

# Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERMSBACK, Editor-in-chief

## CLOSED-CIRCUIT TV

TV installations in schools, industrial plants and public institutions offer real opportunities for installation and servicing.

## EASILY CONSTRUCTED AUDIO GENERATOR

Four-transistor instrument produces sine waves from 15 to 150,000 cycles. Ideal for checking hi-fi equipment; has many other uses.

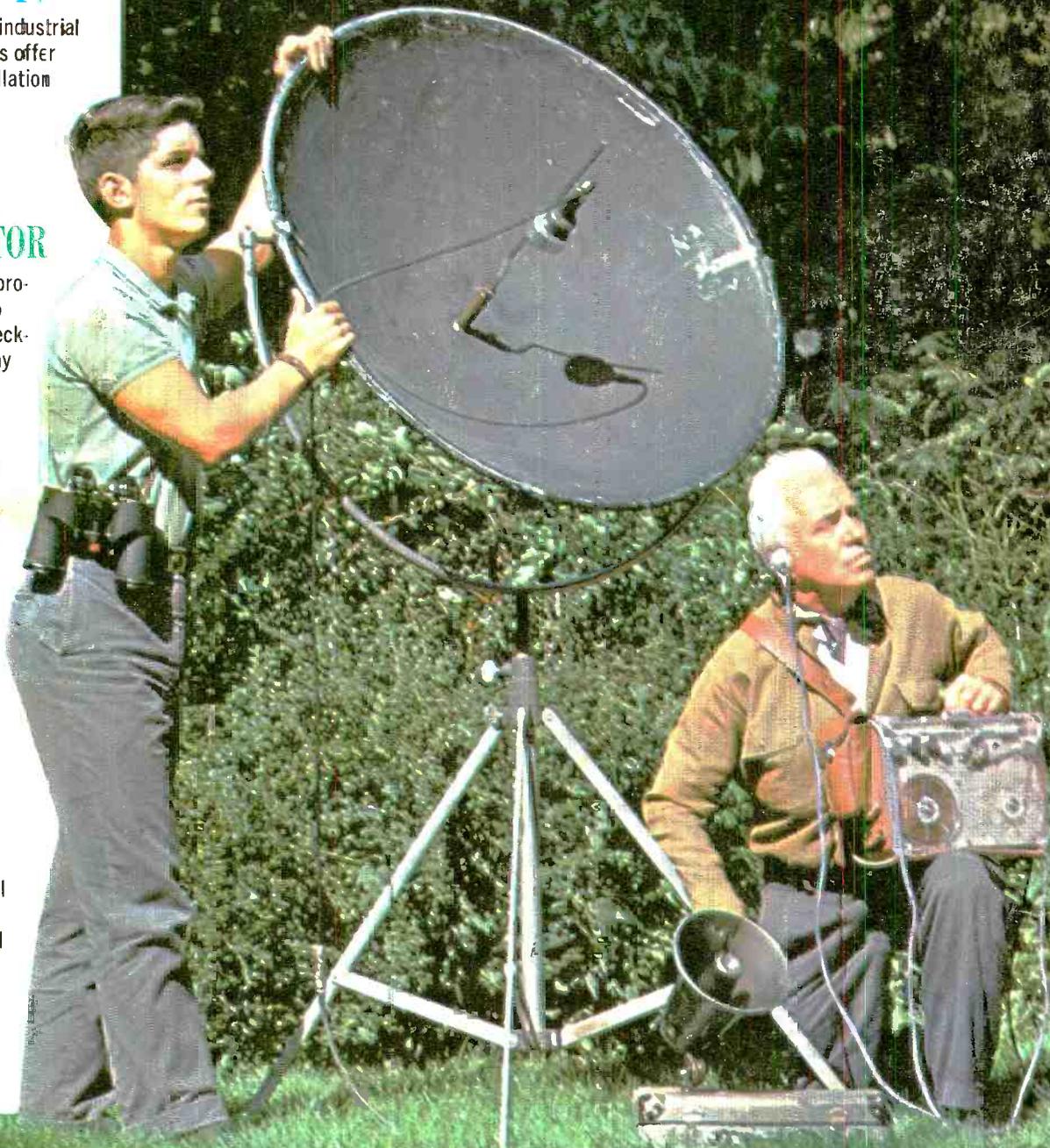
## TRANSISTOR POWER SUPPLY FOR YOUR SHOP

Build a 5-transistor supply that will give you regulated voltage from 0.5 to 28 volts. Will supply 2 amperes regulated up to 15 volts; 3 amperes from 15 to 28.

## RECORDING SOUNDS IN NATURE

(See page 44)

Professor Kellogg of Cornell gives a description of the techniques of recording bird songs and other outdoor sounds that will be interesting to all sound enthusiasts.



# TRIPLETT

# 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 **\$37.50**; leather case **\$3.20**.

Available For Immediate Delivery From Your Triplet Distributor's Stock



## 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

**\$64.50**

**THE TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO**

MANUFACTURERS OF PANEL AND PORTABLE INSTRUMENTS, ELECTRICAL AND ELECTRONIC TEST EQUIPMENT

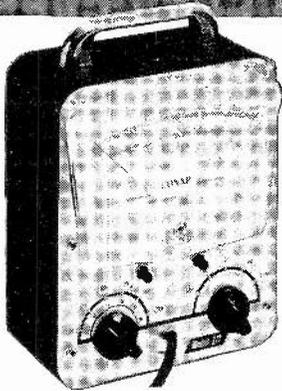


**FOR EVERY PURPOSE—THE WORLD'S MOST COMPLETE LINE OF V-O-M'S**

# ALL-AMERICAN KITS

## from CONAR

You know CONAR Kits are **QUALITY** because all parts are **AMERICAN MADE** and backed by a **4-POINT GUARANTEE**



### NEW MODEL 211 VTVM WITH FULL-VIEW 6" METER

The right combination of years-ahead styling, performance, quality, and accuracy—at a remarkably low price.

A sensitive bridge-type circuit is the heart of this new Model 211 VTVM.

High input resistance is 12.2 megs. Shunting capacity is just 36 mmfd, permitting you to make AC measurements over a wide range of frequencies and well up into the RF region. Calibration is simple and stable. Forget about constant recalibration when switching from range to range. As with all Conar instruments, all parts are U.S. made, including 1% precision resistors for the accuracy and reliability you demand. The big 6", two-color, jeweled meter is rugged and will easily withstand 100% overload without damage. **KIT \$31.95 Assembled \$44.95**

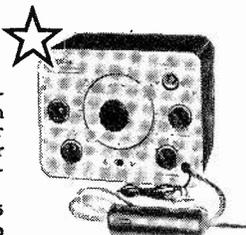
American-made components do make a difference in Electronic equipment. You buy accurate specifications, reliable performance, precise fit, ready sources of supply. That's why CONAR kits are *all-American* . . . and always will be.

As a division of National Radio Institute, we have a half-century reputation to uphold. NRI has sold more Electronic training kits than any other company. Experience like this, plus American parts is why we can offer an unprecedented 4-Point Guarantee (see below). Put your trust in Conar Kits for proper kit engineering, simplified construction and reasonable prices. Mail the coupon now for our new 1962 catalog.

#### TUNED SIGNAL TRACER with HIGH IMPEDANCE PROBE

Exclusive cathode follower probe for use on tube and transistor sets. Built-in speaker & tuning eye. Calibrated attenuators.

**KIT \$39.95  
Assembled \$57.50**



#### SIGNAL GENERATOR FOR AM-FM-TV-USE

Ideal for alignment & trouble shooting. Accuracy better than ±1%. Freq. coverage 170 kc to 60 mc. High output. Easy to build.

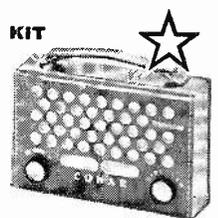
**KIT \$21.50  
Assembled \$29.50**



#### 6-TRANSISTOR PORTABLE RADIO KIT

A portable with excellent tone and sensitivity. No delicate printed circuits. Attractive, durable case. Big 4" speaker.

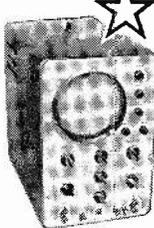
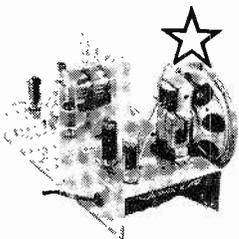
**KIT only \$25.50**



#### "ADVENTURES IN ELECTRONICS" KIT

Perfect for teenagers (16 to 60) wanting to learn Electronics. Build 10 exciting projects. 49-page instruction book, all parts included.

**KIT only \$18.50**



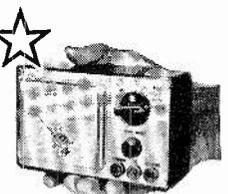
#### 5-INCH WIDE BAND OSCILLOSCOPE KIT

For black & white, color, AM-FM and Electronic applications. High intensity trace. Extremely stable sync. Advanced design.

**KIT \$ 89.50  
Assembled \$139.50**

#### POCKET-SIZE V-O 20,000 OHMS/VOLT

3-in-1, completely portable tester. Jeweled meter. Includes mercury cells, 48" test leads. For all basic AC, DC & ohms measurements.



**KIT \$17.95  
Assembled \$19.95**

### 4-POINT GUARANTEE

The CONAR 4-point guarantee is your assurance of complete satisfaction on all purchases. Every item must perform in accordance with stated specifications. Your money will be promptly refunded if for any reason you are not entirely satisfied. The complete guarantee is clearly stated in your copy of the 1962 Conar Catalog.

## CONAR instruments

division of NATIONAL RADIO INSTITUTE

CONAR Kits are performance tested and approved by NRI . . . first name in Electronics training for nearly a half-century.



### 1962 CATALOG FREE

CONAR INSTRUMENTS BC2C  
3939 Wisconsin Ave., WASHINGTON 16, D. C.

Please send me your new 1962 CONAR CATALOG

Name \_\_\_\_\_

Address \_\_\_\_\_

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

# Radio-Electronics

Formerly RADIO CRAFT — Incorporating SHORT WAVE CRAFT — TELEVISION NEWS — RADIO & TELEVISION\*

FEBRUARY 1962

VOL. XXXIII

No. 2

## editorial

Hugo Gernsback 25 **The Next Phase of TV**

## electronics

Leonard J. D'Airo 30 **Regulated Low-Voltage Supply for Service Bench or Lab**  
*5-transistor unit supplies up to 30 volts*

Len Buckwalter 42 **Equipment Report**  
*Knight-Kit Tachometer*

43 **What's Your EQ?**  
*Answers to January puzzles on page 58*

## audio-high fidelity-stereo

Peter Paul Kellogg 44 **Capture Nature's Sounds on Tape (Cover feature)**  
*How to make the birds sing for the record*

Norman H. Crowhurst 49 **FM Stereo Circuit Developments**

James A. Fred 56 **Spice-Can Audio Mixer**

## radio

Edward M. Noll 26 **FM Antennas for Better Listening**  
*Pick the antenna that's best for you*

Stanley Leinwoll 48 **Short-Wave Forecast**  
*For Jan. 15 to Feb. 15*

George De Salvo 62 **Selective Calling for CB**  
*Home-built device aids CB communications*

## industrial electronics

Ed Bukstein 58 **Industrial Electronics Dictionary**  
*From pulsation welding to register control*

Jack Beever 74 **Closed-Circuit TV for the School**  
*Get as many as 16 channels on one cable*

82 **Early-Warning Ice Alarm**

## test instruments

George D. Philpott 38 **Aligning the Eico 360 Sweep Generator**

Elliott A. McCready 39 **Radiation Meter Measures Minute Currents**  
*Low-cost electrometer also detects heavy radiation*

Stanley E. Bammel 66 **Audio Generator Fits Your Tube Caddy**  
*Build this handy all-transistor sine-wave generator*

Harold Reed 69 **Tape Bias Test Adapter**

## television

Larry Steckler 33 **Tube Layouts in TV Sets, Sylvania 1961-1962**

35 **Color Circuitry**  
*Lowdown on the latest in color TV circuitry*

Jack Darr 59 **Service Clinic**  
*Working with your milliammeter*

## the departments

18 Correspondence

115 New Patents

6 News Briefs

113 Technotes

116 New Books

100 New Products

84 Noteworthy Circuits

86 Try This One

110 New Literature and Business Getters

95 New Tubes & Semiconductors

93 Technicians' News

92 50 Years Ago

## Over 50 Years of Electronic Publishing

EDITOR-IN-CHIEF AND PUBLISHER  
*Hugo Gernsback*

EDITOR  
*M. Harvey Gernsback*

MANAGING EDITOR  
*Fred Shunaman*

TECHNICAL EDITOR  
*Robert F. Scott, W2PWG*

ASSOCIATE EDITOR  
*Larry Steckler*

EDITORIAL ASSOCIATE  
*I. Queen*

SERVICE EDITOR  
*Jack Darr*

ART DIRECTOR  
*Harry Schlack*

TECH. ILLUSTRATION DIRECTOR  
*Wm. Lyon McLaughlin*

ART ASSOCIATE  
*Fred Neinast*

DIRECTOR OF PRODUCTION  
*Elizabeth Stalcup*

DIRECTOR, ADVERTISING SALES  
*Lee Robinson*

EASTERN SALES MANAGER  
*John J. Lamson*

CIRCULATION MANAGER  
*G. Aliquo*

DIRECTOR, NEWSSTAND SALES  
*Joseph L. Bund*

PROMOTION MANAGER  
*Robert Fallath*



Average Paid Circulation  
Over 155,000

## —on the cover—

Story on page 44

Professor P. P. Kellogg of Cornell, with Randolph Scott Little, senior in Electrical Engineering, ready to trap birdsongs.

Color original by D. S. McChesney

**Gernsback Publications, inc.**  
EXECUTIVE, EDITORIAL, ADVERTISING OFFICES

154 W. 14 St., New York 11, N.Y.  
Telephone AL 5-7755

CHAIRMAN OF THE BOARD  
**Hugo Gernsback**

PRESIDENT  
**M. Harvey Gernsback**

SECRETARY  
**G. Aliquo**



Radio-Electronics is indexed in  
*Applied Science & Technology Index*  
(Formerly *Industrial Arts Index*)

\*Trademark registered U. S. Pat. Office

# GET YOUR ELECTRONICS-TV-RADIO HOME TRAINING FROM N.T.S. RESIDENT SCHOOL

## BREAK THROUGH TO HIGHER PAY, GREATER JOB SECURITY

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 as a

**MASTER TECHNICIAN** in Electronics — TV — Radio. One Master Course at One Low Tuition trains you for unlimited opportunities in All Phases: Servicing, Communications, Preparation for 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 open your own profitable business.

Over 1 City Block of Modern School Facilities, Laboratories and Shops Housing Over 1,000 Students.

50,000 Graduates — all over the World — since 1905

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

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

MORE COMPLETE . . . You learn **ALL PHASES OF** Television — Radio — Electronics.

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

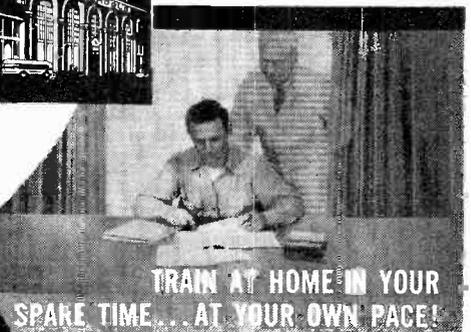
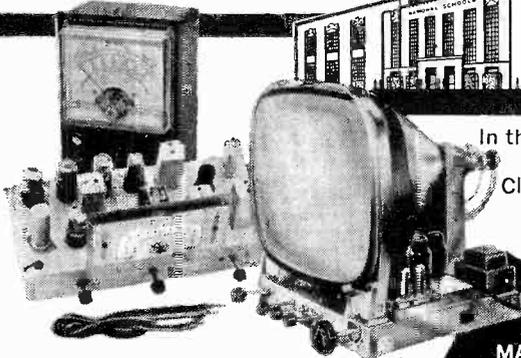
## NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

### THE SCHOOL BEHIND YOUR HOME-STUDY TRAINING



In these modern School Headquarters your Home Training is: Classroom-Developed, Lab-Studio Planned, Shop-Tested, Industry-Approved, Home Study-Designed.



TRAIN AT HOME IN YOUR SPARE TIME . . . AT YOUR OWN PACE!

## 19 BIG KITS YOURS TO KEEP

- Friendly Instruction and Guidance
- Graduate Advisory Service
- Unlimited Consultation
- Diploma Recognized by Industry
- **EVERYTHING YOU NEED FOR SUCCESS**

### M.T.S. IS NOT JUST A MAILING ADDRESS ON A COUPON

N.T.S. is a real school . . . a world famous training center since 1905. Thousands of men from all over the world come to train in our shops, labs, studios and classrooms.

You learn quickly and easily the N.T.S. Shop-Tested way. You get lessons, manuals, job projects, personal consultation from instructors as you progress. You build a Short-Wave, Long-Wave Superhet Receiver plus a large screen TV set from the ground up with parts we send you at no additional cost. You also get a Professional Multitester for your practical job projects. The Multitester will become one of your most valuable instruments in spare time work while training, and afterwards, too. Many students pay for their entire tuition with spare time work. You can, too . . . we show you how.

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

After you graduate you can open your own TV-Radio repair business or go into high paying jobs like these: Communications Technicians, Hi-Fi, Stereo and Sound Recording Specialists, TV-Radio Broadcasting Technician, Technician in Computers & Missiles, Electronics Field Technician, Specialist in Micro-Waves and Servomechanisms, Expert Trouble Shooter, All-Phase Master Technician, TV-Radio Sales, Service and Repair.

**RESIDENT TRAINING AT LOS ANGELES**  
If you wish to take your Electronics-TV-Radio training in our famous Resident School in Los Angeles — the oldest and largest school of its kind in the world — write for special Resident School catalog and information, or check special box in coupon.

## MAIL COUPON NOW FOR FREE BOOK & ACTUAL LESSON

No obligation.  
No salesman will call.



## NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

Mail Now To  
National Technical Schools, Dept. RG-22  
4000 S. Figueroa St., Los Angeles 37, Calif.  
Please rush FREE Electronics - TV-Radio "Opportunity" Book and Actual Lesson.

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

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



ACCREDITED MEMBER

## NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

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

# News Briefs

## New Tubes Use Fiber Optics

A new vidicon tube with a fiber-optics faceplate has been announced by RCA Electron Tube Div. RCA is also making available to the industry samples of a fiber-optics orthicon and two cathode-ray tubes with glass-fiber faceplates.

The new vidicon is a 1-inch tube 6½ inches long. There are more than 500,000 individual fibers in the useful area of the face. Each is .0006 inch in diameter, about one-fifth the diameter of a human hair. The tube has a resolving ability of about 600 TV lines.

The following five areas are ones where fiber-optics principles in electron tubes might be advantageous for providing higher resolution, greater photometric efficiency and increased reliability at low cost:

High-resolution reconnaissance and facsimile pickup systems.

Examination of organs within human body by using TV camera systems with a flexible telescope or "fiberscope".

Television camera systems on moving vehicles where only the lens need be stabilized.

Inspection by television of otherwise inaccessible cavities.

High-speed electronic printing using a Compositron tube that can achieve a speed of 20,000 characters per second.

Earlier fiber-optic cathode-ray tubes and storage devices were mentioned in the October 1961 issue, page 52.

## Hams Have a Satellite

The efforts of the amateurs in extending the frontiers of radio, both on the earth and in space, are being recognized by the Air Force, which launched a 1/10-watt amateur short-wave radio transmitter into a polar orbit last December.

Oscar (Orbital Satellite Carrying Amateur Radio) is a "serious civilian noncommercial effort to obtain information from outer space, and to introduce to amateur radio operators throughout the world new techniques in the field of space communication," says the Amateur Radio Relay League, official amateur organization.

The miniature transmitter is programmed to key automatically the letters HI—four dots followed by two dots of Morse code. This is the universal amateur symbol for laughter, or the recognition of something

important or startling. The transmitting frequency is 145.0 mc.

The first reported reception of the ham satellite signals came from a Navy amateur stationed at Marie Byrd Land in Antarctica.

With the large number of amateurs (200,000 in the United States alone) as compared to military and other official stations for observing satellites, it is hoped that new information of value will be obtained. Many hams have had experience in tracking satellites, and have experimented with reflected signals from the Echo passive satellites.

Recently, hams have even used the moon as a reflector for coast-to-coast communication. This was, of course, done earlier by the military and Bell Laboratories, but the hams did it with a very small fraction of the power used by the bigger stations.

## Unused Television Channels To Fixed-Station Users?

FCC Commissioner Robert E. Lee has suggested that additional frequencies for a number of non-broadcast services can be provided by assigning nonallocated vhf TV channels to them. Commissioner Lee believes that more than 50 channels would be available, opening some 2,000 frequencies to such uses as police and fire departments, industrial plants and other public and private services that need more frequency space. He suggests that existing TV stations would be protected by permitting such operation only at distances of 150 miles or more from TV stations operating on the same channel.

Commissioner Lee has been an advocate of moving TV entirely to the uhf spectrum, and some look at this proposal as a gradualistic attempt to achieve that aim.

## Coast Guard Testing New Distress Signal

A new type of distress signal, designed to clear the 2182-kc radio-telephone channel for distress messages, has been put into operation at New York and San Francisco.

The signal consists of two tones, 2,200 and 1,300 cycles per second, alternating 4 times a second over a period of 45 seconds. It will indicate to all stations listening on the 2182-kc distress frequency that a vessel or aircraft is in serious trouble or that a person has been lost

overboard, and that distress traffic is to follow. Upon hearing the signal, all stations must cease transmitting on the distress frequency and listen for the distress messages.

This will allow the Coast Guard to clear this normally cluttered channel when they cannot clearly make out an incoming low-power distress message.

The system was adopted by the International Telecommunication Union at its 1959 Geneva Convention.

The alarm generator may be used with any transmitter that has a speech amplifier with an input impedance of more than 40 ohms, and requires a 48-volt power source. On pressing a button, it transmits two sinusoidal notes following each other every ¼ second for 45 seconds. It uses four identical transistors and three diodes, mounted on three boards. One contains the 2,200-cycle oscillator and switch, another the 1,300-cycle circuitry and the third the 250-msec multivibrator that switches tones, plus the output amplifier.

## Radio-Controlled Moods

Technological control of human behavior is receiving heavy emphasis by the Military, the American Medical Association learned at its recent annual clinical meeting in Denver, Colo.

Dr. Otto Schmitt, head of the Department of Biophysics at the University of Minnesota in Minneapolis, described the electrical method, which injects signals into the nervous system to stimulate or depress certain emotions, and the chemical method of implanting radio-controlled pellets containing chemicals, which are activated by an outside signal.

Dr. Schmitt also states that approximately 30 special sensing instruments may be placed in the body to test reactions under stress.

A part of the recent military  
(Continued on page 10)

**Advertising Representatives:** Los Angeles: Harker-Husted-Coughlin, 408½ South Alvarado St., Tel. DUnkirk 7-2328. San Francisco: Harker-Husted-Coughlin, 444 Market St., Tel. Garfield 1-0151. Atlanta: J. Sidney Crane & Associates, 22 Eighth St. N.E., Tel. TRinity 2-6720. Florida: Lu Neff Associates, 15 Castle Harbor Isle, Fort Lauderdale, Fla. **United Kingdom:** Publishing & Distributing Co., Ltd., Mitre House, 177 Regent St., London, W. 1, England.  
**Foreign Agents:** Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, London E.C. 4.  
**Subscription Service:** Address form 3579 and correspondence to Radio-Electronics, Subscriber Service, 154 West 14th St., New York 11, N.Y. When requesting a change of address, please furnish an address label from a recent issue. Allow one month for change of address.

# Now! Work Over 300 PRACTICAL PROJECTS with these PARTS AT HOME!

## to help You learn ELECTRONICS RADIO - TELEVISION - RADAR

NOW . . . at home in your spare time you can get the very kind of training and subsequent Employment Service you need to get started toward real earnings in one of today's brightest opportunity fields—TELEVISION-RADIO-ELECTRONICS. Now that Electronics is entering so many new fields, here is a chance of a lifetime to prepare to cash in on its remarkable growth.

DeVry Tech's amazingly practical home method enables you to set up your own HOME LABORATORY. You spend minimum time to get maximum knowledge from over 300 practical projects, using the same type of basic equipment used in our modern Chicago and Toronto Training Centers!

### DeVry Tech Provides EVERYTHING YOU NEED . . .

—to help you master TV-ELECTRONICS. In addition to the home laboratory and easy-to-read lessons, you even use HOME MOVIES—an exclusive DeVry Tech series. You watch hidden actions . . . see electrons on the march. Movies help you to learn faster . . . easier . . . better.

### EARN WHILE YOU LEARN

DeVry Tech's practical training helps you toward spare time income servicing Radio and Television sets.

### LABORATORY TRAINING

Full time day and evening training programs in our modern Chicago and Toronto Laboratories are also available. MAIL COUPON TODAY for facts.

### EFFECTIVE EMPLOYMENT SERVICE

Get the same Employment Service that has helped so many DeVry Tech graduates get started in this fast-growing field.

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



Accredited Member  
of National Home  
Study Council

# DeVRY TECHNICAL INSTITUTE

CHICAGO 41, ILLINOIS

CHECK  
These Exciting  
JOB  
Opportunities:

TV-Radio Broadcast Technician  
Color TV Specialist  
Radar Operator • Airline Radio Man  
Missile Electronic Technician  
Laboratory Technician  
Computer Specialist  
Your Own Sales & Service Shop  
... PLUS MANY OTHERS

### MAIL COUPON TODAY!

DeVRY TECHNICAL INSTITUTE  
4141 Belmont Ave., Chicago 41, Ill., Dept. RE-25

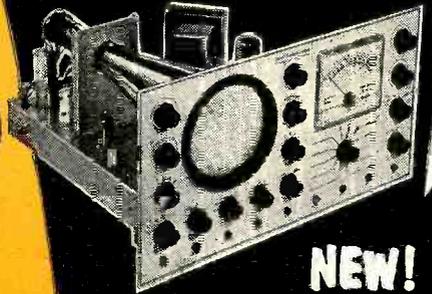
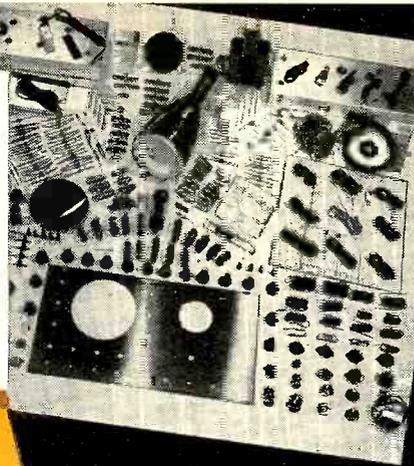
Please give me your FREE booklet, "Electronics in Space Travel," and tell me how I may prepare to enter one or more branches of Electronics.

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

Street \_\_\_\_\_ PLEASE PRINT Apt. \_\_\_\_\_

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

2045 Canadian residents address: DeVry Tech of Canada, Ltd.  
970 Lawrence Avenue West, Toronto, Ontario



NEW!  
ALL NEW!

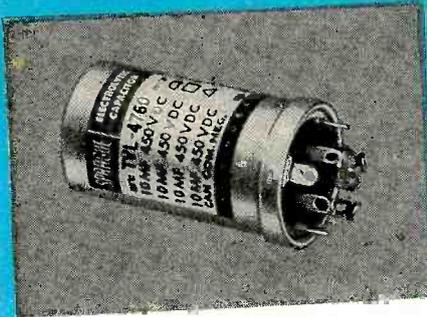
Shown above is the valuable new combination oscilloscope and voltmeter which DeVry Tech men build during their training.



Build and keep this BIG DeVry Engineered TV set—easily converted to U.H.F. (DeVry offers another home training, but without the TV set.)

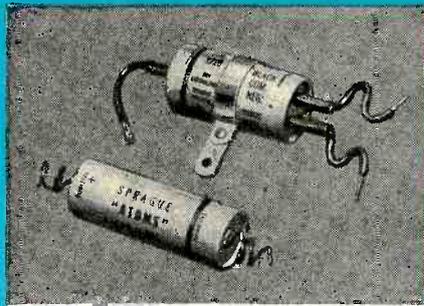


Electronics in  
SPACE TRAVEL



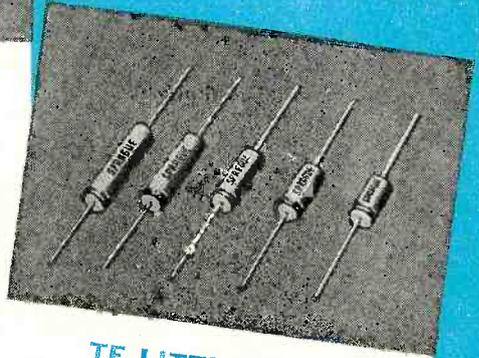
### TVL TWIST-LOK® CAPACITORS

These 'lytics take on the toughest TV and radio duty, give maximum trouble-free service, *without HUMMM!* They are dependable at extremely high and low temperatures. Cathodes are etched to meet the needs of high ripple currents, high surge voltages.



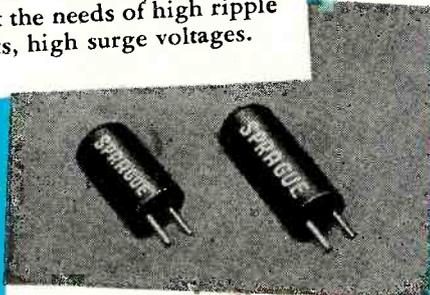
### TVA ATOM® CAPACITORS

Atom tubulars are service favorites because they fit anywhere, work anywhere. They're the *only* small size 85 C (185 F) capacitors in ratings up to 450 WVDC. They have low leakage current, long shelf life, and withstand high ripple currents, high surge voltages.



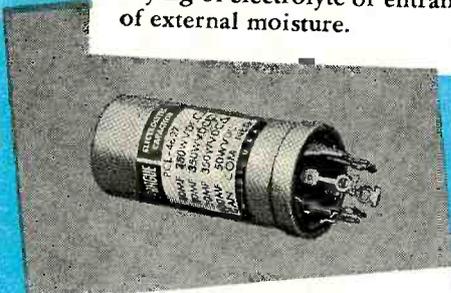
### TE LITTL-LYTIC® CAPACITORS

The very best ultra-miniature replacements for transistor circuits, offering unusual reliability through all-welded construction. No pressure joints to cause "open" or intermittent circuits. Long shelf life—extremely important in sets used only part of the year.



### VL VERTI-LYTIC\* CAPACITORS

These single-ended molded tubulars are the ideal replacement for units of this type found on printed wiring boards. Keyed terminals assure fast manual mounting and correct polarity. Resin end fill protects against drying of electrolyte or entrance of external moisture.



### PCL PRINT-LOK® CAPACITORS

The printed circuit version of the Twist-Lok. Universal base replaces any of the printed circuit 'lytics in use today. No makeshift mounting adapters to damage capacitor or add extra height . . . no possibility of high resistance contacts.

## EVERY 'LYTIC YOU NEED . . .

- every value
- every rating
- every style

Shown here are the more popular of Sprague's big family of Electrolytic Capacitors, the broadest in the industry. Other types include Metal-encased Screwbase; Plastic-encased High-MF; Metal-encased Octal-base; Ultra-low leakage Photoflash. All are listed and described in Sprague's NEW Catalog C-614. Get your copy from any Sprague distributor, or write Sprague Products Company, 81 Marshall Street, North Adams, Massachusetts.

\*TRADEMARK



WORLD'S LARGEST CAPACITOR MANUFACTURER

# The only electronics home study program that guarantees\*... **A Commercial FCC License** **...Or Your Money Back!**

No other electronics home study program can equal that offered by Cleveland Institute. And that's why we make this exclusive guarantee:

\*Completion of our Master Course prepares you for a First-Class Commercial Radio Telephone License with a Radar Endorsement. If you fail the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire duration of your enrollment period.

**This Course Is Designed Specifically For Men With Previous Electronics Training or Experience and Provides...**

- Advanced electronic theory and math. (You will receive a special 10" Electronic Slide Rule and complete instructions).
- Special training in the practical application of electronics skill in such advanced fields as Computers . . . Servo-Mechanisms . . . Magnetic Amplifiers . . . AC Circuit Analysis . . . Pulse Circuitry . . . Color TV . . . Radar . . . Advanced Measuring Techniques . . . Industrial Electronics . . . Instrumentation . . . Automation . . . Radio Telemetry . . . Semiconductors.



**Get This Handy Pocket Electronics Data Guide Free . . .**

Conversion factors, formulas, tables and color codes at your fingertips. Yours without obligation, simply for responding NOW to this opportunity to improve your future.

**Send This Coupon Today** →

**Cleveland Institute of Electronics**

1776 E. 17th St., Desk RE-62B, Cleveland 14, O.

Accredited by the Accrediting Commission of the National Home Study Council  
*(An Accrediting Commission Approved by the U. S. Office of Education).*



**Three Free Booklets Tell How CIE Training Opens The Door To Unlimited Opportunities**



**More Reasons How CIE Will Help You Get Ahead in Electronics**

**Job Service . . .** every month, for three years, CIE will supply you with a listing of hundreds of job opportunities. High paying, interesting jobs . . . with top companies throughout the world. See how CIE training opens a whole new world in electronics opportunity.

**Electron Bulletin . . .** every month, every student receives a free copy of this informative bulletin. Keeps you up to date on what's going on in electronics.

I want to know more about your electronics home study training program. Please send me your free booklets described above plus your handy pocket Electronics Data Guide. I understand there is no obligation. I have had training or experience in electronics as indicated.

**Mail Coupon To**

Cleveland Institute of Electronics  
 1776 E. 17th St., Desk RE-62B, Cleveland 14, Ohio

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

I'm now working in \_\_\_\_\_

I want to know about the following area of electronics \_\_\_\_\_

(please print)

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

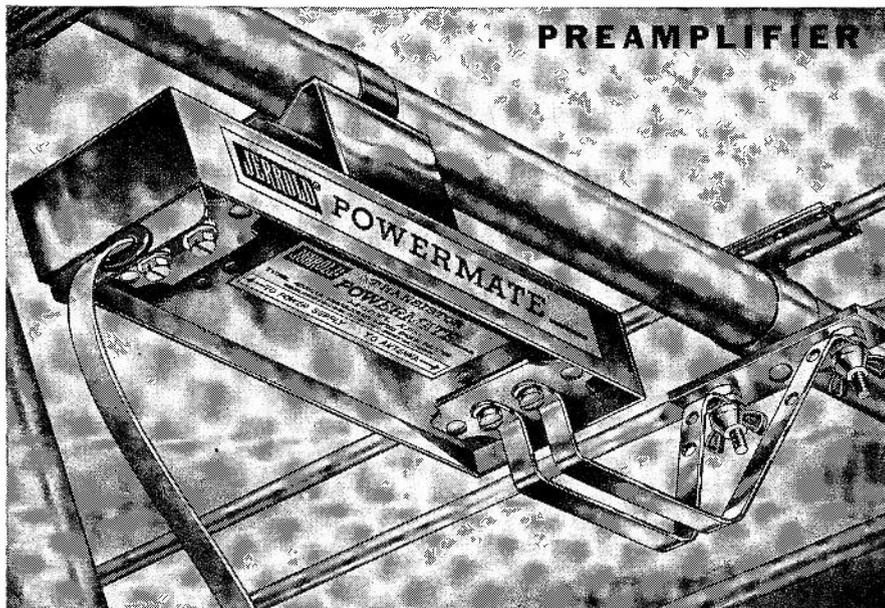
Address \_\_\_\_\_

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

RE-62B

Servicemen everywhere say,  
**"OUTPERFORMS THEM ALL!"**

# NEW TRANSISTOR **JERROLD® POWERMATE**



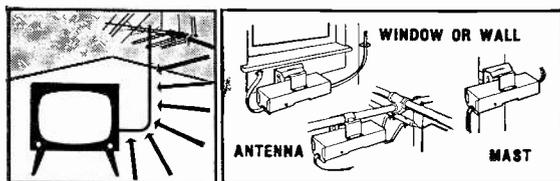
## offers highest gain, lowest noise figure

Here's the preamplifier for every TV antenna in your area, whether new or up for years! The exclusive universal bracket of the new JERROLD Transistor POWERMATE permits mounting directly on the antenna boom (for greatest boost before download losses) or at any other point—along the mast, on the wall or windowsill, behind the set—anywhere your best judgment dictates.

And look at this gain: An average of 13.9db at Channel 13 and 18.25db at Channel 2—by far the highest in the business! This remarkable gain gives any antenna system the lowest System Noise Figure obtainable—the key to better pictures.

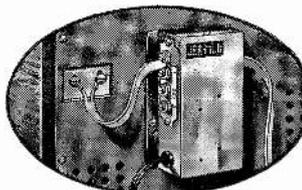
See your distributor today, or write for special bulletin describing System Noise Figure.

*Only \$39.95 list, complete with power supply*



### NO TUBES, NO BATTERIES, NO OSCILLATION, NO FEEDBACK

Mount it on the boom or anywhere along the download. Thoroughly neutralized against oscillation; output impedance balanced to prevent radiation back to antenna. Same 300-ohm lead that carries signal also carries 15 volts ac to POWERMATE. No tubes or batteries to replace.



### REMOTE AC POWER SUPPLY OPERATES 1OR 2 TV OR FM SETS

Installs on or near receiver, draws less current than an electric clock. No polarity problems when attaching to lead, no danger of transistor damage.

**JERROLD® ELECTRONICS CORPORATION**  
 Distributor Sales Division, Dept. IDS-201.  
 The Jerrold Building, Philadelphia 32, Pa.

Jerrold Electronics (Canada) Ltd., Toronto, Ontario  
 Export Representative: CBS International, New York 22, N.Y.

AMERICA'S LEADING MANUFACTURER OF TV-FM RECEPTION AIDS AND MASTER-ANTENNA-SYSTEM PRODUCTS

(Continued from page 6)

emphasis on pattern recognition, exemplified by the ability to recognize a face or predict events on the basis of experience, these studies will prove helpful in medical, economic and other fields.

A decision for the future, says Dr. Schmitt, is the matter of how much scientific behavior control is justifiable and prudent.

### Pilot Radio Head Dies

Isidor Goldberg, one of the very earliest of the radio pioneers, died Nov. 23, at the age of 68. During his career he had been active in practically all areas in the field, from simple broadcast equipment through short wave and television to high fidelity, in which Pilot, the firm he founded, is now most active.



Mr. Goldberg worked for the old Electro Importing Co. (E.I. Co.) as a boy of 16. Shortly thereafter he began to make components, and in 1922 organized the Pilot Electric Mfg. Co. In the late '20's the Pilot Wasp, possibly the first of the widely marketed radio kits, appeared. It was followed by the Super-Wasp, a very popular ac kit.

In 1928 Pilot and Gernsback's *Radio News* cooperated in a pioneer television broadcast, in which TV images were flashed across the Hudson River. In more recent years, the company became one of the leading makers of high-fidelity equipment. Mr. Goldberg remained president of the company up to his death.

### "Lighthouses in Sky" Coming

A complete, global, all-weather navigational system using Transit satellites as guides may be in operation by the end of 1962. This prediction was made by Rear Admiral Jack P. Monroe, director of the Astronautics Div. of the Navy, as a result of successes in launching recent Transit satellites.

A ship could fix its position to within 1/10 mile in any kind of weather by tuning in on one of the lighthouse satellites. At present, Admiral Monroe said, a navigator is lucky to come within 2 miles by using celestial navigation.

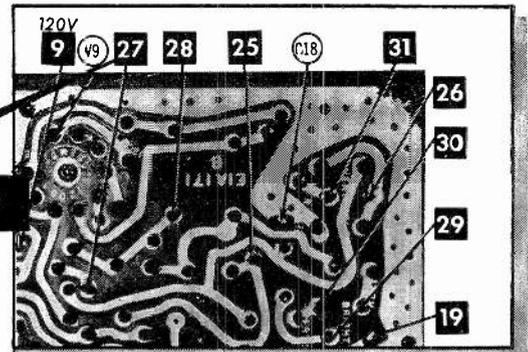
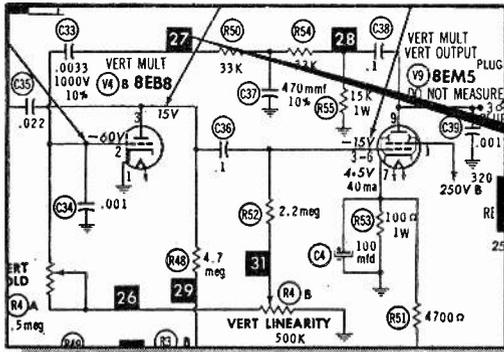
The latest Transit satellites carry a small oval-shaped atomic generator, weighing 4½ pounds and measuring about 5 x 5½ inches, to

(Continued on page 14)

# exclusive in PHOTOFACT the world's finest electronic service data

famous Howard W. Sams **CIRCUITRACE**® and **SERVICING AIDS!**

handiest, most-complete data ever published to speed and simplify servicing—  
equally useful for troubleshooting in the home or on the bench...



**CIRCUITRACE**®

exclusive Sams standardized, uniform system for fastest, easiest printed board troubleshooting...

**Here's how CircuitTrace works:** All test points are clearly shown on the schematic and each is plainly coded (see illustration at left). The same test points are similarly coded on the printed board photo (see illustration at right) so you instantly know where to make your

measurement! No more costly hunting for test points...no more guesswork...no need to look at both sides of the board—identifies tubes, transistors, and foil connections of parts throughout circuits. CircuitTrace makes printed board servicing a breeze!

## TIME-SAVING SERVICE AIDS for field or shop

### FIELD SERVICING NOTES

#### SAFETY GLASS REMOVAL (MODEL KC386)

Remove 4 screws holding the trim strip at the top of the safety glass. Tilt glass out and remove.

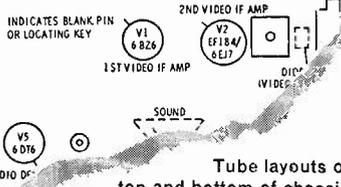
#### FUSE AND FUSE DEVICE

**TV:** Sweep - 1/2 Amp. (M1)  
LV Supply - Fuse Wire (M2)  
Filament - Fuse Wire (M3)  
See "Tube" section for details.

Radio

Valuable instructions for making all necessary adjustments in the home, locating fuses, removing safety glass, etc.

### TUBE PLACEMENT CHARTS



Tube layouts of top and bottom of chassis show sync and sound paths, tube keyways, fuses, rectifiers, etc. Helps you trace signal path to localize the trouble.

### TUBE FAILURE CHECK CHART

#### POWER SUPPLY FAILURE

No raster, no sound Fuse Wire (LV Power), Fuse Wire (M2)

#### SWEEP FAILURE

No raster, has sound Fuse (Sweep), V8, V9, V10, No vertical deflection V7, Poor vert. linearity or foldover V7, Poor horiz. linearity or foldover V7, Narrow picture V8, V9, V10, Vert. sync V7, V8, V9, V10

Points out probable causes of common troubles, tells you which tubes to replace to correct the symptom. Also shows series-string filament connections.

### DISASSEMBLY INSTRUCTIONS

#### TV CHASSIS REMOVAL

1. Remove 10 push-on type knobs
2. Remove 12 wood screws in

You get step-by-step procedure for removing chassis, CRT, speakers, knobs, hidden bolts and connections. Avoids parts damage—saves valuable time.

### HORIZONTAL SWEEP CIRCUIT ADJUSTMENTS

Set the Horizontal Hold Control to Horizontal Frequency Slug (B1) tally. Keep turning B1 in the out of sync. Reverse the

Detailed instructions help you solve the troublesome problem of adjusting the horizontal circuits (oscillator, linearity, and width)—avoids guesswork!

These are just a few of the dozens of great features in PHOTOFACT for fastest, easiest, most profitable servicing. See your Sams Distributor for full details on an Easy Buy Library or Standing Order subscription!

### NOW IN PHOTOFACT!

**FREE BONUS 20-LESSON Second-Class Radiotelephone License Course!**

Will help you pass the exam for an FCC License—so you can upgrade your career in electronics and become an expert in communications! Now Free in current PHOTOFACT Sets. Don't miss it—enter your subscription with your Distributor!



**FREE**

**PHOTOFACT INDEX**

Your invaluable guide to over 52,000 TV, Radio, Electronic listings—covering virtually every model produced since 1946. Helps you locate the proper PHOTOFACT Folder you need to solve any service problem in any model. Send coupon today for your FREE copy of the latest PHOTOFACT Index!

### HOWARD W. SAMS & CO., INC.

Howard W. Sams & Co., Inc., Dept. 6-B2  
1724 E. 38th St., Indianapolis 6, Ind.

- Send FREE Photofact Cumulative Index  
Send full information on:  Easy Buy Plan  Standing Order Subscription  "Peet" Program

Shop Name \_\_\_\_\_  
Attn.: \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



**The Making of a Magnet.** Bell scientists test new superconducting electromagnet, the small cylindrical object being removed from helium bath at minus 450 degrees F. An early experimental design produced a field strength over 65,000 gauss.

## OUT OF SOLID STATE SCIENCE COMES A POWERFUL NEW MAGNET

Bell Telephone Laboratories' creation of a powerful superconducting electromagnet once again illustrates the role of materials research in the advancement of communications.

It has long been known that certain materials called superconductors have a zero electrical resistance at temperatures near absolute zero. A solenoid of superconductive wire carrying a large current should be capable of producing an extremely powerful magnetic field without the bulky power equipment that is needed for conventional electromagnets.

A formidable obstacle blocked the way, however. The strong magnetic field tended to destroy the wire's superconductivity.

Bell Laboratories scientists studying superconductors—as part of their endless search for new materials for communications—were led to the discovery of a number of alloys and compounds having exceptional superconductive properties. One of these materials, a

compound of niobium and tin, was found to possess a startling ability to retain its superconductivity in intense magnetic fields of over 100,000 gauss. Bell scientists went on to show how the brittle, intractable material could be made into a wire and hence wound to make an extremely powerful electromagnet.

By finding a low-cost way to create enormously powerful magnetic fields, Bell scientists have brought closer new applications of magnetism in communications. Intense magnetic fields provide an invaluable tool in research, and offer an attractive means for containing hot plasma in thermonuclear experiments.

The new magnet is another example of how Bell Laboratories research not only works to improve Bell System communications but also benefits science on a broad front.



**BELL TELEPHONE LABORATORIES**

World center of communications research and development

# The Same School That Originated The RTS BUSINESS PLAN

**NOW**  
Proudly  
Presents...

## A SPECIAL COMPACT COURSE COVERING ALL THREE PHASES OF **ELECTRONICS**

The Entire Course Is Made  
Up Of The Following:

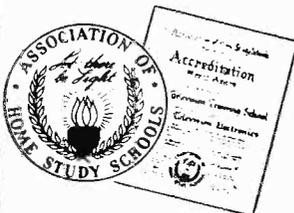
- 35 LESSONS COVERING BASIC AND INTERMEDIATE ELECTRONICS
- 9 EQUIPMENT KITS COMPLETE WITH TUBES AND BATTERIES
- SOLDERING IRON
- 25 LESSONS COVERING THESE ADVANCED ELECTRONIC SUBJECTS:

Thyratron Tubes • Semiconductors •  
Electronic Symbols and Drawings •  
Voltage-Regulators • Electronic-  
Timers • Control Systems • X-Rays •  
Photoelectric Devices • Dielectric  
Heating • Geiger Counters • Pulse  
Circuitry • Clippers and Limiters •  
Multivibrators • Electronic Counters •  
Radar • Magnetic Amplifiers • Analog-  
Computers • DC Amplifiers • Digital  
Computers • Storage Systems • Input  
and Output Devices • Servomechanisms •  
Telemetry

- 60 EXAMINATIONS
- UNLIMITED CONSULTATION SERVICE
- K&T MANUALS
- DIPLOMA UPON GRADUATION

AND MUCH MORE...

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



**RTS ELECTRONICS DIVISION**  
815 E. ROSECRANS AVENUE  
LOS ANGELES 59, CALIFORNIA

Est. 1922



L 201 B

**BASIC • INTERMEDIATE • ADVANCED  
DESIGNED FOR THE BUSY MAN OF TODAY**

This is MODERN training for the MODERN man. You'll find no "horse and buggy" methods here. Every page of this streamlined course is devoted to important Electronics principles and practical projects. You'll be amazed how fast you grasp Electronics the RTS way. RTS has combined modern THEORY and PRACTICE to make this the finest training program of its kind available!

**SATISFIES NOVICE, TECHNICIAN OR HOBBYIST**

Whether you're new to Electronics or an old "pro," chances are you'll find this to be the ideal course for you. The novice will appreciate the completeness of the training. It starts with the most basic considerations, covering each important point thoroughly, yet concisely. The technician will enjoy the practical review of fundamentals and profit from the 25 advanced subjects covered.

**RTS GIVES YOU "TOP MILEAGE" FOR YOUR TRAINING DOLLAR**

The price quoted below buys EVERYTHING — there are no extras to pay for. RTS has gone "all out" to give you the best training value in America. Why pay hundreds of dollars for training such as we offer when it's available for this LOW PRICE? If you can find a better training bargain... BUY IT!

**CAN BE COMPLETED IN MONTHS INSTEAD OF YEARS**

Some students will complete this course with "Jet-Like" speed but we allow up to two years if your circumstances require it. You study at your own rate. You are ENCOURAGED but not pushed. You'll find the lessons professionally written but easy to understand. LET US SEND YOU ONE OF THESE LESSONS ALONG WITH YOUR CAREER BOOKLET SO YOU CAN SEE FOR YOURSELF. NO OBLIGATION!

COMPLETE  
COST...  
INCLUDES ALL KITS,  
TUBES, BATTERIES, ETC.  
**\$125.00\***

\* TERMS ALSO AVAILABLE  
AS LITTLE AS

**\$500 DOWN \$500 PER MONTH**  
**SAVE TIME — SEND**  
**\$5.00 WITH COUPON**  
YOUR FIRST LESSONS AND  
KIT WILL BE RUSHED TO YOU  
THE SAME DAY THEY ARE RECEIVED!

**Rush  
Coupon**

**NO  
SALESMAN  
WILL  
CALL!**

**DON'T LOSE OUT — FIND OUT!**

RTS ELECTRONICS DIVISION, Dept. RE-22

815 E. ROSECRANS AVENUE LOS ANGELES 59, CALIFORNIA

Rush me full information by return mail. (Please Print)

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

Address \_\_\_\_\_

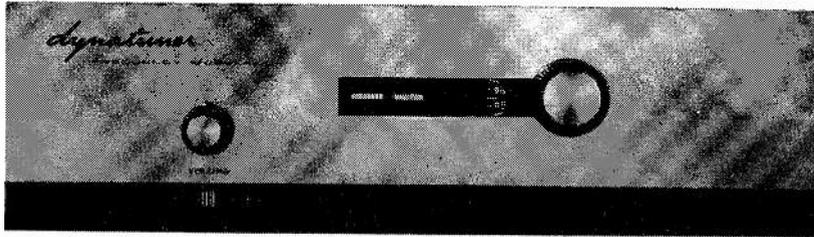
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**ENROLL ME NOW**  **SEND MORE FACTS**

## a significant advance in high-fidelity reproduction

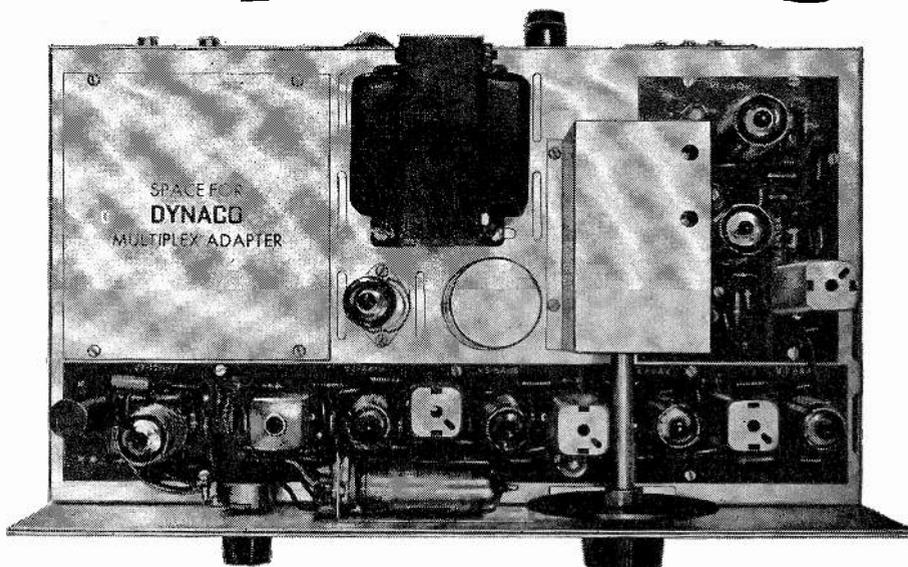
WE ARE PROUD TO INTRODUCE THE LONG-AWAITED

# dynatuner



AN FM TUNER IN THE DYNAKIT TRADITION OF OBVIOUS

# superiority



Complete including cover, \$79.95 kit; \$99.95 semi-kit; \$119.95 factory wired and tested

Dynakit specifications are always based on reality rather than flights of fancy, so our Dynatuner specification of 4 microvolt (IHFM) sensitivity appears somewhat archaic when practically all competing tuners imply greater sensitivity in their advertising. Performance is what counts, however, so we invite you to compare the DYNATUNER directly with the most expensive, most elaborate FM tuners available.

We know you will find lower distortion, lower noise, and clearer reception of both weak and strong signals than you ever expected. You will find new pleasure in FM listening free of distortion and noise.

Best of all, the amazing performance of the Dynatuner is achieved in actual home use—and maintained for many years, since it can be completely aligned for optimum performance without external test facilities. Thus, after shipment or after tube change, or after any other source of changing operating characteristics, the Dynatuner can be re-instated to peak performance.

Naturally, the Dynatuner includes provision for an internal multiplex adaptor. The FMX-3 will be available soon and can be added at any time for full fidelity stereo FM reception—your assurance that DYNAKIT always protects you against obsolescence.

Slightly higher in the West. Write for detailed information on this and other Dynakits.

**DYNACO, INC., 3912 Powelton Avenue, Philadelphia 4, Penna.**  
CABLE ADDRESS: DYNACO, PHILA.

(Continued from page 10)

power two of the four radio transmitters, the other two by solar cells and nickel-cadmium batteries.

### Brief Briefs

"High fidelity" from your hot-air heating system is promised by one manufacturer, who makes a unit that mounts on the hot-air duct above the furnace and carries music to every register in the house. "If two units are used—one on the hot-air ducts; the other on the cold-air return—a stereo effect results," says the manufacturer, Roger-Mark Corp. of Chicago. . . .

Ultra-pure fused quartz is announced by General Electric Co. The new pure quartz has higher heat resistance—deforms at half the rate of ordinary quartz at temperatures of 1,200°C or higher. . . .

RCA announces development of a new thermoelectric material—an alloy of germanium and silicon—that produces more electricity direct from heat than any previously known materials. A platelike arrangement of the new material with a square-foot surface heated to 1,000°C can produce up to 10 kilowatts, according to the report. . . .

Alternator-rectifier system to replace the dc generator in motor cars has been announced by Motorola. Silicon-diode rectifier and transistorized voltage regulator form part of the equipment. System is rated at 600 watts.

New superconducting supermagnet developed by Westinghouse is only a pound in weight, develops a flux density of 43,000 gauss. Niobium-zirconium wire, in a bath of liquid helium, carries the fantastic currents required.

### Calendar of Events

ERA Annual Convention, Jan. 23-27, Hollywood Beach Hotel, Fla.

IRE Winter Convention on Military Electronics, Feb. 7-9, Ambassador Hotel, Los Angeles, Calif.

Pacific Electronic Trade Show, Feb. 9-11, Shrine Exposition Hall, Los Angeles, Calif.

IRE, AIEE International Solid State Circuits Conference, Feb. 14-16, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

International Exhibition of Electronic Components, Feb. 16-20, Parc des Expositions, Paris, France.

IRE, AIEE, NBS Scintillation and Semiconductor Counter Symposium, Mar. 1-3, Shoreham Hotel, Washington, D. C.

EIA Committee and Section Meetings, Mar. 14-16, Statler Hilton Hotel, Washington, D. C.

EIA 38th Annual Convention, Mar. 23-25, Pick-Congress Hotel, Chicago, Ill.

IHFM High Fidelity Show, Mar. 20-25, Ambassador Hotel, Los Angeles, Calif.

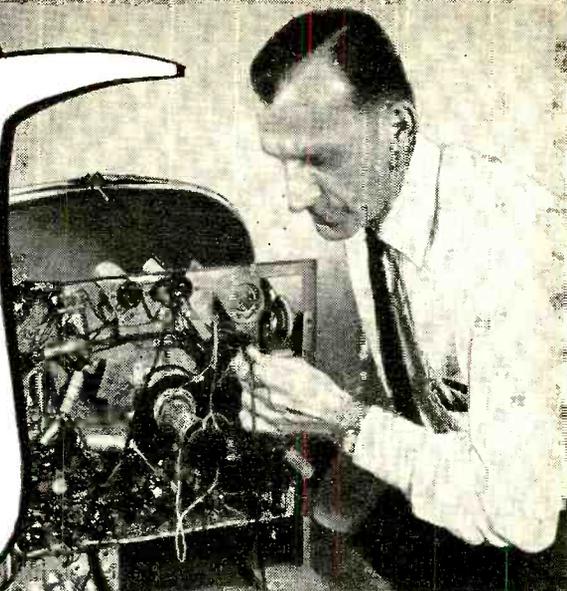
IRE International Convention, Mar. 26-29, Coliseum, New York, N. Y.

### Research Man Heads RCA

Elmer W. Engstrom, RCA research engineer for many years, became president of the company at the end of last year. Engstrom has been with the company for 31 years, and a vice president since 1955. Before his elevation, he was in charge of the RCA research laboratories in Princeton, N. J. Active in several fields, some of his most prominent

I chose **COYNE**  
**TELEVISION**

**RADIO-COLOR TV**  
home training because  
Coyne has been training  
men for good jobs OR  
their **OWN BUSINESS** for  
**NEARLY 60 YEARS**



Giant opportunity field! Join the thousands Coyne Home Training is preparing for a successful future in TV—open the door to better pay jobs, or your own business! COYNE—a leading residential, practical school—oldest of its kind—established 1899—is the institution behind this training.

Here is **MODERN—QUALITY TELEVISION** Home Training designed to meet the rigid standards that have made Coyne famous. You get personal supervision of Coyne Staff who know TV and know how to teach. **Learn quickly and easily in spare time.** No previous experience or advanced education necessary.

I chose **COYNE** because  
their new method costs less  
than half what most others do!



**SEND COUPON FOR FREE BOOK**

Send coupon below for all-new fully-illustrated book and full details including **EASY PAYMENT PLAN. NO COST OR OBLIGATION—NO SALESMAN WILL CALL**



Modern, up-to-the-minute. Easy to follow, step-by-step instructions—fully illustrated with 2150 photos and diagrams. **UHF and COLOR-TV included.** So practical you can quickly earn extra money in TV-Radio Sales and Service. Not only Coyne Quality training, but costs *half* what you'd expect to pay because you pay only for training—no costly extras. Free life-time employment service.

B. W. Cooke, Jr.  
President

**COYNE**  
**ELECTRICAL SCHOOL**

Founded 1899

CHARTERED AS AN EDUCATIONAL INSTITUTION NOT FOR PROFIT

1501 W. Congress Parkway, Dept. 22-H5, Chicago 7, Illinois

**COYNE TELEVISION  
HOME TRAINING DIVISION**

1501 W. Congress Parkway, Chicago 7, Ill.  
Dept. 22-H5

Send **FREE** Book and details of your Television - Radio - Color TV Home Training offer.

Name \_\_\_\_\_

Address \_\_\_\_\_

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

# AEROVOX ELECTROLYTIC CAPACITORS PROVIDE TOP QUALITY IN EVERY EXACT REPLACEMENT TYPE YOU NEED

PRODUCT  
NEWS  
FROM



**AFH** twist-prong 'lytics feature 85°C operation, improved sealing, high-purity aluminum foil construction throughout, ruggedized prongs and mounting terminals.

**PR**

for exact replacements in TV receivers and antenna rotating devices. Available in singles, duals, triples, quads, and quints for 0-65°C operation.



**PRS** compact "Dandee" units for trouble-free repair of series-string TV and AC-DC table radios. Made in singles, duals, and triples, as well as AC rated and non-polarized units.

**SRE**

... "Bantam" metal tubular 'lytics hermetically-sealed in aluminum cans with cardboard insulating sleeves. Smaller than the PRS but capable of handling full size loads to 85°C.



**PTT-PWE** miniaturized tubular 'lytics for repair of personal transistor radios, portable TV sets, and all space-tight requirements. Feature "Polycap"® plastic cases with exceptional humidity resistance.

**BCD**

upright mounting 'lytics for replacement in printed circuits, transistorized and auto radios. "Polycap" case and epoxy seal offer excellent moisture barrier to protect against drying out or leakage.



**HCB**

... high-capacity-low voltage 'lytics designed especially for applications such as motion picture sound equipment, electric fence controls and other low voltage applications.



Remember—it pays to use Aerovox!



Ask your Aerovox Distributor for a free Electrolytic Guide AFG-370 and AFH Twist-Prong 'Lytic Booklet AFH-46L.

**AEROVOX CORPORATION**  
DISTRIBUTOR DIVISION NEW BEDFORD, MASS.

Technical Leadership - Manufacturing Excellence

work has been in connection with color television. It may have been this to which chairman of the board David Sarnoff referred in stating that the selection "reflects our confidence in his ability and experience, particularly in those areas where RCA anticipates great future growth."

## A. Hoyt Taylor Passes

Dr. Albert Hoyt Taylor, one of the earliest radar pioneers, died in California at the age of 82. As early as 1922, Dr. Taylor noted—while making experiments in Navy radio communications—that passing ships on the Potomac created an interference pattern. He reported this to the Navy, and suggested that the effect might be used to detect enemy vessels. Continuing his work, he was able to detect planes at a distance of 50 miles by 1932, and in 1938 installed the first radar on a battleship. This work—especially after the outbreak of World War II—was done in cooperation with other inventors and developers, notably Sir Robert Watson-Watt of Britain.

Dr. Taylor received the United States Medal of Merit after the war, and was also recipient of the Stuart Ballantine Medal from the Franklin Institute, the Medal of Honor from the Institute of Radio Engineers, the John Scott Medal and the Pioneer Award of the Professional Group of Aeronautical and Navigational Electronics. He was a Fellow of the Institute of Radio Engineers, American Institute of Electrical Engineers and the American Physical Society. He was president of the Institute of Radio Engineers in 1929.

## Appleton Receives IRE Medal

Sir Edward Appleton, principal and vice chancellor of the University of Edinburgh, has been awarded the 1962 Medal of Honor of the Institute of Engineers. It will be presented to him at the March 28 International Convention banquet. The medal was awarded to Dr. Appleton "for his distinguished pioneer work in investigating the ionosphere by means of radio waves."

The directors announced the 1962 officers at the same meeting that granted the Medal of Honor. The 1962 president is Patrick E. Haggerty, president and director of Texas Instruments, Inc. The vice presidents are Andre M. Angot, technical director of Telecommunications Radioelectriques et Telephoniques, Paris, France, and T. A. Hunter, president of Hunter Mfg. Co., Iowa City, Iowa, and research professor at the State University of Iowa.

The directors also made five other awards and elevated 78 leading radio engineers and scientists to the status of Fellow of the Institute of Radio Engineers.

## Secretary-Eliminator Developed

A multi-lingual phonetic typewriter for transforming the human

voice into typed symbols was described at the 62nd meeting of the Acoustical Society of America in Cincinnati, Ohio, by Dr. Toshiyuki Sakai of Kyoto University, Kyoto, Japan.

Using 5,000 diodes and 3,000 transistors, the unit has three subsystems—a phoneme classifier, the control system and the speech analysis system. At present, the typewriter translates speech sounds into codelike symbols, but further research will permit segmentation into linguistic symbols.

The unit has unlimited linguistic and transmission distance possibilities, says Dr. Sakai.

## Optical Maser a Welder

Light from a laser (optical maser) can weld titanium, unaided by any other power source, says Lieut. Col. Elmer M. Morse, chief of the Air Force Aeronautical Systems Div. laboratory at Dayton, Ohio.

Laboratory researchers, he said, cut a dime-sized piece of titanium alloy in two, trained laser light on it and made spot welds with no difficulty.

## Sound Researcher Wins Nobel Prize

The 1961 Nobel prize in medicine was awarded to Dr. Georg von Békésy, for researches into the action of sound in the human ear. Dr. Békésy proved by actual experiment, using solutions containing aluminum and coal particles, how sound waves actually travel in the ear. His experiments proved that the older theories of hearing, long considered inadequate but never superseded by better ones, were in fact invalid, and that the inner ear, or cochlea, works much like a microphone in converting sound energy into electrical energy and transmitting it to the brain.

## Communications With Computers

A new communications system, using computer techniques, has been unveiled by the ITT Information Systems Div. It blends communication and computer technologies to process and switch telegraphic messages and data at speeds running up to at least 1,000,000 bits per second. The computer's memory contains such information as lists of all possible addresses or messages received and sent, instructions as to steps to be taken with regard to messages bearing any of these addresses, instructions as to priority, etc. Thus, the president of an international company, for example, could dictate a duplicate message to each of the branches of a certain division of his company throughout the world, and have them delivered at 9 o'clock the same morning, which might be several days later, with correction for the International Date Line.

The device is expected to have great value in processing and reporting internal information for companies or other organizations. END

# GET YOUR First Class Commercial F.C.C. LICENSE IN 12 WEEKS!

## Is the course proven?

A high percentage of our fulltime resident students get their 1st class licenses within 12 weeks from the time they start the course. Intensive FCC license training is our specialty — not just a sideline.

## Is the course complete?

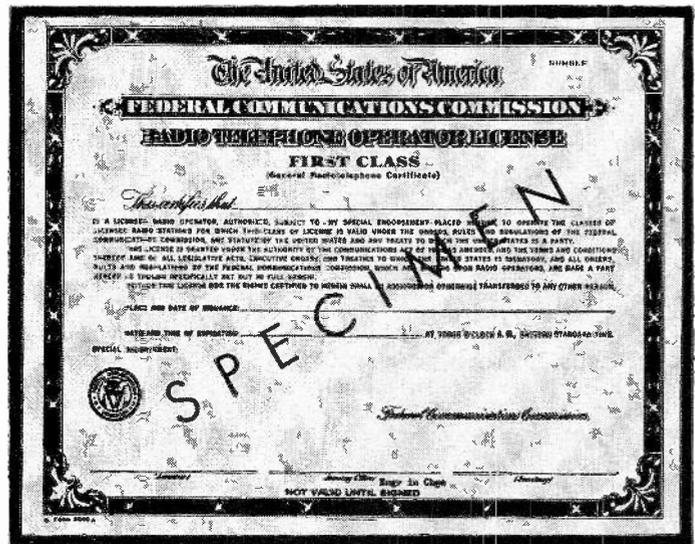
The Grantham course covers all the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics.

## Is the course "padded"?

The streamlined Grantham course is designed specifically to prepare you to pass certain FCC examinations. All of the instruction is presented with the FCC examinations in mind. If your main objective is an FCC license and a thorough understanding of basic electronics, you want a course that is right to the point — not a course which is "padded" to extend the length of time you're in school. The study of higher mathematics or receiver repair work is fine if your plans for the future include them, but they are not necessary to obtain an FCC license.

## Is it a "coaching service"?

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



## Is the course guaranteed?

The now famous Grantham Guarantee protects your investment. When such "insurance" is available at no extra cost, why accept less?

## Is it a "memory course"?

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

**THE GRANTHAM FCC License Course in Communications Electronics is available by CORRESPONDENCE or in RESIDENT classes.**

# Grantham Schools

1505 N. Western Ave.  
Los Angeles 27, Calif.  
(Phone: HO 7-7272)

408 Marion Street  
Seattle 4, Wash.  
(Phone: MA 2-7227)

3123 Gillham Road  
Kansas City 9, Mo.  
(Phone: JE 1-6320)

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

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

Grantham resident schools are located in four major cities — 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.

**MAIL COUPON NOW — NO SALESMAN WILL CALL →**

Accredited by the National Home Study Council

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

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

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

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

Address \_\_\_\_\_

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

I am interested in:  Resident Classes

Home Study

24-B

# Correspondence



## UNCRIMP THE JOINT

Dear Editor:

There are many who disagree with the "Technician's Guide to Good Soldering" (November 1961 issue), which recommends wrapping or crimping.

Crimping may be desirable in missile electronics where no maintenance is anticipated. Since the equipment will undergo only a half-hour's use before plunging into the ocean, it is not likely that any connecting wire will have to be removed from a terminal. Otherwise, there is a compelling case for crimpless joints—at least from the viewpoint of the wretched field engineer whose job it is to keep the equipment in working order.

Of course, crimping is highly desirable from a production foreman's point of view because it requires less soldering care and, therefore, speeds his work. Ultimately, however, it is the customer-user whose judgment is important, not the production foreman.

With a little care, you can get perfectly reliable joints without even bending the end of the lead. We have yet to hear any objections raised against crimpless soldering to the holes in etched-circuit boards (though some technicians deplore the expedient that calls for bending each lead, slightly where it emerges from the back of the board).

This plea for crimpless soldering  
(Continued on page 22)

## ABOUT ELECTRONIC IGNITION

Dear Editor:

In the December 1961 issue, Mr. J. S. Pitman raises a question as to the reliability of the thyatron ignition system described in the September 1961 issue. The author himself points out that a serious problem exists.

Commander Smithey states that the 2D21 thyatrons need replacement approximately every 4,000 to 5,000 miles. Relatively simple circuit analysis suggests that peak cathode-current pulses are of the order of 5 to 10 amperes, which is many times the 0.5-amp rating of the 2D21. Use of a high-current thyatron would solve this problem and perhaps extend operating life, though it would not reduce circuit complexity.

However, Mr. Pitman does have a point. The failure rate of a system is a function of the number of components, and a complicated system using the same grade of component under similar

conditions may be expected to cause trouble with a frequency in proportion to the number of components.

I do object to calling Commander Smithey's system transistorized (though it may be technically correct), since the transistors are part of a special power supply and do not perform the primary switching function. The single industrial-grade power transistor in the Transfire system manufactured by our company does directly switch the coil primary current while drawing only a fraction of an ampere through the distributor contacts. Special coil design, minimal number of components and conservative operation yield a simple and reliable system which has all the performance advantages you listed for the thyatron-tube system, and has much lower initial and maintenance costs.

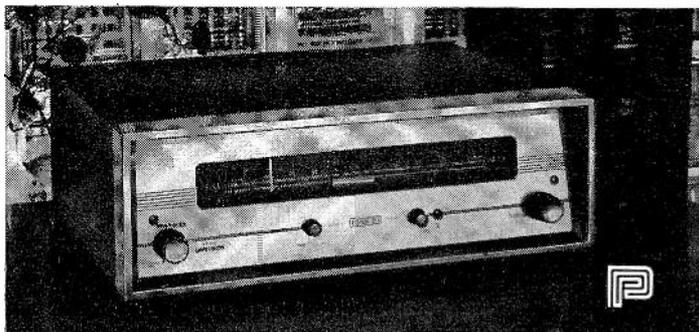
W. F. PALMER

Palmer Electronics Labs  
Carlisle, Mass.

# FM • STEREO • MULTIPLEX

All on One Chassis  
and in **KIT FORM**

by **PACO**



**That's Right — No external Multiplex Adapter required** . . . PACO introduces the new model ST-35MX FM Stereo Multiplex tuner, featuring the finest multiplex circuitry, ALL ON ONE CHASSIS . . . ALL IN ONE CABINET AND IN KIT FORM (with factory pre-aligned multiplex section).

The ST-35MX FM Stereo-multiplex tuner is designed for the discriminating Audiophile who demands the ultimate in distortionless FM Stereo reception. Its incomparable features include ultra high sensitivity, rock-stable AFC, pin point selectivity combined with broad band response.

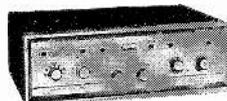
The ST-35MX has been engineered to meet the most critical standards. Highly styled in a handsome black and gold case . . . it is the perfect companion to Paco's popular SA-40 Stereo preamp-amplifier or any other fine quality stereo system. Available and on display at all leading distributors throughout the world. Write for catalog.

AVAILABLE THREE WAYS IN HANDSOME GOLD AND BLACK ENCLOSURE  
**MODEL ST-35MX** (Kit) with full pre-aligned multiplex circuitry and PACO detailed assembly — operating manual . . . . .NET PRICE \$99.95

**MODEL ST-35PAMX** (Semi-Kit) with both tuner and multiplex sections factory-wired and completely pre-aligned for hairline sensitivity. Complete with PACO detailed assembly — operating manual.

NET PRICE \$119.95

**MODEL ST-35WMX** (ready to operate). Factory-Wired, aligned, calibrated and assembled. Complete with operating manual . . . . .NET PRICE \$139.95



**Model SA-40**  
STEREO PREAMP-AMPLIFIER KIT  
Kit Net Price: \$79.95  
Factory Wired Net Price: \$129.95



**Model ST-25 MX**  
FM STEREO TUNER KIT  
Kit Net Price: \$69.95  
Factory Wired Net Price: \$99.95



**Model MX-100**  
STEREO MULTIPLEX ADAPTER  
Kit Net Price: \$49.95  
Factory Wired Net Price: \$69.95

WRITE FOR CATALOG



**Model V-70**  
VACUUM TUBE  
VOLTMETER KIT  
Kit Net Price: \$31.95  
Factory Wired  
Net Price: \$49.95



**Model G-32**  
SWEEP GENERATOR  
AND MARKER ADDER  
Kit Net Price: \$85.95  
Factory Wired  
Net Price: \$129.95



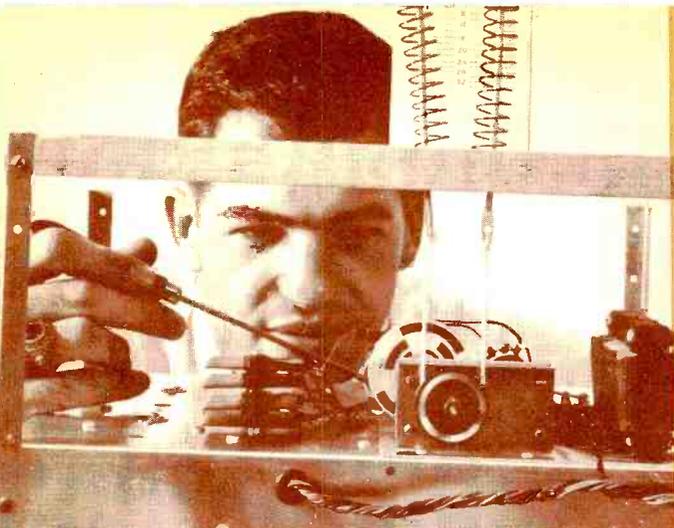
**Model G-34**  
SINE-SQUARE  
WAVE GENERATOR  
Kit Net Price: \$64.95  
Factory Wired  
Net Price: \$99.95



**Model C-25**  
IN-CIRCUIT  
CAPACITOR  
TESTER KIT  
Kit Net Price: \$19.95  
Factory Wired  
Net Price: \$29.95

**PACO Electronics Co., Inc.**  
a division of **PRECISION Apparatus Co., Inc.**  
Subsidiaries of Pacotronics, Inc.  
70-81 84th Street, Glendale 27, Long Island, New York

Manufacturers of Fine Electronic Equipment for over 30 years.



## Special Training Equipment Included

Pick the field of your choice—and train at home with the leader—NRI. In addition to Industrial Electronics and FCC License training explained at the right, NRI offers comprehensive courses in Radio-TV Servicing and Radio-TV Communications. Except for the FCC course, all NRI courses include—at no extra cost—special training equipment for actual practice at home, building circuits and working experiments. Makes theory you learn come to life in an interesting, easy-to-grasp manner.

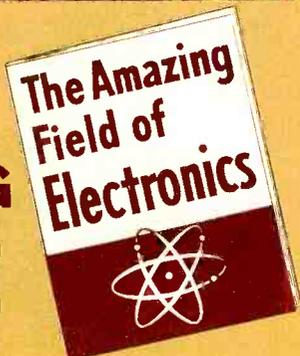
## Multiplexing, FM Stereo Broadcasting Included

NRI training keeps up with the times. New, additional profit opportunities exist for the Technician who understands the latest technical advances. Course material now covers FM Stereo Broadcasting, tells you about Multiplexing equipment, other recent developments.

## Learn More to Earn More

Act now. The catalog NRI sends you gives more facts about the field of your choice, shows equipment you get and keep. No obligation. Cost of NRI training is low. Monthly payments. 60-Day Trial Plan. Mail postage-free card today. **NATIONAL RADIO INSTITUTE, Washington 16, D.C.**

Send for  
64-Page  
CATALOG  
FREE



# NRI—Oldest and Largest Radio Television School Now Offers NEW HOME STUDY TRAINING IN INDUSTRIAL & MILITARY ELECTRONICS

This is the age of Electronics. Rapidly expanding uses for Electronic Equipment in industry, business, the military demands more trained men. Prepare now for a career as an Electronic Technician to assure advancement or to profit from your hobby. NRI now offers a complete course in **ELECTRONICS**—Principles, Practices, Maintenance. Computers, telemetry, automation, avionics are changing our world, yet all employ the same basic principles . . . and that is what this NRI course stresses with illustrated lessons and special training equipment. Mail card below.



## NEW HOME STUDY TRAINING FOR YOUR FCC LICENSE



An FCC Commercial License combined with NRI time-tested training can be the keys to a better future for you with higher pay, interesting work, more rapid advancement as the rewards. Prepare at home *quickly* for your FCC examinations through

NRI's new, low-cost, special training. Like other NRI-trained men, you can be monitoring TV shows, radio broadcasts, operating shipboard and aviation radio, or holding down other important jobs. Get full details—mail the card below.

**FOR MORE INFORMATION-TURN PAGE**

**Cut Out and Mail—No Stamp Needed**



**NATIONAL RADIO INSTITUTE  
WASHINGTON 16, D.C.**

Send me your Electronic, Radio-TV catalog without cost or obligation. I am interested in the course checked below. (No representative will call. Please PRINT.)

- INDUSTRIAL ELECTRONICS     COMMUNICATIONS  
 FCC LICENSE                       SERVICING                      **WX**

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

Address \_\_\_\_\_

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

**ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL**

**ELECTRONICS NEEDS  
4 TO 7  
QUALIFIED TECHNICIANS**



**FOR EVERY ENGINEER**



# Join The Thousands Who Trained For Advancement With NRI

Thousands of NRI graduates throughout the U. S. and Canada are proof that it is practical to train at home. NRI graduates are in every kind of Electronics work: inspectors, maintenance men, lab technicians, testers, broadcasting and mobile communications operators, Radio-TV service technicians, or in essential military and government posts. Catalog tells more about what NRI graduates do and earn. Mail postage free card.

## Choose from 4 Courses

- 1 INDUSTRIAL ELECTRONICS**  
Learn Principles, Practices, Maintenance of Electronic equipment used today by business, industry, military, government. Covers computers, servos, telemetry, multiplexing, many other subjects.
- 2 FCC LICENSE**  
Every communications station must have one or more FCC-licensed operators. New NRI course is designed to prepare you for your First Class FCC exams. You learn quickly, training at home in your spare time.
- 3 COMMUNICATIONS**  
Training for men who want to operate and maintain radio and TV stations; police, marine, aviation, mobile radio, etc. Includes FM Stereo broadcasting. Course also prepares you for your FCC license exam.
- 4 SERVICING**  
Learn to service and maintain AM-FM Radios, TV sets, Stereo Hi-Fi, PA systems, etc. A profitable, interesting field for a spare-time or full-time business of your own.



"THE FINEST JOB I EVER HAD" is what Thomas Bilak, Jr., Cayuga, N. Y., says of his position with The G. E. Advanced Electronic Center at Cornell University. He writes, "Thanks to NRI, I have a job which I enjoy and which also pays well."



**BUILDING ELECTRONIC CIRCUITS** on specially-designed plug-in type chassis, is the work of Robert H. Laurens, Hammonton, N. J. He is an Electronic Technician working on the "Univac" computer. Laurens says, "My NRI training helped me to pass the test to obtain this position."



"I OWE MY SUCCESS TO NRI" says Cecil E. Wallace, Dallas, Texas. He holds a First Class FCC Radio-telephone License and works as a Recording Engineer with KRLD-TV.



**MARINE RADIO OPERATOR** is the job of E. P. Searcy, Jr., of New Orleans, La. He works for Alcoa Steamship Company, has also worked as a TV transmitter engineer. He says, "I can recommend NRI training very highly."



**FROM FACTORY LABORER TO HIS OWN BUSINESS** that rang up sales of \$158,000 in one year. That's the success William F. Kline of Cincinnati, Ohio, has had since taking NRI training. "The course got me started on the road," he says.

**SEE OTHER SIDE**

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

**BUSINESS REPLY MAIL**  
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

**NRI** National Radio Institute  
3939 Wisconsin Avenue  
Washington 16, D.C.

## NRI IS OLDEST—LARGEST SCHOOL OF ITS KIND

Training men to succeed by home study has been the National Radio Institute's only business for over 45 years. NRI is America's oldest and largest Electronics home-study school. Don't delay. Cut out and mail POSTAGE-FREE CARD.



**MAIL POSTAGE-FREE CARD**

Servicemen everywhere are saying:



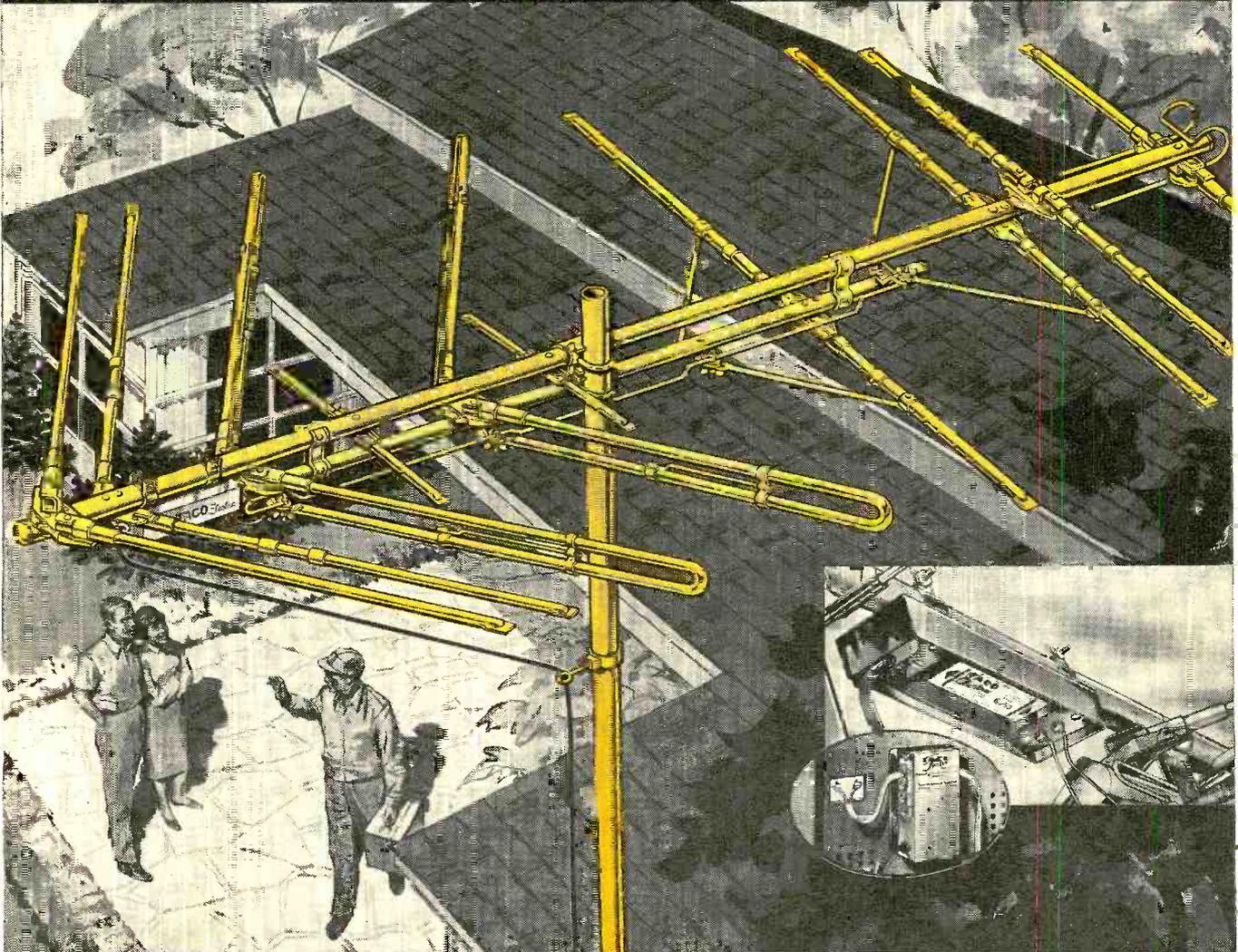
brings in sharp pictures where other electronic antennas fail

It stands to reason that TACO would produce, in the T-BIRD ELECTRA, the world's best electronic antenna. Only TACO gives you the combination of the most rugged, highest-performance antennas plus the finest in antenna-mounted transistorized preamplifiers (designed by Jerrold).

So, with the T-BIRD ELECTRA you assure customer satisfaction, even in the severest "problem" areas. Rigid chrome-alloy aluminum elements and

contacts eliminate the antenna "friction noise" and "signal flutter" inherent in some so-called "high-gain" antennas. There's a T-BIRD ELECTRA for every TV/FM home need, priced from \$79.75. And it's completely pre-assembled for your convenience.

Only TACO offers custom area engineering on electronic antennas to help you solve any type of signal problem. For these special services, see your TACO distributor.



\*The TACO ELECTRA preamplifier is available for use with any antenna.



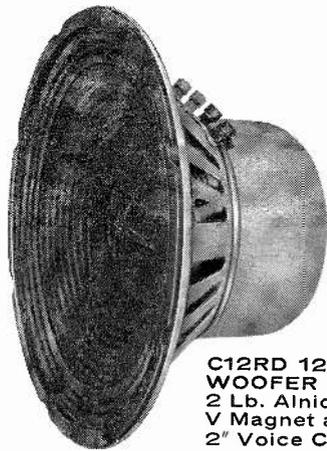
**TECHNICAL APPLIANCE CORPORATION**

Distributor Sales Division • Dept. JTD-13, Sherburne, New York

A Subsidiary of Jerrold Electronics Corporation

# MUSIC BIG GAS LIFE

## Utah's High-Fidelity CONTINENTAL SPEAKERS



**C12RD 12"  
WOOFER**  
2 Lb. Alnico  
V Magnet and  
2" Voice Coil

**YOU GET LIFE-SIZE SOUND** in every range, from 20 to 20,000 CPS, with Utah's precision-engineered stereo/high-fidelity speakers. Tweeters and mid-range speakers feature a specially engineered horn formula to enhance "presence". Each speaker has color-coded 4-way terminals.



1124 Franklin St.  
Huntington  
Indiana

Please mail me prices, specifications and performance details of your Continental speaker line.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

(Continued from page 18)

does not represent simply a fanatical minority view. Tektronix, for example, favors crimpless joints; and it is generally acknowledged that Tektronix produces some of the finest, most reliable, most *easily serviced* equipment in the industry.

DALE L. HILEMAN  
San Francisco, Calif.

### ELECTRONIC IGNITION —IN USE

Dear Editor:

Here's to three cheers for Commander Smithey and sour grapes to J. S. Pitman. Enjoying that surging, economical power more every day! I added an option—a switch that keeps the filaments on and heated for short stops. Be glad to hear of any hints that come up. Try 500  $\mu\text{f}$  for C4.

WM. SENDER

Parma, Ohio

### AMPEREX TRANSISTORS ARE AVAILABLE

Dear Editor:

We noticed in your "Transistor Roundup" in the December 1961 issue that Amperex does not appear among the list of transistor manufacturers.

Amperex has a number of transistors in various types that sell for \$5 or less. We have approximately 25 franchised semiconductor distributors and are listed in the Newark Industrial, Burstein-Applebee and Radio Shack Industrial mail-order catalogs.

We will be pleased to furnish your readers with our list of distributors as well as a free copy of our semiconductor catalog upon request.

It may be interesting to note that our Slatersville, R.I. plant has been in full production for over a year, and that a number of original transistor types are being manufactured there.

M. SMOLLER

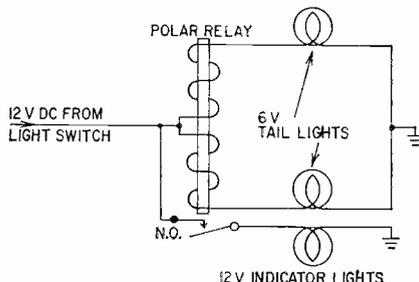
Manager,

Advertising & Sales Promotion  
Amperex Electronic Corp.  
230 Duffy Ave.  
Hicksville, N. Y.

### TAIL-LIGHT INDICATOR

Dear Editor:

Those who wish to build the Tail-Light Indicator on page 108 of the April issue, but do not care for the expense of transistors and photocells, might try one of these ideas.



Visit the local junk yard and obtain an ammeter from an old car. Change the value of the shunt and install it in

series with the tail lights. The actual installation is simple and requires only inserting the meter in series with the lead to the tail lights. Add a switch to the circuit and you can check your stop lights too.

On cars with 12-volt batteries you might try the circuit shown here. When both tail lights are lit, the relay will not energize. But if either light should fail, the indicator (mounted on your dash) lights. If necessary, the polar relay can be shunted to the proper current range. The tail lights must be replaced with 6-volt units as they are in series with the relay coils, but use a 12-volt indicator lamp or a series resistor and a 6-volt lamp.

ROBERT G. CASEY  
Seine, France

### ATTENTION TECHNICIANS

Dear Editor:

I am not satisfied with the present New York TV service license bill sponsored by ESFETA (Empire State Federation of Electronic Technicians Associations).

Any license bill is administered by a license board. Men appointed to this board are those suggested by the state trade association (ESFETA).

The Department of Education does not determine the scope of the license examination that will be used under the license law (after the grandfathers get in). The contents of these examinations are determined solely by the members of the license board. This, in effect, means that the standards of our license law would be set forth by the technicians' organization and not the State Education Department. The department merely prints the examinations; it does not compose them.

ESFETA does not require all their members to be qualified technicians and they have even abandoned in recent years their one-time requirement that all officers must be qualified technicians.

With this combination we are finding a lowering of the average technical standards by those who will be placed in a position to set the standards of our industry under the license law. Therefore, unless the qualifications for the position of license-board member is more strongly specified in the present bill, we have no guarantee of a good license law. If enough New York State technicians voice their opinion for high standards of the board members, we can have it. Write today before it is too late.

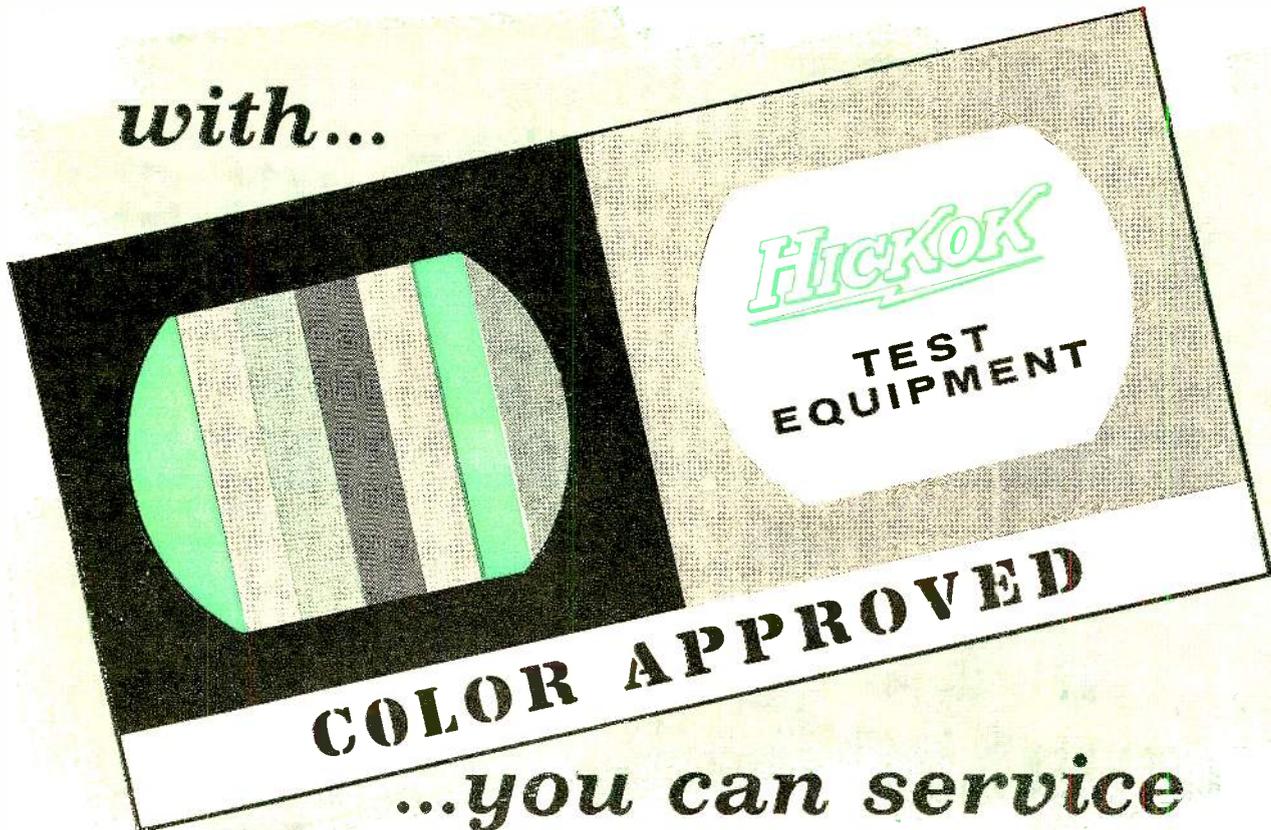
MELVIN COHEN

RD No. 1

Hudson Falls, N. Y.

[ESFETA members are asked to state their opinions. After all, there are two sides to every story. As the proposed law states, a certain number of board members are to be service technicians, so only technicians will be able to fill these positions. And like any appointed office, someone has to do the selecting. They may not select the best men all the time, but this holds true for every organization.—Editor END

with...



...you can service

**COLOR TV**

*simply...swiftly...profitably!*

Color TV is Here... Prepare now... But, before you invest in color test equipment, get *all* the facts. Plan to attend a Hickok Color Clinic and write for our free booklet, "Why NTSC?".

These manufacturers have announced that they will be marketing color television sets this fall.

**DU MONT**    **ADMIRAL**  
    **ZENITH**  
**Emerson**  
**Magnavox**  
**Olympic**  
**PHILCO**

Remember, Hickok Color Approved Test Equipment is built to NTSC standards, recognized and approved by leading TV manufacturers.



656  
NTSC Standard Color Bar Generator



660  
White Dot-Bar Generator



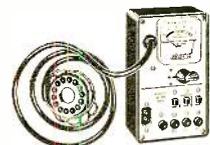
675A  
Wide Band Oscilloscope



691  
Heterodyne Marker-Adder



615  
Sweep and Marker Generator



CR33  
Color Tube Tester

The



**Electrical Instrument Co.**

10531 Dupont Avenue • Cleveland 8, Ohio



# UNCOMPROMISING ENGINEERING

## BEST BUYS IN SERVICE INSTRUMENTS: everything from Scopes to Probes



DC-5 MC  
5" Scope #460  
Kit \$79.95  
Wired \$129.50

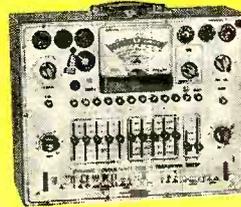
Also Avail.—5" Push-Pull Scope #425  
Kit \$44.95 Wired \$79.95



Peak-To-Peak  
VTVM #232  
& Uni-Probe®  
Kit \$29.95  
Wired \$49.95

VTVM #221  
Kit \$25.95  
Wired \$39.95

Pat. #2,790,051



Dynamic Conductance  
Tube & Transistor Tester #666  
Kit \$69.95 Wired \$109.95  
Complete with steel cover & handle



TV-FM Sweep Generator  
& Marker #368  
Kit \$69.95 Wired \$119.95

## BEST BUYS FOR INDUSTRIAL TESTING: everything from Bridges to Supplies

NEW Metered  
Variable Auto-  
Transformer AC  
Bench Supplies:  
#1073 (3 amp.)  
Kit \$35.95  
Wired \$47.95  
#1078 (7½ amp.)  
Kit \$42.95  
Wired \$54.95



NEW Extra-Low-  
Ripple 6 &  
12 Volt  
Battery  
Eliminator  
& Charger #1064  
Kit \$43.95  
Wired \$52.95



NEW AC  
Volt-Watt  
Meter #260  
Kit \$49.95  
Wired \$79.95

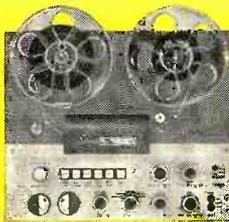


1350 Combinations!  
Series/Parallel R-C  
Combination Box #1140  
U.S. Pat. No. 2954518  
Kit \$13.95 Wired \$19.95



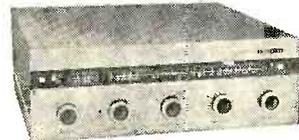
## BEST BUYS IN STEREO & MONO HI-FI: everything from Tape Decks to Speakers

Transistorized  
Stereo/  
Mono  
4-Track  
Tape  
Deck  
Wired  
Model  
RP100W  
\$399.95  
Semi-Kit  
Model  
RP100K  
Electronics in Kit form \$299.95



An original, exclusive EICO product  
designed and manufactured in the  
U.S.A. (Patents Pending)

NEW FM-Multiplex  
Autodaptor MX99  
Kit \$39.95 Wired \$64.95  
Designed for all EICO  
FM equipment (HFT90,  
HFT92, ST90) and any  
other component quality,  
wide-band FM tuners  
having multiplex outputs

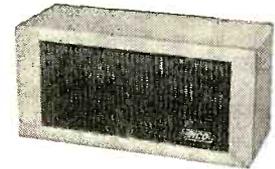


NEW FM-AM Stereo Tuner ST96  
Kit \$89.95 Wired \$129.95 Inc. FET

NEW 70-Watt Integrated  
Stereo Amplifier ST70  
Kit \$94.95 Wired \$149.95



NEW 40-Watt Integrated  
Stereo Amplifier ST40  
Kit \$79.95 Wired \$129.95



Bookshelf Speaker System HFS1  
Kit \$39.95 Wired \$47.95

## BEST BUYS IN "HAM" GEAR: from Transmitters to Code Oscillators



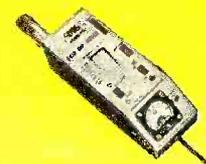
NEW 60-Watt CW Transmitter #723  
Kit \$49.95 Wired \$79.95



90-Watt CW Transmitter #720  
U.S. Pat. No. D-184776  
Kit \$79.95 Wired \$119.95



Universal Modulator Driver #730  
Kit \$49.95 Wired \$79.95  
Cover E-5 \$4.50



Grid Dip Meter #710  
Kit \$29.95 Wired \$49.95

Over 2 MILLION EICO instruments in use. Compare EICO side-by-side critically with products selling for 2 or 3 times more. Buy your EICO right "off the shelf" from 1500 neighborhood dealers coast to coast, most of whom offer budget terms.

## BEST BUYS IN CITIZENS TRANSCEIVERS AND TRANSISTOR RADIOS

Over 80 unique  
products to  
choose from!



Citizens Band Transceivers  
From: Kit \$59.95 Wired \$89.95  
Superhet; prealigned xmitter  
osc; match different antennas  
by variable "pi" network.  
Single & multi-channel models.



NEW Walkie-Talkie  
Citizens Band  
Transceiver #740  
Kit \$54.95  
Wired \$79.95.  
Carrying Case \$3.95.  
Complete with rechargeable  
leakproof battery & charger.  
Operates 2500 hours on the battery.  
U. S.-made by EICO.



Transistor Portable Radio RA6  
Kit \$29.95 Wired \$49.95 Incl. FET



EICO, 3300 N. Blvd., L.I.C. 1, N.Y.

Send free 32-page catalog & Distributor's name.

Send Free Schematic of Model No. \_\_\_\_\_

Send new 36-page GUIDEBOOK TO HI-FI for which I enclose 25c for postage & handling.

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M.

Add 5% in the West © 1962 Electronic Instrument Co. Inc., 3300 N. Blvd., L. I. C. 1, N. Y.

## THE NEXT PHASE OF TV

... A Future L-P Television Record Is Possible ...

ACCORDING to the head of the Federal Communications Commission, Mr. Newton Minow, as well as a majority of TV critics, a sizable percentage of today's television programs have sunk to an incredible low, so low, indeed, that more and more people turn to other forms of entertainment.

The flight from television is by no means new; it is of long standing. In recent years, serious attempts have been made to lure distressed TV audiences into pay-TV presentations, where viewers could see worth-while, adult television fare. But pay TV—as we have pointed out on this page before—does not seem to be the solution to the acute problem.

In the meantime, the country is turning more and more to high fidelity and stereo, where people can enjoy first-class music and all that goes with it—at the expense of TV, by doing without it.

The thought seems obvious—why not combine high-fidelity TV with high fidelity and stereo? NOT BROADCAST TV, BUT YOUR OWN SELECTED TV, on a regulation TV receiver?

Indeed, RCA has experimental tape recorder models that can do just that, but so far none are for sale. Prerecorded TV programs might be the stimulus that could lead to their manufacture at prices that could put them within the reach of the home viewer.

In our opinion, tape records do not seem to be the only solution for a number of reasons. One is that the country has grown used to phonograph discs in high fidelity and stereo. They are simple to handle, particularly long-playing (L-P) ones.

Why not, then, record TV special programs, such as "My Fair Lady" and hundreds of others, with sound and video on L-P records? Then we could feed the TV output of such programs of our own selection into our present television set, using its video circuits. (We do this now when we feed audio from a record player into the TV's audio system.) Then we would not be a captive audience, listening and viewing mediocrity, interspersed with often-offensive commercials.

The idea, simple and obvious as it is, has so far been technically unfeasible, even if you could record electronically the wide frequency range. To record normal TV impulses on an L-P record, it would have to be enormous in dimensions—about 25 feet in diameter for a ½-hour program. Obviously, such a system is unworkable.

Yet there seem to be other solutions to the problem. The writer suggests one which, when worked out technically, would seem feasible for the future.

To begin with, why use TV impulses? Why not use a special kind of motion picture and record complete motion pictures on a flat disc? We can do this readily today with optical micropictures.

For over 50 years, French manufacturers have made special optical lenses about ¼ inch long and about 3/32 inch in diameter. On the flat end is cemented an almost invisible photographic bit of microfilm. Usually the subject is a comely girl.\* The lens is often mounted in one end of a pen

\*Such a lens, mounted in a religious cross, containing the Lord's Prayer, is at present sold for 50¢ by jewelry and novelty stores. If you cannot secure one, send a stamped return envelope to the author for the name of the manufacturer.

or pencil. The picture, sharp and clear when viewed against the light, nevertheless measures only 1/32 x 3/64 inch.

With modern techniques, we can reduce even this size considerably yet get excellent pictures, plus an optical sound track.

The entire motion picture would run in a tight spiral, not in a groove, of course, but on a disc, similar to today's records.

As we wish to use both sides, obviously the record cannot be transparent, but the film spiral must be mounted on a white or, better, a mirrored surface such as polished aluminum, for instance.

The optical pickup head, which follows the picture track, also carries a lamp which throws a powerful beam of light on the picture, reflecting the film image into the pickup head. Here we can do two things: One would be to throw the enlarged motion picture onto a screen, pick off the sound with a photoelectric cell, and leave out the TV set entirely.

That, we believe, is not the best way. It is more logical to install the picture record and its associated gear in the top of the future TV set, where it belongs. Then we attach a special, small TV camera to the pickup head, and feed the output to the TV receiver. This, we think, solves the problem in a sensible way.

Let us caution here that TV records on flat discs are a project for the future. Enormous technical difficulties must be overcome, despite its attractive possibilities. Such records, even if finally mass-produced, would probably always cost far more than present L-P records.

When TV tape records were first contemplated, no feasible solution seemed in sight for many years, until Ampex finally evolved its brilliant super-speed, revolving magnetic transducer head. A similar breakthrough might make disc TV recording possible.

Certainly, in the future, TV set manufacturers would provide better hi-fi speakers to anticipate the new demand that is bound to follow such TV records. Yes, such receivers would be more expensive, because they must combine TV, hi-fi and stereo.

Coming back to the TV records—they naturally would be expensive too at first. Yet, as always, mass production would surely lower the prices. If a hit musical or smash drama were assured a good percentage of income to its producers from a million or more TV records of the productions, they would not have to worry about audience attendance—indeed, we can foresee the time when such productions would be exclusively for a "record" audience first, then later played to a live audience.

The world's great operas, symphonies in the best concert halls—all can be recorded in audio and video on L-P in the future. There seems to be no limit once the system has been perfected.

Does all this spell the doom of live TV? Certainly not in the slightest. Television has its own peculiar and unrivaled pre-eminence that no home-use recording can ever challenge. News, sports, spot events, talks by eminent politicians, debates, vaudeville, panel shows and dozens of other functions—if put on intelligently and in good taste—will always have a good audience. The two systems of entertainment need never compete with each other—nor should they. —H.G.

# FM antennas for better listening

## Types of antennas and their characteristics

By EDWARD M. NOLL

The antenna has always been important in FM. But with stereo multiplex FM, a good antenna is absolutely vital, even in metropolitan areas. The signal-to-noise ratio of the stereo signal is far below that of a conventional mono FM signal, and if the signal at the receiver input is inadequate, the multiplex subcarrier will not be strong enough to lock in the receiver's multiplex circuits. Poor stereo separation or complete absence of stereo may be the result.

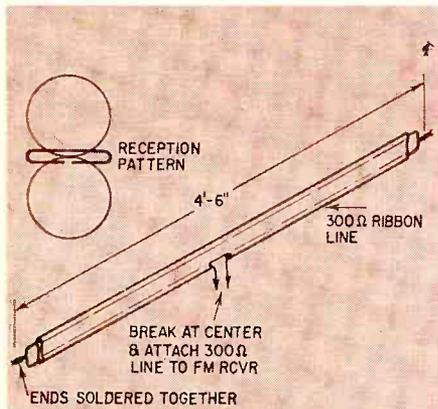


Fig. 1—Simple FM antenna can be made from a length of 300-ohm twin lead.

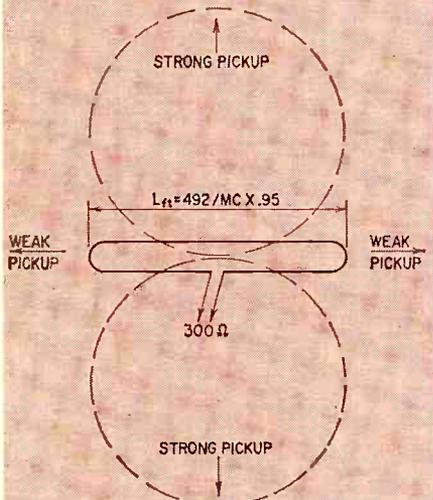


Fig. 2—The basic folded dipole and its figure-8 pattern.

A good antenna keeps local signals well above the level at which interference and background noise can mess up the reproduced program. At the same time, longer distance signals can be raised above the noise level, reducing fading and interference. The stronger the signal delivered to the tuner input, the more it can be made to exceed the background noise of the receiver.

Sensitivity of FM tuners is usually given in terms that relate microvolts of signal to background quieting. This figure is generally presented as the minimum signal strength required for a certain amount of db quieting (usually 20 or 30 db). To say a receiver has a sensitivity of 1  $\mu$ v for 30-db quieting indicates that an incoming 1- $\mu$ v signal will reduce the normal no-signal background noise level of the receiver by 30 db. If the incoming signal is strong enough to press down the background noise by 40 db, the background, in a practical sense, can be called noiseless.

A correctly installed antenna can do much to optimize the weaker and more distant FM stations. By correct antenna positioning and orientation, these signals can be raised above the background noise. They can be made strong enough to dominate interference from local stations on nearby channels.

Built-in antennas are included with most FM receivers and tuners. The built-in antenna is usually a piece of 300-ohm Twin-Lead stapled to the cabinet. Such a simple antenna is often good enough for the stronger local stations. But reception is better when the antenna is improved.

Attic- or window-mounted antennas help considerably if it is not possible to go to a roof-mounted outdoor type. A ribbon-line folded dipole (Fig. 1) can be stapled to attic rafters or other convenient mounting. The length of such a ribbon antenna can be about 4½ to 5 feet. Solder the ends together as shown. Break one lead at its center and attach the 300-ohm transmission line that must be run between the folded dipole and the antenna terminals of the FM unit. As shown, the antenna is most sensitive when placed broadside to the received signal. When the transmitters in the area are located in differing directions, mount it broadside

**FOLDED DIPOLE & PATTERN** = a

Metropolitan and suburban areas for strong signals

**S-DIPOLE & PATTERN** = b

Metropolitan and suburban strong signal areas where a broader pattern is desirable because signals arrive from several directions

**TURNSTILE & PATTERN** = c

Metropolitan and suburban strong signal areas where an omnidirectional pattern is needed because signals arrive from many directions

**DIPOLE & REFLECTOR & PATTERN** = d

Urban and near-fringe areas where signals arrive from same direction. Stacked versions of A, B, C, or D can be used in near fringe areas 25-40 miles out

**90° END-FIRE HORIZ DIPOLES & PATTERN** = e

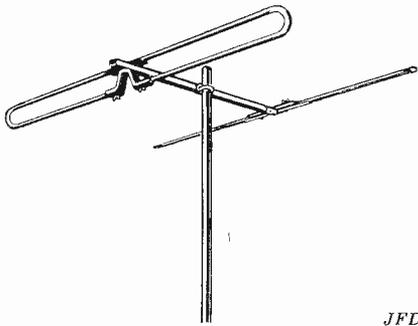
For urban and near fringe areas where a broad uni-directional pattern is needed

**SMALL YAGI & PATTERN** = f

Fringe and other weak signal areas 30-80 miles out

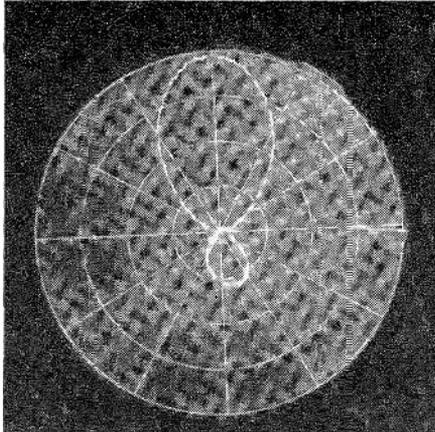
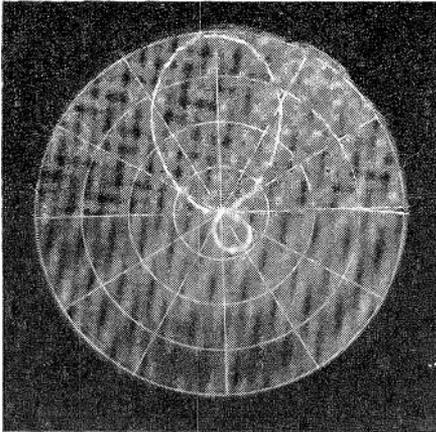
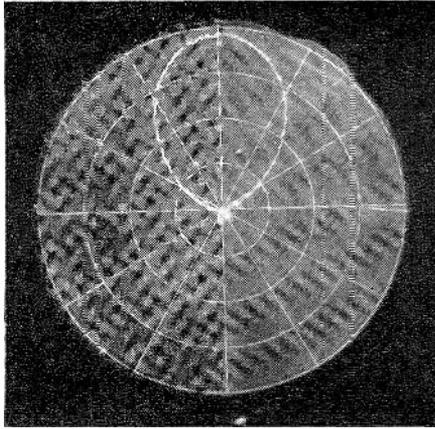
**LARGE YAGI & PATTERN** = g

For fringe areas beyond 80 miles. Number of elements depends on how far out and how weak signals are

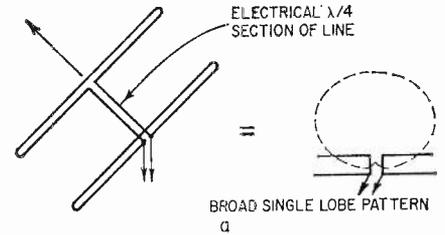


JFD

Fig. 3—A folded dipole and reflector for FM (above) and its radiation patterns at 88 mc (right), 78 mc (below) and 108 mc (lower right).



where all FM transmitter signals arrive from approximately the same direction, a simple gain type antenna (one with additional elements to increase the gain in one direction—see Fig. 3) can be used. The reflector element, which is longer than the dipole, lowers the sensitivity of the antenna on its side of the driven element and increases it in a direction away from the



300 Ω ribbon	246/MC x .82
150 Ω "	" x .77
75 Ω "	" x .68
Coax	" x .6

b

Fig. 5—End-fire folded dipole and its single-lobe pattern. The table shows length of the quarter-wave section.

to the weakest signal you wish to receive.

An outdoor antenna is best if optimum performance is desired. There are a variety of outdoor FM antenna styles, from the simple dipole to the high-gain Yagi. Let us consider the physical and electrical characteristics of the more common styles.

#### Frequency, bandwidth and size

The FM band occupies a 20-mc span of frequencies between 88 and 108 mc. Spectrum-wise it is positioned just above television channel 6. Hence the FM antenna is somewhat shorter than

low-band TV antennas, and the usual FM antenna is not nearly so elaborate. Typical half-wavelength dimensions at the center and ends of the FM band are given in Table I.

Most FM antennas are cut to the center of the band or on the low-frequency side of center. This gives reasonable sensitivity over the entire span of frequencies. Some drop in sensitivity is to be expected at band edges because of the 20-mc bandwidth. If you want to receive a weak station near the band edge, you can increase signal strength by choosing a length that resonates at or near its frequency (Table I).

Often a simple folded dipole (Fig. 2) is used as an FM antenna. It is a half-wavelength long and has a resistance of 300 ohms when center-fed. Thus 300-ohm line can be used to transfer the signal from the antenna to the 300-ohm input terminals of the receiver. A horizontal dipole antenna has a figure-8 horizontal directivity pattern. Thus its sensitivity is maximum broadside to the antenna element. (Minimum pickup is in line with the antenna.) When installing an antenna in an urban or suburban area, the two minima are spaced in the directions from which no FM signals are likely to arrive. With station signals arriving from various angles, such an antenna does not give optimum results. Nevertheless, in strong-signal areas it can usually be positioned for good reception of all local stations.

If you are fortunate enough to live in a suburban or near-fringe area

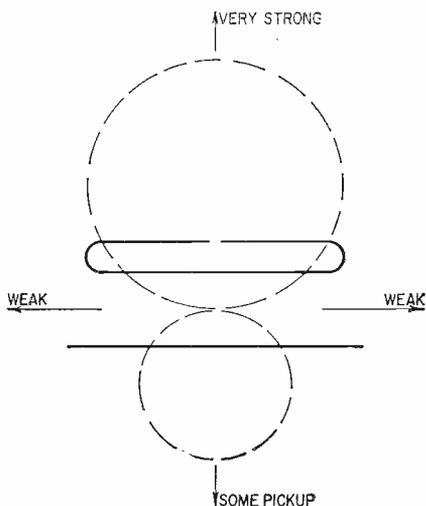


Fig. 4—Folded dipole and reflector with its horizontal directivity pattern.

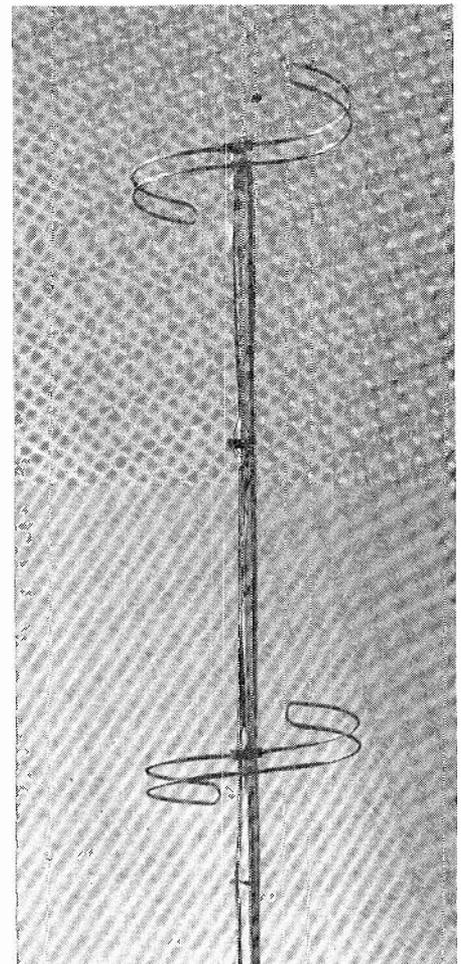


Fig. 6—Stacked S-folded dipoles.

Taco

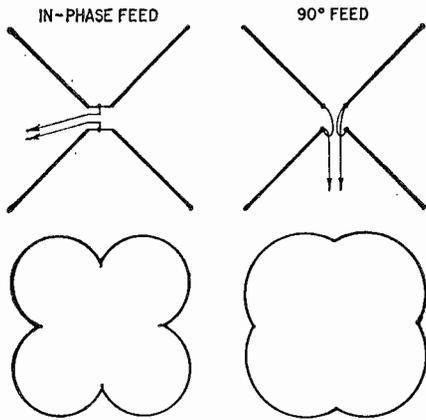


Fig. 7—Turnstile feed arrangements and their effect on the antenna pattern.

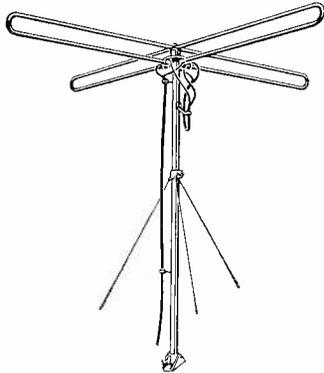


Fig. 8—The folded-dipole turnstile is a popular FM antenna.

Amphenol

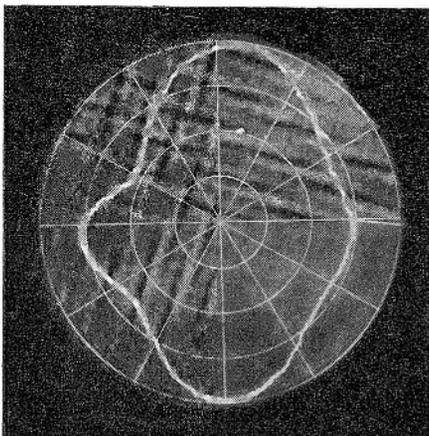
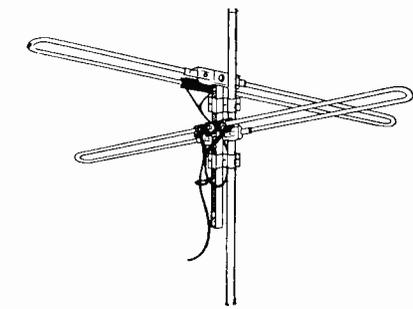
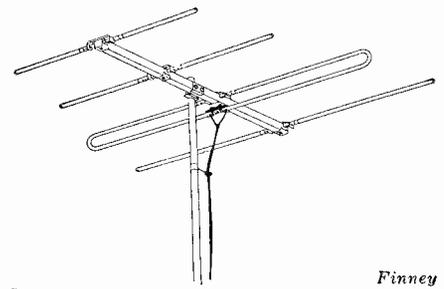
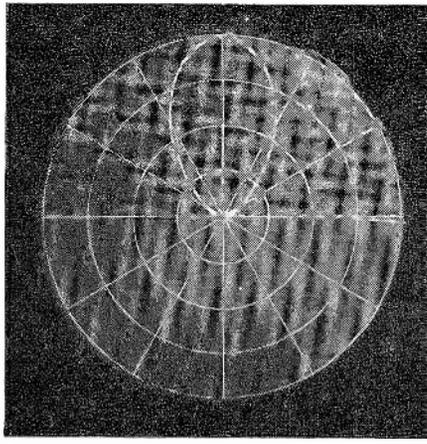
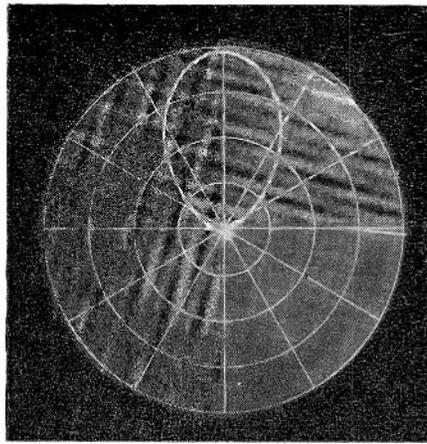


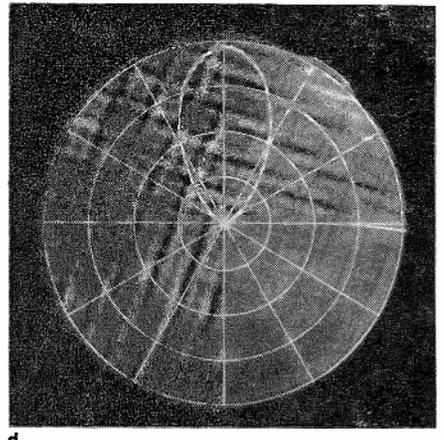
Fig. 9—A typical turnstile (a) and its pattern at 98 mc. (b).

reflector (Fig. 4). When using such an arrangement, some 35% to 45% more signal voltage can be delivered to the receiver input than with a single dipole.



Finney

Fig. 10—Four-element FM Yagi (a) and its patterns at 88 mc (b), 98 mc (c) and 108 mc (d). Note how directivity increases with frequency.



The horizontal radiation pattern for the folded-dipole and reflector combination at the center and two end frequencies of the FM band is given in Fig. 3.

Table II shows the SWR and gain figures of the various styles of antennas at specific frequencies in the FM band. Notice that the gain of the dipole and reflector combination decreases with frequency. Remember that the reflector must be cut long enough to act as a reflector at the low end of the band. The effectiveness of the combination declines toward the high-frequency end.

A gain antenna must be oriented carefully for best reception from the weaker FM stations you wish to receive. Such an antenna does have some back pickup and can handle strong signals that arrive from the back. The single dipole is least sensitive to signals in line with its individual antenna elements.

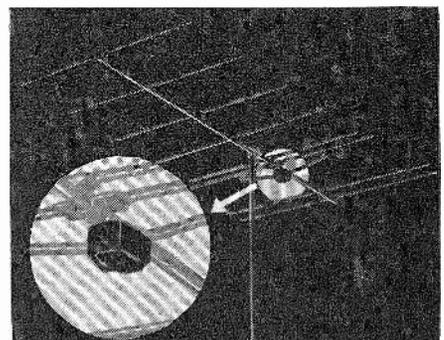
When a folded-dipole driven element is used, a 300-ohm transmission line is customary. For a straight dipole, a lower-impedance line can be used. This can be 75- or 150-ohm ribbon line or a 50- or 72-ohm coaxial line. Many FM receivers and tuners have terminals for connecting either high- or low-impedance lines.

Occasionally two driven elements are used, as shown in Fig. 5. In this arrangement two driven dipoles are employed. One dipole is driven in a manner that will place it in quadrature (90° related) with respect to the second dipole. This can be done by using a

section of transmission line 90° (a quarter wavelength) long between the points of attachment to the two dipoles. The physical length of this 90° section is determined by multiplying the quarter-wavelength free-space dimension times the velocity factor of the particular transmission line. Typical lengths are shown in the diagram.

The advantage of this so-called end-fire arrangement is that a cardioid (heart-shaped) horizontal directivity pattern is obtained. It has a broad forward pattern that makes the antenna sensitive to many angles of arrival as far as its forward directivity is concerned. The side and rear pickup of the antenna is quite poor so noise and interference pickup from the back are minimized. It performs well for a loca-

Fig. 11—Broad-band Yagi with antenna-mounted booster.



Winegard

tion where signals arrive over a rather broad angle in the forward direction.

### Turnstile antennas

A popular FM antenna is shown in Fig. 6. The driven element is basically a folded dipole. The folded dipole is shaped into a figure-S. This gives a much broader figure-8 horizontal directivity pattern. Such an antenna sacrifices its pickup, to some extent, in a direction exactly broadside to the antenna element. Its pickup at angles quite divergent from the broadside line is improved. Also, it does not have sharp minima in line with the antenna element. Stacked S-folded dipoles permit higher gain.

An FM antenna can be made sensitive in more than two directions by using two in-phase dipoles mounted at right angles (Fig. 7). The horizontal directivity of this arrangement is like a clover leaf. However, there are now four minima and, in orienting such an antenna, they can be troublesome if signals are arriving from several directions.

The most common form of turnstile antenna is shown in Figs. 8 and 9. One of the dipoles is fed in quadrature with the second. This 90° feed arrangement consists of an electrical quarter-wave section of line between the two right-angle dipoles. The 90° feed arrangement of the turnstile pair provides an omnidirectional horizontal pattern as shown. Such an antenna need not be oriented when it is installed because its pickup is uniform at all compass angles. There are some minimum positions which are not very deep, and therefore, not particularly objectionable. Conical driven elements can be used to get a still more uniform omni-directional pattern.

### Parasitic antennas

Additional parasitic elements (Fig. 10) can be added to increase the gain of an FM antenna and sharpen its directivity. This style of antenna is used to best advantage in fringe and far-fringe areas. When long-distance FM stations arrive from different directions, such an antenna is used with a rotator.

Yagi antennas have very high gain and a sharp horizontal directivity pattern. The greater the number of parasitic directors, the higher the antenna gain and the sharper the directivity pattern. If such an antenna is to be installed in a fixed position, it must be oriented very carefully in the direction of the signal.

Such an antenna picks up local stations reasonably well, even though they may not be in line with the most sensitive direction of the antenna. Hence in many locations such an antenna can be oriented in the direction of the weak distant signal and will still have enough pickup for the reception of local FM signals.

Yagi antennas of this type must be broad-banded if they are to have reasonably uniform sensitivity over the entire FM spectrum. When an FM enthusiast is interested in receiving a weak long-distance station, it is possible to cut and

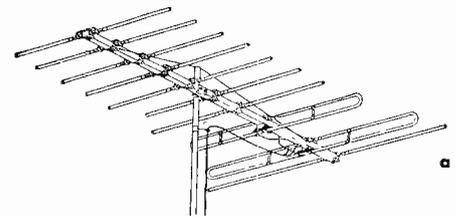
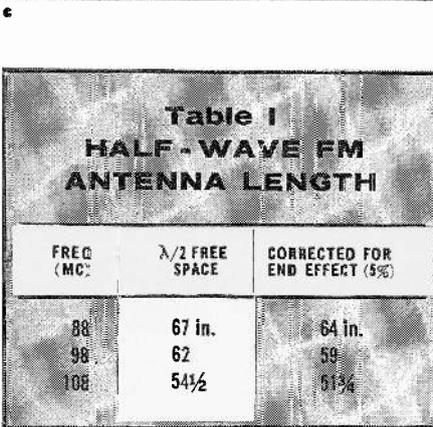
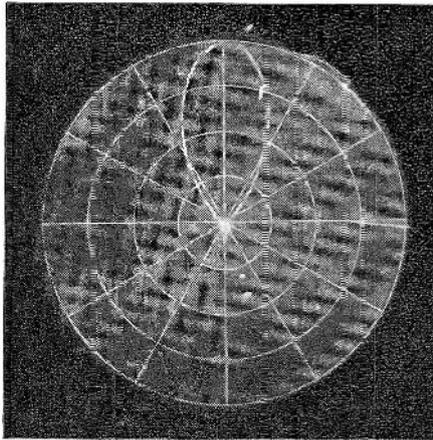
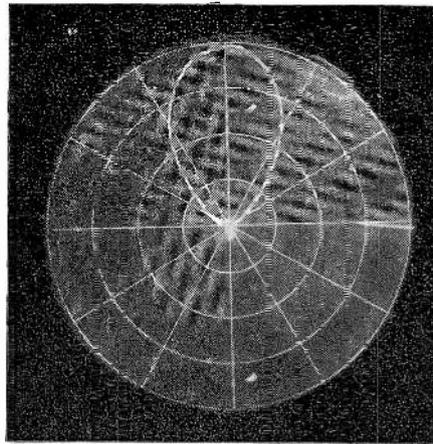


Fig. 12—A complex 10-element Yagi (a) and its patterns at 88 mc (b), 98 mc (c) and 108 mc (d). Note that, while directivity increases with frequency, the change is slight.

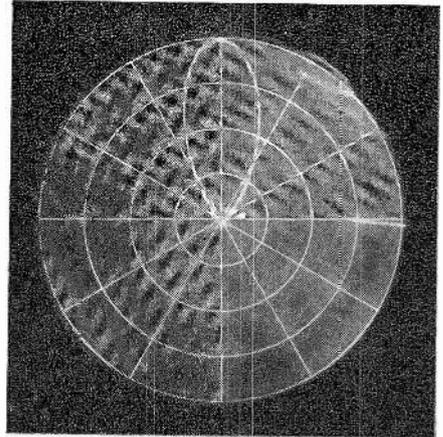


Table I  
HALF-WAVE FM  
ANTENNA LENGTH

FREQ (MC)	$\lambda/2$ FREE SPACE	CORRECTED FOR END EFFECT (5%)
88	67 in.	64 in.
98	62	59
108	54½	51¾

assemble a Yagi tuned to its precise frequency. An alternative to this plan is to make some alterations in the element dimensions of a commercial

Yagi to peak its sensitivity at a given frequency. It is possible, at times, to obtain a channel-6 TV Yagi antenna at a bargain price. The elements of this Yagi can then be cut down to a specific FM frequency. Spacing between elements need not be changed.

The Yagi in Fig. 11 is a broad-band type. Note the booster mounted on the antenna. Optimum dimensions for the dipoles permit the combination to display a more uniform pickup over the entire 20 mc of the FM band. The reflector is cut into the low end of the band; directors, the high end. The patterns of the model in Fig. 12 show how the pattern sharpens when many elements are used. Hence the antennas must be oriented critically to get the most out of them. END

Table II — SWR and GAIN COMPARISONS

ANTENNA TYPE	VOLTAGE-STANDING-WAVE RATIO			DB GAIN OVER REFERENCE DIPOLE					
	88 MC	98 MC	108 MC	88 MC	90 MC	95 MC	100 MC	105 MC	108 MC
Folded Dipole Turnstile									
Quadrature Fed	1.8	1.3	1.35						
Folded Dipole and Reflector	1.5	1.9	2.5	3.0	3.2	3.0	2.4	2.0	1.5
Four-Element Yagi	1.2	1.6	2.5	5.0	5.4	5.8	6.0	7.3	7.1
Six-Element Yagi (Twin Drive)	1.5	1.4	1.5	6.8	7.4	8.4	8.8	9.4	9.6
Ten-Element Yagi (Twin Drive)	1.3	1.3	1.5	8.7	9.3	10.2	10.6	10.8	11.1

The radiation patterns in Figs. 3, 9, 10 and 12, and the information in Table II are printed through courtesy of the Finney Co.

# REGULATED LOW-VOLTAGE SUPPLY for service bench or lab

Variable from 0.5 to 30 volts, 2- to 3-ampere output, 0.5% regulation—powers most battery-operated transistor equipment

By LEONARD J. D'AIRO\*

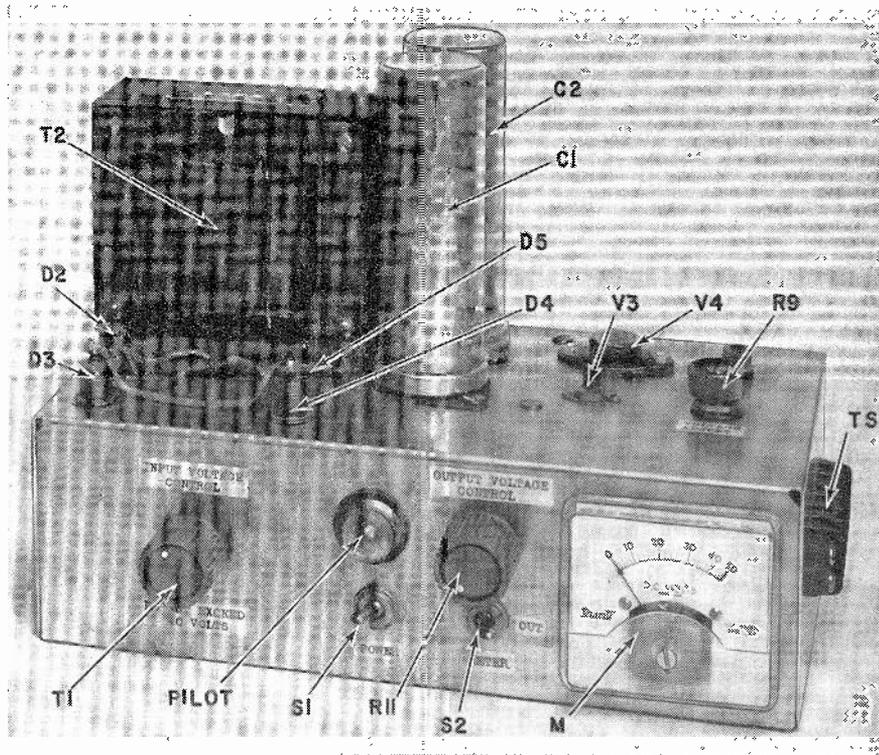
**W**HEN servicing and testing battery-operated equipment, a rectified ac power supply often forms the power source. This supply must be able to provide the required operating voltage and current for the equipment and at the same time present a low-impedance source to the circuit, as does the battery it replaces. Also, there must be little or no ac ripple in the output.

A conventional regulated supply uses a fixed reference voltage to set the level of the regulated output voltage (Fig. 1). Because of it, the output voltage cannot vary more than a fraction of its set value. To get a variable voltage range and still have good regulation at any point in this range, the reference voltage must be variable. But to do so defeats the purpose of regulation.

It seems that the only possible solution is to connect a potentiometer across the output (Fig. 2), and take the variable output voltage between the wiper arm and ground. But this solution presents a new problem. Once large currents are drawn through the potentiometer by the load, the voltage drop across the resistance plays havoc with the output voltage. Once again we lose regulation.

But, suppose that instead of the potentiometer a transistor is used whose conductivity can be manually controlled (Fig. 3). Its action is similar to the potentiometer alone and it would be possible to control the output voltage as required without fear of voltage drop over a wide current range. Current is then limited only by the transistor used. This arrangement is the one that is used in the regulated power supply shown in the photographs.

The supply uses four power transistors and one small-signal transistor. Output voltage is variable from 0.5 to 28 volts with 0.5% regulation at any point. Maximum ac ripple is 40 mv, and the voltage output vs temperature drift is 0.75% between 30° F and 150° F. Output current ranges from 0 to 2 amperes at any voltage up to 15, and



The completed power supply.

from 0 to 3 amperes at any voltage above 15.

## The circuit

The complete circuit of the regulated power supply is shown in Fig. 4. A Minneapolis-Honeywell type DA3F3 (V1) power transistor is the positive line series regulator. A 2N102/13 (V2) and 2N217 (V3) are used as the control amplifier and sensing amplifier, respectively. A second DA3F3 (V5) in the negative lead acts as the variable series

regulator and a 2N1031 (V4) is its control amplifier. The DA3F3 transistor was used because of its 30-amp maximum collector current, 100-watt dissipation and low cost. (The transistors may be obtained direct from Minneapolis-Honeywell Regulator Co., Union, N. J., at \$5 each.) Total cost of the regulated supply will be about \$80.

Referring to Fig. 4, rectified ac is applied across V1's emitter and ground. Fixed regulated output voltage is taken between V1's collector and ground.

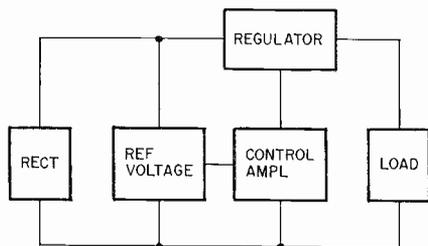


Fig. 1—Block diagram of conventional regulated power supply.

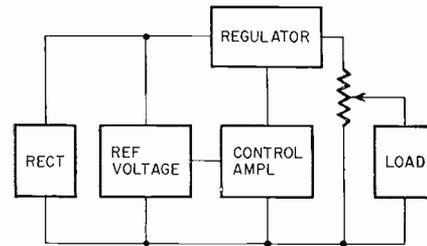
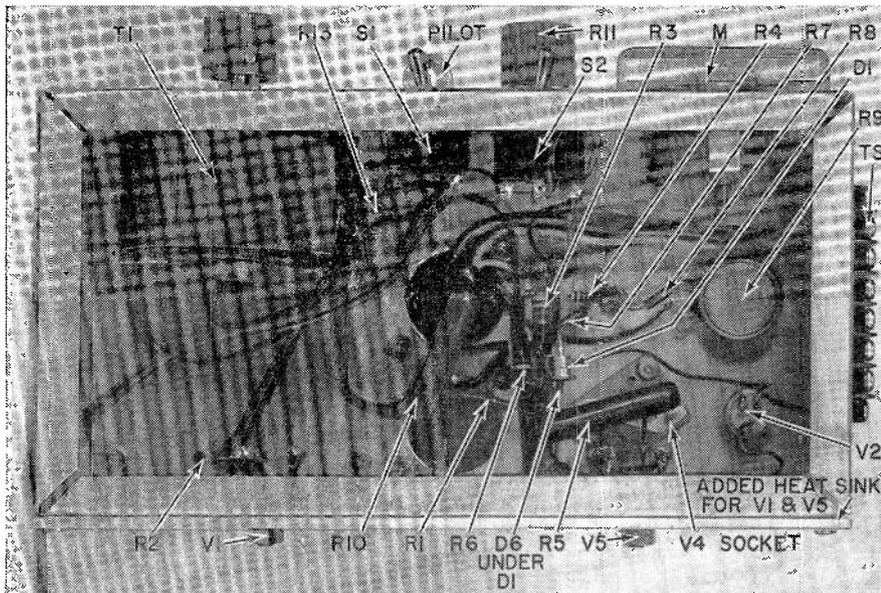


Fig. 2—Potentiometer across the output supplies a variable "regulated" voltage.

\*Author, *Servicing Transistor Radios*, Gernsback Library.



Underchassis. Note the added sheet of aluminum fastened to the rear of the chassis for additional heat dissipation.

Variable regulated voltage is taken across V1's collector and V5's emitter.

### Regulating action

Zener diode D6 sets the level and regulating range of V3's emitter to 27 volts. Resistors R4, R8 and R9 form a voltage-divider network for V3's base and bias V3 into conduction. (R9 is adjusted so V3's base is 3 volts more negative than the emitter. This sets the regulated output voltage at 30.) When V3 conducts, its collector tends to approach the same value as its emitter. Since the collector is connected directly to V2's base, this positive voltage (with respect to ground) causes V2 to conduct. V2's collector is connected to V1's base and to the supply voltage through resistor R2. The current V2 drawn through R2 causes a voltage drop across it that biases V1 into conduction.

If the current drawn by the load tends to increase, the output voltage will decrease in proportion due to the I/R drop across V1. This drop in output voltage is sensed by V3's base as an increase in base bias voltage, and V3 goes into saturation. With V3 saturated, the collector voltage now equals the emitter voltage. This causes V2 to conduct more heavily, drawing a larger current through R2. The increased current through R2 causes a larger voltage drop across it which, in turn, biases V1 into heavier conduction, decreasing its internal resistance and increasing the output voltage to compensate for the original drop. The same action occurs if the input voltage decreases.

On the other hand, if the load current decreases or the input voltage in-

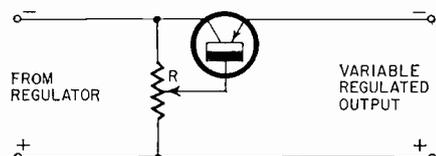


Fig. 3—Transistor provides a variable regulated output with better control and less voltage drop.

creases, the opposite action occurs. An increase in output voltage is sensed by V3 as a decrease in base bias. This causes V3 to go out of saturation or conduction (depending upon the degree of change). V2, in turn, conducts less and approaches cutoff. Less current flows through R2 and the voltage drop across it decreases. V1 now conducts less, increasing its internal resistance and decreasing the output voltage.

Because R2 is connected between the emitter and V1's base, this transistor is normally biased at cutoff. Any voltage applied to it will not cause it to conduct. Therefore, to turn it on, some means must be used to bias it in the forward direction. We do this by connecting a starting resistor (R1) from the supply voltage to V3's emitter to turn the regulator on.

(When V3 conducts, it starts V2 and V1 in turn.) The value of this resistor is small enough to turn the regulator on and yet large enough so as not to affect regulation. Diode D1 prevents the supply voltage from affecting the output (since it is back-biased), and, because of D6, the voltage at the emitter cannot rise above 27, regardless of the supply voltage.

Transistors V4 and V5 operate in much the same manner as V1 and V2 except that V4 conduction is manually controlled. V4 and V5 are actually emitter followers with the emitters leveling off at a voltage slightly less than that of the base. If the output requirements did not exceed 250 mw, the load could be connected between the wiper arm of R11 and ground. But, since the output is 112 watts maximum, V4 is used to multiply the 250-mw rating to 25 watts. V5 can then regulate 4 amperes at 28 volts. Resistor R12 limits V4's base current and prevents the base voltage from equaling the collector voltage (which can permanently damage or destroy the transistor).

The maximum input voltage applied to the regulator should not exceed 40 volts. This limit prevents breakdown

between the collector and emitter of V1. As a protective measure, the variable autotransformer (T1) is used to adjust the input voltage to T2 so the rectified ac applied to the regulator never exceeds the 40-volt limit. T1 is necessary since the output voltage of the rectifier increases as the load current decreases. Meter M monitors this input voltage.

### Construction hints

Any method of construction is feasible since there is no ac or rf signal to contend with. Layout and leads can follow any pattern that suits the constructor, provided, of course, that heavy enough wire (No. 10) is used to carry the large currents provided.

The supply shown in the photographs was built on a 5 x 10 x 3-inch aluminum chassis. T1 and T2, D2, D3, D4 and D5 and the filter capacitors are all mounted on the left-hand side of the chassis. The two regulator transistors are mounted on the rear of the chassis with a 1/8 x 3 x 10-inch piece of aluminum supplementing it as a heat sink. Transistors V3 and V4 are mounted above the chassis on the right-hand side, while V2 and the remainder of the components are mounted under the chassis. All transistors must be insulated from the chassis. A transistor socket is used to mount V3. The VOLTAGE control (R11), POWER switch, METER switch and meter are mounted on the front panel of the chassis.

If desired, the power supply section (transformers and rectifiers) can be replaced by any convenient power supply capable of delivering the required voltage and current, such as the standard battery eliminator that often adorns the service bench.

### Operation

After construction and wiring are complete, check to make sure you have made no mistakes. Assuming that all is satisfactory, connect a 30-ohm 50-watt wirewound resistor or equivalent load to terminals 1 and 2 of the regulator. This represents a 1-ampere load. Connect an accurate voltmeter to these terminals. Turn R9 to maximum resistance, input voltage down to zero. Apply power. Increase the input voltage to 34, and adjust R9 until the external voltmeter reads 30. Increase the input voltage to 40. There should be no change in the output-voltage meter reading. If the output voltage does increase, either D6 or D1 should be replaced. Decreasing the size of R4 may also help if D6 cannot be replaced. Vary the input voltage between 32 and 40. There should be little if any change—that is, no more than a 0.2-volt variation.

With the input voltage set at 40, vary the load current over the 3-ampere range. Again there should be no more than a 0.2-volt variation. If the change exceeds 0.2 volt by a large amount, D6 or V3 should be replaced, or R4 decreased (do not make R4 less than 150 ohms).

With the regulator operating properly, connect a load across terminals 1 and 3. Regardless of the load, the volt-

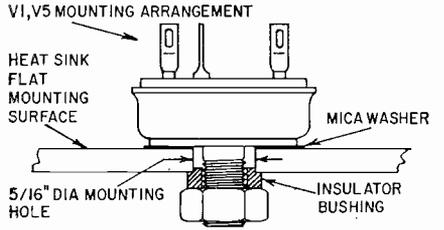
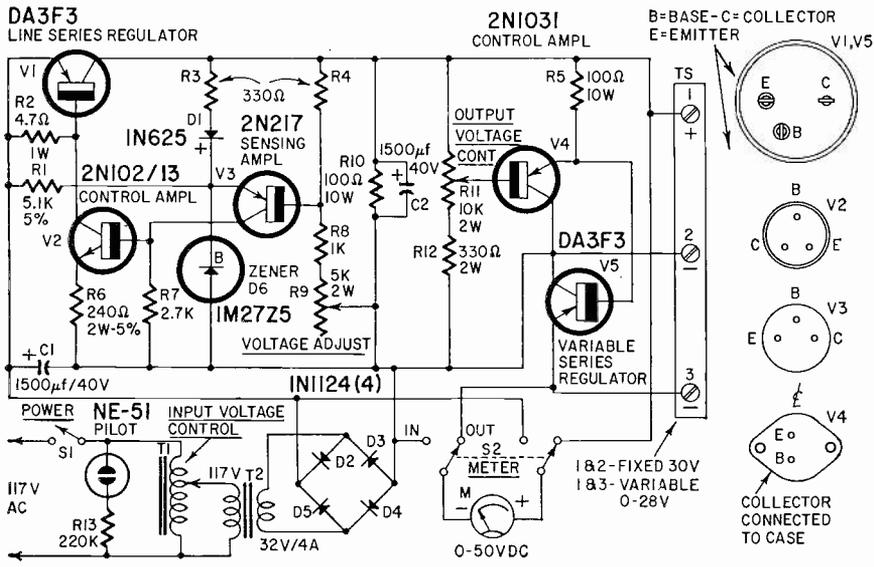


Fig. 4—Circuit of the regulated power supply.

- R1—5,100 ohms, 5%
- R2—4.7 ohms, 1 watt
- R3, R4—330 ohms
- R5, R10—100 ohms, 10 watts
- R6—240 ohms, 2 watts, 5%
- R7—2,700 ohms
- R8—1,000 ohms
- R9—pot, 5,000 ohms, 2 watts
- R11—pot, 10,000 ohms, 2 watts
- R12—330 ohms, 2 watts
- R13—220,000 ohms
- All resistors 1/2-watt 10%, unless noted
- C1, C2—1,500 µf, 40 volts, electrolytic
- D1—1N625
- D2, D3, D4, D5—1N124
- D6—Zener diode, 1M27Z5 (Motorola)
- M—0-50 volts dc
- S1—spst toggle
- S2—dpdt toggle
- T1—variable autotransformer, 1 ampere
- T2—rectifier transformer: primary, 117 volts; secondary, 32 volts, 4 amperes
- TS—terminal strip, barrier type, 3 lugs
- V1, V5—DA3F3 (Minneapolis-Honeywell, see text)
- V2—2N102/13
- V3—2N217
- V4—2N1031 (Bendix or equivalent)
- Pilot-lamp assembly with NE-51 lamp
- Case, 5 x 10 x 3 inches
- Transistor heat sinks, see text
- Miscellaneous hardware

age between these terminals should vary between 0 and 28 volts when R11 is varied.

If the output voltage remains constant regardless of the setting of R11, then there is either a mistake in the wiring or V4 or V5 is defective.

One feature of this regulator is its "built-in" short-circuit protection which prevents the transistors from acting as fuses. If the load current ever exceeds the maximum of 3 amperes, or if the output terminals are accidentally shorted, the entire regulator shuts it-

self off. It remains in this condition until the overload or short is removed. This action is the function of V3. As the load increases beyond 3 amperes, the voltage output decreases to a point where V3 cuts off completely. In turn, it causes V2 to cut off. With V2 no longer conducting, no current flows through R2. This places the base of V1 at the same potential as its emitter. V1 now no longer conducts and the output voltage drops to zero.

Even though the starting resistor is still in the circuit, V3 will not conduct as long as the overload or short remains. This is because the overload or short prevents V3's base voltage from building up to a point where it can conduct. Removing the short returns the circuit to normal and the regulator will once again start. For those who wish added protection, an spst pushbutton switch can be placed in series with R1. This switch can be used for starting the regulator after it has been shorted.

As an added note, because of the difference in characteristics between identical transistors, R1's value may have to be decreased to insure proper starting under full load. The value chosen should be such that it will start the regulator and at the same time not affect regulation.



# attention technicians

Here is the second RADIO-ELECTRONICS "Fold-up", a special feature aimed to help speed your service work. The page to the right is actually an 8-page booklet of tube basings for the 1961 and 1962 Sylvania TV receivers. A new booklet will continue to appear each month. Each one will cover a different make of TV receiver. When clipped together you will have a complete guide to tube layouts that will easily fit into your tube caddy.

To put your booklet together, cut out the page. Fold the top down and back, keeping the cover facing you. Then fold from left to right on the line marked *fold here*, keeping the cover facing you. Staple the booklet along the left hand edge. Now run a sharp knife or razor blade along the closed top and you're finished. You now have a useful piece of service information, exclusive with RADIO-ELECTRONICS.

If you have any comments on this booklet or suggestions for other subjects that might be covered in the same format, send them to Booklet Editor, Radio-Electronics, 154 West 14 Street, New York 11, N.Y.



"That's the trouble with these built-in sets."





# COLOR CIRCUITRY

By **LARRY STECKLER**  
ASSOCIATE EDITOR

## The new RCA and Zenith receivers

*The two sets have some basic differences as well as similarities*

FOR THE FIRST TIME IN SEVERAL YEARS there are some new color TV circuits—TV circuits designed and used by someone other than RCA. Up till now, no matter whose color set you bought, you were almost certain to get an RCA chassis. But this year Zenith announced its entry into the field of color TV. Here are the Zenith circuits in a side-by-side comparison with the latest RCA has to offer.

Let's examine the basic structure of the two sets first. The Zenith 29JC20 chassis is hand-wired, uses no printed boards or printed circuits and uses Zenith-designed color circuits. RCA's CT-C11 chassis has five printed boards and the latest improvements and advances in the circuits they have developed over the years.

The block diagrams (Fig. 1) show the arrangement of the color circuits in the two receivers.

### Color amplifiers

Zenith takes the composite video information off the video detector through a capacitor and 4.5-mc trap (Fig. 2-a). This trap prevents any 4.5-mc signal from entering the color circuits where it might cause a 920-ke beat interference which would be visible on the screen.

A 6GH8 and a 6AU6 color amplifier system get the color information from the composite video signal. The stages are similar to video if stages. They are stagger-tuned and provide an essentially flat response of about 1 mc.

RCA takes the composite video signal for the color circuits off the output of the first video amplifier (Fig. 2-b). No 4.5-mc trap appears in this circuit because it follows the video detector and the 4.5-mc signal does not reach the video amplifier.

There is only a single 6AU6 band-pass amplifier. Of course, there is already one additional stage of amplification as the color signal is taken off the first video amplifier plate rather than the detector.

### Automatic color control

To minimize changes of color level caused by slight changes in the incoming signal level, Zenith applies automatic color-control (acc) bias—a gain-control signal developed at an acc-killer phase detector (Fig. 3)—to the grid of the first color amplifier. The amount of bias depends on the burst level input, which in turn depends on the strength of the incoming signal. RCA has no equivalent circuit.

### Color killers

It is desirable to have the color amplifiers turned off during black-and-white programs—to prevent color

streaks or confetti from appearing in the black-and-white pictures. Automatic bias voltage from the color-killer stage is applied directly to the control grid of the output (second) color amplifier (Fig. 4-a). This -50 volts cuts off the Zenith color amplifiers when there is no color program. When a color program is being viewed, the color killer is cut off and the -50 volts removed, allowing the color amplifier to operate normally.

RCA also has a color-killer circuit (Fig. 4-b). It too cuts off the color amplifier when no color program is on. The difference between the RCA circuit and Zenith's is mainly the KILLER THRESHOLD CONTROL. There is no such unit in the Zenith receiver. This control permits setting the killer so that the color amplifier will not be cut off, even when the color signals are very weak. This is extremely important in fringe areas where the color signal may be far

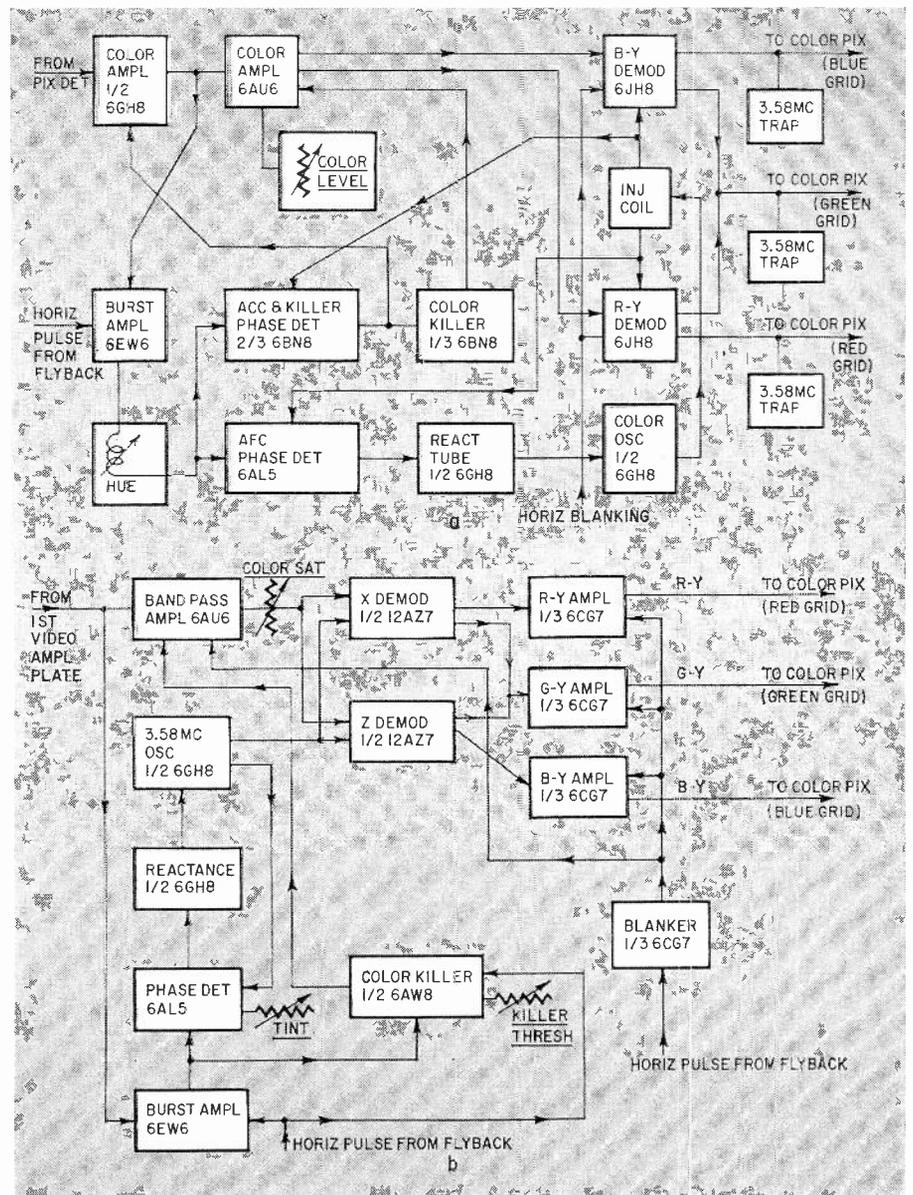


Fig. 1—Block diagrams of the Zenith (a) and RCA (b) color receivers.

down.

Both Zenith and RCA have controls to adjust the intensity of the color in a color picture. RCA calls this control **COLOR SATURATION** (Fig. 2-b). It is in series with the output of the color amplifier. Zenith calls the control **COLOR LEVEL**. It is in the cathode circuit of the second color amplifier and varies the bias of that tube (Fig. 2-a).

Should a viewer want to watch a color broadcast in black-and-white or should the color circuits be operating improperly, they can be cut off manually. The Zenith owner simply turns the **COLOR OFF** switch (Figs. 2-a and 4-a). It turns on the color-killer tube and turns off the color amplifier. In the RCA receiver, the **KILLER THRESHOLD** control will do the same thing (Fig. 4-b). It must be set so the color killer is turned on even when a color signal is present. Zenith's switch is a push-pull unit on the **COLOR LEVEL** control. RCA's color-killer control is on the back apron of the set.

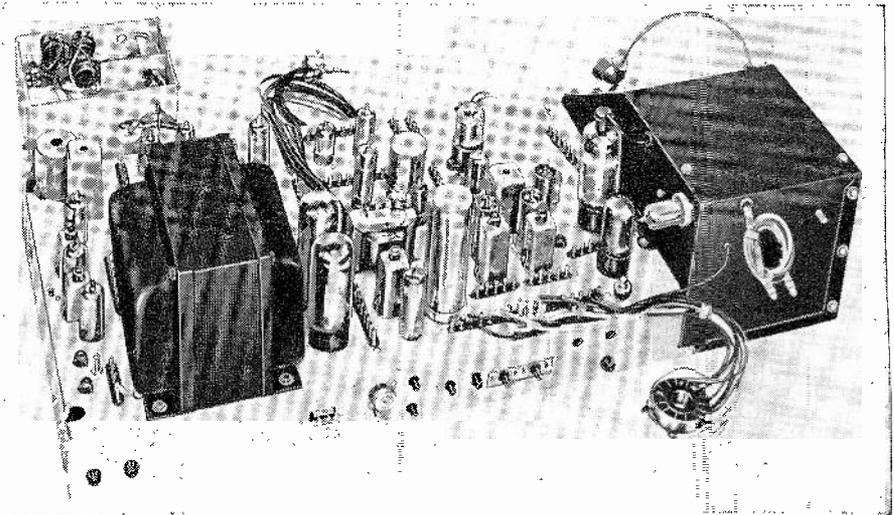
### Burst amplifier

From the plate circuit of Zenith's first color amplifier, the burst signal is coupled through a capacitor to the grid of the burst amplifier. This 6EW6 is gated with a positive 45-volt pulse so it conducts only during the burst-time interval. This separates from the burst the color signal, which is then fed to the afc phase-detector circuit (Fig. 5-a). The **HUE** control, a variable coil in the plate circuit of the burst amplifier, is part of a network which varies the phase of the burst signal.

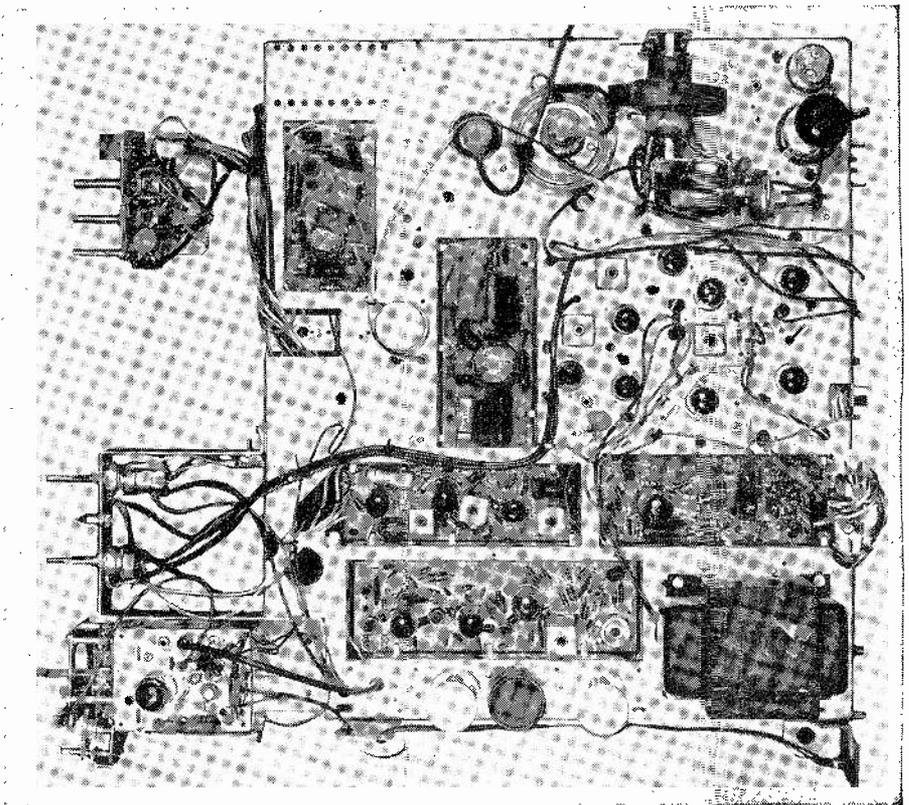
In the RCA set, the composite video signal tapped off the chroma takeoff coil in the grid circuit of the color amplifier (Fig. 5-b) is fed to the burst amplifier grid. It too is gated so that only the burst signal is passed through amplified to the phase detector. The control in this set is called **TINT** and is a potentiometer off to one side of the burst-phase transformer secondary. In both cases this is a front-panel control.

### Color oscillator

In the color sync circuits of the Zenith receiver, half of the 6GH8 acts as the 3.58-mc color oscillator, while the other half is used as a reactance control for the oscillator (Fig. 6-a). A variable coil in the oscillator section is set to fix the oscillator frequency, while the crystal maintains frequency stability. Phase is controlled by the afc phase-detector circuit in conjunction



The Zenith 29JC20 color TV chassis.



The RCA CTC11 color TV chassis.

with the reactance tube. The RCA circuit is essentially the same. There are slight differences, however. Zenith's oscillator output is coupled to the primary of a tunable transformer with two secondary windings. With the

transformer adjusted for correct demodulation, the 3.58-mc signals appearing in the secondaries are 90° out of phase with each other. Also, one signal is in phase while the other is 90° out of phase with the burst signal.

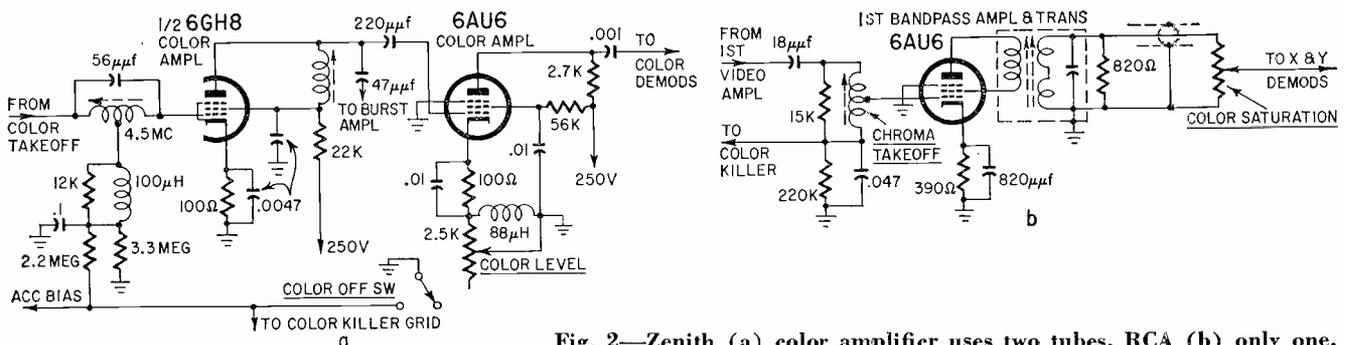


Fig. 2—Zenith (a) color amplifier uses two tubes, RCA (b) only one.

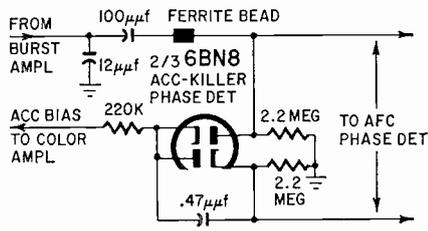


Fig. 3—Automatic color control regulates gain of color amplifiers.

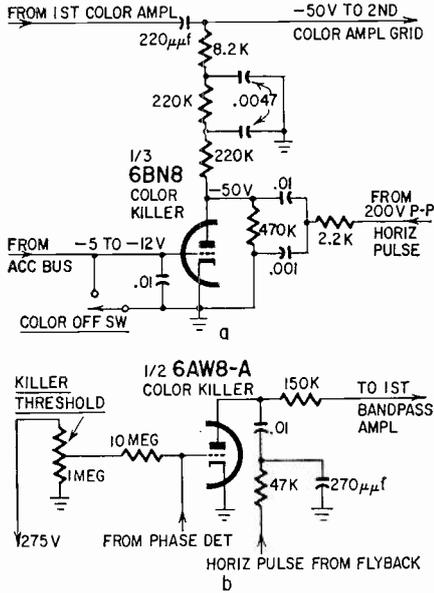


Fig. 4—Color-killer circuits are very similar. Zenith (a) uses part of a 6BN8, RCA (b) part of a 6AW8.

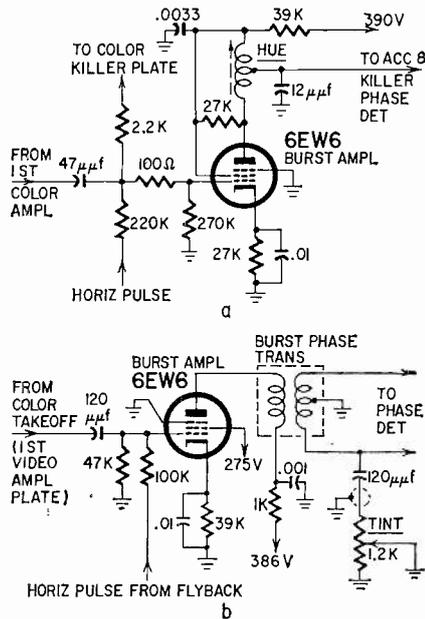


Fig. 5—The burst amplifier is where Zenith's hue and RCA's tint controls are found. Zenith (a) uses a tunable coil. RCA (b) uses a potentiometer.

Color sync is maintained by coupling the burst signal into the afc phase-detector circuit and comparing it with the phase and frequency of the oscillator output. The signal appearing in the secondary of the quadrature transformer—which is 90° out of phase with the burst signal—is coupled back to the

afc phase-detector circuit as the sampling signal of the oscillator output. The operation of this circuit is very similar to the afc circuit used in horizontal oscillator systems.

RCA's 3.58-mc oscillator output is fed to a more conventional transformer with one primary and one secondary (Fig. 6-b). The additional secondary is avoided by taking off part of the oscillator output at the primary of the transformer (making it automatically 180° out of phase with the signal on the secondary) and feeding it to the phase detector. As in the Zenith circuit, color sync is maintained by coupling the burst signal into the afc phase-detector circuit and comparing it with the phase and frequency of the oscillator output.

In both sets, any deviation in phase or frequency of the oscillator signal in comparison to the incoming burst signal will cause either a positive or negative correction voltage, depending on the phase shift. This correction voltage is fed to the grid of the reactance tube, causing its plate current to decrease or increase—depending on the polarity of the correction signal—and correspondingly decreasing or increasing the oscillator frequency.

#### Demodulation circuits

Now we come to the major difference between the two sets. It is in the color demodulators. Zenith uses a two-tube 6JH8 circuit (Fig. 7-a). One tube is used as an R-Y demodulator, the other as a B-Y demodulator. These tubes are sheet-beam tubes that contain double plates and a pair of balanced deflectors to direct the tube current to either of the two plates. A control grid varies the intensity of the current flow through the tube. These tubes develop balanced output signals of both positive and negative polarities. This eliminates the need for phase-inverter stages to obtain G-Y (or a separate G-Y amplifier—following the demodulators. Instead, the G-Y signal is recovered from the negative outputs of the two demodulators. The three color-difference signals are fed directly to the respective color grids of the picture tube.

RCA uses a more conventional circuit (at least more conventional tubes). A separate half of a 6CG7 is used for each of the color-difference amplifiers and there are X and Z demodulators to produce the R-Y and B-Y signals fed to their respective amplifiers (Fig. 7-b). The G-Y signal is derived from

the outputs of the two demodulators. As in the Zenith set, the color-difference signals are fed to their respective color grids in the color picture tube. The signals are matrixed in the tube itself, resulting in proper beam intensities for correct reproduction of red, blue and green on the screen.

At this point, let's take a little time out from our comparison of circuits to see what happens in the Zenith demodulators. In the 6JH8 tube, electrons flow from the cathode to either of the two plates in the form of a planar beam or sheet. After leaving the cathode, the control grid varies the intensity of the beam. The focus electrodes direct the electrons into the required sheet beam, which is then accelerated and deflected to either of the two plates.

The B-Y demodulator has the 3.58-mc CW signal coupled from the color oscillator through the quadrature transformer to the deflector plates. Since these plates are connected directly across the secondary of the quadrature transformer, the signal on one plate is 180° out of phase with the signal on the other.

We get an output from a plate only when its associated deflector is receiving the positive cycle of the 3.58-mc signal. As the two plates are fed the same signal 180° out of phase, one is positive while the other is negative. This polarity changes each half-cycle. Therefore, the output at the plates switches back and forth from one plate to the other as each deflector receives the positive half-cycle. The color sig-

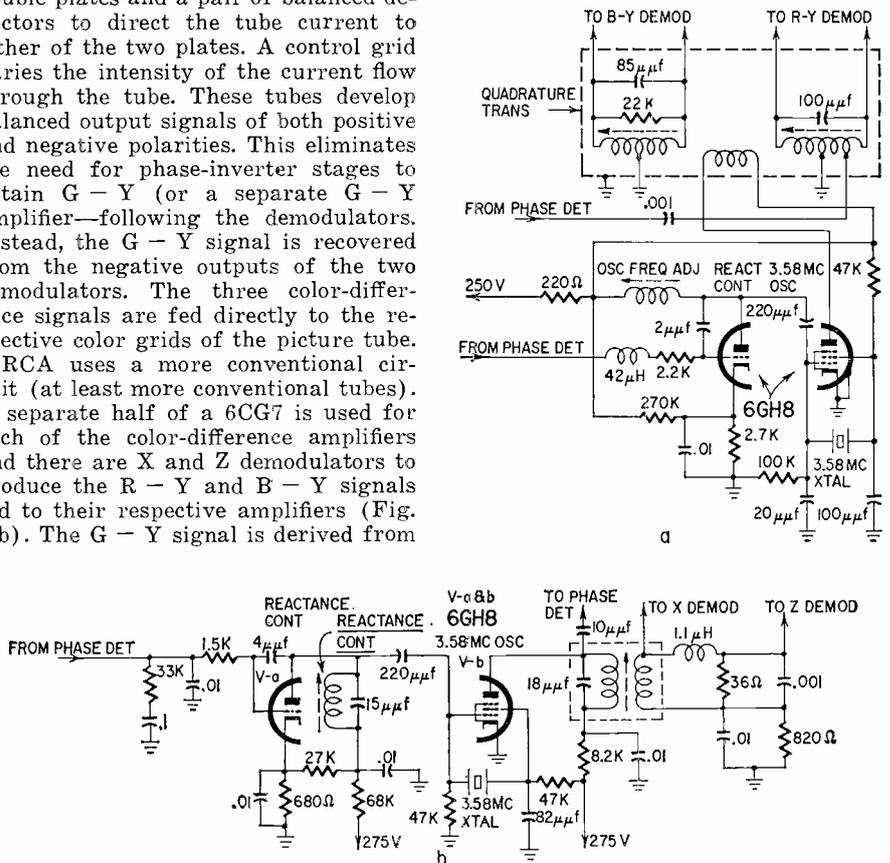


Fig. 6—Reactance-oscillator circuits are almost identical in Zenith (a) and RCA (b) circuits.

# Aligning the EICO 360

THE EICO 360 SWEEP SIGNAL GENERATOR is a versatile and capable alignment instrument when it is constructed and tuned according to the factory instructions. However, a constructor might run into trouble attempting to align the internal swept oscillator if he does not have the equipment deemed necessary in the factory instructions. If a signal tracer and accurate high-frequency receiver are not on hand, the following procedure will do the job nicely.

First, align the variable oscillator trimmer to the correct frequency by adjusting it until the rf carrier is at 108 mc as determined on the dial of an accurately calibrated FM receiver with its antenna disconnected. Align the variable oscillator as per factory instructions with the fixed swept oscillator temporarily disconnected to eliminate spurious frequencies. Then check at 54 mc for the second harmonic to fall at 108 mc on the receiver dial. This will show if the variable oscillator is tuned to the correct frequency at the 108-mc portion of the dial.

Second, replace the grid cap of the fixed swept oscillator tube, 7193, and prepare to align this section of the instrument. The ceramic trimmer for this adjustment may be reached through the small hole in the top of the instrument case, so it is advisable to have it in the case before going further.

According to the factory instructions, the fixed swept oscillator must be tuned to 114 mc on the nose. The differential and sum frequencies generated between the variable and fixed swept oscillator determine the fundamental output frequency. Therefore, by aligning the fixed swept oscillator to a frequency, for example 24 mc higher than the frequency of the variable oscillator (when the variable oscillator is tuned to 24 mc according to the dial), should give the correct frequency setting of 114 mc to the fixed swept oscillator.

To do this correctly, connect the customary scope and marker generator to a TV receiver as though a general video alignment procedure were in the making. Adjust the sweep signal generator dial to the center intermediate frequency of the TV set—24 or 44 mc. Check this frequency with the marker generator or crystal marker harmonics on the scope. Be sure the sweep frequency control on the 360 is turned to the OFF position. With the sweep oscillator rf control on full, adjust the fixed sweep oscillator trimmer until the moving pip appears and centers on the scope screen. This will be the fundamental output rf of the sweep oscillator and should be centered on top of the marker pip (24 or 44 mc). By turning the sweep frequency control to 10-mc sweep, the bandpass curve of the receiver should now appear on the scope screen with the marker showing at the correct frequency.—George D. Philpott

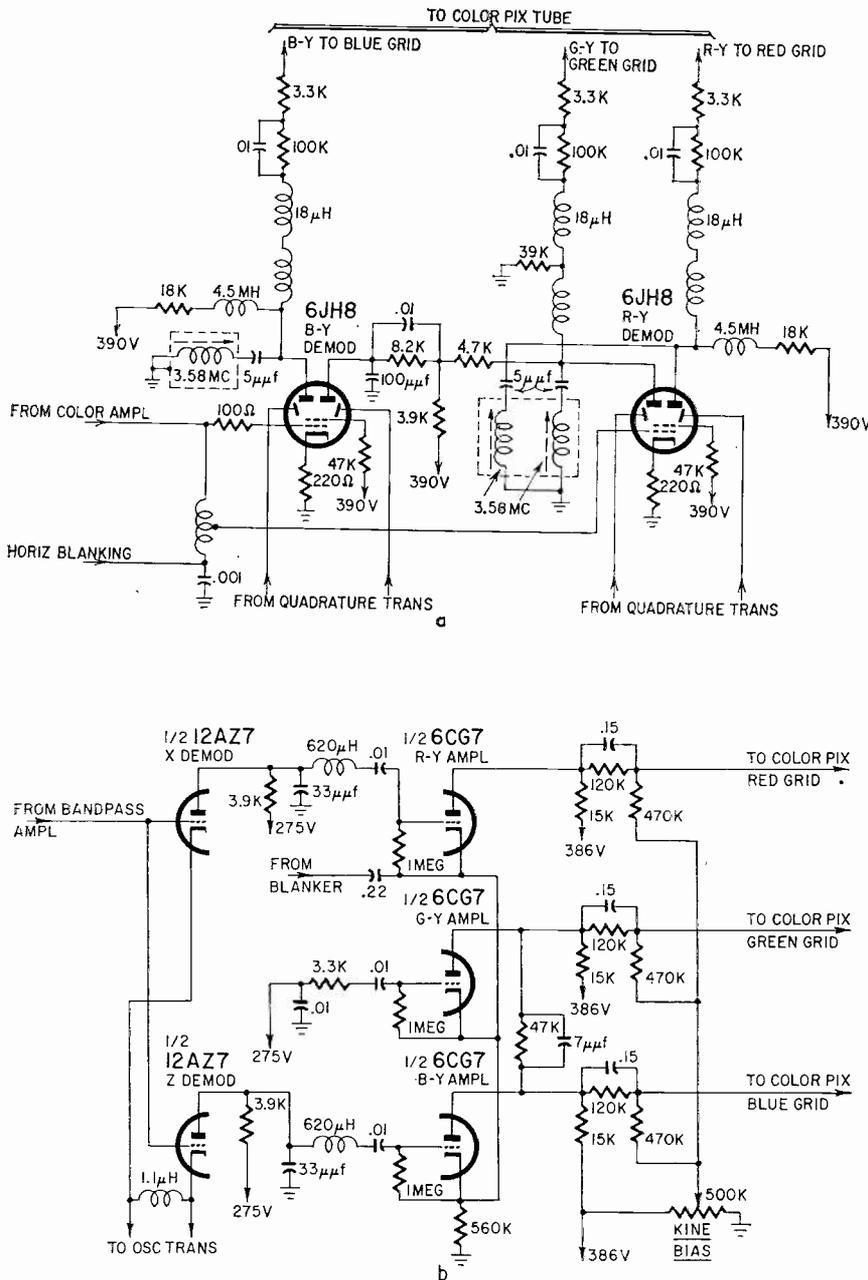


Fig. 7—Color demodulators show the greatest circuit differences. Zenith (a) uses two special double-plate tubes. RCA (b) uses five triode sections.

nal, which is also a 3.58-mc signal, is fed to the control grid of the tube. Since the deflectors are alternately positive every half-cycle, the output signals on the two plates are of opposite polarity.

The R - Y demodulator operates the same way, with two exceptions—the 3.58-mc CW signal fed to the deflectors is 90° out of phase with the signal on the B - Y deflectors, and the color signal fed to its control grid is lower in amplitude.

## Convergence magnets

Zenith has a one-piece plastic assembly around the CRT neck to hold three coils and three of the four static convergence PM magnets around the neck of the picture tube. They are adjusted for convergence in the center area of the picture tube only, even if they affect the whole raster. A fourth, a blue mag-

net located near the base of the picture tube, affects the lateral movements of the blue electron beam, and also moves the green and red beams in the opposite lateral direction. RCA's system is almost identical.

The dynamic convergence adjustments, 12 of them, are located on one Zenith dynamic convergence panel. RCA also mounts their 12 dynamic convergence controls on a single panel.

There you have it—the circuits, the controls, the comparison—and a sneak preview of something new the service technician will be anxious to study. It may be that the new Zenith is the first of a number of sets with new ideas and new circuitry. Or other manufacturers may stick to old and well known principles. If we master each new circuit as it comes out, we will have nothing to worry about either way. END

# RADIATION METER

## MEASURES MINUTE CURRENTS

*Lab-quality electrometer requires no special parts—  
is also useful as high-intensity radiation alarm*

By ELLIOTT A. McCREADY

The electrometer is an instrument rarely found outside the laboratory. Like the high school physics type electroscopes, it is made to work by the electrostatic forces between two charged bodies. It is a highly sensitive instrument for measuring both a minute electric charge and the current dissipating this charge.

This instrument can be built from readily available parts for around \$30 (less if you have a usable meter. Its input resistance is  $10^{15}$  ohms and its input capacitance  $12 \mu\mu\text{f}$ . It can be used to measure currents as low as  $10^{-14}$  ampere; can be scaled in roentgens with a maximum reading of 0.5 and (with the modification described) 10 roentgens per hour. The higher r/h scale makes it usable as a fallout alarm, though not for quantitative measurement of heavy fallout. It is completely portable, with self-contained power supply. Some types of electrometers are actually calibrated electroscopes; in others, specially designed vacuum tubes detect and amplify small currents.

A good example of the calibrated electroscopes type electrometer is an instrument used to measure accumulated dosages of radiation acquired by Civil Defense or atomic workers. This pocket dosimeter is illustrated in Fig. 1. A movable quartz fiber, plated to make it conducting and attached at both ends to a fixed wire element, is deflected away from this element by a charging voltage. The voltage is then removed and the fiber remains deflected until radiation ionizes the air surrounding it, allowing the charge to leak off and the quartz

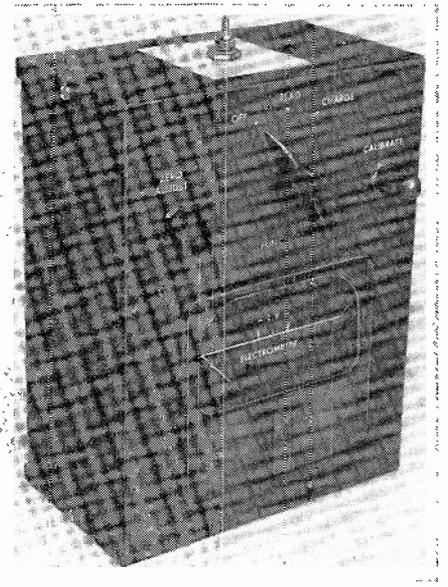
fiber to collapse toward the fixed wire element. The ionizing current required to collapse the fiber a given amount is calibrated in units of accumulated radiation.

The pocket dosimeter measures a given quantity of radiation. To measure the intensity of radiation, a vacuum-tube electrometer, coupled to a suitable probe unit (an ion chamber) is used. The ion chamber converts radiation into a minute electric current, which is measured by a vacuum-tube electrometer calibrated in units of radiation intensity.

The ion chamber is adapted to measuring very high intensities of radiation. Typical instruments have ranges of more than 500 roentgens/hour. The familiar Geiger counter, on the other hand, can measure only up to about 50 milliroentgens. (A roentgen is the intensity of radiation emitted by 1 gram of radium at a distance of 1 yard. A Geiger counter would be of little use in measuring the immense radiation intensities of an atom bomb explosion.

Earlier electrometers almost invariably used the deflected quartz fiber or gold leaf. Present day instruments use a specially designed electrometer tube, carefully constructed to minimize grid-current flow and stray leakage currents. One of the better instruments is currently being marketed for about \$450.

If you could construct an electrometer of comparable quality for \$30 or less, you could probably think of a lot of uses for it. If it were portable, you could use it as a high-sensitivity radiation detector. I used it as a detector of static electricity, to discover the best way to eliminate static charges on phonograph records. It would also be



The radiation detector and meter.

useful as a static detector in industrial machinery. It will measure the output of the negative-ion generators now being combined with air purifiers, and will detect radioactive ores.

### Circuit

You can build such an electrometer, with and without using any special components. The secret is a rather unique circuit that eliminates one of the bugaboos of the vacuum-tube electrometer—grid-current flow.

The electron flow between the filament and positively-biased control grid of an ordinary electron tube decreases when one of the elements surrounding the control grid is given a negative charge. The size of the charge is determined by the proximity of the surrounding probe element to the control grid. A very small negative charge on the screen grid repels many electrons emitted by the filament and prevents them from reaching the control grid. This is the logical element to use as a probe and, as the screen grid is not in the filament-control-grid electron path, there will be no probe current, provided we heat the screen grid as little as possible by running the filament at a low temperature.

In practice, the electrometer (Fig. 2) consists of a 3Q4 tube, its 3-volt filament operated at close to 1 volt to obtain a control-grid current of  $20 \mu\text{a}$  at a positive grid potential of 3. A known variable negative charge is now placed on the screen grid and the meter is calibrated in volts.

To measure ionizing current, the electrometer is charged and the voltage

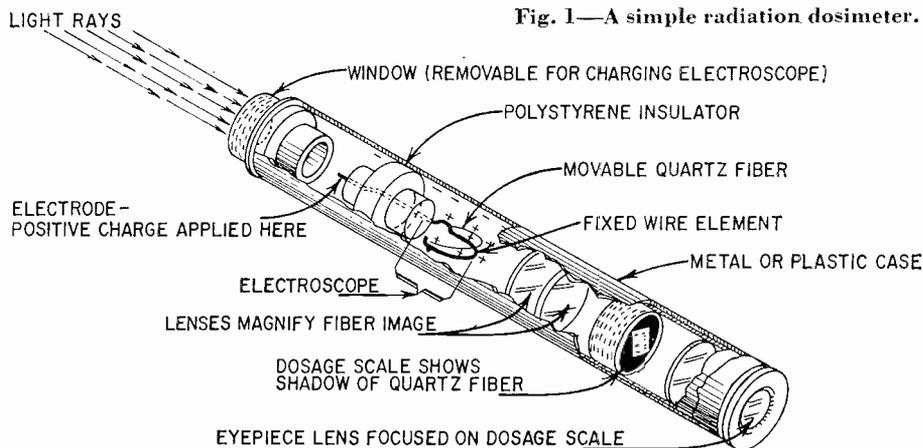
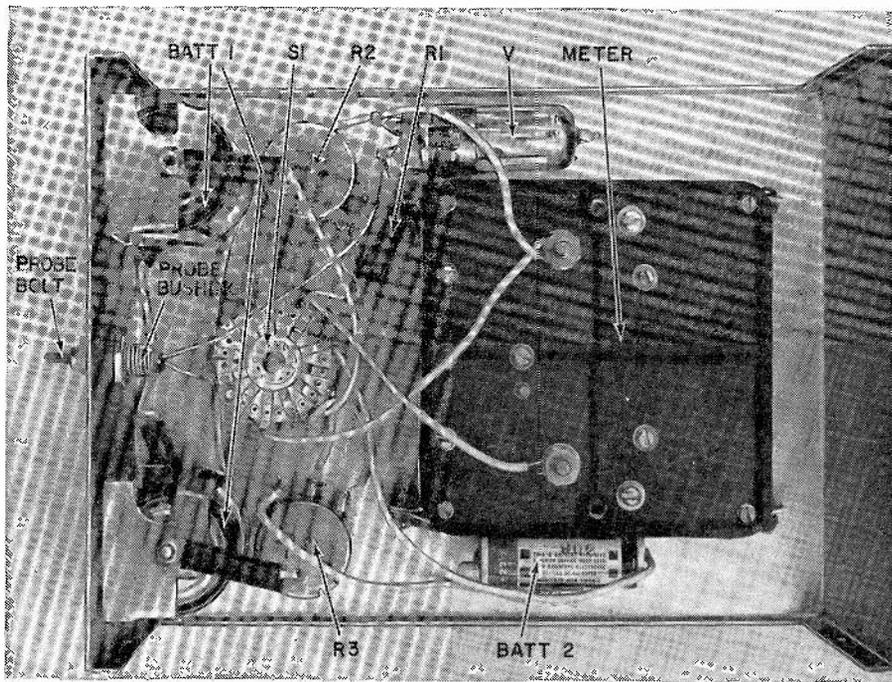


Fig. 1—A simple radiation dosimeter.



The underchassis view.

drop through two convenient points on the meter scale is timed. Current may now be easily calculated using the known capacitance of the electrometer, the voltage drop and the time. This method of measuring current by timing a voltage drop considerably reduces the cost and complexity of the instrument. For very small currents, accuracy may be increased by subtracting the characteristic leakage current of the instrument itself from the above calculation, and readings can be speeded up by drawing a graph which plots current against time.

### Construction

The electrometer is built into a 6 x 8 x 3½-inch, two-piece aluminum chassis and all components are mounted on the flanged portion. The 20- $\mu$ a meter which measures grid current is mounted at the lower end of the chassis, leaving room for FUNCTION switch S1 and the tube socket near the probe. The switch is a three-section unit. The third section is used as a meter shunt when the instrument is turned off. Shunting the delicate meter damps the movement and protects it when not in use. Both tube socket and switch are ceramic for high insulation resistance.

**Caution:** Use a new socket and switch. Fingerprints and dirt on spare-parts-box components will make overall leakage current intolerable.

The probe is a 1½-inch 4-36 bolt mounted through a ⅜-inch polystyrene rod. It is drilled through the center and threaded on the outside to make a bushing. Place a solder lug under the bolt head on the inside of the chassis. Allow about ⅜-inch of the bushing to project from the chassis and strip the paint from a 2 x 2-inch area surrounding it.

Be very careful to avoid handling the tube socket, switch and bushing any more than absolutely necessary. Any fingerprints or dirt on these parts will

increase leakage current. Clean the tube base by swabbing with denatured alcohol, or soak it in pure bleach, flush in running water and blot dry with an absorbent tissue.

As overall probe-to-chassis capacitance of the electrometer is used in making current measurements, dress your leads as shown in the underchassis photo. If you have access to a capacitance bridge, you can measure the capacitance of the instrument when it is completed. In any case use stiff, tinned copper hookup wire for the probe-to-switch-to-socket connection, and dress all other leads well away from it.

The only portion of the circuit which is connected to the aluminum chassis is the positive terminal of the charging battery, BATT 2. The rest of the circuit must be well insulated from chassis.

As the filament voltage regulation is very important, especially for small current measurements, don't attempt to use ordinary dry cells for BATT 1. The mercury cells suggested have very good regulation, although alkaline cells might do the job too, and would be less expensive.

### Calibration

The initial portion of the calibration procedure should, by rights, be a part of the construction section—the selection of R1. First, tack in a 75-ohm resistor as indicated in the schematic. Now, assemble the chassis, turn the FUNCTION switch to READ, and set ZERO ADJUST control R2 for a full-scale meter reading (zero volts charge). This should occur with R2 near its center position. If it doesn't the probe may have picked up a charge. Ground this charge by grasping the chassis in one hand and the probe bolt in the other. Now release the probe bolt first, then the chassis. If this doesn't remedy the situation, try other sizes of R1 until the meter reads

full scale with the ZERO ADJUST control near midpoint.

Now calibrate the meter in volts by connecting a high-resistance dc voltmeter between probe bolt (negative) and chassis of the electrometer. Switch the FUNCTION switch to READ, ground the probe as described and set the ZERO ADJUST control for a full-scale meter reading. Next, place the FUNCTION switch in the CHARGE position and adjust the CALIBRATE control for a half-scale meter reading. Note the voltage. Now adjust the CALIBRATE control for readings of 1 volt either side of half-scale and note the voltages.

Mark both the half-scale and the two 1-volt positions on the meter scale. Electrometer readings will be made by timing the meter drop through 2 volts. Finally, disconnect the voltmeter and, with the FUNCTION switch in the CHARGE position, set the CALIBRATE control so the meter rests slightly left of the higher voltage calibration.

Before measuring the characteristic leakage current of the electrometer, let the instrument warm up for about 45 minutes with the FUNCTION switch in the CHARGE position. This warmup period allows filament voltage to stabilize, and the constant charge on the probe and associated circuitry counteracts "insulator soak-in," or dielectric absorption, which might tend to make instrument leakage current appear rather high.

After the warmup period, place the FUNCTION switch in the READ position, ground the probe and reset the ZERO ADJUST control. Now, charge the instrument by momentarily rotating the FUNCTION switch from READ to CHARGE and back. The meter should stabilize slightly to the left of the higher voltage calibration. If not, recharge the instrument or readjust the CALIBRATE control. Now, time the meter drop over 2 volts and calculate leakage current with the equation:

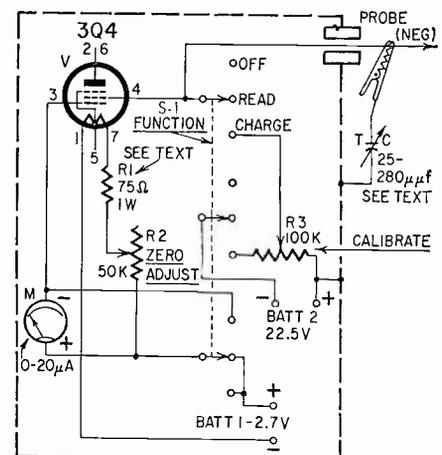


Fig. 2—Schematic of the electrometer.

- R1—75 ohms, 1 watt (see text)
- R2—pot, 50 ohms, wirewound
- R3—pot, 100,000 ohms
- C—mica trimmer, 25–280  $\mu$ mf (see text)
- M—0–20- $\mu$ a dc meter
- S1—3-pole 3-position ceramic rotary switch (see text)
- BATT 1—two 1.35-volt mercury cells (Mallory RM42R or equivalent)
- BATT 2—22.5-volt hearing-aid battery (Burgess UI5 or equivalent)
- Socket, 7-pin miniature ceramic (see text)
- Cabinet, 2-piece aluminum, 8 x 6 x 3½ in (Bud Minibox or LMB Tite-Fit box/chassis)

$$I = \frac{CV}{t}$$

where I is the leakage current in amperes, C is the capacitance of the electrometer in farads, V is the voltage drop (2 volts) and t is the time in seconds. If you have a capacitance bridge, measure the probe-to-chassis capacitance of your electrometer and use this value in the equation. If not, use a value of  $12\mu\text{f}$ , which should be very close if you have constructed the instrument as illustrated. In my electrometer, a 40-minute interval is required for a 2-volt loss of charge. This figures out to a leakage current of:

$$I = \frac{12 \times 10^{-32} \times 2}{2,400} = 1 \times 10^{-14} \text{ amperes.}$$

Using a mid-scale value of 12 volts, the leakage resistance of the instrument is:

$$R = \frac{E}{I} = \frac{12}{1 \times 10^{-14}} = 1.2 \times 10^{15} \text{ ohms.}$$

Leakage current will vary somewhat with humidity, but this figure shows what the instrument is capable of. If your figures show a much higher leakage than this, check to make sure probe wiring is well separated from the chassis and other components and wiring. Also make sure that no solder rosin lodged between switch contacts.

The graph, drawn to expedite current readings (Fig. 3), is laid out on 3 x 3-cycle log log graph paper and plots current against time. Basic leakage current of the electrometer will be a factor at figures of about 10 times this leakage current and below. Above this figure the graph will be a straight line. If you use a meter capacitance of  $12\mu\text{f}$ , the straight-line portion of your graph will be identical to that illustrated. For other values of electrometer capacitance, plot the graph from the equation:

$$I = \frac{CV}{t}$$

Subtract instrument leakage current from the calculated values below about  $0.1\mu\text{a}$  ( $0.1 \times 10^{-10}$  amperes).

An additional horizontal scale, calibrated in roentgens per hour (r/hr) may be added to the graph for radiation readings. Unfortunately, in its present form, the electrometer would read about 0.5 r/hr maximum. To increase this maximum reading we must add capacitance between probe and chassis and, while we are about it, we may as well make the radiation scale coincide with the current scale, giving us an instrument range of .01 to 10 r/hr.

The added probe-to-chassis capacitance is a 25-280- $\mu\text{f}$  trimmer to which two tinned copper wire leads have been soldered. Terminate one of these leads with a miniature alligator clip and solder the other to a lug mounted under one of the chassis screws. Theoretically, the total capacitance of the electrometer with trimmer attached should be about  $175\mu\text{f}$  to make radiation and current scales coincide. Due to the added probe surface with trimmer attached, this capacitance will be greater.

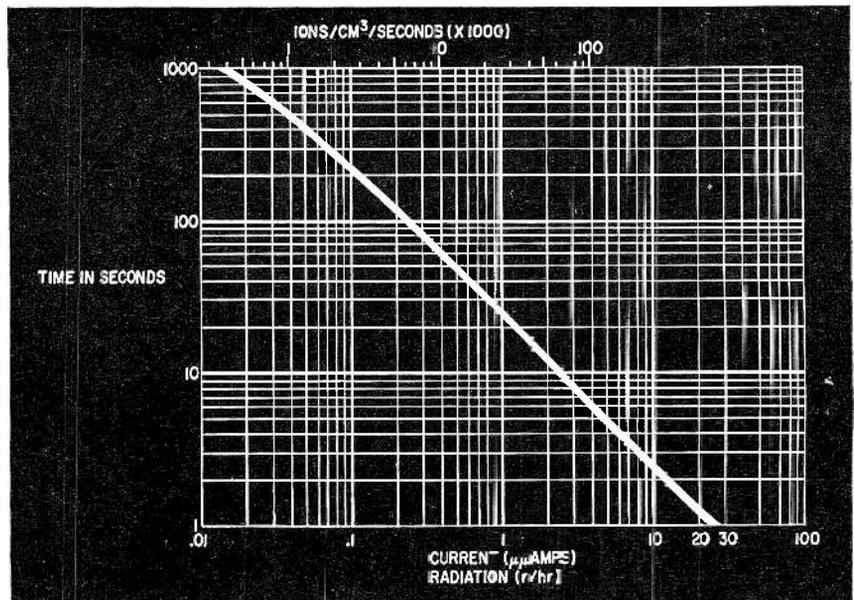


Fig. 3—Chart speeds measurements.

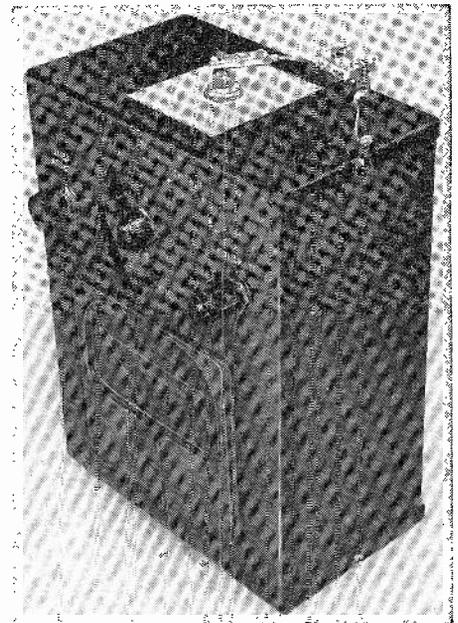
Actual measurements on my instrument have shown that a radiation intensity of .03 r/hr will result in an ionizing current of  $0.58\mu\text{a}$ . If the chassis, bushing and probe sizes of your electrometer are as specified, your instrument will show the same current-radiation relationship. To calibrate the electrometer in r/hr, consult your graph and determine the times corresponding to  $0.58\mu\text{a}$  ( $t_1$ ) and  $.03\mu\text{a}$  ( $t_2$ ). Next, with trimmer disconnected, place a small piece of radioactive material (the luminous hand from an old watch will do) in such a position that the electrometer will drop through 2 volts in 10 seconds. Now connect the trimmer and adjust it so that, with the radioactive material in the same position, the 2-volt drop will occur in

$$\frac{10 \times t_2}{t_1} \text{ seconds.}$$

The upper scale of the graph is plotted in ions per cubic centimeter per second, which is a standard unit for measuring the output of negative-ion generators. This scale was plotted on the assumption that the volume of air contributing mostly to electrometer discharge was approximately 250 cubic centimeters (based on the size of the instrument). This assumption is fairly accurate and in any case serves as a means of comparison between generators. This scale is also plotted logarithmically and, if you use an electrometer capacitance of  $12\mu\text{f}$ , will be identical to the graph of Fig. 3. For different values of electrometer capacitance use the equation:

$$\text{Ions per cm}^3 \text{ per second} = \frac{CV}{4t \times 10^{-17}}$$

where C is the capacitance of the electrometer in farads, V the voltage drop (2 volts) and t the time in seconds. This equation is derived from the fact that the product of CV is the charge in coulombs, and the charge on one electron (ion) is  $1.6 \times 10^{-19}$  coulombs.



Modification for high-intensity radiation measurement.

#### Operation

The electrometer is extremely sensitive to static charges. About the worst possible set of operating conditions would be an operator clothed in fuzzy wool or flannel, wearing rubber-soled shoes and working on a wool rug.

The electrometer can measure radiation intensities from about .001 to 10 r/hr in two ranges. The lower range (trimmer capacitor disconnected) is not calibrated, but an extra logarithmic scale may be added to the graph using a current of  $0.53\mu\text{a}$  as the equivalent of .03 r/hr. Radioactive ores may be detected and compared by placing the ore near the probe.

While this instrument was not designed to cope with large quantities of radiation, but rather to measure minute currents, it can be a useful alarm for heavy and dangerous radiation. A 1-second discharge period corresponds roughly to 25 roentgens/hour, which means that a person could remain

in the area safely for about 2 hours (see below). Discharge in half a second or less indicates that the area is definitely dangerous, and, if the needle drops immediately, radiation is probably present in lethal quantities.

Should it ever become necessary to measure fallout radiation, the following dosages, together with their probable effects on the human body, will be of interest:

- Less than 50 roentgens (r) — relatively little risk
- 50–300 r — some injury and radiation sickness.
- 300–500 r — serious injury or death.
- 500–1000 r — death almost certain.
- Above 1,000 r — death certain.

The above figures are total-body dosages. A dosage of 1 roentgen being that acquired by exposure to an intensity of 1 r/hr for a period of 1 hour.

The electrometer can measure the output of a negative-ion generator:

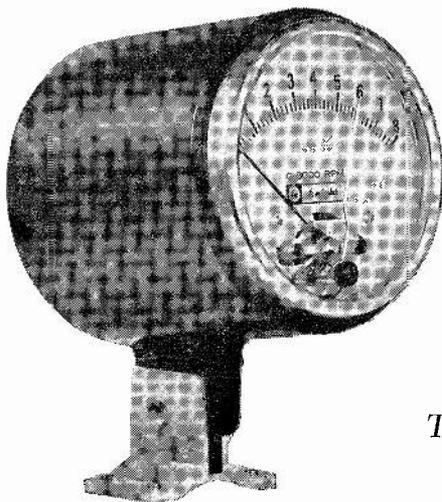
As with all low-current measurements, allow the instrument to warm up for a period of 30–45 minutes. Now, with the generator operating in a closed room to eliminate spurious air currents, place the electrometer about 3 feet away, in the air flow of the generator. Charge the electrometer, time the voltage drop and use the graph to determine the output. Several readings should be taken, and a little practice will demonstrate where the instrument should be placed for the highest reading. I have found that ion generators produce a higher output after operating for 30 minutes or more.

Static charges of electricity may be detected at great distances with the aid of the electrometer. No warmup period is required for this operation and the instrument should be operated with the probe discharged. As an example of its sensitivity to static electricity, run a hard rubber comb through your hair and bring the charged comb toward the electrometer probe. A sizable meter deflection can be obtained at a distance of up to a foot.

All the examples to this point have dealt with negatively charged objects. What if a material bearing a positive charge is brought near the electrometer probe? You would expect the meter to indicate an increase in grid current. It does, momentarily. But when the positively charged object is removed, the instrument acts as if it had acquired a negative charge—the meter is deflected several volts. The reason for this is simple. When the charged object was held near the probe, electrons from the screen grid were attracted to the probe bolt, leaving the screen grid with a deficiency of electrons, or positive charge. This positive charge attracted electrons from the filament and, when the charged object was removed, the screen grid, probe bolt and associated wiring had a surplus of electrons, or a negative charge.

If you ever have had occasion to use an electrometer but couldn't locate one, don't let it happen again. If not, build this one anyhow—you never can tell when it will be a lifesaver! **END**

## EQUIPMENT REPORT



# Knight-Kit tachometer

*This little unit offers 3% accuracy*

**By LEN BUCKWALTER**

IN MEASURING BOAT OR CAR ENGINE rpm, the electronic tachometer is faced with a set of stringent operating conditions. Surrounding temperatures constantly shift, voltage varies with engine speed and signal input rarely presents ideal waveforms. There's an added problem of versatility—the tach should operate in a variety of ignition systems from 2-cycle outboard motors with magneto power to any conventional auto engine.

A recent circuit with several unusual design elements to meet these requirements is in the Knight-Kit tachometer. Despite overall simplicity, the unit has been refined to the point where readout accuracy is held to 3% under adverse conditions. Tracing out the circuit (see diagram) reveals where some five design steps are used to keep error within tolerable limits.

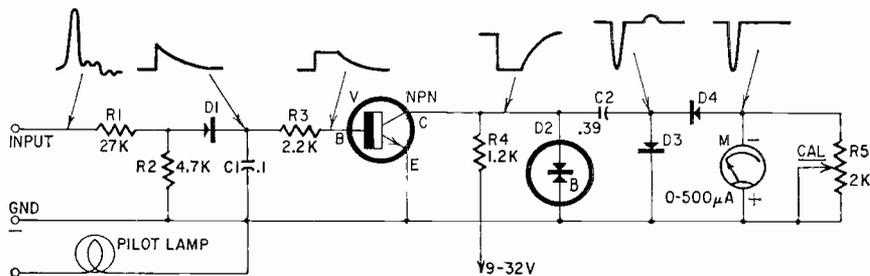
Signal input to the tach is a pulse tapped from the breaker points of either magneto or distributor. In a 6-volt car, the value is typically 200 volts. (The points make and break 6 volts, but the ignition-coil secondary impresses much higher potentials across them.) An initial design consideration occurs here. To make the tach a universal instrument, input impedance is kept high—more than 27,000 ohms. Otherwise the

unit would short out the characteristically high impedance of magneto systems (motorcycles, outboards, etc.). R1 and R2 form a divider for isolation and to drop the signal voltage to a manageable level (about 15% of original value).

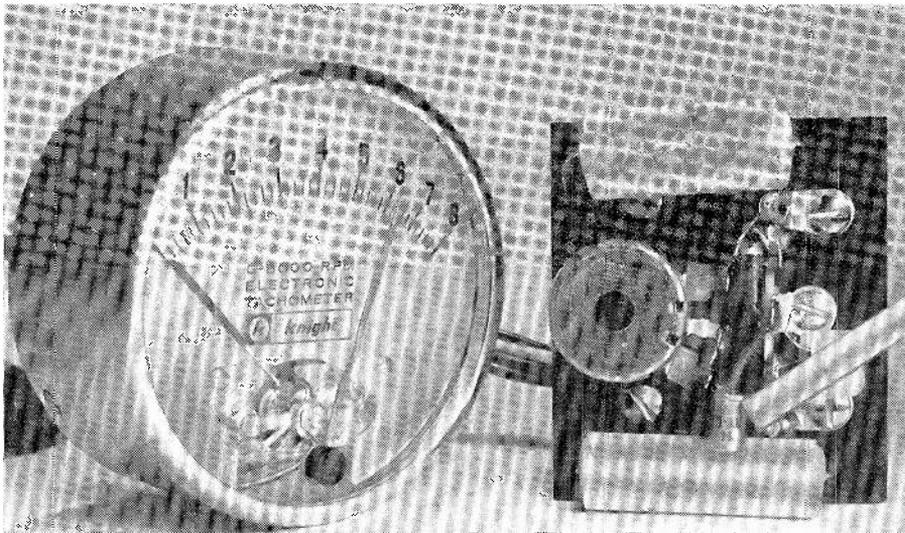
The signal encounters D1 and C1 next. They form a network that gives each incoming pulse a uniform shape. Key function is to eliminate the effects of ringing in the ignition coil. Ringing sets up a train of damped oscillations that trail along with each pulse. Under some conditions the tachometer could be deceived into counting them as separate pulses. In fact, some ignition systems intentionally use a certain amount of oscillation during normal operation. The diode capacitor serves as an integrator that makes the circuit insensitive to the trailing edge of the main pulse. R3 limits current and clips the signal somewhat to protect the transistor base.

The transistor amplifies the pulses. An n-p-n unit is shown here for a negative-ground application. An equivalent p-n-p is used for positive-ground operation. Leakage is the prime concern here. The transistor is selected for less than 3- $\mu$ a leakage at room temperature.

Kingpin of the circuit's stability with fluctuating battery voltage is Zener diode D2 across the transistor's



**Circuit of the versatile unit.**



Circuit board inside the instrument. Pointer indicates the Zener diode which is actually a double unit.

collector. Operating at a nominal Zener voltage of 6, it insures equal amplification for each pulse. When the output pulse at the collector is positive-going, the Zener prevents it from exceeding 6 volts. This is shown by the flattening of the waveforms at the collector. The lower portion is leveled as the transistor collector reaches saturation. Thus, limits are set and pulses emerge with

equal amplitude. This will hold true for input signals that might range between 10- and 500-volt amplitudes.

The Zener diode serves another function too. Any battery rated between 9 and 32 volts may power the circuit. Voltage is automatically reduced to the desired level by the Zener diode. This action also corrects small fluctuations that occur as the vehicle generator

changes speed. (D2, a Hoffman RT-6, is a double-anode unit that consists of two Zener diodes back-to-back. This configuration sharply reduces the adverse affects of heating. The temperature coefficient of the pair is just a tiny fraction of that of a single diode.)

Now that pulse *amplitude* is made equal in all cases, the next section of the circuit can act upon pulse *width*. C2, D3 and D4 form another shaping network. The short time constant set by C2 produces the waveform shown at the junction of C2 and D4. (the negative-going dip of short duration). Any positive-going component is shunted to ground by D3 while the desired signal moves on to the meter via D4.

The meter is calibrated directly in rpm. It measures the average voltage of incoming pulses. As pulse repetition rate rises with rpm, higher average voltage is indicated. Calibration control R5 is used to set the instrument for readings on any type ignition system.

Since the tachometer will operate over a wide range of signal input voltages, highly accurate calibration is possible with line voltage as a reference. A simple formula takes into account line frequency, number of engine cylinders and cycles. For example: for an 8-cylinder 4-cycle engine, R5 is used to set the meter to 900 rpm when input is 60-cycle house current. END

## WHAT'S YOUR EQ?

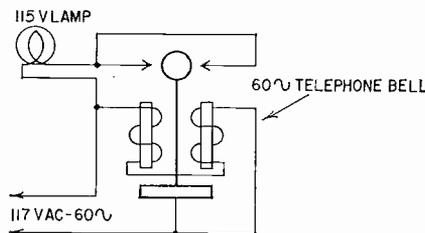
It's stumper time again. Here are three little beauties that will give you a run for the money. They may look simple, but double-check your answers before you say you've solved them. For those that get stuck, or think that it just can't be done, see the answers next month. If you've got an interesting or unusual answer send it to us. We are getting so many letters we can't answer indi-

vidual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). Also, we're in the market for puzzlers and will pay \$10 and up for each one accepted. Write to EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

For answers to last month's puzzle see page 58.

### Forbidden Current Path

In this hookup, a standard ac ringer is so hooked up that the clapper makes a good contact with a pair of contacts at each end of its swing, putting the lamp across the line. Why doesn't the lamp light when the bell is ringing and the clapper is making contact?—*I. S. Kerstetter*

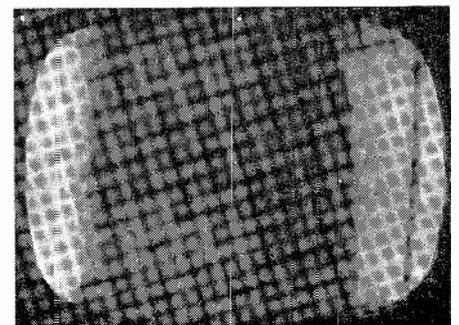


if the resistor and capacitor are interchanged (that is, the capacitor is placed between points A and D, and the resistor between points D and B)?

(To save calculation, the capacitive reactance of a 1- $\mu$ f capacitor at 60 cycles is 2653 ohms.)—*Walther Richter*

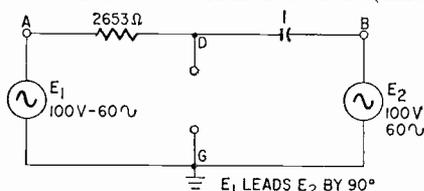
### Service Stinker No. 3

Look at the picture. What is the trouble? Horizontal phase diode out? Bad horizontal oscillator?—*Jack Darr*



### Simple (?) Ac Problem

In the circuit shown two ac generators furnish the two voltages  $E_1$  and  $E_2$ .  $E_1$  and  $E_2$  are both 100 volts (rms)



60 cycles, but  $E_1$  leads  $E_2$  by  $90^\circ$ . (In other words, the potential of point A with respect to ground G reaches its maximum or peak value one quarter-cycle earlier than the potential of point B with respect to G does.)

a. What will be the voltage between points A and B, and what will be the voltage between points D and G?

b. Will it make any difference, as far as these two voltages are concerned,

# CAPTURE NATURE'S SOUNDS ON TAPE

*It takes patience and practice to get a bird to sing for your tape recorder*

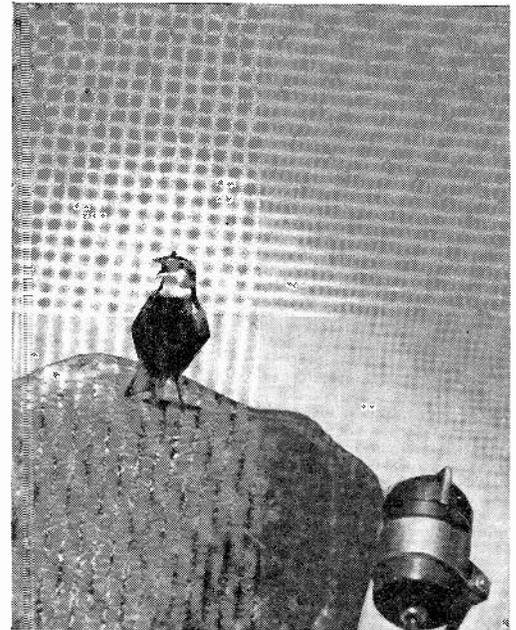
By **PETER PAUL KELLOGG\***

EVERY YEAR HUNDREDS OF LETTERS COME to Cornell University asking about recording sounds in nature. Many come from people who think it might be interesting, but don't know how to start. Other letters come from those who have tried but are dissatisfied with the results. Many who started recording as a

\*Dr. Kellogg is Professor of Ornithology and Biological Acoustics in the Department of Conservation and assistant director of the Laboratory of Ornithology at Cornell University, Ithaca, N.Y. He began recording sounds in nature in 1929. This article has been amplified and brought up to date by the author from an earlier paper published in the *Atlantic Naturalist* and is used here with permission.

hobby combining their interests in electronics and the out-of-doors become so fascinated by the possibilities of making scientific contributions in the field of bio-acoustics that they have joined organizations or expeditions where their efforts have been very valuable.

This article shows how to get started with the simplest of equipment—perhaps with what you already have. Then we show how to improve and modify home equipment so it will be better suited to this rather special field. Here we are concerned with recording bird sounds. But the same principles also apply to almost every phase of natural history sound recording.



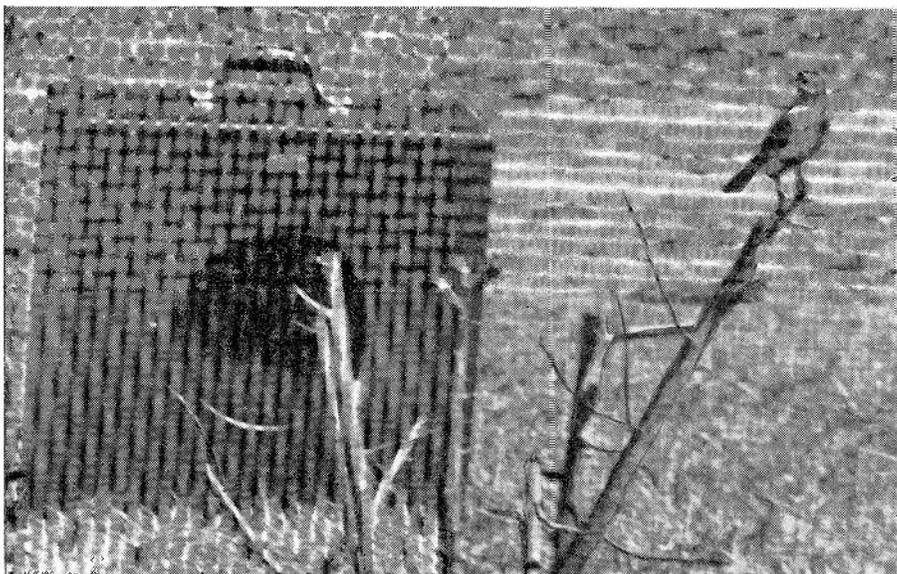
**Chestnut-collared longspur sings for microphone placed by his song perch.**

## Basics of nature recording

Almost any recorder, even the inexpensive home types, will give pleasing results with a number of bird species. The trick is to get close. To do so, you can take advantage of normal bird behavior. First, try attracting your quarry by playing his voice back to him. You can also use any available recording of the same species. When birds are in the mood to sing, they often respond so well to a recorded song that it can be embarrassing. We have had wrens come right into the house. A semipalmated sandpiper searched between my boots looking for his rival as I stood near the loudspeaker, and a white-crowned sparrow sat on the rim of our parabolic reflector and sang when we played his song back to him on the edge of Hudson Bay.

The best way is to plan your attack a little ahead. As soon as you have evidence that a bird is interested in responding, get ready. Place your recorder in an open window or other hiding place with curtains drawn so you can see what is going on and can operate the recorder without being seen. Arrange the microphone in front of the window at a point close to where you expect the bird to alight. Arrange a convenient perch for the bird close to this point and cover or eliminate all other likely nearby perching places. If you want to be very realistic—and it often pays big dividends—place a small mirror near the perch.

Most home type recorders have only a built-in speaker but, if you have an auxiliary or external speaker, place it in the group with the perch, micro-



A. A. Allen

**Early evidence of a mockingbird's interest in a reproduction of his own song. The photo was made in 1935.**

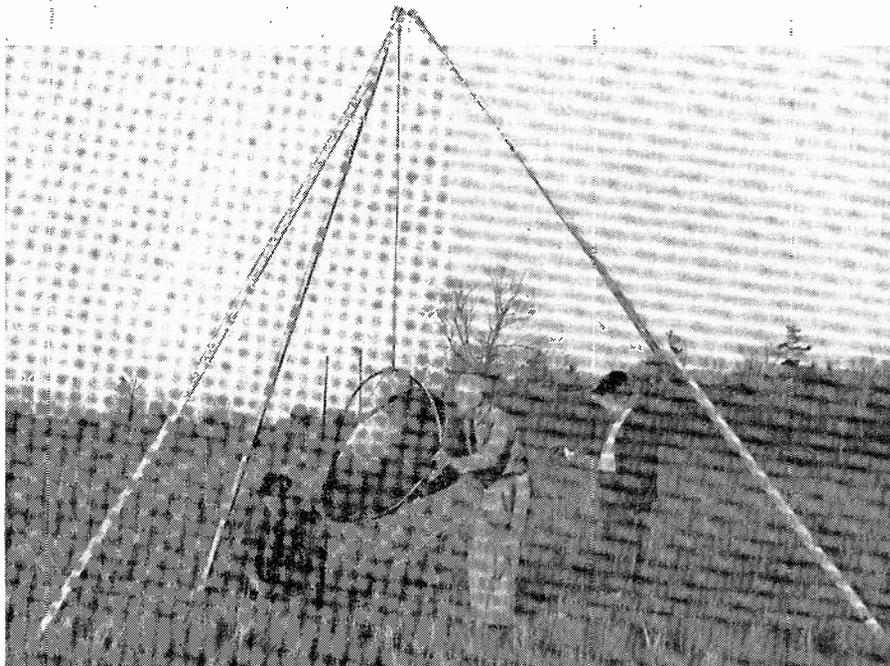
phone and mirror. Now put on your recorder a reel of tape on which you have recorded three or four of the best available songs of the species you are after. They don't have to be top quality. Most birds don't seem to mind if the recordings are poor and very noisy by our standards. Play through the three or four songs and wait. If the bird flies in, be prepared to record. If not, rewind the tape and play it again. Success doesn't crown every effort like this but it is a real thrill once in a while.

Another technique worth trying is to take advantage of song perches. Birds are creatures of habit and sometimes it almost seems as though they mark out the boundaries of territory by flying from one song perch to another and singing from each one. Watch for the

ready to work. Any packing box or a pile of brush can be placed where you propose to hide. If you see that these changes do not bother the bird, then it is a simple matter to arrange things the way you want them without much change in the appearance of things and the bird will probably never notice you.

### Extending your mike cable

You may be very successful with the methods described above, but opportunities will increase if you can lengthen your microphone cable. This seems simple, but it is not just a matter of buying more cable and attaching it. Doing this ruins the signal because of added noise and sometimes introduces frequency distortion as well. The secret of using a long line from the micro-



A. A. Allen

Parabolic reflector suspended from tripod by soft rope can be used for following birds in flight.

song perches and select the one that seems to offer the best possibilities. You will have to get your recorder close to the song perch and it would be best if you could hide there, too. It would be much better to have a long cable on your microphone but this is not possible with the ones that come with home recorders.

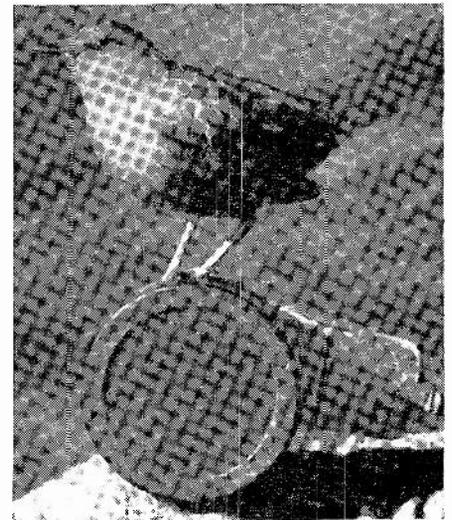
While most birds come back again and again to favorite song perches, the psychological attachment to the perch is not very strong. Small changes or the addition of anything that seems dangerous or suspicious to the bird may cause him to abandon a perch. Therefore, avoid conspicuous changes or camouflage them with natural materials. Also avoid the use of bright objects, or put a cover over them. Once the bird has accepted your setup, it's easy to get your recording. But since acceptance may take a little time, it is sometimes worth while to make your first setup using dummy equipment. A small box with a cord attached can substitute for your real microphone until you are

phone is that the microphone and the line must be low impedance. Most home recorders are designed to use high-impedance crystal microphones and short lines. These microphones are usually of poor quality.

Perhaps the best solution is to buy a new low-impedance dynamic microphone, a new shielded line of the desired length and a transformer, to be used close to the recorder, to match the low-impedance microphone and line to the high impedance of the recorder input.

This may sound complicated to the uninitiated, and certainly the person considering it should have either some familiarity with audio circuits or the help and advice of an expert. This modification should cost between \$50 and \$200, depending on the quality of microphone and transformer selected. Several manufacturers offer special cable transformers for this purpose. They are spliced into the cable near the tape recorder.

Most important are shielding and proper grounding if hum is to be



A. A. Allen

The little Water Ouzel sat right on the microphone and sang within inches of the diaphragm.

avoided. It is best to use 2-conductor shielded cable between the microphone and the transformer. Connect the microphone case to the shield at one end and the transformer case at the other. The signal leads from the microphone run only to the transformer primary, which is strapped to match the microphone impedance, usually 50 to 200 ohms. It is sometimes tricky to connect the transformer to the recorder without introducing hum. Often it is best to ground the shields at the transformer only through the ground lead of the shielded cable. The shield goes on to the body of the plug which goes into the recorder (Fig. 1). If the transformer is not well shielded magnetically, it may be desirable to orient it with respect to the recorder to minimize hum pickup.

### Choosing a mike

Microphones are always a compromise between output for a given signal and the frequency range over which they give a reasonably flat response. Crystal units normally supplied with home type recorders generally have high output in the mid-range but poor low- and high-frequency response. Any effort to broaden the frequency response usually decreases sensitivity.

Most bird-sound studies are made with dynamic microphones. These instruments have the advantage of reasonable response over most useful frequencies, fair output, great ruggedness

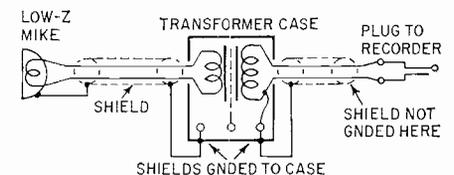


Fig. 1—Grounding arrangement when a matching transformer is added to the long mike cable.

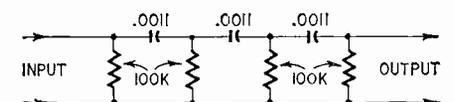
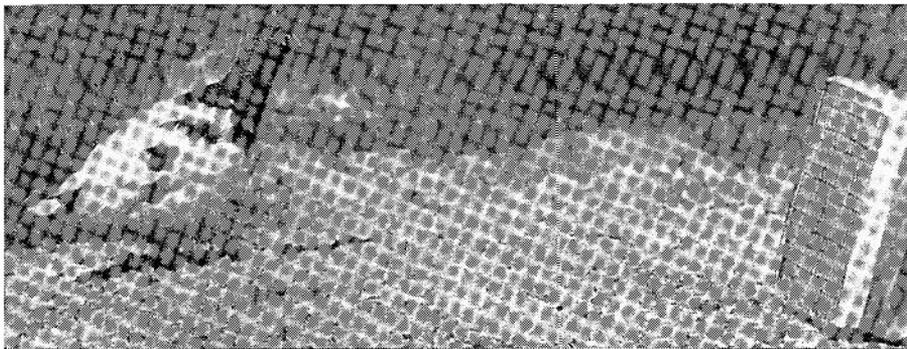


Fig. 2—A 1.5-kc high-pass filter.

No. and Family		Name Set Com.		Ref.	Cut No.	Date and Time	Recorded By: Expedition and Personnel				
Locality			Lat. Long. Alt.	Habitat		Level of Recording	Length of Cut	Quality	Weather Temp.: Air Water		
Recorder	Tape Speed "/Sec.	Microphone	Parabola? Dis./ft.	Dist. from Animal	Identification By: How?		If Rerecording, Type of Original Catalog No. of Orig.		Specimen Collected By Where Located		
Number of Animals Male Female Immature Indeterminate			Physical Description of Sound; How Distinguished								
Apparent Biological Purpose of Sound			What Behavior Accompanied Vocalization				What Did Animal Do When Not Vocalizing?				
Response to Imitation, Playback, Decoy etc.; Equipment Used										Edited By:	
Description of Exact Place From Which Sound Was Made; Special Set-up etc.										On Species Reel	
										Cataloged	
										Region	
Background Sounds (Underline Species To Be Cross-Indexed) How Are Other Species Distinguished?											

Fig. 3—A file of these sheets is used for each reel of tape in Cornell's library. They identify every bit of material recorded on the reel.



A. A. Allen

**Willow Ptarmigan attracted to speaker by playing back its own voice.**

and low impedance which enables them to transmit energy over long lines with relatively little loss.

Ribbon microphones have many of the advantages of the dynamic type, but are usually heavier, not so rugged and very sensitive to wind disturbance.

Capacitor (condenser) microphones have excellent frequency response throughout the entire spectrum. Many have useful output even at 100 kc and are used when exploring ultrasonic frequencies such as those encountered in studies of dogs, bats and some other mammals. The low output and extremely high impedance of capacitor microphones, plus the need for a high polarizing voltage, make it mandatory that the preamplifier, and usually the power supply, be located within inches of the microphone head. Until recently, this requirement almost excluded this microphone from the field. Now, with small, efficient transistor amplifiers and power supplies two companies (A.K.G. and Neumann) have offered capacitor microphone systems with battery-operated power supplies suitable for field use. Although these systems are expensive compared to simpler microphones, they are superior and will probably be popular with those who want the best available.

**Parabolic reflectors**

Parabolic reflectors are almost a necessity for anyone planning on doing much bird-song recording. However, they are expensive and cumbersome and have other limitations. The cost of a suitable unmounted aluminum parabola is about \$50, but good ones can sometimes be found on the surplus market. The effectiveness of a parabolic reflector increases with size. A 40-inch parabola will collect about 1,600 times as much sound energy from the direction in which it is pointed as the microphone alone would do from the same point. Unfortunately, as the size of the reflector increases, so does the inconvenience of handling it. The choice of size is always a compromise. At Cornell we use mostly 40-inch reflectors with a 10-inch focal length, but for most bird songs a 36-inch reflector with a 10- or 12-inch focal length would be satisfactory. Smaller reflectors have poor low-frequency response, are less directional and pick up less sound energy from the source. Always mount the microphone at the focal point with its sensitive part facing the parabola, not the bird.

With a good reflector, properly adjusted to the microphone and correctly pointed, excellent recordings have

been made of a bird song at distances of over 100 yards. This, however, requires excellent weather and noise conditions. In practice, distances of 25 to 100 feet are more usual. Better recordings should theoretically be possible when the microphone alone is within a couple of feet of the bird, but it is often impossible to tell the difference between recordings made with a parabola and with the microphone close up. Certainly, however, it is much less work to get a desired song when using a good parabola.

**Portable recorders**

Portable recorders are especially useful in bird-sound recording. According to our definition, a portable recorder is battery-powered and weighs less than 30 pounds. Such recorders, if quality instruments, are rather special and usually cost many times the price of home recorders. They vary from 8 to 20 pounds in weight and are marvels of electrical and mechanical perfection, comparing favorably with the finest professional studio machines. Most recorders in this class are designed for use with high-quality low-impedance microphones, and can readily be used with long or short microphone cables as the occasion demands.

Home type recorders can be used away from commercial current outlets if you use a converter to change the battery current available in a car to 60-cycle ac at 117 volts. This gives a much greater degree of freedom with this type of recorder and, when combined with a long microphone cable, it is possible to record in very remote places. Converters of this type cost between \$50 and \$100.

**Tape speed**

Some birds have very high-pitched songs and notes which begin or change with such suddenness that they are very difficult to record, even with the best professional equipment available today. Therefore, it is desirable to record at the highest tape speed available. Good recordings of many bird songs can be made at 7.5 ips, but many warblers and finches have song qualities which make them difficult to record even at 15 ips. We have found many advantages in using 15 ips and have standardized on it. We have modified many recorders to operate at this speed, and strongly recommend it for serious work.

**Recording quality**

In general, anything that causes a recorded bird song to be different from what is heard in the field should be avoided. This imposes a difficult problem because in the field we have sounds coming from all about us. Our ability to segregate these sounds and to concentrate on those coming from one direction, while disregarding sounds from all other directions, permits us to "hear through the noise" and to disregard it to a great extent. Recorders, unless they record stereophonically, receive sound through one microphone and play it back through one speaker. All sounds,

desired and undesired, come out from the same point and there is no chance for the ears to separate them or distinguish between them.

Noise mixed with the desired sound is perhaps the easiest fault to look for in a recording. However, there are two kinds of noise. One is in the environment when the recording was made. While this type of noise is not the fault of the person doing the recording, careful workers try to choose a time when such noises are lowest and do everything possible to minimize them. Wind screens often help reduce the blast effect of the wind. One type fits tightly over the microphone and is usually purchased from the microphone manufacturer. The other, equally effective, is made from a tightly woven material, such as organdy, cut to fit over the entire parabolic reflector and microphone, and held tight with an elastic hem. Electronic filters can often be used to reduce greatly the low frequencies of traffic and wind noise without affecting the bird songs. Fig. 2 shows a simple 1.5-kc high-pass filter that can be inserted between the recorder's high-impedance input and a crystal mike or line-to-grid transformer. Especially effective are adjustable bandpass filters such as the Krohn-Hite, model 310-AB (Krohn-Hite, 580 Massachusetts Ave., Cambridge 39, Mass.) These filters permit the removal of objectionable low and high frequencies at the same time, but be sure you avoid cutting into the desired sound frequencies. If you don't, you'll get an unpleasant "thin" quality to the sound or may even eliminate important parts of the sound.

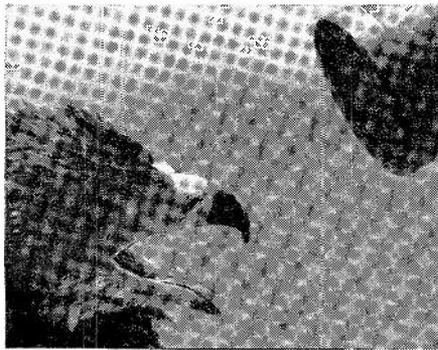
The second type of noise comes from the recording equipment itself and may vary from occasional or regular rumbles to steady hiss or hum.

Distortion is usually distinguished from noise and defined as tones or frequencies in the recorded version which were not in the original. The ear will tolerate small amounts of distortion much more readily than it will tolerate noise. The more familiar the sound, the easier it is to detect distortion. In general, recorders having less than 2% or 3% distortion are very satisfactory. For analytical work, minimum distortion becomes more important.

Wow and flutter are caused by irregular motion of the tape as it passes over the magnetic heads. They are very objectionable because they can add trills and tremolos to a recorded bird sound. These faults are more likely to occur in low-grade recorders, but they can be caused by dirty parts or poor maintenance in good recorders. Again, these faults are more evident when listening to familiar sounds. Therefore this type of imperfection is dangerous in bird-sound recording since, if we are not too familiar with the bird, the fault may pass unnoticed and be attributed to the bird.

#### Dynamic range

No recorder can handle as wide a range of sound intensities as the human ear can perceive. Therefore, there must



A. A. Allen

#### This young Golden Eagle came right up to the mike.

always be some compression in recorded sound if it has a wide dynamic range. Intensity is usually limited at the upper end by the same amount of distortion we are willing to tolerate. In modern professional recorders, this is usually set at 1% to 3%. In home recorders it may run much higher. The lower end of the dynamic range is determined by noise introduced by the equipment. With the best equipment, the dynamic range is usually satisfactory if not adequate for recording the total range of a great orchestra.

#### Frequency response

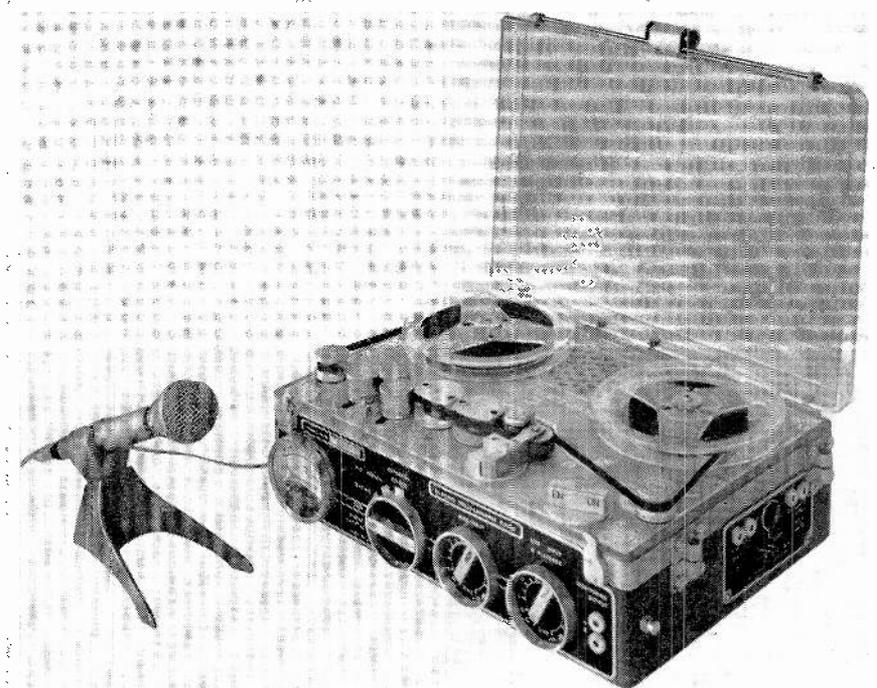
This characteristic has been left until last because so much emphasis is usually placed upon it. The frequencies to which human beings respond are between 20 and 20,000 cycles for young people. Older people tend to lose their responses to high frequencies first. It is questionable if many people, young or old, can detect the presence or absence of frequencies above 10,000 or 12,000 cycles in human voice—or in bird songs. In advertising, great emphasis is usually placed on uniformity of response throughout the sound spectrum. This

may be desirable or even necessary for technical work involving the analysis of bird songs but it is not of great importance for listening to them, since most people are hard pressed to detect the difference in loudness represented by doubling the power of sound or cutting it in half. Such a change in loudness is referred to technically as a change of 3 decibels. Therefore, a system which is uniform throughout the spectrum within this 2-to-1 power range is satisfactory for all but critical measurements.

#### Care and use of recordings

Some system must be developed if tape recordings are to be of much use. As soon as possible after a recording is made, play it back. Pick out the parts to be saved, splice them together and erase the remainder. The Cornell Library of Natural Sounds has a separate reel for each species and all recordings of that species are given a cut number and added to that reel as soon as possible. Each cut is separated from the next by a foot or two of white, plastic leader tape, and a short announcement is spliced onto the beginning of each cut giving the scientific and common names, the cut number and the name of the person who made the recording. A separate editing sheet (Fig. 3) is prepared for each cut. On this sheet complete notes are kept showing all details of the recording, such as locality, date, time and background sounds, and especially information about the bird, its activities at the time and how it responded to a reproduction of its voice. In this way it is possible to find easily any recording in the collection and to recall the entire experience.

The use of sound recordings is still in its infancy. Educational uses are most obvious. They include combin-



Professional tape recorder for field recording and the one used by the author is the Nagra-III. Price is over \$1,000.

ing phonograph records with pictures. Some sound studies have indicated relationship of species. Others have related to bird behavior and might be thought of as vocabulary studies. Other studies show how voice changes when members of a species are isolated for long periods, such as has occurred sometimes with insular birds which are also represented on the mainland. Some studies have been made in search of beauty in bird song and the quest has led to every part of the world. Perhaps one of the most rewarding efforts is to select a single species and try to record and catalog all of its songs and calls—throughout the day, the season, the year and throughout the range. This is a big job, but eventually it must be done. Certainly it is fully as important as collecting specimens of the birds themselves and it will probably reveal just as many important facts.

Of the 8,000 species of birds in the world, hardly more than 1,000 have had any record made of their voices. Even in the United States many birds are still to be recorded. One of the most challenging of these has been Townsend's solitaire. It is a beautiful songster, as we found out this year.

I would like to suggest that if you should get seriously interested in the recording and study of bird songs, please consider permitting the Library of Natural Sounds at Cornell University to copy your tapes and include them in their collection where they will be catalogued, preserved and made available for scientific study to scholars throughout the world and with credit to the contributor. END

#### Suggested Reading on Technical Aspects of Recording

Herman Burstein, and H. C. Pollak. *Elements of Tape Recorder Circuits*. New York: Gernsback Library, Inc., 1957.

Nathan M. Haynes, *Elements of Magnetic Tape Recording*. Englewood Cliff, N. J.: Prentice-Hall, Inc., 1957.

W. E. Lanyon, Editor *Animal Sounds and Communication*. Washington, D. C.: American Institute of Biological Sciences, 1960.

Joel Tall, *Techniques of Magnetic Recording*. New York: Macmillan Co., 1958.

#### GHOSTLY BATHTUB

In the old days of radio, people occasionally heard voices or music coming from kitchen sinks, metal rain gutters and downspouts or other pieces of metal sometimes miles away from radio stations. Now, in the age of TV, we have found a video counterpart of this phenomenon in an eerie green-glowing bathtub.

Recently, a husband woke up in his Kansas City home to see a greenish-white light coming from the bathroom. Investigation revealed the bathtub was luminescing.

Next night nothing happened. Then a week later it happened again. The next night it was gone. Each Wednesday night it happened. Finally he figured it out. Every Wednesday night his wife took a sun-lamp bath. The cast iron of the tub absorbed enough rays from the sun lamp to cause a long-persistence afterglow!—*Walter Inman*

# SHORT-WAVE FORECAST

Jan. 15–Feb. 15

By STANLEY LEINWOLL†

During late January and February the ionosphere is affected by three major changes in earth/sun relationships.

First, because of the lengthening hours of daylight in the northern hemisphere, the number of hours during which the higher daytime frequencies can be used for long-distance short-wave communication increases.

Second, as the distance between the earth and the sun increases, the intensity of ultraviolet radiation striking the ionosphere decreases. As a result, daytime MUF's fall from peak mid-winter levels.

Finally, because the sun is headed more directly overhead, its heating effects on the ionosphere increase, and the ionosphere expands.

The combination of an expanded ionosphere and the fact that there are fewer hours of night for recombination of ions and free electrons to take place results in an increase in maximum usable frequencies at night.

The tables show the optimum broadcast band, in megacycles, for propagation of programs between the locations shown during the time periods indicated.

To use the tables, the listener selects the one most suitable for his location, reads down the left side to the region he wishes to hear, then follows the line to the right until he is under the appropriate time. (Time is given at the top of each table in 2-hour intervals from midnight to 10 pm, in your local standard time.) The figure thus obtained is the short-wave band (in megacycles) nearest to the optimum working frequency.

For example, a listener in Chicago would use the Central USA table. He would be most likely to hear broadcasts from West Europe in the 6 megacycle band at 8 pm, Central Standard Time.

#### EASTERN US 10:

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6	6	9*	21	21	21	17	11	9	9	6
East Europe	7	7*	6*	9*	21	21	17	11	9	7	7	7
Northern Latin America	11	9	9	11	15	17	15	17	17	15	11	11
Southern Latin America	11	11	9	11	15	15	15*	17	17	15	11	11
Near East	7	7	6*	11*	17	17	17	11	11	11	9	7
North Africa	7	7	7	11*	17	17	15	15	11	11	9	9
South & Central Africa	9	9	7*	17	21	21	21	15	11	11	11	11
Far East	11	9	9	7	9	7*	9*	7*	9*	15	15	11
Australia & New Zealand	11	11	9	9	11	11	15*	15	15	17	17	11

#### CENTRAL US 10:

West Europe	6	7*	7*	9*	21	21	17	11	9*	7	6	6
East Europe	7	7	7*	9*	15	11	9*	9*	9	9	7	7
Northern Latin America	11	9	9	15	17	17	15	17	17	15	11	11
Southern Latin America	11	9	9	15	15	17	17	17	15	11	11	11
Near East	9	7*	7*	9*	17	15	11	9	9	9	7	7
North Africa	7	7	7*	7*	17	17	17	11	9	9	9	7
South & Central Africa	9	9	9*	17	21	21	21	17	15	11	11	9
Far East	7*	7*	7	7	9	9*	7*	9*	21	21	11	9
Australia & New Zealand	11	11	9	9	11	11	15*	15	17	17	15	11

#### WESTERN US 10:

West Europe	6*	7	7*	11*	17	17	15	9	7	6	6	6*
East Europe	7	7	7*	7*	11	15	15	9	9	7	7	7
Northern Latin America	9	9	9	9	15	15	15	17	17	15	11	11
Southern Latin America	11	9	9	11	15	15*	17	17	17	15	11	11
North Africa	9	7	7	11	17	17	15	9	9	9	7	7
South & Central Africa	9	9	9*	15	21	21	21	15	15	11	11	11
Far East	7	7	7	7	9	9	9	17	17	15	9	9
South Asia	7	7	7	7	9	15	11	11*	15	15	15	9
Australia & New Zealand	11	11	9	7	11	11	15	15	21	21	17	15

†Radio-frequency and propagation manager, RADIO FREE EUROPE.

\*Reception may be very poor or impossible on this path at this hour.

# FM STEREO CIRCUIT DEVELOPMENTS

*There are three main detection systems—switching, matrixing and envelope.  
Here's how they work*

## By NORMAN H. CROWHURST

PRESENT REACTIONS TO FM STEREO VARY from surprise that it works at all to skepticism whether it will ever be possible to get good quality with it. Actually, as several sensible, nontechnical people have already guessed, FM stereo is having the same kind of troubles stereo disc had when it first came in.

It's no use to transmit stereo unless someone can listen to it. On the other hand, the adapter makers cannot field-test their products unless someone transmits. The real neck-sticker-outers of the hi-fi industry have gone ahead and designed the best adapters they knew how, with very little to go on. Initially, only one manufacturer had the advantage of advance field testing.

So they worked with home-made generators, to simulate the transmitted signal, and made adapters that gave what they felt was acceptable separation, distortion, SCA (Subsidiary Communications Authorization) subcarrier rejection, etc. Mostly they started by trying the G-E or Zenith circuit. In some instances, they satisfied themselves with "optimizing" these circuits—making minor changes that improved performance. But in more cases they felt they could do better by trying for some completely new way of doing it.

This has resulted in a number of claims to having produced "unique" circuits, supposedly quite different from everybody else's. On the assumption that everybody else more or less copied G-E or Zenith, their claim to uniqueness may be supportable. But when one examines the various circuits, it seems they have mostly discovered the same things, independently, so they end up not being the least bit unique! However, it's to the credit of the industry that it has so many engineers who can think up and develop something original—even if they end up finding essentially the same things.

### Detection methods

So far there are three main detection methods: switching, following the original Zenith concept; filtering, reinserting subcarrier into the L-R modulation, detecting and matrixing; envelope detection, utilizing the fact that, when the subcarrier is added in correct phase to the composite signal, the top of the envelope is left program waveform, while the bottom is right. Fig. 1 shows these three concepts.

The Zenith circuit used a beam-switching tube to switch from left to right. If a relatively large-amplitude, symmetrical-waveform switching signal (regenerated subcarrier) is used, we get square-wave switching. Close to the zero switching-waveform level, the entire signal is transferred from the "left" plate to the "right" plate, and back again (Fig. 2).

Notice that, if left and right momentarily are of the same phase and magnitude, the output at each plate is a half-time sample of the waveform. But, if they are momentarily out of phase

(and, say, approximately equal magnitude), the output at each plate is a succession of half-waves of 38 kc, with a peak value on the waveform for that channel (Fig. 3).

During half-cycles of the 38-kc switching waveform, in the case where L and R are identical (Fig. 3, top), each output gives the momentary waveform value for half the time—a complete half and half. When left and right are opposite (bottom), although the 38-kc switching occurs abruptly, a half-cycle of the received 38 kc appears in each output, whose peak touches the momentary waveform value for that side (L or R). The average value of this half wave will be less than the peak—representing some leak from left to right and vice versa. An averaging-type filter will cause the output in one channel to be affected by the output from the other.

The remedy for this is the injection of opposite channel—or composite—in opposite phase, so each channel is itself unaffected by the instantaneous value in the other (Fig. 4). This was shown in the original Zenith circuit.

In the cathode a small replica of  $L + R$  appears in opposite phase from the L and R appearing at the respective switching plates. By appropriate adjustment of values (or the slider on the cathode pot), this exactly neutralizes the "leak" from left to right and right to left, with a slight loss of "wanted" channel as well.

Scott and several others use, or have experimented with, essentially the same method, but with semiconductor diodes instead of a beam-switching tube

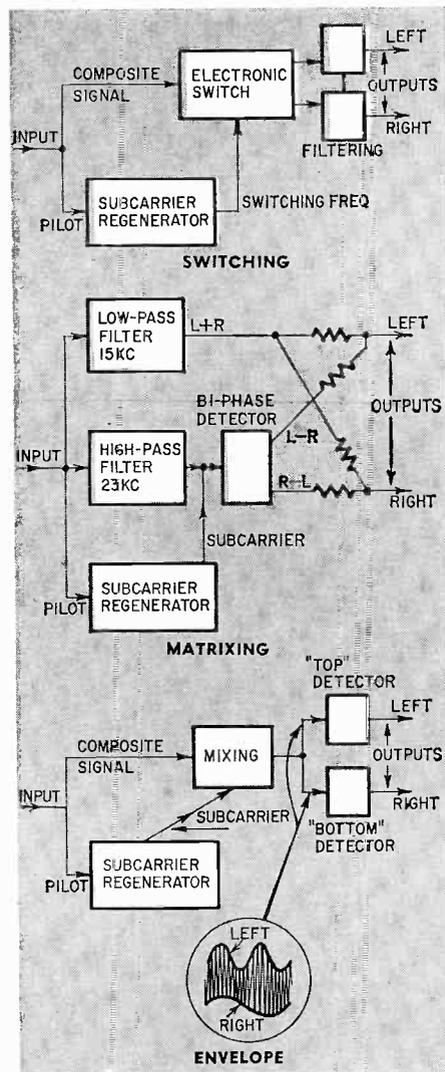


Fig. 1—Comparison of the three basic detection methods developed to date.

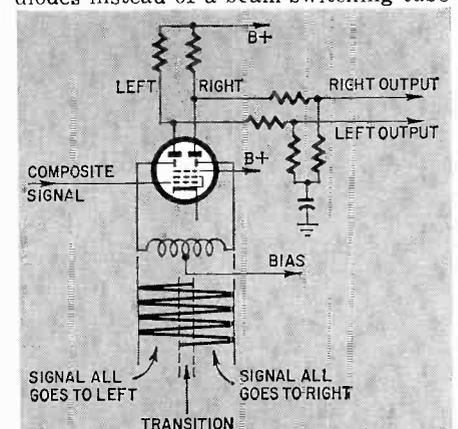


Fig. 2—Switching method using beam-switching tube. Composite signal goes to control grid, switching frequency to beam-switching electrodes.

(Fig. 5). A feature employed by Scott is the use of a form of vestigial sideband operation, by the filter response shaping. This deviation is compensated by the phasing of the regenerated sub-carrier.

The people who worked with filters and matrixing have been having troubles. As our previous article pointed out, it is not feasible to design a phase-linear filter including high-pass function, which such a circuit needs. The frequencies above 23 kc have to be separated from those below 15 kc. Consequently, normal linear detection will not retrieve the L - R signal, correct in magnitude and phase at all audio frequencies.

What may be regarded as a slight misadjustment, or compensation, can get complete separation between left and right, after matrixing, at any one audio frequency. Careful adjustment, using the matrixing adjustment to get maximum separation at lower audio frequencies while the subcarrier reinsertion phase is adjusted for maximum separation at the higher frequencies, can give *acceptable* separation throughout the audio range (Fig. 6).

It can never be perfect, however good the circuit design and adjustment. But it can be made fairly good, and it's more tolerant of tuner alignment errors that upset the output linearity than are some other circuits.

The third form of detection is the one most engineers have "discovered" independently. Each of the previously published circuits—Zenith, G-E and Scott—was unique. Although they are by no means identical, they have similarities. But each one has its individuality too. This third form—envelope detection—appeals because it requires no filters at all for the stereo function (Fig. 7). More than a cost-saving device, this avoids the problems they bring, in correct alignment or setting values.

This method works on a very simple principle: if the regenerated sub-carrier is added to the composite received signal in the correct phase, the left-channel waveform forms the top of the envelope and the right channel the bottom (Fig. 8). Detection is just a matter of having one detection element follow the top (positive) peaks and another the bottom (negative) peaks. As with the switching method, there is some slight interaction, equivalent to leakage, which can be offset by precisely similar methods.

### Subcarrier regeneration

Every reception method calls for subcarrier regeneration. Every method also requires that the subcarrier be used in the correct phase. Otherwise separation suffers, and distortion may increase.

The term subcarrier regeneration is used for the whole operation of isolating the 19-kc pilot frequency from everything else and producing a 38-kc signal whose phase is correctly controlled by the 19-kc pilot. The method may simply frequency-double, or it may

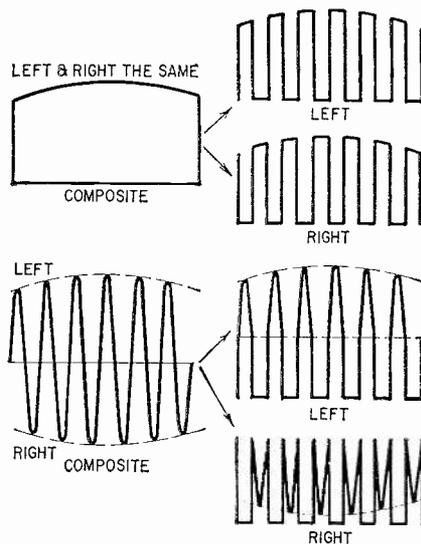


Fig. 3—Effect of one channel on the other when the switching method is used. When both signals are momentarily the same (top), the switching delivers half the waveform at each output. When the signals are different (bottom), only the peaks reach the instantaneous value of the signal at each output.

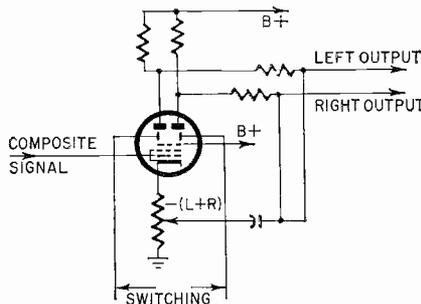


Fig. 4—Method of compensating for the cross-mixing used by Zenith with the beam-switching tube.

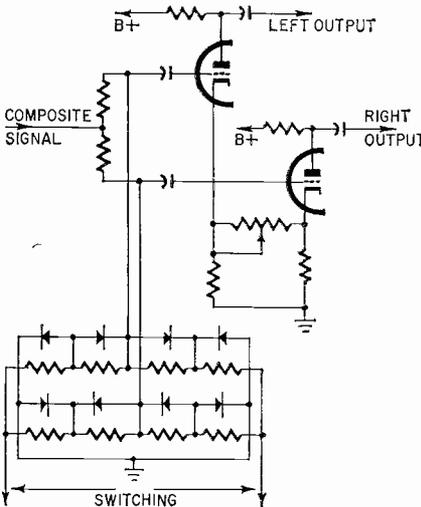


Fig. 5—Diodes for detection by switching. The diode bridge is used by Scott. Compensation for cross-mixing is slightly simplified.

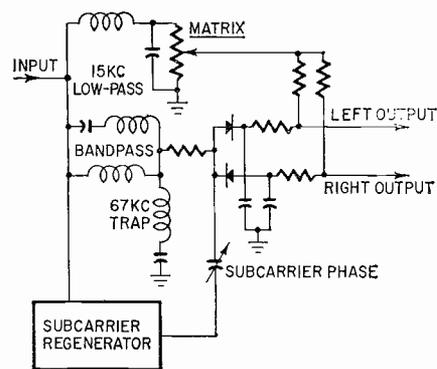


Fig. 6—Basic elements of matrixing detection. For maximum separation, set matrix adjustment for maximum low-frequency separation at the same time as the carrier phase control is set for maximum separation at 12,000 cycles.

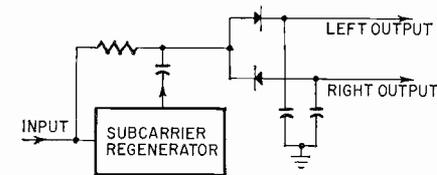


Fig. 7—The basic circuit for envelope detection is extremely simple.

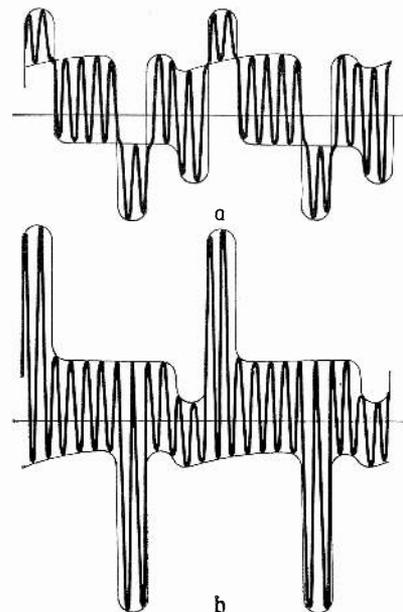


Fig. 8—The basis of envelope detection. By adding to the composite signal (a) the regenerated subcarrier in correct phase, the waveform (b) has the left-channel waveform as its top edge and the right-channel waveform as its bottom edge.

use a synchronized (locked) oscillator at either frequency—19 or 38 kc. The circuit configuration does not change very much. The difference that will identify which is used is usually in the coils. Where an oscillator is used, the coil either has a regenerative winding or the cathode is tapped up from ground on the grid winding—a cathode-coupled Hartley circuit.

A problem several ran into was

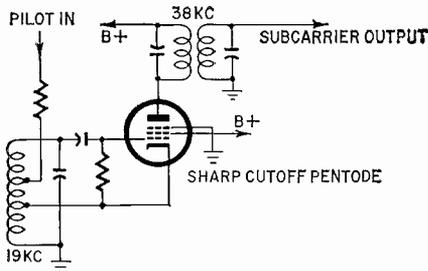


Fig. 9—A common form of oscillator-cum-doubler circuit.

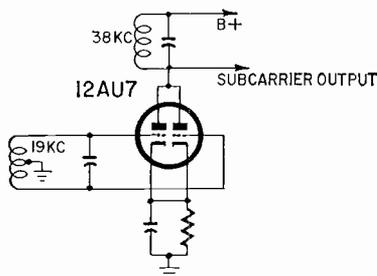


Fig. 10—A fairly simple doubler circuit with extremely good performance.

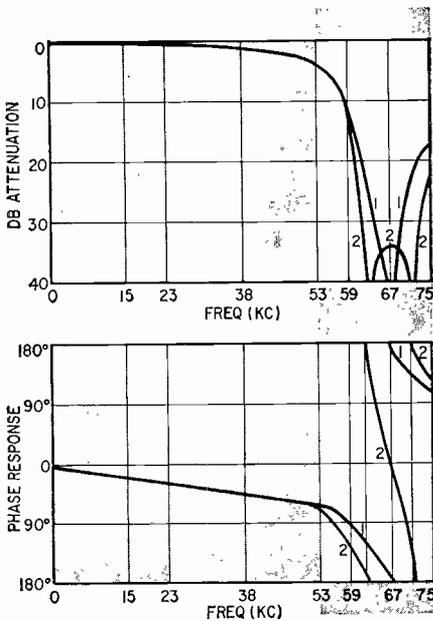


Fig. 11—The filter approach to eliminating SCA trouble. Curves 1 show the response of original single-reject filters. Curves 2 show the response of improved types with extra rejection.

that of satisfactorily separating the 19-kc pilot from everything above and below it. A high-Q tuned circuit is a big help, but several found this could also be influenced by the second harmonic of 9.5 kc in the program, and possibly the third harmonic of 6½ kc. The presence of audio frequencies near these values could shift the subcarrier phase enough to cause considerable degradation of separation.

The solution is to use stages with very low distortion (which one would think they needed for high fidelity, anyway) before the pilot is separated from the rest. Some have used a 9.5-kc trap instead, but this seems the wrong way to do it.

Some preferred amplifying and doubling the pilot frequency to produce the subcarrier. They found that phase of the reinserted 38 kc varied less with signal level at the antenna than when they used an oscillator. But, of course, the regenerated subcarrier's magnitude fluctuates.

On simulated signal this may be all right. But field testing showed the magnitude fluctuation proved worse, at least in circuits using matrixing or envelope detection. The amplitude fluctuations in the subcarrier are indistinguishable from those caused by the received sidebands and get detected as noise.

After field tests, practically everyone has gone over to a synchronized oscillator in one form or another. Some use 19 kc, some 38 kc, as the oscillator frequency. Most are content with a curvature type doubler using the plate circuit of a tube that also serves as oscillator in its grid circuit. Fig. 9 shows such an arrangement with a pentode. Triodes have also been used this way.

A very good doubler, needing few parts beside a 12AU7, applies push-pull 19 kc to the 12AU7 grids and gets 38 kc at the common plates (Fig. 10).

Coupling between tuned circuits has been another problem. To get better selectivity or rejection of all but 19 kc, double-tuned circuits may be used. But it was difficult to find a coil or transformer manufacturer who knew how to wind an "undercoupled if" for 19 kc. The same trouble may also account for some unnecessarily distorted 38-kc outputs.

### SCA subcarrier rejection

A number of the circuits work quite well on transmissions without an SCA subcarrier as well as the stereo multiplex. But they run into trouble when tried out on a transmission with SCA subcarrier. Mostly it shows up, not as breakthrough, but as birdies. Several have tried putting in extra filtering to get rid of the 67-kc sidebands as well as the 67 kc itself (Fig. 11).

This works, as far as getting rid of the interference is concerned, but it poses more serious problems in gaining the phase linearity needed in the low-pass filter action, below 53 kc. And considerable rejection is needed, in most receivers, to get rid of the birdies over the whole range from 59 to 75 kc.

The rejection either has to be so far down that any slope detection, as the frequency modulation shifts the nominal 67 kc through the range between 59 and 75 kc, does not produce enough amplitude-modulated output to be audible. From this viewpoint, it is better not to use any filters, because this avoids any slope detection (Fig. 12). But to be completely "clean", the response at the output of the tuner needs to be flat out to 75 kc, which is a tough requirement.

Another possible cause of the birdies, and one which is doubtless responsible in many adapter circuits, is

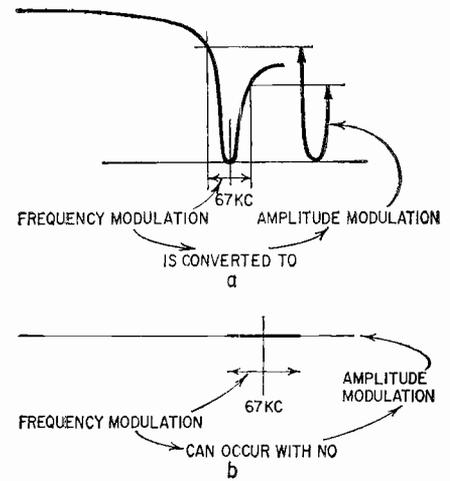


Fig. 12—Why the filter approach (a) always converts the basic FM of SCA to a form of AM, causing it to be detected and form beats with the stereo. These beats appear as birdies. The no-filter approach (b) avoids detecting the FM by using the flattest possible response.

the presence of third and fourth harmonics of 19 kc, along with the wanted second—38 kc. These frequencies, 57 and 76 kc, beat with 67 kc to produce 10 and 9 kc, respectively. But when the 67 kc is modulated, the birdies "dip" to much lower frequencies, often to 1,000 cycles or lower.

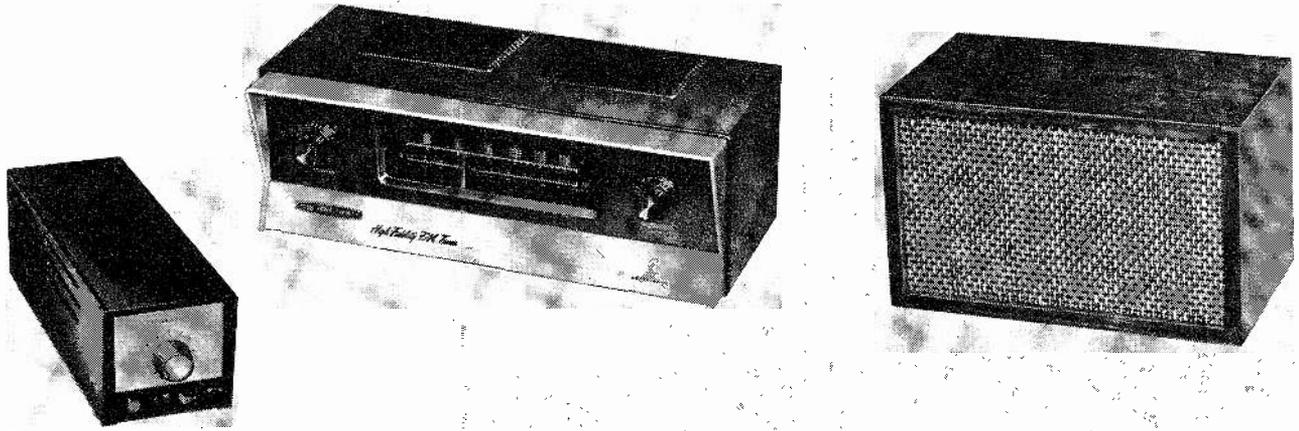
Where this is the cause, the remedy is a much cleaner regenerated subcarrier, as well as whatever other measure is used to control what happens to the SCA subcarrier itself. Actual adapter circuits seem to have almost run the gamut of possible combinations of the features we have discussed: type of detection, method of subcarrier regeneration and procedure for SCA rejection.

### Transmissions

Not to be overlooked among all the problems is the possibility that the transmissions used for reception and field testing may not be perfect. Lack of separation or other problems may not be caused by poor adapter design or alignment. It may be failure of the transmitter to conform to the FCC requirements about subcarrier phasing, or some other feature about the signal.

Although SCA subcarriers may have been overmodulated before stereo was introduced without trouble on monophonic transmission, now they could cause severe trouble unless the modulation is brought in line for stereo. The best solution for the station might be to forego the SCA revenue and concentrate on good stereo. Some adapter makers are hoping this will happen. But there's no guarantee. Meanwhile, if someone hears birdies, the adapter gets the blame.

As with stereo discs, at the beginning we needed both good discs and good pickups, so each could check the other. We got them before too long. Undoubtedly the same thing is happening with FM stereo. END



**FM STEREO AT LOW COST**

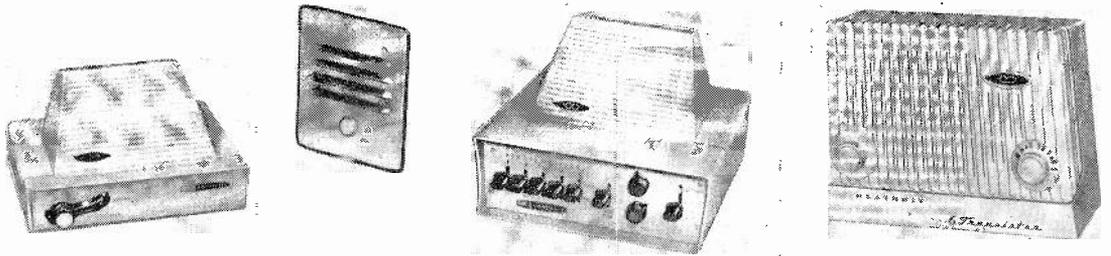
A "value packed" combination for exciting stereo FM entertainment! Tuner has pre-assembled, prealigned FM tuning unit for fast, easy assembly. Features flywheel tuning, automatic frequency control, handsome modern styling. Stereo converter has self-contained power supply, cathode follower outputs for A & B channels. 12 lbs.

**Kit AJ-31S** (includes AJ-31 tuner and converter)...no money down, \$7 mo....  
Saves \$2.50 ..... only **\$69.95**

**SPACE-SAVING AS-81 SERIES  
MINIATURE HI-FI SPEAKER SYSTEM KITS**

Measures only 10 3/4" x 6 1/2" x 6 3/8". 70-14,000 cps response. 6" woofer, 3" tweeter. 8 ohm imp. 6 watt power rating. Factory assembled cabinet. 10 lbs.

**Kit AS-81**... Unfinished..... **\$17.50**  
... Mahogany or Walnut..... **\$19.95**



**SAVE TIME & STEPS WITH A HEATHKIT INTERCOM SYSTEM**

Complete indoor & outdoor communications facilities in easy to build kit form. All-transistor master handles up to five indoor or outdoor remotes. Powerful 1 watt output and specially designed frequency response assure crisp, clear communications. Costs only 5c a month to operate!

**Kit GD-121 Master Station** . . . 5 lbs. . . no money down, \$5 mo. . . . . **\$29.95**  
**Kit GD-131 Indoor Remote** . . . 3 lbs. . . . . **\$8.95**  
**Kit GD-141 Outdoor Remote** . . . 2 lbs. . . . . **\$5.95**

**"CORDLESS" AM RADIO**

Battery powered. 4" x 6" PM speaker; transistor circuit; ivory & green. 3 lbs.

**Kit GR-131 Radio** (less battery) . . . . . **\$19.95**  
**GRA-131-1: Battery pack** 2 lbs. . . . . **\$1.10**

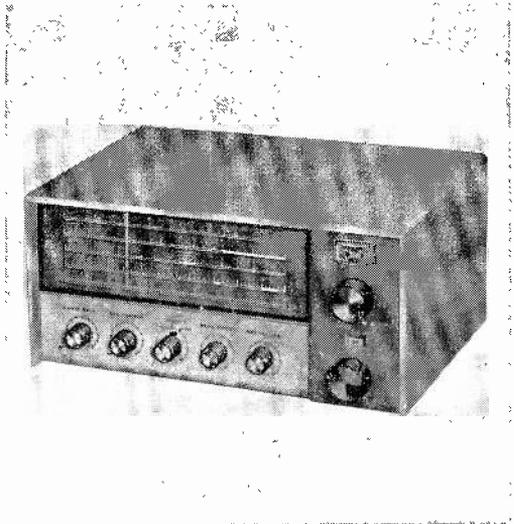
**HEATHKIT® offers MORE-more new**

Whatever your interest, there's a Heathkit for you. Over 250 kits—each priced to save you money. Guaranteed to be easy to build and to provide years of enjoyment and superior performance.

*Why take chances in kit buying—Heathkit's broad guarantee assures satisfaction every time.*

Compare this guarantee with any competitive electronic kit manufacturer. See why Heathkit gives you more. Our pride in our quality, in our reputation and goodwill, in our painstakingly engineered "check-by-step" instructions is reflected in the unconditional guarantee that you, regardless of technical knowledge or experience, can build any Heathkit.

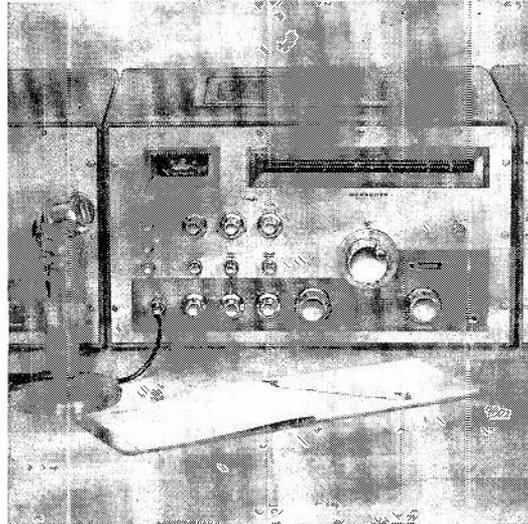
**MONEY BACK GUARANTEE**  
The Heath Company unconditionally guarantees that you can build any Heathkit product and that it will perform in accordance with our published specifications, by simply following and completing our check-by-step instructions, or your purchase price will be cheerfully refunded.



**WORLD-WIDE REACH!  
SHORT WAVE RECEIVER**

Covers 550 kc to 30 mc in four bands. Illuminated 7" slide-rule dial & meter. Versatile controls for top reception. "Velvet touch" tuning. Easy circuit board assembly. Beige & aqua color. 9 lbs.

Kit GR-91...no money down, \$5 mo.....**\$39.95**



**NEW! FIRST COMPLETE FILTER-TYPE  
SSB TRANSMITTER IN KIT FORM!**

Another Heathkit first! Every desired SSB feature at half price. Send for full specifications and compare for yourself! Operates 80 through 10 meters with out-of-band coverage for MARS operation. 180 watts PEP—SSB & CW, 75 watts AM. Parallel 6146's in final. All power supplies built-in. Unique simplified alignment procedure!

Kit HX-10 SSB TRANSMITTER...92 lbs... no money down, as low as \$22 mo.**\$334.95**



**NEW CITIZEN'S BAND TRANSCEIVERS**

New high-efficiency transmitter. 3-crystal controlled transmitting channels; single crystal or variable receiver tuning. Adjustable squelch, automatic noise limiter. Press-to-talk mic. Signal meter. 13 lbs.

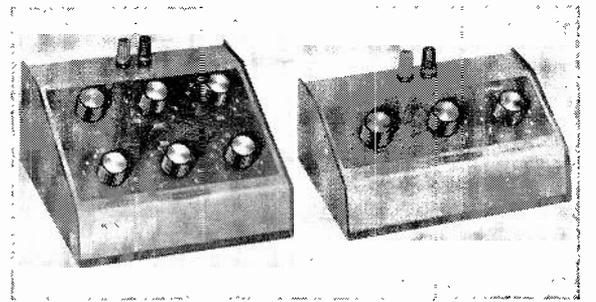
Kit GW-11... specify AC or DC...  
no money down, \$7 mo.....ea. **\$69.95**



**POCKET SIZE  
"WALKIE TALKIE"**

4-transistor; crystal-controlled. Range 1 mile Easy circuit board assembly. 2 lbs.

Kit GW-31 ea. **\$24.95**



**RESISTANCE & CAPACITOR DECADES**

Provide precision resistor values from 1 ohm to 999,999 ohms in one ohm steps, at 1/2 of 1% accuracy... capacitor values from 100 mmfd to 0.111 mfd in 100 mmf steps.

Kit IN-11...6 decade resistance kit...4 lbs....  
no money down, \$5 mo.....**\$24.95**  
Kit IN-21...3 decade capacitor kit...3 lbs.....**\$17.95**

**kits, better guarantee, easier terms**

*Don't wait to buy the kit you need!  
Heathkit's easy terms let you  
enjoy it while you pay!*

No need for cash. Beginners, enthusiastic amateurs and dedicated professionals will find kits to meet their needs... and pocketbooks. Here is tremendous quality at the lowest possible cost PLUS new relaxed credit terms. You can purchase any kit from \$25 to \$600 with no down payment and take up to 18 months to pay. What's more, when you purchase the kit of your choice, you purchase with confidence, with the sure knowledge that it will outperform any competitively priced product. Enjoy it today... pay for it tomorrow. Remember, no money down and up to 18 months to pay. With a Heathkit every dollar invested gives double enjoyment, double value!

**HEATH COMPANY**  
Benton Harbor 20, Michigan



Yes, send me my free 1962 Heathkit catalog

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

Order direct by mail or see your Heathkit dealer.

Ship  Parcel Post  Express  C.O.D.  Best Way

Ordering instructions: Fill out the order blank. 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. Dealer and export prices slightly higher.

ITEM	MODEL NO.	PRICE

**Free Catalog!**



Send in today for your free 100-page catalog. Over 250 kits (more than 40 are new) in this most complete catalog of kits. Every piece is top quality... save up to 50%. Get a catalog now and receive 1962 Heathkit supplements.

*This Christmas Give a Heathgift... from the World's Shopping Center for Electronic Kits*

# Spice-Can Audio Mixer

By JAMES A. FRED

THOSE spice cans in your wife's kitchen cabinet make handy containers for housing small electronic gadgets. You will also find other small cans such as bandage cans, 35-mm film cans, food containers around the home and shop.

I had been intending to make a two-input, one-output audio mixer for several years, but never seemed able to find volume controls small enough to fit into the real small spice cans. When I learned that Mallory had introduced a type MLC carbon control that was only 1/2 inch in diameter, I knew that it was time to build the audio mixer.

An audio mixer of this type is especially useful with an amplifier that only has one input jack. The mixer described will accept two signals, one from a microphone and a record player. Or one signal from a microphone and one from an electric guitar. For that matter, practically any two signals can be fed into the mixer where individual volume controls allow independent control of their amplitude. Thus you could have a musical background and, when you want to make an announcement, you merely turn up the gain on the microphone input and the microphone will override the music. Used with a tape recorder you dub in your voice with a musical background.

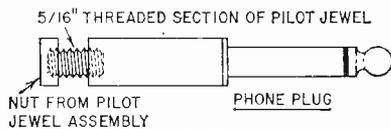


Fig. 1

The first thing to do is to assemble the necessary parts. If your wife has saved a spice can for you, you are ready, but if she hasn't look through her stock and find one that is nearly empty. You can buy her a replacement on your next visit to the supermarket. I used phono jacks for the inputs and used a head-phone plug for the output. You should use whatever type plugs and jacks fit your particular equipment.

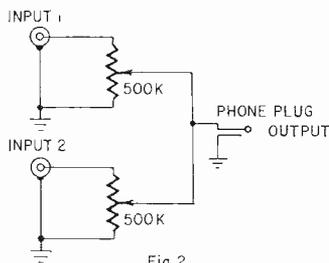


Fig. 2

The phone plug needed a modification and a small threaded addition to make it work. The phone plug is a Mallory type 85 miniature plug with an aluminum barrel. Modify it by cutting off 5/16 inch from the threaded end of the barrel. Then take a glass jewel assem-

bly from a Dialco pilot-light assembly and cut 5/16 inch of the threaded portion off it. Screw this threaded portion into the short piece you cut off the barrel. Insert the threaded part of this assembly through the hole in the spice-can lid and screw on the hex nut that was part of the pilot-light assembly (Fig. 1).

Several circuits can be used. Two are shown that are quite different in action. The first (Fig. 2) is better if your inputs have equal amplitude. The other (Fig. 3) is preferable if you are using a high-output phonograph and a low-output microphone.

Make the holes in the spice can be-

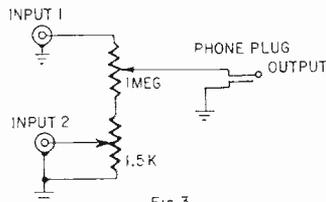
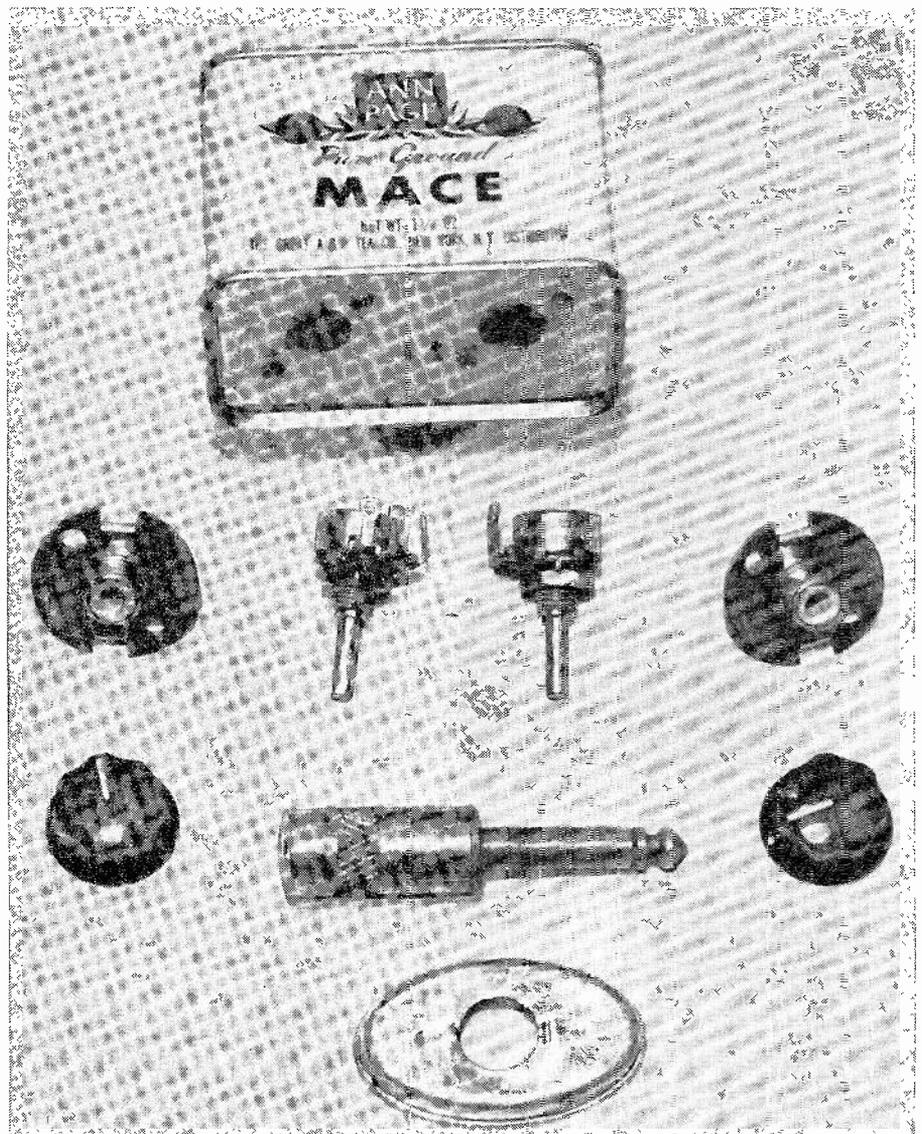


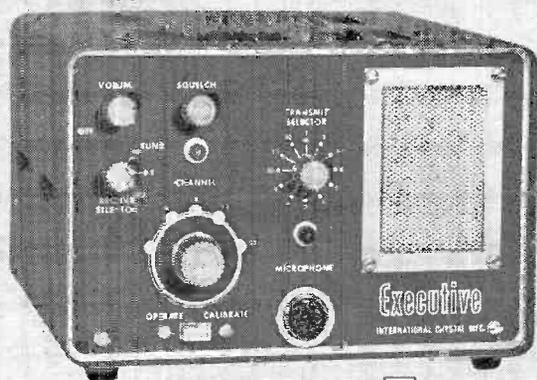
Fig. 3



fore painting it to cover up the advertising on the can. Mount the parts before the wiring is started. The input jacks and volume controls can be wired through the lid opening. The leads are very short so it won't be necessary to use any shielded wire. Short wires are left sticking out through the lid opening and are soldered to the output plug, and the lid is then pushed on. Now paint, apply decals or other printing and the audio mixer is ready to use. END



INTERNATIONAL'S **Executive** MODEL 100



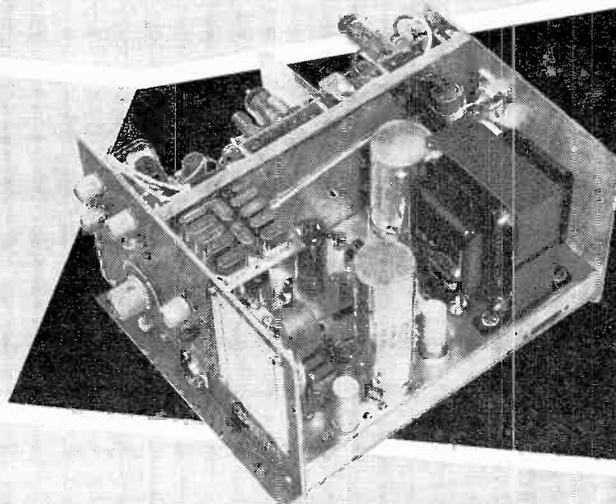
# citizens band transceiver

A precision engineered transceiver for Citizens Band licensees seeking outstanding design and performance. Tunable dual conversion superheterodyne receiver covering all 23 channels. Two crystal control receive positions. Push-to-talk operation. Three way power supply for 6/12 vdc and 115 vac. Five watts plate input. Certified tolerance  $\pm .005\%$ . Size 5½" x 8½" x 9" deep.

Complete with 1 transmit crystal, 1 receive crystal, new style ceramic microphone and coil cord..... \$199.50

**Advanced engineering featured in the Executive Model 100**

- NEW crystal filter minimizes adjacent channel interference.
- NEW built-in calibration circuit.
- NEW International NR squelch.
- NEW 12 position crystal control transmit channel selector.
- NEW front panel microphone jack.
- NEW provision for connecting external speaker and S/meter.



**FREE** INTERNATIONAL'S 1962 CATALOG

Your buying guide for precision radio crystals and quality electronic equipment. Complete data on International's Citizens Band transceivers and accessories.

Send for it TODAY!



International Crystal Mfg. Co., Inc.  
18 North Lee, Oklahoma City, Okla.

Rush FREE 1962 Catalog RE2

Name \_\_\_\_\_  
Please print

Address \_\_\_\_\_

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

**INTERNATIONAL Crystal Manufacturing Co., Inc. • 18 North Lee • Oklahoma City, Okla.**

# INDUSTRIAL ELECTRONIC DICTIONARY

From pulsation welding to  
register control

By ED BUKSTEIN

**Pulsation welding:** A form of resistance welding in which the power is alternately applied and disconnected. During the off intervals, the electrodes dissipate heat into the surrounding air but the useful heat at the junction of the metals to be welded remains practically un-

diminished. This technique avoids overheating the electrodes and prevents them from becoming welded to the work.

**Pulse equalizer:** A circuit that produces output pulses of uniform size and shape in response to input pulses which may vary in size and shape. The one-shot multivibrator is often used for this purpose.

**Pulse resolution:** The minimum time separation between input pulses that will permit a circuit or component to respond properly. Many circuits will not respond to a second input pulse until the circuit has recovered from the effect of the first input pulse. This recovery time (pulse resolution) is usually specified in microseconds ( $\mu\text{sec}$ ) or millimicroseconds ( $m\mu\text{sec}$ ).

**Pyrometer:** A temperature-measuring instrument. (See Photoelectric pyrometer.)

**Radio-frequency heating:** The process of heating a substance by exposing it to a field of high-frequency energy. When the material to be heated is a conductor of electricity (a bar of metal, for ex-

ample), *induction heating* is used. As shown in Fig. 24, the metal to be heated is placed in a coil connected to a high-power rf oscillator. The rapidly alternating magnetic field established in the coil induces eddy currents in the metal to be heated. These currents flowing through the resistance of the metal produce power losses and raise the temperature of the metal. Induction heating is used industrially to solder lids on metal containers, dry paint on metal surfaces, detonate explosive rivets, etc.

At higher radio frequencies, the induced currents tend to flow on the surface of the metal (skin effect), causing the surface to heat while the interior remains relatively cool. This technique is used to surface-harden gears, cams, blades, etc. Compared to conventional heating methods, induction heating has the advantage of being easily and accurately controllable both in terms of temperature and localization of heat.

When the material to be heated is a nonconductor (rubber or plastic, for example), *dielectric heating* is used. As shown in Fig. 24, the material to be heated is placed between a pair of metal

## What's Your EQ? January Solutions

### Zenith 17B20

The FRINGE-LOCK control, a 5-meg unit in first and second grids of 6BU8 noise-clipper/age, open. This allowed the sync clipper section of this tube to run wild. Figs. 1 and 2 show the pulses

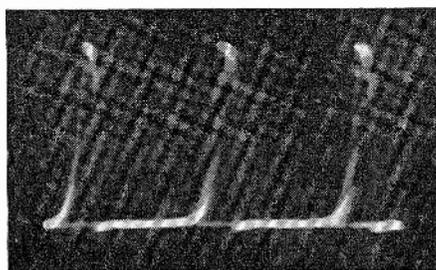


Fig. 1—Horizontal pulses from flyback, found on plate, pin 2 of 6CN7 horizontal afc.

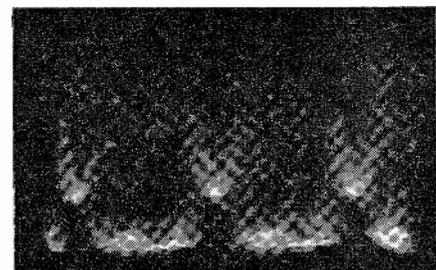
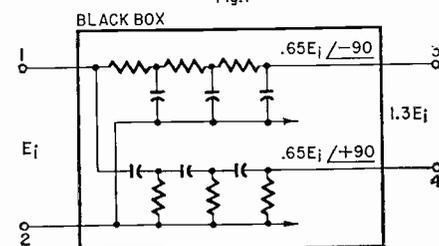
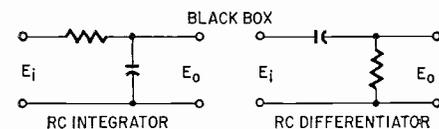


Fig. 2—Blurry mess found on pin 3, cathode, of 6CN7. After repair, this looked like Fig. 2, but 180° out of phase, of course.

found on the plate (pin 2) and cathode (pin 3) of the 6CN7 afc. The pulses from the horizontal discharge tube on pin 2 are OK, but the pulses from the 6BU8 are quite a mess. Replace control.

### High Output Black Box

The gain through a simple, unloaded R-C integrator or differentiator (Fig. 1) varies with the phase shift through the network. It varies with the cosine of the phase angle, being 1 at 0°, 0.866 at 30°, 0.500 at 60° and 0 at 90°. If two or more units with the same phase shift are cascaded, and the impedance of connected networks so chosen that they do not load one another, the phase shift through the cascaded networks is the sum of the individual phase shifts



and the network gain is the product of the gains of the individual networks. Therefore, a "Black Box" can be connected as in Fig. 2 to obtain a voltage approximately 1.3 times the input voltage at the frequency for which it is designed. The three 30° sections cascaded have a total phase shift of 90° and an overall gain of 0.866°, or approximately 0.65. (The theoretical maximum gain of such a network is 2.) Such "amplifying" R-C networks may be used to construct cathode-follower oscillators."

### Puzzle in fours

Since the sum of the power dissipated by all three resistors must equal the total power supplied:

$$IE_1 + P_2 + R_3I^2 = P_T$$

Since  $E_1$  is equal to 4, as is  $R_3$ , we substitute and rearrange:

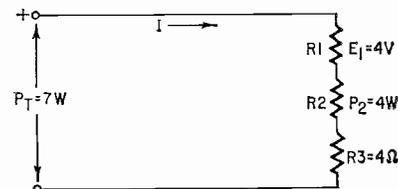
$$4I^2 + 4I + 4 = 7$$

$$\text{or: } 4I^2 + 4I - 3 = 0$$

Solving the quadratic:

$$(2I + 3)(2I - 1) = 0$$

Equating each factor to zero, we have



or  $2I + 3 = 0$  and  $2I - 1 = 0$   
then:  $2I = -3$        $2I = 1$   
and  $I = -3/2$        $I = 1/2$  amp

The negative current has no meaning to us in this problem, so we use  $1/2$  ampere, and find that it gives correct results.  $R_1$  equals 8 ohms and  $R_2$  equals 16 ohms.

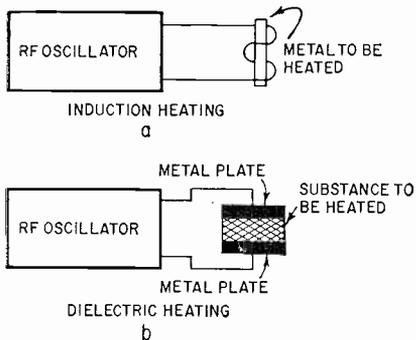


Fig. 24—Rf energy is used for heating metals (a) and nonconductors (b).

plates connected to an rf oscillator. The material to be heated becomes the dielectric of a capacitor, and dielectric losses produce a temperature increase. This technique is used to bond plywood, cure rubber and soften plastics for molding operations.

**Radiography:** The process of obtaining an X-ray photograph. The object to be examined is placed between the X-ray tube and a sheet of photographic film. After penetrating the specimen in proportion to its density, the X-rays expose the film. When developed, the film shows a shadowlike picture of the internal structure of the specimen. Radiographic inspection is used industrially to inspect welded joints, locate internal flaws and air bubbles in metal castings, check alignment of internal components of complex assemblies, etc. When inspection speed is more important than fine detail and resolution, a fluorescent screen may be used instead of the film. This technique is known as *fluoroscopy*.

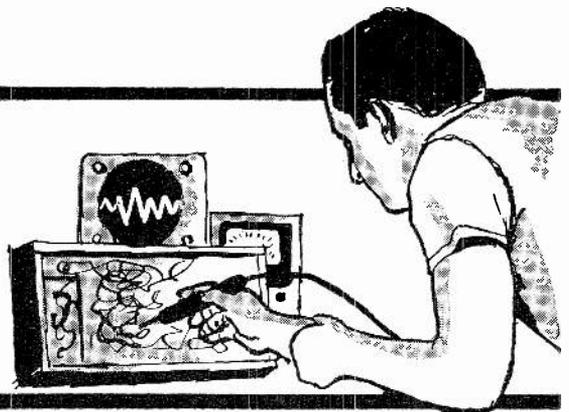
**Register:** (1) An electromechanical counter consisting of a set of numbered discs similar to those used to indicate automobile mileage. Each input pulse to the register energizes a solenoid which provides the mechanical force to advance the numbered discs. The register is widely used for product counting and packaging. In these applications, a moving part of the machine closes a switch (once for each operation), and the switch completes the circuit to the register solenoid. For counting objects moving along on a conveyor belt or assembly line, a photo-relay circuit activates the register as each object passes through a light beam.

(2) In computer terminology, a register is a circuit used to store a number while that number is being used in a calculation. Since the numbers are usually expressed in binary notation (a succession of ones and zeros), the register commonly consists of a number of flip-flop stages. Some of the stages are *on* to represent the ones of the binary system, and the other stages are *off* to represent the zeros.

**Register control:** A system of circuits and mechanical components used to control the relative position of a strip of material (paper, cloth, metal, etc.) with respect to the active parts of the machine through which the strip is passing. (See Photoelectric register control.)

TO BE CONTINUED

## SERVICE CLINIC



Conducted by  
**JACK DARR**  
SERVICE EDITOR

This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV. Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it.

THE AVERAGE TV TECHNICIAN HAS ONE very useful test instrument in his shop that doesn't get nearly as much wear and tear as it should. It will furnish a lot of very useful information about lots of circuits, if used when it should be. This is the milliammeter section of the shop's vom.

The typical shop vom is a pretty accurate instrument, or ought to be, usually with a 50- $\mu$ a 250-mv basic meter movement. This gives us a voltmeter with 20,000-ohms-per-volt resistance.

Current ranges, which is what we're interested in, run from 50  $\mu$ a up to 10 amperes. One typical unit has the following scales: 0 to 50  $\mu$ a, 1 ma, 10 ma, 100 ma, 1,000 ma, and 10 amperes. This covers about any reading you will need.

### Using the milliammeter

What can we do with one of these? Quite a lot. For instance, one of the most important readings in a TV set is the cathode current of the horizontal output tube. By opening the cathode circuit and connecting the 500-ma vom scale in series with it, we can check the current to see if the new tube we just put in is going to last.

For instance, the 'BQ6 series should never draw more than 110 ma. Normal current should run from 70 to 100 ma. If you find the tube pulling about 120 ma, you can expect a callback at this address within 3 weeks. Correct currents for any other similar tube can be found in the tube manuals.

In stacked-B circuits, a milliammeter can often help locate those obscure defects that drive you mad. If voltages are all off, break the circuit at the audio tube cathode, or any other "source" of the low half, and measure the current there. There are two basic causes for low voltages—low supply

voltages and overloads caused by something in the lower half drawing excessive currents. Hanging the milliammeter there will show whether the low voltage is caused by an overload.

To get normal current, pick some resistor in the circuit and calculate the current through it by Ohm's law. There is usually a small dropping or filter resistor somewhere in or around one of these circuits. For example, a cathode resistor in the audio tube's bias circuit. If it is about 500 ohms and has a 10-volt drop across it, current flow is 20 ma.

One item that seems to bug technicians is the little transistor radio. A milliammeter can be a big help when servicing these little monsters. Hook it in series with the battery and check the total current drain. This will give you a lot of helpful information in a hurry. If the current is lower than it ought to be, you've got a weak battery, incorrect bias on an audio transistor, open filter capacitor, etc. Too much current could mean a leaky filter capacitor, shorted transistor, incorrect bias on audio transistors, etc.

Hybrid and all-transistor auto radios are also easier to service with a current meter. If the fuse is blown, connect the 10-ampere scale of the meter in its place and turn the set on. If there's a short, it'll tell you right away. Be ready to turn the radio off in a hurry if that meter pointer seems headed for outer space. If there is something else wrong, such as an open transistor, open audio transformer, burned bias resistor, bias adjustment potentiometer set wrong and the like, current checks will tell you that, too. When replacing a power transistor, use the current meter to set the collector current of the new transistor at the correct value. Wrong operating currents will cause premature failure.

Blown B-plus fuses in TV sets can be checked by connecting the milliammeter in place of the fuse and reading the actual current. This is especially valuable if you suspect some kind of intermittent short in some of the power supply circuits. Set the meter on a scale high enough to prevent meter damage if a sudden short does show up. After you know it's safe, you can drop down to the 100-ma scale and read the exact value of the current.

After you accustom yourself to the idea of reading currents instead of voltages in certain circuits, you'll find that new uses for this section of the vom will suggest themselves all the time.

### Stacked-B trouble

*I have a DuMont RA-165 for repair. The picture is snowy and the sound is distorted on all stations. The contrast control must be fully advanced.*

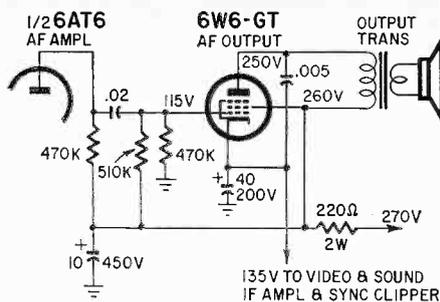


Fig. 1—Stacked B-supply of a DuMont RA-165.

*The 135-volt line is too high and the 270-volt line is too low.—J. S., Queens, N. Y.*

This could be a voltage distribution problem, quite common in some sets with stacked-B circuits. This set takes the video if, part of the tuner and several other voltages from the

audio stage (Fig. 1). The 150-volt line begins at the cathode of the 6W6 and supplies a lot of other things in the set.

Shorts in the 6W6 can burn up the 220-ohm 2-watt resistor in the 270-volt line, upsetting the voltages. Normal resistor drift can upset the voltage divider in the grid of the 6W6—the 510,000 and 470,000-ohm resistors in series to ground, with the control grid tied to the tap. If the 470,000-ohm resistor to ground opens or if its resistance increases, the plate current flow of the 6W6 (which is the main factor in determining what the cathode voltage shall be) changes accordingly, and all the stages supplied by the 135-volt line are upset.

### Snowy picture

*A very snowy picture appears on the screen of a Westinghouse V-2313-25 chassis. Tubes are all good, plenty of signal from antenna, but I can't get it*

**GUARANTEED FM AND  
FM STEREO RECEPTION  
FROM 200 MILES!**

# Winegard STEREO-TRON

World's Most Powerful FM Antenna!

**NEW ELECTRONIC FM ANTENNA FOR LONG DISTANCE FM AND STEREO!** Now Winegard Guarantees unexcelled FM performance with the new Winegard electronic Stereo-Tron. Actually **GUARANTEES** your customer will receive 85% of all FM stations in a 200 miles radius over normal terrain with a rotor. Built in transistor amplifies signals, really gets L-O-N-G distance reception. Opens a new field of opportunity in the fast growing FM and FM stereo market.

**MODEL PF-8 FM STEREO-TRON YAGI—Gold Anodized!** This is the world's most powerful FM antenna. Because Multiplex requires an antenna with greater sensitivity and gain to offset the power loss of the carrier and subcarrier, Winegard's PF-8 is the best antenna you can install for Multiplex. When you hook up a PF-8, weak signals come in like "locals." Recommended for use where signals are under 10,000 microvolts. For strong signal areas, same antenna without amplifier, Model FM-8, is recommended.

The PF-8 has a minimum gain of 26 DB over a folded dipole with a flat frequency response of  $\pm 1/4$  DB from 88 to 108 m.c. It features a built-in TV-FM coupler and has eight elements with **EXCLUSIVE "TAPERED T"** driven element engineered

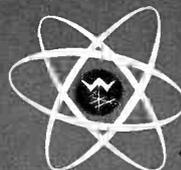
to perfectly match the powerful transistor, direct coupled, built-in amplifier. It is available two ways—Model PF-8 for 300 ohm twin lead or Model PF-8C for 75 ohm coax.

### Important Features of Winegard Electronic FM Antennas

1. Transistor amplifier is designed as part of the "Tapered T" driven element (model PF-8) for unprecedented efficiency and signal-to-noise ratio.
2. At no extra charge, built-in FM-TV coupler allows you to use one power supply and down lead when used with a WINEGARD POWERTRON TV antenna.
3. Beautiful gold anodized permanent finish—100% corrosion proofed—all hardware irridized. This is the finest finish of any antenna—has richest appearance—meets U.S. Navy specifications.
4. The quality of craftsmanship and fine materials in these antennas tell their own story—perfect mechanical balance—100 m.p.h. wind tested.

Winegard makes a complete line of FM antennas. Write for information and spec. sheets. Also get **FREE**, Station Log and FM map of U.S.

**MODEL PF-4 FM ELECTRONIC TURNSTILE**  
Gold Anodized! Non-directional FM antenna with 16 DB gain in all directions over a folded dipole. Has Winegard offset mount and transistor amplifier with TV-FM coupler. Also available without amplifier, Model FM-3T.



# Winegard

**ANTENNA SYSTEMS**

3013-2D Kirkwood Avenue, Burlington, Iowa

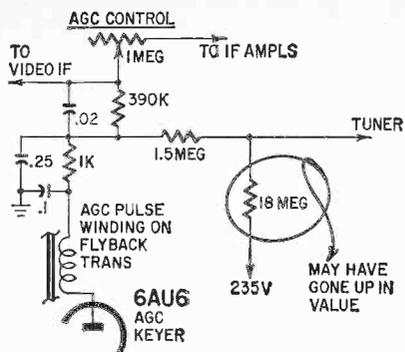


Fig. 2—The 18-megohm resistor often increases in value.

to clear up. The agc control doesn't have the right action—very little effect on the picture.—R. E., Poteau, Okla.

This is agc trouble. If you check the agc line, you'll probably find that it is pretty low compared to what you

should have with a good signal. Check out the resistors and capacitors in the agc network, especially the 18-megohm resistor which furnishes the agc buckling voltage (Fig. 2). They have a bad habit of increasing to about 25–30 megohms, which is not enough to let the set block but make it very snowy.

### Replacing 12WP4 tube

What cathode-ray tube would be suitable to replace a 12WP4 in a Philco 51-PT-1207? A 12- or 14-inch round or rectangular tube will do.—C. C., Lincoln, Neb.

Philco representatives say it is not practical to use any other picture tube as a replacement for the 12WP4. This is a special type tube with a non-standard base and a thin neck that requires a special deflection yoke and associated assembly. A standard tube cannot be fitted into the existing assembly.

Circuits in Philco sets using this tube develop only about *one-fourth* the power required for standard tubes, and the boosted B-plus voltage is only about 225—one-third to one-half less than that developed by sets using standard 12-inch tubes. Thus, in addition to mechanical alterations, you will have to redesign the horizontal and vertical deflection circuits to operate from a higher B-voltage and to supply the additional deflection power needed by other 12-inch and larger tubes. Many of the set's other components would probably have to be changed to insure proper operation and freedom from breakdown.

Considering all of these factors, the cost of converting the set to use a standard 12-inch tube would probably be more than what it would cost you to go out and buy a new 12AWP4—available at Philco distributors for around \$65. END

**NEXT BEST THING TO THE WINEGARD ELECTRONIC POWERTRON TV ANTENNA**

# NEW TRANSISTOR TV-FM WINEGARD TENNA-BOOST

**MOUNTS ON ANY ANTENNA**

MOUNTS ON ANTENNA



Model MA-300

only **\$34.95** LIST

### INSTALL IT... FORGET IT!

ALL ELECTRIC, ALL-AC POWER SUPPLY costs less than 27c a year to operate. Many exclusive features.

No costly, nuisance batteries!



Built-in two set coupler.



• Polarity Control Switch



AC outlet on power supply.



## 19 DB GAIN! CUTS SNOW...BOOSTS SIGNAL!

Now you can make any TV or FM antenna work better by magnifying signals with the new Winegard transistor Tenna-Boost.

Tenna-Boost has up to 19 DB gain, no peaks and valleys. Ultra low noise. Linear frequency response. VSWR input better than 1.5:1 across all frequencies. Output VSWR 1.8:1 or better. This fine frequency response plus the very low VSWR make Tenna-Boost excellent for color.

Winegard's exclusive input band-pass filter eliminates interference from citizen's band, Hams, garage door openers, etc. Only TV and FM signals are amplified.

All metal parts are anodized, irridized or stainless steel. Completely weather-proof, trouble-free. Install it... forget it.

There's a big difference in antenna amplifiers! Ask your distributor or write for technical bulletin.

FOR THE ULTIMATE IN TV RECEPTION

Winegard Transistorized Electronic Powertron TV Antennas. 3 Models to Choose From.



# Winegard

ANTENNA SYSTEMS

3013-28 Kirkwood • Burlington, Iowa

# selective calling for

# CB

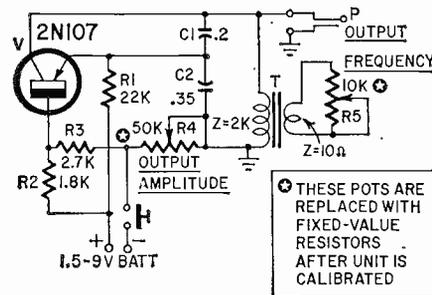
Don't monitor the  
channel. Let an alarm  
tell you when you're  
being called

By GEORGE DE SALVO

This article describes the operation, construction and calibration of a device designed to improve the reliability of communications on the Citizens band. The system consists of two units—one at the receiving station and one at the transmitting station. The unit used at the called (receiving station) triggers a signaling device to alert the called station when a special signal is received. The system is simple to build and calibrate, noncritical in tuning and has been proved reliable during 6 months of operation.

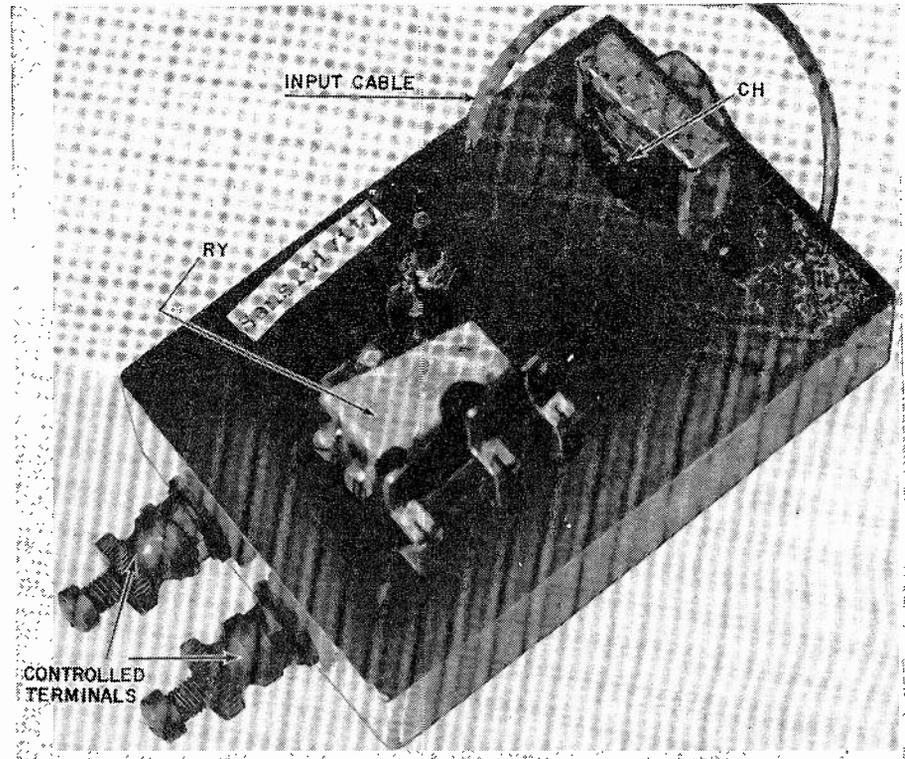
Conditions on today's Citizens band are becoming more and more crowded and difficult. It is estimated that by the end of 1962 there will be more than 800,000 licensed stations. What this congestion will do to decrease the reliability of contacts is already evident in large metropolitan areas. A strong nearby station operating on an adjacent channel can easily drown out an important call on the monitored channel. If the operator is not listening carefully, the message goes unnoticed. This is especially significant to the many commercial CB users. We will describe a device which will partially solve these problems. It can be built for about \$15.

The idea behind the system is very simple. The calling transmitter sends a tone over the air on the channel monitored. The monitoring receiver is



- R1—22,000 ohms
- R2—1,800 ohms
- R3—2,700 ohms
- R4—pot, 50,000 ohms (see text)
- R5—pot, 10,000 ohms (see text)
- All resistors 10%, 1/4 watt or higher
- C1—0.2  $\mu$ f, miniature ceramic, 9 volts or higher
- C2—0.35  $\mu$ f, miniature ceramic, 9 volts or higher
- BATT—1.5-9 volts (see text)
- P—phone plug
- S—spst pushbutton switch
- T—audio transformer: primary, 2,000 ohms; secondary, 10 ohms (Lafayette TR-93 or equivalent)
- V—2N107
- Miscellaneous hardware

Fig. 1—The coder unit is a simple 1-transistor oscillator.

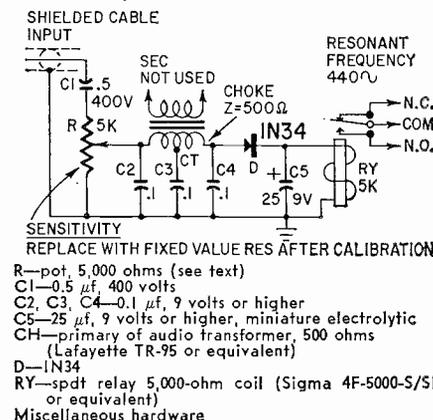


Top view of the decoder.

equipped with a filter system which attenuates all signal components except for the transmitted tone. This tone actuates a relay which signals the operator that a call is coming thru for him alone. This method has several advantages. First, only a message directed toward the particular receiver is heard. This

eliminates the annoyance of having to listen to the conversation of other users. Second, the tone is easier to distinguish than a voice call when buried in noise and other conversations. When coupled to the decoder, a key tone as little as 2 db above the background noise is enough to alert the receiving operator. Third, when used on the radio-control channels, as much as 25 watts input can be used for signaling. This will really get through the 5-watt noise and extend the signaling range. The users can then switch to a clear channel for voice communication.

Fig. 2—The decoder is a tuned filter and a relay.



- R—pot, 5,000 ohms (see text)
- C1—0.5  $\mu$ f, 400 volts
- C2, C3, C4—0.1  $\mu$ f, 9 volts or higher
- C5—25  $\mu$ f, 9 volts or higher, miniature electrolytic
- CH—primary of audio transformer, 500 ohms (Lafayette TR-95 or equivalent)
- D—IN34
- RY—spdt relay 5,000-ohm coil (Sigma 4F-5000-S/51L or equivalent)
- Miscellaneous hardware

## How the circuit works

The system itself consists of two units. The coder, actually a tone generator, is used at the transmitter. A decoder, actually a filter, demodulator, and relay combination, is used at the receiver.

The choice of the triggering tone must be left to the individual constructor. We chose 440 cycles. This frequency was chosen because it is a widely used standard and tests for frequency devi-

# how will your success in electronics compare with this man's?

*Will you have a rewarding career,  
like Robert T. Blanks? Or will you  
never get beyond a routine job?*

It's up to you.

**LET'S LOOK AT THE FACTS.** There's something wonderful about understanding how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men.* In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

**ADVANCED TECHNICAL KNOWLEDGE IS THE KEY** to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

**CREI OFFERS YOU**, for study at home, a complete program in electronic engineering technology designed to prepare you for a rewarding, well-paying career in electronics. CREI equips you with a practical working knowledge of advanced and up-to-date electronic developments that will put you on the level of specialization where men are most in demand.

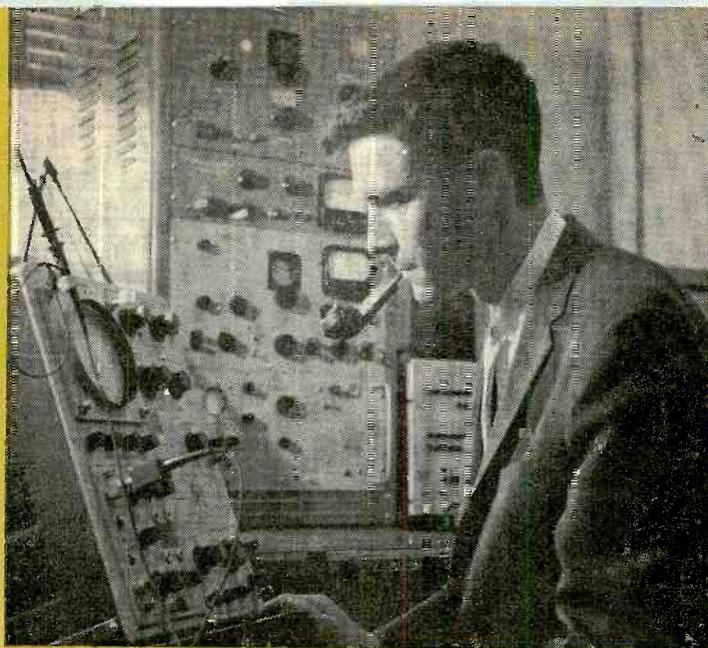
**CREI MEN LIKE ROBERT T. BLANKS** hold positions as associate engineers, engineering aides, field engineers, project engineers and technical representatives. They work in every area of electronics, from manufacturing to research.

**WHEN YOU ENROLL IN A CREI HOME STUDY PROGRAM**, you study courses to which a number of today's leading engineers and scientists have made substantial contributions. You are guided and assisted by CREI's staff of experienced instructors. You study texts that are specifically prepared for home study use.

Through CREI, you have a choice of programs covering every field of electronics:

**RADAR • COMPUTERS • SERVOMECHANISMS • INSTRUMENTATION • AERONAUTICAL AND NAVIGATIONAL • COMMUNICATIONS • TELEVISION • AUTOMATION AND INDUSTRIAL ENGINEERING TECHNOLOGY • NUCLEAR ENGINEERING TECHNOLOGY**

Programs are available for men, such as engineers, who already have extensive technical knowledge, as well as for men with limited technical training or experience.



*A CREI Home Study Program helped Robert T. Blanks become an Electronics Engineer. Blanks is employed by the Research and Study Division, Vitro Laboratories, Silver Spring, Md. Division of Vitro Corporation of America.*

**THE HIGH CALIBRE OF A CREI HOME STUDY EDUCATION** is attested to by America's biggest corporations, where CREI students and alumni attain positions ranging from engineering technicians to engineers to top officials. Such companies are National Broadcasting Company, Pan American Airways, Federal Electric Corporation, The Martin Company, Northwest Telephone Company, Mackay Radio, Florida Power and Light and many others. They not only recognize CREI Home Study educational qualifications but often pay all or part of CREI tuition for their employees.

**CREI HOME STUDY PROGRAMS** are the product of 35 years of experience; CREI was among the first to have its curricula accredited by the Engineers' Council for Professional Development. Each program has been developed with the same painstaking skill and care that CREI put into its electronics courses for the Army Signal Corps, its special radio technician courses for the Navy, and its group training programs for leading aviation and electronics companies. For those who can attend classes in person, CREI maintains a Residence School in Washington, D. C.

**YOU CAN QUALIFY**, for a CREI Program, if you have basic knowledge of radio or electronics and are a high school graduate or the equivalent. If you meet these qualifications, write for **FREE 58-page book** describing CREI Programs and career opportunities in advanced electronic engineering technology. Use coupon below, or write to: The Capitol Radio Engineering Institute, Dept. 1402-K, 3224 Sixteenth St., N. W., Washington 10, D. C.

Mail coupon today for **FREE 58-page book**



## THE CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula—*Founded 1927*  
Dept. 1402-K, 3224 Sixteenth St., N. W.,  
Washington 10, D. C.

Please send me details of CREI Home Study Programs and Free Book, "Your Future in Electronics and Nuclear Engineering Technology." My qualifications are noted to obtain immediate service.



### CHECK FIELD OF GREATEST INTEREST:

- |   |  |
|---|--|
| <input type="checkbox"/> Electronic Engineering Technology            | <input type="checkbox"/> Automation and Industrial Electronic Engineering Technology |
| <input type="checkbox"/> Servo and Computer Engineering Technology    | <input type="checkbox"/> Nuclear Engineering Technology                              |
| <input type="checkbox"/> Aero and Navigational Engineering Technology |  |

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

Address .....

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

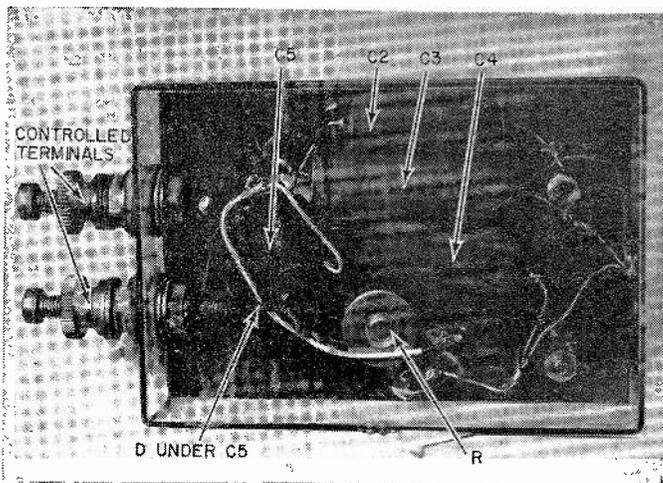
Employed by .....

Type of present work .....

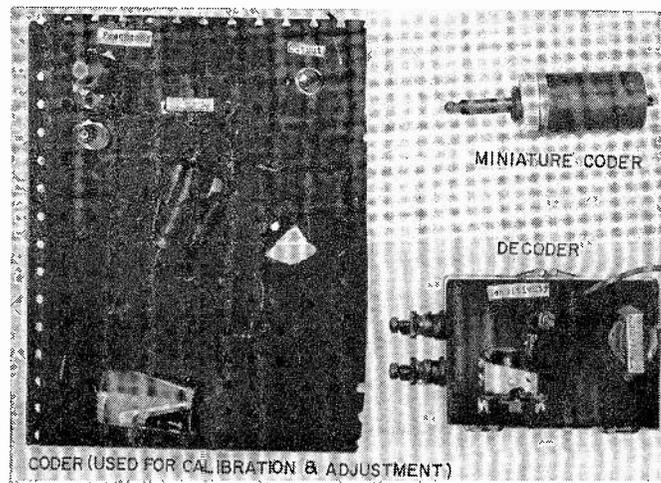
Education: Years High School ..... Other .....

Electronics Experience .....

Check:  Home Study  Residence School  G.I. Bill #21



Underchassis of the decoder. Note that this unit is built into a plastic case.



The complete system.

ation and drift can be carried out with a high degree of accuracy.

The coder consists of a simple Colpitts sine-wave oscillator with modifications. Its frequency is determined by tank circuit T, C1 and C2. (Fig. 1). T is a transistor type audio output transformer. When its secondary is open, the frequency of oscillation is

$$f = \frac{1}{2\pi L \sqrt{C_1 C_2 / (C_1 + C_2)}}$$

when L is the inductance of the primary of T. However with the inclusion of R5 the frequency can be varied over a 2-to-1 range and set. This is possible because the resistor loads the transformer, effectively changing the inductance of the primary. R4 controls the output amplitude. The other resistors bias the transistor for proper operation. The battery can be between 1.5 and 9 volts, depending on the output required. Transistor V can be any p-n-p unit which can take 9 volts collector-to-emitter and has a beta ( $\beta$ ) of 10 or better. All values shown are for a resonant frequency of 440 cycles. The circuit is quite stable and did not drift more than 1 cycle from 32° to 120° F (the limits of our test).

The decoder consists of double-pi network filter followed by a half-wave demodulator (rectifier) coupled to a high-impedance relay (Fig. 2). Capacitor C1 blocks the dc from the plate circuit and passes the signal to choke CH, which is the 500-ohm center-tapped primary of a transistor output transformer. Its secondary is left open. C2, C3 and C4 tune this winding to a res-

onant frequency (in our case 440 cycles). Diode D and C5 form a half-wave peak rectifier that provides a dc output to drive the sensitive relay—a 10-mw Advance unit with a 4,000-ohm coil. However, any high-impedance relay with 10-mw sensitivity is suitable. The contacts can be used to sound a buzzer or other signaling device.

### Alignment and calibration

Alignment is simple if both the coder and decoder are constructed to resonate at approximately the same frequency. Use a dummy load for your transmitter during this procedure. First we must set the resonant frequencies exactly. This is done by tuning the coder to match the decoder. There are two ways to do this. The first requires no instruments other than a voltmeter and can be completed easily and quickly.

Plug the coder into the mike jack of your CB transmitter. Connect the decoder to the plate of the audio power amplifier tube of the receiver as shown in Fig. 3. Set the coder's output amplitude control at maximum. Key the transmitter on.

Set the coder's frequency control at maximum resistance. Slowly turn up the sensitivity control of the decoder until the relay trips. If the resonant frequencies are reasonably matched, this should occur at approximately half rotation. Place a dc voltmeter across the relay coil and adjust the frequency control of the coder for maximum voltage. Then turn the decoder's sensitivity control back to zero and bring it up slowly as before. The relay should trip

at a lower setting than before. The frequency controls are now set. Lower the coder's amplitude control while raising the decoders sensitivity control. Adjust for maximum decoder sensitivity.

If a scope and audio generator are handy, a much more exact alignment is possible. Connect the scope's vertical input across the filter's output (across the relay coil) and set the signal generator at the frequency that produces maximum deflection on the scope (Fig. 4). This is the resonant frequency of the decoder's filter. Apply the signal from the coder's output into the horizontal plates of the scope. Adjust the coder frequency control until a slowly rotating ellipse is observed. The slower the better. Both coder and decoder are now matched.

Even if the circuits are designed perfectly from the standpoint of equations for resonance, one of the preceding methods must be used for optimum matching. This is because the components, particularly the transformers, may vary considerably from unit to unit or brand to brand.

A code frequency between 200 and 2,000 cycles should be used. They are easily passed by the audio circuits of the transceiver and are easily obtainable with standard components. We could have tabulated capacitor values to be used for a certain transformer for a set bandpass, but as mentioned previously component variation makes this futile.

The final model of the decoder was built into a small plastic box and the signal was taken through shielded

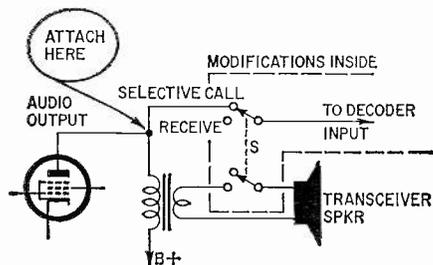


Fig. 3—How to connect the decoder into your CB receiver circuit.

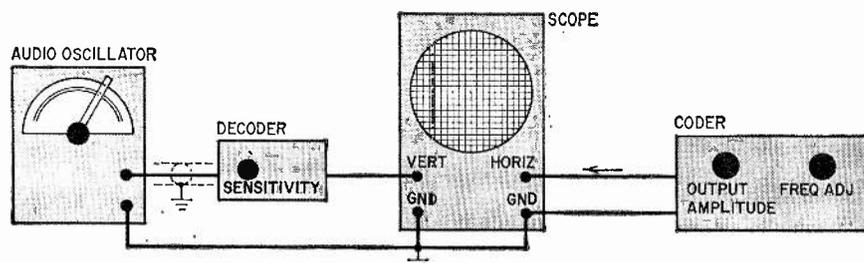


Fig. 4—Use this calibration setup to adjust your coder and decoder.

cable from the plate of the audio tube through a switch which chooses either connection to the speaker or to the decoder. We used a loud buzzer for a signaling device.

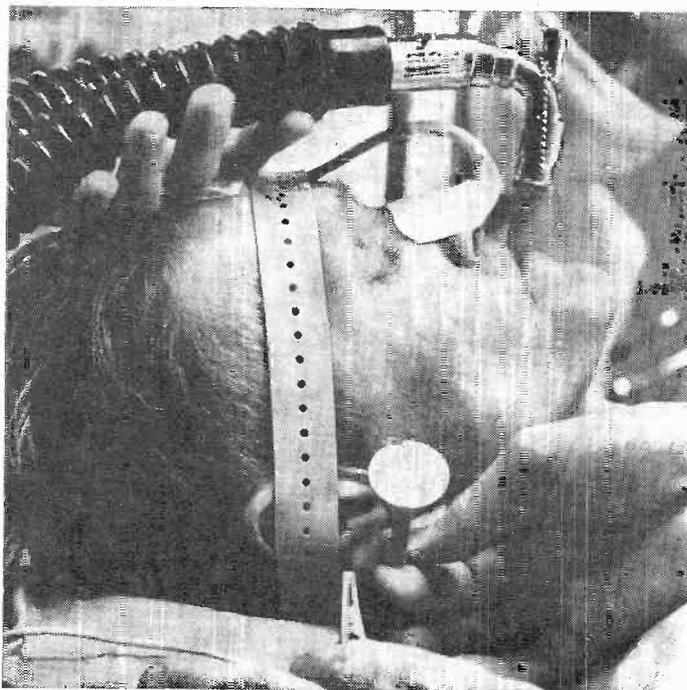
The coder was first built in a hay-wire fashion. It was then calibrated as indicated. Pot settings were noted, then replaced with fixed resistors. To reduce size, subminiature high-capacitance ceramic capacitors replaced the usual paper units. The mounting frame was removed from the transformer and the whole unit shrunk enough to fit in a small pill bottle which we terminated on one end in a phone plug and an on-off pushbutton switch on the other.

When you want to call a station equipped with a decoder, plug in the coder into the mike jack, key the transmitter and switch on the coder. The transmitter may be keyed with a signal that indicates what channel to use for voice communication or "Come home—soup's on." This reduces air time.

On the receiving side, the decoder's sensitivity is adjusted so that voice or noise does not trip the relay accidentally while even a weak key frequency tone will trigger the signal. A superhet receiver is needed to insure proper operation. It should also have some sort of squelch.

Either or both units have other uses too. The coder can act as an audio sine-wave generator or as a code-practice oscillator. The decoder could be used in any application where a tone-controlled response is required. **END**

## *electrical anesthesia*



Electrodes are placed against the head of a simulated patient in a demonstration of a new electric anesthesia technique being developed by Dr. James D. Hardy of the University of Mississippi Medical Center. The instant the 700-cycle current is turned on the patient becomes unconscious. As soon as it is turned off the patient awakens. Best of all there appear to be no after-effects. Research is being continued by the university under a contract with Army Medical Research Development Command.

# THE TURNER 254C

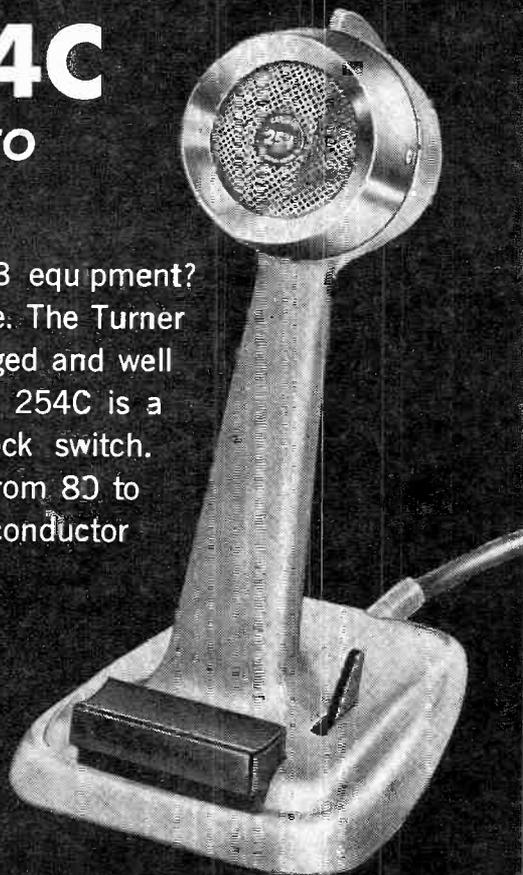
## NEW BASE STATION MICROPHONE TO IMPROVE CB PERFORMANCE

Not getting the performance you'd like from your CB equipment? The trouble could be in your present base station mike. The Turner Model 254C is the ideal replacement—attractive, rugged and well below the price you might expect to pay. The Model 254C is a ceramic microphone with on-off push-to-talk and lock switch. Durable gray hammertone finish. Smooth response from 80 to 7,000 cps. Level: -54 db. Cable is 7 feet long, single conductor shielded. Economy-priced at only \$14.10 net.

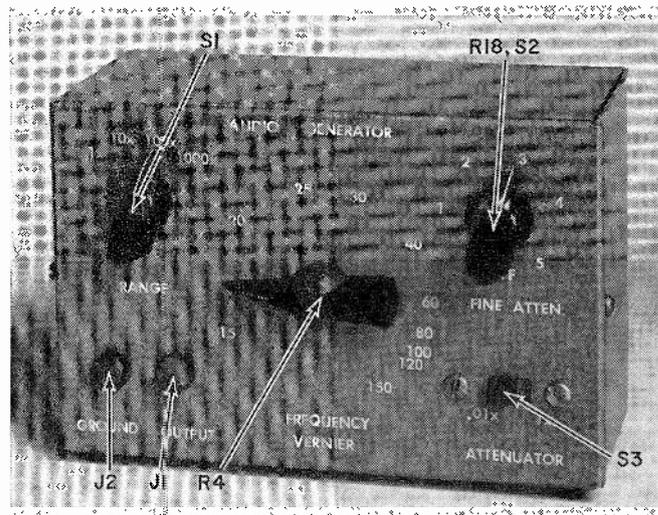
FOR MORE INFORMATION WRITE:

**THE TURNER MICROPHONE COMPANY**

933 17th Street NE,  
Cedar Rapids, Iowa



# audio generator fits your tube caddy



Completed unit is only 2 inches deep.

Portable 4-transistor unit is excellent for hi-fi work

By **STANLEY E. BAMMEL**

Here is an all-transistor wide-range sine wave audio generator. It covers 15 to 150,000 cycles in four slightly overlapping ranges. It is portable and just the thing for testing hi-fi equipment and is easily built from non-critical parts. The cost is relatively little.

The circuit is basically a Wien-bridge oscillator. Direct coupling throughout makes its wide frequency range possible, eliminates such problems as motorboating and reduces the cost. The Wien-bridge oscillator (Fig. 1) consists of an amplifier with a phase shift of  $0^\circ$  or  $360^\circ$  and a voltage gain of 3. Feedback is taken through the Wien bridge network which feeds a third of the output voltage back to the input. The oscillator works at the frequency at which the network gives a phase shift of zero.

Transistor V1 provides a high input impedance through the use of an un-bypassed emitter resistor (Fig. 2). The input impedance of the stage is approximately  $R_e(B + 1)$  where  $R_e$  is the emitter resistor and B the ac beta of the transistor. All the 2N1265's I have tested have had an ac beta of 50 to 100. Therefore, the input impedance of this stage ranges between about 165,000 and 330,000 ohms. Negative feedback through R11 raises this impedance even higher.

V1 is biased through a network made up of R1, R6, R7, R9, R23 and R4-b. The network also limits the effective range of R4-b.

The signal is direct-coupled from V1's collector to V2's base. Returning

V2's emitter to a tap on the battery is a convenient way of providing it with a low impedance at the proper voltage. This arrangement also allows a fairly high-value collector resistor for V1 which makes for high gain.

V2's output impedance is fairly high, so an emitter-follower or common-collector stage (analogous to a cathode follower in a tube circuit) is used at the output. This stage (V3) provides a low output impedance.

V4 in conjunction with the diodes and other components forms an automatic amplitude control. This is what makes the generator possible. Anyone who has tried to build a transistorized variable oscillator has undoubtedly run into the problem of providing a constant amplitude across the whole frequency range. V4 and the diodes take care of this.

V4 is normally biased to cutoff but, when oscillator amplitude goes high enough, it conducts on negative peaks. A pulse proportional to the excess amplitude appears at V4's emitter. This pulse is coupled through C10 to D1 and D2. These diodes rectify the pulse and apply a forward bias to D3 and D4. C11 and C12 filter the rectified current. As the forward bias on a semiconductor diode increases, its resistance decreases. Therefore, the resistances of D3 and D4 decrease and they pass some of the signal at V1's collector to ground through C11 and C12. When this happens, gain decreases. Overall, the circuit regulates output voltage within  $\pm 10\%$ .

The extra components in the two high ranges are necessary to get the

## BENCH



## TESTED

Unit performs well. Produces clean sine wave over range of 13 cycles to 150 kc. All ranges overlap enough so that no frequency is at the absolute end of the dial rotation. Unit fits easily inside tube caddy and can be handy for checking hi-fi equipment in the home.

desired sweep of 10 to 1 per range. Without them, the ratio is only about 9 to 1 on the  $\times 100$  range and 4 to 1 on the  $\times 1000$  range.

## Construction hints

I built my unit in a 3 x 4 x 6-inch chassis box. Anything with enough room on the front panel for the controls should be OK. Keep the leads in V1's base circuit as short and as isolated as possible because this is a high-impedance circuit. Otherwise, layout is not critical.

I mounted most of the small parts on a piece of phenolic board. The parts are mounted on one side and all connections are made on the other.

The oscillator should work with the values shown. It is not especially sensitive to variations in different transistors. In fact, almost any general-purpose transistors should be all right. The only exception may be V1. It should have as high a beta as possible.

If you build this circuit and find that it does not oscillate evenly over the whole range or will not oscillate at all (in the latter case, check for wiring errors first), raise the value of R11. This lowers the negative feedback and raises the overall gain. If you have difficulty getting it to oscillate on the low end of each range, lower the value of R5. If the difficulty is on the high end, lower the value of R22.

On the other hand, if the output is distorted, gain is too high. Lower the

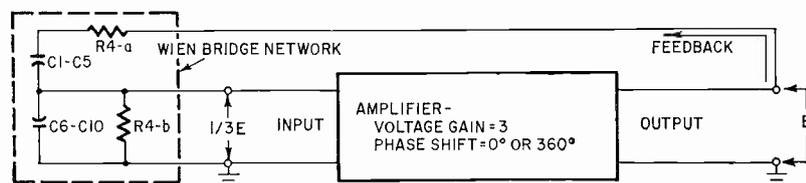


Fig. 1—A Wien-bridge oscillator is at the heart of the unit.

# How I Went From Peanuts To Profits In The Servicing "Rat Race"



"After 5 years with the same small servicing outfit I was getting nowhere — fast! Other men seemed far more advanced and much more successful than I. While I scrimped and saved, they were living high.

"I was in a rut. One day I analyzed what makes one service technician more successful than another! *Know-How!* The smart service technician has the latest information on radio, TV, hi-fi he handles every day. No wonder he can do any job faster, better, easier.

"The Gernsback Library Technician's Book Club showed me how to turn this know-how into profits. I joined and regularly, I chose a valuable book packed with the kind of up-to-the-minute servicing data that pays off. I put the new methods and techniques I learned to work for me. Before long, I'd quit my job and started my own shop. Now—I have men working for me! I'm still a member of the Technician's Book Club. And—the more I learn—the more I earn!"

Find out how the G/L Technician's Book Club can lift you out of the servicing rut and start you on the road to profits. Read the offer below and mail the coupon now.

## MONEY-MAKING SERVICING DATA AT YOUR FINGERTIPS WHEN YOU NEED IT MOST!

The G/L Technician's Book Club helps you get ahead faster by providing a steady

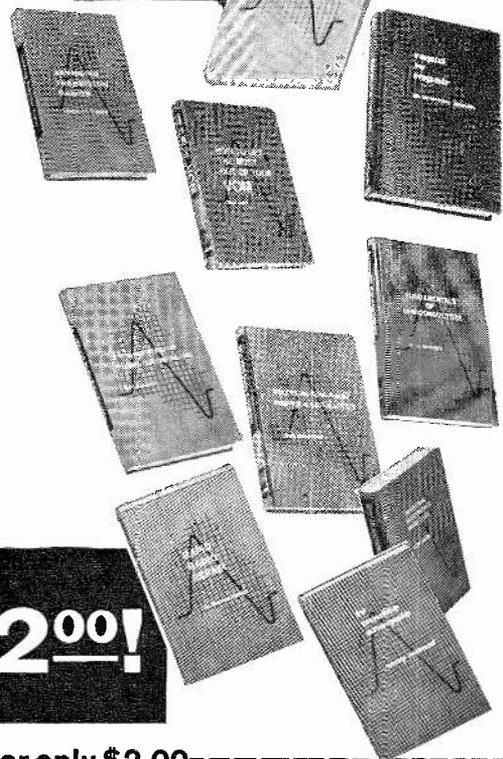
source of vital information—at a price you can afford!

Nowhere else can you find so many tips, short-cuts, and time-saving techniques at such low cost or theory and fundamentals explained so clearly by top-notch technical writers—information you can put to work immediately.

Mail the coupon and start your membership in the G/L Technician's Book Club with any 3 of these books for only \$2.00 (values up to \$10.35). Examine them in your own home at our risk. If you don't agree they're worth their weight in tax deductions\*—return them within 10 days and owe nothing. If you keep them, simply send us your remittance. Please act fast. Quantities are limited. First come first served!

You will receive every month, a brochure describing the latest books published in every field of electronics. You needn't buy a book every month—nor any particular book any month. Buy as few as 4 books offered by many of the world's leading technical publishers during the next 12 months. And you pay only the special low discount price which saves you up to 27%! You may cancel any time thereafter. Send no money now unless you wish. Mail the coupon today to Gernsback Library, Inc., Dept. 22A, 154 West 14th St., N.Y. 11, N.Y.

\*Books purchased for professional use are tax deductible.



Start your membership with your choice of any of these **3 IMPORTANT BOOKS** for only **\$2.00!**  
VALUES UP TO \$10.35—LIMITED QUANTITIES

Choose the 3 books you want below for only \$2.00

- RAPID TV REPAIR**—Lists hundreds of tough TV problems alphabetically for quick and easy reference. Tells how to find'em and fix'em in minutes. Save servicing time with troubleshooting charts.
- THE VTVM**—Tells how the VTVM works, describes meter scales, probes, alignment, servicing. Offers dozens of new ideas on using the VTVM.
- TV TROUBLE ANALYSIS**—Unique "theory of trouble" approach shows you how to recognize component and circuit failure as they effect audio and video and fix them fast. Prepares you to service all types of sets.
- PRACTICAL AUTO RADIO SERVICE**—Covers transistor, hybrid FM and AM models. Compares auto with home radio servicing. Covers removal, installation, troubleshooting, power supplies, interference, suppression, tuner theory, etc.
- FUNDAMENTALS OF SEMICONDUCTORS**—Thorough rundown on theory and practical applications of all kinds of semiconductors—transistors, diodes, photocells, solar generators, Hall effect devices, and

- others. Application of principles in practical devices.
- SERVICING TRANSISTOR RADIOS**—Ins and outs of the specialized knowledge needed to handle these tricky sets. Theory, instruments to use, pitfalls to avoid, alignment, hints on how to handle transistors.
- RAPID RADIO REPAIR**—An alphabetized "instant" guide to finding tough troubles in FM, transistor, hybrid auto sets and other modern receivers.
- SERVICING COLOR TV**—Get ready for the color breakthrough! This book answers all your questions about chroma circuits, matrix testing, the flyback system test equipment. Contains numerous troubleshooting charts.
- HOW TO GET THE MOST OUT OF YOUR VOM**—Get more mileage out of this versatile instrument. How to choose, build, work with and extend the use of the VOM.
- PRINTED CIRCUITS**—Practically an encyclopedia on printed circuits. How they developed, how to work with them, make your own, repair them.

**TECHNICIAN'S BOOK CLUB**  
**Gernsback Library Dept. 22A**  
**154 West 14th Street, New York 11, N. Y.**

Enroll me as a member of the G/L Technician's Book Club. Start my membership with the 3 books I've checked at the left for only \$2.00 (plus a few cents postage). Each month send me a brochure describing the current selections which I may purchase at special discount prices if I wish. I understand that my only obligation is to purchase just 4 additional books within the next 12 months, and that I may cancel anytime thereafter. I also understand that I may cancel immediately, simply by returning these first 3 books within 10 days.

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

I enclose \$2.00 (plus 24¢ postage)       Bill me later.

value of R11 or raise the value of R22 or R5.

These adjustments are fairly easy to make by adding resistors in parallel or in series. To lower the value, insert a relatively high value parallel resistor. To raise the value, insert a relatively low-value series resistor. Experiment until you have it exactly right.

Other adjustments that might be necessary may be the extra components in the two highest ranges. These values were determined experimentally and must be adjusted the same way.

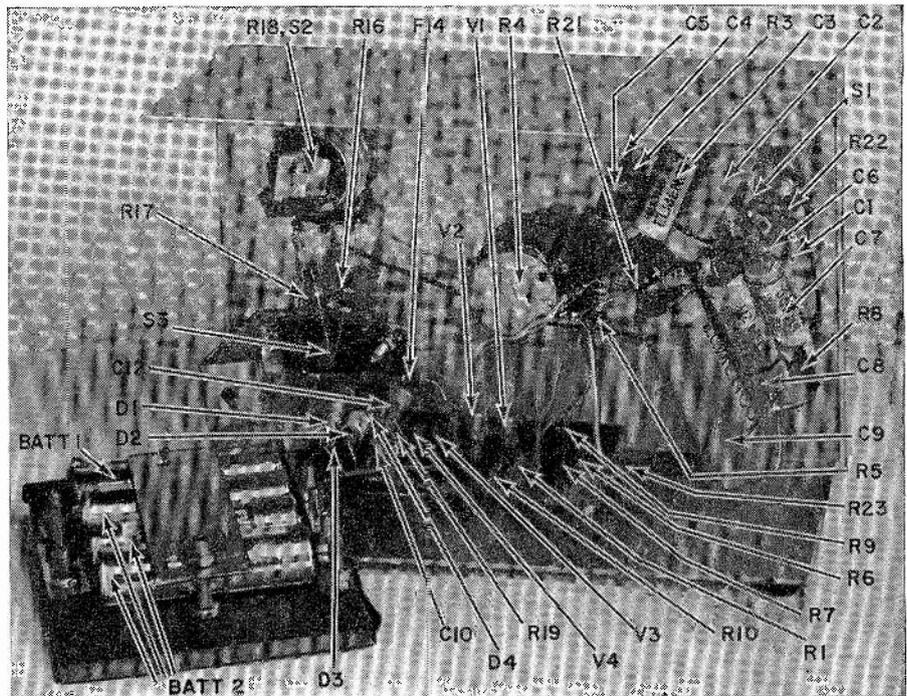
(Mr. Bammel states that R21, R22, and R23 were used for calibration and may not be needed or may vary with the exact value of the 10% resistors used in the frequency-determining network. He suggests eliminating R13 entirely and changing R14 to 4700 ohms. In some cases, calibration requires placing R23 in parallel with R6 instead of in series with it as shown.—Editor)

### Calibration

The unit is easy to calibrate with the aid of an oscilloscope. Set the scope's horizontal sweep for line sweep and hook the generator's output to the vertical input terminals. With the RANGE switch on  $\times 1$ , set the generator's FREQUENCY VERNIER for a stationary pattern. Now divide the number of vertical peaks on the scope screen by the number of horizontal peaks and multi-

$$\text{ply by } 60 \left( F = \frac{V}{H} \times 60 \right).$$

The next higher range should be exactly 10 times the frequency of the lower. If the frequency is higher, more capacitance is needed; if lower, less capacitance.



Inside the case. Note subassembly on phenolic board.

If one range oscillates weakly, there is not enough feedback. If one is distorted, there is too much feedback and it is overloading. In either case, the two capacitors for that range are not exactly equal, or at least they are not in the same relationship as the capacitors in the other ranges. If the capacitor in one leg (S1-b) is too large or the capacitor in the other leg (S1-a) is too small, there will not be enough feedback. If it is the other way around, there will be too much feedback.

All changes must be made in respect

to all variables (frequency and amplitude). For instance, if the frequency is too high and there is not enough feedback, the total capacitance should be increased. To get more feedback, the capacitor selected by S1-a must be increased in value or the capacitor selected by S1-b must be decreased. Since you want to increase the total capacitance, increase the one selected by S1-a. In this way both problems can be solved with one change.

Capacitance can be adjusted in much the same way as resistance. This was

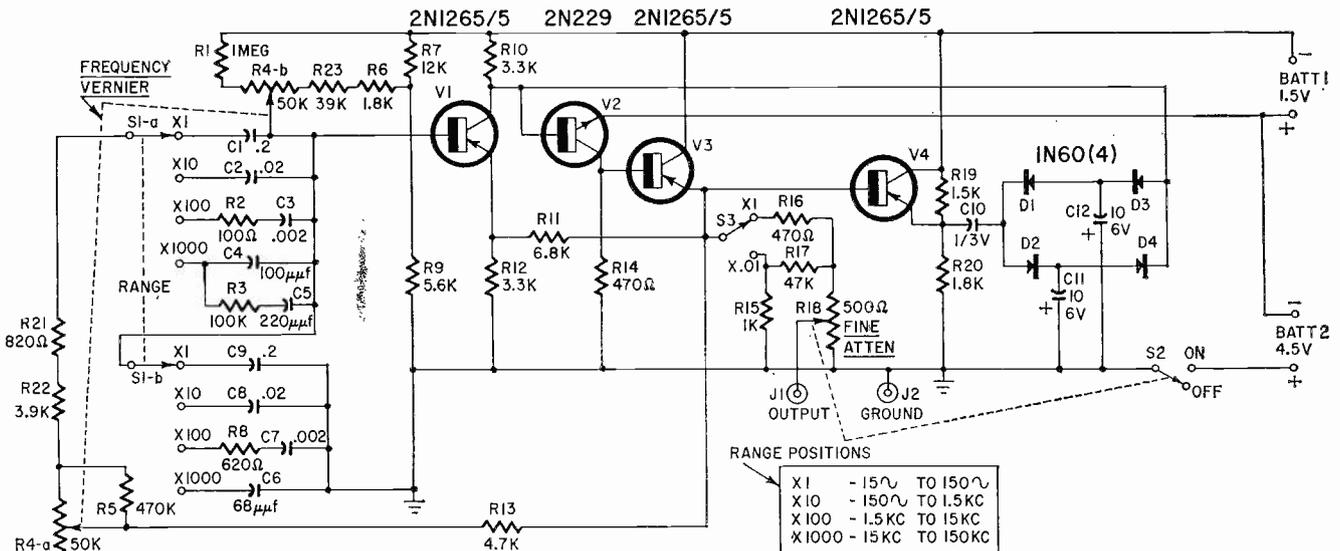


Fig. 2—Four transistor circuit is straightforward and easy to build.

- R1—1 megohm
- R2—100 ohms
- R3—100,000 ohms
- R4—dual pot, 50,000 ohms each section (Clarostat AD47-50K S or equivalent)
- R5—470,000 ohms
- R6, R20—1,800 ohms
- R7—12,000 ohms
- R8—620 ohms
- R9—5,600 ohms
- R10, R12—3,300 ohms
- R11—6,800 ohms (see text)
- R13—4,700 ohms
- R14, R16—470 ohms

- R15—1,000 ohms
- R17—47,000 ohms
- R18—pot, 500 ohms, with spst switch
- R19—1,500 ohms
- R21—820 ohms
- R22—3,900 ohms
- R23—39,000 ohms
- All resistors  $\frac{1}{2}$ -watt 10%
- C1, C9—0.2  $\mu$ f, paper
- C2, C8—.02  $\mu$ f, paper
- C3, C7—.002  $\mu$ f, paper
- C4—100  $\mu$ f, tubular ceramic
- C5—220  $\mu$ f, mica
- C6—68  $\mu$ f, ceramic disc

- C10—1  $\mu$ f, 3 volts disc ceramic (Centralab UK-105 or equivalent) or electrolytic
- C11, C12—10  $\mu$ f, 6 volts, electrolytic
- BATT 1—1.5 volts (D cell)
- BATT 2—4.5 volts (3 D cells)
- D1, D2, D3, D4—IN60
- J1, J2—tip jacks
- S1—2-pole 4-position rotary switch (Centralab PA-1002 or equivalent)
- S2—spst on R18
- S3—spdt slide switch
- V1, V3, V4—2N1265/5
- V2—2N229
- Case—3 x 4 x 6 inches, chassis box
- Miscellaneous hardware

described earlier. The only difference is that in paralleling, a relatively low-value capacitor is used and in series a relatively high-value capacitor is used. (Paralleling will increase total capacitance; a series connection will decrease total capacitance.) Sometimes extremely high value units must be in series, and it may be much easier to just try different capacitors of the same value.

If a scope is not available, feed the generator output through an amplifier and speaker. Then compare the tone to a piano or other musical instrument. By consulting a frequency chart, you'll know just what frequency you are getting.

### Variations

The generator could be modified in several ways. For example, it could produce only a single fixed frequency. Simply substitute two fixed resistors for R4-a and R4-b and eliminate the RANGE switch.

Another possible modification would replace the continuously variable FREQUENCY VERNIER with a step control. To do this, use a multi-position rotary switch and a group of fixed resistors to replace R4. Fig. 3 shows one possible

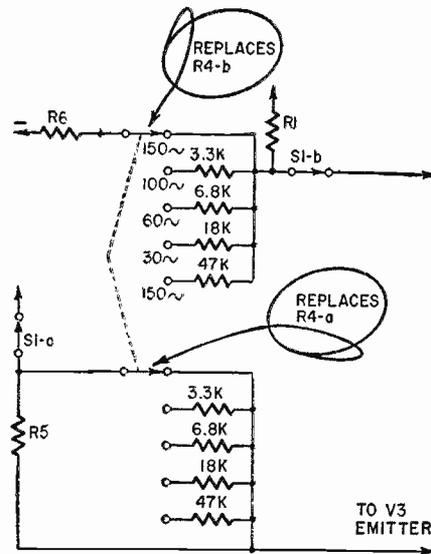


Fig. 3—This step frequency selector can be used instead of the continuously variable control shown in Fig. 2

arrangement. You might want to use different value resistors to get desired frequencies. But keep the resistors within the range of 5,000 to 50,000 ohms. END

## Tape bias test adapter

By HAROLD REED

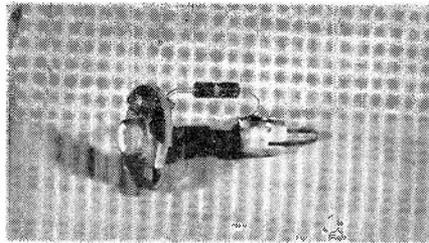
THE little gadget described here will make it easy for the audiophile to check the bias current to the record head of his tape recorder as well as to measure the erase current flowing through the erase head. Also, it is one of those welcome time-savers for the service technician.

These measurements should be made if quality of reproduction from a recorded tape is below par or if erasure of the tape is incomplete. The recommended procedure for measuring bias and erase currents is to break the ground side of the connections to the head and insert a 100-ohm resistor in this circuit—usually inconvenient.

Most recorders have standard phono jacks and plugs to connect the electronic section and the tape deck, with the jack mounted on the deck assembly.

The tiny test adapter consists of one of these jacks and plugs. The center conductors of these two items are connected with a short length of No. 14 bus wire. This size wire gives rigidity to the gadget. Spaghetti tubing slipped over the wire prevents shorting to the ground side. Then solder a 100-ohm resistor between the ground sides of the jack and plug, as shown in the photo.

To use the test adapter, remove the



plug going to the head jack on the deck and plug it into the adapter jack. Insert the adapter plug into the head jack. Now, connect an audio vtvm across the 100-ohm resistor with the high side of the vtvm toward the head. Set the recorder in the record mode to place the bias oscillator in operation, and read the voltage drop across the resistor on the meter. The same procedure holds for either record or erase head measurements.

The bias or erase current, whichever is being measured, is determined by

$$I = \frac{E \times 1000}{R}$$

where I is the current in milliamperes, R is the resistor value (100 ohms) and E is the voltage drop across R.

Bias current will usually range from 0.5 to 1 ma, and erase current will run from 5 to 15 ma. Compare the results with the recommended values given in the service manual of the recorder.

Where necessary, other connectors may be used. Since the oscillator frequency is normally above 50 kc, for greatest accuracy the test should be made as close to the heads as possible—there is usually a voltage drop in the connecting cable between the oscillator and record or erase head. Keep test adapter leads as short as possible. END

**NOW  
YOU CAN BUILD  
A FINE  
Schober Organ  
FOR ONLY  
\$550**

You can assemble this new Schober Spinet Organ for \$550 — or half the cost of comparable instruments you have seen in stores. The job is simplicity itself because clear, detailed step-by-step instructions tell you exactly what to do. And you can assemble it in as little as 50 hours.

You will experience the thrill and satisfaction of watching a beautiful musical instrument take shape under your hands. The new Schober Electronic Spinet sounds just like a big concert-size organ — with two keyboards, thirteen pedals and magnificent pipe organ tone. Yet it's small enough (only 38 inches wide) to fit into the most limited living space.

You can learn to play your spinet with astounding ease. From the very first day you will transform simple tunes into deeply satisfying musical experiences. Then, for the rest of your life, you will realize one of life's rarest pleasures — the joy of creating your own music.

For free details on all Schober Organs, mail the coupon now. No salesman will call.

THE *Schober Organ* CORPORATION

43 West 61st Street, New York 23, N. Y.  
Also available in Canada and Australia.

**MAIL THIS COUPON TODAY**

The Schober Organ Corporation  
Dept. RE-17  
43 West 61st Street  
New York 23, New York

- Please send me FREE booklet and other literature on the Schober Organs.
- Please send me the Hi-Fi demonstration record. I enclose \$2 which is refundable when I order my first kit.

Name.....

Address.....

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

**Free**

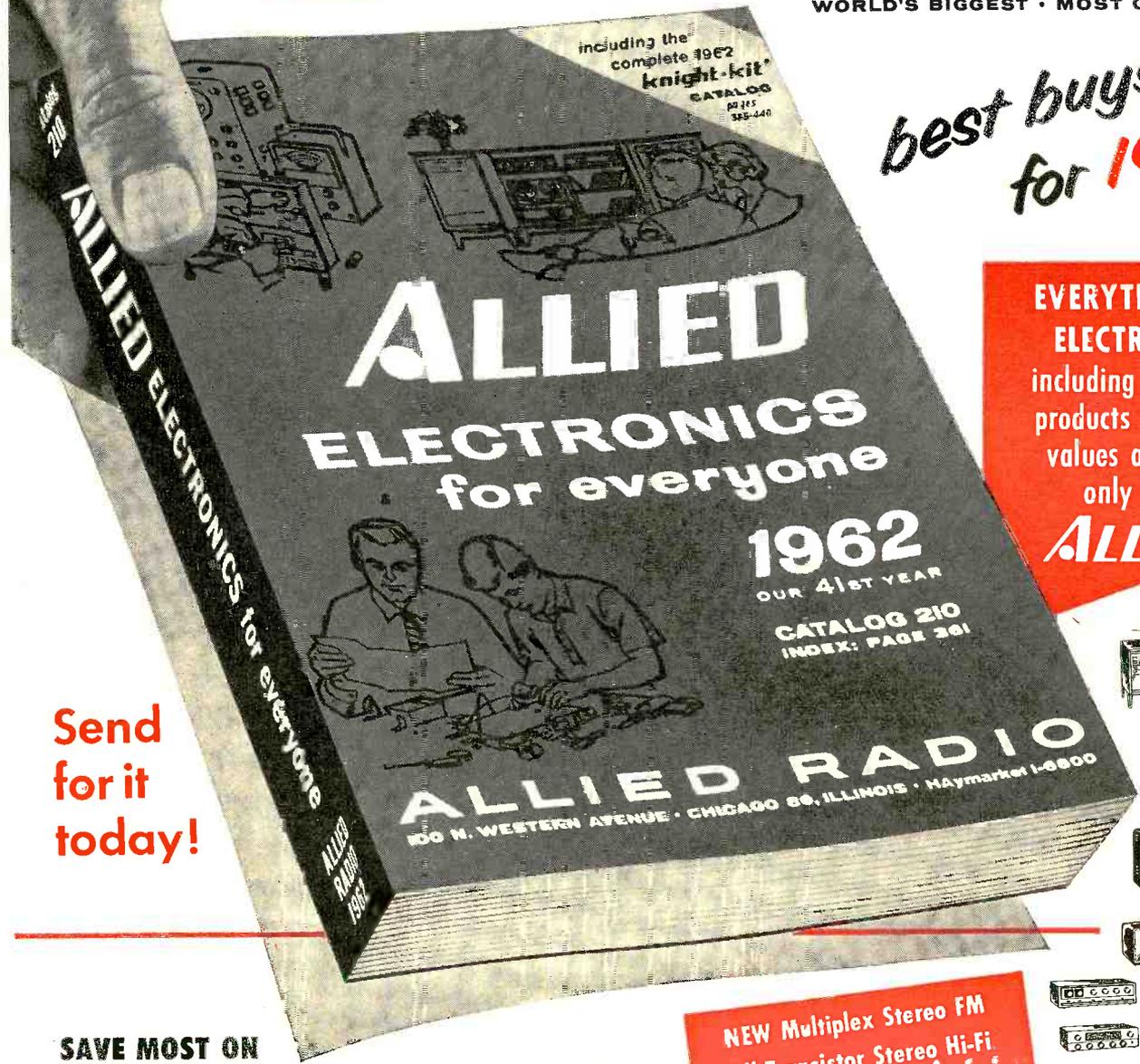
**ALLIED**

**444-PAGE ELECTRONICS CATALOG**

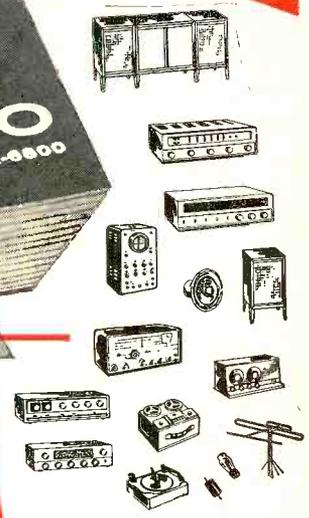
WORLD'S BIGGEST • MOST COMPLETE

*best buys  
for 1962*

**EVERYTHING IN  
ELECTRONICS  
including exclusive  
products & special  
values available  
only from  
**ALLIED****



**Send  
for it  
today!**



**SAVE MOST ON  
EVERYTHING IN ELECTRONICS**  
world's largest selection of famous-name brands

- New Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- New Multiplex Stereo FM • All-Transistor Stereo Hi-Fi
- Money-Saving Build-Your-Own KNIGHT-KITS® for Every Need
- Best Buys in Tape Recorders, Tape, and Supplies
- Citizens Band 2-Way Radios • Short-Wave Receivers
- Amateur Receivers, Transmitters, and Station Gear
- Latest Public Address Systems, Paging and Intercom Equipment
- TV Tubes, Antennas, Accessories • Batteries, Wire and Cable
- Test and Laboratory Instruments • Tools, Hardware
- Huge Listings of Parts, Tubes, Transistors, Technical Books

**NEW Multiplex Stereo FM  
All-Transistor Stereo Hi-Fi**

**exclusive money-saving KNIGHT® products**  
SAVE MOST on famous 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 (including latest Multiplex Stereo and All-Transistor hi-fi) and save most. KNIGHT products are acclaimed by all those who recognize integrity in design and manufacture and who appreciate value.

**NO MONEY DOWN**  
on Allied's new Credit Fund Plan  
Now—enjoy 50% more buying power—up to 24 months to pay—see our 1962 Catalog for simple details.

**SEND FOR 444-PAGE CATALOG TODAY!**

Satisfaction Guaranteed or Your Money Back

**ALLIED**

RADIO-ELECTRONICS



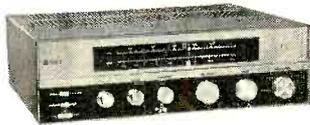
**BIG PLUS!**  
in your 1962  
**ALLIED**  
CATALOG

includes complete catalog featuring over 90 exciting

**knight-kits**   
A PRODUCT OF ALLIED RADIO

**NEW for '62 and simply great!**  
available only from **ALLIED**

**new**  
HI-FI KITS



All-In-One FM-AM Tuner-Amplifier Kit with latest built-in MULTIPLEX Stereo FM, less case.....\$129.95



MULTIPLEX Self-Powered Adapter Kit, for Stereo FM reception.....\$19.95



Deluxe Stereo FM-AM Tuner Kit with latest built-in MULTIPLEX Stereo FM.....\$99.95



ALL-TRANSISTOR 50-Watt Stereo Amplifier Kit, less case.....\$79.95

**new**  
HOBBYIST KITS



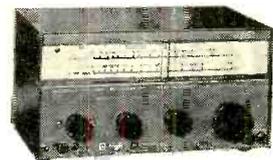
ALL-TRANSISTOR Wireless Intercom System Kit (2 units).....\$45.90



TRANSISTORIZED Electronic Tachometer Kit . \$24.95



Amazing 100-In-1 Electronic Science Lab Kit.....\$29.95



ALL-TRANSISTOR 2-Band AM-Shortwave DX'er Radio Receiver Kit.....\$19.95

**Knight-Kits offer the most satisfying build-your-own experience in the world!**

**5 BIG REASONS WHY:**

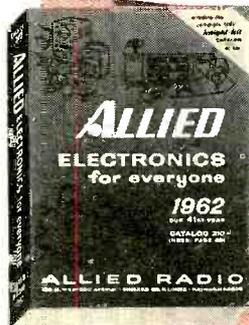
- **Convenience Designed**—makes you a kit-building expert—even the very first time!
- **Wonderful to Build**—you'll marvel at the sheer ease of assembly with the exclusive "show-how" manual guiding you like a good instructor.
- **You Own the Best**—you'll enjoy with pride a true custom-built product, professional in its engineering and performance.
- **You Save So Much**—because you buy direct from Allied at our money-saving volume prices—and because you do the easy assembly yourself.
- **Easiest to Buy**—NO MONEY DOWN on Allied's new Credit Fund Plan—easiest terms ever!

**MONEY BACK GUARANTEE:** Buy any Knight-Kit. Build it! Use it! You must be satisfied or you get your money back!

**see more than 90 KNIGHT-KITS**

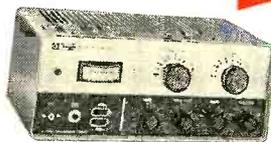
- 21 HIGH-FIDELITY KITS
- 25 HOBBYIST KITS
- 31 INSTRUMENT KITS
- 14 AMATEUR & CITIZENS BAND KITS

KNIGHT-KITS are also available in Canada



**Send for it today!**

**new**



Phone and CW 60-Watt Ham Transmitter Kit.....\$49.95



Mutual Conductance Tube Tester Kit.....\$99.50

- World's Largest Stocks • Lowest Money-Saving Prices
- Fastest Shipment • Expert Help • Easiest-Pay Terms
- Satisfaction Guaranteed or Your Money Back

send for the world's biggest electronics catalog!

**Free**

ALLIED RADIO, Dept. 200-B2  
100 N. Western Ave., Chicago 80, Ill.

Send FREE 1962 ALLIED 444-page Catalog

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

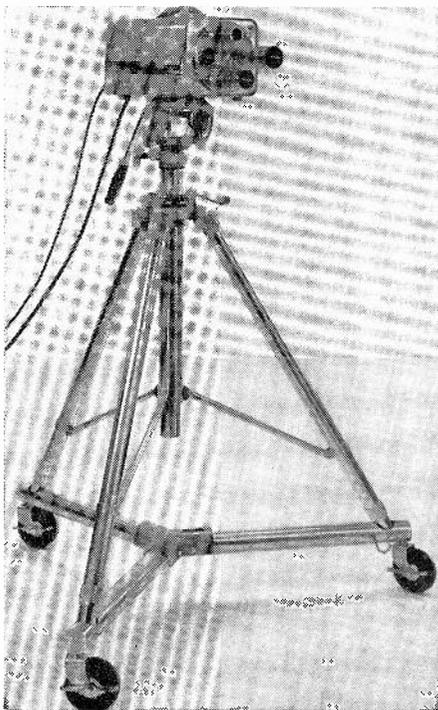
Address \_\_\_\_\_

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

**RADIO**  **World's Largest Electronic Supply House**

# CLOSED-CIRCUIT TV FOR THE SCHOOL

*How an efficient low-cost system can be set up*



Argus CCTV camera on its mobile tripod.

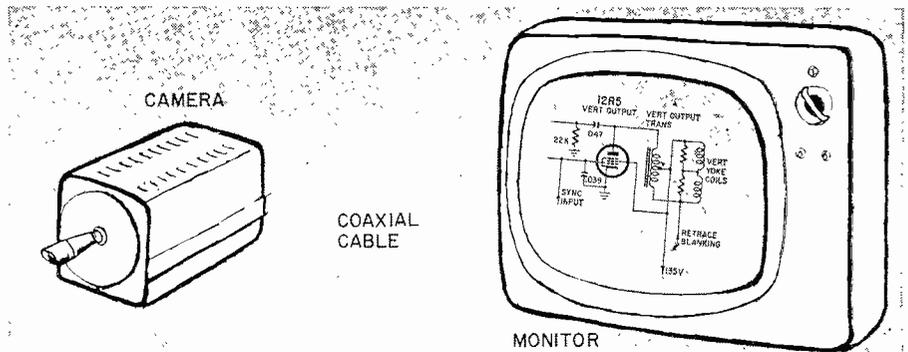


Fig. 1—Basic closed-circuit system consists of camera and monitor tied together by coax cable.

By JACK BEEVER

CLOSED-CIRCUIT TELEVISION IS A VERY broad term, one that encompasses every use of a television camera and viewer that does not include a broadcast transmitter as part of the system. In complexity, it ranges from a simple camera and monitor connected by coaxial cable all the way to the state-wide educational systems, which include the coaxial cable linking of all schools within a school district, and the linking of school districts by microwave.

Microwave links do not eliminate the closed-circuit-concept since a microwave transmission is not broadcast—it is point-to-point, and almost as private as a length of coaxial cable.

The applications most interesting to us are in the small-business area. They extend from the simplest surveillance setup of a single camera to the largest in-building multiplex installation. Large building systems may involve a group of buildings on commonly owned ground—such as a college campus or a large hospital. Even prisons are adding complex CCTV systems.

A quick look at the most commonly talked-about application, the industrial camera and monitor setup, should clear the way for the more interesting multiplex automatic-studio systems.

The basic output of an industrial TV camera is composite video that contains currents from dc to as high as 8 mc, depending on the quality and adjustment of the camera. A video monitor accepts such signals and produces TV pictures from them. Therefore, if we connect a camera and monitor with coax cable, as in Fig. 1, we have a basic closed-circuit system. It provides a picture whose quality is limited by the characteristics of either the camera or monitor.

System limitations are:

- ▶ It provides no sound signal. Audio, if needed, must be provided by a separate system.
- ▶ It operates in a range of frequencies that includes power-line frequencies, and is subject to hum troubles due to ground loops. On long runs, grounding may become a problem.
- ▶ The cable can carry only one signal. It cannot be multiplexed.
- ▶ Due to the wide range of frequencies in use, the cable's loss varies widely, and compensating amplifiers are needed if long runs are intended. These amplifiers have

high gain at the high frequencies, and low or no gain at the lower frequencies.

The camera/monitor system also has advantages—don't sell it short. Some of them are:

- ▶ It uses a minimum of apparatus.
- ▶ Maintenance costs are low.
- ▶ Installation is generally simple.
- ▶ Longer runs are possible without amplifiers than with rf systems.

Such systems are most commonly used for surveillance in factories, warehouses, department stores, banks, railroad yards and traffic control.

## Educational CCTV

When you enter the educational field, new problems arise—you need flexibility and you can't afford to get it by hiring a full-time crew of technicians and cameramen. The chances are that the equipment will be operated by instructors and students.

Let's take a look at the requirements of a high school or preparatory school when the curriculum is aimed toward scientific or academic career building. Keep in mind that the main object is to "spread out" a teacher or an experiment. We might want to be able to place a camera in the physics, chemistry, biology or general science laboratory, gymnasium, assembly hall and any other special service rooms.

It is not necessary that these rooms all have cameras operating simultaneously, and since the camera is the most expensive single piece of equipment in closed-circuit systems, it is likely that the school's budget cannot afford very many.

We need viewing devices—TV receivers or monitors—in every room where students assemble. We also need provisions to pipe off-the-air educational TV programs to every viewing location.

Take a look at what going video with simple camera and video monitors entails. You need coaxial cables from each camera location to a centrally located patch panel, a kind of telephone switchboard for coaxial cable. From this same point, cables would run to each room where monitors would be located—which means all rooms.

## CCTV via rf

Such spiderweb wiring is extremely expensive and requires very large conduits or raceways and pull boxes. There is a less expensive and more flex-

BRING 'EM BACK ALIVE!



Now, Electro-Voice offers the finest acoustically-correct enclosures for your home music system . . . and at a saving to you of up to 50%!

In just a few short hours, you can assemble an E-V KD6 Aristocrat or KD9 Marquis kit —without special tools or previous woodworking experience. And you'll obtain the same full sound as the factory-assembled models . . . yet you'll *save up to one-half!*

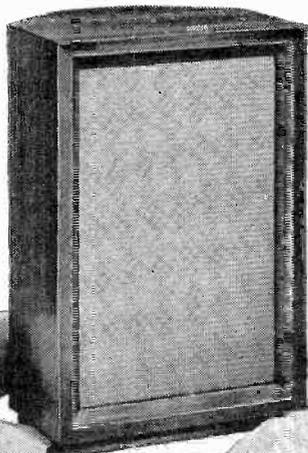
Carefully pre-cut and complete with easy-to-follow instructions, each E-V enclosure kit features handsome birch veneer that can be easily finished to match any decor, with complete E-V Finishing Kits. For the final sparkling accent, an AK6 Grille can easily be added.

The KD6 and KD9 are each scientifically designed, acoustically correct enclosures that will add up to an extra octave of performance to any full-range speaker. The folded-horn KD6 uses the corner of the room as part of the horn, to increase performance without increasing size. The KD9 with its rear-facing ducted port provides similar range extension for along-the-wall applications.

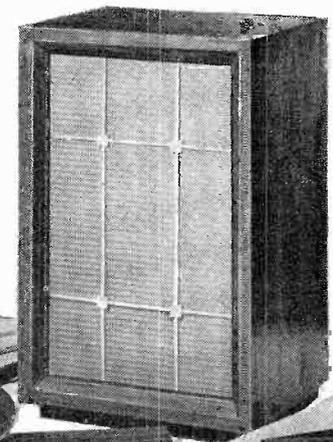
Each kit is pre-cut for any 12" speaker. KD9 also accepts 15" speakers. For superb results, choose one of the six E-V 12" speakers ranging in price from \$19.50 to \$125.00. There is the precise model for your requirements. Both kits are also designed for simple addition of any E-V Building Block Kit. You can start with a coaxial speaker and easily build to a complete 3-way system in step with your budget.

For the perfect combination of performance and economy, put your high fidelity loudspeaker in an Electro-Voice kit enclosure. You'll bring 'em back alive —every favorite musical performance, and at lower cost than you dreamed possible! Write for your free E-V catalog today!

# Now! Build the Biggest in High Fidelity! Bargain Fidelity!



**MODEL KD6 ARISTOCRAT KIT**  
*Finest corner enclosure for any 12" full-range or 3-way speaker.*



**MODEL KD9 MARQUIS KIT**  
*Superb response from 12" or 15" speaker when used along the wall.*  
(shown with AK6 grille)

**MODEL KD6 ARISTOCRAT KIT** For any 12" speaker. Also pre-cut for E-V Building Block components and Wolverine Step-Up Kits. Uses folded-horn plus corner of room to extend range—save space. Size: 29 3/4 inches high, 19 inches wide, 15 1/4 inches deep. Shipping weight 36 pounds. Net each \$39.00.

**MODEL KD9 MARQUIS** Similar to Aristocrat at left, but for 12" or 15" speakers. Ducted rear port design provides optimum bass response in along-the-wall installations. Size: 29 3/4 inches high, 19 inches wide, 14 1/4 inches deep. Shipping weight 38 pounds. Net each \$36.00.

**E-V FINISHING KITS** Complete with stain, filler, sealer, shellac, high gloss and satin varnishes, finishing papers, brushes and easy-to-follow instructions. Available in Walnut, Cordovan Mahogany, Fruitwood, Cherry, Golden Oak and Ebony. Net each \$6.00.

**AK6 TRIM KIT** Add a sparkling brass grille to KD6 or KD9. Net each \$4.80.

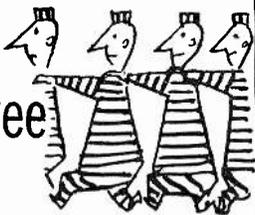
**E-V DO-IT-YOURSELF INSTRUCTION BOOKS** Complete, concise instructions help the home workshop enthusiast to build E-V high fidelity enclosures. Available for Aristocrat, Marquis, Regency or Baronet. Net each \$1.00.



**ELECTRO-VOICE, INC., Dept. 224E**  
Buchanan, Michigan  
Please send my free copy of the E-V high fidelity catalog.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

do  
you  
belong  
to  
a  
service  
technicians'  
association?...  
club?...  
student  
or  
employee  
group?...



**YES?**... Then you are  
eligible to take  
advantage of

## Radio-Electronics

special group  
subscription rates.

WRITE to our  
friendly representative

**MR. G. ALIQUO**  
**RADIO-ELECTRONICS**  
154 West 14th Street  
New York 11, N. Y.

He'll give you full details

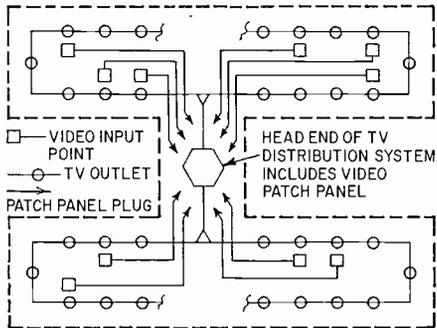


Fig. 2—Spiderweb of coax cables is needed for school video CCTV system.

CHANNEL	LOWER BAND EDGE	VIDEO CARRIER	AUDIO CARRIER	UPPER BAND EDGE
07	4.75	6	10.5	10.75
09	16.75	18	22.5	22.75
011	28.75	30	34.5	34.75
013	40.75	42	46.5	46.75

FREQUENCIES IN MC

Fig. 3—Table of specifications for the four subchannels possible using an rf system.

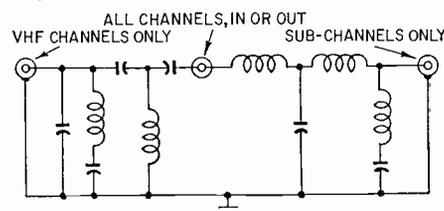
ible method—going rf—which means that you use self-originated programs modulating vhf carriers, just as is done in a TV broadcast.

Only one exception is made—you do not broadcast. Instead, you feed the vhf into a coaxial cable. And since you can multiplex on vhf, it is practical to run 10 channels on the same cable and, at a higher cost, up to 16 simultaneous channels.

The simplest form of vhf TV transmission is found in cameras such as the Argus (RADIO-ELECTRONICS, Nov. 1959). It contains a built-in modulator and, when operating, puts out a 0.1-volt signal at any one of the low-band TV channels (2, 3, 4, 5 and 6). Such a signal can be sent over more than 1,000 feet of RG-59/U coaxial cable or 2,000 feet of RG-11/U before it falls below a level of 3,000  $\mu$ v, and any television set will perform well on 3,000  $\mu$ v.

However, the big improvement is that we can feed camera signals into the cable simultaneously, one on channel 2, another on 4 and still another on 6. Any standard TV receiver tapped onto that cable can show the picture of any of the cameras at will. A point to remember is that these cameras put out a double-sideband signal, so you can't use channel 3 when using 4, or channel 5 when using 6. If you did, you would be getting mixed up with the

Fig. 4—Crossover network for separating subchannels from vhf channels.



lower sidebands of the higher channel.

One big advantage of such systems is economy. Standard television receivers can be used; and, thanks to mass production, they cost less than the technically simpler video monitors.

Video monitors, however, are usually of very high quality. They are classed as test instruments, and close tolerances are held in their construction.

### Vhf distribution systems

For a school of any size to use off-the-air educational TV properly, it needs a television distribution system so the signals received can be piped into the various classrooms. This system does almost exactly the same job for off-the-air channels as was just described for the vhf-output cameras. As a matter of fact, if one of the off-the-air channel inputs is replaced by a camera with a vhf output, it will distribute this signal to all receivers in the building. The only thing it does not do is provide points of origination within the building itself.

One way of doing this (and the approach used in some early installations) is to install a system of coaxial cables originating in various rooms and terminating at some point convenient to the distribution system's head end (Fig. 2). Note that certain areas have been selected as input points for video signals from a camera so a camera operating in these rooms can feed its signals back to the head end location. At the head end, these cables end in patch-panel plugs, or coaxial connectors. Here they are made convenient to a patch panel which allows the input of any camera to be connected to a modulator which produces a vhf carrier with the proper video modulation. This modulator is in actuality a miniature TV station and with a microphone and camera produces an actual TV signal.

With the system described, a number of modulators on different channels may be used to run simultaneous programming—the camera outputs going to the patch panel, from patch panel to modulator, and from modulator onto the television distribution system's head end. Signals are now available at any receiver within the building.

### Another approach

This system is quite workable, but has limitations. The school planners must determine in advance what rooms are to be used for program origination. If too many rooms are chosen, the cost of coaxial cable becomes astronomical, since each camera input runs all the way to the head end or studio location. The system lacks flexibility and rapidly becomes cumbersome and expensive. Another approach uses only one cable passing from room to room and which can be used to transmit pictures in both directions. These pictures may originate in the building, from any room which has a television outlet.

This new system calls for a new concept in coaxial cable wiring. Basically, coax is a practical transmission line for all frequencies between dc and 300 mc. Above this range, losses of practical

# ASTONISHING\*

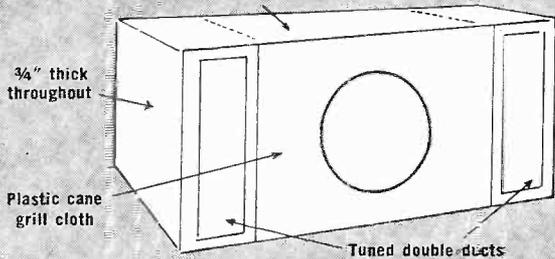
**Cabinart SPEAKER SYSTEMS**  
*outperform high-rated, higher priced systems*

**FREE 10 DAY TRIAL OFFER** You Must Be Satisfied Or Your Money Back

## Check These Cabinart Stand-Out Features

- ✓ Maximum possible speaker response
- ✓ Expertly engineered and matched
- ✓ Newer low resonance
- ✓ Smoother mid-range
- ✓ Less off-color tone

Acoustic damping material inside



\* E. T. Canby says, "The Cabinart speaker system . . . is really an astonishing piece of equipment at its price which is an unbelievable \$15 (mfr's note: now \$18) — speaker and enclosure, complete and integrated . . . with an 8" speaker inside of quite extraordinary quality. I am really impressed by the sound and by the simple ingenuity of the entire construction." In Audio, November, 1961.

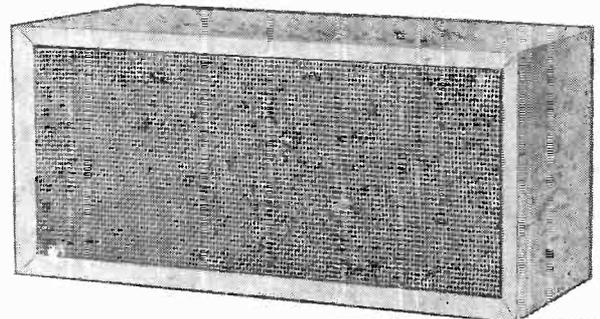
Reprint of Mr. Canby's complete review of Cabinart speaker systems is available on request.

Pioneers in hi fi quality since 1948.

# CABINART

ACOUSTICAL DEV. CORP. Haledon, New Jersey

Cabinart Is One Of America's Largest Manufacturers of Speaker Systems and Enclosures



### mark I 8" model

11" high x 9½" deep x 23" long  
 Shipping Weight: 27 lbs.

Sculptured Front Walnut Veneer, Oiled Finish \$30.00

Extended range speaker response 45 to 13,000 cps. 8 Ohm imp.

**\$18<sup>00</sup>**  
 Unfinished

Prices F.O.B. Factory

### mark II 12" model

14" high x 11½" deep x 23¾" long  
 Shipping Weight: 37 lbs.

Sculptured Front Walnut Veneer, Oiled Finish \$43.20

12" coaxial incl. 3" Alnico V PM tweeter. 8 Ohm imp. Speaker response 40 to 15,000 cps.

**\$27<sup>00</sup>**  
 Unfinished

These units are also available from distributors everywhere. If your distributor does not have these items in stock, place your order **DIRECT WITH US FOR IMMEDIATE DELIVERY!** Your order will be shipped one day after it is received!

Cabinart Acoustical Dev. Corp.  
 82 Geyer St., Haledon, N. J.

Please ship the following to be used in my home for 10 full days. I understand unit (s) may be returned and my money refunded within that time unless fully satisfied.

- .....Mark I Unfinished \$18.00 each
- .....Mark II Unfinished \$27.00 each
- .....Mark I Oiled Walnut \$30.00 each
- .....Mark II Oiled Walnut \$43.20 each

(Please make check or money order payable to Cabinart Acoustical.)

Name \_\_\_\_\_

Address \_\_\_\_\_

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

# "TAB" TUBES

Six Months Guarantee!! No Rejects!  
NEW & Used Gov't & Mfrs. Surplus!

Orders \$10 or more, Receiving types only vpd, 48 states

0A2	.80	68J6	.69	12AT6	.59	18S1	1.00
0B2	.85	68K7	.69	12AT7	.84	117Z6	1.10
0C3	.69	68L7	1.25	12AU6	.69	4-65A	16.00
0D3	.35	68N6	.98	12AU7	.69	2D21	2/\$1
0Z4	.59	68O6	1.19	12AX7	.78	3D23	3/\$1
1A7	.89	68Z7	1.25	12BA6	.65	717A	3/\$1
1B3	.78	6C4	.43	12BA7	.69	4-125	29.00
1R5	.78	6C5	.59	12BD6	.69	4-250	35.00
1S4	.78	6CB6	.80	12BE6	.69	4E27	7.00
1T4	.78	6CD6	1.49	12BF6	.59	4PR60	29.50

Send \$5 for Catalog!

1U4	3/\$1	6H6	.58	12BH7	.99	4X150G	\$15
1U5	.73	6J5	.52	12BY7	.98	4X250	35.00
1X2A	1.99	6J6	.48	12E27	.99	4X500	38.00
3Q4	.68	6K6	.59	12CU6	1.45	58P4	7.50
3Q5	.86	6KF	1.65	12SA7	.94	58P1	12.00
3S4	.68	6L6	1.19	12SG7	.89	35T	4.00
3V4	.89	6S4	.59	12SH7	.89	100T	7.00
5R4	.98	6S8	.99	12SJ7	.75	316A	5/\$1
5U4	.96	6SA7	.69	12SK7	.94	388A	3/\$1
5V4	.80	6SB7	1.2	12SQ7	.84	4168	4.00

Wanted Test Equipment from schools & U

5Y3	.58	6SC7	.89	19BG6	2.15	450T	42.00
6AC7	.70	6SG7	.78	25BQ6	1.39	807	1.00
6AG7	.89	6S7	.89	25L7	.69	866A	1.89
6AK5	.69	6SK7	.72	25W4	.77	811	4.40
6AL5	2/\$1	6SL7	.89	25Z5	.63	813	9.00
6AG5	.69	6SN7	2/\$1	50L6	.75	814	8.45
6AS7	3.00	6SR7	.79	EL34	3.49	815	2.05
6AT6	.49	6T8	.98	35L6	.69	829B	8.00

Wanted 811, 812, 815 and 504 TV tubes! Top \$\$\$ Paid

6AU4	1.10	6AU5	.98	35W4	.43	825A	7.50
6AU5	1.19	6V6GT	.70	35Y4	.69	872A	3.50
6AU6	.69	6W4	.79	35Z5	.63	1625	2/\$1
6AX4	.79	6W6	.89	60	6.14	6	4.00
6BA6	.59	6X4	2/\$1	50B5	.69	5879	.98
6BA7	1.00	6X5	.49	50C5	.69	5881	2.70
6BB6	.69	6Y6	.97	50L6	.69	5550	3.69
6BE6	.59	7N7	.89	KT66	3.29	5654	1.00
6BG6	1.50	12AL5	.59	75	.89	5894	12.00
6BH6	.72	12AQ5	.75	80	.59	7193	10/\$1

TUBES WANTED! WE BUY! SELL & TRADE!

## "TAB", SILICON 750MA\* DIODES

Factory Tested Gtd.1  
NEWEST TYPE! LOW LEAKAGE  
D.C. or Batty. Derate 20%

rms/piv	35/50	rms/piv	70/100	rms/piv	140/200	rms/piv	210/300
	.09		.17		.22		.31
rms/piv	280/400	rms/piv	350/500	rms/piv	420/600	rms/piv	490/700
	.38		.50		.63		.77
rms/piv	560/800	rms/piv	630/900	rms/piv	700/1000	rms/piv	770/1100
	.63		.98		1.08		1.35

Low Priced T300 Silicon Diodes  
Rated 400piv/280rms@100°C  
.25 each; 30 for \$7; 100 for \$22; 500 for \$100

Diode order \$10 shipped Post free

GTD! Octal Silicon-5U4G-Tube Replacement  
1120Rms 1600Piv \$4 @; 2 for \$6; 4 for \$10

NEW BATTERY CHARGER BC612X  
For 6 or 12 Volt Batteries  
Trickle & Full Charge up to 10 amps  
Charges 6 & 12 volt batteries.  
Built ready to use BC612X @ \$14.00  
BC612B up to 2 amps. @ \$7.45

ZENER DIODES 150to400 MW Cased T024Pckg  
Within 20% V Range \$1 @, 3for\$2  
KIT ZENER DIODES upto400MW 2for\$1

D.C. POWER SUPPLY 115V/60to800Cys Inpt.  
330&165VDC Up to 150MA. CASED! SPECIAL \$5

SILICON POWER DIODE STUDS\*  
Operation Up to 125°C Case Temp.

D.C. Amps	50Piv	100Piv	150Piv	200Piv
	35Rms	70Rms	105Rms	140Rms
2	.25	.35	.45	.55
3	.60	.85	1.00	1.25
6	.70	1.20	1.25	1.50
12	.85	1.80	1.50	1.70
35	1.80	2.15	2.50	2.90
70	4.75	5.70	4.25	4.50
240	4.80	5.70	6.90	8.40

D.C. Amps	300Piv	400Piv	500Piv	600Piv
	210Rms	280Rms	350Rms	420Rms
2	1.00	.80	2.10	1.95
3	1.50	1.80	3.70	3.50
6	1.75	2.00	3.70	5.20
12	2.00	2.00	3.90	5.20
35	4.95	6.10	4.50	7.0
70	10.80	15.30	10.80	15.30
240	19.60	29.75	19.60	29.75

\*Derate 20% for Battery or Capacitive Load or D.C. Blocking! \*Stud mounted on Heat-sink.

TWO 866A's and FILAMENT \$6  
XFMR 10 kv insid SPECIAL!

TRANSISTOR POWER CONVERTER  
12VDC to 500VDC up to 200MA  
100 Watts Tap at 250VDC  
D500  
12VDC to 250VDC up to 150MA  
Type C1225E \$30

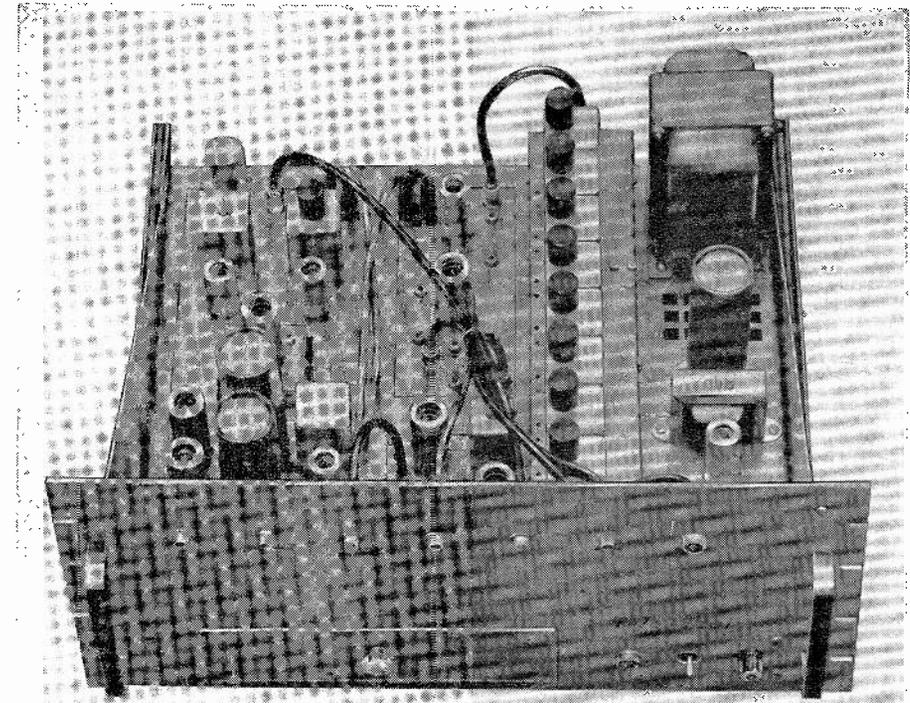
"SUPERIOR!" Powerstat #10 Variable X FMR  
165 Watt 0 to 132V Special \$6 each, 2 for \$10

"TAB" FOR TRANSISTORS & DIODES!!!!  
Factory Tested & Guaranteed!

Full Length Leads U.S.A. Mfg.

PNP Hi Power 15 Amp. T03 & T036 Pckg.  
2N441, 2N277 \$1, 12 for \$10  
2N442, 2N278 \$3 @; 2N443, 2N174 \$4 @  
3 Amp. 2N157, 2N158, 2N255, 2N256,  
2N307, 2N554, T03GP \$5 for \$12  
PNP 2N123, 2N107, CK722 5 for \$1; NPN 2N292,  
2N3, 2N10, CK722 5 for \$1; PNP 2N223 c30 @,  
12 for \$9, 100 for \$65.  
PNP 2N670/300MW c50 @, 10 for \$4  
PP 2N671 1 Watt e75 @, 10 for \$6  
Round or Diamond Base Mica Kit c30 @,  
Power Heat Sink Fins 80 Sq \$1.39.  
Kit Glass Diodes equiv. 1N34A, 46, 48, 51,  
12 for \$1, 100 for \$6, 1000 for \$50

"TAB" TERMS: Money Back Guarantee!  
Our 18th year. \$2 min. order  
F.O.B. N.Y.C. Add. nyp charges  
or for C.O.D. 25% Dep. Prices  
shown subject to change.  
111-GB Liberty St., N.Y. 6, N.Y.  
Send 25¢ for Catalog



This modulator produces a complete vhf TV carrier. The strength of the rf output signal is 1 volt. Unit is made by Jerrold.

cables becomes too great and we get into trouble with amplifiers. However, in the usable band, coax is our own private broadcasting space, and we can do anything we like. We can broadcast TV on frequencies other than those assigned by the FCC, for instance. And just as channel 4 signals from New York City cross channel 3 signals from Philadelphia at Trenton, N. J., going in opposite directions, we can similarly broadcast two ways in our own private space, the coaxial cable. We must obey the physical laws, however. We cannot, for example, broadcast two channel-3 signals simultaneously. It confuses the TV receivers.

### Four "extra" channels

Let's look at the unused spectrum space we have—the space not used by standard TV receivers or FM sets. Since TV uses frequencies between 54 and 88 mc and 174 and 216 mc, we have a good area below 54 mc where losses will be low. We can broadcast (in the cable) at these frequencies (called, in the trade, subchannels). Creating these subchannels is simple: we convert a standard TV channel to a subchannel by a simple heterodyne converter.

TV channels are 6 mc wide, but the job of working with TV is easier if there is a blank, unused channel be-

tween each working channel. Therefore, we find that we can easily have four channels below channel 2, which starts at 54 mc. For example, we could have channels which we'll designate 07, 09, 011, 013. Fig. 3 shows the frequencies chosen for these subchannels.

This arrangement has a secondary value since a single broad-band converter can change all these frequencies at one time, with one oscillator, to the high channels—7, 9, 11 and 13—an economy in some applications.

Since we can do these things, we need to look at devices for coupling into a coaxial cable which loops from room to room. This is not too easy if we stick to the concept of using a wall plate outlet which contains the necessary matching and isolation networks. It is likely to make it necessary to take out the plate whenever we wish to change the function in the room. For instance, to change from an rf receiver to a video monitor or camera, we would have to change the outlet circuitry. This is too cumbersome, especially for nontechnical operating people.

One approach to this is simply to refrain from putting any works into the wall in the first place. Just bring out the cable ends and plug whatever devices you need between the ends. If the outlet is not to be used, merely

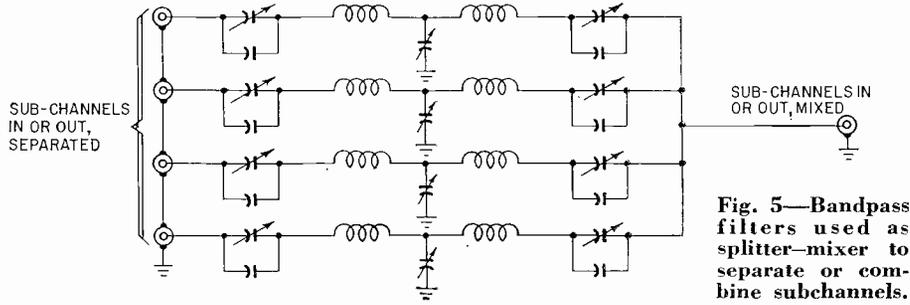
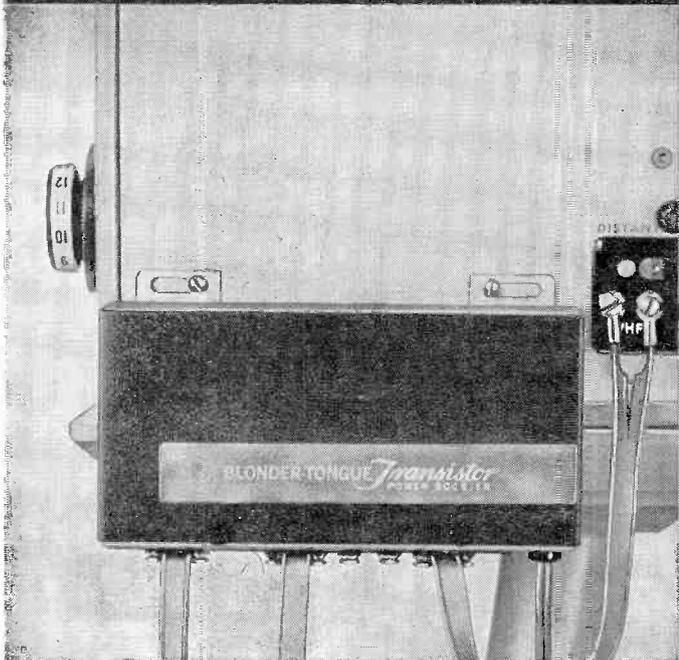
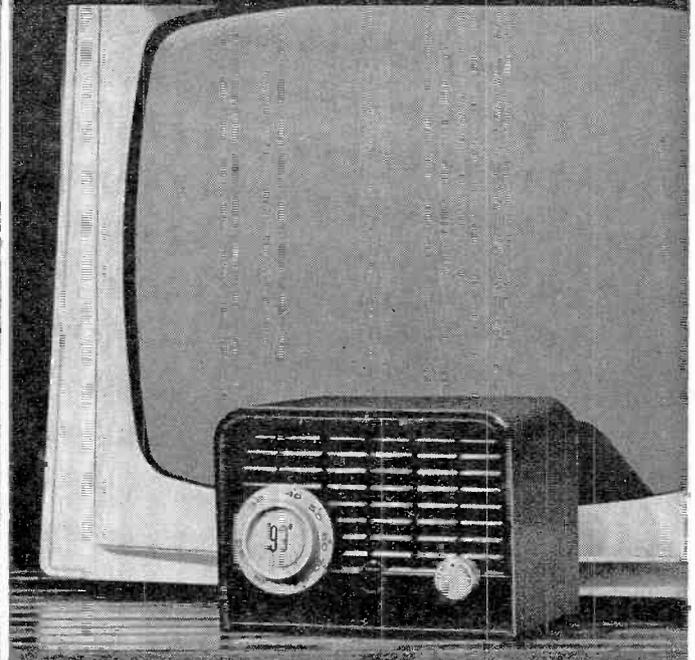


Fig. 5—Bandpass filters used as splitter-mixer to separate or combine subchannels.

# WEAK SIGNAL?

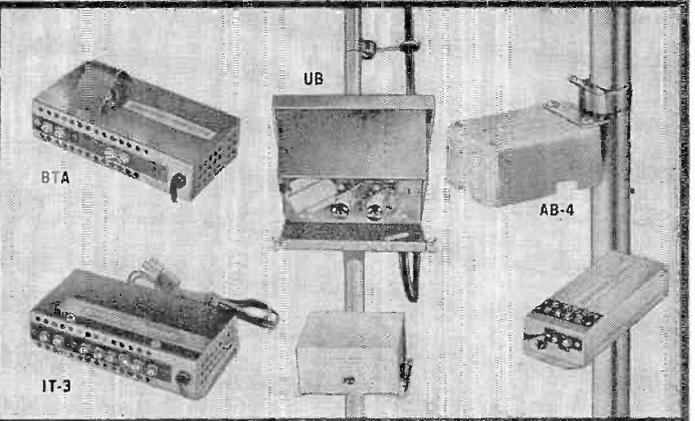


# READY FOR UHF?



## TV & FM AMPLIFIERS

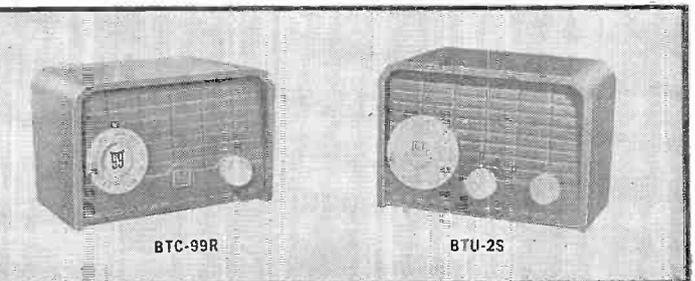
MODEL	DESCRIPTION	GAIN AVERAGE	AMPLIFIER	MOUNTING	LIST PRICE
BTA	Home VHF/FM booster for single set.	8 db	Tube	Indoor	15.70
B-24c	Home VHF/FM booster for up to 4 sets.	9 db	Tube	Indoor	24.95
IT-3	Home VHF/FM booster for up to 4 sets.	12 db	Transistor	Indoor	33.00
AB-4	Home VHF/FM booster, battery powered. For up to 4 sets.	12 db	Transistor	Indoor or Mast Mounted	29.95
AB-2	Home VHF mast mounted booster. Remote power supply.	10 db	Tube	Mast Mounted	53.95
UB (70-83)	UHF booster (ch 70 thru 83).	15 db	2 Tubes	Mast Mounted	84.50
UB (72-76)	UHF booster (ch 72 thru 76).	21 db	2 Tubes	Mast Mounted	103.75



## UHF CONVERTERS

MODEL	IMPEDANCE	INPUT CHANNELS	OUTPUT CHANNELS	GAIN	LIST PRICE
BTC-99R	300 Ohm	14 thru 83	5 or 6	—	23.95
BTU-2S	300 Ohm	14 thru 83	5 or 6	5 to 8 db	39.95
BT-70	300 Ohm	70 thru 83	5 or 6	5 to 8 db	41.50

Where all other methods fail to bring in UHF channels, use the model UB-UHF amplifier with the BTC-99R, the BTU-2S converter, or any all channel (VHF and UHF) receiver.



## SELECT THE BLONDER-TONGUE TV PRODUCT TO DO THE JOB BEST

From the world's only matched, and integrated line for CATV, CCTV, ETV, MATV and home TV.  
Available through parts distributors. Write for 28-page planning and installation manual.

engineered and manufactured by

**BLONDER-TONGUE**

9 Alling St., Newark, N.J.

Canadian Div.: Benco Television Assoc., Tor., Ont. Expert: Rocke Int'l. Corp., N. Y. 16, N. Y.-CABLES:ARLAB  
home TV accessories • UHF converters • master TV systems • closed circuit TV systems

# LEARN

electronics theory this easy way.  
No previous technical knowledge required.

# BUILD

the finest professional quality TV Set  
on a practical "pay-as-you-wire" plan.

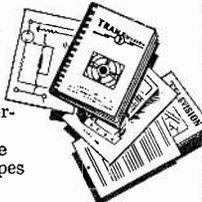
# SAVE

up to 1/2 on cost of equivalent  
educational course plus TV set.

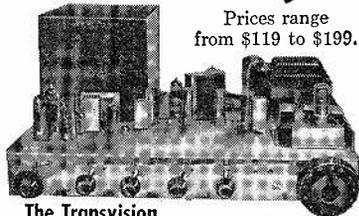
Build the Transvision "Professional" TV Kit described below and get this complete course of study for \$7.95 (available only to Transvision Kit builders.)

Requires no previous technical knowledge. Prepared by experts in teaching novices about electronics.

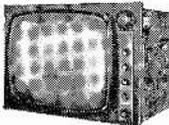
**YOU LEARN:** About block diagrams... How to read and follow electronic circuits... How to use basic measuring instruments... Theory and operation of basic electronic circuits... How to service TV, Radio, and other types of electronic equipment.



Prices range from \$119 to \$199.



**The Transvision "Professional" TV Kit**  
Choice of 19", 23", or 27" Picture Tube... Easy "Pay as You Wire" Terms... Only \$15 for the Starting Package.



A few of the **Professional Quality Features** of Transvision TV Kits:

Choice of push-pull 10-watt audio or output to your Hi-Fi System... D.C. restoration... Ultra-linear sweep circuits... Standard Coil Model PKO Automatic Tuner... Super-sensitivity for fringe areas... Complete line of Accessories for Custom Installations.

U. S. Armed Services and over 4000 schools and colleges have selected Transvision Receivers for educational television.

**ASSEMBLY MANUAL—\$2.00**

See how easy it is to assemble the Transvision Kit. Cost of Manual refunded on purchase of Kit.

**TRANSVISION** New Rochelle, N.Y.  
NE 6-6000

**START NOW — MAIL THIS COUPON**  
TRANSVISION Electronics, Inc., New Rochelle, N.Y. Dept. R.E.  
 Send FREE 12-page Catalog...  I enclose \$2 for Assembly Manual, refundable on purchase of Kit.  
 I enclose \$15 for Starting Pkg. on pay-as-you-wire plan. (Complete Kits range from \$119 to \$199.)

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

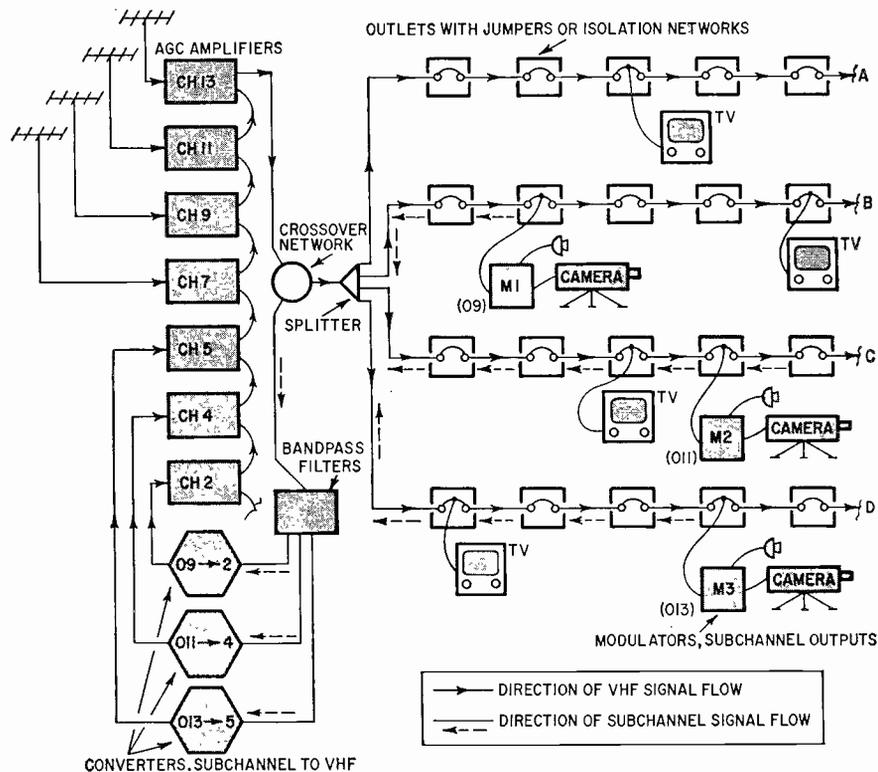


Fig. 6—Typical educational CCTV system layout.

connect the ends with a jumper plug. The approach is simple, but not so easy in practice. The designer must be extremely careful that the necessary connections show no discontinuities and look to the signal exactly as though the cable were unbroken. Else he will be plagued with troubles caused by reflections, ghosts and standing waves.

### Auxiliary equipment

Before a system can be designed around these concepts, some auxiliary pieces of equipment are necessary. One of these is a crossover network quite similar in function to the familiar crossover networks of the hi-fi fan, but working at an entirely different frequency range.

For reasons which will become clear later, we need a crossover at around 50 mc. Fig. 4 gives the schematic of a unit that matches 75 ohms (for coaxial cable) and splits all frequencies below 50 mc out at one terminal and all those above at the other.

Another requirement is met by a multiple bandpass filter (Fig. 5) designed to separate subchannels found in a cable to individual terminals. Once separated they may be processed separately. It can also be used to combine separate subchannels into a single cable. The usual splitters and pads (attenuators) found in vhf television distribution systems are also needed and we must be sure that these devices do not discriminate against the sub-channel frequencies.

With these components we can build a system following the usual rules about distribution system layout. Fig. 6 is the circuit of a simple system we can study for its method of operation. Basically, we have a 7-channel TV distribution system. Each channel is amplified by an amplifier having auto-

matic gain control. Such amplifiers hold their outputs within 1 db of the set level even if input changes as much as 20 db. The amplifiers are bridged in their output circuits so all seven signals appear in the cable leaving the top (channel 13) amplifier. Four are conventional off-the-air television signals—channels 7, 9, 11 and 13. (Don't worry about where you can find such a channel allocation in a given area—if you haven't got a usable setup like this, you can make one by rearranging the channels with vhf-to-vhf converters.)

The other three signals—2, 4 and 5—originate within the building. All signals proceed to the crossover network, entering through the leg that passes frequencies above 50 mc and emerging from the all-pass terminal.

From here, following the solid arrows, they go to the splitter and thus to the four branches of the system. These system branches have the outlets inserted at strategic points—and all outlets have an insert of some sort, either the proper network or a jumper plug.

So far, with the exception of the crossover network, we have a conventional TV distribution system. The difference comes with the cameras and modulators shown connected to outlets in branches B, C and D. These modulators either have subchannel outputs or

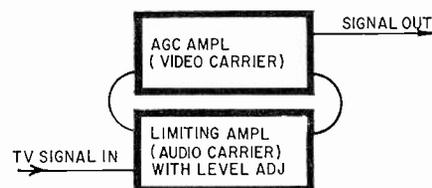
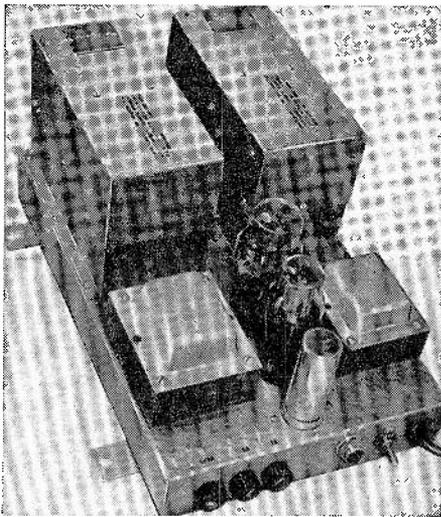


Fig. 7—How audio carrier level is reduced to prevent interference with the video signal.



Crystal-controlled converters.

else their outputs are converted to subchannels.

By using the proper insertion plugs, the subchannel signal from the modulator of each camera is inserted into the system, the energy being sent back toward the amplifier, along the path indicated by dotted arrows. These plugs do not in any way interfere with vhf signals, which pass straight through. Arriving at the crossover network, the subchannel signals are shunted away from the amplifier outputs (which would interfere by acting as a tuned stub) and toward the bandpass filters (illustrated in Fig. 5). The bandpass filter splits them apart and feeds them to the proper converters, where they are converted to vhf channels 2, 4 and 5. From the converters, these vhf signals are sent to the amplifiers and return to the system as vhf signals.

Now, here is what we have. Any camera can be taken, with its modulator, to any outlet and its signal will be seen in every room where the receiver is turned to its channel. All cameras may be operated simultaneously without in any way affecting the others or the off-the-air channels. Note that the head-end equipment does not have to be touched—it is fully automatic.

### How to get 16 channels

The system described uses only seven channels—the greatest number possible with ordinary vhf television receivers. This limitation is imposed by the lack of selectivity in the receivers, which cannot satisfactorily separate adjacent channels such as 2 and 3 or 7 and 8. As mentioned earlier, up to 16 channels may be used, but this requires additional apparatus.

Let us explain. The difficulty with adjacent channels is a beat produced in the video amplifier of the receiver between the aural (sound) carrier of the lower channel with the video carrier of the desired channel. This beat (heterodyne) is the difference between these two frequencies, 1.5 mc, and falls right into the video range, producing a herringbone pattern on the screen. The remedy is to lower the power of the audio carrier considerably. This reduces the power of the beat below a visible

point since a beat note is always directly related to the weaker of the two signals producing it. This can be done with the audio signal because all TV receivers use an FM sound system, and have much surplus audio gain.

Reducing the audio carrier 10 to 14 db is enough, and is done as shown in Fig. 7. The two devices represented by blocks are an age amplifier and a sound limiter, both with adjustable output levels. The signal to be regulated is brought into the sound limiter, where the sound carrier is stripped off. The video carrier and its sidebands are passed on to the age amplifier. In the sound limiter, the sound signal is amplified, limited (clipped) and its level set by an output controlling potentiometer. The video signals are amplified in the age amplifier and their levels set by the level control. The two signals are then mixed, with any ratio desired. The ratio needed is largely a function of the receivers used, and should be set up so that the worst receiver is out of trouble. In this way, the 12 vhf channels (2-13) can be used, and, if we add on the 4 subchannels, we have a 16-channel system.

The kind of system described has other features which greatly extend its use. For example, we could easily isolate any of its branches by removing a jumper plug, terminating the line coming from the direction of the head end, and then do anything we liked in the isolated branch—go video or go on-channel uhf, subchannel vhf, or use the cable for audio, alarm, or ringing a doorbell for that matter. At the splitter, we can interconnect any two branches and make an isolated interconnecting system. The possibilities are limited mostly by the user's imagination.

One of the desirable features from the viewpoint of the user is the freedom from obsolescence—a piece of cable doesn't readily go out of fashion—and that is all there is inside the walls. Anything else is external and can be installed as needed without labor expense.

So there you are, a new, simple concept which gives the system designer immense scope for his imagination. END



# 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 MATH-EMATICS 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.

### FREE If You Send Coupon Now

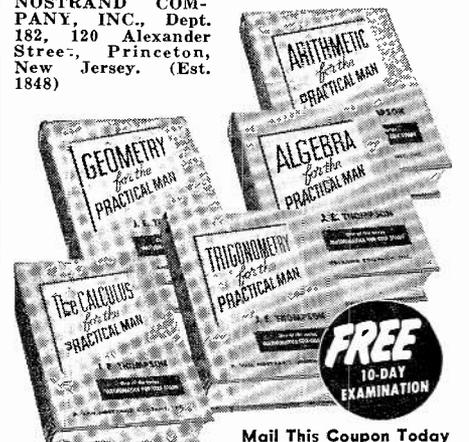
Simplified Accounting—58-page book tells how to keep books; figure balances, profit and loss, collections, depreciation, interest, inventory, credit, etc. Contains 31 sample forms. Lists for \$1, but yours to keep without obligation.

### 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!

### Try Complete Course FREE

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. 182, 120 Alexander Street, Princeton, New Jersey. (Est. 1848)



Mail This Coupon Today

D. Van Nostrand Company, Inc., Dept. 182, 120 Alexander St., Princeton, N. J.

Please send me, for FREE examination, the 5-volume set of Thompson's MATH-EMATICS 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 \$2.85 (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

# EARLY-WARNING ICE ALARM

ICE formations are a problem on microwave relay, radar, vhf and uhf broadcast and on community TV antenna installations. Ice distorts the beam pattern, increases power losses through leakage and may cause hazardous loadings on the structure.

Several types of detectors have been developed to sound an alarm or turn on heaters *after* ice forms. The new early-warning ice alarm, developed by Hydrodynamics, Inc., 949 Selim Rd., Silver Spring, Md., monitors air temperature and precipitation and detects conditions—low temperature and precipitation—that favor ice formation. Thus, it actuates an alarm or turns on heaters *before* ice actually forms. This system is valuable in detecting incipient icing conditions around airports, turnpikes and other sites where advance warning of icing is important.

The circuit of the early-warning ice alarm is shown in Fig. 1. The detection unit, connected between the grid of the control tube and ground, consists of a precipitation detector and a Thermoswitch (Fig. 2) that closes at a critical predetermined temperature—generally around 35° to compensate for evaporative cooling. The two detector elements are in series so the alarm is inoperative until precipitation and freezing temperatures occur simultaneously.

The precipitation detector consists of two parallel coils of fine nichrome wire wound around the outside of a plastic tube. When the coils are dry, the resistance between the terminals is infinite. A drop of water shorts the coils together and the resistance drops to around 500,000 ohms.

A 2.8-watt 6-volt heater inside the detector coil form melts sleet or snow so the detector responds equally to all types of precipitation. It also keeps the detector warm to hasten drying so that it clears itself when precipitation stops. It is fed 6 volts through the cable shield.

When temperature closes the Thermoswitch and precipitation shorts the detector coils, current flows from the upper end of the 6-volt winding through the relay, grid biasing resistor and

detection head to ground. The voltage developed across the detection unit upsets the bias on the grid and causes the relay to pull in and flash the alarm or operate an auxiliary relay to turn on heaters.

The 5-megohm pot enables the operator to adjust the threshold sensitivity to compensate for accumulation of dirt on the precipitation detector. The momentary switch is for testing the amplifier and alarm circuits. **END**

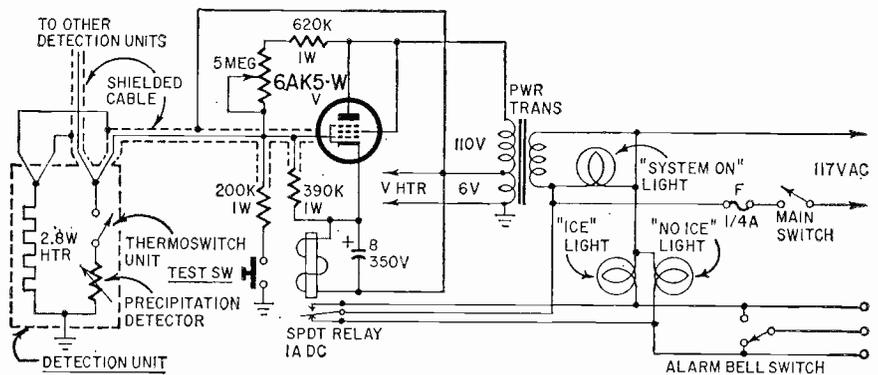
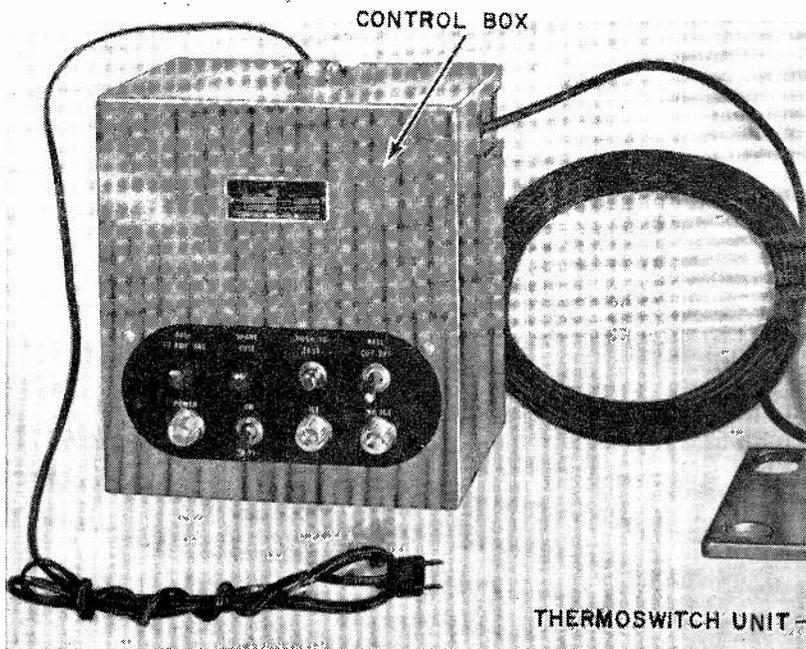
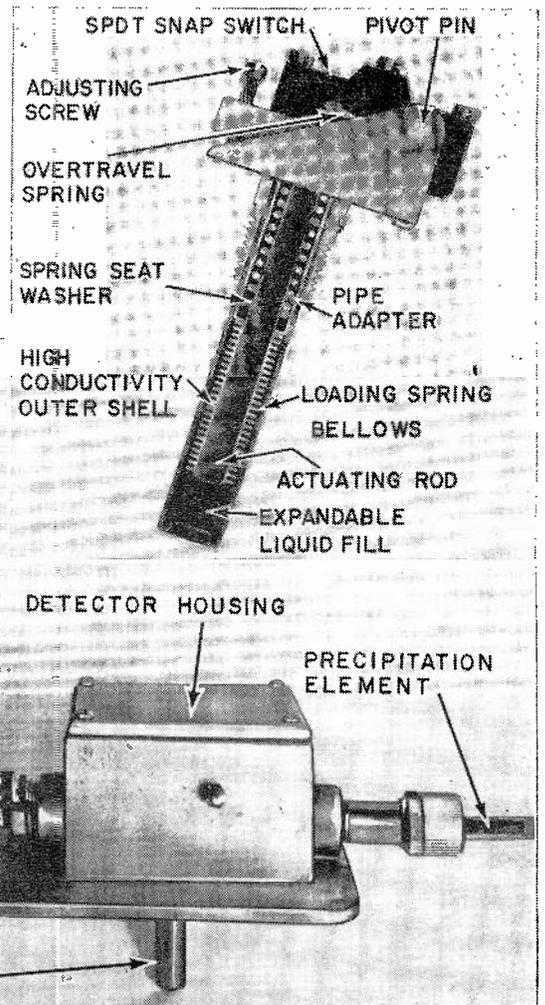


Fig. 1—Diagram of the circuit used to detect incipient icing conditions.

Fig. 2—Internal construction of the Fenwal Thermoswitch.

The complete ice alarm system.



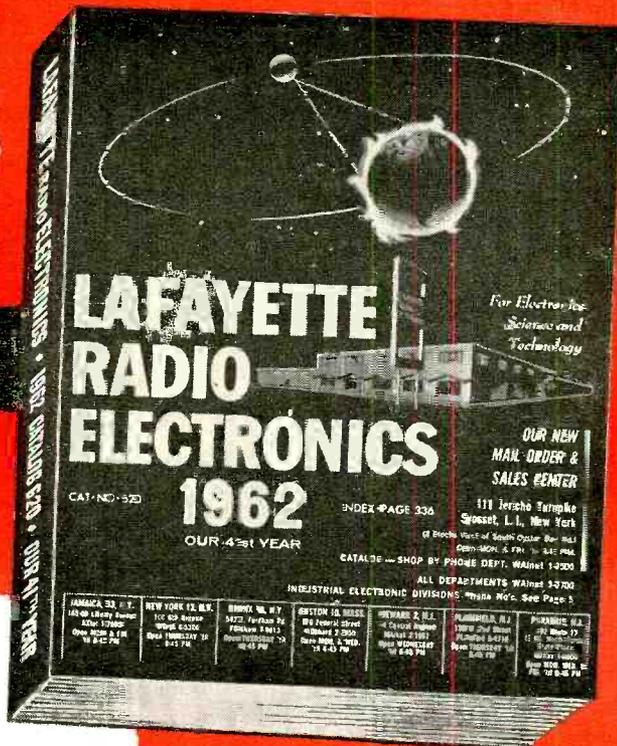
# FREE!

## LAFAYETTE

**340 PAGE 1962  
ELECTRONICS CATALOG**

*"America's Hi-Fi &  
Electronics Shopping Center"*

Yours free for the asking — the biggest, best and most comprehensive catalog in the 41-year history of Lafayette Radio. Audiophile, Experimenter, Hobbyist, Technician, Engineer, Student, Serviceman, Dealer — you'll find what you want in this latest Lafayette catalog.



**CATALOG # 620**

**LARGEST STOCK SELECTION** Stereophonic Hi-Fi equipment, Citizens Band, Ham and Amateur equipment, Radio & TV parts, Optics, Industrial Supplies, and much more, including all the favorite name brands.

**LAFAYETTE EXCLUSIVES.** Featured are the famous Lafayette Kits . . . dollar for dollar the best value for your money today. You'll also see hundreds of Lafayette specials . . . available on y from Lafayette. And, as always, **SATISFACTION GUARANTEED OR MONEY REFUNDED.**

**LOWEST PRICES.** You'll save money too with Lafayette's low, low prices. The lowest prices are always in the Lafayette catalog.

**24-HOUR SERVICE.** Quick, courteous service is your guarantee at Lafayette. Most orders are fully processed within 24 hours after receipt in the mail Order Division.

**NEW EASY-PAY PLAN**  
Now, **NO MONEY DOWN . . .**  
up to 24 months to pay.



**COMPLETELY WIRED,  
FULL SIZE TUBE TESTER  
TE-15 . . . 19.95**



**10,000  
OHMS-PER-VOLT  
MULTITESTER  
TE-10 . . . 9.95**



**NEW! KORDEX™  
TRANSISTORIZED  
SEMI-KIT TAPE RECORDER  
RT-201 . . . 17.95**

**SUPERHETERODYNE  
COMMUNICATIONS RECEIVER  
KT-200, Kit . . . 64.50  
HE-10, Wired . . . 79.95**



**NEW!  
FM MULTIPLEX  
ADAPTER  
LT-200 . . . 29.50**



**CITIZEN'S  
BAND  
MOBILE ANTENNA WHIP  
HE-800WX . . . 6.95**

### LAFAYETTE'S

**NEW MAIL ORDER HEADQUARTERS  
111 JERICHO TURNPIKE  
(2 Blocks West of South Oyster Bay Rd.)  
SYOSSET, LONG ISLAND, NEW YORK**



**LAFAYETTE RADIO, DEPT. JB-2  
P.O. BOX 10, SYOSSET, L. I., N. Y.**

- Rush my **FREE Lafayette 1962 Catalog 620**
- Please send me # \_\_\_\_\_, shipping charges collect.
- I am enclosing \$ \_\_\_\_\_.



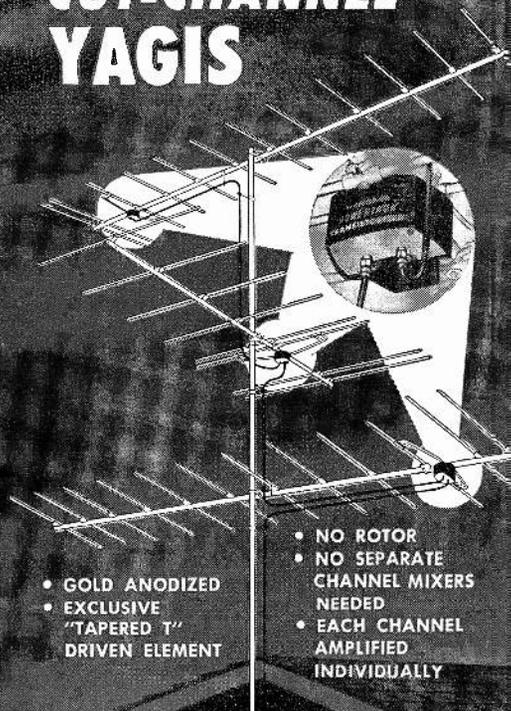
**340 PAGES**

Name \_\_\_\_\_

Address \_\_\_\_\_

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

# NEW *Winegard* ELECTRONIC CUT-CHANNEL YAGIS



- GOLD ANODIZED
- EXCLUSIVE "TAPERED T" DRIVEN ELEMENT

- NO ROTOR
- NO SEPARATE CHANNEL MIXERS NEEDED
- EACH CHANNEL AMPLIFIED INDIVIDUALLY

## AMPLIFIED TV RECEPTION IN ALL DIRECTIONS

**ABSOLUTELY THE ULTIMATE IN BLACK AND WHITE AND COLOR FRINGE AREA RECEPTION!**

Winegard's new cut channel yagis are the **HIGHEST GAIN (28 DB) TV ANTENNAS EVER MADE!** Each is powered by a transistor amplifier individually peaked for perfect results. Because TV signals are amplified at the point of interception, the finest possible signal-to-noise ratio results.

Each Powertron yagi amplifier has two 75 ohm coaxial connectors: for down-lead to the power supply and from built-in mixing coupler for connection to another Powertron without interaction.

Power consumption is only .05 Watt each. Eight Powertron yagis can be run from one power supply on one down-lead. Low band, FM and all channel models can be stacked 72" apart. High band models can be stacked 30" apart and placed between low band.

There are six (8-element) cut channel and broad low band models—eight (12 element) cut channel and broad high band models plus two FM and three all channel models. Ideal for motels, apartments, trailers, wherever the finest installation is needed.

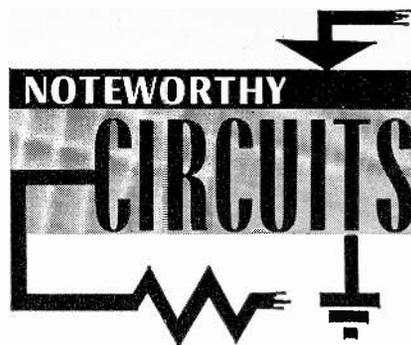
**Run up to 8 antennas from one power supply**

For full details ask your distributor or write for technical bulletin.



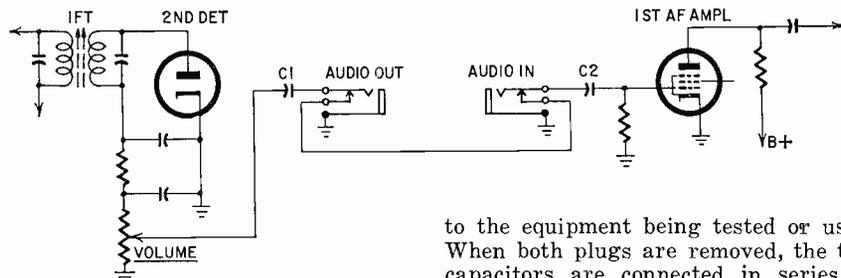
# Winegard

3013-2E. Kirkwood • Burlington, Iowa



## HANDY TESTER FROM OLD RADIO

By using the circuit modification shown, any transformer type receiver can be used as an audio amplifier for testing tuners, preamplifiers, etc., for signal tracing or troubleshooting, and as a signal source for checking ear-phones, amplifiers and signal-operated relays.



The two jacks shown in the diagram can be placed anywhere on the chassis, but the closer to the takeoff point the better. If the connection between the grid lead and the AUDIO IN jack is more

than a few inches long, the wire should be shielded. Remove the original coupling capacitor from the set and substitute two capacitors, C1 and C2, each having double the value of the capacitor removed. Installing two capacitors, one in series with each jack, eliminates the need for external coupling capacitors

to the equipment being tested or used. When both plugs are removed, the two capacitors are connected in series to provide the original coupling capacitor value. (NOTE: Do not use this arrangement in ac-dc receivers, nor plug ac-dc equipment into the jacks because of the potential shock hazard.)—*Louis Maggi*

## MINIATURE PHOTOELECTRIC ALARM

Tiny silicon diodes, cadmium sulphide photocells and an acorn-size radio-control relay make it possible to construct photoelectric alarms much smaller than comparable units of a few years ago. Using the parts specified, you can construct a photoelectric alarm in the small plastic box in which the relay is shipped and still have room to spare. The alarm operates satisfactorily at 12 feet with a 50-watt lamp and a double convex lens to concentrate the beam. I used a Jewell relay (Lafayette F-260), Lafayette MS-827 photocell, a 1N538 silicon rectifier and a miniature pot and electrolytic.

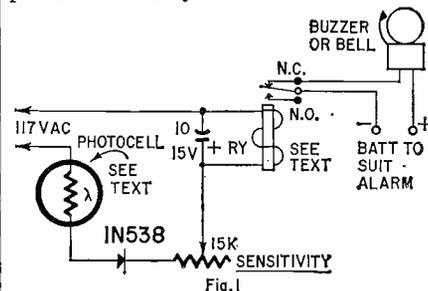


Fig. 1 shows the circuit wired so the alarm sounds while the light beam is broken and stops when light is restored. To adjust, set the pot for maximum resistance and plug in the line cord. The alarm will sound. Point the photocell at a light and slowly adjust the pot until the alarm stops. Interrupt the light beam with your hand and the alarm should sound again.

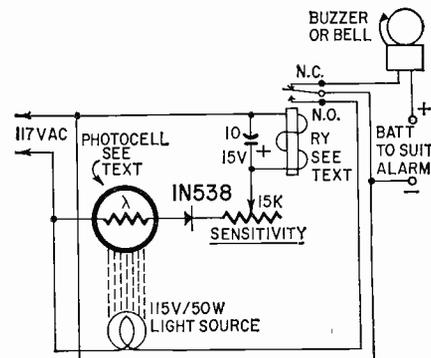
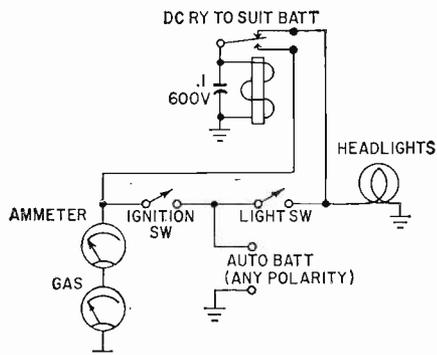


Fig. 2 is the circuit arranged so the alarm sounds continuously when triggered. Here, the light source (exciter lamp) is wired through the normally open relay contacts. To set the alarm, use another light source to trip the relay so it pulls in and turns on the exciter lamp. Interrupting the exciter lamp's beam causes it to go out and the alarm sounds until the relay is reset with an auxiliary light source.—*Martin H. Patrick*

## MODIFIED HEADLIGHT REMINDER

Here is my simplified version of the headlight reminder described on page 116 of the September 1961 issue. I've substituted a buzzer, made from a spdt relay, for the transistor oscillator and audio amplifier. Mount the buzzer at some point under the dash that provides a good sounding board. With the lights

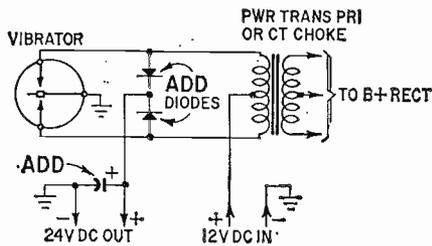
on and the ignition off, the coil circuit is completed through the normally closed contacts and the relay vibrates like a buzzer. When the ignition is turned on, the relay locks in through the normally open contact.



With a little effort, you can connect the buzzer to a separate speaker or to the radio speaker in the car. If you use the radio speaker, be careful to eliminate the possibility of shorting out the audio voltage or feeding high-voltage pulses from the buzzer into the radio's output circuit.—*Thomas A. Markland*

### NOVEL DC-TO-DC CONVERTER

You can obtain 24 volts dc for surplus relays and other equipment from a 12-volt vibrator power supply by using the circuit shown. The added diodes form a full-wave rectifier that "adds"



12 volts to the battery voltage. Add a capacitor of a few hundred microfarads to smooth out the voltage on the 24-volt line.

This method of voltage doubling is adaptable to any voltage and current by appropriate choice of vibrator, diodes and transformer. A center-tapped choke can be substituted for the transformer if a B-plus voltage is not needed.—*Richard L. Koelker* END



I'll get him for you, would you mind holding the line a few milliseconds.

## FREE Catalog

OF THE WORLD'S FINEST  
ELECTRONIC GOV'T  
SURPLUS BARGAINS



HUNDREDS OF TOP QUALITY  
ITEMS—Receivers, Transmitters,  
Microphones, Inverters, Power Sup-  
plies, Meters, Phones, Antennas, In-  
dicators, Filters, Transformers, Am-  
plifiers, Headsets, Converters, Control  
Boxes, Dynamotors, Test Equipment,  
Motors, Blowers, Cable, Keys, Chokes,  
Handsets, Switches, etc., etc.  
Send for Free Catalog—Dept. R.E.

**FAIR RADIO SALES**  
2133 ELIDA RD. • Box 1105 • LIMA, OHIO

PLEASE MENTION  
**RADIO-ELECTRONICS**  
WHEN ANSWERING ADS

WE  
WANT TO BUY  
CERTAIN TYPES  
OF  
UNUSED TUBES  
AND  
ELECTRONIC EQUIPMENT

**BARRY** ELECTRONICS  
CORPORATION

512 BROADWAY, NEW YORK 12, NEW YORK • Walker 5-7000

## ADVANCE YOUR SKILL and EARNING POWER WITH THESE PRACTICAL, FACTUAL PUBLICATIONS

A. C. W. SAUNDERS ANNOUNCES  
A NEW EDITION OF HIS  
FAMOUS TRANSISTOR COURSE, ENTITLED

### "WORKING WITH TRANSISTORS"

Theory and practice in the use of transistors, with detailed circuit analysis. Profusely illustrated, using unique "Block-A-Matic" diagrams, the new look in schematics.

This transistor course has been accepted by technical schools, engineering colleges and electronic firms for their training programs. Highly praised in voluntary testimonials from leading engineers, technicians, service men and electronic companies.

AS A TEXT BOOK—A TREMENDOUS VALUE  
ONLY \$4.95 POSTPAID

(May also be purchased as a home-study course with advisory and grading service. Write for particulars.)

### "WORKING WITH THE OSCILLOSCOPE"

Fast, easy way to master the 'scope. Exclusive "Block-A-Matic" schematics; 26 projects; 200 diagrams; demonstrate its infinite uses in radio, TV, transistors, tubes, etc. A practical working manual for your bench.

ONLY \$3. POSTPAID

### TECHNICAL MANUAL WRITING

A fact-packed home-study course in 20 lessons

Essential to meet fast-growing demand for electronic technical writers. Concise, complete, thorough. Covers: writing and construction of commercial and military publications; illustrations and diagrams; layout and reproduction procedures. Includes free consulting and advisory service.

Check coupon for complete details.

ELECTRONIC TECHNICAL PUBLISHING CO. DEPT. RE  
P.O. Box 306, Astor Sta., Boston 23, Mass.

CLIP  
AND  
MAIL  
NOW!

Name .....

Street .....

City & Zone .....

State .....

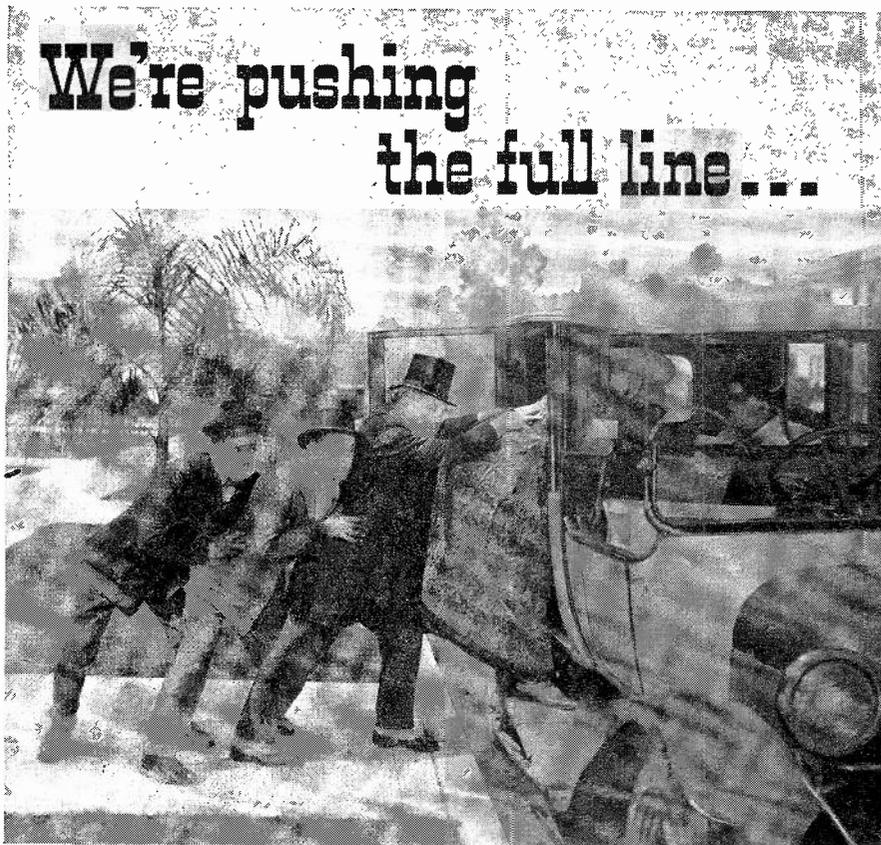
Rush me the following:

..... copies "TRANSISTORS"

..... copies "OSCILLOSCOPE"

I enclose \$.....

..... free details "TECH.  
MANUAL WRITING"

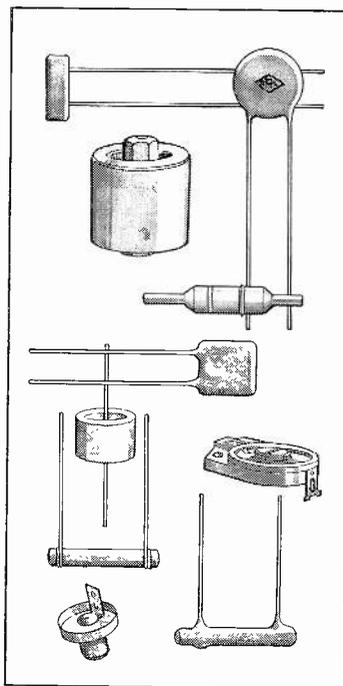


## (of Centralab Ceramic Capacitors)

Sometimes we get so wound up in talking about our "only from CENTRALAB" ceramic capacitors that we forget to remind you about the *standard* ones.

CENTRALAB has plenty of both—as well we should. We *pioneered* ceramic capacitors many years ago—and we still give you the finest product and the widest choice.

Discs, tubulars, buffers, trimmers, feed-thrus—for every standard and special application, in radio-tv servicing or industrial use—CENTRALAB makes them and makes them best. That's why CENTRALAB is the best ceramic capacitor line for you to buy.



**Centralab.**

THE ELECTRONICS DIVISION OF GLOBE-UNION INC.  
922L EAST KEEFE AVENUE • MILWAUKEE 1, WISCONSIN  
CENTRALAB CANADA LIMITED—AJAX, ONTARIO

D-61335

ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS

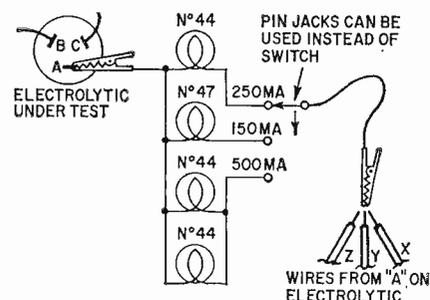
PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS



### SIMPLE SHORT LOCATOR

A few days ago one of the benchmen was servicing a Philco 51-T1602. The filter choke was well cooked. After checking the filters—they tested good—he temporarily replaced them with new filters and a new choke, which was at least twice as big as the original. But when he turned on the set, the choke began to get hot.

Next, he unsoldered all leads from the electrolytic—section A in the sketch—and connected his multimeter (500-ma range) to A and then, one at a time, touched all the leads that had been connected to A with the meter's other lead. Result? Do you know anyone who wants



to buy a vom with its needle wrapped around the pin?

Since then, I've developed a little gadget which tests for shorts, but uses pilot lamps rather than a meter—pilot lamps are much less expensive than meter movements. The simple circuit is shown in the diagram. Note that I actually have a four-range milliammeter. Of course, the unit will locate shorts that show up only under operating voltage, a very pleasant point to ponder.—*Nate Silverman*

### MOUNTING SPEAKERS

The service technician often finds himself confronted with a perplexing speaker replacement problem simply because the bracket, nuts and bolts supplied as mounting accessories will not fit. Usually this happens when the original speaker was held in place with metal screws driven directly into the magnet-shoe assembly.

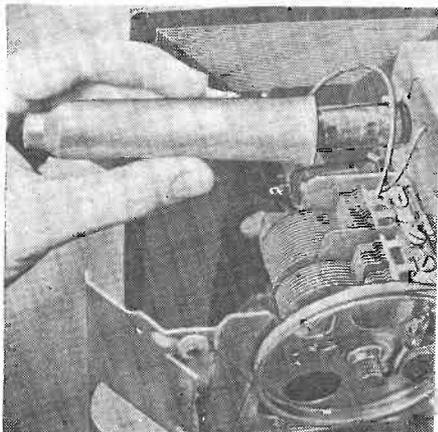
The logical answer, it seems, is to drill identical holes in the replacement unit and go from there with the metal screws. But this is usually the road to ruin, for nine out of ten magnet shoe assemblies are at least 1/8 inch thick. Drilled but untapped, the metal

screw will go in for only a few turns and snap off.

The easy way out is to drill the mounting holes where they belong, making sure the drill size is just under the diameter of the metal screw to be used. Then countersink the hole with a drill larger than the body of the screw, to a depth, from the bottom of the hole, approximately the thread width of the metal screw. With this thread clearance, the screw will now be able to tap its way into the remaining bottom wall of the hole, cut clean and hold firmly.—  
*George D. Philpott*

### CLIP INSULATOR IS TUBE PULLER

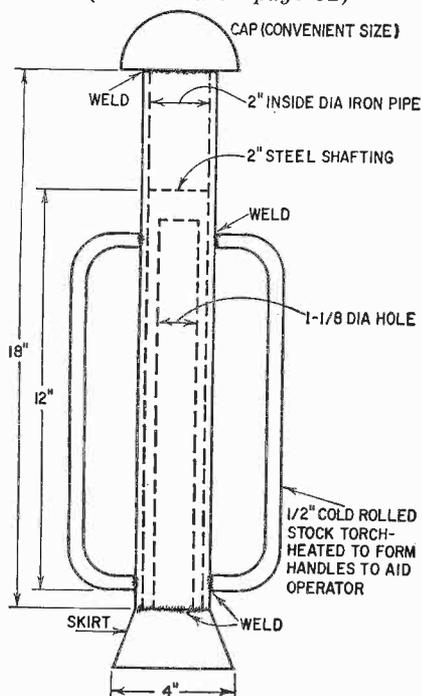
Need a tube puller to remove a hot or hard to reach tube? A Mueller No. 43 clip insulator makes a good substi-



tute if you've misplaced your regular puller or it's busy elsewhere on the shop bench.—*Joe Crane*

### DRIVE GROUND RODS EASIER!

Ground rods are placed where needed, be the ground hard or soft. The odds are that the going will be tough, since no one places equipment in a swamp if he can avoid it. Driving the rods to  
(Continued on page 92)



# YOU NEED THIS...

## FREE GIANT ALL NEW 1962 BA CATALOG

**SAVE UP TO 50% ON B-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**

**BURSTEIN-APPLEBEE CO. Dept. RE-2**  
 1012-14 McGee St., Kansas City 6, Mo.

Rush me New 1962 B-A Catalog No 621

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

**RUSH COUPON TODAY!**

Why not take advantage of the Radio-Electronics

## 4-POINT SUBSCRIPTION PLAN

1

It saves you money

2

It assures you of getting every copy every month

3

It protects you against possible price increases

4

It gives you the best articles by the best authors

1 YEAR \$5 • 2 YEARS \$9 • 3 YEARS \$12

# RCA Announces 2 NEW HOME TRAINING COURSES to Help You Build a Career in Electronics!

RCA Institutes has created two new home training courses designed to give you the very latest, up-to-the-minute training in the fastest-growing areas of this important field. With the addition of these courses, RCA Institutes now offers you the widest selection in its 53-year history!

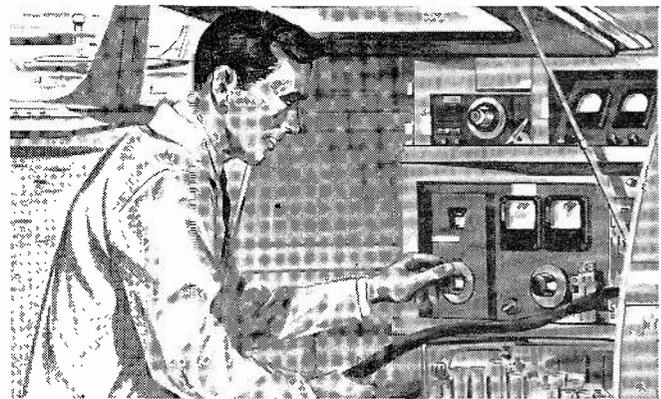
Founded in 1909, RCA Institutes is one of the largest technical schools in the United States devoted exclusively to electronics. A service of the Radio Corporation of America, RCA Institutes offers the finest facilities for technical instruction, especially designed to fit your needs. The very name "RCA" means dependability, integrity and scientific advance.



## Computer Programming

You train for a career in the vital field of business computer programming—for electronic data processing—one of the fastest growing opportunities in the business world today.

**No Previous Technical  
Experience Necessary!**



## Communications Electronics

You get the latest technical training needed to service and maintain 2-way radio and mobile communications, plus the technical foundation for today's space and aviation communications.

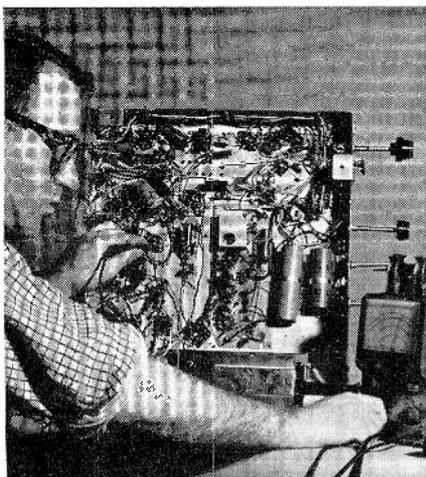
**Prepares You for  
an FCC License**

# HOME STUDY COURSES

*in Electronic Fundamentals · TV Servicing · Color TV  
Communications Electronics · Automation Electronics  
Computer Programming · Transistors*

**Voluntary Tuition Plan.** All RCA Institutes Home Study courses are available under the Voluntary Tuition Plan. This plan affords you the most economical possible method of home study training. You pay for lessons only as you order them. If, for any reason, you should wish to interrupt your training, you can do so and you will not owe a cent until you resume the course. No other obligations! No installment payments required.

**RCA Personal Instruction.** With RCA Home Study training you set your own pace in keeping with your own ability, finances, and time. RCA Institutes allows you ample time to complete the course. Your lesson assignments are individually graded by technically trained personnel, and helpful comments are added where required. You get theory, experiment, and service practice beginning with the very first lesson. All lessons are profusely illustrated. You get a complete training package throughout the entire course.



**You Get Prime Quality Equipment.** All kits furnished with the course are complete in every respect, and the equipment is top grade. You keep all the equipment furnished to you for actual use on the job . . . and you never have to take apart one piece to build another.

## RESIDENT SCHOOLS *in Los Angeles and New York City— You can study electronics in the city of your choice.*

**No Previous Technical Training Required For Admission. You Are Eligible Even If You Haven't Completed High School.** RCA Institutes Resident Schools in Los Angeles and New York City offer training that will prepare you to work in rewarding positions on research and production projects in fields such as automation, transistors, communications, technical writing, television, computers, and other industrial and advanced electronics applications. If you did not complete high school, RCA will prepare you for such training with

**SEND POSTCARD FOR FREE  
ILLUSTRATED BOOK TODAY!  
SPECIFY HOME STUDY OR  
NEW YORK OR LOS ANGELES  
RESIDENT SCHOOL**

courses specially designed to provide the basic math and physics required for a career in electronics.

**Free Placement Service.** RCA Institutes graduates are now employed in important jobs at military installations such as Cape Canaveral, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, and in radio and TV stations all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 92.06% of the graduates who used the FREE Placement Service accepted by important electronics companies . . . and had their jobs waiting for them on the day they graduated!

**Coeducational Day and Evening Courses.** Day and Evening Courses are available at Resident Schools in New York City and Los Angeles. You can prepare for a career in electronics while continuing your normal full-time or part-time employment. Regular classes start four times each year.



### 3 NEW LOCATIONS

In addition to RCA Institutes Inc. courses, Radio Corporation of America offers a limited selection of basic Resident School Courses in Electronics at three new locations . . . Chicago, Philadelphia, and Cherry Hill, N. J., (near Camden). For complete information, write the city of your preference next to your name on the attached postcard.

RCA INSTITUTES, INC. DEPT. RE22 A SERVICE OF RADIO CORPORATION OF AMERICA, 350 WEST 4TH ST., NEW YORK 14, N. Y.  
PACIFIC ELECTRIC BLDG., 610 S. MAIN ST., LOS ANGELES 14, CALIF.

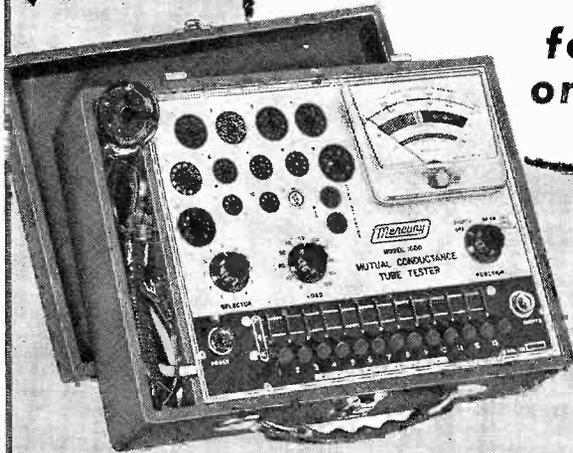


The Most Trusted Name in Electronics

# NEW

## a true DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

for \$ **79.95** Net



**Model 1000  
MUTUAL CONDUCTANCE TUBE TESTER**

Tests all present tube types... and all new tube types including the

- NEW NUVISTORS
- NEW 12-PIN COMPACTRONS
- NEW 10-PIN TUBES
- NEW NOVARS

✓ Tests for true dynamic mutual conductance (GM)

✓ Tests for shorts and leakage between any tube elements

✓ Tests for gas and grid emission... sensitivity over 100 megohms

✓ Tests picture tubes

See your local electronics distributor

**Mercury ELECTRONICS CORPORATION**  
manufacturers of quality electronic products

111 Roosevelt Avenue, Mineola, New York  
West coast branch: 4306 W. Victory Blvd., Burbank, Calif.

The Model 1000 is one of the most up-to-date mutual conductance tube testers available today. It is extremely quick to set-up, enabling you to make a complete and accurate test in just seconds of any tube you may possibly come across—present types or new types—under actual dynamic operating conditions.

### JUST CHECK THESE ADDITIONAL FEATURES

• Also tests foreign and hi-fi tubes, voltage regulators, battery type tubes, auto radio hybrid tubes, thyratrons and most industrial tube types • 13 lever switches provide complete versatility in accommodating all tube types and basing arrangements • Two point test principle overcomes obsolescence caused by new base pin arrangements or new internal jumpers in tubes • Automatic line voltage regulation • Built-in 7-pin and 9-pin straighteners on panel • Long lasting phosphor bronze tube sockets • Handsome two-tone etched aluminum panel • The most complete tube chart conveniently located in cover • New tube listings subscription service available • Housed in handsome gray leatherette case with convenient compartment for cables • Small compact size: 14" x 9½" x 4¾".

\* Slightly higher in the West

(Continued from page 87)

permanently moist soil means 10-foot units, which in turn means driving from a stage to get them started. Sledging at that height is a bit tricky and slow, hence we improved on the old technique by fabricating a "drive barrel" that can readily be manipulated by two men with a force equal to sledging.

The D-shape side handles are made of ½-inch cold-rolled stock torch-heated for bending in the blacksmith's vise. They were arc-welded to the barrel. It consists of an 18-inch length of 2-inch pipe into which is welded a 1-foot section of 2-inch steel shafting with a 1¼-inch bore extending to within 1 inch of the upper end to form the ram section.

The bottom of the barrel has a skirt welded so the device can stand upright in tool truck or shed. An oval cap welded to the top serves as a hand grip as one man manipulates the ram while the second holds the rod steady in getting it started plumb.

Once the rod is started straight, both men grip the side handles and proceed to alternately lift and slam down the device to penetrate most soils as effectively as with a compressed-air tool.—  
*Paul C. Ziemke*

### SEALING UHF LEAD-IN

Because uhf lead-ins of the oval and round types are hollow, moisture must be prevented from entering the tube. The usual method is to leave both ends of the lead-in open with the end connected to the antenna curved over the top of the mast, keeping rain out. A much surer method is to seal the ends.

After the lead-in length has been determined, place the coil of wire in a gas or electric range oven which has been preheated to about 150°F. Allow the lead-in to remain in the shut-off oven for about an hour to dry out any moisture. Then seal both ends of the lead-in with a hot soldering iron. The polyethylene insulation melts readily and an airtight moistureproof seal results.—  
*Warren J. Smith*

### 50 Years Ago

In Gernsback Publications

#### HUGO GERNSBACK, Founder

Modern Electrics.....	1908
Wireless Association of America.....	1908
Electrical Experimenter.....	1913
Radio News.....	1919
Science & Invention.....	1920
Practical Electrics.....	1921
Television.....	1927
Radio-Craft.....	1929
Short-Wave Craft.....	1930
Television News.....	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In February, 1912, Modern Electrics The Quenched Spark, by C. A. LeQuessne, Jr.

The Marconi Valve Receiver. Wireless Transmission of Secret Messages.

Universal Detector, by R. Cowden. An Improved Poulsen Ticker, by Ellery W. Stone.

A Simple Loading Coil, by Allen Dahlquist. A "Micrometer" Tuning Arrangement, by F. E. Sickles.

## fix ELECTRIC APPLIANCES \$3 TO \$5 AN HOUR

FREE BOOK tells about profitable spare-time or full-time business that pays \$3-\$5 hour—right at home! 400 MILLION Appliances now in use. People need them fixed. YOU make good money doing it. Our complete, easy course trains you for top earnings. At no extra charge you get time-saving Appliance Tester. Get FREE Book, FREE Sample Lesson! Mail coupon NOW.

NATIONAL RADIO INSTITUTE, Appliance Div. Dept. FB2, Washington 16, D.C.

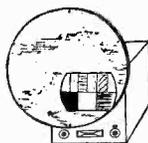
Send FREE Book, FREE Appliance Repair Course Lesson.

Name.....

Address.....

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

## CONVERT TO COLOR TV



**COLORDAPTOR**—A simple 10-tube circuit and rotating color wheel converts any size B & W TV to receive compatible color.

**COLORDAPTOR**—Easily attached to any TV set, does not affect normal operation, often built from parts experimenters have on hand, BRILLIANT COLOR!

Complete booklet—gives theory of operation, all construction details, schematic, and sample color filters..... **\$195**

Essential Parts Kit—Includes all special parts—coils, delay line, crystal, color filters. Add \$1.00 for sets over 16". **\$19.95**

**COLORDAPTOR**

1798 Santa Cruz, Menlo Park, Calif.

TECHNICIANS'

# NEWS

## MAKE COMPLAINTS PAY OFF

New York, N. Y.—Handle customer complaints immediately and you may save the customer. You spend money on advertising to get new customers, so why not spend a little to save one you already have. These words were part of a talk given by Jules W. Rubin, national advertising manager of Allied Radio, at a meeting of the American Management Association.

Another interesting point of the talk was Mr. Rubin's statement that prompt action on a complaint, in addition to turning the complaining customer into a public relations representative for the firm, probably will convert the customer to one of the firm's best sources of new business—he will recommend the company to friends.

If the customer has a complaint, real or imagined, and sees it handled quickly to his satisfaction, he will sing your praises.

## AL MERRIAM DEAD

Elbert (Al) Merriam, national service manager of Symphonic Electronic Corp., died of a heart attack late in November. Service manager of Sylvania Home Electronics Corp. for years, he was known to numerous radio technicians throughout the country.

## FREE ADS FOR TECHS

Aurora, Mo.—The local radio station, KSWM, is going to cooperate with TESA of SW Missouri by giving spot announcements plugging TESA and telling the public how to identify a TESA shop. TESA will boost the station by setting pushbuttons on car radios and home sets that have pushbuttons to the station when they service such sets.

## TECHS NEED UPGRADING

Harrisburg, Pa.—Upgrade your business to survive, was the message given to delegates of the Pennsylvania Federation of Television & Radio Service Associations by Edward Wimmer, vice president of the National Federation of Independent Businesses, to a meeting of the FTRSA in the Hotel Harrisburg.

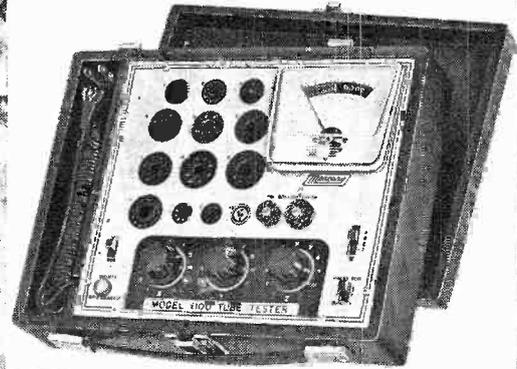
Mr. Wimmer's subject was "Unfair, Unjust Competition." He included suggestions on how to upgrade a business: "Instead of spending your money on trading stamps and other gimmicks, lay a bright new rug on the floor of your store and put up a bright neon sign to let the public know you're in business. Paint the walls and ceiling in bright contrasting colors, and up-

## Model 1100 TUBE TESTER

# New... TESTS THEM ALL!

Tests all present and all new tube types including:

- NEW HUVISTORS
- NEW 12-PIN COMPACTRONS
- NEW 10-PIN TUBES
- NEW NOVARS



... and is priced amazingly low ... only **\$39<sup>50</sup>** Net

✓ Tests for dynamic cathode emission

✓ Tests for shorts and leakage

✓ Tests for grid leakage

✓ Tests for gas content

See your local electronics distributor



### ELECTRONICS CORPORATION

manufacturers of quality electronic products

111 Roosevelt Avenue, Mineola, New York

West coast branch: 4306 W. Victory Blvd., Burbank, Calif.

Here is the answer to aggressive-minded technicians who seek a dependable, professional performing tube tester at a minimum cost. Hard-to-find tube defects are a snap for the Model 1100! It will test all the present tube types and all the new tube types... in fact any type you may possibly come across. It is so compact and versatile, the serviceman will want it at his side wherever he goes.

### JUST CHECK THESE ADDITIONAL FEATURES

- Also tests battery type tubes, auto radio hybrid tubes, voltage regulators, foreign and hi-fi tubes, thyatronns and most industrial tube types • Exclusive meter bridge circuit provides accuracy found only in the more expensive tube testers • Will detect any short in a tube, even where internal pins are tied or heater is tapped • Checks each section of multi-section tubes separately • Long lasting phosphor bronze tube sockets • Handsome two-tone etched aluminum panel • Built-in 7-pin and 9-pin straighteners on panel • The most complete tube chart conveniently located in cover • New tube listings subscription service available • Housed in handsome black leatherette case with a special lead compartment • Small compact size; only 10 3/4" x 8 1/4" x 3 1/4".

\* Slightly higher in the West

## AUDIO unlimited

Specializes in SAVING YOU MONEY

- ✓ FACTORY FRESH COMPONENTS
- ✓ LOWEST POSSIBLE QUOTATIONS
- ✓ FAST DELIVERY

We are FRANCHISED DEALERS for most Hi-Fi lines. Most orders SHIPPED PROMPTLY from stock. RECORDING TAPE at LOWEST PRICES. FREE 95 page STEREO CATALOG 192R Lex. Ave., Cor. 32 St., New York 16, N. Y. Visit Our Showroom

### HI-FI RECORDING TAPE

Splice Free (except 2400') Freq. Resp.; 20, 20,000 cps. 15 day money-back guarantee

	3-11	12-23	24"
1200' 7" Acetate	\$1.29	\$1.17	99¢
1800' 7" Acetate	1.79	1.59	1.45
1800' 7" Mylar	1.99	1.95	1.85
2400' 7" mylar	2.69	2.59	2.49
2400' 7" tensilized mylar	2.99	2.95	2.90

Can Be Assorted. Add 15¢ Postage Per Reel 10¢ for 24+ Lot Orders

HI-FI COMPONENTS, TAPE RECORDERS  
At wholesale prices shipped within 24-48 hours. We'll airmail low quotes on your packaged Hi-Fi inquiries. Send for free wholesale catalogue.

**CARSTON** 125-RD East 88 St. New York 28, N. Y.

# NEW SAMS BOOKS

**ONLY COURSE OF ITS KIND!**

## COMPUTER BASICS

This great 5-volume set on computer theory, design, operation, testing and maintenance provides all you need to know for a career in today's vital data processing field! Over 1200 pages, 455 illustrations.

5 Volumes in slip case ..... **\$22.50**  
(descriptive folder available on request)




### Howard W. Sams Handbook of Electronic Tables & Formulas, Revised Edition

Completely revised, updated and enlarged to include nearly 50% more material than the popular first edition. Truly a one-source reference for all electronics charts, tables, formulas, laws, symbols, constants, standards, codes, service, installation and design data. Six FULL-COLOR foldout pages show latest FCC assignments for the entire frequency spectrum. Only book of its kind! Hard cover. **\$3.95**  
192 pages; 5½ x 8½". Only .....

### Bench Servicing Made Easy

Bob Middleton's new and really practical book on troubleshooting techniques. Here is a step-by-step guide to the location of defective components in any TV circuit you're likely to run across—the kind of help servicemen want but haven't found until now. Presents brand-new material based on the author's own workbench experience. Eleven big-help chapters. 160 pages; 5½ x 8½". Only **\$2.95** .....

### Design & Operation of Regulated Power Supplies

Regulation of supply currents and voltages is an extremely important factor in today's electronic equipment. This valuable book describes dozens of different methods for controlling power supply outputs. Covers circuit operation; discusses variations in design parameters to achieve desired results. Six fact-packed chapters. 128 pages; 5½ x 8½". **\$2.95** Only .....

### Servicing Transistor Radios, Vol. 10

Covers 53 models produced in 1960-61. Includes famous PHOTOFAC<sup>®</sup> Standard Notation Schematics, chassis photos, alignment instructions, parts lists and replacement data for each model. **\$2.95**  
160 pages; 8½ x 11". Only .....

### NEW! Howard W. Sams REPLACEMENT GUIDE

#### FOR TV & AUTO RADIO CONTROLS

Vol. 4. Greatly expanded—covers 30,640 TV and 1,286 auto-radio models. Lists recommended replacement controls of Centralab, Clarostat, CTS-IRC, and Mallory. 8½ x 11". Only **\$1.00** .....



## HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. B-22  
1720 E. 38th St., Indianapolis 6, Ind.

- Send me the following books:
- Computer Basics, 5 Vol. (CSS)  Send folder
  - Electronic Tables & Formulas (HTF-2)
  - Bench Servicing Made Easy (BSE-1)
  - Des. & Op. Reg. Power Supplies (RPS-1)
  - Servicing Transistor Radios, Vol. 10 (TSM-10)
  - Replacement Control Guide, Vol. 4 (RGC-4)

\$.....enclosed.  Send Free Book List

Name \_\_\_\_\_

Address \_\_\_\_\_

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

IN CANADA: A. C. Simmonds & Sons, Ltd., Toronto 7  
(outside U.S.A. priced slightly higher)

grade your store to the point where your customers will find it a pleasure to walk in."

### TEXAN ELECTRONICS

Weatherford, Tex.—State tax on radio and electronic components has been repealed. A general retail sales tax has been substituted.

Also repealed was the bond required of the service dealer and the technician.

This word comes from James M. Cotten of the Texas House of Representatives.

### COLOR TV TRAINING

Philadelphia, Pa.—Almost 300 TV service technicians attended the second in a series of six seminars on the intricacies of maintenance and repair of color TV at the Drake Hotel.

A session is being held every three weeks, and every technician who completes the course successfully will be awarded a certificate stating that he is qualified to service and repair color TV sets. The program is being sponsored by Almo Radio Co.

Morris Green, president of Almo, pointed out that service follows sales and service dealers should be prepared to handle every technical problem.

Mr. Green said Almo has arranged for some of the top service engineers in the country to conduct the classes. These factory experts, he explained, will show service technicians every conceivable timesaving shortcut known in the color-TV field today, which in turn will benefit the customer, who will receive finer workmanship at a lower cost.

### TECHS AND TAPE

New York, N. Y.—Service calls on tape recorders can be reduced if the customer is shown how to operate the device, according to Allan E. Bachman, executive vice president of the National Better Business Bureau. Although today's tape recorder is not difficult to operate, he states, the customer should be shown exactly how to operate it. The Better Business Bureau has found that customer dissatisfaction with electric and electronic equipment is due largely to lack of knowledge and understanding of how it works, rather than an inherent fault of the equipment itself.

### WEST COAST ROUNDUP

Oakland, Calif.—Yellow Page advertising was the topic of a recent Alameda County Television & Radio Association meeting at the Driftwood Restaurant. Guest speaker was Jack Morrison, assistant sales manager of Pacific Telephone & Telegraph directory advertising.

Sacramento, Calif.—This California State Electronics Association chapter discussed a system that would allow the association to provide service to the public on Sundays and holidays. The objective is to give the public confidence that when they call the association, they know that they will be referred to a firm that is reliable and can be trusted.

Hermosa Beach, Calif.—Three groups sat in the Hot-n-Tot Cafe for a meeting during which the 1962 Sylvania TV chassis was shown and discussed by factory service representatives. Groups attending were the South Bay RTA-CSEA, and the San Antonio and Los Cerritos chapters of CSEA.

Los Cerritos, Calif.—The telephone as a business tool and classified advertising as a sales aid made the meat of a recent meeting of the Los Cerritos chapter of the California State Electronics Association.

San Diego, Calif.—Color TV course was flooded, with 88 instead of the expected 40 technicians attending. The course is free to association members. There is a charge of \$2 per session for nonmembers. The course was planned by the San Diego and North Shore chapters of CSEA.

Burbank-Glendale, Calif.—About 150 members of this CSEA chapter attended a 2-hour discourse on color TV by Charles Wack, RCA field-service engineer. Slides were used to illustrate the talk.

Bakersfield—A representative of Sprague Electronics spoke to the local technicians group on "Condensers Are Here to Stay." The speaker went into the Sprague capacitor concept and the future of electronic equipment.

San Diego—This chapter and North County chapter joined for their combined installation dinner and dance at the El Cortez Hotel. The newly elected officers for San Diego are Eugene H. O'Brien, president; Howard D. Ellis, vice president, and G. S. Lowell, secretary-treasurer. For North County, G. W. Douglas, president; Jack Cornell, vice president, and Edgar Paden, secretary-treasurer.

San Bernardino—Pricing was subject of talk by Walter Burns. Forty dealers attended.

Stockton—This was second session of a three-part jam course on transistor theory and repair. Jack Hutt, local electronics engineer and instructor, was hired for this program. END



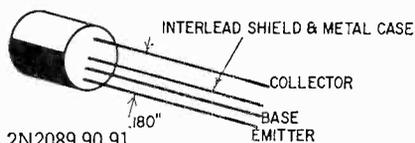
"New type of capacitor, my eye!  
That's a filter-tip butt!"

# NEW TUBES and SEMI-CONDUCTORS

WITH SEMICONDUCTORS AT THE REINS WE start with a group of germanium units for FM radios, continue along with a uhf oscillator, break stride on three TV horizontal output tubes and wind up with a group of flat conduction-cooled selenium rectifiers.

## 2N2089, 2N2090, 2N2091

These three germanium transistors are designed for use as an rf amplifier, oscillator-mixer and if amplifier, respectively, for FM and FM-AM radios. All three are post alloy diffusion transistors (PADT). They feature low collector leakage, high current gain, high  $f_{max}$  and a high collector-base



2N2089,90,91

breakdown voltage. Also, they will work well even when supply voltages are as low as 3 volts.

The 2N2089 is controlled for low noise and high power gain at 100 mc. The 2N2090 features high conversion gain up to 100 mc. The 2N2091 has low output capacitance and conductance at 10.7 mc as well as low noise and good age performance.

Maximum ratings of these Amperex transistors are:

$V_{CB}$	20
$V_{CE}$	20
$I_C$ (ma)	10
$P_C$ (mw)	83
$I_E$ (ma)	11
(reverse ma)	-1
$I_B$ (ma)	1

Characteristics of these transistors are:

	2N2089	-90	-91
NF (noise figure) (typical db)			
(at 100 mc)	8	9.5	—
(at 10.7 mc)	—	3	3
(at 1 mc)	—	1.5	1.5
$h_{FE}$ average	150	150	150
$Z_{RB}$ (Base impedance, ohms)	20	25	27

## T2028

Here is a germanium micro-alloy diffused-base transistor (MADT) designed for use as either a vhf or uhf amplifier in communication and radar circuits operating at frequencies up to

## For The Independent Serviceman Who Wants To Be Truly Independent

# The New Lafayette Associate Store Program Offers You A Most Unusual Opportunity To Own Your Own Business

If you have a basic knowledge of radio, television or electronics, and if you have ambitions for true independence and security, a Lafayette Radio Electronics Associate Store can be the beginning of a profitable and respected career. ■ Within the past year, Lafayette Radio Electronics began to explore the possibility of expanding on a nationwide basis. Twenty men such as you (some with established stores, some with little or no business experience) were granted associate store franchises. They have been given the benefit of Lafayette's many years of experience selling stereo kits, citizen band radios, recorders, science and electronics kits, tools, components, hobby supplies, television repair equipment and all the other things that make this the fastest-growing industry in the country. Today, every one of these men is the owner of a thriving business and is well on his way to a better way of life. (A list of these successful associates is available on request.) ■ As a result of this success, Lafayette has decided to expand the program. We are now looking for a limited number of men who are willing to invest at least \$10,000 to get the things they've always wanted out of life: travel, new home, new car, education for the children, security of their own business. ■ For more information on how you can own a profitable business, fill out and mail the coupon below and find out more about Lafayette's:

**Protected Territory** Yours will be the only franchised Lafayette Radio Electronics Associate Store in your marketing area. This means that when your customers want the advertised and branded merchandise supplied by Lafayette, they'll come to you. **Marketing Direction** With the knowledge gained from past successes, we will help you set up a complete program, from choosing the right location, to designing your store for maximum profits, to setting up your inventory. **Executive Guidance** Our program will help you function effectively in the day to day operations of your store. We'll show you how to deal with customers, how to establish a large, loyal following, how to build public relations. In short, Lafayette will show you how to be the kind of responsible executive who is a success in business, a leader in the community. **Advertising Support** Millions of dollars have been spent to establish Lafayette Radio Electronics and its franchised dealers as the primary source for electronics radio and science equipment. The Lafayette sign in front of your store will indicate to everyone that you are associated with a multi-million dollar organization, one of the largest of its kind in the world. Furthermore, all-year 'round advertising, public relations and promotion campaigns will continue to send customers to your store. ■ Fill out and mail this coupon today. This can be the beginning of a new way of life.

**Lafayette Radio Electronics Corporation**  
165-08 Liberty Avenue, Jamaica 33, New York  
**Mr. Robert Laub**

RE22

Please send me full information on how I can own my own profitable business. I understand there is no obligation.

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



Duotone needles, of course... tipped with genuine diamonds, sapphires or osmium. Most people forget to change their styli or don't know how to change them. Why not suggest a Duotone diamond needle replacement for every phonograph that comes into your shop? It's the stylus with the whole diamond tip that's handset and hand polished. Your customers will appreciate the service and you'll appreciate the increase in business.

Write for Free 1962 Duotone Needle Wall Chart and see DUOTONE Distributor.

**DUOTONE**  
COMPANY, INC. KEYPORT, N. J.

Ask By Name For  
**GENUINE**  
"NO-NOISE"  
PRODUCTS

your assurance of brand name quality

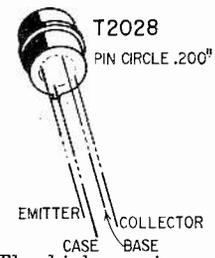
**NO-NOISE Volume Control and CONTACT RESTORER**  
• Cleans • Lubricates • Protects  
• Not a Carbon Wet Solution  
2 oz. Bottle \$1.00  
6 oz. Spray Can \$2.25  
Net to Servicemen

**NO-NOISE TUNER-TONIC with PERMA-FILM**  
• Cleans, lubricates, restores all tuners, including wafer type.  
• Non-toxic, non-inflammable.  
• Economical—a little does a lot.  
6 oz. Aerosol Can \$3.25  
Net to Servicemen

**FREE** with each can of **ELECTRONIC CHEMICAL** products—**5" PLASTIC EXTENDER**  
• Push Button Assembly  
• For Pin Point Applications  
• Does Not Cause Shorts

**ELECTRONIC** Chemical new formula EC-44  
Lubricates, conditions, cleans all electrical contacts. Economical... a little does a lot!  
6 oz. spray can \$3.50  
Net to Servicemen.

**ELECTRONIC CHEMICAL CORP.**  
813 Communipaw Avenue Jersey City 4, N. J.



800 mc. The high maximum frequency of oscillation (typically 1600 mc) and exceptionally low noise figure assure proper operation in such circuits.

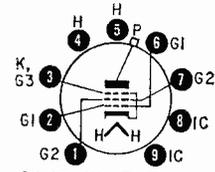
Maximum ratings of the Philco T2028 are:

V <sub>CB</sub>	20
V <sub>CES</sub>	20
V <sub>EB</sub>	0.5
P <sub>total</sub> (mw)	60

High-frequency characteristics when V<sub>CB</sub> = -10.4, I<sub>c</sub> = -1.3 ma and f = 200 mc are:

PG (power gain, typical db)	18
3 db bandwidth (typical mc)	9
NF (noise figure, typical db)	4.0

**6GJ5, 12GJ5, 17GJ5**  
These three tubes comprise a series of high-perveance beam power tubes intended for use as the horizontal deflection amplifier in TV receivers. They come in a Novar envelope. All three are identical except for heater ratings

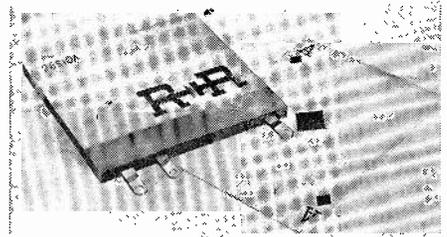


which are: 6.3 volts, 1.2 amps for the 6GJ5; 12.6 volts, 600 ma for the 12GJ5 and 16.8 volts, 450 ma for the 17GJ5. Also, both the 12GJ5 and the 17GJ5 have an 11-second controlled warmup for use in series-string heater circuits.

Maximum ratings for these RCA tubes in horizontal deflection amplifier service are:

V <sub>b</sub> (boost plus dc power supply)	770
(peak positive-pulse)	6,500
(peak negative-pulse)	1,500
V <sub>G2</sub>	220
V <sub>G1</sub>	-55
(peak negative pulse)	330
I <sub>k</sub> (peak ma)	550
(average ma)	175
G <sub>2</sub> (input watts)	17.5

**Flat selenium rectifiers**  
New line of flat conduction-cooled selenium rectifiers have been announced by Radio Receptor. Currently available



units include half-wave, doubler and bridge arrangements in single- or three-phase circuits for voltages up to 130 rms and current outputs to 10 amps dc. These units are only a quarter the size of equivalent air-cooled units.

**DOWN TO EARTH**  
Everyone's going for Audion's "Down to Earth" Hi-Fi Values.  
..... Write for free catalog.  
**audion** 1038-R NORTHERN BLVD ROSLYN, L.I., NEW YORK

**TAPE RECORDERS**  
**HI-FI COMPONENTS SLEEP LEARN KITS**  
Unusual Values Free 1962 Catalog  
**DRESSNER**  
1523RE Jericho Tpke, New Hyde Park, N.Y.

**MERITAPE**  
Low cost, high quality recording tape, in boxes or cans.

**CONVERT TO COLOR TV**  
**COLORDAPTOR**—A simple 10-tube circuit and rotating color wheel converts any size B & W TV to receive compatible color.  
**COLORDAPTOR** — Easily attached to any TV set, does not affect normal operation, often built from parts experimenters have on hand, **BRILLIANT COLOR!**

Complete booklet—gives theory of operation, all construction details, schematic, and sample color filters. \$1.95

Essential Parts Kit—Includes all special parts—coils, delay line, crystal, color filters. Add \$1.00 for sets over 16". \$19.95

**COLORDAPTOR** 1798 Santa Cruz, Menlo Park, Calif.

**TV Tuner Problems?**  
Simply send us your defective tuner complete: include tubes, shield cover and any damaged parts with model number and complaint.  
Send for details and FREE Mailing Kit

**CASTLE TV TUNER SERVICE, INC.**  
5710 NORTH WESTERN AVENUE, CHICAGO 45, ILLINOIS  
653 PALISADE AVENUE, CLIFFSIDE PARK, NEW JERSEY  
IN CANADA: 136 MAIN STREET, TORONTO 13, ONTARIO

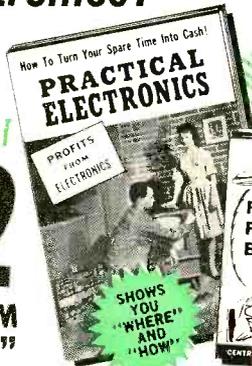
Castle Overhaul  
**ALL MAKES ONE PRICE**  
90 Day Warranty **9.95**

# DON'T TURN ANOTHER PAGE until you clip out this coupon!

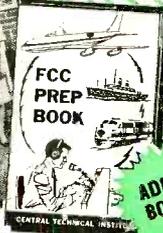
It could be the turning point in your life!  
**Make More Money Soon... with Electronics!**

# GET 2

**"PROFITS FROM ELECTRONICS"**



SHOWS YOU "WHERE" AND "HOW"



ADDED BONUS

# FREE BOOKS

**"FCC PREP BOOK"**

Central Technical Institute's 64-page book on electronics is packed with free information on amazing career opportunities for you in: Industrial Electronics, Automation, Radio, Color TV, Radio-TV Broadcasting, Electrical Wiring, Appliance Servicing, Communications Electronics, Radar, Missiles, Computers, Nuclear Energy, and many others! This free book tells all about Central Technical Institute's different NEW Home Study Course, "PRACTICAL ELECTRONICS." This Home Study course is so complete, it even contains instructions on how to set up and run your own

This handy 31-page book tells you all you need to know to pass the 3rd class FCC Radiotelephone examination, qualifying you to operate radio-telephone transmitting stations used by airlines, police, railroads, emergency services, etc.

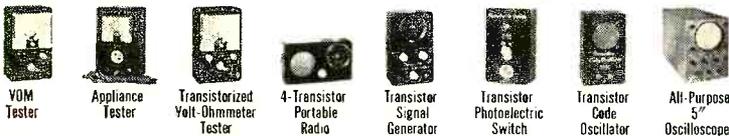
electronics servicing business. FREE "PROFITS FROM ELECTRONICS" book also contains full information on Central's new Instant Kits, below. All you need do to get this valuable book is fill in your name and address on the above coupon, and MAIL IT TODAY!

**GET INTO THE DYNAMIC, \$11,000,000,000 FIELD OF ELECTRONICS!**  
**Gain Higher Income! New Prestige! A Fine Future!**



## BUILD CENTRAL'S NEW INSTANT KITS®

Central Technical Institute's new INSTANT KITS are designed to teach you as you build. Each inexpensive kit comes complete, ready to assemble . . . in only a few short hours of building and learning, you have a piece of test equipment that meets commercial standards, can be used in your business, or sold to customers at a profit. And Central Technical is developing new kits for you to build. See the sample selection below:



**START A BUSINESS OF YOUR OWN . . . OR QUALIFY FOR A HIGH PAY CAREER!**  
 Over 50,000 successful graduates since 1931!

"THANKS to my Central training, I have my First Phone (FCC) Ticket, which gives me an advantage over my competitors. I am a franchised RCA dealer, employ a bookkeeper and usually two servicemen." R. R. "Jack" Merrill, Pryor, Oklahoma.

Superintendent of Communications for the K. C. Southern Railway Company is Central graduate Lawrence D. Fry, with 15 years of railroad communications experience. "Central is a fine school," says Mr. Fry. "I've always recommended it, and have sent several students to Central."

Field Service Representatives for the Bendix Computer Division, L. A., California, are Central graduates E. John Kempf, left, and Robert Young. Mr. Kempf was employed as a maintenance man before he became interested in radio and TV. His first project was building test equipment at home. After enrolling with Central, he began to make extra money repairing radios, auto radios, etc. "The field of Computers is expanding, and there's a real need for trained technicians," he says. "I have found the work to be both profitable and interesting!"



**YOU CAN EARN EXTRA MONEY SOON!**  
**Study at home in spare time—no High School diploma required!**

With a sincere desire to get ahead, make more money and enjoy an interesting career . . . you can earn while you learn, keep your present job, and set your own pace. Find out how much fun electronics can be! See how you can add to your income! High income, prestige, and security for you and your family can be yours! Don't let a 4c stamp stand in your way. MAIL THE ABOVE COUPON TODAY and GET YOUR 2 FREE BOOKS NOW. The little time you spend mailing this coupon may be one of the best investments you'll ever make!

## Central Technical Institute

1644 WYANDOTTE, KANSAS CITY 8, MISSOURI  
**RESIDENT TRAINING**—Central also offers a full-time ECPB-Accredited Technical Institute program at its resident school in Kansas City, Missouri. Mail the coupon at page top for information.

**MAIL THIS NOW!**

Please give me my **TWO FREE BOOKS ON ELECTRONICS** and tell me how I can cash in on opportunities in electronics.

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

Address .....

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

**CENTRAL TECHNICAL INSTITUTE**  
 1644 WYANDOTTE, DEPT. RE 22C  
 KANSAS CITY 8, MO.  
 Accredited Member National Home Study Council

VALUABLE COUPON

NO OBLIGATION!

**CLIP OUT THIS COUPON, FILL IN YOUR NAME AND ADDRESS, AND MAIL TODAY . . . FOR 2 FREE BOOKS PACKED WITH EXCITING INFORMATION ON ELECTRONICS. NO OBLIGATION!**

# 6

## NEW RIDER BOOKS FOR THE MAN IN A HURRY TO GET AHEAD

**HOW TO BUILD ELECTRONIC EQUIPMENT** by J. Richard Johnson. Whether electronic equipment is your hobby, or you are called upon to build it as an engineer or technician, this book will help you do a better, cleaner job and get the most out of the equipment you are building. While it provides complete instructions on how to build electronic equipment starting from the schematic diagram, the kit-buyer — not quite ready to build equipment from "scratch" — will also get better results. Presented in the order in which things would be done in a typical project, the book starts with an explanation of what typical electronic equipment looks like. It progresses to a coverage of the tools and materials, the selection and working of the chassis, layout, checking, painting, marking and calibrating. #286 hard-cover, \$6.95.

**ELECTRONIC EQUIPMENT MADE EASY FOR THE BOAT OWNER** by John D. Lenk. The first book that takes the mystery out of pleasure craft electronics. It provides a working knowledge of what marine electronic equipment is available; what it will do; how it operates; how to install it; how to buy it intelligently and how to use the instruments effectively. An important feature of the book is the recommended equipment chart which includes all types of equipment — tube or transistorized. #287, hard-back, 200 pages, \$5.95.

**SATELLITE TRACKING** by Stanley J. Macko. Welcome to the satellite field! This remarkable book provides a keen insight into the theory and practice of satellite tracking. You will understand why satellites are launched, how they are launched, why they behave as they do and be able to derive the orbital elements of any terrestrial satellite with a minimum of information. The explanation of orbits, orbital elements of a satellite and their computations is made absolutely clear. The mathematics involved consists of no more than simple algebra and trigonometry. #289, hard back, \$5.50.

**FUNDAMENTALS OF ROCKETS, MISSILES & SPACECRAFT** by Marvin Hobbs. This book is the entire story of rocketry from its early days. It treats the theory and applications of the basic elements of rockets, missiles and propulsion systems for space vehicles as well as both manned and unmanned spacecraft. The fundamentals of solid and liquid propellents, rocket engine components, basic rocket and missile elements, aerodynamic shapes of vehicles and nosecones, guidance and telemetry, are covered prior to the treatment of missile and space rocket classes and types. Launching methods for small rockets, and all classes of missiles and space vehicles are included. The background objectives and the basic details of both manned and unmanned spacecraft are treated prior to advanced propulsion concepts. Ideal for those entering the missile or space field as well as for anyone desiring to become better acquainted with its principles and details. #278, hard back, \$8.95.

**MASTER CARTRIDGE SUBSTITUTION GUIDEBOOK** by Jack Strong. Enables you to locate the exact or equivalent replacement cartridge for nearly every record player manufactured since 1930. It pays for itself over and over again by: saving time locating the right replacement quickly; saving money by cutting down on the number of cartridges you need to stock. Even old record players can be serviced through the use of universal replacement types. Every service technician will want this guidebook. #288, \$2.00.

**TUBE CADDY-TUBE SUBSTITUTION GUIDEBOOK — 1962 EDITION**—by H. A. Middleton. (direct receiving tube substitutions only... plus added new feature, 1300 direct CRT substitutions.) The new, 1962 edition of this remarkable "tool", designed for the serviceman's tube caddy, carries a greatly increased number of direct receiving tube replacements. It lists new tubes that replace certain older tubes, and in turn can be replaced by older tubes. 16-page section of direct CRT substitutions has been added. #299 still only 90c.

### ORDER TODAY—10 DAY GUARANTEE

Mail to your distributor, bookstore or order direct: JOHN F. RIDER PUBLISHER, INC. (a div. of Hayden Publishing Co.) 116 West 14th St. N. Y. 11, N. Y.

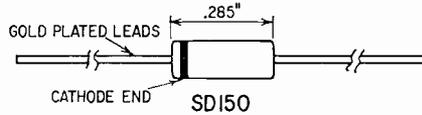
I have enclosed \$..... Please send:  
 #286, \$6.95     #287, \$5.95  
 #289, \$5.50     #278, \$8.95  
 #288, \$2.00     #299, 90c  
 FREE CATALOG

We guarantee satisfaction or return within 10 days of purchase for full refund.

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

### SD150

A very-high-speed silicon switching diode for computer circuits and general-purpose applications. The diode incorporates an oxide passivated planar structure built in a high-resistivity epitaxial layer grown on a low-resistivity silicon substrate. This structure makes



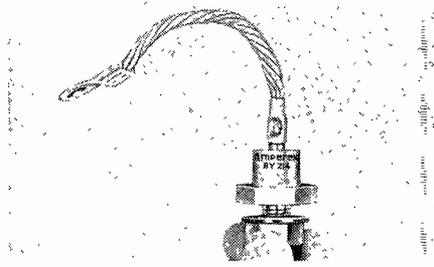
possible a diode having high conductance, fast recovery time, low leakage and low capacitance. Minimum conductance is 50 ma at 1 volt, and recovery time is less than 2 nanoseconds.

Maximum ratings of the General Electric SD150 are:

V (reverse)	50
I (average rectified ma)	75
(forward steady-state dc ma)	115
(recurrent peak forward ma)	225
(peak forward surge amps)	2
P (dissipation, mw)	250

### BYZ14, BYY15

These are double-diffused silicon power rectifiers rated at 20 amperes. They are mounted in 50-ampere cases for added reliability and durability. Both Amperex units are designed for use in industrial power supplies, battery chargers, induction and dielectric

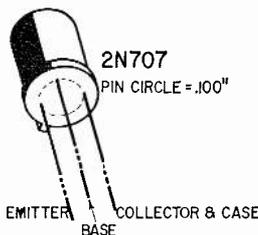


heating equipment and broadcast transmitters. They can also be used in series-parallel arrangements for heavy duty.

They have been specifically designed to cope with high-voltage surges in heavy-duty rectifying circuits. Their 400-volt recurrent peak-inverse-voltage rating is supplemented by a transient peak-inverse-voltage rating of 600 for the BYZ14 and 800 for the BYY15.

### 2N707

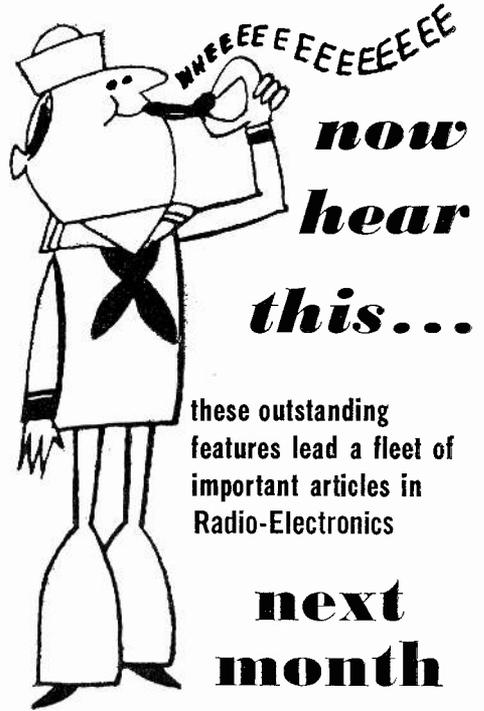
An n-p-n silicon planar transistor intended for vhf oscillator and amplifier applications. It will oscillate at fre-



quencies up to 400 mc and will provide an 8-db power gain at 100 mc.

Maximum ratings of this General Instrument transistor are:

V <sub>CB0</sub>	56
V <sub>EB0</sub>	4
V <sub>CER</sub> (10-ohm resistor between base and emitter)	28
P <sub>total</sub> (mw)	300 END



these outstanding features lead a fleet of important articles in Radio-Electronics

next month

### navy careers in electronics

It used to be "Join the Navy and See the World" —now you can discover or explore a world of electronics in the new Navy (or other branch of the service). There are so many opportunities for education and advancement. This article outlines them all.

### pinpoint color tv faults

Servicing color can be complex—but this pithy article shows you how to track down any trouble faster. From there on—the job is simple.

### simplest signal injector

Remember the noise injector? This atomic age version looks like an ordinary probe. Contains its own batteries and two transistors. Tremendously helpful in all forms of servicing.

### using the tv check tube

Can you use one check tube for all TV sets? If so—which one? There are at least four on the market now. This story tells you which one and shows you how.

### closed circuit tv in the photo studio

How one photographer uses TV to "preview" photos of his portrait subjects and show them instant proofs.

## march issue



on sale—feb 20

RADIO-ELECTRONICS

# Wake Up



**A new day is dawning in electronics. Transistors are here to stay... they are now being used everywhere; in radio, television, Hi-Fi, intercoms, and in nearly all new electronic equipment...**

**Why put off transistor circuit servicing any longer... there's gold in them thar hills. But you must be equipped to do the job fast and efficiently. Here are the tools that you will need.**

## NEW SENCORE TRANSI-MASTER

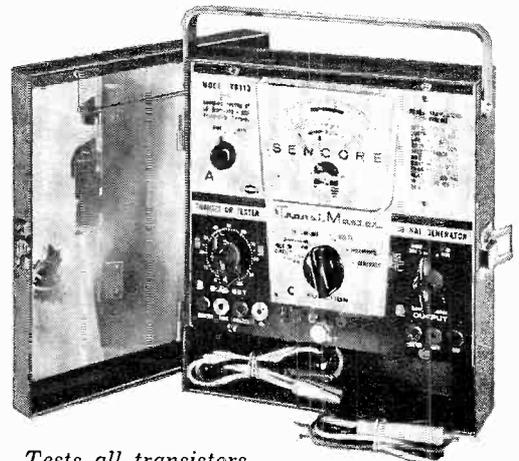
This Tester will analyze the entire circuit in minutes and test transistors in-circuit or out of circuit. Here is how you can pin point troubles step by step.

First, check the batteries with the 0 to 12 voltmeter. If the batteries are O.K., check the current drain with the 0 to 50 milliamp meter. A special probe is provided so that you do not need to break the circuit. Excessive current indicates a short; low current indicates an open stage or cracked board. All PF schematics indicate average current.

If trouble is not located by now, isolate the trouble to a specific stage by touching the output of the harmonic generator to the base of each transistor and note spot where sound from speaker (or scope where no speaker is used) stops or becomes weak. The generator becomes a sine wave generator for audio stages to help find distortion.

If trouble points to a transistor, check it in a jiffy with the exclusive in-circuit power oscillator check provided by the TR110. A special probe is also provided for this.

If the transistor checks bad in-circuit, remove it and give it an out of circuit check with the oscillator check or the more accurate DC check. The DC check is provided for comparison reasons, experimental or engineering work and to match transistors in audio output stages. Beta (current gain) is read direct or on a good-bad scale for service work. **DEALER NET. ONLY \$4950**



*Tests all transistors in-circuit or out-of-circuit*

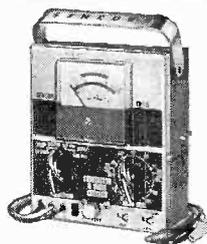
### Model TR110

**It's a COMPLETE TRANSISTOR TESTER**

- SIGNAL TRACER • VOLTMETER
- BATTERY TESTER • MILLIAMMETER

## NEW SENCORE TRANSISTOR AND DIODE CHECKER

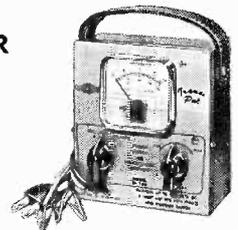
Here is a low cost tester that has become America's favorite. The TR115 provides the same DC out of circuit checks as the TR110; leakage and current gain. Beta (circuit gain) can also be read direct or as good or bad. Opens or shorts in the transistor are spotted in a minute. The TR115 checks them all from power transistors to the small hearing aid type. Japanese equivalents are listed also. This famous tester is used by such companies as Sears Roebuck, Bell Telephone and Commonwealth Edison. New circuits enable you to make service checks without set-up charts even though charts are provided for critical checks.



**Model TR115**  
Dealer Net  
**\$1995**

## SENCORE BATTERY ELIMINATOR AND TROUBLE SHOOTER

For replacing batteries during repair. Many servicemen say that they wouldn't service transistor circuits without this power supply. The tried and proven PS103 is a sure fire answer. It can be used to charge the nickel cadmium batteries as well. Dial the desired output from 0 to 24 volts DC and read on meter. Low ripple insures no hum or feedback. Total current drawn can also be read on the PS103 by merely flicking the function switch to milliamps. The PS103 is the only supply that will operate radios with tapped battery supplies such as Philco, Sylvania and Motorola. No other supply has a third lead.



**Model PS103**  
Dealer Net  
**\$1995**

Now in stock at  
your Authorized  
Sencore Distributor



**SENCORE**  
ADDISON, ILLINOIS

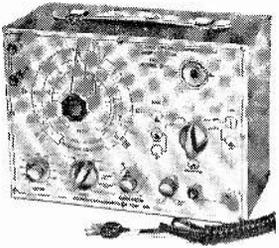
**ALL NEW!**



**EMC advances in Audio and Test Equipment—by far the Best Values obtainable in Wired or Kit form.**

**EMC Model 801 RC Bridge and In-Circuit Capacity Checker**

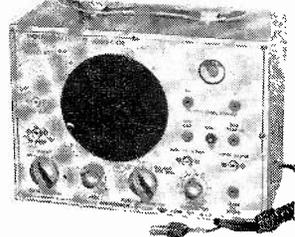
A new comprehensive resistance and capacity checker. It measures condensers for actual value, leakage, and power factor. In addition it measures condensers while still connected in their original circuits for opens, shorts or intermittents.



Model 801 Wired .....\$38.95 — Model 801 Kit .....\$24.95

**EMC Model 802 Signal Tracer and Generator**

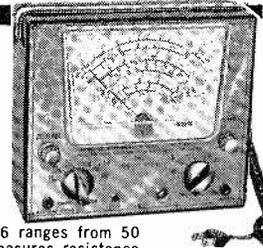
Generates its own audio, IF and RF signal for tracing. Uses both a magic eye tube and a speaker for signal detection. Checks noisy components. Checks and compares magnetic, ceramic and crystal cartridges. Supplied with two shielded audio probes and RF crystal demodulator probe.



Model 802 Wired ....\$38.95 Model 802 Kit .....\$24.95

**EMC Model 107A Peak to Peak Vacuum Tube Volt-Ohm Capacity Meter**

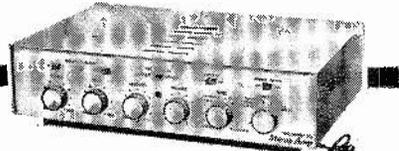
6" meter cannot burn out — entirely electronic. Measures peak to peak AC voltages to 2800 volts in 6 ranges. Measures capacity in 6 ranges from 50 mmfd to 5000 mfd. Measures resistance in 6 ranges from .2 ohm to 1000 megohms. Measures DC volts to 1000 volts in 6 ranges. Input resistance 16.5 megohms.



Model 107A Wired ....\$51.40 — Model 107A Kit ....\$36.50

**EMC Model 214 Stereo Amplifier**

A compact, highly attractive dual 14W amplifier with built in preamplifiers having 56 watts peak power output. Has rumble filter and contour control switch. Extremely low distortion and noise level. It can be used as a 28 watts (56 watts peak) monaural amplifier or as a monaural amplifier so arranged that one pre-amplifier is used to drive the internal amplifier while the other preamplifier is used to drive any existing monaural amplifier.



Model 214 Wired .....\$106.80 — Model 214 Kit .....\$68.90

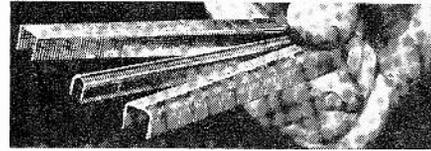
Yes, tell me more, send me **FREE** a detailed catalog of the Complete EMC Line. Dept. RE-262

NAME .....  
STREET .....  
CITY ..... STATE.....

**EMC** Electronic Measurements Corp. 625 B'way, New York 12, N. Y. Ex. Dept., Pan-Mar Corp., 1270 B'way, New York 1, N. Y.

**NEW PRODUCTS**

**INDUSTRIAL STAPLES** for fastening low-voltage wiring indoors or out. 'Heller-Ply' staples



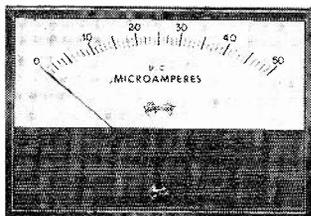
made of steel base, electroplated with copper, for rust, corrosion and salt-water proofing.—Heller Roberts Instruments Corp., 6115 Carnegie Ave., Cleveland 3, Ohio.

**SOLDERLESS TERMINAL KIT.** Tool for crimping terminals, stripping and cutting wire; assorted terminals for all popular uses, snap-opening pouch for hanging. *Solderless Terminal*



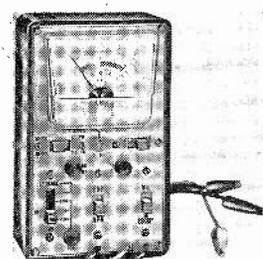
**Connect-All Kit:** 10 compartments hold more than 90 insulated terminals, color-coded for size, and selector chart.—Vaco Products Co., 317 E. Ontario St., Chicago 11, Ill.

**PANEL METER, model 420-R.** 4.53-in. scale, 2.93 x 4.46-inch panel area, shielded movement.



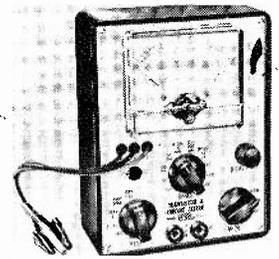
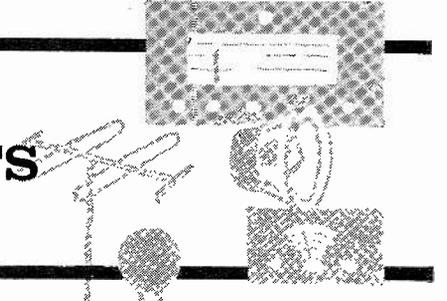
—Triplett Electrical Instrument Co., Harmon Rd., Bluffton, Ohio.

**TRANSISTOR ANALYZER, model 212.** Tests dc gain in 3 ranges to 200; gain or leakage on high or low-power transistors; oscillator; in-circuit transistors. Checks condition of diodes and internal battery without removal of instru-



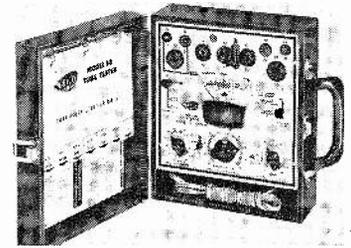
ment from case; measures battery voltage on 0-12-volt scale, dc drain on 0-80-ma scale. 3 external leads and socket for transistor check, also test leads for measuring voltage and current.—Electronic Measurements Corp., 625 Broadway, New York 12, N. Y.

**TRANSISTOR AND CIRCUIT TESTER, model 680.** 50- $\mu$ a, 3 1/2-in meter movement reads actual transistor parameters plus all vom ranges for servicing transistor equipment. Dc ranges:



50  $\mu$ a, 5 ma, 500 ma. Dc voltage ranges: 5 and 50. Resistance ranges: R  $\times$  1 (0 to 2,000 ohms, 12 ohms center scale), R  $\times$  100 (0 to 200,000 ohms, 1,200 ohms center scale), R  $\times$  10K (0 to 20 megohms, 120,000 ohms center scale.—EICO, (Electronic Instrument Co. Inc.), 33-00 Northern Blvd., Long Island City 1, N. Y.

**TUBE TESTER, model 88.** 10 sockets. Tests 9-pin Novars, 10-pin tubes, 12-pin Compactrons



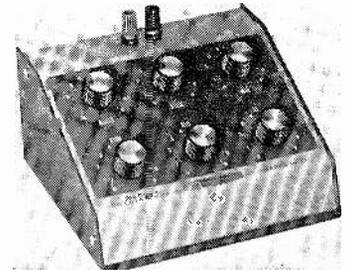
and nuvistors, many others. Seco grid-circuit test plus cathode-emission, filament-continuity and open-element tests.—Seco Electronics Inc., 5015 Penn Ave. So., Minneapolis 19, Minn.

**CAPACITOR SUBSTITUTION BOX, model 1803.** 18 capacitors. Rotary switches select desired value between 100  $\mu$ mf and 0.22  $\mu$ f. Capacitors in 100-470- $\mu$ mf range silver-mica,  $\pm$ 5% ac-

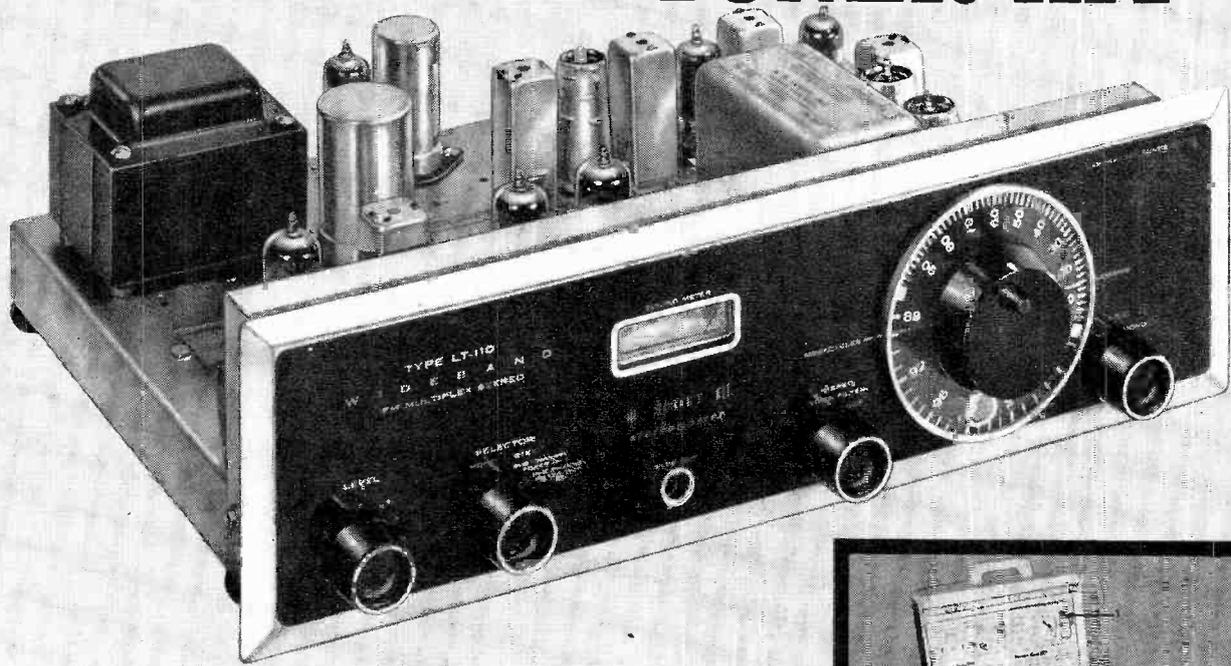


curacy, 500 volts; in .001-0.22- $\mu$ f range, molded,  $\pm$ 10%, rated at 600 volts.—Precision Apparatus Co., Inc., 70-31 84th St., Glendale 27, N. Y.

**6-DECADE RESISTANCE KIT, model IN-11, (illus).** Switch selection of resistance values from 1 to 999,999 ohms in 1-ohm steps; forty-three 1/2% 1-watt resistors. Model IN-21 3-decade capacitor kit: capacitance values from 100  $\mu$ mf to 0.111  $\mu$ f in 100- $\mu$ mf steps. 1% silver mica capacitors. Ceramic wafer switches.—Heath Co., Benton Harbor, Mich.



# SUPERB NEW SCOTT MULTIPLEX TUNER KIT

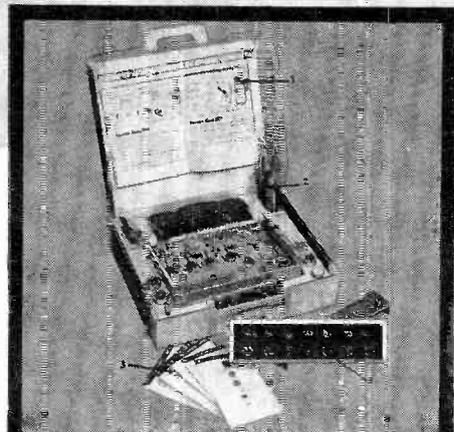


## Now you can build a Multiplex Tuner that meets rigid factory standards

Now have the fun of building a genuine H. H. Scott Wide-Band FM Stereo Tuner in just a few hours . . . and save money, too. Revolutionary Scott-developed kit building techniques assure you of performance equaling Scott factory units.

The new LT-110 Scottkit features a pre-wired and tested multiplex section plus the famous silver-plated factory built and aligned front end. Sensitivity of this magnificent new tuner is 2.2  $\mu$ v. IHFM. There are special provisions for flawless tape recording right "off-the-air."

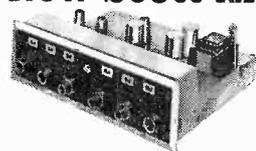
Scott Wide-Band multiplex tuners are the standard of the industry. They have been chosen by leading FM stations from Boston to San Francisco. If you want to build a truly professional component choose a Scottkit. All H. H. Scott kits are backed by over 15 years experience in the design and production of superb components. Important features include front panel tape recorder output and precision illuminated tuning meter. All critical parts heavily silver plated. Unique Ez-a-Line system assures factory performance without expensive test equipment. Dimensions: 15½ W x 5¼ H x 13 D in accessory case.



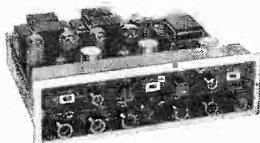
### These Exclusive Scottkit Features Make Kit Building Foolproof and Fun

1. All assembly diagrams show parts in exact size and in full color, eliminating mistakes.
2. All wires cut to exact length and pre-stripped assuring correct lead placement and dress.
3. Exclusive Part-Charts with parts mounted in order of assembly, eliminating confusion and mistakes. No loose bag of parts.
4. Handsome appearance makes Scottkits completely professional in looks as well as in performance.

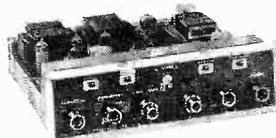
## New Scott Amplifier Kits to match the LT-110



**LC-21 Preamplifier Kit**  
Performance so outstanding this kit is used for laboratory purposes. Hum level —80 db. distortion less than 0.1%, frequency response 8 to 50,000 cps. **\$99.95\***  
Matching LK-150 130 Watt Power Amplifier **\$169.95\***



**LK-72 80 Watt Stereo Amplifier Kit** —  
Plenty of power for any hi-fi system. Complete tape recording and monitoring facilities. Oversized transformers weigh 12 pounds! Performance equal to the best pre-amp/power amp systems. **\$159.95\***



**LK-48 48 Watt Stereo Amplifier Kit** —  
12 front panel controls. Gives full power down to 20 cps. Husky output transformers. All aluminum chassis and DC operated preamps. Scott quality at a best-buy price. **\$119.95\***

## H. H. SCOTT

H. H. SCOTT, INC., Dept. 570-02-3, 111 Powdermill Road, Maynard, Mass.

Send me your new Scottkit catalog and complete information on FM Stereo.

Name \_\_\_\_\_

Address \_\_\_\_\_

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

Export: Morhan Exporting Corp., 458 Broadway, NYC.  
Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto.

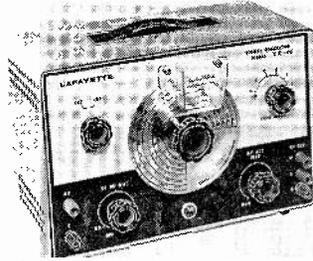
\*Case extra. Slightly higher west of Rockies

**VTVM, model 48.** Balanced vacuum-tube bridge circuit for all voltage and resistance measurements. 7 dc ranges ( $7\frac{1}{2}$  meg-ohms per-volt sensitivity on 1.5-volt range). 7 ac ranges, peak to peak and rms, response  $\pm 1$  db, 40 cycles



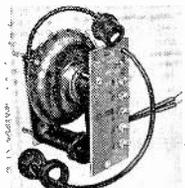
to 4 mc (600-ohm source, 5-volt range). 7 db ranges, -6 to +66 db (0 db = 1 mw, 600 ohms). 7 electronic ohmmeter ranges (10 ohms center scale, initial range).—Precision Apparatus Co., Inc., 70-31 84th St., Glendale 27, N. Y.

**RF SIG GEN, model TE-20.** Factory-wired and calibrated.  $4\frac{1}{2}$ -in etched-steel vernier tuning dial. Fundamental output 120 kc to 120 mc in 6 bands, calibrated harmonic band 130 to 260 mc. Built-in 400-cycle oscillator has adjustable output



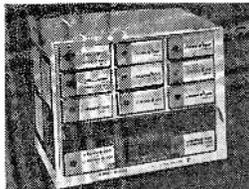
to 8 volts; continuously variable rf attenuator and high and low rf outputs. Frequency accuracy  $\pm 5\%$ . Tube complement: 1 12BH7-A, 1 6AR5, 1 selenium rectifier. Power requirements: 105-105 volts ac, 50 cycles, 112 watts.—Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, N. Y.

**REPLACEMENT FLYBACKS** for wide range of models without circuit or chassis alteration. Model 110-325 (illus) replaces Trav-ler part No.



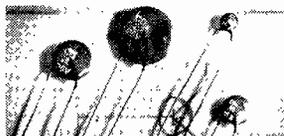
TR 28; Model HO-330, Sparton part No. PC-70036.—Stancor Electronics, 3501 Addison St., Chicago, Ill.

**CAPACITOR KIT, model K-100.** 19 tubular electrolytic capacitors, 14 types, replace more than 50 conventional capacitor types. Ranges:

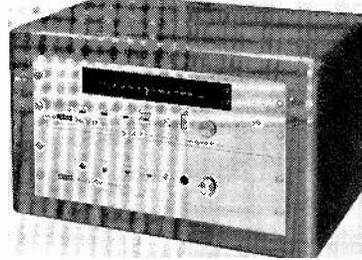


2-500  $\mu$ f, voltage maximums 50 to 475 volts.—General Electric, Electronic Components Div., Owensboro, Ky.

**25-VOLT CERAMIC CAPACITOR, type HCC.** Available ratings: .01, .05, .10 and 22  $\mu$ f, tolerance +80% and -20%. Minimum leakage resistance at +25°C exceeds 50 megohms at 5 volts and 2 megohms at 25 volts. Maximum power factor 10%.—Cornell-Dubilier Electronics, Div. Federal Pacific Electric Co., New Bedford, Mass.

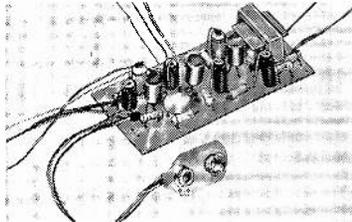


**MODULATOR, model AT (Audio-Trol).** Replaces audio distribution system in hotels, motels and institutions. Uses unused TV channels of standard receiver for audio reception. Source FM tuner, AM radio, Muzak, records, tape or microphone. Audio programming piped from head end of TV distribution system, where Audio-Trol is installed. Feeds 5 separate channels of audio through circuitry which prevents cross-modulation between adjacent channels. Channel



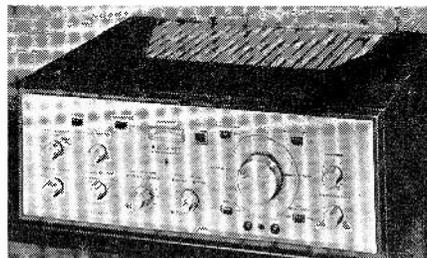
conversion achieved by crystal-controlled video carrier and FM sound carrier. 4.5-mc separation produces audio program through TV speaker. Power requirements 45 watts at 117 volts, 60 cycles ac. Shown rack-mounted with FT-100 FM tuner.—Jerrold Electronics Corp., 15th and Lehigh Ave., Philadelphia, Pa.

**SUBMINIATURE AUDIO AMPLIFIER, model PK-522.** 2  $1\frac{1}{2}$  x  $1\frac{1}{4}$  x  $3\frac{3}{4}$  inches; 3 transistors: 2 input leads for tape record/playback heads, radio tuner, crystal or ceramic phono cartridge or microphone. 2 output leads for 2-10-



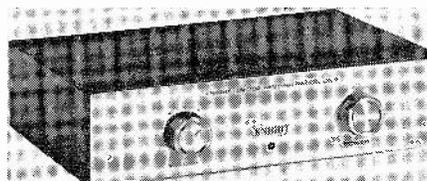
ohm speakers and 2 for on-off spst switch. 3 leads for volume control and 2 terminating in battery clips. Available accessories: 9-volt battery, 5,000-ohm volume control, miniature crystal mike, miniature speaker.—Lafayette Radio Electronics Corp., 111 Jericho Tpke., Syosset, N. Y.

**TUNER/AMPLIFIER SYSTEM, model 355.** Multiplex section: 5 tubes and 11 diodes. Modular concept allows isolation of power amp to 50 feet away. FM section: silver-plated cascode front end, 2-mc wide-band detector and if's. Control center: 2 low-level inputs switchable from front



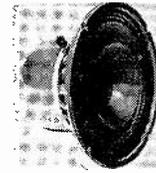
panel, separate bass and treble controls and stereo balancing features, tape recording and monitoring facilities with front-panel control and output. Each section self-powered.—H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

**REVERBERATION UNIT, Knight model KN-702:** Hammond type 4 reverberation chamber for delay of audio signal, 4-tube amplifier with volume control. May be connected to speaker out-



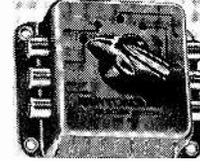
put terminals of any existing hi-fi amplifier without circuit changes.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

**SPEAKER AND TWEETER, Nova 3:** 8-in full-range speaker (illus). 2 cones mounted sepa-



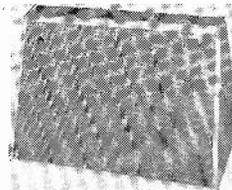
ately but connected to same 2-in. voice coil. Response 30-16,000 cycles, impedance 8 ohms, magnet 1-lb Alnico V, baffle opening  $7\frac{5}{16}$ -in diameter. Nova T-1 tweeter: twin-cone laminar construction, response 1.2-25 kc  $\pm 2$  db, built-in crossover at 1,200 cycles.—Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.

**REMOTE SPEAKER SWITCH, model 671,** for switching any of 5 monaural speakers to



monaural amplifier. Mounts on wall or cabinet.—Switchcraft, Inc., 5555 N. Elston Ave., Chicago.

**MONITOR SPEAKER SYSTEMS** employ 12-inch coaxial loudspeakers with flat response. High-frequency drivers with diffraction horns



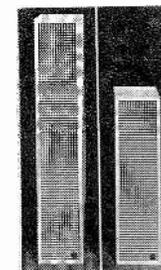
extend response to 20,000 cycles. Impedance connections available for 16, 50 and 600 ohms. Sentry I for wall or ceiling mounting, Sentry II floor model.—Electro-Voice, Inc., Buchanan, Mich.

**COLUMN SPEAKERS.** Vertical stack of six adjusted-range cone speakers, for a fan-shaped, broad horizontal, narrow vertical pattern for paging and PA applications. 20-watt Columnair unit measures 5 x 5 x 28 inches, 40-watt unit



8 x 6 x 42 inches. May be rear, side or corner-mounted.—Atlas Sound Corp., Div. American Trading & Production Corp., 1419-51 39th St., Brooklyn 18, N. Y.

**COLUMNAR LOUDSPEAKERS** for music and speech. Acoustic tapering reduces effective length of column at high frequencies, maintaining proper vertical dispersion at all frequencies. Uniline model UCS-6 (left), 60-in column; 6 extended-range 8-in. speakers. Range 35-17,000 cycles, power capacity 150 watts, impedance 16



ohms, vertical angle 16°, horizontal angle 120°. Model CS-4 (right), 40-in column; 4 extended-range 8-in. speakers. Range 45-17,000 cycles, power capacity 80 watts, impedance 8 ohms, vertical angle 22°, horizontal angle 120°.—University Loudspeakers Inc., 80 S. Kensico Ave., White Plains, N. Y.

# 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, \$29995

Available on Budget Terms. As low as \$30.00 down.

Combines all the features of both  
the Model 1075 and Model A107

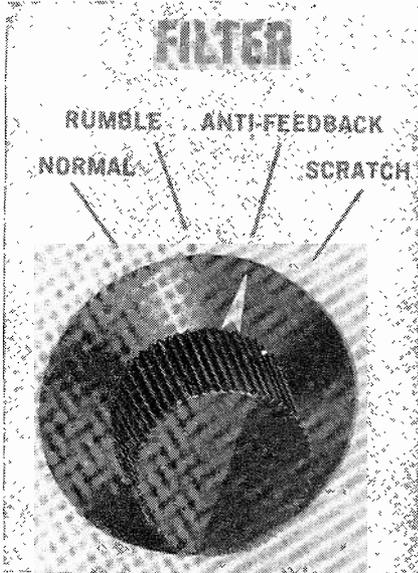
- |  |                                      |
|--|--------------------------------------|
| COMPLETE R.F. and I.F.                       | HI-VOLT INDICATOR                    |
| VIDEO TEST PATTERN                           | YOKE and HI-VOLTAGE TRANSFORMER TEST |
| COMPOSITE SYNC                               |                                      |
| FM MODULATED AUDIO                           | <b>Also Now Provides:</b>            |
| COLOR PATTERNS                               | SWITCH-TYPE TUNER                    |
| HORIZONTAL and VERTICAL PLATE and GRID DRIVE | NEGATIVE BIAS SUPPLY                 |
| B+ BOOST INDICATOR                           | AGC KEYING PULSE                     |
|  | PICTURE TUBE MODULATION              |



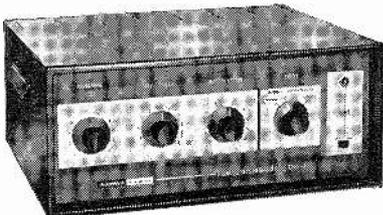
**B & K MANUFACTURING CO.**  
1801 W. BELLE PLAINE AVE • CHICAGO 13, ILL.  
Canada: Atlas Radio Corp., 50 Wingold, Toronto T9, Ont.  
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

See Your B&K Distributor or Write for Bulletin AP18E

**YOU WON'T  
FIND THIS**



**CONTROL  
ON ANY  
OTHER P.A.  
AMPLIFIER  
IN THIS  
PRICE  
CLASS**



What's different? The anti-feedback position—which equalizes frequencies most sensitive to generation of feedback "howl" without reducing articulation. This increases sound output under difficult acoustical conditions by at least 100%. And there's plenty more that makes the new Harman-Kardon COMMANDER Series of public address amplifiers different. Features usually reserved for much costlier equipment are included: 25 & 70 volt & recorder outputs, fader/mixer and master volume controls, magnetic cartridge input, locking covers, etc. Find out why sound men now use the COMMANDER Series for all their needs. Write for detailed catalog. Commercial Sound Division, Harman-Kardon, Plainview, L.I., N.Y.

Send free detailed catalogs: Desk 2F

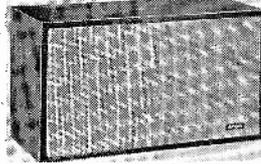
Name \_\_\_\_\_

Address \_\_\_\_\_

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

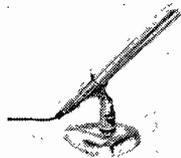
**harman kardon**

**BOOKSHELF ENCLOSURES**, with matching Jensen speakers. Tube-vented design avoids bass booming near cone-resonance frequency of woofer, boosts entire bass range. Speakers connected in crossover network to 8-ohm output



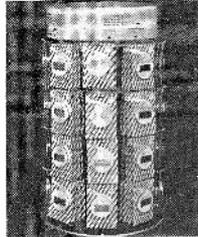
terminals on back. *Model TSE-4S* (illus): one 12-in. woofer and two 3½-in. tweeters. *Model TSE-2AS*: one 8-in. woofer and one 3½-in. tweeter.—Argos Products Co., 301 Main St., Geona, Ill.

**NONDIRECTIONAL MICROPHONES**, 400 series. Wide response, pressure-operated moving-coil dynamics. Can mount on ½-in. 27-thread desk or floor stand. Grip cam lock for insertion or



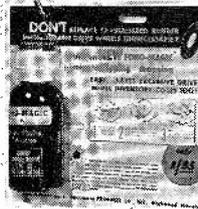
removal without disconnecting, adapter supplied. *Models 401 and 402*, adjustable impedance and response.—Turner Microphone Co., 901 17th St. N.E., Cedar Rapids, Iowa.

**PRERECORDED TAPES**. 4 stereo selections on 3-in reel, 15 minutes playing time. Each *Add-*



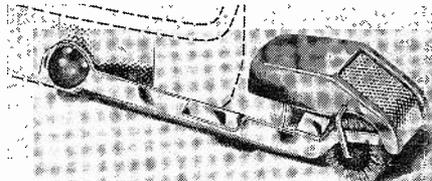
*A-Tape* includes four splicing labels for additions or editing. Compatible for 4- or 2-track stereo playback.—Coleman Electronics, Inc., 133 E. 162nd St., Gardena, Calif.

**COATING FOR PHONOGRAPH PARTS**, *Fono-Magic*, liquid compound of rubber and carbide particles, applied with brush, eliminates turntable slipping and dragging caused by crystallized rubber drive wheels. Coats metal drive



surfaces with nonslipping rubber to increase traction; carbide particles scratch crystallized surface and expose live rubber.—R-Columbia Products Co., Inc., 2008 St. John Ave., Highland Park, Ill.

**AUTOMATIC RECORD CLEANER**, redesigned *Dust Bug* model. Sweeps record just before playing, using specially designed nylon fiber brush with cylindrical plush pad, both

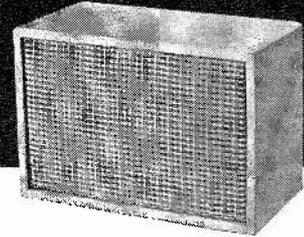


dampened with antistatic fluid. Installs on any tone arm, no vertical stylus loading on cartridge. User-replaceable brush and pad.—Electro-Sonic Laboratories, 627 Broadway, New York, N.Y.

**PA TRANSFORMERS**. Outputs 4 and 8 ohms, power steps of 0.5, 1.0 or 2.0 watts. Standard open-channel frame mounting with solder lugs for primary and secondary leads. *Model A-8109* (illus), for 70.7-volt line, has taps for primary impedances of 2,500, 5,000 and 10,000

the  
**HiFi  
STEREO  
COMPACT  
EXTENSION SPEAKER**

THIS AMAZING SPEAKER WILL BRING THE FINEST SOUND YOU HAVE IN YOUR HOME TO ANY ROOM YOU DESIRE.



Here is a speaker system ideal for the home, office or even industrial applications where clear undistorted sound is required.

By simple connections to your present sound source, such as Hi Fi and stereo components, consoles, TV, radio and public address or intercom systems, the "compact" will produce crystal clear sound with almost no distortion, even at high volume levels. Dimensions of cabinet 5" x 7" x 10".

**\$6<sup>95</sup>**  
UNFINISHED

**100% MONEY BACK GUARANTEE**

If you do not feel this is the finest dollar value you have ever received in the high fidelity industry

**NEWPORT MANUFACTURING CORP.** RE  
1823 E. 40th St., Cleveland 3, Ohio

Please send \_\_\_\_\_ Compact Systems

Name \_\_\_\_\_

Address \_\_\_\_\_

Enclosed find  Money Order  Check

Please add 7½% per unit to cover shipping and handling.



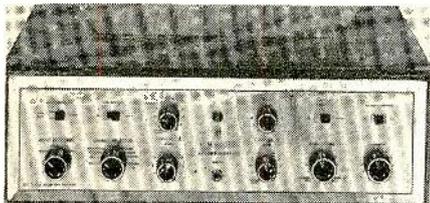
ohms. Model A-8099 for 25-volt line, has taps for primary impedances of 312.5, 625 and 1,250 ohms.—Stancor Electronics, Inc., 3501 Addison St., Chicago 18, Ill.

**PA SPEAKER, model SA6PAD.** Voice-coil impedance 8 ohms, diameter 1 inch. Transformer



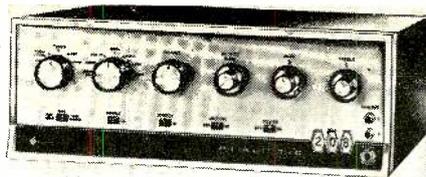
mounting bracket, rim mounting holes, aluminum baked-enamel finish. Alnico V magnets.—Quam Nichols Co., 234 E. Marquette Rd., Chicago, Ill.

**STEREO AMPLIFIERS, Model 222C** (illus), 44 watts; model 299C, 72 watts. Both full power over audio spectrum from 20 to 20,000 cycles. Stereo headphone output on front panel, push-



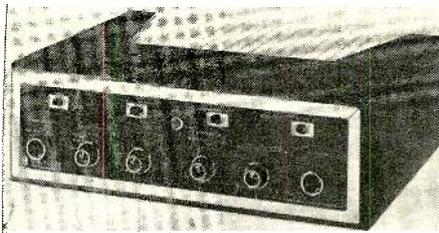
pull on-off switch for presetting all controls.—H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

**TRANSISTORIZED STEREO AMPLIFIER, model TA-208.** 50 watts; 18 transistors plus 1 rectifier and 2 driver transformers. Basic elements on PC board, rear output sections separated. Front-panel controls: 5-position input selector; 7-position function switch; ganged volume control; concentric balance and blend;



clutched bass and treble; tape-head control; rumble, loudness and scratch controls; tape recorder input and earphone jacks. Rear panel: 1 switched and 1 unswitched ac receptacle; speaker phase switch; tape recorder outputs. Equalization  $\pm 1$  db, deviation not more than  $\pm 1$  db, 20 cycles to 20 kc, output 2.0 volts.—Radio Shack Corp., 730 Commonwealth Ave., Boston 17.

**STEREO AMPLIFIER KIT, model LK-48.** 48-watt unit includes separate bass and treble on each channel, stereo balance control, front-panel tape monitoring facilities and derived

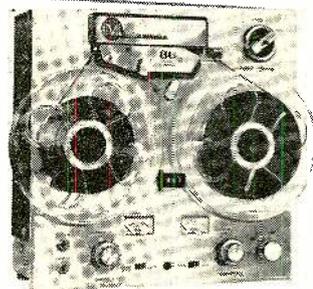


center-channel output. Parts mounted on separate charts; wires precut and prestripped; mechanical parts prewired to the chassis.—H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

**STEREO TAPE-MONITOR AMPLIFIER, model A-1320.** Tapes monitored through headphones during recordings. For tape systems with preamps but not power amplifiers.—Koss, Inc., 2227 N. 31st St., Milwaukee, Wis.

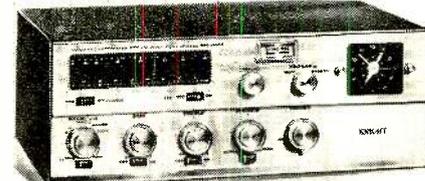
**STEREO-COMPACT TAPE RECORDER, model 86.** Heterodyne filter for distortion-free recording. Independent stereo VU meters for recording or playback models. Recording amplifiers and playback preamps. Automatic equalization of

recording playback at  $7\frac{1}{2}$  or  $3\frac{3}{4}$  ips, adjusted as speed control is set. Range: 25-18,000 cycles.



**Model ERQ:** half-track stereo or monaural recording; half or quarter-track stereo or monaural playback, **RMQ:** quarter-track recording, stereo or monaural; quarter or half-track playback, stereo or monaural. **ESM:** half-track only recording and playback, stereo or monaural.—Viking of Minneapolis, Inc., 9600 Aldrich Ave. So., Minneapolis 20, Minn.

**STEREO FM RECEIVER, Knight model KN-310MC.** Compact all-in-one unit. Tuner with



transistor-nuvistor circuit, signal-strength meter and a/c. 40-watt all-transistor amplifier section and automatic clock timer for preset on-on-off switching. Output: 20 watts per channel, less than 1% harmonic distortion. Response:  $\pm 1$  db, 20-20,000 cycles at rated power.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

**STEREO SPEAKER, model B-4000,** for large rooms. 8 tweeters in column for even distribution of highs, special mid-range unit and two woofers. (Continued on page 110)

## TV-RADIO Servicemen or Beginners...

Send for *Coyne's*  
7-Volume Job-Training Set  
on 7-Day **FREE TRIAL!**



The First  
Practical  
TV-RADIO-  
ELECTRONICS  
Shop  
Library!

Answers **ALL** Servicing Problems **QUICKLY** . . .  
Makes You Worth More On The Job!

Put money-making, time-saving TV-RADIO-ELECTRONICS know-how at your fingertips—examine Coyne's all-new 7-Volume TV-RADIO-ELECTRONICS Reference Set for 7 days at our expense! Shows you the way to easier TV-Radio repair—time saving, practical working knowledge that helps you get the BIG money! How to install, service and align ALL radio and TV sets, even color-TV, UHF, FM and transistorized equipment. New photo-instruction shows you what makes equipment "tick". No complicated math or theory—just practical facts you can put to use immediately right in the shop, or for ready reference at home. Over 3000 pages; 1200 diagrams; 10,000 facts!

**SEND NO MONEY!** Just mail coupon for 7-Volume TV-Radio Set on 7-Day FREE TRIAL! We'll include the FREE BOOK below. If you keep the set, pay only \$3 in 7 days and \$3 per month until \$27.25 plus postage is paid. Cash price only \$24.95. Or return set at our expense in 7 days and owe nothing. Either way, the FREE BOOK is yours to keep. Offer limited, so act NOW!

"LEARNED MORE FROM THEM THAN FROM 5 YEARS WORK!"

"Learned more from your first two volumes than from 5 years work."  
—Guy Bliss, New York

"Swell set for either the serviceman or the beginner. Every serviceman should have one."  
—Melvin Masbruch, Iowa.

**FREE DIAGRAM BOOK!**

We'll send you this big book, "150 Radio-Television Picture Patterns and Diagrams Explained" ABSOLUTELY FREE just for examining Coyne's 7-Volume Shop Library on 7-Day FREE TRIAL! Shows how to cut servicing time by reading picture-patterns, plus schematic diagrams for many TV and radio sets. Yours FREE whether you keep the 7-Volume Set or not! Mail coupon TODAY!



Like Having An Electronics Expert Right At Your Side!

**VOL. 1—EVERYTHING ON TV-RADIO PRINCIPLES!** 300 pages of practical explanations; hundreds of illustrations.

**VOL. 2—EVERYTHING ON TV-RADIO-FM RECEIVERS;** 403 pages; fully illustrated.

**VOL. 3—EVERYTHING ON TV-RADIO CIRCUITS!** 336 pages; hundreds of illustrations, circuit diagrams.

**VOL. 4—EVERYTHING ON SERVICING INSTRUMENTS!** How they work, how to use them. 368 pages; illustrated.

**VOL. 5—EVERYTHING ON TV TROUBLESHOOTING!** Covers all types of sets. 437 pages; illustrations, diagrams.

**VOL. 6—TV CYCLOPEDIA!** Quick and concise answers to TV problems in alphabetical order, including UHF, Color TV and Transistors; 868 pages.

**VOL. 7—TRANSISTOR CIRCUIT HANDBOOK!** Practical Reference covering Transistor Applications; over 200 Circuit Diagrams; 410 pages; illustrated.

ALL 7 BOOKS HAVE BRIGHT, MODERN, VINYL CLOTH WASHABLE COVERS

**FREE BOOK—FREE TRIAL COUPON!**

Educational Book Publishing Division

**COYNE ELECTRICAL SCHOOL**

1455 W. Congress Parkway, Dept. 22RE, Chicago 7, Illinois

Yes! Send me COYNE'S 7-Volume Applied Practical TV-RADIO-ELECTRONICS Set for 7-Days FREE TRIAL per your offer. Include "Patterns & Diagrams" book FREE!

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

Address .....

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

Check here if you want Set sent C.O.D. Coyne pays postage on C.O.D. and cash orders. 7-Day Money-Back Guarantee.

**Coyne**

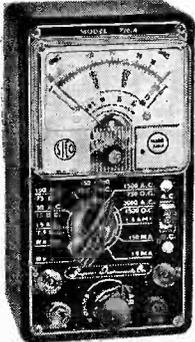
**ELECTRICAL SCHOOL**  
1455 W. Congress Parkway  
Dept. 22RE, Chicago 7, Illinois

# 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:

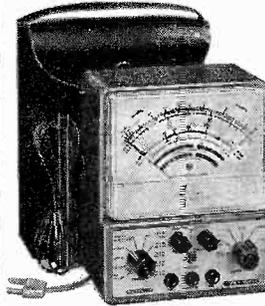
- 6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
- 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
- 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm.
- 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amperes.
- 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

The Model 770-A comes complete with test leads and operating instructions. Price is \$15.85. Terms: \$3.85 after 10 day trial then \$4.00 monthly for 3 months.

SUPERIOR'S NEW MODEL 79

## SUPER-METER

WITH NEW 6" FULL VIEW METER



### SPECIFICATIONS:

- D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
- A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
- D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
- RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
- CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
- REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
- INDUCTANCE: .15 to 7 Henries. 7 to 7,000 Henries.
- DECIBELS: -6 to +18, +14 to +38, +34 to +58.

The following components are all tested for **QUALITY** at appropriate test potentials. Two separate **BAD-GOOD** scales on the meter are used for direct readings.

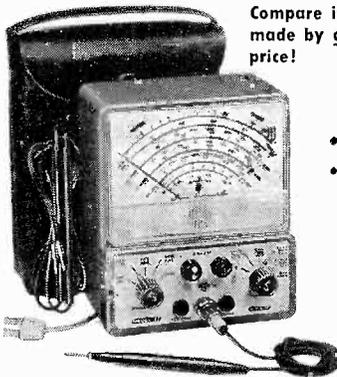
All Electrolytic Condensers from 1 MFD to 1000 MFD.  
All Selenium Rectifiers. All Germanium Diodes.  
All Silicon Rectifiers. All Silicon Diodes.

Model 79 comes complete with operating instructions, test leads and carrying case. Price is \$38.50. Terms: \$8.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 77

## VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER



Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!

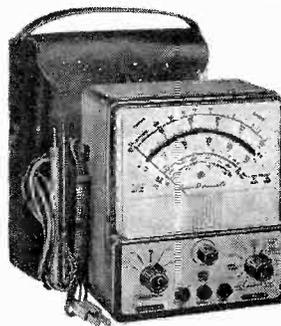
### SPECIFICATIONS:

- DC VOLTS—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1500 volts.
- AC VOLTS (Peak to Peak)—0 to 8/40/200/400/800/2000 volts.
- ELECTRONIC OHMMETER—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- DECIBELS—10 db to +18 db, +10 db to +38 db, +30 db to +58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- ZERO CENTER METER—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads and carrying case. Price is \$42.50. Terms: \$12.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 80

## 20,000 OHMS PER VOLT ALLMETER



6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

### SPECIFICATIONS:

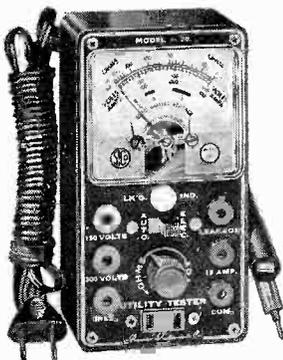
- 7 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
- 6 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
- 3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms. 0-20 Megohms.
- 2 CAPACITY RANGES: .0025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
- 5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
- 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Price is \$42.50. Terms: \$12.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

## FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS \* AUTOMOBILES



INCLUDED  
FREE

64 page condensed course in electricity. Profusely illustrated. Written in simple, easy-to-understand style.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils
- Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. Price is \$15.85. Terms: \$3.85 after 10 day trial then \$4.00 monthly for 3 months.

## DID YOU EVER?

- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write... wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
- ▶ Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business... We ship at our risk!

# NO

CONTRACT TO SIGN

CO-MAKERS

EMPLOYER  
NOTIFICATION

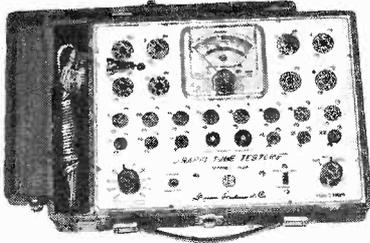
The simple order authorization included in this offer is all you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT  
IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A  
MULTI-SOCKET TYPE

## TUBE TESTER



### SPECIFICATIONS:

- Tests over 1000 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types.
- 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 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



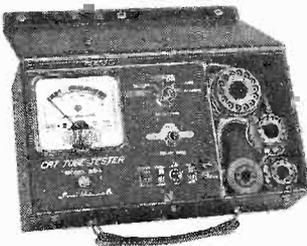
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.
- Free-moving built-in roll chart provides complete data for all 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 tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 comes housed in a handsome, portable, saddle-stitched Texon case. Price is \$47.50. Terms: \$11.50 after 10 day trial then \$6.00 monthly for 6 months.

SUPERIOR'S NEW MODEL 83A

## C.R.T. TESTER

Tests and Rejuvenates  
ALL PICTURE TUBES



ALL BLACK AND WHITE TUBES  
From 50 degree to 110 degree types—  
from 8" to 30" types.

ALL COLOR TUBES  
Test ALL picture tubes—in the carton  
—out of the carton—in the set!

Model 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

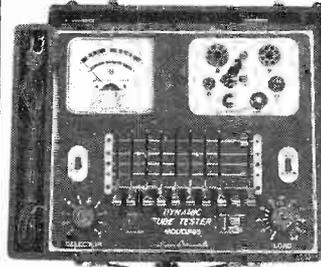
Model 83A will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus.

Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. Price is \$38.50. Terms: \$8.50 after 10 day trial then \$6.00 monthly for 5 months.

SUPERIOR'S NEW MODEL 85

## TRANS-CONDUCTANCE TYPE TUBE TESTER

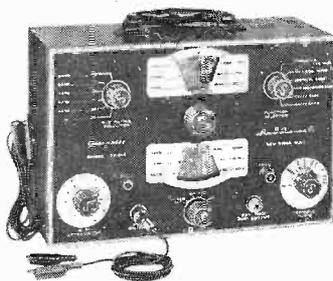


- Employs latest improved TRANS-CONDUCTANCE circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- **SYMBOL REFERENCES:** Model 85 employs time-saving symbols (•, +, •, A, ■, □) in place of difficult-to-remember letters previously used. Repeated time-studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube becomes necessary and ad-hoc.
- **"FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube.
- **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers at no charge for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Price is \$52.50. Terms: \$12.50 after 10 day trial then \$8.00 monthly for 5 months.

SUPERIOR'S NEW MODEL TV-50A

## GENOMETER 7 Signal Generators in One!



- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

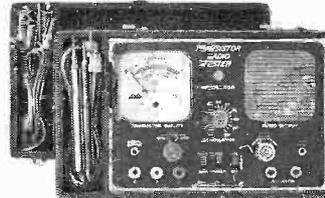
A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers  
• Black and White TV • Color TV

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Price is \$47.50. Terms: \$11.50 after 10 day trial then \$6.00 monthly for 6 months.

SUPERIOR'S NEW MODEL 88

## TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS



AS A TRANSISTOR RADIO TESTER

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble is located and pinpointed.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium 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.

# SEND POSTCARD TODAY

(NO POSTAGE  
NECESSARY)

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-920 3849 TENTH AVENUE, NEW YORK 34, N.Y.

**FOR TECHNICIANS, SERVICE MEN,  
HI-FI, STEREO HOBBYISTS**

**SWITCHCRAFT**  
Everyday Necessities

**2 NEW PHONO JACK**

- Eliminate rivet mounting.
- Convenient replacement for old style Jacks.

No. 3501FP—Lock Nut back of panel, requires only 1/4" hole.



No. 3501FR—For front of panel mounting, where necessary to assemble Jack through the panel from the back due to lack of space.



**NEW PHONO PLUG**

No. 3502—Removable handle—exposed terminals. Nickel plated brass body and handle. Can be used in multiples even where Jacks are on 1/16" centers.



**NEW PHONO EXTENSION JACK**

No. 3503—Removable handle. Cable clamp. Shielded. Nickel plated brass.



Send for catalog A-401

**SWITCHCRAFT** © 5579 N. Elston Ave. Chicago 30, Ill.  
Canadian Rep: Atlas Radio Corp., Ltd.,  
50 Wingold Avenue, Toronto, Ontario

**AMAZING**

**TV  
LIFE-SAVER®**  
ONLY \$4.95

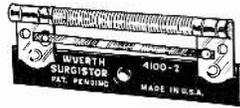


U.S. Pat. 2,914,637

**Eliminates Costly TV Troubles**

By absorbing damaging in-rush current so destructive to Television and Hi-Fi tubes, the TV LIFE-SAVER eliminates 3 out of 4 Service calls by more than tripling the life of all tubes . . .

**PROTECTION**



Model 4100-2, 100-275 watts 117 V. \$1.85 List  
Model 8050-4, 250-400 watts 117 V. \$2.15 List

**WUERTH SURGISTOR®**

A new component easily installed to reduce call-backs by eliminating surge current damage to television and Hi-Fi tubes.

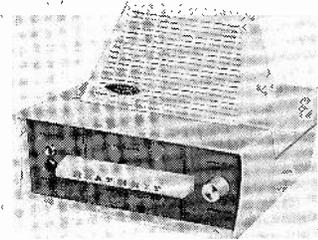
See your dealer or distributor today for these money saving, equipment saving Miracle Inventions. Or, send your order direct to us for prompt action.

**WUERTH PRODUCTS CORP.**  
1949 Moffett St., Hollywood, Florida

(Continued from page 105)

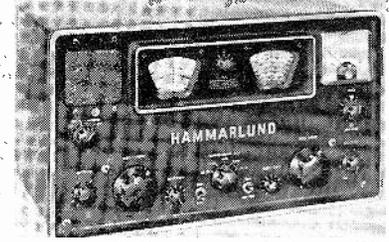
Response 35-20,000 cycles, crossover at 200 and 1,500 cycles, impedance 8 ohms, 30 watts. Model B-2000, bookshelf unit. B-3000 for apartment-sized rooms; B-1000, indoor-outdoor speaker.—R. T. Bozak Sales Co., 587 Connecticut Ave., S. Norwalk, Conn.

**WIRELESS INTERCOM KIT, model GD-51.** Power line is transmission medium for low-frequency rf signal. No interunit connecting



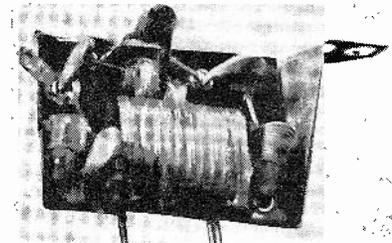
leads, no additional wiring for added units. All-transistor circuit, self-contained 117-vac power supply, squelch circuit, overload diode and 2 indicating lights.—Heath Co., Benton Harbor, Mich.

**BUILT-IN CB SPEAKER** for HQ-105 TR transceiver, to replace 24-hour clock timer. Full



coverage. Available factory-wired as HQ-105 TRS.—Hammarlund Mfg. Co., Inc., 460 W. 34 Sts., New York 1, N.Y.

**ANTENNA COIL ASSEMBLY, model 1359A,** replacement for RCA and Admiral tuners. Balun coil, 3-section if trap eliminate interference be-



tween TV sets over if band. Mounted in phenolic board/metal plate assembly.—Coleman Electronic Products, 1017 N.E. 3rd Ave., Amarillo, Tex.

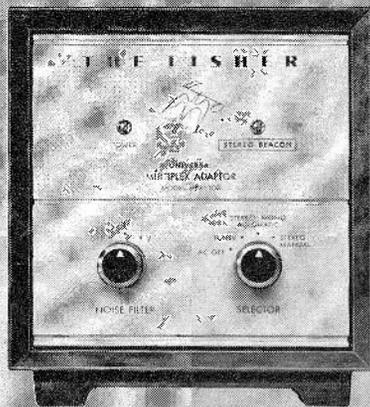
**All specifications from  
manufacturers' data**

**NEW BUSINESS GETTERS**

**NEW LITERATURE**

**WALL CHART** explaining FM stereo for dealer personnel and consumers.—Harman-Kardon, Inc., Plainview, L.I., N.Y.

**DIAMOND NEEDLE DISPENSER DR-1.**—Duotone Co., Keyport, N.J.



(unbiased)

**this Fisher Multiplex Adapter works with any brand of FM equipment**

Now everyone can enjoy FM Stereo with the only truly universal (and, you might say, impartial) Multiplex Adapter. Only the Fisher MPX-100 will convert to FM Stereo Multiplex operation any FM tuner or receiver ever made, regardless of age, brand or model.

What's more, the Fisher Universal MPX-100 recognizes FM Stereo Multiplex programs automatically with its 'electronic brain,' the exclusive Fisher Stereo Beacon. Whenever the FM station you have selected is broadcasting in stereo, the Stereo Beacon lights a signal and switches the equipment automatically from regular to stereo operation. This ingenious Fisher invention makes Multiplex a pleasure, not a problem. Price, less cabinet, \$119.50\*.

FREE! Write for 1962 Fisher Handbook—a 40-page illustrated guide and component catalogue for custom stereo installations.

Fisher Radio Corporation  
21-51 44th Drive  
Long Island City, N. Y.

Please send free 40-page Handbook, with complete specifications on the MPX-100.

Name \_\_\_\_\_

Address \_\_\_\_\_

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

RE206

\*SLIGHTLY HIGHER IN THE FAR WEST.

**BECOME A RADIO TECHNICIAN FOR ONLY \$26.95**

**BUILD 20 RADIO CIRCUITS AT HOME**

with the New **PROGRESSIVE RADIO "EDU-KIT"** <sup>only \$26.95</sup>  
Reg. U.S. Pat. Off.

**ALL Guaranteed to Work!**

**A Complete Home Radio Course**

- 12 Receivers
- 3 Transmitters
- Signal Tracer
- Signal Injector
- Code Oscillator
- Sq. Wave Generator
- Amplifier

- No Knowledge of Radio Necessary
- No Additional Parts or Tools Needed
- Excellent Background for TV



**FREE** Set of Tools, Pliers-Cutters, Tester, Soldering Iron, Alignment Tool, Wrench Set.

**WHAT THE "EDU-KIT" OFFERS YOU**

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. You will learn radio theory, construction and servicing. You will learn how to work with punched metal chassis as well as the new Printed Circuit chassis. You will learn the principles of RF and AF amplifiers and oscillators, detector circuits, tuning circuits. You will learn and practice code, using the Progressive Code Oscillator. You will build 20 Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator, Amplifier and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for TV. In brief, you will receive a basic education in Electronics and Radio, worth many times the small price you pay, only \$26.95 complete.

**PROGRESSIVE TEACHING METHOD**

The Progressive Radio "Edu-Kit" is the foremost in educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." You begin by building a simple radio. Gradually, in a progressive manner, and at your own rate, you construct more advanced multi-tube radio circuits, learn more advanced theory and techniques, and do work like a professional radio technician. These circuits operate on your regular AC or DC house current.

**THE KIT FOR EVERYONE**

You do not need the slightest background in radio or science. The "Edu-Kit" is used by young and old, schools and clubs, by Armed Forces Personnel and Veterans Administration training and rehabilitation.

One of the most important aspects of the "Edu-Kit" is the Consultation Service which we provide. We welcome students to send us their problems, whether related to any of the material covered in the "Edu-Kit" course, or other experiences in the field of electronics.

**THE "EDU-KIT" IS COMPLETE**

You will receive all parts and instructions necessary to build 20 different radio and electronic circuits, each guaranteed to operate. Our kits contain tubes, tube sockets, variable electrolytic mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, wiring, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls, switches, etc. In addition, you receive Printed Circuit materials, including Printed Circuit Chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, pliers, cutters, an alignment tool, professional electric soldering iron, Wrench set, and self-powered, dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Oscillator, a High Fidelity Guide, FCC Amateur License Training Book, and a Quiz Book. All parts, components, etc., of the "Edu-Kit" are 100% unconditionally guaranteed, brand new, carefully selected, tested and matched. Everything is yours to keep. The complete price of this practical home Radio and Electronics course is only \$26.95.

**TROUBLE-SHOOTING LESSONS**

You will learn to trouble-shoot and service radios, using the professional Signal Tracer, the unique Signal Injector, and the dynamic Radio and Electronics Tester. Our Consultation Service will help you with any technical problems.

J. Stasattis, 25 Poplar St., Waterbury, Conn. writes: "I have repaired several sets for my friends and made more. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a course, but I found your ad and sent for your kit."

**FREE EXTRAS**

- Set of Tools • Radio Book • Radio and Electronics Tester • Electric Soldering Iron • Pliers-Cutters • Alignment Tool • Tester Instruction Book • Hi-Fi Book • TV Book • Quiz Book • Membership in Radio-TV Club • Consultation Service • FCC Amateur License Training • Printed Circuitry • Certificate of Merit • Valuable Discount Card • Wrench Set

**UNCONDITIONAL MONEY-BACK GUARANTEE**

**ORDER FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH \$7.00**

- "Edu-Kit" Postpaid. Enclosed full payment of \$26.95
- "Edu-Kit" C.O.D. I will pay \$26.95 plus postage.
- Send me FREE additional information describing "Edu-Kit."

Name \_\_\_\_\_  
 Address \_\_\_\_\_

**PROGRESSIVE "EDU-KITS" INC.**

1186 Broadway, Dept. 194G, Hewlett, N. Y.

**PICTURE TUBE REPLACEMENT GUIDE**

Pub. No. ETR 702-F. 24 x 30-in wall chart lists essential data on 460 types of TV picture tubes, including interchangeability guide.—General Electric, Electronic Components Div., Owensboro, Ky.

**FM STEREO BROADCASTING** described in 7-page leaflet, BK-50. Diagrams and text outline G-E-Zenith system.—Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, N.Y.

**PLATE ASSEMBLY REPLACEMENT GUIDE** No. PRG-612. 6-page chart of printed circuit R-C units gives manufacturers' parts numbers, identification printed on the part, and Aerovox catalog number.—Aerovox Corp., Distributor Div., New Bedford, Mass.

**NEEDLES AND ACCESSORIES** presented in 52-page catalog, including illustrated charts for needle identification and replacement.—Astatic Corp., Conneaut, Ohio.

**TRANSISTOR TRANSFORMER NOMOGRAPH**, for design of class-A and class-B transformer-coupled transistor audio and servo amplifiers, determines required primary and secondary impedances of output and driver transformers.—Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y.

**MASTER INDEX** lists 20 radio and 15 TV "Most-Often-Needed" service manuals, with cross-reference for individual sets.—Supreme Publications, 1760 Balsam Road, Highland Park, Ill. 25¢.

**DISCOUNT RECORDS AND TAPES** detailed in 144-page Catalog No. 211. Lists more than 1,600 stereo records, 300 monophonic recordings and 800 four-track stereo tapes.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

**INDUSTRIAL AIDS**, scientific, mathematical and optical, offered in 160-page Catalog No. 621. Includes technical data and illustrations on instruments and components, photographic and optical items as well as math training aids.—Edmund Scientific Co., Barrington, N. J.

**RF INTERFERENCE SHIELDING** described in reprinted 4-page article "Shielded Rooms For Electronic Equipment." Outlines techniques, materials, design and construction details, including 5 photos.—Aec Engineering & Machine Co., C. C. Borden, vice president, Tomlinson Rd., Huntingdon Valley, Pa.

**RADIO EQUIPMENT** listed in 50-page illustrated catalog. Items include wire, cable, tubing and electronic hardware, as well as radio-TV accessories and components.—Birnbach Radio Co., Inc., 145 Hudson St., New York 13, N. Y.

**TAPE RECORDERS** and hi-fi equipment described in 16-page illustrated catalog. Technical details given on 8 Sony models and 3 professional mikes plus accessories.—SuperScope, Inc., 8150 Vineland Ave., Sun Valley, Calif.

**HI-FI EQUIPMENT CATALOG** offers eight pages of photos and specs on four Norelco tape recorders with Buyer's Guide and Applications Chart. Full line of loudspeakers also included.—North American Philips Co., Inc., High Fidelity Products Div., 230 Duffy Ave., Hicksville, N. Y.

**TAPE-LOG**, 32-page illustrated catalog, lists over 1,500 4-track stereo tapes, covering libraries of 38 major labels.—Danken Associates, 8244 Vista Del Mar, Playa Del Rey, Calif. 60¢.

**COMMUNICATIONS PRODUCTS** shown in 4-page Bulletin No. 7010. Illustrations and specs given on Telerite line, including MIL-spec and miniature jacks and plugs as well as hybrid and standard assemblies.—Uehnte Co., Div. United-Carr Fastener Corp., Newtonville 60, Mass.

**VHF TRANSLATORS**. Illustrated 4-page leaflet contains information on indoor and outdoor models, plus double-conversion system.—EMCEE, Electronics Missiles & Communications, Inc., 262 E. 3rd St., Mount Vernon, N. Y.

**WIREWOUND RESISTORS** presented in 20-page Catalog 14 RF, with full illustrations, specs and performance characteristics.—Cinema Engineering, Div. Aerovox Corp., 1100 Chestnut St., Burbank, Calif.



**11 OLSON STORES PLUS MAIL ORDER**

**Olson Stores In:**

**AKRON, OHIO**  
69 W. State Street

**ATLANTA, GA.**  
485 Peachtree St.

**BUFFALO, N.Y.**  
711 Main Street

**CHICAGO, ILL.**  
4101 N. Milwaukee Ave.

**CHICAGO, ILL.**  
123 N. Western Ave.

**CLEVELAND, OHIO**  
2020 Euclid Ave.

**CLEVELAND, OHIO**  
6813 Pearl Road

**COLUMBUS, OHIO**  
142 N. High Street

**INGLEWOOD, CALIF.**  
4642 W. Century Blvd.

**MILWAUKEE, WISC.**  
423 W. Michigan

**PITTSBURGH, PENN.**  
5918 Penn Avenue

Fill in coupon for a FREE One Year Subscription to OLSON'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.

MAIL TO: ■■■■■■

**OLSON ELECTRONICS**  
729 S. Forge Street  
Akron 8, Ohio

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

# "ONE DOLLAR" buys

As much as \$15 worth - Everything Brand New and sold to you with a money back guarantee.

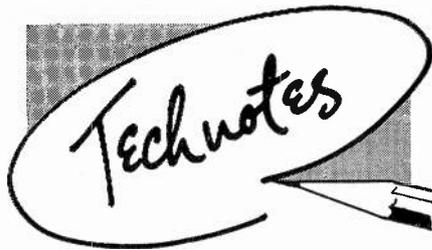
## 10% OFF & FREE GIFT — ON PURCHASE OF \$10 OR OVER!

- |  |   |  |   |
|--|---|--|---|
| <input type="checkbox"/> 1-5" PM SPEAKER<br>alnico #5 magnet . . . . . \$1                   | <input type="checkbox"/> 100 - ASSORTED 1/2 WATT<br>RESISTORS some in 5% . . . \$1            | <input type="checkbox"/> 15 - ASSORTED ROTARY<br>SWITCHES regular \$15 value \$1   | <input type="checkbox"/> \$15.00 TELEVISION PARTS \$1<br>"JACKPOT" best buy ever . . . \$1      |
| <input type="checkbox"/> 1-4" PM SPEAKER<br>alnico #5 magnet . . . . . \$1                   | <input type="checkbox"/> 70 - ASSORTED 1 WATT<br>RESISTORS some in 5% . . . \$1               | <input type="checkbox"/> 10-6' ELECTRIC LINE<br>CORDS with plug . . . . . \$1  | <input type="checkbox"/> 1 - \$10 INDOOR TV ANTEN-<br>NA hi-gain, 3 section, tiltproof \$1      |
| <input type="checkbox"/> 1-3" PM SPEAKER<br>alnico #5 magnet . . . . . \$1                   | <input type="checkbox"/> 35 - ASSORTED 2 WATT<br>RESISTORS some in 5% . . . \$1               | <input type="checkbox"/> 4-50' SPOOLS HOOK-UP<br>WIRE 4 different colors . . . \$1   | <input type="checkbox"/> 5 - TV CHEATER CORDS \$1<br>with both plugs . . . . . \$1              |
| <input type="checkbox"/> 1-3 1/2" TWEETER<br>SPEAKER for Hi-Fi . . . . . \$1                 | <input type="checkbox"/> 40 - ASST. PRECISION RE-<br>SISTORS in 1 percenters . . . \$1        | <input type="checkbox"/> 25' - INSULATED SHIELDED<br>WIRE #20 braid-metal jacket \$1   | <input type="checkbox"/> 75' - MINIATURE ZIP CORD \$1<br>2 conductor, 101 uses . . . . . \$1    |
| <input type="checkbox"/> 5 - SETS SPEAKER PLUGS<br>male & female, wired, long leads \$1      | <input type="checkbox"/> 20 - ASS'TED WIREWOUND<br>RESISTORS 5, 10, 20 watt . . . \$1         | <input type="checkbox"/> 35' - TEST PROD WIRE \$1<br>deluxe quality, red or black . . . \$1  | <input type="checkbox"/> 100' - TWIN TV LEAD-IN<br>WIRE 300 ohm, heavy duty . . . \$1           |
| <input type="checkbox"/> 3-AUDIO OUTPUT TRANS-<br>FORMERS 50L6 type . . . . . \$1            | <input type="checkbox"/> 50 - ASSORTED TUBULAR<br>CONDENSERS .001 to .47 . . . \$1            | <input type="checkbox"/> 50 - STRIPS ASSORTED<br>SPAGHETTI handy sizes . . . . \$1   | <input type="checkbox"/> 50' - FLAT 4-CONDUCTOR \$1<br>WIRE many purposes . . . . . \$1         |
| <input type="checkbox"/> 2-AUDIO OUTPUT TRANS-<br>FORMERS 50L6 push-pull . . . \$1           | <input type="checkbox"/> 50 - ASST. CERAMIC CON-<br>DENSERS some in 5% . . . . . \$1          | <input type="checkbox"/> 100 - ASSORTED RUBBER<br>GROMMETS best sizes . . . . . \$1  | <input type="checkbox"/> 20 - ASSORTED TV KNOBS<br>ESCUTCHEONS, \$20 value . . . \$1            |
| <input type="checkbox"/> 3-AUDIO OUTPUT TRANS-<br>FORMERS 6K6 or 6V6 type . . . \$1          | <input type="checkbox"/> 50 - ASST. MICA CON-<br>DENSERS some in 5% . . . . . \$1             | <input type="checkbox"/> 50' - HI-VOLTAGE WIRE \$1<br>for TV, special circuits, etc. . . \$1   | <input type="checkbox"/> 15 - ASSORTED STANDARD<br>TUNER VHF STRIPS . . . . . \$1               |
| <input type="checkbox"/> 2-AUDIO OUTPUT TRANS-<br>FORMERS 6K6 push-pull . . . \$1            | <input type="checkbox"/> 35 - ASST. DISC CERAMIC<br>CONDENSERS popular numbers \$1            | <input type="checkbox"/> 200' - BUSS WIRE #20 tinned<br>for hookups, special circuits, etc. \$1  | <input type="checkbox"/> 6 - ASSORTED STANDARD<br>TUNER UHF STRIPS . . . . . \$1                |
| <input type="checkbox"/> 3-AUDIO OUTPUT TRANS-<br>FORMERS 3Q4, 3Q5, 3S4 . . . \$1            | <input type="checkbox"/> 35 - DISC CERAMIC CON-<br>DENSERS 5000 mmf . . . . . \$1             | <input type="checkbox"/> 200' - HOOK-UP WIRE \$1<br>any color of your choice . . . . \$1   | <input type="checkbox"/> 1 - 70' FLYBACK TRANS-<br>FORMER incl Schematic Diagram \$1            |
| <input type="checkbox"/> 10 - FILTER CHOKE TRANS<br>75 $\Omega$ , 1 henry, 100ma . . . . \$1 | <input type="checkbox"/> 25 - ASSORTED MICA<br>TRIMMER CONDENSERS . . . . \$1                 | <input type="checkbox"/> 250 - ASST. SOLDERING<br>LUGS best types and sizes . . . \$1  | <input type="checkbox"/> 1 - 90' FLYBACK TRANS-<br>FORMER incl Schematic Diagram \$1            |
| <input type="checkbox"/> 3 - I.F. COIL TRANSFORM-<br>ERS 456kc, most popular type \$1        | <input type="checkbox"/> 50 - 100K 1/2 WATT RE-<br>SISTORS 10% . . . . . \$1                  | <input type="checkbox"/> 1 - LB SPOOL ROSIN-CORE<br>SOLDER 40/60 . . . . . \$1   | <input type="checkbox"/> 1 - TV VERTICAL OUTPUT \$1<br>TRANSFORMER 10 to 1 ratio . . . \$1      |
| <input type="checkbox"/> 3 - I.F. COIL TRNSFRMRS<br>456kc transistor type 3/4x3/4" . . \$1   | <input type="checkbox"/> 50 - 220K 1/2 WATT RE-<br>SISTORS 10% . . . . . \$1                  | <input type="checkbox"/> 600 - ASST. HARDWARE KIT<br>screws, nuts, washers, rivets, etc. \$1   | <input type="checkbox"/> 1 - TV VERTICAL OUTPUT \$1<br>TRANSFORMER 16 to 1 ratio . . . \$1      |
| <input type="checkbox"/> 2 - G.E. #RTL-143 I.F. COIL<br>TRNSFRMRS 456kc w/flange . . . \$1   | <input type="checkbox"/> 50 - 470K 1/2 WATT RE-<br>SISTORS 10% . . . . . \$1                  | <input type="checkbox"/> 200 - ASST. SELF TAPPING<br>SCREWS #6, #8, etc. . . . . \$1   | <input type="checkbox"/> 1 - VERTICAL BLOCKING \$1<br>TRANSFORMER standard type . . . \$1       |
| <input type="checkbox"/> 3 - I.F. COIL TRANSFORM-<br>ERS 10.7mc for FM . . . . . \$1         | <input type="checkbox"/> 20 - WIREWOUND RESIS-<br>TORS 50 ohm, 10 watt . . . . . \$1          | <input type="checkbox"/> 150 - ASST. 6/32 SCREWS<br>& 150 - 6/32 HEX NUTS . . . . \$1  | <input type="checkbox"/> 2 - RATIO DETECTOR \$1<br>COILS 4.5mc . . . . . \$1                    |
| <input type="checkbox"/> 3 - I.F. COIL TRANSFORM-<br>ERS 262kc for Auto Radios . . . \$1     | <input type="checkbox"/> 300 - ASSORTED 1/2 WATT<br>RESISTORS short leads . . . . \$1         | <input type="checkbox"/> 150 - ASST. 8/32 SCREWS<br>& 150 - 8/32 HEX NUTS . . . . \$1  | <input type="checkbox"/> 2 - RATIO DETECTOR \$1<br>COILS 10.7mc . . . . . \$1                   |
| <input type="checkbox"/> 4 - OVAL LOOP ANTENNAS<br>assorted popular sizes . . . . . \$1      | <input type="checkbox"/> 15 - TUBULAR CONDENS-<br>ERS .047-600v . . . . . \$1                 | <input type="checkbox"/> 100 - ASST. RUBBER FEET<br>FOR CABINETS best sizes . . . \$1  | <input type="checkbox"/> 2 - TV SOUND I. F. COILS \$1<br>4.5mc . . . . . \$1                    |
| <input type="checkbox"/> 3 - LOOPSTICK ANTENNAS<br>hi-gain, ferrite, adjustable . . . \$1    | <input type="checkbox"/> 15 - TUBULAR CONDENS-<br>ERS .47-400v . . . . . \$1                  | <input type="checkbox"/> 15 - ASST HANDY RADIO<br>& TV BRACKETS many uses \$1  | <input type="checkbox"/> 2 - TV SOUND I. F. COILS \$1<br>21.25mc . . . . . \$1                  |
| <input type="checkbox"/> 3 - VARIABLE CONDENS-<br>ERS superhet 420/162 mfd . . . . \$1       | <input type="checkbox"/> 20 - TUBULAR CONDENS-<br>ERS .01-600v . . . . . \$1                  | <input type="checkbox"/> 8 - ASST. LUCITE CASES \$1<br>hinged cover, handy for parts . . \$1   | <input type="checkbox"/> 2- SOUND DISCRIMINATOR \$1<br>COILS 4.5mc . . . . . \$1                |
| <input type="checkbox"/> 3 - ASST. SIZES RADIO<br>CHASSIS PANS drilled & plated \$1          | <input type="checkbox"/> 15 - TUBULAR CONDENS-<br>ERS 1-600v . . . . . \$1                    | <input type="checkbox"/> 4 - TOGGLE SWITCHES \$1<br>SPST, SPDT, DPST, DPDT . . . . \$1   | <input type="checkbox"/> 2 - SOUND DISCRIMINA-<br>TOR COILS 10.7mc . . . . . \$1                |
| <input type="checkbox"/> 12 - RADIO OSCILLATOR<br>COILS standard 456kc . . . . . \$1         | <input type="checkbox"/> 15 - TUBULAR CONDENS-<br>ERS .25-600v . . . . . \$1                  | <input type="checkbox"/> 6 - ASST. SLIDE SWITCHES \$1<br>SPST, DPDT, etc. . . . . \$1  | <input type="checkbox"/> 25 - ASSORTED TV PEAK-<br>ING COILS all popular types . . . \$1        |
| <input type="checkbox"/> 3 - 1/2 MEG VOLUME CON-<br>TROLS with switch . . . . . \$1          | <input type="checkbox"/> 10 - HI-VOLTAGE CON-<br>DENSERS .007-1600v . . . . . \$1             | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 5 mmf and 15 - 25 mmf . . . \$1  | <input type="checkbox"/> 4 - ASST. TV ION TRAPS \$1<br>for all type TV Receivers . . . . \$1    |
| <input type="checkbox"/> 5 - 1/2 MEG VOLUME CON-<br>TROLS less switch . . . . . \$1          | <input type="checkbox"/> 3 - ELECTROLYTIC CON-<br>DENSERS 50/30-150v . . . . . \$1            | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 50 mmf and 15 - 68 mmf . . . \$1   | <input type="checkbox"/> 4 - TV CENTERING RINGS \$1<br>fits on back of deflection yoke . . \$1  |
| <input type="checkbox"/> 5 - 1 MEG VOLUME CON-<br>TROLS less switch . . . . . \$1            | <input type="checkbox"/> 2 - ELECTROLYTIC CON-<br>DENSERS 80/80/20-150v . . . . \$1           | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 100 mmf and 15 - 250 mmf . . \$1   | <input type="checkbox"/> 25 - ASSORTED TV COILS \$1<br>sync, peaking, width, ratio, etc . . \$1 |
| <input type="checkbox"/> 5 - 50K VOLUME CON-<br>TROLS less switch . . . . . \$1              | <input type="checkbox"/> 10 - ASST. RADIO ELECT-<br>ROLYTIC CONDENSERS . . . . . \$1          | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 470mmf and 15 - 680mmf . . . \$1   | <input type="checkbox"/> 5 - TV PICTURE TUBE<br>SOCKETS wired with 20" lead \$1                 |
| <input type="checkbox"/> 5 - ASST. 4 WATT WIRE-<br>WOUND CONTROLS . . . . . \$1              | <input type="checkbox"/> 5 - ASST. TV ELECTROLYT-<br>IC CONDENSERS . . . . . \$1              | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 820mmf & 15 - 1000mmf . . . \$1  | <input type="checkbox"/> 5 - TV HI-VOLT ANODE \$1<br>LEADS 20" length . . . . . \$1             |
| <input type="checkbox"/> 10 - ASSORTED VOLUME<br>CONTROLS less switch . . . . . \$1          | <input type="checkbox"/> 2 - ELECTROLYTIC CON-<br>DENSERS 10/40-450v . . . . . \$1            | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 2200mmf & 15 - 2400mmf . . . \$1   | <input type="checkbox"/> 3 - TV CARTWHEEL CON-<br>DENSERS 20 kv - 500 mmf . . . \$1             |
| <input type="checkbox"/> 5 - ASSORTED VOLUME<br>CONTROLS with switch . . . . . \$1           | <input type="checkbox"/> 3 - ELECTROLYTIC CON-<br>DENSERS 16/16-450v . . . . . \$1            | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 3300mmf & 15 - 4700mmf . . . \$1   | <input type="checkbox"/> 2 - TV CARTWHEEL CON-<br>DENSERS 30 kv - 500 mmf . . . \$1             |
| <input type="checkbox"/> 100 - VOLUME CONTROL<br>HEX NUTS fits 3/8" bushing . . . \$1        | <input type="checkbox"/> 4 - ELECTROLYTIC CON-<br>DENSERS 80-100v . . . . . \$1               | <input type="checkbox"/> 35 - MICA CONDENSERS \$1<br>20 - 6800 mmf and 15 - 1000 mmf . . \$1   | <input type="checkbox"/> 3 - HV RECTIFIER SOCK-<br>ETS for 1B3 Tube, mounted . . . \$1          |
| <input type="checkbox"/> 10 - SURE-GRIP ALLIGA-<br>TOR CLIPS 2" plated . . . . . \$1         | <input type="checkbox"/> 30 - FP ELECTROLYTIC<br>COND. MOUNTING WAFERS \$1                    | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-5 mmf and 15-10 mmf . . . \$1   | <input type="checkbox"/> 3 - HV RECTIFIER SOCK-<br>ETS for 1X2 Tube, mounted . . . \$1          |
| <input type="checkbox"/> 1 - GOLD GRILLE CLOTH<br>14"x14" or 12"x18" . . . . . \$1           | <input type="checkbox"/> 2 - ELECTROLYTIC CON-<br>DENSERS 50/50-150v . . . . . \$1            | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-25 mmf and 15-47 mmf . . . \$1  | <input type="checkbox"/> 1 - TV FOCALIZER \$1<br>adjustable for any ohmage . . . . \$1          |
| <input type="checkbox"/> 10 - SETS PHONO PLUGS<br>& PIN-JACKS RCA type . . . . . \$1         | <input type="checkbox"/> 5 - ELECTROLYTIC CON-<br>DENSERS 25-50v . . . . . \$1                | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-56 mmf and 15-82 mmf . . . \$1  | <input type="checkbox"/> 1 - SILICON RECTIFIER \$1<br>750ma, 500PIV . . . . . \$1               |
| <input type="checkbox"/> 2 - \$2.50 SAPPHIRE NEE-<br>DLES good for 10,000 plays . . . \$1    | <input type="checkbox"/> 5 - DIODE CRYSTALS 2-IN21<br>1-1N34, 1-1N60, 1-1N64 . . . . \$1      | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-100mmf & 15-150mmf . . . \$1  | <input type="checkbox"/> 2 - SILICON RECTIFIERS \$1<br>500ma, 400PIV . . . . . \$1              |
| <input type="checkbox"/> 20 - ASST. PILOT LIGHTS \$1<br>#44, 46, 47, 51, etc. . . . . \$1    | <input type="checkbox"/> 4 - DIODE CRYSTALS 1-IN34<br>1-1N80, 1-1N89, 1-1N82 . . . . \$1      | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-250mmf & 15-470mmf . . . \$1  | <input type="checkbox"/> 3 - SILICON RECTIFIERS \$1<br>350ma, 200PIV . . . . . \$1              |
| <input type="checkbox"/> 10 - PILOT LIGHT SOCK-<br>ETS bayonet type, wired . . . . . \$1     | <input type="checkbox"/> 3 - SELENIUM RECTIFIERS \$1<br>2 - 65ma and 1 - 75ma . . . . . \$1   | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-1000mmf & 15-1500mmf . . \$1  | <input type="checkbox"/> 3 - TV ALIGNMENT TOOLS \$1<br>Assortment #1 . . . . . \$1              |
| <input type="checkbox"/> 50 - ASSORTED TERMINAL<br>STRIPS 1, 2, 3, 4 lugs . . . . . \$1      | <input type="checkbox"/> 2 - SELENIUM RECTIFIERS \$1<br>1 - 100 ma and 1 - 250 ma . . . . \$1 | <input type="checkbox"/> 35 - CERAMIC CONDENS-<br>ERS 20-2000mmf & 15-5000mmf . . \$1  | <input type="checkbox"/> 3 - TV ALIGNMENT TOOLS \$1<br>Assortment #2 . . . . . \$1              |
| <input type="checkbox"/> 100' - FINEST NYLON DIAL<br>CORD best size, .028 gauge . . . \$1    | <input type="checkbox"/> 2 - SELENIUM RECTIFIERS \$1<br>1 - 75ma and 1 - 350ma . . . . . \$1  | <input type="checkbox"/> 10 - ASSORTED TUBES \$1<br>Radio, TV, Industrial . . . . . \$1  | <input type="checkbox"/> 3 - TV ALIGNMENT TOOLS \$1<br>Assortment #3 . . . . . \$1              |
| <input type="checkbox"/> 35 - ASST. RADIO KNOBS<br>screw and push-on types . . . . \$1       | <input type="checkbox"/> 2 - SELENIUM RECTIFIERS \$1<br>1 - 65ma and 1 - 450ma . . . . . \$1  | <input type="checkbox"/> 4 - TUNGSOIL 1U4 TUBES \$1<br>also serves as a 1T4 . . . . . \$1  | <input type="checkbox"/> 3 - TV ALIGNMENT TOOLS \$1<br>Assortment #4 . . . . . \$1              |
| <input type="checkbox"/> 100 - ASSORTED KNOB<br>SET-SCREWS best sizes . . . . . \$1          | <input type="checkbox"/> 20 - ASST. TUBE SHIELDS \$1<br>for 7 pin and 9 pin Tubes . . . . \$1 | <input type="checkbox"/> 3 - SYLVANIA 35W4 TUBES \$1<br>factory cartoned . . . . . \$1   | <input type="checkbox"/> 3 - TV ALIGNMENT TOOLS \$1<br>Assortment #5 . . . . . \$1              |
| <input type="checkbox"/> 25 - ASSORTED RADIO DIAL<br>POINTERS popular types . . . . . \$1    | <input type="checkbox"/> 35 - ASSORTED SOCKETS \$1<br>7 pin, 8 pin, 9 pin . . . . . \$1       | <input type="checkbox"/> STANDARD BRAND TUBES \$1<br>O24, 1B3, 1X2, 5U4, 5Y3,<br>6AC7, 6A6, 6AX4, 6CB6, 6CG7,<br>6J6, 6K6, 6SN7, 6UB, 6X8, 12AT7,<br>12AU7, 12AX4, 50L6 . . . . . Each \$1 |   |
| <input type="checkbox"/> 25 - ASSORTED CLOCK<br>RADIO KNOBS in colors . . . . . \$1          | <input type="checkbox"/> 25 - ASSORTED PRINTED<br>CIRCUIT SOCKETS best types \$1              |  |   |
| <input type="checkbox"/> 50 - ACORN RADIO KNOBS \$1<br>1/2" diameter, push-on . . . . . \$1  | <input type="checkbox"/> 20 - INSTRUMENT POINT-<br>ER KNOBS popular screw type \$1            |  |   |

**HANDY WAY TO ORDER** — Simply pencil mark items wanted (X in square is sufficient), enclose with money order or check. You will receive a new copy of these offers for re-orders.

**ON SMALL ORDERS** — Include stamps for postage, excess refunded. **LARGER ORDERS** shipped express charges collect.

**BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.** TELEPHONE CORlland 7-2359

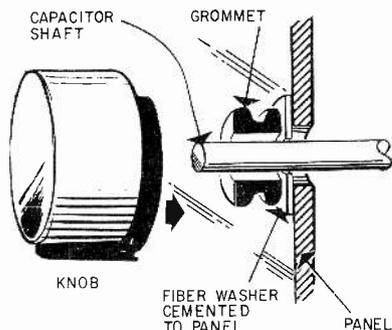


### RCA 8EY4DJ

A common trouble in these record players is excessive hum. There are two causes. One is heater-cathode leakage in the 12AX7 and is cured by replacing the tube. A more subtle 60-cycle hum can be reduced by adding a length of insulated wire from pin 4 of the 12AX7 to the middle terminal on the tone control. Both of these points are at B-minus, but adding the wire cancels hum pickup caused by circulating currents.—*M. L. Leonard*

### BC-221 FREQUENCY METER

**Complaint:** At times the frequency on both the low and high band would drift badly. This condition would not improve no matter how long the set was left operating.

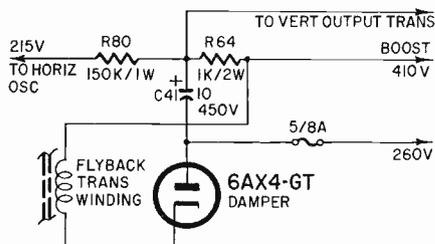


**Test:** The drift was traced to a defective corrector control. It was loose and had a wobbly shaft. However, replacement was almost impossible unless I wanted to rip up the precise oscillator section and take a chance on disturbing the dial calibration.

**Cure:** After hours of thought, I decided to try to correct the drifting of the spacing of the corrector control capacitor by inserting some pressure between the control knob and the front panel. I placed a fiber washer over the control shaft of the capacitor and cemented it between the shaft and panel to keep the control shaft from wobbling. Then I placed a rubber grommet between the fiber washer and the control knob. By adjusting the control knob to give enough pressure to keep the control rotation stiff and to steady any movement between the rotor and stator plates, once the control has been set, I solved my problem.—*George P. Oberto*

### OLYMPIC 1TB61

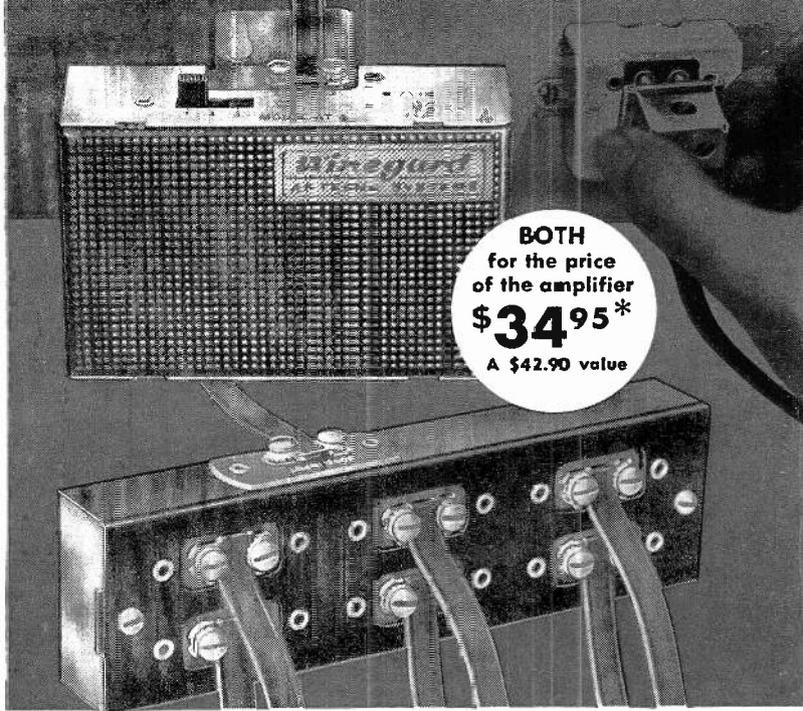
Horizontal sync was unstable and, while the picture had straight sides, it was about 4 inches narrower at the bottom. After much checking, we replaced C41 and cleared up the trouble.



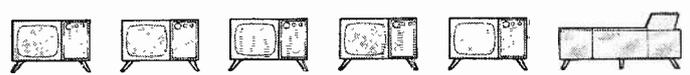
The vertical output stage and the horizontal oscillator get B-plus from the same source. When this capacitor opened, the output of the vertical output tube was fed to the horizontal oscillator, causing the symptoms above.—*William R. Seabrook*

New transistor Home TV and FM System!

# Winegard BOOSTER-PACK & 'SIX-SET' COUPLER



**BOTH**  
for the price  
of the amplifier  
**\$34.95\***  
A \$42.90 value



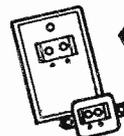
## DRIVE UP TO 6 TV AND FM SETS

Cut snow . . . improve contrast . . . deliver sharper, clearer pictures to each set. New low noise, high gain transistor combined with advanced circuitry gives Winegard AT-6 "Booster-Pack" a flat gain of 16 db on low and FM bands . . . a flat 14 db gain on high band.

Shock-proof, full AC chassis with AC isolation transformer (NOT AC-DC). Draws 1.2 watts. Gain control switch prevents overdriving sets on local stations. No heat. Can be mounted remote from coupler. Also ideal as single set booster.

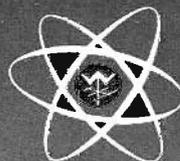
New, Winegard 300-ohm "Six-Set" coupler has low insertion loss, positive isolation between sets. No need to terminate unused outputs.

You get both AT-6 "Booster-Pack" and LTS-63 "Six-Set" for the price of "Booster-Pack" alone: a \$42.90 value for only \$34.95 list. Ask your distributor.



For real convenience, add Winegard flush or surface mount 300-ohm plug-in outlets. Even folks with only one TV set appreciate being able to move it from room-to-room.  
For finest all-channel reception, use a Winegard "Teletron" antenna with your "Booster-Pack".

\*Limited Time Offer

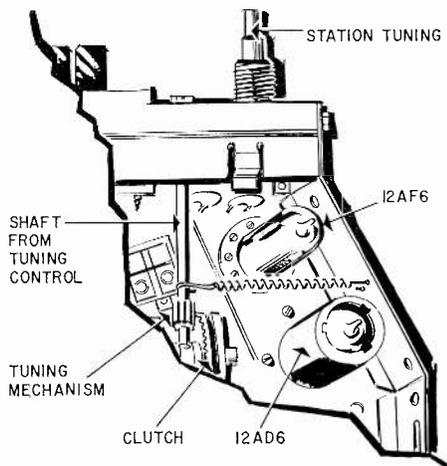


# Winegard

ANTENNA SYSTEMS  
312-20 Kirkwood Avenue, Burlington, Iowa

## FORD 75BF AUTO RADIOS

Complaints of tuning-dial slipping where the slippage is in the clutch mechanism can be cured by mounting a phonograph or dial-cord spring from the tuning shaft close to the gear drive to the right side of the cabinet to exert more



pressure on the clutch mechanism. Don't use too heavy a spring or the pushbuttons won't work properly and will wear excessively.—George P. Oberto

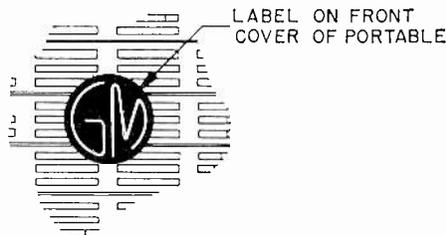
## GM PORTABLES

Scattered throughout the United States are some Delco Radio portable radios with a "GM" label. These portables have an anodized aluminum case which gives the radio a gold appearance, and a black front cover. They are complimentary radios and service information is not available.

The problem is what to do if one of these radios is

## WE BUY TECHNOTES

RADIO-ELECTRONICS wants Industrial Technotes. These should cover equipment (including closed-circuit television) actually used in industrial work, or technotes on counters, controls and other apparatus whose users are largely industrial. Unillustrated Technotes pay \$5; circuit diagrams raise the price to \$9 and acceptable photos are worth \$7 each. Send your technotes from industry to Technotes Editor, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N. Y.



brought into your shop.

If you were to look at a 1959 Buick portable radio, you would immediately notice the similarity between this radio and the GM portable. This not only applies to the external appearance but also the circuit. The main difference between the two radios is the lack of a connector in the GM portable. Since it was not designed to be part of a car radio, the connector has been left out.

If one of these GM portables is brought into your shop for repair, dig out the 1959 Buick, Pontiac or Oldsmobile service bulletin and go to work.—Delco Testing Tips **END**



Save 30% on 4-track Stereo Music on Tape!

Empty 3 in. plastic reels 7¢ ea.

**BARGAIN PRICES!**

**SEND FOR OUR FREE**

Tape Recorder/Blank/Recorded Tape Catalog  
**SAXITONE TAPE SALES**  
(Div. of Commissioned Electronics Co., Inc.)  
1776 Columbia Road Washington, D.C.

### TV PICTURE TUBES All Aluminized Glass Types BUY DIRECT AND SAVE

• 12LP4—\$8.95 • 17BP4—\$9.95 • 21AL/ATP4—\$16.75

• 24DP4—\$24.50 • 27EP4—\$39.95

ALL TYPES AVAILABLE

These tubes are made from reprocessed glass. All materials including electron gun are brand new.

All Prices with old tube F.O.B. Chicago

### PICTURE TUBE OUTLET

2922 MILWAUKEE • Chicago 18

FREE... Write for complete Picture Tube list.

# ELECTRONICS

## Engineering-Technicians

Bachelor of Science Degree, 30 Months  
Save Two Years' Time

- Radio-Television Plus Color Technician (12 Months)
- Electronics Engineering Technology (15 Months)
- Electronics Engineering (B.S. Degree)
- Electrical Engineering (B.S. Degree)
- Mechanical Engineering (B.S. Degree)
- Civil Engineering (B.S. Degree)
- Architecture (B.S. Degree)

Approved for Veterans  
DAY AND EVENING CLASSES

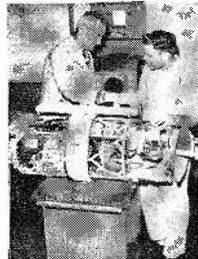
Write for Catalog and Registration Application.  
New Term Starting Soon.

Your Name .....

Address .....

City .....

State .....



Heald's Microwave and Radar Laboratory Equipment.

## HEALD'S ENGINEERING COLLEGE

Established 1863

Van Ness at Post, RE  
San Francisco, Calif.

# YOU SAVE MONEY!

RUSH US YOUR LIST OF HI-FI COMPONENTS FOR A SPECIAL QUOTATION

WRITE FOR FREE AUDIO DISCOUNT CATALOG A-15

New low prices on amplifiers, tuners, tape recorders, speakers, etc.

**KEY** ELECTRONICS CO.  
120 LIBERTY ST.  
NEW YORK 6, N.Y.

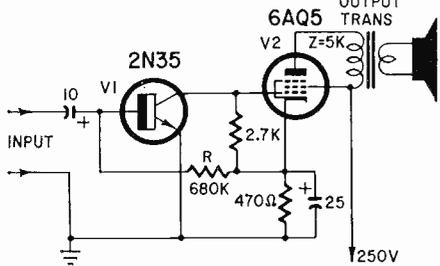
# new PATENTS

## TRANSISTOR-TUBE AMPLIFIER

Patent No. 2,979,664

Wm. F. Palmer, Carlisle, and Geo. Schiess, Watertown, Mass. (Assigned to Sylvania Electric Products, Inc., Wilmington, Del.)

V1 is energized by the dc drop across the cathode resistor. This voltage remains steady in class-A operation. V1 is coupled directly to V2. R sets the transistor bias current. It is also a



feedback resistor to stabilize the first stage. For example, if the base input goes positive, less current flows into the cathode resistor, driving the cathode more negative.

With 30-mv input, the output is 1 watt and the gain is about 60 db. At 4 watts output, distortion is 10%.

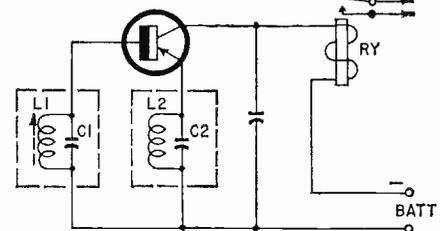
## CONTROL CIRCUIT

Patent No. 2,972,116

Charles E. Lowe, Fenton, Mich. (Assigned to General Motors Corp., Detroit)

At frequencies near alpha cutoff, a transistor has negative resistance and will oscillate. If L1-C1 is tuned to a frequency slightly above that of L2-C2 (both being near cutoff), oscillations persist. The frequency will be between the resonant values, where the inductive reactance of L1-C1 cancels the capacitive reactance of L2-C2.

L1-C1 is very sensitive to slight displacements of its core. Oscillations cease as soon as it is



tuned to the frequency of L2-C2—when the core connected to a detector indicates the proper setting.

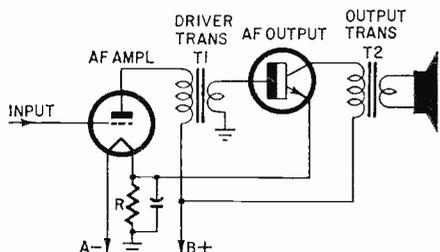
Transistor current will be higher during oscillation, so the relay is energized while L1-C1 is tuned higher than L2-C2.

## HYBRID RADIO

Patent No. 2,970,213

Francis M. Dukat, Waltham, Mass. (Assigned to Raytheon Co.)

Tubes are ideal amplifiers. They have high input and output impedances, and are not readily damaged by overload or affected by temperature. Their big disadvantage (particularly in



portable radios) is that they require filament power. Since the audio output tube requires the most filament power, it is especially desirable to substitute a transistor in this stage.

This inventor shows a simple method for obtaining power for the output transistor. The emitter-base circuit is in series with the filament string. R bypasses some of the current to prevent too high emitter input. The B-battery supplies the tubes and also the collector. In a set using midjet tubes, this supply may be 30 volts. The vacuum tube feeds the transistor through T1. T2 is the output transformer.

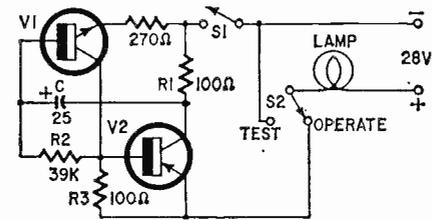
## LIGHT FLASHER

Patent No. 2,977,581

George H. Rodgers, Anaheim, Calif. (Assigned to Marco Industries Co., Anaheim.)

Components used here are so small they may be housed in a compact, plug-in cylinder. The lamp flashes on and off when S1 is closed and 28 volts is applied.

When S1 is closed, a small charging current



flows into C through R1, R2, R3 and the lamp. The rising voltage at V1's base drives it into conduction. Current through R3 biases V2 to conduction too. Enough current can now flow through the lamp to light it.

V2 conduction discharges C, allowing V1 to block again. V2 blocks, also, so the lamp is extinguished and the cycle repeats.

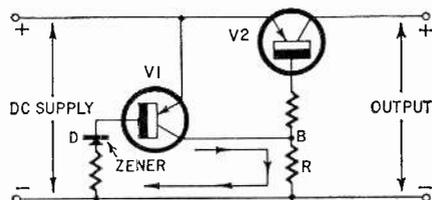
S2, a test button, checks the lamp and the voltage supply.

## TRANSIENT ELIMINATOR

Patent No. 2,971,102

Robert T. Schultz, 1250 N. Tresey Ave., Glendora, Calif.

This circuit is placed between a power supply and its load to eliminate transient overloads that may damage transistors and other delicate components. D is a Zener diode whose



breakdown value is higher than the supply voltage. Therefore V1 is normally blocked. V2 conducts, transmitting power between its emitter and collector.

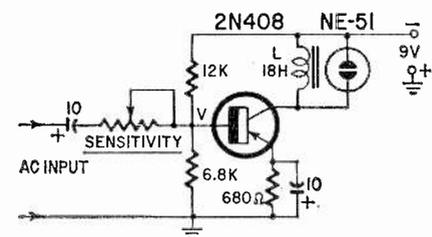
When a transient arrives, the diode breaks down, closing V1's base circuit. Hole current flows in the direction of the arrows through R. This generates a positive bias at B, blocking V2 during the overload.

## TRANSISTORIZED LEVEL INDICATOR

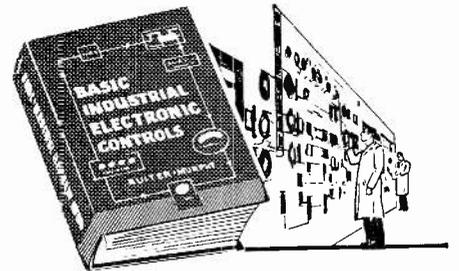
Patent No. 2,972,705

Joseph A. Howells, Riverton, N.J. (Assigned to Radio Corp. of America)

With only a 9-volt supply, this circuit uses a neon lamp to indicate audio level. Normally V is biased to conduction but, when a



large signal arrives, it overcomes the bias and blocks V. Collector current ceases abruptly, causing L to generate a high instantaneous voltage. This signal is indicated by the neon glow. END



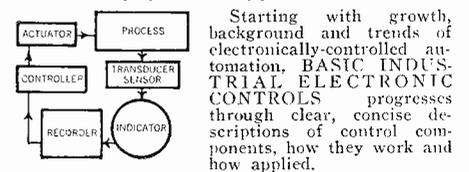
Here's what you want to know about

# INDUSTRIAL ELECTRONIC CONTROLS!

-- all commonly used types; how they work; how applied; where and why!

HERE, just off press, is a practical guide to basic electronic controls written specifically for mechanical and electrical engineers, technicians, servicemen, etc. who find this sort of specialized knowledge increasingly important in their work. It provides a sound understanding of control equipment and usage; serves as a ready reference; answers your questions, brings you fully abreast of control methods and trends throughout industry.

### A Quick Guide to Methods, Equipment, Applications



Starting with growth, background and trends of electronically-controlled automation, BASIC INDUSTRIAL ELECTRONIC CONTROLS progresses through clear, concise descriptions of control components, how they work and how applied.

Includes details on commonly used types of Transducers, Indicators, Recorders, Controllers and Actuators. The section on synchros alone is worth the full price of the book. A section on electronic measuring of physical characteristics covers acceleration, altitude, color, density, dew-point measurement, displacement, flow, humidity, length, level, moisture content, pressure, speed, sound, viscosity and many more.

Finally, you get examples of electronic control at work in such diverse applications as thickness gauging; flaw detection; cleaning, weighing and welding. Typical control systems as applied to paper making are described in detail to illustrate modern control processes in general. Here, you learn how electronic control is applied to flow measurement, water sterilization, bearing temperatures, pH measurements, paper edge control, moisture content, tension, basis weight and other factors involved in a fully automated system.

Written by Jacob H. Ruitter, Jr. and R. Gordon Murphy. 352 pages, over 290 illustrations. Price \$8.50.

### 10 DAY FREE TRIAL

Dept. RE-22, Technical Division, HOLT, RINEHART & WINSTON, INC. 383 Madison Ave., New York 17, N.Y.

Send new 352-page BASIC INDUSTRIAL ELECTRONIC CONTROLS (#709857) manual for 10-day FREE examination. If I decide to keep book, I will then send you \$8.50 in full payment plus postage. If not, I will return book postpaid and owe nothing. (SAVE! Send \$8.50 with order and we pay postage. Same 10-day return privilege with money refunded).

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

OUTSIDE U.S.A.—Price \$9.00 cash with order. 10-day return privilege with money refunded. Above offer expires Oct. 15, 1962

# 34¢ EACH

## ELECTRONIC MARKET

### 1 YEAR GUARANTEED RADIO-TV TUBES

All tubes not necessarily new, but may be electronically perfect factory 2nds or used. Each clearly marked. ELECTRONIC MARKET will replace FREE any tube that becomes defective in use within 1 year from date of purchase. All tubes individually boxed and marked. Partial Listing Only — Thousands More Tubes in Stock!

024	5AV8	6AX5GT	6CH8	6SK7	12BH7
1A7GT	5A24	6B8	6CL6	6SL7	12B06
1B3GT	5CB8	6BA6	6CM6	6SQ7	12B7R
1H5GT	5R4	6BC5	6CM7	6SR7	12CA5
1S5	5T8	6BC8	6CW7	6T4	12D4
1T4	5U4	6B06	6C08	6T8	12F8
1U5	5U8	6BE6	6CR6	6U5	12K5
1V2	5V4G	6BF5	6CS7	6V6GT	12L7
1X2	5V6GT	6BG6G	6CU5	6V6GT	12L6
2A4	5X8	6BH6	6C06	6X4	12M7
2B4	5Y3	6B96	6D6	6X5GT	12R5
2C15	6AB4	6B96	6D6	6X8	12SA7
3A15	6AH4GT	6BK7	6D6	6X8	12SA7
3BC5	6AH6	6BL7GT	6D6	6X8	12S7
3B6	6AL5	6BN6	6D6	6X8	12S7
3B26	6AN8	6BQGT	6H6	12A05	12SN7GT
3BC8	6A06	6BQGT	6H6	12A05	12S07
354	6A07	6BR8	6H6	12A05	12S07
3V4	6AR5	6B5G	6H6	12A05	12S07
4B07A	6AS5	6B5G	6H6	12A05	12S07
4B5	6AT6	6B76	6H6	12A05	12S07
4B27	6AU4GT	6B77	6H6	12A05	12S07
4CB6	6AU5GT	6C4	6H6	12A05	12S07
5AM8	6A08	6C48	6H6	12A05	12S07
5AN8	6AY5GT	6CB6	6H6	12A05	12S07
5AT8	6AV6	6CDB6	6H6	12A05	12S07
	6AX4GT	6CF6	6H6	12A05	12S07

ORDER SHIPPED SAME DAY RECEIVED.

SHIPPING INSTRUCTIONS: ELECTRONIC MARKET PAYS YOUR POSTAGE on orders of \$10 or more in U.S.A. and Territories. Send approx. postage on Canadian and foreign orders. Any order less than \$10 requires 25¢ handling charge. Send 25% on C.O.D.'s. ANY RECEIVER TUBE NOT LISTED ALSO AVAILABLE AT 34¢ EACH.

# 25¢ DISCOUNT

When purchasing lots of 50 or more same type tube per tube

# 74¢ SILICON RECTIFIERS

500 MA 'TOP HAT' ALL PURPOSE Epoxy construction

COMPLETE LINE OF INDUSTRIAL TUBES

ONE OF THE LARGEST INVENTORIES IN THE COUNTRY

## ELECTRONIC MARKET

3750 E. 10th CT., HIALEAH, FLORIDA

Phone: OXford 1-5331

# GOOD PRICES FOR GOOD PHOTOGRAPHS

RADIO-ELECTRONICS 154 West 14th St. New York 11, N.Y.

Detect police radar traps before they detect you  
Plans \$1.00 Kits (with assembled antenna) \$19.95  
wired units \$29.95 extra antennas \$4.50 each

## RADAR KING®

Both S- and K-band operation. S-band antenna shipped unless otherwise specified. Kits and wired units supplied with dual input for simultaneous operation of S- and X-band.

WARDELL SMITH

65 Glenwood Rd., Upper Montclair, N.J. est. 1924  
pat. pending

# new BOOKS

**BASIC MATHEMATICS (Vols. 1 and 2)**, by Norman H. Crowhurst. John F. Rider Publisher Inc., 116 W. 14 St., New York 11, N.Y. 6 x 9 in. 141, 136 pp. \$3.90 ea.

An attempt to substitute common sense for tradition in teaching mathematics, by an author who has made audio clear to many. Vol. 1 covers arithmetic, including graphs. Vol. 2 introduces algebra, geometry and trigonometry "as ways of thinking in mathematics."

**SYMBOLS, SIGNALS AND NOISE**, by J. R. Pierce. Harper & Bros., 49 E. 3 St., New York 16, N.Y. 5 1/2 x 8 in. 294 pp. \$6.50.

Communication (information) theory explained so that scientifically minded laymen can understand it. Mathematics is used, but kept, in most cases, to numbers below 10.

**BOOLEAN ALGEBRA AND ITS APPLICATIONS**, by J. Eldon Whitesitt. Addison-Wesley Publishing Co. Inc., Reading, Mass. 6 x 9 in. 182 pp. \$6.75.

An introductory treatment that includes set theory, symbolic logic and switching circuits, along with problems and answers.

**SERVICING AGC SYSTEMS (Revised Edition)**, by Henry A. Carter and Thomas A. Lesh. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5 1/2 x 8 1/2 in. 126 pp. \$2.

The latest circuits explained and illustrated, with hints to speed troubleshooting and repair.

**ELECTRONIC TIPS AND TIMESAVERS** by John A. Comstock. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5 1/2 x 8 1/2 in. 96 pp. \$1.50.

You'll wonder why you never thought of these helpful hints dealing with repair, test and substitution. All are clearly illustrated and described.

**FUNDAMENTALS OF UHF**, by Allan Lytel. John F. Rider Publisher Inc. 116 W. 14 St., New York 11, N.Y. 5 1/2 x 8 1/2 in. 153 pp. \$3.90.

A practical book on receivers, transmitters, antennas and test equipment for technicians and hams.

**LE TRANSISTOR? . . . MAIS C'EST TRES SIMPLE!** by E. Aisberg. (The Transistor? It's Really Very Simple!) Societe des Editions Radio, 9, rue Jacob, Paris. 7 x 9 in. 146 pp. 12 nf (new francs).

As in his previous three books, Aisberg has succeeded in writing the masterpiece in the field—a treat for those who can read French.

**RADIO TRANSMITTERS**, by Laurence F. Gray and Richard Graham. McGraw-Hill Book Co., 330 W. 42 St., New York 36, N.Y. 6 x 9 in. 462 pp. \$12.50.

Covers the design, operation and maintenance of circuits and components, as well as test and measurement techniques. END

## the business-like approach

to SERVICE CHARGES and RECORD KEEPING



For customer's prices on every replacement part, plus flat rate and hourly service charge data, regional and national. Dave Rice's OFFICIAL PRICING DIGEST, listing over 63,000 items. \$2.50.

▲ AVAILABLE FROM YOUR DISTRIBUTOR ▼

If you want to operate on a professional level, Dave Rice's OFFICIAL ORDER BOOKS give you triplicate forms for order, invoice, and office records...spaces for tubes, parts, serial numbers, labor and tax charges, signatures, etc. 75¢ per book, \$6.50 for dust-proof box of 10.



*Dave Rice's*  
**ELECTRONIC PUBLISHING COMPANY, INC**

133 N. Jefferson St. • Chicago 6, Ill.

## SILICON RECTIFIERS

750 MA TOP-HATS

Factory Direct MFG. PRICES

Low leakage Newest Type			
PIV/RMS	PIV/RMS	PIV/RMS	PIV/RMS
50/35 .07 ea.	100/70 .15 ea.	200/140 .20 ea.	300/210 .29 ea.
400/280 .35 ea.	500/350 .45 ea.	600/420 .55 ea.	700/490 .70 ea.
800/560 .79 ea.	900/630 .90 ea.	1000/700 1.00 ea.	1100/770 1.20 ea.

General Purpose 400PIV at 300MA  
Special 2 for .50 25 for 6.00  
100 for 20.00

100 Different prec. res., 1/2 W, 1 W, 2 W  
of 1/2%, 1% Tolerance.....Only \$1.25

General Electric 1N91 Power Junction  
Diode .....10 for \$1.00  
Int. Rect. Selenium PIV4400/RMS160  
DC Current 10MA .....10 for \$1.00

PIV	Current	Price	PIV	Current	Price
200	2 Amps	.50	400	15 Amps	2.10
400	2 Amps	.85	50	50 Amps	2.40
100	15 Amps	1.20	100	50 Amps	3.15
200	15 Amps	1.65	200	50 Amps	4.10

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 ELECTRONICS CO.**  
NYC 7, NY 87 Chambers St. WO 2-5727



## WANT BACK ISSUES?

Copies of most issues of Radio-Electronics are available.

1961 issues	50¢
1960 issues	55¢
1959 issues	60¢

Five cents extra for each earlier year

Radio-Electronics, 154 West 14th St., N.Y. 11, N.Y.

# SCHOOL DIRECTORY

## LEARN TRANSISTOR, COMPUTER OR RADAR ELECTRONICS AT HOME!

Prepare now for a profitable career in one of these growing fields. Learn theory and practical application of all makes and types with proven home study courses from the Philco Technological Center.

For FREE information write:

**PHILCO®**  
TECHNOLOGICAL CENTER  
P.O. Box 4730, Dept. R-2, Philadelphia 34, Pa.

## HIGH SCHOOL

You can still finish High School—at home, in your spare time. No interference with job or social life. Win more pay, better job, new respect. Take only the subjects you need. Personalized guidance. Diploma to graduates. I.C.S. will send you 3 valuable books FREE to help you get started: (1) "How to Succeed," (2) High School subjects, (3) sample lesson. Write: INTERNATIONAL CORRESPONDENCE SCHOOLS DEPT. 39420 A, SCRANTON 15, PA.

## B. S. DEGREE IN 36 MONTHS

INDUSTRY & GOVERNMENT NEED  
50,000 NEW ENGINEERS A YEAR!  
Accelerated year-round program puts you in the job-market a whole year early! Also B.E. degree in 27 mos. Aero., Chemical, Civil, Electrical, Mechanical, Electronics; Math, Chemistry, Physics. Quality instruction; widely recognized. Graduates employed from coast to coast. Self-help program. Modest rate. Start Mar., June, July, Sept., Jan. Catalog: 1522 E. Washington Blvd., Ft. Wayne 2, Ind.

## INDIANA TECHNICAL COLLEGE

## ENGINEERING DEGREES



E.E.  
Option Electronics,  
Mechanical,  
Also in Liberal Arts  
earned by  
**HOME STUDY**  
Resident Classes Also  
Available if Desired  
Special course preferred  
**PACIFIC INTERNATIONAL  
COLLEGE OF ARTS  
& SCIENCES**  
Primarily a correspondence  
school  
Chartered 1935

5719-M Santa Monica Blvd. Hollywood 38, Calif.

LEARN  
RADAR MICROWAVES  
COMPUTERS—TRANSMITTERS  
CODE • TV • RADIO  
Phila. Wireless Technical Inst.  
1533 Pine St., Philadelphia 2, Pa.  
A Non-Profit Corp.  
Founded in 1908  
Write for Free Catalog to Dept. RE-2  
Classes now forming

**ENGINEERING EDUCATION  
for the Space Age**  
NORTHROP INSTITUTE of Technology is a privately endowed, nonprofit college of engineering offering a complete Bachelor of Science Degree Program and TWO-YEAR accredited technical institute curricula. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics, and space technology. Write today for catalog—no obligation.  
NORTHROP INSTITUTE OF TECHNOLOGY  
1181 West Arbor Vitae Street, Inglewood 1, California

## Learn Mathematics

Today, to get ahead as a technical man, you must understand basic mathematics—logarithms, slide rule, algebraic notation and laws, algebraic functions, linear equations, quadratic equations, higher degree equations, applied geometry, applied trigonometry, progressions and series, transcendental equations, empirical equations, etc.

Grantham School has just recently developed an unusual home study course which can bring you up to date in these subjects.

Don't let inadequacy in math hold you back. Write for details today.

GRANTHAM SCHOOLS, INC.  
ENGINEERING DIVISION  
1505 N. Western Ave. Los Angeles 27, Calif.

## LEARN ELECTRONIC ORGAN SERVICING

This new, high paying profession can now be learned easily in your spare time.

- ★ Complete Training — All Makes and Models
- ★ Scientific Teaching Aids Make Learning Easy
- ★ No Prior Knowledge of Electronics Necessary

GET FULL DETAILS ON THIS  
AMAZING COURSE  
WRITE FOR FREE BOOKLET

**NILES BRYANT SCHOOL**  
Dept. L, 3731 Stockton Blvd.  
Sacramento 20, California

## learn more . . . earn more

Become an Electronics Engineer. Major corporations regularly interview and employ seniors. **B.S. DEGREE IN 27 MONTHS** in Engineering. **IN 36 MONTHS** in Business Administration. Well-equipped labs. Small classes. *Low costs.* Enter Mar., June, Sept., Jan. Write J. G. McCarthy for Catalog and Career Book.

## TRI-STATE COLLEGE

2422 College Avenue • Angola, Indiana

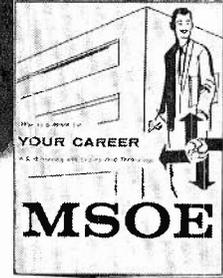
## GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic & advanced courses in theory & laboratory. Electronic Engineering Technology an ECPD accredited Technical Institute curriculum. Assoc. degree in 29 mos. B.S. also obtainable. G.I. approved. Graduates in all branches of electronics with major companies. Start Feb., Sept. Dorms, campus. High school graduate or equivalent. Catalog.

**VALPARAISO TECHNICAL  
INSTITUTE**  
Dept. C Valparaiso, Indiana



## FREE CAREER BOOKLET



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. RE-262, 1025 N. Milwaukee St.  
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.....

# R-E Classified ADS

Rates—50¢ per word (including name, address and initials. Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for April issue must reach us before Feb. 12, 1962.

RADIO-ELECTRONICS, 154 West 14 St., New York 11, N. Y.

## SERVICES

TV TUNERS—rebuilt or exchanged, \$9.95 complete—all types—fast, guaranteed service. Send tuner with all parts to: L. A. TUNER EXCHANGE, 4611 W. Jefferson Blvd., Los Angeles 16, Calif.

TRANSISTORIZED products dealers catalog, \$1. INTERMARKET, CPO 1717, Tokyo, Japan.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. New and used instruments bought, sold, exchanged. HAZELTON INSTRUMENT CO., 128 Liberty St., New York, N.Y.

HOW and where to obtain capital. Write RELIABLE SERVICE, Box 214-RE, Rome City, Ind.

INVENTIONS WANTED for immediate promotion! Patented, unpatented. Outright cash; royalties; CASCO, Dept. 3, Mills Bldg., Washington 6, D.C.

FREE confidential bargain sheets of electronic components—Lowest prices in the country! KNAPP, 3174 8th Ave. S.W., Largo, Fla.

PATENTS—INVENTIONS. U.S. Patent Office searches. Patent development of electronic, electrical and electromechanical inventions. Send for Free Protection "Invention Certificates" and "Invention Information." GEORGE SPECTOR, Licensed professional patent engineer; U.S. Patent Office former examiner, 3615 Woolworth Bldg, 233 Broadway, N.Y.

## MISCELLANEOUS

INDEPENDENT THINKERS—investigate Humanism! Write AMERICAN HUMANIST ASSOCIATION, Dept. RE, Yellow Springs, Ohio.

FREE Freethought book list and sample rationalist magazine "The Liberal." FRIENDSHIP LIBERAL LEAGUE INC., Thomas Paine Center, 5233 N. 5th St., Box R-E, Philadelphia 20, Pa.

PRINTING PRESSES, type, supplies. List 4¢. TURNBAUGH SERVICE, Mechanicsburg, Pa.

BOOK 200 electric stunts, \$1.00. CUTT-RADO, 875 Arastradero, Palo Alto, Calif.

JUST OUT! New 324-page illustrated catalog offering savings up to 50% on over 100,000 auto parts and accessories—everything to renew, rebuild, renovate '28-'31 Model A Fords. All makes (1920-1962 models), trucks, foreign and sports cars. Hollywood accessories, custom styling, hi-speed equipment. Send 25¢ for postage, packing—refundable on first order. WHITNEY, 1919 DD-2 Archer, Chicago 16, Ill.

EXOTIC EARRINGS! Details free. Pair, \$1.00. OHGA, RA-337, Sigakenkusatu, Japan.

BUY/RENT COMEDY, PARTY RECORDS. Sampler and catalogs, \$1.00. DRC, Dept. RE-2, 11024 Magnolia Blvd., No. Hollywood, Calif.

100 DIFFERENT United States commemorative stamps. ½¢ to 10¢ face, used \$1.00; mint, \$4.95. IRWIN, Box 12D, Brooklyn 29, N.Y.

## FOR SALE

### Electronics

RADIOS, transceivers, recorders—everything Japanese. UNITA, 545 Fifth, New York 17.

PRINTED CIRCUITS. Free catalog lists hundreds of circuits. CLOUD "9" ENGINEERING, Brookdale, Calif.

SHORT CIRCUITS pinpointed within 5 feet or your \$4.50 back. Own a patented pocket-size Dynamic Short Locator. DYNAMICO, 11370 SW 60th Terr., Miami 43, Fla.

TRANSISTOR IGNITION—save gas, tune-ups. Points, plugs last 50,000-100,000 miles. Improved cold starting, high-speed performance. Complete negative-ground 12v system, \$34.50. Special coil, \$12.50. PALMER ELECTRONICS, Carlisle, Mass.

SCHEMATICS, repair information. Television \$1.50. Radio 75¢. Send make and model. SCHEMATICS UNLIMITED, Box 65, Flushing 64, N.Y.

SCHEMATIC DIAGRAMS, exact replacement parts orders: Japanese transistor or tube radios, recorders, transceivers, electronics equipment. Give model and manufacturer, \$1.00. TECHSERVICES, CPO 849, Tokyo, Japan.

TV, RADIO tubes and parts wholesale. Brand New. List free. R T M CO., 508 Clifford, Flint 3, Mich.

DOOR OPERATORS, \$59.95. Automatic chain drive. Not a kit—highest quality. Free Literature. DEMSCO, Sebring 25, Ohio.

SUPERSENSITIVE directional microphone picks up a whisper at great distances. Used by investigators to record faint, distant sounds without being detected. Easily constructed for about \$7. Step-by-step plans, \$1.95. DEE CO., Box 7263-A, Houston 8, Tex.

APPLIANCE LAMP, range, vacuum parts wholesale. Catalog 25¢. SECO, 112 So. 20th St., Birmingham 3, Ala.

PROFESSIONAL ELECTRONIC PROJECTS—Organs, Timers, Computers, etc.—\$1 each. List free. PARKS, Box 1665, Lake City, Seattle 55, Wash.

BEFORE YOU BUY Receiving Tubes or Hi-Fi Components send now for your giant FREE Zalytron current catalog—featuring nationally known Zalytron First Quality TV-Radio Tubes, Hi-Fi Stereo Systems, Kits, Parts, etc. All priced to Save You Plenty—Why Pay More? ZALYTRON TUBE CORP., 220 W. 42nd St., N.Y.C.

CONVERT ANY TELEVISION to sensitive big-screen oscilloscope. Only minor changes necessary. Plans \$1.95. RELCO, Box 10563-D, Houston 18, Tex.

ELECTRONIC SURPLUS CATALOG, 5,000 items. Send 10¢. BILL SLEP CO., Drawer 178R, Ellenton, Fla.

SAVE DOLLARS on Radio, TV Tubes. Brand new. Parts at less than manufacturer's cost. 100% Guaranteed. No re-brands or pulls! UNITED RADIO, Box 1000-R, Newark, N.J.

DIAGRAMS FOR REPAIRING RADIOS, \$1; television \$2. Give make and model. DIAGRAM SERVICE, Box 672 RE, Hartford 1, Conn.

DIAGRAMS for TV, \$2.00; for radio, \$1.00. HIETT DIAGRAMS, Box 816, Lareda, Tex.

GOVERNMENT SURPLUS. Voltmeters, \$1.05. Freq meters, \$4.37. Transmitters, \$6.18. Receivers, \$5.65. Oscilloscopes, multimeters, walkie-talkies, resistors, condensers, Typical Government Surplus Prices. Exciting details FREE. N. Y. ENTERPRISES, International Airport, Box 402-F12, Jamaica 30, N.Y.

RADIO and TV TUBES. Jobber boxed. RCA, G-E, Sylvania, Westinghouse, 65% off list price. 25% deposit on all orders, balance COD, FOB NY. SUTTON ELECTRONICS, Box 503, Hicksville, N.Y.

ELECTRONIC ACTIVATOR — capacity sensing. Operates bells, floodlights, displays etc. by internal relay. Metal case 5x6x12". Four tubes and time delay. Completely guaranteed. \$39.95. Kit \$29.95. TRI-TRONICS LAB INC., Euless, Tex.

SMALL SET BUILDER'S big information catalogue—25¢, refundable. LABORATORIES, 1131-B Valota, Redwood City, Calif.

## Audio—Hi-fi

COMPONENTS, Recorders, Tapes. FREE Wholesale Catalogue. CARSTON, 125-T East 88th St., New York 28, N.Y.

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. Easy Time Payments Plan, 10% down—up to 24 months to pay. HI-FIDELITY CENTER, 220 RC E 23 St., New York 10, N.Y.

TAPE recorders, Hi-Fi components, Sleep-learning equipment, Tapes, Unusual values. Free catalog. DRESSNER, 1523R Jericho Turnpike, New Hyde Park, N.Y.

PROMPT DELIVERY. Lower prices. Amplifiers, Tape Recorders, Tuners, etc. No catalogs. Individual Quotes. Compare. L. M. BROWN SALES CORP. Dept. R, 239 E. 24th St., New York 10, N. Y.

SAVE 30%. Stereophonic music on tape. Request tape, recorder Catalog R-1. SAXITONE TAPE SALES, 1776 Columbia Rd, Washington 9, D.C.

RENT STEREO TAPES—over 2,000 different—all major labels—free catalog. STEREO-PARTI, 811-RE, Centinela Ave., Inglewood 3, Calif.

SALE ITEMS. Component quotes. Bulk tapes. BAYLA CO., Box 131-RE, Wantagh, N.Y.

WEST COAST HI-FI—send for lowest quotations Tuners, Amplifiers, Recorders, Pickups, Speakers, Etc. 6-transistor radio, \$12.95. **ELECTRONICS**; 10217 Venice, Los Angeles 34, Calif.

## General

ENGRAVE panels, nameplates, models using "Dupliscaler" engraving machines. Details, sample engraving, 20¢. Write **DESCO PRODUCTS**, 4329-RF Woodman, Van Nuys, Calif.

QUIET noisy TV tuners and controls with Lectroclean. 4-oz. unbreakable bottle, 50¢. **HANDLE**, Box 146, Brooklyn 19, N.Y.

## BUSINESS AIDS

500 PRINTED GUMMED Name and Address Labels, \$1.00. No COD's. Print clearly. **ADDISON MAIL ORDER**, RE-6, 1840 Addison, Chicago 13, Ill.

NIPPO Check Protectors, \$9.95. Warranted! Free Trial Offer! **ALBRIGHT**, Tip-ton 1, Ind.

RUBBER STAMPS—name, address, \$1.00. 1,000 Business Cards, \$3.99. Free catalog. **ALCO**, Box 244-R, Urbana, Ill.

BUSINESS CARDS, LABELS, RUBBER STAMPS. Send for free descriptive literature. **HEIGHTS INDUSTRIES**, Capitol Heights 27, Md.

TV SHOP BILLBOARDS. Key circuit symbols; resistor, wiring codes; helpful time-saving hints. 10 2 3/4 x 6 1/4 wall-mounting billboards, assorted colors, \$1.00. **MIL-LETT**, 5208 Longton, Cleveland 24, Ohio.

## WANTED

WANTED: BC-348's, laboratory equipment, manuals, klystrons. Cash, swap. **ENGINEERING ASSOCIATES**, 434 Patter-son Rd., Dayton 19, Ohio.

WANTED—MISCELLANEOUS Quicksilver Platinum, Gold, Silver. Ores analyzed. **MERCURY TERMINAL**, Norwood, Mass.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special purpose, Magnetrons, Klystrons, broadcast types, etc. Want military & commercial lab/test and communications equipment such as G.R., H.P., AN/UPM prefix. Also want commercial receivers and transmitters. For a fair deal write **BARRY**, 512 Broad-way, New York 12, N. Y. Walker 5-7000.

STROMBERG-CARLSON AU-35 amplifier wanted. **GEORGE GENRICH**, Crescent St., Farmington, Conn.

## EDUCATION/INSTRUCTION

SLEEP LEARNING. Startling method 92% effective. Brochure free. **ASR FOUNDATION**, Box 21RE, Henry Clay Station, Lex-ington, Ky.

LEARN WHILE ASLEEP, Hypnotize with your recorder, phonograph or amazing new Electronic Educator endless tape recorder. Catalog, details free. **SLEEP-LEARNING ASSOCIATION**, Box 24-RD, Olympia, Wash.

NEW CONCEPT OF LEARNING SELF-HYPNOSIS! Now on tape or record! Free Literature. **McKINLEY-SMITH CO.**, Dept. T5, Box 3038, San Bernardino, Calif.

## ENGINEERING DEGREE IN SCIENCE MATH 27 or 36 MOS.



B. S. degree—36 mos. • B. E. degree—27 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 March, June, July, September, January. Quality education. Graduates employed from coast to coast. Govern-ment approved for veteran training. Students from 50 states, 40 countries. 20 buildings; dorms, gym. Campus. Save time and money. Earn board. Write for catalog, 1722 E. Washington Boulevard, Fort Wayne 2, Indiana

## INDIANA TECHNICAL COLLEGE

## ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

Aerovox Corp.	16
Allied Radio	70-73
Audio Unlimited	93
Autolux	96
B&K Manufacturing Co.	103
Barry, Electronics Corp.	85
Bell Telephone Labs	12
Bionder-Tongue Labs	79
Brooks Radio & TV Corp.	112
Burstein-Amichev Co.	87
Cabinet Acoustical Engineering Corp.	77
Capitol Radio Engineering Institute	63
Carsten	93
Castle TV Tuner Service	96
Central Technical Institute	197
Centralab Div. of Globe-Union	86
Cleveland Institute of Electronics	9
CLASSIFIED ADS	118-119
Coloradaptor	92, 96
Commissioned Electronics Co.	114
Conar Instruments Div. of National Radio Institute	3
Coyne Electrical School	15, 105
De Vry Technical Institute	7
Dressner	96
Duotone Co. Inc.	96
Dynaco Inc.	14
Electro-Voice Inc.	75
Electronic Chemical Corp.	96
Electronic Instrument Co. (EICO)	24
Electronic Market	116
Electronic Measurements Corp.	100
Electronic Publishing Co. Inc.	118
Electronic Technical Publishing Co.	85
Fair Radio Sales	85
Fisher Radio Corp.	110
Gernsback Library Inc.	67
Grantham School of Electronics	17
Harman Kardon	104
Head's Engineering College	114
Heath Co.	52-55
Hickok Electrical Instrument Co.	13
Holt, Rinehart & Winston Inc.	115
Indiana Technical College	119
International Crystal Manufacturing Co.	57
Jerrold Electronics Corp.	10, 21
Key Electronics Co.	114
Lafayette Radio	83, 95
Mercury Electronics	92, 93
Moss Electronic Inc.	106-109
National Radio Institutes	19-20, 92
National Technical Schools	5
Newport Manufacturing Co.	104
Oison Electronics	111
Pacotronics Inc.	18
Picture Tube Outlet	114
Progressive Edu-Kits Inc.	111
RCA Electron Tube Div.	Back Cover
RCA Institutes	88-91
Radio Tube Co.	120
Radio-TV Training School	13
Rider (John F.) Publisher Inc.	98
Sams (Howard W.) & Co. Inc.	11, 94
Saxstone Tape Sales Div. of Commissioned Electronics	14
Schober Organ Co.	69
Scott (H. H.) Inc.	101
Senecore	99
Smith (Wardell)	116
Sprague	8
Standard Kolsman Industries Inc.	Inside Back Cover
Switchcraft Inc.	110
TAB	78
Technical Appliance Corp.	21
Subsidiary of Jerrold Electronics Corp.	21
Transvision	80, 119
Triplet Electrical Instrument Co.	Inside Front Cover
Tuner Co.	65
Utah Electronics Corp.	22
Van Nostrand (D.) Co. Inc.	81
Warren Distributors Co.	116
Whiggar Co.	60-61, 84, 113
Wuerth Products Corp.	110

## SCHOOL DIRECTORY PAGE 117

Niles Bryant School  
 Grantham School of Electronics  
 Indiana Technical College  
 International Correspondence School  
 Milwaukee School of Engineering  
 Northrop Institute of Technology  
 Pacific International College of Arts & Sciences  
 Phila. Wireless Technical Institute  
 Philco Technological Center  
 Tri-State College  
 Valparaiso Technical Institute  
 Printed in USA

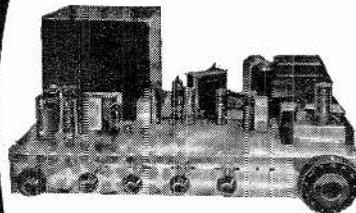
## BUILD THE FINEST

*Professional Quality*  
 CUSTOMIZED

# TV KIT

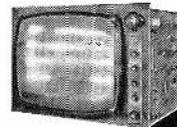
On Easy "Pay As You Wire" Terms  
 Only \$15 for the Starting Package!

The  
 "PROFESSIONAL"  
 Series—designed for  
 the perfectionist seeking  
 the finest in TV performance.  
 Easy to assemble. No technical  
 knowledge required. An ideal  
 "learning" Kit with a Complete  
 Course of Study is available.

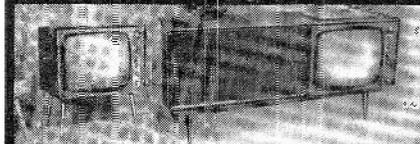


Also available:

**WIRED CHASSIS**  
 for custom  
 installations  
 with a choice



of vertical or horizontal  
 controls and the newest  
 19", 23" or 27"  
 Picture Tube.



Beautiful Cabinets —  
 designed to enhance sound quality and blend with  
 modern decor. For TV or combination TV and Hi-Fi.

A few of the *Professional Quality Features*:  
 Choice of push-pull 10-watt audio or out-put to your Hi-Fi system . . . D.C. resto-ration . . . Ultra-linear sweep circuits . . . Standard Coil Model PKO Automatic Tuner . . . Super-sensitivity for fringe areas . . . Complete line of Accessories for Custom Installations.

**CHOICE OF 19", 23" or 27" CRT.** Prices range from \$119 to \$199.

U.S. Armed Services and over 4000 schools and colleges have selected *Transvision Receivers* for educational television.

Interested in Electronics?



Learn the basic principles of elec-tronics from the Course available with the Kit.

**ASSEMBLY MANUAL—\$2.00**

See how easy it is to assemble the *Transvision Kit*. Cost of *Manual* refunded on purchase of *Kit*.

**TRANSVISION** New Rochelle, N.Y.  
 NE 6-6000

START NOW — MAIL THIS COUPON

TRANSVISION Electronics, Inc., New Rochelle, N.Y. Dept. RE

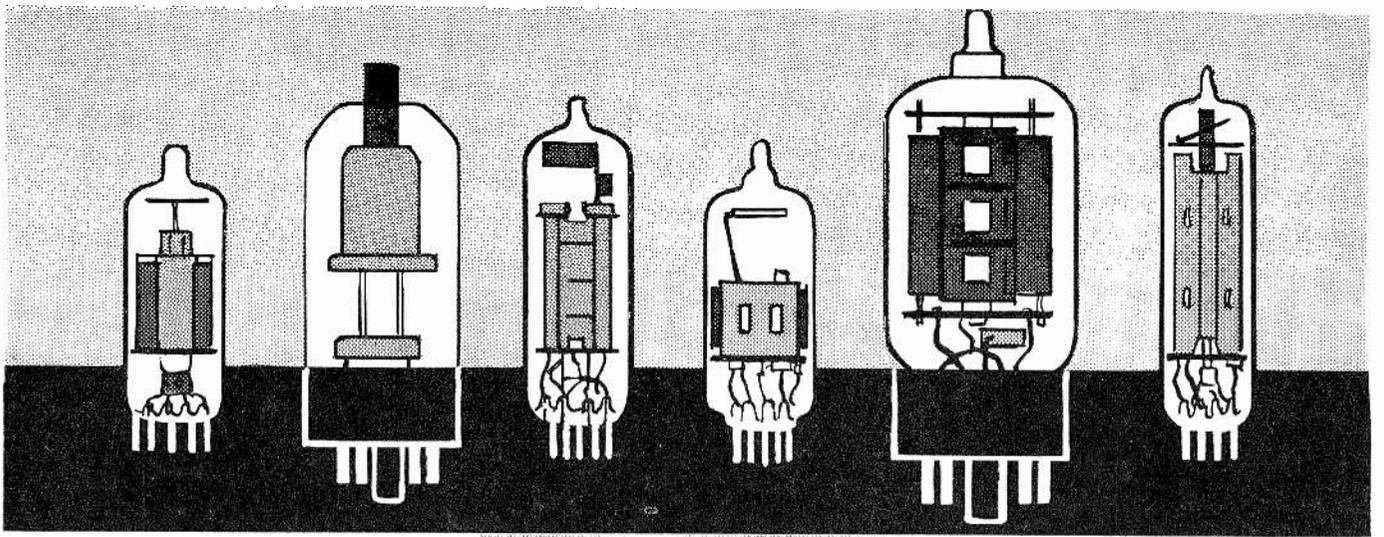
Send FREE 8-page Catalog...  I enclose \$2 for Assembly Manual, refundable on purchase of Kit.

I enclose \$15 for Starting Pkg. on pay-as-you-wire plan. (Complete Kits range from \$119 to \$199.)

Name \_\_\_\_\_

Address \_\_\_\_\_

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



Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
—	0Z4	.79	—	5CQ8	.84	—	6BN6	.74
—	1AX2	.62	—	5CZ5*	.72	—	6BQ6	1.05
—	1B3	.79	—	5EA8	.80	—	6BQ7	1.00
—	1DN5	.55	—	5EU8	.80	—	6BS8	.90
—	1G3*	.79	—	5J6	.68	—	6BU8	.70
—	1J3*	.79	—	5T8	.81	—	6BX7	1.02
—	1K3*	.79	—	5U4	.60	—	6BY5	1.15
—	1R5	.62	—	5U8	.81	—	6BY6	.54
—	1S4	.59	—	5V3	.90	—	6BY8	.66
—	1S5	.51	—	5V6	.56	—	6BZ6	.55
—	1T4	.58	—	5X8	.78	—	6BZ7	1.01
—	1U4	.57	—	5Y3	.46	—	6BZ8	1.09
—	1U5	.50	—	6A8G	1.20	—	6C4	.43
—	1X2B	.82	—	6AB4	.46	—	6CB6	.55
—	2AF4	.96	—	6AC7	.96	—	6CD6	1.42
—	2BN4	.64	—	6AF3	.73	—	6CE5*	.57

**BUY DIRECT FROM RAD-TEL**

**NOW!**  
Over 450 Types

**Up to 75% OFF**

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
—	6H6	.58	—	12AQ5	.60	—	12J8	.84
—	6J5GT	.51	—	12AT6	.43	—	12K5	.65
—	6J6	.67	—	12AT7	.76	—	12L6	.58
—	6K6	.63	—	12AU6	.51	—	12SA7	.92
—	6L6	1.06	—	12AU7	.60	—	12SF7	.69
—	6N7	.98	—	12AV6	.41	—	12SH7	.49
—	6S4	.51	—	12AV7	.75	—	12SJ7	.67
—	6SA7GT	.76	—	12AX4	.67	—	12SK7	.74
—	6SG7GT	.41	—	12AX7	.63	—	12SL7	.80
—	6SH7GT	.49	—	12AY7	1.44	—	12SN7	.67
—	6SJ7	.88	—	12AZ7	.86	—	12SQ7	.78
—	6SK7GT	.74	—	12B4	.63	—	12U7	.62
—	6SL7GT	.80	—	12BA7	.84	—	12V6	.53
—	6SN7GT	.65	—	12B06	.50	—	12W6	.69
—	6SQ7	.73	—	12BE6	.53	—	12X4	.38
—	6T4	.99	—	12BF6	.44	—	17AX4	.67

NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

EACH TUBE INDIVIDUALLY & ATTRACTIVELY BOXED & BRANDED RAD TEL

—	2EN5*	.45	—	6AF4	.97	—	6CF6	.64
—	3AL5	.42	—	6AG5	.68	—	6CG7	.61
—	3AU6	.51	—	6AH4	.81	—	6CG8	.77
—	3AV6	.41	—	6AH6	.99	—	6CK4*	.70
—	3BA6	.51	—	6AK5	.95	—	6CL8	.79
—	3BC5	.54	—	6AL5	.47	—	6CM6	.64
—	3BE6	.52	—	6AM8	.78	—	6CM7	.66
—	3BN6	.76	—	6AQ5	.53	—	6CM8*	.90
—	3BU8	.78	—	6AR5	.55	—	6CN7	.65
—	3BV6	.55	—	6AS5	.60	—	6CQ8	.84
—	3BZ6	.55	—	6AS6	.80	—	6CR6	.51
—	3CB6	.54	—	6AT6	.43	—	6CS6	.57
—	3CS6	.52	—	6AT8	.79	—	6CS7	.69
—	3DG4*	.85	—	6AU4	.82	—	6CU5	.58
—	3DK6*	.60	—	6AU6	.52	—	6CU6	1.08
—	3DT6	.50	—	6AU7	.61	—	6CY5*	.70
—	3Q4	.63	—	6AU8	.87	—	6CY7	.71
—	3Q5	.80	—	6AV6	.41	—	6DA4*	.68
—	3S4	.61	—	6AW8	.90	—	6DB5	.69
—	3V4	.58	—	6AX4	.66	—	6DB6	.51
—	4BQ7	1.01	—	6AX5	.74	—	6DE6	.58
—	4BZ7	.96	—	6AX7	.64	—	6DG6	.59
—	4BZ8	1.10	—	6AX8*	.92	—	6DK6	.59
—	4CS6	.61	—	6BA6	.50	—	6DN6	1.55
—	4DT6	.55	—	6BA8	.88	—	6DQ6	1.10
—	5AM8	.79	—	6BC5	.61	—	6DT6	.53
—	5AN8	.86	—	6BC7	.94	—	6DT8*	.79
—	5AQ5	.52	—	6BC8	.97	—	6EA8	.79
—	5AS8*	.86	—	6BD5	1.25	—	6EB5*	.72
—	5AT8	.80	—	6BE6	.55	—	6EB8	.94
—	5AV8	1.01	—	6BF5	.90	—	6EM5*	.76
—	5BC8	.79	—	6BF6	.44	—	6EM7	.82
—	5BE8	.83	—	6BG6	1.66	—	6EU8	.79
—	5BK7	.82	—	6BH6	.65	—	6EW6	.57
—	5BQ7	.97	—	6BH8	.87	—	6EY6*	.75
—	5BR8	.79	—	6BJ6	.62	—	6F5GT	.39
—	5BT8*	.83	—	6BJ7	.79	—	6FE8	.75
—	5CG8	.76	—	6BK7	.85	—	6GH8	.80
—	5CL8	.76	—	6BL7	1.00	—	6GK6*	.79
—	5CM8*	.90	—	6BN4	.57	—	6GN8*	.94

Save on Rad-Tel's Quality  
**BRAND NEW TUBES**  
1-Year Guarantee  
1-Day Service

Service men:  
New Tube Types offered by Rad-Tel are marked with an asterisk.

Send For Free Trouble Shooting Guide and New Tube & Parts Catalog



**RAD-TEL'S HI-FI IMPORTS**

Designed especially for Hi-Fi and Stereo

Foreign	Replaces	Rad-Tel Price
ECC-81	12AT7	1.18
ECC-82	12AU7	.96
ECC-83	12AX7	.96
EL-84	6BQ5	1.15
EZ-81	6CA4	.80

—	6T8	.85	—	12BH7	.77	—	17BQ6	1.09
—	6U8	.83	—	12BK5	1.00	—	17DQ6	1.06
—	6V6GT	.54	—	12BL6	.56	—	17W6	.70
—	6W4	.60	—	12B06	1.06	—	18FW6*	.49
—	6W6	.71	—	12BR7	.74	—	18FX6*	.53
—	6X4	.39	—	12BV7	.78	—	18FY6*	.50
—	6X5GT	.53	—	12BY7	.77	—	19AU4	.83
—	6X8	.80	—	12BZ7	.75	—	19BG6	1.39
—	7A8	.68	—	12C5	.56	—	19C8	1.14
—	7AU7	.61	—	12CN5	.56	—	19T8	.80
—	7B6	.69	—	12CR6	.54	—	21EX6	1.49
—	7EY8*	.73	—	12CU5	.58	—	25AV5	.83
—	7F8	.90	—	12CV6	1.06	—	25AX4	.70
—	7N7	.90	—	12CX6	.54	—	25BK5	.91
—	7S7	1.01	—	12D4*	.69	—	25BQ6	1.11
—	7Y4	.69	—	12DB5	.69	—	25C5	.53
—	8AU8	.83	—	12DE8	.75	—	25CA5	.59
—	8AW8	.93	—	12DL8	.85	—	25CD6	1.44
—	8BQ5	.60	—	12DQ6	1.04	—	25CU6	1.11
—	8CG7	.62	—	12DS7	.79	—	25DN6	1.42
—	8CM7	.68	—	12DT5*	.76	—	25EH5	.55
—	8CN7	.97	—	12DT7*	.79	—	25L6	.57
—	8CS7	.74	—	12DT8*	.79	—	25W4	.68
—	8CX8	.93	—	12DU7	1.01	—	32ET5	.55
—	8EB8	.94	—	12DW8*	.89	—	32L7	.90
—	8SN7	.66	—	12DZ6	.56	—	35B5	.60
—	9CL8	.79	—	12ED5	.69	—	35C5	.51
—	11CY							

# TOP

Higher Gain

Lower Noise

# OF THE HEAP

85% of all TV servicemen prefer Standard turret type replacement TV tuners.

1 year guarantee backed by the world's largest TV tuner manufacturer.

Trade-in allowance for the defective tuner being replaced.

In TV It's Standard

See your local authorized Standard Coil Distributor

## **standard kollsman**

INDUSTRIES INC.

FORMERLY STANDARD COIL PRODUCTS CO., INC., MELROSE PARK, ILLINOIS



## SELL THE POPULAR RCA SILVERAMA PICTURE TUBE

### To Increase Your Business and Build Customer Confidence

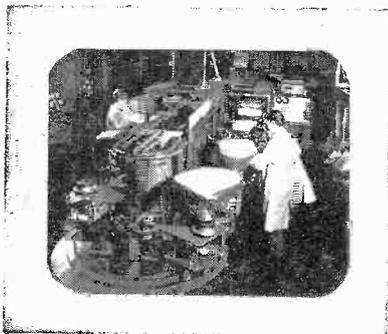
Before any RCA Silverama Picture Tube goes into its carton for shipment to your distributor, it has been through one of the most exhaustive series of quality tests in the picture-tube industry.

Every Silverama undergoes the same electrical tests as RCA's original equipment picture tubes. Even the Silverama envelope has been thoroughly cleaned, tested and inspected before re-use. Only then is the famous RCA high-quality phosphor screen added.

Such tests—plus uncompromising quality control at every step of

manufacture, assure you that RCA Silverama is the finest replacement TV-picture tube modern science and technology can produce.

But most important to your business: this superior tube is priced to compete with other name brand picture tubes. Thus for no extra cost you can provide the business-building extras of assured quality performance, fewer complaints, callbacks and in-warranty failures—plus the brand-name your customers want and trust, RCA Silverama. See your authorized RCA Tube distributor today!



Automatic testing. 26 different tests for major characteristics are performed on this automatic test unit. A tube failing a single test is automatically rejected.



Final checkout. At the end of the production line, just prior to packaging, sample batches of Silverama picture tubes receive a focus check for additional assurance of quality.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.



The Most Trusted Name in Television