AUGUST

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

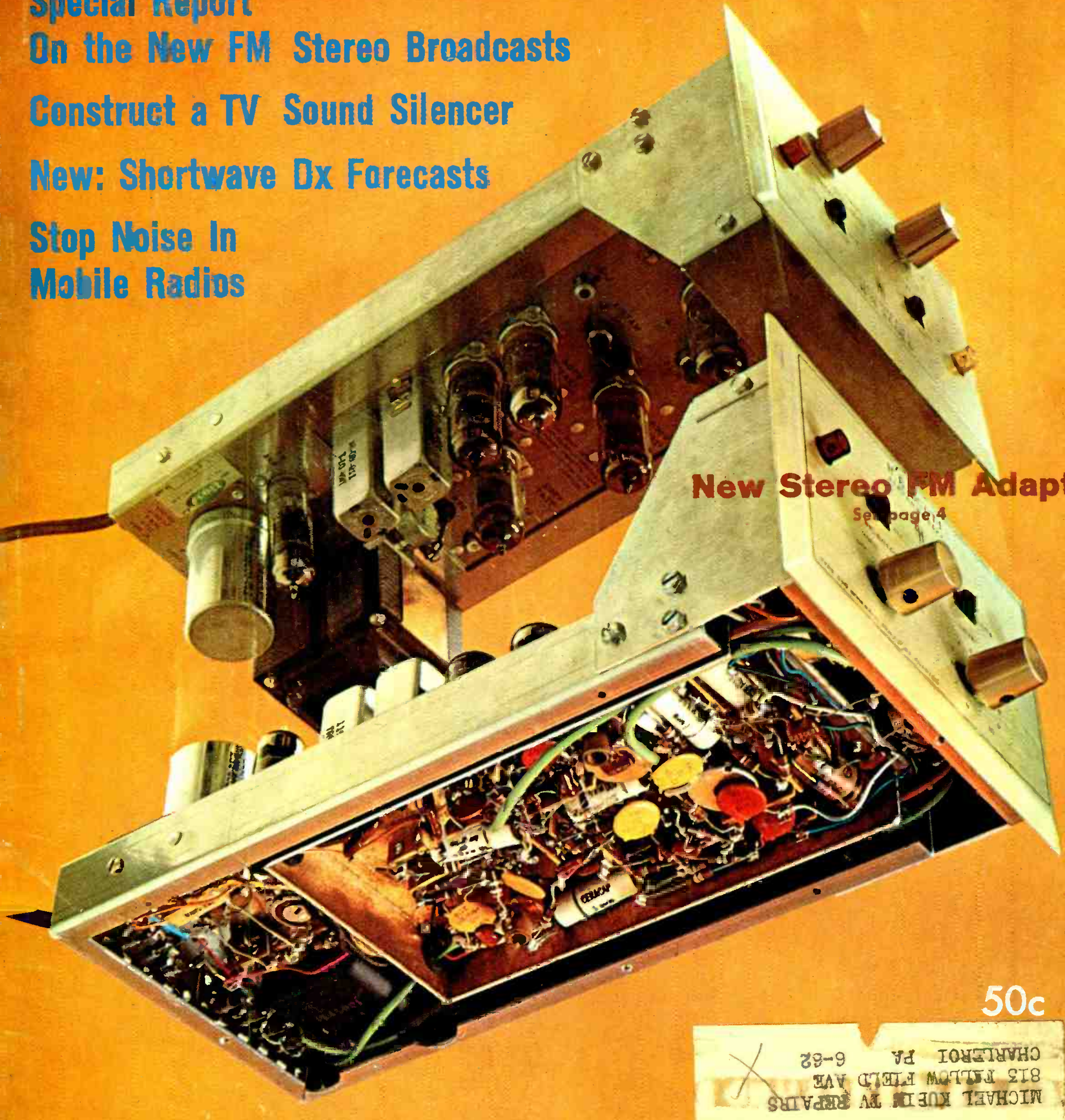
HUGO GERNSBACK, Editor

Special Report On the New FM Stereo Broadcasts

Construct a TV Sound Silencer

New: Shortwave Dx Forecasts

Stop Noise In Mobile Radios



New Stereo FM Adapter

See page 4

50c

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.**

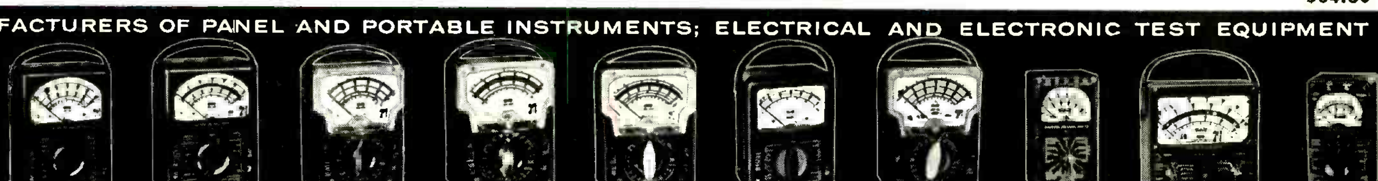
Available For Immediate Delivery From Your Triplett Distributor's Stock

MODEL 100

The most comprehensive test set in the Triplett line is Model 100 V-O-M Clamp-On-Ammeter Kit, now available at distributors. The world's most versatile instrument—a complete accurate V-O-M plus a clamp-on-ammeter with which you can take measurements without stripping the wires. Handsome, triple-purpose carton holds and displays all the components: Model 310 miniaturized V-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



630 630-A 630-PL 630-APL 630-NA 630-T 631 666-HH 625-NA 666-R

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

To assure ADVANCEMENT or to turn your hobby into a new and PROFITABLE CAREER in the fast growing field of ELECTRONICS

"HOME LAB" EQUIPMENT

At no extra cost, the NRI Electronics course includes especially developed training kits to bring to life the things you learn. You get practical experience with basic circuits and components performing many experiments with these kits:

KIT 1 Get practical experience measuring voltage, current, building circuits.

KIT 2 Build Vacuum Tube Voltmeter. Make tests on series and parallel circuits.

KIT 3 Practice with resistors, capacitors, coils. Work with half-, full-wave, bridge, voltage doubler and pi-type filter circuits.

KIT 4 Build circuits with pentode tubes, selenium rectifiers, transistors. Build oscillator, check signal phase shift with oscilloscope.

KIT 5 Experiment with thyratron tube circuits, Lissajous patterns. Study basic amplitude detector circuits, modulation, demodulation.

KIT 6 Get practical experience with magnetic amplifiers, learn to use modified Prony brake; determine motor torque. Use strobe disc to measure motor speed.

KIT 7 Learn effects of feedback. You build and experiment with dc coupled (instrument) amplifier. Study broad-band amplifiers; photocells.

KIT 8 Experiment with multivibrators used as timing generators in binary counters, and as frequency dividers. Learn to use blocking oscillators, thermistors.

KIT 9 Practical experience in telemetry circuits used in earth satellites, remote control devices. Work with basic circuits used in digital and analog computers.

KIT 10 Assemble circuits in electrical and electro-mechanical systems, make valuable practical electronic circuits.

NRI

THE FIRST NAME IN ELECTRONICS TRAINING FOR NEARLY 50 YEARS

. . .you will want to investigate the new NRI Home-Study Course in Industrial Electronics

PRINCIPLES • PRACTICES • MAINTENANCE

A Comprehensive Training Plan by America's Oldest and Largest Home-Study Electronics School

Send for this FREE CATALOG

OLDEST & LARGEST HOME STUDY ELECTRONIC SCHOOL

National Radio Institute

WASHINGTON 16, D. C. IHF

Send me full information without cost or obligation.
(No representative will call. Please print.)

Name____________________ Age______

Address____________________

City____________ Zone______ State______

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

RADIO-ELECTRONICS published monthly at Mt. Morris, Ill., Gernsback Publications Inc. Second-class postage paid at Mt. Morris, Ill. Copyright © 1961, by Gernsback Publications Inc. All rights reserved under Universal International and Pan-American Copyright Conventions. SUBSCRIPTION RATES: US and possessions, Canada; $5 for 1, $9 for 2, $12 for 3 years. Pan-American countries: $6 for 1, $11 for 2, $15 for 3 years. Other countries: $6.50 for 1, $12 for 2, $16.50 for 3 years.

Radio-Electronics

AUGUST 1961
VOL. XXXII No. 8

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

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

PRODUCTION MANAGER
Elizabeth Stalcup

DIRECTOR, ADVERTISING SALES
Lee Robinson

EASTERN SALES MANAGER
John J. Lamson

CIRCULATION MANAGER
G. Aliquo

DIRECTOR, NEWSSTAND SALES
Adam J. Smith

PROMOTION MANAGER
Robert Fallath

Average Paid Circulation Over 157,000

—on the cover—

A mirror gives us a top and bottom view of a Scott FM multiplex adapter. The photo is of a prototype; the production model appears on page 27.

Color original by Irving Kaufman

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

the departments

News Briefs

"Bugs" in New Batteries?

Fuel cells of the future may take advantages of the high chemical reaction rates available with living organisms. This statement was made by John A. Welch, president of Joseph Kaye & Co. of Cambridge, Mass. Experiments with batteries that incorporate the life cycles of living bacteria to generate electricity direct from chemical fuels have had promising results, he says. Reaction rates may be as much as a million times as fast as those obtained in conventional chemical reactions. Furthermore, the cell does not depend on unusual conditions such as high temperature or pressure, necessary for many present fuel cells.

G-E, Zenith Start Stereo FM

Starting at the earliest moment permitted by law, 0001 Daylight Saving Time, June 1, stations WGFM, Schenectady, N.Y., and WEFM, Chicago, Ill., inaugurated FM stereo broadcasting under the FCC's new rule permitting multiplex stereo service. General Electric, owners of WGFM, claim the "first," since June 1 began an hour earlier in Schenectady, in the Eastern time zone. Thus Zenith's WEFM, starting at the same clock time, was actually an hour later. WGFM initiated a regular schedule of stereo broadcasting with 20 hours a week programmed for the first few weeks at least. WEFM did not immediately announce a stereo schedule, but is expected to devote a considerable portion of its time to that type of broadcasting.

200K Citizens-Banders

The FCC issued its 200,000th Citizens Radio license at the end of May. One year ago there were 117,000 CB licenses and, in July 1959, about 50,000. Thus the Citizens Radio Service is the fastest-growing service licensed by the FCC.

License 200,000 went to Lois J. Worden of Spennard, Alaska. She says she will use it in her car to contact her home and to talk to neighbors who have no telephones.

New Cathode Heats in 1/10 Second

Adopting a filamentary cathode for fast warmup, Amperex Corp. claims the fastest-heating cathode ever produced. It delivers full output power in 100 milliseconds. The new cathode consists of a rectangular frame across whose length a number of very fine wires are strung parallel to each other like the strings on a harp, for which reason it is called the harp cathode. The large number of fine wires gives the emitting element a high surface-to-volume ratio, resulting in fast warmup and thermal equilibrium. The large number of parallel paths makes low voltages feasible; the 1.6 volts used on this tube is the closest approximation to a unipotential cathode yet achieved in a filament. Current in the present type is 3.2 amps. The multiple-wire cathode also reduces inductance and cuts hum.

Radio Propagation Course

The National Bureau of Standards presents a 3-week course in radio propagation this summer. It covers Tropospheric Propagation in a 1-week section which runs from July 31 to Aug. 4. A second 2-week section covering Ionospheric Propagation starts Aug. 7 and concludes Aug. 18. Prerequisites are a bachelor's degree in electrical engineering or physics, or other suitable academic or practical experience. For further details, contact Edmund H. Brown, Educational Director, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

More Companies in Color TV

General Electric states that it will have color television receivers on the market in the fall of this year, and that some sets may be available as early as August.

General Electric was one of the pioneers in color TV and it was under the direction of Dr. W.R.G. Baker, G-E vice president, that the present color standards were formulated. Although the company has not marketed color TV receivers, company spokesmen state that training in color servicing for its distributor service organization has been continuing for a number of years.

The new G-E sets, it is stated, will feature a color balance stabilizer developed and patented by the company's TV receiver department. It is designed to prevent changes in hue as picture brightness changes.

After maintaining absolute silence on its color plans, Philco displayed three 21-inch color TV receivers at its midsummer distributors convention. Two were console models, the third a table type. Deliveries were expected to begin in August, the distributors were told.

At about the same time, Westinghouse spokesmen stated that the company "definitely will not" introduce color TV this year. Rumors continue, however, that Westinghouse will join the color group before the end of the year.

No Air-Borne FM Receivers

The Federal Aviation Agency has forbidden the use of portable FM receivers in aircraft. Tests indicate that the local oscillator of some FM receivers generated signals that were picked up in the aircraft navigation band. This, according to the FAA, tripped the "red flag" alarm that indicates that the fixed-tune navigation receiver is not working properly. To avoid confusion or the possibility that interference not heavy enough to trip the alarm might result in falsifying the information supplied by the receiver, the ban was established.

The FAA tested a number of electronic devices often operated in aircraft, including portable AM radios, dictating machines and recorders, and found that only the FM receiver was a probable producer of interference.

Microwaves Beating Uhf

Microwaves are the most reliable form of long-range radio communications, the Electronic Industries Association reports. The report was the outcome of a study of the private microwave systems of the United States. Long range in this case refers to distances of 200 miles or so.

The EIA report states that while the uhf 952- to 960-mc band is used widely for short-range systems, its communications capacity is lower than that of the 2,000- and 6,000-mc bands, and that the trend is toward these bands. Significant growth in the 6,000-mc band is anticipated, while similar increase in the 2,000- and 960-mc bands is not expected.

Advertising Representatives: Los Angeles: Harker-Husted-Coughlin, 400 South Alvarado St., Tel. DUnkirk 7-2328. San Francisco: Harker-Husted-Coughlin, 444 Market St., Tel. GArfield 1-0151. 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.

The 12,000-mc band may also receive considerable use. The average system studied was 207 miles long, using an average of 8 relays, or about 25 miles per hop.

Hugo Gernsback Award

The annual Hugo Gernsback $1,000 Scholarship for 1961–62 has been awarded to Harvey R. Lehman, New York.

Mr. Lehman, who is 24 and the father of two small daughters, enrolled at New York University as an evening student in 1957 and transferred to day sessions in 1960.

A senior, he expects to receive his degree with the Class of 1962 and then go into graduate work in the field of solid-state electronics.

Mr. Lehman is president of Eta Kappa Nu, honorary electrical engineering society, and a member of Tau Beta Pi, an all-engineering honorary society.

The award is presented each year to the student considered the most promising by the university's College of Engineering faculty.

Transistors Will Replace . . . ?

Two well known companies, Philco's Lansdale Div. and CBS Electronics, announce that they are getting out of the entertainment tube business. The use of receiving tubes by original equipment manufacturers has declined 31% since 1955, reported Wm. J. Peltz of the Lansdale Div., and the plant has been producing 80% transistors, 10% cathode-ray tubes and only 10% receiving tubes.

CBS Electronics reported that it was closing its factories at Danvers and Newburyport, Mass. Raytheon is taking over the inventory of CBS tubes and continuing to service CBS distributors and their customers. The closing of the CBS tube plants marks the end of the oldest tube operations in the field, that of Hytron, who started making tubes in 1921 and merged with CBS 10 years ago.

Education Out of the Air

Stratovision—first advocated and described by Westinghouse in 1945—has been put into successful operation over parts of Illinois, Indiana, Michigan, Ohio, Kentucky and Wisconsin. Educational programs on channels 72 and 76 are broadcast

how to get a Commercial FCC LICENSE

Mail Coupon NOW!

An FCC License Or Your Money Back!

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial Radio Telephone License with a Radar Endorsement. Should you fail to pass 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 period of your enrollment agreement.

Increase Your Technical Knowledge

Get a government license plus an understanding of such electronic applications as computers . . . industrial electronics . . . radar . . . communications . . . and many more.

Get This Handy Pocket Electronics Data Guide FREE . . .

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

Sorry—Not For Beginners!

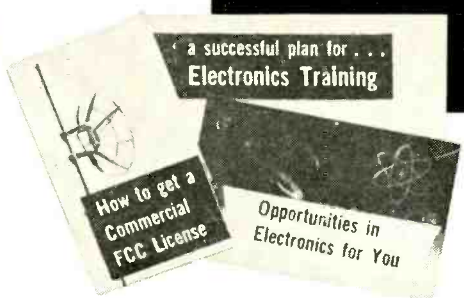
Please inquire only if you really want to get ahead and to add to what you have already learned in school, in the service, or on the job. Some previous schooling or experience in electronics, electricity, or related fields is necessary for success in Cleveland Institute programs.

Cleveland Institute Training Results in Job Offers Like These . . .

ELECTRONICS TECHNICIANS: RCA has positions for technicians, field engineers & instructor technicians to install, maintain, and teach military radar, communications, and fire control equipment. Company benefits.

RADIO OPERATORS & TECHNICIANS American Airlines — Chicago, Detroit, St. Louis, Cincinnati and Cleveland — has openings for radio operators and radio mechanics. Operators must have a 2nd class FCC license and ability to type 40 wpm. Many company benefits.

CLEVELAND INSTITUTE OF ELECTRONICS
Desk RE56A 1776 E. 17th St. Cleveland 14, Ohio



good training doesn't cost . . . it pays!

get all three FREE!

We can train you to pass your License Exams if you've had any practical experience — amateur military, radio servicing, or other. Our proven plan can help put you on the road to success.

- **Your FCC ticket will be recognized by employers as proof of your technical ability.**

Accredited by the National Home Study Council

Cleveland Institute of Electronics
Desk RE 56A, 1776 E. 17th St., Cleveland 14, Ohio

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

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

In what kind of work are you now engaged? ____________

In what branch of Electronics are you interested? ____________

Name ____________ Age ______

Address ____________

City ____________ Zone ______ State ______

RE 56A

Blonder-Tongue Laboratories

from planes in flight. The planes fly 23,000 feet high over Montpelier, Ind., and their service area is within a radius of 200 miles from that city. Actually, good pictures have been received over greater distances.

According to Blonder-Tongue Labs, which installed some of the school master antennas used in the system, outstanding educators are being recruited in a "talent search" to obtain instructors when the broadcasts go on a regularly scheduled basis at the beginning of the school year in September. As budgets are laid down at present, teachers will be allowed an expenditure of up to $50 per lesson, 12 to 20 hours in preparation time, and the services of artists and designers.

Calendar of Events

International Conference on Medical Electronics, July 16-21, Waldorf-Astoria, New York.

NATESA Convention, Aug. 17-20, Pick-Congress Hotel, Chicago.

Western Electronics Show and Convention, (WESCON) Aug. 22-25, Cow Palace, San Francisco, Calif.

Chicago High Fidelity Show, Aug. 25-26, Hotel Sherman, Chicago.

German Radio, Television and Phonographic Industries Exhibition, Aug. 25-Sept. 3, Berlin, Germany.

Conference of the Association for Computing Machinery and International Data Processing Exhibit, Sept. 5-8, Statler Hilton Hotel, Los Angeles, Calif.

IRE Symposium on Space Electronics and Telemetry, Sept. 6-8, Albuquerque, New Mexico.

IRE-AIEE-ASEE International Conference on Electrical Engineering Education, Sept. 6-13, Sagamore Conference Center, Syracuse University, Adirondacks, New York.

ISA Instrument Automation Conference and Exhibit, Sept. 11-15, Los Angeles Memorial Sports Arena, Los Angeles, Calif.

EIA Fall Conference, Sept. 12-14, Biltmore Hotel, New York, N.Y.

IHFM High Fidelity Show, Sept. 13-17, Trade Show Building, New York, N.Y.

AIEE-IRE Engineering Management Conference, Sept. 14-15, Roosevelt Hotel, New York, N.Y.

IRE Symposium on Engineering Writing and Speech, Sept. 14-15, Bellevue-Stratford Hotel, Philadelphia, Pa.

National Exhibition of Radio and TV, Sept. 14-25, Parc Des Expositione, Paris, France.

RCA Builds TV Satellite

The Defense Electronics Div. of RCA has obtained a contract to build for the Government an experimental communications satellite capable of relaying TV programs and telephone traffic across the Atlantic. The National Aeronautics and Space Administration stated that the contract would amount to about $3,250,000.

The new satellite, expected to be launched in 1962, will weigh about 100 pounds, and will circle the earth from 1,000 to 3,000 miles up. It is expected to be able to relay about

600 simultaneous telephone calls or one TV program. It will be an active repeater, with equipment for receiving and retransmitting signals.

Edward Cahill Passes

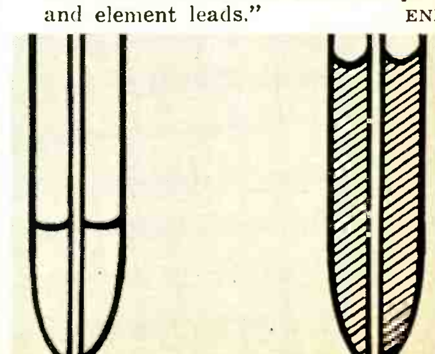
The first president of the RCA Service Co., Edward C. Cahill, died May 30 in Camden, N. J. He was 60 years old.

Mr. Cahill was known to many service technicians through his visits to meetings and as host to visiting delegations to the company's establishment at Cherry Hill, N. J. He had been with RCA from 1928 till his retirement, due to ill health, in 1958.

Mr. Cahill obtained his degree of Electrical Engineer from the Milwaukee School of Engineering shortly before beginning to work for RCA. He was a member of the Institute of Radio Engineers and of the Society of Motion Picture Engineers.

Tube Pins to Stay Soldered

An improved technique for soldering the base pins of picture tubes may end the open-pin troubles that have plagued TV technicians in the past, according to Ralph Shields, Sylvania's product sales manager. The new pins are tapered and filled with solder from tip to top, as shown at the right in the illustration. Open contacts and intermittents that often occurred with the older "conventional" soldering method (left in the illustration) cannot occur. The tapered pin assures maximum contact and lowest electrical resistance while reducing the rocking and twisting required to seat tubes in "the extremely tight-fitting sockets specified by some receiver manufacturers," said Mr. Shields, and "will eliminate inevitable cracked bases or broken connections between base pins and element leads." END



The Same School That Originated The RTS BUSINESS PLAN

...NOW *Proudly Presents*...

A SPECIAL COMPACT COURSE COVERING ALL THREE PHASES OF ELECTRONICS

BASIC • INTERMEDIATE • ADVANCED

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 • Telemetering
- 60 EXAMINATIONS
- UNLIMITED CONSULTATION SERVICE
- KIT MANUALS
- DIPLOMA UPON GRADUATION

AND MUCH MORE...

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!

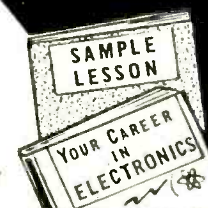
LOWEST COST AND TERMS

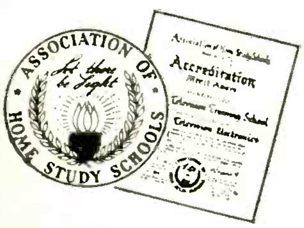
ALL KITS ARE SENT TO YOU COMPLETE. TUBES AND BATTERIES ARE INCLUDED AT NO EXTRA COST

No Kit Deposits Required.

THE FIRST TRAINING KIT IS SENT IMMEDIATELY UPON ENROLLMENT

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

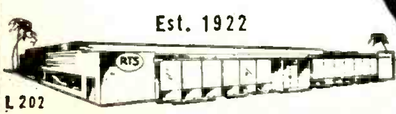




Rush Coupon for FREE FACTS!

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

Est. 1922



L 202

DON'T LOSE OUT — FIND OUT!

RTS ELECTRONICS DIVISION Dept. RE81
815 E. ROSECRANS AVENUE LOS ANGELES 59, CALIFORNIA

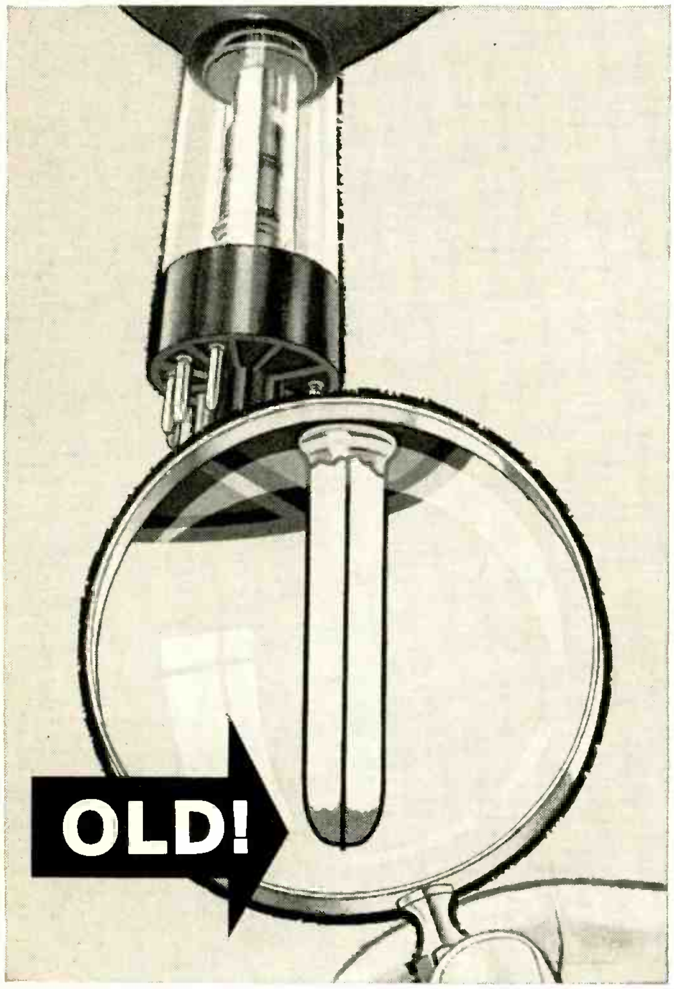
Rush me full information by return mail. (Please Print)

Name ______________________ Age ______
Address ______________________
City ______________ Zone ____ State ______

NO SALESMAN WILL CALL ON YOU!

New Sylvania Technique eliminates erratic pin soldering

Picture tube callbacks due to "open-pin connections" dramatically reduced

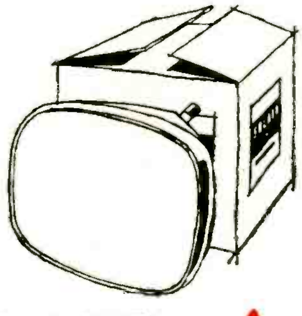


The "old" conventional pin soldering method relied upon contact between pin and wire only at their tips.

New Sylvania pin soldering technique extends solder far up into the pins—provides maximum contact with the wire—assures low electrical resistance and high mechanical strength.

What does the new Sylvania pin soldering technique mean to you? It means the solution of a long-standing, industry-wide pin soldering problem. Callbacks will be reduced—crimping and resoldering will be a thing of the past.

Thousands of service technicians have proven for themselves—in millions of service calls—that Sylvania SILVER SCREEN 85 TV PICTURE TUBES are the surest way to build a better business. You should, too. Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N.Y.



SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Two outstanding products by the HIDDEN **500*** who plan for your future:

DIFILM® BLACK BEAUTY® molded tubular CAPACITORS

DIFILM® ORANGE DROP® dipped tubular CAPACITORS

TWO GREAT TUBULARS . . . TAKE YOUR CHOICE!

(± 10% Capacitance Tolerance is standard at no extra cost)

- Sprague Difilm Capacitors can't be beat! Dual-dielectric construction combines the best features of both Mylar® polyester film and special capacitor tissue. And for additional reliability, Difilm capacitors are impregnated with Sprague's HCX®, a solid impregnant which produces a rock-hard capacitor section—there's no wax to drip, no oil to leak!

- **BLACK BEAUTY Molded Tubulars** are actually low-cost versions of the famous Sprague high-reliability capacitors used in modern military missiles. They're engineered to withstand 105°C (221°F) temperatures . . . even in the most humid climates! And their tough, molded phenolic cases can't be damaged in handling or soldering.

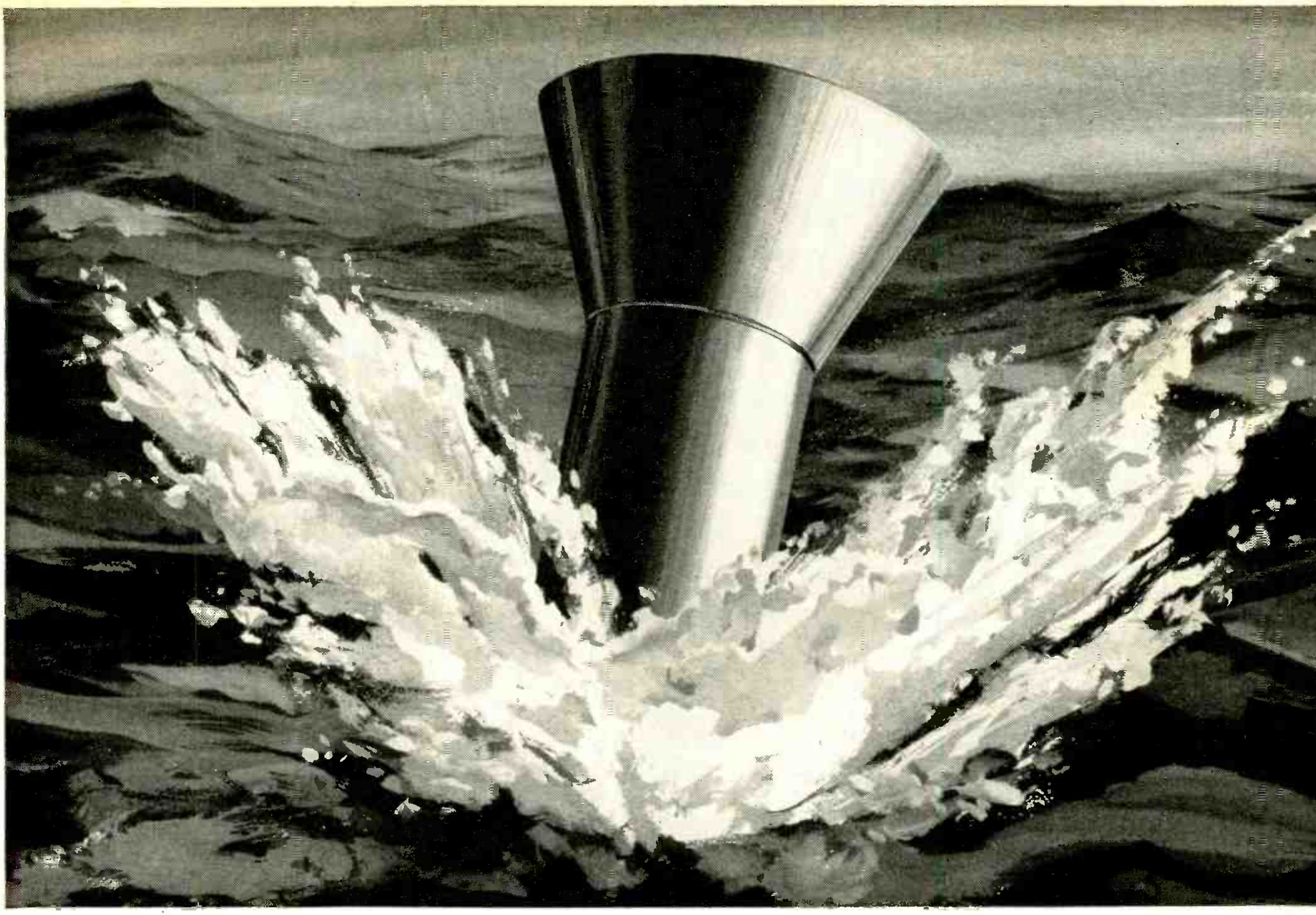
- **ORANGE DROP Dipped Tubulars** are the perfect replacement for radial-lead capacitors now used by leading manufacturers of TV sets. Leads are crimped for neat mounting on printed wiring boards. Extremely small in size, they'll fit anywhere, work anywhere. And they're double-dipped in epoxy resin for extra protection against moisture.

*__The "Hidden 500"__ are Sprague's 500 experienced researchers who staff the **largest research organization in the electronic component industry** and who back up the efforts of some 7,000 Sprague employees working in 14 manufacturing operations—four at North Adams, Mass.; Bennington and Barre, Vt.; Concord and Nashua, N. H.; Lansing, N. C.; Grafton, Wis.; Visalia, Calif.; two at Ponce, Puerto Rico; and Milan, Italy.

Get your copy of Catalog C-614 from any Sprague distributor, or write Sprague Products Co., 81 Marshall St., North Adams, Massachusetts.

SPRAGUE®
THE MARK OF RELIABILITY

WORLD'S LARGEST CAPACITOR MANUFACTURER



HOW THE OCEAN GREW "EARS" TO PINPOINT MISSILE SHOTS

A quarter of the world away from its launching pad an experimental missile nose cone enters its ocean target area.

How close has it come to the desired impact point?

Where actually did the nose cone fall?

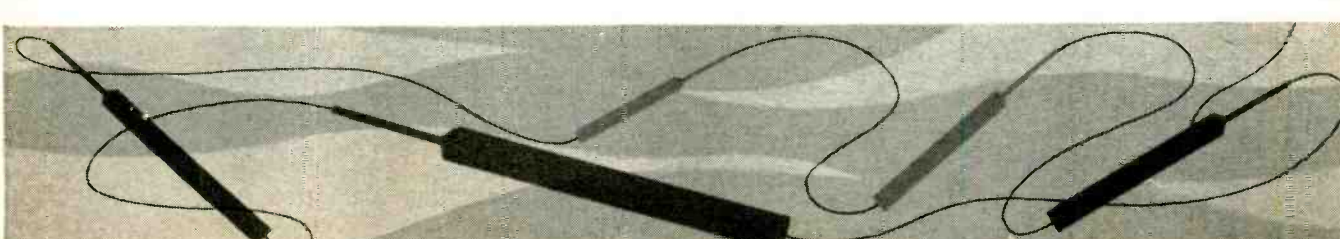
To answer these questions quickly and accurately, Bell Laboratories developed a special system of deep-sea hydrophones—the Missile Impact Locating System (MILS) manufactured by Western Electric and installed by the U. S. Navy with technical assistance from Western Electric in both the Atlantic and Pacific Missile ranges. MILS involves two types of networks.

- One is a long-distance network which utilizes the ocean's deep sound channel. It monitors millions of square miles of ocean. The impacting nose cone releases a small bomb which sinks and explodes at an optimum depth for the transmission of underwater sounds. Vibrations from the explosion are picked up by hydrophones stationed at the optimum depth and carried by cables to shore stations. Time differences in arrivals between these vibrations at different hydrophones are measured and used to compute location of the impact.
- The other is a "bull's-eye" network that monitors a restricted target area with extraordinary precision. This network is so sensitive it does not require the energetic explosion of a bomb but can detect the mere splash of a nose cone striking the ocean's surface—and precisely fix its location.

The universe of sound—above the earth, below the ocean—is one of the worlds of science constantly being explored by Bell Laboratories. The Missile Impact Locating System reflects the same kind of informed ingenuity which constantly reveals new ways to improve the range of Bell System services.

BELL TELEPHONE LABORATORIES

World center of communications research and development



Correspondence

REGENERATION PROBLEM

Dear Editor:

I built the "Tax" radio described on page 33 of the May issue and found I had trouble getting it to regenerate. I added a .001-µf bypass capacitor from the TS terminal of the tickler coil to the positive 6-volt bus. This made all the difference in the world, and this little set is the smoothest-operating and most sensitive of many transistor hookups I have tried. I omitted the last audio stage as the receiver has plenty of pep without it.

MELVIN LEIBOWITZ
Wilmington 1, Del.

[That .001-µf capacitor you mention was not originally intended to be there —though it will solve a no-regeneration problem. The author's unit, which we tested, had to be modified to *reduce* regeneration as mentioned in the text of the story. The difference between his unit and yours is probably only a matter of differences between the A0-1 transistors you used in the detector stage. As you cerainly know, there is often wide variation in the characteristics of one particular transistor type. —*Editor*]

PATENTS AREN'T GIMMICKED

Dear Editor:

Mr. Cohn's letter, printed in the June issue of RADIO-ELECTRONICS, asserted that the Ignition System patent (No. 2,955,248) described in the New Patents section of the April issue would not work as intended and that the base circuit was overly elaborate. Whether Mr. Cohn's assertions are true or not is not of immediate concern. The editor's comments following that letter are of greater moment because they show a distrust of patents which is unwarranted.

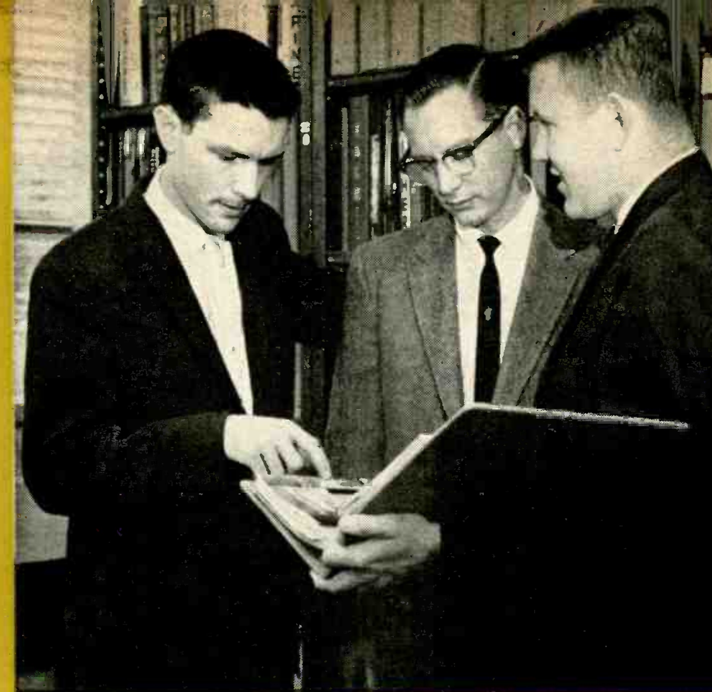
Specifically, the editor's comment that "The patent may have been intentionally wrong" and that "The added complexity in the base circuit may have been necessary to avoid infringing on an existing patent" are remarks founded upon misconceptions.

There is nothing to be gained in slipping a "gimmick" into a patent and much can be lost. If a patent is to be of any value, it must describe an operative device. Where the description is so inaccurate that the invention does not operate, the patent is invalid. The inventor is required by law to describe the best mode known to him of carrying

Opportunities in Electronic Engineering Technology

CREI

there is a CREI home study program to meet your need



YOU CAN OPEN MANY DOORS with CREI Home Study Programs in Electronic Engineering Technology. For example: One CREI Home Study Program helped Robert T. Blanks, (above, left) become an Electronics Engineer. Another Program helped Robert I. Trunnell, (center) become an Electronics Technician. While John H. Scofield, (right)—a Mathematician—is currently studying still a different CREI Program to increase his understanding of electronics and the mathematical principles that apply to it. All are employed by Vitro Laboratories, Silver Spring, Md., Division of Vitro Corporation of America.

Today thousands of advanced electronics personnel—engineering technicians, engineers, administrators, executives—attribute their present high salaries and positions to their home study of CREI's comprehensive Programs in Electronic Engineering Technology. Wherever you go—wherever thorough knowledge of electronic engineering technology is a prime requisite—you'll find CREI Home Study students and alumni welcomed.

Employers are quick to recognize the value of your enrollment in CREI Home Study Programs—to your company as well as to yourself. Often promotion comes before you complete your studies. Your CREI-acquired knowledge helps you form new associations, earn new respect from colleagues and co-workers. And your whole family shares the benefits when you prepare for—and get—desired promotions and advancements through CREI Home Study Programs.

INDUSTRY-RECOGNIZED CREI HOME STUDY PROGRAMS PREPARE YOU FOR INCREASED RESPONSIBILITIES, CHALLENGING POSITIONS IN ELECTRONICS.

When you enroll in the CREI Home Study Programs, you join more than 20,500 students who are presently working in almost every phase of electronics in all 50 states and most countries in the free world. 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. Completion of your CREI Home Study Program depends upon your on-the-job electronics experience, the amount of time you devote to study and the program you choose.

Demand for CREI-prepared men today far exceeds the supply—has exceeded the supply for many years. CREI Home Study Programs are specifically designed to prepare you for responsible positions in the electronic industry. In addition, *CREI Home Study Programs are kept up to date to include latest advancements in electronics.* We invite you to judge the Programs for yourself. Check the thoroughness and completeness of CREI Home Study Programs in the catalog provided upon request. These Programs include:

INTRODUCTION TO ELECTRONIC ENGINEERING TECHNOLOGY • ELECTRONIC ENGINEERING TECHNOLOGY • SPECIALIZED COMMUNICATIONS ENGINEERING TECHNOLOGY • SPECIALIZED AERONAUTICAL AND NAVIGATIONAL ENGINEERING TECHNOLOGY • SPECIALIZED TELEVISION ENGINEERING TECHNOLOGY • SPECIALIZED SERVOMECHANISMS AND COMPUTER ENGINEERING TECHNOLOGY • SPECIALIZED ENGINEERING MATHEMATICS • AUTOMATION AND INDUSTRIAL ELECTRONIC ENGINEERING TECHNOLOGY • NUCLEAR ENGINEERING TECHNOLOGY

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. These companies not only recognize CREI Home Study educational qualifications but often pay all or part of CREI tuition for their staff members.

CREI Home Study Programs are the product of 34 years of experience; CREI itself 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 World War II electronics courses for the Army Signal Corps, its special radio courses for the Navy, and its post-war group training programs for leading companies in aviation and electronics. For those who can attend day or evening classes in person, CREI maintains a fully accredited ECPD Technical Institute Residence School Program in Washington, D. C.

REQUIREMENTS FOR ENROLLMENT Pre-requisite is a high school education or equivalent *plus* basic electronics training and/or practical electronics experience. (Electronics experience and/or training not necessary for Residence School.) If you qualify, send for the latest CREI catalog and full information at no cost. Veterans may apply under the G.I. Bill. If you're doubtful about your qualifications, let us check them for you. Mail coupon to: The Capitol Radio Engineering Institute, Dept. 1408-H, 3224 Sixteenth St., N.W., Washington 10, D. C.

CAPITOL RADIO ENGINEERING INSTITUTE · CREI · FOUNDED 1927

The Capitol Radio Engineering Institute

ECPD Accredited Technical Institute Curricula · Founded 1927
Dept. 1408-H, 3224 Sixteenth St., N.W., Washington 10, D. C.

I am interested in the opportunities offered by the CREI Home Study Programs in Electronic Engineering Technology.

☐ I believe my qualifications as listed below meet CREI requirements. Please send me your latest catalog and full information at no cost.

☐ Please check my qualifications below and let me know if I am eligible for CREI Home Study Programs.

CHECK FIELD OF GREATEST INTEREST:

☐ Servo and Computer Engineering Technology
☐ Electronic Engineering Technology
☐ Aero and Navigational Engineering Technology
☐ Automation and Industrial Electronic Engineering Technology
☐ Nuclear Engineering Technology

My educational and electronics experience qualifications are:
(All information held in strict confidence)

Employed by_____
Type of present work_____
Education: Years High School_____ Other_____
Electronics Experience_____
Name_____ Age_____
Address_____
City_____ Zone_____ State_____
Check: ☐ Home Study ☐ Residence School ☐ G.I. Bill

forward his invention. Intentionally slipping in a "gimmick" with the purpose of misleading the public is one of the better ways of destroying what otherwise would be a valid patent. It is a fundamental of patent law that the inventor must disclose an operative form of his invention. If the description in a patent is wrong, you may be sure the error was unintentional.

The editor's remark concerning adding complexity to the base circuit to "avoid infringing on an existing patent" simply does not make sense. Two patents may conflict—that is, they may both claim the same invention—but one patent cannot infringe another patent. The invention described in one patent may be dominated by another patent so that the invention cannot be built without infringing the dominant patent. That situation does not appear here to be the case and it is highly probable that the "added complexity" serves a useful function. To Mr. Cohn I suggest that he buy a copy of the Ignition System patent. A copy of any United States patent can be obtained at a cost of 25c per copy from the Commissioner of Patents, Washington 25, D.C. The full text of the patent may dispel his doubts as to the operability of the invention.

LOUIS L. ORENBUCH

Boston, Mass.

IMPROVED LIGHT-LEVEL METER

Dear Editor:

The light-level indicator by Harold Reed on page 78 of the June issue is certainly a simple and versatile piece of equipment with many possible applications not foreseen by the author. I was pleased to see that a Canadian photoconductive cell is specified because we certainly owe Canada more business due to the large purchases they regularly make from the USA.

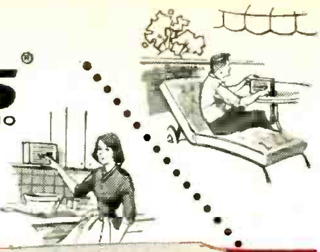
However, I wonder why Mr. Reed suggests making this versatile device cumbersome by requiring its output to be read on an external ac vtvm. Why not use a slightly larger box that can also house a rectifier type ac milliammeter?

According to the article, readings across the 10,000-ohm load resistor R1 range from 0 to 100 volts, which amounts to a current range of 0 to 10 ma through 10,000 ohms. Such a current range is a "natural" for a rectifier type meter, even using an ordinary 1-ma movement.

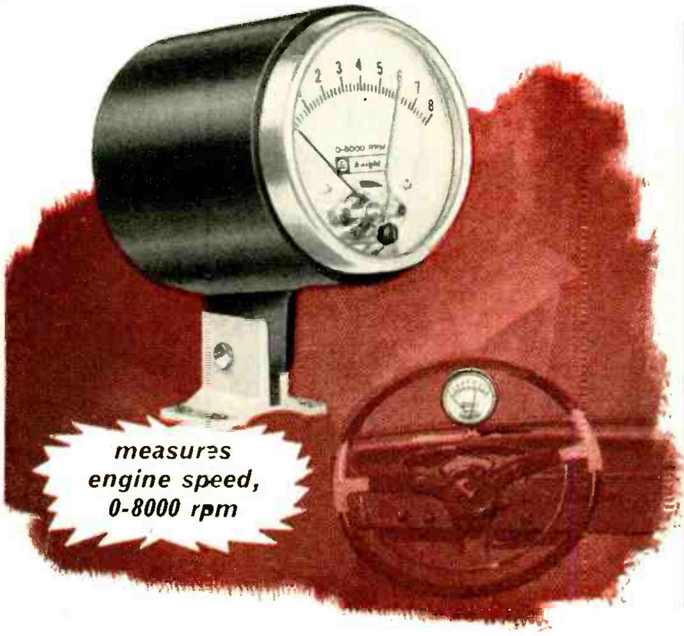
I have altered the original circuit to insert the rectifier type ac milliammeter to read the current through R1 rather than the voltage drop across it. The 6.25-ohm meter shunt is based on the usual 50-ohm resistance of a 0–1-ma dc meter. This provides two meter ranges of 1.11 and 10 ma ac. A shunt for any other meter should make the high current range 9 ma dc, which works out to 10 ma dc, or equal to 100 volts drop across R1. A type B or B-C Conant rectifier will handle the 10 ma maximum and provide good sensitivity at the low end of the 1.11-ma range but 10 ma is its maximum rating. The

NEW-simply great knight-kits®

A PRODUCT OF ALLIED RADIO



talk of the kit world...only at ALLIED



New Money-Saving Electronic Tachometer Kit

3% Accuracy Regardless of Temperature or Voltage Variations

Until Sept. 15 **$19.95** No Money Down

Another KNIGHT-KIT *first*—a precision tachometer in money-saving, easy-to-build form. Helps you drive at your best engine speed efficiency, like the professionals. Transistor switching and Zener diode regulator contribute to exceptional 3%-of-full-scale accuracy, regardless of voltage or temperature changes. Operates with 4, 6 or 8 cylinder automotive engines; simple installation. Ideal also for outboard marine engines using battery or magneto ignition system from 2 cycle 2 cylinder and up. Big illuminated D'Arsonval meter; 0-8000 rpm scale; separate reference pointer may be preset to any desired speed. For 12-volt systems only. With cables, mounting hardware, wire and solder. Shpg. wt., 2 lbs.

83 Y 944. For negative ground systems (American cars).
83 Y 980. For positive ground systems (Foreign cars).
No Money Down. INTRODUCTORY PRICE EITHER TYPE... **$19.95**

Deluxe Wireless Intercom System Kit at Lowest Cost

Works Anywhere Without Wires — No Installation!

PAIR **$37.90** No Money Down

This easy-to-assemble intercom operates without installation or wiring—just plug into any AC or DC wall outlet for step-saving communication! Change locations easily—anywhere. Ideal for home, office or store. In the home, you can communicate with nursery, garage, basement or patio. In office or shop, provides time-saving communication. Will operate between adjacent buildings that are on same electric-company line transformer. Perfect for baby sitting. Features power-line noise silencing circuit for absolutely quiet "standby"; premium quality throughout. Has Talk-Listen switch, with lock-on feature for constant listening. Handsome cream-toned plastic cabinet, 9 x 5½ x 5½". Can be used in systems consisting of 2 or more units, as desired. Shpg. wt., 3½ lbs.

20 YX 272-2. Complete 2-Station System. NET **$37.90**
83 Y 941. Additional Station. NET EACH **$18.95**

SEE DOZENS OF GREAT **knight-kit** BUYS in

Allied's Summer Sale Book!

Make your money-saving selections from page after page of great KNIGHT-KIT values and special offers! Save most on the best in build-your-own Stereo, hobby, instrument and Ham kits. Also see terrific closeouts on tape recorders, phonos, records and tape; specials in radios, cameras, TV accessories, Citizens Band radio, amateur gear, P.A., test instruments, tools and electronic parts. Send coupon today!

free

SAVE AS NEVER BEFORE on everything in Electronics—hundreds of special bargains—dozens of new products! Write for this big value-packed Sale Book today!

SEND FOR IT NOW!

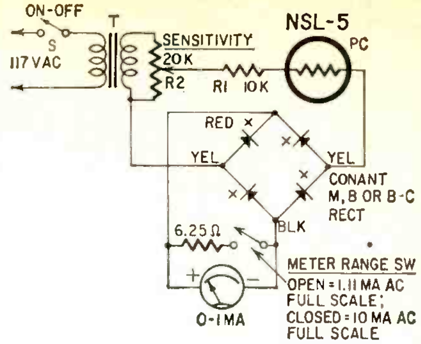
ALLIED RADIO, Dept. 34-H1
100 N. Western Ave., Chicago 80, Ill.

☐ **Send FREE Allied Sale Book No. 205**

Ship me the following:
☐ 83 Y 944 Tachometer Kit. ☐ 20 YX 272-2 Intercom System
☐ 83 Y 980 Tachometer Kit. ☐ 83 Y 941 Intercom Station
$............. enclosed

Name________________________
PRINT
Address______________________
City____________ Zone_____ State________

ALLIED RADIO



type M rectifier being good for 100 ma will handle any possible overload in this instrument. The rectifier types mentioned are usually readily available from distributors.

Obviously, if light levels are very low, a more sensitive dc meter is indicated. The foregoing seems to be the best choice for the constructor who likes it all in one box and possibly doesn't own an ac vtvm.

H. B. CONANT

Conant Labs.
Lincoln, Neb.

EARTH HUM

Dear Editor:

No one less than that much-maligned genius, Nikola Tesla (whom I knew well and revered), proposed way back when we were kids the idea of setting the whole earth into electrical oscillation and taking off information or power from it at standing-wave maxima around its surface. The earth has conductivity, self-inductance and capacitance, and therefore a natural period of oscillation. It is not at all unlike those self-oscillation cavities between earth and the ionosphere discovered by Lincoln Laboratory researchers, which are shocked into oscillation at 7.8 cycles by lightning discharges which provide the energy and the conducting self-inductance for the earth and ionospheric capacitor elements of an oscillating system (RADIO-ELECTRONICS, March 1961, page 10).

It is even just possible that the observed oscillations *are* those of the earth itself. If not, and only some high-powered mathematical deductions can tell or guess, then a more far-reaching search at lower and higher frequencies may disclose such earth oscillations. Where Tesla failed in his early attempts, perhaps our later technological advances may point the way for use of his ideas in communications or in power transmission.

B. F. MIESSNER

Miessner Inventions Inc.
Miami Shores, Fla.

RADIO MAGS FOR SALE

Dear Editor:

I have more than 10 years of back issues of many radio and TV magazines including, of course, RADIO-ELECTRONICS. I would like to sell these issues. Can you suggest an outlet? All magazines are in very good condition.

D. BERNARD FRITZ

3350 St. Lawrence Ave.
Reading, Pa.

END

LAFAYETTE is America's Citizens Band Headquarters

Complete Portable Communications for Everyone

NO LICENSES, TESTS OR AGE LIMITS

LAFAYETTE 9-TRANSISTOR
CITIZENS BAND
"WALKIE TALKIE"

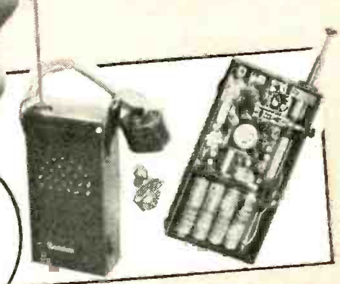
42.95
2.00 Down
2 for $82.95

- Completely Wired—Ready to Operate
- Fully Transistorized — 9 Transistors plus 1 Diode
- Uses Inexpensive Penlight Batteries
- No License, Tests or Age Limits
- Comes with Leather Carrying Case, Earphone, Antenna, Batteries and Crystals

As simple and easy to use as the telephone—and twice as handy. Receives and transmits up to 7 miles under favorable conditions, or 1.5 miles under average conditions. Weighs only 18-oz. and slips into your pocket. Push-to-talk button operates built-in speaker as sensitive microphone.

COMPLETELY PORTABLE—POCKET SIZE Only 6⅜x3¼x1⅝"

HE-29



Complete with Leather Carrying Case, Earphone, Antenna, Batteries, and Crystal

LAFAYETTE HE-20A *Deluxe* CITIZENS BAND TRANSCEIVER

ONLY **109.50**
5.00 Down

MADE IN U.S.A.

Now With Added Deluxe Features—

- Pi-Network for Greater Power Output
- Calibrated "S" Meter
- 14 Tube Performance, 3 Diodes
- Built-in 12 Volt Power Supply for Mobile Use
- Complete with Matched Crystals for Channel 9

A highly efficient 2-way communications system operating over a distance of up to 20 miles or more depending on terrain. Features 4 crystal-controlled transmit positions and 4 crystal-controlled receive positions. Tuneable superhet receiver covers all 23 assigned channels. Other highlights include dependable push-to-talk ceramic mike & relay, adjustable squelch control, automatic series gate noise limiter and illuminated dial.

LAFAYETTE HE-15A SUPERHET Citizens Band TRANSCEIVER

ONLY **59.50**
5.00 Down

MADE IN U.S.A.

- Completely Wired—Not A Kit
- 5 Crystal-Controlled Transmitting Positions
- Tuneable Receiver Over Full 23 Channels
- High Output Crystal Microphone
- Complete with Transmitting Crystal for Channel 9

A compact, precision transmitter and receiver covering up to a 20 mile or more radius, depending upon conditions. The HE-15A features an effective full-wave variable noise limiter, RF jack on front panel, planetary vernier tuning, 5-prong microphone jack for easy relay addition, and 12 tube performance from 4 dual-function tubes, 2 single-function tubes, 2 rectifiers.

HE-19	Telescoping Whip Antenna	Net 3.95
HE-16	Power Supply for 12 Volts	Net 10.95
HE-18	Power Supply for 6 volts	Net 10.95

HE-800WX

LAFAYETTE ALL-IN-ONE CITIZENS BAND MOBILE ANTENNA

The Scoop Buy for Citizens Band Mobiles

6.95

- Chrome Swivel Base
- Stainless Steel Spring
- 102½" Stainless Steel Whip for Optimum 11-Meter Performance

Chrome swivel ball mount base designed for mounting on any surface. Stainless steel spring holds rod in properly adjusted position and prevents rod damage from shocks and blows. Stainless steel whip for maximum resiliency and strength.

NEW! LAFAYETTE RADIO FIELD INDICATOR

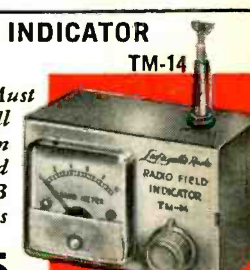
TM-14

- Continuously Indicates Transmitter Output
- Rugged 200 ua Meter Movement
- Requires No Electricity, Batteries or Transmitter Connection

Check the performance of marine, mobile or fixed transmitter. Features a 200 ua meter movement with variable sensitivity control. Earphones can be plugged in for an aural check of output. Antenna extends from 3¼" to 10¾". Magnet on bottom plate allows easy mounting on car dash or metal surfaces. Size, less antenna, 3⅛W, 2¼H, 2"D.

A Must for All Ham and CB Operators

6.95



LAFAYETTE RADIO

PLEASE INCLUDE SHIPPING CHARGES WITH ORDER

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

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

EICO® ...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

Transis-
torized
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-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

EICO 1961 KITS AND WIRED

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!

EICO, 3300 N. Blvd., L.I.C. 1, N.Y. C8
☐ 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..........

*Including Posi-Lock® Mounting Bracket (PAT. PEND.)

NEW DeLuxe
Citizens Band Transceivers:
#770: 117 VAC—
Kit $69.95 Wired $99.95
#771: 117 VAC & 6 VDC,*
#772: 117 VAC & 12 VDC*—
Kit $79.95 Wired $109.95

Citizens Band Transceivers:
#760: 117 VAC—
Kit $59.95 Wired $89.95
#761: 117 VAC & 6 VDC,*
#762: 117 VAC & 12 VDC*—
Kit $69.95 Wired $99.95

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

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

Add 5% in the West

See us at the New York Hi-Fi Show, Booth 424, September 13-17

URGENCY RADIOS

. . . Instant Emergency Radios Are Long Overdue . . .

IN this age of cold-war philosophy, nuclear bombs and potential devastation of whole cities, it has been a constant wonder to us why our Federal and local governments—to say nothing of our electronic industry—have done so little to prepare for alerting the population INSTANTLY.

Admittedly, we have siren-alarm systems in most of our cities to warn us of major disasters, but even these could fail at crucial times.

At times when vital news is in the making, the sounding of sirens might not always be warranted, particularly at night when the populace is asleep. But it might be desirable to issue an alert or broadcast an important message. This could happen in such cases as a threatening flood, long disruption of the electric supply system, threat of war or even heavy sudden snowfall.

What is needed urgently in our present high-speed, danger-fraught civilization is a standby or *urgency radio*, which could be energized via radio from a central point, to impart urgent information to the citizens.

Such a radio receiver, which we can also call *Alarmradio, alertradio, disasteradio* or *S.O.S. radio*, can readily be manufactured today. Any good radio engineer with a little imagination can design various models. It is even possible to manufacture auxiliary kits or units that could be connected to existing radios.

However, before such radios could be made, a number of agencies would have to be authorized to initiate the impulse that would energize the silent radios into positive action instantly.

It would seem to us that this lies in the domain of our broadcast stations, many of which operate 24 hours a day, often automatically.

The *original* urgency signal would probably be sent out by the mayor or chief of police of each city or locality. These officials would decide whether the citizens were to be alerted. The city's urgency signal, on a special frequency (or by wire), would then trigger all local broadcast stations, which in turn would send out the actual urgency signal. This would be quite automatic without interference by the broadcast stations, which would merely act as relays.

For a number of technical reasons, it might also be necessary to broadcast the *triggering impulse* on a special frequency or wavelength set aside specifically by the Government for this purpose.

Since many radio receivers today are energized by the power line supply, its failure would of course put out of action any urgency radio dependent solely on house current. For that reason alone, the first requirement of such a receiver is that it must have a standby battery supply. A special relay would instantly switch from one current supply to the other. It would be extremely unusual to have both electric supplies fail at the same time.

The circuit that is to carry the special alarm impulse must of course be turned on "perpetually"—it must be ready at all times, otherwise the alarm would be worthless. Leaving a receiver on perpetually is not a serious problem. The current drain of the typical ac–dc midget is small and, in all probability, the life of the receiver under continuous operation would be at least equal to that of intermittent operation. It might even be greater. For example, Westinghouse now makes two table-model receivers in which only the B-supply is disconnected when the set is turned off; the tube heaters run constantly (as long as the receiver is plugged in).

Transistor radios with their very low standby current would be ideal for urgency radios, particularly if they are supplied with dual power supplies (batteries and line-operated).

The circuit of an urgency radio must of necessity be engineered so that, when it is triggered, the volume control is cut out completely and automatically, making certain that the radio comes on full blast—if it is to do its work efficiently. The alarm impulse will trigger the radio on only for a short time—say 5 minutes. It turns off automatically after that period, so as not to keep going indefinitely in case the owner is absent.

When finally produced, urgency radios may eventually replace present-day radios—the alarm feature being simply an adjunct to a modern radio, as, for instance, is the clock receiver alarm that wakes you.

As to the cost of such a set, it will not be much more than a present-day clock radio. The standby battery supply will probably be extra.* —*H.G.*

*See also "Emergency Alarm in Your Home," March 1961 issue of RADIO-ELECTRONICS, page 82.

COVER STORY

STEREO FM FROM YOUR OWN TUNER

How one of the new multiplex adapters works

By
DANIEL R. VON RECKLINGHAUSEN*

Very recently, the Federal Communications Commission adopted standards describing the compatible stereophonic signal to be broadcast from a single FM station. Set engineers are now facing new design problems. One design approach is shown here in a detailed description of the workings of an FM multiplex adapter for FM tuners.

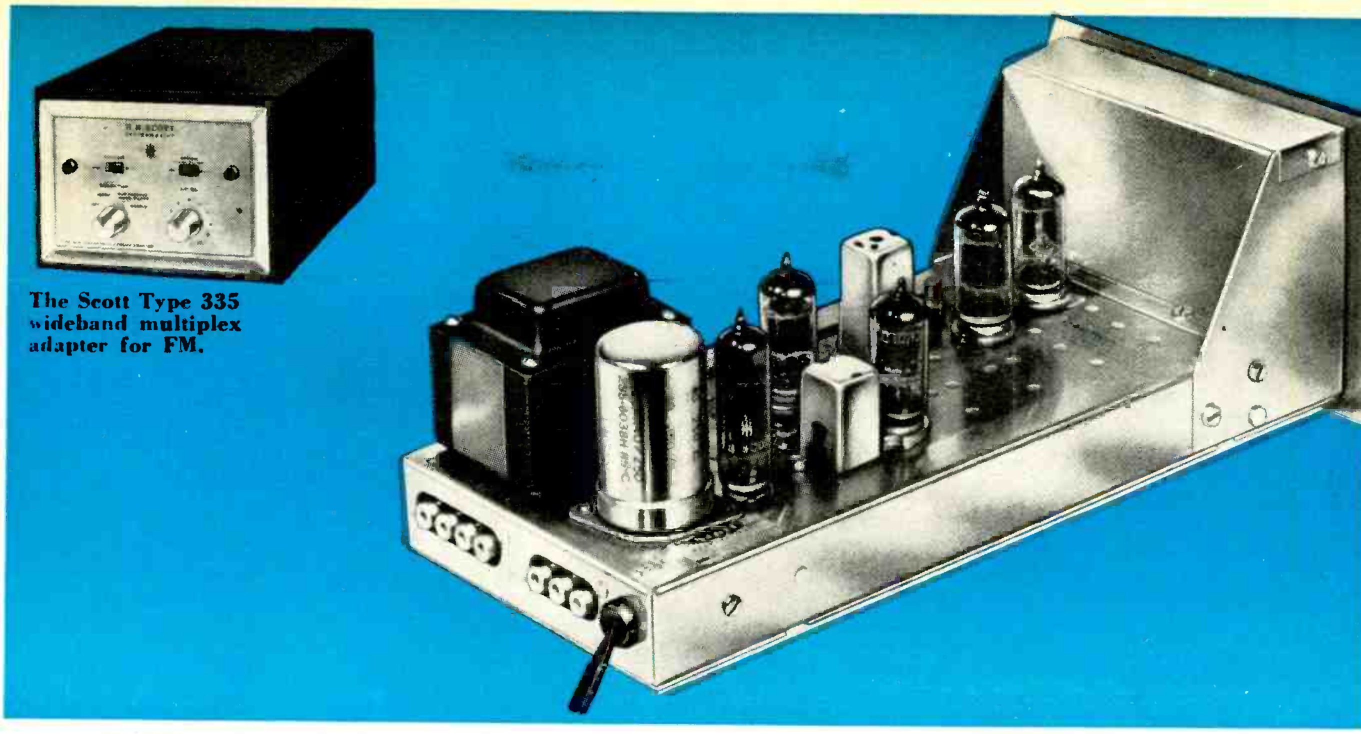
In essence, the FCC standards specify that the sum (A + B) of the left and right stereophonic channels (A and B) frequency-modulate the station's carrier up to 90%. This permits the monophonic listener to receive a satisfactory composite of the stereo program similar in quality to the type of sound obtained when playing a stereo record with the left and right pickup terminals connected in parallel.

The stereo information, or more accurately the difference (A − B) of the left and right stereophonic channels, amplitude-modulates a 38-kc subcarrier. The subcarrier itself (38,000 cycles) is suppressed in the modulation process. Its upper sideband (38,050 to 53,000 cycles) and its lower sideband (23,000 to 37,950 cycles) are preserved. Together, they frequency-modulate the station's carrier up to 90%. Therefore, all the advantages of frequency modulation are preserved since all signals applied to the station's transmitter cause only frequency modulation and not amplitude modulation.

These signals appear at the multiplex output of an FM tuner after the station's signal has been converted to an intermediate frequency, amplified, limited and detected. Fig. 1 is a basic block diagram of an FM tuner connected to a multiplex stereo adapter. A quick and superficial inspection of the signal specifications would tend to make the casual reader suspect that 90% main-channel modulation and 90% subchannel modulation would result in 180% modulation and, therefore, severe overmodulation. This is not so since both the main-channel and the subchannel signals are interleaved and together can

*Chief research engineer, H. H. Scott Inc., Maynard, Mass.

Philco Corp. Photo



The Scott Type 335 wideband multiplex adapter for FM.

cause only 90% carrier modulation (or 67.5-kc peak carrier deviation).

Combining channels

The interleaving is one of the most interesting features of the stereo system specified by the FCC. Consider first a transmitter that is modulated by a channel-A signal only. Here, the main channel and the subchannel would be modulated equally and in phase. The instantaneous main-channel modulation would vary from zero to alternately positive and negative peaks of 45% (Fig. 2). The subchannel signal would be zero whenever the instantaneous audio input to the subchannel is zero. It would vary (at a 38-kc rate) between plus and minus 45% whenever the input signal peak is at either +45% or −45%. The phase of the subchannel sidebands would be shifted 180° for a negative audio input.

The main-channel and the subchannel signals add so that now the total composite signal appears to be a sine wave and a horizontal 0% modulation line (representing channel B) with the space between the sine wave and the zero line filled in with the 38-kc sidebands. The peak of the sine wave is now 90%; so far no interleaving has taken place. Fig. 2 illustrates this modulation. *Note that the phase of the 38-kc component is shifted 180° for the negative portion of the audio sine wave.*

To show that interleaving takes place, assume that channels A and B have an input of the same voltage and frequency. If the two signals are in phase, only the main channel will receive a signal since the difference signal is zero. Should the phase of one input signal be reversed, the main channel would be unmodulated and the subchannel would be fully modulated. Here, the composite signal appears as if two out-of-phase sine waves were present (as they actually are at the stereo transmitter inputs) with the space between them filled in by the subcarrier sidebands. Consequently, if any two signals are present at the two inputs, both will appear in the composite signal with any difference between them filled in with subcarrier sidebands. Fig. 3 illustrates this process. In all cases, the original A and B inputs are visible as individual envelopes of the composite signal with the waveform "oscillating" back and forth between the two audio signals.

This "oscillating" is even more apparent when two audio signals of different frequencies are applied to the two audio inputs (Fig. 4). It seems as if the transmitter input were switched 38,000 times per second between the two audio inputs with the sharp switching transients removed by a filter. This is actually one of the methods used to produce stereo signals. For this reason, the stereo broadcasting system adopted by the FCC is properly called a "time-multiplex" system since the transmitter is connected half the time to channel A and the other half to channel B, switching at a 38-kc rate. Note again the phase reversal of the 38-kc component as the two audio sine waves cross each other.

Separating the stereo signal

The methods of generating a composite stereo signal point out two basically different ways of separating this signal. One (shown in the July issue of this magazine) uses a 23-53-kc filter, followed by detection, and the use of a sum-and-difference matrix network to obtain the A and B audio outputs.

The second method (used by H. H. Scott) makes use of the time-multiplex aspect of the stereo signal. Here, the composite signal is applied to an AM detector (along with a 38-kc reinserted carrier) to produce the channel A output. The composite signal is also applied to a second identical detector to produce the channel-B output. Here, the phase of the 38-kc reinserted carrier is shifted 180°.

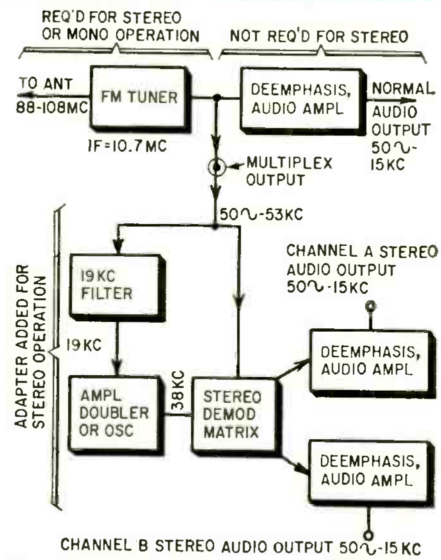


Fig. 1—Block diagram of FM tuner connected to a multiplex adapter.

This detection process might be thought of to be the inverse of the time-multiplex modulation process. In detection, the composite signal is "switched" in succession to the left and right audio amplifiers. The proper audio output is obtained if the switching is done at the exact time (38,000 times per second) when the A and B components of the composite signal arrive at the "switch". For perfect separation of the two audio signals, the reinserted subcarrier has to be in exact phase with the second harmonic of the 19-kc pilot carrier broadcast by the FM station. The same pilot carrier also synchronizes the "switch" at the FM transmitter. This pilot carrier modulates the transmitter 10% (maximum) and with the 90% composite signal modulation accounts for 100% transmitter modulation.

Fig. 5 is a block diagram of the H. H. Scott type 335 Multiplex Stereo Adapter. Here, the signal from the FM detector (multiplex output) is first

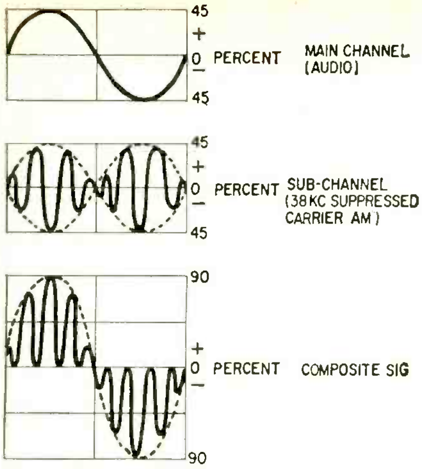


Fig. 2—Development of composite waveform with channel A input only. Pilot carrier is omitted for clarity.

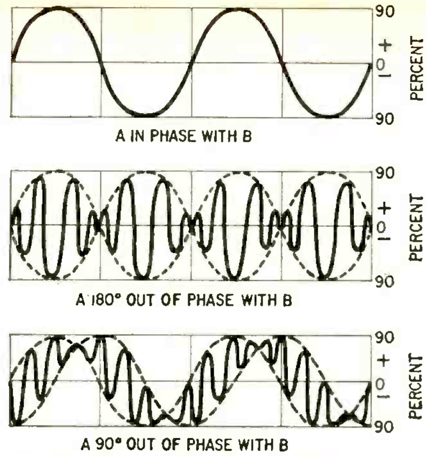


Fig. 3—Composite signal when channel A and channel B are both fed the same signal and phase is varied. Pilot carrier is omitted for clarity.

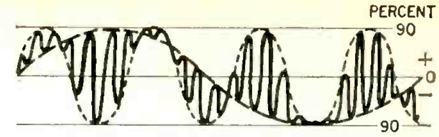


Fig. 4—Composite signal when channel A and channel B are fed different signals. Pilot frequency is omitted for clarity.

amplified in a high input-impedance stage so that the low output voltage (0.3 volt rms at 75-kc deviation) is increased to the proper level for detection. The low output impedance of this stage also allows a 53-kc low-pass filter to be driven. This filter removes frequencies above 53 kc such as background music (SCA) subcarriers which might be operating between 60 and 75 kc.

To get good separation and low distortion, the frequency response of the combination of the tuner with its limiters and detector, the input stage of the adapter, and the 53-kc filter has to be kept to close limits. For example, 30-db separation can be obtained only when the frequency response departs no more than 0.3 db from a flat response between 50 and 53,000 cycles and the phase response is linear to 3° in the same range. Since, in normal tuners, audio-frequency response is controlled to only 1 db, we decided to process the composite signal from the multiplex output rather than use the tuner's normal audio output and then try to devise a subchannel circuit of matched and adjusted frequency and phase response.

All existing H. H. Scott tuners use a wide-band ratio detector which has excellent frequency response. Its low internal impedance, approximately 2,000 ohms, permits the use of a 3-foot output cable to the multiplex adapter without changing the frequency or phase response up to 53 kc. A detector that has a higher internal impedance (such as a discriminator) would require special adapter circuitry to balance out the connecting-cable capacitance. For this reason and because tuners of other makes have different output voltages or response characteristics, the type 335 adapter is recommended for use only with H. H. Scott tuners.

The relatively small multiplex output coupling capacitor and the severe low-frequency phase-shift requirements of the multiplex system demand that the adapter have an input impedance greater than 20 megohms. To accommodate component tolerances, a 50-megohm input impedance was chosen.

After the 53-kc filter, the 19-kc pilot carrier is selected by a 19-kc filter. This filter is made narrow to prevent the adapter's 38-kc oscillator from being synchronized by either main or subchannel modulation components or by noise when listening to a weak signal. The 19-kc signal is then amplified and injected into a 38-kc oscillator circuit, phase-locking this oscillator to the 19-kc pilot signal. Phase locking is maintained at all rf signal levels. Measurements with a wave analyzer have shown that the separation of left and right audio channels is maintained even with such low rf signal levels that the signal-to-noise ratio makes listening impossible. All tuned circuits are temperature-compensated so the 38-kc oscillator has a warmup drift of only .01% in the absence of a pilot carrier.

The outputs of the 53-kc low-pass filter and the 38-kc oscillator drive the two balanced-bridge stereo demodulators which produce basically the left and right channels. The two wide-band amplifiers following the demodulators have a common efficiency-balance circuit which compensates for the demodulator's detection efficiency of main and subchannel signals. This control is factory set to assure best separation of left and right channel signals. It is similar in function to a separation control which was a front-panel control on adapters designed to receive the early experimental and now nonstandard multiplex broadcasts.

Since the multiplex stereo system chosen by the FCC carries a form of amplitude modulation of the stereo subchannel, no additional subchannel limiting is required as it would be for a system employing a frequency-modulated subchannel. A subchannel limiter in the FCC system would only distort the difference signal. Therefore, the circuits processing the subchannel signal have to operate as linear and distortion-free as possible. This means that, for a given combination of FM tuner and adapter, the main and subchannel signals will always be in the same ratio regardless of the reduction of audio output which might be experienced as the received signal fades to a low strength. Therefore, any separation control in a multiplex adapter should not be on the front panel where it might be misadjusted by uninformed friends, neighbors or children.

The outputs of the wide-band amplifiers drive 75-microsecond de-emphasis networks. Here, any component tolerance will affect frequency response without changing separation. Experiments have shown that adequate separation of left and right signals cannot be maintained with separate de-emphasis networks for the main and subchannels.

Tape recording and multiplex

Multiplex stereo broadcasting will provide tape recorder users a major source of stereo program material. Field and laboratory tests indicated that adequate recordings could not be made unless the 38-kc signal and its harmonics from the reinsert subcarrier oscillator were suppressed to a very low level. Otherwise, the 38-kc, 76-kc, 114-kc, etc.

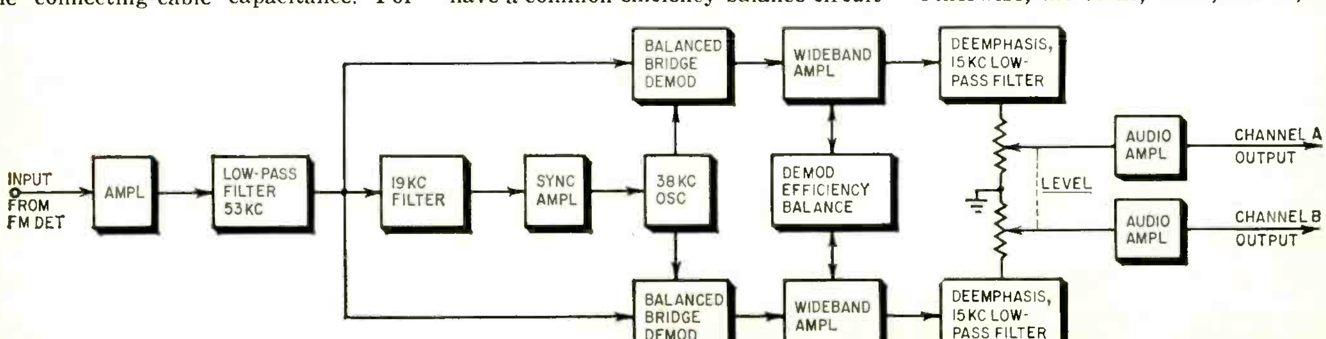


Fig. 5—Block diagram of the H. H. Scott multiplex adapter.

components would mix with the tape recorder's bias-oscillator frequency to produce beat tones recorded on the tape. The problem was intensified because of the pre-emphasis network in the recording circuit and the limited dynamic range of the tape at such high frequencies.

The tape recording problem has been eliminated in the 335 multiplex adapter by using balanced-bridge demodulators and 15-kc sharp-cutoff low-pass filters. The output of these filters feeds a stereo level control which in turn feeds a pair of anode follower amplifiers. These amplifiers produce 2 volts output with low internal impedance with 90% modulation and have outputs for stereo tape recorders and stereo amplifiers.

A number of circuit refinements have been incorporated in this self-powered adapter. A front-panel switch permits listening to either multiplex stereo or AM-FM stereo broadcasts if an AM-FM tuner is the signal source. Another switch permits listening to the monophonic portion of the broadcast. Other switches insert noise filter circuits for stereo reception of weak signals with reduced noise and full-frequency response or full separation.

Listening to FM signals with an FM tuner connected to a multiplex stereo adapter provides a number of new experiences. Since stereo broadcasting is not required by law from an FM station, a number of monophonic programs can be heard—but not in stereo. Other stations may have a noise, best described as a "swishing whistle." This is caused by that particular station operating a background music service (SCA) in the the subcarrier frequency range of 20—53 kc. Stations are permitted to do this as long as they are not engaged in multiplex stereo operations at the time. The rate of the "swishing whistle" is controlled by the rate at which this background music is performed and the noise is not a fault of the tuner or adapter.

When listening to stereo programs in weak-signal areas, the signal-to-noise ratio of the stereo signal is poorer than for the monophonic signal. This is one sacrifice that has to be made since you cannot get something (stereo) for nothing (no loss of signal-to-noise ratio). An outdoor antenna oriented toward the station will generally offset this loss and also reduce interference which might be picked up from other directions.

It has also been found that the same station's signal arriving directly and by multipath reflection causes considerable distortion in stereo and only a slight increase in distortion in mono. Here, the reflected signal acts as interference. It was always possible to eliminate this distortion by reorienting the antenna (even an indoor antenna) or by reversing the antenna leads. In some cases, a directive outdoor antenna was required. An antenna rotator proved helpful in orienting the antenna for optimum listening from several stations.

The FCC-approved system can be received with extremely simple adapters that provide adequate results with inexpensive FM radios and tuners. Fortunately for the more demanding music listener and recordist, it is possible to design multiplex equipment with the same high engineering standard found in high-quality wide-band tuners. The 335 stereo adapter was designed for this type of service.

Just because some problems have been mentioned, don't be scared off. Proper choice of equipment and careful installation will make multiplex stereo at least as great a boon to the music listener as the development of the stereo record. At the least it puts a new source of stereo sound in your home. END

BUILD A VOLTMETER THAT CAN'T BURN OUT

By T. L. BARTHOLOMEW

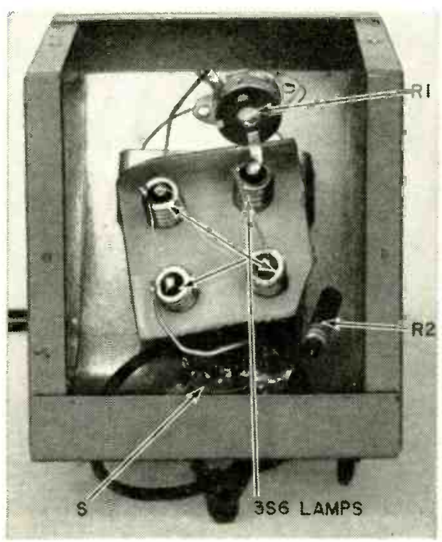
THIS VOLTMETER WAS DESIGNED FOR TESTING batteries, particularly those used in the photographic field. Such units range from 1.35 to 510 volts. Voltmeters are frequently left on display counters in photographic stores for the convenience of the public and to help sell batteries. Therefore, high-voltage batteries are often tested with the meter set on some low range. The result is a burned-out multiplier resistor or meter movement.

With the circuit shown, a 510-volt battery can be applied with the meter set to the 5-volt range, without damaging the meter or the battery. In normal operation the circuit has 1,000-ohms-per-volt sensitivity. The 3S6 120-volt pilot lamps have a cold resistance of about 500 ohms each. R1 is made adjustable since the cold resistance of the 3S6 lamps is not consistent. The meter is a 1-ma movement with a 0- to 5-volt scale.

After the circuit is assembled, a voltage is applied to the meter and a standard meter is connected in parallel. Then R1 is adjusted till both meters read the same. R2 may seem extra large but, if the meter is set on the 50-volt range and 500 volts is applied, the 2-watt size is required.

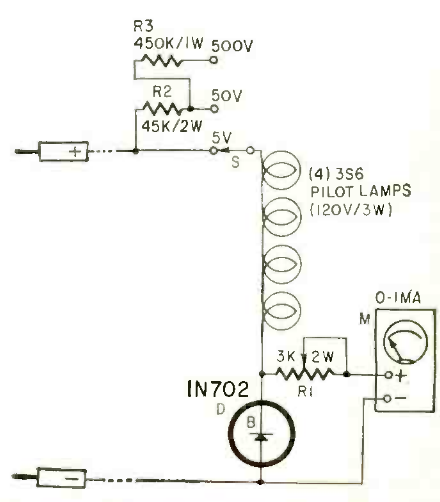
How it works

Let's assume the meter is set on the 5-volt range and a voltage is applied to its terminals, polarity as indicated. As the voltage is slowly raised, the meter reaches full scale (1 ma). As the voltage continues to rise, Zener diode 1N465 breaks down because of the voltage drop across R1 and the meter. The current in the meter at this point will be about 1.3 ma. Any additional current in the circuit will flow through the Zener diode. Also, as the voltage is raised, the filaments in the lamps become warmer and their internal resistance increases. By the time 510 volts is reached, the lamps have come up to full brilliancy and their resistance has increased to about 5,000 ohms each. Maximum current is about 25 ma through the lamps, 1.4 ma through the meter and 23.6 ma through the diode. END



It's no trouble to fit the few parts into a small meter case.

R1—pot, 3,000 ohms, 2 watts
R2—45,000 ohms, 2 watts
R3—450,000 ohms, 1 watt
D—1N702 Zener diode
M—0-1 ma
S—single-pole 3-position rotary switch
Pilot lamps, type 3S6 (4)
Probes (2)
Meter case to suit
Miscellaneous hardware



Circuit of burnout-proof voltmeter.

Don't let the tuner THROW YOU

What you don't know can hurt you!
Can you get a picture with the oscillator tube dead?
How about the rf tube?

By HAROLD DAVIS

MOST service technicians would rather change the baby's diapers than fool with a tuner. Both are messy jobs.

There are two reasons why tuners are on the black list—repairs are a tedious operation, and we know less about tuners than other parts of the set, mechanically speaking, that is.

The multitude of switches and contacts makes tracing circuits difficult, and many of us don't take the necessary time to find out what they are all about. For example, when a service technician looks at a diagram and sees 120 volts indicated on a terminal that isn't connected to anything, it is only natural for him to be thrown into a state of confusion (Fig. 1).

The first thing that the tuner does is to couple and match the antenna lead-in to the tuner's input circuit. In some of the older sets, the antenna connects direct to the center-tapped primaries of the antenna transformers on the turret-coil strips. In others, an impedance-matching device—a balun—matches the *bal*anced 300-ohm antenna to the tuner's *un*balanced (single-ended) input circuit. The balun consists of two bifilar coils, usually mounted side by side on the back of the tuner.

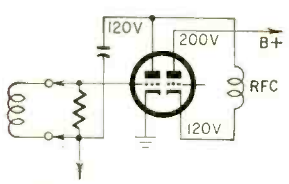


Fig. 1—Plates and cathodes suspended in air but the voltages shown here will stop the technician who doesn't spot the circuit as a cascode arrangement.

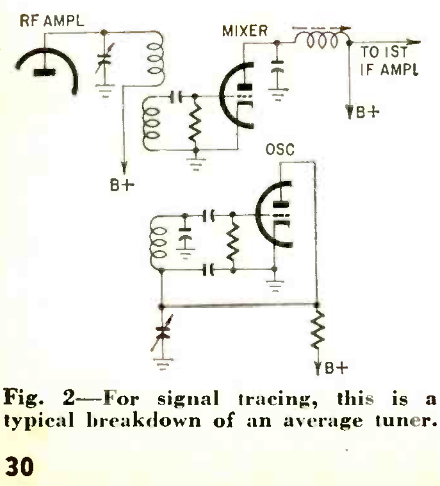


Fig. 2—For signal tracing, this is a typical breakdown of an average tuner.

The rf amplifier must, of course, amplify the signal, but how depends on the signal itself. Strong signals develop so much agc that the rf amplifier ends up biased to where it is giving no gain, and possibly even a loss.

The output from the amplifier is fed to the grid of the mixer through a 10-$\mu\mu$f or smaller capacitor, except in Standard Coil strip tuners, which are inductively coupled.

The mixer output is fed through a tuned circuit to the input of the first if. At the same time, the tuner oscillator supplies the signal with which the incoming one is mixed to form the if (Fig. 2).

Any time a customer calls and says she has snow on one or more stations, we arrive on the scene with an rf amplifier tube in hand. But when we straighten up after wrestling 10 or 15 minutes trying to get it in the socket and find we still have the white stuff, we begin to wonder why we got into this alleged business in the first place.

When we get snow in a picture there is one thing we can be sure of—we are not getting enough picture through so the agc tube can develop enough bias to reduce rf gain. With few exceptions, snow is caused by either the rf amplifier not operating normally or the circuit ahead of it.

An accepted procedure would be to check the tube plate voltages. Use a socket adapter so you don't have to tear into the tuner itself. In strong-signal areas, if you cup your fingers over an rf tube that is not amplifying properly, signal strength will increase.

If voltages on the tube seem OK, but signal strength increases when you cup your fingers over the tube, the signal is not getting to the rf amplifier grid.

Proving this is simple. Pull the tube, wrap a turn of one end of a 5-$\mu\mu$f capacitor around the grid pin and reinsert the tube. If you hold the other end of the capacitor in your hand, enough signal will reach the grid, in strong-signal areas, to prove the point positively.

Baluns and transformers

Antenna transformers and baluns connected to outdoor antennas are often knocked open by flashes of lightning. They can also be burned open by a cross ground between antenna and set.

Whatever the reason, if the coil is open, there will be snow on the screen. Sometimes it will not appear on a strong high-frequency channel due to the capacitance coupling effect, but it will almost always show up on low channels.

The baluns on RCA and Philco sets stick out like sore thumbs. On a Philco, it is the thing that keeps you from seeing how to put a tube in the tuner. On RCA's it sticks out from the tuner like a handle on a frying pan.

Defects in these coils are usually obvious. They are also easily repaired. If they're not too badly burned, one can usually determine the number of turns and rewind them. Also, Miller makes replacements.

On late-model sets, especially portables, one has to make like Sherlock Holmes to find the antenna transformer. The difficulty in getting to these tiny mites is a good reason for reaching in, breaking the leads and installing a new one on top of the tuner. As two of the leads go to the antenna connections, only the secondary leads have to be connected in the tight place. Some typical antenna input circuits are shown in Fig. 3.

Remember, a good antenna transformer works effectively only when it is connected through a balanced ribbon-type line to a 300-ohm antenna. With anything less than this, the set will usually perform better if only one side of the antenna is connected.

In my home town we learned this early in the game. Our first station was uhf and most people had bowties, etc. Then came the vhf's, one on channel 3 and another on channel 12, and few people wanted to buy another antenna. Someone found he could get a very sat-

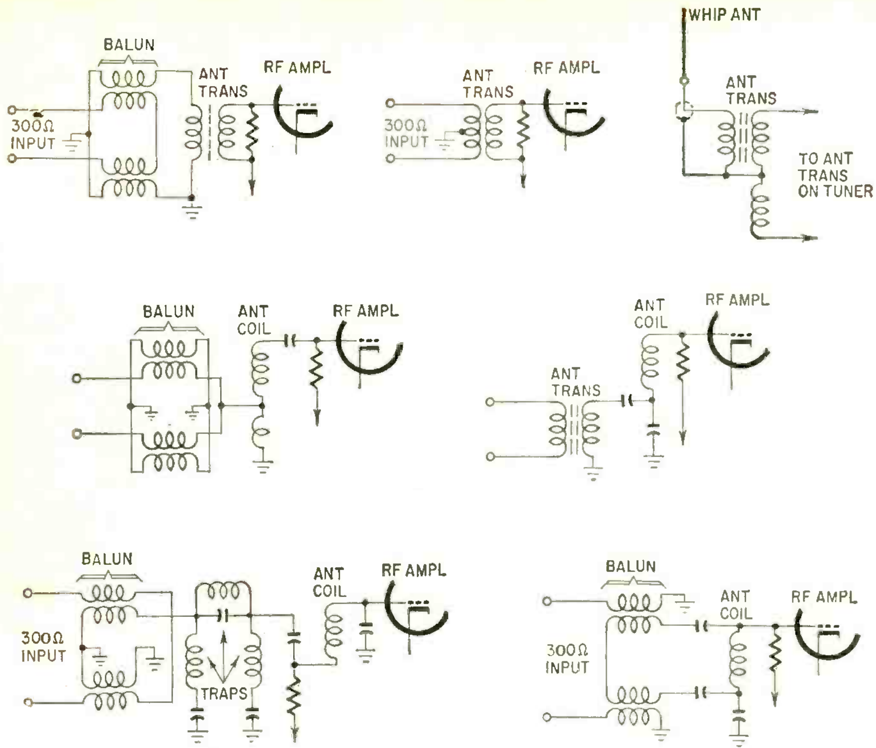


Fig. 3—Some typical antenna input wiring arrangements.

isfactory arrangement by installing a switch that would open one lead when receiving the vhf's. We finally lost the uhf and to this day thousands of people are still operating on the uhf antenna, but with only one side connected.

With such an arrangement, the set is simply operating on a long piece of wire, and you'll find it isn't too bad an idea, particularly if you lift the center-tap ground on the primary side of the antenna transformer and insert a little 5-μμf capacitor between it and ground (real, not chassis). Running one end to the chassis through a capacitor is the next best bet.

To determine what kind of performance the rf tube is delivering, lift the tube and stick one lead of a 5-μμf capacitor in the plate terminal. If the set has series-string heaters plug in a piece of wire in place of the heater pins. Holding the other end of the capacitor or attaching it to the antenna will sometimes give such results that you wonder why they put the tube there in the first place.

Continuing through the tuner, move your little 5-μμf capacitor to the grid of the mixer. Do this by wrapping a turn around the grid pin (be sure you get the right one) and re-inserting the tube. If the rf amplifier is operating normally, re-insert it too with the other end of the test capacitor fastened to its plate (Fig. 4).

This test will show the condition of the coupling between the rf plate and the mixer grid. If you have trouble here, you'll have to go to work looking for the open circuit. A magnifying glass will help.

The output of the mixer is coupled to the grid of the first if. Some RCA sets incorporate the first if in the tuner. One of these, a late model, uses two 6U8's. Another older model used two 6BQ7's.

Obviously, the mixer must get plate voltage and, if it has a screen, it must get screen voltage too. The element being used for the oscillator plate must have voltage, too, making as many as three hot spots on the oscillator–mixer tube.

A cascode rf amplifier will also have three hot spots, but sometimes only one of these is connected to B plus. If the tube goes bad the other two spots will be dead. Also, with the tube out of the socket, you will find only one hot terminal, an item that has caused the wrecking of many a tuner.

The oscillator

About the only thing the average service technician knows about the oscillator in a tuner is that he can twist the slug and sometimes shift the frequency. Sometimes this depends on what kind of a tuner it is. On some of the continuous-wound types like RCA and others use, you often have to turn everything on it to get the frequency shifted. If one of them has been in and out of shops very much, you can shake it and hear the loose slugs rattling around.

We had one recently that someone had cut the bottom out of with a can-opener—and I didn't much blame him. Getting into one of these old-timers is worse than taking the head off an automobile motor.

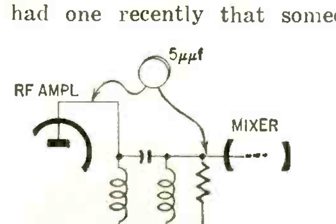


Fig. 4—A jumper made from a 5-μμf capacitor makes a quick check on coupling between the rf amplifier and the mixer.

The correct procedure, however, for adjusting oscillator slugs on continuous-wound tuners (these are the types that do not have strips) is to start with the channel 13 slug for all frequencies between it and channel 6, and then the channel 6 slug for the others. Then you can adjust the individual slugs, starting at channel 13 and working your way down to channel 2. On other tuners each coil is separate and can be adjusted in any order without affecting the other channels. But, before you start fooling around with slugs it is best to find out if that is what is needed.

Experienced men can look at the screen and listen to the rush in the speaker and tell if the oscillator is out. On most sets the screen will be snowy, especially on the low bands, and you're lucky if some of the broadcast stations or high-frequency commercials don't start bouncing in on some of the channels.

If you want to be sure that the tuner oscillator is not working, brush the dust off the signal generator and set it to a frequency about 20 mc above the frequency of the channel you want to receive. Connect it to the set's antenna lead by clipping on over the insulation. If you don't get the picture and sound, move up to 40 mc above. Some sets have 20-mc if's and others 40 mc. (This is speaking generally—the actual frequencies run from about 21 to 27 mc and 42 to 47 mc, depending on the manufacturers.)

If your oscillator puts out like mine, you will hardly have to make any connection at all. Just throw the output lead in the general direction of the set and you can get a picture.

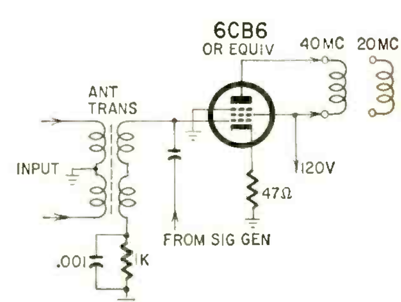


Fig. 5—A simple antenna transformer, a 6CB6, and 40-mc and 20-mc if coils make a handy test tuner. Just couple the unit to your signal generator.

This works so effectively that, when we wanted a 40-mc if signal for testing, we rigged up a 6CB6 as a mixer as shown. Using the test oscillator, we can supply a signal of virtually any frequency (Fig. 5). Your test oscillator need not be calibrated as high as you will want to go. A harmonic can usually be found even on the first band. This arrangement is also handy for determining that the tuner oscillator is way off frequency. END

By ALEX M. SCHOTZ*

2 decade type preamps

Transistor amplifiers have high-impedance input, gain of 100 and exceptionally flat frequency response

These transistor preamplifiers have a voltage gain of 100, flat frequency response from 5 cycles to 50 kc, down 2 db at 100 kc. Output is a minimum of 1 volt rms before clipping. Input impedance of the first preamp is about 30.000 ohms; output impedance 500 ohms. The second preamplifier's input impedance is more than 500,000 ohms and its output impedance also 500 ohms. They can be used to match a high-impedance microphone to the phono input of an amplifier, or to extend the range of an ac voltmeter or scope.

To get a fairly high input impedance, the input transistor in both amplifiers is used in a common-collector circuit. In this configuration, input impedance is governed primarily by the emitter load divided by $1 - \alpha$ of the particular transistor selected. However, the transistor selected must have a substantially lower I_{co} than the operational base-bias current or temperature variations may cause it to operate in the cutoff region.

The 500-ohm output impedance permits long leads between the preamp and main power amplifier with little loss in voltage transfer and frequency response. With a low-impedance output, noise pickup between the preamp and final amplifier is minimized.

In the first circuit (Fig. 1), V1 and V2 are connected in a compound common-emitter configuration, often referred to as a Super-Alpha†. V2 acts as a common leg of V1 and provides negative feedback which maintains the gain of the composite circuit. The input resistance also is much larger than that of a single common-emitter stage because V1 operates as an emitter follower whose load is V2. The approximate input resistance for this circuit is calculated by multiplying V1's beta by V2's beta by the size of the unbypassed emitter resistance R4 ($R_{IN} \approx \beta_1 \times \beta_2 \times R_E$). The beta for a 2N44 is 25. Therefore, the approximate input resistance is $25 \times 25 \times 50 = 31,250$ ohms.

Voltage gain for the composite circuit is 10+. The output from V2's collector is coupled through dc blocking capacitor C3 to V3's base. V3 is operated in a common-emitter circuit which further amplifies the signal. Resistance in V3's collector circuit was selected so the output impedance would be 500 ohms. V3's gain is stabilized by R8, an unbypassed resistor at the emitter. This local degenerative feedback also improves the frequency response. Total voltage gain of the preamplifier is more than 110×. By adjusting FEEDBACK control R3, the gain can be set at 100×. At other settings of R3, the amplifier frequency response and input impedance can be increased, but only at the sacrifice of gain. The circuit draws 10 ma.

A second preamp

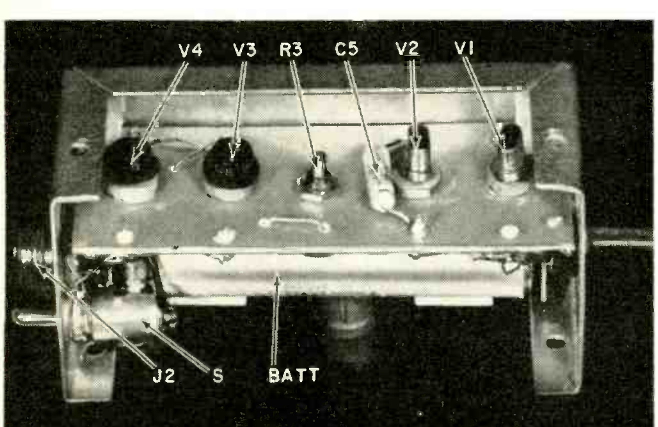
The input stage of the second preamplifier (Fig. 2) consists of transistors V1 and V2 connected in a compound common-collector configuration. Compared with the first preamp, input impedance is increased tenfold. However, in a common-collector configura-

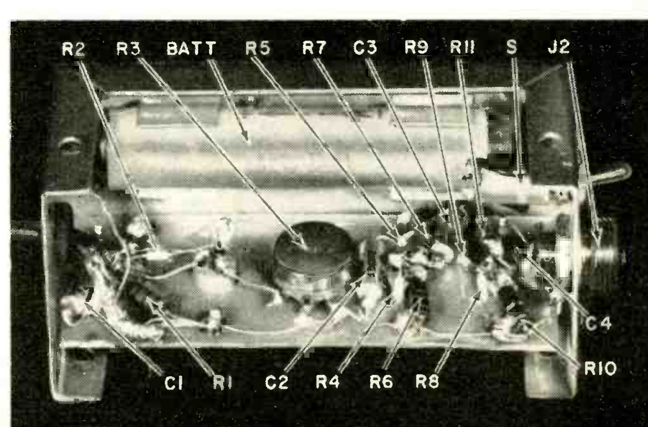
BENCH TESTED

One of the editors tested the preamp (the four-transistor unit described in this article). It could be set to give a voltage gain of 100 over the entire audio range, meeting the author's specifications. Careful construction of the input stage as stressed by the author is essential to low-noise operation.

*Outboard Marine Research Center, Milwaukee, Wis.

†Alan R. Pearlman, "Some Properties and Circuit Applications of Super-Alpha Composite Transistors," *IRE Transactions on Electron Devices*, January 1955, pp. 25–43.





Two views of the transistor amplifier of Fig. 2.

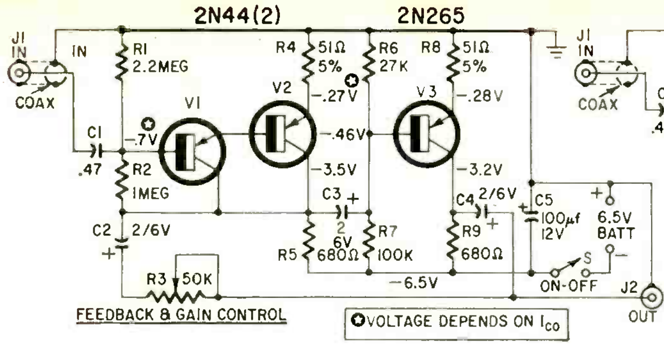


Fig. 1—This 3-transistor preamp has input impedance of 30,000 ohms.

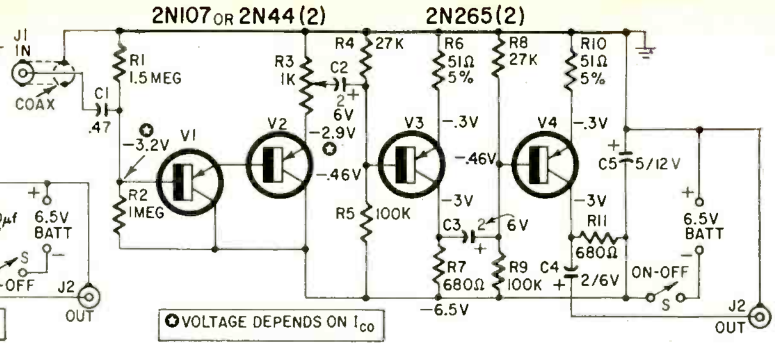


Fig. 2—More elaborate unit has 500,000-ohm input impedance and 4 transistor stages.

tion, the voltage gain is less than one. To get the same amount of amplification as for the first preamp, an additional transistor stage is needed. The amount of gain is set by adjusting R3.

A still higher input impedance is possible; simply use silicon transistors, which have a much lower I_{co}. Silicon transistors usually cost more than germanium types. Unless the application warrants the added expense, germanium transistors will do.

Both amplifiers are extremely stable and can be used as decade amplifiers. A 20% voltage variation in the power supply causes less than 5% change in the amplification of either one, although a mercury battery is suggested as the power source.

With the exception of the input transistor, any transistor with similar characteristics may be used with the same results. It may be necessary, however, to change the bias resistors so that center voltage appears at the collectors of the amplifying transistors. These resistors are R6 and R7 in Fig. 1, and R4, R5, R8, R9 in Fig. 2.

PARTS LIST FOR FIG. 1

R1—2.2 megohms
R2—1 megohm
R3—pot, 50,000 ohms
R4, R8—51 ohms, 5%
R5, R9—680 ohms
R6—27,000 ohms
R7—100,000 ohms
All resistors 1/10 watt or higher
C1—0.47 µf, 10 volts
C2, C3, C4—2 µf, 6 volts, miniature electrolytic
C5—100 µf, 12 volts, miniature electrolytic
BATT—6.5 volts, mercury (Mallory TR-135 or equivalent)
J1—coax connector, cable type (Amphenol 75-PC1F)
J2—coax connector, chassis type (Amphenol 75-PC1M)
S—spst, toggle
V1, V2—2N44
V3—2N265
Battery holder
Transistor sockets (3)
Case, 4 x 2¼ x ⅝ inches
Bakelite sheet, 3⅞ x 1½ x 1/16 inch
Miscellaneous hardware

The noise figure can be reduced by using low-noise resistors, but this would increase the cost. In the prototype, composition resistors were used and the noise measured with an audio voltmeter, the input shorted out and the controls set for maximum gain. It was −67 db for the first and −61 db for the second type of amplifier.

Be extremely careful wiring the input stage of either preamp. Input leads should be coax and all leads to the input transistor must be kept as short as possible.

PARTS LIST FOR FIG. 2

R1—1.5 megohms
R2—1 megohm
R3—pot, 1,000 ohms
R4, R8—27,000 ohms
R5, R9—100,000 ohms
R6, R10—51 ohms, 5%
R7, R11—680 ohms
All resistors 1/10 watt or higher
C1—0.47 µf, 10 volts
C2, C3, C4—2 µf, 6 volts, miniature electrolytic
C5—5 µf, 12 volts, miniature electrolytic
BATT—6.5 volts, mercury (Mallory TR-135 or equivalent)
J1—coax connector, cable type (Amphenol 75-PC1F)
J2—coax connector, chassis type (Amphenol 75-PC1M)
S—spst, toggle
V1, V2—2N44, 2N107
V3, V4—2N265
Battery holder
Transistor sockets (4)
Case, 4 x 2¼ x 1⅝ inches
Bakelite sheet, 3⅞ x 1½ x 1/16 inch
Miscellaneous hardware

Both preamps can be constructed on a printed-circuit board with very little rearrangement of the parts.

If sensitivity is more important than stability and frequency response, shunt the emitter resistors of the amplifying transistors with large capacitors to increase the overall gain. **END**

Remember?

By GEORGE J. RUPP

Remember the manufacturer who installed the picture tube in such a manner that it was impossible to remove it without removing the chassis first. So what? Well, it was almost impossible to remove the chassis without removing the picture tube! I wonder how they ever got them together at the factory? Which came first . . . the chassis or the picture tube?

Remember the Zenith "cement mixer" tuner? In 13 years we have seen only one that required service, but what were they trying to do anyway?

Remember the Bendix without a horizontal oscillator? Its circuit is in the diagram. Notice that the screen is bypassed through the power supply filter. If this filter develops high power factor, the screen will no longer be by-passed for 15,700-kc pulses and the oscillator will not oscillate! The remedy is to bypass the screen with a .05-µf, 1-kv capacitor. I have seen this repair last for years.

Remember the Capehart that had two if's connected in series?

Remember the G-E's that had a surge arrester long before any other set?

Remember the set you had to take the front molding off to remove the chassis? And it was almost impossible to replace the molding.

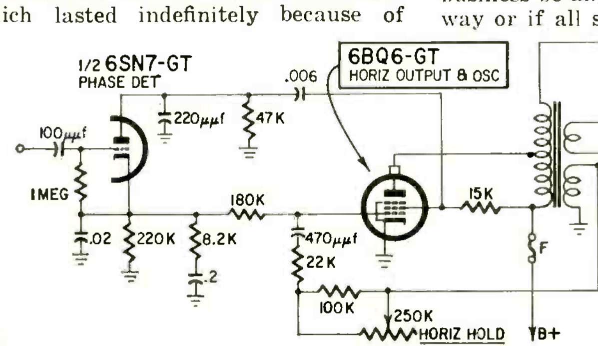
Remember the DuMont's, Crosley's, Capehart's and Stromberg-Carlson's with those continuous tuners which also covered the FM band? Many of these are still around today.

Remember the Stromberg-Carlson's that used a 6AL5 to trigger a relay for delayed B-plus? This feature, if combined with a fan to circulate air around the chassis, would help make any good set last almost a lifetime.

Remember Philco's 7-volt loctal tubes which lasted indefinitely because of their high design center? They were originally used in auto receivers where the voltage fluctuates over a wide range.

Remember the Bendix that had both a dc video amplifier and a dc audio amplifier? Needless to say, these sets had excellent video and audio-frequency response. But when the vertical oscillator would quit, the vertical amplifier would draw excessive current and burn up a resistor. Where was the resistor? In the high-voltage cage! (Nice and easy to get to if you were in the know!)

There were many other miscarriages and good features which I am sure that you could add to the list. Would this business be any fun if it were any other way or if all sets were alike? **END**



No separate horizontal oscillator tube in this old Bendix.

TV Sound Interrupter Has Only Four Parts

Sensitive device uses no tubes or transistors—permits you to silence the TV when the phone rings or to cut out unwanted announcements

By ELLIOTT A. McCREADY

Some years ago RADIO-ELECTRONICS described a "wireless sound silencer" operated by the chairside reading lamp. Turning on the lamp turned off the TV sound, and vice versa. This sound interrupter works the same way, and takes advantage of high-performance components not available at that time. The result is a unit sensitive to small variations in light that does not need a tube or transistor amplifier. A grand total of only four components (photocell, relay, potentiometer with switch, battery makes this unit a snap to build and practically foolproof in operation.

The components are merely wired in series, what could be simpler? An increase in room lighting lets more current from a battery flow through a photocell, closing a relay and opening the voice-coil circuit at the TV receiver. Decreasing room lighting reverses the procedure.

A Clairex type CL-4 cadmium selenide photocell is the heart of the sound interrupter. It is not a self-generating photocell, but one whose resistance changes with varying light intensities. Nearly a perfect insulator in total darkness, the resistance of the CL-4 drops to a few hundred ohms in sunlight.

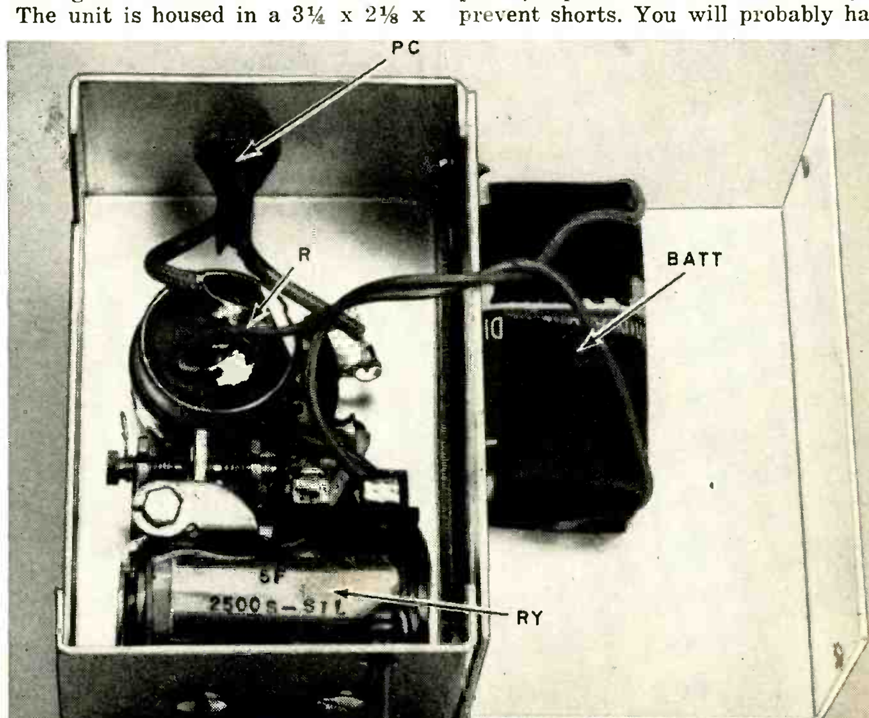
A Sigma 5F relay with a 2,500-ohm coil and 5-milliwatt sensitivity is adjusted to pull in between 500 and 600 μa and drop out at between 400 and 500 μa. This may appear to be stretching the capabilities of the relay somewhat, but actually it is not. I have succeeded in adjusting this relay so it will pull in at 400 μa! (An excellent article on relay adjustment appeared in the November, 1958, issue of RADIO-ELECTRONICS.)

A 50,000-ohm potentiometer is used to adjust the sensitivity for optimum operation under different conditions of ambient room lighting.

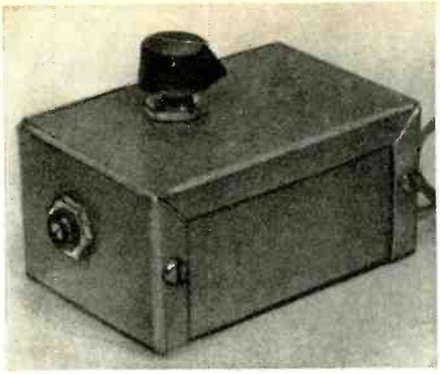
A closed-circuit jack in the voice-coil circuit of the television receiver lets you remove the unit, if desired, without affecting TV sound.

The unit is housed in a 3¼ x 2⅛ x 1⅝-inch aluminum chassis box. As this case is just large enough to accommodate all the components, plan carefully and consult the photos before you start work.

Cement the photocell inside a ⅜-inch threaded control grommet and mount as shown. Cement the hearing-aid battery to the unflanged portion of the chassis and, after wiring is completed, tape the ends of the battery to prevent shorts. You will probably have



Parts arrangement inside the unit.

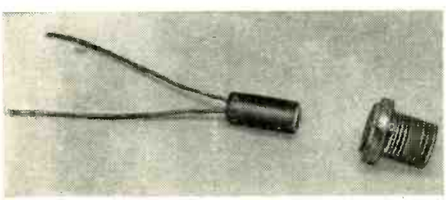


The completed unit, ready to use.

to bend the lugs of both relay and potentiometer to make room for the battery. Be careful when assembling the chassis or the battery wire may foul the relay armature!

After the unit is wired and assembled, cement four triangular felt pads to the base of the chassis to avoid scratching the TV cabinet.

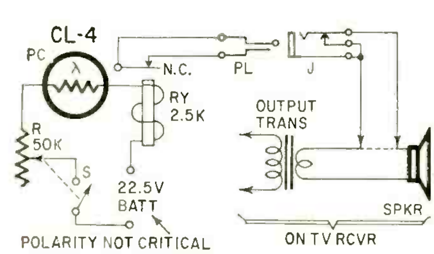
For best results use the commercial killer at night with normal ambient room lighting. An ordinary table lamp will not provide enough light differen-



The CL-4 photocell and its mounting.

tial to trigger the unit properly if the room is flooded with sunlight.

Place the unit on top of the television receiver, connect it up, and aim it in the general direction of the control lamp. Turn both the control lamp and the instrument on and advance the SENSITIVITY control to the point where the TV sound just cuts off. Now, when the control lamp is switched off, TV sound will return. A shaded lamp containing a 100-watt bulb will insure satisfactory operation at a distance of 12 feet (with other room lights operating normally). END



Circuit of the TV sound interrupter.

R—potentiometer, 50,000 ohms, with spst switch
BATT—22.5 volts (Burgess U-15 or equivalent)
J—miniature closed-circuit phone jack
PL—miniature phone plug
PC—Clairex CL-4 photocell
RY—5 mw, 2,500-ohm coil (Sigma 5F-2500-S/SIL or equivalent)
S—spst on R
Chassis box, $3^{1}/_{4}$ x $2^{1}/_{8}$ or $1^{5}/_{8}$ inches
Miscellaneous hardware

DX SHORT-WAVE FORECAST

for August

By STANLEY LEINWOLL*

TYPICAL SUMMERTIME SHORT-WAVE PROPAGATION CONDITIONS ARE EXPECTED TO continue in August. During the daylight hours, the greatest number of long-distance openings are expected in the 15-mc broadcast band, with conditions reaching a peak during the late afternoon and early evening.

At night and during the early morning hours, the 9- and 11-mc bands are expected to be best for reception of distant stations.

The tables show the optimum short-wave broadcast band, in megacycles, for short-wave 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 own location, reads down the left side to the region he wishes to hear, then follows the line to the right till he is under the figure showing the nearest time. (Time is given at the tops of the columns in your local standard time, in 2-hour intervals from midnight to 10 pm.) The figure in the intersecting square is the short-wave band (in megacycles) nearest to the optimum working frequency.

For example, a listener in the Eastern USA would be most likely to receive broadcasts in the 9-mc broadcast band from Western Europe at midnight, while the 15-mc band would be best at noon, Eastern Standard Time.

The tables are designed to serve primarily as a general guide, since day-to-day variations in receiving conditions can be large.

At certain hours, propagation over some of the paths given in the tables is impossible or extremely difficult (for example from Western USA to West Europe) with reception questionable. If an opening does occur, however, it is most likely to be in the bands shown.

*Radio Frequency and Propagation Manager, RADIO FREE EUROPE

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	9	7	7	11	11	11	15	15	17	17	15	11
East Europe	9	7	9	11	11	11	15	15	15	11	11	9
Northern Latin America	15	11	11	15	15	15	15	15	15	15	15	15
Southern Latin America	15	11	9	9	15	15	15	15	15	15	15	15
Near East	9	7	9	11	11	11	15	15	15	15	11	11
North Africa	9	7	9	11	11	11	15	15	17	17	15	11
South & Central Africa	7	9	9	15	15	15	15	15	11	9	7	7
Far East	11	9	9	9	11	11	11	11	15	15	15	11
Australia & New Zealand	11	11	11	9	9	9	7	15	17	17	17	17
CENTRAL US to:												
West Europe	9	7	9	11	11	11	15	15	15	11	11	9
East Europe	9	9	9	11	11	11	15	15	11	11	11	11
Northern Latin America	11	7	9	15	15	15	15	15	15	15	15	11
Southern Latin America	11	9	9	15	15	15	15	15	15	15	15	15
Near East	9	9	11	11	11	11	15	15	15	11	11	11
North Africa	9	7	7	11	11	15	15	15	15	15	11	9
South & Central Africa	9	9	11	15	15	15	15	15	17	17	11	11
Far East	11	9	7	7	11	11	11	15	15	15	15	17
Australia & New Zealand	11	11	9	9	7	7	11	21	21	21	21	17
WESTERN US to:												
West Europe	9	9	9	11	11	11	15	15	15	11	11	11
East Europe	9	9	9	11	11	11	15	11	11	11	11	11
Northern Latin America	9	9	9	11	15	15	15	15	15	15	15	11
Southern Latin America	11	9	9	15	15	15	15	15	15	15	15	15
North Africa	9	7	9	11	11	11	15	15	15	11	11	11
South & Central Africa	9	7	9	15	15	15	15	11	9	7	6	9
Far East	11	11	9	9	11	15	15	15	15	15	15	17
South Asia	9	9	9	9	11	15	15	15	15	15	15	17
Australia & New Zealand	11	15	11	9	7	9	17	21	21	21	21	15

Make auto radio installations quiet installations

STOP NOISE IN MOBILE RADIOS

By WAYNE LEMONS

SINCE the beginning of car radio, noise has been annoying—both for user and technician. Eliminating all noise is seldom easy. It's dismaying to find that two apparently identical cars have entirely different noise characteristics. Citizens-band and FM car radios add to the problems. Therefore, if you expect to become proficient at eliminating ignition noise, generator hash and other types of interference, you must be able to isolate the source of the noise in the most direct manner. There is no substitute for experience but, for experience to be of value, some basic knowledge of the noise sources is essential.

Roughly, noise can be divided into five categories: ignition noise; generator and regulator hash; wheel noise; noise created by accessories, such as gas and oil gauges, and the type that has become a problem only since the advent of the transistor set—low-tension noise. The last, which resembles ignition noise, is amplified by the transistor stages since they are biased directly from the 12-volt A-supply.

Let's discuss each of these noise types and effective elimination procedures.

Ignition noise

Ignition noise appears as a popping sound that speeds up and slows down with changes in engine speed. It enters the radio through the antenna system or through the A-supply. Even when it enters by the A-supply route, it is generally radiated into the set's input stage. Most technicians disconnect the antenna to determine whether the noise is entering by that path. But this can give a false indication. Even though the noise is entering through the A-supply, pulling the antenna lead-in may lower the noise considerably.

Why? Well, take a look at Fig. 1, a typical auto radio input circuit. Capacitor C represents the inherent capacitance of the antenna cable. Note that it forms a part of the capacitance to resonate L1. Removing this capacitance by pulling the antenna lead-in detunes the input stage drastically. This lowers the radio's sensitivity, and noise that is entering otherwise than through the antenna may be appreciably reduced.

A much better method is to provide a dummy antenna (Fig. 2). It is a standard lead-in plug with an 82-$\mu\mu$f capacitor connected from the center terminal to the shell. This capacitance closely simulates that of the removed antenna lead-in and restores the sensitivity of the input stage.

Pull the lead-in and replace it with the dummy antenna. If you find the noise is almost, if not entirely, eliminated, you can reasonably assume that it is entering through the antenna system. If the noise is not reduced, bypassing the low-tension wiring is necessary.

Checking the antenna system

If the system is new, check for proper grounding of the lead-in shield at the car body. Such things as undercoating, dirt or rust can keep the shield from making a low-resistance ground. Checking with an ohmmeter is *not* enough. A ground connection that will pass considerable current without noticeable loss may not be a good rf ground! Noise in the vicinity of the engine is extreme; radio amplification is high. Noise currents creating microvolt drops can cause severe noise interference in a radio! **Grounding must be absolute!**

If the antenna system is not new, the same precautions apply, only more so! In practice, you'll find that 50% to 75% of the noise that develops in existing radio installations is caused by a defective antenna system! If the antenna appears to be in good mechanical condition, try tightening the mounting nut to reduce noise. If this doesn't help, measure the resistance from the mast to the car body. It should read infinity on an R × 100,000 ohms scale. Any resistance reading indicates that moisture or dirt has penetrated the antenna insulating material. It is usually more economical to replace the antenna than repair it. Special types, though, that can be disassembled, will respond to treatment. Most of the common cleaning solutions will clean the insulator and eliminate any leakage.

A substitute antenna makes a dramatic demonstration for your customer. But you must make a good ground to the car body with the lead-in shield at the antenna end. Also readjust the antenna compensating trimmer on the radio or it may appear to have less sensitivity. Some technicians solder a length of braid with a battery clip on one end to the antenna shield so they can make a low-resistance ground to the car body with ease. The test antenna must, of course, extend outside the car body.

Remember, it is most important to check the antenna system for defects when noise is a problem. **No other suppression measure will satisfactorily eliminate noise if the antenna system is defective!**

If there is noise after the antenna is eliminated as a source of trouble, install a suppressor in series with the high-tension (center) lead to the distributor. This suppressor should be inserted as close to the distributor as possible. There are suppressors that plug directly into the distributor but the general type in use today requires that the lead to the center post of the distributor be cut and the suppressor inserted. These suppressors are screwed onto the wire ends and usually eliminate the last traces of noise except in stubborn cases. Spark-plug suppressors may also be used or suppressor-type spark plugs that have a suppressor resistance built in. Some cars have a radio type wiring harness. A resistance is built into each lead going to the distributor. Don't be lulled into believing these won't give trouble! One of the most difficult noise problems we ever encountered was when one of these wires developed a spark gap at the terminal. This created more noise than anything could suppress!

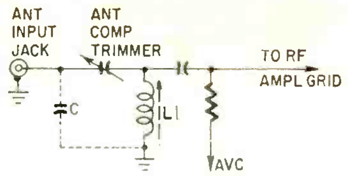


Fig. 1—Typical auto radio input circuit.

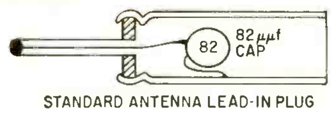


Fig. 2—Dummy antenna.

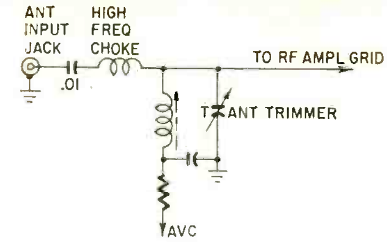


Fig. 3—A choke is inserted in series with the antenna lead.

Built-in noise suppression

Briefly, we'd like to cover some of the built-in radio design features that tend to suppress noise in the modern radio. Though these components do not often fail—they are sometimes removed because they neither help nor hinder reception when the radio is playing on the bench. The circuit in Fig. 3 shows a choke inserted in series with the antenna lead. Physically this choke is about 30 or 40 turns of fine wire on a ¼-inch form. Its purpose? The answer may not be obvious—but it helps eliminate motor noise. How? By acting as a choke at short-wave frequencies.

But, you may ask, why bother about noise at short-wave frequencies in broadcast-band radios? First, noise generally has to be amplified by the entire radio to be objectionable. This means that it must be introduced near the front end. There is very little selectivity at the front end, so noise, at any frequency, is impressed on the first grid with considerable intensity. The noise will brute-force its way through the radio because of the considerable amplification it gets in the first stages.

Second, any sharp pulses of noise may shock-excite a resonant circuit into oscillation. Such shock excitation appears as modulation at the pulse or noise rate and will be reproduced in the radio's output. So it is important to maintain high selectivity in the front end of a car radio and to attenuate high-frequency pulses when necessary.

An example of a selective input is the Motorola model CRA60X. Fig. 4 is a bandpass circuit. Coils L1 and L2 are not impedance-coupled. They are at opposite ends of the tuning mechanism. The only coupling between the resonant circuits of L1 and L2 is C1, a .002-μf capacitor. A simplified circuit (Fig. 5) clarifies this coupling arrangement. Note that C1 is common to the resonant circuits of both L1 and L2. If the circuits track, the impedance matching is perfect even though it's low impedance, and there is a maximum transfer of energy. Frequencies not at resonance will be effectively bypassed by C1's low reactance.

Other built-in noise suppressors are the so-called spark plates. These are capacitors formed by insulating a fairly large piece of metal from the chassis with fiberboard. These capacitors are more effective in bypassing spark noises because they are lower impedance. Sometimes they short out. Usually they can be replaced with an ordinary mica or ceramic capacitor of about 500 μμf. Leads, though, should be kept short and grounding should be to the outer case of the radio rather than to some arbitrary point on the chassis.

Other noise sources

Now back to other noise sources. Noise is often reradiated by A-supply wiring that proceeds from the engine compartment through the firewall and passes near the radio. Connecting a 0.5-μf capacitor from this wire to ground will usually strip it of all noise.

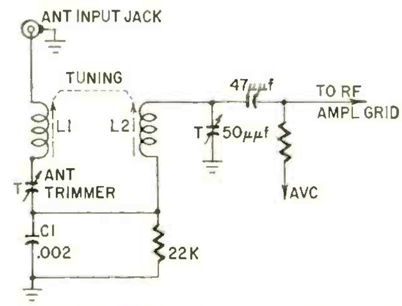


Fig. 4—Motorola bandpass input circuit.

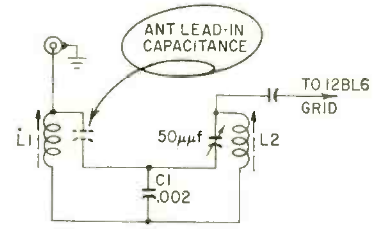


Fig. 5—Simplified bandpass circuit.

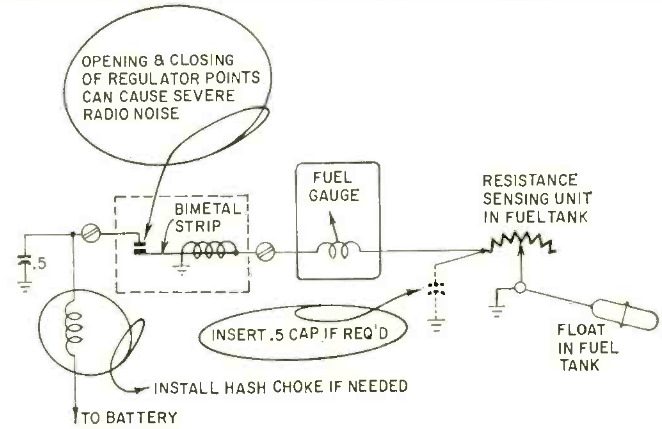


Fig. 6—How capacitor and hash choke can be used to eliminate noise caused by fuel gauge voltage regulator.

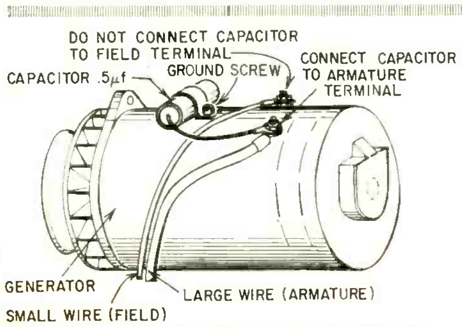


Fig. 7—Connecting bypass capacitor to generator.

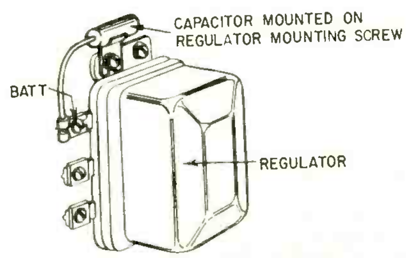


Fig. 8—Bypass-capacitor mounting on voltage regulator.

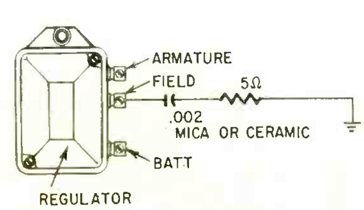


Fig. 9—Generator regulator field-terminal suppressor network for high frequencies.

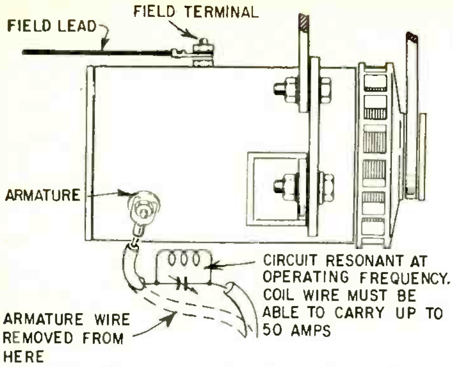


Fig. 10—Resonant circuit used to eliminate generator whirring. No bypass capacitors are used.

You can find the best place by using a test capacitor from a terminal on the wire to the nearest ground. Metal rods which go through the firewall may carry noise. Grounding them to the firewall in the engine compartment is the best remedy.

Most noise sources can be eliminated by connecting a capacitor from the battery supply lead of the device to ground right at the device causing the noise, including directional signals, oil gauges, horns, ignition coils, etc.

Another source of noise in recent makes of cars, especially Fords, is the regulating unit used to hold constant the voltage going to the fuel gauge (Fig. 6). Jarring the dash may cause this noise, and radio trouble will be suspected. To check, disconnect the battery lead to the regulating device. To eliminate the noise, connect a capacitor from the battery terminal on the device to the nearest ground. Stubborn cases may require a hash choke made from several turns of No. 12 or 14 wire. They are found in the A-supply of all vibrator type radios. You can no doubt salvage one for use in this application. Connect as in Fig. 6, as close to the regulating device as possible.

Generator and regulator noise

A 0.5-μf metal-encased capacitor should be connected from the armature terminal to ground. It will bypass any noise that might develop. Generator noise is recognized by its whirring sound. Do not connect a capacitor to the field terminal of the generator (Fig. 7). Occasionally it is necessary also to bypass the armature terminal at the regulator. Mounting may be as in Fig. 8. Be sure the regulator is grounded by a braid if it is mounted on rubber. Connecting a capacitor to the field terminal of the regulator will cause damage to the regulator contacts and should not be attempted except as explained in the high-frequency noise-suppression data in this article.

Low-tension noise

Important only in radios having a transistor output stage, low-tension noise enters through the A-supply and resembles ignition noise. It is recognized because it continues even with the radio volume turned down. The simplest cure for this is to connect a 500- to 1,000-μf 25-volt capacitor from the A-supply line to ground. It can be a radio fault. The A-supply line is bypassed inside the radio by high-value electrolytics and one may have opened. However, if a capacitor on the A-line will eliminate it—it is probably better than pulling the radio.

Wheel and tire static

Wheel static and tire static sound alike and are often intermittent. To test for wheel static, drive the car until the noise starts. Then turn off the ignition. If the noise persists, touch the brakes lightly. Wheel noise usually disappears when the brakes are applied. Tire noise, on the other hand, is not affected by the brakes. To test for tire static, drive through a puddle of water or wash the tires. Tire static is temporarily eliminated when the tires are wet.

Wheel static is always developed by the front wheels. A collector ring (available at most radio supply houses) installed between the hub cap and the axle will bypass these static discharges. A special kit is necessary to eliminate tire static. It consists of a powder that is blown into the tire as it is inflated.

High-frequency suppression

Since the coming of Citizens-band radio and FM car radios there is more need for noise suppression at high frequencies. Amateur mobile operators have been fighting this problem for years but only recently has the average technician become concerned.

High-frequency suppression techniques vary even more from car to car than broadcast radio. It is usually best to do a complete job on every car. Otherwise the car owner may find when he hits a bump that he has noise; maybe another bump will make it disappear.

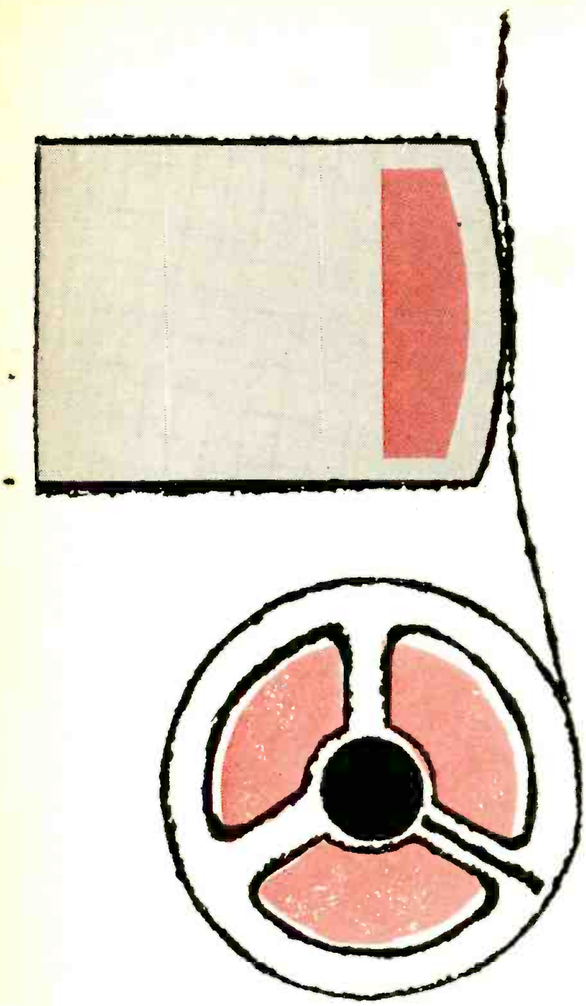
Bonding is important at high frequencies. We prefer copper straps from 1 to 2 inches wide rather than braid. Install them from the engine to the firewall and from engine to car frame. Install a strap from the negative battery terminal to the regulator case or mounting screw and also from the negative battery terminal to the car body. Make these bonds as short as possible but leave enough slack for normal movement. Make sure there is good bonding from the engine to the firewall. Bond any other metal parts which you suspect might not make a perfect ground.

Special feedthrough capacitors are available for insertion in series with the armature wire on the generator or regulator.

The regulator may also cause intermittent bursts of noise that can be eliminated only by bypassing the field terminal. If this is necessary, use a .002-μf capacitor, either mica or ceramic, in series with a noninductive, 5-ohms 1-watt carbon resistor (Fig. 9). This unit is available from Motorola; order part No. 1V80700A89.

Sometimes your best efforts will not take out all the whirring noise created by the generator at high frequencies. If this happens, it can be greatly reduced by installing a parallel-resonant circuit, tuned to the operating frequency, in series with the armature lead to the generator (Fig. 10). The wire or tubing forming the coil must be capable of carrying up to 50 amperes without overheating. It's a good idea to mount the unit in a metal box but it often isn't necessary. Do make sure that the connections are tight. An open-circuited generator will burn up! With the engine and radio running, adjust the trimmer for minimum noise. You can set the resonant circuit initially using a grid-dip meter, and then just a touchup will be all that is necessary when the unit is installed. *Remove any bypass capacitors from the generator when installing a resonant trap of this kind.*

Whatever the source of noise, there is always a cure. It can be an interesting challenge or one of the most frustrating experiences, especially if you're in a hurry. Usually, we find it best to try and sell a complete noise-suppression job—using all the techniques covered in this story—and we do sell it more often than not! END



ALL ABOUT TAPE RECORDERS

PART IV—SWITCHING—ELECTRONIC AND MECHANICAL

By JACK DARR
SERVICE EDITOR

Well, we still have a bit of the electrical section left over, despite our promise last month. We've still got the switching, both electrical and mechanical, to work over.

With the exception of stereo types, a tape recorder has only one amplifier, and it is used for both playback and recording. This requires transposing input and output whenever the record–playback switch is actuated, giving us some complicated-looking switching at times (Fig. 1). However, it isn't as complicated as it seems if you break the switch down into sections. Just remember what each section does and you won't have any trouble tracing it out.

On modern schematics, the sections of the switch are scattered all over the place (Fig. 2). This makes the diagram simpler and a lot easier to read. Each section is usually numbered or lettered and the contacts are also numbered, as seen in Figs. 1 and 2, to show that they are all part of the same switch. The moving part of the switch is one long piece of insulation, actuated by the inevitable cam or pushbutton.

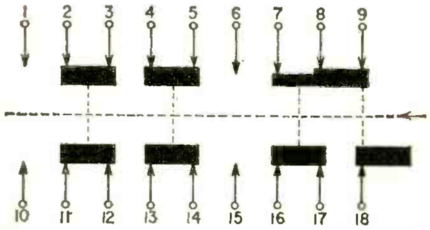


Fig. 1—Typical multi-section switch used in tape recorders. Sliders are mounted on long piece of insulation and operated by an arm or cam.

The multideck rotary wafer switch isn't used too much. Right now, I can't think of a modern tape recorder that has such a switch, although there must be some. The more popular makes use the slide switch shown. This is all to the good since sliders are a lot easier to service and check than multideck rotaries! A cam actuates them, with a heavy return spring to pull the slider back into place. Rest position is always playback, with the switch being pulled or pushed into the recording position by a cam.

In pushbutton-controlled recorders, a safety button prevents the record switch from being accidentally depressed unless the safety button is pushed at the same time. This engages the arm that moves the switch, and the machine is switched for recording. This keeps the operator from accidentally erasing a prerecorded tape while trying to play it.

These switches can be cleaned with standard spray-can contact cleaners. Spray on liberally and work well into the switch with a soft brush. Operate the switch several times while spraying. When clean, wipe off all excess cleaner, using a paper towel or very soft rag. Be very careful not to bend any switch contacts.

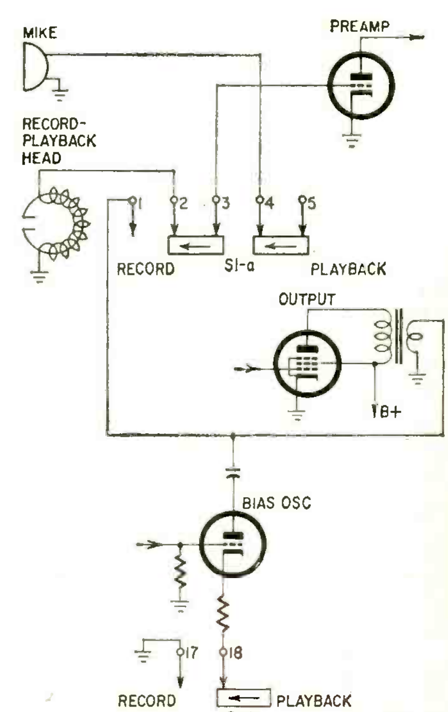


Fig. 2—Switch sections will be found all over the schematic, usually close to the circuit in which they work.

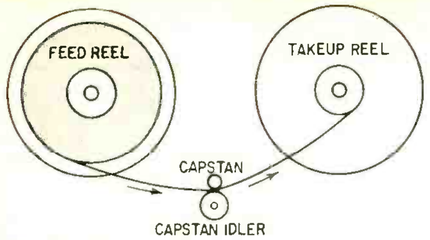


Fig. 3—Basic parts of a tape transport.

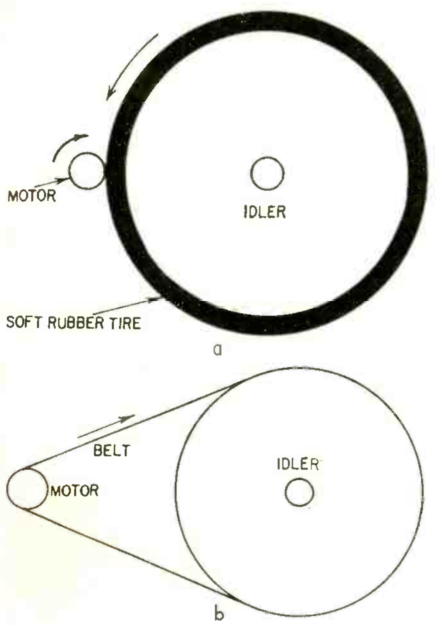


Fig. 4—Idler drive used in tape recorders.—Basic belt drive.

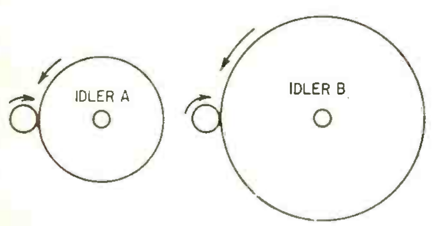


Fig. 5—With same motor rpm's, idler rpm is determined by ratio of idler diameter to motor-shaft diameter.

Tape transport and drive

Now we come to the hardest part of tape-recorder servicing—the tape transport or driving mechanism.

Fundamentally, this is simple. All it has to do is pull the tape past the recording head at a precise speed, and rewind the excess on the other side. Sounds easy! It's just like record changers. All they have to do is turn a record and change it for another, but they can sure come up with some unholy hunks of machinery to do it! Same thing with tape recorders; you'll find some of the most unusual-looking things under that little plastic cover!

Let's get down a few basic facts before we start on the details. Fig. 3 shows the basic parts of a tape-transport mechanism—the supply reel, sometimes known as the feed reel, the capstan and the takeup reel. The capstan is sometimes on the end of the motor shaft and sometimes it is a large drum driven by the motor (with the small shaft shown on top). The large drum types always have a fairly heavy flywheel arrangement to keep speed constant.

The tape is held against the capstan by the capstan idler, a rubber-faced roller. We've left out such essentials as the tape-guides, pressure pads and stuff, for clarity.

Because there has been (and is) some confusion about the exact functions of these parts, let's spell them out. Only the *capstan* has anything to do with the tape-speed! (If the feed reel drags, it can slow down the tape, but it can't make it run faster!) The takeup and feed-reel drives have nothing to do with it. Their only purpose is to take up the tape and release it as needed. So unless there is a definite defect such as a dragging brake, don't look in these places for troubles originating in tape speed.

In single-speed machines the capstan is often the end of the motor shaft. In two- or three-speed machines this isn't possible because it's pretty difficult and expensive to build a motor like that, so some other way of changing speed is necessary.

Drive methods

There are three ways to drive a tape-transport mechanism. First and probably most popular is the simple idler drive. It is exactly the same as that used on most record-player motors (Fig. 4-a). A small metal shaft on the end of the motor contacts a rubber-tired wheel. The idler drives the reels, and by the use of another idler in contact with the first, other mechanisms. Second is the belt drive (Fig. 4-b). The belts are made of either fabric, impregnated with rubber for better grip, or solid rubber. The remaining method is a direct gear drive, which we won't bother to illustrate since, to my knowledge, no commercial (home type) recorders use it.

Many tape machines use a combination drive: the idler or idlers are driven by the motor, in turn driving belts.

Speed changing

With the advent of two- and even three-speed recorders, drive design underwent a radical change. It was no longer possible to use a simple shaft on the end of a motor to drive a single idler. Some method for varying tape-recorder speed had to be found.

If we hold the shaft of a rotating motor against the rim of an idler, the speed of the idler is determined by the ratio of the diameters of the two (Fig. 5). If the motors are turning at the same speed, idler A is going to run faster than idler B, because it would take the motor more revolutions to get all the way around the larger circumference of B. This holds true no matter which of the diameters we change. So to make an arrangement capable of different speeds, we use the same main idler to drive the mechanism, and alter the speed by changing the diameter of the driving shaft. (It's simpler!)

This is done with a step pulley (Fig. 6). (It isn't really a pulley!) This is a shaft that has two or three steps of different diameters. With a mechanical arrangement that will slide this step-drive up and down, we can place any step against the idler, changing the ratio and the speed. Incidentally, this does not have to be on the motor shaft. It can be an idler, to avoid mechanical complications. In fact, most applications like this drive the step idler with a belt or idler on the step-idler shaft, mounted below the step. Professional machines and some of the older home types (mostly the two-speed jobs) had a nice simple speed change. The driving capstan is removed and another

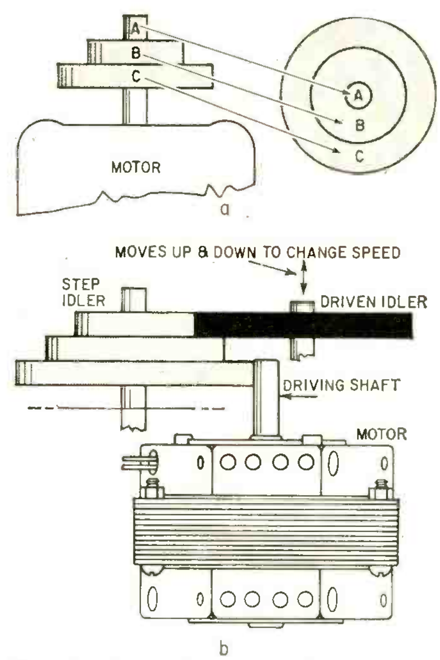


Fig. 6—Step idler is used to change speed by changing ratio of driving-shaft diameter to idler diameter.

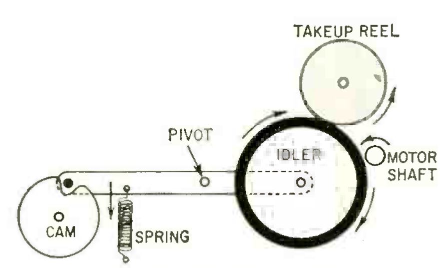


Fig. 7—Simple straight actuating arm driven by a cam.

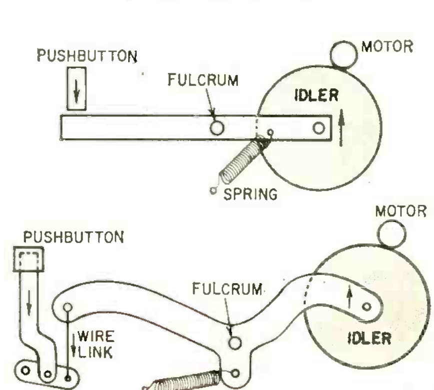


Fig. 8—Straight arm and bent arm have identical functions.

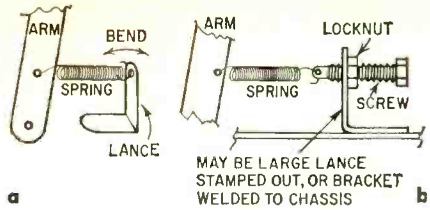


Fig. 9—Two methods of adjusting spring tension.

capstan of a different diameter is slipped over the shaft! (We might mention here that the diameter of the capstan idler, the small roller that holds the tape against the capstan, has absolutely nothing to do with the tape speed!)

Arms, levers, linkages

Now we're coming to something that isn't too common in electronic apparatus—mechanical levers, arms and assorted linkages. You might call these things mechanical switches, for they do the same thing that a switch does in electrical circuits—change the function of parts. You're going to see a lot of them, and some will be pretty weird-looking. However, if you'll only remember what they're supposed to *do*, they'll be simple.

For example, take an actuating arm. This is a straight piece of metal with a pivot somewhere along its length (Fig. 7). What does it do? It moves something! For instance, if we put an idler on one end, we can use the arm to push the idler against the drive drum of a reel, holding it against a motor shaft or another driven idler at the same time; so, the reel turns.

Now look at Fig. 8. At the top is our straight arm; below, a weird-looking hunk of metal. Both do the same thing! The lower arm simply looks more like a typical unit found in a modern tape recorder. The unusual shape allows the central part of the arm to clear some other part of the machinery. You'll find this in almost every commercial tape recorder. An actuating arm is seldom a simple straight piece of metal. It may assume some very weird shape, but always remember that it can be replaced (in theory) by a straight arm! Just check each one for what it does and don't let the shape confuse you!

Each arm has a single function all its own. For instance, one moves the pressure pad in and out against the recording head. Another moves the drive idler against the takeup reel, and so on. So don't let the apparent complexity of the system throw you. Just check the machine very carefully and find out what it isn't doing. Then, locate the cam, arm and lever associated with that part of the machine, and there's your trouble!

Let's say that a tape recorder works fine, except that it won't rewind the tape. We go directly to the drive mechanism on the feed reel (which must drive this reel backward to rewind). We check the drive idler, arm, cam, and whatever other parts are associated with this one function only. The trouble must be somewhere in that section.

One more typical characteristic of these machines deserves mention. In no case that I can think of is the arm or lever actuated directly by the pushbutton or cam. Notice the springs shown in Figs. 7 and 8? They do the work! When the cam is moved into operating position, we might say, the spring pulls the arm so the idler is forced against or away from the drive wheel or whatever we want it to do. Therefore, the action depends on the proper spring tension to a great extent. In most cases this tension is adjustable. Unfortunately, it isn't in all tape recorders so we sometimes have to make corrections.

Standard practice for adjusting spring tension involves fastening the end of the spring to a tongue of metal stamped up out of the chassis or bedplate of the machine, called a lance. It can be bent back and forth to change the spring tension, but bend it carefully! If you break one off, it's an awful job to solder another one onto the chassis, because there isn't any room in most machines.

This lance is shown in Fig. 9. In the better machines, an adjustment screw and locknut are provided (Fig. 9-b). However, for economy, most machines you'll find will use the simple lance.

Most of the springs are quite similar to the dial-cord springs used on radios. It's a good idea to pick up a couple of envelopes of assorted dial springs at your distributor's display the next time you're there. This will give you an assortment of springs of different sizes and there will usually be a suitable spring somewhere in the package.

In many cases, a little more tension may be added to the original spring by clipping off two or three turns at one end and forming another loop. If you need more tension and the lance is bent as far back as it will go, remove the spring, bend the lance back to mid-position (easy now!) and clip the spring off. If there is room, another spring can often be added in parallel with the original to get the tension just right.

One word of caution: Most troubles which appear to be caused by weak springs are often traced to lack of lubrication causing bearings to drag, drive slippage, bent or binding arms or levers, or something like that. Clean up all of these possible trouble spots before going too deeply into spring tension.

Professional recorders usually have very special requirements as to spring tension. Kits of exact-duplicate springs are available at parts houses for most of these machines and should be used whenever repairs are made on them. Their speed-regulation requirements are much more exacting than the home tape machines, so use the exact-duplicate parts.

That winds things up for this installment. See you next time, when we'll go a little deeper into the mechanical jungle under the modern home-type tape recorder. TO BE CONTINUED

FCC Cracks Down on TV Owners

Two owners of television sets have been summoned by the FCC to appear at a hearing and "show cause why they should not cease and desist" from causing interference to nearby radios. This is believed to be the first time the FCC has found it necessary to take action against a TV viewer.

According to the FCC, Miss Nellie Feaster, of Maysville, W.Va., a shut-in, initially complained that three neighbors had TV sets which radiated signals that disrupted the radio reception upon which she depended for recreation. This was verified, the commission added, by FCC field engineers.

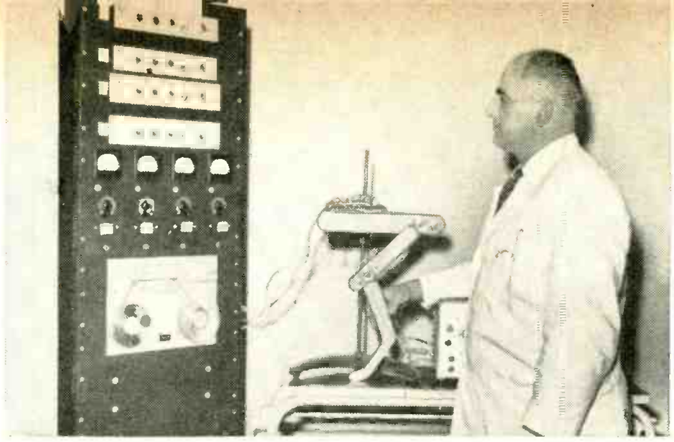
One set owner took corrective action after two letters of warning from the commission. The other two never replied and the FCC took what it called "more compelling action."

Those ordered to appear at the hearing were identified by the FCC as Charles Funkhouser and Emory Feaster. The commission said its action was based on Section 15.69 of the FCC rules, which states:

"The operator of a radio [or television] receiver, regardless of tuning range, date of manufacture, or of certification, which causes harmful interference shall promptly take steps to eliminate the harmful interference."

TV and FM receivers and tuners made after Dec. 31, 1957, are required to have a seal stating that they meet the radiation limit requirements. Operation of a set manufactured after Dec. 31, 1957, which does not have the noninterference seal or label attached is prohibited.

Because we were able to obtain the highly topical story "Special Report on FM Stereo" (page 57) at the last minute, Joe Marshall's "Practical Hi-Fi FM Alignment," which was scheduled for the space, had to be held over. It will definitely appear in the September issue.



Dr. Kantrowitz operates the simulator to program a tape.

TO WALK AGAIN

Electronic signals make paralyzed legs walk again

By LARRY STECKLER
ASSOCIATE EDITOR

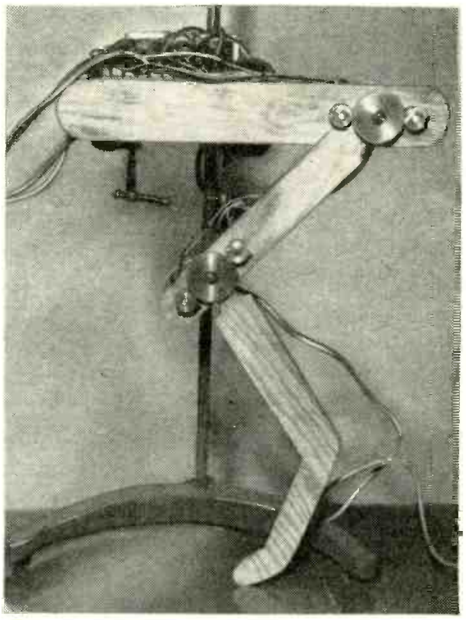


Fig. 1—Simulator used to program tape that controls muscle movements.

Can the paralyzed legs of a paraplegic walk again? It may one day become possible. The man or woman paralyzed from the waist down may again resume normal everyday activities. But this "miracle" takes a skillful blending of medical and electronic skills.

PARALYZED LEGS ARE OFTEN CAUSED BY A break in nerve passages, usually along a spinal cord that has been damaged or severed. The leg muscles are not injured and would operate normally if the messages from the brain that tell them what to do could get through. It is much like having two perfectly good telephones (one the brain, the other the leg muscles) whose connecting wire has been cut, making them useless for communications.

Dr. Adrian Kantrowitz, together with René Khafif of Maimonides Hospital, Brooklyn, N. Y., is performing preliminary research in this field. He feels that it may be possible to put the paraplegic back on his feet. So far he has successfully used electronic equipment in a dog's leg to move that leg in a basic walking motion.

But there is a long road between stimulating 4 muscles to get the basic movements of a dog's leg, and the 40 muscles needed for normal walking by a man. It is a start in the right direction and may, at some future date, restore the ability to walk to people whose legs are paralyzed. The same techniques might also restore the use of other paralyzed muscles.

Dr. Kantrowitz proposes an electronic source of signals—a multiple-channel tape recorder to replace the brain. Each channel on the tape feeds an electronic signal directly to an appropriate muscle, causing it to contract, thus moving the leg. The trick is to get the right muscles to act at the right time.

Using the present system, a leg-motion simulator is used to control the signals (program) (Fig. 1) which must be prerecorded. This unit is moved manually in a walking motion. As it is moved, gears at the knee and hip joints vary the resistance of four potentiometers. Through these potentiometers is fed a special pulse signal at a 60-cycle rate.

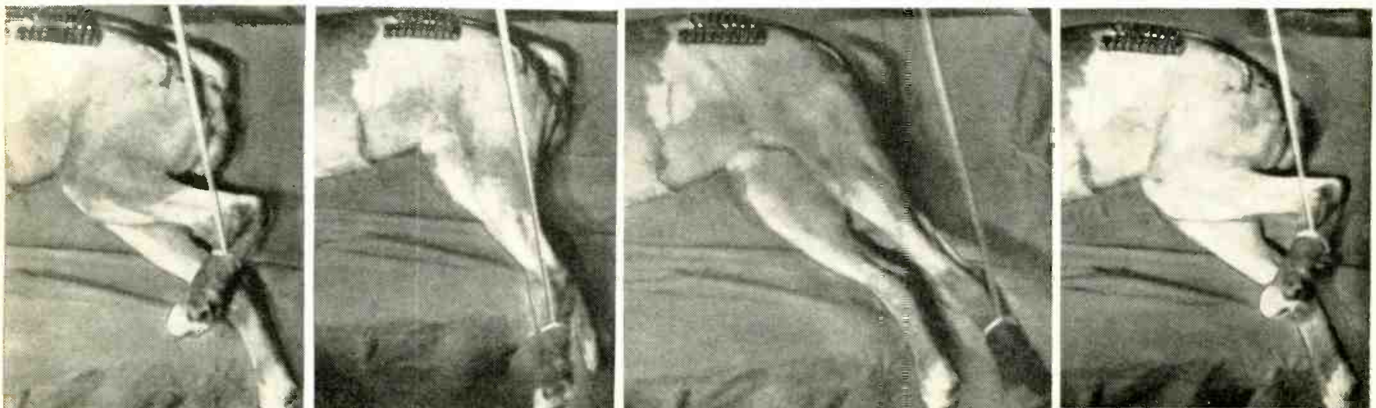


Fig. 2—These basic movements of a dog's legs are produced by the signals from the tape recorder.

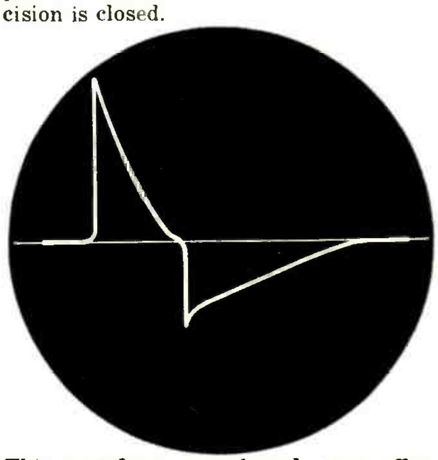
The pots vary the amplitude of this signal according to their resistance setting.

A typical pulse is shown at the end of the article. Note that positive and negative portions look different, but total area is the same. This pulse at a 60-cycle rate was found to be the most effective one for stimulating the leg muscles.

A separate signal is fed to each potentiometer of the simulator, and the resulting signals are recorded simultaneously on a four-track tape. The head photo shows Dr. Kantrowitz using the stimulator to produce the necessary signals.

A standard four-channel Viking tape recorder is used along with four Viking record and playback amplifiers. Only the tape-head connections were modified so the recorder would record all four channels simultaneously.

Once the tape has been programmed, it is time for the doctor to go to work, so let's move to the hospital surgery. A dog's leg is temporarily paralyzed with a local anesthetic. Then special electrodes are connected to the nerves that control two flexor and extendor muscle pairs in the hip and knee. Next the incision is closed.



This waveform was found most effective for stimulating leg mucles.

Later, the free ends of the electrode leads are connected to the proper channel outputs of the tap recorder (the leg is still paralyzed). Now the recorder is turned on and the signal, which was recorded earlier (the one produced by the simulator) is played back to these nerves. The dog's leg moves in a walking motion. The leg makes four basic moves. They are all shown in Fig. 2.

This is as far as work has progressed. What is needed to make the system practical? Subminiature tape recorders for a start. Battery stimulators, better surgical techniques and a thousand other things. Yet even when the needed tiny 40-channel tape recorder is ready, there is still a long way to go. An automatic guidance system will be a must. If the user starts to fall, the system must automatically correct for it and bring the body equilibrium back to normal. A miniature power source—possible atomic or solar batteries—is also needed. So there is still a long, long way to go, but the first steps have already been taken and perhaps the following ones will progress a little faster. END

WHAT'S YOUR EQ?

We've been swamped! Each day the post office delivers so much mail for our EQ column that we've had trouble keeping up with it. We're happy to learn so many of our readers are interested in the puzzles, but we just won't be able to answer any individual letters. We will publish any interesting solutions we receive.

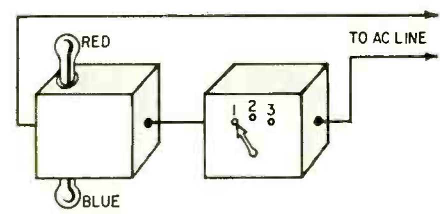
Our black box problem this month is a little different, it has two black boxes instead of one. And the TV stinker is a little more difficult than usual.

Send us more problems on the engineering level—we have plenty of TV and general ones. $10 and up will be paid for each one accepted. Write to EQ Editor, RADIO-ELECTRONICS, 154 West 14th St., New York 11, N. Y.

Answers to July puzzles are on page 75. Answers to this month's puzzles appear next month.

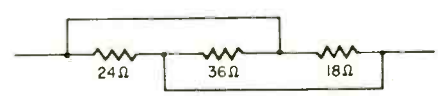
A Lighting Problem

Two boxes are connected by a single wire. A lead runs from each box to an ac source. On the first box are mounted two bulbs; on the second a single-pole, three-position switch. In the first position of the switch, the red bulb glows; in the second, the blue one glows, and in the third position, both bulbs light. What is the simple circuitry in the two boxes that performs this bit of "magic"?—*Charles B. Randall*



Resistor Mixup

This apparently simple problem in resistance becomes more confusing as you study it. Find the effective resistance of this circuit.—*Fred W. Blakeley*

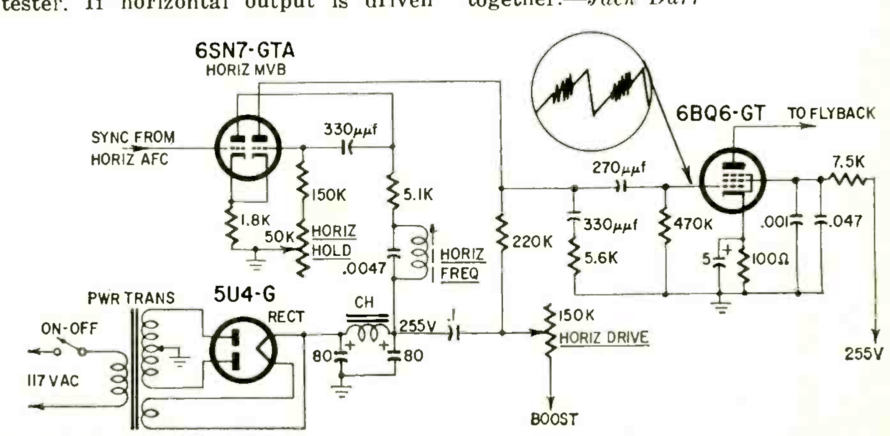


Yuletide Effect

Symptoms: Horizontal oscillator in a Truetone 2D1235A squegged, and made "Christmas trees" all over the place. No high voltage at all. Tubes and all parts OK.

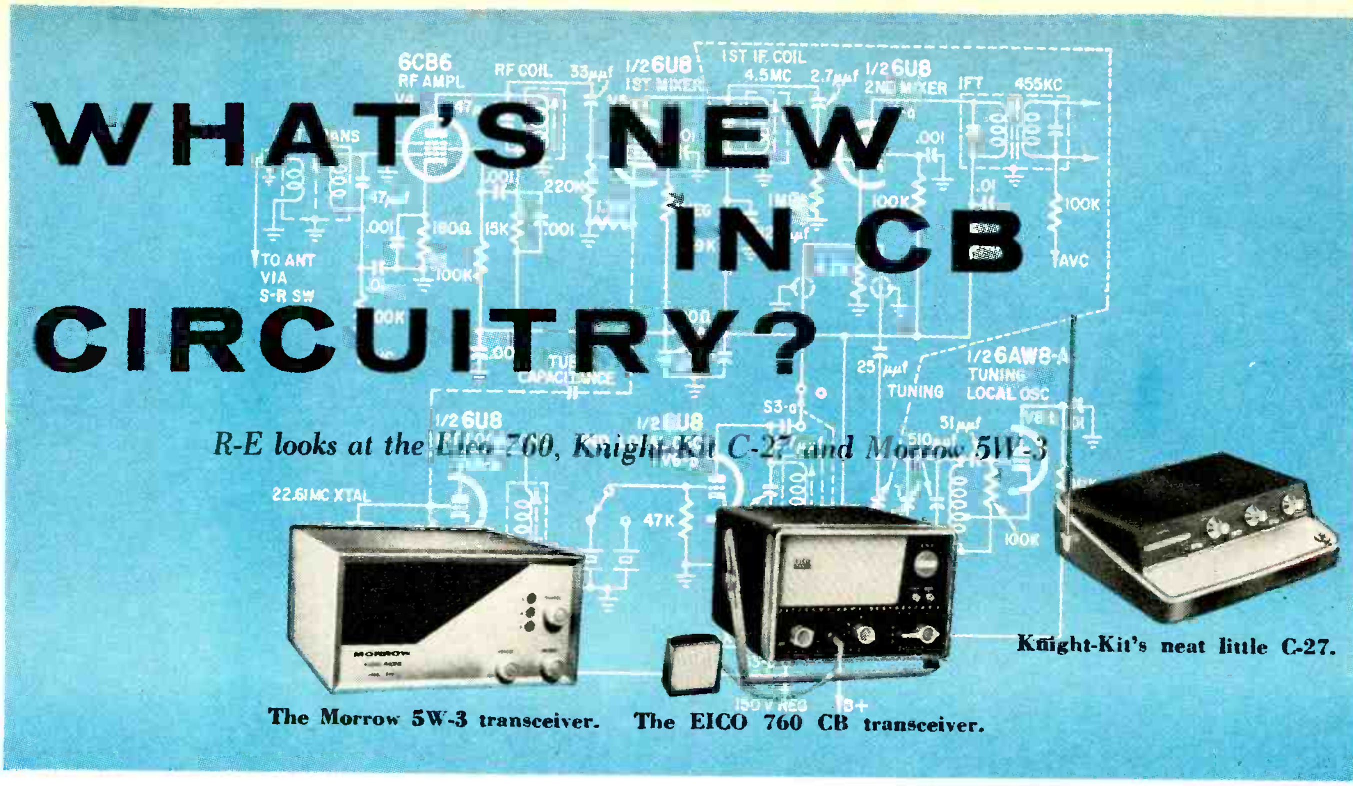
Clues: If horizontal oscillator coupling capacitor is disconnected from horizontal output stage, output stage can be driven to full output, plenty of high voltage and brightness, by using external horizontal drive pulse from tester. If horizontal output is driven in this way to bring boost voltage up, horizontal oscillator then puts out perfectly shaped, locked-in-sync waveform. If the two are re-connected, waveform at horizontal output tube grid looks like drawing—almost as if a color burst were being added to the slope of the waveform—and whole thing won't work.

Hint: The oscillator and output stages will work separately and all parts are good, but the two won't work together.—*Jack Darr*



WHAT'S NEW IN CB CIRCUITRY?

R-E looks at the Eico 760, Knight-Kit C-27 and Morrow 5W-3



The Morrow 5W-3 transceiver. The EICO 760 CB transceiver. Knight-Kit's neat little C-27.

By ROBERT F. SCOTT
TECHNICAL EDITOR

The number of CB licensees is increasing by several thousands each month, and transceiver manufacturers are hard at work developing new and improved circuitry to cope with conditions on the crowded band. Receiver sensitivity, selectivity and noise figure are constantly being improved, power supply drain is being reduced and transmit–receive switching is being simplified to minimize malfunctions and simplify servicing. This month we are going to take a look at the complete circuit of one of the popular Eico transceivers and a few circuit innovations in other models.

Eico 760 series

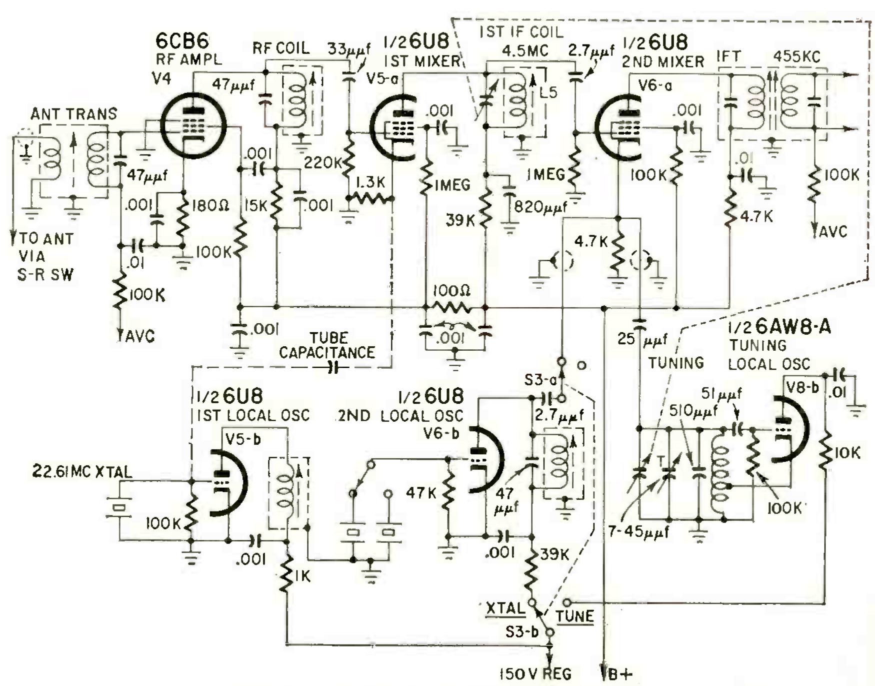
These transceivers, supplied as a kit or factory-wired, are available in three models. The 760 is for use as a base station operating from 117-volt 60-cycle power lines. The 761 and 762 have dual power supplies that permit them to be used in base-station and mobile installations: the 761 operates from 117 volts ac and 6 volts dc; the 762 from 117 volts ac and 12 volts dc.

The 760 series transceiver is a compact unit 6 inches high, 8½ inches wide and 9 inches deep. Two antenna jacks are supplied. The one on the rear apron is used for a separate antenna of any type. The other, adapted for either front-panel or top mounting, is for direct-mounting a portable type base-loaded whip.

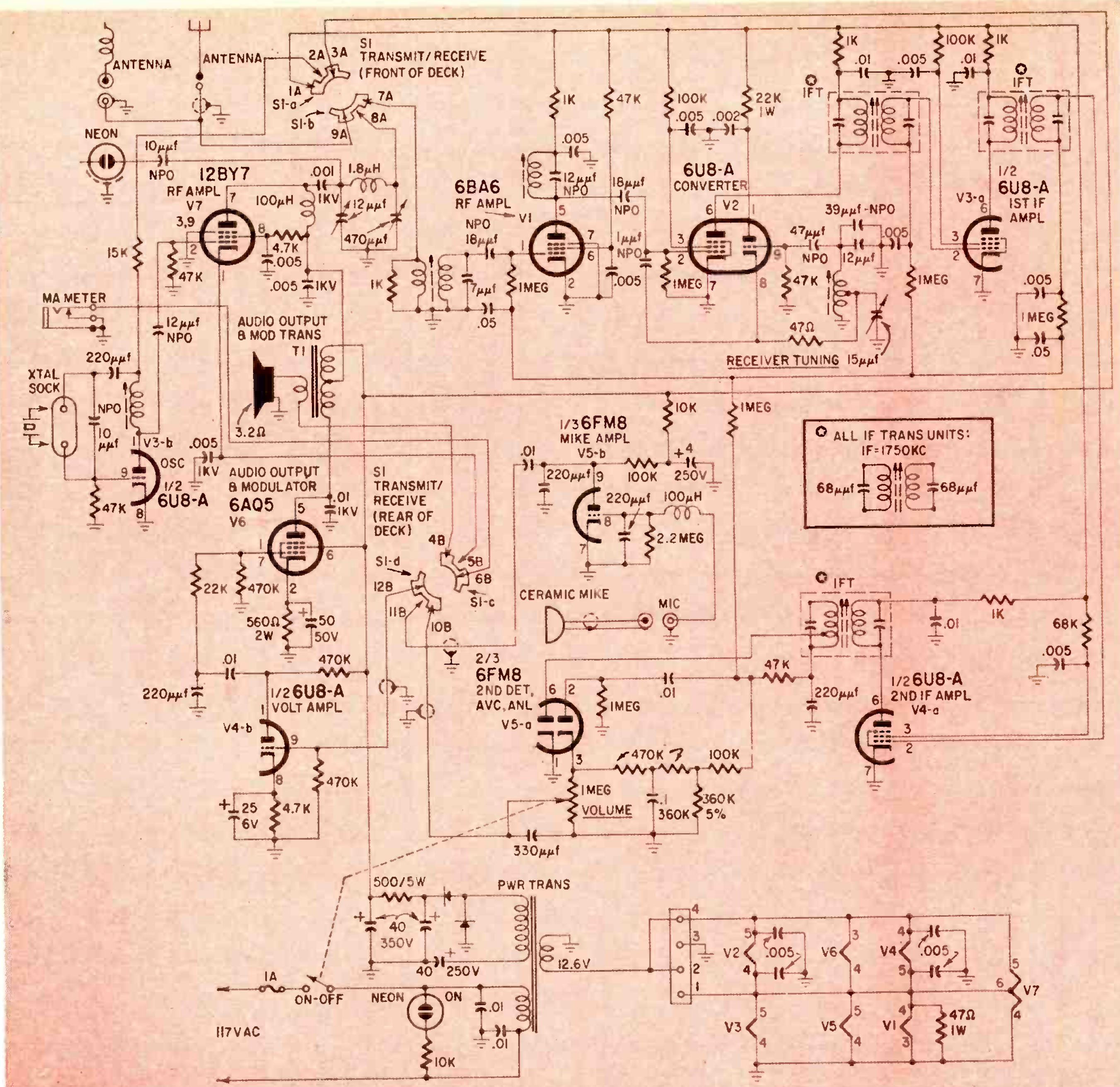
The transmitter operates on any one of the 23 class-D CB channels with a third-overtone crystal. The receiver is a single-conversion superhet tunable to any channel from the front panel. The kit is supplied with the transmitter amplifier and oscillator circuits prewired, tuned and covered by a shield that is fastened in place by sealed nuts. Color-coded heater, B-plus and rf leads are brought out for switching.

The circuit of the 760 is shown on the next page. It is a single-conversion superhet with 6BA6 rf amplifier, 6U8-A converter, one 6U8-A pentode section as a 1750-kc if amplifier, the diode sections of a 6FM8 as second detector, avc and series type noise limiter. The detector output feeds a two-stage audio system consisting of the triode half of a 6U8-A as voltage amplifier and a 6AQ5 audio output stage and modulator.

The transmitter's rf circuits consist of a crystal oscillator (V3-b) capacitance-coupled to the 12BY7 rf amplifier. When the send–receive switch (S1) is in the TRANSMIT position, section S1-b connects the antenna to the tuning network in the plate circuit of the 12BY7, S1-a switches B-plus from the receiver's rf and if circuits to the transmitting oscillator. S1-c opens the secondary of T1, the audio output and modulation transformer, and grounds the rf power amplifier cathode through the meter jack. S1-d disconnects the grid of the voltage amplifier (V4-b) from the receiving volume control and connects it to the output of microphone amplifier V5-b. The 100-μh rf choke and the two 220-μμf capacitors at V5-



Front end of the Knight-Kit CB-27.



Complete circuit of the Eico 760 transceiver.

b's grid and plate prevent feedback due to stray rf that may be picked up on the mike and its cable.

Knight-Kit C-27

The receiver in Allied Radio's model C-27 Knight-Kit transceiver is a double-conversion superhet that gives the operator a choice of receiving on two preselected crystal-controlled channels or manual tuning of any one of the 23 CB channels. The circuit of the C-27's front end is at the left. Incoming signals in the range of 26.965 mc (channel 1) to 27.255 mc (channel 23) are amplified by the 6CB6 and fed to the grid of the first mixer (V5-a). The first crystal oscillator operates at 22.61 mc. Its signal is fed to V5-a's cathode and heterodynes these signals down to the first if range of 4.355 to 4.645 mc. (Each channel carrier produces a first if signal equal to the difference between the channel's frequency and 22.61 mc.) These first if signals appear at the plate of the first mixer and at the grid of second mixer V6-a.

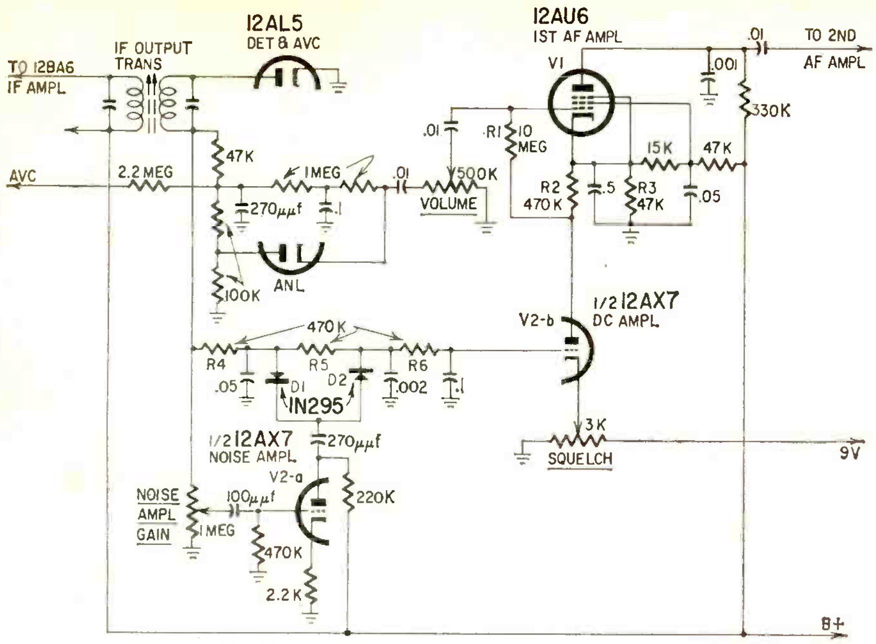
V6-a's cathode is coupled to the plate of the crystal-controlled second oscillator (V6-b) or the grid of the manual tuning oscillator (V8-b) through S3, the XTAL-TUNE selector switch. V6-b's crystals are matched to those in the transmitter so the desired incoming signal is heterodyned to 455 kc in V6-a's plate circuit. When S3 is in the TUNE position, the first if coil (L5) is tuned to the first if of the desired channel and oscillator V8-b is tuned to a frequency that produces the 455-kc second if.

Noise-immune squelch

Squelch circuits that mute the receiver when no carrier is on the channel are used in many CB transceivers. However, most squelch circuits open on impulse type noises produced by electric motors, lightning, electric signs and other sources of electrical interference. In the September 1960 issue, we described the noise-immune squelch in the Vocaline ED-27. Now, we'll take a look at the noise-immune squelch in the Morrow 5W-3 on the next page.

The squelch circuit consists of V1, V2 and diodes D1 and D2. The first af amplifier (V1) has R1 and R2 connected in series between its grid and cathode. The cathode is supplied with fixed bias applied to the top of R3. V2-b is a dc amplifier with R2 as its plate load resistor. When V2-b conducts, it develops enough voltage drop across R2 to cut off V1 and mute the receiver. Thus, V2-b must be cut off whenever a signal is coming in.

This is done by returning V2-b's grid to the avc line through R4, R5 and R6. Incoming signals develop a negative voltage that biases V2-b to



Noise-immune squelch circuit used in the Morrow 5W-3.

cutoff. The SQUELCH control in V2-b's cathode circuit sets the squelch level.

Up to this point, the circuit is conventional. Any noise strong enough to develop enough avc voltage opens the squelch and the noise is heard in the speaker. To make the squelch immune to noise, Morrow has added noise amplifier V2-a and diodes D1 and D2. When the receiver picks up noise, V2-a amplifies it and feeds it to D1 and D2 connected with reverse polarity across R5. The rectified noise voltages oppose the avc voltage and prevent the dc amplifier from cutting off. This keeps the 12AU6 cut off so the receiver is muted. The noise amplifier does not operate on normal signals because voice frequencies are greatly attenuated by the 100-$\mu\mu$f coupling capacitor in its grid circuit.

The noise amplifier gain control is a secondary squelch adjustment on the rear of the transceiver. This and the SQUELCH control require careful balancing for optimum operation. The first step is to remove the antenna and turn the NOISE–AMPL–GAIN control off or fully counterclockwise. Adjust the front-panel SQUELCH control until the receiver is just quiet. Reconnect the antenna and the squelch will open if there is any electrical interference being picked up. If there is no noise, create some with an electric drill or similar device and the squelch will open. Advance the NOISE AMPL GAIN control until the receiver is again quiet.

Manufacturers of 100-mw and 5-watt transistorized transceivers are beginning to release their diagrams for publication. We'll bring you the lowdown on some of these soon. END

2 NEW TV CIRCUITS

One simplifies the TV receiver, the other lengthens tube life

By WAYNE LEMONS

THE VERTICAL SYNC CIRCUIT USED IN THE 1961 RCA (KCS 131 and KCS 132) chassis may become "standard" since it is both simple and sensitive. The new RCA's use only a single-stage sync separator (triode section, 6AV6) (Fig. 1). The sync output of this stage is negative. The kind of vertical oscillator used can be controlled with a negative pulse to the cathode. However, cathode circuits are normally low-impedance, which would reduce the sync pulse drastically.

RCA solved the problem by returning the cathode of the oscilaltor through a diode. The sync pulse arrives when the oscillator is cut off (not conducting) and the negative sync pulse "sees" an open circuit and is impressed on the oscillator cathode without attenuation. This negative pulse "encourages" the oscillator to conduct (as would a positive pulse on the grid). When the oscillator tube tries to conduct, the cathode voltage goes highly positive. This biases the diode (the diode plate is now positive) so that it conducts and passes the oscillator tube current until the positive spike turns it off (see waveform in Fig. 1).

Note that, during the time the oscillator is conducting, the cathode circuit is low-impedance, so noise or other sync disturbance is virtually short circuited.

Fig. 2 is another innovation used in these chassis. It is a positive feedback circuit that prevents damage to the horizontal output tube should the horizontal oscillator fail. The circuit oscillates when there is no drive at the 6DQ6 grid. Some of the energy in the plate circuit is returned through C1 and R1 to the grid. The frequency of oscillation is low, and no raster is developed. But enough negative voltage is generated on the 6DQ6 grid to prevent the tube from drawing excessive current. During normal operation, network C1, R1 acts to shape the oscillator input waveform, thus eliminating the drive control previously used. END

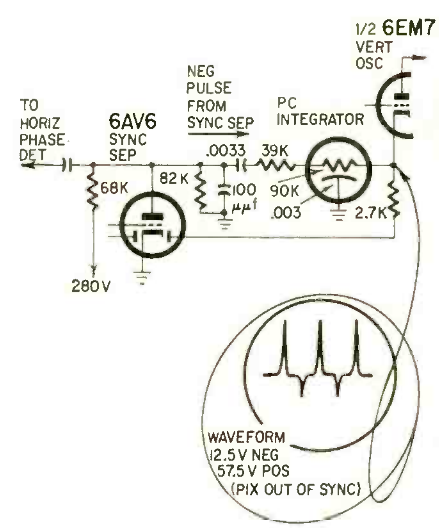


Fig. 1—Vertical sync circuit in the RCA KCS-131 and KCS-132.

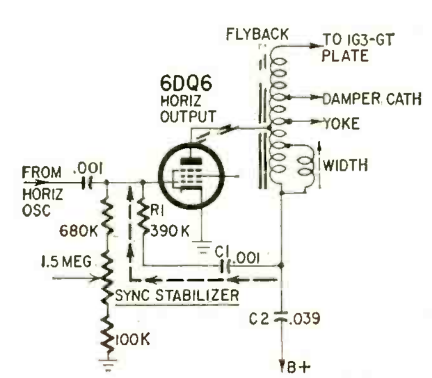


Fig. 2—Protective feedback circuit in the 1961 RCA sets.

By TOM JASKI

Relays for industrial use

Third article of a series on how relays work. How to select your relays for given applications

LAST MONTH WE WERE INTRODUCED TO the many types of relays used in industry. This installment will tell how and where relays are used and how to pick the right relay for a particular application.

Relays are the simplest on–off amplifying devices, with the greatest possible current gain in a single step. Kilowatts of power can be controlled with a few watts of control power—a "magnification" as high as 1,000 or more. This can be done electronically, with thyratrons and ignitrons. But consider the cost difference, even taking in account only the initial cost of the devices themselves.

Here is the first rule for deciding whether relays are suited for a particular application. **Where we want to control large currents with small control currents or high voltages with low control voltages, at reasonable but not extraordinary speed and with an absolute minimum of auxiliary equipment, the relay is the least expensive device with exceptionally high reliability.**

Unless the reliability requirement is high enough to require redundance (a number of controls all capable of doing the job) or environmental conditions are extreme, it is difficult to beat relay reliability. Only where the number of operations is very high, more than several hundred per hour, do nonmechanical control devices begin to show a definite advantage. For example, consider the millions of relays that reliably complete hundreds of thousands of telephone circuits a day all over the world.

Here then is the second relay application rule. **If the number of operations is moderate, relays can be used. If they are extremely high, other means must be considered.** The break-point between relays and nonmechanical devices depends on the quality of the relays and the nature of the service, which includes reliability considerations, and the initial-cost comparison between relays and other devices. Power transistors promise to make inroads on relay applications, but certainly will not replace them overnight.

Accessibility is another major consideration. If the circuit must be reliable but completely inaccessible, relays are at a disadvantage as they *do* need some maintenance from time to time. Thus for a communications satellite whirling about our planet for perhaps decades (such satellites are past the planning stage), relays must be pretty well excluded. But if the relay can be reached at all, even with some difficulty, its use is usually justified. Consider the millions of relays in aircraft control. True, specially designed relays with more than ordinary reliability are used, but they are still relays.

The next advantage of relays is that they can control simultaneously a large number of independent circuits. Relays with as many as 51 contacts are available, and each of these can control a separate circuit. Also, a relay can separate load and control circuits completely, although it is not the only digital control device that can do so (magnetic amplifiers also can). Finally, relays are not susceptible to temperature changes, and many types can operate under conditions that would preclude transistors, although giant strides have been made, thanks to missile requirements toward high-temperature operation of electronic equipment.

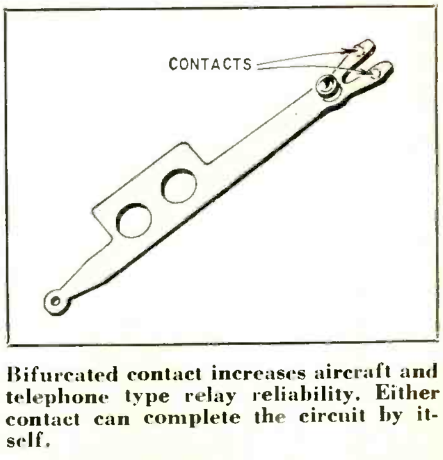
These are the basic keys to relay application. Before we go on to selection, a word or two about reliability, what it is and how it is built into relays.

Relay reliability

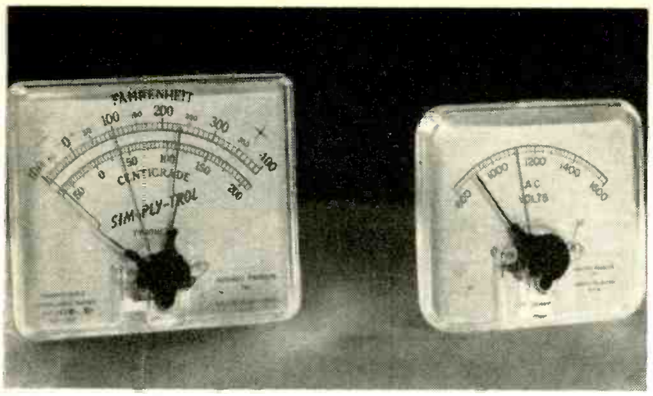
The need for reliability is most obvious in extreme examples. If a relay is used to lower the landing gear of a jet aircraft, no one will dispute the necessity of using a reliable one. If a relay controls the amount of air supplied to a blast furnace, and failure of the relay ruins hundreds of tons of steel, reliability presents no puzzle. If the control rods which keep an atomic pile from fissioning all at once are regulated by relay circuits, human life for miles around depends on relay reliability. In such extreme examples, safety is built into the circuits by using various "fail-safe" methods, to be discussed later. But still, relay reliability must remain high.

What makes a relay reliable? Chiefly attention to detail and refinements in manufacture. While stamped metal parts may be accurate enough for average use, precisely machined ones are needed for highest reliability. Normal coil insulation will do for ordinary conditions, but special coil dips must be considered for the extremes. A single contact is good enough in general, but high-reliability contacts must be "bifurcated," that is, have two contact points, each one heavy enough to carry the circuit current (see diagram). Where marginal attracting force of the armature is normally used, reliable relays are designed with much larger available force. When contact corrosion must be prevented, the ultimately reliable design encloses the contacts in a vacuum. Relays for high-altitude operation, where the air is much less of an insulator, are hermetically sealed, carrying their own atmosphere with them. Relays subjected to great shocks and vibration are designed with as rigid and as lightweight moving parts as feasible, yet with relatively great contact pressures.

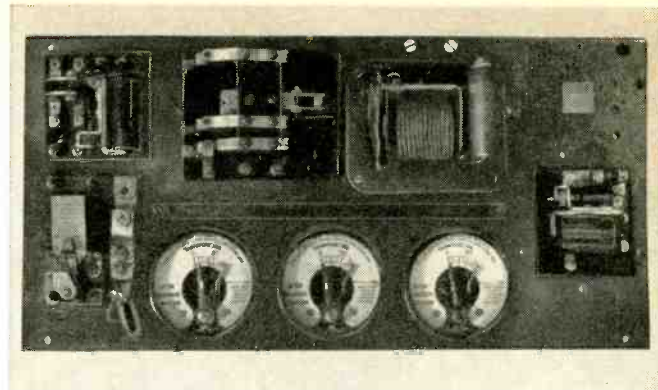
In other words, reliability is the result of careful design, precise manufacture and the use of the best materials available. This is certainly not always justified. In our mass-production technology there are many relay applications where relay failure may be annoying but cause no serious



Bifurcated contact increases aircraft and telephone type relay reliability. Either contact can complete the circuit by itself.



Modern meter relays.



Sometimes control panels are an assembly of different types of relays.

hazards, delays or loss of income. In these cases, the simplest, least expensive relay may be good enough, and many manufacturers carry special lines of inexpensive relays to satisfy such needs. Some examples of inexpensive relay construction can be found in the automotive field for the control of horns and directional signals.

Relay selection

How then do we select the relay for the particular application we have in mind? Many factors must be considered (see Table I). For any application the order of importance for these factors varies. In aircraft applications, high altitude may be the most important consideration, one seldom encountered in industry. For communications, space may be at a premium; in industry this is rarely a problem. If we define the field of application, the problems become more universal.

For industrial applications some general rules can be set up.

Delicate silver wire contacts of pipe-organ relay do not carry much current. Since many of these units are used in a single organ, they must be inexpensive.

The load to be controlled in industry generally, is the first consideration. This determines the size of the contacts, and classifies the relay as extra-heavy-duty, heavy-duty, medium-duty or light-duty. Beyond the extra-heavy-duty relays we use their larger cousins, called contactors, or even larger circuit breakers. Below light duty are the delicate meter relays, which can carry only milliamperes through their contacts.

The size and number of contacts needed pretty well fix the frame requirements, and the ampere-turns needed for the coil. The next selection to be made is the coil operating voltage and type (whether ac or dc). A wide variety is available, as shown by Table II, reproduced from the Struthers-Dunn relay catalog. With the voltage selected, the current requirements for a particular relay size are fixed.

The quality of the relay must next be considered. This is partly defined by the application, but even then there is some variety. Here the most important consideration is the spare-parts situation. If the plant is already using hundreds of relays of a particular type, that relay is preferred, since a stock of spare parts is already on hand. If it is the first relay in the plant, versatility may have to be considered. Can this relay do jobs that will come up in the future, or is it good for only this one kind of application? Relay selection seldom concerns a single item!!

What make relay should I use? This, too, involves a number of considerations. If you expect to use many relays and hope to reduce parts supplies, it may be advantageous to select a manufacturer who uses interchangeable parts in his line of relays. If the applications vary too widely, this may be an idle hope. In any case, relay selection obviously demands a knowledge of present application requirements, as well as an intelligent guess about future needs.

Special relays should never be used unless the job leaves no choice. A one-of-a-kind relay in a critical position may require 100% spare-parts stock, an uneconomical feature to say the least.

Relay characteristics are next in consideration. (For example, timing, and how the timing is to be done.) For large time delays, thermal devices or dashpots are used, with escapements running a poor third. Escapements are expensive, delicate but precise. Thermal devices are inexpensive, reliable but very rough on timing. Dashpots are somewhere in between, reasonably accurate and quite simple, but not as reliable as thermal delays. If no timing is involved, the relay speed must still be considered. If several circuits must be closed in sequence, a selection of relay closing times, which may reliably provide the sequence because of their inherent relay characteristics is available to the user. It may be the most economical way to provide sequental operation.

The sensitivity of the relay may be important. If the contact requirements are easily satisfied, control needs can be cut down by using sensitive relays, which require less coil wattage. Sensitivity must be considered in relation to reliability and initial cost. Sensitive relays are not as reliable over many operations. But if reliability is satisfied, and current requirements are not high, sensitivity may recoup high initial relay cost by lightening other parts in the control system.

Environment constitutes another important factor in industry. Safety and possible mechanical damage considerations may require installation in a special enclosure. These enclosures have

TABLE 1

FACTORS TO BE CONSIDERED IN RELAY SELECTION

Type of operation (single throw, double throw, interlocked)
Load current, phase numbers and characteristics (duty)
Control current, voltage and type (ac, dc)
Mounting (base, switchboard, panel, rack)
Type of action (clapper, solenoid, thermal, electrostrictive, etc.)
Speed of relay (slow opening, slow closing, timed or fast)
Number of operations per hour (quality of relay)
Spare parts to be stocked (existing relay stocks in plant)
Sensitivity
Special service
Enclosure (NEMA classification or Mil specs)
Vibration and shock (shockproof or shockmounting)
Altitude (hermetic sealing)
Accessibility (reliability)

Note: The order of the importance of these factors depends on the application.

TABLE II—OPERATING DATA FOR STANDARD RELAYS

112XAX RELAY				COIL DATA			
AC (60 cycles)		DC					
VOLTS	MA	VOLTS	MA	WIRE GAUGE	NO. OF TURNS	APPROX. RESIST-ANCE (DC) OHMS	APPROX. IMPEDANCE (60 CYCLES)
1.0	177.	0.08	145.	20	310	.55	6
1.4	143.	0.10	117.	21	385	.84	9
1.6	116.	0.12	95.	22	475	1.26	13
2.0	91.	0.15	73.	23	605	2.1	22
2.5	74.	0.19	60.	24	750	3.1	34
3.5	52.5	0.25	43.	25	1,050	5.8	60
4.3	41.5	0.30	33.	26	1,325	9.0	100
5.0	38.0	0.39	31.	27	1,450	12.5	130
6.0	31.5	0.49	26.	28	1,750	19.	190
8.5	23.	0.62	18.8	29	2,400	33.	370
12.0	19.	0.78	15.5	30	2,900	50.	630
13.5	15.7	0.95	12.8	31	3,500	74.	860
16.	11.8	1.30	9.7	32	4,650	129.	1,350
20.	9.65	1.60	7.9	33	5,700	197.	2,070
23.	7.65	2.00	6.3	34	7,200	312.	3,000
33.	6.00	2.50	4.9	35	9,200	504.	5,500
43.	4.66	3.20	3.8	36	11,800	840.	9,230
55.	3.85	3.90	3.15	37	14,300	1,220.	14,300
67.	2.98	4.80	2.43	38	18,500	1,995.	22,500
87.	2.25	6.40	1.84	39	24,500	3,450.	38,500
103.	1.93	8.00	1.58	40	28,500	5,050.	53,000
130.	1.53	9.70	1.25	41	36,000	7,700.	85,000
146.	1.22	11.70	1.00	42	45,000	11,700.	120,600
168.	.95	16.00	0.84	43	54,000	19,000.	177,000
225.	.74	21.00	0.61	44	74,000	34,000.	300,000

NOTE: Current and voltage values shown are minimum for standard relay adjustment. Current values are in milliamperes and ac values are based on 60-cycle alternating current.

TABLE III—RELAY SELECTION CHART

APPLICATION	DUTY	CONTROL CURRENT	TYPE	ENCLOSURE	MOUNTING	TYPE DELAY
Machine-Tool Control	h	ac	cl, sl	gp	bs	mtr
Steel Mill Control	h	ac, dc	cl, sl	df	bs	odp
Elevator Control	m	dc	cl, sl	op	swbd	odp
Transmitter Primary Ckt	m	dc	cl, sl	wp	bs	....
Pump Control	h	ac	cl, sl	wt	bs	odp
Small Motor Control	l	ac, dc	cl	gp	bs	esc
Gen. Field Protection	h	ac	cl, ind	sp, gp	swbd	mtr
Printing Press Control	h	dc	cl, sl	dt	bs	odp
Oil Burner Control	m	ac	sl	ep	bs	odp
Marine General Purpose	h	dc	cl, sl	wt	bs	esc adp
Spotweld Timer	h	ac, dc	sl	dt	bs	esc mot
Inductive Loads (transf.)	h	ac	sl	gp	bs	....
Dynamic Brakes	h	ac	sl	wp	bs	....
Chemical Process	m	ac, dc	cl, met	ep	bs	esc
Mining Machinery	h	ac	cl, sl	dt	bs	odp
Food Machinery	m	ac	cl, sl	wt	bs	esc mot
Packing Machinery	m	ac	cl	dt	bs	esc mot
Canning Machinery	h	ac, dc	cl, sl	gp	swbd	esc slug
Vending Machines	l	ac, dc	cl, tel	gp	bs	esc adp
Pin Ball Games	l	dc	cl, sl	op	bs	esc adp
Food and Drink Dispenser	l	ac, dc	cl	op	bs	esc adp
Amateur Radio Control	l	dc	tel	op	rck	slug
Novelty Displays	l	ac	cl	op	bs	esc adp
Antenna Transfer	m	dc	sl	gp	bs	....
Computers	l	dc	cl, tel	op	rck	elect slug
Process Instrument Control	l	dc	met	gp	bs pan	....
Boiler Control	h	ac, dc	cl, met, sl	op	swbd	odp
Oil Refineries	h	ac	cl, sl, met	ep	bs	mot
Band Switching	m	dc	rot, sl	gp	bs	....
Break-In	l	dc	cl, tel	op	rck	....
Keying	m	dc	cl	op	rck	....
Automotive	m	dc	cl	gp	bs	therm
Railroad	h	dc	cl, sl	wp	bs	adp
Aircraft	m	ac, dc	cl	herm. vac	bs	esc
Gas Pumps	m	ac	cl	ep	bs	....
Intercommunication	l	dc	tel	op	bs	....
Lighting Control	l	ac	sl	gp	bs	....
Overload Control	h	ac	therm	op	swbd	therm
Undervoltage	m	ac	ind	gp	swbd	....

KEY TO NOTATIONS:

DUTY: h= heavy
m= medium
l= light

MOUNTING: bs= base
swbd= switchboard
rck= rack
pan= panel

DELAYS: mot= motor
esc= escapement
adp= air dash pot
elect= electronic
odp= oil dash pot
slug= slug
therm= thermal

TYPE: cl= clapper
sl= solenoid
ind= induction
met= meter relay
tel= telephone type
rot= rotary switch

ENCLOSURES: gp= general purpose
wp= weatherproof
wt= watertight
dt= dusttight
ep= explosion-proof
op= open
herm= hermetically sealed
vac= vacuum relay

been standardized for industrial equipment by the National Electrical Manufacturers Association (NEMA), ASA (American Standards Association) and AIEE (American Institute of Electrical Engineers). NEMA classifications can be found in equipment catalogs. Thus a NEMA 1 is a general-purpose metal enclosure. NEMA 2 is drip-proof; NEMA 3 is weatherproof; NEMA 4, watertight; NEMA 5, dust-proof. NEMA 9 is for hazardous locations where explosive gases or vapors may be encountered; NEMA 12 is a heavy-duty industrial enclosure. Sometimes relays are mounted in a separate room with other electrical equipment and an enclosure may not be necessary.

A multiple-factor problem

As with all other industrial electrical equipment, there is another requirement to be satisfied, which may in fact be a multiple set of requirements. Federal, state and local governments have safety rules and codes which apply. Fire-insurance companies may have their own standards. Sometimes local utilities add their two cents. All these must be taken into consideration when selecting relays. Generally, relays which satisfy Underwriters labs requirements will be acceptable to all. If the relay is installed by union electricians, it must be Underwriters-approved in any case. This is not capricious. If any accident is caused by, or involves, the relay, the manufacturer, contractor and owner are protected at least to the extent that they did not attempt to use inferior materials where personnel safety was involved.

Relay selection is then not a simple matter of taking the first one that will do the job. It is a serious matter, involving many factors. All must be weighed in relation to each other and the demands of the circuits. Table III shows the results of a survey carried out several years ago to find out what types of relays were used for what types of control, the enclosures used and even the types of time delay used, if any.

The selection of relays is also closely related to the *manner* in which they control equipment. Thus by proper selection it may be possible to do a job with far fewer relays than had been supposed. On the other hand, special conditions, reliability requirements and such may demand more relays than were anticipated. For example, most skilled relay circuit designers could redesign existing telephone circuits to use about half the relays the equipment now contains. But this kind of design would necessarily sacrifice reliability, not in terms of relays themselves, but in terms of operational reliability. Therefore, this just isn't done, since the company must maintain certain operational standards.

In the next article in this series we hope to show how circuit design can reduce relays and contacts per relay or properly distribute contacts over the relays used. This will be entitled "Unusual Relay Circuits. END

OTL circuits in transistor sets

Modern circuits that take the output transformer out of the transistor receiver

By ROBERT F. SCOTT
TECHNICAL EDITOR

IN the article "Offbeat Transistor Radio Circuits" (RADIO-ELECTRONICS, April 1961, page 32) we covered the different types of agc circuits that the busy service technician may run across in transistor radios. This article covers the OTL (*o*utput *t*ransformer-*l*ess) audio output circuits used in many popular transistor portables and auto radios.

Fig. 1 is the basic circuit of a common-emitter push-pull transistor amplifier. The center-tapped driver transformer secondary feeds signal voltages that are equal and 180° out of phase to the transistor bases. The collectors are paralleled across the battery through the halves of the split load. Collector currents develop series-aiding ac voltages across the load.

In most practical circuits, the load impedance ranges from 200 to several thousand ohms. Since conventional speaker voice coils are two-terminal types with impedances ranging from 2 to 50 ohms, a push-pull output transformer is generally used to match them to the transistor amplifier. However, there are cases where speakers with special center-tapped voice coils are connected directly in the collector circuits.

Fig. 2 shows the transformerless output circuit used in RCA-1189, RC-1196A and similar chassis. The transistor amplifier is designed to operate in the class-AB to -B region. The RC-1189 (Fig. 2-a) uses a single 130-ohm center-tapped speaker connected between the collectors and ground. Bias for the upper transistor is provided by current flow through R15 and R16, and bias for the lower transistor is provided by current flowing through R17 and R16. Larger sets with the RC-1196A chassis use two 130-ohm center-tapped speakers in parallel as in Fig. 2-b. Resistor and voltage values for this chassis are marked with asterisks.

Hybrid auto radios with transistor output stages generally use a 12K5 power tetrode or the tetrode section of a 12DL8 or 12DV8 as a driver that is transformer-coupled to the output transistor(s). Several recent Motorola sets such as the 95MF and 04MA feature transistor drivers direct-coupled to vacuum-tube voltage amplifiers. The audio circuit of the 04MA is shown in Fig. 3. This circuit is very similar to the 14MR used in 1961 Ramblers.

The 2N573 driver transistor has its base direct-coupled to the plate of the 12AE6-A. Base bias and the driver's input signal are developed across the 3,900-ohm resistor common to the voltage amplifier plate and driver base circuits.

A pair of 2N176's is used in the output stage. When used with a single speaker, the circuit (Fig. 3-a) resembles Fig. 2-a. Both have center-tapped driver transformers and center-tapped speakers. Bias is adjusted with the 200-ohm pot and the transistors are stabilized by paralleled 4.5-ohm thermistors in the emitter return lead.

Fig. 3-b shows the arrangement used in two-speaker installations. In this case, a pair of 20-ohm speakers and a 100-ohm volume control are paralleled across a center-tapped inductor in the collector circuits.

Motorola 95MF

The audio amplifier in the Motorola 95MF (Fig. 4) is not an OTL type but we are showing it as another version of the transistor output stage that you may encounter. Comparing it with Fig. 3-a, we see many similarities and a few startling differences.

The af amplifier and driver are essentially the same. The secondary of

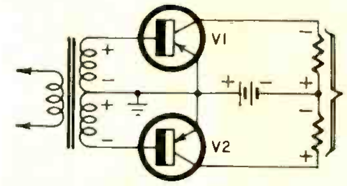


Fig. 1—Basic circuit of a common-emitter push-pull transistor amplifier.

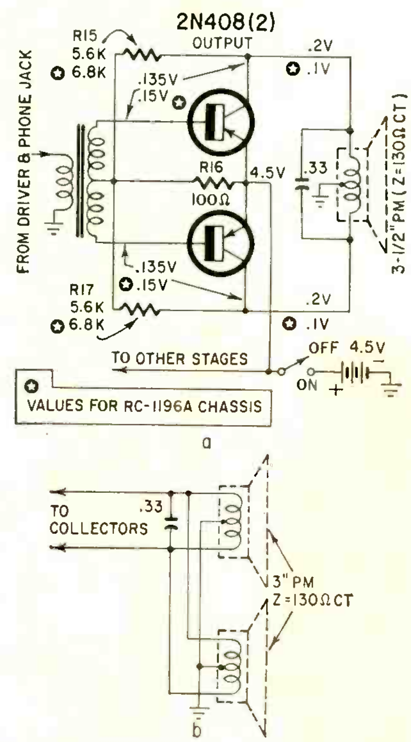
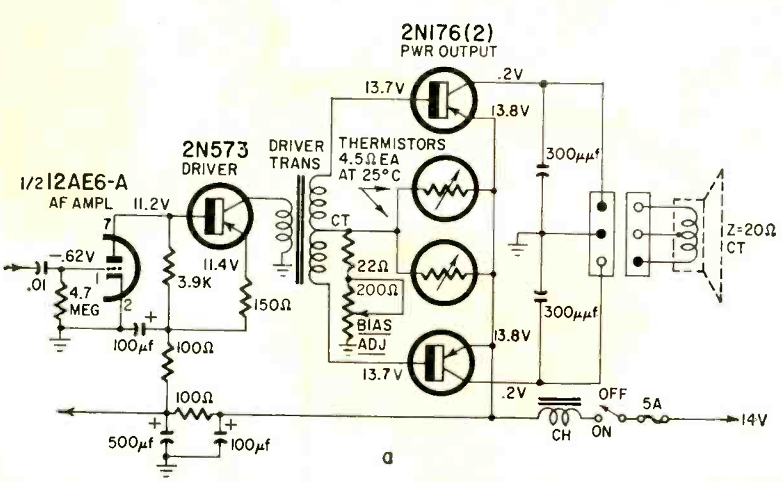


Fig. 2—OTL circuit used in the RCA-1189, RC-1196A and similar chassis.



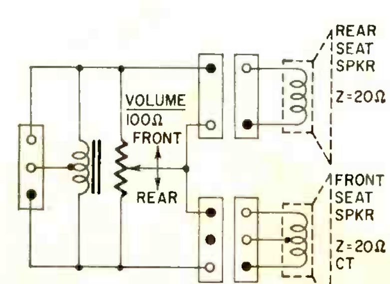


Fig. 3-a (left)—Audio circuit of the Motorola 04MA auto radio. b (above)—The setup for front- and rear-seat speakers.

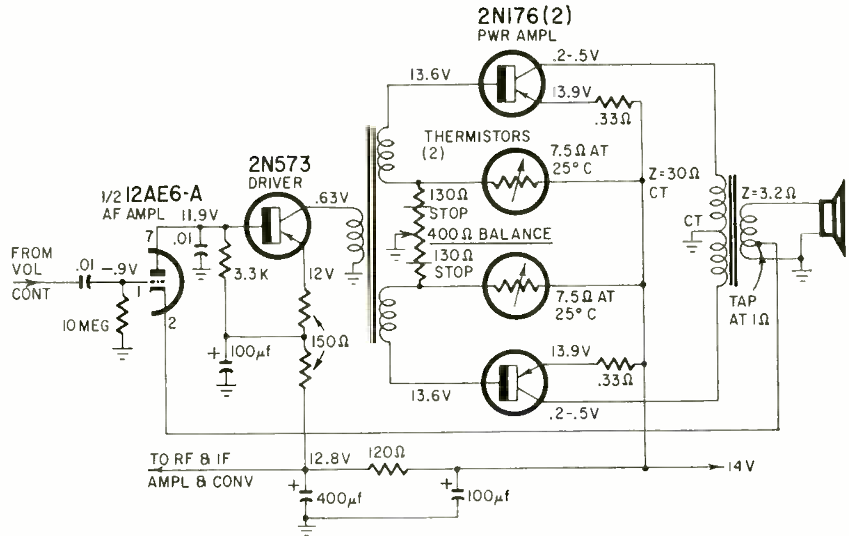


Fig. 4—Audio amplifier in the Motorola 95MF.

the driver transformer is a center-tapped type, and the emitters are connected to the tap through paralleled thermistors. The collectors work directly into the tapped 20-ohm speaker.

The circuit in Fig. 4 has twin secondaries, separate 0.33-ohm stabilizing resistors and thermistors and a BALANCE control for equalizing the bias on the 2N176's. Ordinarily, a 30-ohm center-tapped speaker could be used in the collector circuits if it were not for the feedback circuit that has been added to improve audio response. Feedback is taken from a tap on the voice coil to the af amplifier's cathode. An output transformer isolates the voice coil and feedback network so they cannot upset the dc distribution in the transistor circuits.

Single-ended push-pull circuits

Fig. 5 is the basic circuit of a single-ended push-pull OTL amplifier. Comparing it with Fig. 1, we see that the positions of the load and battery have been transposed. The transistors are now in series across the split power supply and are in parallel across the two-terminal or single-ended load.

When the transistor outputs are paralleled across the load as in Fig. 5, the load impedance required to match the transistors is *one-quarter* of that required by the push-pull circuit in Fig. 1. This drastic reduction in load impedance and the elimination of the center tap on the load make it possible to develop transformerless output circuits that are easily matched to conventional speakers.

Fig. 6 is a practical version of the basic circuit in Fig. 5. Output transistors V1 and V2 are operated as push-pull common-emitter amplifiers operating class AB or B. The bias for V1 is supplied by current flowing from the negative end of BATT 1 through R1-a, R2-a and the speaker to the positive end of BATT 1.

Similarly, V2 is biased by current flow from BATT 2 through R1-b, R2-b and the speaker. R3-a and R3-b provide dc stabilization and set the transistor's operating points at levels where they are comparatively independent of transistor characteristics and ambient and transistor junction temperatures.

V1 and V2 are biased to cutoff so there is little or no current flow when no signal is being applied to the input. When a signal is fed to the amplifier, equal out-of-phase voltages are fed from the secondaries of the driver transformer to the bases of V1 and V2. Each transistor is driven to conduction on alternate half-cycles of the input signal and collector-to-emitter currents flow alternately through the speaker.

The OTL circuits in the Motorola HS-678 and Westinghouse V-2393-3 chassis are shown in Figs. 7 and 8, respectively. Capacitors C16 and C17 in the Motorola provide negative feedback from collector to base to improve frequency response. Some other portables use slightly modified versions of Fig. 6. For example, the Motorola HS-730 chassis uses two 2N185 transistors and two 4.5-volt batteries. Also, 1-ohm stabilizing resistors corresponding to R3-a and R3-b in Fig. 6 are inserted in each emitter return. The Philco model T-60 has matched T-1008 transistors, two 1.5-volt cells and a 15-ohm speaker. Feedback capacitors are omitted.

The circuits in Figs. 6 and 7 operate from split battery supplies with the speaker as the common collector load. The positive end of the supply is grounded in the Motorola circuit, and the negative end is grounded in the Westinghouse version.

A power supply consisting of a center-tapped battery or a pair of batteries is not an absolute requirement for the single-ended OTL circuit although a study of American transistor radios will lead you to believe that this is so. In fact, quite a few European and Japanese transistor radios have single-ended push-pull OTL amplifiers with a single battery.

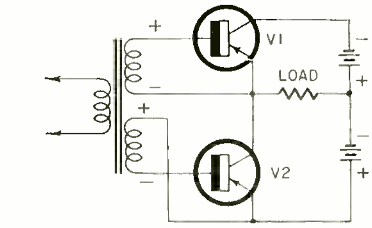


Fig. 5—Basic circuit of a single-ended push-pull OTL amplifier.

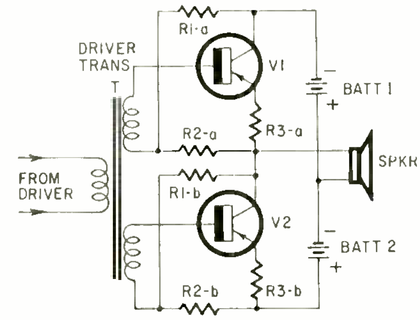


Fig. 6—Practical version of the circuit in Fig. 5.

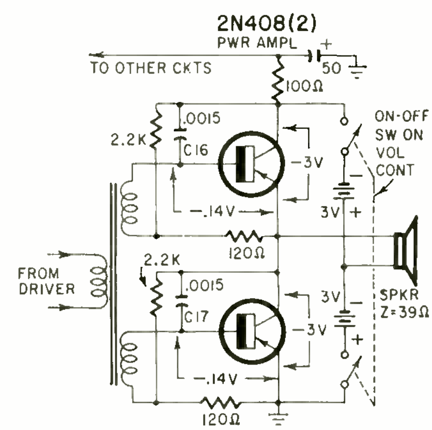


Fig. 7—OTL circuit found in the Motorola HS-678.

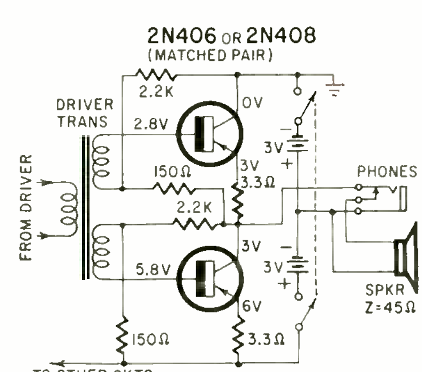


Fig. 8—This circuit is used in the Westinghouse V-2393-3 chassis.

Single-battery OTL circuit

Fig. 9 is the output circuit in a French transistor portable—the Pizon Brothers "Translitor Pocket." R1, R2, R3 and R4 form a voltage divider which provides half the battery voltage (4.5 volts) at the junction of R2 and R3. In effect, each transistor operates with a supply of 4.5 volts or half the battery voltage, as in the single-ended push-pull OTL circuits described previously.

The speaker is connected between the positive battery line and the junction of R2 and R3 through a large blocking capacitor. The resistors in the voltage divider are proportioned for correct bias for class-B operation with both transistors at cutoff.

When no signal is applied to the input, the blocking capacitor is charged to half the battery voltage. When a signal is applied to the input, the transistors conduct on alternate half-cycles. Current flow causes the voltage at the circuit mid-point (the junction of R2, R3 and C) to swing alternately positive and negative around the 4.5-volt level and the charge on C varies at an audio rate. These alternating currents flow through the speaker and reproduce the applied audio signal.

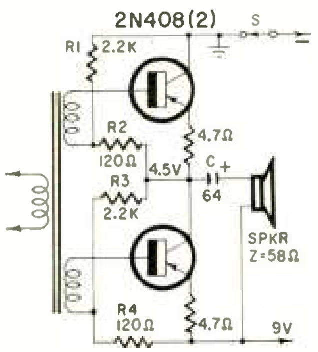


Fig. 9—Output circuit in the Pizon Brothers "Translitor Pocket".

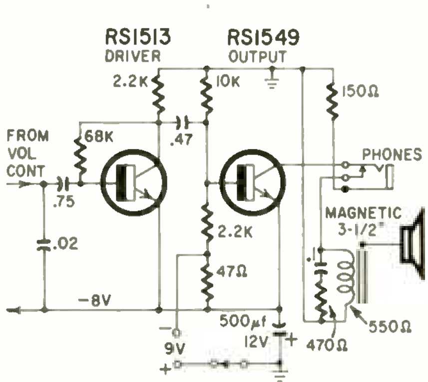


Fig. 10—G-E uses a 550-ohm magnetic speaker in the B version of the P807 radio.

Novel G-E circuit

General Electric is using a 550-ohm magnetic (not permanent-magnet dynamic) speaker in the B version of the P807 and P808 transistor portables. The circuit (Fig. 10) uses RS1513 and RS1549 (catalog numbers) n-p-n transistors as driver and output respectively. The coil of the magnetic speaker is in the output collector circuit. END

TV Service Clinic

conducted by

JACK DARR, SERVICE EDITOR

This is your column in the magazine: the service is absolutely free; there is no charge for answering your questions, and your name and address will be kept confidential if you so wish. The main purpose is to help everyone working in electronics with their unusual problems. Send in your questions; each one gets an immediate personal answer. Later, the more interesting cases are published in the Clinic columns.

Due to the many peculiarities found in commercial TV circuits, you might find a different answer to a question than the one we give, even though the "conductor" of this column is himself a full-time professional TV technician. We would be interested to hear of such cases, as we feel that the more widespread the knowledge of such peculiarities, the better off we'll all be! So, if you have an unusual service job, or one which is giving you trouble from an obscure cause, send in a question on it; we'll answer it promptly and to the best of our ability.

THERE'S NO SUCH THING AS A TV TROUBLE symptom that has only one possible cause. Apparently the average TV set delights in trying to throw the service technician a curve when it presents its symptoms. Nowhere is this more prominent than in diagnosing picture-tube troubles.

The major picture-tube trouble symptoms are loss of brightness or focus, and fixed brightness (heater-cathode short). They are usually caused by a weak or defective CRT. But they can also be caused by other components, ones we may not think of unless we're particularly wary. Remember this before you make any quick diagnoses.

For example, in the CBS 921 series, a heater–cathode short in the 6U8 sync inverter and agc keyer will cause dim pictures and loss of brightness, and will fake all the normal symptoms of a dead picture tube. This is caused by the keyer upsetting the 130-volt line connected to the CRT cathode through the brightness control. This prevents the brightness control from cutting off the tube. This particular set uses a semi-direct-coupled video stage, and changes in the plate circuit can affect CRT bias.

Troubles in circuits which might be considered entirely separate from the video amplifier can also give trouble. For example, in a G-E 21C110 chassis, we had these symptoms: weak sound, picture clear but very dim, and the brightness control wouldn't cut the tube off. There were all the symptoms of CRT trouble, with the sound thrown in for good measure. Fig. 1 shows the culprits—the .0022 capacitor and the 1,000-ohm resistor. The key clue here was the positive 40 volts measured on the 130-volt line. Why did the 135-volt line affect CRT brightness? Because this is where the brightness control is connected! So, with this voltage down to only 40, the brightness control could not raise the cathode high enough to cut off the electron beam in the tube. The grid in this case returns to ground through 180,000 ohms with no applied potential, if you do not count the vertical retrace pulse as an applied potential.

Speaking of vertical retrace elimination, here is a most friutful source of troubles like those we've been talking about! Leakage in the decoupling capac-

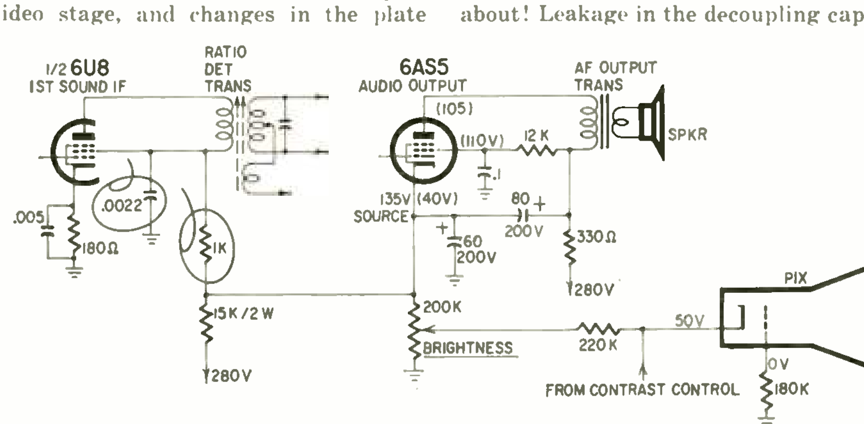


Fig. 1—It looked like a bad picture tube but was really a case of low voltage on the 135-volt line. Voltages in parenthesis are those actually found in faulty circuit.

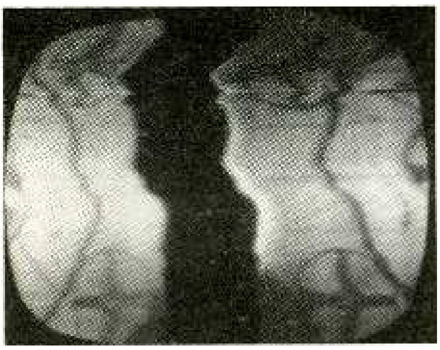


Fig. 2—Clue to this trouble is in the waveform of Fig. 3.

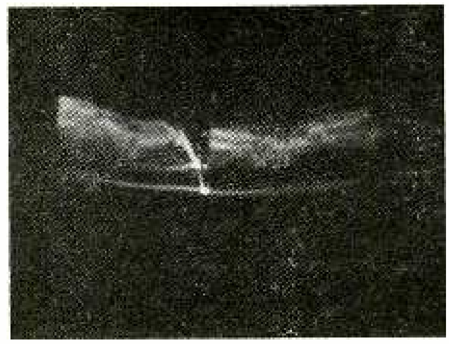


Fig. 3—The tipoff, the bend in the waveform, shows 60-cycle hum—the cause of the pulling in Fig. 2.

itor can cause incorrect voltages to be fed to the control elements on the CRT, wherever they are connected, and you wind up with the same kind of defect, an apparently bad picture tube.

Leakage through video coupling capacitors can also upset the voltages on CRT cathodes, and once again we wind up with the same symptom. Dc leaking through from the video amplifier plate circuit can bias the CRT to cutoff so that you can get no raster at all, or buck out the control voltages so that you can't turn the brightness down, depending upon where the video signals are fed to the CRT, grid or cathode.

About the best way to be sure about this kind of trouble is to take your voltage readings directly on the base of the tube. Many of today's picture tubes show 28 to 72 volts for visual extinction of focused raster. This means that amount of negative voltage on the grid, or an equivalent positive voltage on the cathode. So, if your set controls will cause the voltages to vary through at least this amount of range, and the picture tube will not cut off or brighten, depending upon which symptom you have, then you can be pretty sure you've got a bad CRT.

There is always the possibility that this defect may be an open element, such as grid or cathode, and may be caused by an unsoldered wire in a base pin. Resolder, or use a pin crimper on all suspected pins, then check with a good CRT checker.

To finish, look at Fig. 2. There's a good typical symptom. Fig. 3 shows the corresponding video pattern on the scope. Bad horizontal phase detectors? No. Open electrolytic filter capacitor in the B-plus line feeding the horizontal oscillator! One key clue here—notice the jaggedness of the vertical lines in the picture on the screen. They are typical of open filtering, *but not always!* So, always check out *all* the possibilities before you let yourself get pinned down to a positive diagnosis!

Snow

I can't find a listing for a Philco TV, model UE4200S code 40, run 7. It had a raster and no picture so I replaced two of the if tubes. Now I get a weak picture with a lot of snow. Sound OK. Voltages OK.—J. F. S., Cleveland.

Your model UE4200S Philco uses their 7L40U chassis, and is listed in Sams *Photofacts*, Folder 362-7. Most of the Philco TV sets list model numbers, such as "UE4200-( )" and use the same basic chassis, the 7L40, for instance. Minor modifications will change the last digit, making it a 7L41, etc. The U in the model number indicates that it has a uhf tuner.

From the symptoms you give, your trouble seems to be in the tuner. This model uses a combination vhf/uhf tuner, a T-63. It has a 6BQ7-A rf amplifier and a 6X8 mixer. The fact that you get sound but lots of snow in the picture points to a weak rf amplifier. (The oscillator must be working, or you wouldn't get a picture at all.)

Check the 6BQ7. If it is shorted, put a nine-pin socket adapter in the rf amplifier socket, plug in a new tube and measure the voltage on pin 1. It should be 255 volts. Now measure pins 3 and 6. They should both measure 130 volts. If these readings are not correct, measure the resistance of the 1,800-ohm resistor connected between the 265-volt input (the orange wire) and the second deck of the wafer switch (from the front). If the original 6BQ7 shorted out it burned this resistor up, possibly opening it almost entirely. Another possibility is an open circuit somewhere in the balun coils in the tuner's antenna input. These are mounted in a small open-sided shield on the left rear corner of the tuner. The twin-lead from the antenna terminals on the back of the cabinet goes to the top of this box. Each terminal should read continuity to ground and to each other. If you're still in doubt, examine the coils themselves with a fairly high-power magnifying glass. Only a small stroke of lightning or a hit on the power line within a few blocks of the house can open these delicate coils.

Red-hot vertical output tube

I've got a Philco 52T2120 on the bench, with no high voltage. I'm confused by the voltage readings. The 6AH4 vertical output runs red-hot, if I vary the height control to get 85 volts on the vertical oscillator plate. This is an odd one, and I'd appreciate your help.—G. J. B., Quincy, Mass.

This is a wild one! Actually, your trouble here is not in the vertical output stage, but in the fact that you don't have the proper bias on it. In this chassis, the negative voltage for the 6AH4 bias is fed through the vertical linearity control, but it originates at the horizontal output tube's grid (Fig. 4)!

From the readings you gave, it looks as if your horizontal oscillator output is low. Check the plate circuit, especially that 12,000-ohm resistor off the 240-volt line. This 12,000-ohm resistor has been the cause of a lot of trouble. The grid drive signal on the horizontal output tube should be −35 volts. You show 25 volts on the output plate of the horizontal oscillator, and it should be 145; the grid is zero, and should be −30 to −36 volts.

One very likely possibility here is a weak or bad damper tube, or other troubles in the damper circuit, which could cut the boost voltage entirely or lower it. Of course, this condition could also be due to the low drive on the horizontal output, so you're just going to have to check it all out a piece at a time. However, I believe I'd begin with that horizontal oscillator. Get it up to par first, then see what else may be wrong.

By the way, the day I received your letter, I had just finished a job with exactly the same symptoms in an old RCA! This, however, turned out to be a weak damper tube. The red-hot vertical output tube and all the other symptoms were there, though!

Poor sound

I need information on a Hyde Park model C11 TV. The trouble is in the

(*Continued on page 56*)

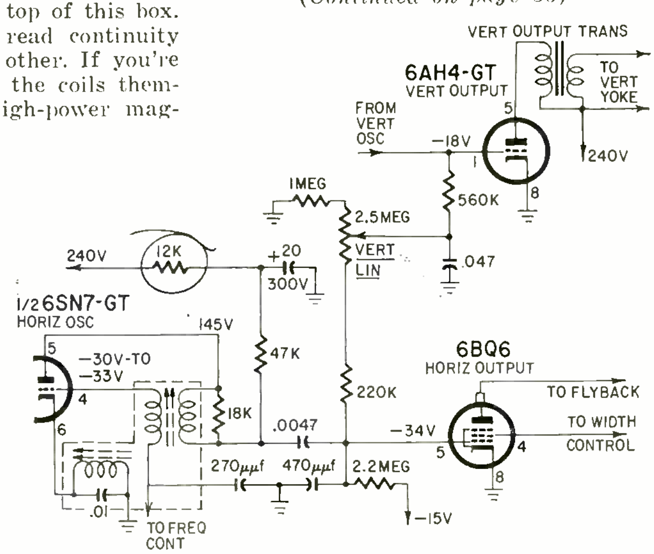
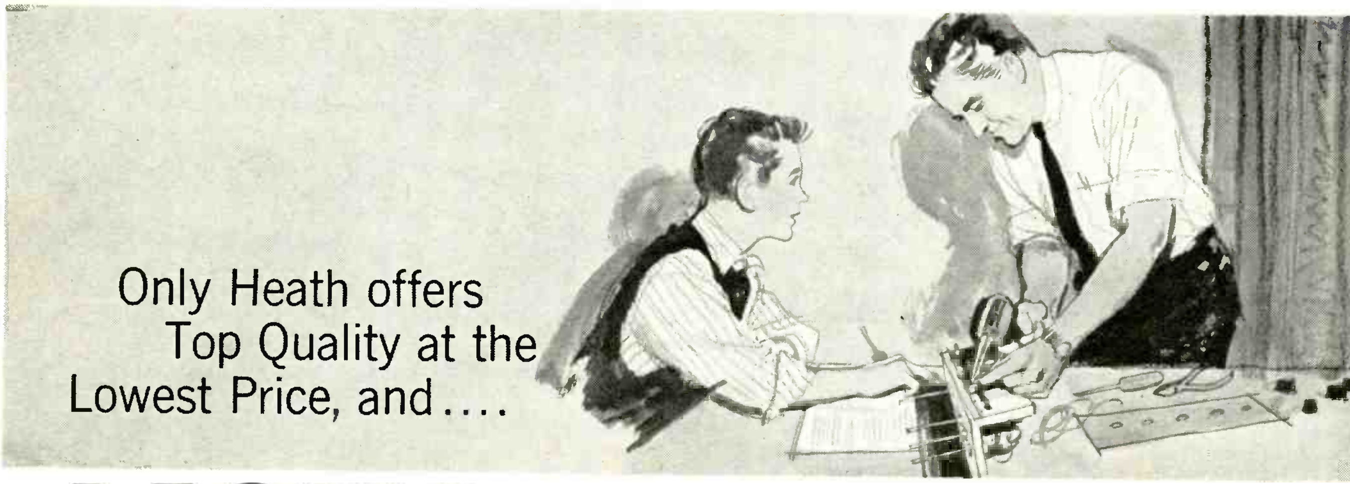


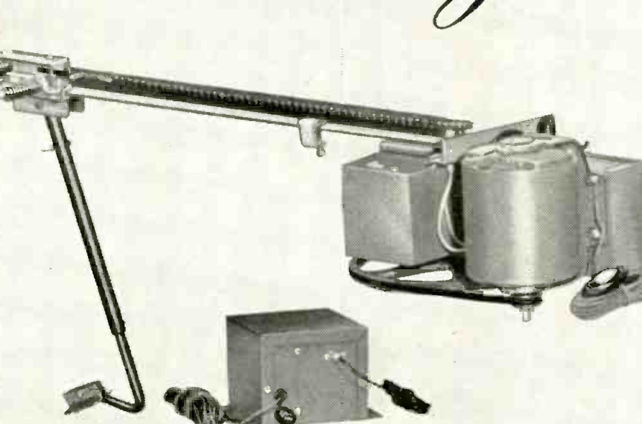
Fig. 4—Trouble in vertical circuit may originate at horizontal output tube.



NOW—*we guarantee you*

At your service . . .

THE NEW HEATHKIT AUTOMATIC GARAGE DOOR OPENER!



Compare price, compare features, and you'll buy this latest Heathkit labor-saving wonder! Opens and closes all overhead track-type doors up to 8′ high automatically! Garage light turns on when door is open, stays on for short period after door closes! Safety release device. Adjustable operating force! Tone-coded "hi-power" 6 or 12 v transmitter and special receiver prevents interference. Easy one-man assembly. All parts included. 65 lbs.

Kit GD-20 (mechanism, transmitter, receiver)... $11 dn., $10 mo. **$109.95**
Kit GDA-20-1 (extra transmitter) .... $2.50 dn., $5 mo.... **$24.95**

BIG-BUY PORTABLE 4-TRACK STEREO TAPE RECORDER

All-in-one monophonic or 4-track stereo tape record and playback! Two tape control levers; individual tone balance and level controls; monitoring switch for listening while recording; "pause" button for editing; two "eyes" to check recording levels. Also functions as "hi-fi stereo center" for record players, etc., or to feed tape music to separate hi-fi system. Parts for all amplifiers and speakers included; turquoise and white cabinet and 3¾″—7½″ speed tape deck are assembled. Less mic.

Kit AD-40... 49 lbs.... $18 dn., $16 mo. **$179.95**
Assembled ADW-40... 49 lbs.... $30 dn., $26 mo........ **$299.95**

NEW HIGH FIDELITY PA AMP.

Heath exclusive; 20 watt *hi-fi rated* PA amp. Two inputs; equalization switches; electrical mixing; sealed "pads"; tape recorder, line, and voice coil output. Plug-in, low-Z mic. Xformers separate. 24 lbs.

Kit AA-31...
$6 dn., $6 mo........ **$59.95**
Mic. Xformers, AN-11 **$11.95**

"LEGATO-COMPACT"

All Altec Lansing speakers! 2-12″ hi-compliance woofers; exponential horn and driver; range 30-22,000 cps; assembled. 800 cps network. 30 watts program; 16 ohm Z. Assembled, finished cabinets; 32″ l x 19″ d x 32⅜″ h 132 lbs.

Kit AS-21U, unfin.. **$224.95**
Kit AS-21W, wal... **$229.95**
Kit AS-21M, mahog **$229.95**

HEATH COMPANY Benton Harbor, Michigan / a subsidiary of **DAYSTROM, INCORPORATED**

Introducing a new styling concept in two popular Heathkit Stereo Units

Here's a handsome matching pair for your new Heathkit stereo system! Both have new louvered wrap-arounds of luggage-tan vinyl-clad steel with contrasting charcoal-grey front panels framed with polished aluminum bezels . . . a regal new look to Heath's medium-price stereo line.

HEATHKIT AJ-11 AM/FM TUNER

Successor to the popular AJ-10, this new version features fly-wheel tuning, two "magic-eye" tuning indicators, adjustable FM automatic frequency control, AM "fidelity" switch for max. selectivity or fidelity, dependable 12 tube circuit, built-in power supply. 21 lbs.

Kit AJ-11...$7 dn., $7 mo. **$69.95**
Assembled AJW-11...$13 dn., $11 mo. **$129.95**

HEATHKIT AA-151 28-WATT STEREO AMPLIFIER

Here's the popular SA-2 model all dressed up in brand-new styling. Delivers 28 hi-fi rated watts (14 per channel) for plenty of power. Has clutched volume controls, ganged tone controls, 4 dual inputs. 28 lbs.

Kit AA-151...$6 dn., $6 mo. **$59.95**
Assembled AAW-151...$12dn.,$11mo. **$119.95**

can build any Heathkit®!

IGNITION ANALYZER

Switch to primary, secondary, parade or superimposed patterns. See condition of plugs, points, wiring, coil & condenser. Plug-in ID-11 Timing Light available. 15 lbs.

Kit IO-20...$9 dn. **$89.95**
Assembled IOW-20 . **$169.95**

NEW TELEPHONE AMPLIFIER!

Hands-free phone chats! Ideal for conferences, dictation, etc. Place handset on cradle, unit turns on, instantly ready! All-transistor; long-lasting battery power. Easy to build. Ivory color.

Kit GD-71 .... 4 lbs... **$19.95**

LOW COST DEPTH SOUNDER

Best value in marine electronics. Detects fish, submerged objects, and bottom depth. Big 4¾" dial calibrated from 0-100'. 6-transistor circuit, battery powered. Corrosion & splash-resistant aluminum cab. Transducer included. 9 lbs.

Kit MI-10 $7 dn., $7 mo. **$69.95**

NEW . . . 3-BAND MARINE RDF

Extended coverage and BFO to receive Consolan signals! Covers 188-410 kc Beacon & Consolan, 535-1620 kc Broadcast, 1650-3450 kc Marine band. Loop and "sense" antenna eliminate double null. 10 transistor circuit, battery powered.

Kit MR-11 . . 12 lbs. **$109.95**

You get guaranteed success with Heathkit!

Never before has a manufacturer of do-it-yourself kits guaranteed your success in completing a project. Heath does so and backs it up with an iron-clad, money-back guarantee! By making this guarantee, we hope to banish any doubt you may have about your ability to build a kit. How is such a guarantee possible? The careful planning that goes into the design of Heathkit equipment revolves around this paramount thought—anyone, regardless of background or experience, must be able to build any Heathkit. This same thought guides the writing of the detailed Heathkit assembly instructions with the world famous "check-by-step" system. These attributes plus the experience of a million customers attests to the fact that anyone can build a Heathkit. Order your favorite Heathkit today. Enjoy top quality equipment with savings of up to 50% and the satisfaction of doing it yourself. Get guaranteed success with 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.

FREE Catalog!

Contains complete descriptions and specifications on all of the above new models plus more than 200 other famous Heathkit items. Send for your free copy, use the coupon below; see how you can enjoy top quality equipment with savings of up to 50% with Heathkit!

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.

Please send the following items:

Item	Model No.	Price

Order direct by mail or see your Heathkit dealer.

Ship ☐ Parcel Post ☐ Express ☐ C.O.D. ☐ Best Way

HEATHKIT by Daystrom

HEATH COMPANY
Benton Harbor 20, Michigan

☐ PLEASE SEND MY FREE COPY OF THE 1961 HEATHKIT CATALOG

Name ______

Address ______

City ______ Zone ____ State ______

(*Continued from page 53*)
sound. The customer worked on it himself! Now the quality is bad, and the volume is low. He replaced the quadrature coil with one from a junk TV set. Can you tell me the correct part number of an exact replacement?—F. H., Jersey City, N. J.

I'm sorry to say that I couldn't locate a model C11 either, but I did turn up a model 17CD, which looks very much like the circuit in the sketch you sent me.

Quadrature coils used with the 6BN6 sound detector should be very much alike, as they are all simply parallel-resonant L-C circuits resonated at 4.5 mc. A Thordarson Meissner 20-1005 coil will replace most of them, and should work in this set. A Miller 1481 is also good.

It would be a good idea to check the sound takeoff coil; it can be replaced by a Miller 6203, if necessary. Run a complete sound alignment on the set. See if you get a distinct peak in sound on both coils. If you can, they're OK; if not, replace them.

Vertical stretch

Set: Philco 22B4000, deflection chassis D181. Trouble: Uncontrollable vertical stretch at the top of the picture. The linearity control will bring the top down almost as it should be, but not quite. Checked everything—all electrolytics, resistors and tubes.—J. T. C., Bertram, Tex.

Only one thing left! The vertical output transformer (Fig. 5). Since you have checked all the other common causes such as weak tubes and bad resistors which would cause low plate voltages, the only answer is a shorted turn or turns in the output transformer. This lowers the Q so badly that the output stage cannot deliver a linear waveform. Quick-check: disconnect the original transformer, and connect any vertical output transformer of the same type in its place. If the picture comes back up, even though it doesn't make a perfect picture, this is the trouble. Replace with the proper type.

Pix-tube substitution

Can a 16DP4-A picture tube be substituted for a 16EP4 metal tube? The TV set is a Zenith 2438RZ1, with 12,000 volts on the second anode.—F. L., Franklin Lakes, N. J.

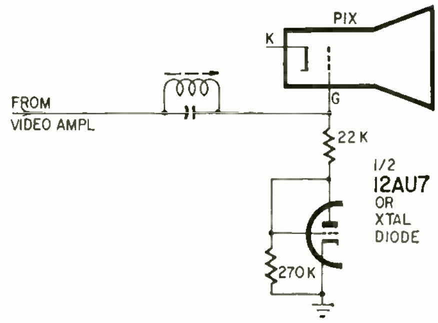


Fig. 6—Dc restorer circuit for use in Stromberg-Carlson TV.

Yes! This should be an easy substitution, as the two tubes are practically identical, electrically. In choosing tubes for substitutions, we merely compare the physical characteristics (length, screen size) and the electrical characteristics (high voltage needed, base connections, method of focusing and so on). If the two are close enough so that not too many changes are necessary, we OK it. These are very close; they even use the same ion-trap magnet, the double type.

Wants dc restorer

I'd like to add dc restoration to a Stromberg-Carlson 21CM2. It already has a very good picture, but I think it will be better. Also, the electrostatic-focus tube in this set now doesn't focus as sharply as the original magnetic-focus type did. Should I replace it with an EM focus type?—R. D. M., Wichita, Kan.

Here is a circuit (Fig. 6) you can use to add a dc restorer to the Stromberg-Carlson TV. You can use a crystal diode instead of the tube shown, but be sure to pick one that has a very high back-resistance, at least 750,000 ohms.

You can solve the focus problem by changing the focus voltage. Hook up a temporary lead to pin 6 of the new tube, and try different voltages on this electrode, watching the focus on a blank raster. The voltage may be anywhere from ground (zero) to 300 volts. Use the value that gives the best focus.

Rectifier headaches

I've got two TV sets with rectifier problems. One, no voltage, no light, no sound. The other, tubes all lit but no B-voltage. Both use dry rectifiers.—B. T., Washington, D. C.

In a series-heater TV circuit using dry rectifiers, there are two major circuits: the heater string(s), and the high-voltage supply or B-plus (Fig. 7). Troubles in either stop the set from playing.

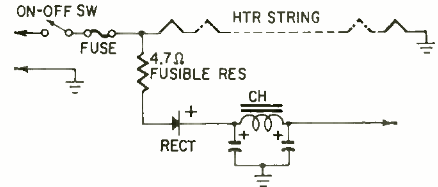


Fig. 7—Half-wave rectifier circuit. Output is about 130 volts.

In your first set, it looks as if you've got an open fuse, bad switch or bad interlock or line cord. You have no voltage on *anything!* It is either this or you've got two defects at the same time! A bad tube and an open fusible resistor in the rectifier circuit.

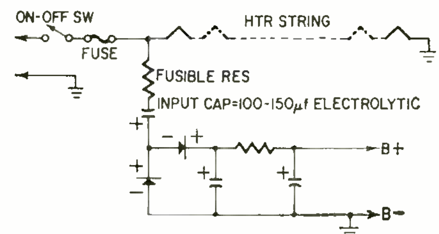


Fig. 8—Half-wave voltage doubler. Output is about 260 volts.

In the second set, this could be an open fusible resistor, or a bad input capacitor. If the set uses a half-wave voltage doubler (Fig. 8), this is quite common. If the electrolytic opens, you have no ac input to the rectifiers, and no B-plus.

6BG6 Failure

I recently converted a Capehart model 3006 MP. The 6BG6 lasts about an hour. I can't find the voltage and resistance readings for this set anywhere.—L. I., San Jose, Calif.

Although you didn't give me the voltage readings around that 6BG6, I firmly suspect that something is wrong there! The correct voltages should be: cathode, −120 volts; screen grid, +175; control grid, −145. **Don't try to measure the plate voltage.** These voltages are measured from chassis, which accounts for the peculiar values. The cathode of this stage in this Capehart is returned to a −120-volt point in the power supply.

Your major difficulty is obviously too much current is being drawn by the 6BG6. Open the cathode circuit and insert an 0–500-ma dc meter. The total plate-screen current here should never be more than 110 ma, and average about 100 ma. More than this shortens tube life considerably!

Check your horizontal linearity adjustment. Tune it for a distinct dip in the plate current. This will aid in getting that plate current down. END

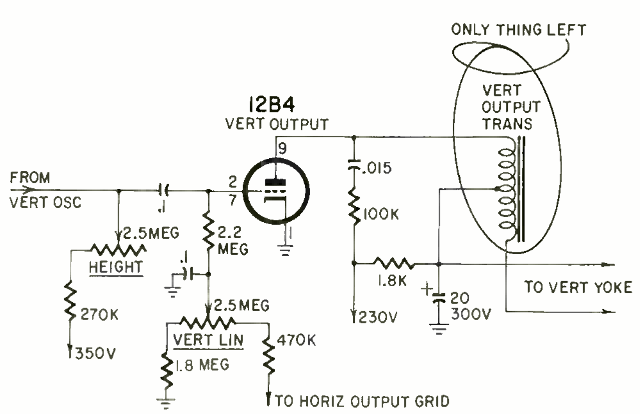


Fig. 5—Poor linearity here is probably caused by a bad vertical output transformer.

By DAVID LACHENBRUCH

SPECIAL REPORT ON FM STEREO

Survey-report on the new form of radio entertainment tells you what you can expect from it and what it can't do

Broadcast engineer sets up tape program for demonstration of Zenith's stereo FM system. At right is stereo portion of transmission gear.

PERPLEXED ABOUT MULTIPLEX? You're not the only one. Not since the stereo disc was introduced has there been so much confusion in the field of high fidelity.

Many of the answers will unfold gradnually. But this much is certain now:

The newly selected FM stereo multiplex standards can provide high-fidelity stereo with good separation, little distortion and good frequency response from 50 to 15,000 cycles on both channels.

The stereo multiplex standards chosen April 19, 1961, by the Federal Communications Commission, after thorough field testing, were based on similar proposals by Zenith Radio Co. and General Electric. They provide for a main FM channel that consists of the sum of the left and right stereo channels (L + R), a pilot subcarrier at 19 kc and a stereophonic subcarrier at 38 kc (the second harmonic of the pilot). The stereo subcarrier is amplitude-modulated by the difference of the left and right channels (L − R).

Because the main FM channel carries the sum of left and right, your old monophonic FM receiver will reproduce a conventional monophonic signal through its single amplifier–speaker system. Stereo receivers contain a matrixing system that combines the difference and sum signal in such a way as to direct the left and right signals to the proper amplifiers and speakers.

Subsidiary communications

The stereo system adopted by the FCC also permits FM stations to transmit a *second* subcarrier if they wish. This is called a Subsidiary Communications Authorization (SCA) subcarrier, and is limited to the 53- to 75-kc range when the station is broadcasting simultaneously in stereo. (The stereo difference subcarrier covers the 20–50-kc range.) SCA subcarriers are used for special point-to-point transmissions such as background music for restaurants and factories. The FCC is allowing stations to transmit both SCA and stereo material at the same time for economic reasons. Some FM stations depend on SCA service for their profits. For many an FM station, SCA service will subsidize stereo broadcasting, which is expected to be unprofitable—at least at the start.

Questions and answers

Here are some of the questions most frequently asked about FM stereo, with answers based on the consensus of radio industry opinion at press time:

How many FM stations will be broadcasting stereo, and how soon?

A few are doing it now. The first to provide stereophonic FM service were WGFM, owned by G-E, in Schenectady, New York, and Zenith's WEFM, Chicago, both started June 1. The Government permits FM stations to start stereocasting any time they wish, if they use FCC-approved transmitting equipment and notify the FCC at least 10 days before they begin.

Nevertheless, probably not more than 20 or 25 stations will actually be broadcasting stereo before the end of the year, because stereo multiplex broadcasting equipment is in short supply. A station must have a stereo generator and multiplex exciter equipment, plus a complete two-channel audio system and the standard stereo programming gear —stereo pickups, tape players, etc. Station equipment manufacturers are just beginning to turn out specialized stereo multiplex equipment, and there's a long waiting list for it.

In most cases, stereo multiplex programming will come to the big cities first. Stereo broadcasting will probably be under way in New York, Chicago, Los Angeles, San Francisco, Philadelphia, Boston and Washington by the time this article appears.

Surveys made by prominent companies or people in the broadcasting industry indicate that only about 40% of the nation's FM stations expect to be stereocasting even by the end of 1962. That would be about 340 out of the approximately 850 FM stations now on the air. Probably some never will convert to stereo. After all, rock-and-roll sounds no better in stereo.

You can expect the more prosperous larger stations, and those specializing in good music, to be first with stereo.

Will these stations broadcast stereo all day long?

Probably not, at first. While they're breaking in the multiplex equipment and trying to accumulate a backlog of stereo discs and tapes, you can expect just a small amount of stereo programming each day. The expansion will be gradual, as the number of multiplex receivers in the area increases.

When can I get equipment to receive FM stereo?

Some of it is on the market right now. The timetable for stereo receiving gear will run this way: First, adapters for component FM tuners and for tuners in some stereo phonograph consoles will be available. Second, complete stereo tuners for component hi-fi systems. Third, stereo FM–phonograph console combinations. Finally, stereo table-model radios.

What will I have to pay for a stereo adapter for my FM tuner?

Prices of adapters vary widely, from Dynaco's $29.95 kit to H. H. Scott's self-powered adapter at $99.95. The others are just about everywhere in between. What you will have to pay will depend largely upon the make and model of your FM tuner.

Must my multiplex adapter be made specifically for my tuner, or can any adapter be used with any tuner?

At this early stage, at least, it's recommended that the adapter you buy be specifically designed for your FM tuner. Most tuners made within the last year or two have multiplex jacks; some of them have a "multiplex" or "MX" position on the function control switch. If yours does have a multiplex jack, there's a good chance it can use an adapter (made by the maker of your tuner) which will work from the tuner's own power supply. But some tuners require self-powered adapters.

There probably never will be a "universal" adapter that will work with every tuner. So it's a good idea to wait until the company that made your FM tuner comes out with a multiplex attachment. At the very least, you should get a guarantee that the adapter you buy will give satisfactory results with your tuner.

Wide-band tuners with ratio detectors are the most easily adapted. Other types can be adapted too, but require more complex adapter circuitry. Some narrow-band tuners probably can't be adapted economically. One less optimistic kit maker warns that "a very high percentage" of existing monophonic FM tuners can't be "satisfactorily" converted. The fact that a tuner includes a multiplex jack is no guarantee that an adapter will work satisfactorily with it.

Obviously, the adaptability of your tuner depends on its make and type. If it's getting along in years and you're not too satisfied with its monophonic performance, it's a good idea to consider buying a complete stereo tuner.

Is installing an adapter a complicated job?

If you're technical-minded enough to be reading RADIO-ELECTRONICS, you should have no trouble so long as you use the proper adapter. The simplest adapter just plugs into the multiplex jack of the tuner, and has coaxial output cables for right- and left-channel outputs. Others come with complete instructions, some of them including tuner modification parts for optimum performance.

Does multiplex reception require additional controls?

That depends on whom you ask and whose equipment you buy. Some adapters have no controls at all; they can't even be seen from the control panel, since they're plugged into the back of the chassis. They're generally turned on and off by the "multiplex" switch or function-selector control on the front panel of the tuner. On those that do have controls, the most common knob you'll see will be marked dimension. This increases or decreases the channel separation by varying the relationship of the A + B signal to the A − B signal.

At least one make of adapter (Crosby) also will have a phase control. This is designed to eliminate distortion by adjusting the phase relationship of the subcarrier to the sideband. Other adapters have gain or level controls.

Self-powered adapters have on–off switches. At least two adapters (Fisher and Eico) have pilot lights that glow when a stereo signal is being received.

Will it be possible to adapt monophonic FM tuners in stereo phonograph consoles?

Manufacturers will offer adapters for many recent sets, but some models may require so many modifications that it would be easier to replace the entire FM tuner. Stereo adapter kits for consoles equipped with multiplex jacks will cost between $30 and $60, depending on make. Most adapters for consoles won't have dimension, phase or gain controls.

Will it be worth while to convert table-model FM radios to stereo?

Usually not. In addition to adding a stereo adapter, you'd have to buy a second amplifier and speaker system. In most cases, manufacturers won't offer adapter kits for table radios. History shows that the public is reluctant to "adapt" or "convert"—for example its unwillingness to accept FM and uhf converters.

Will there be table-model stereo radios on the market?

Yes, indeed — but they won't be commonplace until late this year or early next. The first ones will be two-piece "twin" sets joined together by a cable. Actually, the "master" set usually will contain all the active circuitry, and the "slave" will have only the second speaker. Many will be rather expensive. Zenith, for example, expects to price its first stereo table radios at about $140 or $150.

There will be some inexpensive ones, though. Granco has already announced a line of Stereo Companion radios. They will use the "two-step" approach. The customer can buy a monophonic FM radio first—for as little as $29.95, including multiplex jack. Later he can buy a Companion unit, with multiplex adapter and twin amplifier and speaker, in a matching cabinet, for $19.95 and up. This is plugged into the master set. The result: a two-piece stereo radio.

Granco and some others will also sell single-piece stereo table radios. They'll be about 30 inches wide, with speakers mounted at both ends, and with provision for external speakers for greater separation.

Will stereo FM reception pose new problems?

Yes, especially if you live a good distance from the station. Unfortunately, we don't get anything for nothing, and loss of distance is the price of packing extra information into the station's carrier. It's estimated that, on the average, a stereo FM signal will "get out" only about two-thirds as far as a comparable monophonic FM signal, at a given signal-to-noise ratio. For monophonic reception of stereocasts, the station's range won't be cut drastically, but if you want to receive a stereocast in stereo, you can figure that the reach of the station will be cut by about one-third.

Then an outdoor antenna will usually be needed?

It will be more of a necessity than ever. Outdoor antennas are generally recommended for best hi-fi FM monophonic reception—but, with multiplex, antenna installations become critical. Antenna-mounted preamplifiers may be needed in fringe areas to make up for the loss of reach in the station's carrier. They'll be available for as little as $20.

Doesn't the new stereo system really mean the end of monophonic FM?

Not at all. The radio industry expects to keep on selling monophonic FM table sets, and even hopes for an increased market as a result of the extra attention FM will receive from the new stereo system. Since the multiplex standards are compatible with monophonic reception, signals received on a conventional FM receiver should not be degraded—at least theoretically.

Unfortunately, much of the program material (discs and tapes) now available to FM stations is not 100% compatible—that is, adding the left and right signals doesn't produce a full, balanced monophonic signal. In its report to the FCC on its tests of program material, the National Stereophonic Radio Committee stated that 25% of the stereo discs and tapes now available provide "inferior" monophonic reproduction. The chairman of NSRC's field-test panel, A. Prose Walker went much further, saying only a portion of the available stereo program material is fully compatible. The committee challenged the recording industry to make more stereo records suitable for mono listening when channels are combined.

No one knows all the answers about the new field of stereo multiplexing yet. But for the hi-fi enthusiast, these are the most important facts:

It works. It's good. It opens a new field of stereo enjoyment. END

IT'S ALL-THE-WAY NEW!
IT'S 2/3 BIGGER THAN LAST YEAR!
IT'S FROM RADIO SHACK
fastest growing Electronics Company in America

GIANT SIZE FREE 1962 Electronics CATALOG

PLUS ALL OTHER ISSUES FOR 1 FULL YEAR
CUT OUT A CARD BELOW—MAIL IT TODAY

Here's one for you, 2 EXTRAS for a friend, a neighbor

Mail cards...

You and your friends can save on the finest in ELECTRONICS

in Radio Shack's famous catalogs

OVER 100,000 ITEMS FOR PRO, AMATEUR *STEREO, HI-FI, HAM RADIO, TAPES, RECORDS, KITS, PARTS, AND MORE!*

FREE 336-page Giant Catalog for 1962 has more lines, bigger values than ever before including 30 pages of build-it-yourself kits!

FREE Catalog Supplements as issued for one full year are loaded with exciting values.

NEW No Money Down Credit Terms—every item is extra easy to buy—take up to 2 years to pay. SATISFACTION GUARANTEED or money back.

Send for your free year's catalog subscription today, and tell two friends to do the same. We've made it easy with THREE cut-out cards at right.

Turn the page—see 6 big values featured in our famous catalogs

RADIO SHACK CORP.

America's Electronics Headquarters
730 Commonwealth Ave., Boston 17, Mass.

Place 3c stamp here

RADIO SHACK CORP.

730 Commonwealth Avenue

Boston 17, Massachusetts

61H10

Place 3c stamp here

RADIO SHACK CORP.

730 Commonwealth Avenue

Boston 17, Massachusetts

61H10A

Place 3c stamp here

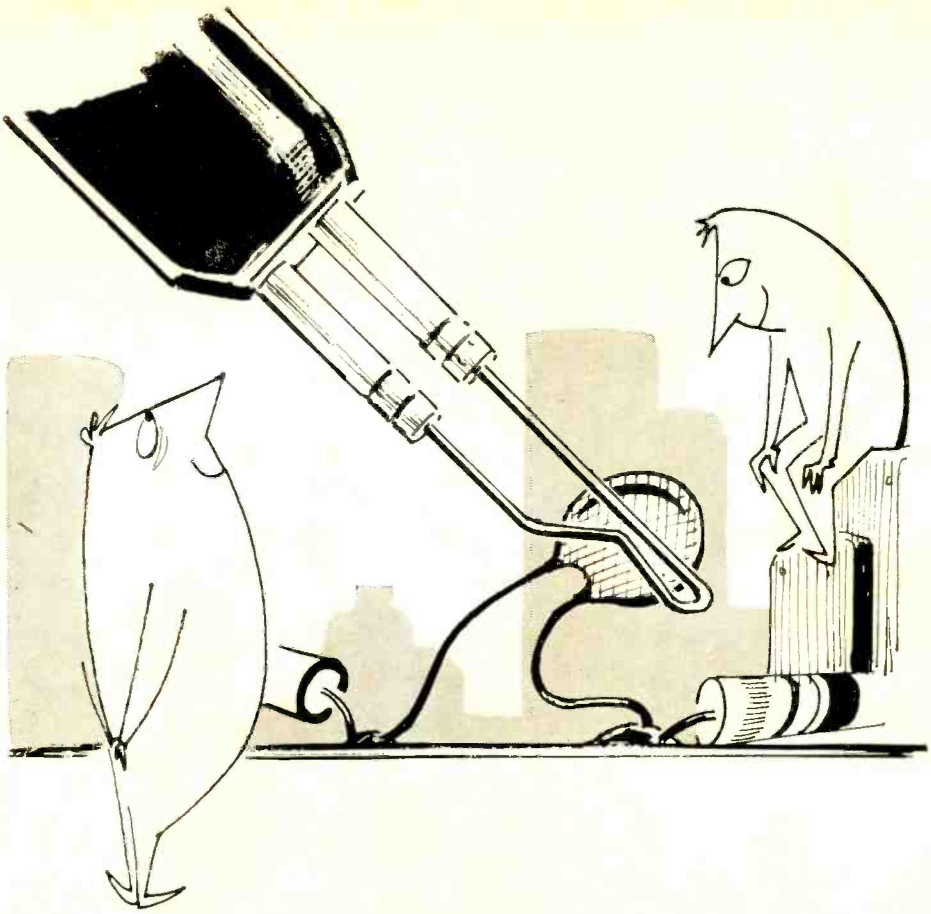
RADIO SHACK CORP.

730 Commonwealth Avenue

Boston 17, Massachusetts

61H10B

PEEWEE'S VERTICAL DRIFTING AND DREAMING



Peewee cured the vertical foldover only to discover a new trouble

By MIKE WAYNE

WHEN I walked into the shop that morning, after my 2-day "fishing" holiday, I knew something was wrong. Peewee didn't look up when I came in. This was not unusual in itself, but the way he just sat there glaring at a TV set on the bench without moving a muscle, not even his head, told me that Peewee was having trouble.

"Good morning," I said cheerfully.

"What's good about it?" asked Peewee tritely.

"Lots of things. The catfish were biting down on Greasy Creek and the trotline was full of 'em this morning and . . ."

"Never mind," interrupted Peewee, "you won't think it's so good when Mrs. Johnson comes after this set and it isn't fixed yet."

"You mean you're still working on the vertical trouble in the set?" I chided.

"Don't get 'holier than thou' until you hear the story."

"All right, let's hear the story, and it better be good!"

"Well, it's like this," began Peewee. "You know how this set's raster was folding up at the bottom?"

"Yes, and foldover is nearly always caused by trouble in the vertical output stage."

"I know, that's what you told me, but with this type circuit it's pretty hard for me to determine just what is the output stage and what is the oscillator stage." He continued, "It's an overall feedback type of circuit, sort of like an audio driver and output stage with feedback from the plate of the output to the grid of the input."

"That's pretty close to what it is," I agreed. "You know how good an oscillator that makes. In fact, that is fundamentally what any multivibrator is—an amplifier with the output fed back into the input (Fig. 1)."

"I think I understand how it works," noted Peewee, "but that doesn't seem to make it much easier to troubleshoot."

"I don't know about that," I said, "but go ahead with your story. What did you do to correct the foldover? It doesn't seem to have any now."

Now the picture rolls

"It doesn't have any foldover now. But it has a trouble I never noticed before. After it heats up for a while the picture starts rolling."

"So you have vertical drift," I said, "was that a complaint when the set was first brought in?"

"No, and I called Mrs. Johnson and she said that the picture never rolled before."

"You still haven't told me what you did to correct the foldover."

He looked a little sheepish. "I replaced all the capacitors in the circuit."

"Why did you do that?"

"Well, I checked a couple with the leakage tester and they both had some leakage so I just decided to replace all of 'em in the vertical circuit," replied Peewee defensively.

"You know that I always say to replace only the parts that are bad. Besides the fact that, the customer shouldn't have to pay for the parts, she doesn't need—you don't get the satisfaction out of knowing what caused the trouble. Without finding out for sure what is wrong, you don't gain any knowledge for use on the next job."

"I figured the capacitors would be cheaper for Mrs. Johnson than all the labor I would have to do checking each one," he justified himself.

"Maybe that's sometimes true," I admitted, "as slow as you are, but we can't penalize Mrs. Johnson just because you're slow. Over and above that, you still have trouble with the set."

"I don't have the foldover anymore."

"True, but you do have what seems to me like a more serious problem—you

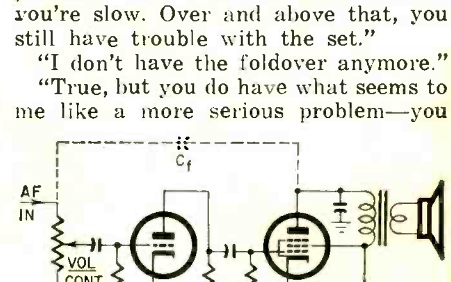


Fig. 1—Sketch shows how an audio amplifier can become a multivibrator by inserting capacitor C_f. This is similar to vertical deflection circuit discussed in the text.

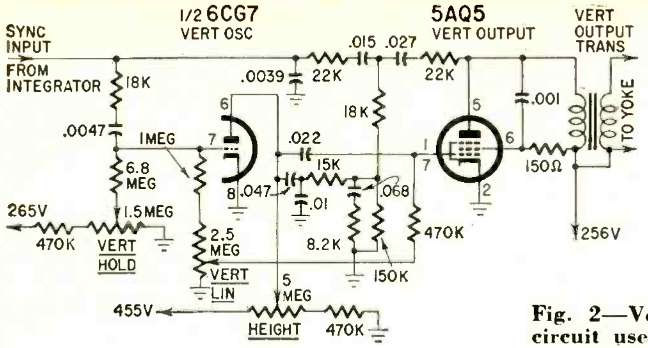


Fig. 2—Vertical oscillator-output circuit used in the RCA KCS95.

say it starts rolling after it has been on a little while?"

"That's right."

"How come you noticed it?"

"After I got the foldover out, I slipped the set back into the cabinet and I thought I'd let it run a little while to make sure it was all right."

"That, at least, is commendable," I said.

"In about 10 minutes the picture started to roll."

"Could you lock the picture back in with the vertical hold control?"

"I could and did," he said, "but after about 15 minutes more the picture started rolling again. I stopped it again with the hold control and this time it ran almost an hour before rolling."

"Then it rolled again?"

"Yes," he said, "and this time I couldn't stop it. The hold control was at the end of its rotation."

"Any more to your story?" I asked.

"Not much," replied Peewee, "except that when I turned the set off for a while and then turned it back on, the picture was rolling but I could stop it in about the mid-range of the hold control."

"What have you done about the rolling?" I wanted to know.

"I replaced the 6.8-megohm resistor in series with the vertical hold control—you know the one that's always changing value?" he said.

"Yes, I know the one, but I don't ever recall its giving this kind of trouble. It always just throws the vertical out of range of the hold control."

"I know that," he said, "but I didn't want to take any chances."

"From the looks of things, you weren't taking any chances. I think you've replaced everything in the circuit but the vertical output transformer and the yoke."

"Well, just about," admitted Peewee. "I guess I was getting desperate."

"I guess!" I said as sarcastically as I could.

"What do you think is wrong, O Master?" he said, with mock reverence.

Let's see the schematic

"I think we had better try to analyze the situation first," I said. "Let's take a look at the schematic."

"Fine with me," said Peewee, "but I think I know it by heart by now."

"Let's look again anyway and see if we can eliminate anything."

He pulled the schematic in front of me. The set was an RCA KCS95 but the same or similar vertical circuit (Fig. 2) is used in many RCA models as well as by several other manufacturers.

We studied the schematic closely and agreed that just about anything in the circuit could be causing the vertical drift.

"We can probably eliminate the output transformer and yoke," I said, "because they are relatively low impedance and would have to change drastically to cause roll."

"I thought so too," he answered, "but remember that 8-inch Emerson portable that was giving us trouble something like this and we found out from the factory that the output transformer was at fault?"

"I'll not likely forget that," I said, "but you remember that the Emerson developed foldover along with the rolling, and your capacitor replacing spree seems to have eliminated the foldover in this one."

"Anyway," confessed Peewee, "I already tried another vertical output transformer."

"Did we have an exact replacement?" I asked. "This looks like the original."

"It is the original," he said. "I didn't have an exact replacement but I soldered in one we had in stock. I knew that even though it didn't match the yoke, there should be some change in the way the vertical circuit acted."

"What happened?" I asked.

"Well, it *didn't* match too good," he said, "but the picture started rolling just like before, so I was pretty sure it wasn't the output transformer."

"That's pretty good thinking," I said.

"Thanks," said Peewee, obviously pleased.

"Not real good, just pretty good," I returned. "Neither one of us can be said to be thinking real good, so far."

"What do you mean by that?" he wanted to know.

The light dawns

"Well," I said, "let's look over the clues and see if we don't already have a way to arrive at the solution."

"I know that tone of voice, you think you know what's wrong."

"No, I don't yet; but I think I might know how to find out."

"Let's hear it," he said, "and spare me the lecture."

"If I do lecture, it will be about half to myself."

"I'm waiting for the solution," said Peewee.

"All right," I said, "let's see what we know. First, we know that the rolling must be caused by heat. Right?"

"Right."

"We also know that, according to the customer, this problem hasn't occurred before."

"But you know customers," interjected Peewee, "half the time they won't tell you the truth."

"Well, occasionally they won't," I agreed, "but it's usually unintentional; we just fail to explain properly. We get so wrapped up in our technical jargon that we forget that the customer probably doesn't know vertical roll from distorted sound. Then, when we get the wrong answer, we suspect that they are falsifying."

"Lyin' would be a better word!" he said.

"You didn't hear a word I said, did you?" I asked. Then I continued without giving him a chance to answer. "You better open up those big ears of yours to some facts if you're ever going to be worth what I'm paying you."

"OK, I'm listening."

"Well, you had better be!" I growled. "I don't want our customers criticized either to their face or behind their backs, and especially without just cause. Our customers are what pay your salary and we can't expect them to give us the right answers every time just the way we want to hear it. I have a strong suspicion that you got the straight dope from Mrs. Johnson."

"OK, OK," said Peewee, "I stand corrected."

"Good. Now, let's continue with the trouble in this set. It didn't roll before, as far as we know, and it only rolls when it gets hot. What might that indicate to you?"

Peewee thought a moment—then said cautiously, "Could it be something that I put in?"

"Could be," I said, "and I have a strong hunch that it is, especially since you replaced most of the capacitors with ceramic units."

"Isn't ceramic OK?" he asked.

"Ceramics make excellent bypasses and many types work very well in timing circuits, but not always. Sometimes certain batches change pretty drastically with heat."

"You mean one of those ceramics I replaced may be causing the trouble?" wondered Peewee. "How can we tell?"

"That's what I meant when I said neither one of us was really thinking."

"You mean there is some simple way to tell?"

"It could hardly be simpler," I replied. "Let's turn the set on again."

We allowed the set to warm up, locked in the picture vertically. I picked up a common shop tool and moved it from one capacitor to another in the vertical circuit. As I came to one capacitor, the picture started rolling. The longer I held the instrument close to it, the faster the picture rolled.

"There's your trouble. The .022 ceramic coupling capacitor you replaced is changing value as the set heats up."

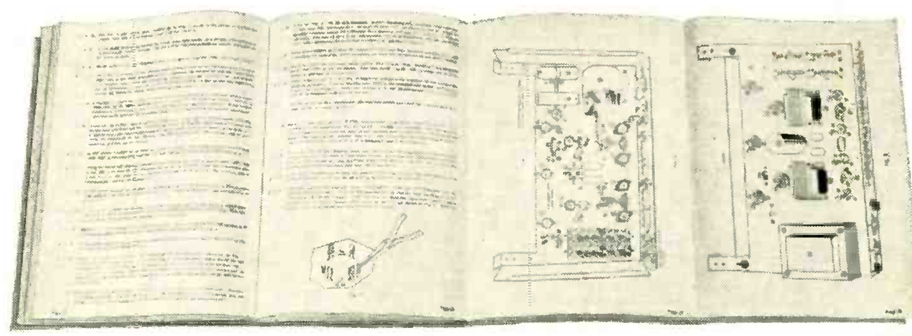
"Well, I'll be dern," marveled Peewee. "First time I ever knew a soldering gun was fit for anything but soldering." END

THIS COULD HAPPEN TO YOU...UNLESS

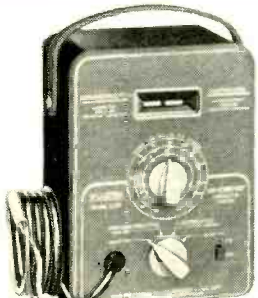
THE KIT YOU BUILD IS A PACO

COMPARE THESE PACO FEATURES:

No mistaken identity or endless searching. Parts are clearly pictured and labeled; resistors are neatly mounted and identified!



Step-by-step instruction book makes assembling a Paco Kit foolproof! Paco gives you giant, fold-out diagrams on corresponding instruction pages so you can see both at the same time.



PACO Model C-25 IN-CIRCUIT CAPACITOR TESTER KIT

Reveals dried out, shorted, or open electrolytics—in the circuit—with Paco's exclusive Capacity Dial. Instantly finds open or direct shorted capacitors without removing from circuit. Great time saver!

Specifications:

SIMPLE SEQUENTIAL TEST: reveals open or shorted capacitors, including electrolytic types.

ELECTROLYTIC DIAL: indicates actual electrolytic values while capacitor is in-circuit; any electrolytic which yields a capacity reading on Electrolytic Dial is automatically revealed as not open or shorted.

ELECTROLYTIC TEST: indicates in-circuit electrolytic capacity from 2 mfd to 400 mfd in two ranges; condenser is automatically proved non-shorted and not open if Capacity Reading can be obtained.

Model C-25: Kit, complete with PACO-detailed assembly-operating manual. Kit Net Price: $19.95

Model C-25W: Factory-wired, ready to operate. Net Price: 29.95

PACO Model DF-90 TRANSISTORIZED DEPTH FINDER KIT

Protect your boat against shoals and underwater hazards with this compact, easy-to-read depth finder. Transistors prolong battery life, provide utmost accuracy and portability. A boon to fishermen—locates hard-to-find schools of fish. A low cost safety device for every boat owner.

Specifications:

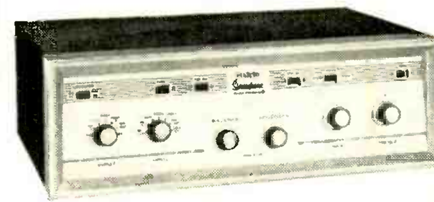
FULLY TRANSISTORIZED: 5 transistors, with a low battery drain for extremely long battery life.

HIGH INTENSITY INDICATOR: for sensitive, accurate response under all conditions.

FAST, EASY READINGS: made possible by means of over-sized scale calibrated at one-foot intervals from 0 to 120 feet.

Model DF-90: Kit, complete with PACO-detailed assembly-operating manual. Kit Net Price: $84.50

Model DF-90W: Factory-wired, ready to operate. Net Price: $135.50



PACO Model SA-40 STEREO PREAMP-AMPLIFIER KIT

Assemble a superb home music system with this true 40 watt stereo preamp-amplifier. Unmatched flexibility, less than 0.5% distortion, and handsome design make this the ideal component for music lover and audiophile alike!

Specifications:

MUSIC WAVEFORM POWER OUTPUT: 25 watts per channel (50 watts total).

RESPONSE: 30 cps to 90Kc, ± 1.0% db

HARMONIC DISTORTION: less than 0.5% at 20 watts per channel output.

Model SA-40: Kit, complete with black and gold case and PACO-detailed assembly-operating manual.................Kit Net Price: $79.95

Model SA-40W: Factory-wired, with black and gold case, ready to operate. Net Price: $129.95

Paco Electronics Company, Inc., Dept. RE8
70-31 84th Street, Glendale 27, L. I., N. Y.
Please send me your complete illustrated catalog.

Name ....

Address ....

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

©PACOTRONICS, INC. 1961

FREE! COMPLETE ILLUSTRATED CATALOG

Mail this coupon for the complete Paco catalog of electronic equipment kits, including test instruments, measuring instruments, and high fidelity components.

PACO KITS BY PACOTRONICS

calibrate your

RF SIGNAL GENERATORS

Get 0.5% accuracy on those often-used frequencies

By GEORGE D. PHILPOTT

Every service technician—and many electronic experimenters—has at least one rf generator in his shop. When was the last time the instrument was calibrated and how accurate is it now? Good question, isn't it? Well, don't despair, it can be calibrated and you can be the one to do the job.

Fig. 1 shows a simple way of mixing and detecting an audio beat frequency, or null, between a kit and an accurately calibrated rf signal generator. Connect the diode output to the amplifier (audio section) of any small radio, and a beat note will be heard as the two instruments are brought to resonance at the desired frequency. Thus, using this system, the calibrated output of one generator is used to locate an identical frequency of the instrument being calibrated.

I don't use this particular method because it is never wise to gauge a precision instrument with anything but a precision gauge. If the calibrated oscillator happens to be off at some points, say 3% to 5%, the possibility of error in kit alignment might total twice the amount.

This leaves us the alternate method of using a good communications receiver that can pick up WWV on 2.5, 5, 10, 15, 20, 25 and 30 mc. Of course, it is not essential that all these frequencies be available, but the 5-, 10- and 25-mc signals are important.

Besides an accurate receiver, a 100-kc crystal calibrator is a valuable aid during alignment. The unit shown in Fig. 2 will provide highly accurate harmonics (marker pips on a scope) to 32 mc. Set the CALIBRATE trimmer so the 100-kc signal zero-beats with WWV or other standard-frequency signal. Adjust the trimmer on an unmodulated signal.

But no matter which method you use remember this one point: "For all practical purposes, a technician is concerned mostly with having his rf signal generator accurate on *often-used frequencies*. If an instrument's accuracy varies at certain unused portions of each band range, but is correct at important frequencies, the instrument is useful. We want accuracy at 175 kc (ancient radio if), 262.5 kc (car radios) and all points between 450 and 470 kc. The broadcast-band range should be absolutely accurate at 1620 kc (open-gang position) even if other frequencies are only relatively close. Stations are the most accurate checkpoints on the AM dial.

For FM alignment we need accuracy at 4.5, 8.1, 9.1 and 10.7 mc. Going to the higher TV intermediate frequencies, 1% tolerance is necessary. Of course, crystal markers are best for scope-checking a TV if strip, but an accurate variable marker generator is always desirable for identifying the crystal's harmonics. Here a reset accuracy of 0.5% is worth having. Get it from your set, and the instrument automatically becomes one of the most valuable units on the bench.

However, before you can expect such accuracy from an instrument, an alignment chart should be made of instrument dial settings. If the kit does not have a vernier tuning knob, flange-calibrated with 360° division marks, buy one and add it to your generator. A fixed hairline is not difficult to install above the knob. Then, as calibration proceeds, a frequency chart (Fig. 3) may be drawn to give exact dial positions for 100-kc frequency steps, at frequencies between 19 and 50 mc.

A reminder before we actually start calibrating: ferrite or powdered-iron core slugs are for padding the *low-frequency* portion of the dial—the trimmers take care of the high end. The serrated outside plates of the variable capacitor may be "knifed" (bent slightly to increase or decrease capacitance) to track any single (the most often used) range.

Alignment procedure

1. Turn the receiver and rf signal generator on and allow an initial 30-minute warmup. Connect the unmodulated rf output of the generator to the receiver antenna input through a .01-μf capacitor. If the receiver is a communications type, turn the beat oscillator on to help locate generator harmonics.

2. Tune the receiver to 700 kc (clear-channel frequency of WLW), the signal generator to 175 kc on the dial. Adjust the appropriate coil slug or trimmer—depending on the 175-kc position, high- or low-freqeuncy portion of the range—until the fourth harmonic of 175 kc (700 kc) can be heard in the receiver. Zero-beat this harmonic with WLW. Since succeeding harmonics grow progressively weaker from the fundamental, check the 175-kc frequency by turning the generator to 87.5 kc and noting the weaker eighth harmonic. The second harmonic of 350 kc (700 kc) will be much stronger in the receiver than the 70-kc fourth harmonic of 175 kc, indicating that this medium overtone is the correct fourth harmonic and that the 175-kc adjustment is correct.

3. With the receiver still tuned to 700 kc, go back to 87.5 kc on the gen-

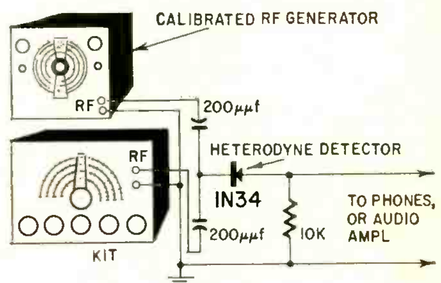


Fig. 1—Output of two rf signal generators connected to produce a detected audio beat.

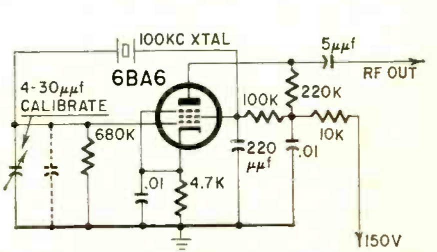


Fig. 2—100-kc crystal oscillator. The dashed capacitor in the grid circuit is needed only when the crystal will not zero-beat with WWV at 10 mc.

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship at our risk one or more of the testers described on these pages.

SUPERIOR'S NEW MODEL 770-A

VOLT-OHM MILLIAMMETER

FEATURES:

- Compact—measures 3⅛" x 5⅞" x 2¼".
- Uses "Full View" 2% accurate 850 Microampere D'Arsonval type meter
- Housed in round-cornered, molded case.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.

6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.

2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm.

3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps.

3 DECIBEL RANGES: —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with test leads and operating instructions. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL VIEW METER

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
DECIBELS: —6 to + 18, + 14 to + 38, + 34 to + 58.

The following components are all tested for **QUALITY** at appropriate test potentials. Two separate **BAD-GOOD** scales on the meter are used for direct readings.
All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. All Germanium Diodes.
All Silicon Rectifiers. All Silicon Diodes.

Model 79 comes complete with operating instructions, test leads and carrying case. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price!

SPECIFICATIONS:

- **DC VOLTS**—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1500 volts.
- **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2000 volts.
- **ELECTRONIC OHMMETER**—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- **DECIBELS**—10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads and carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.

MIRRORED SCALE permits fine accurate measurements where fractional readings are important.

SPECIFICATIONS:

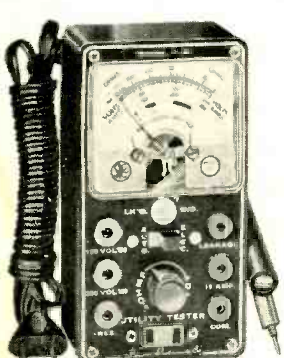
7 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes. 0 to 15 Amperes.
3 DECIBEL RANGES: —6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. **Price is $42.50. Terms: $12.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 70 UTILITY TESTER

FOR REPAIRING ALL ELECTRICAL APPLIANCES
MOTORS ★ AUTOMOBILES



INCLUDED FREE
64 page condensed course in electricity. Profusely illustrated. Written in simple, easy-to-understand style.

As an electrical trouble shooter the Model 70:
• Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc. • Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:
• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70 comes complete with 64 page book and test leads. **Price is $15.85. Terms: $3.85 after 10 day trial then $4.00 monthly for 3 months.**

DID YOU EVER?

- ▶ Order merchandise by mail, including deposit or payment in full, then wait and write... wait and write?
- ▶ Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?
- ▶ Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business... We ship at our risk!

NO

CONTRACT TO SIGN

CO-MAKERS

EMPLOYER NOTIFICATION

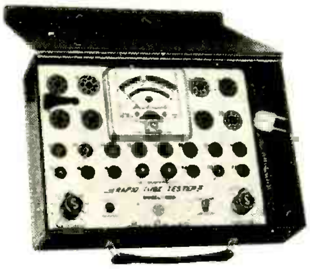
The simple order authorization included in this offer is _all_ you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 82A

MULTI-SOCKET TYPE TUBE TESTER



SPECIFICATIONS:

- Tests over 1000 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82A comes housed in handsome, portable, saddle-stitched Texon case. **Price is $36.50. Terms: $6.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large-easy-to-read type.
- **NOISE TEST**: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- **SEPARATE SCALE FOR LOW-CURRENT TUBES**—Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 comes housed in a handsome, portable, saddle-stitched Texon case. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 83A

C.R.T. TESTER

Tests and Rejuvenates ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES
From 50 degree to 110 degree types—from 8" to 30" types.

ALL COLOR TUBES
Test ALL picture tubes —in the carton —out of the carton —in the set!

Model 83A provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.

Model 83A properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

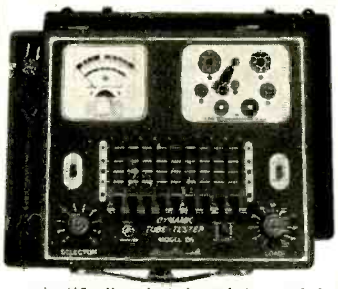
Model 83A will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus.

Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83A applies a _selective_ low voltage _uniformly_ to assure increased life with no danger of cathode damage.

Model 83-A comes housed in handsome portable Saddle-stitched Texon case—complete with socket for all black and white tubes and all color tubes. **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL 85

TRANS-CONDUCTANCE TYPE TUBE TESTER



- Employs latest improved **TRANS-CONDUCTANCE** circuit. Test tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- **SYMBOL REFERENCES:** Model 85 employs time-saving symbols (°, +, ●, ▲, ■;) in place of difficult-to-remember letters previously used. Repeated time-studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes necessary and advantageous.
- **"FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube.
- **FREE FIVE (5) YEAR CHART DATA SERVICE.** Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers _at no charge_ for a period of five years after date of purchase.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. **Price is $52.50. Terms: $12.50 after 10 day trial then $8.00 monthly for 5 months.**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

A versatile all-inclusive **GENERATOR** which provides **ALL** the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. **Price is $47.50. Terms: $11.50 after 10 day trial then $6.00 monthly for 6 months.**

SUPERIOR'S NEW MODEL 88

TESTS ALL TRANSISTORS AND TRANSISTOR RADIOS

AS A TRANSISTOR RADIO TESTER

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble is located and pinpointed.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsinide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors _as they are released!_

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-on Cables for Transistor Testing; an R.F. Diode Probe for R.F. & I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! **Price is $38.50. Terms: $8.50 after 10 day trial then $6.00 monthly for 5 months.**

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. **No interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC., Dept. D-897, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

- ☐ Model 770-A....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model 79..........Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 77..........Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 80..........Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TW-11....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 83-A......Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 70..........Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model 82-A......Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 85..........Total Price $52.50 $12.50 within 10 days. Balance $8.00 monthly for 5 months.
- ☐ Model TV-50A..Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 88..........Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.

Name ....

Address ....

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

All prices net, F.O.B. N.Y.C.

Export Division: Rocke International Corp., 13 East 40th St., New York 16, N.Y.

Frequency	Main Dial Reading	Vernier Dial Reading
175 kc	175 kc	5
262.5 kc	264 kc	3
455 kc	455 kc	11
600	595 kc	25
1000 kc	1000 kc	4
1620 kc	1620 kc	18
4.5 mc	4.5 mc	34
5.0 mc	5.0 mc	22
8.1 mc	8.2 mc	44
9.1 mc	9.2 mc	58
10.7 mc	10.7 mc	75
TV Intermediate Frequencies (19.75 to 35 mc)		
19.75 mc	19.55 mc	33
20.00 mc	19.80 mc	65
20.1 mc	20.00 mc	72
20.2 mc	20.10 mc	78
20.3 mc	20.20 mc	84
Etc. through to 35 mc. Individual dial calibrations at 100-kc intervals, as above.		
TV Intermediate Frequencies. (39.75 to 50 mc)		
Charted the same as above TV frequencies at 100 kc intervals.		
Remember: accurate second harmonics of the above frequencies are useful for checking TV tuner bandwidth. The 4th harmonics of the 25-mc range are useful above 100 mc for FM alignment, etc.		

Fig. 3—A typical frequency calibration chart for an rf signal generator.

erator and again zero-beat the eighth harmonic of 87.5 kc with WLW. Now, tune the receiver to approximately 1050 kc, and find the twelfth harmonic of 87.5 kc, which may be very weak. Zero-beat again. Then tune the generator to 262.5 kc. Adjust the appropriate coil slug, or trimmer, until the fourth harmonic of 262.5 kc is heard at 1050 kc in the receiver.

At this point, note how harmonics are used to cross-check entirely different multiple frequencies at various points on the receiver. Even though the 700-kc frequency is not an even multiple of 262.5 kc, it has been used to check the exact position of the eighth harmonic of 87.5 kc. This means the twelfth harmonic will be accurate at 1050 kc, the fourth harmonic of 252.2 kc.

The frequencies given above are just examples, of course. In some parts of the country it may be quite impractical to use 700 kc. And though at least four generators will tune down to 87.5 kc, a large number will not. Use any frequencies you find expedient—the principle is the same.

4. Switching to the important 455-kc if portion of the rf spectrum, tune the receiver to 910 kc. (More than forty American stations broadcast on this frequency, so the spot should not be hard to find.) Adjust the slug or trimmer in the generator until a strong second harmonic of 455 kc is heard in the receiver. Zero-beat this harmonic and note the vernier dial setting of the instrument. When the generator is accurate at 455 kc, it is usually within 1% at all nearby frequencies.

5. As previously mentioned, the broadcast-band range (550 to 1650 kc) should be accurate at the open-gang position of 1620 kc. Because 1620 kc is above the regular broadcast band, the generator should be aligned as close as possible to broadcast stations of known frequency by the zero-beat method. The 1620-kc frequency can be checked by noting the exact position of an 810-kc second harmonic from the generator on the receiver dial at 1620 kc. If the receiver setting then checks with the fundamental 1620 kc of the generator, the instrument is correctly calibrated at this very useful frequency.

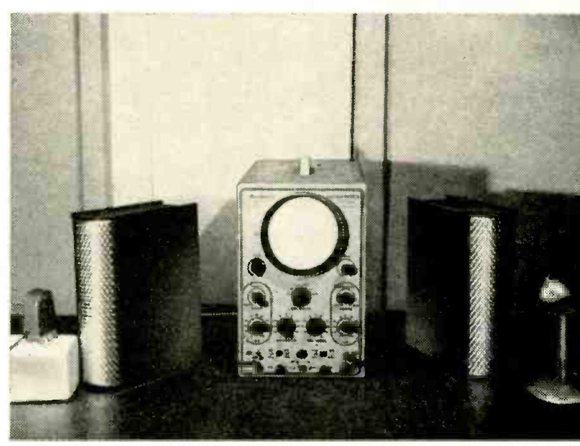
At this point, a 100-kc crystal calibrator becomes handy for checking even-frequency locations on the broadcast band. As we go higher, exact broadcast-frequency harmonics are important for checking short-wave fundamentals. If such a calibrator is available, simply capacitance-couple it to the receiver antenna input (wrap the calibrator output lead several times around the antenna wire).

6. Assuming that the next generator range covers frequencies from approximately 1650 kc to around 5 mc, alignment is relatively easy. The low-frequency end of this range can be checked accurately by tuning the receiver to the National Bureau of Standards signal (WWV) at 2.5 mc. If the signal cannot be heard, tune the receiver back to the broadcast band, 1250 kc. Zero-beat the generator 1250-kc fundamental with the receiver signal. Switch the receiver back to short wave, and find the accurate second harmonic of the 1250-kc generator output and you'll be right on 2.5 mc. Then switch the generator back and adjust the coil slug until a 2.5-mc zero is obtained. Then, without altering the instrument dial setting, tune the receiver to approximately 5 mc and check for the second harmonic of the 2.5-mc generator output and the beat between this harmonic and WWV. When the receiver is definitely tuned to 5 mc, set the generator at 5 mc on the dial and adjust the trimmer until the familiar beat is heard between the generator and WWV. With a crystal calibrator on, all even frequencies, at 100-kc intervals, may be noted and compared with vernier dial settings for chart listing, thus establishing the necessary reset accuracy.

7. As we progress into the higher frequencies (to 50 mc), the alignment technique remains the same. If the exact fundamental frequency cannot be located and compared with a known signal on the receiver, use second harmonics of our accurately compared lower frequencies to determine the receiver dial position. Then align the generator to these settings. A 10-mc frequency may be found accurately by zero-beating the second harmonic of 5 mc from the generator with the 100th harmonic of a crystal calibrator. A 20-mc frequency can be determined by the resulting accuracy of our 10-mc second harmonic, and so on for any other frequencies for which you wish to calibrate your generator.

That's it! A complete, simple, accurate alignment system that will bring your rf signal generator accuracy up to the necessary 1% or better. END

system phasing



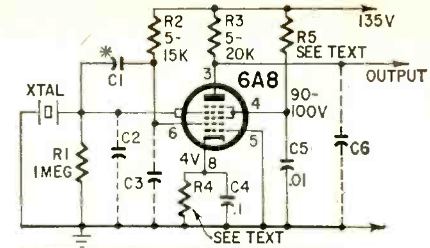
An especially useful job for the scope is checking the phasing of a stereo hi-fi system. Any scope will do, and it requires only two microphones, preferably high-output units though low-impedance mikes will work if the scope has enough gain.

To check phasing, connect one microphone to the horizontal input of the scope—with the internal sweep off, of course. Connect the other microphone to the vertical input. Place both mikes in front of one speaker, and play part of a stereo test disc. The scope will display a diagonal line if the inputs to the amplifiers from the mikes are about equal, and if the gain of the two amplifiers is equal. If the line isn't at a 45° angle from horizontal, adjust the scope's vertical and horizontal gain controls until you get a good diagonal line.

Then place one of the microphones in front of the second speaker in the stereo system, adjust the stereo system gain so that volume from both speakers is equal, and observe the pattern. If the pattern is the same on the scope now as when both mikes were in front of one speaker, the two channels are in phase, right through the speakers. If the diagonal flops over 90°, the outputs of the two channels are *not* in phase. Reverse the leads to one speaker to set your phase straight. END

Coil-less Crystal Oscillator

By ALBERT H. TAYLOR



* 30μμf FOR 100KC; 15μμf FOR 1000KC; 5μμf FOR 6200KC

Years ago R-E published the circuit of a crystal oscillator without a coil. Here is a simpler modern version that uses the negative mutual conductance between grids 2 and 4 of a pentagrid converter tube. The 6A8 operates with normal dc voltages instead of the values in transitron and dynatron circuits.

The resonant tank circuit is composed of the crystal shunted by C2, the sum of stray capacitances and the interelectrode capacitance between grid 4 and cathode. Grid 2's supply resistor (R2) should not be higher than the reactance of C3, the capacitance between grid 2 and ground. Similarly, R3 should not exceed the reactance of the output capacitance C6. The diagram shows typical values for a 6A8. R4 is selected for 4 volts cathode bias and R5 for 90 to 100 volts on grid 3. Or try a pentagrid converter tube such as the 6BE6.

Feedback capacitor C1 must be kept small. If it is too large, the crystal may oscillate on spurious low-frequency modes or the tube may operate as a relaxation oscillator independent of the crystal.

For lower amplitude and purer waveform, rectify and filter the output and apply it to grid 1 as avc bias. For lower and more constant amplitude, amplify the output with a video stage before rectifying. Keep the avc time constants small as possible with good filtering to prevent blocking. END

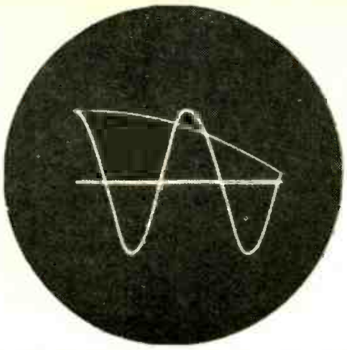


Fig. 1—Sine wave has equal positive and negative amplitudes.

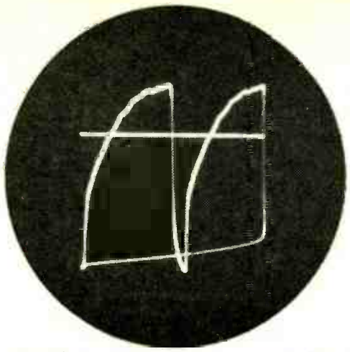


Fig. 2—Complex wave generally has unequal positive and negative amplitudes.

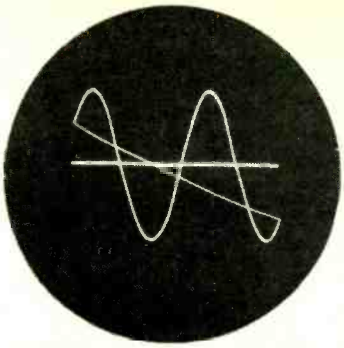


Fig. 3—This sine-wave voltage is 180° out of phase with the one in Fig. 4.

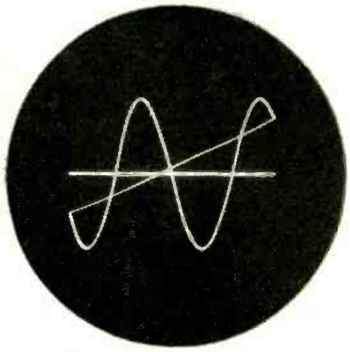


Fig. 4—This sine wave is 180° out of phase with the one in Fig. 3.

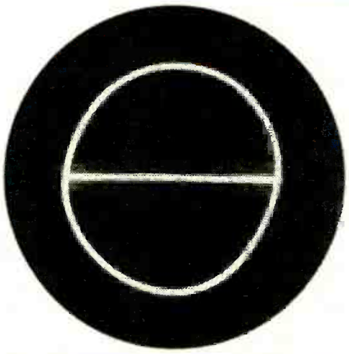


Fig. 5—Circular pattern is formed by two sine waves 90° out of phase.

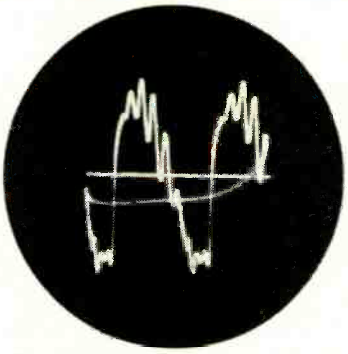


Fig. 6—Complex waves are built up from a number of sine waves.

The scope in electronics

By ROBERT G. MIDDLETON

You can do a lot with your scope

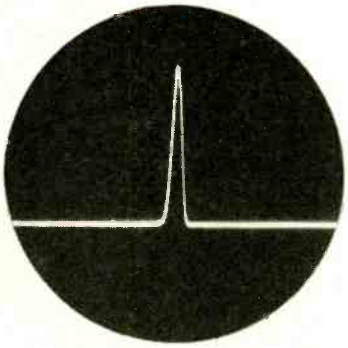


Fig. 7—A pulse is a complex waveform.

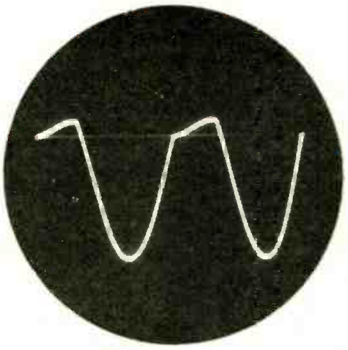


Fig. 8—Diagonally clipped sine wave has many frequencies.

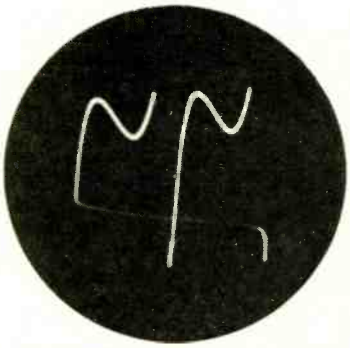


Fig. 9—Combination pulse and sine waveform found in the Synchroguide circuit.

Fig. 10—Combination sine and square waveform.

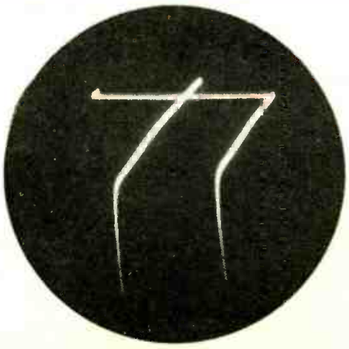


Fig. 11—Combination of a pulse and a sawtooth.

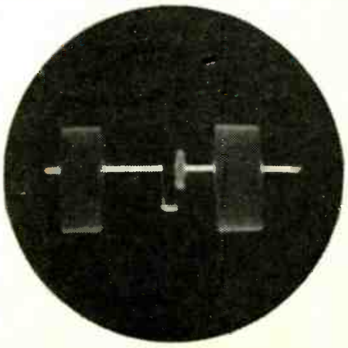


Fig. 12—Output waveform from a color bar generator.

Few technicians recognize the wide range of oscilloscope applications in electronics work. Yet it performs instantly analyses which would otherwise require hours or days of effort to solve with pencil, paper and tables of functions. In this article we will show some of the things you can do with a scope.

For example, let us determine the positive and negative portions of common ac waveshapes. A simple sine wave has equal positive and negative amplitudes, as in Fig. 1. On the other hand, a complex wave, (Fig. 2) has unequal positive and negative amplitudes. The scope quickly and effortlessly shows how much of the waveform is positive (above the zero-volt level) and how much is negative (below the zero-volt level).

The scope also shows the phase of one ac voltage with respect to another (Figs. 3, 4). These sine waves are 180° out of phase with each other. When checking phase, use the scope's external-sync function. This makes the time base independent of the vertical input signal. We drive the external-sync terminal of the scope from any convenient source which has the same frequency as the signals being investigated.

present in the original sine wave. All the new frequencies are in harmonic relation to the original frequency. In other words, the new frequencies are integral multiples (2, 3, 4, 5, etc.) of the fundamental frequency.

We have seen individual examples of a sine wave and a pulse waveform. In electronic circuits, we often find waveshapes which are combinations of such basic forms. For example, in the Synchroguide circuit, we find a characteristic pulse-and-sine wave (Fig. 9).

If we pass a square wave through a harmonic-distortion analyzer (commonly used in audio testing), the fundamental sine wave can be removed (Fig. 10). The output from the distortion analyzer is a combination sine-and-square waveform. This is another example of a basic combination waveform.

Inspection of Fig. 10 shows that the distortion analyzer has an inherent phase shift in its circuits. In other words, the peaks of the half-sine waves are not centered on the square-wave pattern. Instead, the peaks are shifted to the left of center. We see another important fact in Fig. 10—the peak voltage of the fundamental in a square wave has a greater amplitude than the

An unblanked retrace in a scope pattern is not necessarily "just a nuisance." The experienced operator learns to look for information on retrace. In Fig. 13 the forward trace is thick, and its detail is so highly compressed that all fine structure is invisible. On the other hand, the retrace expands the information, which becomes clearly visible as a succession of pulses. Lab scopes have triggered sweep and trace-expansion functions which make such detail visible in the forward trace. However, when we use a service scope, we must unblank the pattern and inspect the retrace for such fine detail.

An oscilloscope can show the current waveform in a circuit, as well the voltage waveform. For example, if we insert a small resistor in series with the cathode lead of a horizontal output tube, the current waveform is displayed when the scope is connected across the resistor (Fig. 14). This is the waveform of the space (total) current in the tube. Or, it is the sum of control-grid, screen-grid and plate current.

In this type of test, we convert current to voltage by inserting the small series resistor. It is interesting to note that one manufacturer is now marketing

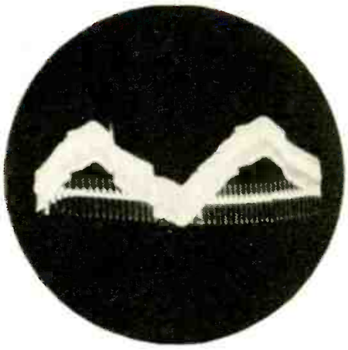


Fig. 13—Information expanded and clearly visible on retrace.

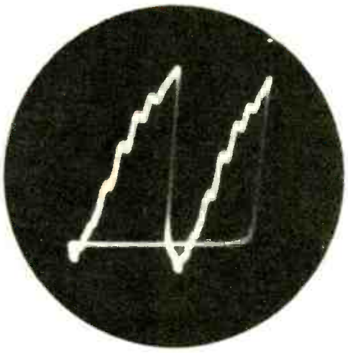


Fig. 14—Cathode-current waveform for a horizontal output tube.

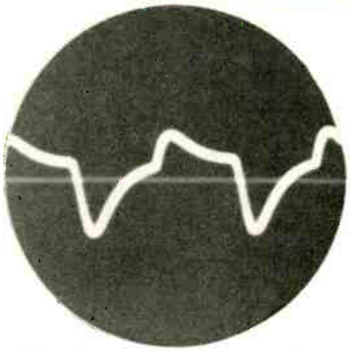


Fig. 15—Current waveform through a resistor, both ends of which are above ac ground.

A sine-wave signal looks like a sine wave only when displayed on a sawtooth time base. For example, if we apply one sine-wave signal to the vertical input terminals of the scope and another one to the horizontal input treminals, a circular or elliptical pattern appears on the screen (Fig. 5). In this example, the two sine waves are 90° out of phase. The pattern is not a perfect circle because there is a small harmonic content in the sine waveforms.

All waveforms which are not sine waves are called complex waves. Complex waves, like the one in Fig. 6, are built up from a large number of sine waves. This is readily apparent here, but is less obvious when examining the pulse waveform of Fig. 7. Nevertheless, the pulse is built up from a large number of sine waves which we do not see as such in the complete complex waveform.

When any waveform is distorted in an amplifier or other electronic circuit, new frequencies are generated. A simple sine wave has only one frequency. However, the clipped sine wave in Fig. 8 has a large number of frequencies not

square wave itself. This can also be shown by a mathematical analysis of the square wave (which is a laborious calculation requiring calculus).

Another basic combination waveform is the pulse-and-sawtooth (peaked sawtooth) wave, illustrated in Fig. 11. We find this waveshape across the vertical deflection coils in a TV receiver. The required amplitudes of pulse and sawtooth components depend on the resistance and inductance of the deflection coils. When inductance is high and resistance low, we must use a waveform with a larger pulse component and a smaller sawtooth component. Otherwise, a true current sawtooth does not flow through the coils.

A color bar signal is a good example of a combination pulse-and-sine waveform. Fig. 12 shows a typical output waveform from a color bar generator. We see the horizontal sync pulse, followed by the 3.58-mc burst and flanked by (R − Y) bar signals. The bar signals also have a 3.58-mc frequency. They differ from burst only in phase. This is a practical example of the importance of phase in electronics work.

a small magnetic probe which makes it possible to inspect current waveforms without opening the circuit. The probe jaws are merely clamped around any current-carrying wire. It is a logical development of the familiar clamp-on ac probe used with ordinary meters.

Service-scope manufacturers are also marketing differential - input oscilloscopes. Previously, these have been used only in the laboratory. A differential-input scope has two vertical input leads and a ground lead. Or it has a push-pull input. If we connect the two vertical input leads across any resistor in a circuit, we see the current waveform (Fig. 15). Such scopes have the interesting function of showing current waveform across resistors, both sides of which are above ground potential. An ordinary scope cannot do this.

Why is an ordinary scope useless in this application? Simply because the ground lead of an ordinary scope would necessarily short one side of the resistor to ground. On the other hand, a differential-input scope has two hot leads which are connected across the resistor. One of these inputs is called

Vertical Input 1; the other, Vertical Input 2. The scope ground lead is connected to the receiver chassis. Hence, there are three leads to be connected when working with a differential-input scope.

Of course, a differential-input scope is not limited to testing waveforms across resistors. We can also check waveforms across capacitors or inductors, both terminals of which are hot. Hence, electronic circuits can be tested

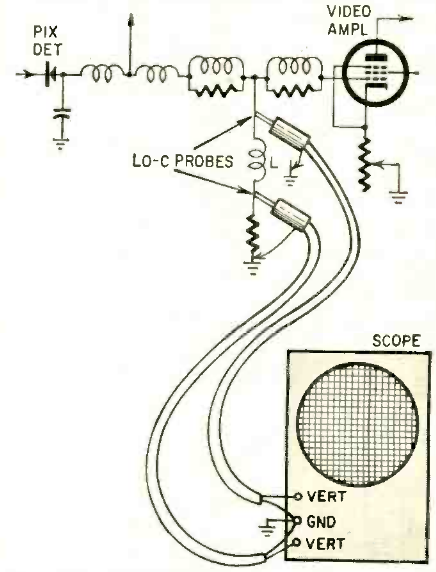


Fig. 16—Signal voltage across a peaking coil can be displayed on the screen of a double-ended scope.

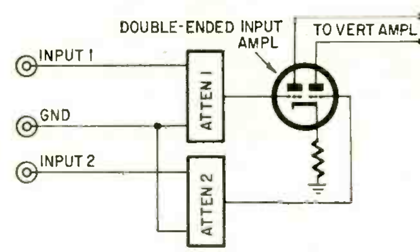


Fig. 17—Two vertical attenuators are used in a differential-input scope.

much more completely when a differential-input scope is used. It eliminates much of the guesswork from electronic servicing.

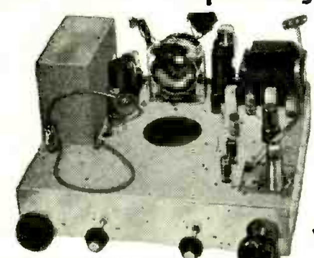
For example, Fig. 16 shows how to connect a differential-input scope across the shunt peaking coil in a video amplifier to check the waveform across the coil. Each of the series peaking coils can be checked in the same manner. We use a low-capacitance probe on each vertical input cable to minimize circuit loading and waveform distortion.

A differential-input scope, of course, has two vertical attenuators (Fig. 17). The attenuators are required, as in an ordinary scope, to avoid overloading and to set the vertical gain. Thus, there are more controls to contend with than we are used to.

You will find that there is no better way of learning how to use a scope than practical experience. This is what counts in the long run. Make a practice of using your scope on every electronics job that comes to the bench. This most useful instrument will soon lose its mystery. END

DX-16 Super Deluxe TV KIT

70° or 90° — operating all 17", 21", 24" and 27" PICTURE TUBES



Dimensions 17½" W x 16" D
Shipping weight 40 lbs.

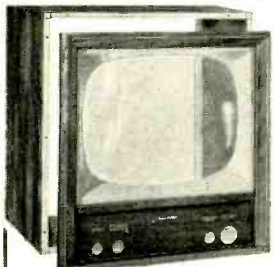
★ Produces a 16-Tube Chassis with 30-Tube performance.
★ Latest Intercarrier Circuitry and Multi-section Tubes.
★ Standard Neutrode Tuner for Selectivity & Fine Definition.
★ All Video and I.F. Coils factory pre-aligned and tuned.
★ Large 250ma Power Transformer for dependable service.
★ 12" Speaker or Twin-cone 6" x 9" Speaker.

Includes ***LIFE-SIZE*** step-by-step Building Instructions
Most Up-To-Date and Practical Course in Television

COMPLETE KIT with SET of WESTINGHOUSE TUBES $93.49
4—6CB6, 6U8, 6T8, 6C4, 12BH7, 6SN7, 6BQ6, 6W4, 6K6, 1X2B, 5U4. 6BN4, 6GC8, incl. in the Tuner (less CRT)

Also sold on **EASY-PAYMENT-PLAN** Buy **LIFE-SIZE** Instructions—$2.49—and buy Parts as you build.

BUILD YOUR OWN CABINET FOR ANY TV CHASSIS



Comparable to the type that Top Mfrs. use on high priced TV sets.

CABINET KIT with 90% of the job done, Includes—
FRONT SECTION in Solid Mahogany, Walnut or Blond Korina. **TOP, SIDES, BACK, MASK, SAFETY GLASS, ETC.**
And EASY-TO-FOLLOW ASSEMBLY INSTRUCTIONS

Front, Top and Sides supplied in a beautiful Piano Finish ● Knob panel undrilled ● For matching Mask specify type or number of CRT used. Same price—Mahogany, Walnut or Blond. (Shipping weight 36 lbs.)

21" CABINET KIT 26"H, 25"W, 22"D $26.97

23" TV CABINET KIT . . $28.47 24" or 27" TV CABINET KIT . . $38.47 21" or 23" FRONT SECTION for flush to wall mounting.... $19.45

TECH-MASTER #2430-B

**90° TV Chassis—*LATEST #630 CIRCUITRY*
*WORLD'S MOST POWERFUL TV CHASSIS***

Complete ready to play, including Tubes, etc. (less CRT) $175.85 .... Brochure on request

EICO Debunks the idea of high prices—on HI-FI, STEREO & TEST EQUIPMENT. See page 24—send order to us on any items shown . . . Free Catalog on entire Line on request.
EICO BOOK "GUIDE TO HIGH FIDELITY" regular 50¢..........Now 25¢ prepaid

70° TV CONVERSION KIT all Essential Parts $11.97
90° TV CONVERSION KIT all Essential Parts 13.97
110° TV CONVERSION KIT all Essential Parts 15.98
TV AGC KIT complete w/6AU6 and Instructions. . $4.59
AC-DC PHONO AMPLIFIER incl 12AT6, 50C5, 35W4 5.98
12" UNIVERSAL TWIN-CONE SPKR. 6.8 magnet 5.97

TUBULAR CONDENSERS—85°C TOP QUALITY—Equally as good for Radio or TV work

.0047-400v, .01-400v, .02-400v, .047-400v, .001-600v, .0047-600v, .01-600v, .02-600v, .03-600v 5¢ ea.
.1-400v, .25-400v, .47-400v, .047-600v, .1-600v, .25-600v, .001-1000v, .0047-1000v, .01-1000v, 8¢ ea.
.03?-1000v, .047-1000v, .1-1000v, .007-1600v, .03-1600v, .05-1600v, .005-3000v, .001-6000v, 14¢ ea.

ELECTROLYTIC CONDENSERS—85°C

1-50v, 1-150v, 2-450v, 25-50v, 8-150v 19¢ ea.
20/20-150v, 50/30-150v, 40-150v, 10-450v, 20-450v, 30-450v, 40-450v, 60-450v, 80-450v......34¢ ea.

CARBON RESISTORS—Regular factory stock in Stackpole, Speer, etc.

½ WATT 10% 10, 20, 39, 47, 68, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820, 1kΩ......2¢ ea.
½ WATT 10% 1800, 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k, 27kΩ...2¢ ea.
½ WATT 10% 33k, 39k, 47k, 56k, 68k, 82k, 100k, 120k, 150k, 180k, 220k, 270k, 330kΩ......2¢ ea.
½ WATT 10% 390k, 470k, 560k, 680k, 820k,Ω 1, 1.2, 1.5, 2.2, 6.8, 10, 15 MEGΩ...... 2¢ ea.
1 WATT 10% 3.3, 10, 39, 100, 120, 150, 330, 470, 560, 680, 820, 1k, 1800, 2700, 4700Ω.. 3¢ ea.
1 WATT 10% 6800, 10k, 15k, 18k, 22k, 27k, 33k, 39k, 47k, 68k, 82k, 100k, 150k, 470k, 680kΩ 3¢ ea.
2 WATT 10% 18, 22, 82, 100, 180, 2200, 3900, 4700, 6800, 8200, 18k, 22k, 100k, 470kΩ.... 4¢ ea.

WIREWOUND RESISTORS

5-10w, 15-10w, 20-10w, 50-10w, 70-10w, 100-10w......16¢ ea.
150-10w, 220-5w, 280-10w, 350-5w, 500-5w, 650-10w, 680-10w, 820-5w, 1K-10w, 1500-10w, 1800-5w 16¢ ea.
2K-10w, 2500-10w, 3K-10w, 5K-10w, 6K-10w, 7K-10w, 8K-10w, 10K-10w, 15K-10w, 20K-10w....16¢ ea.

CERAMIC CONDENSERS 1, 2, 3, 5, 6, 10, 22, 25, 47, 50, 51, 56, 82, 100, 120, 150 mmf .. 3¢ ea.
CERAMIC CONDENSERS 220, 250, 270, 330, 470, 1k, 1200, 1500, 2k, 5k, 6800, 10k mmf . 3¢ ea.
MICA CONDENSERS 5, 25, 50, 60, 68, 75, 100, 120, 150, 220, 270, 330, 470, 510 mmf .. 3¢ ea.
MICA CONDENSERS 560, 680, 820, 1k, 1500, 2k, 2500, 3300, 4700, 6k, 6800, 8k, 10k mmf 3¢ ea.

- ☐ 1 – 5" PM SPEAKER alnico #5 magnet........$1
- ☐ 1 – 4" PM SPEAKER alnico #5 magnet........$1
- ☐ 1 – 3" PM SPEAKER alnico #5 magnet........$1
- ☐ 1 – 3½" TWEETER SPEAKER for HI-FI $1
- ☐ 5 – SETS SPEAKER PLUGS wired..........$1
- ☐ 3 – AUDIO OUTPUT TRANS. 50L6 type........$1
- ☐ 2 – AUDIO OUTPUT TRANS. 50L6 push-pull . .$1
- ☐ 3 – AUDIO OUTPUT TRANS. 6K6 or 6V6 type . $1
- ☐ 3 – I.F. COIL TRANSFORMERS 456 kc $1
- ☐ 3 – I.F. COIL TRANSFORMERS 10.7 mc. FM .$1
- ☐ 3 – I.F. COIL TRANSFORMERS 262 kc (auto). $1
- ☐ 40 – ASST. PRECISION RESISTORS best sizes . .$1
- ☐ 5 – SELENIUM RECTIFIERS 65ma list $1.50 ea. $1
- ☐ 4 – SELENIUM RECTIFIERS 75ma..........$1
- ☐ 2 – SELENIUM RECTIFIERS 300ma..........$1
- ☐ 1 – SELENIUM RECTIFIER 500ma..........$1
- ☐ 1 – TV RATIO DETECTOR COIL 4.5mc $1
- ☐ 1 – TV RATIO DETECTOR COIL 10.7mc $1
- ☐ 1 – TV SOUND I.F. COIL 4.5mc $1
- ☐ $15 – "JACKPOT" TELEVISION PARTS $1
- ☐ 50 – ASST. MOLDED CONDENSERS shortleads. $1
- ☐ 20 – WIREWOUND RESISTORS 50 ohm 10w. . $1
- ☐ 2 – SILICON RECTIFIERS 500ma..........$1
- ☐ 1 – SILICON RECTIFIER 750ma..........$1
- ☐ 1 – LB. SPOOL ROSIN CORE SOLDER $1
- ☐ 4 – 50' SPOOLS HOOK-UP WIRE 4 colors . . .$1
- ☐ 10 – 6' ELECTRIC LINE CORDS with plugs. . .$1
- ☐ 10 – 6' RESISTANCE CORDS 450ohm with plugs $1
- ☐ 50' – 2-CONDUCTOR ZIP CORD No. 18.....$1
- ☐ 5 – TV CHEATER CORDS with both plugs $1
- ☐ 5 – TV CRT. SOCKETS with 18" leads $1
- ☐ 5 – Hi-VOLT. ANODE LEADS with 18" leads . .$1
- ☐ 50 – STRIPS ASST. SPAGHETTI best sizes . .$1
- ☐ 100 – ASST. RUBBER GROMMETS best sizes $1
- ☐ 100' – TWIN LEAD-IN WIRE 300Ω heavy duty $1
- ☐ 50' – FLAT 4-CONDUCT. WIRE many purposes $1

"ONE DOLLAR" Buys

As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

DEDUCT 10% ON ANY ORDER OF $10 OR OVER (ON DOLLAR BUYS)

Plus a FREE SURPRISE PACKAGE

- ☐ 25' – INSULATED SHIELDED WIRE $1
- ☐ 32' – TEST PROD WIRE deluxe (red or black) . .$1
- ☐ 10 – DIODE CRYSTALS 1N34A $1
- ☐ 300 – ½ WATT RESISTORS short leads........$1
- ☐ 20 – TUBULAR CONDS. .47-100v (tests 600 v). .$1
- ☐ 100 – ASST. ½ WATT RESISTORS some 5% .$1
- ☐ 70 – ASSORTED 1 WATT RESISTORS " " .$1
- ☐ 35 – ASSORTED 2 WATT RESISTORS " " .$1
- ☐ 50 – ASST. TUBULAR CONDENSERS $1
- ☐ 50 – ASSORTED FUSES popular sizes $1
- ☐ 75 – 100K ½ WATT RESISTORS 10%......$1
- ☐ 75 – 470KΩ ½ WATT RESISTORS $1
- ☐ 20 – ASST. WIREW'ND RES. 5, 10, 20 watt . .$1
- ☐ 4 – DIODE CRYSTALS 1—IN60 2—IN64 1—IN69. .$1
- ☐ 4 – DIODE CRYSTALS IN64 ....$1
- ☐ 4 – DIODE CRYSTALS IN69...............$1
- ☐ 100 – ASST. CERAMIC CONDENSERS......$1
- ☐ 35 – ASST. DISC CERAMICS best numbers....$1
- ☐ 50 – ASST. MICA CONDENSERS some in 5% .$1
- ☐ 6 – ASST. SLIDE SWITCHES spst, dpdt, etc....$1
- ☐ 3 – ASST. TOGGLE SWITCHES spst, dpdt, etc. $1
- ☐ 15 – ASST. ROTARY SWITCHES $15 worth...$1
- ☐ 100' – FINEST NYLON DIAL CORD best size . .$1
- ☐ 200 – SELF TAPPING SCREWS #8 x ½" $1
- ☐ 35 – ASST. RADIO KNOBS screw and push-on . .$1
- ☐ 100 – ASSORTED KNOB SET-SCREWS $1
- ☐ 25 – ASSORTED CLOCK RADIO KNOBS $1
- ☐ 600 – ASST. H'DWARE screws, nuts, rivets, etc. $1
- ☐ 35 – ASST. SOCKETS octal, noval and miniature .$1
- ☐ 25 – ASST. PRINTED CIRCUIT SOCKETS ...$1
- ☐ 10 – ASST. VOLUME CONTROLS less switch. . .$1
- ☐ 5 – ASST. VOLUME CONTROLS with switch. . .$1
- ☐ 20 – ASST. PILOT LIGHTS popular types $1
- ☐ 10 – PILOT LIGHT SKTS. bayonet type, wired. .$1
- ☐ 50 – ASST. TERMINAL STRIPS 1, 2, 3, 4 lug .$1
- ☐ 10 – ASST. RADIO ELECTRO. CONDENSERS.$1
- ☐ 5 – ASST. TV ELECTROLYTIC CONDENSERS.$1
- ☐ 25 – ASST. MICA TRIMMER CONDENSERS. .$1
- ☐ 15 – TUBULAR CONDENSERS .047-600v $1
- ☐ 2 – ELECTROLYTIC COND. 40/40-450v $1
- ☐ 3 – ELECTROLYTIC COND. 50/30-150v........$1
- ☐ 25 – ASST. PEAKING COILS popular types ..$1
- ☐ 35 – DISC. CERAMIC CONDENSERS 5000mmf $1
- ☐ 25 – ASST. RADIO DIAL POINTERS $1
- ☐ 8 – ASST. LUCITE CASES handy for parts $1
- ☐ 3 – ASST. SIZES RADIO CHASSIS PANS. . .$1
- ☐ 3 – VARIABLE CONDENSERS super 420/162mfd. $1
- ☐ 12 – RADIO OSCILLATOR COILS 456 kc......$1
- ☐ 4 – OVAL LOOP ANTENNAS ass't hi-gain types $1
- ☐ 3 – LOOPSTICK ANT. new ferrite adjustable . . .$1
- ☐ 3 – ½ MEG VOLUME CONTROLS with switch. $1
- ☐ 5 – ASST. 4 WATT WIREWOUND CONTROLS $1
- ☐ 5 – ½ MEG VOLUME CONTROLS less switch . .$1
- ☐ 5 – 1 or 2 MEG VOLUME CONTROLS 1/switch . $1
- ☐ 10 – SURE GRIP ALLIGATOR CLIPS $1
- ☐ 1 – GOLD GRILLE CLOTH 14"x14" or 12"x18" $1
- ☐ 10 – SETS PHONO PLUGS and PIN JACKS. .$1
- ☐ 2 – $2.50 SAPPHIRE NEEDLES 4000 playings $1
- ☐ 1 – RCA 70° FLYBACK TRANS. #75240.....$1
- ☐ 1 – 90° FLYBACK TRANS. incl. schematic $1
- ☐ 3 – TODD 60° DEFLECTION YOKES........$1
- ☐ 1 – $7 INDOOR TV ANTENNA hi-gain 3 section $1
- ☐ 20 – ASST. TV KNOBS, ESCUTCHEONS, Etc. $1
- ☐ 15 – ASST. TV COILS sync. peaking, width, etc. $1
- ☐ 15 – ASST. STANDARD TUNER VHF STRIPS. $1
- ☐ 6 – ASST. STANDARD TUNER UHF STRIPS. .$1
- ☐ 35 – MICA COND. 20—50 mmf & 15—68 mmf $1
- ☐ 35 – MICA COND. 20—100 mmf & 15—270 mmf $1
- ☐ 35 – MICA COND. 20—470 mmf & 15—680 mmf.....$1
- ☐ 35 – MICA COND. 20—820 mmf & 15—1000 mmf.....$1
- ☐ 35 – MICA COND. 20—2200 mmf & 15—2400 mm $1
- ☐ 35 – MICA COND. 20—6800 mmf & 15—10000 mmf . . .$1
- ☐ 35 – CERAMIC COND. 20—5 mmf & 15—10 mmf. . .$1
- ☐ 35 – CERAMIC COND. 20—25 mmf & 15—47 mmf. . .$1
- ☐ 35 – CERAMIC COND. 20—56 mmf & 15—82 mmf. . .$1
- ☐ 35 – CERAMIC COND. 20—100 mmf & 15—150 mmf .$1
- ☐ 35 – CERAMIC COND. 20—270 mmf & 15—470 mmf .$1
- ☐ 35 – CERAMIC COND. 20—1000 mmf & 15—1500 mm $1
- ☐ 35 – CERAMIC COND. 20—2000 mmf & 15—5000 mmf $1
- ☐ 2 – TOP BRAND TUBES 35W4..............$1
- ☐ 4 – TOP NAME 1U4 TUBES also serves as 1T4 .$1

TOP NAME TUBES OZ4, 1B3, 1X2B, 5U4, 6AC7, 6AX4, 6CB6, 6J6, 6K6, 6U8, 6V6, 6SN7, 6X8, 12AU7, 12AX7, 50L6 ....Each $1

- ☐ 3 – TV ALIGNMENT TOOLS assortment #1 . . .$1
- ☐ 3 – TV ALIGNMENT TOOLS assortment #2 . . .$1
- ☐ 3 – TV ALIGNMENT TOOLS assortment #3 . . .$1
- ☐ 3 – TV ALIGNMENT TOOLS assortment #4 . . .$1
- ☐ 3 – TV ALIGNMENT TOOLS assortment #5 . . .$1

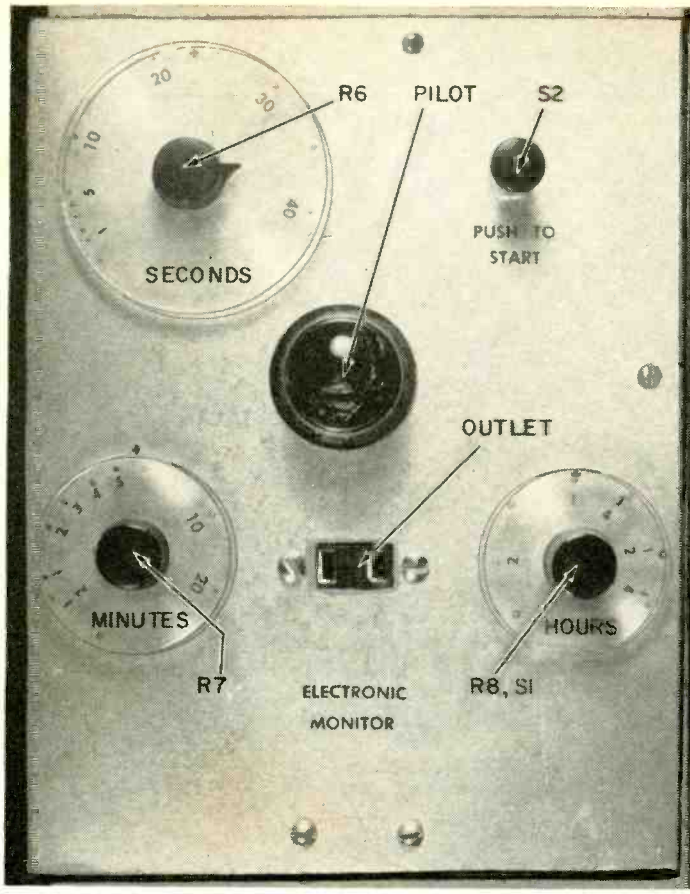
EACH ALIGNMENT TOOL is different and valued at over $1

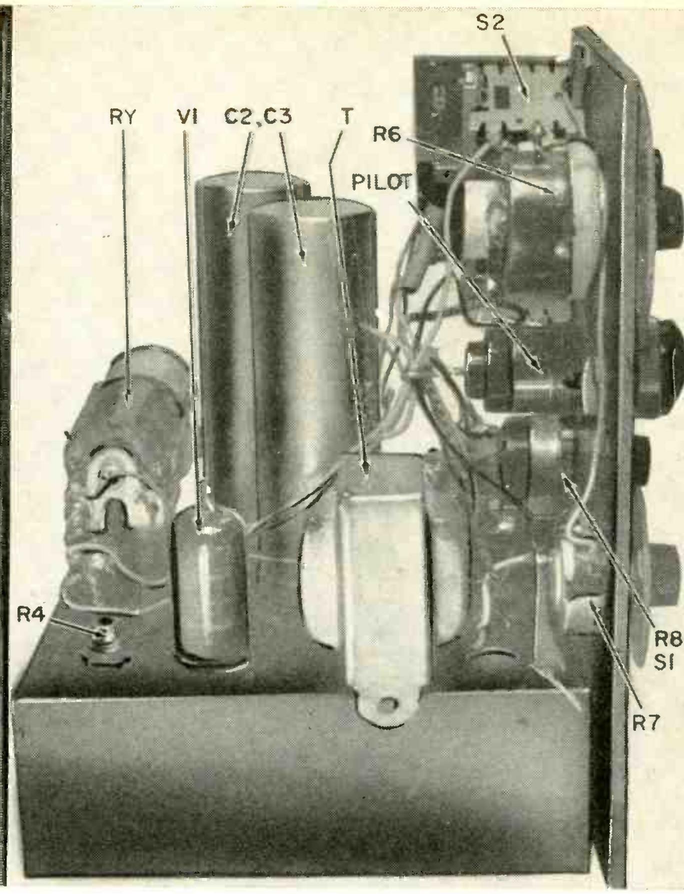
HANDY WAY TO ORDER—Simply tear out advertisement and pencil mark items wanted (X in square is sufficient); enclose with money order or check. You will receive a new copy of this ad for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess will be refunded. Larger orders shipped express collect.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

TELEPHONE COrtland 7-2359



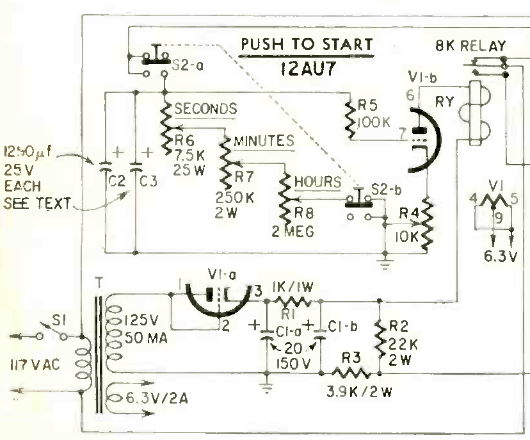


(Left) Front panel of Monitor. Dial scales on transparent plastic discs are attached to knobs. (Right) Side view.

ELECTRONIC MONITOR

Is a Wide-Range Timer

By
B. E. WRIGLEY



Schematic of Monitor. S2 is shown in position to discharge C2, C3. Pressing button (S2) charges capacitors from tap on voltage divider across power supply. If desired, a second outlet may be used in place of the pilot light.

R1—1,000 ohms, 1 watt
R2—22,000 ohms, 2 watts
R3—3,900 ohms, 2 watts
R4—pot, 10,000 ohms
R5—100,000 ohms, ½ watt
R6—pot, 7,500 ohms, linear, 25 watts or larger
R7—pot, 250,000 ohms, linear, 2 watts
R8—pot, 2 megohms, linear, with spst switch
C1—20-20 μf, 150 volts, dual electrolytic
C2, 3—1,250 μf, 25 volts, electrolytic, see text
S1—on-off switch on R8
S2—dpdt spring-return pushbutton switch
RY—8,000-ohm plate-circuit relay
V1—12AU7
T—power transformer, 125 volts at 50 ma, 6.3 volts at 2 amperes (Stancor PA-8421 or equivalent)
Panel-mounted pilot-light assembly (Dialco 431 and lamp or equivalent)
Socket, 9-pin miniature
Ac receptacle
Chassis, panel and miscellaneous hardware

A timer that turns equipment on (or off) for a length of time that varies from one or two seconds to more than two hours.

Dual-section tube serves as relay control tube and power-supply rectifier.

THE fascination of relay action and R-C combinations to control time delay has made the electronic timer one of the more popular construction projects. Most timers are limited to a specific use (e.g., phototimer) because they use a single control. It is technically possible—with vernier control and dial spread—to extend the calibration of timers. In practice, it doesn't work out very well to try to calibrate beyond the range either of seconds, minutes, or hours. But by using three controls in tandem, you can, within the same instrument, time any of these three ranges with accuracy.

The Electronic Monitor uses one tube—a dual-triode 12AU7—with one half acting as power supply rectifier. Two high-capacitance low-voltage capacitors C2, 3, (one unit could be used to match the total capacitance) in parallel store a charge to place a positive voltage on the grid of the relay control tube. (The capacitors in the original unit are surplus and may not be available to the average builder, but a pair of 1,000-μf capacitors may be substituted.) This activates the plate-current relay and closes a set of contacts that supply power to an external outlet. Discharge is controlled by the three pots, R6, R7, R8. They drain the capacitors at a rate determined by their setting until the voltage on the grid of the control tube drops below the preset level required to cut off plate current and open the relay. This level is set by the cathode pot, R4.

S2 is a dpdt pushbutton switch. Hold it down to apply a positive voltage to the capacitors, charging them to the required voltage. The voltage is drawn from a voltage divider in the power supply. When the relay is activated, release S2 and the timing cycle begins, since S2 in its normal position grounds the control pots and discharges the capacitors through them.

The relay has spdt contacts which, in the normally open position, close a circuit to a large pilot light which functions as an indicator and, if properly selected, as a darkroom light. If desired, a second power outlet could be controlled from this relay switching position. Then the monitor could turn *on* an appliance after a desired time interval.

The unit is best calibrated with a stop watch, but an electric clock with a sweep second hand plugged into the outlet controlled by the timer will work well. The dials are marked by trial and error—a process not too tedious if linear pots are used. In theory, it should be possible to calibrate the pots on the basis of the R-C constant. But because of inadequate voltage regulation and the use of other than precision components the discharge time will not be exactly in accordance with the time constant.

The time constant is approximately 10,000 ohms per minute in the circuit illustrated. Therefore, the pots were chosen to give overlapping ranges of from 0–40 seconds, 0–20 minutes, 0–2½ hours. In operation, the time range is selected and the proper control set to the desired time interval. The other pots must be zeroed. Although it might seem possible to time to the second with an interval as great as the full range, such calibration is not possible. However, the hour range is accurate within a minute, the minute range within a few seconds, the second range within the calibrator's ability.

The unit illustrated works well as a phototimer, a phone call-duration indicator and an egg timer. It also brews coffee in the pot or cooks chicken in an electric skillet with aplomb. Whatever the use, make certain that the relay contacts are equal to the power load of the unit to be controlled.

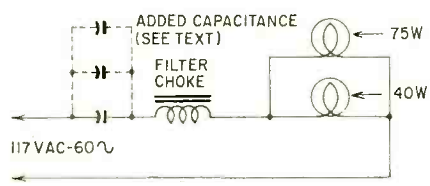
The monitor was built on a discarded surplus utility box 6 x 6 x 2¼-inches with an 8 x 6-inch pressed-wood panel. Any chassis and panel will do. The size is determined primarily by the size of the electrolytics and by the space allotted to the dials of the tuning controls. In the pictured unit, dials were cut from polystyrene and small instrument knobs cemented to them for mounting. Dial marking was done with a hot darning needle and decals were added. Although the illustrated dials are close-calibrated only on the lower end of the applicable range, they may be calibrated to the smallest division convenient to the size of the dial and the patience of the builder. END

What's Your EQ *July Solutions*

Parallel-bulb Puzzler

The theory of operation is based on the fact that a series-resonant circuit will pass a maximum current when it is in resonance with the frequency of the supply source. In this case it is 60 cycles. Included in the circuit is also a resistor in the form of a 75-watt bulb. By changing any one of the three values —inductance, capacitance, resistance— we upset the balance of the resonant circuit, and thereby decrease the current.

To make this puzzler, select a filter choke of about 0.5-henry inductance and about 60 ohms dc resistance. Set up the experiment as shown in the figure, using any available filter choke handy. Start with a 1-μf nonelectrolytic



capacitor. Turn the 40-watt bulb into the socket. If it lights, turn it out again and add another 1-μf capacitor in parallel with the first. Continue this in small steps, adding preferably 0.5-μf capacitors until the 40-watt bulb fails to light. Now turn in the 75-watt bulb, and it should glow. All that remains is to connect three similar sockets and insert in them bulbs of smaller wattages, such as a 25, 15 and another 15.

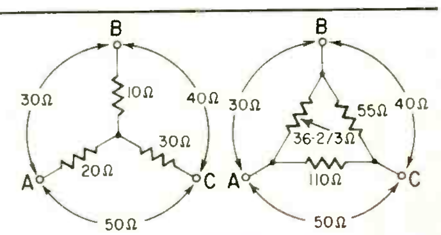
A word of caution when working on your experimental hookup: You are leading line voltage out onto your bench —be careful! Also the capacitors store up a considerable charge—don't think the circuit is "dead" when you pull the plug. Screw in a lamp and discharge the capacitor. And, be sure you have only one bulb turned into its socket when you are experimenting for the proper value of capacitance.

When you get the proper value, a single capacitor (or two if necessary to get the correct value) may be substituted and the unit built into a box for demonstration purposes. It is a good idea, as stated before, to make the top panel plastic and keep the wiring in plain sight so the parallel connections can be seen plainly. This adds greatly to the mystification.

Observe that, by taking resistance out of the resonated circuit (turning the bulbs in *decreases* the resistance in the parallel bulb circuit), we do not unbalance the resonant period greatly. On the other hand, by increasing resistance (turning the bulbs out), we reach a definite point where the circuit suddenly drops out of resonance.

Black Resistor Box

Resistance between A and B is 30 ohms; between B and C 40, and between A and C, 50 ohms. The easy answer is at the left. But, where resistors can be hooked up in Y-formation, they can also be hooked up in delta with the same results, as shown at the right.



What's the Trouble

Since the set was nearly new, the shop technician decided to make a couple of localizing checks before pulling the chassis (always a good idea). He replaced the 6EM7 vertical oscillator output again, but, as the outside technician had noted, it did not cure the fault. Looking at the circuit, he saw that the sync separator might be introducing the bar, or that perhaps the video amplifier was in some way superimposing the bright bar. The shop technician localized the trouble to these stages by pulling one tube, the 6EB8, which was both the video amplifier and the sync separator. With the 6EB8 out, the bright bar disappeared. A new 6EB8 cured the trouble. The original tube was checked and found to have a slight leakage from heater to grid and heater to cathode of the triode section.

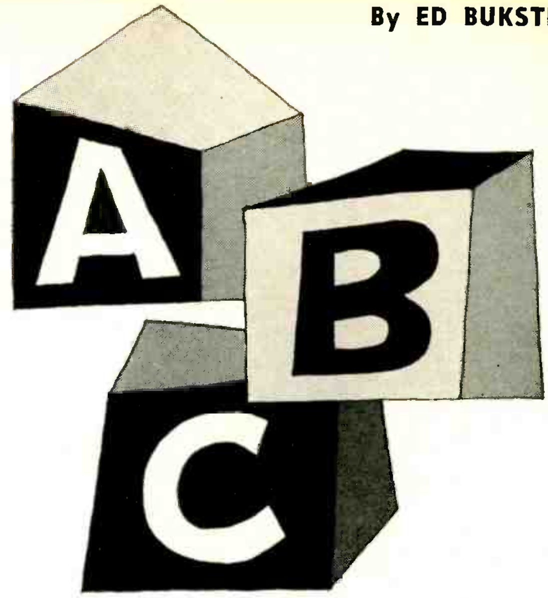
Notes on June Puzzles

The frequency-divider puzzle was answered by a number, all of whom suggested that a feedback from stage 4 to stage 3 would give the effect of an extra four counts, and thus produce an output at the count of 12. Two methods of solving the problem of resetting the counter were proposed.

The Voltage Jungle

It appears that by using aiding and bucking circuits in an autotransformer configuration, two more voltages may be added to the 21 given by the author. This gives us 23 voltages: 19.2, 23, 28.75, 38.4, 46, 57.5, 69, 76.8, 86.25, 92, 96, 115, 138, 143.75, 153.4, 172.5, 191.7, 230, 287.5, 345, 460, 575 and 690.

By ED BUKSTEIN*



INDUSTRIAL ELECTRONIC DICTIONARY

This second installment runs from barrier-layer cell to capacitive storage welding

Barrier-layer cell: A type of photocell that develops a small amount of voltage in proportion to the amount of illumination it receives. The barrier-layer cell is also known as a photovoltaic cell.

Binary circuit: A circuit having two stable states and switching from one to the other each time it receives an input pulse. The two sable states of the binary circuit shown in Fig. 3 are V1 below cutoff and V2 conducting, and V1 conducting and V2 below cutoff. Each time a negative pulse is applied to the circuit's input, the tube previously conducting is driven below cutoff. The increasing plate voltage of this tube raises the opposite grid above cutoff, reversing the state of the circuit. Since two input pulses are required for a complete cycle of operation (the first pulse reverses the circuit; the second pulse restores it to its starting condition),

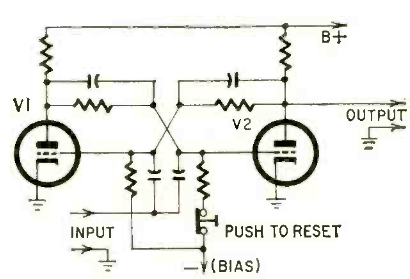


Fig. 3—Binary circuit requires two input pulses for each complete cycle of operation. Reset switch starts circuit with right-hand tube conducting.

*Northwestern TV & Electronics Institute, Minneapolis, Minn.

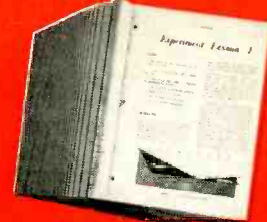
RCA training at home can be the smartest investment you ever made

Look what you get in the Course in Radio and Electronic Fundamentals

40 Fascinating THEORY LESSONS

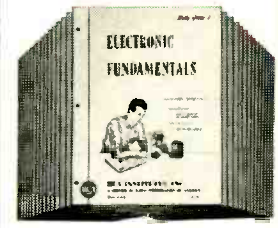
Containing all the basic principles of radio and electronics in easy-to-understand form.

40 EXPERIMENT LESSONS



Each containing absorbing, practical experiments bound together in 20 books.

40 SERVICE PRACTICES



Full of practical, time-saving and money-saving servicing tips, bound into 20 books.

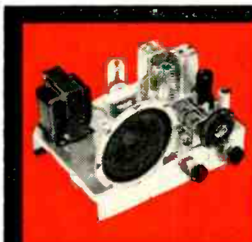
PLUS ALL THIS AT NO EXTRA COST...

15 KITS

to build a Multimeter, AM Receiver and Signal Generator. Kits contain new parts for experiments, integrated so as to demonstrate what you learn in the lessons and to help you develop technical skills. Each kit is fun to put together!

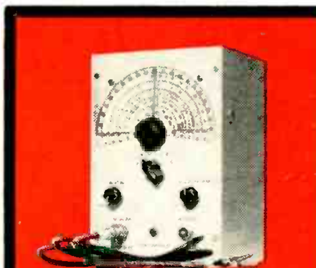
MULTIMETER

A sensitive precision measuring instrument you *build* and *use* on the job. Big 4½" meter with 50 microamp meter movement. 20,000 ohms-per-volt sensitivity d-c, 6,667 a-c.



AM RECEIVER

Have the satisfaction of building your own radio receiver with this high-quality 6-tube superheterodyne set. Big 5" speaker, fine tone!



SIGNAL GENERATOR

A "must" for aligning and trouble-shooting receivers. Build it for your own use. 170 KC to 50 MC fundamental frequencies for all radio and TV work.

Also, comprehensive, fully-integrated home study courses in • *Television Servicing* • *Color Television* • *Electronics For Automation* • *Transistors. Stake out your future in electronics* with any one of this wide variety of courses. Practical work with the very first lesson! Pay-only-as-you-learn! No long-term contracts to sign! No monthly installments required. Pay only for one study group at a time, if and when you order it!

SEND FOR FREE HOME STUDY CATALOG TODAY!

RESIDENT SCHOOL COURSES in Los Angeles and New York City offer comprehensive training in Television and Electronics. Day and Evening classes. Free Placement Service. Catalog free on request.

RCA INSTITUTES, INC.
A Service of Radio Corporation of America • 350 W. 4th St., New York 14, N. Y. • 610 S. Main St., Los Angeles 14, Calif.

RCA®
The Most Trusted Name in Electronics

RCA INSTITUTES, INC. Home Study School, Dept. RE-81
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N. Y.

Without obligation, rush me the FREE 64-page illustrated booklet "Your Career in Electronics" describing your electronic home study training program. No salesman will call.

Name..

Address..

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

Veterans: Enter discharge date..

CANADIANS—Take advantage of these same RCA courses at no additional cost. No postage, no customs, no delay. Send coupon to: RCA Victor Company, Ltd., 5581 Royalmount Ave., Montreal 9, Quebec.

For Resident School Courses See Ad On Opposite Page

the circuit functions as a 2-to-1 frequency divider. (The binary circuit is also known as a bi-stable multi-vibrator, Eccles-Jordan circuit, trigger circuit and flip-flop.)

The manual reset switch in Fig. 3 is used to remove the bias momentarily from V2, allowing it to conduct and establishing the starting condition (V1 below cutoff and V2 conducting). This is the off condition of the circuit. When an input pulse is applied, V2 is driven to cutoff and V1 conducts. This is the on condition of the circuit.

Binary counter: A pulse-counting instrument consisting of a number of binary circuits connected in cascade. Fig. 4 shows the switching actions which occur in a four-stage binary counter. At the start, all stages are off. The first stage turns on when the first input pulse is applied, and turns off again when the second pulse is applied. As the first stage turns off its left-hand tube conducts and the decreasing plate voltage provides a negative trigger pulse to turn on the second stage. Each stage is turned on and then off by each pair of trigger pulses it receives, and each stage generates a trigger pulse (for the following stage) when it returns to the off condition. As a result, two input pulses must be applied to the first stage to turn on the second stage. Four inputs to the first stage will turn on the third stage, and eight inputs to the first stage will turn on the fourth stage.

To provide a front-panel indication of the number of input pulses the counter has received, a neon lamp is connected to each stage (across the plate load of the left-hand tube). Therefore, the light will be lit when the stage is on. The four lights are numbered 1, 2, 4 and 8 (Fig. 4) and the pulse count is indicated by the lights that are on. After 6 input pulses, for example, lights 2 and 4 will be lit. After 11 pulses, lights 1, 2 and 8 will be lit; etc.

A four-stage binary counter has a counting capacity of 2^4 or 16. All four stages (Fig. 4) are off again after 16 input pulses have been applied. At this time, the last stage produces an output pulse and the switching actions listed in Fig. 4 are repeated for the next group of 16 pulses (17 through 32 inclusive). For a greater counting capacity more stages may be connected in cascade. Five cascaded stages will have a capacity of 2^5 or 32; six stages in cascade will have a capacity of 2^6 or 64, etc. The additional neon lamps,

8 ← 4 ← 2 ← 1 ← IN

FOURTH STAGE	THIRD STAGE	SECOND STAGE	FIRST STAGE	INPUT PULSES
OFF	OFF	OFF	OFF	START
OFF	OFF	OFF	ON	1
OFF	OFF	ON	OFF	2
OFF	OFF	ON	ON	3
OFF	ON	OFF	OFF	4
OFF	ON	OFF	ON	5
OFF	ON	ON	OFF	6
OFF	ON	ON	ON	7
ON	OFF	OFF	OFF	8
ON	OFF	OFF	ON	9
ON	OFF	ON	OFF	10
ON	OFF	ON	ON	11
ON	ON	OFF	OFF	12
ON	ON	OFF	ON	13
ON	ON	ON	OFF	14
ON	ON	ON	ON	15
OFF	OFF	OFF	OFF	16

Fig. 4—Four-stage binary counter has 16 combinations of on and off. Neon lamps numbered 1, 2, 4, and 8 indicate pulse count.

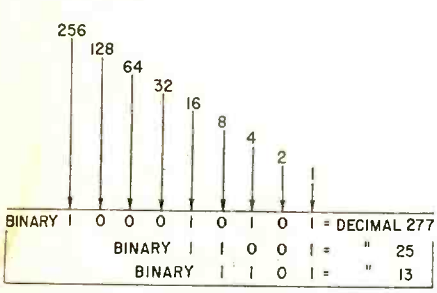


Fig. 5—Binary system of notation uses only two symbols—0 and 1. Positional values from right to left are 1, 2, 4, 8, 16, etc.

one for each stage, are numbered according to the binary sequence: 1, 2, 4, 8, 16, 32, 64, 128, etc.

Binary notation: A number system using only two symbols: 0 and 1. (The familiar decimal number system uses 10 symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9). The ones and zeroes of the binary system are referred to as *bits* rather than digits. The binary numbers 101, 101110, and 11010110 are therefore three-bit, six-bit, and eight-bit numbers.

In the decimal system of notation, the digits (from right to left) represent units, tens, hundreds, thousands, etc. By contrast the bits of a binary number (from right to left) represents units, twos, fours, eights, sixteens, etc. As shown in Fig. 5, binary number 1101 therefore means one 1, no 2, one 4, and one 8, and is therefore equivalent to thirteen in the decimal system ($1 + 4 + 8 = 13$).

In digital computers and control equipment, quantities are expressed in binary notation because each bit can be *stored* in a binary stage (on = 1, off = 0), in a ring-shaped magnetic core (clockwise magnetization = 1, counterclockwise = 0), in a punched paper tape (hole in tape = 1, no hole = 0), etc. Because these two-state circuits and components are simpler and less critical in design than ten-state circuits and components, the use of binary rather than decimal notation permits a considerable reduction of circuitry.

Binary scaler: Same as binary counter.

Bucky grid: An assembly of alternate strips of lead and wood used in conjunction with X-ray equipment. The Bucky grid is placed between the specimen to be examined and the photographic film (Fig. 6). In passing through the specimen, some of the X-rays are scattered and emerge at various angles. These scattered rays tend to fog the film and to reduce the contrast. The Bucky grid prevents scattered rays from reaching the film.

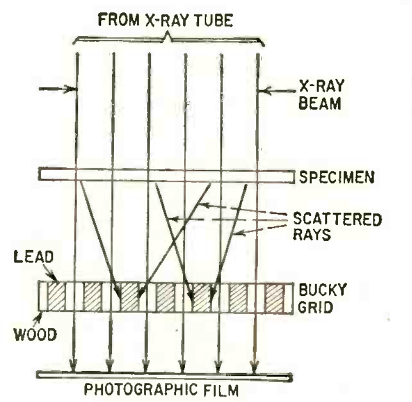


Fig. 6—Scattered x-rays are absorbed by lead strips of Bucky grid. Straight-line radiation passes through wood strips to photographic film.

As indicated in Fig. 6, the scattered rays strike the sides of the lead strips and are absorbed. Straight-line radiation reaches the film by passing through the wood between the lead strips. The Bucky grid is moved about during the exposure time to prevent X-ray shadows of the lead strips from appearing on the film.

C

Capacitive storage welding: A form of resistance welding in which energy is stored in a bank of capacitors and then released to produce the weld. The capacitors are charged from a dc source and then discharged through the primary of the welding transformer (Fig. 7). The resulting current flow in the secondary circuit produces enough heat to weld the metals. To Be Continued

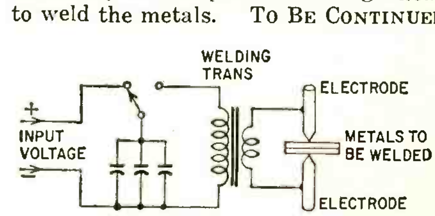
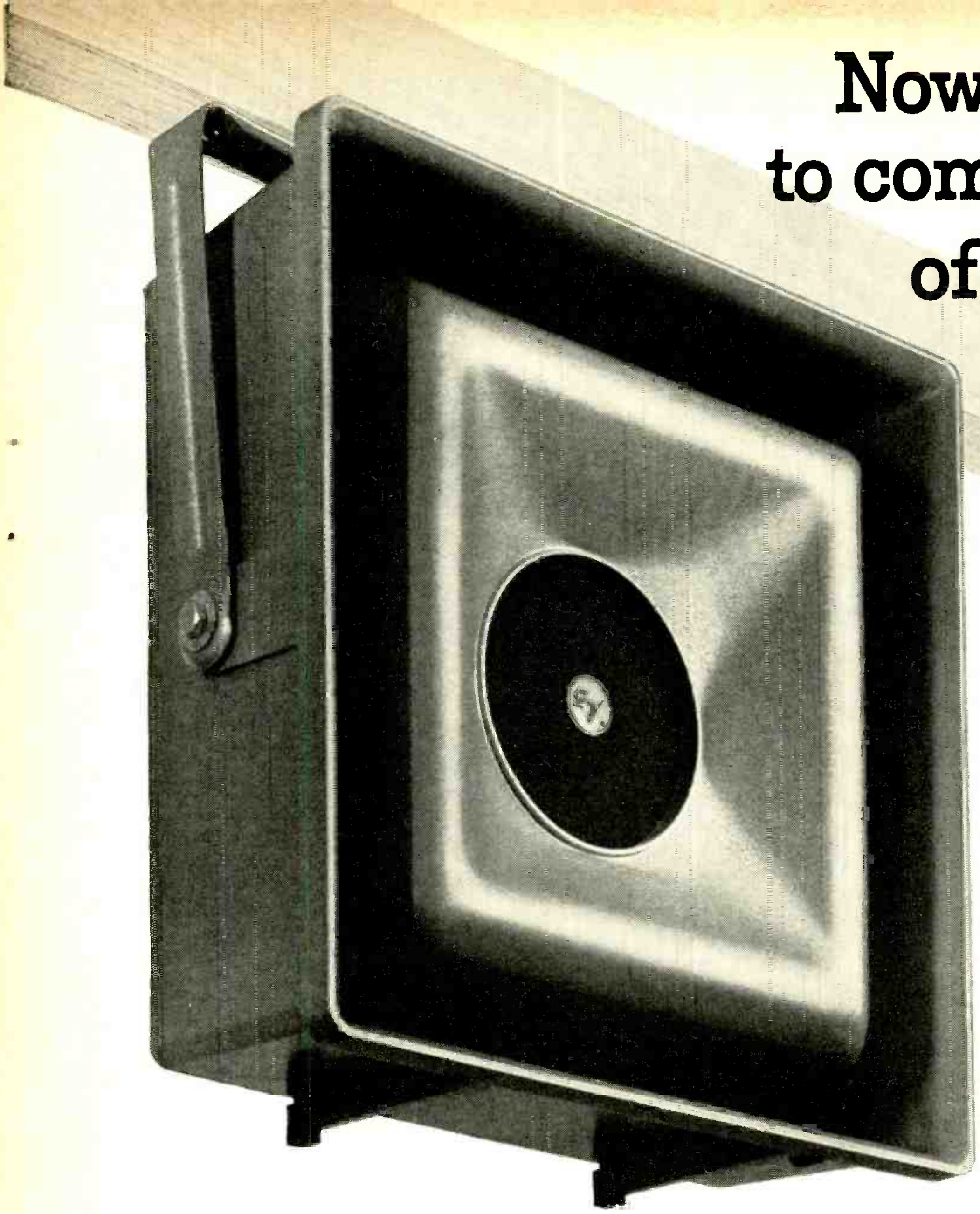


Fig. 7—Capacitive storage welder allows charged capacitors to discharge through primary of welding transformer. Secondary current produces heat to weld metals.



Now is the time to come to the aid of your outdoor party!

The more you enjoy outdoor living, the more you'll enjoy the Electro-Voice Musicaster—world's finest weather-proof loudspeaker system.

A Musicaster will add to your fun wherever you are. Whether you're dancing under the stars, swimming in the pool, or relaxing around the barbecue in the backyard, music from a Musicaster adds the pleasure of outdoor high-fidelity music from your present Hi-Fi system, radio, phonograph or TV set.

It's easy to connect for permanent use outside, or you can simply move your Musicaster into the recreation room for year-'round pleasure.

Designed for indoor-outdoor use, the E-V Musicaster obtains high-fidelity response from a heavy-duty weather-proofed speaker mounted in a rugged aluminum die-cast enclosure. This combination insures long-lasting satisfaction under all conditions.

Now is the time to come to the aid of your outdoor party . . . with an Electro-Voice Musicaster. It's easy to install . . . send for full information and the name of your nearest E-V sound specialist.

ELECTRO-VOICE High-Fidelity Speaker System . . . it's Weather-proofed!

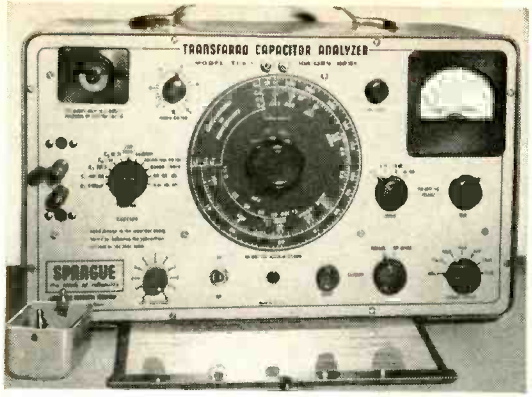
P.S. If your school, church or club needs a tough, high-quality, all-purpose speaker, the smart choice is an Electro-Voice Musicaster.

SPECIFICATIONS:
Frequency Response: 60-13,000 cps
Dispersion: 120°
Power Handling Capacity: 30 watts program
Impedance: 8 ohms
Size: 21½" H x 21½" W x 8½" D
Weight: 31 lbs. net
Price: $54.00
Musicaster II available with additional tweeter to extend response to 18,000 cps. Price: $75.00

Electro-Voice, Inc. Dept. 814F
Buchanan, Michigan
Please send me your booklet, "How to Enjoy High-Fidelity Outdoors."
Name________
Address________
City________ State________

Electro-Voice®

ELECTRO-VOICE, INC., Consumer Products Division, Buchanan, Michigan



Sprague TCA-1 Transfarad capacitor anyalzer. Shield, left, fits over test terminals to prevent stray pickup from affecting reading when testing small value capacitors.

Low-Voltage Capacitor Analyzer

By WAYNE LEMONS

This new capacitor analyzer is especially designed for safe testing of low-voltage transistor circuit capacitors. The test voltage applied to the bridge circuit for capacitance and power-factor tests is only 0.5 volt. A special circuit measures low-capacitance units (from 1 to 100 μμf). Even the insulation resistance of 3-volt ceramic capacitors can be measuring without over-stressing the insulation. A high-gain meter amplifier provides a full-scale sensitivity of 0.6 μa for measuring the leakage current of low-voltage units.

This instrument measures capacitance with the time-honored bridge circuit, but the technique has been refined so that only a very small voltage is applied to the capacitors under test. The maximum voltage across the bridge is only 0.5 ac and even less across the capacitor being tested. This compares with 25 volts and more used in some earlier bridges, enough to destroy the low-voltage capacitors found in transistor circuits!

With only 0.5 volt applied to the bridge, however, a 12AT7 voltage amplifier is needed to provide a sharp null reading. An eye sensitivity control on the front panel lets the operator select a sharper or broader null by controlling the voltage input to the eye amplifier.

Bridge circuit

The basic bridge circuit used in the TCA-1 is shown in Fig. 1. The 0.5-volt ac is applied across the main dial resistor in parallel with a standard capacitor and the unknown capacitor in series. The main dial is rotated until the bridge thus formed is nulled (voltage is zero). When this occurs, the eye opens (maximum shadow width) and the value of the unknown capacitor is read directly on the calibrated dial.

This kind of bridge has one drawback—it is hard to balance when small-value capacitors (under 100 μμf) are to be measured. Sprague solved this problem with a trick often used by technicians—shunting the small-value capacitor with a known-value of around 25 μμf and then subtracting that from the reading obtained on the bridge. The TCA-1 automatically switches in the fixed capacitor and the dial is calibrated accordingly so that no mental gymnastics are required.

Electrolytic bridge

Fig. 2 is the basic Wein-bridge circuit used for measuring the capacitance and power factor of electrolytics. Since power factor is analogous to the series resistance of a capacitor, an adjustable resistor is placed in series with the standard capacitor (2 μf). This is the power-factor control and it is adjusted for maximum eye opening in conjunction with the main dial. The power factor, in percentage, is read directly from the power-factor dial (the smaller the figure, the better the capacitor).

Other functions

In addition to capacitance measurements at low voltage, the TCA-1 reads insulation resistance (leakage in ohms) of paper, film, mica, ceramic, etc. capacitors as well as leakage current of electrolytics. These functions are read directly on the panel meter. To provide the extreme sensitivity necessary to register leakage accurately with small amounts of applied voltage, a meter amplifier is used with the meter so that full-scale sensitivity is 0.6 μa on the lowest range. Leakage currents as small as .02 μa can be read with ease. Insulation resistance to 20,000 megohms can be read (500 megohms center-scale). Calibration voltages are supplied internally so the meter amplifier can be preset for the correct value of gain. This means that the accuracy of the instrument will not be affected by the normal aging of tubes or parts. In addition, the meter amplifier is completely encapsulated to keep out moisture. The TCA-1 also has both magnetic and electronic regulation to provide good stability and accuracy with a line-voltage variation of even 20 volts.

Operation

The TCA-1 is simple to operate. To measure capacitance, simply set the selector to the anticipated range and rotate the main capacitance dial until the eye opens. Read the value of capacitance directly from the calibrated dial. If the null is not sharp on low-value capacitors, place the shield over the input terminals to eliminate stray hum pickup. If a sharp null still cannot be obtained or if the eye flickers, the capacitor should be discarded. Note: adjusting the eye sensitivity control may produce a sharper null.

To measure insulation resistance and leakage, the meter amplifier must be calibrated first. (This uncomplicated process is fully explained on the pull-out slide at the bottom of the instrument. The slide also contains instructions covering most of the functions of the analyzer. A good instruction book also comes with the instrument to explain special functions.) For capacitors with a voltage rating of 25 or more, the insulation resistance is read directly on the ohms scale of the meter. For capacitors rated at less than 25 volts and for electrolytics, the voltage may be preadjusted from 0 to 150 and the leakage read directly in microamperes on the meter scale. Capactitors that have excessive leakage or in which the leakage does not stabilize should be discarded.

The TCA-1 is made by Sprague Products Co.

END

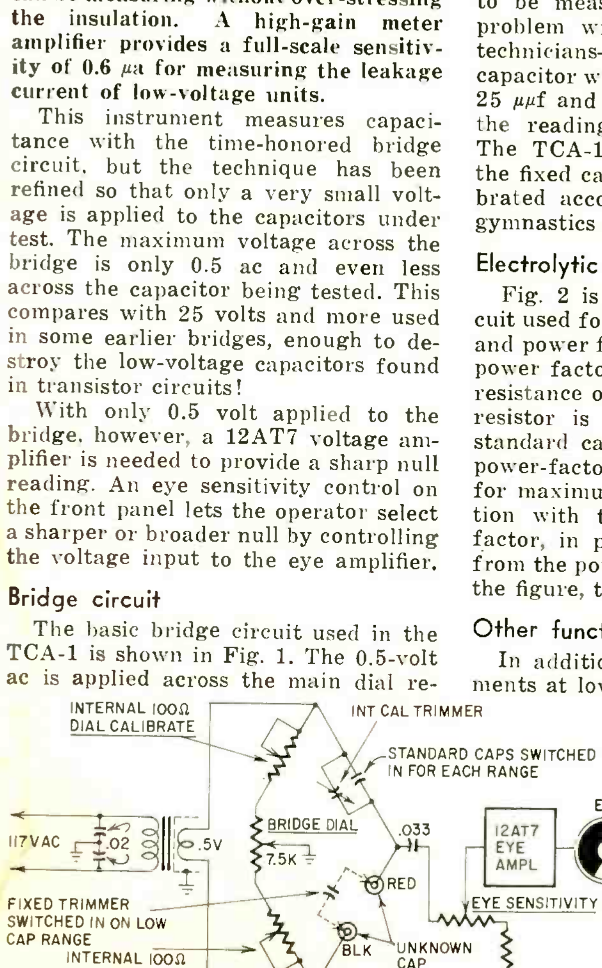


Fig. 1—Basic bridge circuit used in measuring small capacitances.

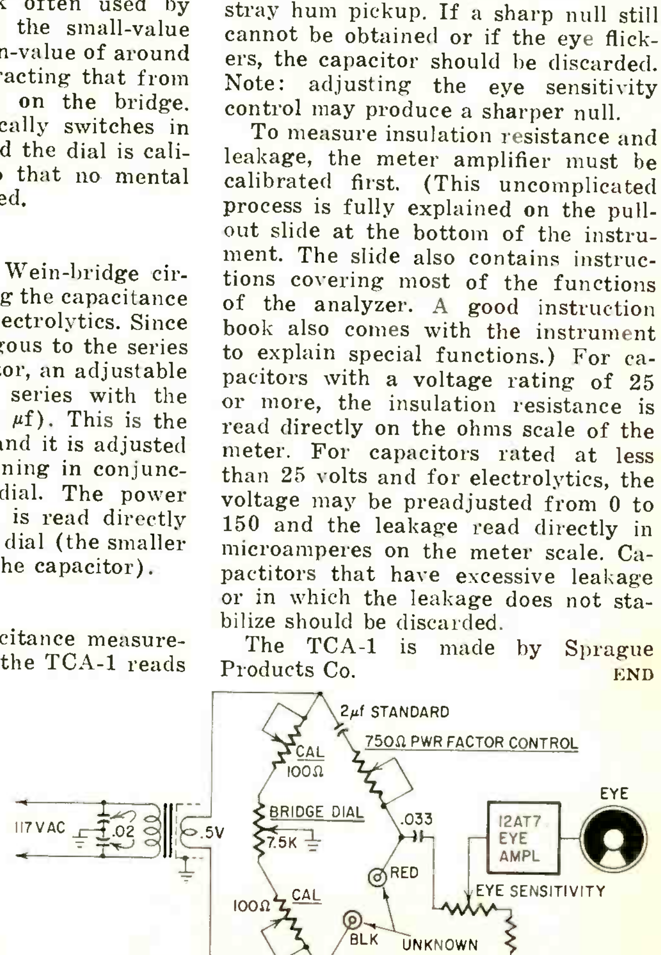
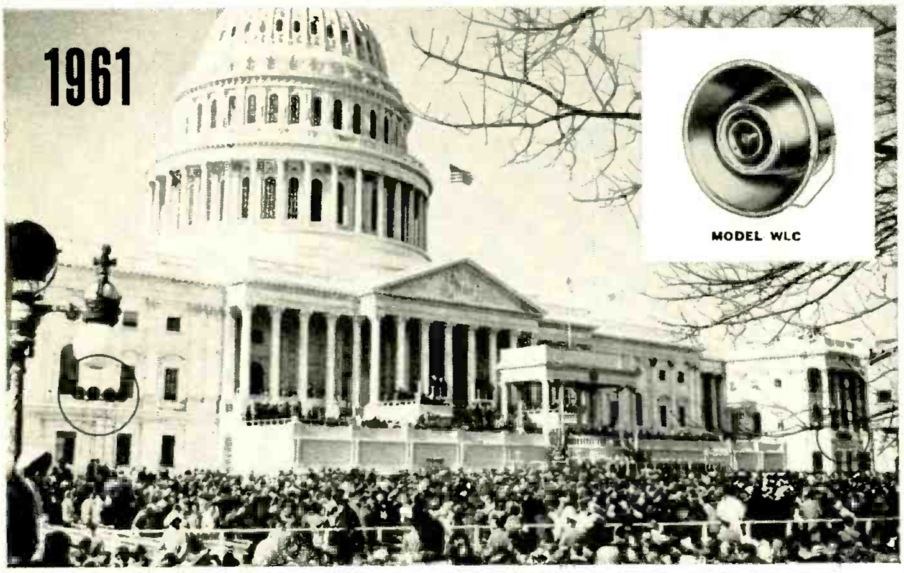


Fig. 2—Wein-bridge circuit used to measure electrolytic capacitance and power factor.

UNIVERSITY IS CHOSEN AGAIN FOR PRESIDENTIAL INAUGURATION



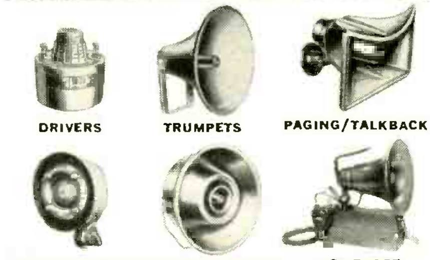
Flanking the main platform where the ceremonies took place are two arrays of four University WLC's each, the finest outdoor high fidelity speakers made. The heavy snow that fell the day before the 1961 inauguration had no effect whatsoever on the performance of these speakers.

UNIVERSITY—THE WORLD'S LARGEST MANUFACTURER OF PUBLIC ADDRESS SPEAKERS

For every public address installation, University's complete line of drivers, trumpets, paging/talk-back and many special purpose speakers assures you of the exact speaker required to do the job as specified, at minimum cost and without waste. For complete information, write Desk J81, University Loudspeakers, Inc., 80 So. Kensico Avenue, White Plains, N.Y.

OUTDOOR HIGH FIDELITY LOUDSPEAKERS REPEAT SOUND SUCCESS OF '57

Wherever highest quality reproduction of voice and music is essential – with wide-angle coverage at high output levels, full frequency response and complete protection against the weather – that's where you'll find University up front. Not only at Washington's Capitol Plaza, but at auditoriums, parade grounds, stadiums and concert halls throughout the world. For all University's weatherproof speakers are *genuine dual-range systems*, with separate bass and treble drivers – resulting in full-bodied lows, cleaner highs, greater efficiency, less distortion and superior acoustic projection.



UNIVERSITY™

A Division of Ling-Temco Electronics, Inc.

this is the way to enjoy music outdoors!

with University's

MUSIC/AIRE™

weatherproof high fidelity speaker systems

There's no need to settle for the restricted range of a portable when you go outdoors. Instead, connect a Music/Aire speaker (or two for stereo) to the speaker terminals of your radio, phono, TV set, or hi-fi amplifier . . . and thrill to wide-range, full-bodied high fidelity sound wherever you go. Each model is a genuine dual-range speaker, with separate woofer and tweeter. Leave 'em out in rain or shine—they're immune to everything but superb sound! For new illustrated brochure, write Desk J-8, University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N.Y.

MLC ideal for moderate-size areas. Front loaded folded horn. 12¾" x 9⅛" x 10⅝" deep. $34.50

BLC with extended bass. Front loaded folded horn. 22¾" dia., 9¼" deep. $53.70

UNIVERSITY™

A Division of Ling-Temco Electronics, Inc.

INDUSTRIAL ELECTRONIC BREADBOARDING

Let a breadboard speed your circuit design problems

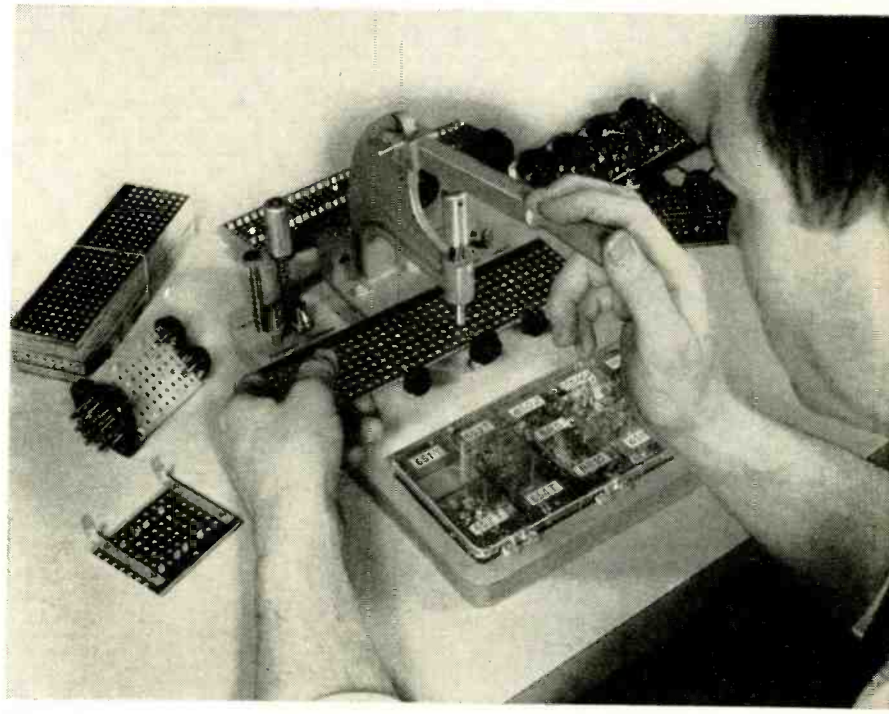
By JAMES ROBERT SQUIRES*

BREADBOARDING once meant pulling out an actual wooden breadboard and setting up an experimental electronic circuit on it. Today things are a little different and many "breadboard" systems (the name stuck) are available as aids for the circuit designer and experimenter. They can be both time- and money-savers if used properly.

Before using any breadboard, there are a few points the circuit technician must consider, whether he is an experimenter or an industrial technician.

Pulse circuits, for example, must be laid out with the utmost care. Extra pains must often be taken to preserve the shape of a square wave.

Stray inductance and capacitance along with cold-solder joints often restrict breadboard applications. Generally, it is wise to breadboard a circuit so that stray L and C will be about the same as they will be in the finished package.



Alden Products kit 42 makes variety of breadboard and prototype circuits.

The breadboard technician should keep in mind the future of the components making up the proposed circuit. Any special components such as a matched pair of Zener diodes are rather expensive. Of necessity, they must be used on the board in the proposed circuit as well as in the finished package. Components like these must be treated with kid gloves.

A few good rules are to be observed. First, never install special components in a breadboard until all surge currents and voltages have been measured (when possible). Then start the power supply at lower-than-rated values and slowly raise the voltage. Monitoring the current drawn from the supply can save you dollars and your temper. Very often, a few simple applications of Ohm's law will indicate any excessive (or damaging) currents or voltages. Special components should be tested before installation. It will put the refund argument in your favor when you do find a bad item.

Location and orientation of components in relation to others should be the same as intended in the final package. This applies especially to high-frequency components, mechanical arms and power resistors. All special-component leads should be left as long as possible to avoid mounting problems in the final assembly.

Often the finished package must be visualized and the breadboard built along these lines. This is to prevent changes of relative lead positions after you get the circuit operating properly. Then the final package is constructed without any substantial change in component or lead positioning.

After the circuit is functioning as planned, the next step is mounting it in its finished package. Cooling and electrostatic and electromagnetic shielding problems should be considered. Have the number of adjustments been reduced to a minimum? Are special components properly mounted? Once these questions have been answered, the circuit can be packaged.

Whenever semiconductors are used, heat becomes an important considera-

*Hughes Aircraft Co.

tion. A household hair dryer is useful for raising their temperatures during heat tests. All components that will be subjected to higher temperatures or confined in poorly cooled spaces should be derated. Again the hair dryer will point out any temperature-sensitive components. Leave room for diode and transistor heat sinks where necessary. Heavy vibration means that the transistors must be soldered in place.

The breadboard should not be dismantled until the finished package is operating. This eases those embarrassing moments when the finished package refuses to work.

The quality of the board reflects the quality of the worker. The old adage, "The sloppier it is, the better it works," is not true in transistor circuitry. A shorted lead can destroy expensive diodes, transistors or other components. A new adage—"Neatness is an economical must"—has displaced the old.

Breadboards for sale

Many manufacturers sell breadboard kits. Here is a listing of various breadboard sources and a brief description of the products offered.

American Research Laboratories (336 S. Main St., Fort Atkinson, Wis.) and Pomona Electronics (1126 W. Fifth Ave., Pomona, Calif.) are two companies handling complete circuit synthesizers for from approximately $300 to $400. Pomona Electronics also handles breadboard flat-mounting seven-, eight- and nine-pin tube sockets. Rimak Inc. (10929 Van Owen St., N. Hollywood, Calif.) produces a kit under the name See-Zak. Mounting plates are used as subparts of a larger main chassis. Starter kits prices start at about $17.

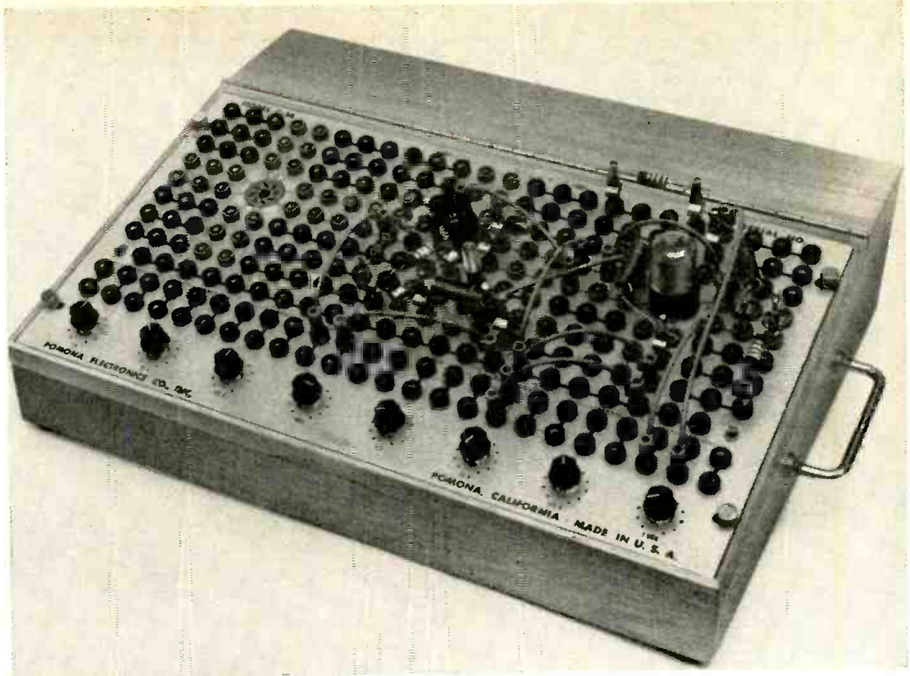
Vector Electronics Co. manufactures a complete line of Structures for Circuitry. Its line includes many forms of terminal turrets and plug-in units. It also manufactures complete experimenter's chassis which include zip terminals for easy construction. Price for its 20X chassis, with accessories, is approximately $6.25. More complete prices and listings are available from the company, 1100 Flower St., Glendale 1, Calif.

Specific Products (21051 Costanso Street, Woodland Hills, Calif.) lists its super kits for about $19. A new transistor kit is also available. Specific Products makes a series of adjustable power supplies for use with its breadboards. These provide B-plus and filament power for most tube circuitry.

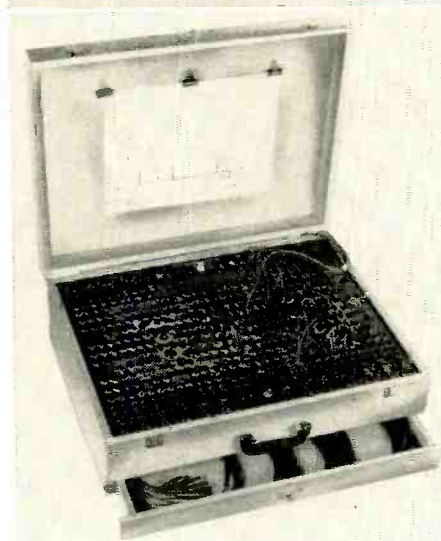
Alden Products Co. (117 North Main St., Brockton 64, Mass.) produces components for packaging a completed breadboard design. Its Get Started Terminal Card kit sells for about $115.

The Printed Circuit Division of Techniques Inc. (40 Jay St., Englewood, N. J.) offers a complete line of etched-wire printed-circuit kit components. Kits start at $3.75 and are handy where printed circuits are used.

Dunlap Electronics (764 Ninth St., Des Moines, Iowa) produces printed-circuit boards and chassis adaptable to

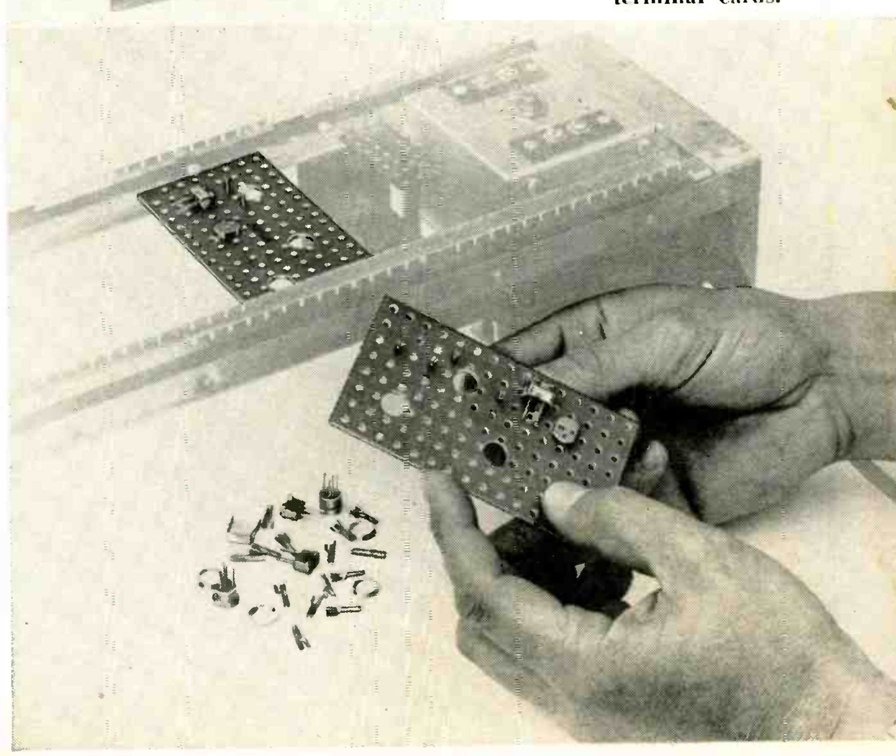


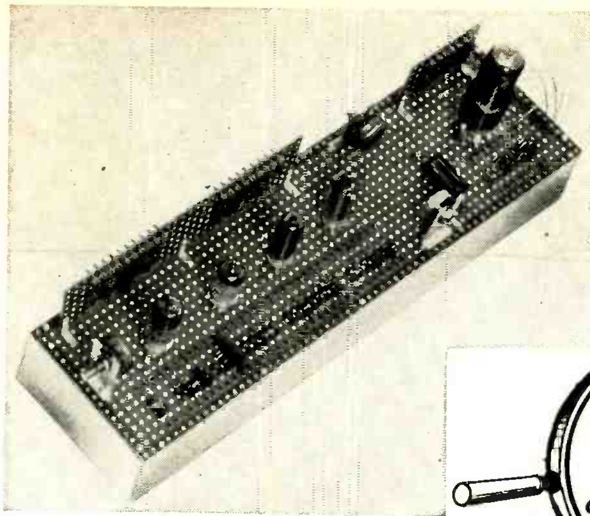
Pomona Electronic model C-38 Circuit Designer with a test circuit setup.



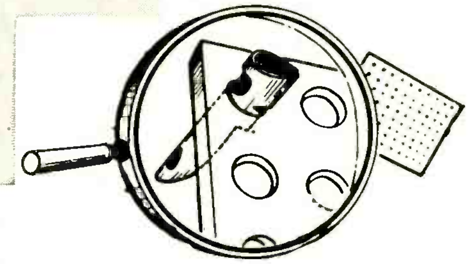
Breadboard setup using the American Research Laboratories model A-55 Electronic Circuit Synthesizer.

Detailed view of Specific Products Speed Chassis terminal cards.





A Vector breadboard layout before wiring.



Flea clips from Lafayette Radio.

both breadboard work and final packaging design.

Often there is a need to try out an idea without spending time on soldering. Walsco Electronic Manufacturing Co. (Rockford, Ill.) produces a breadboard kit which uses Walsco spring connectors that give positive contact without soldering. Tube and transistor sockets as well as control-mounting brackets are provided. Components are soldered to the tube sockets. However, component juggling is simplified by the spring contacts. This has a dealer's net of about $10.

For those who cannot go to the expense of a formal breadboard layout, there are the less expensive methods. Perforated Bakelite and Masonite boards are especially suited to transistor work. Flea clips are used as subminiature metal terminals. Boards and clips may be purchased at many large radio supply houses. Lafayette Radio (165-08 Liberty Ave., Jamaica, N. Y.) offers the flea clips. Also, Vector manufacturers a Vectorboard having 1/16-inch holes that take their T-28 flea clip. The T-28 sells for $1.55 per hundred. Newark Electric Co. (223 W. Madison St., Chicago, Ill.) lists a complete line of press-fit Teflon-insulated terminals. With these boards and terminals, breadboards can be fashioned to meet most job requirements. This is only a sample cross-section of the available commercial electronic-breadboard kits. END

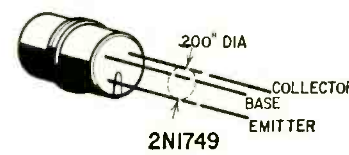
One of Techniques Inc.'s larger printed-circuit kits.

NEW TUBES and SEMI-CONDUCTORS

WANT TO BUILD A STEREO AMPLIFIER?—there's a tube for it here. Need tubes for 26-volt operation?—they're here too. You'll also find a group of twin triodes for horizontal or vertical oscillators in TV receivers.

2N1749

A germanium micro-alloy diffused-base transistor designed for use as the video output stage in television receivers.



The high-gain–bandwidth product (typically 115 mc) provides uniform gain for the video frequencies. Polarities are similar to p-n-p junction transistors.

Maximum ratings of the Philco 2N1749 are:

V_{CB}	40
V_{CE}	40
V_{EB}	1
I_C (ma)	10
P_{total} (mw)	75

7887, 7888, 7889

These three tubes are 26.5-volt heater versions of the 6111, 5718 and 7889, respectively. The 7887 is a medium-mu double triode for oscillator, amplifier and low-power servo circuits. The 7888 is a high g_m, medium-mu triode for uhf oscillator and low-frequency oscillator and amplifier applications. The 7889 is a high-mu double triode for low-level audio circuits.

Characteristics of these Sylvania tubes are:

	7887	*7888*	*7889*
V_{htr}	26.5	26.5	26.5
I_{htr} (ma)	90	45	90
V_p	100	100	100
R_K (ohms)	220	150	1,500
R_P (ohms)	4,000	—	—
g_m (μmhos)	5,000	5,000	1,800
μ	20	27	70
I_P (ma)	8.5	8.5	0.8

ECL86/6GW8

A 9-pin miniature triode-pentode designed for audio applications. The compact tube is well suited for modern

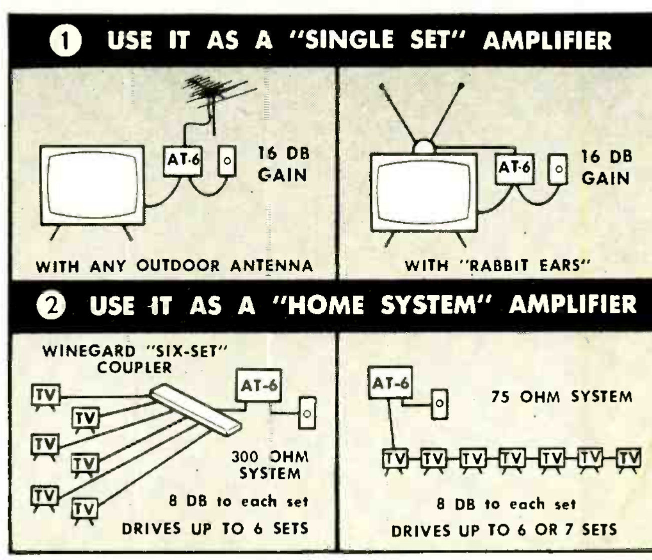
NEW...Home TV Signal Amplifier

Clears up snow, improves contrast, adds miles to reception distance!

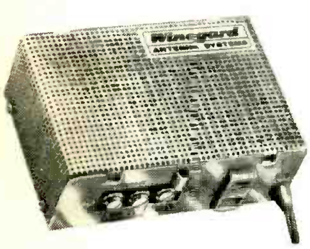
Here's the most unusual (and most useful) home TV-FM signal amplifier you've ever seen! Winegard "Booster-Pack" utilizes new low noise, high gain transistor* to give you a flat gain of 16 db on the low band and FM . . . a flat gain of 14 db on the high band.

Shock-proof . . . full AC chassis with AC isolation transformer (not AC-DC). Draws only 1.2 watts . . . cost only 27c per year to operate if left on continuously. No heat radiation. Can be mounted on back of TV set, on baseboard, in basement, attic, etc. Use "Booster-Pack" as a single set booster or as a home system amplifier for up to 6 or 7 sets. (See right)

*Special transistor so new that this amplifier could not have been produced until now.

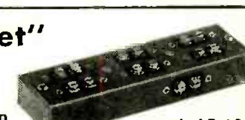


No other amplifier under $80.00 has all these features!



- Drives from 1 to 7 TV/FM sets
- Ideal for color
- Power Consumption: 1,2 watts
- Gain: Low and FM: 16 db
  High: 14 db
- Input: 300 ohm
- Output: 300 ohm and 75 ohm
- Transistor*: Low noise, high gain type
- Power Transformer: AC isolation type
- Gain Control: 3-position switch
- AC Outlet: To receive TV set power plug
- Precision Wiring . . . finest quality throughout

New! Winegard "Six-Set" SIX SET TV COUPLER



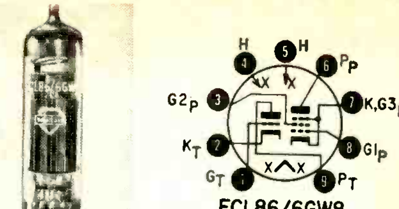
For connecting up to 6 TV sets to "Booster-Pack" or to Winegard Powertron antenna. 300 ohm input and outputs. Low insertion loss, positive isolation between sets.

Mod. LT-63
$7.95 List

ASK YOUR DISTRIBUTOR OR WRITE TO:

Winegard ANTENNA SYSTEMS

WINEGARD CO., 3013-8 Kirkwood Ave., Burlington, Iowa



ECL86/6GW8

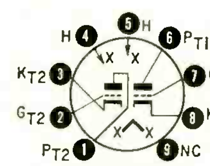
stereo amplifiers and requires a minimum of drive voltage for high power output. It has a 6.3-volt heater that draws 0.7 ampere.

Typical characteristics of this Mullard tube are:

	Pentode	Triode
V_p	250	250
V_{G2}	250	
g_m (μmhos)	10,000	
μ	21	100
R_p (k ohms)	48	
I_p (ma)	36	
I_{G2} (ma)	6	
Power output (watts)	4	

6FQ7, 8FQ7

General - purpose medium - mu twin triodes in a 9-pin miniature envelope designed for use as vertical and horizontal oscillators in TV receivers. Both types have heaters with controlled warmup time. The RCA 6FQ7 and 8FQ7 can also be used in phase inverter, multivibrator, sync separator, sync amplifier, and resistance-coupled af amplifier circuits.



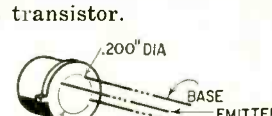
6FQ7, 8FQ7

Maximum ratings of the RCA 'FQ7 series in horizontal-deflection oscillator service are:

V_p	330
V_G (peak neg pulse)	660
I_K (peak) (ma)	330
(dc) (ma)	22
P_p (either plate) (watts)	4
(both plates) (watts)	5.7

2N1289

A germanium meltback n-p-n transistor for high-speed switching circuits. It combines high current gain, high frequency performance, low collector capacitance and low leakage current with a high emitter breakdown voltage. The case is isolated from all elements of this transistor.



2N1289

Maximum ratings of the General Electric 2N1289 at 25°C are:

V_{CER} (R_{BE} = 10,000 ohms)	15
V_{EBO}	15
V_{CBO}	25
I_C (ma)	100
P_{total} (mw)	75

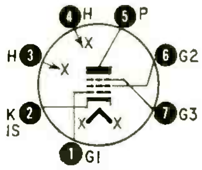
Electrical characteristics are:

h_{FE} (I_C = 10 ma, V_{CE} = 1 v) (typical) 150

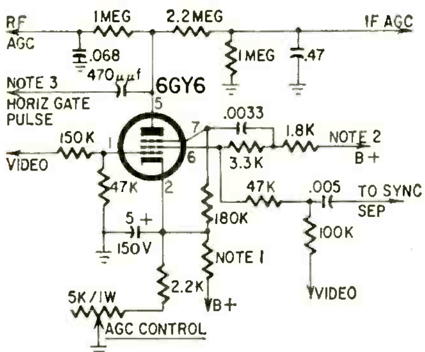
f_{hfb} (alpha cutoff frequency) (I_E=5 ma, V_C=1 v) (typical) (mc) 60

6GY6

A sharp-cutoff 7-pin miniature pentode designed so that grid 1 and grid 3 can each be used as independent control electrodes. This makes the tube well suited for use in gated-agc amplifier circuits and noise-inverter circuits in TV receivers.



6GY6



NOTE 1: SELECT TO OBTAIN 60-65V ON CATHODE (NORMAL PIX)
NOTE 2: EFFECTIVE SCREEN VOLTAGE SHOULD BE 180V OR MORE
NOTE 3: GATE PULSE ON PLATE SHOULD BE 350-400V

In a TV noise-inverter circuit, the 6GY6 can provide a high inverted-noise output voltage at grid 2 for use in cancelling positive-going noise pulses at the signal grid of the sync-separator tube. In addition, a portion of the inverted-noise output voltage can be applied to grid 3 to provide noise immunity for the agc amplifier circuit. A typical noise-immune agc-sync circuit using the 6GY6 is shown in the diagram.

Maximum ratings of the RCA 6GY6 in gated-agc amplifier and noise-inverter service are:

V_P	300
V_P (peak positive)	600
V_{G3} (pos bias value)	0
(neg bias value)	100
V_{G2} (supply)	300
V_{G1} (pos bias value)	0
(neg bias value)	50
P_P (watts)	1.7

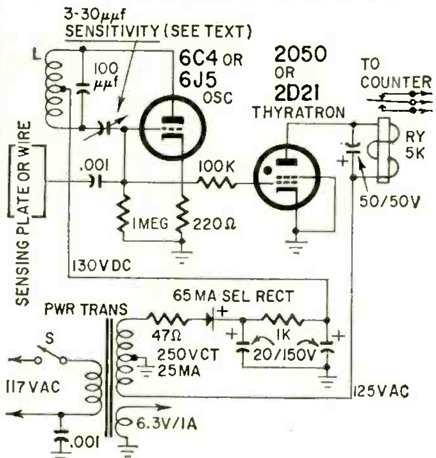
Radio Transistor Replacements

Tung-Sol has announced a line of 11 replacement transistors intended to fill almost every transistor radio replacement need. This group of transistors makes it possible for the service technician to stock only a small number of transistor types, yet be able to repair a large variety of transistor receivers. The 11-transistor group is made up of a pair of mixer/oscillator transistors, a pair of if transistors, a p-n-p 6-volt audio amplifier transistor, two pairs of 9- and 12-volt transistors, and two p-n-p audio output transistors. (A pair of transistors consists of one p-n-p and one n-p-n transistor with similar characteristics.) END

NOTEWORTHY CIRCUITS

CAPACITANCE RELAY & TRAFFIC COUNTER

Readers have asked whether my induction type proximity relay ("Electronic Counter Has Many Uses," December 1959) can be used as a traffic counter. I suggest a capacitance-operated circuit like the one shown for this application. These units operate reliably at distances up to 3 feet from large metal bodies such as automobiles. Once adjusted, the circuit is quite stable and



operates unattended for long periods of time.

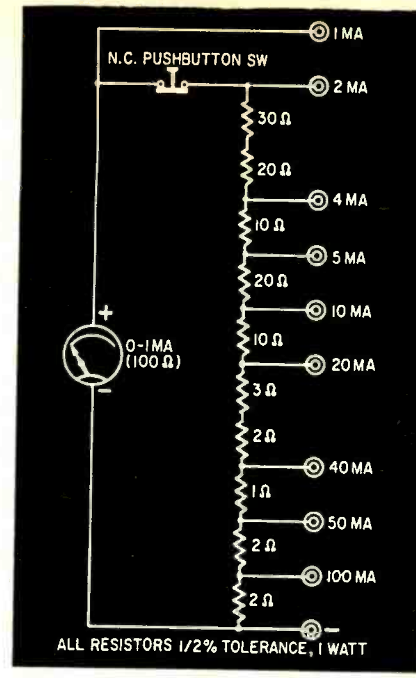
Oscillator coil L consists of 100 turns of No. 28 or 30 enameled wire on a ½-inch form. The tap is at the center. The power transformer has a 250-volt center-tapped secondary. Half the voltage is rectified and fed to the oscillator. The other half supplies ac to the thyratron.

To adjust, start with the sensing plate or antenna in the normal position and the SENSITIVITY control set to maximum capacitance. Back off the control until the relay just pulls in. Increase capacitance until the relay just releases. Set the relay spring tension armature gap and contact spacing for optimum operation.—*John Potter Shields*

WIDE-RANGE MILLIAMETER

Most multimeters measure voltage and resistance in a number of convenient ranges—but when there is a need for accurate *current* measurements, in milliamperes, the ranges are very limited. This milliammeter supplements your multimeter by providing nine current ranges covering from 1 to 100 ma.

The basic movement is a 0–1 milliammeter panel meter with an internal resistance of 100 ohms. Precision resistors totaling 100 ohms are connected in series across the meter, in a univer-



sal or "ring" shunt arrangement. Connections are tapped off various points in this resistor chain, and wired to banana jacks on the panel. The full-scale ranges are 1, 2, 4, 5, 10, 20, 40, 50, and 100 ma. Since the meter scale was unchanged for simplicity of construction, merely multiply the meter reading by the range selected. The great number of ranges provided make this instrument a very suitable aid in running tube-characteristic graphs, etc.

A miniature normally closed pushbutton switch is mounted on the panel above the jacks. It must be pressed to disconnect the shunt resistors whenever 0–1-ma readings are made.

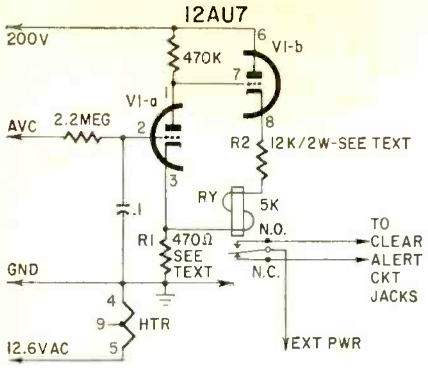
The resistors are soldered to the banana jack lugs and supported by their own pigtail leads. The resistors used were purchased from EICO, which lists them as replacement parts for the EICO model 1171 resistance decade box. Any other resistors may be used as a substitution, with corresponding changes in meter accuracy.

All parts were mounted in a black Bakelite case, obtainable from any mail-order house. Wiring is obviously not critical.—*William E. Bentley*

CONELRAD ALERT MONITOR

Following the article by Harold Reed in the January 1960 issue of RADIO ELECTRONICS, I would like to offer a circuit modification which provides more positive relay action and protects the plate relay against excessive current when avc voltage reaches high values.

Resistor R1, which is common to the cathode circuits of both halves of the twin triode, has a dual function. First, it sharpens the triggering action of the avc voltage since the positive voltage developed at pin 3 increases as the plate current of the second triode rises. At the same time, the first triode is practically cut off at 7.5 volts avc. Any further increase in the avc voltage will not cause the plate current of the sec-



ond triode to rise. If R1 and R2 are chosen to place the pull-in and release points of the relay about halfway between zero and 7.5 volts avc, there is no need for adjustments as long as the monitor is used with the same receiver.

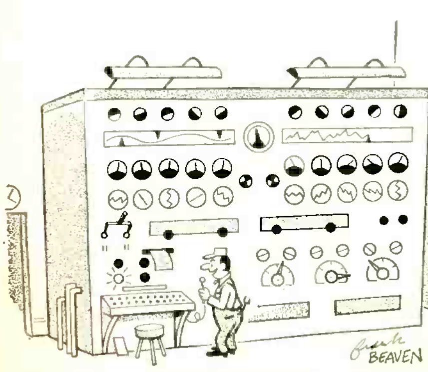
The relay contacts are used to light a red pilot lamp at the operating table, in the "alert" condition, and a green light in the "clear" condition. The "clear" contact at the same time completes the circuit from the transmit-receive switch to the relay which controls the transmitter's high-voltage supply. The station, therefore, cannot go on the air if the Conelrad monitor is in the "alert" condition.

This circuit, of course, is also of the "fail-safe" variety. That is, the receiver and monitor must be operating properly, and a station of sufficient signal strength to give at least 4 volts avc must be tuned in, before the transmitter can get high voltage.

The table shows the action of the circuit with the component values used in the circuit diagram:

Voltages at tube pins 2 (Avc)	3	1 & 7	8	*Relay current*
0.0	1.75	38	50	3.0 (ma)
−7.5	3.5	118	118	7.3
−4.0	3.3	103	105	6.5 Pull-in
−1.6	2.4	66	73	4.2 Release

This particular unit was built for use in a friend's ham station. All components fit nicely into a 2 x 4 x 4-inch box (Premier AC-442 or similar). An octal plug is installed on one narrow side to connect the monitor directly to the accessory socket on a spare Heathkit AR-3 receiver. The only modification to the receiver is to bring the avc voltage from the hot side of the volume control to one of the free pins of the socket.—*Ernest T. Thiersch* END


"Testing . . . 2 times 2, 3 times . . . "

TECHNICIANS' NEWS

SERVICE LICENSE STATUS

The following report comes from the *TSA-Michigan News*. If you have any data to update this list please write Association Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N.Y.

California State	pending
Canada, Toronto	no report
District of Columbia	pending in Congress, failed in 1960
Delaware State	failed 1960
Florida, Fort Lauderdale	planning
Florida, Miami	failed 1961
Illinois State	pending, failed 1959
Indiana State	failed 1961, 1959
Kansas, Topeka	failed 1960
Louisiana State	passed in 1958, amended 1960 to cover entire state
Michigan State	failed 1960
Michigan, Allen Park	passed city ordinance 1960
Michigan, Dearborn	passed city ordinance 1960
Michigan, Detroit	passed city ordinance
Michigan, Inkster	passed city ordinance 1960
Michigan, Lincoln Park	passed city ordinance 1960
Minnesota, St. Paul	passed city ordinance
Missouri State	pending
Missouri, Kansas City	passed city ordinance 1960—challenged
New York State	failed 1961, 1960
New York, Niagara Falls	passed city ordinance 1959
North Carolina State	pending
Ohio, Cleveland	failed 1961
Oregon State	planning
Pennsylvania State	pending
Tennessee, Memphis	no report
Texas State	passed sales tax measure requiring bonding
Texas, El Paso	pending
Washington State	failed 1961, 1959, 1957
Wisconsin, Green Bay	city ordinance?

SERVICE BOOTH AT HOME SHOW

St. Louis, Mo.—A service booth set up at the Bildors Home Show by the Better Business Bureau of Greater St. Louis, the Electronics Club, TEAM, TESA and the independent service industry was a booming success. Large crowds showed great interest in the display. A demonstration of a tube which checked good in a tube tester, but would not work in a receiver impressed the consumer. Four men manned the booth at all times, TV technicians on hand among them to answer technical questions.

TESA WISCONSIN NEWS

Indianhead—Election reports: Harley Rautmann, president; Vern Townsend, vice president; Obert Thomley, treasurer, and Rupert Sanasac, secretary. Thanks to T. Jorgensen of WEAU-TV, Eau Claire, NATESA, TESA-Wisconsin and Indianhead will get some free advertising.

Green Bay—At a recent meeting at the Wisconsin Public Service Building, members were urged to obtain advertising from distributors. Also members were urged to go to the State Convention in Milwaukee.

Sheboygan County—Discussion on advertising. Members urged to attend State Convention.

Milwaukee—Better Business Bureau congratulates association for its local interest and cooperation to avoid public criticism by maintaining the highest principles for electronic servicing.

SERVICE SEMINAR

Joplin, Mo.—About 200 technicians attended a B&K service seminar held at the Connor Hotel . . . sponsored by the Norman Electrical Supply Company. Hienz Theile, a B&K field engineer, was in charge of the meeting and demonstrated various service instruments. After the technical session, there was a rush of technicians to the platform to get a closer look at the gear.

INSTALLATION NIGHT

Milwaukee, Wis.—Covic's Amerwood Hall was the scene of TESA's installation night for 1961. The new officers are: Art Nelson, president; Dan Smith, vice president; Frank Schroeder, secretary, and John Guendert, treasurer. Among the guests attending were Mr. Frank Moch, NATESA executive director, and Sam Maksimuk, TESA–Chicago director.

COLOR TV CLINIC

Michigan—More than 100 service dealers and their technicians from Oakland and Macomb counties attended a clinic on color TV held at Radio Specialties Company. A training session on setup procedures in color TV receivers was presented by Jim Kelly, RCA sales engineer. Following the formal presentation, Mr. Kelly discussed individual color TV service problems with the technicians.

LICENSING IN EL PASO

El Paso, Tex.—A request for a city ordinance to license television and radio service technicians has been made by Ray Burdette, president of the Texas Electronics Association, before the City Council. Association members feel that a licensing program will eliminate the technician who cheats the public with poor work and fake advertising. The proposed law would set up qualifications for technicians and would cover television–radio service dealers, master television–radio technicians, television–radio technicians and apprentice television–radio technicians.

INDUSTRY CONFERENCE

Chicago, Ill—Twenty-four top-level executives representing all segments of electronics production, distribution, sales and servicing, met at the Conrad Hilton Hotel to discuss broad aspects of industry problems. The major outcome of the meeting was an agreement to form the first all-inclusive conference to serve in a liaison capacity between manufacturers, distributors, service technicians and factory representatives. M. Harvey Gernsback, spoke for RADIO-ELECTRONICS at the conference.

An organizing committee, with the co-sponsors of the first meeting acting as co-chairmen, will develop plans for periodic meetings of the conference to implement the suggestions made at the initial session. The commitee consists of Mauro E. Schifino, of Rochester, N.Y., president of the National Electronic Distributors Association, and Frank J. Moch, of Chicago, executive director of the National Alliance of Electronic Service Associations as co-chairmen, with Gail S. Carter, executive vice president of NEDA, and S. I. Neiman, of Chicago, director of the Electronics Information Bureau.

SYLVANIA SERVICE STATIONS

New York, N.Y.—Two branch service stations have been opened here by Sylvania Home Electronics Corp. to supplement customer service on its TV's, radios and phonographs in the metropolitan area. Sylvania says the service operations are designed to supplement and not replace service presently handled by Sylvania dealers and service contractors.

According to Peter J. Grant of Sylvania, "It is not our intent to compete with independent service technicians. However, there are numerous non-servicing dealers in the New York area and we feel this move is necessary to provide proper service for our customers."

NEWS OF YAKIMA

Union Gap, Wash.—Yellow Page advertising was an important part of a recent meeting of the Radio TV Service Association of Yakima. Don Minter, representing Bell Telephone Yellow Page advertising showed the group how its members might consolidate their ads and reduce advertising costs without reducing the effectiveness of their ads.

Bill Peterson of the Olympic Collection Service spoke about his rates and methods of collections. It was agreed to investigate further his plan to set up a credit information service. END

Correction

There is an error in Fig. 1 of the article "CB Transceiver from Car Radio" on page 48 of the July issue. As originally shown, the third section of the relay is wired so no B-plus voltage is applied to the first af amplifier plate when transmitting. It should be wired so this stage receives B-plus at all times.

To correct: Connect the lead from the 6AQ5 screen directly to the bottom end of the 470,000-ohm 6AT6 plate resistor and to the arm of the center relay section. Disconnect the B-plus lead supplying the receiver's if and rf circuits (B to Conv and RF Ampl.) from the bottom end of the 6AG6 plate resistor and connect it to the normally closed (top) contact that feeds B-plus to the 27-mc converter.

We thank Mr. Joseph San George, of Dunkirk, N. Y., for calling the error to our attention.

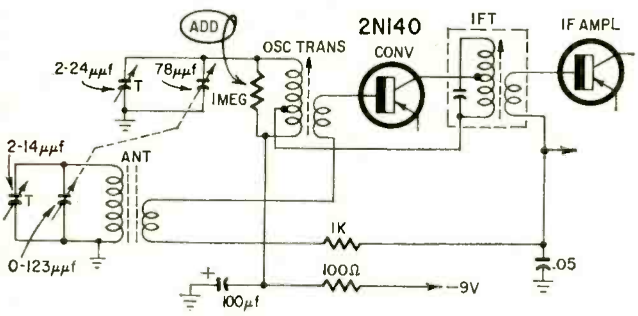
Technotes

WATCHMASTER TIMER

Worked OK for a half hour and then went erratic. Mike pulses were firing printer OK. Input to motor had some spikes that weren't supposed to be there. Replaced 6L6 which proved to be slightly gassy, enough to distort the waveshape of the output pulse that fed the motor. Be sure to clean motor and re-oil.—*W. G. Eslick*

RCA 8-BT-7, -8

In some of these radios, parasitic oscillations or squegging may occur. This is caused by the oscillator coil, and is in the tuned primary circuit. Eliminate this annoying trouble by shunting a 1-megohm ½-watt carbon resistor across the primary of the oscillator transformer. Sometimes, measuring the oscillator injection voltage with a scope or rf-type vtvm will determine if a 1-megohm resistor is needed or not. The proper voltage should be between 0.2 and 0.7 volt, peak to peak. Any more than this and you need the shunt resistor.—*A. von Zook*



Q METER FOR SERVICE

I find my Q meter very useful for repairing defective rf and if transformers in radio and TV receivers when the fault is a bad capacitor in the unit. This usually shows up as B-plus leakage between primary and secondary because these built-in capacitors come leaky.

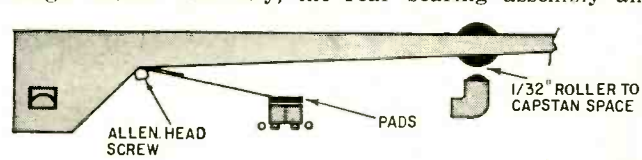
It is usually best to replace the entire transformer, but sometimes an exact replacement is not available. When this happens, I remove the transformer from the chassis, take off the shield can and remove the defective capacitor. Then, by hooking only the coil leads to the inductance terminals of the Q meter and using the correct operating frequency, I can find what capacitance is needed to duplicate the defective unit. I usually use a good no-drift duramica or silver mica as a replacement.—*Seymour Winterfield*

STEELMAN TRANSITAPE & AIRLINE 7111M RECORDERS

Trouble: Takeup reel does not turn during forward and fast forward.

Solution: The takeup pulley is powered by a spring belt driven by a pulley that is an integral part of the flywheel. When the belt is worn, kinked, greasy or broken, there is little or no takeup action on the reel.

To replace the belt, you must remove the motor, the speed-change bracket assembly, the rear bearing assembly and



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 uses 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.

the flywheel. When removing and replacing these parts, the following precautions should be taken:

Unsolder the motor leads, *do not loosen the lug screws or the motor brushes will fall out. Do not drop the flywheel to the floor nor back into the bearings. A slight distortion of the flywheel shaft will ruin it, and dropping the wheel into the bearings can crack the sapphire bearings.*

When replacing the rear bearing plate, back the bearing all the way out so there is no danger of tightening the plate on the sapphire bearing and crushing it. It does not take too much pressure to do this. Use a drop of oil.

To replace the belt, use Steelman part No. 678042 (see diagram). Note that the belt is looped around a casting projection. When the unit is reassembled, the belt is slipped down into place with a small screwdriver.—*Max Alth*

NO SOUND—A DOG

Take one G-E TV receiver, any model using the kind of sockets shown in Fig. 1. Symptom: no sound at all. Make a highly technical measurement of the plate voltage as in Fig. 1. Hmm. No voltage. Don't be overconfident; double-check. Measure the resistance of the primary of the output transformer; completely open! Diagnosis complete: replace output transformer. After carefully selecting replacement, matching impedances, etc., job is done and set makes beau-

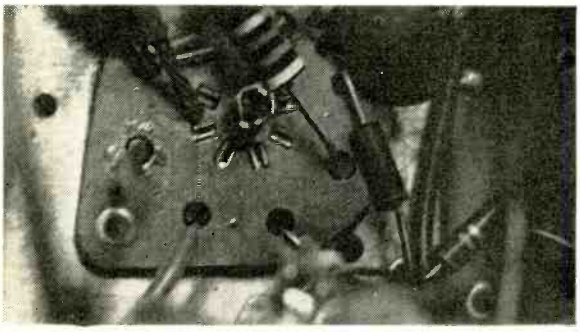


Fig. 1

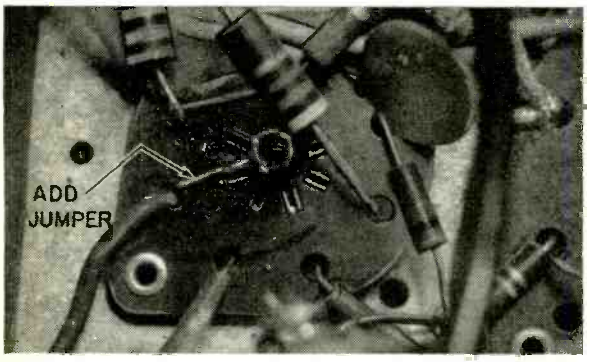


Fig. 2

tiful picture. Only one very minor detail: there is still no sound, and the 6AQ5 plate still has no voltage on it. Hmm.

After returning from a coffee break, make even more detailed analysis of situation. Purely by accident, discover that there is good continuity everywhere in this circuit except for one place—between the tube-socket pin connector and the lug! Hmm! Replace socket? In *this* set? Perish the thought! Final, and practical remedy: carefully tack-solder short piece of solid wire between lug and pin connector, as in Fig. 2. Don't clog up the hole in the socket. Lay wire alongside connector, inserting other end in hole with blue wire from output transformer, as shown.—*Jack Darr* END

new PRODUCTS

ANTENNA TESTER, *model 520.* Direct-reading scales give answers in numerical values. For 50-ohm coaxial transmission-line applications.

Measures standing-wave ratio, and rf power to 1,000 watts in 3 ranges. Precision-built dual cylinder type air coupler.—**Seco Electronics Inc.,** 5015 Penn Ave. S., Minneapolis 19, Minn.

AUTO RADIO TUBE CHECKER, *Vis-U-All,* operates on any 117-volt, 60-cycle ac outlet. 17 x 15

x 8 in. 23 lb.—**GC Electronics Co.,** (Div. of Textron Electronics, Inc.), 400 S. Wyman St., Rockford, Ill.

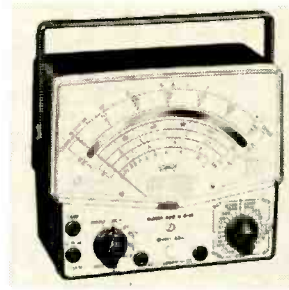
SINE–SQUARE-WAVE GENERATOR, *model G34,* covers frequency range of 6 cycles to 750 kc. Amplitude control, potentiometer and 60-db at-

tenuator variable in 20-db steps. Frequency accuracy ±5%. Power requirement 117 volts ac, 50/60 cycles. 13 x 8½ x 7 in.—**Paco Electronics Co. Inc.,** 70-31 84th St., Glendale 27, N. Y.

ADD-A-TESTERS, *Models 661 DC Ammeter* (illus.) and *657 Milliohmmeter. 661* plugs into

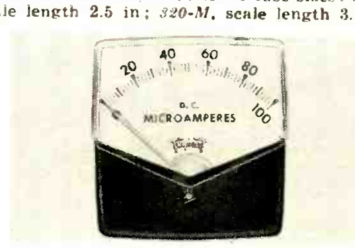
any 260 or 270 and *657* combines with 260 to measure resistance values to .001 ohm.—**Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44.

VOLT-OHM-MILLIAMMETER, *model 800.* 70 ranges and longer mirrored scales (6.95-inch top



arc). Frequency compensation from 40 cycles to 20 kc. Overload protection. 20,000-ohms-per-volt dc sensitivity; 10,000-ohms-per-volt ac sensitivity. 7½ x 6¼ x 3⅞ in.—**Triplett Electrical Instrument Co.,** Harmon Rd., Bluffton, Ohio.

PANEL METERS, *M Series.* 4 case sizes: *220-M,* scale length 2.5 in; *320-M,* scale length 3.34 in;



420-M, scale length 4.5 in; *820-M,* scale length 7 in.—**Triplett Electrical Instrument Co.,** Harmon Rd., Bluffton, Ohio.

AUDIO OSCILLATOR MODULE, *Model 101,* provides 60-, 600-, 440-, 800- and 1,000-cycle standards for industry and laboratory use and tone generators for construction of electronic musical instruments. Frequency range 20 cycles to 12 kc. Operating voltage 6 to 22.5 dc. Output 4 volts into a resistive load of 250,000 ohms

at input of 20 volts ±1 volt. Complete module, no external tuning components necessary. 4 oz.—**Henry Francis Parks Laboratory,** P.O. Box 1665, Lake City Station, Seattle 55, Wash.

TELEPHONE AMPLIFIER, *GD-71,* frees hands. No external power source required: operates from single 9-volt battery for up to 100 hours

use. Automatically switches on when handset is placed on amplifier. Inductive pickup coil, built-in speaker, volume control and circuit board. Ivory-colored plastic cabinet.—**Heath Co.,** Benton Harbor, Mich.

RECEIVER, *NC-190,* with variable if selectiv-

ity, ferrite filter. Dial selector allows selection of either calibrated amateur or popular foreign broadcast bands. 60 to 1 bandspread tuning ratio with built-in vernier. 5 separate main tuning ranges covering 540 kc to 30 mc. Sensitivity better than 1 μv for 10-db S/N ratio.—**National Radio Co. Inc.,** 37 Washington St., Melrose 76, Mass.

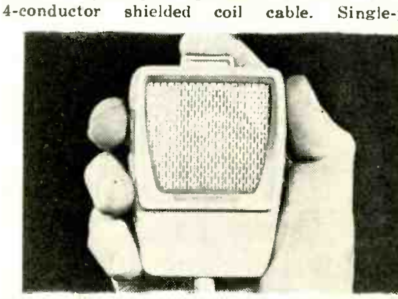
CITIZENS-BAND TRANSCEIVER, *model E.* Tunes in all 22 channels with flip of switch. One-hand operation. 8 crystal-controlled receive and transmit channels. Noise limiter and adjustable squelch with 8 permeability-tuned high-Q

circuits. Overall receiver sensitivity 0.5 μv for 10-db quieting. Selectivity 5 kc at 6 db down. Transmitter operates at full 5-watt input. 11¼ x 9½ x 4¾ in. 9 lb.—**Sonar Radio Corp.,** 3050 W. 21st St., Brooklyn 24, N. Y.

TWO-WAY RADIOS, *Personal-Com* (illus.) and companion *Personal-Com 300,* for Citizens-band

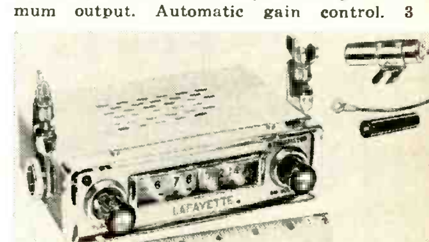
operation. Ranges up to 1 mile. Pocket-size. 2 and 1 lb, respectively.—**Radio Corp. of America,** 30 Rockefeller Plaza, New York 20, N. Y.

CITIZENS-BAND MICROPHONE, *CM-30.* Ceramic transducer element for high sensitivity. 100- to 6,000-cycle spectrum at −49 db. 6-ft 4-conductor shielded coil cable. Single-pole,



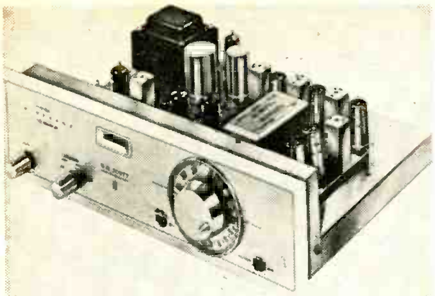
normally open push-to-talk switch. Dashboard mounting brackets. Mikes with normally closed switches available on order. Lightweight shatterproof plastic.—**Sonotone Corp.,** Elmsford, N. Y.

8-TRANSISTOR AUTOMOBILE RADIO, *FS-232.* Low current consumption, 0.2 amp at maximum output. Automatic gain control. 3 if



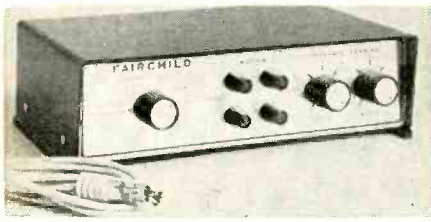
stages, 1 rf stage. Built-in 4-in speaker, noise-suppressor capacitor, distributor suppressor. For 12-volt operation. 7 x 2½ x 4¾ in.—**Lafayette Radio Electronics Corp.,** 165-08 Liberty Ave., Jamaica 33, N. Y.

WIDE-BAND FM MULTIPLEX STEREO TUNER, *model 350.* 10 tubes, 11 diodes. Receives either monophonic FM or stereo FM multiplex programs. Special circuitry for stereo tape recording. Silver-plated front end. 15½ x 5¼ x 13¼ in.

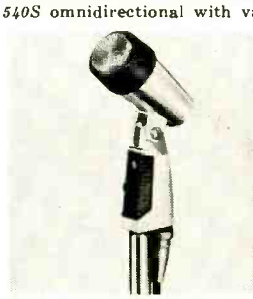


—H. H. Scott Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

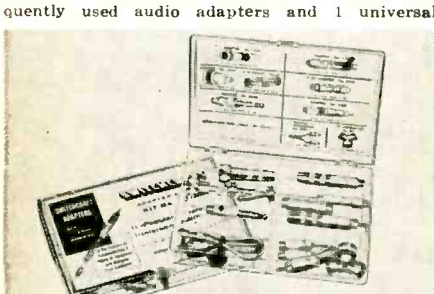
SENSING DEVICE, *Compander,* for home playback systems, continually scans amplifier output and increases high-level signals without affecting low- or medium-level passages. Connects to output and input of existing home equipment.—**Fairchild Recording Equipment Corp.,** 10-40 45th Ave., Long Island City 1, N. Y.



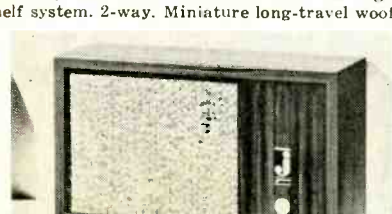
MIKES. Dual impedance and on-off switches, *Models 540S Sonodyne II* (illus.) and *546 Unidyne III. 540S* omnidirectional with variable frequency response. *546* features vibration isolation and Cannon connector.—**Shure Brothers Inc.,** 222 Hartrey Ave., Evanston, Ill.



AUDIO ADAPTER KIT, *No. 331A,* for mating dissimilar connectors. Contains 11 most frequently used audio adapters and 1 universal application molded interconnecting cord. Fits into caddy. Reusable plastic box.—**Switchcraft Inc.,** 5555 N. Elston Ave., Chicago 30, Ill.



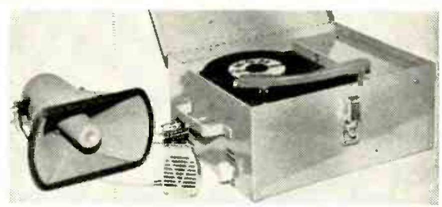
HI-FI SPEAKER SYSTEM, *model X-10.* Ultra-compact, less than one-sixth bulk of regular shelf system. 2-way. Miniature long-travel woofer, mass-loaded, precisely matched to enclosure. 3-in direct-radiator tweeter response out to 14,000 cycle. For use with any amplifier having 4-, 8- or 16-ohm outputs. 6-watt power rating. 7¼ x 13 x 4¾ in.—**Jensen Mfg. Co.,** 6601 So. Laramie, Chicago 38, Ill.



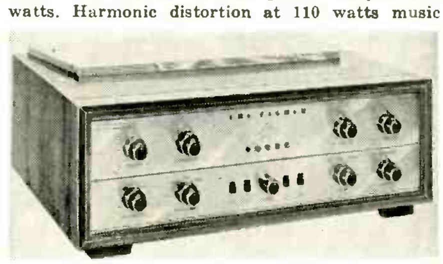
LINE RADIATOR, *model LR-4* PA speaker system. Well defined polar pattern due to stacking of speakers one above the other. Radiates maximum energy in horizontal plane with vertical dispersion. Handles up to 30 watts of audio.—**Electro-Voice Inc.,** Buchanan, Mich.

OUTDOOR HI-FI SPEAKERS, 6 (*Model UT-6H.* illus.) for outdoor use such as patio and pool sides where hi-fi response is more important than extremely high-power. 2 separate coaxial sound sources: one operates in middle and upper frequency ranges, other for low-end reinforcement of bass response. Rating 30 watts.—**Racon Electric Co. Inc.,** 1261 Broadway, New York 1, N. Y.

PA RECORD-PLAYING SYSTEM, *Sportsman.* Mike and speaker. Portable. Transistorized high-power amplifier. Long-range trumpet horn speaker (up to 3 miles). Battery-powered including phono motor.—**Volt-Air Twins Mfg. Co.,** 6716 Park Ave., Allen Park, Wayne, Mich.

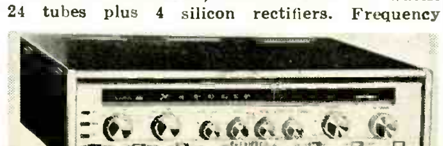


STEREO CONTROL AMPLIFIER, *X-1000,* for home installations. Music power output 110 watts. Harmonic distortion at 110 watts music power 0.5%. Intermodulation distortion at 100 watts rms 0.8%. Overall frequency response 20–20,000 cycle + ½ db. Channel separation at 1 kc better than 55 db. 20 front-panel controls, 2 rear-panel controls.—**Fisher Radio Corp.,** 21-21 44th Drive, Long Island City 1, N. Y.



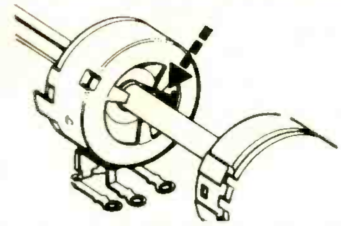
STEREO AMPLIFIER, *AA-151.* 28-watt unit with 4 dual inputs and fingertip controls. Clutched volume controls for single-or dual-channel adjustment. Ganged controls adjust tone. Luggage-tan vinyl-clad steel cabinet with charcoal gray front panel.—**Heath Co.,** Benton Harbor, Mich.

STEREO RECEIVER, *model S-8000.* 64 watts. 24 tubes plus 4 silicon rectifiers. Frequency



response 20–20,000 cycles ±1 db at 30 watts. FM IHFM sensitivity 1.8 μv for —30-db noise and distortion below 100% FM. Also contains AM tuner. 16¼ x 14 x 4½ in. 36 lb with case.—**Sherwood Electronic Laboratories Inc.**, 4300 N. California Ave., Chicago 18, Ill.

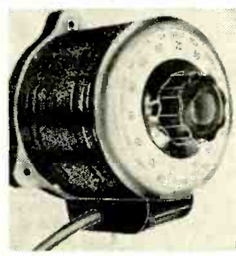
STEREO CONTROLS from manufacturer's dual concentric controls with use of specially tempered spring that inserts between shafts of



front and rear controls and provides sufficient tension to insure their simultaneous rotation.—**Centralab**, Electronics Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

SEALED POLYSTYRENE CAPACITORS for long-life applications. Leakage resistance in excess of 500,000 megs/μf. 25-, 125- and 500-volts dc units available with 2.5%, 5.0%, 10% or 20% tolerances.—**Centralab**, Electronics Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

VARIABLE AC TRANSFORMER, *TR-115*. Precision toroidal wound core. Full rated output from 0 to 130 vac with negligible voltage variation.



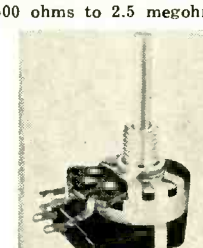
Large easy-to-read dial. Bottom tabs for bench or wall mounting. 2-conductor outlet, 5-amp fuse, on–off switch. 5½ x 5½ in. 10 lb.—**Lafayette Radio Electronics Corp.**, 165-08 Liberty Ave., Jamaica 33, N. Y.

FLYBACK TRANSFORMERS, for Magnavox TV sets. *HO-331* replaces parts 320055-1, 320061-1

and 320061-3; *HO-334* (illus.), part 320811-1; *HO-335*, part 360779-1.—**Stancor Electronics Inc.**, 3501 W. Addison St., Chicago 18, Ill.

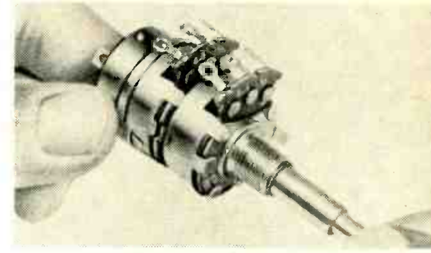
FLYBACK TRANSFORMERS for exact replacements. *HO-323* replaces Trav-ler TR 24; *HO-324*, AMC, Artone and Trav-ler TR-27; *HO-337*, Silvertone 80-368, 80-390, 80-411; *HO-338*, Airline, Raytheon and Truetone C-201-21025-1.—**Stancor Electronics Inc.**, 3501 W. Addison St., Chicago 18, Ill.

CONTROL/SWITCH COMBINATIONS, *Series 44/44S*, for low-powered, battery-operated transistorized equipment. Rated at 0.2 watts. Available from 500 ohms to 2.5 megohms. Resistance



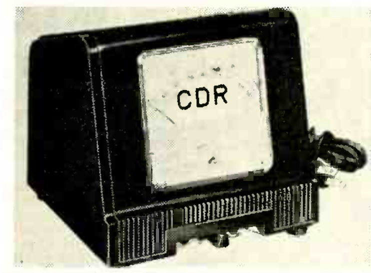
tolerance of ±20% to 100,000 ohms and ±30% above that. Rotation 300° mechanically with or without switch, 262° with switch. Approximately 0.24 oz. 41/64-in diameter, 23/64-in depth without switch. With switch, depth 9/16 in from mounting panel.—**Clarostat Mfg. Co. Inc.**, Dover, N. H.

TV CONTROL REPLACEMENT, *Uni-Tite*, for field assembly of units in minimum time. Completed assembly permanently locked together au-



tomatically without tools. Allows assembly of more than 200 replacement controls for TV, radio and car radio from assortment of 35 rear units, 30 front units, 3 switches and selection of shafts.—**Clarostat Mfg. Co. Inc.**, Dover, N. H.

ANTENNA ROTOR SYSTEM, *CDR Ham-M Rotor*, supports dead weight of 1,000 lb. Ice-,



moisture- and wind-proof. Remotely controlled. Calibrated in increments of 5°. Separate transformer. Mounts on any pipe or mast up to 2-1/15 inches, adapts for tower mounting.—**Cornell-Dubilier Electronics Div.**, Federal Pacific Electric Co., 50 Paris St., Newark, N. J.

STRAPLESS CHIMNEY MOUNT, *Catalog No. 52*, can be installed on brick, stone or cement

block chimneys. Exerts up to 1,500-lb. clamping pressure. Rustproof.—**R-Columbia Products Co. Inc.**, 2008 St. Johns Ave., Highland Park, Ill.

TV–FM SIGNAL AMPLIFIER, *Booster-Pack*. Gain control switch permits owner to vary signal power. Special transister. 300- and 75-ohm outputs. Ac receptacle for TV or FM sets. Full

shockproof ac chassis. Flat gain of 16 db on low band and FM, and 14 db on high. Will drive up to 6 TV sets with 8-db gain for each set. Draws only 1.2 watts.—**Winegard Co.**, 3000 Scotten Blvd., Burlington, Iowa.

GARAGE-DOOR OPERATOR, all-transistor, portable. Additional transmitters available where door will regularly be operated from more than one car. Unit controls garage light which remains on for 2 minutes after door closes. If door strikes object power shuts off and door automatically stops.—**Perma-Power**, 3100 N. Elston Ave., Chicago 18, Ill. END

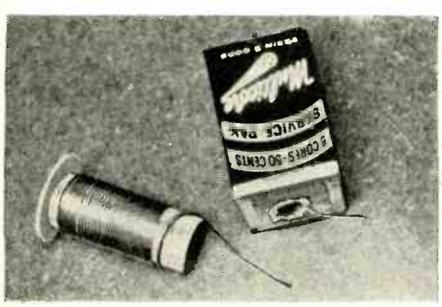
All specifications from manufacturers' data.

NUT DRIVER HELPER

Removing short self-tapping screws is simple. But putting them back in a tight place where they can't be started with the fingers is something else. For example, when fastening a TV tuner and case back in place, the self-tapping screws are usually so short that they go back in the nut driver far enough to make it impossible to screw them back into place. To prevent this, solder two nuts together, the same size as the nut driver being used. Then drop the soldered nuts into the nut driver's opening. Now the self-tapping screw will not go all the way into the nut driver and can be screwed into place without trouble. Just rap the nut driver on the bench to remove the two soldered nuts. —*George E. Lytle*

SOLDER STORAGE

Here is a solution to the problem of the solder roll which keeps rolling off the workbench, doesn't stay put and is difficult to use with one hand. When you purchase a roll of solder, save the box. Then pry off the end of the spool if it is cardboard or metal; saw it off if it is



wood. Cut a hole about 1 inch in diameter in the top of the box. Then replace the roll in the box, modified end up, and thread the free end of the solder through the hole. When you need solder, just a pull with one hand gives you all you need. In addition, the box is stable in any position and is not easily misplaced.—*Ronald S. Newbower*

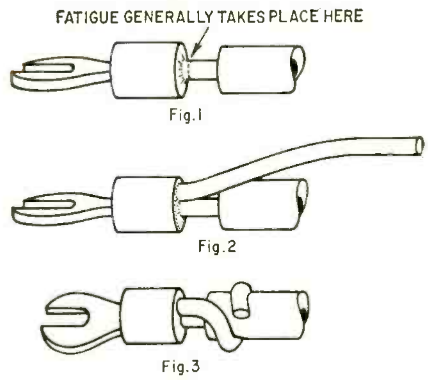
AIR-CONDITIONED TV

For a long time, we couldn't figure out why some of the sets we cured of intermittent faults, which played OK in our shop, quit playing after a couple of days in the customer's home. Then we found this happened because we repaired the sets in our air-conditioned shop. The chilled air kept the intermittents from showing up!

Now, after repairing a TV set, we put it out in a fry room and let it run, making a double check. Our Florida climate makes this easy.—*Harry J. Miller*

BETTER TERMINAL CONNECTIONS

If you are using connectors such as banana plugs, pin jacks or spade connectors, where the wire must be soldered into the plug, the wire will invariably break at the solder junction if it is subjected to vibration or flexing (Fig.



1) unless a portion of the insulation is made a part of the pin or plug. This can be solved by taking a short piece of solid hookup wire or the "trimmin's" from resistors or capacitors and inserting it into the plug (Fig. 2) along with the conductor wire and soldering the two in together. Now, with a pair of long-nose pliers, wrap the protruding end of the short, solid wire securely around the insulation of the conductor about 3/16 inch up from the end (Fig. 3). The insulation will now take the flexing without fatigue much longer than the conductor would have.—*Ray L. Allen*

REFLECTING RECEPTACLE

When a stylus or a new crystal has to be installed on a phono arm, you're bound to have trouble seeing where the small screws go. And sometimes, when a small screw or bolt is dropped, it is lost. To avoid this, place a ladies compact mirror inside a shallow tin (such as the can cellophane tape comes in). Place this unit underneath the phono arm. Now you can see what you are doing and any small bolts or screws that you drop fall into the reflecting receptacle.—*A. von Zook*

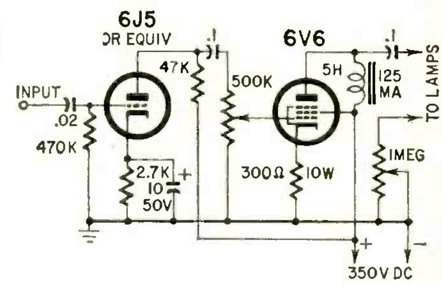
MUSIC INTO LIGHT

In the December, 1954, RADIO-ELECTRONICS, an article under this title appeared, describing how to make fluorescent tubes light by voltage from your amplifier.

For most of us, such an installation would be too large and much too expensive, but the same idea can be used with neon bulbs, and the results are interesting and entertaining.

The simplest (although not the best) arrangement is merely to wire one or more neon bulbs directly across the primary of your output transformer. NE-30's probably show up best and will fit in standard light sockets, but any kind may be used. Not more than two bulbs can be used this way, unless the volume is turned uncomfortably high. Some distortion is inevitable with this hookup, although it will be scarcely noticeable, unless you have a high-quality rig.

A better way is to build the small two-stage amplifier described in the original article (see diagram), using for the input a 470,000-ohm grid resistor and .02-μf capacitor. This can be wired into the plate or grid circuit of a voltage amplifier. Several bulbs can be used with this



system, even one of the blue argon two-plate bulbs, which give an odd effect.

If you use all NE-30's, try leaving one clear, and coloring the others blue, green, yellow or pink. (Be sure to give only a very light tinge of color.)

The flickering and pulses of these bulbs in different colors keep even the small fry quiet and interested (at least for a little while)! A friend of mine (adult)even hypnotized himself into a sound sleep while watching a single bulb pulse in rhythm to a staccato mambo beat.

While seldom effective with vocal records, when used with jazz or latin records (barrelhouse piano is best of all) or anything with a definite beat, one of these musical lights can entertain even your more blasé friends an entire evening.—*R. C. Sandison* END

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 August, 1911, *Modern Electrics*

Multiple Tone Wireless Stations, by Dr. Alfred Gradenwitz.
The Mystery of the Ether, by Owen Ely.
Elimination of Inductance Disturbances.
Lightning Protection for Wireless Stations, by Philip Edelman.
A Flame Audion, by Mearle Mellinger.
Universal Detector, by P. Mertz.
Wireless Without an Aerial, by Ed. Egloff.
Lightning Phenomena, by Dr. C. P. Steinmetz.

new PATENTS

REMOTE CONTROL SYSTEM

Patent No. 2,946,054

Emmor V. Schneider, Alliance, Ohio. (Assigned to Alliance Mfg. Co., Wilmington, Del.)

This system uses a "carrier" in the audio range. The signal is picked up by a receiver to operate a relay.

When the switch is closed on the transmitter (Fig. 1), the vibrator alternately closes and

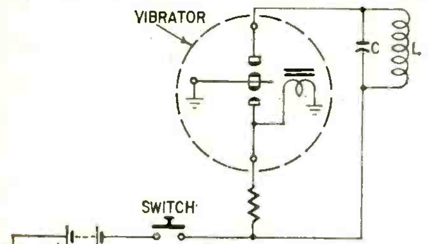


Fig.1

opens the circuit through tuned-circuit L-C and causes it to oscillate at its resonant frequency, say 5 kc. Thus, we have a 5-kc carrier keyed on and off by the vibrator at a 115-cycle rate. (Fig. 2).

L radiates the waves to a receiver (Fig. 3). Its loop has many turns of wire. The secondary

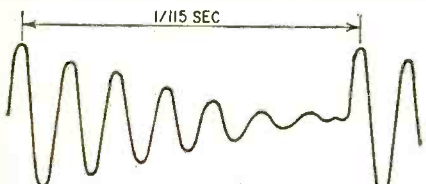


Fig.2

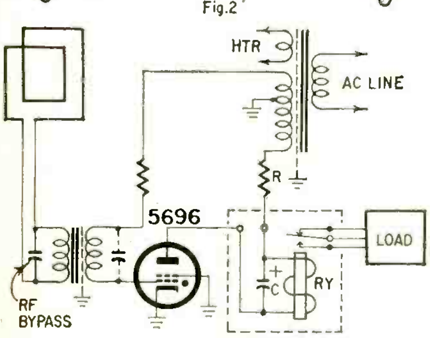


Fig.3

is tuned by stray capacitance to 5,000 cycles. The thyratron operates from ac. When its plate goes positive (about 100 volts), its grid goes negative by about 5 volts.

A positive signal at the grid overcomes the bias and triggers the tube. Rectified 60-cycle pulses flow into relay RY. A shunt capacitor C eliminates relay chatter. Since 115 cycles is much higher than 60, there will always be a positive signal on the grid during the period when the plate of the tube is positive.

VOLTAGE DISCRIMINATOR

Patent No. 2,956,158

Paul L. DiMatteo, Levittown, N. Y. (Assigned to Sperry Rand Corp.)

This tube conducts only within a predetermined range of signal voltage. It blocks above or below this range. Fig. 1 shows how the tube is used to

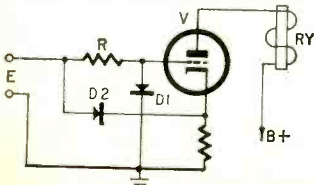


Fig.1

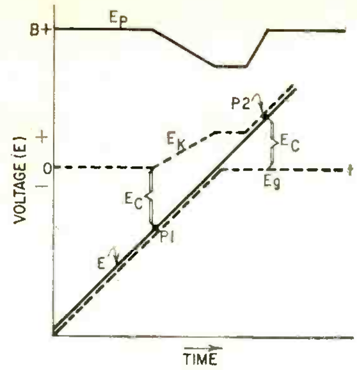


Fig.2

control a relay. R is a large resistor.

Assume that the signal is very negative and growing in a positive direction. This signal (E) is shown as a full line in Fig. 2. The diagram also shows how other voltages vary with E. The cathode voltage (E_k) and grid voltage (E_g) are dotted lines. The plate voltage (E_p) is a full line.

At the beginning, E and E_g must be equal since D1 is blocked. The tube is also blocked so E_k must be zero. As soon as E and E_g rise above cutoff ($-E_c$) plate current begins, and E_k begins to rise. The corresponding dip in E_p is due to the drop across RY.

If E continues to rise, it eventually becomes positive. Then D1 conducts and clamps E_g at ground potential as shown. Thus plate current levels off and so does E_k. When E finally overtakes E_k (permitting D2 to conduct), they rise together. All these results are shown graphically in Fig. 2.

To summarize, grid bias is measured by the difference $E_g - E_k$. When this value equals $-E_c$, cutoff is reached. This occurs at two points, P1 and P2. When E is within this range, bias is *less* than cutoff, permitting tube conduction. Outside this range V blocks.

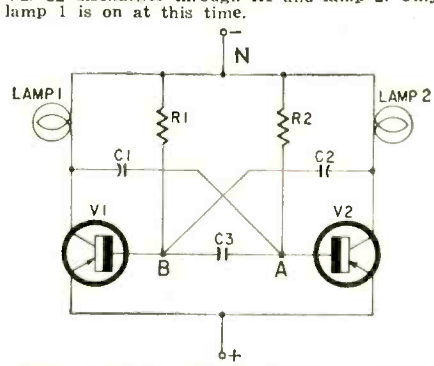
The patent describes several applications, including waveshaping and switching.

LAMP FLASHER

Patent No. 2,960,627

Dennis A. Hunt, Northolt, England. (Assigned to Rotax Ltd., Willesden, London, England.)

These transistors conduct alternately, flashing their respective lamps on and off. Assume V1 conducts through lamp 1, so that C1 charges through R2. As point A goes positive, it blocks V2. C2 discharges through R1 and lamp 2. Only lamp 1 is on at this time.



Upon completion of the charge, A assumes the negative potential of N, so V2 can conduct through lamp 2. C2 charges through R1, thus B goes positive to block V1. C1's charge leaks off through R2 and lamp 1. Only lamp 2 is on during this time.

C3 shorts out any transients in the power supply.

END

"Fred's doing so well he's hired a tube caddy."

BUSINESS and PEOPLE

Stanley I. Lehrer was elected to the Board of Directors of Arco Electronics, Inc., Great Neck, N. Y. He is assistant secretary of the company and a director and member of the executive committee of Microlab, Livingston, N. J.

Berne N. Fisher joined Gonset Div. of Young Spring & Wire Corp., Burbank, Calif., as president. Previously, he was vice president of Tele-Computing, Inc., and general manager of its Value Engineered Products Div.

H. T. Harwood (left) was appointed director of public relations for Shure Brothers, Inc., Evanston, Ill. He had been advertising manager. **Leonard H. Serwat** was appointed personnel director. He comes to the company from Motorola, Inc., where he held a similar position.

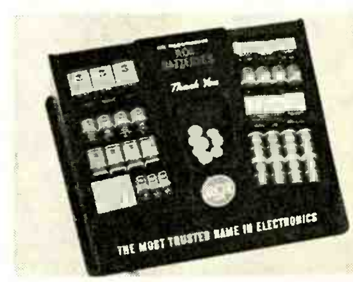
Chester S. Wright was appointed manager, market research for Stancor Electronics Inc., Chicago, Ill. He has been with the company for 5 years and in the industry for over 20 years.

H. Jerome Noel (left) joined Howard W. Sams & Co., Inc., Indianapolis, as vice president. He had been a vice president of Standard Life Insurance Co., and vice president and director the Advisors Fund Management Corp. **Mal Parks, Jr.** was promoted to director of marketing. He will continue as general manager of the Magazine Div. and the Technical Book Div.

Larry Epstein joined Harman-Kardon, Plainview, N.Y., as sales manager of the new Commercial Sound Products Div. He has been active in the industry for over 20 years, most recently with such companies as Bogen-Presto, University Loudspeakers and RCA.

John T. Mallen was appointed equipment sales manager, entertainment products for the Sylvania Electronic Tube Div. with headquarters in Chicago. He had been Midwestern equipment sales manager. **Eugene M. Sorensen** was appointed Midwestern region equipment sales manager, industrial and military. He formerly had been the company's supervisor of military and industrial sales.

RCA Electronic Tube Div., Harrison, N. J., introduced a new combination tray



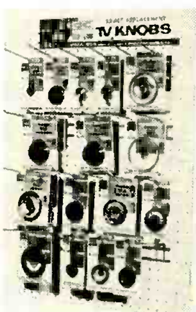
and battery merchandiser designed to promote sales of its transistor radio batteries.

Vaco Products Co., Chicago, designed a counter merchandiser for its solderless

terminal repair kit. The company also introduced a Triple Feature promotion for its solderless terminals.

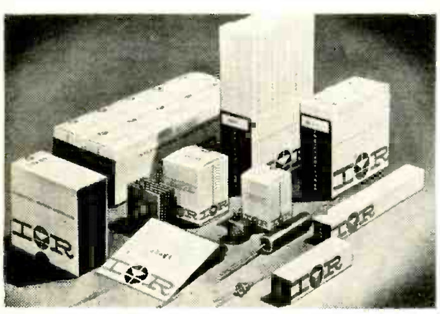
Sylvania Electronic Tube Div. was awarded the NATESA Friends of Service Management plaque for 1960 for the

tenth consecutive year. **William O. Spink** (right), vice president, marketing of the division, is shown accepting the plaque from **James O. Humphrey**, Western secretary of NATESA.



GC Electronics Co., Rockford, Ill., is offering service technicians a self-service display and best-seller selection of exact replacement TV and radio knobs for seven leading makes.

International Rectifier Corp., El Segundo, Calif., is under way on a new commercial products distributor pro-



gram which includes a self-service merchandising display, a new package program and a combination handbook photocell package to introduce its type IR photocells and solar cells.

Obituaries

Ray F. Sparrow, executive vice president of P. R. Mallory & Co. and a pioneer electronic industry executive, died in Pembroke, Ontario, Canada, after an illness of several months.

Frank Sprayberry, founder of the Sprayberry Academy of Radio & TV and widely known in the electronic industry, died at his home in Delray, Fla.

Edward C. Cahill, former president of RCA Service Co., Camden, N. J., died at the age of 60. He has been in semi-retirement since 1958 because of ill health. He was a member of the Board of Regents of the Milwaukee School of Engineering, from which he graduated in 1928 END

new LITERATURE

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.

HI-FI AND STEREO TAPE SYSTEMS GUIDE, *Form 780,* diagrams a variety of recommended equipment and system connections for hi-fi and stereo tape recording playback systems. 9 systems described in 12-page brochure.—**Viking Customer Service Dept.,** 9600 Aldrich Ave. So., Minneapolis 20, Minn.

TV KITS AND WIRED CHASSIS, 23-, 24- and 27-inch *Professional Series,* available on "pay-as-you-wire" basis, announced in *Catalog P-361.* Complete technical specifications. Photos show top and bottom views of chassis and how to use units with vertically or horizontally mounted control panels.—**Transvision,** 450 North Ave., New Rochelle, N.Y.

SILICON DIFFUSED RECTIFIERS presented in 6 pages of new catalog. Illustrations and complete mechanical and electrical specifications for more than 150 units ranging from 60 to 600 volts PIV and from 250 ma to 22 amperes.—**Warren Schoonmaker, Raytheon Co.,** Semiconductor Div., 215 First Ave., Needham, Mass.

CAPACITOR WALL CHART *ETR-2609A* lists 34 single-section tubular electrolytic capacitors that will, through use of application rating, replace estimated 100 existing types. Application-rating concept permits one unit to replace many types within specified capacitance, voltage and size limitation ranges. 14 x 20 in. 2-color heavy stock. —**Available from General Electric distributors.**

LOUDSPEAKER SYSTEM, *Olympus,* available with wood fretwork grille hand-carved in Orient or five different grille fabrics. Dark mahogany, tawny walnut, oiled walnut, Danish teak or ebony. Enclosure occupies slightly more than 6 cubic feet and weighs almost 100 lb.—**James B. Lansing Sound Inc.,** 3249 Casitas Ave., Los Angeles 39.

TV *Antennas, Hardware, Accessories and Radio Parts,* a complete line, offered in fully illustrated brochure *No. 19.* Front-page index shows item and description as well as page it appears on.—**IE Manufacturing,** 3039 W. Carroll Ave., Chicago 12, Ill.

ELECTRONIC PROJECTS in *Catalog No. 6* exceed preceding catalog by 69 additional projects. Each has been proved by actual breadboarding before release. Relative difficulty of projects called out by symbols. Prices.—**Henry Francis Parks Laboratory,** PO Box 1665, Lake City Station, Seattle 55, Wash.

SEMICONDUCTOR DEVICES. More than 270 featured in new 12-page catalog. Gives electrical specifications, dimensions and prices. — **International Rectifier Corp.,** 1521 E. Grand Ave., El Segundo, Calif.

ADAPTERS, *Add-A-Testers,* for Simpson 260/270 multimeters described, illustrated and priced in **Catalog Sheet ST-302.—Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44, Ill.

INDUSTRIAL TUBE *Catalog PA-400* gives data on more than 400 industrial and special-purpose tubes. Reference chart style. Indexed.—**CBS Electronics,** Danvers, Mass. 50¢.

ASTRON CAPACITORS FOR INDUSTRIAL APPLICATIONS is 20-page illustrated catalog that includes complete listing of all types of industrial capacitors available from manufacturer. Complete cross-reference chart covering MIL to commercial conversion provided. —**Astron Sales Corp.,** 255 Grant Ave., East Newark, N.J.

PHONOGRAPH NEEDLE AND REPLACEMENT GUIDE *1961 Supplement* indicates, in 8 pages, needle replacement, record speed and needle number in either diamond, jewel or osmium. List price also shown.—**Duotone,** Locust St., Keyport, N.J.

SWITCH *Catalog E* covers wide variety of basic designs and suggests additional combinations available as standard or custom-built switches. Complete dimensional drawings of switch components. Quick-reference information. 16 pages.—**Guardian Electric Manufacturing Co.,** 1550 W. Carroll Ave., Chicago 7, Ill. Write on company letterhead.

TEST EQUIPMENT *Catalog No. 42-T* provides specs, prices and photos for each item. 7 pages.—**Triplett Electrical Instrument Co.,** Bluffton, Ohio.

TOOLS catalog, *Illustrated Buyers' Guide,* lines up 216 individual numbers of screwdrivers and nut drivers, plus over 250 other tool items and display units. 16 8½ x 11-in. pages Kalamazoo-punched for insertion into any binder.—**Vaco Products Co.,** 317 E. Ontario St., Chicago 11, Ill. END

new BOOKS

VIDEO TAPE RECORDING, by Julian Bernstein. John F. Rider Publisher Inc., 116 W. 14th St., New York 11, N.Y. 6 x 9 in. 268 pp. $8.95.

The mechanical and electronic phases of modern video recording are discussed here. The book begins with basic theory that may be understood by readers with limited technical knowledge. Waveforms, signals, TV and tape principles are described. Later chapters are directed to technicians and engineers, but most of the book is clear and detailed, understandable by the general reader.

The author gives special attention to those circuits that are not used in TV, but which are important in video recording. Photos and block diagrams illustrate the latest RCA and Ampex systems.

LINEAR CIRCUITS, Part 1, Time-Domain Analysis; Part 2, Frequency-Domain Analysis, by Ronald E. Scott. Addison-Wesley Publishing Co. Inc., Reading, Mass. 6 x 9 in. 510 pp. $6.75.

This is a first course in electrical engineering. It assumes a knowledge of physics and some calculus. This volume covers basic circuit theory and transient response due to step and impulse excitation. Networks are discussed and analyzed in detail, with many examples appearing in the text. Exercises end each chapter, the answers being given at the back of the book.

Part 2 (a second volume) begins with sine waves and phasors, continuing on into transformers. Fourier and Laplace methods are used to solve problems.

ELIMINATING MAN-MADE INTERFERENCE, by Jack Darr. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 160 pp. $2.95.

Radio and TV interference can be tracked down and eliminated. This book shows you how to proceed. It discusses various interference sources: motors, hams, ignition, medical apparatus, etc. Problems relating to mobile, marine and aircraft radio are treated separately. Numerous case histories are given, some from the files of the FCC.—*IQ*

TUNNEL DIODE MANUAL. General Electric Co., Electronics Park, Syracuse 1, N.Y. 5½ x 8½ in. 96 pp. $1.

The engineer will find here the equations he needs for circuit design. The experimenter will be more interested in the practical schematics. Oscillators, switches, logic elements and amplifiers are discussed. Test circuits and specifications complete the manual.

SILICON ZENER DIODE AND RECTIFIER HANDBOOK (2nd Edition). Motorola Semiconductor Products, Inc., 5005 E. McDowell Rd., Phoenix, Ariz. 5½ x 8½ in., 182 pp. $2.

The Zener diode is finding more and more uses in electronic circuits. Basically it is a voltage regulator, but many applications are not widely known. Some novel uses are described in this manual: light dimming, multiplying the voltage rating of a capacitor, meter protection. Design equations, practical schematics and testing methods are described. One chapter discusses silicon diodes and rectifier circuits.

BASIC ELECTRONICS, by Glade W. Wilcox. Holt, Rinehart and Winstron, Inc., 383 Madison Ave., New York 17, N.Y. 6 x 9 in. 402 pp. $6.25.

Communications, power and industrial electrons are covered here. The book begins with the theory of electrons and simple circuits, and develops at a pace suitable for self-study. There are three parts: components, circuits, applications. Each is well-illustrated, clearly explained. Although a first book, the reader will gain a good knowledge of receivers and transmitters, hi-fi and stereo, industrial controls, and tubes and transistors.

PRINCIPLES OF SERVOMECHANISMS, by A. Tyers and R. B. Miles. Pitman Publishing Corp., New York, N.Y. 5½ x 8¾ in. 176 pp. $6.50.

Junior engineers and technicians who have little math preparation will understand this book. Only a knowledge of electron circuit theory and trigonometry are needed. The text is practical and well illustrated. It describes synchros, motors, amplifiers and thyratrons, as well as other equipment used in automatic control devices.

LAPLACE TRANSFORMATION (2nd Edition), by William T. Thomson. Prentice-Hall, Inc., Englewood Cliffs, N.J. 6 x 9 in. 255 pp. $10.

Here is a rigorous and complete presentation of Laplace transformation and its applications. The subject is explained in detail and examples are worked out in the text. Separate chapters show how to use the method for problems involving electrical circuits, dynamics and structures.

After learning the basic material, the advanced student can go on to the chapters on complex variables, closed-loop systems and partial differential equations. The book ends with a table of transform pairs.

SERVICING HI-FI AM-FM TUNERS, Vol. V. Howard W. Sams & Co. Inc., 1726 E. 38 St., Indianapolis, Ind. 8½ x 11 in. 160 pp. $2.95.

Everything you need to know to service 18 models made in 1958–59: schematics, resistance charts, alignment data, etc. A cumulative index is included as usual. There is also a short chapter on various types of speakers.

ELECTRONIC CIRCUIT ANALYSIS, Vol. 1, *Passive Networks*, by Phillip Cutler. McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N. Y. 6 x 9 in. 454 pp. $8.

This is written at a level between that of the technician and the engineer. A knowledge of electronics and algebra is needed. This book has been used for training courses and is ideal for self-study. The presentation is unusually clear and detailed. Among major topics are transients, transformers and tubes. Many of the examples are worked out. Many others, not worked out, are supplied with answers.—*IQ*

HOW TO TROUBLESHOOT A TV RECEIVER (2nd Edition), by J. Richard Johnson. John F. Rider Publisher Inc., 116 W. 14 St., New York 11, N.Y. 5½ x 8½ in. 150 pp. $2.50.

Three-quarters of all servicing time is spent *finding* the trouble. The rest is easy. This author concentrates on troubleshooting and how to speed it up. He shows how to obtain information from schematics, customers' complaints, by turning controls and watching patterns.

CONTROL SYSTEM ANALYSIS AND SYNTHESIS, by John J. D'Azzo and Constantine H. Houpis. McGraw-Hill Book Co. Inc., 330 W. 42 St., New York 36, N. Y. 6 x 9 in. 580 pp. $13.50.

This book may be used by students at both graduate and undergrad levels. The first chapters prepare the reader for the math required, and show the use of block diagrams. Attention is directed to the methods used to check systems for stability and to obtain optimum performance from a given design. The theory and use of analog computers are discussed. Several math appendices, problems and examples are included.

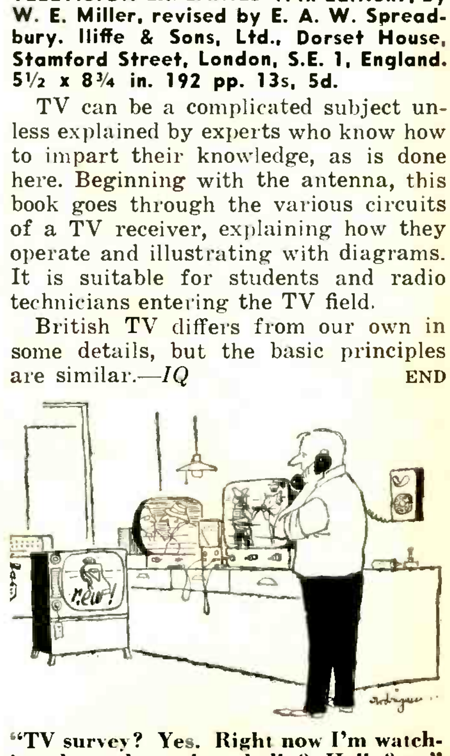
SERVICING TRANSISTOR RADIOS, Vol. VI. Howard W. Sams & Co. Inc., 1726 E. 38 St., Indianapolis, Ind. 8½ x 11 in. 160 pp. $2.95.

Transistor sets are small, but servicing them can result in big headaches. This manual helps you to do a fast repair, alignment or replacement, as the case may be. It analyzes 62 models, manufactured in 1960–61. An introductory chapter discusses transistor circuit techniques.

TELEVISION EXPLAINED (7th Edition), by W. E. Miller, revised by E. A. W. Spreadbury. Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E. 1, England. 5½ x 8¾ in. 192 pp. 13s, 5d.

TV can be a complicated subject unless explained by experts who know how to impart their knowledge, as is done here. Beginning with the antenna, this book goes through the various circuits of a TV receiver, explaining how they operate and illustrating with diagrams. It is suitable for students and radio technicians entering the TV field.

British TV differs from our own in some details, but the basic principles are similar.—*IQ* END

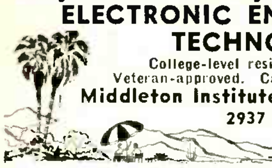


"TV survey? Yes. Right now I'm watching three channels . . . hello? Hello? . . ."

SCHOOL DIRECTORY

Study in the "Valley of the Sun"

ELECTRONIC ENGINEERING TECHNOLOGY



College-level resident schooling
Veteran-approved. Catalog on request

Middleton Institute of Electronics
2937 E. McDowell Rd.
PHOENIX
ARIZONA

---

double your income with degree

A college education is a good investment! More rapid advancement, too. **Important firms like Tri-State College graduates** . . . return regularly to interview seniors on campus. Become an Electronics Engineer. Qualify faster here.

Bachelor of Science Degree in 27 Months

in Electrical (Electronics or Power major), Mechanical, Chemical, Aeronautical, Civil Engineering. IN 36 MONTHS B.S. in Business Administration (General Business, Accounting, Motor Transport Management majors). For earnest, capable, mature students. Small classes. More professional class hours. Beautiful campus. Well-equipped labs, modernized buildings, new dorms. Year-round operation. Enter Sept., Jan., Mar., June. Founded 1884. **Write J. G. McCarthy, Director Admissions, for Catalog and "Your Career in Engineering and Commerce" Book.**

TRI-STATE COLLEGE 2481 College Avenue
Angola, Indiana

SCIENCE
ENGINEERING

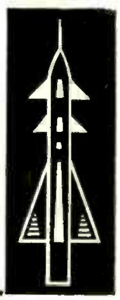
B.S. Degree—36 mos. • B.E. Degree—27 mos.
Accelerated year-round program: Aero., Chem., Civil, Elec., Mech., Metal.; Math., Chem., Physics. Modest rate. Earn board. New classes start Sept., Jan., Mar., June, July. Catalog. **1581 E. Washington Blvd., Fort Wayne 2, Ind.**

INDIANA TECHNICAL COLLEGE

GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic and advanced courses in theory and laboratory. Assoc. degree in electronics in 29 mos. B.S. in electronic engineering obtainable. ECPD accredited. G.I. approved. Graduates in all branches of electronics with major companies. Start September, February. Dorms, campus. High School graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
Dept. C Valparaiso, Indiana



ENGINEERING COURSES

E.E.
Option Electronics or Power
Mechanical, Civil & Physics
Also in Liberal Arts
presented through
HOME STUDY
Resident Classes Also Available if Desired
Specify course desired.
PACIFIC INTERNATIONAL COLLEGE OF ARTS & SCIENCES
Primarily a correspondence school

PACIFIC INTERNATIONAL C. A. S.

5719-M Santa Monica Blvd. Hollywood 38, Calif.

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.

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

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-8
Classes now forming

LE A R N

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

FREE! ELECTRONICS CAREER KIT

If you're interested in breaking into a good-paying job in Radio-TV-Electronics, I. C. S. will send you absolutely free a famous Career Kit with 3 famous booklets that have helped thousands of others—just like yourself—on the road to real success. Includes:

1. "HOW TO SUCCEED" Career Guide—36-page gold mine of career tips and information.
2. "JOB CATALOG" of opportunities in your field of interest.
3. "SAMPLE LESSON" (math) to demonstrate the famous I. C. S. method.

Send today for your free I. C. S. Career Kit with these 3 famous booklets. There's no obligation. This may be the big break you've been waiting for. Mark and mail the coupon today.

INTERNATIONAL CORRESPONDENCE SCHOOLS

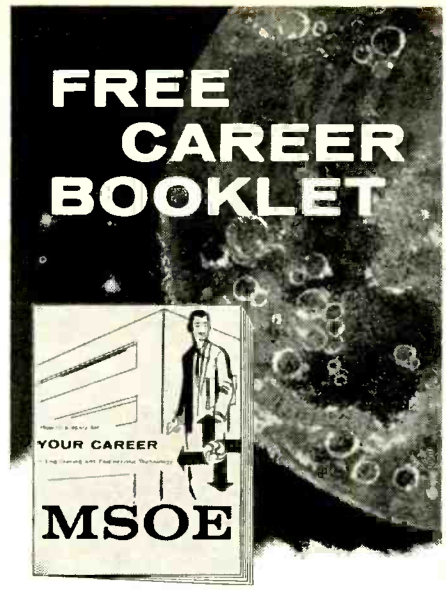
Dept. 37087G Scranton 15, Penna.

Please send free Career Kit with 3 famous booklets

☐ General Electronics	☐ Radio-TV Serv'g	☐ Practical Electrician
☐ Industrial Electronics	☐ Sound Equipt. Serv'g	☐ Profess'l Eng. (Elec.)
☐ Radio-TV Eng'r'g	☐ Electrical Eng'r'g	☐ Electrical Drafting
☐ Electronic Servicing	☐ Electrical Tech.	☐ Other

Name ____________ Age ____
Address ____________
City ____________ State ____

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-861, 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 ____________

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

August 1961

Printed in USA

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 October issue must reach us before August 10, 1961.
RADIO-ELECTRONICS, 154 West 14 St., New York 11, N. Y.

RENT STEREO TAPES—over 2,000 different—all major labels—free catalog. STEREO-PARTI, 811-RE, Centinela Ave., Inglewood 3, Calif.

HAVE YOUR PHOTOGRAPHS LAMINATED IN PLASTIC. Preserved indefinitely. 8 for $1.00. Send your photograph for sample. 10¢. SALES & SERVICE, Box 8332, Pittsburgh 18, Pa.

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.

---

500 PRINTED, GUMMED NAME AND ADDRESS LABELS, $1.00. No C.O.D.'s. Print clearly. RE-1, ADDISON MAIL ORDER, 1840 Addison, Chicago 13.

NEW CONCEPT OF LEARNING SELF-HYPNOSIS! Now on tape or record! Free Literature. McKINLEY-SMITH CO., Dept. T5, Box 3038, San Bernardino, Calif.

AMPLIFIERS, TUNERS, speakers, radios, cameras, optics. Finest quality, lowest prices. Free catalog. MYERS IMPORTS, 623 Gay, Knoxville, Tenn.

PROFESSIONAL ELECTRONIC PROJECTS—Organs, Timers, Computers, etc.—$1 each. List free. PARKS, Box 1665, Lake City, Seattle 55, Wash.

BUSINESS CARDS, LABELS, RUBBER STAMPS. Send for free descriptive literature. HEIGHT INDUSTRIES, Capitol Heights 27, Md.

PROMPT DELIVERY, we will not be undersold. Amplifiers, Tape Recorders, Tuners, etc. No Catalogs, Air Mail Quotes. Compare. L. M. BROWN SALES CORP. Dept. R, 239 E. 24th St., New York 10, N. Y.

SOLAR CELLS. 1⅛" diam. 20 ma in sunlight. $1.50 ea. 10—$10.00. ELECTRONIC PRODUCTS CO., 605 Prairie St., St. Charles, Ill.

PRINTING PRESSES, Type, Supplies, Lists 4¢. TURNBAUGH SERVICE, Mechanicsburg, Penna.

3-LINE RUBBER STAMP. $1.00. REPCO, Box 956, Evanston, Ill.

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.

RUBBER STAMPS. Free circular. H. Cox, 463 B St., Ashland, Ore.

DISCOUNTS UP TO 50% on Hi-Fi amplifiers, tuners, speakers, tape recorders, individual quotations only, no catalogs. AUDIO WORLD, 117-20 14th Road, College Point, New York.

PRECISION RESISTORS, carbon-deposit. Guaranteed 1% accuracy. Millions in stock. ½-watt 8¢. 1-watt, 12¢. 2-watt, 15¢. Leading manufacturers. ROCK DISTRIBUTING CO., 902 Corwin Rd., Rochester 10, 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.

TECH-LIT, monthly mailing service, gives you all Westinghouse service manuals (television — stereo/fidelity — radio) plus Tech-Lit News for the current model year for only $6.50. WESTINGHOUSE TECH-LIT, P.O. Box 71, Metuchen, N.J.

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 Broadway, New York 12, N. Y. WAlker 5-7000.

RADIO & TV TUBES at Manufacturers' Prices! 100% Guaranteed! Brand-new! No rebrands or pulls! UNITED RADIO, Box 1000-R, Newark, N.J.

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.

ELECTRONIC SURPLUS CATALOG, 5,000 items. Send 10¢. BILL SLEP CO., Drawer 178 R, Ellenton, Fla.

COMPONENTS, Recorders, Tapes. FREE Wholesale Catalogue. CARSTON, 125-T East 88th St., New York 28, N.Y.

CONVERT ANY TELEVISION to supersensitive big-screen oscilloscope. Only minor changes necessary. Plans $1.95. RELCO, Box 10563, Houston 18, Tex.

WANTED—MISCELLANEOUS Quicksilver Platinum, Gold, Silver. Ores analyzed. MERCURY TERMINAL, Norwood, Mass.

HIGHLY DIRECTIONAL MICROPHONE picks up a whisper a block away. Used by investigators, broadcasters. Build for about $7.00 with simple materials. Plans, $2.00. DEE CO., Box 7263, Houston 8, Tex.

TRANSISTORIZED products dealers catalog, $1. INTERMARKET, CPO 1717, Tokyo, Japan.

WANTED: BC-348's, laboratory equipment, manuals, klystrons. Cash, swap. ENGINEERING ASSOCIATES, 434 Patterson Rd., Dayton 19, Ohio.

DIAGRAMS FOR REPAIRING RADIOS, $1; television $2. Give make and model. DIAGRAM SERVICE, Box 672 RE, Hartford 1, Conn.

FRANCHISES MAKE PROFITS! Operate your own exclusive franchised business. Write today for free interesting details. NATIONAL FRANCHISE REPORTS, Dept. RE-528, 333 N. Michigan, Chicago 1.

---

20 ASSORTED 1- and 2-tube circuit diagrams: receivers, transmitters, amplifiers, power supplies, etc. 50¢, full-page diagrams. ELECTRONICS SERVICES, 16 Bayside Ave., Hamilton, Ontario, Canada.

QUIET OPERATION of your receiver with a Qualitykit noise control. Reduce noise without signal loss by variable attenuation of high frequencies. Improve readability. Available as assembled unit in attractive box for $4.95, or as kit for panel mounting for $3.75. Complete with instructions for easy installation. Postpaid from QUALITY-KIT, PO Box 5184, North Charleston, S.C.

NEW ELECTRONIC-SCIENTIFIC KITS. Mine detectors, SW, experimental, printed circuits. Send 10¢ for catalog. KIT-TRONICS CORP., Dept. B, 6509 Whitman Ave., Van Nuys, Calif.

REPAIR AND TROUBLESHOOTING MANUAL on 16mm sound and projectors. Additional Service Sheets every month. $6. WESLEY TROUT, Engineer, Box 575, Enid, Okla.

EARN $150 WEEK as Mechanical, Electronics Draftsman. Send $25 complete home-study course. PRIOR INC., Dept. 125, 23-09 169 St., Whitestone 57, N.Y.

SPEAKER SALE. Component quotes. Tapes. BAYLA CO., Box 131-RE, Wantagh, N.Y.

TRANSISTORIZED Police Radar Detector Kit. All parts and simple instructions. Ready to wire. Legal. Works through car radio speaker. Improved long-range model M. $19.95, postpaid. DEEKIT CO., Box 7263, Houston 8, Tex.

GARAGE DOOR OPERATORS $59.95. Rugged chain-drive automatic units. Highest quality. Free literature. DEMSCO INC., Sebring 23, Ohio.

BARBELLS, exercise equipment. Courses. Catalogue 10¢. GOOD BARBELL CO., Box 143, Siloam Springs, Ark.

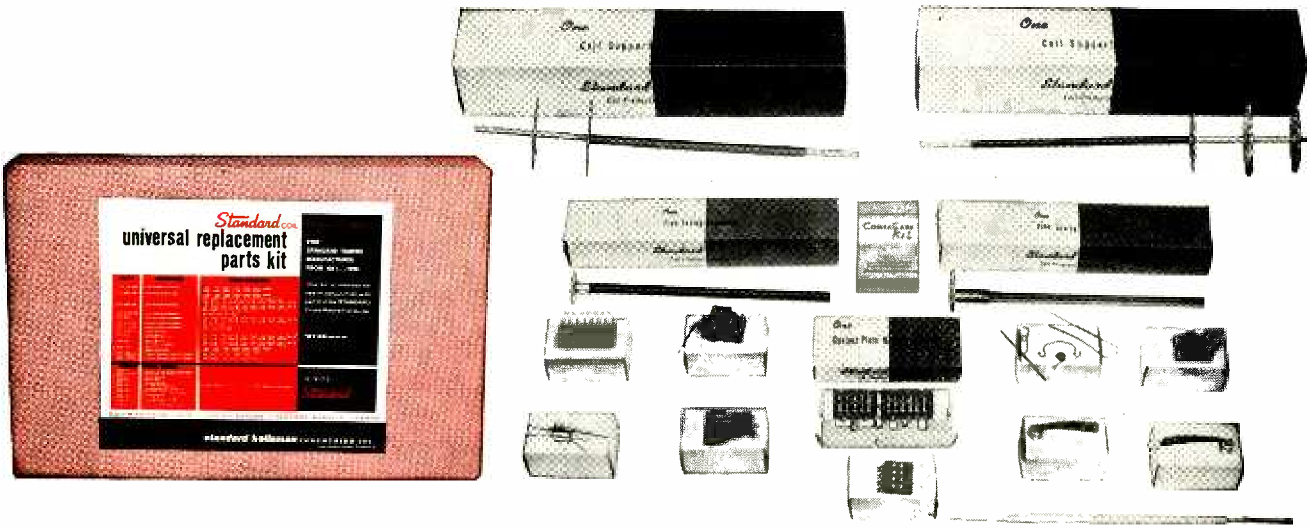
DIAGRAMS to repair recorders, televisions, radios, $1.50. Give make, model. HANDEE, Box 146, Brooklyn 19, N.Y.

BUY — SELL — TRADE cameras, lenses, telescopes, amateur radio equipment. DENSON ELECTRONICS, Box 85, Rockville, Conn.

Universal Replacement Parts Kit

MODEL 31T 3890

Popular Standard Coil field replacement parts used extensively by servicemen for STANDARD tuners manufactured from 1947-1956.



MODEL 31T 3890 A kit of mechanical and electrical parts for shop and field use to be used in conjunction with Section II of the STANDARD Cross Reference Guide. These parts make up 90% of the replacement parts most commonly used in field service.

INCLUDED FREE

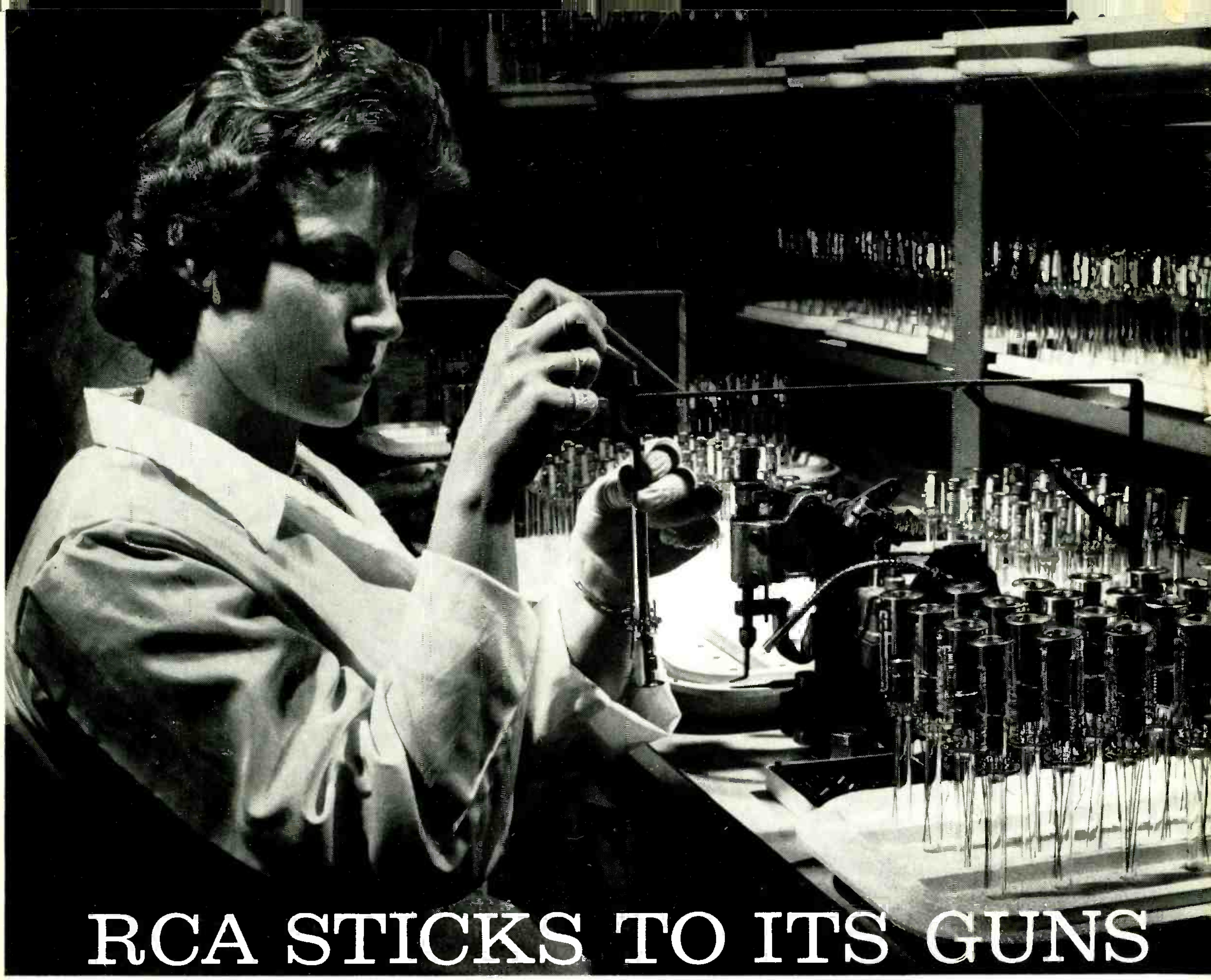
- Special IF alignment tool for late model STANDARD TV and FM tuners.
- Popular special springs, detent springs and roller assembly, detent ball assemblies, etc.

BE PREPARED . . . GET YOURS TODAY from any authorized Standard COIL distributor

• **$27.99 DEALER NET**

standard kollsman INDUSTRIES INC.

FORMERLY STANDARD COIL PRODUCTS CO., INC., MELROSE PARK, ILLINOIS



RCA STICKS TO ITS GUNS

The life of RCA Picture Tubes depends on it

The electron gun, heart of every TV picture tube, is a precision instrument. A speck of dust in the wrong place can mean the difference between poor and outstanding performance in a picture tube.

RCA assures outstanding performance in Silverama Picture Tubes by assembling every electron gun in the super-clean, dust-free atmosphere of the "White Room" at RCA's modern plant in Marion, Indiana.

Measured in terms of your business—this extra precaution helps to substantially reduce troublesome "in-warranty failures" and costly call-backs. Sell the finest name brand picture tube—RCA Silverama.

Silverama contains all-new electron gun, all-new parts and materials except for the envelope which is used. See your Authorized RCA Distributor today.

Workers wearing lint-free smocks, must enter "White Room" through an airlock. Room is kept under constant pressure to force any air-borne dust out when a door is opened.

Finished guns after ultrasonic cleaning in a super wetting agent are carried to the assembly line in these covered plastic cases—further protection against contamination.

Guns await final assembly in this pressurized plastic housing. Blower at top maintains pressure, prevents dust from entering housing.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

RCA ®

The Most Trusted Name in Television

RADIO CORPORATION OF AMERICA