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See Page 4
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editorial
Hugo Gernsback  31 Earth Signals on the Moon

audio—high fidelity—stereo
Earl E. Snader  35 What About the Bias Oscillator?
First of a series on the heartland of tape recording
Robert D. Hochberg  50 7-Station Intercom Uses 1 Master
System has transistor amplifier and binary switching for flexibility
Norman H. Crowhurst  53 More Circuits for FM Stereo
Eico, Fisher, Heath and Pico

radio
Stanley Leinwoll  52 SW Propagation Forecast
May 15-June 15
64 Single-Sideband Techniques Improve Shortwave Listening
E. L. Safford, Jr.  80 Midget 4-Channel CB R/C Receiver
4-transistor package circuit makes it small

test instruments
I. Queen  70 Expanded-Scale Voltmeter
Checks nickel/cadmium batteries accurately
Wayne Lemons  74 Two new tools for transistor servicing
Equipment report: Heathkit IM-30 and B&K model 960

electronics
Eric Leslie  47 Automation Makes Golden Resistors (Cover Feature)
59 What's Your EQ?
Answers to May puzzles on page 70
John A. Comstock  84 Soldering Shortcuts
A page of pictorial hints

industrial electronics
Alex M. Schotz  32 Check Auto Ignition with an Ohm-Dwell Tachometer
Transistorized automotive test instrument you can build
Robert G. Middleton  44 Unusual Oscilloscope Techniques
Industrial methods applicable to TV service
Dellroye D. Darling  48 Induction Heating Turns the Trick
Heating the outside without warming the inside

television
John R. Lange  38 Nuvistors Cut Noise in VHF TV Booster
Cut down on the snow. Try this do-it-yourself unit
Larry Steckler  41 Tube Layouts in TV Sets—Motorola 1961—1962
Mike Wayne  56 Jumping to Conclusions
The jumper wire in TV service
W. E. Parker  60 TV Camera You Can Build—Part II
Circuit operation and coil-winding details
Jack Darr  66 Service Clinic
Vertical bending at top of picture
72 RATIC—Harbor TV Radar
Makes any ahf TV set a radar receiver

what's new
43 Pictorial reports of new developments

the departments
102 Corrections
22 Correspondence
102 New Books
92 New Literature
97 New Patents
87 New Products
95 New Tubes & Semiconductors
6 News Briefs
105 Noteworthy Circuits
98 Technicians' News
85 Technotes
100 Try This One
99 50 Years Ago
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VETERANS: Give copy of discharge...
Earth Station

The term is no longer science fiction—you can visit one in Andover, Me. Constructed by Bell Telephone, it is the US link in a worldwide communications system making use of a series of Telstar repeater satellites. Telephonic and TV messages will be exchanged between the site and the satellite in orbit. This satellite will receive, amplify and retransmit the signal to similar stations in other parts of the world. Eventually, a total of 20-40 satellites, in orbit, will be needed to insure complete worldwide communication at all times.

The “earth station” consists of a radome 210 feet in diameter and 161 feet tall. Inside is a 340-ton steel and aluminum rotatable antenna structure. It consists of a horn antenna with an opening that measures about 3,600 square feet and two fairsized houses containing transmitter and receiving equipment. The horn will scoop up a billionth of a watt of the signal broadcast from the Telstar satellite. A maser amplifier is located at the apex of the horn. It uses a synthetic ruby as a central element, cooled to −456°F by liquid helium.

A supplementary control station located a quarter mile from the radome is where the actual work will be done. Two tracking antennas are located outside this building. A quad-helix command tracker picks up the satellite’s 136-me beacon and telemetry and will transmit commands to the satellite on about 120 mc. Once the satellite begins to transmit its broad-band communications signal and associated precision beacon, the other antenna, an 8-foot dish, will track on this signal with much greater precision. It controls the large horn in the radome through a servo system.

The Andover station will be linked to the Bell Telephone Network by conventional broad-band microwave radio relay system.

People May Be Own Power Supplies

Persons who have electronic equipment such as Pacemakers or nerve stimulators implanted in their bodies, may in the future supply their own power to the equipment, according to Francis M. Long, assistant professor of electrical engineering at the University of Wyoming.

The power supply from implanted electronic equipment has always been a problem. When external batteries are used, connections must be made through the skin, with continuous danger of infection, as well as mechanical problems and annoyances. Pacemakers (heartbeat timers) have been made completely self-contained with both circuitry and batteries implanted in the body. In these cases, an operation every 5 years or so to renew the battery is necessary.

Experiments made by Professor Long would lead to the belief that a piezoelectric crystal, inserted where it would be subject to muscular motion, could supply enough power for such equipment. The crystal could be inserted, he suggests, in such places as between the diaphragm and the rib cage, and the motion caused by breathing would act on it as a phonograph stylus. A similar crystal in a phonograph pickup, producing small but sufficient quantities of power for certain types of implanted equipment.

New Electrostatic Recordings Are On Uncoated Tape

A new system of electrostatic recording in which the charge is injected into highly resistive tape (usually Mylar) was described at the recent IRE convention. The charges are injected into the body of the tape itself by drawing the tape over a knife-edge electrode, while its reverse side is in contact with the conducting back-up electrode. As in magnetic recording, bias (dc or ac) can be used.

The playback system consists of a thin metallic “readout” electrode placed between two electrostatic shields. Tape is drawn across this as in a magnetic playback device. Potentials up to 40 millivolts are induced in the playback electrode.

After recording, and after each playback, the tape is neutralized with an “ion bath,” produced by a high-voltage corona discharge from pointed electrodes, located between the recording or playback head and the pickup spool. This neutralizes any uncompensated charges that may have been produced by friction in reeling and unreeling. The process adds greatly to the life of the recording, reducing noise as well as print-through during storage.

A study of recordings now more than 3 years old leads to the belief that the new system yields a highly permanent recording, and a

(Continued on page 12)
JUNE, 1962

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JUNE, 1962

www.americanradiohistory.com
(Continued from page 6) useful life greater than 100 years for Mylar tape records is predicted.

Sunlight's Direction May Guide Satellites

According to Heinz Gabloffsky of the Northrop Space Laboratories, a satellite may be guided through space by detecting the position and direction of the sun. The information, fed to an electronic discriminator, which might be compared with the afe system in television receivers and other electronic apparatus, would be used to correct the course of the satellite.

It is interesting to note that guidance by solar position is believed by some scientists to be a factor in the homing instinct of such insects as bees and of birds.

Viewer "Sees Double" With TV Spectacles

A miniature television receiver worn like a headset permits the wearer to either watch a display on a monoscope-like reflecting lens or to look through it at the scene ahead of him.

The device, called an Electrocular, was developed by a team from the Ground Systems Laboratory of the Hughes Aircraft Co. under the direction of Dr. A. Victor Stern. It is expected to be useful to persons who may require data or a second scene to be presented to them while watching the scene ahead. A plane pilot, for example, could watch certain indicators without moving his eyes from the air area ahead, a tank commander could see the scene ahead of him as televised from an observation helicopter high in the air as well as the direct view from his tank, or a surgeon could scan information on the patient's respiration, heartbeat and other data while carrying on the operation. The lens, set at a 45° angle to the eye, permits the wearer to read information on it or look straight through it without being distracted noticeably by the other view.

The device consists of a miniature electrostatic TV tube, with a prism to turn the picture 90° and project it on the lens, where it appears as a bright green image. A control unit supplies power, deflection and sync to both camera and receiver, thereby simplifying sync problems.

"Home Broadcast Stations" Give Headaches to FCC

"Peewee broadcast stations," operated by children, have been creating "mounting difficulty" for FCC field engineers who have had to track down the irregular transmissions, which interfere with regular broadcasting as well as with aviation, police and other safety services. Many of the young people have no idea that there is anything illegal in such transmission, and the commission itself has received so many letters from youthful radio enthusiasts, inquiring how they can use a purchased kit or home-assembled equipment to broadcast voice and records to the immediate neighborhood without an FCC license, that it has put out a special bulletin of instruction to these correspondents.

Known as Information Bulletin No. 17-G, it was issued in February, and contains 2½ pages of information as to what is legal in low-power radio and what is not. It points out that while certain types of equipment can be operated without a license, such equipment is constructed under strict controls designed to prevent interference with licensed radio services. The booklet also contains information for those who wish to pursue the study of radio, either as amateurs or as a career.

Graeco-Schenectady

More than 550 terms ending in "tron" have been discovered by a British electronic magazine. These range from Accutron, an electronic watch, to Zyklotron, a high-frequency tube. Many of the terms are trademarks or company styles rather than names of electronic devices, and some (such as Shucktron, a device for removing the shells of oysters) are not electronic.

Decade Counter Uses Luminescent Panel

A joint demonstration was made by Sylvania Electric Products and Beckman Instruments of a universal EPUT (Events Per Unit of Time) and timer which uses a luminescent panel numeric display instead of the familiar numeral display tubes. This was the first time that lumi-
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JUNE, 1962
and not just any 12AX7A?

All 12AX7A schematics look alike. And at first glance, all 12AX7A tubes also look alike. Yet, the use of a Sonotone 12AX7A tube can make a world of difference in performance.

The 12AX7A, used in signal stages for high gain, has virtually become the standard in the low level stages of audio preamp circuits where noise, hum and tube microphonics become major problems. If you examine a Sonotone 12AX7A closely, alongside another, you will see a significant difference in construction. You will notice a trident shaped, tongued structural member at the top of the tube — called a “Damper Mica.” The tongue supports the two cathodes — acts like the leaf of a spring, absorbing the shock of external impact and vibration.

As a result of this unique construction, the Sonotone 12AX7A is remarkably free from microphonic tendencies. It is also sturdier and more capable of withstanding impact and vibration without physical damage or electrical malfunction.

In addition, the Sonotone 12AX7A employs a coiled heater which restricts unwanted magnetic fields in the heater cathode assembly when AC is used for the heater supply. This reduces the AC hum component to a point where it is no longer necessary to use rectified and filtered heater supplies.

Small wonder that the Sonotone 12AX7A is specified by the leading manufacturers of high fidelity amplifiers. It is their way of insuring the quality of their instruments.

The next time you replace a 12AX7A, remember that not all of them are alike. There are enough distinctive qualities in the Sonotone 12AX7A to make its choice a sure and safe one. That's the point about all Sonotone tubes—all have that extra something that spells better performance.

In addition to the high-gain 12AX7A, Sonotone also features selected quality audio output tubes—the EL34 and EL84—available in matched pairs for push-pull applications.

Next time the schematic calls for the 12AX7A, or any type of tube for home entertainment or industrial application — replace with Sonotone.

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Raymond Wolfe of Bell Telephone Labs prepared to replace conventional n-type thermoelectric material with new bismuth-antimony alloy.

(Continued on page 18)
are you standing still in electronics while this man advances?

Find out why—and do something about it—if you have the ambition to want a career instead of just a job.

LET'S LOOK AT THE FACTS. There's something wonderful about knowing how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, but only to qualified men. In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

CREI OFFERS YOU, for study at home, a complete program in electronic engineering technology designed to prepare you for a rewarding, well-paying career in electronics. CREI equips you with a practical working knowledge of advanced and up-to-date electronic developments that will put you on the level of specialization where men are most in demand.

CREI MEN LIKE MEARL MARTIN, JR, hold positions as associate engineers, engineering aides, field engineers, project engineers and technical representatives.

WHEN YOU ENROLL IN A CREI HOME STUDY PROGRAM, you study courses to which a number of today's leading engineers and scientists have made substantial contributions. You are guided and assisted by CREI's staff of experienced instructors. You study texts that are specifically prepared for home study use.

Through CREI, you have a choice of programs covering every field of electronics:

- RADAR
- COMPUTERS
- SERVOMECHANISMS
- INSTRUMENTATION
- AERONAUTICAL AND NAVIGATIONAL COMMUNICATIONS
- TELEVISION
- AUTOMATION AND INDUSTRIAL ENGINEERING TECHNOLOGY
- NUCLEAR ENGINEERING TECHNOLOGY

Programs are available for men, such as engineers, who already have extensive technical knowledge, as well as for men with limited technical training or experience.

THE HIGH CALIBRE OF A CREI HOME STUDY EDUCATION is attested to by America's biggest corporations, where CREI students and alumni attain positions ranging from engineering technicians to engineers to top officials. Such companies are National Broadcasting Company, Pan American Airways, Federal Electric Corporation, The Martin Company, Northwest Telephone Company, Mackay Radio, Florida Power and Light and many others. They not only recognize CREI Home Study educational qualifications but often pay all or part of CREI tuition for their employees.

CREI HOME STUDY PROGRAMS are the product of 35 years of experience. Each program has been developed with the painstaking skill and care that CREI put into its electronics courses for the Army Signal Corps, its special radio technician courses for the Navy, and its group training programs for leading aviation and electronics companies. For those who can attend classes in person, CREI maintains a Residence School in Washington, D. C.

YOU CAN QUALIFY for a CREI Program, if you have basic knowledge of radio or electronics and are a high school graduate or the equivalent. If you meet those qualifications, write for FREE 58-page book describing CREI Programs and career opportunities in advanced electronic engineering technology. Use coupon below, or write to: The Capitol Radio Engineering Institute, Dept. 1406-K, 3224 Sixteenth St., N. W., Washington 10, D. C.

Mail coupon today for FREE 58-page book

THE CAPITOL RADIO ENGINEERING INSTITUTE
Founded 1927
Dept. 1406-K, 3224 Sixteenth St., N.W., Washington 10, D.C.

Please send me details of CREI Home Study Programs and Free Book, "Your Future in Electronics and Nuclear Engineering Technology."
My qualifications are noted to obtain immediate service.

CHECK □ Electronic Engineering Technology □ Nuclear Engineering Technology
FIELD OF GREATEST INTEREST: □ Servo and Computer Engineering □ Automation and Industrial Electronic Engineering Technology

Name ____________________________________________________________________________ Age __________
Address ____________________________________________________________________________
City ____________________________________________________________________________ Zone State __________
Employed by ____________________________________________________________________________
Type of present work ____________________________________________________________________________
Education: Years High School __________ Other ____________________________________________________________________________
Electronics Experience ____________________________________________________________________________

Check: □ Home Study □ Residence School □ G.I. Bill __________

JUNE, 1962
What sets the stage for scientific discovery?

H. E. D. Scovil, pioneer developer of the solid state microwave maser, explains a point at a symposium at Bell Telephone Laboratories.

There is no one answer. But surely discovery is more likely when people are stimulated to think in new ways. And nothing more powerfully stimulates scientists and engineers than up-to-the-minute discussion of the latest developments.

Bell Laboratories scientists and engineers make a point of exchanging information on their latest advances not only among themselves but with the great world-wide professional community to which they belong. Last year, for example, Bell Laboratories specialists delivered over 1200 talks to technical societies and universities. The stimulating exchange of new ideas plays an indispensable role at the world center of communications research and development.
**Is the course proven?**
A high percentage of our full-time resident students get their 1st class licenses within 12 weeks from the time they start the course. Intensive FCC license training is our specialty — not just a sideline.

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

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

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

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

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

---

**The Grantham FCC License Course in Communications Electronics is available by Correspondence or in Resident Classes.**

---

**Grantham Schools**

1505 N. Western Ave. Los Angeles 27, Calif. (Phone: HO 7-7727)
408 Marion Street Seattle 4, Wash. (Phone: MA 2-7223)
3123 Gilham Road Kansas City 9, Mo. (Phone: JE 1-6320)
821-19th Street, N.W. Washington 6, D.C. (Phone: ST 3-3614)

**Accredited by the National Home Study Council**

To: GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western 408 Marion 3123 Gilham Rd. 821-10th NW
Los Angeles Seattle Kansas City Washington

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

Name
Address
City State

I am interested in: [ ] Resident Classes [ ] Home Study

Mail Coupon Now — No Salesman Will Call
IN P.A. SPEAKERS
as in Mike Stands
ATLAS SOUND offers
- FULL LINE
- QUALITY
- PROFIT
- SERVICE

You name the application, there's an
Atlas "job-rated" speaker just perfect
for the task. Engineered to the latest
state of the art, built for long life, priced
right for your profit, supplied to serve
all your needs. All with the same quarter-
century know-how that brings you...

EVERYTHING IN MIKE
STANDS & ACCESSORIES

(Continued from page 14)
George E. Smith. They report that
the figure of merit of an alloy
of 88% bismuth and 12% antimony
was raised from 1.2 to 2.9 \times 10^4
per degree K, at room temperature, with
a magnetic field of 17,000 gauss.
The figure of merit, or "Z", is
an expression which tells how much
electricity can be obtained from a
thermoelectric junction and is re-
lated to the voltage produced by a
given amount of heat applied to the
junction, to the resistivity of the
material and to its thermal conduc-
tivity. At a temperature of 100°K, a
record-breaking Z of 9.6 \times 10^4
per degree K was reported, with a field
of only 1,000 gauss.
The improved material and
techniques should find immediate
application in low-temperature elec-
tronic refrigeration. The magnetic
field technique may be applicable to
other thermoelectric materials.

Pay TV With a Difference
A pay-TV system that does not
mean a takeover of TV servicing
was announced for Denver, Colorado
by the Gotham Broadcasting Corp.
and the Macfadden-Bartell Corp.
when they revealed the filing of an
application with the FCC for author-
ization to conduct a 3-year test of
the system. The different thing about
the Teleglobe pay TV system is that
the picture is transmitted unscram-
bled. Sound is piped into a separate
amplifier-speaker unit via telephone
lines. Therefore, no connections are
made to the TV receiver and it can
be serviced just as any receiver.
Connections to the pay-TV audio chan-
nel have nothing to do with the TV
set, as a separate amplifier speaker
assembly supplied by Teleglobe (see
photo) is used. When the user turns
on the audio system its use is re-
corded electronically at the Tele-
globe-Denver data processing center.
The customer is then billed monthly
according to what he watched.

Electronic Engineers Meet
Again breaking records of all
previous conventions, the Institute
of Radio Engineers was host to some
72,479 of the world's leading experts
in electronics, space technology and
communications at its fiftieth an-
iversary convention in New York
City, March 28-29. A 4-day technical
program saw the presentation of 265
papers in 54 technical sessions which
covered everything from space elec-
tronics to art and music.
The most startling new develop-
ment exhibited was the disinte-
gration of a small portion of a stain-
less steel sheet with a light beam
from a laser. After burning a hole
through 1/32-inch steel in .0005 sec-
ond, the beam continued its way
to blow up a balloon lying on a table
some 10 feet distant.
The IRE's annual electronic
exhibition consisted of more than
850 separate exhibits, completely
filling four floors of the New York
Coliseum.

One of the important pieces
of business of the convention was to
continue arrangements for merging
the IRE with the American Institute
of Electrical Engineers. If the
merger is approved by the members
of both societies, this may be the last
convention of the IRE. The next one
would be of the Institute of Electrical
and Electronic Engineers. It was
remarked by one visitor that the
time is ripe for such a merger, since
among the more than 800 ex-
hibits, there were apparently only
two or three that included radio—
the rest were purely electronic.

Brief Briefs
Standard frequencies trans-
mittted by the National Bureau of
Standards and the US Naval Observ-
atory were made higher by two parts
in one billion, beginning Jan. 1, 1962.
The change is too small to be detected
by ordinary equipment, but is signif-
ificant to those using specialized appa-
ratus.

Claimed to be the smallest car-
diac pacemaker, this little instru-
mant is 2 inches square and \% inch
thick. Worn externally, it weighs
only 4 ounces, including a 6-month
battery. Bipolar electrodes connect
it directly to the heart's myocardium,
to regulate the heartbeat.

A battery that operates on su-
gar with a combination of catalysts,
to produce current at 0.7 volt, is an-
ounced by Electro-Optical Systems
of California and Sonotone Corp. of
New York. Such batteries, it was
stated, might theoretically be usable
to produce electricity on space craft,
using human waste as fuel.

Weathers Industries, Barrington,
N. J., of the famous Weathers
pickup, has been acquired by Tele-
PrompTer Corp. Paul Weathers
becomes director of engineering for the
new TelePrompTer Div.

END
There's matchless quality in the Knight-Kit®

**KF-90 STEREO MULTIPLEX FM-AM TUNER KIT**

Dazzling stereo FM plus AM...lavish features

America's best tuner buy! Fully equipped for breathtaking stereo FM multiplex reception, this easy-to-build, expertly engineered tuner is yours at unbelievably low cost. Features advanced built-in multiplex circuitry for sparkling FM stereo reception, as well as sensitive regular monophonic FM and AM reception—all from a single self-contained beautifully styled tuner. Outstanding highlights: 1 1/2 µV IHFM usable sensitivity on FM for real "pull-in" power—terrific for fringe areas; unique StereoFinder to locate stereocasting stations—Dimension Control "finds" multiplex signal, then lets you adjust for best stereo effect. Dozens of other superb features (see left). The quality can't be matched; the savings can't be duplicated. Order the Knight-Kit KF-90 today—no money down (just check coupon). Incomparably priced at a low, low... $99.95

Satisfaction guaranteed or your money back

Send no money down on Allied's Credit Fund Plan

Name, please print

Address

City____________________Zone____State_______

Order Today

Allied Radio
100 N. Western Ave., Chicago 80, Ill.

☐ Ship me the Knight-Kit KF-90 Tuner 83 YU 914AN

☐ Ship No Money Down on Allied's Credit Fund Plan
DON'T BE A "SCREWDRIVER MECHANIC."
Every year, hundreds of “do-it-yourself-ers” damage or ruin their sets, pile up needless expense, and endanger their safety by trying to make their own TV repairs. Your TV is the most intricate piece of equipment you’ve ever owned—far more complicated than your car! If you're tempted to tinker with it, DON'T! Guesswork is much too costly.

LEAVE YOUR TV REPAIRS TO A "PRO."
Years of training and experience make the TV technician an expert. He has repaired hundreds—perhaps thousands—of TV sets. He spends countless hours and hundreds of dollars on manuals, keeping up-to-the-minute on new developments, circuits, trouble-shooting techniques. He is qualified in every way to diagnose TV trouble accurately—cure it quickly and safely.

DON'T LOOK FOR SERVICE "BARGAINS."
There aren't any! Cut-rate prices mean cut-rate methods and cut-rate parts in your TV set. And these lead to unsatisfactory set performance, probable damage, and additional costly repairs. The expert TV technician charges a fair price for honest service. He can't afford special deals and service "bargains" any more than you can!

CALL YOUR TV EXPERT AT THE FIRST SIGN OF TROUBLE.
Don't wait for your set to go completely dead. Failure of one TV part sets up a chain reaction—other parts are damaged and repair costs pile up. Early attention prevents this and also makes it easier—and less expensive—to find and cure the trouble. To keep your repair costs low, call your TV technician when trouble starts!

TRUST YOUR INDEPENDENT TV TECHNICIAN.
As a member of your community, he stakes his reputation on your continued satisfaction. His years of study and experience, his large investment in equipment, and the fact that he's in business for himself are your assurances of good work and honest prices. His first loyalty is to you—his customer.
NEW SWITCH
NEW COMFORT
NEW STYLE

TURNER'S NEW

355C CITIZEN'S BAND
MICROPHONE

An all new styling concept from Turner—the company that gave you the famous Turner 350C microphone. Now, with the 355C you get the same Turner ruggedness and dependability in an entirely new microphone design. The convenient hand-ease switch means fast and convenient operation in any mobile situation.

See Turner's new 355C at the Parts Show,
Booth E-105, Suite 1204.

THE TURNER MICROPHONE COMPANY
952 17th Street N.E., Cedar Rapids, Iowa

IN CANADA: Tri-Tel Associates, Ltd., 81 Sheppard Avenue West, Willowdale, Ontario

JUNE, 1962
FREE ROLLER SKATES
with each Centralab ACK-100
AUTO RADIO CONTROL KIT

YOU GET:
24 of today's fastest movers
PLUS
• free sturdy steel cabinet
PLUS
• auto-radio control cross reference
PLUS
• free roller skates

$49.95 THE PRICE OF THE CONTROLS ALONE!

See your distributor now!—Offer will be withdrawn when supplies are exhausted.
Centralab controls are listed in Sams' TV & Auto-Radio Control Replacement Guide.

THE ELECTRONICS DIVISION OF GLOBE-UNION INC.
922F EAST KEFE AVENUE • MILWAUKEE 1, WISCONSIN
In Canada: Centralab Canada Ltd., P.O. Box 400, Ajax, Ontario

RADIATION NOTES
Dear Editor:
It must be a great comfort to know that when the needle on Mr. McCready's radiation meter (February 1962, page 39) fails rapidly, we will be dead very shortly. Mr. McCready should also say that 50 roentgens of whole body irradiation received in 6 minutes is much worse than 50 roentgens in 2 hours or a day, etc. The ABC considers less than 0.3 roentgens per week a "safe" working level.
Besides all that, I am dubious about a ceramic socket maintaining better than 10^9 ohms for more than a very short time, and suggest the home builder use a mica-filled socket, cutting out a notch for pin 4 and soldering a connection directly to this pin, or sliding a bushing.
Tom Jaski
San Mateo, Calif.

TRAPPING THE RADAR DETECTOR
Dear Editor:
Muni Quip Corp. currently manufactures more radar speed meters than anyone else. Users of Muni Quip Radar have available a special circuit which shuts off the radar waves until a car which is obviously speeding is spotted. By merely flipping a switch, this circuit is energized to instantly read the speed of the approaching vehicle containing the radar detector.
This is a very effective countermeasure, and renders a radar detector useless when facing traffic police who have equipped their radar speed meter with this Muni Quip feature.
President
BRYCE K. BROWN
Muni Quip Corp.
Decatur, Ill.

VIDICON FOR TV CAMERA
Dear Editor:
I have read, "Construct Your Own Low Cost TV Camera" in the May 1962 issue with great interest. Here's a tip that might be helpful to those building this TV camera.
The type 6198 vidicon tube specified has not been made for some time and is not readily obtained. To assure optimum results from what appears to be a well designed vidicon camera using minimum circuitry, it is suggested that a first-line vidicon tube (type 7038 or 7735A) be used.
These types are available from Allied Radio and other distributors and
(Continued on page 26)
Hints on Reducing Hum...

In high fidelity sound systems... and in many kinds of commercial and industrial electronic equipment... reduction of 60-cycle hum is one of the toughest problems that a technician has to tackle. Most hum comes from 60-cycle voltage sneaking into the signal circuit. There are, of course, many well-known precautions that should be observed... using shielded or coax cable between major components, keeping cables short especially in the low-level portion of the system, making sure connectors are tight. Here are some other thoughts that may be useful.

Power supplies in sound systems... hi-fi or commercial... generally operate at higher temperatures than those encountered in radio or TV. So it pays to be particular about filter capacitors. It pays to use electrolytics rated at 85° C. Those rated at only 65° C start to run into trouble. Then too, because of the added heat, the vent construction is important. In other words, "How good is the seal?" Our tip is to always use Mallory FP-WP electrolytics... voltage ratings are conservative and dependable... they have excellent stability at high temperature... and they all have etched cathode construction. This latter is extremely important in avoiding hum. We covered the reasons in a previous TIP (remember?).

Here's another source of hum... filament circuits. Many of the highest quality sound systems use a DC filament supply in the preamplifier. It's easy to add this refinement to any system. All you'll need is a Mallory FW-50 "packaged" silicon rectifier circuit. It's encapsulated in a tiny plastic block and takes up very little space. Simply connect the FW-50 to the circuit, add a WP-042 electrolytic and filament hum disappears permanently. If you want more specific information, write and ask us.

Another tip: call on your Mallory Franchised Distributor for prompt service, at sensible prices, on Mallory capacitors, switches, silicon rectifiers, controls, and batteries... and for any other parts you may need.
THE MOST COMPLETE LINE OF QUALITY TAPE RECORDING EQUIPMENT IN THE WORLD

- Sony Stereo Tape Deck 262-D - 4 & 2 track stereo recording and playback tape transport to add tape to your existing hi-fi system. $89.90. (Also available, not pictured, the new SRA-2 stereo recording amplifier for the 262 D. $89.90.)
- Sony Sterecorder 777-S - All transistorized professional 2 & 4 track stereo recorder featuring the revolutionary Sony Electo Bi Lateral Heads. The world's finest tape recorder. $725.
- Sony Sterecorder 300 - A complete professional-quality hi-fi stereo tape system with 4 & 2 track recording and playback in one portable unit. $399.90.
- Sony Portable 101 - 2 speed, dual-track, hi-fidelity recorder with 7" reel capacity. $99.90.
- Sony Sterecorder 464-D - Dual performance 4 track stereo tape deck with built-in recording & playback preamps for custom installations and portable use. $199.90.
- Sony Wireless Microphone CR-4 - Pocket size mike and transmitter providing complete freedom from entangling microphone cables. $250.
- Sony Condenser Microphone C-37 A - For purity of sound reproduction, the unqualified choice of professional studios throughout the world. $295.
- Sony Sound on Sound Recorder 262 SL - The perfect recorder for language, music and drama students. With 4 track stereo playback. $199.90.
- Sony Sterecorder 111 - A popularly priced, high quality bantam recorder for everyday family fun. $79.90.
- Sony Condenser Microphone C-17 B - Miniature size (3 1/4 " x 3 1/2" diameter) and exceptional background isolation unidirectional cardioid pattern. $350.
- Sony Newscaster Portable EM-1 - A professional on-the-spot battery powered portable recorder with precision spring wind constant speed motor. $495.

All Sony Stereocorders are Multiplex ready!
HERE’S WHY YOU SHOULD QUALIFY FOR MEMBERSHIP IN THE “PEET” PROGRAM!

JOIN THIS SELECT GROUP OF Photofact-Equipped Electronic Technicians

ENJOY THESE EXCLUSIVE BENEFITS—NO COST TO YOU IF YOU QUALIFY!

1

Through your membership in the dynamic “PEET” program, you:

- Gain deserved recognition as a reputable businessman
- Acquire exceptional public trust and confidence
- Win favorable publicity, both locally and nationwide
- Earn more—“PEET” members are proving it daily

2

Get dynamic national advertising support

CONTINUOUS ADVERTISING IN TV GUIDE

Powerful national advertising monthly in TV Guide now carries the “PEET” message to over 8,000,000 TV families, building dynamic support and demand for the services of “PEET” members. Now more than ever it pays to belong to the “PEET” program!

3

Powerful, outstanding business aids at no cost to you!

How to apply for membership in the “PEET” program

If you now own a PHOTOFACT Library, or plan to own one, you can apply at once for membership in the powerful “PEET” Program, designed to build prestige and business for the Service Technician who qualifies. Membership helps you win public respect and confidence, provably helps you earn more, as hundreds of “PEET” members can testify. Benefits cost you absolutely nothing if you qualify. So act now—see your distributor or use coupon at right.

GET YOUR “PEET” APPLICATION IN NOW!
(Continued from page 22)
carry the manufacturer's standard warranty and guaranty. JULIAN McBARRON Closed-circuit TV field engineer Allied Radio Inc., Chicago

[While many readers may prefer a new tube, the article suggested surplus 6198's as part of a low-cost system, since they can be obtained at about half the cost of the new 7008's or 775A's.]

DON'T FORGET MALLORY!
Dear Editor:

On page 55 of the May issue is a feature on "Replacing Japanese Transistor Radio Batteries." You listed a number of Eversed, Burgess, Baner, Ray-O-Vac and RCA equivalents of various Japanese types. But you neglected to cover any batteries made by our client, P. R. Mallory & Co. Inc.

For your information, Mallory supplies mercury, manganese and zinc-carbon batteries which will do a superior job in transistor radios. The mercury types in particular are notable for their long service, up to five times as long as zinc-carbon, and are particularly outstanding in the smaller sizes.

Here are the equivalent Mallory types for the list you published:

<table>
<thead>
<tr>
<th>Size and Japanese Model</th>
<th>Mercury</th>
<th>Manganese</th>
<th>Zinc-Carbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5-v D cell, UM-1</td>
<td>RM-42</td>
<td>Mn-130</td>
<td>M-13R</td>
</tr>
<tr>
<td>1.5-v C cell, UM-2</td>
<td>Mn-140</td>
<td>M-14P</td>
<td>M-14R</td>
</tr>
<tr>
<td>1.5-v AAA cell, UM-3</td>
<td>ZM-9</td>
<td>Mn-150</td>
<td>M-15R</td>
</tr>
<tr>
<td>1.5-v AAA cell, UM-4</td>
<td>Mn-240</td>
<td>M-240</td>
<td></td>
</tr>
<tr>
<td>1.5-v N cell, UM-5</td>
<td>RM-401</td>
<td>Mn-910</td>
<td>M-910</td>
</tr>
<tr>
<td>9-v 906R</td>
<td>TR-146</td>
<td>Mn-160</td>
<td>M-1600</td>
</tr>
<tr>
<td>9-v 906S</td>
<td>TR-177</td>
<td>M-1600</td>
<td></td>
</tr>
</tbody>
</table>

HAL M. PARSHAL
Aitkin-Kynett Co. Inc.

ABOUT THAT MIXER
Dear Editor:

As always, we at Switchcraft enjoy reading each issue of your fine magazine. The February issue was no exception. One article was very interesting to our sales and engineering departments—"Spice-Can Audio Mixer."

The unusual interest was created because we have been manufacturing a miniature audio mixer, the Mini-Mix, for quite a few years.

If any readers are interested in details of this unit they can send for our Catalog A-401.

C. J. SHULTZ
Sales Promotion Manager
Switchcraft Inc.
5555 N. Elston Ave., Chicago 30, Ill.

IMPROVED SOUND INTERRUPTER
Dear Editor:

The August 1961 issue contained an article by Elliott A. McCready titled "TV Sound Interrupter Has Only Four Parts." This circuit would work well, except for one minor detail. When the normally closed relay is opened by photocell action, the contacts place absolutely no load on any kind across the secondary of the audio output transformer. If this condition remains very
Learn RADIO TELEVISION ELECTRONICS
by Practicing at Home in Your Spare Time

Electronics is the outstanding career field of the 1960's. There are more better-than-average opportunities in Electronics than in any other field—openings for which you could qualify through NRI training. Thousands of men like yourself have stepped up to good money in Industrial Electronics, Radio and TV Broadcasting and Radio and TV Servicing with NRI training.

Make More Money Soon
If you decide to be a Radio-TV Service technician, NRI training can help you step up your income soon after you enroll. We show you how to apply your knowledge to make extra cash in spare time doing Electronic repairs or servicing radios and TV sets for friends and neighbors. If desired NRI assists you in job placement when you're ready. In short, whatever branch of Electronics you select, NRI is well qualified to help you grow in your new career...in usefulness, in prestige, in monetary gain.

Train With The Leader

NRI is America's oldest and largest home-study Radio-TV, Electronics training school. For nearly half a century NRI has maintained the confidence and respect of students, graduates and the Electronics Industry by constantly supplying practical, complete, up-to-date home-study training at a cost most everyone can afford. Read the capsule descriptions of NRI courses on the other side of this page. Then, mail the postage-free card today for the FREE NRI CATALOG. National Radio Institute, Washington 16, D. C.
PICK THE CAREER YOU WANT IN THE WONDERFUL FIELD OF ELECTRONICS

TRAIN AT HOME WITH THE LEADER

INDUSTRIAL ELECTRONICS

Prepare for a career as an Electronic Technician in industry, business, government, the military, with this NRI course in Electronics—Principles, Practices, Maintenance. Computers, telemetry, automation, missiles, rockets all employ the same basic principles... and that is what this NRI course stresses with illustrated lessons, special training equipment.

TELEVISION-RADIO SERVICING

(NINCLUDES COLOR TV)

NRI's time-tested course in Servicing not only trains you to fix radios, TV sets, hi-fi, etc., but also shows you how to earn spare-time money starting soon after enrolling. Fast growth in number of sets, color-TV, stereo, means money-making opportunities in your own spare-time or full-time business or working for someone else. Special training equipment included.

TV-RADIO COMMUNICATIONS

In the NRI Communications course you get actual experience as NRI prepares you for your choice of Communications fields and an FCC License. Commercial methods and techniques of Radio and TV Broadcasting; teletype; facsimile; microwave; radar; mobile and marine radio; navigation devices; FM stereo multiplexing are some of the subjects covered. You work with special training equipment.

FCC COMMERCIAL LICENSE

For men with Radio-TV experience who want to operate or service transmitting equipment used in broadcasting, aviation, marine, microwave, facsimile or mobile communications. A Service Technician is required by law to have an FCC License to work on C-Band, other transmitting equipment. From Simple Circuits to Broadcast Operation, this new NRI course trains you quickly for your Government exams.

Job Counselors Recommend

Today, a career in Electronics offers unlimited opportunity. Job counselors advise, "For an interesting career, get into Electronics." The National Association of Manufacturers says, "There is no more interesting and challenging occupation in American industry."

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long, the transformer may burn up.

I have studied the circuit closely and found a way out of this trouble. Fig. 1 is a diagram of your circuit. My addition calls for a relay with two sets of contacts—one set normally closed, and the other normally open. When the relay is triggered by the action of the photocell, the normally open contacts close and shunt a low-value resistor across the output transformer to prevent any damage to the output tube or other components associated in the circuit. The normally closed contacts act as before. ROBERT BAKER Detroit, Mich.

[The length of a commercial should not be long enough to damage the equipment. However, some circuits are more susceptible to this trouble than others.]

The relay specified (Sigma 5F-2500-S-SIL) has double-throw contacts so you don’t need a new relay with double-pole contacts (Fig. 2). Use a 3-conductor plug and 3-conductor, closed-circuit jack between the relay and receiver. The arm of the relay goes to the top end of the transformer secondary and the normally closed contact goes to the top end of the voice coil. The normally open contact connects to the other end of the secondary and voice coil through the resistor.—Editor]

HALF-POCKET RADIO TOO BIG
Dear Editor:
I recently built the Tax radio described in the March 1962 issue. Performance was excellent, but I have been able to cut its size in half and retain almost the same performance.

The following changes were made:
For a pot I used a Lafayette VC61. It is mounted outside the case. I replaced the variable capacitor with a transistor socket. Then I determined the value of a capacitor which would pick up my favorite station, and plugged it in.

Several capacitors for desired stations can be made up and marked with the letters of the station. JOSHD BOSTON, Mass.

[Congratulations! There is certainly nothing wrong with this approach. It is probably especially useful in areas where there are only one or two stations. Guess you now have a quarter-pocket radio.—Editor]
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EARTH SIGNALS ON THE MOON
...Coming Communications Problems Between Earth and Moon...

WITHIN the next few years—certainly before 1970—men will have landed on the moon, opening up a vast new world.

However, before humans actually visit the moon, they will have been preceded by electronically equipped robots, specifically designed to pre-explore the moon's inhospitable environment. Many moon-landing vehicles and machines already have been designed, and prototypes built. These robot explorers will make "soft" landings on the lunar surface, after having been propelled by rocket over the 238,000 miles separating the moon from earth. Guided entirely by electronics and telemetric control, not every one of the early lunar flights can be expected to turn out smoothly. There probably will be mislandings—not all moonshots will be successful, any more than all our first earth satellites succeeded. But we may be certain that before 1970 we will have succeeded in setting down a number of lunar robots that will make later manned landings reasonably safe.

One of the difficult problems in precise moon landings—possibly solved theoretically by now—is the time lag of telemetering the robots from earth. It takes 1.2 seconds for light or radio waves to span the 238,000 miles between earth and moon in one direction. Even if you could follow a rocket's flight to the moon via telescope, it would be impossible actually to see the last important 50 or so feet of the descent. Because light from the moon takes 1.2 seconds to reach the earth observer, he of course could not see the approach to landing till 1.2 seconds later. It would therefore be a most difficult operation to land a rocket robot telemetrically from earth.

There are, however, better and more precise means to soft-land lunar robots. Let us mention only one. The principles we used during World War II in the electronically operated proximity fuze—or similar ones—can conceivably operate the robot's retro-rockets, independent of earth telemetry. These means will be certain and automatic for all landing purposes. Once the robot equipment has arrived safely and intact on the moon, earth scientists can take over certain operations via telemetry. Because, in all likelihood, the robot must be able to move over small distances for orientation and exploring purposes, it will be equipped with a TV camera so that earth observers can see the machine's immediate environment. Other vital information sent via radio for the benefit of physicists, geologists and astronomers would be transmitted automatically by the robot's exploratory instruments.

While we have made innumerable radio contacts with the moon since 1946, bouncing signals off its surface successfully, there will be some future problems which cannot be solved with certainty until we actually get to the moon.

Because lunar robot receivers must of necessity be exceedingly sensitive, interference from earth transmitters to the special moon-beamed signals intended to operate the moon robots will become critical.

Consider that the moon always turns its same side to the earth. It is known today that all frequencies (even broadcast waves) penetrate our atmosphere to a certain degree. But frequencies, from the vhf range down to centimeter waves, probably reach the moon in various intensities from earth transmitters "visible" to the moon. As the earth turns, many earth transmitters will contact the moon once in 24 hours.

Note also the inevitable Doppler effect of the rapidly spinning earth—1,000 miles an hour at the Equator—when it transmits vital signals to a moon robot. This complicates reception.

Earth signals will come in strongest on the moon robot's instruments when the earth station is exactly opposite to it. They will become progressively weaker as the earth transmitter nears a 90° angle vis-à-vis the receiver on the moon. This is because the radio waves now must pierce the vast horizontal mass of the earth's atmosphere, against the former 150 miles or so when the moon is overhead. To circumvent this, we require a number of transmitters located at different points on the earth, all connected in a radio network, if we intend to maintain 24-hour uninterrupted communication with moon robots.

Another completely unsolved problem is future radio communication on the moon. Because of its small diameter, the moon's horizon is much nearer than that on earth. The moon having no Heaviside layer, radio communication can reach only as far as the horizon, some 2 miles, if the transmitter and receiver are 10 feet above the ground. We know nothing of the ground composition of the moon—whether it is conductive or not. Hence we cannot know until we get to it if we can communicate through ground-wave conduction as we do on earth. If we can, the problem of radioing to any distance and to the far side of the moon will become simple and inexpensive. If not, we must set up a cumbersome and expensive radio relay system.

—H.G

*The author first predicted echo radio signals from the moon in his former magazine, Radio News, in the article "Can We Radio the Planets?" in the February, 1927 issue. In January, 1946, the US Signal Corps first established two-way radio contact with the moon in 2.4 seconds, as predicted by the author 19 years before. (His forecast time had been 2.5 seconds, an error of 1/10 second.)

Check Auto Ignition with an Ohm-Dwell Tachometer

Three-way instrument is a must when you tune up your car. Easy to build and use.

By ALEX M. SCHOTZ*

When servicing a modern automotive engine, we must be able to measure point dwell time, point resistance and engine rpm. This article describes a home-built single instrument that will do these three things.

Most dwell meters indicate how long the breaker points are closed before they open when the engine is running. They measure the percentage closed-contact time in relation to the total open and closed period. This indication is converted to degrees on the meter scale.

Converting these percentages to degrees depends on the number of lobes on the cam operating the points. The number of lobes divided by 360° gives the number of cylinders. It is simple to convert the percentage dwell time to degrees—a four-cylinder engine has four lobes: 360° divided by 4 equals 90°, and four divided by 360° equals 1.1% per degree. For six cylinders, we get 60° or 1.66% per degree. For eight cylinders, we get 45° or 2.2% per degree.

Generally, dwell meters are set up so that, when the breaker points are closed, current passes through a meter (previously adjusted to indicate full scale), and, when the points are open, the meter reads zero. When the engine is running, the action is very rapid, and the meter needle does not have time to read either full scale or zero. Instead, it assumes a position equivalent to the average period that the contacts are closed.

For Fig. 1 is a simplified diagram of the dwell meter used in the ohm-dwell-tachometer described in this article. The input leads are attached across the breaker points. They must match the ignition polarity. With the engine at rest and the breaker points fully closed, V is forward-biased through R2. This in turn causes V to conduct fully, and V then acts as a closed switch. Now R4 is adjusted so the meter reads full scale.

Then the auto engine is started and revved up to the proper rpm. Every time the breaker points open, V is cut off because it is reverse-biased by BATT 1 through R1. This stops the flow of current through the meter. The meter indicates the average closed time of the breaker points, as previously described.

C1 and R2 form a low-pass filter which bypasses the high-frequency pulses that occur when the breaker points open. R3 is a current-limiting resistor. It protects the meter against too much current flow caused by misadjusting R4. Capacitor C2, in parallel with the meter, provides electrical damping to prevent it from oscillating. The greater the capacitance, the slower the reaction time of the meter. If the input leads are reversed, the meter will give the wrong indication, because, when the points are open, the car battery's potential will forward-bias V.

When adjusting, installing or checking ignition points, a low-resistance ohmmeter is very handy.

The instrument should be able to indicate down to 0.1 ohm. To do so simply, a shunt type ohmmeter circuit is necessary (Fig. 2). The meter should have either a low internal resistance or a low-resistance shunt in parallel with a high-resistance meter. As a general rule, low-internal-resistance meters are the higher-current type.

Fig. 1—Simplified diagram of dwell meter.

Fig. 2—Shunt-type ohmmeter circuit.
Two practical limits govern meter selection for this application—the current drain on the activator and the fact that the meter has to serve as a tachometer. We used a sensitive meter and the appropriate shunt (R5).

In this circuit (Fig. 2), V is forward-biased through R2, forcing it to conduct fully. R4 is adjusted so the meter needle is at full scale. When the two input leads are shorted, zero current goes through the meter and the needle returns to its relaxed position, indicating zero resistance.

**Meter calibration**

To calibrate the meter scale you’ll need a low-resistance decade box with accurate resistors or have to know the meter’s effective internal resistance.

With a resistance decade box, the scale can be marked off by connecting the meter’s input leads across the decade-box terminals. The desired points are set on the box and then marked on the meter face at the point where the needle comes to rest.

If a decade box is not available, accurate resistance values can be calculated with the formula:

\[ Rx = \frac{R_m}{\left(\frac{M_i}{m_i}\right) - 1} \]

where \( Rx \) is the resistance to be measured in ohms and \( R_m \) is the internal resistance of meter. (When a shunt is used, this must be taken into account and thus the effective internal resistance value is the combination of both shunt and meter resistance in accordance with Ohm’s law.) Also \( M_i \) is the full-scale range of meter in ma. (This is the effective value and once again if a shunt is used, this must be taken into account.) And \( m_i \) is the meter reading in ma when \( Rx \) is connected to the input terminals.

The formula can be rearranged so that meter readings are predicted with different values of resistance:

\[ m_i = \frac{Rx M_i}{R_m + Rx} \]

The meter I selected has a 0–1 ma movement and its internal resistance is 40 ohms. To measure resistances smaller than 0.1 ohm, a shunt \( (Rs) \) was selected to increase the current to 5 ma. The shunt’s value was calculated by the formula:

\[ Rs = \frac{E_m}{N - 1} \]

where \( Rs \) is the shunt value in ohms.
N is the selected full-scale reading divided by the original full-scale reading, and \( R_m \) is the meter resistance in ohms.

Inserting the known values, the shunt's resistance is:

\[
R_s = \frac{40}{20} = 10\ \Omega 
\]

With the 10-ohm shunt, the current rating was increased to 5 mA and the effective internal resistance became 8 ohms. With these values set, 10 resistance points to be indicated on the meter dial were chosen. By inserting each of these resistances in the stated formula it was possible to mark these points on the meter face. The resistance points chosen and their matching currents on the 0-5-mA scale are shown in the chart below, with the percent of indication of full scale:

- 0.1 ohm = 0.0018 mA 1.23%
- 0.5 ohm = 1.054 mA 5.18
- 1.0 ohm = 1.852 mA 1[0]0.04
- 1.5 ohm = 2.758 mA 15.76
- 2.0 ohm = 3.498 mA 20.00
- 5.0 ohm = 1.928 mA 38.4
- 10.0 ohm = 1.756 mA 56.6
- 20.0 ohm = 3.558 mA 71.6
- 50.0 ohm = 4.323 mA 86.67
- 100.0 ohm = 4.689 mA 92.0

By interpolation more points were indicated.

The tachometer

Many ignition technicians either have a tachometer or advocate the use of a dwell meter simultaneously with a tachometer. Those who would like to construct their own ohm-dwell meter will find a simple and foolproof circuit in Fig. 3. The schematic shows where the resistances and external terminals can be brought out to replace the 13-volt internal battery supply. They can be connected to the 13-volt automotive battery.

The tachometer range designed to be used with the ohm-dwell meter indicates 0-5-000 rpm and can be applied to 4-, 6-, or 8-cylinder 4-cycle battery ignitions, or 2- or 4-cylinder 1-cycle ignitions. It counts the number of ignition point closings.

![Fig. 3—Ohm-dwell meter circuit for the man who already has a tachometer.](image)

Breaker points are interrupted at every other revolution per cylinder on a 4-cycle engine, and at every revolution per cylinder on a 2-cycle engine. This means that on a 4-cylinder 4-cycle engine there are two interruptions per revolution, and on a 4-cylinder 2-cycle engine there are four interruptions per revolution.

![Fig. 4—Complete circuit of the ohm-dwell tachometer.](image)

Breaker points are interrupted at every revolution per cylinder on a 4-cycle engine, and at every revolution per cylinder on a 2-cycle engine. This means that on a 4-cylinder 4-cycle engine there are two interruptions per revolution, and on a 4-cylinder 2-cycle engine there are four interruptions per revolution.

**Points closed per rpm**

<table>
<thead>
<tr>
<th>Points closed per rpm</th>
<th>Adjust meter to read</th>
<th>4-cycle engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1,800</td>
<td>4 Cylinders</td>
</tr>
<tr>
<td>3</td>
<td>1,200</td>
<td>6 Cylinders</td>
</tr>
<tr>
<td>4</td>
<td>900</td>
<td>8 Cylinders</td>
</tr>
</tbody>
</table>

Layout and wiring are not critical and are left to the discretion of the builder. With a few additions and modifications, this instrument could measure voltage and the ohmmeter range could be extended. Switching out the meter shunt in the ohmmeter circuit extends the range approximately five times. However, the scales will not coincide.

Charts can be prepared for cross reference with the information supplied here if redrawing all or some of the scales on the meter face is not desired.

The accuracy of any instrument depends on the components used and the accuracy of the calibration method. For example, if meter accuracy is 3% of full scale, the linear response obviously can deviate as much. When it is possible to calibrate the meter at different settings of the indicating needle with an accurate transducing source, do so.

Switching from the tachometer to the dwell circuit, or vice versa, is arranged so it can be done while the engine is operating, without damaging the meter or any of the components.

Since the input impedance of the dwell tachometer is greater than 7,000 ohms, there is practically no loading effect on the ignition. When the dwell-tachometer is operated on its own power supply, this instrument will operate on all ignition voltages up through 24.
What About the Bias Oscillator?

The part it plays in tape recording

By EARL E. SNADER*

A little time spent examining the tape recorder bias oscillator, to get a clear picture of why it is needed and how it can be serviced, should be worth while to the technician. This article describes what the bias oscillator does in the recording process, gives reasons for differences in impedances and other characteristics, and briefly, effects on output caused by too much or too little bias.

A second article will describe a number of bias circuits as used in commercial machines, and a third will be devoted to servicing bias oscillators.

A tape recorder is expected to make a recording on a tape that can be sensed by a reproducing system and changed back into sound as nearly like the original as possible.

In a magnetic tape recorder this is done by using a tape coated with fine iron particles. The recording head is an electromagnet which has been connected to the output of an audio amplifier. As the tape moves past this electromagnet, at a carefully controlled speed, each iron particle on the tape retains the magnetism that is induced when the flux from the head passes through it.

The coils of the record head are wound on a metal core specially designed to follow the varying magnetic field produced by the audio current from the recording amplifier flowing through the coils, and to concentrate this field at the particular point where the record head is in contact with the tape.

Tape recorder head gaps

There is a gap in the core of the record head where the tape touches the head. The magnetic flux in the core of the record head passes through the magnetic coating on the tape across this gap.

The width of the gap has an important bearing on tape head operation. A recording head must have a gap just wide enough to permit enough flux to penetrate the coating on the tape to leave the iron particles in a magnetized condition. Gap widths from 0.005 to 0.010 micro-inches are common.

The structure of a tape playback head is very similar to that of a recording head, except that the coils may have more turns (for greater output), and the gap may be smaller. A tape play-

back head often has a narrower gap so it can reproduce higher frequencies. The gap on a tape head gets wider as the head wears. One of the most common symptoms of a worn head is a noticeable drop in high-frequency response.

Gaps as small as 90 micro-inches are used in playback heads for slow tape speeds. Gap widths of around 150 micro-inches are common on machines that have been designed primarily for playback at a tape speed of 7 1/2 inches per second. If the tape is run at higher speeds, 15 or 30 ips, the gap width of the playback head can be made larger without sacrificing high-frequency response.

Fig. 1 shows how the magnetic flux is concentrated around the gap so it can penetrate the coating of iron particles on the tape.

Up to this point, it would appear that magnetic tape recording is a very simple process, requiring nothing more than a suitable mechanism for moving tape past a recording head that has been connected to the output of an audio amplifier.

Actually it doesn't work out this way, because magnetic tape is a nonlinear recording medium. The differences in the magnetic pattern that is transferred to the tape do not correspond exactly with the differences in the magnetic flux that caused them. The amount of permanent magnetization that remains in the iron particles as a result of the flux from the recording head can be plotted on the hysteresis curve for a given type of particles and coating.

If nothing more than an audio signal is used to energize the electromagnetic recording head, the resulting magnetic pattern on the tape will never be exactly the same as the magnetic fluctuations that produced it. Such a recording will be distorted when it is played back.

A low distortion level is not important in some applications. But it is important in audio recording, and something must be done to make the magnetic pattern on the tape suitable for playback so the listener will hear an accurate reproduction of the original.

Bias plays its part

This is where bias comes in. If a direct or alternating current of the right magnitude is passed through the record head coils along with the audio signal from the recording amplifier, a magnetic pattern that will not reproduce as a badly distorted signal can be placed on the tape.

A common method of biasing the record head is to superimpose an alternating current on the audio current that is fed to it. The alternating current is at some ultrasonic frequency, and its amplitude may be as much as 10 times

Fig. 1—Cross-section views show effect of gap length on flux field.

*Customer service, Viking of Minneapolis.
the average amplitude of the audio signal. This alternating current is generated by a fairly stable oscillator, set to operate at about 30 kc in some tape recorders or as high as 100 kc in others.

When ac at an ultrasonic frequency biases a record head, it causes each iron particle on the tape to go through a number of complete hysteresis loops as it passes the gap. The particular magnetized condition that has been induced in each particle will then remain according to the magnitude and frequency of the audio signal (on which the bias signal has been superimposed) at the moment the particle leaves the gap. This leaves a magnetic pattern on the tape that can be played back to reproduce a fairly accurate copy of the original audio signal.

It is important to note that the alternating bias current is superimposed on the audio signal from the recording amplifier. The amplitude of this current remains constant. It is not modulated by the audio signal from the recording amplifier. If the combined audio and bias signal is viewed on a scope, the bias signal will appear to be riding on the waveform of the audio signal. The difference between an amplitude-modulated signal and the composite signal at a magnetic tape recording head is shown in Fig. 2.

Factors affecting recording

A number of variable factors affect recording. The ratio, already mentioned, between the amplitude of the audio signal and the bias signal is important in determining the quality of a magnetic tape recording. The electrical and mechanical characteristics of the record head, the characteristics of the magnetic coating on the tape, the bias oscillator frequency, the tape speed and the frequencies that are being recorded are all important in the complete recording process and must be carefully controlled.

In addition to generating the alternating current to bias the record head, the bias oscillator also supplies power to the erase head. The erase head removes any previous recording that may have been on the tape before a new recording is made. The structure of the erase head is similar to that of a record head, but with a wider gap for better penetration of the magnetic coating on the tape. Its windings are designed to handle more current than the windings on some record heads. It is common practice to have two gaps in an erase head, for more efficient erasing (see Fig. 1).

Much more power is required to drive the erase head than to bias the record head. This power must be provided either by the bias oscillator or by an amplifier that can handle the relatively high-frequency bias oscillator signal. Since power is transferred from the bias oscillator to the erase head, or from such an amplifier to the erase head, an impedance match is required. It is not as important to match impedances between the bias oscillator and the record head because only a relatively small amount of power is required here.

The ratio between the amplitude of the audio signal being recorded and the bias signal is fairly critical and varies with different recording heads. It is best to get specific information from the manufacturer of the tape recorder.

Clues to improper bias

There are some simple ways of judging whether a record head is getting the correct amount of bias current. Low bias causes excessive high-frequency response in the recording, a noticeable lack of low-frequency response, low output, a tendency to distort on peaks of the audio signal and a high level of background noise.

Excessive bias increases the playback output of the recorded tape, but there will be a noticeable lack of high-frequency response. This happens because an overbiased record head will partially erase at the same time it is recording. This partial erasure begins at the higher audio frequencies.
LOW-IMPEDANCE RECORD HEAD

| Inductance | .08 Henry |
| DC resistance | 140 ohms |
| Impedance at 1,000 cycles | 565 ohms |
| Bias frequency | 40-100 kc. |
| Recording bias current | 0.9-1.5 ma |
| Recording audio current | .08 ma |

MEDIUM-IMPEDANCE RECORD/PLAYBACK HEAD

| Inductance | .3 Henry |
| DC resistance | 260 ohms |
| Impedance at 1,000 cycles | 1,884 ohms |
| Bias frequency | 40-100 kc. |
| Recording bias current | 0.3-0.5 ma |
| Recording audio current | .04 ma |
| Average output at 1,000 cycles | 2 mv |
| Average output at 10,000 cycles | 1 mv |

HIGH-IMPEDANCE PLAYBACK HEAD

| Inductance | 0.8 Henry |
| DC resistance | 400 ohms |
| Impedance at 1,000 cycles | 5,024 ohms |
| Average output at 1,000 cycles | 2 mv |
| Average output at 10,000 cycles | 2 mv |

Fig. 3—Typical specs of low-, medium- and high-impedance record, record-playback, playback and erase heads.

A lack of high-frequency response during playback does not always indicate that there is too much bias on the record head. A worn playback head or a record or playback head out of alignment with respect to the tape can also kill high-frequency response in playback. A clue to an overbiased condition is that the output will be high at the same time the high-frequency response is depressed. A worn or misaligned head causes poor high-frequency response and low output.

Head impedances

Record and playback heads can be classified as low-, medium - and high-impedance. Since impedance is related to frequency, a record head represents two impedances. One is the impedance of the head at audio frequencies, and is usually given for 1,000 cycles. The other is the impedance of the head at the bias frequency. Frequent this is not given and must be calculated on the basis of the inductance and dc resistance at the bias oscillator frequency. It is not too important to know the exact impedance of a head, but the technician should be able to judge whether a head is in the general classification of low, medium or high impedance. The electrical specifications of typical heads in these three classifications are in Fig. 3.

High-impedance rf transmission lines have resonant points, both in terms of line length and operating frequency. The same conditions exist in the circuit of a high-impedance erase or record head. When a parallel-tuned circuit, represented by the coil and circuit capacitances of an erase or record head, is tuned to resonance, the least amount of current flows. Resonances, then must be avoided or at least controlled in a recorder; because it will not record unless the correct amount of bias current is flowing in the record head. By the same token, an erase head will not erase unless the correct amount of current is flowing in its windings. This point is most important in tape recording systems that are put together with individual components such as a separate tape deck and separate recording amplifiers.

Systems that use low-impedance heads are not as critical, because the connections to the heads are nonresonant lines. More power is required to drive low-impedance heads. It is often more difficult to control distortion levels when appreciable power is being handled. A recording amplifier for higher impedance heads can use simpler circuitry and be made to do a good job if it is designed to avoid problems of head resonances.

Resonances must be avoided or controlled in a good tape playback system just as in a good recording system. The cardinal rule, in a playback system, is "to keep the leads from the playback head as short as possible." Excessive lead length will cut down the high-frequency response and not be as susceptible to resonance effects. Such a system is a little more expensive because of the transformer. Also, the transformer must be carefully designed and mounted to avoid hum pickup problems.

Bias oscillator frequency

The normal operating frequency of the bias oscillator is important for determining the range of recording frequency response of a given recorder. The bias oscillator should operate at a frequency at least five times as high as the highest audio frequency to be recorded. This is because any harmonics lower than the fifth harmonic of the audio frequencies being recorded may be strong enough to heterodyne with the fundamental frequency of the bias oscillator and produce birdies in the recording.

Just as an example, let us assume that a tape recorder with a 30-kc bias oscillator is being used to record audio frequencies from 7,000 to 8,000 cycles. The fourth harmonic of 7,000 cycles is 28 kc. This harmonic can beat with the bias oscillator fundamental to produce an undesirable 2,000-cycle sound. It is possible that some trace of this 2,000-cycle beat note might become a permanent part of the recording put on the tape. Fig. 4 is a table that shows the beat notes that would appear for audio signals from 7,000 to 8,000 cycles under these circumstances.

Fifth and higher-order harmonics may be present in a recorder with the bias oscillator operating at a frequency five times the highest audio frequency being recorded, but they are usually too weak to cause serious trouble. It might appear that all tape recorders should be designed with bias oscillators that operate at high frequencies, particularly if high fidelity is the objective. But this introduces complications of excessive radiation from the bias oscillator into other parts of the recording amplifier, losses caused by capacitance effects in parts of the circuit, and head resonances if high-impedance heads are used. Most recorders, therefore, use bias oscillator frequencies below 70 kc.

The bias oscillator in a tape recording amplifier often is more or less independent of any other sections of the amplifier except for a common power supply. It is connected to the record head at the output of the record amplifier in some kind of a shunt-feed arrangement. There are exceptions, but this is the most common system. The block diagram in Fig. 5 shows the bias oscillator in relation to the rest of the complete recording amplifier.

![Fig. 5—Block diagram of a tape recorder. Playback section omitted for clarity.](image-url)
Nuvistors cut noise in VHF TV booster

Build this unit and get frame-grid-noise figure with a $2.36 tube.

By JOHN R. LANGE, K9ARA

IN FRINGE TV AREAS THE SLOW CONTRIBUTION OR NOISE FIGURE OF A TV BOOSTER OR RF STAGE IS MAINLY DETERMINED BY THE TUBES USED. MOST COMMERCIAL TV TUNERS AVERAGE NOISE FIGURES OF ABOUT 5 TO 6 DB ON CHANNELS 2 TO 6, AND 7 TO 9 DB ON CHANNELS 7 TO 13. SOME OF THE LATER BOOSTERS AND TUNERS USING THE NEWER FRAME-GRID TYPE TUBES MAY GIVE NOISE FIGURES OF ABOUT 3 TO 5 DB ON CHANNELS 2 TO 6, AND 4.5 TO 6 DB ON CHANNELS 7 TO 13.

The importance of noise figure can be appreciated when one realizes that a 5-db reduction in noise figure at a quiet receiving location reduces TV snow as if the receiving antenna were stacked with another or the TV station's transmitted power doubled. My previous TV booster design, which appeared in the November 1957 issue of RADIO-ELECTRONICS, used frame-grid tube types such as the 417A, 6688 or 5847 for the input stage to get lowest possible noise figures. However, these tubes cost anywhere from $7 to $15, and the second 6A44 around $4.

But recently the RCA 6CW4 nuvistor has appeared. This tube gives noise figures at vhf within 0.25 db of those obtainable with the more expensive frame-grid tube types. This $2.36 tube also takes less power and simplifies the power supply requirements.

The two-channel cascode type booster shown in the photographs was built to evaluate the nuvistor for TV booster use and to improve Chicago TV reception from the two stations featuring nearly continuous local color TV programming. Total cost for parts was under $20. Noise figures are about 3.25 db on channel 5, and 5 db on channel 9. Snow reduction and color picture improvement was surprising and as good as that obtained with the previous triode-connected 6688, 6AJ4 booster.

The two-channel booster was built on a 7 x 7-inch No. 16 aluminum subchassis complete with power supply and is mounted in a 8 x 7-inch aluminum chassis base. It would be even better to use a brass subchassis since ground

![Completed two-channel booster. One channel (5) covers the low band; the other (9), the high band.](image-url)

**Fig. 1—Circuit of the nuvistor TV booster. Only one channel is shown.**

**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1, R2</td>
<td>47 ohms, 1/2 watt</td>
</tr>
<tr>
<td>R3</td>
<td>44-600 ohms, 2 watts</td>
</tr>
<tr>
<td>R5, R7</td>
<td>47 ohms, 1/2 watt</td>
</tr>
<tr>
<td>C1, C2, C3, C4, C5, C6, C8, C9</td>
<td>1-0.01-µf ceramic for channels 7 to 13</td>
</tr>
<tr>
<td>C7, C11</td>
<td>22, 47 µf, 475 volts (Mallory FP-258 or equivalent)</td>
</tr>
<tr>
<td>L1, L2, L3, L4, L5, L6, L7</td>
<td>See coil winding table</td>
</tr>
<tr>
<td>REC, IN1763</td>
<td>500 ma, 400 PIV</td>
</tr>
<tr>
<td>RFC1, RFC2</td>
<td>See coil winding table</td>
</tr>
<tr>
<td>5-dip toggle</td>
<td>Power transformer: primary, 117 volts; secondary, 155 volts; 6.3 volts, 600 ma (Stancor PS-8415 or equivalent)</td>
</tr>
<tr>
<td>V1, V2</td>
<td>6CW4 nuvistors</td>
</tr>
<tr>
<td>Chassis, 5 x 7 inches</td>
<td>No. 16 gauge aluminum or brass</td>
</tr>
<tr>
<td>Case, 3 x 5 x 7-inch aluminum chassis</td>
<td>Clamps for tubes, Cinch-Jones SNS or equivalent</td>
</tr>
<tr>
<td>Miscellaneous hardware</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**

RESISTORS 1/4 W UNLESS NOTED

**INPUT FROM ANT**

**OUTPUT TO TV**

**INPUT TO L7**

COIL WINDING DATA

SEE TABLE

ALL CAPS, EXCEPT C7-C9 8µf, 470V FOR CHANNEL 5 TO 6.

500µf FOR CHANNELS 7 TO 13
connections and the nuvistor sockets could then be soldered in. I used 2-56 machine screws to fasten down the sockets, ground lugs and standoff terminals. Plate power is switched to either the booster peaked for channel 5 or the one on channel 9. Input and output leads are quickly shifted, using clothespin type antenna clips. Because of the modest power requirements, power could probably be taken from the TV set since only about 40 to 70 volts at about 18 ma is required for plate power. A single-channel unit could then be mounted in a small case and hidden inside the TV set. For ultimate single-channel fringe-area use, the booster could be built-in a weatherproof box and mounted up near the antenna with power being sent up externally. Fig. 1 gives the circuit for a single-channel booster. For a two-channel booster, add two more nuvistor stages. The power supply can be switched to both amplifiers. To avoid interference, switch off plate voltage of the unused channel.

Build-it hints

Carefully bend out the two opposite tabs on the nuvistor socket horizontally and orient the plate lead, pin 2, toward the output after inserting the socket in a 1/4-inch diameter hole. If a brass plate is used, solder the socket tabs in place. For an aluminum plate, drill a clearance hole for a 2-56 screw in each tab and bolt the socket down. No interstage shields are used on the subchassis. A 2-inch-wide shield inside the base, up from the floor and even with the center lines of the second-stage sockets, may eliminate regeneration in some layouts. This will help reduce coupling between the input and output coils if they are too close to each other.

Lead lengths of the input-tube cathode bypass capacitor, C1, and the grid ground strap at pin 4 of the second stage should be as short and direct to a chassis ground as possible. Other lead lengths are not too critical if the layout shown in the photos is generally followed.

The input transformer coil has an important effect on the booster's noise figure. The coils are overcoupled past the point of maximum gain to present to the tube an impedence giving lowest noise figure. Cambridge Thermionic 1/4-inch diameter forms were used. The high-frequency powdered-iron cores (coded white) for 30-mc and higher were used. Lower-frequency iron cores will lower the coil Q and increase the noise figure.

The low-band input, neutralizing, and output coils were wound tightly with No. 28 enameled wire. Apply a coat of polyethylene cement (used on plastic models and available at hobby shops) and let the coils dry for a day before winding the input or output windings on top in a reverse direction. Do not use regular model-airplane type cements since they lower coil Q.

Center-tap input coil L1 by scraping the enamel from about a 1-inch length of lead after the coil is half wound. Place another scraped lead in parallel and twist the two leads several times. Then coat them with solder, and wind the remaining half of the coil. The two twisted and soldered leads then come out at right angles to the coil and are soldered to a ground point. Check with an ohmmeter to make sure that windings L1 and L2 are not shorted.

Wind the coils for channels 7 to 13 with No. 24 wire. This is easy to do after the forms are mounted in the chassis. The rf chokes and interstage coils, L4 and L5, are tightly wound over a 3/16-inch-diameter rod or drill shank. By scraping the enamel off, tinning with solder and bending the leads before sliding out the rod, the choke will not be distorted when soldered into the circuit.

Booster alignment

The booster can be peaked with a TV station signal, but for best results use a sweep generator, oscilloscope and 300-ohm balanced detector pad as shown in Fig. 2 to get a properly centered overall bandwidth alignment. First, however, center the input circuit response for best noise figure. This can be observed by disconnecting L6 from the circuit and temporarily replacing it with a 150-ohm resistor. Touch an rf crystal demodulator probe connected to the scope to the plate end of the 150-ohm resistor and observe a broad single-peaked curve. Center this curve by adjusting the input and neutralizing coil cores on the desired TV channel. The number of coil turns on L2 may have to be varied a turn or so if the response cannot be centered using the coil cores. Then remove the resistor and reconnect L6. Now check overall response using the 300-ohm balanced detector probe. The curve should have the shape shown in Fig. 2-b and the core of the output transformer coil should maximize the curve center at the desired channel. On channel 2 or 3, the overall curves may be too narrow for good color TV definition. Widen bandwidth by soldering a 15,000-ohm (or lower value) resistor in parallel with L6, from the plate of V2 to C6. Bandwidth can also be widened by increasing the number of turns on L7. Gain will be lowered but there will be little effect on the noise figure. For extreme black-
Bandwidth and optimized the noise from channels and the short dark picture areas and the booster gives a desirable gain and narrow bandwidth may be desirable.

Bandwidth can be increased to give a flat response over several TV channels on either side of a single channel picked according to coil-winding data. Simply wind the input and output windings (L1 and L7) below, and separated 1/32 to 1/8-inch from, grid and plate windings L2 and L6. Also add 7 to 45-µf trimming capacitors across L1 and L7. Check and align the input response first, then the overall response. When adjusting the double-tuned coils, you'll find that separation between the two windings will mainly determine the bandwidth. The capacitor will tilt the curve, and the core maximizes the curve amplitude in general at the desired frequency range. There is some interaction in adjustments.

Final test

Make final adjustments with the TV signal and TV set. Pick a time when the signal is weak, but not fading, and external interference is at a minimum. Connect the booster between the antenna and TV set. Make sure input leads, output leads and power cord are separated from each other. Use short a lead as possible between the booster and TV tuner.

Turn on the TV set and booster and after sufficient warmup time (at least 15 minutes) adjust the output coil core for maximum picture contrast and the input and neutralizing coils for maximum picture contrast and least picture snow. Note the snow content of dark picture areas while tuning the booster. Sometimes, particularly on channels 7 to 13, wrapping a 4-inch square of aluminum foil around the input lead and sliding it along 1 to 4 feet from the booster will improve the picture. Readjust or remove the slider, however, when viewing other channels.

I found that reducing the size of input tube cathode bypass capacitor C1 from 500 to 50 or 100 µf, reduced bandwidth and optimized the noise figure on channel 9. However, too small a capacitor will cause oscillation.

If the booster oscillates (induced by a white or torn raster on the TV screen), turn off the booster and retune neutralizing coil L3 until there is no oscillation when the booster is turned on again. Oscillation may occur when the booster is located at the antenna or some distance from the TV set. It can be caused by radiation from the long output lead being picked up by the antenna. If this is happening, use 300-ohm shielded line between the booster and TV set.

If a 75- to 300-ohm transformer is connected to the TV tuner, coax can be used between the booster and TV set. For coupling to a 75-ohm coax line, cut the number of turns on L7 in half and ground one end of the coil. Persistent oscillation may require adding a 15,000-ohm or lower value damping resistor across L6, as mentioned previously, to lower the gain and increase bandwidth, particularly on channels 2 and 3.

If the booster gives little or no improvement, check operating voltages. Plate voltage should be around 70 and total current drain about 18 ma. For longest tube life in antenna-mounted units, lower plate voltage to about 40 by increasing the value of R3 and R4, with a negligible change in noise figure.

Notes

L2, L3, L6 are tightly wound on 1/4-inch-diameter slug-tuned coil forms such as James Millen 6904B-8 with No. 19 mix core (coded white) or Cambridge Thermionic Corp PLS-6 or IS-6 with 2004-D core (coded white.) L1 center-tapped, and L7 are reverse-wound over L3 and L6, respectively. L4, L5, RFC1, and RFC2 are air-core tightly wound chokes, 3/16-inch diameter.
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TUBE LAYOUTS
IN TV SETS
Compiled by Larry Steckler, Associate Editor

HOW TO FOLD
Fold the top down and back, keeping the cover facing you. Then trim the right and left edges. Now staple the booklet along the vertical center fold, about ¾ inch from the top and bottom. Now fold from left to right, keeping the cover facing you. Trim a fraction of an inch off the top and trim the bottom to size and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS,
LASER PACKS A WALLOP. The intense beam of light was powerful enough to burst a balloon 10 feet away. Fragments of the balloon are just starting to drop to the floor. In another test the laser beam was used to punch a hole through a sheet of stainless steel. The laser fired a 1/2000-second burst of light. Both demonstrations were conducted at the IRE show.

RUNAWAY MISSILES AND SATELLITES are destroyed when these musical rods are triggered with the right combination of tones. If the correct five tones are not received, nothing happens—this keeps stray signals from triggering the destruct mechanism and killing an astronaut or destroying a valuable missile. The tuning rods are made by Raytheon and are part of a command receiver supplied by Thompson Ramo Wooldridge to missile manufacturers.

SPACE COMMUNICATIONS SYSTEMS will make good use of this Amplotron. It delivers 25 watts at 2300 mc and is well suited for telemetering packages, voice and facsimile transmission from space, or in equipment where light weight and small size are important. This new Raytheon tube weighs only 16 ounces.

SOLDERING TWEEZERS should be an excellent tool for semiconductor circuits. Separate 6-watt element in each arm applies heat to the transistor, diode, or other semiconductor lead directly. Solders fast with a minimum of heat. The Oryx-made tool is imported from England.
unusual oscilloscope techniques

Some methods used in industry could be valuable in TV Service

By ROBERT G. MIDDLETON

SOPES IN INDUSTRY ARE BECOMING almost as universal as voltmeters. The quality-control department in a semiconductor plant is full of them. With suitable adapters we can display a complete family of plate characteristics for a tube or collector characteristics for a transistor. Although we do not usually think of a plate-characteristic plot as a waveform, the ingenuity of electronic engineers has translated the oscilloscope virtually into an electronic computer which performs instantaneously analyses that would require hours or days to complete with point-by-point measurements, graph paper and slide rule.

Auto electricians now use the scope to check engine ignition systems, which used to be checked with a screwdriver within recent memory. Special probes reduce the high-tension spark voltage for the scope. The low-tension waveforms in the ignition system are also displayed concurrently or consecutively. The scope operates as a voltmeter, showing instantaneous voltage values as waveforms on a linear time base. The up-to-date auto mechanic is as familiar with oscilloscope operation as with hex wrenches and hydrometers.

The oscilloscope finds vital application in the manufacture of ferrite cores to operate as ultra-speed memories in computers. For example, Fig. 1 shows the drive and switching-time waveforms for a fast-response computer type core. This type of memory product provides a clear-write and read-restore memory cycle at rates to 1 μc. If a permanent record is required, special cameras are used to photograph the screen pattern.

Varieties of scope patterns

Of course, there are many types of scope patterns in practical electronics work. Some are well known, others are just beginning to be generally recognized. Let us look at some of the more important pattern characteristics to see why they are so informative in electronic test procedures.

Patterns displayed on a linear time base are both familiar and of general utility. Fig. 2 is an example. This display shows a thyratron rectifier circuit operating at three different conduction angles. Both grid and anode are supplied with ac. Average plate current is controlled by a phase shifter.

Fig. 1—Drive and switching time waveforms show the extremely fast response of a computer type ferrite core. Time is 0.02 nsec per division. Ampex.

Fig. 2—Anode-cathode waveforms for thyratron rectifier circuit. a—Where scope was connected. b—Full anode current. c—Medium anode current. d—Zero anode current.
in the grid circuit. Thus, although the grid does not control the amplitude of the anode current, it does control the angle of current flow. Thus it controls the average anode current. Current flows only during the horizontal intervals of the anode voltage waveform. The horizontal interval appears somewhat fuzzy because of plasma oscillation during conduction by the tube.

Next, let us look at Fig. 3. This is a pulse-width automatic-frequency-control (afc) circuit. It is commonly checked with a scope at X. Typical patterns are shown in Fig. 4. They are traced on a 5,250-cycle sawtooth linear time base and three complete cycles are displayed.

A visual-response curve, on the other hand, is usually displayed on a 60-cycle sine-wave time base. Fig. 5 shows a typical frequency-response curve for a video amplifier. The video amplifier should not be confused with the if. amplifier. The video amplifier in a TV receiver is the section between the picture detector and the picture tube. Beginners sometimes ask about the prominent “marker” which appears around zero frequency. This is not actually a marker though it can be regarded as such. The pseudo marker is a byproduct of practical demodulator probes, which have incomplete demodulating and filtering action at very low frequencies.

**Cyclogram displays**

Less familiar to many of us, perhaps, is the cyclogram type of display, which is highly useful in industrial work and could be used much more in TV service. Note the partial afc and horizontal output circuits in Fig. 6. We get a cyclogram display by connecting the vertical input lead of the scope at X and the horizontal input lead at Y. Use a low-capacitance probe at X to avoid waveform distortion caused by circuit loading. In a cyclogram pattern, a signal voltage from a circuit is “swept” by another signal voltage from the same circuit (or equipment section). The ground lead from the scope is connected to the receiver chassis or common ground bus of the equipment under test.

Thus, a cyclogram is really two waveforms in one integrated pattern. The horizontal excursion of the beam is no longer a uniform time-axis function but has become a signal-voltage function. To put it another way, the signal information is developed both vertically and horizontally on the scope screen. The total information provided is not only doubled, but new data are displayed concerning instantaneous relationships between the two signal voltages. Of course, reading cyclograms is somewhat more difficult than reading simple patterns displayed on linear time bases.

When various circuit faults occur, the normal cyclogram pattern changes (Fig. 7). Note how different capacitor defects cause characteristic changes in the cyclogram pattern. We see that many circuit troubles show up clearly as distortions of the cyclogram pattern. Although unfamiliar to most of us, cyclogram patterns are actually easier to work with than ordinary sawtooth time-base displays.

Cyclograms are easier to use because no scope synchronizing adjustment is required. We switch off the sawtooth time-base function in a scope when displaying cyclograms. We do not use the sync controls of the scope. A cyclogram pattern is automatically locked on the screen at all times.

A cyclogram has two amplitudes, or peak-to-peak voltages; a certain vertical amplitude and a certain horizontal amplitude. Changed amplitudes in either direction are indications of circuit trouble, just as are pattern distortions. Hence, we calibrate a scope both vertically and horizontally when working with cyclogram patterns.
All cyclograms obey electrical laws, which the electronic technician should keep in mind. First, we can obtain cyclograms between any two points in a circuit and such patterns may or may not enclose an area. If an area is outlined by the pattern, we know that there is reactance between the two test points. If a straight or curved line which encloses no area is displayed, we know that there is no reactance, but only resistance, between the two test points.

The resistance in an electronic circuit may be linear or nonlinear. Ordinary composition and wirewound resistors are linear. In other words, they produce a straight-line cyclogram when tested by any ac voltage, whether sine-wave, square-wave, sawtooth, pulse or other voltage waveform. On the other hand, transistors, semiconductor diodes, and class-B amplifier stages are exam-

Again, in Fig. 8 observe that the cyclogram pattern brightness starts with a "sunburst" display and then diminishes clockwise around the cyclogram. A small change in pattern shape can be accompanied by a large change in brightness variation. Circuit trouble is indicated by the abnormal brightness variation.

Beginning with our next issue, Radio-Electronics will gradually introduce a new, larger type, aimed at making articles easier and quicker to read. Watch for the new style! We will welcome comments from our readers as to the new typography and any other features in our makeup and layout which you feel might be improved.

End
automation makes golden resistors

Noble metal under end-caps is key to automated production, increases reliability and cuts noise

By ERIC LESLIE

WHEN IT BECAME NECESSARY TO TURN out high-quality, absolutely reliable resistors in almost astronomical quantities for the Armed Forces and the Bell Telephone System, Western Electric engineers were faced with some completely new production problems. The resistors had to be of the deposited-carbon type, of the reliability required for missile applications, and were required in quantities of several tens of millions, annually. Old methods simply would not work, and a completely automated production line was set up.

One of the special features of the line is that both production and quality are controlled by computers, so that reliability is maintained at all points during production, rather than by final inspection. The resistors are made by depositing a thin layer of carbon on a ceramic core. The traditional method of terminating such resistors has been to apply a silver paste to the ends, a process which included several hours of baking. This is out, for high-speed automatic production, and it was decided to apply a thin layer of the noble metal, gold. To do so, and to do it in the time which could be allotted to this part of the job, required a machine almost as complex as the sealing machines used in making vacuum tubes. There are no less than 30 of the bell-jar “stations” in the machine shown on the cover.

When the resistors are ready for terminating, the carbon has already been deposited. They are then held in masks—disc-shaped objects through which one end of a resistor can be seen projecting in the cover picture—under a bell-jar from which all the air has been pumped, and a very low-pressure atmosphere of argon substituted. Disc-shaped gold cathodes above the resistors are used to supply the gold, which is actually eroded, or “sputtered” off the metal onto the ends of the resistors. A high voltage at low current (1,500 to 3,000 volts at 20 to 50 milliamperes) is applied to the cathode, and small particles of gold are knocked loose from the surface of the cathode by impinging argon ions and deposited on the resistor ends.

About ten-millionths of an inch of gold is deposited on the carbon. The discharge of high-voltage electricity is what creates the flickering reds and purples inside the tube.

The gold that doesn’t reach the resistors is deposited inside the bell-jar and has to be removed periodically. The gold deposited inside the glass can also be seen in the cover picture.

The caps to which the resistor’s wire leads are attached are also flashed with gold. They are put on the resistor on a machine that caps both ends at the same time, with enough force to weld the gold plating of the cap to the gold on the ends of the core. This makes about as low-noise and reliable a contact as is possible to design.

Only one more operation is needed to make a full-fledged resistor out of our carbon-coated core. Enough of the carbon must be removed to give it a precise value. This is done on a helixing machine, which cuts a spiral from end to end of the resistor, removing the carbon from a spiral strip. Only one or two turns may be cut for a low-resistance unit, leaving most of the carbon on the resistor. More turns are cut for higher ohmages, till for very high resistance units only a narrow several-turn spiral of carbon remains on the unit. A computer-controlled bridge balances when the desired resistance is reached, disengaging the lathe which removes the carbon. The bridge also senses any non-linearity that would be caused by chipping or thin spots in the carbon coating, and rejects any resistors showing such faults. The computer control also rejects any resistor that reaches its value before 75% of its length is used, or fails to reach the value in the full available length.

Only finishing operations, such as placing the resistor in its insulating coat, checking it for leaks, etc., are required, once it has left the helixing machine.

A prototype unit. The disc cathode can be seen in a bell-jar at right. The mask and a sputtered resistor are lying on top of the base. In the actual machine, the hand-wheel at left is replaced by a rubber-tire wheel, which rolls along a track to rotate the resistor and mask while being sputtered.
induction heating turns the trick

How would you handle this job—heat only the threads on a steel shaft

By DELROY D. DARLING

You are an industrial electronic technician. Or maybe you're a methods engineer. (This is a high-class term for a jack-of-all-trades.) The boss comes to you with a problem. He says, "Sam, we've got two hundred thousand shafts, and each one has a threaded section on one end. In the machine where these shafts will be used, a nut will be constantly running on and off the threads. We'll have to harden the threads so they don't wear out".

You know how to harden steel. You heat it up to a red heat, and then plunge it in a "quench" bath to cool it quickly. In some operations it doesn't matter too much how you heat the steel. You can use an oven, or a direct flame, or any other method. But your boss is a mindreader.

He says, "We've got to do this hardening real quick, to make money, and we can't use an open flame because the steel will absorb carbon from it and become brittle. Besides, a flame will probably heat too deep and change the character of the steel in the core of the shaft, which has to stay tough."

Now you know! If you can't use a flame or an oven, and you want lots of heat real quick, there is only one answer: induction heating! Being a good electronics man, you know that induction heating will allow you to heat these shafts quickly to the required temperature, and with this type of heating you can control not only the area to which the heat is applied, but also the depth. That will leave the core of the shafts unchanged after the hardening takes place.

So you tell the boss "Look, give me a day to check and I'll tell just what equipment you need".

Back in the cubby hole they call your office, you pull out a sheet of paper and lay out the problem:
1. You must heat only the part of the shaft that is threaded.
2. You must heat only the surface of the threads, so they will retain their strength.
3. You must do all this in a very short time.

With induction heating, No. 1 is no problem. You know that induction heating produces heat by passing electric current through the steel. However, no actual electrical connection is necessary to the work, because the currents (called "eddy currents") are induced in the work by an expanding and collapsing magnetic field produced by a coil placed around the work.

Heat will be produced only where these eddy currents flow, and they will be confined to the general location of the work coil. By shaping the coil correctly, considering the shape and size of the work, heat will be produced only where you want it.

No. 2 on the list isn't a serious problem either. "Skin effect" that causes so many problems in high frequency ac circuits is an ally in the induction-heating business. High-frequency ac currents tend to flow in the...
surface of a conductor. The higher the frequency, the closer to the surface the current will flow. The same is true for the eddy currents induced in the work by an induction-heating work coil. So, all you have to do to control the depth of heating is select a suitable frequency. (Of course, if you apply the heat for too long, it will "soak" into the work, so time has something to do with depth of heat penetration, too.)

This "skin effect" is one of the big advantages of induction heating, especially for a job like this one at hand. Flame heating heats from the surface inward, but to heat the surface of a piece of work quickly, without allowing the heat to soak in, requires a very intense flame. If you apply this intense flame to something like these threads, the outer edges of the threads will likely burn before the root has a chance to heat. Induction heating will produce heat to the required depth over the entire surface of the threads, without burning.

From theory into practice
So far you have solved the boss's problem in a theoretical sense. Now for the practical part: choosing a suitable machine for the job. There are several important factors that govern the type of machine to be used for a particular application. Let's make another list.

1. Output frequency. Induction heating is done with frequencies all the way from 60 cycles to 450 kc or even higher. The lower frequency machines are used to heat large masses to a considerable depth. High frequencies are used to heat small pieces, or for operations such as surface hardening, etc., that require shallow penetration.

Up to about 10 kc, the most satisfactory equipment is mechanical. Package motor-generator sets are available with outputs of up to 10 kc and power ratings as high as 1200 to 1500 kw. However, beyond 10 kc an ac generator must have so many poles, and run at such a high speed, use of a mechanical generator becomes impractical.

When higher frequencies are required, vacuum tube oscillators are usually used. These are actually very simple oscillator circuits, although the control equipment used with them may be complex. Most large vacuum tube generators operate in the range of 400 to 450 kc, with output power up to 100,000 watts or more.

This thread hardening job needs shallow penetration, so 450 kc will be about right. That means you will need a tube-type generator.

2. Power output. We already know the upper limits of output power for both types of generator. Now, what power will we need to heat these threads? Well, now we're into the economics of the problem. In induction heating, as anywhere else, kilowatts cost money, and quite a lot of money, too. When speed isn't important, a small machine, at a lower price, may fill the bill. But, in a production shop time is money, too. Usually, a larger capacity machine will more than pay for itself in time saved per unit produced.

These threaded shafts are small, but we need rapid heating both for shallow penetration and high-speed production. Ten kilowatts will probably be adequate, although a test run is usually the best way to determine the power required for a particular job. (Most of the companies that build this equipment have facilities for test runs, and are happy to make them.)

You will also have to make sure that adequate line power is available. A 10-kw tube-type generator will need about 20 kva of three-phase power, at 230 or 460 volts.

3. Cooling. High-power tubes such as those used in induction heating generators may be either air or water cooled. However, since water is used to cool the work coil, most generators use water-cooled triodes in the oscillator circuit. Our 10-kw unit will need about 5 to 10 gallons per minute to cool the tube, plus some additional water for the work coil. You will have to make sure an adequate water supply is available at the work location.

4. Controls. Naturally, the generator unit will have to have fuse or circuit-breaker protection. But it will also need special safety devices, such as an automatic shutdown if the cooling water supply should fail. Protection against tube burnout caused by excessive grid or plate current, and safety interlocks to shut off high voltages when the cabinet is opened. The Federal Communications Commission requires proper shielding so the unit won't radiate interference.

All these requirements will be met by any unit made recently by a reputable manufacturer. Used equipment should be checked carefully to make sure it has proper protection and control facilities.

So, there is the answer to the boss's problem. He needs a vacuum tube generator with a 10-kw output, working at about 450 kc. It will need a water supply, and a three-phase power line. The work coil and material handling equipment will have to be specially designed for the job, of course, but the induction heater manufacturer will be happy to take care of that.

Well, another problem solved. Type it all on a sheet of paper and put it on the big man's desk EARLY next morning. If he's in the right mood maybe it will get you that raise.
7-station intercom uses 1 master

By ROBERT D. HOCHBERG

The two most disturbing problems in home intercommunication systems are that substations can't call other substations, and that most people just don't have the patience to wait for the amplifier tubes to warm up. The common and quite expensive solution to these problems has been to use all-master systems requiring multiconductor cables and ac sources at each station location, and to allow the five or more amplifiers to operate continuously. The intercom system described here solves these problems by combining the economy of the master-sub systems with the versatility of the all-master systems.

*It provides for calls between any
two of its seven stations. *It uses a single, transistor amplifier. *It partially solves the multi-cable problem with a binary type coded signaling system. *It provides for a station located outside the front door. *It needs no outside power, though the batteries may be replaced by a well-filtered power supply if desired. Even then, the unit will require ac power at only one location.

In purpose, this intercom is similar to "Intercom Super Duper Model I" (Radio-Electronics, January 1961). In approach, however, the two are quite different. The Model I uses six vacuum tubes, three of which are in the relay exchange circuit. The proper connections are made through rather critical biasing of the relay control-tube grids.

My unit uses just four low-drain transistors— which draw current only when the unit is in operation—and an exchange circuit which has no tubes or transistors.

The heart of the system is a control cabinet containing the amplifier, exchange relays and batteries. It can be located in an attic, under a stairway or in just about any other accessible but out-of-sight location. One of the two batteries controls the exchange relays and the first two amplifier stages. The other battery controls only the output stage of the amplifier. With this arrangement, both batteries should last about the same length of time. Cables run from the control cabinet to each of the masters. Each master unit uses one speaker which doubles as a microphone, one two-pole seven-position selector switch, and two four-pole double-throw lever switches as function selectors.

The binary exchange circuit

As shown in the schematic, the hot amplifier output lead is connected to the armature of RY1, an spdt relay. Depending on the position of the armature, the signal may be fed either to RY2 or RY3. (Since RY1 and RY2 are activated by the same signal, a single two-pole double-throw relay may be used instead.) From RY2 the signal may be sent to RY4 or RY5, and from RY3 it may be sent to RY6 or RY7. (Here a three-pole double throw relay may be substituted for RY4, RY5 and RY6). RY4, RY5, RY6 and RY7 channel the signal to masters 1, 2, 3, 4, 5, 6 and door. Thus, by energizing the proper

Switching relays and transistor amplifier are inside this case.
Circuit of the intercom amplifier, switching circuits, a remote station and the door station.

exchange relays, the output signal may be fed to any desired station.

Now let's assume someone at Station 4 wants to call someone at Station 6. He answers his selector switch to 6 and depresses his talk button. Three things happen: First, his speaker is connected across the input of the amplifier and disconnected from its normal position on its output relay. Second, P is grounded, energizing the two relays which supply current to the amplifier. Finally, leads A and C are grounded through the selector switch, activating RY1, RY4, RY5 and RY6 in the control cabinet. These channel the output of the amplifier to the speaker of Station 6.

If the doorbell rings, the person answering switches the nearest station to 7 and depresses the talk button to be heard outside the front door. To hear a reply, he has merely to push his DOOR MONITOR button. This sends power to the amplifier, connects his speaker through the exchange relays to the amplifier output, and connects the door station through RY7 to the amplifier input. The DOOR MONITOR button eliminates the need for any controls on the front-door unit.

By now you should be familiar enough with the switching circuit to see that only one two-way conversation can be handled at a time. However, this disadvantage is balanced by the facts that only eight-conductor cables are needed from the master to the control cabinet, and that there is only one amplifier to power.

The greatest advantages of the binary exchange circuit are in a system with many stations. This 7-station system requires 3 wires to operate the exchange relays. A 64-station, all-master system would require only 6 wires to operate the relays. There is, though, a practical limit—a 64-station system would require 63 spdt relays.

Transistor amplifier

The four-transistor amplifier uses CK722's for the first two stages and 2N109's in the push-pull output circuit. Its reproduction fidelity is equal to that of most three-tube intercom amplifiers. (If desired, the unit can be made into an interesting and good-sounding phono amplifier simply by removing the input

Closeup view of the underside of the amplifier chassis.
transformer and connecting a magnetic cartridge in its place.)

The amplifier is built on a 1 1/4 x 6 1/4 x 3-inch aluminum chassis which is placed in the control cabinet after assembly. Follow the schematic, keeping output leads as far as possible from the input. Mount the transformer cores at right angles to one another to minimize inductive feedback. Be careful when soldering to the transistor sockets. Beads of solder may form between the closely spaced prongs.

Use heavy wire (preferably two lengths of No. 18 run parallel) in the circuit connecting the amplifier to BATT 2, and keep BATT 2 as close to the amplifier as possible. The use of light outputs as the cathode to use just one 6-volt battery may cause the amplifier to oscillate.

Bend the relay springs a little so the relays will pull in even after the batteries start weakening. Mount all relays on an insulator such as wood or Plexiglas. Because their armatures are internally connected to their mounting brackets, assembling the relays on a metal chassis would, in effect, connect all the armatures together. As was stated earlier, dpdt and three-pole double-throw relays may be used instead of the parallel spdt units. However, multicontact relays as sensitive as the spdt types used here (50 mw) are expensive.

All connections to the control cabinet are made by running the cables in through holes in the top and fastening them to the barrier strips inside. Two adjacent terminals should be used for each of the A, B, C, D, P and input and ground wires to reduce congestion at the barrier strips. Leads from the relays to the amplifier are routed by way of the terminal strip to facilitate later removal of relay bank or amplifier. END

DUAL CATHODE FOLLOWER

Sometimes we need a way of reversing the polarity of a low-impedance signal or supplying two equal signals 180° out of phase from low-impedance sources. Here is a circuit from Revista de Información Electrónica (Madrid, Spain) that does the trick.

Phase relationships are shown on the diagram. The input triode is a phase splitter and cathode follower. The 1,000-ohm potentiometer is used to balance the outputs. Balance can be checked with an audio vtvm or scope.
THE HEART OF THE EICO MX99 IS A MODIFIED "switching" circuit. First the input is fed to a stage giving about 13.5-db gain with an input impedance of about 10 megohms. C25 provides compensation at the extreme high end (from 20 kc up). C1 isolates the dc voltage due to R4. The composite signal is fed to V2-a, a phase splitter, to produce antiphase signals at A and B. The 19-ke pilot is separated by T2 and amplified by V4. Then it is frequency-doubled by D1 and D2 connected to T3's secondary to produce a pure 38 kc.

This is amplified by V5 and fed to the switching bridge through T4. The switching bridge short-circuits points C and D to ground during alternate half-cycles of the 38-ke regenerated subcarrier. So the grid of V2-b (G) is fed with composite signal, reversed in phase every half-cycle of the 38-ke subcarrier.

Here it is amplified and combined separately with the voltages at A and B, to produce left and right outputs at E and F. When the bridge momentarily short-circuits point C, the signal fed to V2-b grid comes from point B. When this is phase-reversed (in V2-b), it will cancel the signal directly from B to F, so that F has zero output, while E receives an augmented output during this half-cycle of 38 kc.

The nulling action at points E and F also nulls the 67-ke SCA (Subsidiary Communications Authorization) subcarrier if it is present, without any need for a frequency-selective filter. V3-a is a phase inverter to reverse the phase of output E, because the two channels are in phase opposition at E and F. V3-b and V3-c are cathode-follower outputs, with filtering included to reject the switching products resulting from combining A, B and amplified G (which is square-wave switched) at E, F. The voltage change on D1 and D2 when 19 kc is present is used to change the bias of V1-b and thus light the neon to indicate that stereo is being received.
THE PACO MX100 HAS INPUTS with and without compensation, to accommodate narrow- or wide-band tuners. The input then feeds three stages in parallel, two cathode followers and an amplifier. One of the cathode followers feeds a low-pass filter with phase equalization or adjustable response. The other feeds a bandpass filter to select the L—R sidebands. The amplifier stage locks the 19-kc oscillator, which has a 38-kc tuned circuit in its plate. This plate is capacitance-coupled to join the output of the bandpass filter in feeding oppositely phased diodes to demodulate the L—R signal. The low-pass filter terminates in a semi-fixed or a fully adjustable separation control that varies the L+R fed to the matrixing bridge. The outputs from the matrixing bridge feed the grids of the output amplifier stages through printed circuit filters providing de-emphasis and 12 db/octave rolloff (above 15 kc).

HEATHS AC-11 ADAPTER HAS A conventional linear input amplifier stage, which feeds a further amplifier stage for the 19-kc selector circuit, and a cathode follower to feed the composite audio into its matrixing arrangements. The further amplifier stage synchronizes a 19-kc oscillator, whose plate circuit has a 38-kc tuned-circuit transformer, coupling into the L—R detector circuit. The output from the cathode follower feeds a low-pass filter (15 kc) with a separation control on its L+R output, and also a bandpass filter with SCA reject of conventional design, also feeding into the L—R detector circuit. This uses oppositely phased diodes which feed the matrixing bridge. Mixes of L+R and L—R from the matrixing bridge feed the cathode-follower outputs. A capacitor directly across each bridge output provides de-emphasis.
FISHER'S MPX-100 ADAPTS for different input levels with dual inputs. Each presents an impedance better than 20 megohms. The voltage divider is capacitance-compensated by C4. Gain of the first stage is increased about 4 dB for stereo listening by relay contacts RY1-a to avoid an apparent change in level. The plate-circuit input stage (triode section of V1) filters out SCA in coil L1. The 19-kec pilot is fed to the pentode section, which applies it to synchronize V3, the push-pull 33-kec oscillator. At the same time, changes in operating conditions due to the 19 kc, alter bias on V2, triggering relay RY1. With S2 set to STEREO-MONO AUTOMATIC, contacts RY1-b short one grid of oscillator V3 in mono, leaving the switching-bridge ground connection "open" (through R24).

In stereo, the same contacts short the right side of the bridges to ground and allow the oscillator to operate, delivering a switching voltage through current-limiting resistors (R18 through R21) to the bridges. This short-circuits the signal fed through R9 and R10 to V4 and V5 on alternate half-cycles, separating left and right to these two channels. Common-cathode connections, with adjustments, provide separation and balance control. After level controls, feedback filtering over the second half of V4 and V5, right and left output is delivered to the output jacks. The switching is such that, in the "off" position (shown), left and right inputs are connected directly to left and right outputs.

For mono, opening the ground connection at the right side of the bridges stops the switching operation, and allows the same signal to be fed to both V4 and V5 simultaneously, through R9 and R10.
EXPENSIVE TEST APPARATUS IS NEEDED for many jobs in the TV service shop. Sometimes, though, properly used inexpensive equipment is faster and more accurate than the electronic wonders. This is true of the jumper wire, not very expensive at best, but a most versatile piece of test equipment. Besides the obvious uses of substituting parts, connecting test speakers, etc., there are many other ways to use this piece of wire with a clip on either end. Let’s look at a few examples.

No high voltage

The horizontal amplifier tube is red hot. You suspect the oscillator, but is it the primary cause? A faulty phase-detector circuit could be causing the oscillator to run off frequency or not at all. Take a jumper and ground the sync input grid (Fig. 1). High voltage comes back on? Then you have trouble in the phase detector. Better check the diodes or coupling capacitors. (Incidentally, you can ground the grid from the top of the chassis if you use a test adapter socket.)

Unstable horizontal oscillator

Let’s now suppose you have a horizontal oscillator (multivibrator) that tends to take off; drops out of sync at the slightest provocation or wiggles, jiggles or otherwise cuts up. Better check to see that the oscillator circuit is adjusted properly. How? Connect a jumper across the ringing coil. Connect another from the sync input grid to ground. Now adjust the horizontal hold control until the picture floats by slowly. Remove the jumper from the ringing coil. Adjust the ringing coil until the picture again floats by. Remove the jumper from the sync input grid. Unless you have troubles in the circuit, the oscillator should now work perfectly. If the oscillator takes a jumper across the ringing coil, increase the size of R in Fig. 2 to 10,000 ohms and leave it in the circuit.

Horiz oscillator squeegging

Let’s say you have a gunboating (squeegging) Synchronoguide horizontal oscillator. You’re in the home with no scope. You can make a fairly satisfactory adjustment with the help of a couple of jumpers.

Remove the sync signal by grounding it out with a jumper. (The grid of the sync clipper tube is usually a good place.) Connect another jumper across the phase coil (L2 in Fig. 3).

Adjust the horizontal frequency slug (L1) until the picture floats by (center the resistance control if there is one). Now remove the jumper from across the phase coil and adjust the phase coil until the picture again floats by. Unground the sync circuit. If the oscillator and control have no defective parts, the picture should lock in with virtually no instability. If it doesn’t lock in you can start looking for defective components.

Got a sync problem?

The sync clipper is one of those combination sync clipper and noise-cancelling circuits using a 6BU8, 6CS6, etc. You realize that the trouble could be something in the noise-cancelling cir-
No agc voltage

It's a keyed age circuit. Use a jumper here? Sure! Connect it from the grid.

Fig. 5—Artificially keying an age tube.

Fig. 6—Isolating the cause of sound bars.

If the sound bars are diminished, then something is loose or a tube is microphonic and the sound from the speaker is disturbing it.

Snowy picture

This is often caused by excessive (negative) age voltage to the tuner because of an open delay resistor, R in Fig. 7. Check for this by connecting a jumper from the tuner age terminal to ground. Clear the trouble? Then you have excessive agc. Still snowy? Then the trouble is in the rf amplifier circuit or antenna.

No vertical deflection

Is it in the output stage or the oscillator? A jumper from the heater winding (hot side) to the output grid will produce deflection (distorted though it will be there).

Fig. 7—Grounding age to check delay resistor.

Fig. 8—Checking vertical output stage.

is) if the output stage is operative (Fig. 8).

(In circuits where the bias would be upset drastically by a direct jumper, use a 0.25 uf capacitor in series with the jumper or, better still, make up a capacitor jumper.)

Bright vertical bars

They're in the raster. Is it sweep trouble or are they being introduced into the video? A jumper tells you which. Simply short out the video input (Fig. 9). If the raster clears, you know you have either trouble in the video circuit or radiation from an unshielded flyback circuit. If the lines don't go away, you have a horizontal sweep problem. Maybe a ringing yoke.

Fixed brightness

The brightness control has no effect. The picture tube checks OK. A jumper from grid to ground in the circuit of Fig. 10 will eliminate the vertical retrace circuit as a source of trouble. (It's often caused by a shorted capacitor in that circuit.)

Distorted sound

You suspect a leaky coupling capacitor—C in Fig. 11. You'd like to check it without disconnecting it first. Place a meter across the cathode resistor. Now ground the control grid with a jumper wire. Voltage go down? The capacitor is defective (leaky) since it is obviously causing the tube to draw more current.

High-voltage shock

Dislike getting shocked when you disconnect the picture-tube anode lead? This often happens even though you have shorted it out once or twice with a screwdriver. Connect a jumper, first to ground and then to the anode lead—you can't get shocked and even the most timid soul shouldn't be squeamish about removing the lead.

Of course this short article doesn't cover everything a jumper can be called upon to do (even a big book probably wouldn't hold all that could be written about the remarkable jumper), but it's a start—you take it from there. END
By W. E. PARKER

Last month we presented complete construction details of a closed-circuit TV camera you can make for yourself. Complete alignment and setup instructions were also included. This month we will describe how the camera operates and, as promised, give construction details for the yoke and focus coil. If you make these units yourself, you can cut up to $75 off the total cost of the camera.

Circuit description

Before going into the circuit, let's examine the diagram (Fig. 1). The camera has four main sections—video amplifier, deflection stages, modulator-oscillator, and the power supply.

The four-stage video amplifier (V2-a, b; V3-a, b) amplifies the weak signal from the signal electrode of the camera tube. The vertical (V5-a and b) and horizontal (V6, V7-a and b) deflection stages provide the necessary wave shape and currents to drive the deflection yoke that causes the electron beam to scan the photosensitive screen in the camera tube. The modulator-oscillator (V4) provides the rf carrier that is amplitude-modulated by the output of the video amplifier. A transformer-operated power supply with silicon rectifiers provides the three operating voltages used in the camera.

Video amplifier

The video amplifier stage V2 and V3 (Fig. 1) is not to be confused with a video if strip. The bandwidth of the video amplifier is from approximately 10 cycles to 3.7 mc. A video amplifier must be aligned because of the tuned transformers and usually operates at much higher frequencies (26 mc, 45 mc, etc.). Peaking coils help extend the upper frequency limit of the TV camera video amplifiers. L1, L2, and L3 help reduce the effect of stray and shunt capacitances that attenuate the higher video frequencies. Fine picture detail depends on the response of the video amplifier to higher frequencies.

To help compensate for high-frequency attenuation, a very low-resistance plate load resistor, R16, is used in the plate circuit of V5-a. Peaking coil L2 gives this amplifier stage a rising output characteristic with rising frequency. Additional high-frequency signal amplification is provided by C46. Two dual-section 6DBS-A tubes are used in the four-stage video amplifier section.

The output level of the videocon picture highlights is 1 to 5 mc. With a gain of about 390 in the video amplifier stages, this produces about 1 volt of signal for the grid of the modulator-oscillator section.

Modulator-oscillator

One half of a 12AT7 is used in a Hartley oscillator tunable from 54 to 88 mc. Slug-tuning L4 varies the oscillator frequency.

Rf from the oscillator is fed through C18 to the cathode of V4-a. The amplitude of the video signal on the grid of V4-a determines the amplitude of the rf on the modulator plate. The video signal is also on the plate of this tube. It may be connected to a TV monitor not requiring the rf section of a normal TV set or to a video modulator to modulate a ham TV transmitter.

Vertical scanning

A nearly sinusoidal 60-cycle voltage from the power transformer is shaped by a shunt clipper and a short-time-constant R-C network consisting of C25 and R29. The vertical discharge section (V5-a) is similar to that in

The completed focus coil-yoke assembly ready to be slipped over the camera chassis. Two adjustable brackets are for clamping vidicon and yoke assembly in position.
TV receivers, except that it is not in a self-oscillating circuit (a blocking oscillator or a multivibrator).

The proper sawtooth waveform is generated across C27 and R33. The other section of V6 is a cathode follower that supplies scanning current for the vertical deflection coils in the vidicon deflection yoke. R35 controls the amount of scanning current that flows to the yoke. R37 is the vertical linearity control. R40, the vertical centering control, sets the amount of direct current that flows in the yoke and thus positions the electron beam vertically in the target of the vidicon.

A positive-voltage pulse taken across R32 is applied to the cathode of the vidicon for vertical blanking. It cuts off the scanning beam during vertical retrace.

R33 is fed to the sync clipper to provide the vertical sync pulse.

**Horizontal scanning**

The two sections of the 6DE7 are connected as a cathode-coupled multivibrator. The deflection coils are in the cathode circuit of the output section. Scanning width is controlled by R35, horizontal linearity by R33. The horizontal scan is centered with R33. There is some interaction between the horizontal linearity and the horizontal width controls.

A crystal-controlled oscillator locks the horizontal multivibrator to 15,750 cycles. An alternate circuit is shown in Fig. 2. It reduces the number of tubes from seven to six, including the vidicon pickup tube.

A negative pulse taken across R57 is connected through C29 to the vidicon grid for horizontal blanking. A negative pulse across R69 is fed to the sync clipper to provide the horizontal sync pulse.

**Power supply**

The power supply is very convenient.

---

**Fig. 1**—Circuit of the camera. Note that only 7 tubes are used. Circled letters in schematic refer to the waveforms.

**Fig. 2**—Alternate to horizontal oscillator circuit eliminates one more tube.
The voltages are not extremely critical and may be within 10% of those in Fig. 1. Filter capacitors C22 have four sections. Solder C40 and C41 across V4's socket for proper rf bypassing.

The electrostatic focus of the scanning beam is controlled by R1. The target or contrast of the picture is controlled by R7. The beam or brightness is controlled by R44.

A current surge through either the vertical or horizontal deflection coils (such as a momentary short circuit in the deflection circuit) will deflect or position the scanning beam. Often this "shock deflection" exceeds the correction range of the vertical and horizontal positioning controls. Applying a reverse current surge will cancel the induced magnetism produced by the original unwanted current surge. This can be done by discharging a charged 0.1- to 0.5-mfd capacitor across the deflection coils.

Underscanning the vidicon target area is not recommended as this leaves permanent raster edge marks on the vidicon target. Also, picture quality is degraded when smaller areas are scanned. When the camera scanning amplitudes are reduced, the size of picture on the monitor increases. This is a reversal of what happens when sweep or scanning adjustments are made on a TV receiver. Therefore, increasing camera scanning amplitudes produces a smaller image on the TV monitor. Move the camera closer to the subject if a larger image of the subject being televised is desired. Do not be tempted to reduce scanning amplitudes.

The camera is capable of 250 to 325 lines of resolution. It weighs less than 12 pounds. The rf output is approximately 100,000 microvolts. The camera consumes less power than a 60-watt light bulb. Convenient tripod mounting has been provided.

Making your own coils

As we explained last month, you can cut the cost of your camera sharply if you wind your own deflection and focus coils. Fig. 3-a shows the outline of the finished horizontal deflection coil. Fig. 3-b is the outline of the vertical deflection coil. The table in Fig. 3 gives winding data for the horizontal and vertical deflection coils. It also includes winding data for the focus coil.

The simplest coil is the focus coil. So we will cover its construction first. You'll need a coil form like the one in Fig. 4. You can use a cardboard tube (from a roll of Reynolds Aluminum Wrap, for example) as the core and make the end pieces of fiber, wood or Plexiglas. Now wind the coil. Some form of coil winder is recommended. You'll need 6,500 turns of No. 32 wire.

Once you've finished this comparatively easy part of the coil winding, put the focus coil on the side. Now make the coil forms for the deflection coils. Note that the forms are made of three pieces, two sides and a center (Fig. 5). Note also that each of the side pieces has four slots or slits cut into it. Before you start winding, place a piece of string about 10 inches long in each of the slots. Then start winding. When you have wound 50 turns (for the horizontal coil), stop and tie the four strings, one at a time, around the winding completed so far. Then wind another 50 turns and tie again. Continue this until you have wound the necessary number of turns. Now take off the removable side of the form and slip off the coil. The ties will hold it in a thin flat disc, ready to be curved by hand around the cardboard tube the vidicon slips into. To simplify handling, wrap the sides of the coils with cellulose tape (Fig. 6).

Wind the vertical coils in the same way, only leave 120 turns between ties. You'll need two coils for the vertical section of the yoke and two coils for the horizontal section.

To assemble the coil assemblies you start with a 4-inch long cardboard tube large enough to fit over the vidicon, but not the glass exhaust tip.
Paint the tube with silver or copper conductive paint, leaving four unpainting slots. The slots permit the paint to serve as an electrostatic shield but not as a shorted turn. The deflecting coils are positioned over this tube (Fig. 7). Then wind a soft-iron wire overwrap over the coils, and place a thin copper, aluminum or brass ring against the end of the coils. Connect the ring to the soft-iron overwrap, and the conductive coating. This forms an electrostatic shield and is grounded (Fig. 8).

Fig. 9 shows the final assembly. The tabs carrying the deflection coils is slipped over the vicos. Then the focus coil assembly is slipped into place over the deflection coils. At this stage in the signal ring shield which is made of thin brass, copper tinfoil or aluminum. It contacts the electrostatic shield around the deflection coils. The tabs on the signal ring shield are grounded. If available, a mu-metal shield may be wrapped around the assembly, as shown in Fig. 9 and the photos. It is not absolutely necessary. You have now completed the coil assembly.

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Aid to Educational TV

Congress has voted to furnish $25 million in Federal aid to accredited colleges and universities of the various states, on a dollar-for-dollar basis, to construct educational TV stations for broadcasting instructions to students in public schools and elsewhere. Under the terms of the bill, no state is to receive more than $1 million in aid.

JUNE, 1962
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IF THE VERTICAL LINES AT THE TOP OF A TV picture pull to the right, you can bet that a service technician is going to see that set pretty soon. It is a minor complaint, but very annoying to viewers.

Fig. 1 is a drawing of a TV screen with a cross-hatch pattern and pulling to the right. Eight squares across the top of the picture, with a 53-msec scanning time per line, means about 1/4 of 53, or approximately 6-msec, to scan each square. The top line in Fig. 1 is late by about 1/4 of a square. If the trouble shows up as drawn, the next line is not quite as late, the next still closer to proper timing and, finally, after about 60 lines are scanned, the rest of the lines are on time.

If we connect a scope to the grid of the horizontal output tube through a low-capacitance probe and use the scope's internal sync, we'll see the familiar sawtooth or trapezoidal waveform of Fig. 2. Since the signal on the screen is the one which triggers the sweep inside the scope, a 6-msec delay won't show too much. The sweep will obliquely pull over to match it, and we'll still see a nice clean waveform, showing no signs of trouble.

If we could make the sweep absolutely constant with no variation, then we could detect the slowing down of the top lines of the raster. So, we use the scope's external sync input. For a reference sync signal, we can connect to some point in the circuit where the station-signal horizontal sync is available; for instance, at the horizontal sync separator.

Now, with a stationary reference signal, the pattern will show up looking like Fig. 3. The 6-msec delay of the top lines will cause a displacement of the vertical lines of the pattern, and the typical thickening will show up.

This must be caused by some 60-cycle ac, since the trouble shows up at the top of the picture, every 1/60 second. If the signal causing the trouble is coming from the local 60-cycle power supply, pulling will appear in other parts of the picture at times. It is impossible to synchronize power-line frequency everywhere in the country. If the 60-cycle signal is coming from the station signal, in other words from the vertical sync pulses, then it usually appears at the top of the picture.

There are two possibilities: One, the vertical oscillator-output stage is loading the power supply, often the boost-voltage supply, so heavily that we get a momentary drop in voltage on the sync pulse—sort of an inverted surge. The drop in voltage supply to the horizontal oscillator causes a drop in frequency, and the top lines arrive late.

Two, some portion of the vertical sync pulse is getting into the horizontal oscillator, phase comparator, etc. To test for this, turn off the set's brightness down, and disable the vertical oscillator. With the scope still connected to the horizontal output tube grid, switch in external sync. You can tell if the pulling disappears, because the thickening of the lines will go away.

Try checking the B-plus supply lines with a low-capacitance probe for any sign of vertical spikes or even nine-wave ac at 60 cycles. One rather unusual cause is cross-coupling in the yoke. However, most of these troubles are caused by bad electrolytic capacitors. Bridge each one, and, if they are parts of a multiple-section unit, disconnect each one and bridge one at a time. Leakage between units of multiple electrolytics is one very puzzling defect, so don't overlook it.

Convert to 27-inch screen


You should be able to. The 27EP4 actually calls for 2 kv less than the 24-inch tube. Same deflection angle, and the 27EP4 bulb diameter is really only 2-13/16 inches larger than the 24-incher. You'll probably have to add a 50-mfd 20-kv high-voltage filter capacitor, since the 27EP4 does not have an external conductive coating. With the reserve capacity in your sweep system, you should be able to sweep the extra inches without too much trouble. Set your horizontal linearity up for best linearity and minimum plate current and check the width setting. Also be sure you warn your customer of the cost of replacement CRT's.

Transformer puzzle

I have a vertical output transformer with the number 79B13-4. My distributor says that the number on this transformer has been changed to 79B91. When I tried it in the TV set, I get less sweep with the new transformer. The original transformer was a 79B29-1, and has three leads. I'm lost! —A. G., Union City, N.J.

You forgot to give me the make of TV set but those numbers are unmistakable—it's an Admiral. Somebody

---

Fig. 1—Crosshatch pattern on TV screen reveals vertical pulling at the top of the picture.

Fig. 2—Correct waveform on the grid of the horizontal output tube.

Fig. 3—Displacement of pattern caused by delay results in thickened vertical lines.
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"The Savoy Lounge proudly presents..."

"My sermon for this morning deals with..."

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"FLIGHT 702 NOW LOADING AT GATE..."

"10...9...8...7...6..."

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the width and linearity coils by heating them up. Look to see if they are darkened or charred. They may have an intermittent short to the cores. The flyback is another good suspect. A drop in the boost voltage caused by flyback or high-voltage supply troubles could cause the rolling by changing the plate voltage on the vertical oscillator and output stages.

For a pinpoint check, apply heat with the tip of a soldering iron to all suspected parts in all these circuits. Also, check the damper-tube socket for an intermittent leakage.

Slow warmup

The complaint is that a Dumont RA-165 is becoming progressively slower about producing a raster. Can you give me some advice about this—W. R. J., Toronto, Ont., Canada.

The most frequent cause is a slow-heating picture tube. However, if the tube produces a good picture after it finally does get hot, it isn’t too serious. The best thing to do is check the picture tube with a good tester; this will tell you whether the tube is weak. If it is, many times a “hot-cathode” will help in making it heat faster.

The tester will tell you whether using a brightener will help. We don’t recommend installing brighteners until the tube’s output has fallen so low that it is necessary to overheat the cathode to get enough beam current. Using brighteners on a normal tube will shorten its life of course.

Another possibility, of course, is a slow-heating horizontal output or (more likely) damper tube. You can check this by measuring the high voltage during warmup. If it comes up to its normal value quite a while before the screen shows a raster, then the CRT is slow. If the voltage comes up slowly, check the horizontal output and high-voltage sections.

Incidentally, time the actual warm-up with a watch—never estimate. If the tube shows light within 1.5 minutes, it’s nearly OK. Most people grossly overestimate the time!

Tuner trouble

I have a Philco 22DI330 in the shop. Channel 10 comes in on channel 9. What is my trouble and how can I remedy it?—F. B. Newark, Ohio.

This is caused by a misalignment or, more correctly, miscalibration of the tuner oscillator. This set uses an incremental inductance tuner. This means that there are basically only two oscillator coils used—one for the high channels and one for the lows. The switch in the tuner shorts out sections of the inductor until it is resonant on the desired channel.

Proper tuning procedure on these tuners is always to begin at the highest frequency channel, and tune the small brass screw visible through a hole in the front for best picture and sound. There will be one screw for each channel, usually numbered. Then tune the next lowest, and so on. If your channel 10 is the highest channel available locally, tune it first, then check the rest, tuning if required. If it is way off, move the channel 13 slug a quarter-turn, then go back to channel 10. You will find a marked change. A quarter-turn on channel 13 may have as much effect as five full turns on channel 10.

Horizontal instability

This chassis has been pushing me around quite a bit. It will start in sync, run for about 5 minutes, then fall out. Tickle the horizontal oscillator transformer, and it runs from then on. I took all the old tubes out, put them in a bucket and started with a fresh batch off the shelf. This didn’t do it, so I took those out, and put in another batch. All voltages, waveforms and everything else are absolutely normal. Resitors and capacitors all check OK.—R. C. S. Troy, N. Y.

I’m sorry to say that it looks as if you are blessed with a good thermal intermittent! From the time constant of the defect, I don’t think it will be a tube; this sounds more like a heat-sensitive capacitor or possibly a resistor. When the tube is warm, try heating each capacitor and resistor in the frequency-controlling circuits: the shapers, coupling capacitors, capacitors across the ringing coil, etc. It will undoubtedly take you some time, but that is where it will be found.

A can of the “cooling compound” recently marketed is a great help in cases like this. It is a standard spray can like those used for cleaners, but it contains only the propellant. When sprayed on a suspected part, it cools it very rapidly, and the resultant temperature change will often dig out a stubborn intermittent. If any part seems to be heat-sensitive, try touching each part with the tip of a soldering iron, just long enough to raise its temperature above normal.

Replacement transformer

I need a power transformer for a Tech-Master C-30 TV, but am unable to locate the parts here. Can you help me find a suitable replacement?—G. S. H., Ontario, Canada.

A Triad R-61-BC will replace the power transformer in this set. This transformer has three 6.3-volt filament windings, two at 1.5 amperes, and a separate winding for the damper heater. To use this unit in the Tech-Master set, connect the two 6-amp windings in series, Latching them properly to give you the 12 volts needed (Fig. 5).

Fig. 5—Connect the two 6.3-volt windings in series adding to get the 12-volt winding needed in a Tech-Master C-30. The voltmeter shows when they are connected properly.

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expanded-scale voltmeter

0.4 volt makes the difference between zero and a full-scale reading

By I. QUEEN

Editorial Associate

This meter can measure small differences in voltage. It ranges from about 0.9 to 1.2 volts dc. The tables with the circuit show typical calibrations.

The applied voltage lights a 6.3-volt pilot lamp. At the low voltage, the light is very dim, but is enough to affect a cadmium sulphide photocell. This cell acts like a variable resistor, its output depending upon the light received and on the energizing voltage which is the dc being measured.

The applied voltage lights a 6.3-volt pilot lamp. At the low voltage, the light is very dim, but is enough to affect a cadmium sulphide photocell. This cell acts like a variable resistor, its output depending upon the light received and on the energizing voltage which is the dc being measured.

Circuit of the simple unit along with typical calibration charts.

An Easy One

If we lay out the resistors in the pattern shown in the sketch, it becomes an obvious balanced bridge. So the drop across the 1-ohm resistor is zero.

Iterative Network

We can make this circuit (Fig. 1) more easily understandable by breaking it just after the first section and labeling the new inputs C and D. Since the lattice extends to infinity, we also see resistance R at points C and D. Now we can draw an equivalent circuit as in Fig. 2. This is a simple series-parallel combination which we can solve.

\[ R = 1 + 1 + \frac{R}{R + 1} \]

The last term is the parallel combination of R and 1 ohm. Multiplying both sides of the equation (by R + 1 to get rid of the fraction, we get:

\[ R \times (R + 1) = 2R + R + 2, \]

which is equivalent to:

\[ R^2 - 2R - 2 = 0. \]

This works out to:

\[ R = 1 \pm \sqrt{3} \approx 2.735 \text{ ohms.} \]

The negative solution is an entirely different story, and not applicable to our present problem.

What's Your EQ? May Solutions

Variable-Current Black Box

The circuit is as shown. To solve, first calculate the dc, which must be passing through a resistor of 25 ohms. Since the voltage-current product at
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**RATAN-Harbor**

**TV-Radar**

Any uhf TV set becomes a radar indicator with this new system.

A new type of radar presentation may give the small boatman all the benefits of marine radar for the price of a portable TV receiver. Demonstrated recently by the Coast Guard to the technical press, the new system is called RATAN (Radar and Television Aid to Navigation). The pressmen saw a scene on the TV screens like the one shown in the photo here. Their own ship, the US Coast Guard Cutter Spencer, could be followed on the TV screen throughout the voyage from New York Harbor to Sandy Hook, off the coast of New Jersey.

The new system differs in several respects from conventional PPI (Plan Position Indicator) radar. Most important—to small boatmen, at least—is that the radar scope is any uhf TV receiver. The second point is that RATAN shows each ship in position on a map of the area, unlike the PPI scope, which shows your own ship standing still in the center of the universe, with everything else moving in relation to it. The third feature is that moving vessels show a "wake", due to the persistence of the scope trace. This persistence is controllable by the transmitter operator. Because of the "wake", moving objects can be distinguished from stationary ones. The direction in which a vessel is moving is easily noted and, within limits, its speed can be determined. The long-persistence screen produces another effect. buoys not easily seen on a PPI scope, continue to come up in brightness until they are easily recognizable on the longer-persistence RATAN.

_How it's done_

The secret of the new radar is an instrument that Raytheon calls a "scan-conversion unit." Part of this is a special developed scan-conversion tube, a double-ended device. One end is a picture storage tube, on which the radar presentation (or any other TV picture) can be held any desired time. The other end is a flying-spot camera tube, which scans the picture on the storage face and presents the signals to a uhf TV transmitter.

The scene shown at the Coast Guard demonstration was picked up with an ordinary radar—a Raytheon 1605—at the Coast Guard station at Sandy Hook. The conversion unit picked these signals up as a conventional PPI presentation, and fed them out as a TV raster to an uhf TV transmitter, working on channel 47 (671 mc). RATAN has one limitation. It is what in Europe is called a "harbor radar," covering a fixed area around a permanent radar station. Larger ships would, in addition to RATAN, carry their own radar.

To the small boatman, the advantages are overwhelming. It gives him radar where he needs it most, and at a price he can afford—that of a portable TV. Further, he can understand the RATAN display much more easily than he could a PPI scope. He might have trouble identifying his own craft, but this can be solved in a number of ways. Possibly the easiest is by making what aviators call a procedural turn, and watching for the trace on the screen.

In crowded harbors or heavy fog, such maneuvers would have their disadvantages. A "position locator", a rotating, highly directional beam, so gated on and off that it would be visible to a viewer only when the antenna pointed in his direction, has been proposed. The boatman would see a white line from the transmitter crossing his own craft. This solution was proposed in a paper read to the IRE Convention by A. Roberts of General Precision, and it—or some similar device—may eventually be incorporated into the system. **END**

---

**Area just outside New York Harbor, as seen on RATAN screen.**

**How display looks to boatman. Small circle of wire behind set is antenna.**

**Scan – conversion tube that changes PPI display into TV image.**

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EQUIPMENT REPORT

2 New Tools for Transistor Servicing

Heathkit IM-30 transistor checker and B & K model 960 transistor radio analyst

By WAYNE LEMONS

A new self-powered transistor tester with features usually found only in more expensive testers, has been recently introduced by Heathkit. The model IM-30 checks dc beta and dc alpha, using a special bridge circuit. Bridge null is indicated on a zero-center, 10-0-10 microammeter. Lever switches set the different functions. The instrument checks for IC60 and IC60 leakage, collector-to-emitter shorts, dc gain and ac current gain and ac and dc transconductance, base resistance and collector resistance. Diodes can be checked for forward and reverse current.

Other switches select collector voltage, leak voltage, leak current ranges, collector current ranges and the correct polarity for p-n-p or n-p-n transistors.

A bias control across an internal 1.5-volt battery adjusts collector current to any desired value between 0 and 15 amps. The dc beta (gain in common-emitter circuit) control is calibrated in two ranges: 0-150 and 150-300. The dc alpha is also calibrated on this control in two ranges from 0-0.9966. High- and low-gain ranges are selected by a front-panel switch.

The IM-30 has external binding posts for using external batteries or power supplies for making gains and leakage tests at higher voltages than the internal 9-volt battery supply. Meter scales and ranges are included in the instrument to measure these external sources up to 50 volts. External...
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DELCORADIO, Division of General Motors, Kokomo, Indiana
indicated voltage drops. GAIN shows the bridge circuit. In
ures leakage to the meter. An IM-30 can be used in
15,000 ohms) is switched in to extend the range from 150 to 300. The gain control is also calibrated in dc alpha. Alpha is beta divided by beta + 1. When beginning a transistor check, set the dc bias control until the
bias voltage terminals are also provided.
For transistor radios, the supply in the IM-30 is adequate. For video output and sometimes other transistors in transistor TV's, and for special-purpose and industrial transistors, a higher test voltage may be desirable. Occasionally, a transistor will check OK on a low-voltage test, but have excessive leakage at its rated or operating voltage. This is true even in transistor radios. The IM-30 lets you select the leakage voltage you want to use (which should always be approximately the operating voltage of the transistor in the set) in 1.5-volt steps up to 9 volts. Collector voltages for gain tests can also be selected in the same manner.

Breakdown of tester circuits
Fig. 1 is a simplified circuit of the IM-30 short test. This is made between collector and emitter with the base open. A low-resistance shunt across the meter, and a 10,000-ohm resistor in series with it, protect the meter from damage if the transistor is shorted.

Fig. 2 shows the I CEO leakage test and is identical to the short test except that the meter shunt is selected by a front-panel switch to give a much more sensitive meter indication (15 μA to 1.5 ma). An I-CM leakage test measures leakage current from collector to base with the emitter open (Fig. 3). A simplified base-current circuit.

collector current reads the desired value, usually about 5 ma for small-signal transistors. (Bias may be set so the collector current is most any reasonable value. It will have no effect on the gain reading.) Fig. 5 shows this collector-current test circuit. Fig. 6 is the simplified base-current circuit. Base
currents can be read in ranges of times 10 from 15 μA to 1.5 ma.

Using the IM-30
The IM-30 can be used in service shops to check all transistors including small signal, power, and special types (both p-p-n and n-p-n) for shorts, leakage, gain and other special tests if desired, as well as for checking diodes. Transistors are checked under actual dc operating conditions with voltages similar to those found in the transistorized equipment. The IM-30 is ideal for matching transistors. It is especially good for go-no-go production-line testing. You can set the unit for specified test conditions, check each transistor for shorts, and to see if leakage is within allowable limits.

To check gain, set up the desired bias conditions and set the gain test control for the minimum allowable gain. Pull the gain lever. The transistor under test will deflect the meter one way if the gain is low, the other way if the gain is higher. (Direction of meter indication is determined by whether the transistor is a p-n-p or n-p-n type.)

This looks like a good tester for service technicians, production-line testing, design engineers or just about anyone working with transistors. Fairly easy to assemble, it should take the casual kit builder no more than 8 hours. Just be careful to keep solder from running into the switch rotors. Solder with the terminals down so any stray solder will run out of rather than into the switch mechanism.

BK model 960
A new instrument that goes a long way toward solving the extra equipment problem for transistor radio service is the new B & K. They call it a Transistor Radio Analyzer. It features a 6-12 volt power supply, tapped in 1.5-volt steps, and a single probe "in-circuit" transistor and stage tester. In addition, the model 960 provides a 2-band signal generator (250 to 2,200 kc), a 2,000-cycle audio generator, a vacuum-tube volt-ohmmeter; and an out-of-circuit transistor tester.

Fig. 7 is a simplified circuit of the rf-af generator. Half of a 12AU7 uses separately switched-in oscillator coils to cover 250 to 800 kc (band A) and 800 to 2,200 kc (band B). An RF OFF switch disables this circuit when it is not needed.
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NEW

SENCORE PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

Here it is, the scope that technicians, engineers and service-men from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest labototory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job.

• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes... all the way. Vertical amplifier sensitivity is .053 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectedly. Another Sencore first is the Automatic Range Indicator. Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within 1/2 dB from 20 cycles to 5.5 MC, down—3 dB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 dB from 45 cycles to 330 KC, flat within —6 dB from 20 cycles to 500 KC.

HIGH DEFLECTION SENSITIVITY:
Vertical Amplifier—Vert. input cable .035V/IN. .01V/IN.
Aux. vert. jack .035V/IN. .01V/IN.
Horiz. amplifier—Lo-Cap probe .5V/IN. 1V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:
Vert. input cable 2.7 Meg. shunted by approx. 99 MME
Aux. vert. input jack 2.7 Meg. shunted by approx. 25 MME
Through low cap. probe 27 Meg. shunted by 9 MME
Horiz. input jack 330 K to 4 Meg.

The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE

ADDISON 2, ILLINOIS
The af generator uses the other half of the 12AU7. The circuit constants are such that it oscillates at about 2,000 cycles. The audio can be taken off at the audio output jack for signal-tracing audio stages. A winding on the oscillator coil provides a low-impedance signal for testing speakers at the voice coil jack. The audio also modulates the rf signal when desired.

The tapped, metered power supply is unusually versatile. Taps are provided in 1.5-volt steps along a low-resistance bleeder network (Fig. 8). These taps make it possible to test any radio, even those using a tapped battery power supply, and, since the supply is well filtered and low-impedance, motorboating should be virtually eliminated.

Higher-impedance test power supplies sometimes cause radios that rely on the battery as part of the filter system to motorboat. The power supply current meter has two ranges: 0-15 ma and 0-150 ma. They are selected by a front-panel switch. These are ideal ranges for checking almost any transistor radio.

Since nearly all transistor radios use 9 volts or less, the 12-volt maximum of this supply is adequate for just about any radio that will hit your shop. The vtvm has two ranges: 0-1.5 and 0-15 volts. This will take care of all voltages you’re likely to encounter in transistor service. The 1.5-volt range is ideal for checking bias. The ohmmeter has only one scale.

It reads 1,000 ohms at center scale and has a full-scale reading of 1 megohm.

The in-circuit test

The unique feature of the model 960 is the “in-circuit” transistor and stage tester that utilizes only a single-wire test probe. Here’s how to work it. Switch on the Analyzer and set the function switch to IN CIRCUIT. This switches the meter into a bridge circuit as shown in Fig. 9. Connect the radio to be tested to the power supply, observing correct polarity. Adjust the control marked IN-CIRCUIT METER SET until the meter reads in the green calibrate area. Switch the npn-pnp switch to the type of transistor stage to be tested. Touch the IN-CIRCUIT TEST probe...
to the base of the transistor. This should increase transistor current. (The probe supplies a negative voltage for p-n-p transistors and a positive voltage for n-p-n's.) Since the meter is in a balanced circuit, even a slight increase in overall current will deflect it up scale — if the transistor and its dc circuit are operative. If the meter doesn't deflect up scale, either the transistor or its dc circuit is defective.

Although this in-circuit test does not tell absolutely whether a stage is good, it certainly indicates if the stage is bad. For example, if the meter deflects up scale in an i.f. stage, you know that the dc circuit of the stage is good and that the transistor responds to bias. It does not tell you whether the gain of the transistor or stage is adequate. On the other hand, if there were no up-scale deflection, you would be certain that either the transistor or the dc circuit was defective. Then it

---

**Fig. 8** Metered power supply circuit in the 960.

**Fig. 9** In-circuit test. Meter is in balanced bridge circuit. Test probe placed on base increases current drawn by radio, bridge is unbalanced and meter reads up scale.

---

**Fig. 10** Out-of-circuit transistor leakage-gain test. Would simply be a matter of pinpointing the specific bad part in that stage.

---

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**NEW SENCORE**

ADDISON 2, ILLINOIS
MIDGET
4-channel
CB R/C
receiver

A packaged amplifier unit makes
this tiny receiver practical

By E. L. SAFFORD, JR.

The Centralab TA-12-B, a tiny packaged amplifier, makes possible a very small four-channel radio-control receiver for 27 mc. Requiring only 1.5 to 1.75 volts to operate (a penlight, mercury or wet cell) and only a hair larger than a standard reed decoder, the receiver can be used in model airplanes, model trains or very small model boats.

The relative size of the TA-12-B can be seen in the photos. It consists of four transistors in a high-gain, very stable circuit, with provisions for a volume control. Its circuit and frequency response curve are shown in Fig. 1. Six wire leads provide the connections. A metal cover shields the circuitry. It can be mounted in any position. The output, 0.5 mw, is large enough to drive any power stage. Its price is high, but the unit is small!

Receiver operation

Although the receiver to be described here can be used as either a single- or multichannel type, tones are required. In the single-channel application, any tone from 300 to 1,000 cycles will give good performance. The relay is a Jaico 100-ohm type requiring about 12 ma to close and opening at 8 ma. Without signal, the 2N109 (Fig. 2) draws about 15 ma; with signal, about 6 ma.

For multichannel operation, the relay is converted into a reed decoder. Small pieces of a wristwatch spring are so positioned over the pole piece that when tones of 200, 225, 250 and 280 cycles per second are received, each reed vibrates, the shortest with the highest frequency and the longest with the lowest frequency. As each reed vibrates, it touches a fixed contact positioned above it, making an intermittent connection that can make a second relay or transistor operate. The second relay or transistor causes motors, escapements or other power devices to furnish physical motion. Reed tones must be exact and are governed by the length of the pieces of watch spring.

Circuit details

The superregenerative detector stage is a simple, straightforward, standard circuit using a Philco AO-1 transistor (Fig. 3). The coil is wound on a ½-inch slug-tuned CTC form. The audio voltage output is developed across the 1,000-ohm resistor in the lead to the negative 1.5-volt line. Since the amount of superregeneration is small, I used an oscilloscope to test the operation of this part of the circuit. Connect scope leads across the 1,000-ohm resistor.

When the power is off, the scope line should be thin and narrow. With power connected to the receiver and the stage working, the line on the scope will broaden, indicating the presence of rf. The widened line may be from ½ to ¾ inch higher than the one without power. If a transmitter is turned on and a tone transmitted, you can see the modulation on the wider picture when the receiver is properly tuned.

The two 47,000-ohm resistors and .001-µf disc capacitors form a quench filter for the input. A second quench filter, a 5-µf 6-volt capacitor, is placed across a 27,000-ohm resistor at the TA-12. The 5-µf capacitors are not available everywhere. In most cases, 5-µf or 6-µf units should do the job satisfactorily. — Editor. This gives a good, pure sine wave for tones up to about 600 cycles. Use a smaller capacitor if higher-frequency tones are to be received.

The 2N109 stage is straightforward. Base bias resistor (R8) may be any value from 5,000 to 10,000 ohms. The lower value gives a higher static current and is better for single-channel operation. Be sure to connect the 5-µf coupling and filter capacitors with the polarity shown. Also, do not

Fig. 1.—Circuit of the TA-12-B, a packaged 4-transistor amplifier and its frequency response chart.
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JUNE, 1962
omit the 0.25-µf relay or reed bypass or reduce its value as this will cause trouble.

Reed-unit construction

To convert the Jaico 100-ohm relay into a four-channel reed decoder, the following steps are necessary. First, carefully remove the relay armature and the braded solder lug on the back of the relay frame. Next file down the top of the frame where the armature was pivoted until it is smooth and level and even with the top of the coil. Carefully remove the normally closed fixed contact from the front of the relay frame.

Cut a small piece of metal from a coffee can, about ¾ inch wide and ¾ inch wide. Sand it bright. Bend it tightly together so it is ¾ by ¾ inch in size. Position it on top of the pole piece as shown in Fig. 4-a. Hold it tight against the pole top and solder just the front edge. Be very careful to keep solder from running under the metal strip. Solder between the pole top and the strip will seriously impair the reed unit's performance. The metal strip must touch the pole top tightly. Now get a wristwatch spring. We used one from an old Timex watch. Straighten it out and sand both sides

Fig. 2—Circuit of the complete 4-channel receiver.

C5, C6—001 µf, ceramic
C7, C8—5.6 µf, 6 volts, miniature electrolytics
(Solid Tantalum Texas Instruments capacitor available from Lafayette Radio and Allied Radio)
C9—0.25 µf, ceramic
C10—50 µf, 50 volts, electrolytic
All capacitors 6 volts or higher
LI—1 turn No. 28 enameled wire around L2
L5—11 turns No. 28 enameled wire spaced ¾ inch on CTC (Cambridge Thermionic Corp.) 1.5M 1/4 inch red dot coil form with core. Winding length 1/2 inch.
RFC—100µh
RI—100 ohms (Jaico relay coil or relay,
Jaidinger Mfg. Co., 1921 W. Hubbard St., Chicago 12, Ill.)
VI—AO-1 (Philco)
V2—2N109
Batteries 1.5 and 2.25 volts.
Miscellaneous hardware.
One thin dime is larger than a TA-12-B amplifier.

Bright. Cut four 1 1/4-inch pieces. Bend these 3/4 inch from one end, rounding the bend as in Fig. 4-b. The longer part should now be at least 3/4 inch long. Clamp the short ends against two small soft iron bars and file the inside of the bar smooth so it will fit tightly and firmly against the relay frame (Fig. 4-b).

Cut the long ends of the watch-spring strips diagonally as in Fig. 4-c. The sharper the diagonal, the wider the reed frequencies separate. The flatter the cut, the closer the reed frequencies. Then position the long part of the reeds 1/16 inch above the metal strip you soldered to the relay's pole piece.

Pressing the reed clamp bars tight against the relay frame, solder the edges to hold the bar in place. Do not let solder run between the bar clamp and the frame.

I found that positioning a small magnet like those in a dime store pot holder, as shown in Fig. 4-a, increases the reed vibration amplitude significantly. Try both ends of the magnet against the frame as one end will work better than the other.

When the proper tones are transmitted, and yours will be right around my values if you use the length reeds specified, the reeds will vibrate a full 1/16 inch up and 1/16 inch down. Now you can position fixed contacts over the reeds, above the pole piece, to complete the intermittent contact.

Reed-decoder improvement

The reed decoder can be improved if the magnet can be cut and positioned between the spring clamp bars and the frame as shown in Fig. 5. For those who would like to build the receiver but not the reed unit, use the Min-X reed decoder, with a 200-ohm coil, obtainable through hobby shops. You can get 8 to 10 channels with this commercial item.

Any commercial radio control tone-type transmitter can be used with the receiver, provided its tones can be adjusted to the reed frequencies.
soldering shortcuts

BY JOHN A. COMSTOCK

Many electronic technicians spend about half of their servicing time soldering and unsoldering circuit components. Because of this, much valuable time is wasted solving problems which crop up during various soldering jobs.

Here are several selected soldering shortcuts that will prove helpful. They will save time, trouble, and effort.

When replacing a defective part, how do you mark the location so you solder the replacement to the right lugs? Try coloring the lugs with food coloring. A brush dipped in water removes the coloring quickly.

If a live circuit can't be disrupted while you solder, avoid shocks by wrapping solder with plastic electrician's tape. This also keeps finger grease, which sometimes hampers adhesion, off the solder.

The technician's No. 1 problem is the need for a third hand to hold parts and wires. When they can be pinned down outside the circuit, a rubber band around the spool of solder will do the trick.

If you pick up your soldering gun, squeeze the trigger and discover the tip doesn't heat in the normal time, tighten tip-holding nuts or screws. If spotlights don't light, check for a blown or loose bulb.

END
TECHNOTES

PANEL MOUNTED METER ACCURACY
A meter intended for mounting on an iron panel will not give the same reading when it is removed from the panel. If the series or shunt resistors for the meter must be adjusted, do so with the meter mounted on the panel.
This also holds true for meters used on small portable meter cases. The meter should be a unit intended for such duty. Do not use such a meter too close to a massive iron structure or readings will not be accurate.—Warren Roy

RCA CTC4, CTC5, CTC7 COLOR CHASSIS
Whenever the focus control goes on one of these chassis, install a 56,000-ohm 1-watt resistor in series with the arm of the replacement pot. If you use an RCA replacement part, you’ll find that it is slightly different from the original and a variation on the mounting is needed.
Clip off the locating tab on the replacement pot. It won’t line up with the locating hole in the chassis. This means you must be sure that the mounting nut is securely tightened. You will also find that the control terminals cannot be inserted through the mounting board. Instead, solder a short piece of bus wire to each terminal. These wires can then be inserted into the proper mounting board holes. (Fig. 2).

After installation, if you find that the ranges of the focus control allows proper focus near the maximum clockwise position, add a 330,000-ohm 2-watt resistor as shown in Fig. 1—RCA TV Service Tips

STEELMAN TRANSITAPE MODELS 7111-A, -B
Symptom: Short battery life, slow tape speed.
With a tape in place and running, the motor should draw about 100 ma. Greater current drain indicates improper flywheel pressure, a sticky pressure roller, too much pressure on the pressure pads or, once in a great while, an unsatisfactory motor.
The flywheel is the large brass wheel. Use your fingers and the holes in the casting to check for smooth rotation and end play. The wheel should have an endwise movement of .005 inch. This distance is barely but definitely discernible to the fingers. If necessary, loosen the rear-bearing lock nut, and back the bearing off. Try again. Too much end play will cause slippage (speed loss), and too little play will increase motor load needlessly.
Bring the bearing up very gently. It is made of sapphire
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and too much pressure will crack it. To check the pressure applied to the tape by the pressure arm, run the tape through and check motor current. Now lift the arm by hand, and observe the change in motor current. Stop the motor, and adjust for roller freedom by turning the black rubber roller with your fingers. If it sticks or does not turn freely, replace with Steelman part No. 700047 and shaft No. 700067.

If the roller is satisfactory, check the pressure pads by watching them as you raise the pressure roller 1/16 inch from the capstan. After this distance the pads should leave the tape. If necessary, adjust by loosening the Allen-head screw found under the other end of the pressure arm (see diagram).

Note that, while too much pressure on the tape will reduce motor battery life considerably, too little pressure will cause erratic record and playback. Normal motor battery life is about 50 hours with intermittent Transitaope opera-

DuMONT RA-306

The set developed an intermittent loss of height. Monitoring the B-boost line showed it was affected whenever the height would shrink. The B-plus to the vertical oscillator is fed by bootstrap B. Monitoring the B-boost at flyback terminal 3 showed no appreciable change in B-boost with the height change. R287, the 3,300-ohm resistor in the B-boost line, was checked and its value was found to be off. Replacing the resistor put an end to this intermittent. We used a 5-watt replacement to prevent any recurrence. — Warren Roy

FOCUS PRECAUTIONS

Both the focusing and ion-trap magnets affect the electron beam. Any appreciable adjustment of the focus magnet should be followed up by a readjustment of the ion-trap magnet.

Some TV sets have a funnel to help guide the screwdriver to the focus adjustment screw. If the screwdriver slips, it may move the ion-trap magnet slightly. If only a slight change is made, it may not be noticed immediately. As a general precaution, make it a rule always to check the adjustment of the ion trap after any focus adjustment. — Joe Shane

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6-METER VFO, model HE-61. Shielded tuning components, high-Q Chapp oscillator circuit. Operates in 4-6.5 mc range, output frequency 8 mc. Ferrite tuned coil output approximately 10 v. Use with any transistor having standard 8-mc crystal. Cable with 5-prong power plug for units with correct input, instructions for units without; cable and standard crystal plug for vfo input. Illuminated dial calibrated 60-64 mc. Single-knob planetary drive mechanism. Tube complement: 12BA6 oscillator, 6A2 voltage regulator.-Lafayette Electronics Corp., 111 Roosevelt Ave., Synnott, N. Y.


SELF-SERVICE TUBE TESTER, model 801-L. Tests more than 1,200 types including nuvistors, compactrons, Novar, 10-pin, series-string, OZ4, 1-volt, electron-ray, hi-fi and foreign and 6 and 12-volt auto radio vibrators. Will accommodate new types introduced in the future. Storage compartment holds over 600 tubes.—Mercury Electronics Corp., 111 Roosevelt Ave., Minoa, N. L.

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DC POWER SUPPLIES. Model EC-1, for circuit. Short, leakage, gain tests. Wide-angle meter, transistor socket for out-of-circuit tests, zero adjustments on meter.—4C Electronics, 400 S. Wyman St., Rockford, Ill.

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TUBE CHECKER, Kit IT-21. Checks all common tube types including competition, Novar, navistor, 10-pin miniatures. Tests for quality on basis of total emission, and for shorts, leakage, open elements and filament continuity. Quality read on multi-colored meter scale. Multiple filament voltages, adjustable cathode current, variable meter sensitivity and individual tube-element switching. Thirteen 3-position lever switches allow checking each tube element individually for open or short conditions. Roll chart, line adjust control.—Heath Co., Benton Harbor, Mich.

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CAPACITANCE CHECKER, model 691. 4 ranges for testing capacitors from 10 μf to 1,000 μf. Leakage tests for polarized and unpolarized units. Power factor test for electrolytics from 2–6%. Low-voltage bridge for checking electrolytics in transistor circuits.—Jackson Electrical Instruments Co., 124 McDonough St., Dayton, Ohio.

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Superior performance is the product of efficient design, precision engineering, top quality components and construction. From interior to the clean attractive lines of its exterior, the Model 100 gives you that extra measure of reliability.

Check these outstanding features . . .
Crystal filter for minimizing adjacent channel interference. Built-in calibration circuit • 12-position crystal controlled transmit channel selector • Front panel microphone jack • Provision for connecting external speaker and S/meter • Tunable dual conversion superheterodyne receiver covering all 23 channels. • Two crystal controlled receive positions • Push-to-talk operation • Three way power supply for 6/12 vdc and 115 vac • Five watts plate input • Certified tolerance ± .005% • Brown cabinet with brown and silver panel • Dimensions: 5½" H. x 8½" W. x 9" D.
Complete with 1 transmit crystal, 1 receive crystal, new style ceramic microphone and coil cord $199.50

External S/Meter and Speaker
This external S/meter and speaker is the perfect companion for the Model 100. Constructed with the same clean lines and fine craftsmanship. Utilizes a high impedance vacuum tube volt meter circuit. Connects to socket on rear of transceiver. S/meter reads in three ranges.

Complete with interconnecting cable $49.50

The next time you visit your International dealer ask him for a demonstration of the Model 100 Executive and the system-engineered accessories. A complete catalog of International equipment and crystals may be obtained by writing International Crystal Mfg. Co.
COMMUNITY TV systems, educational and industrial installations. Gain 65 db with agc disabled. Recommended output: Picture carrier 3 volts, sound carrier 1 volt. Input and output impedance 75 ohms; supply voltage 117 volt, 60 cycles, 40 watts. Allied Television Associates Ltd., 27 Taber Rd., Rexdale, Ontario, Canada.

PORTABLE TV CONSOLE, model ST-1, Porta-Studio for schools and industry. Transistorized cameras and mike for audio and video reception. Combined with modulator into complete 2-kw TV, camera-amplifier; 24K748397 and 24C742076 in 50 Motorola models and chassis. HO-741 replaces Motorola 24K748397 and 24K742076 in 279 models and chassis. Stotanov part No. HO-741 replaces 24C740969 and 24C742076 in 50 Motorola models and chassis.

CCTV system, originating any channel from 2 to 13. Lighting equipment and 17-inch monitor. Model ST-2: two camera inputs, lights for two cameras and two 8-inch monitors. BlonderTongue Labs., 9 Alling St., Newark, N. J.


FM-TV INDOOR ANTENNA, Brite-Site. 5 feet when open, works when mounted out of sight. Vinyl plastic, silver printed circuit. RCA, Parts & Accessories, PO Box 644, Camden 2, N. J.

FM-TV ANTENNAS. Combine series. Metropolitan Combines No. 1, 6-in. square boom, 2 elements low-band TV; 3 elements collinear high-band TV, all directional halve element on FM. Suburban Combines No. 2, 7-in. square boom, 4 elements low-band TV; 10 elements collinear high-band TV, 3 elements directional on FM. Fringe Combines No. 3, 160-in. square boom, 6 elements low-band TV; 15 elements collinear high-band TV, 4 elements directional on FM. All units require 2 separate transmission lines, no couplers, pre-assembled spool construction. Finney Co., 34 W. Interlaced, Bedford, Ohio.

10-ELEMENT YAGIS. High-band units give continuous and overlapping frequency coverage in 112- and 305-me ranges, high gain, low vswr. Aluminum alloy tubing, heli-arc welded construction. Model Y-103 for vhf communication frequencies, Y-105 for uhf high-band TV channels. Tarsco, Box 38, Sherburne, N. Y.

STEREO PREAMP-CONTROL CENTER, model FT22, 15 inputs, 14 separate controls. Phononix switch, loudness and volume controls, phasing switch, equalized tape head inputs, separate recorder inputs, switched high-low cutoff filters and pure rectified dc on all filaments. Jopwaltos Co., PO Box 500, Paramus, N. J.

STEREO RECEIVER KIT, model KU-45 Audio Center. Combines AM/FM multiplex stereo tuner and 32-Watt stereo amplifier. Dynamic sideband regulation reduces over-modulation and fringe-area distortion; afe locks in FM broadcast signal, prevents drift. Point-to-point wiring, prewired and prealigned FM front-end assembly. Push-button on-off switch, regular or reversed stereo switch, dual-concentric clutch type bass and treble controls. Amplifier Section: 02 watts continuous sine-wave power output; response ±1 db, 30-15,000 cycles at rated power; harmonic distortion 1.9% at rated power; hum and noise better than 75 db; output impedances 4, 5, 10 ohms each channel. 8 and 16 ohms center channel. Tuner Section: FM sensitivity 2.5 µv usable IF sensitivity, 24-db quieting; i-f bandwidth 100 kc, 3 db down; AM sensitivity 8 µv, 19-db signal-to-noise ratio. 4.3 x 17½ x 13 in. Supplied with parts, tubes, wire, solder, built-in AM loopstick and FM folded-dipole antennas. Allied Radio Corp., 105 N. Western Ave., Chicago 46, Ill.

AMPLIFIER SPEAKER, model S-6490, 8-watt push-pull amplifier, 8-in. woofer, 3½-in. tweeter, built-in crossover network. Operates on any 117-volt, ac power supply, 50-60 cycles, 60 pickup cartridges, lower with high-compliance cartridges. Precision cueing device, integral with arm, for lowers and lifting arm without touching it. Adjustments: static balancing with damped counterweight for overall cartridge weights of 5-19 grams: spring-applied stylus force with knob calibrated from zero to 8 grams; vertical height (range 1½ in.). Stylus overhang (range 7½ in.) individually set for each cartridge. Vertical pivot design keeps stylus in vertical plane for each height adjustment. Bearing friction below 1/10 gram in any direction at stylus. Arm 12½ in. overall, with mounting board for manufacturer's TD-124 and TD-122 turntables. ELPA Marketing Industries, Thorens Div., New Hyde Park, N. Y.


COLUMN SPEAKER, UniLine CS-3. 6 elliptical speakers, 2 tweeters. Response 150-10,000 cycles; vertical dispersion 22°, horizontal dispersion 120°. Power capacity 25 watts, impedance 16 ohms. 48 x 7½ x 8½ in. University Loudspeakers, Inc., 80 S. Renino Ave., White Plains, N. Y.

MINIATURE DRY BATTERIES, 44 types, for transistorized circuits. 8 power ratings from 3 to 13½ volts, 1½-volt increments. Wafer Cell construction, sandwich of artificial manganese dioxide mix between disc-electrodes of zinc and carbon, heat-sealed in airtight plastic envelope. Burgess Battery Co., Freeport, Ill.

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All specifications are from manufacturer's data

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TECHNICAL BOOKLET, 52-page 2-color catalog contains data on 147 books on electronics, TV, radio, audio, computers, electricity, etc., with subject index.—Howard W. Sams & Co. Inc., Technical Book Div., 1251 E. 46 St., Indianapolis 6, Ind.

PLANNING MASTER TV SYSTEMS. 28-page manual gives detailed design information on various systems. Includes data charts and many illustrations.—Blonder Tongue, 9 Alling St., Newark, N. J.


STEREO HI-FI BROCHURE, AL-1950-3. 3-color foldup booklet features mixes, tuners, amplifiers, speakers and speaker systems. Illustrated section covers recommended component arrangements.—Altec Lansing Corp., 1515 S. Manchester Ave., Anaheim, Calif.

ELECTROMAGNETIC RELAYS shown in 16-page Catalog 62. Illustrated sections feature high-performance, power, special-purpose, general-purpose, and telephone types, with full engineering data.—Peters &灞ndorf, Technical Information Section, Princeton, Ind.

TEST LEADS AND COAX CABLES pictured in 4-page ordering guide. Shuts shielded, unshielded and twisted pair, plus clips, ends, plugs, lugs and leads. Contains prices, testing specs and modifications.—Anser Industries Inc., 76 Winthrop St., Newark 4, N. J.

STEREO HI-FI KITS, 8 models, pictured in 4-page leaflet, with full specs. Also available leaflet on kit or assembled marine radio equipment, 6 units, with photos and specs.—Daystrom Products Corp., Box 107, St. Joseph, Mich.

PHOTOCONDUCTOR DEVICES, 4-page, 2-color leaflet describes special features, applications of manufacturer's photoconductor line. Gives technical data on one sample type.—Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

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RUGGEDIZED YAGIS, over 100 types in ranges 30-600 mc, detailed in 16-page Catalog 690. Data include specific frequency, weight, nominal half-power beam width (degrees) for E and H planes, number of driven elements, maximum VSWR, maximum power input, nominal gain above isotropic source. Contains data on stacking systems, coaxial stacking lines, mounting kits for Yagis, skewing information for increased E-plane beam width, power-handling capability and wind-load specifications. Specks given on high-gain uhf screen antennas and special-purpose Yagis.—Technical Appliance Corp., Sherburne, N. Y.

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GENERAL CATALOG. 264 pages of electron components and systems. Capacitors, resistors, test instruments, amateur gear, etc.—Dixie Radio Supply Co. Inc., 1900 Barrow St., Columbia, S. C.

THERMISTORS. 18-page glossy catalog gives definition, manufacturing process, characteristics and application data on 15 types. Many illustrations and diagrams.—Nuclonic Produces Co., Inc., 1601 Grande Vista Ave, Los Angeles 38, Calif.

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 appeared. UNLESS OTHERWISE STATED, ALL ITEMS ARE AVAILABLE TO MEMBERS ONLY...

BARGAIN CURRENT INDICATOR

A 150 to 250-ma pilot lamp can be used to effectively adjust horizontal amplifier drive and similar circuits for minimum current. A fuse substitute is made from a piece of dowel and the ends of a split fuse. The new fuse block fuses are a bit more difficult to substitute, but it is still possible. Drill a hole through the end cap of the fuse for the inner contact wire. The dimmer the lamp, the lower the value of current passing through it.

a. The photo shows: dowel replaces glass fuse body.
b. The pilot lamp is held in one end of the snap-on fuse holder. Jumper makes the connection to the center contact.
c. Top wire is soldered first so heat will not affect insulation of wire through hole that makes contact with bottom contact.—Elmer Carlson

JUNE, 1962 93

If you were not among the 10,123 kit-builders who received this first issue...you're missing something

The first issue of the quarterly R-A-E Journal has now been received by more than 10,000 members of the R-A-E Society—the national organization devoted to the interests of radio, audio, and electronic kit-builders. From initial reports, the Journal is a resounding success. Comments from Society members say: "Bravo"—"Something we have really needed"—"It's a must for kit-builders"—"Packed with wonderful, original ideas."

The R-A-E Journal is available only to members of the Society. You can't buy a copy anywhere. However, more copies are being mailed out daily. You can have one, too. So read on.

WHY THE FIRST ISSUE OF THE JOURNAL SCORED A BULL'S EYE

Under the direction of Milton B. Sleeper, one of the radio-audio pioneers and a recognized authority on kit design, the R-A-E Journal is devoted exclusively to the interests of kit-builders (no record reviews or articles on music).

The new issue contains ten articles and departments on kit designs, kit construction, system planning, Society activities, and related subjects. The Journal serves beginners as well as advanced enthusiasts with how-to articles, reports, and comments written in a clear, concise manner, profusely illustrated with drawings and photographs handsomely printed on fine paper.

It is filled with original ideas, plans, and information on interesting things you can do with simple tools and a kitchen table for a workshop.

When the Journal gets into controversial subjects, no holds are barred. Parts of the "Notes and Comments" and "Members' Roundtable" might be labeled "Too Hot to Handle!" Altogether, you will find the R-A-E Society's Journal unique, stimulating, authoritative.

Most valuable of all are the articles on new kits—kits unlike any you have ever seen because they incorporate developments and practices borrowed from precision instruments and military equipment, but in practical form, suited to home construction.

THE FIRST R-A-E KITS

The first R-A-E kits will be available in August. The overall design, assembly and wiring methods, appearance of the finished instruments, and even the instructions and diagrams are totally unlike any now available. They are not instruments in kit form that were originally designed for factory production-line assembly. R-A-E kits are designed by kit-builders, specifically for kit-builders.

R-A-E SOCIETY MEMBERS SERVE ON THE ADVANCE-TEST PANELS

Before a new R-A-E kit is released, it will be pre-checked by Society members in this way: Ten prototypes will be given to 10 members, some of whom are beginners, some advanced enthusiasts and professionals. Each will assemble his kit and report on his experiences. In return, he will keep the finished kit, without charge. A new panel will be chosen for each new kit; no member may serve twice. Any Society member may apply to serve on an Advance-Test Panel. No purchase of equipment is necessary.

YOU ARE INVITED TO JOIN THE R-A-E SOCIETY

Whether you are a beginner or an experienced kit-builder, you are invited to join the R-A-E Society. Details of the Society's activities are published in the Journal. Annual dues of $1.00 entitle you to all privileges of membership, to receive four issues of the quarterly Journal, and to qualify for service on an Advance-Test Panel.

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Maximum ratings of the RCA 6JU8 are:

- $P_{in}$ (peak ma) 300
- $P_{im}$ (dc me) 54
- $V_{an}$ (post) (hrs neg with respect to cath) 9
- $V_{an}$ (post) (hrs pos with respect to cath) 300

2N1747

A p-n-p germanium MADT unit designed for 10.7-mc FM i.f. and limiter applications and for AM/FM i.f. stages which are only used for FM i.f. signals. It is intended for use in 6-volt auto and 6 to 9-volt portable radios.

Absolute maximum ratings of the Philco 2N1747 are:

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- $V_{es}$ 20
- $V_{es}$ 0.5
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- $P_{r}$ (mw) 60

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In this type of amplifier, the plate of one stage is connected to the grid of the next. Since a plate requires a high positive voltage, while a grid must be negative, a suitable power supply must not couple the stages. However, the capacitance (to ground) of a conventional supply may be as high as 700 μuf.

This power supply is specially designed for low-cost coupling. It is voltage-regulated to eliminate filter chokes, which introduce high capacitance. It delivers 285 volts without load, 199 volts at 20-μa drain.

The secondary of the transformer is kept well away from the primary by winding it on another leg of the core, to reduce capacitance. (Fig. 3.) Chassis and panel are made of insulating Plexiglass.

In R-C timers, a capacitor charges to a critical voltage, at which instant a relay is energized. If the supply voltage is unregulated, the timing interval cannot be controlled precisely. This inventor devised an ingenious solution to this problem.

Two power supplies are used, one positive, to the other negative, relative to ground. By Ohms law, the voltage at point G is

\[ V = (A + B) \times \frac{R}{R + R_c} \]

When \( S \) is closed, the voltage on capacitor \( C \) is \( -V \). When \( S \) is opened, the capacitor begins to charge to \( A \) volts. From the usual formula for a charging capacitor, the voltage at point \( H \) is found to be

\[ V = \frac{(A + B) \times \frac{R}{R + R_c}}{1 + \frac{R}{R_c}} \]

Choosing \( T = RC \), it is evident that the above equations are identical when

\[ e = 1 \]

\[ \frac{1}{e} = \frac{1}{T} = \frac{R}{R_c} \]

When \( R_1 \) and \( R_2 \) are chosen in accordance with the previous equation, the voltages at points \( G \) and \( H \) will be equal (and \( D \) will conduct after a timing interval of \( T = RC \) seconds). There will be an abrupt voltage change from whatever value \( G \) had to the value present at \( H \), and this pulse will be passed through a filter. It will excite a threshold device, which may be a multivibrator. Thus the exact instant of conduction by \( D \) can control some output device.

Note that the timing instant does not depend upon either \( A \) or \( B \), the supply voltages.

**TV REMOTE CONTROL**

**Patent No. 2,997,335**

Shaldon T. Brady, N. Hollywood, and Brian A. Hamper, Sherman Oaks, Calif. (Assigned to Packard-Bell Electronic Corp., Los Angeles, Calif.)

This control is very compact since it contains no power source of its own. Instead it receives a 100-ke signal from the nearby TV receiver. When \( S_1 \) is closed (see schematic) the signal is rectified and used to bias \( V \), a harmonic generator. Output is 300 ke if \( S_2 \) is closed, 480 ke if \( S_2 \) is closed. Additional harmonics and switches may be added if desired.

The selected harmonic is radiated back to the TV set, which amplifies it and uses it to control a relay. Each harmonic controls a different function, such as switching on and off, setting volume, tuning, etc.

**POWER SUPPLY FOR DIRECT-COUPLING AMPLIFIER**

**Patent No. 2,970,278**

John H. Hooper, McLean, Va. (Assigned to USA as represented by Secretary of Conmoses)

In this type of amplifier, the plate of one stage is connected to the grid of the next. Since a plate requires a high positive voltage, while a grid must be negative, a suitable power supply must not couple the stages. However, the capacitance (to ground) of a conventional supply may be as high as 700 μuf.

This power supply is specially designed for low-cost coupling. It is voltage-regulated to eliminate filter chokes, which introduce high capacitance. It delivers 285 volts without load, 199 volts at 20-μa drain.

The secondary of the transformer is kept well away from the primary by winding it on another leg of the core, to reduce capacitance. (Fig. 3.) Chassis and panel are made of insulating Plexiglass.

**PRECISE TIMER**

**Patent No. 2,976,487**

Eva Cohen, Brooklyn, N.Y. (Assigned to Bell Telephone Labs, Inc.)

In R-C timers, a capacitor charges to a critical voltage, at which instant a relay is energized. If the supply voltage is unregulated, the timing interval cannot be controlled precisely. This inventor devised an ingenious solution to this problem.

Two power supplies are used, one positive, to the other negative, relative to ground. By Ohms law, the voltage at point G is

\[ V = (A + B) \times \frac{R}{R + R_c} \]

When \( S \) is closed, the voltage on capacitor \( C \) is \( -V \). When \( S \) is opened, the capacitor begins to charge to \( A \) volts. From the usual formula for a charging capacitor, the voltage at point \( H \) is found to be

\[ V = \frac{(A + B) \times \frac{R}{R + R_c}}{1 + \frac{R}{R_c}} \]

Choosing \( T = RC \), it is evident that the above equations are identical when

\[ e = 1 \]

\[ \frac{1}{e} = \frac{1}{T} = \frac{R}{R_c} \]

When \( R_1 \) and \( R_2 \) are chosen in accordance with the previous equation, the voltages at points \( G \) and \( H \) will be equal (and \( D \) will conduct after a timing interval of \( T = RC \) seconds). There will be an abrupt voltage change from whatever value \( G \) had to the value present at \( H \), and this pulse will be passed through a filter. It will excite a threshold device, which may be a multivibrator. Thus the exact instant of conduction by \( D \) can control some output device.

Note that the timing instant does not depend upon either \( A \) or \( B \), the supply voltages.
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TECHNICIANS' NEWS

PIONEER TECHNICIANS INCORPORATE

An association intended to unite
old-time television-electronic techni-
cians has been organized by a group of
six former RCA-NBC television techni-
cians concerned with the first transmis-
sions of modern television 25 years ago. The purpose of
the new corporation, according to its char-
ter, is to secure the respect of the public
for television-electronic technicians, to
increase their confidence, and to provide for
the development, activities, guidance and
general welfare of electronic techni-
cians.

Membership in four grades is planned:
The senior group will consist of
technicians who were active in the
field before 1941; the second group of
those who were technicians during
the war years and before 1946, the year
television effectively reached the public;
a general group—those who have been
technicians for ten years or more, and
an associate member group for those
younger TV and electronic technicians
not falling in the other groups. Hon-
orary membership may be an elected
grade as determined by an awards com-
mittee.

An organization meeting has been
grounded, and it is expected that a call for
member will be issued after another
charter member meeting, scheduled for
early summer, to adopt the constitution
and bylaws now being written. Mean-
while, those interested in the new or-
ganization may write to Mr. W. Hollander Bobhe, Secretary, 39
Treaty Elm Lane, Haddonfield, N. J.

RTSA-MUNCIE JOINS IESA

Indianapolis, Ind.—The Radio-
Television Service Association of Mun-
cie has joined the Indiana Electronic
Service Association. Leonard Hickey,
president of the group, will be the IESA
director from Muncie.

DOINGS IN INDIANA

Lapel—Installation of new officers
was the business of a steak-dinner
meeting held at Passwater's Restau-
rant. IESA Chairman LaMar Zimmer-
man, Jr. installed the officers.
President of the group is Don
Claus; vice president, James W. Bak-
er; secretary, Gerald Whitesel; treas-
er, Harold Scott; and sergeant-at-
arms is Earl Jarrett.

Indianapolis—A "Beans and
Steak" dinner concluded the member-
ship drive of the Indianapolis Tele-
vision Technicians Association Inc. Two
teams were set up in the membership
drive. The team that brought in the
most new members got the steak, the
losers got the beans.

SERVICE CHARGES A PROBLEM

Philadelphia, Pa.—How much to
charge a customer seems to be one of
the biggest problems the television serv-
vice technician has to face, according
to the February-March issue of Philco's
Servicemen's Bulletin. The article
states "Caught between the rising cost
of doing business and squeeze of com-
petition, shop owners today appear un-
sure of how valuable their services are."

To back up this statement Philco
showed that rates vary over a very wide
range—from a low of $2 to as much as
$12 an hour. The average minimum
charge turned out to be about $4.70.

To help clear up the confusion
Philco offers this formula to determine
what a service shop should charge:
1. Add up all costs for the entire
year other than the technician's sal-
ary. Divide these costs by the number
of full-time technicians, including your-
self, who were employed at any one
time during the year.
2. Add up all technicians salaries
and divide by the number of men to get
average salary.
3. Determine the average number of hours per technician per week
normally spent on calls. Multiply by 52
weeks. Do not include time spent in
picking up parts, making reports or
performing administrative duties, but
do include overtime and bench work
time.
4. Divide the number of hours per
year of productive work (step 3) into
the sum of steps 1 and 2. The answer
is your cost per hour per technician and
the basis of your hourly service rate.
5. To arrive at your minimum
rate, multiply the cost per hour (step
4) by eight to get your average cost per
working day.
6. From your record find the
average number of calls per day per
technician by adding up all the calls
completed in a period, divide by the
number of working days in the period
and divide again by the number of tech-
nicians making the calls.
7. Divide this figure (step 6) into
the cost per working day (step 5) to
get average cost per service call. This
is the basis of minimum service call
charges. Obviously, some figure must be
added to this basic charge if you are to
show a profit.

TRI-STATE NEWS

Wilmingon, Del.—A series of ar-
ticles are being run in the News Jour-
nal by the Television Service Dealers
Association of Delaware to help pro-
mote better customer relations. Mem-
bers of the group are running stories
explaining the charges, problems, etc.
of the service technician repairing his
customer's set.

Camden, N. J.—What's new in the
Motorola line was presented to mem-
bers of the Allied Electronic Techni-
cians Association Inc. of N. J. at a

RADIO-ELECTRONICS
meeting co-sponsored by Philadelphia Distributors and Motorola. Schematics of the new line of receivers were handed out at the meeting.

Glenholden, Pa.—A committee was set up to look into the aspects of helping members who need assistance because of illness, death in the family, etc. The Television Service Dealers Association of Delaware County, Inc. appointed Jim Carver chairman of the committee to be assisted by John Matthey and Charlie Phillips.

ACTIVITY IN WISCONSIN

Green Bay—New officers were officially installed at the annual banquet of the local TESA at the Zuiden Zee Supper Club. Norm Lubow gave a short talk on last year's activities and this year's state convention to be held here.

Sheboygan County — The new sales tax filled the air with questions at a meeting of TESA at the Grand Hotel. Other business included a brief discussion on licensing and the addition of new bad credit risks to the association's master list.

Milwaukee—Committee chairmen summarized last year's activities at TESA's regular meeting at Covics Amberwood Hall. Membership committee reported that their campaign netted several new members last year. Technical Standards reported that 67 technicians' certificates have been issued to date. Activities for the year saw a group medical insurance plan adopted by the association and a lot of work done toward licensing technicians in the state.

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END

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Underwriters Rules for Wireless Installations.

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TURNING TV STANDOFFS

The often difficult task of screwing TV standoff insulators into house siding is simple if you do it with your drill. Remove the bakelite handle and terminal screws from a phone plug, then chuck the plug in your hand drill (Fig. 1). Now you can use this drill to simplify turning TV standoffs (Fig. 2).—John A. Comstock

SOLDERING-GUN REPAIR

An excellent substitute for one of the tip-holding nuts on a soldering gun is a self-tapping screw threaded into one of the holes into which the tip prongs are normally inserted. The screw will provide a good electrical contact. Any tendency of the tip to heat more slowly after a while can be remedied by loosening and retightening the screw, breaking the oxide film formed at the point of contact.—Leonard I. Kindler

MIRROR MAGNIFIES MARKINGS

A shaving mirror of the magnifying type (see photo) makes it quite a bit easier for you to read markings on components in a circuit. Although the markings must be read in reverse, they are magnified several times by the mirror.—Jerome A. Carlson

TRY STRANDED SOLDER

Hammer or pinch wire solder flat, then cut it into narrow strands. This reduces the solder melting temperature, allows better control of quantity applied (essential when soldering in transistorized gear) and permits the use of a smaller iron and less heat.—James C. Conrad

TVI TRAP

The trimmers from a discarded if transformer and a couple of scrap 800-ohm ribbon line can be used as an effective interference trap. The shorted length of ribbon line (3½ inches for the high channels and 4½ inches for the low) is an inductance that is tuned by
the trimmer capacitor. Slip the antenna lead connected to the TV set through the space between the trimmer terminals. Tape the short lengths of twin-lead to the receiver transmission line. The looser the coupling to the antenna, the more selective the trap will be.

If interference is exceptionally severe, it may be possible to find a point of maximum effectiveness by sliding a shotgunning bar (aluminum foil will do) along the lead-in. The point where the interference is least (it's usually within 10 feet of the antenna terminal board) is the place to tape the trap.—E. C. Carlson

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Hack saw a "V" into one end of a short length of pipe for a deburring tool that makes chassis edge burr removal quick and easy. Simply draw the tool toward you over the ragged chassis edge. Those who hack saw a metal chassis while building or servicing electronics gear will find this tool very useful.—Joe C. Allen

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END

CORRECTIONS

There is an error in the caption for Fig. 1 of the article "PA Speakers—Why So Many Types?" on page 55 of the March issue. It should read "Typical horn characteristics. The upper diagrams are for horns of different tapers and equal mouth areas. The lower ones are for horns with equal tapers and different mouth areas."

We thank the author, Victor Brociner, for bringing this to our attention.

In Fig. 4 of the article "New Directions in Hi-Fi Amplifiers" (page 37 of the April issue) there should be a 60-ohm 1 watt resistor connecting the junction of the two driver transformer primaries and the 600-uf filter to the 23-volt bus.

Our thanks to Mr. Walter R. McCarty of Midland, Tex., for calling this to our attention.

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BUILD AMAZINGLY SENSITIVE TRANSMITORIZED TREASURE FINDERS. Locate deep buried treasure. Available partially wired. Inexpensive. Simple, illustrated plans, details. DEPT. DEKETS, Box 7263-E, Houston 8, Texas.

MONEY-BACK GUARANTEE. Pocketable hi-fi six-transistor radio $9.95. Powerful extended-range transistors transceiver, $16.95; pair $29.95. All postage? Money order to TECHSERVICES, CPO Box 845, Tokyo, Japan.

RADIO-ELECTRONICS, 154 West 14 St., New York 11, N. Y.

Audio—Hi-fi

TAPE recorders, Hi-Fi components, Sleep-learning equipment, Tapes, Unused items, Free catalog. DRESSNER, 1523R Jericho Turnpike, New Hyde Park, N.Y.

DON'T BUY HI-FI COMPONENTS, Kits, Tape, Tape Recorders until you get our low, low return mail order catalog. Wholesale Catalog Free. Easy Time Payments Plan, 10 payments to 24 months to pay. HI-FIDELITY CENTER, 220 RC 23 St., New York 10, N.Y.

HI-FI AMPLIFIERS, TUNERS, SPEAKERS, WALKIE-TALKIES, Radios, Tele- scopes, Microscopes, Cameras, low prices. Free Catalog. GM PHOTOELECTRONICS, 623 Gay St., Knoxville 2, Tenn.

SAVE 50%. Stereophonic music on tape. Highest tape, recorder Catalog FREE ADAPT- TONE TAPE SALES, 1776 Columbus Rd., Washington 9, D.C.

RENT STEREO TAPES—over 2,500 different recordings, at major discount. STEREO-PARTY, 811-RE, Centinela Ave., Inglewood 3, Calif.

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HUMLESS amplifiers need dc filament power! 6.3V 1.5AC full-wave bridge rectifier, sample with data $2.00 postpaid. ENGINEERING ASSOCIATES, Dayton 10, Ohio.

SPEAKERS. Quality hi-fi 12" woofer only $8.95, also 12" PM Twin-Cone full-range hi-fi $17.95. Have 3½" tweeters, stiff cone, only $14.95 each. Include shipping charges, excess amount refunded. GENERAL ELECTRONICS, 620 Eggert Rd., Buffalo 15, N.Y.

FREE GIANT WHOLESALE CATALOG, Electronics, Hi-Fi, Tubes, Tools, Radios, Imports, Housewares, or photos, Optics, Appliances, survival products. Write LEK- TRON 241 Everet Avenue, Chelsea, Mass.

U.S. GOVERNMENT SURPLUS—Jeeps, $94.00, Radios $2.53, Guns, Typewriters, Cameras, Tools; thousands of items. Fabulously low surplus prices. Complete information sent immediately. Send $1.00 to: SURPLUS, P.O. Box 512-NN, New Orleans 1, La.

General

FREE GIANT WHOLESALE CATALOG, Electronics, Hi-Fi, Tubes, Tools, Radios, Imports, Housewares, or photos, Optics, Appliances, survival products. Write LAK- TRON 241 Everet Avenue, Chelsea, Mass.

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www.americanradiohistory.com
DIAL telephones, cradle type. Use for private systems, intercoms, etc. Recent Stromberg-Carlson, 4-78 each. GUARANTEED, 4476 Van Ness, Fresno 4, Calif.

TRANSFIRE IGNITION. Transistor electronics. Save gas, line-ups. Points, plugs last 50,000-100,000 miles. Improved coldstarting high-speed performance. Parts, complete conversions, kits from $34.55.
PALMER ELECTRONICS, RE-1, Carlisle, Mass.

BUSINESS AIDS
BUSINESS CARDS, LABELS, RUBBER STAMPS. Send for free descriptive literature. HEIDE INDUSTRIES, 6131 C Street, Capitol Heights 27, Md.
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BUSINESS CARDS, 1000 $3.99. Rubber Stamps, 10 words, $1.00. Catalog Free. ALCO, Box 224-R, Urbana, Ill.

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SLEEP LEARNING. Starting method 99% effective. Brochure free. ASR FOUNDATION, Box 21RE, Henry Clay Station, Lexington, Ky.
TAKE BACHELOR'S and Master's Degree correspondence courses from leading Universities! Directory of 5,000 courses—$2.00: COLLEGE RESEARCH, North Highlands 14, Calif.
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NEW CONCEPT OF LEARNING SELF-HYPNOSIS! Now on tape or record! Free Literature. McKINLEY-SMITH CO., Dept. T5, Box 5034, San Bernardino, Calif.
HYPNOTIZE: Practical Instruction Course, $1.00 (guaranteed) CRYSTALS 28-PK2, Millburn, N.J.
PROFESSIONAL TAP DANCING SIMPLIFIED, $1.00 WALTER KAZAKS, 234 E. 58 St., New York 22, N.Y.

WANTED
CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special purpose. Magnetrons, broadcast tubes, etc. Want military & commercial lab/test and communications equipment such as E.K., 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, G-E, H-P, L&N, etc. tubes, manuals, military electronics. ENGINEERING ASSOCIATES, 434 Patterson Road, Dayton 19, Ohio.
SALES-regional managers needed. All sections of the United States, to call on retailers. Product—the best German-made radio, stereo and hi-fi available. Send resume to SABA, Suite 902, Parkade Building, 519 Federal St., Camden 3, N.J.

JUNE, 1962

MODIFIED BAXANDALL CIRCUIT
The treble section of a Baxandall negative-feedback type tone control uses a center-tapped 500,000-ohm linear potentiometer. The center-tapped pot can be eliminated by using the modified circuit (Fig. 1) taken from Radio et TV (Paris, France). Here, we have a 1-megohm untapped treble control with each end shunted to ground through a transistORIZED fork driver. Fig. 2 shows the parts layout. The transistor type is not critical. You can use almost any audio type with a current gain of 40 or more.

Driver and pickup coils L1, L2 may be salvaged from a high-resistance headphone. Each should have a resistance around 1,000 ohms. C1 tunes L1 approximately to the fork frequency for improved efficiency and waveform purity. It may be omitted if high harmonic output is desired.

Mount the bias magnet, taken from an old meter, headphone or speaker, below the coils and not necessarily in direct contact with the pole pieces. Adjust the spacing so the fork just vibrates. Excessive vibration mars accuracy and stability. Clamp the fork rigidly by its handle to prevent all lateral movement except the sine vibrations. Reverse the connections to L1 or L2 if the circuit does not oscillate.

![Diagram of Modified Baxandall Circuit](image_url)

Tuning forks for B and C (494 and 522 cycles, respectively) are readily available and may be modified to provide a 500-cycle standard. A fork's frequency can be raised by carefully filing the tines and using a scoop to compare its frequency with a known source. If the fork's frequency is too high, file the crotch.

For further information on electronically driven tuning forks as audio standards, see “Tuning-Fork Audio Frequency Standard,” CQ, May 1956, and “Harmonic Generator with Tuning Fork Drive,” Electronic Engineering, January 1966.

ULTRA-SIMPLE TRANSISTORIZED DC MICROAMMETER
Most transistorized microameters described previously use a zero-set...
BUILD 10-25 RADIO CIRCUITS AT HOME
with the New PROGRESSIVE RADIO "EDU-KIT"®

ALL Guaranteed to Work!

A Complete Home Radio Course

No Knowledge of Radio Necessary
No Advanced Training Needed
Schools Invited

WHAT THE "EDU-KIT" OFFERS YOU
The Progressive Radio "EDU-KIT" is designed to give you the home radio course at a round-bottom price. You will receive a radio theory, construction and servicing. You will learn how to build radios, using regular parts and accessories. You will receive a radio theory book, and practice tests, and learn and practice tests are included. You will receive a complete set of radio theory and instruction book, and a complete set of radio parts and accessories.

The "EDU-KIT" is COMPLETE
You will receive all parts and instructions necessary to build several different radio circuits and electronic circuits, each one of which is a complete radio. These circuits will operate on any type of radio receiver, and will be complete in every detail. The "EDU-KIT" is COMPLETE.

TRouble-SHOOTING LESSONS
You will learn to troubleshoot and repair radios, and the "EDU-KIT" will show you how to do it. The "EDU-KIT" will also show you how to make repairs, and how to repair radios. The "EDU-KIT" will also show you how to repair radios.

FREE EXTRAS

- Set of Tools
- Radio Book
- Radio and Electronic Parts
- License Training
- Printed Circuit and Certificate of Guarantee

Choose From These Popular "EDU-KIT" Models

10A9: 10 Circuits $14.95
10A8: 10 Circuits with Printed Circuit $22.95
10A8: 20 Circuits (Includes Printed Circuit and 4 Advanced Circuits) $33.95
10A8: 25 Circuits (Includes Printed Circuit and 25 Advanced Circuits) $39.95

UNCONDITIONAL MONEY-BACK GUARANTEE
Please Rush my Progressive Radio "EDU-KIT" to me, and I will have a complete set of radio theory and instruction book, and a complete set of radio parts and accessories. I will have a complete set of radio theory and instruction book, and a complete set of radio parts and accessories. I will have a complete set of radio theory and instruction book, and a complete set of radio parts and accessories.

ADDRESS: 1186 Broadway, Dept. 1956, N.Y.
bridge requiring at least three fixed resistors and a zero-set potentiometer. Because these circuits employed a germanium transistor, temperature drift necessitated frequent resetting of zero. The diagram shows a minimum-component circuit which overcomes the old disadvantages.

A 2N333 silicon transistor is used. This unit costs $6.50 but offers enough advantages to justify the investment. For example, no zero drift can be seen on the 0–1 dc milliammeter, so no zero-set circuit is needed; no drift on dc input can be seen on the meter and, since the no-signal-current current is so tiny (nominal value of .002 microampere), no on-off switch is needed—the battery will last for its full shelf life.

A 100-µA dc input will deflect the 1-ma meter to full scale (10 sa will deflect a 100-µA 2,000-ohm meter to full scale). Response is linear. The 200-ohm CALIBRATION CONTROL adjusts for full-scale deflection with an accurately known dc input. This control may be enclosed inside the instrument case and provided with a slotted switch for screwdriver adjustment, since it seldom needs adjustment and then only when the calibration is checked periodically.—Ted Ladd

**SOLAR BATTERY POWERS TUNNEL DIODES**

A solar silicon battery, operated from either sunlight or artificial illumination, will supply enough dc power to operate tunnler-diode oscillators and short-distance transmitters. However, some experimenters have had trouble because of the internal resistance of the cell under varying operating conditions. The secret is to provide the cell with a constant, low-resistance output (lower than that of the tunnel diode). Here is a practical solar battery circuit. The light-sensitive unit is a five-module silicon photocell (Internation-rectifier type SM-1029EBP1).

**VOLTAGE OUTPUT**

<table>
<thead>
<tr>
<th>Output Volt</th>
<th>DC Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–12V in bright sunlight</td>
<td>0.5V when photocell is 1 foot from low lamp</td>
</tr>
</tbody>
</table>

**5-MODULE SILICON PHOTOCELL (INTERNATIONAL-RECT, CMOS-1029EBP1 OR EQUIV)**

**TO SERVICE CHARGES and RECORD KEEPING**

For customer's prices on every replacement part, plus flat rate and hourly service charge data, regional and national. Dave Rice's OFFICIAL PRICING DIGEST, listing over 63,000 items, $2.50.

**AVAILABLE FROM YOUR DISTRIBUTOR**

If you want to operate on a professional level, Dave Rice's OFFICIAL ORDER BOOKS give you triplicate forms for order, invoice, and office records ..., spaces for tubes, parts, serial numbers, loaners, charges, signatures, etc. 75c per book, $6.50 for dust-proof box of 10.

**“TAB” TUBES**

**Six Months Guarantee! No Rejection! NEW & USED Gov’t & Mfrs. Surplus!**

**Orders $10 or more, Received Items only send 15 dl slides.**

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
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<td>008</td>
<td>12V Lead</td>
<td>2500</td>
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</table>

**“TAB” SILICON 5750V DIODES**

**Factory Tested & GTO!**

**NEWEST TYPE! LOW LEAKAGE! D.C. or Battery! D.C. or Battery!**

**AC & D.C.**

**In stock**

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**“TAB” TRANSISTORS & DIODES!!!**

**Full-Load Field Tests! Factory Tested & GTO!**

**PNP: Hi Power; 15 amps. $3.50 1/ea. 10 for $29**
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**“TAB” TUNNEL DIODES**

**Operation Up to 1000°C Temp.**

**“TAB” SILICON 5750V DIODES**

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**SILICON DIODES**

**LOWEST PRICES!**

**TO ORDER**

**NEW & USED Gov’t & Mfrs. Surplus!**

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A SUPERIOR LIQUID CONTACT CLEANER

Ultra-New CONTACARE KIT II

Cleans Almost Instantly with Minimum Rubbing

After years of painstaking research, Standard Kollsman for the first time can honestly recommend a liquid contact cleaner. You'll find it in the new ContaCare Kit II. You'll also find a soft tough cloth—lint-free to avoid fouling... and a tube of non-evaporating grease for permanent channel lubrication and contact protection. Instruction sheet is clear, brief, and complete. Kit is compact and sturdy. Try it soon... and save your elbow grease for jobs that need it.

INSIST ON THE GENUINE CONTACARE KIT II

standard kollsman® INDUSTRIES, INC.
FORMERLY STANDARD COIL PRODUCTS CO., INC., MELROSE PARK, ILLINOIS
WORLD'S LARGEST MANUFACTURER OF TELEVISION TUNERS
NOW! Only 4 Picture Tubes can fill 50% of your replacement needs

RCA 21CBP4A, 21AMP4A, 21ZP4B and 21YP4A Universal Silverama® Picture Tubes Replace 33 Industry Types

Now, four—only four RCA Universal Silverama types can take care of half your picture tube replacements. Think of what this means to you in terms of simplicity, economy and efficiency:

- **Fewer trips to the distributor.**
  You can keep these four types in your shop, knowing that you will quickly have use for them.

- **Faster service.**
  For half your picture tube replacements, you have the right tube on hand, in the shop. Saves hours of time picking up the proper tube or waiting for it to be delivered. The time saved gives you a competitive edge!

- **Picture tube replacements from your service truck.**
  It's simple to carry one of each of these Universal types on your service truck so you can make half of your picture tube replacements right on the spot.

- **Fewer types to take care of.**
  Think of the headaches and extra bookkeeping this simplification saves.

These four types are part of a growing family of RCA Universal Picture Tubes designed to help you fill the maximum number of sockets with the minimum number of types.

RCA Universal Silverama Picture Tube types are made with an all-new electron gun, the finest parts and materials and a high-quality envelope that has been thoroughly inspected, cleaned and rescreened prior to reuse.

Start now to simplify your picture tube replacement problems. See your authorized RCA Distributor this week about RCA Universal Silverama Picture Tubes.

*Based on EIA figures for the national movement of the picture tube types below.

<table>
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<tr>
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<tr>
<td>21YP4A 21YP4B 21YP4</td>
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RCA Electron Tube Division, Harrison, N. J.

The Most Trusted Name in Electronics