Build "Mixed 12" Hi-Fi Speaker System

POPULAR ELECTRONICS

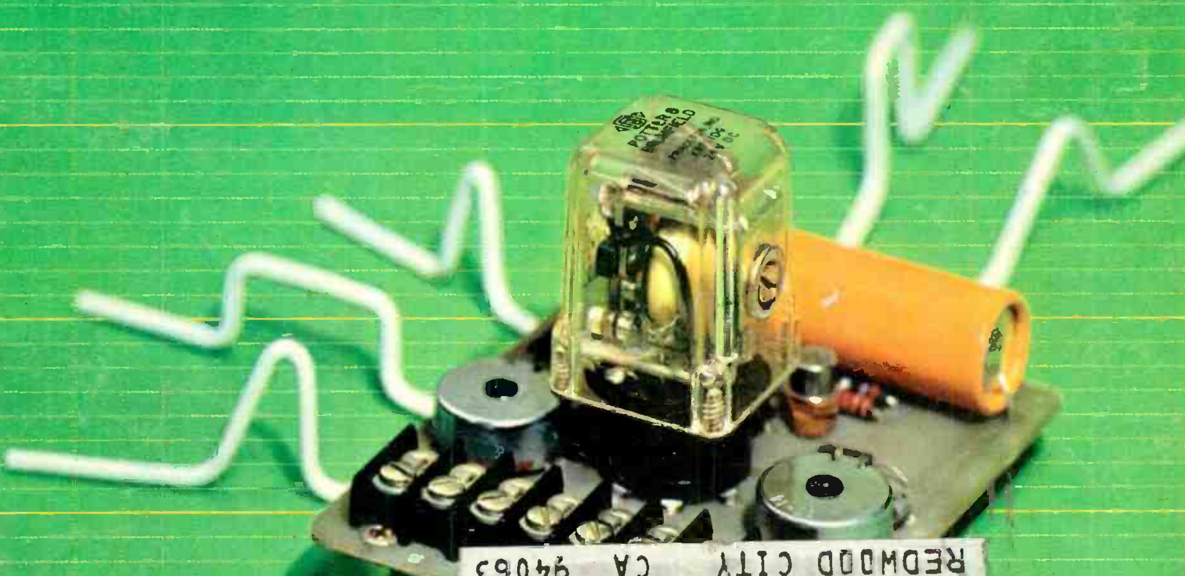
MARCH 1967

50 CENTS

Build CB Rig Power Amplifier • Tame Your TV Tuner

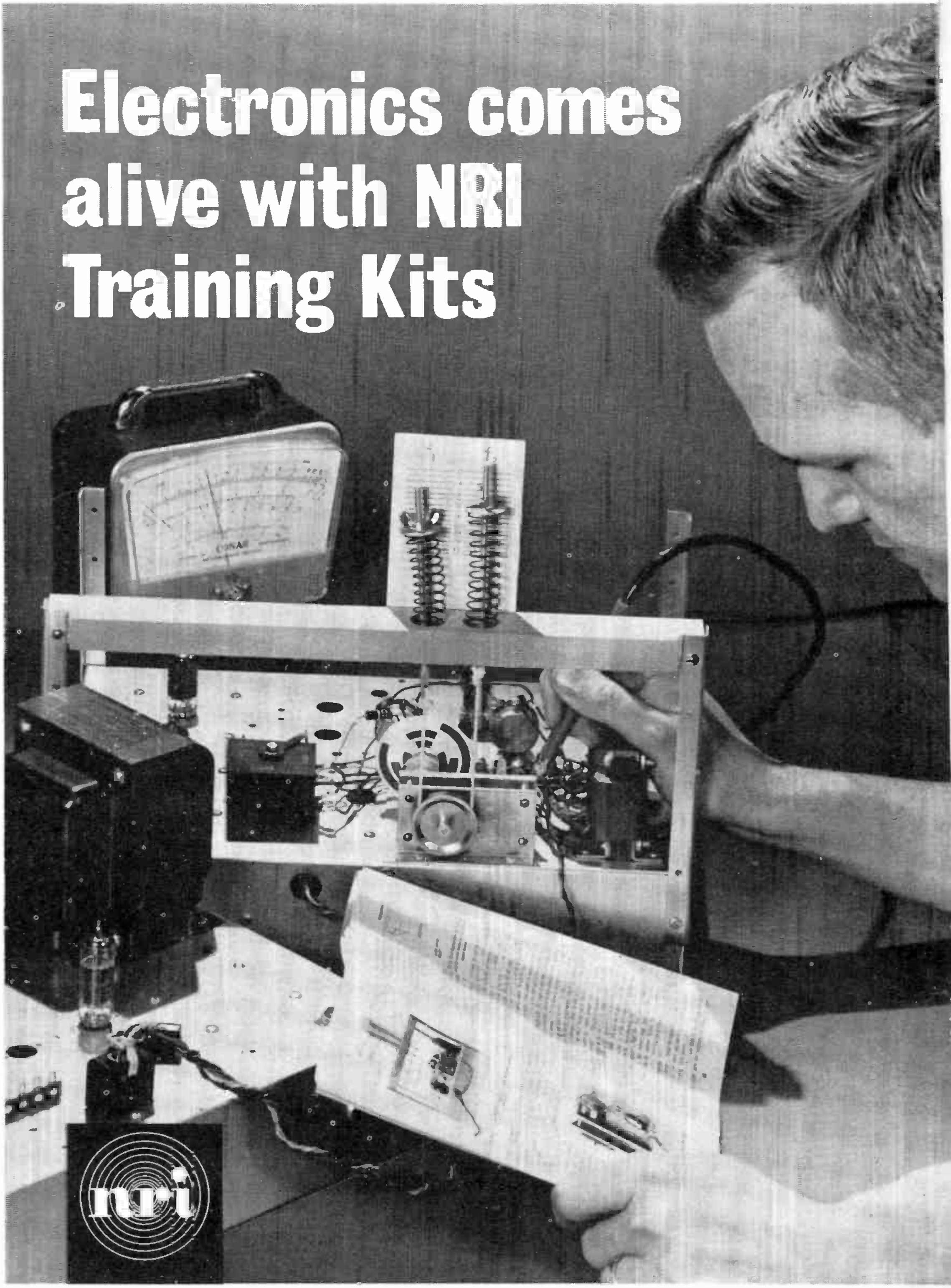
Build "Camper's Cuzzin" Ham Band Converter • Use Our Information Central Answering Service • Solid-State Hi-Fi Preamp • Build "Sentinel" Theft Alarm

Foreign-Language Short-Wave Broadcasts to the U.S.



Build "Supertrol" your all-electronic righ

A ZIFF-DAVIS PUBLICATION


Electronics comes alive with NRI Training Kits
nri

POPULAR ELECTRONICS

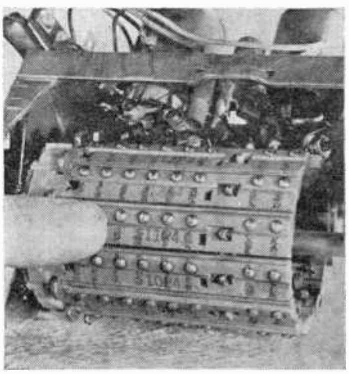
WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

VOLUME 26 **MARCH, 1967** NUMBER 3

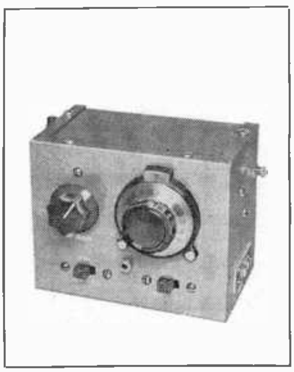
SPECIAL CONSTRUCTION FEATURE

FEATURE ARTICLES

DEPARTMENTS



Tell-tale black striping **51**



Transistorized for campers **55**

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Conrad Studios, Inc.

POPULAR ELECTRONICS, *March 1967, Volume 26, Number 3. Published monthly at 307 North Michigan Avenue, Chicago, Illinois 60601. One year subscription rate for U.S., U.S. Possessions and Canada, $5.00; all other countries, $6.00. Second class postage paid at Chicago, Illinois and other mailing offices. Subscription Service: Portland Place, Boulder, Colorado 80302.*

ELECTRONICS

WHERE CAN YOU EQUAL THIS OPPORTUNITY TO EARN A GOOD PAYING JOB IN A FAST GROWING FIELD?

DeVRY'S "BIG 3" AIDS TO PROGRESS ARE DESIGNED TO SPEED YOU QUICKLY TO A REAL FUTURE IN ELECTRONICS

1. EFFECTIVE TRAINING! Learn AT HOME in spare time, or day or evening in one of our RESIDENT SCHOOLS.

2. INDUSTRY RECOGNITION! DeVry programs, prepared with industry's help, are "JOB-AIMED."

3. EMPLOYMENT SERVICE! for ALL graduates through our contacts with many large, respected companies across North America.

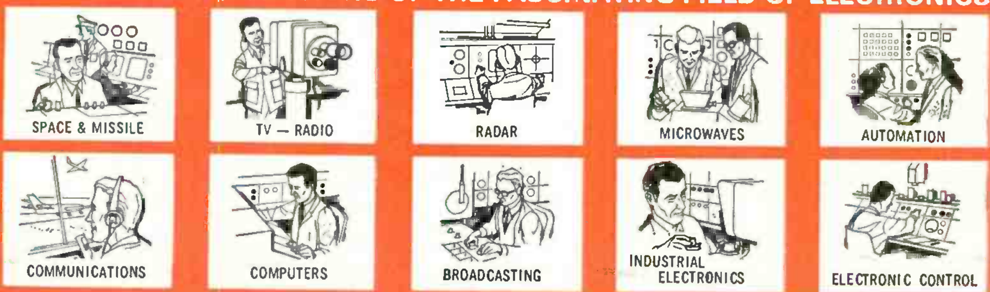
ELECTRONICS is one field that spells OPPORTUNITY in big capital letters for many men 18 to 45. This widespread but FAST GROWING field offers trained men some of today's finest, good-paying job opportunities — or a chance to start a profitable servicing shop!

Even if you don't have previous technical experience or an advanced education, DeVry's "BIG 3" aids to progress may very well be YOUR stepping stones to a BETTER FUTURE. You can learn at home in your spare time, while keeping your present job. Or, in a day or evening program in our U.S. or Canadian resident school, you can develop the very skills needed to make wonderful progress. We even work to get resident students part-time jobs to help with tuition or living expenses, if necessary!

Regardless of how you complete your educational program with DeVry, you can count on industry-recognized, effective training aimed directly at providing on-the-job-type "know-how." This is followed by actual EMPLOYMENT SERVICE to help you get started in Electronics. Or, if you are in the field already, remember that a DeVry recommendation has meant plenty of ADDED DOLLARS in income to many who made themselves more valuable to employers.

See for yourself how you, too, may prepare for the INCOME, the PRESTIGE and the FINE FUTURE that goes with the title of Electronics Technician. Mail the coupon NOW for facts without obligation.

WE PREPARE YOU NOT FOR ONE JOB BUT FOR JOBS IN MANY DIVISIONS OF THE FASCINATING FIELD OF ELECTRONICS



MOVIES, TEXTS AND EQUIPMENT HELP YOU LEARN FASTER

DeVry includes training movies AT HOME, "programmed" texts and many shipments of Electronic parts — to help you learn quickly, remember more.

FREE Send coupon for these two factual booklets NOW!

DeVry Technical Institute

4141 Belmont Avenue
Chicago, Illinois 60641

Accredited Member of National Home Study Council

MAIL COUPON TODAY!

DeVRY TECHNICAL INSTITUTE
4141 Belmont Avenue, Chicago, Ill. 60641 Dept. PE-3-X

Please give me your two free booklets, "Pocket Guide to Real Earnings," and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

- ☐ Space & Missile Electronics
- ☐ Television and Radio
- ☐ Microwaves
- ☐ Radar
- ☐ Automation Electronics
- ☐ Communications
- ☐ Computers
- ☐ Broadcasting
- ☐ Industrial Electronics
- ☐ Electronic Control

Name__________ Age_____

Address__________ Apt._____

City________ State_______ Zip Code_____

☐ Check here if you are under 16 years of age.

2101

HOME STUDY AND RESIDENT SCHOOL TRAINING AVAILABLE IN CANADA

POPULAR ELECTRONICS

PHILLIP T. HEFFERNAN
Publisher

OLIVER P. FERRELL
Editor

ROBERT CORNELL, WA2HDQ
Managing Editor

JOHN D. DRUMMOND
Technical Editor

WILLIAM GALBREATH
Art Director

MARGARET MAGNA
Associate Editor

ALEXANDER W. BURAWA
Assistant Editor

ANDRE DUZANT
Technical Illustrator

NINA KALAWSKY
Editorial Assistant

PATTI MORGAN
Editorial Assistant

H. BENNETT, W2PNA
H. S. BRIER, W9EGQ
L. E. GARNER, JR.
M. P. SPINELLO, KHC2060
Contributing Editors

LAWRENCE SPORN
Advertising Sales Manager

ARDYS C. MORAN
Advertising Service Manager

ZIFF-DAVIS PUBLISHING COMPANY

Editorial and Executive Offices
One Park Avenue, New York, New York 10016
212 679-7200
Eastern Advertising Manager, RICHARD J. HALPERN

Midwestern Office
307 North Michigan Avenue, Chicago, Illinois 60601
312 726-0892
Midwestern Advertising Manager, JAMES WEAKLEY

Western Office
9025 Wilshire Boulevard, Beverly Hills, California 90211
213 CRestview 4-0265; BRadshaw 2-1161
Western Advertising Manager, BUD DEAN

Japan: James Yagi
c/o Fukushima
19-14 Minami 3-chome
Koenji, Suginami-ku
Tokyo, Japan

Circulation Office
Portland Place
Boulder, Colorado 80302

William B. Ziff, Chairman of the Board (1946-1953)
William Ziff, President
W. Bradford Briggs, Executive Vice President
Hershel B. Sarbin, Senior Vice President
Philip Sine, Financial Vice President
Walter S. Mills, Jr., Vice President, Circulation
Stanley R. Greenfield, Vice President, Marketing
Phillip T. Heffernan, Vice President, Electronics Division
Frank Pomerantz, Vice President, Creative Services
Arthur W. Butzow, Vice President, Production
Edward D. Muhlfeld, Vice President, Aviation Division
Irwin Robinson, Vice President, Travel Division

Ziff-Davis also publishes Airline Management and Marketing, Boating, Business & Commercial Aviation, Car and Driver, Cycle, Electronics World, Flying, HiFi/Stereo Review, Modern Bride, Popular Aviation, Popular Photography, Skiing, Skiing Area News, and Skiing Trade News. Travel Weekly is published by Robinson Publications, Inc., a subsidiary of Ziff-Davis Publishing Company.

All subscription correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, Portland Place, Boulder, Colorado 80302. Please allow at least six weeks for change of address. Include your old address, as well as new—enclosing if possible an address label from a recent issue.

EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of art work, photographs or manuscripts.

ZIFF-DAVIS PUBLISHING COMPANY · AUDITED PAID CIRCULATION ABC · MPA

Member Audit Bureau of Circulations

If You Service Citizens Radio Transceivers . . .

you should have

AN INTERNATIONAL

C-12B

FREQUENCY METER

Four Instruments In One

The C-12B is more than a frequency standard — it measures power output, measures AM modulation, and is a signal generator . . . all self contained in one convenient unit.

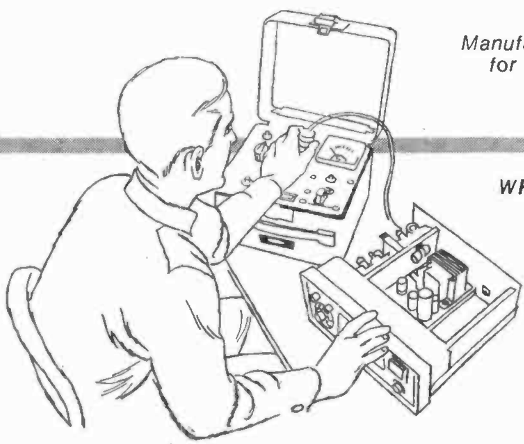
check these features!

- *Frequency Measurement* — Range 26.965 mc to 27.255 mc. Frequency stability ± .0025% 32°F to 125°F; ± .0015% 50°F to 100°F.
- *Power Measurement* — 0 to 5 watts, accuracy ± ¼ watt.
- *Counter Circuit* — Frequency range 0 to 3 kc. Residual error 100 CPS @ zero beat.
- *AM Modulation Measurement* — Range 0 to 100%. Accuracy 3% @ 400 CPS @ 80% modulation.
- *Signal Generator* — Frequency range 26.965 mc to 27.255 mc. Low output 1 microvolt through special pick-off box furnished with meter. High output 100 microvolts through output jack.
- *Panel Controls* — Channel selector, 24 positions • "Hi-Lo" frequency adjust • RF level control • Modulation set • Power • Meter calibration adjust • Function selector, 7 positions • Modulation • RF • Deviation • Calibration • Battery Test "A" • Battery Test "B" • Battery Test "C".
- *Battery Power Required* — 1½ vdc @ 60 ma, 67½ vdc @ 5 ma, 9 vdc.

The C-12B is capable of holding 24 crystals and comes with 23 crystals installed. Everything you need including connecting cable, PK box, dummy load, and batteries.

Cat. No. 620-101 . . . . $300.00

Manufacturers of precision electronic products for home, industry and aerospace needs.



WRITE FOR COMPLETE CATALOG

INTERNATIONAL

CRYSTAL MFG. CO., INC.

18 NO. LEE OKLA. CITY, OKLA. 73102

CIRCLE NO. 17 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

Address correspondence for this department to:
Letters Editor, POPULAR ELECTRONICS
One Park Avenue, New York, N. Y. 10016

FISH "TALK"

Horror of horrors! Re July, 1966, and the article on fish "talk" ("Is Plasmonics for the Birds?"), the simple fact is that every aquarist spends time and effort in order to avoid the slightest contamination of the water through contact with metals that might poison his fish. Copper being one of the principal offenders—I repeat, horror of horrors!

DALE KOBY
New York, N.Y.

You're right about the possibility of contamination, Dale. But, don't despair; reports we have received indicate that better results are obtained with this equipment in lakes and other large bodies of water. So let the fish in your tank be, and stick the copper probes in the ocean.

PERSONAL P.E. INDEX

With regard to Al Diamond's letter (December, 1966), I too have all issues of P.E. (from October, 1954, to date), and have found them to be very good reference material on many subjects. To get around the index problem, I started a card file years ago. I take every issue and go through it for construction items and articles that contain information of interest—even though I think I may never need the information—and type up a 3" by 5" file card for each one. On the card, which starts out with a general classification like "Amplifiers," I put the title, the issue and page numbers, and give a short description of the article. For construction articles, I may even include estimated cost in building, whether a project is simple or difficult, whether it uses tubes or transistors, etc. You might think this would be quite time-consuming, but it isn't. I usually let about six issues pile up and then go through them—I can easily handle six issues in about 45 minutes.

DUTCH MEYER
Missoula, Mont.

"FUZZBOX" ECHOES

Being a "Rock-and-Roll" music lover, I decided to make Mr. Anderton's "Fuzzbox For Under $3" (January, 1967). I made it exactly according to his plan and was quite satisfied. There was one thing though which I thought was lacking and that was a fuzz control. So I proceeded to devise such an item. At total resistance there is no differ-

LETTERS (*Continued from page 8*)

ence between the fuzz with the pot in or out of the circuit, but as you lessen the resistance, the amount of fuzz is lessened accordingly, until zero resistance is reached, at which point no more fuzz exists.

BYRON NATE
Calgary, Alberta,
Canada

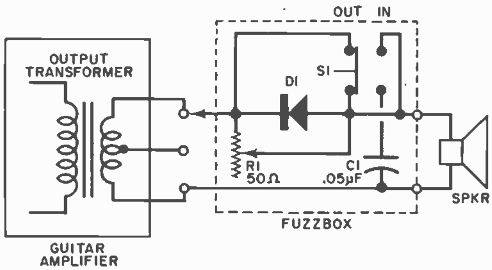
I constructed this simple unit for the lad who lives in the house next door. Although his guitar sounds just as bad as it always has, he is convinced that the POPULAR ELECTRONICS "Fuzzbox" is almost as good as the commercial units which his friends have. The big difference is that the factory units have variable fuzz.

L. E. GRUBGELD, JR.
Palo Alto, Calif.

I built the "Fuzzbox" as per the schematic diagram, using the exact parts specified, and it worked okay. The only fault I found was that the low notes were somewhat distorted with *S1* in the "off" position. I changed the location of the capacitor to get it out of the circuit when the switch is in the "off" position.

JACK WILLHELM
Fort Smith, Ark.

Looks like Byron anticipated your letter, L.E. Your suggestion, Jack, to get the capacitor out of the circuit when it isn't needed is a good one, and Byron, your variable control will be appreciated by many. The Fuzzbox item looks like a real quick-and-dirty



project, but judging by the volume of favorable mail, it works well. We have combined both Byron's and Jack's suggestions into the one diagram shown above.

VU BALLISTICS

May I bring to your attention the fact that the reference level for the vu unit is plus 4 dBm, not 0 dBm as stated in "What Are These Things Called Decibels?" (October, 1966). Also inherent in the use of the vu is the fact that the vu meter has very specific ballistic characteristics which must agree with ASA specifications. There are a number of imported "so-called" vu meters available today, but few, if any, of them have the correct ballistic action in the movement. These meters are mere volume indicators as they

The Regency Imperial is compatible with any CB transceiver on Single Sideband, Double Sideband, or conventional A.M. It provides you with **69** reception modes and **46** transmission modes within the 23 channel CB spectrum. It is the most advanced transceiver available today.................. **$299.00**

Regency ELECTRONICS, INC.
7900 PENDLETON PIKE
INDIANAPOLIS, INDIANA 46227

CIRCLE NO. 30 ON READER SERVICE PAGE

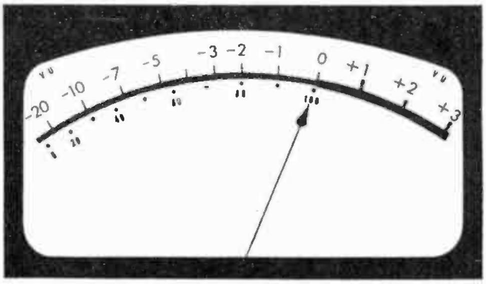
LETTERS (*Continued from page 10*)

do not give the proper averaging of speech or musical waveforms.

Robin H. Spurgin
Vancouver Recording Services
Vancouver, B.C., Canada

Yes, Robin, it's true that 0 vu is equal to 4 dBm, but it's also true that the vu is based on the same 1mW in 600 ohms as the dBm. Reference volume is defined as that strength of electrical speech which gives a reading of 0 vu on a volume indicator which is calibrated to read 0 vu on a steady 1000-Hz wave whose power is 1 mW in 600 ohms. However, the total impedance of the volume indicator is usually about 7500 ohms; and to avoid loading down a 600-ohm line, an additional 3600 ohms of resistance is connected in series with the meter. The loss across this resistance is 4 dB, and in order to bring the vu meter up to the 100% mark (0 vu), a signal strength of 4 dBm is needed.

In the article, an attempt was made to give our readers an understanding of dB's without becoming involved with formulas, and to explain how to use a VOM or a VTVM in conjunction with a chart; it also points out



the difference between the vu and the dBm and states that the two should not be used interchangeably. It's true, too, that a vu meter must have a certain specified ballistic characteristic to read out average levels in a waveform, and to keep it from responding to signal peaks. Your letterhead logo seemed so apropos to this discussion that we have reproduced it here.

ANTENNA PATTERNS

You might want to acquaint your readers with the fact that the polar patterns published in your November 1966 issue in conjunction with my article ("Antenna Placement Does Make a Difference") were plotted in dB with reference to field strength—not power. This does not invalidate the patterns, however, since we are only interested in the order of magnitude between the different antenna mountings.

Robert L. Ruyle, WØFCH, KGI-13471
Lincoln, Nebr.

Fine, Bob; we have had some nice comments on your article, and look forward to your upcoming feature on "grounds" for the ham, SWL and CB'er. —30—

Where the action is you'll find the hot new . . .

Hallicrafters CB-20 "*Reacter*"—*$99.95!*

Yours today—the ruggedest, cleanest, most powerful basic CB transceiver that ever rode the range!

You get Hallicrafters' field-proven, solid-state design—compact, fool-proof. You get high-order modulation, superb sensitivity and built-in noise suppression. You get five-channel convenience.

In short—you get performance equal to that of equipment more than double the price.

Get the full story from your Hallicrafters authorized CB outlet today!

Quality through craftmanship is the whole idea at ***hallicrafters***

Export: International Division,
Canada: Available through Gould Sales Co.

5th & Kostner Aves., Chicago, Ill. 60624

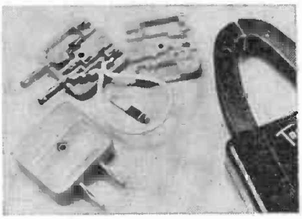
CIRCLE NO. 15 ON READER SERVICE PAGE

PARTS METHODS IDEAS GADGETS DEVICES

TIPS & TECHNIQUES

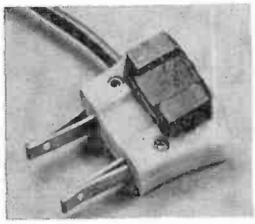
PLUG-IN LOOP ADAPTER FOR CLAMP-ON AMMETERS

Here's an easy way to wrap a clamp-on ammeter around one side of the a.c. power line without breaking into the line, and without disconnecting the unit under test. Secure a plastic light flasher (such as the "Snapit" by Cable Electric Products, Inc.) and carefully drill out the center retaining rivet. Break away the wire-wound flasher element, and connect a 1½"-diameter loop of 14 AWG stranded wire in place of it. Cut a notch in one of the walls of the case to clear the loop of wire. Use a *4-40* nut and bolt in place of the rivet. —*Vincent F. Allen*



MAGNET CURES "LINE CORDITIS"

Like most electronics enthusiasts, you probably have your fair share of power cords that consistently and obstinately unwrap themselves from around your electronic equipment when you are moving it from one place to another, and try to trip you up. You can cure this "line corditis" with a small but powerful magnet. Glue the magnet to the cord plug as shown in the photo. If your equipment cabinet is made of aluminum or other nonmagnetic material, bolt or glue a small sheet of steel to it. Wrap the line cord securely around the unit and place the magnet against the steel plate. —*D. E. Hausman*



WEATHER STRIPPING PROVIDES FEET FOR PROJECTS BY THE YARD

Foam rubber weather stripping, the type used around doors and windows to prevent drafts, can be transformed into excellent and

POPULAR ELECTRONICS
READER SERVICE PAGE

You can get additional information promptly concerning products advertised or mentioned editorially in this issue

1

Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

2

Mail the coupon to the address indicated below.

3

Please use this address only for Product Service requests.

POPULAR ELECTRONICS
P. O. BOX 8391
PHILADELPHIA, PA. 19101

Please send me additional information about the products whose code numbers I have circled

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

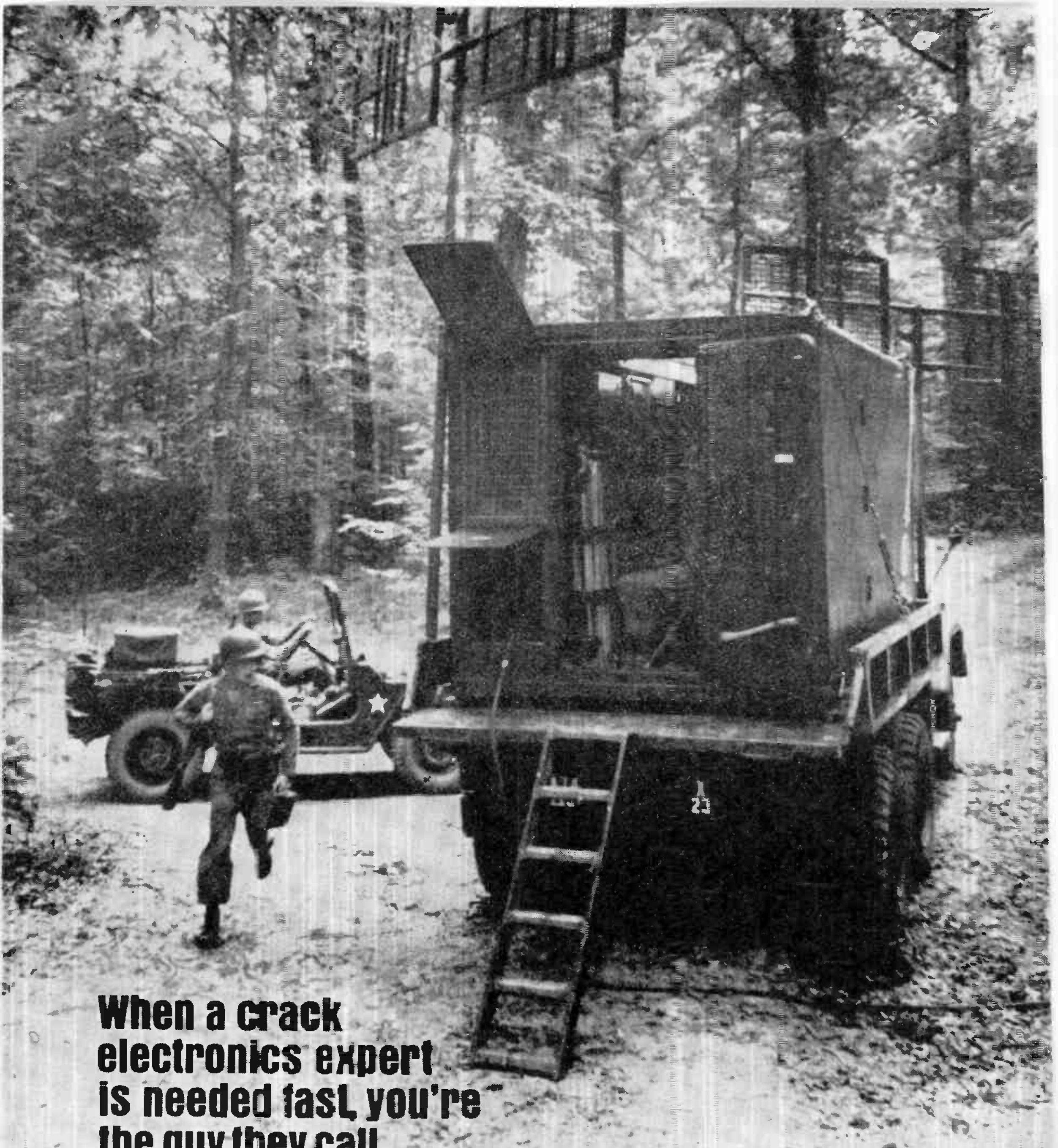
NAME *(Print clearly)*____________________

ADDRESS____________________

CITY__________ STATE__________ ZIP CODE__________

VOID AFTER APRIL 30, 1967

3



When a crack electronics expert is needed fast, you're the guy they call.

Sometimes you feel like a country doctor with sixteen cases of measles in town.

But working on emergencies is nothing new to you.

You're the expert and emergencies are your job.

You're the one guy in the company that can practically field strip a computer and put it back together again. Circuits are so pressed into your brain you can almost hear a short one. They make the TV's you repaired back in high school look like crystal sets.

If it wasn't for the electronic training you got in the Army, you'd still be a tube tester. But the Army opportunity came along and you took it.

A full-dress, eight-hours-a-day, five-days-a-week school that taught you a skill you'll build a career on.

A solid career that can mean sound security all your life.

There's nothing like being an expert. That's what you can be in today's action **Army**

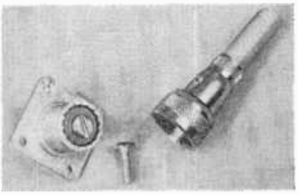
 (Continued from page 14)

inexpensive rubber feet for your projects. The strips are usually backed with an adhesive that will stick to just about any clean surface, so there's no need to drill holes in the cabinet. Use a sharp knife or a pair of scissors to cut the strips into small rectangular or square pieces as required. Strip away the protective backing, and stick the pieces to the bottom of the cabinet. (With some types of weather stripping, it is necessary to use a reducing solution to make the pieces stick.)

—*Jean Heroux*

MICROPHONE CONNECTOR CAN BE COAXED IN EMERGENCY

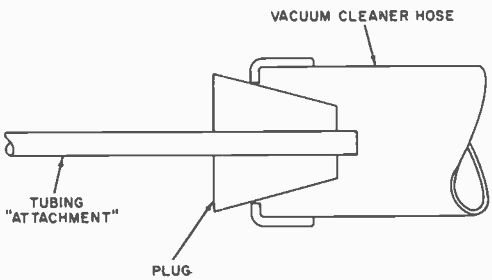
You can use a microphone connector (such as an Amphenol 75-MCIF) and a 6-32 x ½" machine screw to make an emergency PL-259 type connector. Push the machine screw into the center of the coaxial receptacle to extend the center contact. If the connectors seem to bind when you try to screw them together, don't force the fit. Use a longer machine screw for the center contact and try again. A slight difference in number of threads per inch is responsible for the binding. In a great many instances, you will be able to screw the connectors together in spite of a difference in thread, because of normal wear and tear on the parts.



—*David N. Bertollo*

VACUUM CLEANER HOSE ADAPTER CUTS CHASSIS CLEANING CHORES

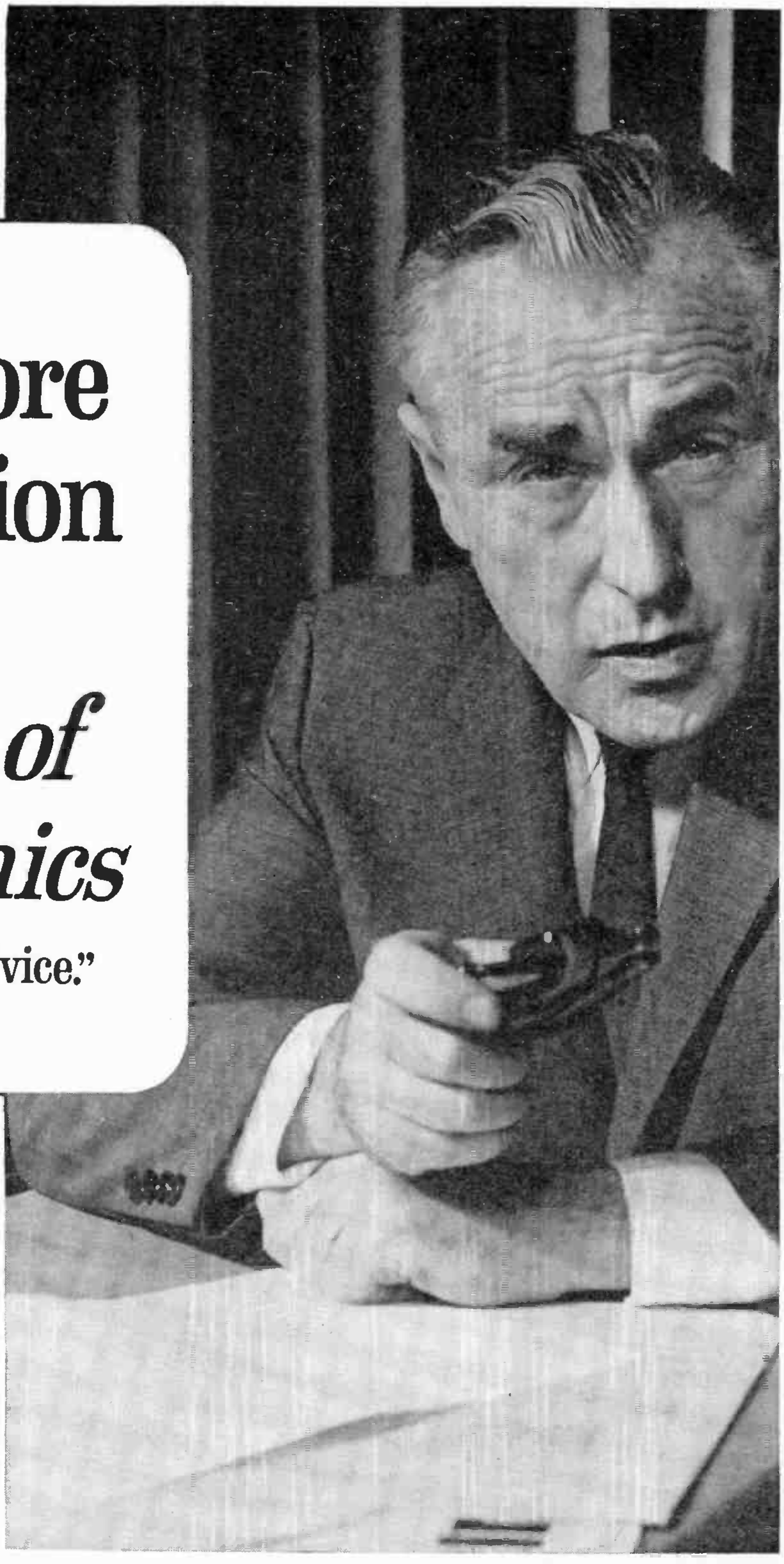
Vacuum cleaner attachments are too large and bulky to get into a radio, TV, or hi-fi chassis satisfactorily. However, a short length of small-diameter flexible plastic tubing and a large cork or other suitable plug can be used to make an adapter that will let you get into every nook and cranny. Drill a hole



through the center of the plug just large enough to allow the tubing to fit snugly. Push the tubing into the hole, and apply a daub of cement to hold it in place. Then push the plug into the end of the vacuum cleaner hose. You can use the adapter either to blow or draw air.

—*William B. Rasmussen*

"Get more education or *get out of electronics* ...that's my advice."



NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15.

MOTOR-SPEED/LIGHT CONTROL

There are a great many uses for the Knight-Kit Model KG-201 motor-speed/light control offered by *Allied Radio Corporation.* It permits control of the speed of electric drills, food mixers, sewing machines, and other electrically operated devices; when used with power tools, there is virtually no loss of torque, even at low speeds. It also controls the brightness of incandescent lamps, photofloods, and units with heating elements up to 900 watts. You can even use it with a soldering iron to limit heat for protection of delicate components. Detailed step-by-step instructions are supplied for easy assembly in just a few hours.

Circle No. 75 on Reader Service Page 15

LOW-COST SPEAKER SYSTEM

Tight budget? Limited living quarters? You'll be interested in the SP5A deluxe speaker system offered by *Tang Incorporated.* Designed with small rooms in mind, the SP5A has a low-distortion, high-efficiency output from 60 to 18,000 Hz (full range is 45-18,500 Hz). It can be used with any amplifier rated at up to 25 watts music power per speaker per channel (or with higher power amplifiers through the addition of a 10-ohm resistor or 8-ohm L-pad). Features include a special 5" speaker, tuned solid walnut enclosure, and a special "money back" guarantee. Two for stereo.

Circle No. 76 on Reader Service Page 15

POLAR DIVERSITY ANTENNAS

A line of polar diversity antennas, designated "AVANTI PDL," is being developed by *Avanti Research & Development, Inc.* At the present time, two models are available—the PDL-27A and the PDL-27B—both intended for the 27-MHz band. The PDL arrays provide for switching between horizontally and vertically polarized signals using a common loop radiator and special crossed feed elements. Their purpose: to permit communications via the horizontal mode when channels are crowded, and also to maximize long-distance reception. All necessary parts, including boom, mount for attachment to a vertical pipe, and switch box are included with each array.

Circle No. 77 on Reader Service Page 15

TRANSCEIVER/COMMUNICATIONS RECEIVER

Citizens Band operators who would like to tune in the ham bands can now do so—with *Hammarlund's* new HQ-205, a 6-channel, 5-watt CB transceiver plus a 540-30,000 kHz communications receiver. The rugged crystal-controlled transceiver is easily retunable to the 10-meter ham band without instruments. Electrical bandspread tuning is provided for 80 through 10 meters and there is a variable BFO for CW or SSB reception, a Q-multiplier, a calibrated S-meter, and a "self-adjusting" noise limiter. An optional accessory matching speaker, communications-type microphone, and a 100-kHz crystal calibrator complete the two-tone beige-and-brown desk-top ensemble.

Circle No. 78 on Reader Service Page 15

MUTUAL-CONDUCTANCE TUBE CHECKER

Said to be the only Gm tester that uses a 5-kHz square wave, *Sencore's* MU140 "Continental" is designed for fast, accurate, true mutual conductance tests. The compact portable unit measures mutual conductance in actual micro-ohms, and features an automatic biasing system. All TV and radio tubes can be checked—including novars, compactrons, nuvistors, magnovals, and foreign tubes—and space is provided for additional sockets to accommodate future tubes with different base arrangements. The MU140 comes in a smartly styled "attache" case, with an up-to-the-minute tube chart.

Circle No. 79 on Reader Service Page 15

2-METER PORTABLE/MOBILE TRANSCEIVER

The HA-144 2-meter transceiver announced by *Lafayette Radio Electronics* is suitable for portable, mobile, or fixed station use. Incorporating 18 transistors and 7 diodes, the HA-144 features a selective 144-148 MHz tunable dual-conversion superhet receiver with 1-μV sensitivity for a 10-dB signal-to-noise ratio. A

Overdrawn? Just charge it.

With TWR-8, powerful 2-watt C-B transceiver you have the portable communications situation well in hand. It's not easy to overdraw because those two husky self-contained ni cad batteries are the types that power so many modern tools and appliances. Besides, an indicator shows just how much reserve is in the battery bank. So—when you're overdrawn—just charge it—using the battery charger provided.

Raytheon puts all the good things that make TWR-8 a super-star portable into one neat styrafoam container, prices the complete "package" at a figure that represents a real old fashioned value. Skeptical? Here's what you get:

TWR-8, 2-watt, 2-channel C-B transceiver—leather carrying case—shoulder strap—10 section telescoping whip and plug-in "shorty" antenna for operation where overhead clearance is limited—earphone in case—2 ni cad batteries—battery charger (117V AC)—set of quartz crystals for Chan. 11—instruction book. Complete **119.95**

RAY-TEL . . . . 213 East Grand Ave., South San Francisco, California. 94080

RAYTHEON

CIRCLE NO. 29 ON READER SERVICE PAGE

PRODUCTS (*Continued from page 22*)

10.7-MHz mechanical filter effectively reduces adjacent station QRM (selectivity is 40 dB down at 30 kHz), and a series gate limiter automatically suppresses noise. The push-pull high-level modulated transmitter delivers over 1 watt of r.f. output power for 2.5 watts input. Supplied with leather carrying case, shoulder strap, whip antenna, mobile power cable, mobile mounting bracket, and ten "D" size batteries.

Circle No. 80 on Reader Service Page 15.

SOLID-STATE CB RIG

Four engineering exclusives are claimed for the "NOVA-23" (Model 7923) 23-channel, 5-watt CB rig announced by *EICO Electronic Instrument Co., Inc.* Small enough to hold in your hand, the unit is "function-engineered" so that you can operate it without difficulty. A dual-crystal lattice filter provides unusual selectivity, while an up-converter frequency synthesizer provides extra stability and trouble-free performance. The unique use of

precision series-mode fundamental crystals results in superior transmit and receive stability (crystals are supplied for 23 channels). Sensitivity is less than 0.5 μV for 10 dB S/N ratio, squelch adjustable to 1 μV. The unit operates from a 12-volt d.c. negative-or-positive-ground supply, or from 117 volts a.c. with an optional power supply. Special feature: a flick of a switch converts the NOVA-23 to a 3.5-watt p.a. system.

Circle No. 81 on Reader Service Page 15

FET COMMUNICATIONS RECEIVER

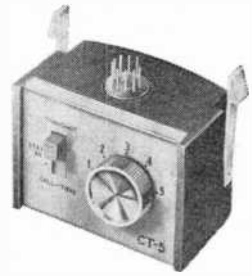
All of the circuitry in the solid-state DR-30 communications receiver available from *Davco Electronics* is contained on nine plug-in glass-epoxy modules. The use of FET's in the r.f. stages of this compact, dual-conversion superhet makes for greater sensitivity, better image rejection and freedom from cross-modulation or overloading on strong signals.

Designed for heavy-duty service, the DR-30 covers 80 through 10 meters (plus a portion of 6 meters), 9.5 to 10.5 MHz for WWV and the 31-meter SWL band, and has provision for two optional crystals for additional frequency coverage.

Circle No. 82 on Reader Service Page 15

CB "CALL-TONE SELECTOR"

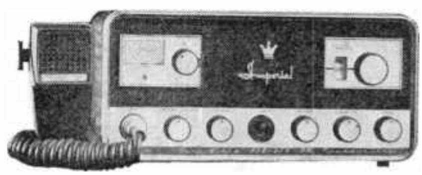
Background "hash" and unwanted calls can be completely eliminated through the use of a CB "Call-Tone Selector" now available from *Fanon Electronic Industries, Inc.* Designated as Model CT-5, it is a compatible unit that plugs into built-in sockets on the bases of Fanon transceivers. With it, any operator can pinpoint a call to any one other CT-5 equipped unit. Transceivers within this "Call-Tone" system cannot be broken into by any transceiver not equipped with a CT-5. Up to five transceiver operators can selectively signal each other on each transceiver with frequency-controlled tone.



Circle No. 83 on Reader Service Page 15

23-CHANNEL DSB/AM TRANSCEIVER

Lots of unusual "goodies" seem to have been made available for the CB'er recently—including the *Regency* "Imperial," a 23-channel transceiver compatible to both sidebands and conventional AM transmit and receive facilities. The Imperial can receive on



three different modes in each of the 23 CB channels, and it can transmit on two modes within each channel. A simple front panel control enables you to select the upper sideband, lower sideband, or AM function on the receiver. For transmitting, you can use the double sideband with reduced carrier facility for conventional AM signals, or transmit on both sidebands simultaneously without carrier. The Imperial operates on 117 volts a.c., or 12 volts d.c.

Circle No. 84 on Reader Service Page 15

ACOUSTIC INSULATOR KIT

Olson Electronics has announced a kit of four acoustic insulators (called the Model HF-97) which fit under the mounting feet of record changers, tape recorders, tuners, amplifiers, etc., and absorb vibrations to prevent acoustic feedback. Each insulator is 2" in diameter and 1⅛" high. Felt pads prevent furniture scratches.

Circle No. 85 on Reader Service Page 15

CIRCLE NO. 2 ON READER SERVICE PAGE

ELECTRONICS LIBRARY

ELECTRONICS FOR PHOTOGRAPHERS

By Marshall Lincoln

Marshall Lincoln, a frequent contributor to POPULAR ELECTRONICS, has turned his talents toward unraveling the mystery of electronics as it concerns the photographer. Exposure meters, strobes, timers, and enlarging meters are discussed in detail (fairly basic material) and some general information is given on automatic cameras and exposure settings.

Published by Amphoto Books, 915 Broadway, New York, N.Y. 10010. 160 pages. Hard cover. $5.95.

ELECTRONIC CABLE HANDBOOK

Anyone who uses or specifies cable has—for the first time—a practical one-source reference in the *Electronic Cable Handbook.* Written by the Engineering Staff of the Belden Manufacturing Company, the book explains the design, construction, and handling of virtually every type of electronic cable—including the exotic cables used in space satellites. It covers specific applications in detail, devoting whole sections to the types of cable used in intercoms and entertainment systems, two-way radio, etc., and includes military and non-military specifications. Couched in easily understood terms, it contains many useful tables and a glossary.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 224 pages. $3.95.

PRINCIPLES OF RF POWER AMPLIFIERS

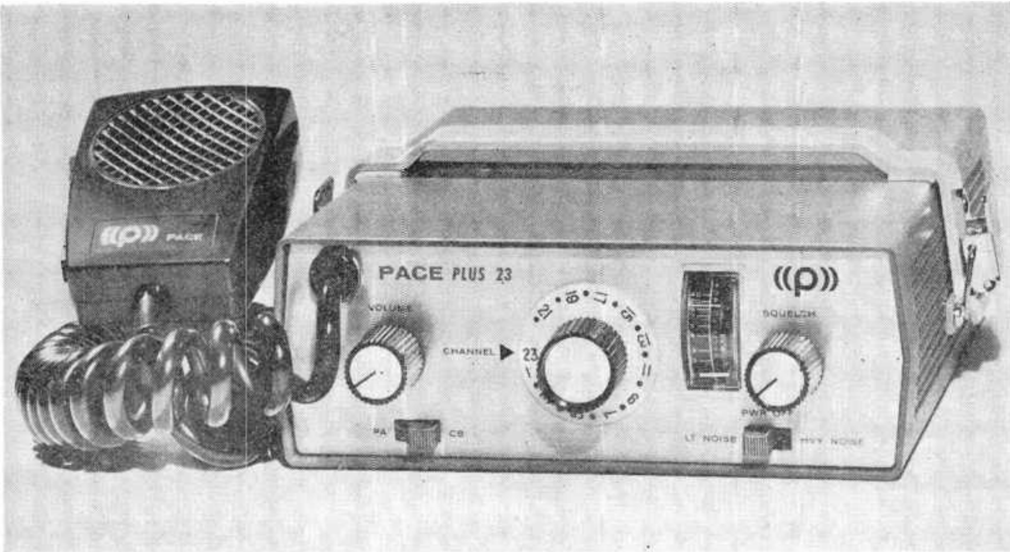
A "basic" book on the intermediate and final power amplifiers used in radio transmitters, this volume opens up with an explanation of the classes of operation and biasing methods, then goes on to discuss amplifier loads, frequency multiplication, neutralization, and the use of r.f. power amplifiers. Final sections cover transmitter troubleshooting and keying methods. Simple diagrams are scattered throughout.

Published by Techpress, Inc., Brownsburg, Ind. 46112. 118 pages. Soft cover. $1.95.

HAVING FUN IN ELECTRONICS

by Leo G. Sands

Your reviewer must assume—after reading this book—that the electronics publishing industry is running out of titles. This is not a "fun" book; it's a concise, well-organized paperback loaded with circuit diagrams. The first two dozen pages concern basic elec-



SOME STRAIGHT-FORWARD TALK ABOUT THE PACE PLUS-23 CB TRANSCEIVER

The PLUS-23 is an all silicon transistor, all solid state Citizen Band 2-way radio, manufactured by Pace Communications Corp., priced at $199.00 with all channels supplied. Ask any proud PACE owner, or ask your dealer for an in-field comparison test. You will find the PLUS-23 even outperforms its own specs. This is because we guarantee our sets will perform to specifications under the worst possible conditions—not under ideal or laboratory conditions.

PACE is a pioneer in all solid state CB design, specializing in all silicon transistor 2-way radios. The advantages are many: You don't risk a rundown car battery because the current drain is so low; you get a compact unit that fits conveniently under the dash—not the large, knee-knocking chassis of a tube set; you get reliability that means top performance on a below-zero winter morning or when it's 100 degrees in the desert sun; you get rugged dependability that keeps on operating after a day-long trip over bumpy mountain roads.

Reliability is the name of the game at PACE. That's why we clip and bend every component lead by hand. And test every PLUS-23 on a vibration stand. We also check every set for all of the published performance specifications—even operation on a weak battery or high voltage conditions. A signed process report goes with every radio—like a pedigree. Take a look at one and see for yourself how we take the guesswork out—and build performance in to every PLUS-23. We build in dependability too. You get full diode protection plus complete AGC at every stage, with heavy duty silicon transistors and lifetime guaranteed circuit boards and computer-verified synthesizer.

How about range? You transmit a full 5 watts with 100% modulation at 12 volts, assuring the best talk power—even with the car motor shut off. You receive with 0.3 uv sensitivity plus the best noise limiting available.

We are proud of our equipment, and stand behind it with a no-gimmick warranty. Don't be fooled by misleading claims. Compare and ask questions before you buy. Have a qualified technician look at a PACE chassis. He will confirm the quality construction and components we use. For more information, and the name of your nearest authorized PACE dealer, write:

((p)) PACE COMMUNICATIONS CORP.

24049 Frampton Ave., Harbor City, Calif. 90710 • Telephone (213) 325-8444

CIRCLE NO. 27 ON READER SERVICE PAGE

LIBRARY (*Continued from page 26*)

tronics theory, but after that the diagrams come thick and fast—we counted 135 and there were more to go. This could be called an "idea" book—which it is; but is it fun to look at circuit diagrams? Forget the title—the book is worth looking at.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 160 pages. $3.25.

THIN-FILM AND SEMICONDUCTOR INTEGRATED CIRCUITRY

by John Doyle

This is not a book of circuits involving the use of IC's. It is a book that deals with the problems of fabricating IC's, from the development of the mask pattern through to the tests for reliability. The author, long associated with National Radio Institute, exhibits an unusual grasp of his subject and provides the reader with liberal reference material.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover. 314 pages. $6.95.

BASIC DATA PROCESSING

by Peter Abrams and Walter Corvine

In the introduction, the authors acknowledge that there are numerous textbooks on computers and programming. But, as they so rightly state, most texts deal with hardware or systems and few books containing a "overview" of the data processing field have been published. This low-cost paperback is well worth the attention of any reader who has any contact with computer data processing. Although the contents are arranged like a classroom text, the treatment of the subject matter is not dry or superficial. For an up-to-the-minute look at data processing at the senior high school level, this book can be highly recommended.

Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017. Soft cover. 464 pages. $5.95.

ABC's OF ELECTRONIC TEST PROBES, Second Edition

by Rudolph F. Graf

Probes are a vital link between test equipment and circuits under test; yet many people think they are just handy terminations for cables. To achieve accurate measurements, test probes must be selected with the right electronic properties for each type of circuit. This book gives complete information on the construction, basic principles, and applications of most of the common types of probes used in up-to-date electronic testing. It is written in down-to-earth language with many supporting illustrations.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 128 pages. $2.25. —30—

HAM HOBBY CLEARINGHOUSE

If you have a hobby or interest in addition to amateur radio and would like to talk about it on the air, you can contact other hams with the same hobby through this column. To be listed here, just send a legibly printed postcard to Ham Hobby Clearinghouse, POPULAR ELECTRONICS, *One Park Ave., New York, N.Y. 10016, including on it your call letters, other hobbies, the frequencies you use, mode of operation, when you operate, and your name and address.*

WA1FKQ—Stamp collecting, clarinet, saxophone, all sports, traffic handling, sometimes NCS of N.E. Teenage Net: 3880 kHz, Tuesdays, Wednesdays, and Thursdays at 2100 GMT; 80 and 10 meters, CW, AM and some SSB weekends and evenings to 0200 GMT. (Douglas A. Fisher, 6 Washington St., Norwood, Mass. 02062)

WA1FRV—Chess, chemistry, cornet, radio and electronics theory, mathematics, general science; 80 and 10 meters, AM and CW; evenings, weekends, and school holidays. (Gerald R. Larocque, 729 Bernardston Rd., Greenfield, Mass. 01301)

WN1HFE—Astronomy, rocketry, science fiction, space exploration; 3719 kHz, CW; Fridays and weekends. (David Rose, Long Crossing Rd., East Hampton, Conn. 06424)

W2FCJ—Motorcycles, flying, guitar, hi-fi, solid-state experimenting, electronics design; 10 and 6 meters, phone; hours vary. (Myron Gottesman, 118 W. 57 St., New York, N.Y. 10019)

WB2SXY—Chess, science fiction, fishing, SWL'ing, hydroponics, astronomy, pen pals, building electronics equipment; low end of 6 meters, CW; after 1500 EST. (W. D. Kasperkoski, 72 Hennessey Rd., Ontario, N.Y. 14519)

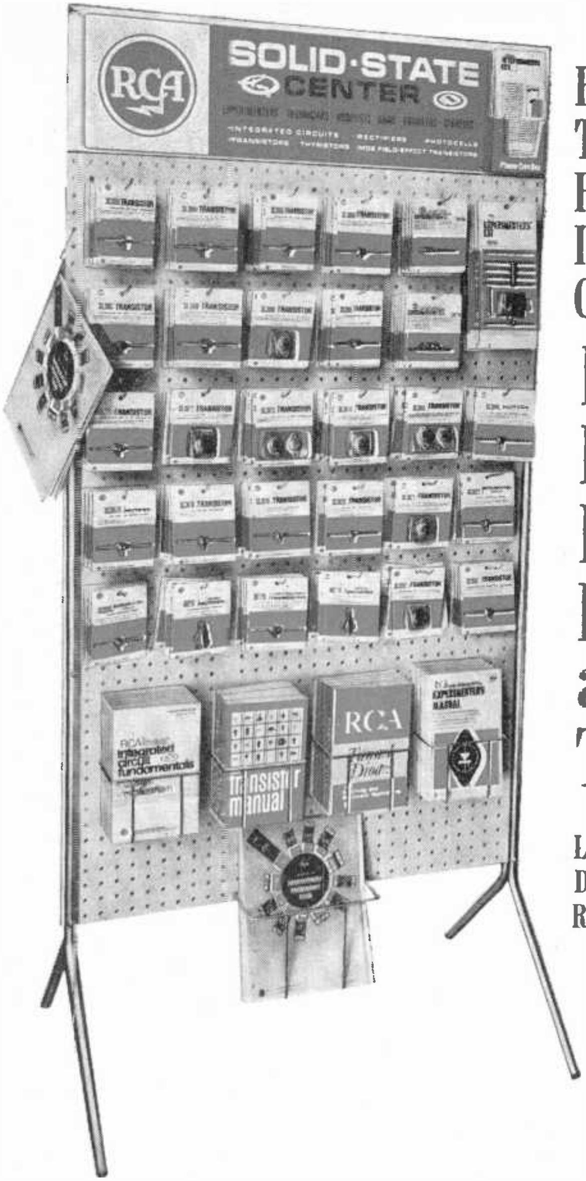
WB2UUH—Current events, races, ARRL Intruder Watch, Spanish; 28 and 50 MHz, AM, and 14 MHz, SSB and CW. (Lee Stewart, R.D. 2, Canisteo, N.Y.)

WN2WZK—Photography, chess, physics, biology; 146 MHz, phone; 0000 GMT daily. (Hilary Miller, 98 Highview Place, White Plains, N.Y. 10604)

WN3ELB—Hockey, ham SWL'ing, current events, professional broadcasting, space and UFO's; 40 meters, CW; afternoons and weekends. (D. J. Zagrodnick, 604 Iolite Ave., Johnstown, Pa. 15902)

WN4CFU—Photography, carpentry, antenna farming; 80 and 40 meters, CW; after school, weekends, and school holidays. (John Craver, 4001 Third St., Chesapeake, Va. 23506)

WNØOOM/6—Swimming, SWL'ing, trombone; 3720-3738 kHz, 21.15 MHz, 80 meters, CW; 2 meters, MARS. (Dennis Merritt, 222 Travis Ct., Suisun City, Calif.) —30—



RCA Transistors Rectifiers Integrated Circuits

For EXPERIMENTERS HOBBYISTS HAMS and TECHNICIANS

LOOK FOR THIS DISPLAY AT YOUR RCA DISTRIBUTOR

Here displayed on the RCA Solid-State Center is the RCA SK-Series Transistors, Rectifiers, and Integrated Circuits; the new RCA 3N128 MOS Field-Effect Transistor; RCA's 40214 Silicon Stud Rectifier; and three RCA Experimenter's Kits. This new Solid-State Center, in addition to its host of devices, also includes technical literature to support the devices right on the rack. It's the "one-stop" answer to the solid-state needs of experimenter, hobbyist, ham, or the replacement requirements of the service technician.

All devices and kits are packaged in easily identifiable see-through packs for your convenience. Included with each device is broad performance data or specific ratings and characteristics where applicable.

RCA Solid-State Center Includes:

- RCA Experimenter's Kits. Three kits enable you to build a light dimmer or any one of 14 different circuits for dozens of applications around the house.
- RCA SK-Series "Top-of-the-Line" Devices: 17 Transistors, 2 Rectifiers, and 2 Integrated Circuits, for experimenter or replacement use.
- RCA Technical Manuals. Four manuals include: RCA Experimenter's Manual, RCA Transistor Manual, RCA Linear Integrated Circuits Fundamentals Manual, and RCA Tunnel Diode Manual.
- RCA Solid-State Replacement Guide. Lists all RCA SK-Series "Top-of-the-Line" Transistors, Rectifiers, and Integrated Circuits and the more than 7,300 types which they replace.

Keep RCA Experimenter's Kits and the RCA SK-Series in mind when you're shopping for solid-state devices. Look for the RCA Solid-State Center. Now at your RCA Distributor. Do it today!

RCA Electronic Components and Devices, Harrison, N.J

RCA® The Most Trusted Name in Electronics

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a postcard to Operation Assist, POPULAR ELECTRONICS, *One Park Avenue, New York, N.Y. 10016. Give maker's name, model number, year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Because we get so many inquiries, none of them can be acknowledged.* POPULAR ELECTRONICS *reserves the right to publish only those items not available from normal sources.*

Globe Transformer Corp. "Pee Wee" Novice transmitter; has a 6L6G oscillator tube and an "8" rectifier tube. Schematic and operating manual needed. (Jack Pejsa, 218 N. Owasso Blvd., St. Paul, Minn. 55112)

Airline Model 62-188 receiver; tunes BC, 6 to 18 MHz, and police calls; has 7 tubes. Schematic and operating manual needed. (Wesley M. Ridgway, Jr., Rt. 1, South Shore, St Charles, Mo. 63301)

RCA Victor Model K80 receiver, ser. 10045, circa 1931; tunes 540 to 4000 kHz and 5800 to 18,000 kHz; has 7 tubes, and magic eye. Schematic and source for parts needed. (Richard Richer, 180 S. Middle Neck Rd., Great Neck, N.Y. 11021)

RCA "Radiola 66" AR-598 receiver; tunes BC. Schematic and parts list needed. (Kenneth J. Pfitzer, 2700 Countryside Dr., Florissant, Mo. 63033)

GE Model E-76 receiver; tunes 540 kHz to 18 MHz on 3 bands; has 7 tubes. Schematic and alignment data needed. (R. W. Gontrum, 10 Wallace St., Lexington, Va. 24450)

Zenith Model 6-S-362 receiver; tunes on 3 bands. Source for electrodynamic speaker needed. **Olson** Model TE-184 VOM. Value of shunt resistor needed. (William P. Korbe, 2437 Waterman Ave., Pittsburgh, Pa. 15227)

DuMont Model 214 oscilloscope. Schematic, operating and servicing manual needed. (William McConnell, III, 4216 Lanark Ave., Ft. Worth, Tex. 76109)

Paco Electronics Model C20 resistance-capacity ratio bridge tester. Schematic and operating manual needed. (Andres Banuchi, 106 Grattan St., Brooklyn 37, N.Y.)

Zenith Model 5-S-319 receiver, ser. S35073; tunes 570 to 1600 kHz and 5 to 18 MHz. Source for compensating coil #20-183 needed. **Truetone** Model D-1143 receiver, ser. 0119706; tunes 570 kHz to 14.9 MHz on 4 bands; has 8 tubes. Schematic, parts list and source for band switch and band coils needed. (Charles Woolf, 16 Hilltop Rd., Freehold, N.J. 07728)

Doolittle Model PUY 12 mobile receiver, ser. 531. Schematic, operating manual and frequency coverage needed. (R. Arthur, 945 S. Mt. Prospect Rd., Des Plaines, Ill. 60018)

Arkay Model A-12 amplifier; has 5 tubes. Schematic needed. (Mark Handley, 31 Mohawk Dr., Clarendon Hills, Ill. 60514)

Solar Model CE capacitor analyzer. Schematic and operating manual needed. (Herbert H. Cross, 59 Flagler Ave., Cheshire, Conn. 06410)

Korting Model MT 156 tape recorder. Operating manual needed. (Luis Rodriquez, 67-59 224 St., Flushing, N. Y.)

(*Continued on page* 34)

ASSIST *(Continued from page 32)*

RCA Model 262 receiver, circa 1934; tunes 140 kHz to 36 MHz on 5 bands; has 10 tubes. Source for first a.f. transformer and output transformer 68728 needed. (John W. Weiler, 220 Wood St., Crown Point, Ind.)

Meissner Model EX signal shifter, circa 1943. Schematic needed. (Charles D. Pierce III, 8527 Golden Ridge Rd., Lakeside, Calif.)

Oak Ridge Products Model 106 "Cathette" CRT tester. Schematic, parts list, and instruction manual needed. (William C. Parker, Box 38, Hannibal, N.Y. 13074)

Hickok Model RFO 5 oscilloscope. Source for low-frequency coil assembly OS2206 and high-frequency coil assembly OS2207 needed. (Lawrence Merat, Frenchville, Pa. 16836)

Radio City Products Model 802N tube tester. Tube testing charts or roll charts needed. (Charles F. Maugle, 156 Pickford Ave., Kenmore, N.Y. 14223)

Motorola Model 53LC2 receiver, chassis HS-347; tunes BC; has wind-up clock. Schematic and source for 1V6, 1AJ5 and 1AH4 tubes needed. (Jim Hiebeler, 2308 W. 110 St., Minneapolis, Minn. 55431)

Triplett Model 1183-SC tube tester, ser. 0693, made for Signal Corps, circa 1943. Schematic needed. (Clifford Fountain, Code 5012, USNOTS, China Lake, Calif. 93555)

Heraldyne receiver, ser. 14535, circa 1927; tunes 100 to 500 meters on 2 bands; has 5 UX-301A tubes. Schematic and parts list needed. **Philco** Model 37-60 receiver, circa 1931; tunes 540 to 1700 kHz and 2.4 to 7.4 MHz; has 5 tubes. Schematic and source for tuning dial assembly and pilot lamp shadow assembly needed. (Robert T. Millard, 1420 Hollywood Dr., Lancaster, Pa. 17601)

Westinghouse scope transformer Model L-406784 needed. (George Kapsokavadis, Kolokotroni 13, Corfu, Greece)

Lavoie Model LA-239A oscilloscope, ser. GNV, made for U.S. Navy, I. D. 91809-100153. Schematic, operating and calibration manuals needed. (Brian G. Petix, 11021 Woodbury Rd., Garden Grove, Calif.)

Philco Model 050 tube tester. Schematic and operating manual needed. (Reuben J. Blatt, 416 Centre St., Hyde Park, Reading, Pa. 19605)

Triumph Model 841 oscillograph. Schematic needed. (Bill Hiiwa, 4212 Harvey Ave., Western Springs, Ill. 60558)

Interocean "Skyrover" receiver, circa 1931; tunes 200 to 400 kHz and BC. Schematic needed. (Jay Budzowski, 755 Arlington Ave., New Castle, Pa. 16101)

AN/GPG-1 radar tracker set T9, surplus. Schematic needed. (Eugene Fleming, 328 Gunnison Ave., Grand Junction, Colo. 81501)

Zenith Model S-17784 receiver; tunes AM and FM. Schematic and operating manual needed. (D.M. Diegert, 6234 Big Tree Rd., Livonia, N.Y. 14487)

RCA "Radiola 62" Model AR-892; tunes BC. Schematic needed. (Mike Campbell, 206 Goff Dr., Leitchfield, Ky. 42754)

Delco Model R1128 receiver, circa 1938; tunes on 4 bands; has 7 tubes. (Edmond McKenzie, 8 Vicky Ct., Trenton, N.J. 08610)

Hammarlund Model HQ-129-X receiver; tunes 0.54 to 31 MHz on 6 bands. Operating and instruction manual needed. (Ronald S. Lettieri, 433 E. Drinker St., Dunmore, Pa. 18512)

Stewart-Warner Model 11-9B7 receiver; has 9 tubes. Source for speaker, knobs, and push button needed. (Clyde E. Propst, Rt. 2, Sellersville, Pa. 18960)

Silvertone Model 2761 receiver, ser. 549264, circa 1949; tunes s.w. from 1.7 to 18 MHz; has 6 tubes. Schematic and source for 1N5, 1A5, 1A7, 1H5 tubes needed. (David Rose, Long Crossing Rd., East Hampton, Conn. 06424)

Supreme Model 546 oscilloscope. Schematic and parts list needed. (Julius Finkel, 9428 Woodley Ave., Sepulveda, Calif. 91343)

Rider Vol. I of radio receiver diagrams, circa 1925, needed. (Donald Ryan, Star Route, Box 301A, S. Plymouth, N.Y. 13844)

United States Model CFM 12823-1 TV set; tunes FM and TV. Schematic needed. (C.B. Mueller, 3801 N. Oakley, Chicago, Ill. 60618) —30—

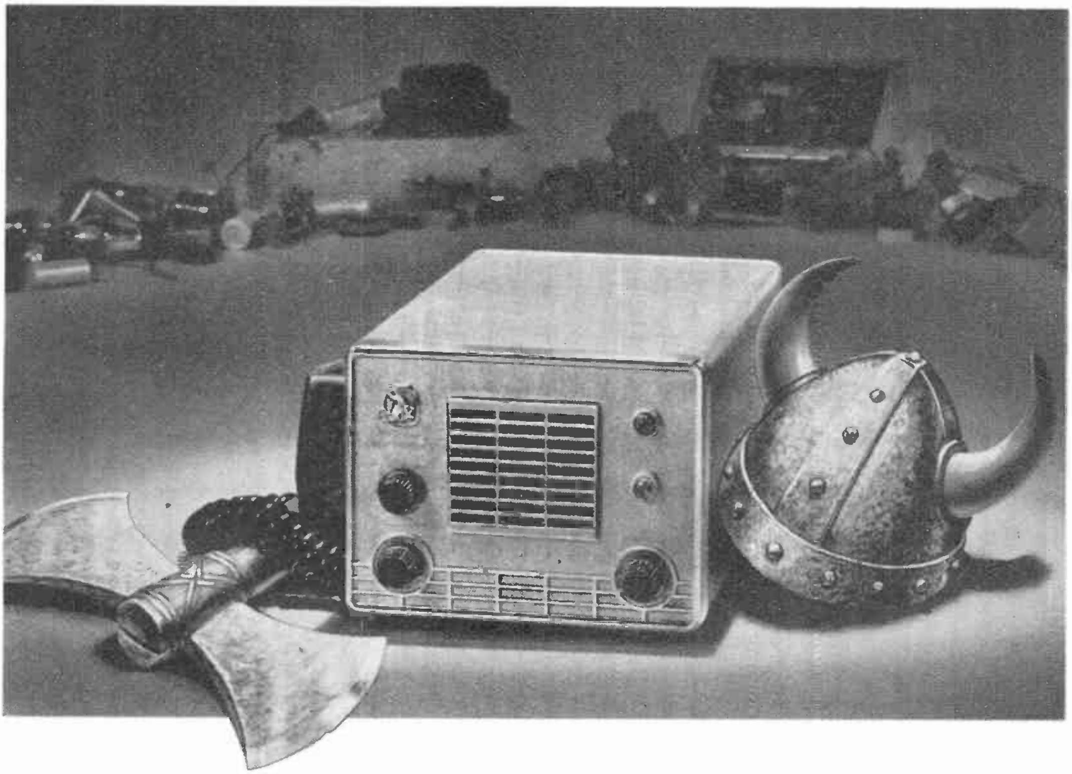
...and still champion

Built in the best traditions of Viking craftsmanship and durability, the Messenger I continues to successfully resist all efforts to take away its position as the most popular Citizens Band transceiver ever made.

The Messenger I's unmatched performance and reliability put you on the air with all the authority you've learned to expect from Johnson's engineering and manufacturing excellence. You'll stay on the air, too, because the Messenger I, like all Johnson products, is built to take the tough day-in, day-out use that CB'ers demand.

Rugged cabinet and chassis design. High-impact microphone that's impervious to heat and moisture. Sensitive superheterodyne receiver for maximum communication range. Only $99.95. FCC type accepted and DOT approved.

Be a winner! Check out a Johnson Messenger I today.



E. F. JOHNSON COMPANY

2498 Tenth Ave. S.W., Waseca, Minn. 56093

Providing nearly a half-century of communications leadership

Please send full details on the Messenger I and the rest of the winning line of Johnson CB products and accessories.

Name____________________

Address____________________

City________ State________ Zip______

CIRCLE NO. 18 ON READER SERVICE PAGE

NEW!

MASTER COURSE IN COLOR TV

WITH NTS COLOR KITS

Big 25" Color TV kits included in new Master Color TV program. You learn Color TV and keep the big new 25" color TV receiver you build with exciting kits we send you.

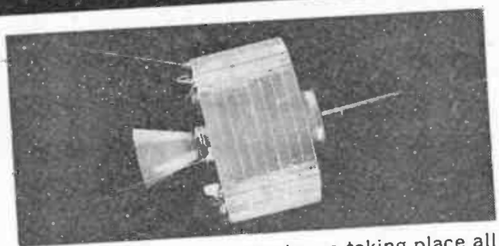
10 million homes in this country will have color TV by the end of 1967. This industry needs technicians as never before, and NTS-trained men can move quickly into the big money.

COLOR TV SERVICING BRINGS HIGH PROFITS.

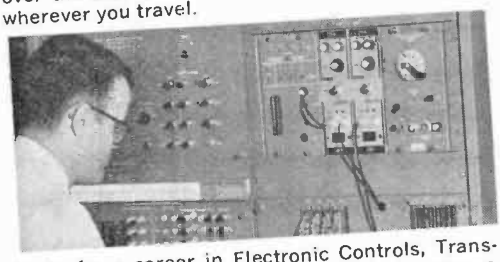
New color sets need careful installation, precision tuning and skilled servicing. NTS home training can put you in this profit picture—prepare you for big pay, security, or start a business of your own.

LIFT OFF...To A "Space Age" Career In Electronics!

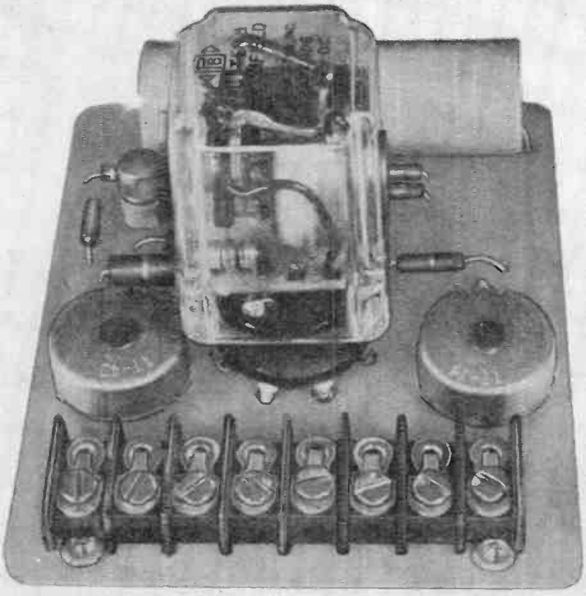
This is the "space age." It crackles with the excitement of new discovery, new opportunities —in communications, industrial electronics, computer technology, closed circuit TV, and many others. Automation has greatly expanded the need for skilled electronics technicians in thousands of manufacturing plants. Only the well trained man makes it big in today's expanding electronics market, and industry demands this kind of man...the NTS man. What does it mean for you? A lifetime career...not just a job! Pick your field, and let an NTS Project Method Program open up the wonderful opportunity-filled world of electronics to you.



New Electronic developments are taking place all over the world, and your training brings top pay wherever you travel.



Train for a career in Electronic Controls, Transmitter Operation, or get your FCC License—a **"must"** in communications work. All included in your Master Program.



COVER STORY

BUILD THE SUPERTROL

For . . .
- Automatic start switching
- Interval timing
- Voltage Sensing
- Delayed Stop Action
- Etc., etc., etc.

By DON LANCASTER

ASK NOT what the Supertrol can do, but rather, what it cannot do. For here is a circuit with an abundance of useful applications. The Supertrol is primarily a free-running master sequence generator, suitable for an exhibit or display, which provides a completely adjustable on/off ratio of from 50 milliseconds to 10 seconds. Husky 10-ampere relay contacts provide dual complementary—off/on, on/off—outputs.

Change around a connection or two and the Supertrol becomes a sensitive voltage level detector which opens or closes a relay with a positive snap action as the input voltage exceeds 2 volts, or drops below 1 volt.

Add a d.p.d.t. switch and once again change some connections around and you have a time-delay relay or an interval timer—depending upon your choice of output contacts. With this arrangement you can turn on a load once for a predetermined time interval, or get a continuous output at the end of an adjustable 0- to 20-second time interval.

How It Works. The Supertrol's actual circuit (Fig. 1) is nothing more than a jazzed-up version of a basic Schmitt trigger as described on page 44. Transistors *Q2* and *Q3* comprise the Schmitt trigger while *Q1* is an emitter follower used to keep charging capacitor *C1* from loading down the circuit. The capacitor charges through potentiometer *R11*, so that this control determines the relay's *on* time. Similarly, *R12*, which provides a discharge path for the capacitor, determines the relay's *off* time.

Most of the resistors added to the basic circuit are for stabilizing purposes, and to help eliminate current surges from the power supply and the unit's control circuitry. Capacitor *C2* helps to speed up the turn-off operation, while *D1* protects *Q3* from voltage spikes due to the inductance of the relay coil.

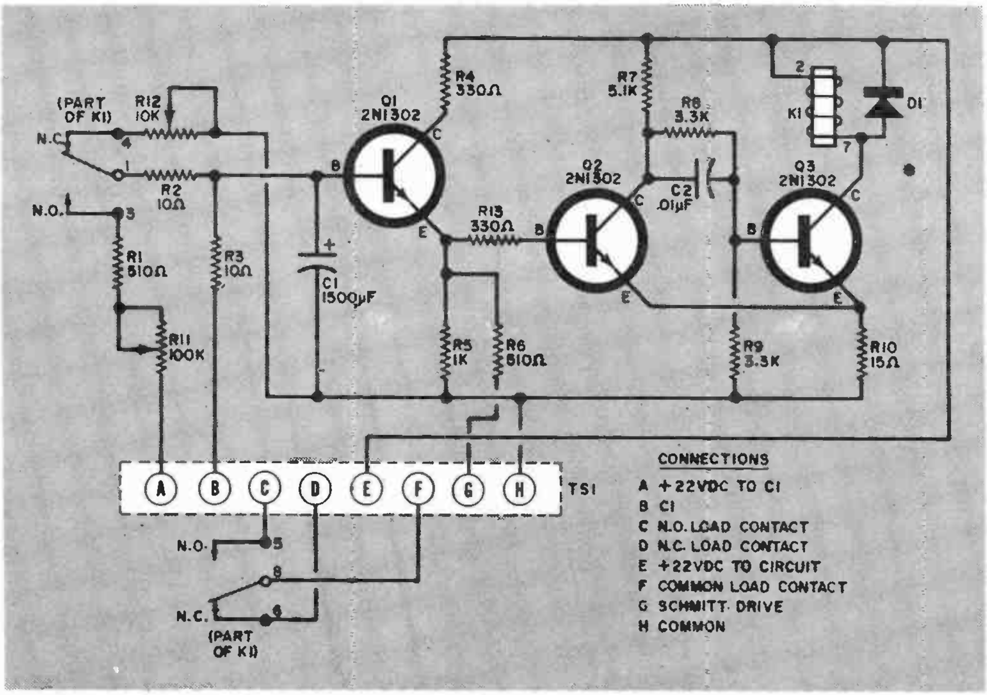


Fig. 1. The Supertrol is a practical application of the well-known Schmitt trigger circuit. A technical explanation of the triggering operation appears on page 44. Relay K1 is the workhorse of the Supertrol and the second set of contacts (octal pins 5,6, and 8) are used to operate other circuits up to a drain of 10 amps. The author brought all control wiring functions out to a terminal strip, but this may be eliminated if the Supertrol is to be used for only one job.

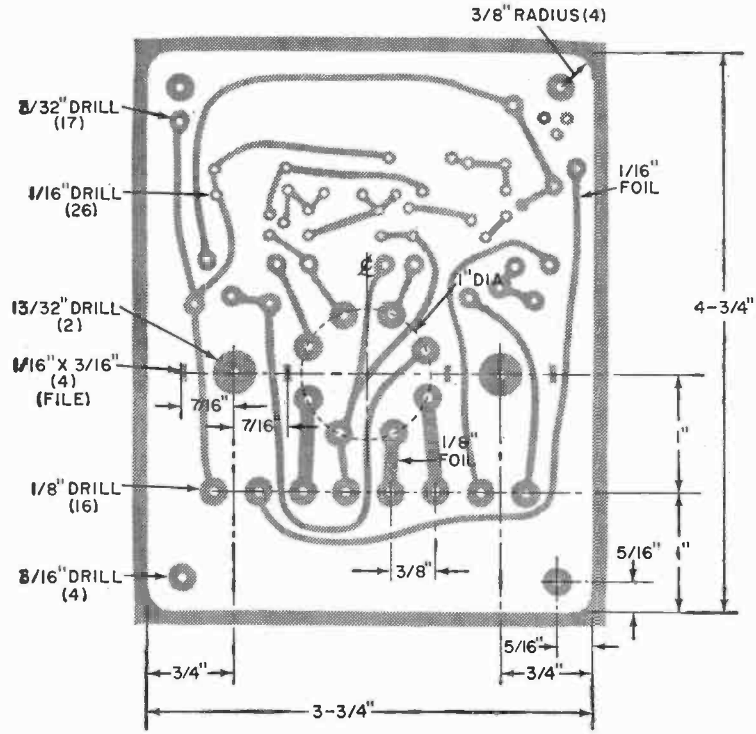


Fig. 2. A printed circuit board can be etched following the outlines shown in this drawing. Use of this outline should be predicated on the physical size of capacitor C1, location of the terminals for the octal socket to hold K1, and whether or not the builder uses twist-tab potentiometers for R11 and R12. Point-to-point wiring can be used in place of a printed circuit without encountering any problems.

PARTS LIST

C1—1500-μF, 6-volt d.c. electrolytic capacitor
C2—0.01-μF disc capacitor
D1—750-mA, 200-PIV silicon diode
K1—24-volt d.p.d.t relay, 400-ohm coil, with 10-ampere contacts (similar to Potter & Brumfield KRP11DG)
Q1, Q2, Q3—2N1302 transistor or similar unit
R1, R6—510-ohm, 1-watt resistor
R2, R3—10-ohm, ½-watt resistor
R4—330-ohm, ½-watt resistor
R5—1000-ohm, ½-watt resistor
R7—5100-ohm, ½-watt resistor
R8, R9—3300-ohm, ½-watt resistor
R10—15-ohm, ½-watt resistor
R11—100,000-ohm twist-tab potentiometer (similar to Centralab TT-40)
R12—10,000-ohm twist-tab potentiometer (similar to Centralab TT-14)
1—3" x 4" x 5" box, or printed circuit board, or both*
1—8-terminal barrier strip (similar to Cinch Jones 140-Y)
Misc.—Octal PC tube socket, knobs (2), threaded rivet-type standoffs (4), solder, 22½ volt battery or a.c.-operated d.c. supply—see below.

*An etched and drilled circuit board, complete with all mounting hardware, is available for $2.50 postpaid in the U.S.A. from DEMCO, Box 16297, San Antonio, Texas 78216

Construction. The Supertrol can be built on a printed circuit board or on a punched phenolic circuit board, and can be housed in a small plastic container or in a metal box. If a printed circuit board is preferred, one can be purchased from the source indicated in the Parts List. If you want to etch your own board, you can do so following the layout given in Fig. 2, and the parts can be mounted as shown in Fig. 3.

For printed circuit construction, be sure to use the specified twist-tab potentiometers since the PC board has been laid out with holes drilled for these units.

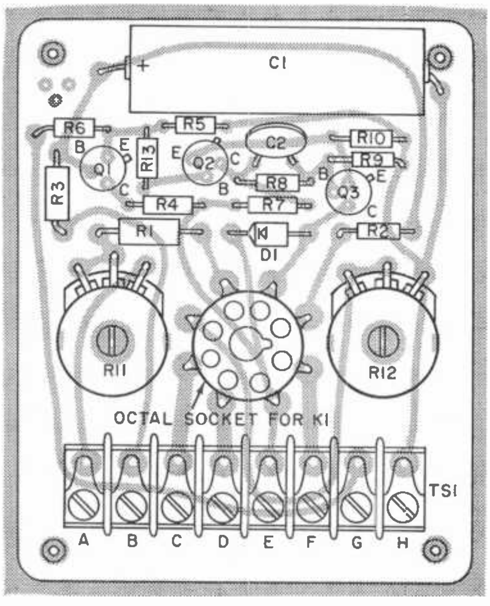


Fig. 3. If you make or buy a printed circuit board the components should be positioned as shown. The 3 spare holes in the corner mount a socket to hold Q1 when this transistor is not in the circuit.

POWER SUPPLY PARTS LIST

C1—500-μF, 25-volt electrolytic capacitor
D1—750-mA, 100-P.I.V. silicon power diode (similar to Motorola 1N4002)
R1—4700-ohm, ½-watt resistor
T1—Power transformer: primary, 117 volts; secondary, 18 volts, 100mA, or higher (similar to Stancor TP-1 or Knight (Allied Radio) 54 A 3987

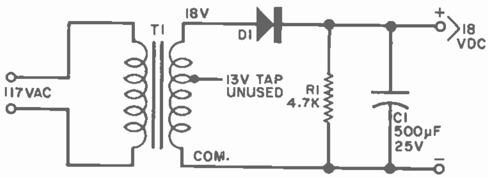


Fig. 4. For continuous duty operation, this power supply can be substituted for the 22½-volt battery. The circuit will work on 17 to 24 volts d.c.

Suitable standoffs can be used to mount the circuit board in its enclosure, if one is used, or else support it on a table or other surface.

While transistors *Q2* and *Q3* can be wired directly to the circuit board, *Q1* should be installed in a socket since it has to be removed from the circuit during certain applications. After completion, the circuit can be tested by hooking it up as shown in Fig. 5. With power applied, it should start oscillating at about 1 hertz. If it does not, adjust *R11* and *R12* as necessary.

If the Supertrol is to be used only on occasion, and if you do not want to go through the expense of building an a.c.-operated power supply, you can operate the unit with a 22½-volt battery which can be housed with the circuit board in the same enclosure. If, on the other hand,

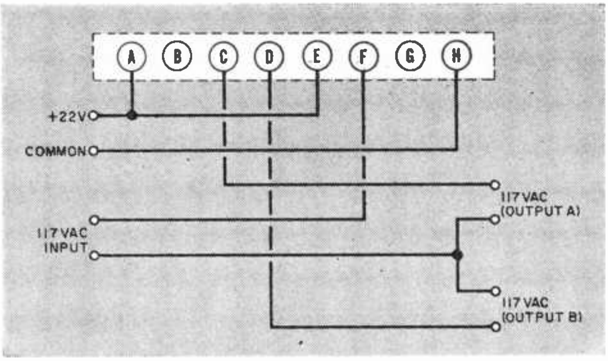


Fig. 5. To test the Supertrol, connect a 22½-volt battery with the plus side going to terminal strip points A and E, and the negative side of the battery to point H. The circuit should start oscillating at about 1 hertz. If the relay does not start clicking, juggle R11 and R12 until the relay has a rhythmic beat. As explained below this circuit is also used to make the Supertrol a display sequence generator.

you plan to use the Supertrol on a fairly continuous basis, you may want to build the power supply shown in Fig. 4 using the parts shown on the accompanying Parts List. The output voltage from this supply will be up to 24 volts depending on the load.

Applications. To have the Supertrol function as a display sequence generator, make the connections shown in Fig. 5, enabling one set of relay contacts to alternately switch the "hot" side of the 117-volt a.c. line between Outputs *A* and *B*. The *common* side of the line goes directly to the load, and there is no connection between this set of contacts and the rest of the Supertrol circuit. The switching time required to go from *A* to *B* is determined by the adjustment of *R11* and *R12*. This circuit is ideally suited for running exhibits and displays.

The connections required for a voltage level detector function are shown in Fig. 6. Here, emitter follower *Q1* must be removed from its socket. This enables the circuit to turn on whenever the input signal exceeds 2 volts or turn off when the signal drops below 1 volt. Input impedance is approximately 1000 ohms. Relay contacts *C* and *D* are used as required to provide power for an alarm bell, signal light, etc.

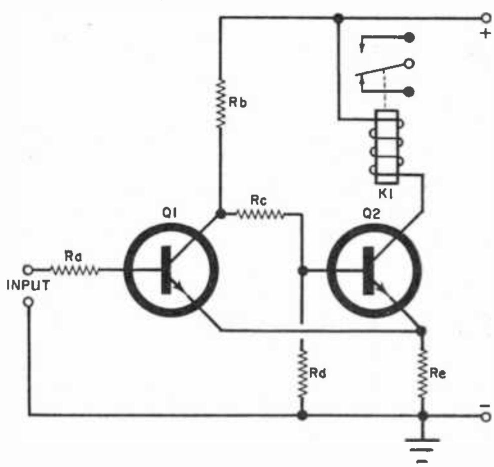
(*Continued on page* 94)

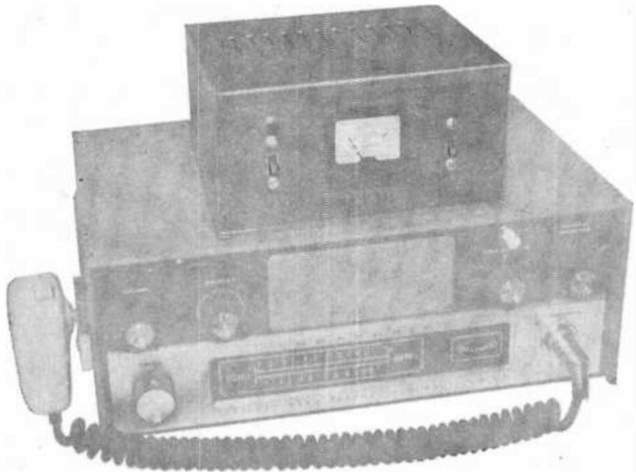
CIRCUIT THEORY

To understand the secret behind the Supertrol's success, consider the Schmitt trigger circuit shown at right. The circuit and biasing arrangement is such that Q1 is normally OFF while Q2, which controls relay K1's current, is normally on.

If a positive voltage—say about 2 volts—is applied to base resistor Ra, Q1 turns on, causing Q2 to turn off due to reverse biasing applied across Rc and the increase in the voltage across emitter resistor Re. This causes the relay, which acts as Q2's collector load, to drop out as the current falls to zero or to any value below its pickup point. The circuit will revert to its original quiescent state whenever the voltage at the input falls below the tripping level, and the relay will pull in again.

By placing a relatively large capacitor in Q1's base circuit (see Fig. 1), and a charging path from a battery through the relay contacts and a couple of current-limiting resistors, the circuit can be made to free-run by the charge and discharge of the capacitor, enabling Q1 and Q2 to change state at a predetermined interval. The rate at which the transistors change state is established by the charge and discharge rate of the capacitor; and this, in turn, is a function of the resistor values chosen. It can be seen that if a potentiometer is substituted for at least one of the resistors, the charging time can be varied at will.





BUILD The "Mule Box"

By **DANIEL MEYER,** KMT 2967

OUTBOARD CONVERTER OFFERS "LEGAL" INCREASE OF CB TALK POWER

IN RESPONSE to hundreds of inquiries as to how the serious CB user can make his communications network more effective—and remain "legal"—the author developed the "Mule Box," an outboard converter that changes the CB signal before it goes on the air from amplitude modulation (regular AM) to double-sideband with reduced carrier (DSBRC). For all means and purposes, any receiver intercepting a DSBRC signal reacts as though the signal were regular AM—with two notable exceptions. The S-meter reading will be much lower, and the apparent "talk power" will be vastly increased.

Due to the circuit design of the Mule Box, it is practically impossible to operate this converter illegally. The power supply will put out only so much voltage, the single tube will take only a moderate "beating," and if you try to overdrive the Mule Box, your signal will be distorted. But if the instructions published in this article are followed, the converter will operate within the FCC interpretation of "average" power input of 5 watts and "average" power output of 4 watts.

EDITOR'S NOTE: The construction, installation, servicing, and maintenance of the project described in this article MUST be made by or under the immediate supervision of a person holding a first- or second-class commercial radio operator FCC license—a CB license is not enough to build or install this amplifier.

How It Works. The circuit (Fig. 1) combines two separate functions: it is an r.f. amplifier that generates the reduced carrier signal; and a switching circuit that operates the T-R change-over relay. When the transceiver is in the receive position, relay *K1* simply connects the antenna directly to the receiver, bypassing the amplifier circuit. When the transmitter is keyed, however, the r.f. voltage present at *J1* is sufficient to force diodes *D1* and *D2* into conduction, applying a positive voltage to the SCR gate. This, in turn, switches on SCR1 to operate the relay.

The output of the transmitter is then switched to the grid circuit of *V1* while the antenna is switched to the plate circuit (point *E*). Because the amount of power required to drive *V1* is considerably less than the 4 watts at the transmitter output, a limiting resistor (*Rx*) is put in series with the grid circuit to cut down the power level and also to present, as nearly as possible, a 52-ohm resistive load to the transmitter output. This is important because some transmitters will not operate properly if the load is highly reactive.

The input voltage of *V1* is stepped up by matching coil *L1* to a level sufficient to drive *V1*. Tube *V1* is biased to almost complete cutoff by battery *B1*. The idea is to drive *V1* so it produces an output of 1 to 2 watts carrier power. This is done by adjusting the matching coil (*L1*) and the drive trimmer (*C1*). When the transmitter is modulated, the additional grid voltage caused by forward modulation drives *V1* to a higher output. However, amplification is nonlinear, and

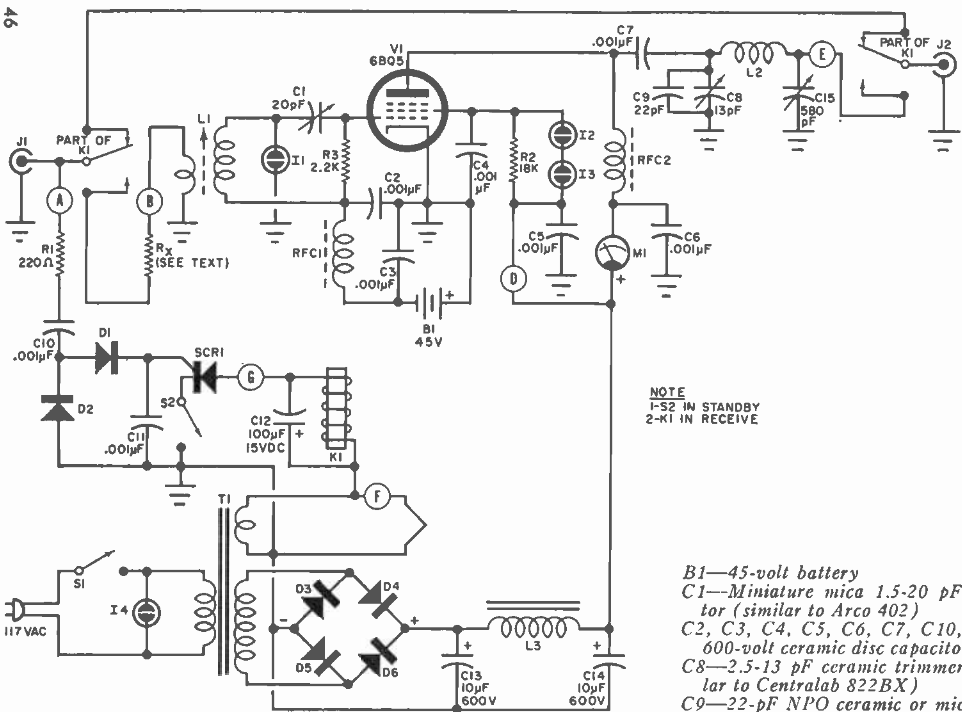


Fig. 1. Schematic diagram of the complete "Mule Box" showing T-R change-over relay K1 in receive position, and OPERATE-STANDBY switch S2 in STANDBY. With S2 set to OPERATE, the transmitter's output appearing at J1 is switched to the grid of V1 while the plate is switched to the CB antenna.

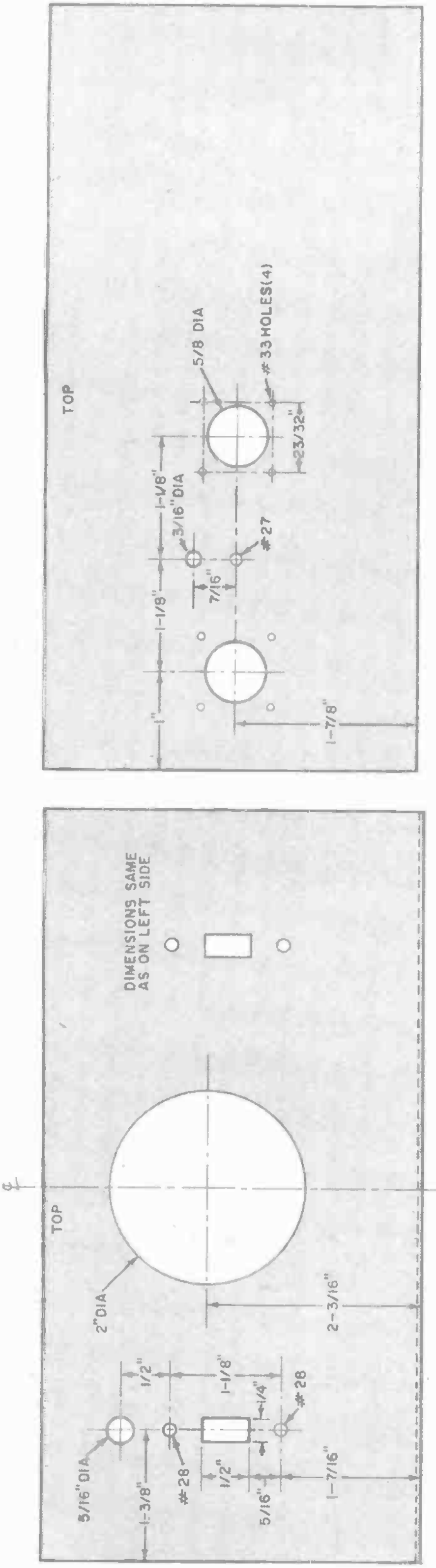
Fig. 2. If you buy the LMB CB-2 aluminum box specified at right, you can build the "Mule Box" using the dimensions below for the front panel.

Fig. 3. The back panel, which mounts the input and output connectors as well as the T-R change-over relay, is drilled following dimensions below, right.

PARTS LIST

B1—45-volt battery
C1—Miniature mica 1.5-20 pF trimmer capacitor (similar to Arco 402)
C2, C3, C4, C5, C6, C7, C10, C11—0.001-μF, 600-volt ceramic disc capacitor
C8—2.5-13 pF ceramic trimmer capacitor (similar to Centralab 822BX)
C9—22-pF NPO ceramic or mica capacitor
C12—100-μF, 15-volt electrolytic capacitor
C13, C14—10-μF, 600-volt electrolytic capacitor
C15—110-580 pF mica trimmer capacitor (similar to Arco 467)
D1, D2—1N34, or 1N294, or other similar germanium diode
D3, D4, D5, D6—0.75-ampere, 600-volt PIV silicon rectifier
I1, I2, I3—NE-2 neon lamp
I4—Neon pilot lamp, with current limiting resistor (similar to Lafayette 34 R 5208)
J1, J2—Coaxial connector (similar to Amphenol 83-1R)
K1—D.p.d.t. relay, 6-volt d.c. coil (similar to Potter and Brumfield KT11D)
*L1—Input coil: primary, 3 turns of #24 enameled wire; secondary, 18 turns of #24 enameled wire on ¼"-dia. coil form with ferrite slug**
L2—Output coil: 9 turns of #16 enameled wire on ¾"-dia. coil form
L3—8-H, 40-mA filter choke (similar to Thordarson 20C52)
M1—0-30 mA, 2¼" d.c. meter (similar to Emico RF-2C)
R1—220-ohm, ½-watt, 10% resistor
R2—18,000-ohm, 1-watt, 10% resistor
R3—2200-ohm, ½-watt, 10% resistor
RFC1, RFC2—22-μH r.f. choke (similar to Wilco W220)
Rx—33-ohm, 1-watt, 10% resistor (see text—value may be reduced for low-power transmitters)
S1, S2—S.p.s.t. slide switch
SCR1—25-volt PIV silicon-controlled rectifier (similar to Motorola MCR 2304L)
T1—Power transformer: primary, 115 volts; secondaries, 360 volts @ 42 mA and 6.3 volts @ 2.8 A (similar to Thordarson 22R38)
V1—6BQ5 vacuum tube
1—6" x 8" x 4½" cabinet (similar to LMB CB-2, gray finish)
*1—Circuit board (DEMCO 135)**
1—9-pin printed circuit miniature tube socket

*Circuit board and coil L1 are available from DEMCO, Box 16297, San Antonio, Texas 78216, for $3 postpaid in U.S.A.; complete kit of parts with punched chassis, $35 postpaid in U.S.A.



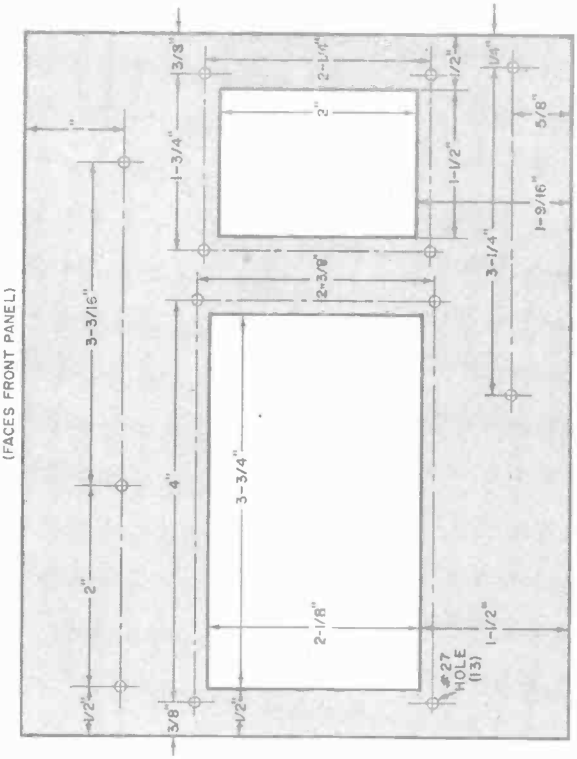
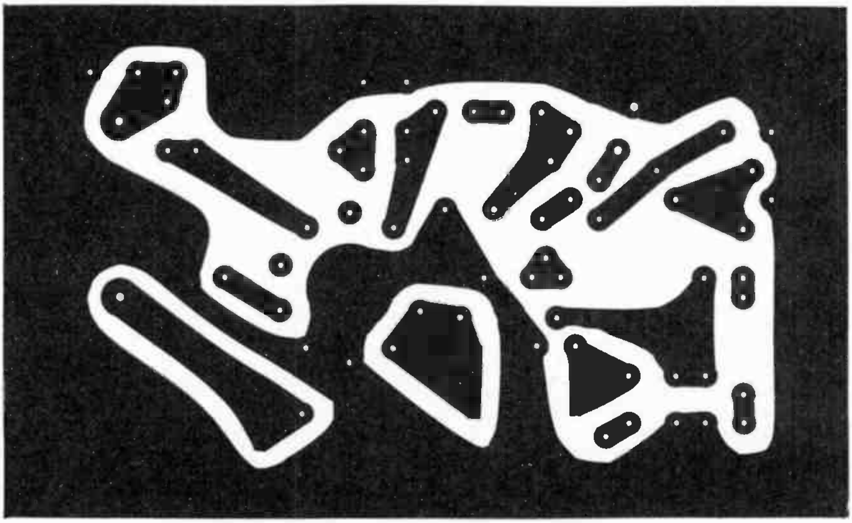


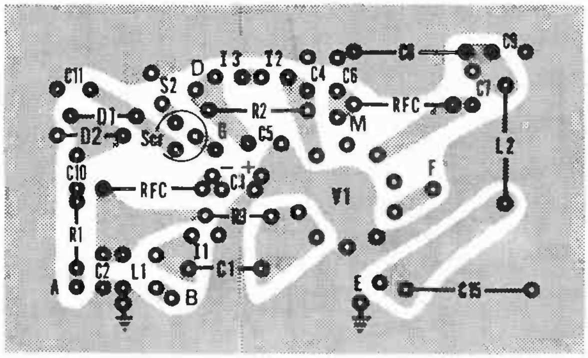
Fig. 4. These are the chassis dimensions. The cut-out at the left mounts the circuit board while the one at right provides seating for the power transformer.

only the forward modulation sideband energy is amplified. The negative half cycle of the modulation envelope is attenuated, resulting in a distortion of the audio waveform—although not enough to cause any great loss of intelligence.

The amplifier output feeds into a *pi* matching network of the type found in most transmitter finals. It matches the Mule Box into an antenna load of approximately 40 to 70 ohms. The power supply, which uses a full-wave bridge rectifier and a capacitor-choke filter, provides good voltage regulation for the amplifier.

Construction. As with all high-frequency r.f. circuits, parts layout and lead dress are critical. Too much coupling between output and input circuits can easily turn the amplifier into an oscillator. Therefore, closely follow the layout given unless you are pretty much a pro and have sufficient experience in building similar equipment. The chassis recommended comes in three separate parts,





Actual-size photo shows foil side of printed circuit board (top); component side of board is at right. Observe polarity markings when installing diodes and electrolytic capacitors.

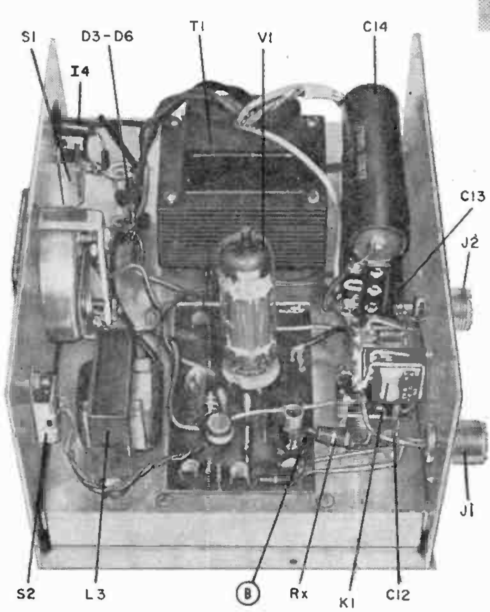


Fig. 5. With cabinet wrap-around cover removed from unit, the completely assembled "Mule Box" should look like this. Note positions of major components.

making the unit relatively easy to assemble.

Begin construction by drilling and punching the necessary holes in the chassis (see Figs. 2, 3 and 4). The meter, pilot light, and switches are mounted on the front panel (Fig. 2) while the connectors (*J1* and *J2*) and relay are mounted on the back panel (see Fig. 3). Mount *C12* under the relay (Fig. 5) and wire the leads directly to the coil lugs of the relay, observing orientation of the capacitor polarity.

Mount the transformer on the main chassis by first removing the four mounting screws holding the transformer together, and reinserting them from the opposite ends of the holes. Then secure the transformer upside-down in its place with wires visible from the top. The four rectifiers go on a terminal strip situated between the transformer and front panel. Follow the schematic (Fig. 1) for proper

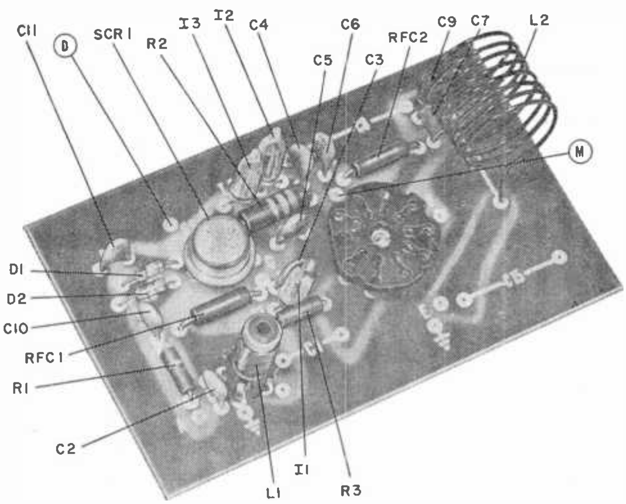


Fig. 6. Except for the necessary inter-unit wiring, the printed circuit board must be fully assembled as shown here before it is installed on the chassis.

polarity orientation of the rectifiers. Filter capacitors *C13* and *C14* are mounted on two terminal strips positioned vertically on the chassis between the transformer and back panel. The filter choke (*L3*) is bolted on the chassis behind *S2*, as shown in Fig. 5.

The circuit board can now be assembled with the parts in the positions indicated by the markings on the printed circuit board (Fig. 6). Trimmers *C1*, *C8*, and *C15* are mounted on the foil side of the board (Fig. 7) so that they will be accessible for adjustments from the bottom of the unit.

Trim off the connecting lugs on *C1* and *C15* where they protrude on the reverse surface of the circuit board to prevent their touching other components. Also, don't let an adjusting screw touch the board, as this would short out the bias battery. Mount *C8* flat against the circuit board as shown, and be sure that the lug on *C8* and *C15* which goes to the adjusting screw is soldered to the circuit board ground.

Screw the main chassis to the back panel and begin final wiring of the circuit. The transformer filament leads go first to the relay coil, and then to point *F* on the board. Mount resistor *Rx* between the relay and point *B* on the board. The connection from *J1* to the relay should be made with bare heavy stranded wire (Fig. 8); the connection from *J1* to point *A* on the board and ground is made with solid bare wire. The connections from the output circuit (point *E*) to the relay and *J2* are made with short pieces of shielded coax cable. Solder the ends of the cable shields at a common point and ground them to the front panel and to the ground near terminal *E* on the circuit board.

Connect one choke (*L3*) lead to a terminal on the rectifier terminal strip, together with a wire run from the positive side of *C13* to this point. Then cut and strip the ends from two 3½" pieces and one 5" piece of hookup wire. Connect one 3½" wire from point *D* (Fig. 6) to the positive (+) meter terminal, and the 5" length of wire from this terminal to the positive side of *C14*. Connect the other 3½" hookup wire from point *M* to the negative side of the meter.

Now mount the front panel on the main chassis. Connect the line cord to one side of the power switch, *S1*, and to the unused lug on the rectifier terminal strip. Connect the transformer primary leads to the rectifier terminal strip and to the unused lug on *S1*. Connect the two leads to *S2* (see Fig. 5). And, finally, connect the battery clip to the points marked + (plus) and − (minus) adjacent to *C3* on the circuit board. (See Fig. 6.)

WARNING: All tests and adjustments must be made by an appropriately licensed technician—your CB license is *not* a commercial operator's license.

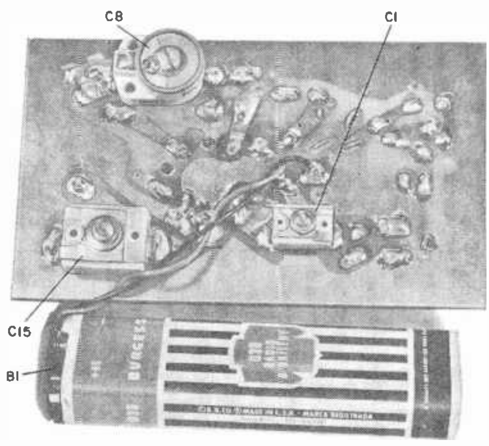


Fig. 7. The trimmer capacitors are mounted on the foil side of the printed circuit board, and are accessible for adjustments from bottom of unit only.

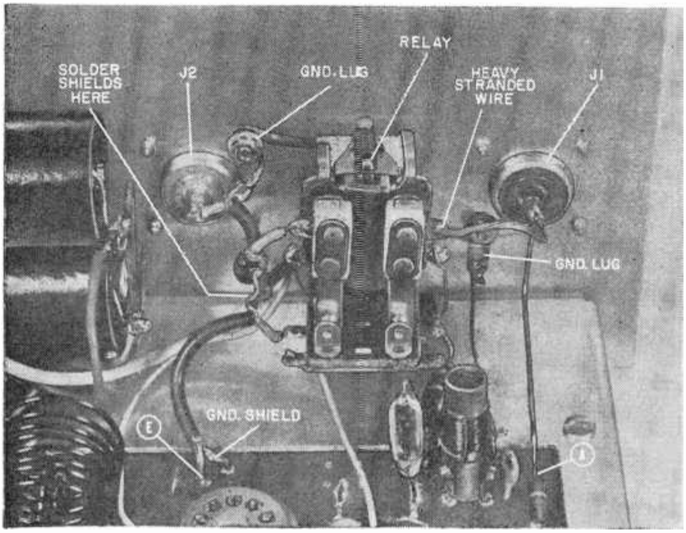


Fig. 8. Be sure to use heavy stranded wire from J1 to indicated relay terminal, and solder the cable shields together to insure common ground throughout.

Adjustment. Install the bias battery in place, turn the power switch on, and check for the presence of approximately 500 volts d.c. from the (+) side of the meter lugs to ground. Watch the Mule Box panel meter as the tube filament warms up. It should read 0 mA. If it indicates a current of more than 1 or 2 milliamperes, the bias circuit is not working properly and the circuit should be checked.

If all seems normal, connect the input of the Mule Box (*J1*) to your transmitter antenna connector, and the output (*J2*) to a 52-ohm dummy load.

Back off a couple of turns on the adjustment of *C1*, and adjust the slug in *L1* until it is even with the top of the coil form. With both your Mule Box and transmitter fired up, key the transmitter as you listen for a click from the changeover relay. The meter on the panel may, or may not, give a plate current reading. If it gives a reading beyond the mid-scale point, back off a bit on the adjustment of *C1* to reduce the reading.

In the following procedure, *C8* and *C15* must be adjusted to resonate on a channel in the center of the band. Adjust *C1* for a reading of 10 mA, and then adjust *C8* and *C15* for maximum meter deflection. These trimmers will interact to some extent, so the adjustments must be gone over at least a couple of times. If you get a reading in excess of 15 mA at any time, reduce the drive (*C1*).

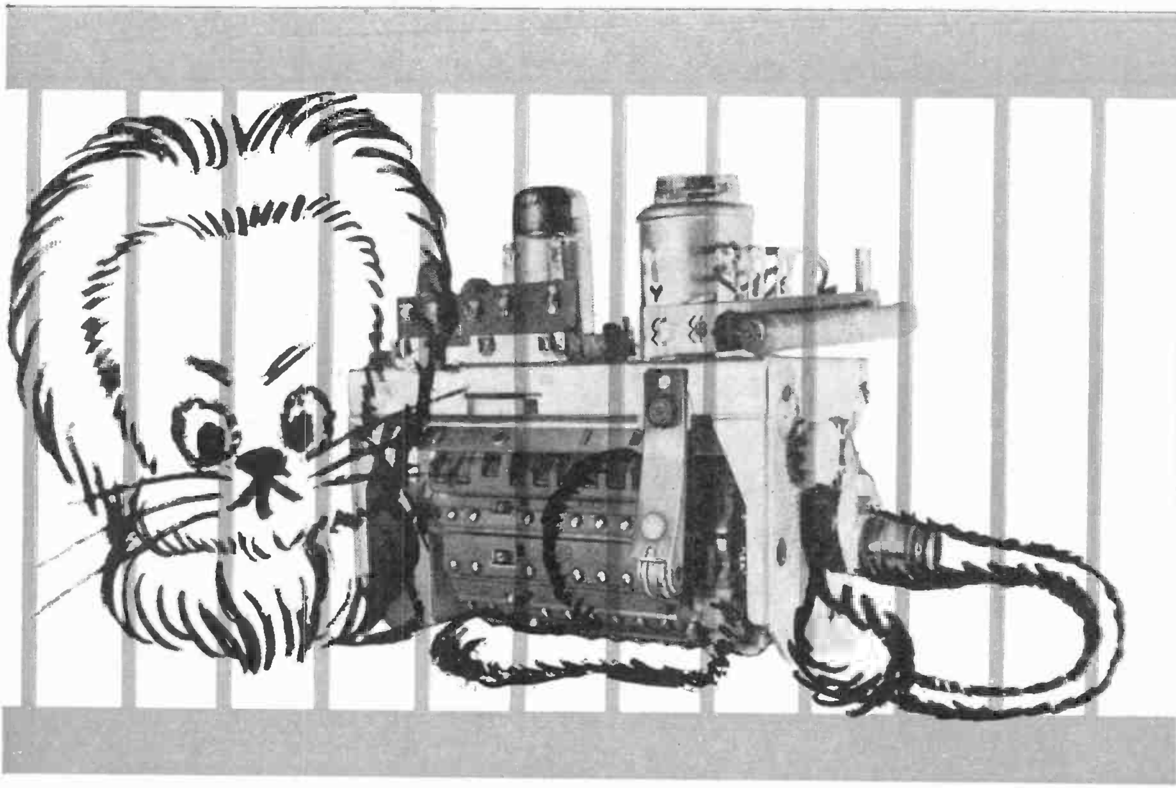
After completing the adjustment of *C8* and *C15*, your next step is to adjust *C1* and *L1* to their final settings. To do this, back off on drive trimmer *C1* and adjust the slug in *L1* by screwing it into the coil form. Observe the meter while making this adjustment, and be sure to keep the current from going above 15 milliamperes. As the slug is advanced into *L1*, neon lamp *I1* in the grid circuit should fire. At the point at which it fires, back off on the slug just enough to extinguish the lamp.

Now recheck your final tank settings and set *C1* for a reading of 10 to 12 mA.

Operation. To check the operation of the unit, whistle into the microphone. If your transmitter has proper forward modulation, the reading on the Mule Box meter should increase to about 20 milliamperes and lamp *I1* should light each time the transmitter is modulated. The screen grid lamps (*I2* and *I3*) should also flash on modulation peaks.

A good operational check is to connect a #47 lamp to the antenna connector. On normal operation, with the Mule Box on *standby*, the lamp should light when the transmitter is keyed and then flicker slightly with modulation. When the Mule Box is on *transmit*, the lamp should be dim with just the carrier applied, power output being between 1½ and 2 watts. When the transmitter is modulated, the lamp should flash brightly on modulation peaks.

(*Continued on page* 95)



Taming Your TV Tuner

By CHARLES L. SMITH

CONTACT CLEANING IS EASY IF YOU FOLLOW THESE IMPORTANT INSTRUCTIONS

IF YOU HAVE TO jiggle the channel-selector knob on your TV set to bring in a program, or if the picture and sound conk out again just as the good guys are shooting it out with the bad guys, it's a good bet that your tuner needs a cleaning. When the many dozens of silver contacts in a tuner become tarnished and dirty from exposure to the atmosphere, they make intermittent and poor electrical connections. Connections can become so bad that the slightest vibration will cause the picture to flash on and off.

Tuner contacts, whether on black-and-white or color TV sets, require frequent cleaning. How often a cleaning is needed depends upon the environment and to some degree upon the way the TV set is used. Tuner design and type of contacts also affect the length of time between cleanings.

Cleaning tuner contacts can be costly. Service shop charges of $5 are not unusual if the set is brought into the shop. Charges run higher if a serviceman is sent to the home. Of course, rates vary. Don't put off cleaning the contacts if you have to "shake well" before using your set, for chances are you are going to jiggle something loose and do damage.

Types Of Tuners. Disregarding the electrical characteristics, but considering the mechanical aspects, there are basically two types of tuners in general use that have a large number of contacts. The turret-type tuner (Fig. 1) takes the prize for the largest number of contacts. The wafer-switch type (Fig. 2) has more hidden nooks than you can shake a cleaning cloth at.

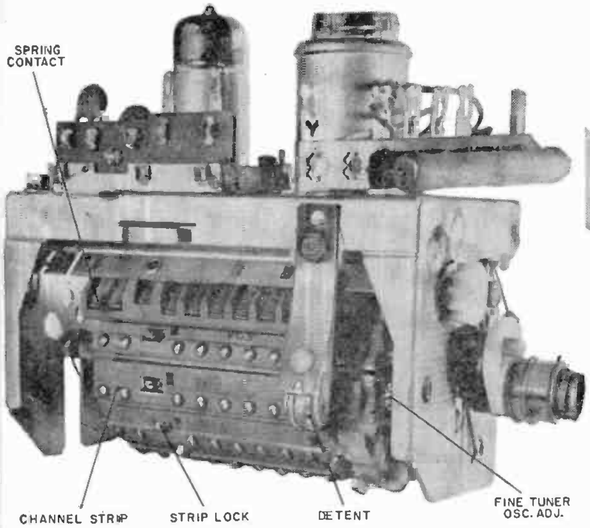


Fig. 1. Exposed turret tuner contacts are easy to clean. The detent should work easily and in a positive manner.

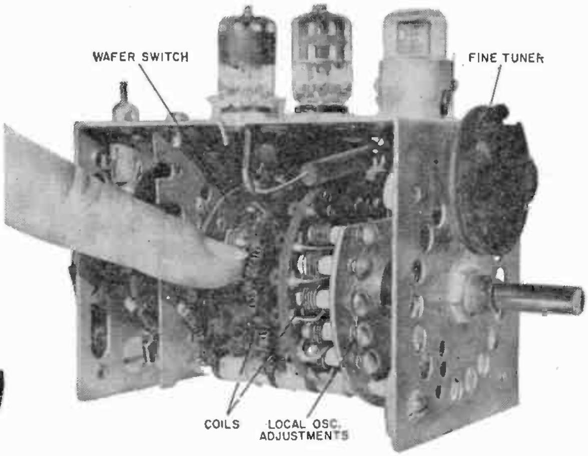


Fig. 2. Touch these coils only at the risk of detuning the channels. Cleaning the wafer-switch contacts presents a challenge, but it can be done.

The turret tuner has a separate plastic strip for each channel. Each strip has a separate set of coils which is connected to a set of fixed half-round contacts. The strips are arranged in a turret-like manner. The turret can be rotated to bring one strip at a time into position, in line with a set of spring contacts.

Unlike the turret tuner, the wafer-switch tuner has a set of coils connected in series on each wafer and, depending

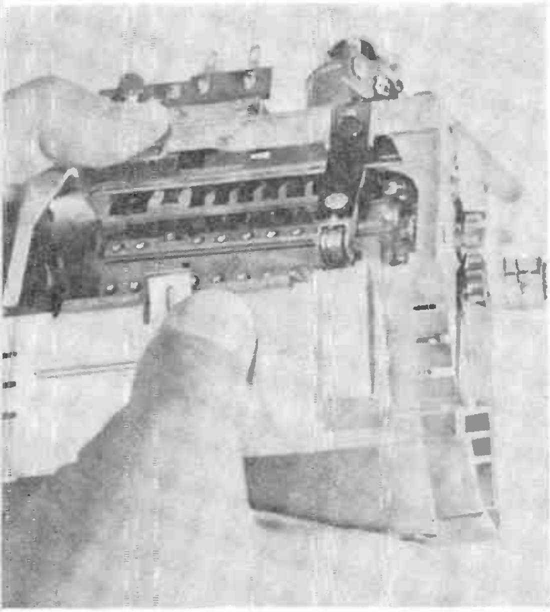


Fig. 4. To remove the shield, depress the lip with your thumb. It is possible to get to the tuner on many sets without removing it from the TV chassis.

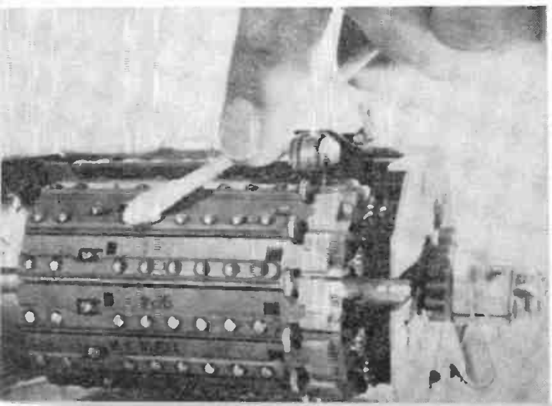


Fig. 5. Use a cotton swab or a piece of cloth dipped in tuner cleaner to make the tuner contacts shine. Rotate the drum to expose the hidden channel strips.

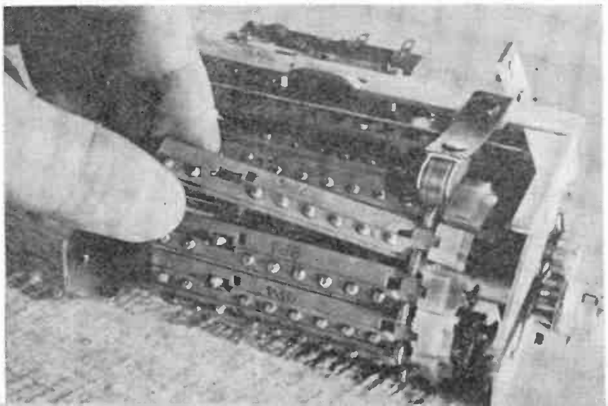


Fig. 6. Depress the channel-strip retainer to release the strip. Remove about five or six sections to get at the spring contacts. Each one is numbered in sequence and should be replaced in proper order.

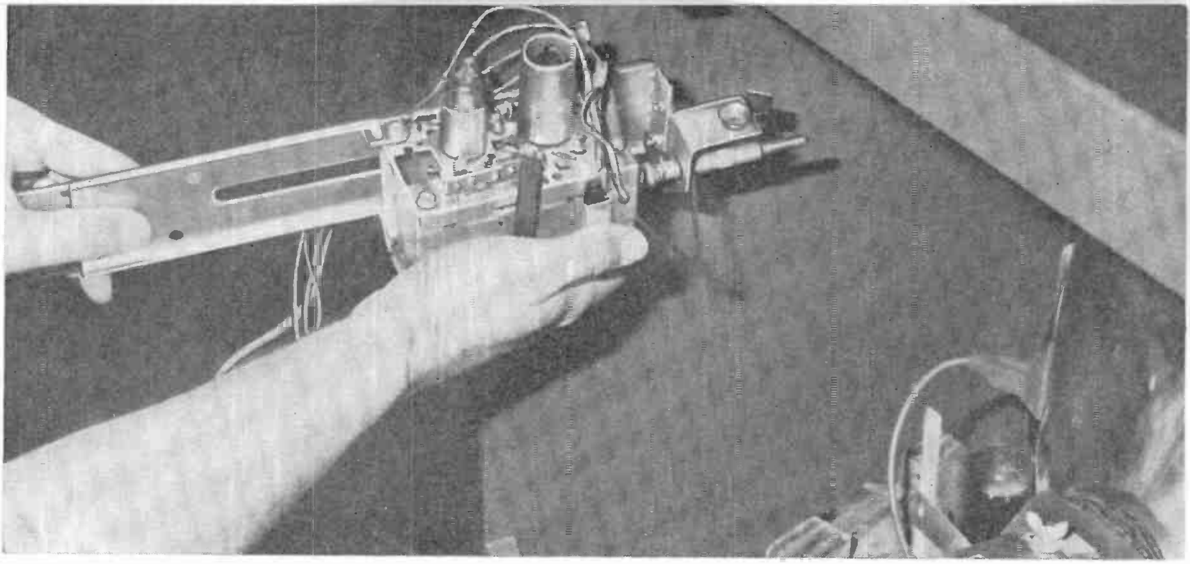


Fig. 3. Modular-type construction on some sets permits easy access to the tuner without the need to pull the chassis. In this case, you don't even have to disconnect any of the leads going to the tuner.

upon the channel selected, more or fewer coils are switched into each tuner circuit. The rotary switches "pick up" the correct number of coils for each channel. For instance, Channel 13 requires only one coil on each wafer, whereas all the coils are "alive" for Channel 2.

Warning: when you clean the tuner contacts, do NOT bend, twist, straighten or adjust any of the coils on the tuner; do NOT loosen, tighten or adjust any of the screws on the tuner; do NOT change the position of any components or leads inside the tuner; DO handle the tuner gently.

Exposing The Tuner. Always a formidable task for a neophyte (and even for a pro so far as some sets are concerned) is the job of pulling the chassis out of the cabinet to get at the tuner. If you never pulled a chassis, and if you have any doubts about your ability to do so, the best advice you can follow is to keep your hands off the set. You can do a lot of damage. But some sets have tuners that are easy to get to; unitized construction permits tuner removal for servicing in a matter of minutes. See Fig. 3.

Study the tuner mounting scheme in your particular set to find and remove the retaining screws. On some sets, only two screws at the back of the set need be taken out to remove the tuner. Carefully remove the tuner without disturbing the attached wiring. You may be able to get at the contacts without disconnecting any of the wires which connect the tuner to the set. If you do re-

Fig. 7. Be careful not to distort the setting of the spring contacts. These contacts can be reset, however, if necessary, by applying a little extra amount of pressure in the appropriate direction.

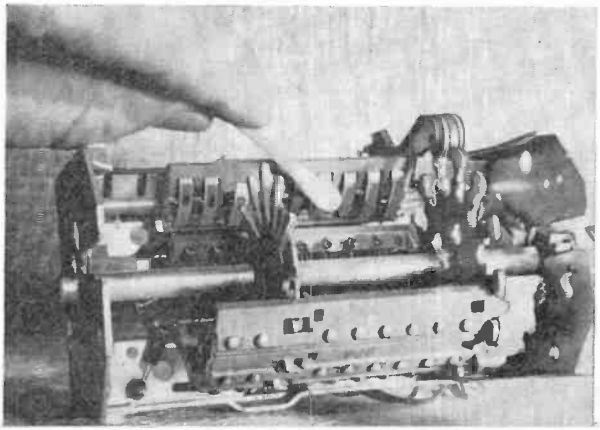
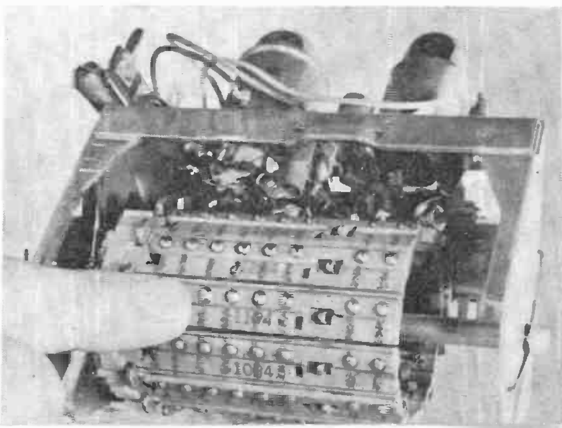


Fig. 8. Smudged channel strips are a sure indication that the spring contacts are riding on the plastic strips. Raise the contacts to clear the plastic, but not enough to miss the contacts on the strip.



move any of the wires, mark the wires and the terminals to prevent cross-wiring when reassembling—don't trust your memory. (Do not remove the tuner if it is mounted on the TV chassis unless you have to. Most chassis-mounted tuners can be cleaned without removal.)

Remove the U-shaped metal cover by depressing the lock until the projecting lip clears the tuner chassis as shown in Fig. 4. Dull, discolored contact surfaces showing thin black streaks reveal a definite need for cleaning.

Cleaning Turret-Type Tuners. Clean away the tarnish by wiping each contact with a cotton-tipped swab, or other suitable piece of cloth, lightly moistened with a cleaning solution, as shown in Fig. 5. Rotate the turret to expose all of the strips. Polish the contacts thoroughly, until all evidence of the cleaner disappears.

When all the rotary contacts are clean, carefully remove about five or six strips as shown in Fig. 6, and rotate the turret until the spring contacts are accessible, as shown in Fig. 7. Clean these contacts carefully. Do not exert enough pressure on the spring contacts to cause them to come to rest at a new angle. These contacts must be properly positioned. If they are too deeply recessed in their slots, they won't make contact with the contacts on the channel strips. If the spring contacts project too far out of their slots, they will ride on the plastic strips and smudge up the strips as well as the contacts so badly that you'll wonder where the yellow went. (Some plastic strips are yellow.) See Fig. 8.

You can check the position of these spring contacts by observing their action as you rotate the turret. The springs should rise and fall as the contacts on the strips pass the springs. If any of the springs do not rise, gently and judiciously pull them down just enough to reset them in a lower position. Recheck the action after an adjustment is made.

It's a good idea to check out the action for all channel strips just in case there is an out-of-round condition which requires a touch-up adjustment. Of course, you should also check to see that the springs are not set low enough to touch the plastic strips.

Don't overlook the detent—it centers and holds the turret on the selected channel. The detent should be free-acting, clean and lubricated. Lubriplate or other similar lubricant can be used. Do not disassemble the detent if it is in working order.

After you have cleaned the tuner and are satisfied with the mechanical action, you can "button it up."

Cleaning Wafer-Switch Tuners. Because of their concealed type of construction, wafer-switch type tuners are more difficult to get into. In a great many cases you can rely on the wiping action of the contacts to do the elbow work on a cleaning job. Try wiping the rotary contacts with a pipe-stem cleaner, soaked in a cleaning solution, as you rotate the tuner shaft. In many cases you have to rely on the rotating contacts to carry the cleaner around to the inaccessible stationary contacts.

Spray cleaners are handy to get at the "buried" sides of the switches, but you should avoid spraying anything except the contacts. Some of the sprays can detune your tuner, especially while they are still wet. If you find a few misplaced channels after an indiscriminate spraying job, you will have to "dry" out the tuner. Most sprays, particularly the aerosols, dry out by themselves.

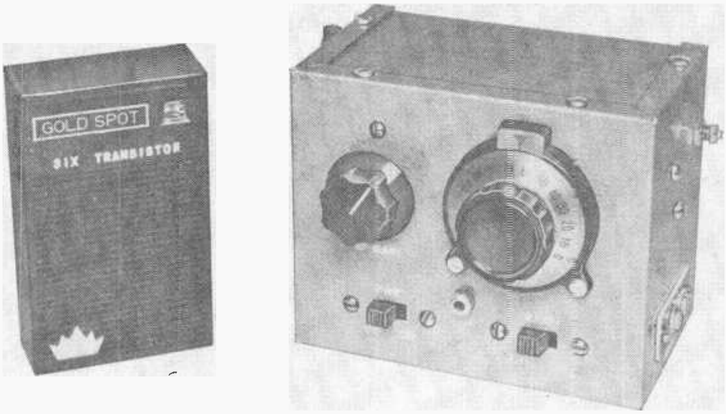
Choosing A Cleaner. Most electronic supply houses stock general-purpose contact cleaners in 2-oz. bottles that sell for about 50 or 60 cents. If you elect to use such a general-purpose cleaner, follow up the contact-cleaning operation with a light, filmy application of silicone lubricant.

There are special-purpose tuner and contact cleaners in various types of packaging, ranging from eye-dropper bottles to aerosol spray cans; prices range from less than a dollar to more than three dollars. The aerosol spray cleaner, consisting of carbon tetrachloride, trichloroethane, or other chlorinated hydrocarbon solvent, washes away foreign matter under the pressure of freon propellant. Freon, containing no active properties, evaporates thoroughly.

Most tuner cleaners deposit an extremely thin film of silicone lubricant that guards against future contamination. -30-

BUILD

The "Camper's Cuzzin"



SMALL CONVERTER SETS UP ORDINARY AM RADIO FOR 75- AND 80-METER HAM BANDS

By **HARTLAND B. SMITH,** W8VVD

THE "CAMPER'S CUZZIN" can convert just about any AM broadcast radio into a 75- and 80-meter ham band receiver to pick up CW, SSB, and AM phone signals. It will even work on your small transistor radio. No modifications or connections to the radio are needed. The converter and the radio need only be placed near each other.

While primarily designed as a companion to the "Camper's Special" 80-meter CW transmitter (POPULAR ELECTRONICS, August, 1965), this unit will do an excellent job for the prospective ham who wants to tune in W1AW code practice transmissions, as well as for the SWL who would like to "dequack" single-sideband signals. It's the BFO in the converter that let's you hear CW and SSB as it should be heard.

Some of the features that make the "Camper's Cuzzin" suitable for camping, fishing and hunting trips are its small size, light weight, and small current battery operation. The low cost involved in building it, about $14, is also appealing.

How It Works. The signal from an antenna connected to *TS1* (see Fig. 1) is coupled to the base of *Q1*. Transistor *Q1* serves both as an amplifier and as a mixer. The slug in *L1* broadly tunes the input circuit for resonance at any frequency between 3.5 and 4.0 MHz; it protrudes through the front of the cabinet and is labeled *RF Gain*.

The r.f. signal is mixed with another signal coupled into *Q1*'s emitter from *Q2* by way of *C5*. The *Q2* circuit is a series-fed Hartley oscillator which can be tuned through a frequency range of 5.1 to 5.6 MHz simply by varying the setting of *C9*. A vernier dial drives *C9* and makes it possible to obtain the very wide bandspread needed for non-critical tuning of SSB signals.

When the oscillator signal mixes with the incoming signal, sum and difference frequencies are produced. The difference frequency, which is on the order of 1.6 MHz, is the one that is needed to feed into the broadcast-band radio. Tank circuit *L2/C2* is slug-tuned to resonate and radiate at this frequency.

If the converter is used in a transmitter and receiver setup, the jumper wire across *TS2* can be removed and a switch or the normally-closed contacts on a transmit/receive relay can be connected in its place. When the transmitter is on, the relay is energized and removes the forward bias voltage needed to operate *Q1*, and "silences" the converter. Notice that battery power to the other circuits in the converter is not affected. This eliminates the oscillator drift which would otherwise occur every time the power was turned on and off.

Transistor *Q3*, like *Q2*, is a local os-

PARTS LIST

B1—9-volt battery
*C1, C7, C13—75-pF NPO disc capacitor**
*C2, C5, C10—100-pF NPO disc capacitor**
C3, C6, C8, C11, C12, C14, C15—0.0047-µF disc capacitor
C4—0.001-µF disc capacitor
C9—15-409 pF variable capacitor (Allied Radio 43 A 3524, or similar)
L1—1.7-5.5 MHz antenna coil (J. W. Miller B-5495-A, or similar)
L2—540-1,650 kHz loop antenna (J. W. Miller 2002, or similar)
L3—Slug-tuned oscillator coil wound on J. W. Miller No. 21A000RBI coil form as described in text
L4—455-kHz oscillator coil (J. W. Miller 2020, or similar)
Q1, Q2, Q3—2N1526 transistor
R1, R9—3900 ohms
R2—10,000 ohms
R3, R6, R8—1000 ohms
R4—100,000 ohms
R5—8200 ohms
R7—18,000 ohms
R10—22,000 ohms
(All resistors ½ watt)
S1, S2—S.p.s.t. switch
TS1, TS2—Two-screw terminal strip
1—5" x 4" x 3" metal box
Misc.—Transistor sockets (3); 2-lug terminal strip (1); 3-lug terminal strip with ground lug (1); ¾" spacers (2); vernier dial; short length of ¼" round insulated rod; knob; 6-32 hardware; solder; wire, etc.

*NPO disc capacitors: Sprague 10TCC, or similar

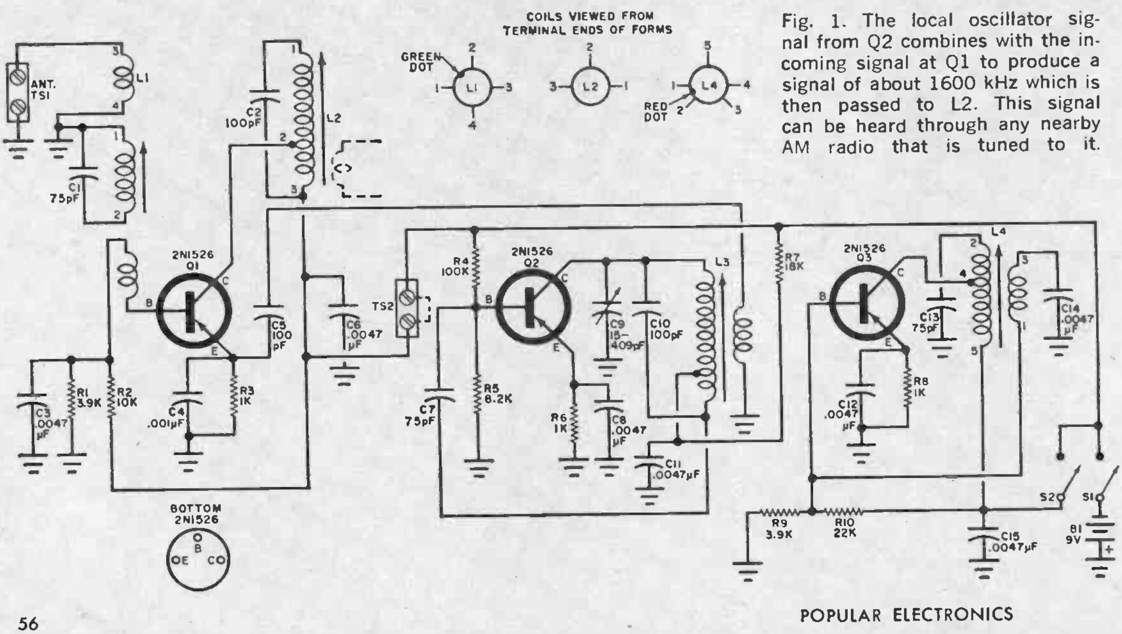
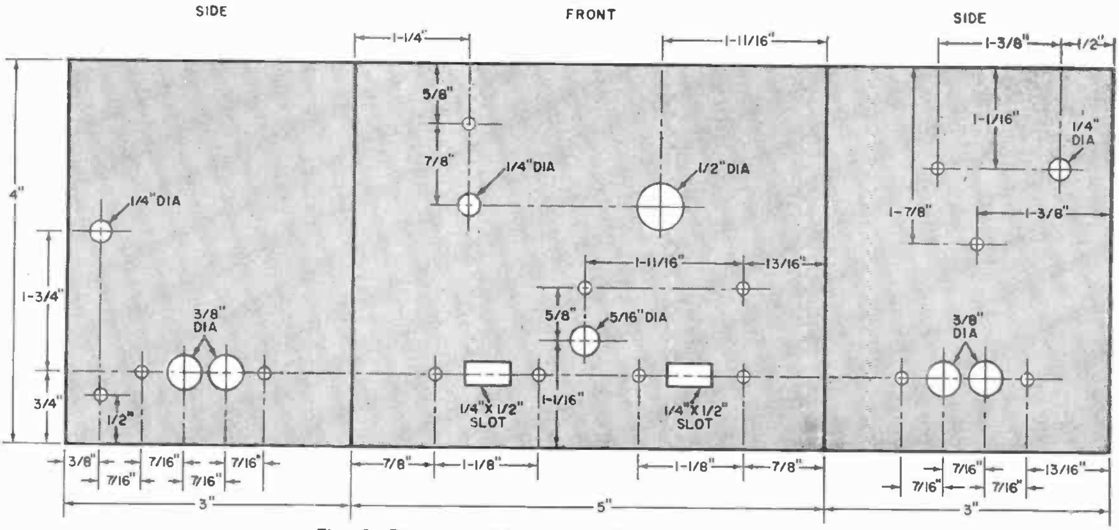


Fig. 1. The local oscillator signal from Q2 combines with the incoming signal at Q1 to produce a signal of about 1600 kHz which is then passed to L2. This signal can be heard through any nearby AM radio that is tuned to it.



ALL HOLES NO. 28 DRILL
UNLESS OTHERWISE NOTED

Fig. 2. Prepare a 5" x 4" x 3" metal utility box exactly as shown. Pay particular attention to the mounting holes for C9 in the upper portion of the front and side.

cillator, but is tuned to approximately 1600 kHz, and serves as a BFO. When *S2* is switched on, the BFO reinserts a carrier to make SSB signals intelligible, or it beats with an incoming CW signal to make it readable. The BFO signal is strong enough to get into the *Q1* circuit without direct coupling. For AM phone reception, *S2* is left in the *off* position.

Power for the converter can be obtained from a 9-volt transistor battery, or from six 1.5-volt penlight cells connected in series.

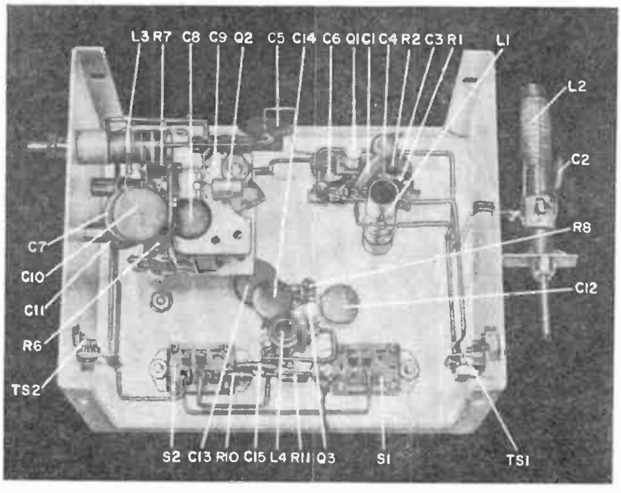


Fig. 3. All components associated with C9 and Q2 should be solidly mounted. For best results, keep leads as short as possible and dress wires neatly.

Construction. Prepare a 5" x 4" x 3" metal box as shown in Fig. 2. Follow the layout shown in Fig. 3. Pay particular attention to the mounting of variable capacitor *C9* and the vernier dial. Use ¾"-long metal spacers to position *C9* securely in place.

Only two plates on the rotor of *C9* are needed. If your capacitor has a fiber spacer strip attached to one end of the rotor plates, carefully cut through this strip, between the second and third plates from the front. Use a pair of long-nose pliers to work the rotor plates free, one at a time. Remove all but the two plates at the front end. Do not do anything to the stator plates, and be careful not to bend or shift the position of the remaining plates.

Good SSB reception will only be possible if the tunable oscillator is mechanically rugged. All components associated with *Q2* and *C9* should be solidly mounted. When mounting *C9* on the chassis, keep your eyes on the ends of the mounting screws and avoid digging into and shorting out the capacitor's plates. If necessary, grind the ends of the screws down, or place washers under the screw heads. Mount *L3*, *C9*, and *Q2* as close to each other as possible in order to keep their leads short. (See Parts List for type of coil form needed for *L3*.)

The tapped primary winding for *L3* requires 23 turns of #28 enamel-covered wire, tapped 3 turns from the *C7* end.

Remove the enamel coating from the ends of the wire and solder the wires to the solder rings supplied with the coil form. Wrap one layer of electrical tape around the untapped 20 turns. The secondary winding consists of 4 turns of #28 enameled wire wound over the tape. Use coil dope to cement each winding in place. If you don't have any suitable cement, you can pour melted wax over the windings.

Modify coil *L1* by adding a 5-turn winding of #28 enamel-covered wire to the top end of the coil, over the secondary winding—this is the end away from the terminals. Use cement or wax to hold the windings in place.

Solder the ground leads of *C8, C11, R5,* and *R6* to a ground lug on the frame of *C9*. The ground leads of *C12, C13, C14* and *R8* go to a ground lug held in place by one of the nuts used to mount the vernier dial.

To mount the control knob for *L1*'s slug, drill a hole the same size as the diameter of the adjusting screw on the slug in the center of one end of a ⅜"-long by ¼"-diameter piece of plastic rod. Cement this end onto the adjusting screw and, when dry, secure the knob in place. Use a knob equipped with a setscrew.

Cut the transistor leads to about ⅜" in length and bend them to conform with the holes in the transistor sockets. Observe polarity when connecting the battery—it can be mounted inside the case. Close the cover before using the unit.

Adjustment. Tune your AM broadcast radio to a "dead" spot near 1600 kHz on the dial. Set the converter near the radio so that *L2* is close to the radio's loop antenna. (If the radio doesn't have a loop antenna, wind about five turns of #28 insulated wire around *L2* and connect one end to the receiver's antenna, and the other end to ground. Turn on the radio and crank up the volume control.

Switch on the "Camper's Cuzzin." Slowly screw the slug into *L2*. If the mixer is working properly, you'll begin to hear a hissing sound in the speaker. Adjust the slug for maximum hiss.

Connect a suitable 75- to 80-meter antenna, preferably fed by a coaxial cable or other 75-ohm lead, to *TS1*. Set the vernier control (*C9*) to its approximate midposition, and adjust *L3* to tune an AM phone amateur station. Move the radio away from the converter until the signal is very faint. (If you had to connect a 5-turn winding on *L2* to your radio, temporarily reduce the number of turns, to reduce the coupling.) Peak the *RF Gain* control for maximum signal.

Tune in an SSB station for maximum by adjusting the vernier control, with the BFO off. Switch the BFO on, and tune *L4* for clearest voice reception. Now jockey the slug in *L3* back and forth until you can hit the low-frequency edge of the band when *C9* is at or near maximum capacity. The high end of the band should come in where *C9* is at or near minimum capacity.

Then tighten the lock-nut on *L3*, and bring the radio back in close to the converter for normal operation.

Operating Hints. When searching for a weak station, adjust the *RF Gain* control for a maximum amount of background noise. For strong CW or SSB signals, you may find it advantageous to cut down the gain to prevent the incoming signal from overriding the BFO.

Putting a converter into operation for the first time is a relatively simple job if you understand what each part of the circuit is supposed to do. In case you encounter any problems, remember that *C1* and *L1* tune between 3.5 and 4 MHz. Coil *L2* should be peaked at 1.6 MHz, and *L3* should resonate at 5.4 MHz with *C9* at half capacity. If you have a general-coverage receiver, listen at 5.4 MHz for the signal generated by *Q2*. Transistor *Q3* oscillates at 1.6 MHz—you can hear its steady carrier on the broadcast set.

Transistor *Q1* is not supposed to oscillate. In the unlikely event that you hear birdies as *L1* is tuned through its range, reverse the leads on the winding you added to *L1*. If this doesn't help, remove a turn or two from the winding.

The "Camper's Cuzzin" is very sensitive. When hooked up to a good antenna, it will pull in any 75- or 80-meter station that can be heard on a top-quality communications receiver. Its ability to separate signals during periods of heavy QRM is dependent, of course, on the selectivity of the broadcast-band receiver with which it is used. Obviously, the sharper the receiver, the better will be the overall performance. —30—

STAMP OUT AUTO THEFT

THE ONLY WAY YOUR CAR CAN BE STOLEN WHEN IT IS PROTECTED WITH THE "AUTO SENTINEL" ALARM IS FOR THE THIEF TO PICK IT UP BODILY AND CARRY IT AWAY

By R. L. WINKLEPLECK

AUTO THEFT is a big business for organized crime and an actively pursued hobby for thousands of teen-agers looking for "kicks." In an effort to stave off these thefts, many laws have been put into effect through which stiff fines and summonses can be handed out to owners who leave keys in ignitions when they get out of their cars, who fail to lock their car doors when their cars are left unattended for a long time, and who conspicuously display valuable goods in their cars—and who commit other such offenses that are open invitations to a thief to ply his trade. Although these

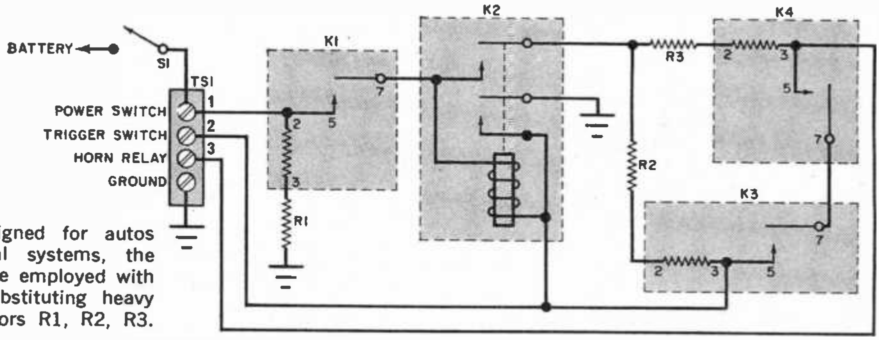


Fig. 1. Although designed for autos with 12-volt electrical systems, the "Auto Sentinel" can be employed with 6-volt systems by substituting heavy jumper wire for resistors R1, R2, R3.

laws are fine as far as they go, they will not effectively thwart a determined car thief. It is for this reason that auto alarms are constantly being designed to help stamp out auto theft.

The "Auto Sentinel" alarm system has a unique quality which places it at the top of the list so far as alarms are concerned; it can be put on the alert without anyone knowing about it, even if the driver is being "cased." There are no external locks or switches mounted on the car to set or deactivate the system. Cost is less than $15.00.

How It Works. The circuit of the Auto Sentinel, shown in Fig. 1, is simple and virtually foolproof. Once it is connected to your car's electrical system and power switch *S1* is thrown on, the battery voltage is applied to thermal relay *K1*. After about 15 seconds, *K1*'s contacts close, and place the alarm system on standby.

If a door is opened while the system is on standby, magnetic relay *K2* energizes and latches in this mode through its lower contacts. Even if the door is opened momentarily and then immediately closed, the alarm circuit is activated.

Once the circuit is activated by a thief, his time begins running out. At the end of about 15 seconds *K3* energizes, grounding the car's horn relay through *K4*, *K3* and *K2*. As the horn relay closes, *K4*'s heater circuit is completed, and after one piercing blast from the horn (at which the surprised thief will, hopefully, drop everything and run for the hills), the horn will continue to sound at a rate of 30 times a minute until *S1* is shut off.

You have 15 seconds (the time needed for *K1* to energize) to get out of your car after the switch is thrown and to close the door. This time margin is more than adequate for you to activate the alarm without alerting anyone to what you are doing, but not adequate enough for a thief to achieve his purpose. Upon re-entering the car, you have another 15 seconds—before *K3* energizes—to switch the alarm system off.

Construction. First, decide where you want *S1* mounted. You can mount it on the same box in which the rest of the circuit is assembled, or you can hide the switch behind the dashboard in any convenient place.

Almost any type of chassis construction is suitable, but since the unit is likely to be subjected to a lot of mechanical stresses, all connections should be mechanically sound—use enough solder

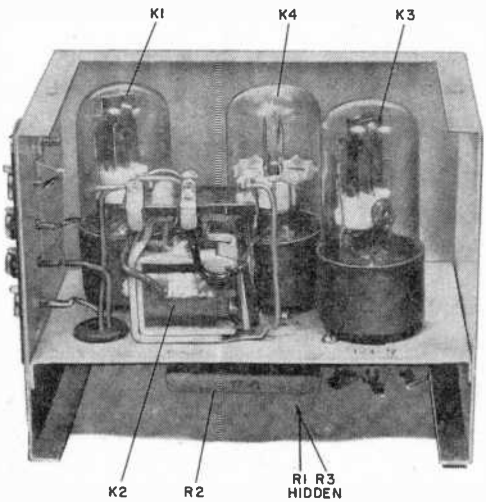


Fig. 2. Typical layout shows all relays mounted on chassis surface while the resistors are underneath it. Note that K1, K3, and K4 are socket-mounted.

to keep them that way. Also, use lockwashers with all screws.

Parts layout is not critical, and can be as shown in Fig. 2. The completed unit is shown in Fig. 3. Construction is the same for both 6- and 12-volt electrical systems except that *R1, R2* and *R3* are not used for a 6-volt system.

If you decide to mount the box in the engine compartment, keep it away from heat, oil, water, and other debris.

Hookup. Connecting the Auto Sentinel to your car's electrical system is a snap. The door switches that operate the dome light, or other courtesy lights, plus a switch on the car's trunk lid, and another on the engine hood all serve as "triggers" for the alarm system. If all your doors, hood, and trunk are not already equipped with switches, you will have the additional task of installing suitable switches in order to protect all entry areas. Mercury switches are the easiest types to install on the hood and trunk lid.

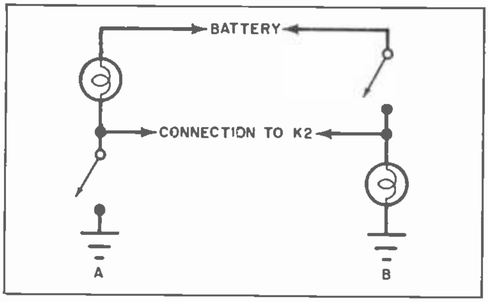


Fig. 4. If a mercury switch is used for the trunk light and it is wired as shown in B, rewire it to conform to the configuration shown in A at left.

PARTS LIST

K1, K3—S.p.s.t., normally open thermal relay with 15-second delay (Amperite 6N015 or similar)
K2—D.p.s.t., 6-volt relay
K4—S.p.s.t., normally closed thermal flasher with 30 flashes per minute (Amperite 6F30 or similar)
*R1—20-ohm, 5-watt resistor**
*R2, R3—15-ohm, 5-watt resistor**
S1—S.p.s.t. switch
TS1—4-post terminal strip
Misc.—Small utility box, hookup wire, octal sockets (3), solder, etc.

**Omit these parts with 6-volt systems*

Generally, door switches are wired like the circuit shown in Fig. 4(a). Connect a wire from terminal *2* on *TS1* to any door switch on the dome light side as shown. If a mercury switch is used for the trunk light and it is wired as shown in Fig. 4(b), rewire it to conform with 4(a).

Connect the horn relay to terminal *3* on *TS1*. (There's nothing to prevent you from installing a siren and let it do the screeching for you, instead of your horn, if you are so inclined.) Finally, connect *S1* between the ungrounded side of the car's battery and terminal *1*. If the alarm box is well grounded, there is no need to make a connection between terminal *G* on *TS1* and the car's ground.

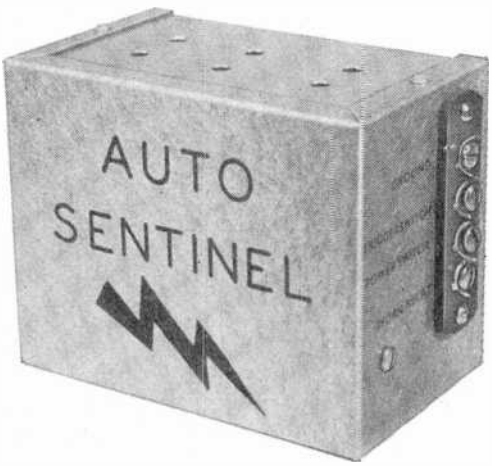


Fig. 3. If desired, the "Auto Sentinel" can be mounted in the glove compartment, or behind the dash where connecting wires can be run out of sight.

Finishing Touches. All that's left now is for you to test the alarm system. If it works as described here, and it should, you're in business, and a thief will just have to look somewhere else to make his illegal livelihood.

Put the system on standby, lock all of the car doors, and relax. Don't worry about the drain on your battery while the alarm is on standby; it's only about 15 milliamperes.

One final word: if you have a tendency to leave your keys in the ignition lock when you get out of your car, forget this whole idea—you'll never remember to turn the Auto Sentinel on—or off! —30—

NEW CAREER PROGRAMS BEGIN WITH "AUTOTEXT" INSTRUCTION METHOD!

Start to learn the field of your choice immediately!

No previous training or experience in electronics needed!

With this new revolutionized method of home training you pick the career of your choice—and *RCA Institutes trains you for it*. RCA's Career Programs assure you that everything you learn will help you go directly to the field that you have chosen! No wasted time learning things you'll never use on the job! The Career Program you choose is especially designed to get you into that career in the fastest, easiest possible way!

And each Career Program starts with the amazing "AUTOTEXT" Programmed Instruction Method—the new, faster way to learn that's almost automatic! "AUTOTEXT" helps even those who have had trouble with conventional home training methods in the past. This is the "Space Age" way to learn everything you need to know with the least amount of time and effort.

CHOOSE A CAREER PROGRAM NOW

Your next stop may be the job of your choice. Each one of these RCA Institutes Career Programs is a complete unit. It contains the know-how you need to step into a profitable career. Here are the names of the programs and the kinds of jobs they train you for. Which one is for you?

Television Servicing. Prepares you for a career as a TV Technician/Serviceman; Master Antenna Systems Technician; TV Laboratory Technician; Educational TV Technician.

FCC License Preparation. For those who want to become TV Station Engineers, Communications Laboratory Technicians, or Field Engineers.

Automation Electronics. Gets you ready to be an Automation Electronics Technician; Manufacturer's Representative; Industrial Electronics Technician.

Automatic Controls. Prepares you to be an Automatic Controls Electronics Technician; Industrial Laboratory Technician; Maintenance Technician; Field Engineer.

Digital Techniques. For a career as a Digital Techniques Electronics Technician; Industrial Electronics Technician; Industrial Laboratory Technician.

Telecommunications. For a job as TV Station Engineer, Mobile Communications Technician, Marine Radio Technician.

Industrial Electronics. For jobs as Industrial Electronics Technicians; Field Engineers; Maintenance Technicians; Industrial Laboratory Technicians.

Nuclear Instrumentation. For those who want careers as Nuclear Instrumentation Electronics Technicians; Industrial Laboratory Technicians; Industrial Electronics Technicians.

Solid State Electronics. Become a specialist in the Semiconductor Field.

Electronics Drafting. Junior Draftsman, Junior Technical Illustrator; Parts Inspector; Design Draftsman Trainee Chartist.

SEPARATE COURSES

In addition, in order to meet specific needs, RCA Institutes offers a wide variety of separate courses which may be taken independently of the Career Programs, on all subjects from Electronics Fundamentals to Computer Programming. Complete information will be sent with your other materials.

LIBERAL TUITION PLAN

RCA offers you a unique Liberal Tuition Plan—your most economical way to learn. You pay for lessons only as you order them. No long term contracts. If you wish to stop your training for any reason, you may do so and not owe one cent until you resume the course.

VALUABLE EQUIPMENT

You receive valuable equipment to keep and use on the job—and you never have to take apart one piece to build another. **New—Programmed Electronics Breadboard.** You now will receive a scientifically programmed electronic breadboard with your study material. This breadboard provides limitless experimentation with basic electrical and electronic circuits involving vacuum tubes and transistors and includes the construction of a working signal generator and superheterodyne AM Receiver.

Bonus From RCA—Multimeter and Oscilloscope Kits. At no additional cost, you will receive with every RCA Institutes Career Program the instruments and kit material you need to build a multimeter and oscilloscope. The inclusion of both these kits is an RCA extra.

CLASSROOM TRAINING ALSO AVAILABLE

RCA Institutes maintains one of the largest schools of its kind in New York City where classroom and laboratory training is available in day or evening sessions. You may be admitted without any previous technical training; preparatory courses are available if you haven't completed high school. Coeducational classes start four times a year.

FREE PLACEMENT SERVICE

In recent years, 9 out of 10 Resident School students who used the Free Placement Service had their jobs waiting for them when they graduated. And many of these jobs were with top companies in the field—such as IBM, Bell Telephone Labs, General Electric, RCA, and radio and TV stations and other communications systems throughout the world.

SEND ATTACHED POSTAGE PAID CARD FOR COMPLETE INFORMATION, NO OBLIGATION. NO SALESMAN WILL CALL.

ALL RCA INSTITUTES COURSES AVAILABLE UNDER NEW GI BILL.

RCA INSTITUTES, Inc., Dept. PE-37
A Service of Radio Corporation of America
350 West 4th St., New York, N.Y. 10014

The Most Trusted Name in Electronics

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

AS DETAILED on page 68 of the February issue, this new department, *Information Central,* will be devoted to answering questions submitted by readers. This month I have chosen another batch of letters from the huge volume of mail received at the POPULAR ELECTRONICS editorial offices. The subject matter of many of them may pertain to your own hobbyist/experimenter activities.

Included in this month's selection are questions on the repair and maintenance of electronic equipment, ham radio, CB, solid-state experimenting, SWL'ing, etc. If you have a problem or question that has been plaguing you for some time, don't hesitate to send it to *Information Central.*

Preselectors for CB. *I have seen some advertisements for 27-MHz preselectors that can be connected between my antenna and transceiver. Are they worthwhile?*

Unless your CB transceiver is an old clunker, it is very doubtful that a preselector will be of much value for *normal* CB operations. At least nine out of every ten CB transceivers have more than sufficient receiver sensitivity; and with the channel congestion problem, you need selectivity—not sensitivity. However, in some instances where "fringe" receiving conditions prevail, you might find a r.f. preselector of value. But you'll have to develop a switching arrangement to keep the r.f. of the transmitter out of your preselector.

Degaussing Coil. *I just assembled a color TV kit and was wondering if I could make my own degaussing coil?*

Although there is some question as to the amount of money you might save, you can make your own degaussing coil if you happen to have a couple of thousand feet of No. 20 cotton-covered wire on your workshop shelf. Simply select a convenient 12"-diameter form and wind about 450-500 turns on it into a coiled-rope shape, about 1" in diameter. Bring the two ends of the coil out and solder them to a zip cord with an a.c. plug to fit into your household 117-volt line. Be sure to insulate the connections between the zip cord and the coil and to tape the coil "bundle" in at least eight or ten different places so that it won't lose its shape. Don't leave the coil plugged in to the house wiring too long as there will be some heating.

Simple Treble Cut. *I own a popular ham band transceiver and would like to add some additional bass. The audio is of good communications quality; but for my voice, it sounds lousy.*

Probably the easiest solution to your problem would be to add the treble cut circuit shown in the accompanying wiring

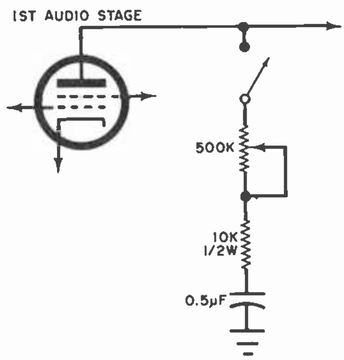


diagram. I would recommend inclusion of a s.p.s.t. switch just in case a visitor doesn't have your particular voice quality.

Large Screen Oscilloscope. *For a high school science project, I would like to convert an old 17" TV receiver into a large screen oscilloscope. Can this be done?*

Yes—at least from a theoretical aspect—you should be able to make this conversion, although the job is not exactly an easy one. You have to know quite a bit about TV circuitry and be a fairly good analyst of wiring diagrams. Generally, the conversion is made by using the existing high voltage circuits and converting the vertical and horizontal drive circuits while adding the proper sawtooth (sweep) oscillator. I understand that plans are available from Relco, A33, Box 10563, Houston 18, Texas, for about $2 which might assist you in this endeavor.

Unfortunately, I have never seen a set of these plans and cannot judge their value.

Intermittent Ohmmeter. *I have a low-cost VOM and it is now "intermittent." Sometimes the meter will read perfectly, but every once in a while I get all sorts of screwy readings.*

The solution to this problem probably lies in the pressure contacts that hold the batteries in place. These contacts—on the cheaper meters—tend to corrode rapidly; and as you jiggle the meter, the batteries shift position and upset your readings. Disassemble your VOM and clean the battery contacts with a good "TV tuner" cleaner spray. Simultaneously, you might find it advantageous to shoot some of the spray into the rotary switch contacts—although, generally speaking, these contacts on good meters are "self-cleaning."

Dial Cord Slippage. *My modestly priced short-wave receiver has a dial cord operated dial mechanism. The cord is slipping and I don't look forward to the mechanics of installing a new one. Is there any other cure?*

Yes; check to be sure that the tension spring is still slightly expanded, thus indicating that the dial cord is working under tension. If the spring has collapsed or if there is any slack, untie one end of the cord and shorten it enough to put the spring to work. You can also coat the dial cord with one of the commercially available non-slip compounds such as Injectorall's "Grip-Well," or GC Electronics' "Liquid Non-Slip."

Antennas for TV DX'ing. *I was told that the best bet for someone living in a deep fringe area, or for a fellow interested in DX'ing, was to stack two identical TV antennas. Is this so?*

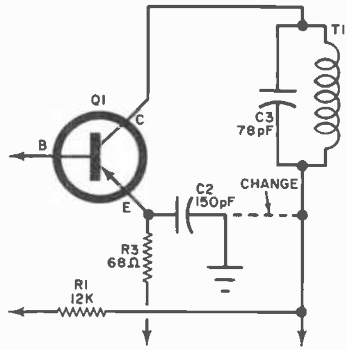
Yes, indeed. All sorts of communications facilities have stacked antennas to increase signal pickup. One of the better articles available on stacking TV antennas appeared in POPULAR ELECTRONICS, November, 1965, page 63.

Is Hertz Really Number 1? *I have the opportunity to read numerous technical electronics magazines and am sick and tired of reading about the changeover from cycles-per-second to hertz. Give me the straight dope—was this thing necessary and is it official throughout the world?*

Oddly enough, the answer is no! Although the U.S. Government has been urging that all publications make the changeover from cps to hertz, most of the government agencies continue to use cycles, kilocycles, megacycles, etc. In fact, the regulations of the International Telecommunications Union are still very much in effect and these regulations—as they pertain to broadcasting and worldwide communications—stipulate that cps should be used in preference to hertz!

Curing CB-12 Feedback. *My faithful Hallicrafters CB-12 transceiver has developed the irritating habit of occasionally squealing when I have the volume control turned up. What's going on?*

You can easily solve this problem by following the service notes published by Hallicrafters. The manufacturer recommends that the transceiver models CB-10 and CB-12 be modified as detailed below. First, remove capacitor *C4* and discard it; this is a 0.01-μF ceramic-disc capacitor in the collector circuit of transistor *Q1*. Unsolder the end of capacitor *C2* (150 pF) which is connected to the junction of *C3*, *T1* and *R1*, solder it directly to chassis ground. The



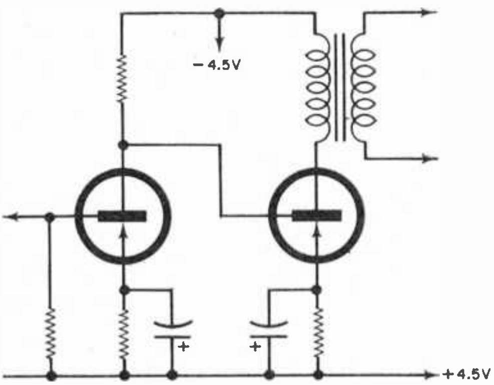
best way to do this is to use the hole in the chassis formerly used to ground *C4*. It may be necessary to add a short extension lead to *C2*. When you make this modest circuit change, your squeal should vanish.

Commercial Kit Diagrams. *I don't understand how kit manufacturers operate. Do they keep instruction books on hand for all of their kits, regardless of when they were manufactured?*

No, most of the kit manufacturers don't have enough storage space for all of the kit manuals that they would be required to store. In the case of the Heath Company, I am informed that they carry complete manuals until the existing surplus stock is depleted. At that time, a condensed version of each manual (eliminating the wiring steps) is prepared, which can be obtained direct from Benton Harbor at prices ranging from 50 cents to $2.00. Beyond this, Heath will also Xerox specification sheets and schematic diagrams at 5 cents a page. The Knight-Kit people tell me that they stock kit manuals until the supply is depleted, but make no provisions to publish a condensed manual. However, anyone can obtain a copy of the schematic diagram of any old Knight-Kit by writing to the Technical Service, Knight Electronics Corporation, 2100 Maywood Drive, Maywood, Illinois 60154.

American Vs. European Transistor Symbols. *Why don't Americans use sensible symbols for transistors? I just saw some British wiring diagrams and their use of transistor symbols really makes sense.*

We'll agree with this reader that the British (literally speaking, European) transistor symbols do make sense and that their circuit diagrams look like tube-style layouts. For those readers not familiar with the European style symbols, the accompanying diagram illustrates the similarity



between solid-state and vacuum-tube amplifier circuits. How it all started, I don't know, but presumably the Europeans improved on our symbol techniques.

Rise Time—What Is It? *My electronics school teacher and I had an argument over the exact definition of "rise time." How do you explain it?*

Very simply. Rise time is the amount of time (measured in very small fractions of a second) it takes for a waveform to go from 10% to 90% of its peak value.

A New Advertising Term? *In looking through an electronics catalog, I saw some capacitors advertised as "GMV"—what does it mean?*

This is an abbreviation for "guaranteed minimum value." The actual value of the capacitor is not less than the value printed on it. You generally see the term "GMV" used with ceramics and electrolytics.

Time-Signal Receiver. *I home-built the "Time-Signal" receiver featured in the October, 1966, issue. I want it to operate on 15.0 MHz, but the oscillator doesn't seem to work right. I didn't see any corrections to this story in "Out of Tune"—what do you think can be wrong?*

Although the receiver will work (on the printed circuit board) with the components shown, some home-built units may operate better if the capacity of *C14* and *C15* is reduced from 0.001 μF to 270 pF. Make these substitutions and your receiver should operate like a charm.

Cutting Down Ignition QRM. *My CD ignition system is raising hob with my mobile CB rig. Neither resistor spark plugs nor shielded ignition leads seem to make a difference. Isn't there somthing I can do?*

The most effective suggestion for reducing ignition noise comes from Sydmur—ground the metal case of the ignition coil; Murray Gellman of Sydmur says that the case "floats" and is a good radiator of r.f. energy. Solder a wire braid to the metal case and ground the other end to the engine block. Don't depend on the supporting bracket holding the coil being grounded—it's insulated from the coil case by layers of paint. If your ignition coil is a new one with a plastic housing, the noise radiation will be particularly bad. However, these coils can be damped by enclosing them in aluminum foil and then grounding the foil to the engine block.

Antique Radios. *I have a Garod V receiver that was manufactured in 1923. Is this worth anything as an antique?*

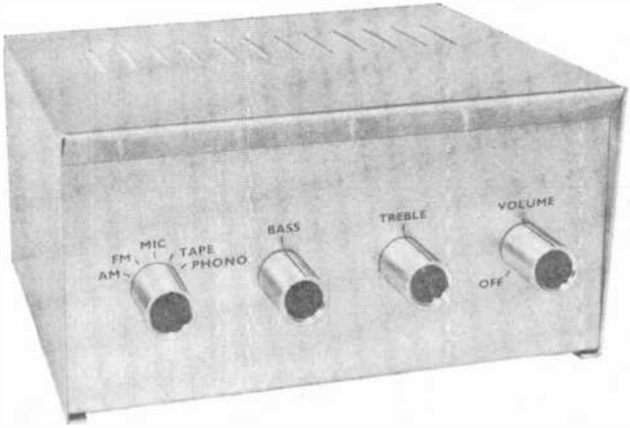
If in good condition, it is worth \$25-\$35, although the number of antique radio collectors is pretty small. By the way, the Antique Wireless Association says that old broadcast receivers fall into three categories: A-V-C. The "A" receivers are "antiques" and were made during 1920-23; you can identify these sets by the "peep" holes in the front panel, separate rheostats on each tube filament, tapped inductances, etc. The "V" receivers are "vintage" and consist of those made during 1924-27; this was the great Neutrodyne era, with Crosley, Radiola, Leutz, etc., receivers being very popular. The "C" receivers are "classics" (Silver-Marshall, National, Scott, etc.), and can be anything made after 1927 and before World War II.

Key Click Eliminator. *I would like to incorporate some sort of transistorized switching in a little CW ham band rig I am building. I understand that solid-state circuits eliminate key clicks.*

(*Continued on page* 101)

BUILD THE

"TWO-BY-TWO" STEREO PREAMPLIFIER



SOLID-STATE HI-FI CONTROL CENTER CAN BE USED WITH ANY STEREO POWER AMPLIFIER. CONSTRUCTION IS SIMPLIFIED THROUGH USE OF PRINTED CIRCUIT BOARDS

By DANIEL MEYER

MODERN DESIGN TECHNIQUES make it possible for you to build this modular "Two-By-Two" stereo preamplifier all at once or one circuit at a time. The completed unit can "tailor" phono, tape, microphone, and AM and FM tuner signals to fit almost any hi-fi amplifier, including the "Brute-70" which was described in the February issue of POPULAR ELECTRONICS.

Generally speaking, a preamplifier—be it a mono or a stereo affair—is the control center of a component hi-fi system. It serves as a "matchmaker" between the program source and the basic amplifier. Regardless of the number and type of program sources, they are all fed into the front end of the preamp, and at the flip of a switch are individually and effortlessly patched into a power amplifier. The preamp also has the ability to raise or lower volume, to boost or cut

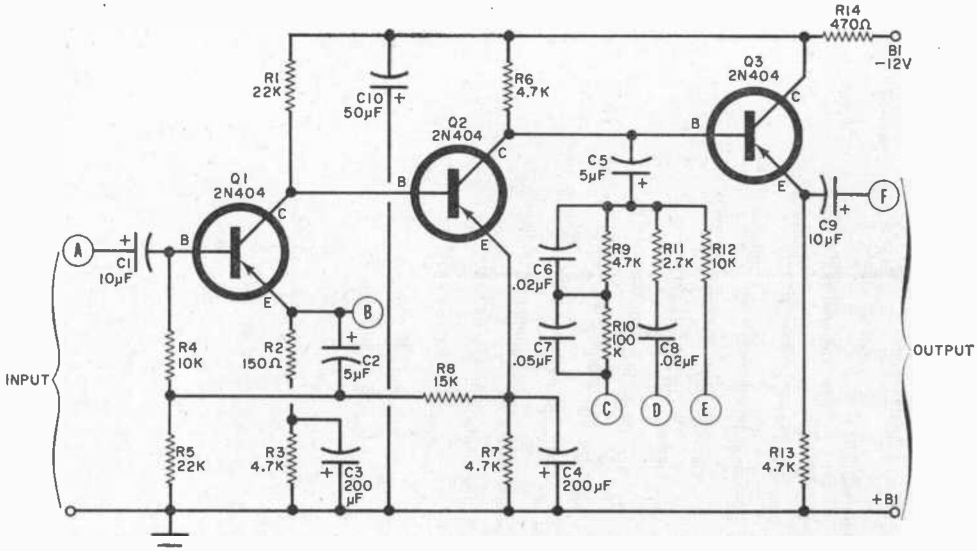


Fig. 1. This is the circuit diagram of one of the fixed gain preamplifiers. The two preamplifiers are identical. Points labeled A,B,C,D,E, and F are printed circuit connection points to input jacks, switches, and other printed circuit boards.

bass and treble, and to compensate for dips and peaks in programs, in room acoustics, and in hi-fi equipment.

In the "Two-By-Two" preamp, there are two sections in each of two identical channels employing 2¼"-square printed circuit boards. One of the sections is a 3-transistor preamplifier equipped with three compensating networks to accommodate the different input devices. The other section is a 2-transistor base and treble tone control circuit capable of a 15-dB boost or cut on both ends of the audio spectrum.

A minuscule amount of power is required by the "Two-By-Two," and almost any 12- or 24-volt d.c. supply will do. In many instances you can steal

PARTS LIST

C1, C9, C13—10-μF, 15-volt electrolytic capacitor
C2, C5—5-μF, 15-volt electrolytic capacitor
C3, C4, C14—200-μF, 6-volt electrolytic capacitor
C6, C8—0.02-μF ceramic disc capacitor
C7, C12—0.05-μF ceramic disc capacitor
C10—50-μF, 25-volt electrolytic capacitor
C11—0.001-μF ceramic disc capacitor
C15—470-pF ceramic disc capacitor
C16, C17—30-μF, 15-volt electrolytic capacitor
C18—50-μF, 25-volt electrolytic capacitor
C19—500-μF, 50-volt electrolytic capacitor
C20—100-μF, 25-volt electrolytic capacitor
D1, D2—500-mA, 100-PIV silicon diode or better
D3—24-volt zener diode
Q1-Q5—2N404 pnp transistor or similar

R1, R5, R19—22,000 ohms
R2—150 ohms
R3, R6, R7, R9, R13, R15, R16, R17, R21, R28, R30—4700-ohms
R4, R12, R18—10,000 ohms
R8—15,000 ohms
R10—100,000 ohms
R11—2700 ohms
} All resistors ½-watt unless otherwise specified

R14, R22, R23—470 ohms
R20—2200 ohms
R24, R25—Dual 50,000-ohm, ½-watt, linear-taper potentiometer
R26—Dual 5000-ohm audio taper potentiometer (with switch S2)
R27, R29—220,000 ohms
R31—1000 ohms, 1 watt
S1—Two section, two-pole, five-position ceramic or other low-loss rotary switch
S2—S.p.s.t. switch (mounted on R26)
T1—Transformer: primary, 117 volts a.c.; secondary, 40 volts center-tapped (similar to Knight 54 A 4731)
1—6" x 8" x 4½" cabinet (similar to LMB CB-2)
Misc.—Printed circuit boards, knobs, wire, solder, spacers, 6-32 machine screws and nuts, input and output jacks, etc.

Etched and drilled printed circuit boards at $1.50 each; all parts (less board and potentiometers) for the 3-transistor amplifier section at $4.50 each; and all parts (less board and potentiometers) for the 2-transistor tone control at $3.25 each are available from DEMCO, Box 16297, San Antonio, Texas 78216.

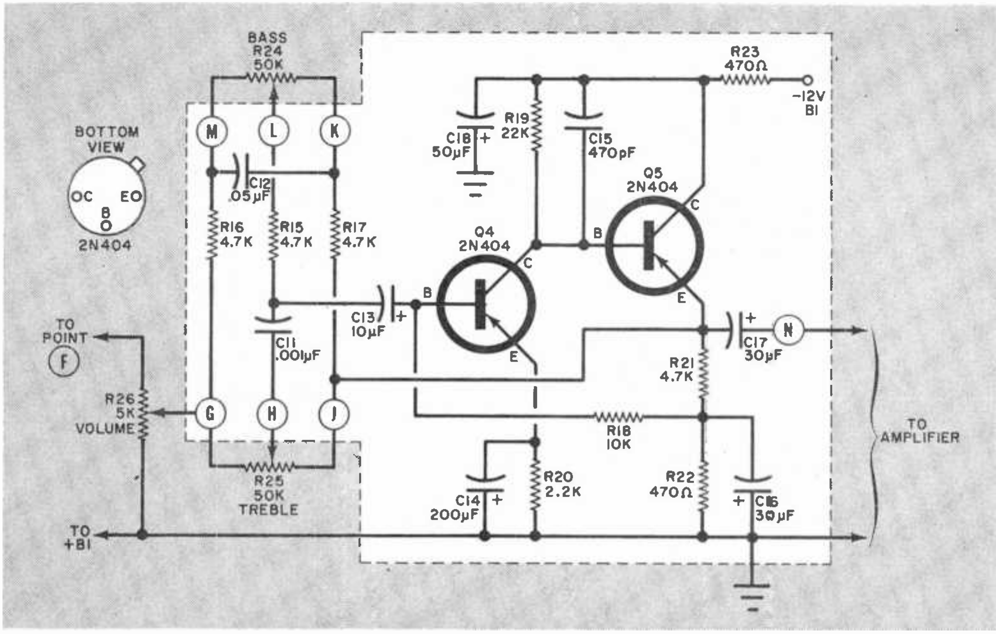


Fig. 2. Circuitry important to the tone controls of the stereo preamp is etched in two printed circuit boards. As in the diagram on the facing page, points G,H,J,K,L,M, and N are connections to jacks, switches, and front panel controls.

this power from your amplifier. Just in case you can't, details for building a simple power supply are presented on page 72.

How It Works. The preamp consists of two high-gain amplifier stages (*Q1* and *Q2*), and an emitter follower stage (*Q3*), as shown in Fig. 1. The three feedback networks (*C, D,* and *E*) from the collector of *Q2* are connected one at a time to the emitter of *Q1* (point *B*) to provide a flat output signal for a magnetic phono cartridge (*C*), a tape head (*D*), and an AM/FM tuner or microphone (*E*). The latter network provides an essentially flat amplifier response characteristic, whereas the first two networks compensate for the disc and tape recording industry's standards and practices.

Input impedance of *Q1* is made high by the bootstrap action of *C2*. This action is achieved in a very interesting manner. An increase in value of any of the bias resistors effectively increases the input impedance. However, there are practical limits which restrict the size of these resistors, and prevent an appreciable increase in impedance. The desired effect of increased input impedance is the reduction of input signal current flow. In this case, it can be achieved by making *R4* "look" like a much larger resistor than it actually is. Fortunately, you can do this with a feedback signal to the bottom of *R4*, which is in phase with the input signal voltage. If the voltage applied to both ends of *R4* is equal and of the same polarity, no current will flow. (The stronger the applied signal, the greater the feedback.) The resulting input impedance is high enough to handle ceramic and other high-impedance microphones without loading problems.

Capacitor *C9* couples the signal to the top of the volume control (*R26*) shown in Fig. 2. The tone controls are low-distortion feedback types with a variable turnover characteristic, which simply means that the point at which boost or cut begins changes as the control is rotated. This is much more desirable than the simpler constant-turnover type tone control, which affects all frequencies up to the designed turnover point even when a small amount of boost or cut is used.

The tone control network, Fig. 2, has a one-stage amplifier (*Q4*), and an emitter follower (*Q5*). Output impedance of this circuit is low, which permits proper operation with almost any type of hi-fi power amplifier made. For a dynamic microphone or other low-impedance pickups not requiring a compensating amplifier response curve, you can omit the compensating networks and wind up with higher gain, but with a lower input impedance—on the order of 10,000 ohms.

A two-pole, five-position rotary switch, as shown in Fig. 3, is used to select any one of the five inputs on one channel of the "Two-By-Two." A double-ganged affair is needed to handle both channels. Use a ceramic or other low-loss switch to minimize crosstalk.

The inherent stability of the circuit permits proper operation over a wide supply voltage range, without modification of bias, and without materially affecting gain. However, the lower the supply voltage used, the lower the clipping point for input signals and the lower the peaks of the output signals, as shown in the specs on p. 98. For best results, use 24 volts. Figure 4 shows a circuit for a zener-regulated, full-wave power supply that you can easily put together, if you need one. It's a good idea to keep a.c. and power supply components on a separate chassis, away from the preamp.

Construction. The "Two-By-Two" can be built and used as a "One-By-One," as a "Two," or just a "One." If you are not interested in stereo and only want a mono preamp, you can assemble a "One-By-One," which is one amplifier section, and one tone-control section. If you just need an amplifier and are not interested in the tone controls, you can build a "One," a "Two," or for that matter a "Three," or even a "Four," leaving off the tone-control section each time.

If you are building the amplifier section only, just connect a jumper wire from point B (see Fig. 1) to the proper compensation network, if one is to be used. However, you will find a rotary switching arrangement to be most convenient, if more than one type of input device is to be used.

The simplest way to put this project together is to use printed circuit boards, as shown in Fig. 5. Other construction techniques can be used, but be alert to the need for proper lead dress and for proper component layout to minimize

(*Continued on page* 98)

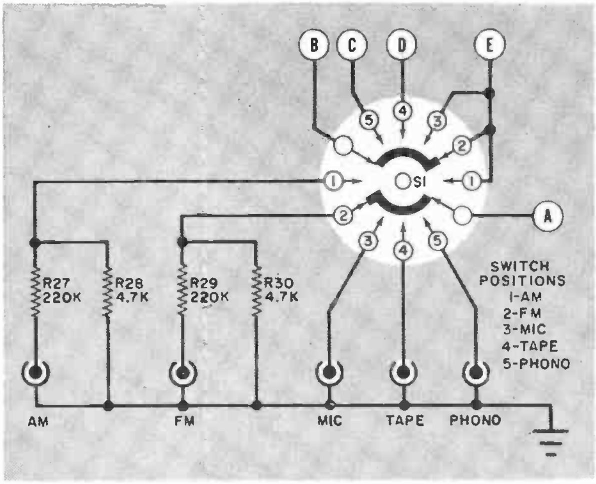


Fig. 3. Input selecting switch feeds compensating network output (C, D, and E) to emitter of transistor Q1 to alter frequency response of preamplifier.

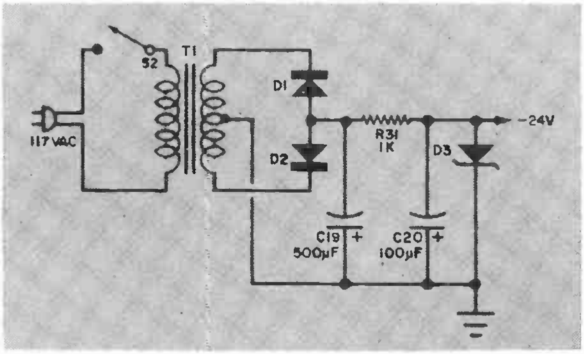


Fig. 4. If you find it difficult to "steal" 12 or 24 volts of pure d.c. from your power amplifier, a zener-regulated, full-wave supply may be substituted.

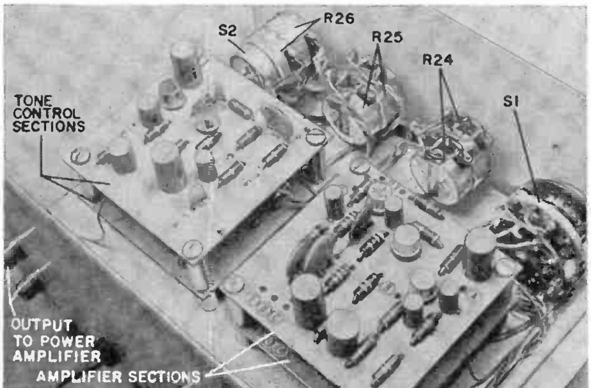


Fig. 7. The amplifier and tone control sections of the "Two-By-Two" can be neatly stacked. Note dual section controls used for a stereo installation.

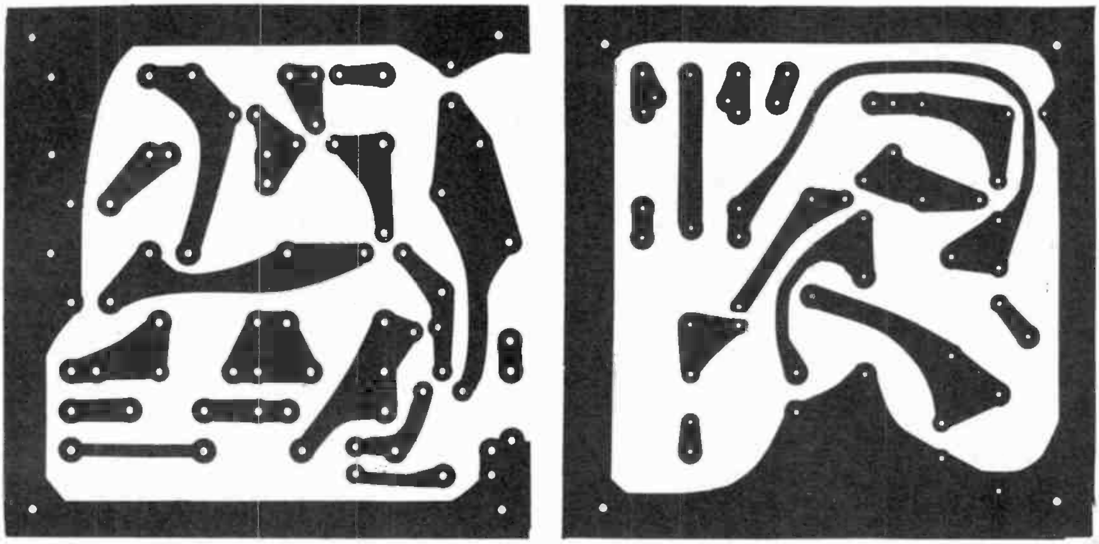


Fig. 5. Same-size layouts of the foil side of the two printed circuit boards are shown above. The fixed-gain preamplifier is to the left and the tone control board to the right. For stereo operation the builder requires 4 boards, two of each circuit.

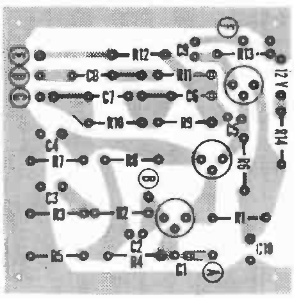
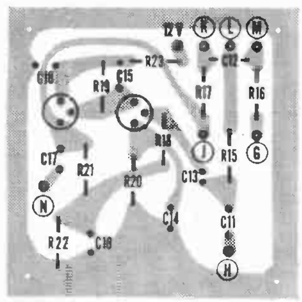


Fig. 6. Position components on plain side of the circuit boards as shown—amplifier to the left and tone control to the right.



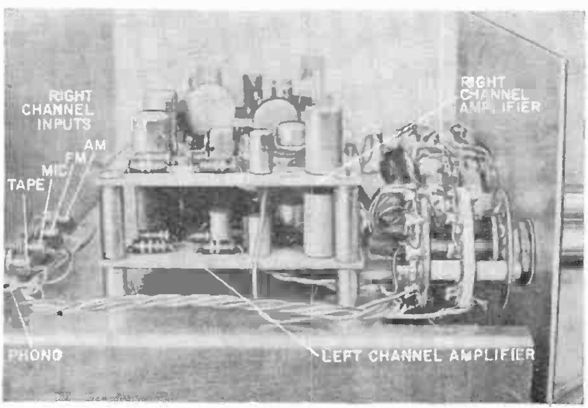


Fig. 8. Side view shows use of metal spacers. Unshielded leads run between switch and input jacks. In case of hum pickup substitute shielded leads.

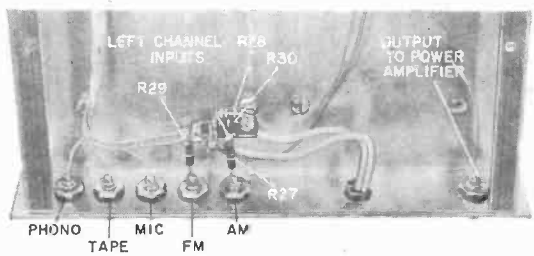
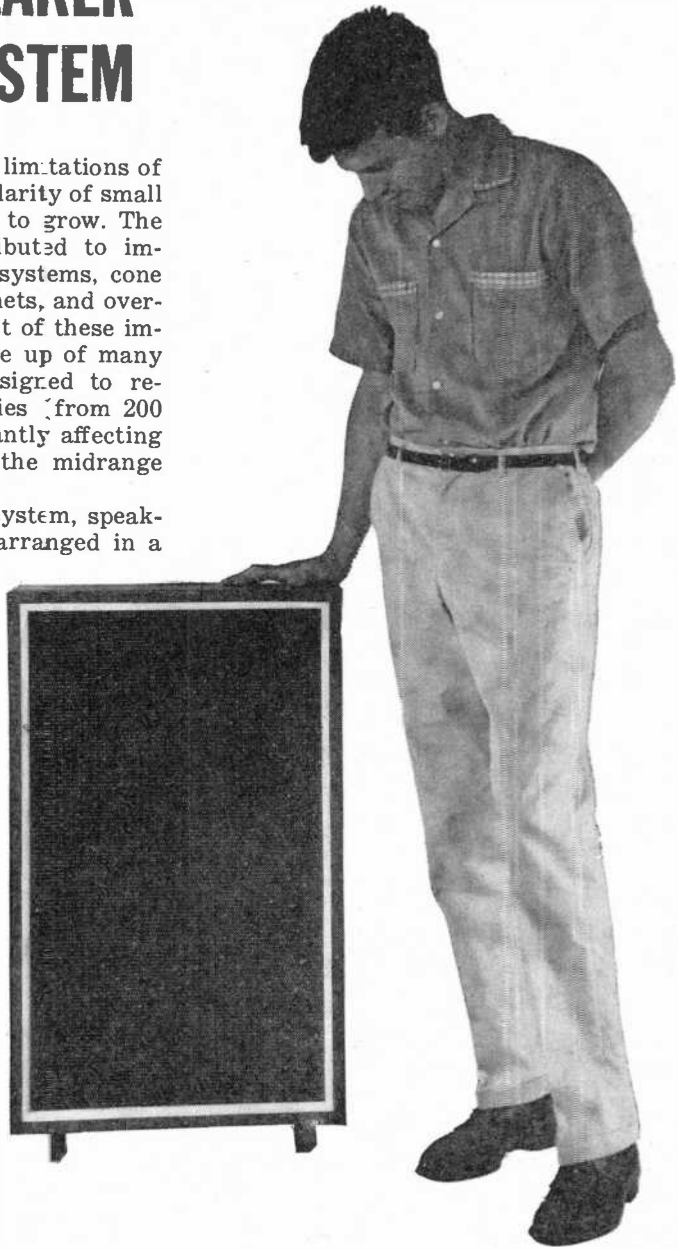


Fig. 9. Underside of chassis is bare except for input loading resistors for the main AM and FM left channel inputs. All input jacks for the right channel are isolated above the chassis. This improves channel-to-channel separation. If hum pickup is a problem use shielded leads here also.

BUILD THE "MIXED TWELVE" SPEAKER SYSTEM

STAGGERED RESONANCE ARRANGEMENT PROVIDES EXCELLENT RESPONSE AT LOW COST



IN SPITE OF the obvious limitations of small speakers, the popularity of small speaker systems continues to grow. The reasons why can be attributed to improvements in suspension systems, cone materials, voice coils, magnets, and overall construction. As a result of these improvements, a system made up of many small speakers can be designed to reproduce the bass frequencies (from 200 Hz down) without significantly affecting their normal response to the midrange and the high frequencies.

In the "Mixed Twelve" system, speakers of different sizes are arranged in a

By DAVID B. WEEMS

somewhat irregular and unusual manner in order to set up a "staggered resonance" condition. For the money (about $35), performance is excellent, and the ability of the system to reproduce "big" source sounds and handle orchestral transients without "going to pieces" is remarkable.

Some multiple-speaker systems reproduce sounds that bounce from one speaker to another, resulting in what can best be classified as a "ping-pong" effect. (Yes, it is possible to create this effect in a mono system.) In the "Mixed Twelve," the audio spectrum is not split up—every speaker in the system works simultaneously. The sounds are more smoothly reproduced and appear to have a more natural character.

Besides the system's low cost, a big advantage of the "Mixed Twelve" is the fact that it can be driven by a low power amplifier.

The Speakers. While a major reason for using small speakers instead of large ones is economy, keep in mind when selecting speakers that there are some which are too poor in quality to be considered. The three most important things to look for in a speaker, besides the way it actually sounds, are magnet strength, cone material, and overall construction. If any of these appear to be below standard, chances are that the speaker will compromise the quality of the sound.

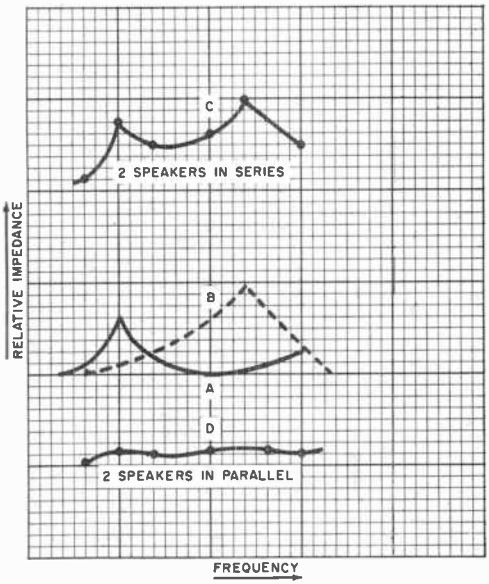


Fig. 1. By connecting two speakers with different resonances in a parallel arrangement, sharp peaks found in a series arrangement can be flattened.

If the magnet strength is insufficient, damping will be inadequate to prevent the speaker cone from continuing to vibrate after the signal is removed. If the speaker cone material is too light in weight, it will "break up" when loud passages are reproduced and add its own voice. The speaker's own voice and continued vibrations are nothing more—or less—than distortion.

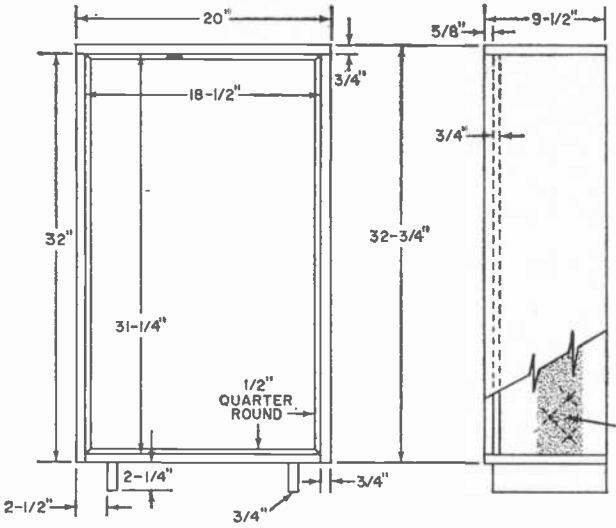
You should also give some thought to the size and shape of the speakers you intend to use. As a rule, a speaker with a large-cone area usually has a better low-frequency response than a speaker with a small-cone area. Conversely, a smaller speaker usually has better high-frequency characteristics. In most speaker systems, the overall audio spectrum is covered by the use of several different-size speakers in one enclosure.

Speaker shape has a direct bearing on the performance of a staggered-resonance system. Round speakers can be used, but oval types offer certain advantages. The oval speaker usually has a better high-frequency response than a round speaker that has the same cone area. And better horizontal sound dispersion is obtained from an oval speaker that has its long axis vertically oriented.

In addition, do not mix speakers having different impedance ratings. If the speakers in a system do not have the same impedance, they will "see" different amounts of power, and the system will not operate as predicted here.

Four of each of the following size speakers are used in the "Mixed Twelve": 3" x 5" (RCA), 4" x 6" (Zenith), and 5" x 7" (imported); the two smaller sizes of speakers have 1.47-oz. magnets, and the largest has a 2.14-oz. magnet. All of them are rated at 3.2 ohms impedance. But you can choose a different assortment of speaker sizes, if you wish, and still come up with a good system.

Speaker Arrangement. Low frequency response (mainly attributed to the stiffness of the cone) in small speakers is limited. When several of them are connected together, however, they help each other boost the low frequency response.



BILL OF MATERIALS

1—31¼" x 18½" sheet of ¾" fir plywood for front panel
*2—32" x 9½" x ¾" sides** } *Soft pine lumber*
*1—20" x 9½" x ¾" top**
*1- -18½" x 9½" x ¾" bottom**
2—9¾" x 2¼" x 1" bottom rails
3—18½" x 2" x 1" braces
1—96"-long piece of ½"-quarter-round molding
12—Speakers of your choice—see text
Misc.—Grille cloth, speaker wire, sheet metal screws, finishing nails, etc.

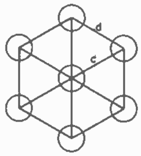
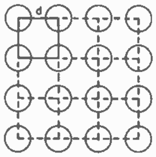
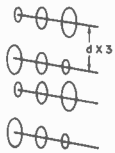
*When ordering, specify 1" x 10" pine shelving.

Fig. 2. Top, bottom and side walls can be cut shallower than shown, but do not change the dimensions of the front board.

If all the speakers had the same resonance characteristic, there would be some unwanted side effects in the midrange. Fortunately, speakers of different sizes and shapes do have different resonant frequencies, and they do bypass many of these side effects when properly hooked up.

Consider two speakers, each having different resonant frequencies with relative curves (*A*) and (*B*) respectively, as shown in Fig. 1. When they are connected in series, a sharply spiked curve (*C*) will be obtained. Total impedance for the two speakers will be approximately double that of either speaker. The curve for the same two speakers connected in parallel (*D*) is more uni-

SPEAKER ARRANGEMENT CHARACTERISTICS

PATTERN	CIRCULAR	SQUARE	LINEAR	STAGGERED
				
NUMBER OF SPEAKER SIZES	1	1	1	3
D/n RATIO*	1.7/1 (D=12, n=7)	1/1 (D=4, n=4) 1.33/1 (D=12, n=9) 1.5/1 (D=24, n=16)	n−1/n	0.5/1 (D=3, n=6) 0.75/1 (D=9, n=12) 0.8/1 (D=12, n=15)
EFFECT OF PATTERN ON MUTUAL COUPLING	Excellent	Good	Fair	Good when speakers are of various sizes
FREEDOM FROM PEAKS IN THE MID-RANGE	Poor	Progressively poorer as n increases	Good	Good
HORIZONTAL DISPERSION CHARACTERISTICS	Poor	Poor	Excellent	Fairly Good

**D=the number of identical distances between adjacent speakers in the speaker pattern, and n=the number of speakers; this is the ratio of the number of identical distances between speakers adjacent to each other and the total number of speakers that gives a good estimate of the tendency of the system to peak. A low ratio is desired because the higher the ratio, the greater the tendency to peak. Terms like good, fair and poor are only relative.*

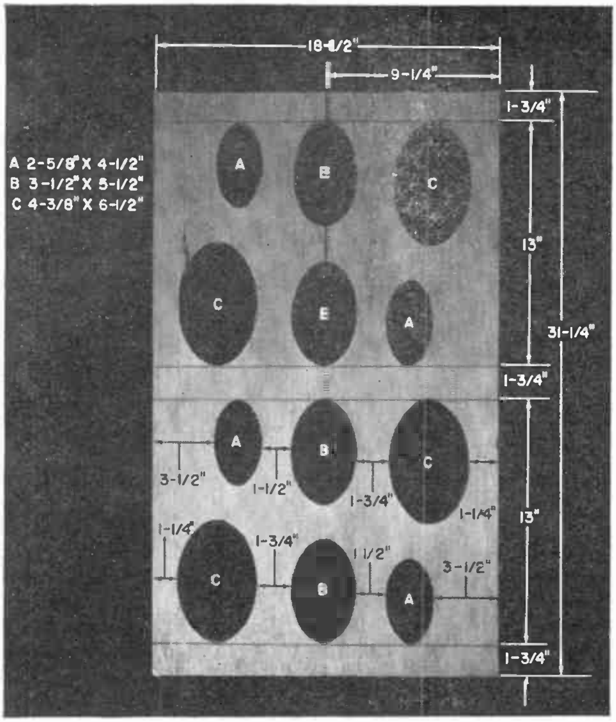


Fig. 3. Using the lines drawn on the front board to obtain proper placement, start drawing speaker cutout lines along the vertical line with medium-size template. Then draw in the other cutout lines.

Construction. The back of the "Mixed Twelve" cabinet has been deliberately left off to minimize the effects of cabinet resonance. As a result of the backless feature, overall dimensions are not critical. The width of the top, bottom, and sides can be slightly larger or smaller than shown in Fig. 2, but do not change the size of the front panel. (Finished width of 10" shelving is 9⅝" and there's no need to strip the lumber down to 9½".)

To lay out the openings on the front panel, draw a line across the top and bottom, spaced 1¾" in from the top and bottom edges, as shown in Fig. 3. Draw two more lines 13" from the top and bottom lines. Then draw a vertical line down the center.

Cut up a piece of heavy cardboard to serve as a template for the cutouts. You will need a separate template for each different size speaker. The dimensions of *A*, *B*, and *C* in Fig. 3 are typical. If your speakers require a different set of contours, modify the cutouts accordingly. (Avoid using speakers larger than 5" x 7", if you don't want to redesign the entire cabinet.)

(*Continued on page* 96)

form and virtually flat over a wide range of frequencies. Also, their combined impedance is reduced drastically.

When several small speakers are used in a single cabinet, a certain amount of desirable mutual coupling at low frequencies is obtained, and a certain amount of undesirable interactions at other frequencies is also present. These interactions can cause dips and peaks in the system's overall response curve. Peaks and dips occur when the distances between speakers are certain fractions of a wavelength of the sound.

To design a multiple speaker system completely free of peaks and dips is almost impossible, but fortunately it is possible to minimize these effects by following a simple rule-of-thumb—stagger the positions of the speakers in the cabinet so that center-to-center distances are not the same for immediately adjacent speakers. The characteristics obtained with different speaker arrangements (at left) can be used for comparison.

Fig. 4. Templates that are cut from heavy paper or cardboard greatly facilitate the laying out of speaker cutout lines on the front board. A different template is needed for each size of speaker used.

SOLID STATE

By **LOU GARNER**, Semiconductor Editor

WE'VE received a number of letters from readers expressing an interest in the "bargain" transistor assortments offered by major outlets from time to time. Most of these bargains consist of plastic bags containing from 50 to 100 unidentified transistors selling at prices representing a net cost of less than 10 cents apiece. But these assortments may not be true "bargains," as a great deal depends on the needs and interests of the individual purchaser.

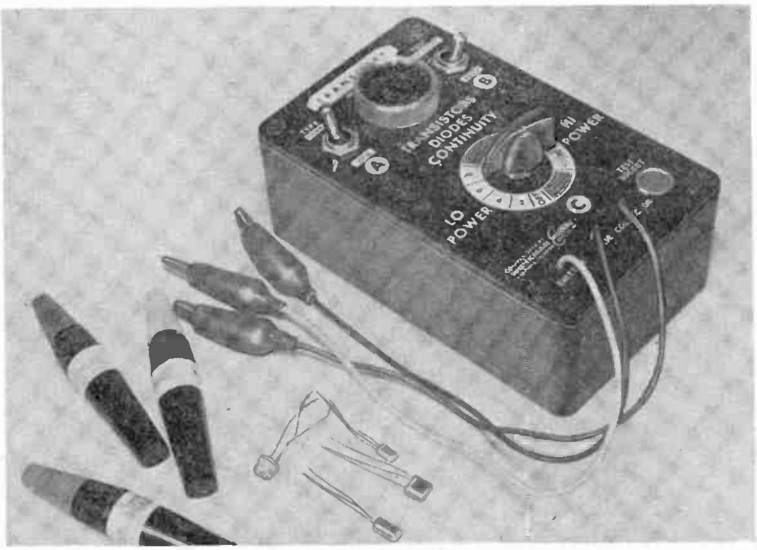
If you have specific projects in mind, your best bet is to use transistor types specified by the original designer (or author). On the other hand, if you like to experiment with different circuits, trying various breadboard arrangements as you go along, and want to keep costs to a minimum, the "bargain" assortments may be just your cup of tea. And they are excellent for school and student use.

One reader, Leonard E. Laabs (220 North College, College Place, Wash.), is planning a serious statistical study of typical assortments as part of a college research project. If you've had any experience with these bargain packages, write to Leonard and pass on your findings.

Remember that any given assortment may contain transistors coming from a variety of sources: manufacturers' surplus, distributors' excess inventory, discontinued types, off-tolerance units, factory overruns, low-voltage types, and units with external defects including incorrect markings, dented cases, or short leads. Some units may be of extremely high quality, while others may be of marginal quality. Often, only a small percentage will be defective.

For example, two seemingly "identical" assortments purchased at the same time from the same dealer may have entirely different contents. One might include up to 70 to 80 percent good-quality units, with the balance of little or no value. Another may contain only four or five top quality devices, but the entire assortment may be useful, even if it's of mediocre quality.

Regardless of original source, or purchase price, maximum dollar value can be obtained by first assorting the units according to type (*npn* or *pnp*), relative gain, and leakage. This can be done using a transistor checker capable of identifying type and which can also check for opens, shorts, leakage and relative gain. Suitable checkers include the Workman Model BZ8 (shown here) and the Seco Model 100 Dynamic



Inexpensive transistor and diode testers like this Workman Model BZ8 can be used for checking transistor type, relative gain, leakage, opens and shorts.

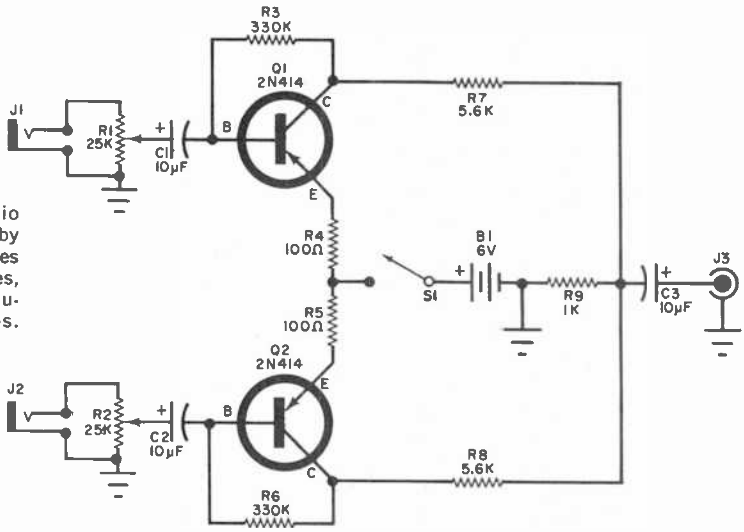


Fig. 1. Two-channel audio mixer circuit submitted by Aron J. Davidson matches low-impedance microphones, phono cartridges, and musical instrument pickups.

Checker. Adopt a suitable color code and use felt-tipped marking pens to identify the transistors as they are checked and sorted.

A red line on the side of the case might be used to identify *pnp* units, while an absence of this line could denote *npn*. Approximate gain (*beta*) can be identified by colored dots, with various colors selected for low-, medium- and high-gain types. Similarly, other colors (or symbols) may be used to identify low- and high-leakage types. If two identical units are found, these could be taped together as a *matched pair* for future push-pull circuit application.

Units found to be excessively leaky, shorted, or open, can be discarded . . . or, if preferred, saved for use as dummies when you're developing and checking circuit layouts. Units that are only slightly leaky can be saved for use in non-critical a.c. amplifier and oscillator circuits. Finally, devices with a single open element (as, for example, an open collector electrode) can be used as general-purpose diodes—you simply clip off the lead to the open electrode.

If adequate test equipment is available, additional tests can be performed to determine noise, temperature, and high-frequency characteristics. As a general rule, however, such extensive tests are not justified unless special jigs are assembled and relatively large quantities of transistors are involved.

Unfortunately, there is no simple way to separate silicon and germanium types, nor can maximum ratings be determined easily using commonly available test equipment without some danger of destroying the device being tested. A good rule-of-thumb is to restrict the use of "bargain package" types to low-voltage, low- to medium-power applications. In other words, don't try to push for maximum outputs.

Reader's Circuit. Submitted by reader Aron J. Davidson (1004 Stratford Ave., Philadelphia, Pa. 19126), an inexpensive and easily assembled two-channel audio mixer circuit is illustrated in Fig. 1. Suitable for use with low- to moderate-impedance microphones, phono cartridges, and musical instrument pickups, it can be assembled as a self-contained "outboard" accessory or, if preferred, incorporated as a built-in feature in an existing guitar or p.a. amplifier.

Aron has used *pnp* transistors (*Q1* and *Q2*) as common-emitter amplifiers. Jacks *J1* and *J2* provide individual channel inputs, *R1* and *R2* are the respective gain controls, *C1* and *C2* are channel input coupling capacitors, and *R3* and *R6* are base bias resistors. Resistors *R7* and *R8* serve partially as collector loads, but are intended primarily to isolate the stages. The combined output signal is developed across common collector load *R9*.

Unbypassed emitter resistors *R4* and *R5* introduce negative feedback which not only stabilizes each stage but also acts to raise the transistors' effective input impedances. The combined signal is applied to output jack *J3* through coupling capacitor *C3*. Operating power is furnished by *B1*, controlled by s.p.s.t. switch *S1*.

Inexpensive components are used throughout. Transistors *Q1* and *Q2* are 2N414's. Jacks *J1* and *J2* are open-circuit phone types, while *J3* is a standard phono jack. Potentiometers *R1* and *R2* are audio tapers and the resistors are all half-watters. Capacitors *C1*, *C2* and *C3* are 25-volt electrolytics, and switch *S1* can be either a toggle, slide, or rotary type. The power pack, *B1*, is a 6-volt battery.

Although neither parts placement nor wir-

(*Continued on page* 102)

ON THE CITIZENS BAND

By **MATT P. SPINELLO,** KHC2060, CB Editor

SOME seventy Canadian GRS licensees recently attended the third General Radio Service Convention held in London, Ontario. The delegates appointed a resolutions committee and a group from their ranks to meet with Department of Transport (D.O.T.) officials in Ottawa.

The resolutions committee will ask the D.O.T. for use of CB channels 1, 2, 3, and 23. (Canadians have been restricted to the use of CB channels 4 through 22 to date.) This request was prompted by the D.O.T.'s recent type-acceptance of 23-channel transceivers for use in Canada.

GRS DELEGATES CONVENE

Another of the 19 resolutions voted on at the Convention consists of a request that the D.O.T. continue its efforts to obtain a reciprocal licensing agreement with the United States Government giving Canadians in the U.S. the same privileges extended to American tourists in Canada. Canadians traveling in the U.S. are unable to use their transceivers to seek assistance from our CB'ers.

With the hope of increasing the effective use of the frequencies allocated to the General Radio Service, the Convention also voted to ask the D.O.T. to approve, without further delay, the use of single-sideband equipment.

And, according to still another resolution, the D.O.T. will be asked to make available to all licensees a handbook dealing exclusively with General Radio Service Rules and Regulations governing transceivers, antennas, legal accessories, and operating procedure. In the event the D.O.T. should decide not to act upon this request, an amendment to the proposal would ask the Central General Radio Service Association to publish the handbook.

In an address presented by Mr. Lorne Greenwood, Regional Superintendent, Radio Regulations, D.O.T., Toronto, Ontario, the Convention was congratulated for having made great progress. Mr. Greenwood also recalled that past Conventions had assisted in obtaining exemption from the radio log-keeping requirements which were once a part of the GRS rules.

As to the present situation, Mr. Greenwood remarked that "At the end of last March (1966) there were 41,534 GRS stations in Canada [and] the number of new licenses issued each year has been averaging between 11,000 and 12,000, but because a large number of licensees do not renew . . . the annual increase . . . of licensed stations has been averaging between 5000 and 6000."

"On the whole," he continued, "the General Radio Service seems to be working out satisfactorily and fulfilling the communications requirements of those for whom it was intended. There are abuses, as we all know, and in a few cases we have had to suspend the operation of stations to keep matters in hand. . .

"Because of the increasing demand for radio frequencies, I believe the same holds true for the GRS as for the other services —it is a matter of either *use or lose* your assigned channels. Therefore, the best advice I can give you is to not only use your portion of the radio frequency spectrum, but use it efficiently and legitimately so that you will always be in a position to justify its need.

"Most users of the radio frequency spectrum want to know what the prospects are for obtaining additional channels, and in this I can offer no encouragement. I like to take the positive approach in all matters and would hope that the future holds promise, but as far as radio frequency communications is concerned there would seem to be little hope for additional channels in the General Radio Service.

"Certainly, present usage and justifiable demand for usage will determine future frequency allocations, both nationally and internationally. But in view of the scarcity of this fixed natural resource, I cannot foresee the day when the demand for radio frequencies will even come close to being satisfied.

"One area where much can be done in improving efficiency in frequency utilization," Mr. Greenwood stated, in conclusion, "is in self-regulation. Your association has done much to encourage this in the General Radio Service and the Department appreciates your efforts in this respect. However, as you know, this is a never-ending task and we continue to solicit your cooperation in this matter. If we fail, the alternative could be more rigid regulations which none of us wants. The more flexible the regulations, the more freedom we have to adjust to changing conditions."

National GRS Club Representative. Gearald Inch, XM-44-969, has been appointed club representative for *SCOPE*, Canada's General Radio Service journal. The appointment was made shortly after the third GRS/CB camp-out held in Tillsonburg, Ontario, of which Gearald was chairman.

Gearald Inch, XM-44-969, new GRS club representative for SCOPE, is shown at his base station.

Under his leadership the event became the largest GRS/CB gathering in the history of the General Radio Service.

Gearald is also past-president of the South Western General Radio Association. His appointment to the unpaid, voluntary staff of *SCOPE* will put him in contact with GRS clubs across Canada and will enable *SCOPE* to give equal coverage to GRS organizational activities in all areas.

"Me-te-a Trail Activities. The 11-Meter Communications Squad, Inc., Fort Wayne, Ind., provided radio communications for the Boy Scouts of America's annual "Me-te-a Trail Activities." Communications were handled for nearly 48 hours, according to Jack Forbing, KHC2683, commanding officer of the "Squad," as 750 scouts tromped through a 14-mile hike. They established ten radio check points along the way, with FCC authorization for the operation under special license KUY3259.

The "Squad" was organized in January, 1960, and today (according to Forbing) sports a most impressive communications network of highly trained, hand-picked operators. Membership is limited to 40. Current officers: Jack Forbing, KHC2683, commanding officer; John Schmitt, KHE1033,

Commanding officer Jack Forbing, KHC2683, and executive officer John Schmitt, KHE1033, of the 11-Meter Communications Squad, Inc., Fort Wayne, Ind., hold blow-up of the official Squad insignia.

executive officer; Wayne Salge, KPJ5297, treasurer; Larry Soughan, KLK7277, technical staff; plus awards, public information, and special events officers.

Special Edition. Richard Steimel, well-known Midwest CB'er and Editor of the Lakeland Citizens Radio Net *Newsletter* (Madison, Wisconsin), recently published a special edition of the club's paper in honor of their fifth anniversary. CB club editors across the country who are on the LCRN's exchange list admitted that Rick's 26-page bulletin is one of the finest, most informative CB club papers ever published.

When the average club paper is larger than 10 pages, it's usually because it has been supplemented with recipes, reprints from other sources, advertising, and sometimes too many off-color jokes. Rick Steimel laid out the "club publication of the year" by eliminating all subjects unrelated to CB and electronics. In his special issue of historic information and statistics, the following full-length articles appear: "What Is Lakeland Citizens Radio Net?"; "Attendance Records Analyzed"; "Five Years At a Glance"; "How Does a Citizens Band Club Get Started?"; "Who Can Belong to a CB Club?"; "Club Activities—They Move the Club"; "State Association News"; "History Highlights"; "Where Does the Money Come From?"; "An Open Letter On Civil Defense"; plus much more information of the same high caliber.

Kudos from POPULAR ELECTRONICS to editor Richard Steimel, and to the members of the Lakeland Citizens Radio Net for five years of growth, development, and public service.

(*Continued on page* 118)

FOREIGN-LANGUAGE BROADCASTS TO NORTH AMERICA

Prepared by BILL LEGGE

LANGUAGE	STATION	Time—EST	Time—GMT	Frequencies (MHz)
ARABIC	Cairo, U.A.R.	6:30-7:30 p.m.	2330-0030	9.475
	Damascus, Syria	8-9 p.m.	0100-0200	9.605
BULGARIAN	Sofia, Bulgaria	8-8:30 p.m.	0100-0130	9.70
CHINESE	Peking, China	8-10 p.m.	0100-0300	9.92, 12.01, 15.095
		10-12 p.m.	0300-0500	9.48, 12.01, 15.08
CZECH/SLOVAK	Prague, Czechoslovakia	8:30-9 a.m. (Sun.)	1330-1400	15.285, 17.825
		10-10:30 p.m.	0300-0330	5.93, 7.115, 7.345
DANISH	Copenhagen, Denmark	7-8:15 a.m.	1200-1315	15.165
		8-9:30 p.m.	0100-0230	9.52
DUTCH	Brussels, Belgium	6:15-8 p.m.	2315-0100	9.615
	Hilversum, Holland	9:30-10:50 p.m.	0230-0350	9.59
FINNISH	Helsinki, Finland	7:15-10:10 a.m.	1215-1510	15.185
FRENCH	Brussels, Belgium	6:15-8 p.m.	2315-0100	9.615
	Lisbon, Portugal	9:15-10 p.m.	0215-0300	5.985
	Paris, France	4-5 p.m.	2100-2200	11.885, 15.13
	Rome, Italy	8:20-8:35 p.m.	0120-0135	9.63, 11.905
	Vatican City	8:10-8:35 p.m.	0110-0135	6.145, 7.25, 9.645
GERMAN	Berlin, Germany	8:30-9:30 p.m.	0130-0230	5.955, 9.73
	Cologne, Germany	7-10 p.m.	0000-0300	6.10, 9.545
		10 p.m.-1 a.m.	0300-0600	6.10, 9.64
	Vienna, Austria	7-9 p.m.	0000-0200	9.77
HUNGARIAN	Budapest, Hungary	7-7:30 p.m.	0000-0030	6.235, 9.833
		9-10:30 p.m.	0200-0330	6.235, 9.833
ITALIAN	Rome, Italy	5:30-8 p.m.	2230-0100	9.63, 11.905
JAPANESE	Tokyo, Japan	7:15-7:30 a.m.	1215-1230	9.505, 9.605
		8:30-9 p.m.	0130-0200	15.135, 17.825
NORWEGIAN	Oslo, Norway	10-11:30 a.m.	1500-1630	15.175
		4-5:30 p.m.	2100-2230	11.85
PORTUGUESE	Lisbon, Portugal	7-9 p.m.	0000-0200	6.025, 6.185, 9.68
		9:45-11 p.m.	0245-0400	6.025, 6.185, 9.68
RUMANIAN	Bucharest, Rumania	6:15-7 p.m.	2315-0000	6.16, 9.57
		10:30-11 p.m.	0330-0400	6.16, 9.57
RUSSIAN	Moscow, U.S.S.R.	7 a.m.-12:30 p.m.	1200-1730	15.135
		6:30-7 p.m.	2330-0000	7.15, 9.685
		8:30-9 p.m.	0130-0200	7.15, 9.685
SPANISH	Buenos Aires, Argentina	8-9 p.m.	0100-0200	9.69
		11-12 p.m.	0400-0500	9.69
	Havana, Cuba	6 a.m.-4 p.m.	1100-2100	6.135, 15.30
		5-11 p.m.	2200-0400	6.135, 11.93
	Quito, Ecuador	6-9 a.m.	1100-1400	9.745, 11.915, 15.115
		7:30-9 p.m.	0030-0200	6.05, 9.745, 11.915
SWEDISH	Stockholm, Sweden	8-8:30 p.m.	0100-0130	9.705
		11-11:30 p.m.	0400-0430	9.705
UKRAINIAN	Kiev, U.S.S.R.	7:30-8 p.m.	0030-0100	7.12, 9.665

SHORT-WAVE LISTENING

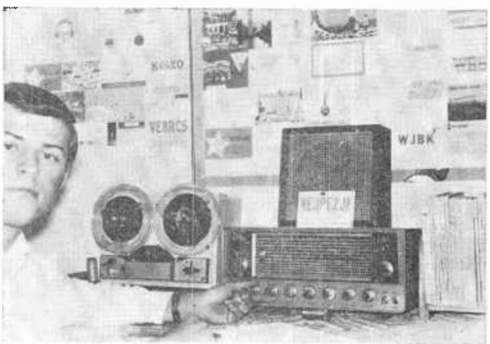
By **HANK BENNETT,** W2PNA/WPE2FT
Short-Wave Editor

BBC VERIFICATION POLICIES

A NUMBER of the readers of this column have asked if there has been a change in the announced verification policies of the British Broadcasting Corporation. Like the *Voice of America,* the BBC has a number of relay stations which rebroadcast programs originating in the London studios. They are located in Malta, Cyprus, Liberia, Aden, Malaysia, and Ascension Island.

As far as we can determine, all reception reports should be sent to the London headquarters, % Chief Engineer, External Service, BBC, Bush House, Strand, London, W.C. 2, England. Unless your report contains exceptionally valuable information (a transmitter fault, identity of new interfering stations, or a sudden or unexpected change in propagation conditions), you will probably receive one of the well-known "Big Ben" acknowledgment cards indicating the location of the specific relay station (presuming that the frequency reported was correct), and a letter which will simply state that the report is in accordance with their published schedule.

Very few true verifications of the BBC London (or old Daventry) stations are in existence. Your Short-Wave Editor was fortunate in receiving one from the BBC TV outlet operating on 41,500 kHz from the Crystal Palace in London.



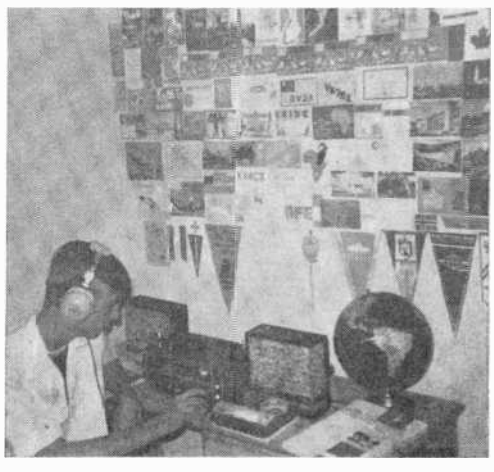
Thomas Treszow, VE3PE2JF, of Toronto, Ontario, Canada, uses a Lafayette HA-225 but keeps an old Philco 825-WAL (not shown) in reserve. He has 23 countries verified out of 55 heard; 24 states verified out of 47 heard. Thomas is also an amateur photographer—he took this photo himself.

John Shoptaw, WPE0EPO, Morehouse, Mo. (at right), receives with a Knight-Kit "Star Roamer" assisted by a 75' "L"-type antenna, 35' high. His record: 67 verified out of a total of 136 countries heard.

1967 Red Cross Tests. In 1967 the Radiocommunications Service of the International Committee of the Red Cross, Geneva, Switzerland, will make test broadcasts on 7210 kHz on the following dates: March 13, 15, and 17; May 22, 24, and 26; July 17, 19, and 21; September 18, 20, and 22; November 20, 22, and 24. Transmissions on all dates will be at 0600-0700, 1130-1230, 1500-1600, and 2300-0000. The 150-kW transmitter will be at Schwarzenburg working into a nondirectional antenna. Languages are to include French, English, and Spanish. You can obtain report forms upon request from the ICRC, 7 Avenue de la Paix, 1211 Geneva 1, Switzerland.

Unfortunately, news of the Red Cross tests was received too late for notice of the broadcasts which took place on January 23, 25, and 27 to be published here in time to be of any use. However, the ICRC offers all listeners able to send in reports on reception of broadcasts for all six months an attestation of "Listener of ICRC Test Broadcasts."

(*Continued on page* 113)



ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF MARCH

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7 a.m.	1200	Copenhagen, Denmark	15.165
7:15 a.m.	1215	Helsinki, Finland	15.185 (Tues., Sat.)
		Melbourne, Australia	9.585 or 11.71
6 p.m.	2300	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665, 9.685
6:45 p.m.	2345	Tokyo, Japan	15.135, 17.825
7 p.m.	0000	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665, 9.685
		Peking, China	15.06, 17.68
		Sofia, Bulgaria	9.70
		Tirana, Albania	7.263
7:30 p.m.	0030	Budapest, Hungary	6.235, 9.833
		Johannesburg, South Africa	9.675, 11.88
		Kiev, U.S.S.R.	7.12, 9.665 (Mon., Thurs., Fri.)
		Stockholm, Sweden	9.705
7:50 p.m.	0050	Vatican	6.145, 7.25, 9.645
8 p.m.	0100	Berlin, Germany	5.955, 9.73
		Havana, Cuba	6.17, 11.76
		London, England	6.195, 7.13, 9.51
		Madrid, Spain	6.13, 9.76
		Moscow, U.S.S.R.	7.15, 7.205, 9.665
		Prague, Czechoslovakia	5.93, 7.115, 7.345, 9.55
		Rome, Italy	9.63, 11.905
8:15 p.m.	0115	Berne, Switzerland	6.12, 9.535, 11.715
8:30 p.m.	0130	Bucharest, Rumania	5.975, 7.195
		Cairo, U.A.R.	9.475
		Cologne, Germany	6.075, 9.735
		Hilversum, Holland	9.59
9 p.m.	0200	Lisbon, Portugal	6.025, 6.185, 9.68
		London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665
		Stockholm, Sweden	9.705
10 p.m.	0300	Bucharest, Rumania	5.975, 7.195
		Budapest, Hungary	6.235, 9.833
		Buenos Aires, Argentina	9.69 (Mon.-Fri.)
		Havana, Cuba	6.135, 6.17
10:30 p.m.	0330	Accra, Ghana	6.11
		Prague, Czechoslovakia	6.095, 7.115, 7.345, 9.55

TO WESTERN NORTH AMERICA

TIME—PST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
6 p.m.	0200	Melbourne, Australia	15.22, 17.84
		Tokyo, Japan	15.135, 15.235, 17.825
6:50 p.m.	0250	Taipei, China	15.125, 15.345, 17.72
7 p.m.	0300	Moscow, U.S.S.R.	15.14, 15.18, 17.76
		Peking, China	9.457, 11.82, 15.095
7:30 p.m.	0330	Stockholm, Sweden	9.705
8 p.m.	0400	Sofia, Bulgaria	9.70
8:30 p.m.	0430	Budapest, Hungary	6.235, 9.833
8:45 p.m.	0445	Cologne, Germany	6.145, 9.735
9 p.m.	0500	Berne, Switzerland	5.965, 9.535
		Moscow, U.S.S.R.	9.64, 11.755, 11.85

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

THUMBNAIL REVIEW OF TR-108 TWO-METER TRANSCEIVER

LOOKING for a neat little 2-meter station for your shack or car? The Knight-Kit TR-108 transceiver may end your search. It features a 15-watt, crystal-controlled AM transmitter, a better-than-average dual-conversion receiver, and a combination 12-volt (transistorized) d.c. and 117-volt a.c. power supply. All this is accomplished with 12 tubes and 2 transistors. The TR-108 is distributed by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680. A matching accessory VFO is also available.

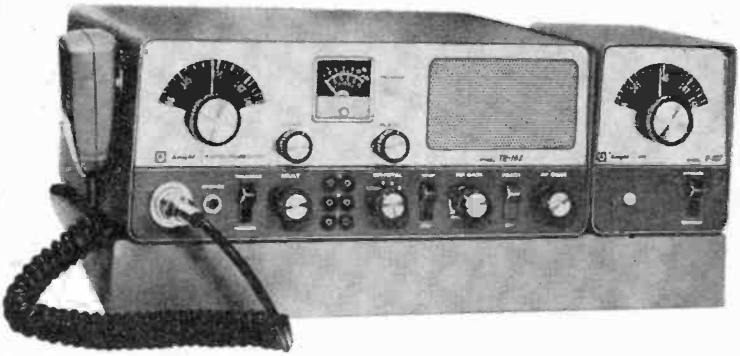
The TR-108 assembly instructions are crystal-clear, and should be easy to follow by anyone who can solder and use simple hand tools. Although we kept no precise time figures and did not try to rush the job, assembly took an estimated 40 hours. (Assembling the matching V-107 VFO required another evening.) A major contribution to the ease of construction is the pre-assembled and pre-aligned, crystal-controlled receiver "front end," which can be installed in minutes using two nuts and soldering four leads.

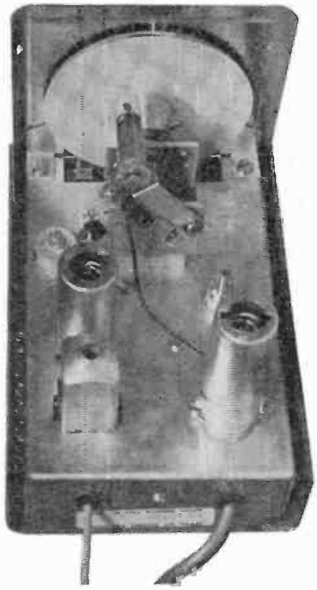
The completed unit worked after a fashion even before it was aligned; but it worked much better after alignment, of course. Although the manual recommends using a 1650-kHz modulated signal generator and two VTVM's to align the receiver i.f. transformers, a single VTVM can be employed if you switch it between the two test points. At any rate, the procedure is completely straightforward.

Peaking the transmitter requires a dum-

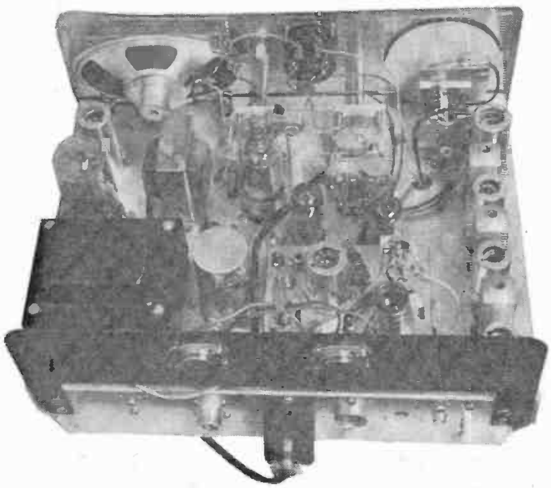
AMATEUR STATION OF THE MONTH

Paul Dumais, W1LJO, Newton Centre, Mass., works all amateur frequencies from 3.5 to 148 MHz. With a 93' tower supporting a 10-, 15-, and 20-meter tri-band beam and a 6- and 2-meter beam antenna to supplement a Hallicrafters HT-32 SSB and Johnson 500 and "6-N-2" transmitters, Paul has little trouble making contacts. (His WAS, WAC, and DXCC certificates prove it.) The receiving is handled by a Collins 75A-4 and a Hammarlund HQ-170 with converters for 50 and 144 MHz. Paul will receive a one-year subscription to POPULAR ELECTRONICS for submitting the winner for March in our Amateur Station of the Month photo contest. To enter the contest, send a clear picture of your station with you at the controls and some details on the equipment you use and your amateur career to: Amateur Photo Contest, c/o Herb S. Brier, W9EGQ, Box 678, Gary, Ind. 46401.





The Knight-Kit TR-108 2-meter transceiver (shown above with its companion V-107 VFO) features 15-watts input to a 2E26 on "transmit," and a dual-conversion superhet with a crystal-controlled converter on "receive." The built-in power supply works both on 117 volts a.c., and 12-15 volts d.c. Interior views are shown below. Except for the common power supply and audio system, the transmitter and receiver sections of the TR-108 are essentially independent of each other. The switching transistors for 12-volt operation are centered on their common heat sink (below, right). Directly at right is an interior view of the transceiver's matching V-107 VFO.



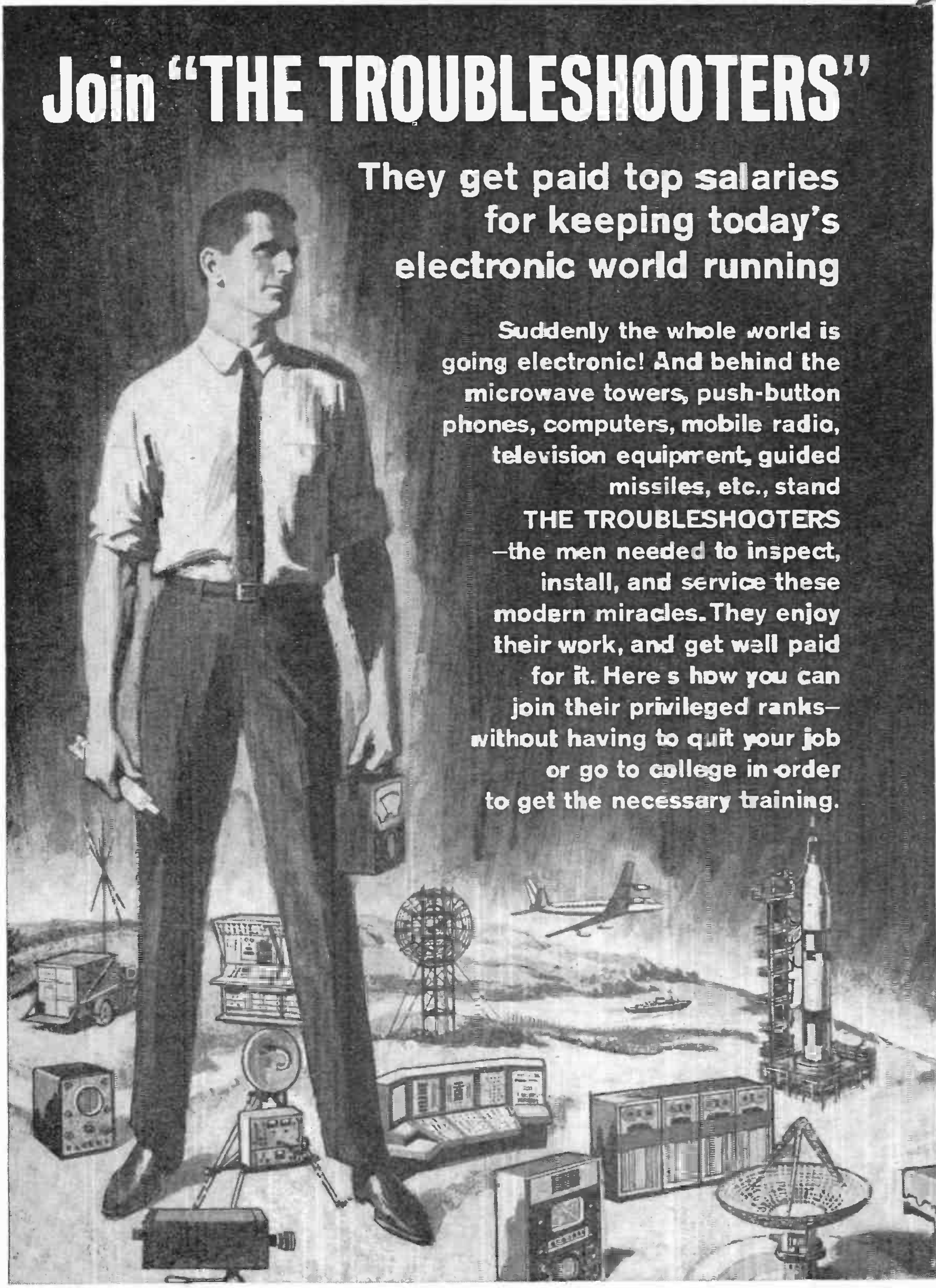
my antenna, which may consist of four #47 pilot bulbs and crystals near each end and the center of the 2-meter band, in addition to the VTVM. The crystals, which oscillate in the 8-MHz range, are later used in normal transmitter operation.

The TR-108 delivers approximately five watts to the antenna and puts out an excellent signal over the normal 2-meter working range; this was verified by your reviewer by the ease of making contacts with a simple, non-directional antenna. Using the microphone supplied, all quality and modulation reports have been flattering. While a VFO is not quite as desirable on the VHF's as on the crowded lower frequencies, having one is undoubtedly an operating convenience; and the companion Knight-Kit V-107 VFO works well in conjunction with the TR-108. After a 15-minute warm-up, its stability is good for equipment of this kind; it is not entirely drift-free, however.

Contrary to the performance of some VHF tranceivers, the rated 1-μV sensitivity and 8-MHz selectivity of the TR-108 on "receive" are more than adequate for a unit of this type. Furthermore, its automatic noise limiter chops ignition noise from passing cars and similar impulse noises down to size. Plugging in the d.c. power plug automatically converts the power supply from power-line operation to 12-volt d.c. mobile operation.

In your reviewer's opinion, the Knight-

(*Continued on page* 110)


Join "THE TROUBLESHOOTERS"
They get paid top salaries for keeping today's electronic world running
Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand THE TROUBLESHOOTERS —the men needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks— without having to quit your job or go to college in order to get the necessary training.

JUST WHEN I FORGOT MY (SOLDERING) GUN! Sequel 4

THE UNABATED FLOOD of entries in our contest on nonsensical remarks about electronics continues on its merry way. Although the "type" of submission seems to have changed—there is a steady incoming flow of puns—we are pleased to see that this contest still has an enormous following.

If you have heard a wild, implausible, or inane remark about electronics, why not tell us about it? Send it in and you may win a soldering gun, a prize that will help you "snuff out" some of those people who talk without thinking.

Typical remarks have appeared in the July, September, November, and December issues.

All About Wives. For some inexplicable reason, "wife" remarks are always good for a laugh and five of the better stories received in the past few weeks concern equipment repair as seen through the eyes of the female side of the household. One hi-fi service call involved what was obviously a frozen motor shaft in a record player. When this fact was announced, the offended housewife exclaimed, *"That isn't true; it's never been that cold in this room!"*

The electronic engineer's wife who is always phoning her husband in the office decided to take things into her own hands when the TV receiver went bad, so she phoned a radio-TV service shop. After she explained the trouble, and the shop diagnosed the symptoms, the wife hung up and then telephoned her husband to bring home an *"intermittent tube."*

When another wife had the TV repairman come over to the house, it didn't take him long to spot the source of trouble, for there was the 300-ohm lead-in hanging a good 1" away from the TV receiver antenna terminal. When this fact was pointed out, the wife indignantly stated that she couldn't see "how come" *the TV signal had traveled 25 miles through the air to get to the antenna and then couldn't jump this last remaining little gap.*

Then, there was the woman who had the repairman come in to fix the vacuum cleaner. Claiming that it needed new brushes, he removed a worn brush, placed it on the table, and said, "Look at this." The housewife exclaimed, *"Well, I'll be! There's not a hair left on it."*

Finally, there was the housewife who had received a solid-state stereo receiver as a Christmas present; when the repairman arrived, he found that the a.c. cord hadn't been plugged in. Why not? Obviously, *anything*—according to the housewife—*that uses transistors uses batteries.*

Puns, Puns, and More Puns. The 1967 Lafayette Electronics catalog has a "Tube Gadget" listed on p. 277. It is described as a "combination 7 and 9 pin miniature tube straightener and tube puller." *It must be specially made for bent tubes.* . . . A group of Californians that reconditions old cathode-ray tubes supported Ronald *Re'gun* for Governor. . . . Mad Magazine's Alfred E. Neumann exclaimed on seeing his new ham ticket, *"What me WØRRY?"*. . . . RCA Victor has a recording crew in Haiti taping some voodoo music—it seems *they bought the rites.*

A woman in my neighborhood with a new color TV receiver had the repairman come over to *delouse the picture tube.* . . . Now that I'm interested in electronic espionage, my wife *wants my bug detector to get the moths out of her closet.* . . . A customer in a hi-fi salon rejected stereo discs, claimed she wanted some new *multiplex recordings.* . . . How come that raven in my room keeps saying *"Neper More"?*

My soldering iron developed a short and my wife *can't understand why I don't lengthen it.* . . . Did you know that if you *keep a roll of solder in the refrigerator you can make better cold solder joints?* . . . You've got to watch those store clerks; the last one didn't know anything at all about *collapsible cable.* . . . My wife's brother is so stupid he believes that if I hooked together all the batteries on earth I'd have *a world series.* . . . Did you hear about the fellow who thinks that *heptode tubes are cool frogs?*

Winners. This month soldering guns go to Michael Breuning, Dennis Courtney, Bruce Feezel, Robert Fleischer, Leroy Ireland, J. V. Luczynski, Don Norwood, Bruce Potterton, Charles Saleeby, Larry Simko, Earl Switzer, and Byron G. Wels. —30—

NEW POWER

FROM FINCO

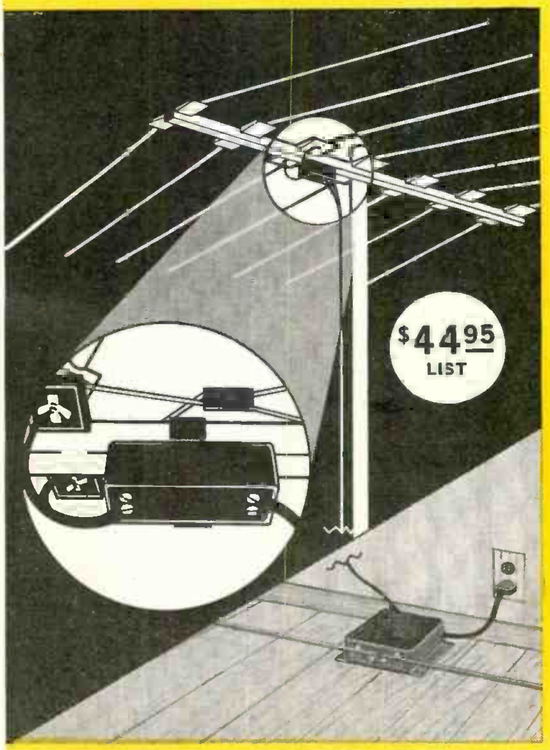
Model 65-3 VHF-TV ANTENNA AMPLIFIER

improves reception of WEAK VHF-TV signals in FRINGE AREAS even where strong local TV or FM signals are present. AMPLIFIES UP TO 7 TIMES for Better Color and B/W

A two-transistor—high and low band—amplifier in one compact weather-resistant housing. Engineered to provide the lowest noise and highest amplification with the most desirable overload characteristics. Designed for easy and convenient installation on antenna boom, mast, or under roof eave.

Amplifier used in conjunction with dual outlet power supply for one, two, or multiple set installations (with Finco 3003 coupler). 117 V 60 cycle input. AC power up to amplifier: 24 volts - 60 cycle. Metal enclosed with easy keyhole mounting. Amplifier and power supply provided complete with mounting hardware. Each unit tested and inspected prior to shipment.

Let Finco solve your Color and B & W reception problems. Write for complete information, schematics and specifications. Form #20-357.



Model 65-3 VHF-TV ANTENNA AMPLIFIER

MAKER OF THE WORLD FAMOUS COLOR FINCO BLACK / WHITE TV AND FM ANTENNAS

THE FINNEY COMPANY
34 West Interstate Street • Bedford, Ohio 44014
Dept. PE

Please send free 65-3 Amplifier Brochure

Name ______________________

Address ______________________

City __________ State __________ Zip ______

CIRCLE NO. 13 ON READER SERVICE PAGE

THE "SUPERTROL"

(*Continued from page* 44)

In this application, the connection from the battery to terminal *A* is broken to prevent *C1*, which is rated at 6 volts, from charging up and shorting out. If you want to replace *C1* with a capacitor of higher voltage rating, say 25 volts, then the connection at point *A* need not be broken. It is important that you put *Q1* back in its socket before applying power to the circuit.

The connections for an interval timer or a time delay relay are the same as required for the voltage level detector (Fig. 6), except that the relay contact selection must be as shown in Fig. 7. This circuit also includes a d.p.d.t. switch, used to control the load power while charging capacitor *C1* is being shorted out. In position 2, power is applied to one set of contacts to enable the capacitor to charge sufficiently to trigger the Schmitt trigger circuit. The charging time is, of course, determined by the setting of *R11*. When *C1* charges to its upper trip point, *Q1* conducts and the relay switches power from the interval output to the delay output. When the switch is flipped to position 1, the capacitor is shorted through a resistor, and the circuit is reset.

The hookup shown in Fig. 7 can be used for a darkroom photo timer, as a delay relay to allow the filaments of a transmitter to warm up before plate voltage is applied, or as a starting relay for a generator or a fluorescent lighting system. You can also use it in a driveway or hallway lighting circuit to extinguish the lighting by delay action. By varying *R11*, the circuit can be made to introduce a time delay varying from 50 milliseconds to 10 seconds.

To keep the load from oscillating, an additional relay can be added to the output connections to lock up on its own contacts and thereby provide a continuous stable output. Another approach to this problem is to reset the switch to position 1 approximately 8 seconds or so before the oscillation starts. —30—

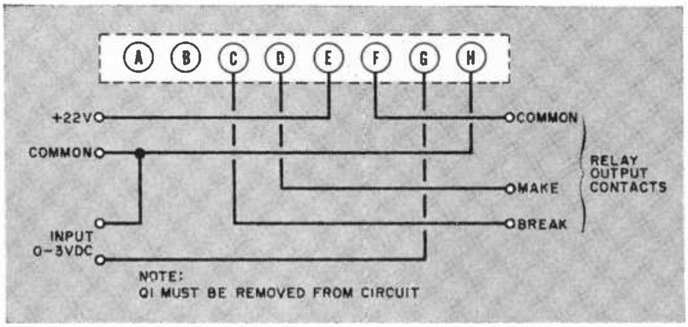


Fig. 6. Remove transistor Q1 and make the external connections in this diagram and your Supertrol becomes a low voltage sensor. An input of 2 volts turns the circuit on and a drop below 1 volt turns the circuit off. This circuit could be used as an alarm.

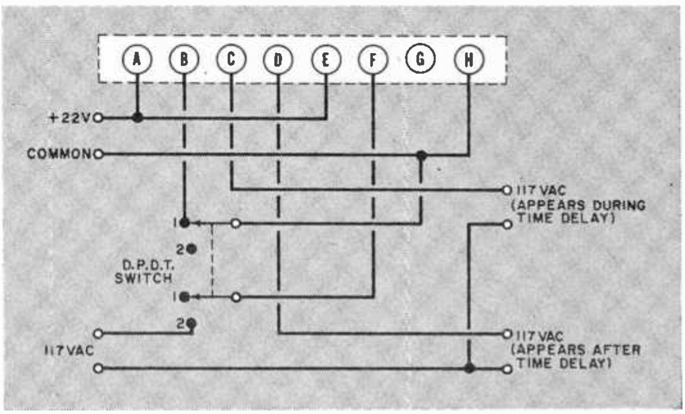


Fig. 7. The most practical application of the Supertrol is as an interval timer. However, this requires an external d.p.d.t. toggle switch wired into the circuit as shown here. Timing begins with the switch in position 2. Circuit reset is position 1.

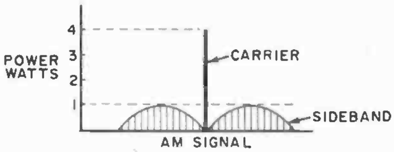
THE "MULE BOX"

(*Continued from page* 50)

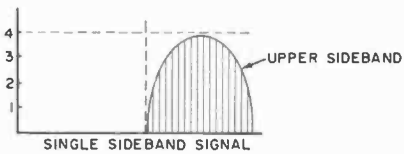
A few words of warning concerning the adjustments described above are in order at this time. First, running the carrier output at a higher level than indicated will only result in illegal operation and short tube life. Output power will not be increased, since the tube cannot produce any more power with the power supply specified. —30—

Why DSBRC?

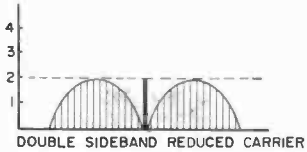
According to FCC Regulations (Part 95.43), the ideal unmodulated CB transmitter would have an average power input of 5 watts and an average power output of 4 watts. When the carrier wave is 100% amplitude-modulated, two sidebands appear, also containing r.f. power, but particularly carrying all of the useful voice intelligence, as in (A) below. To increase the "talk power" of a CB rig, a possible method would be to eliminate the useless carrier and concentrate all of the available r.f. energy in one or both sidebands, as in (B). Although advanced forms of voice communications (SSB) do just this, the absence of a carrier introduces a new set of complex receiving problems. The "Mule Box" effects a compromise by reducing the r.f. power in the carrier and simultaneously increasing the power in the intelligence-carrying sidebands, as in (C). Thus, the DSBRC signal sounds "louder." This idea has been used commercially for several years in the Regency "Range Gain" CB transceiver.



(A)



(B)



(C)

"MIXED TWELVE"

(Continued from page 77)

Draw the cutout shapes on the front panel as shown in Fig. 4. Carefully cut out the openings and then paint the front of the panel and the sides of the openings. Use flat black paint to obtain a uniform front panel appearance and to keep the openings from being noticeable through the grille cloth.

Glue and nail all joints. Be sure to sand and stain the cabinet before tacking the grille cloth in place. Frame the front panel with ½" quarter-round molding.

Now center and mount the speakers over their respective holes, using 8 x ¾" pan-head sheet-metal screws to secure them. Glue 1" x 2" pieces of wood between the rows of speakers as shown in Fig. 5.

Wire the speakers all in phase as shown in Fig. 6. You can check speaker phase by observing the direction of cone movement as you momentarily connect a 1½"-volt flashlight battery across the speaker terminals. When the speakers are all wired in place, double-check the phase by once again momentarily connecting the battery across the entire system; all cones should move in the same direction at the same time. If any of the cones do not move in the same direction as the majority, reverse the connections on the nonconformers.

To dampen the system, tack a 2"-thick sheet of cotton batting, or other suitable material, to the top of the cabinet and let it drape down to the bottom of the cabinet to form a thick "curtain" over the backs of the speakers.

Connect the "Mixed Twelve" to the 4-ohm output terminals on your hi-fi amplifier . . . and relax. -30-

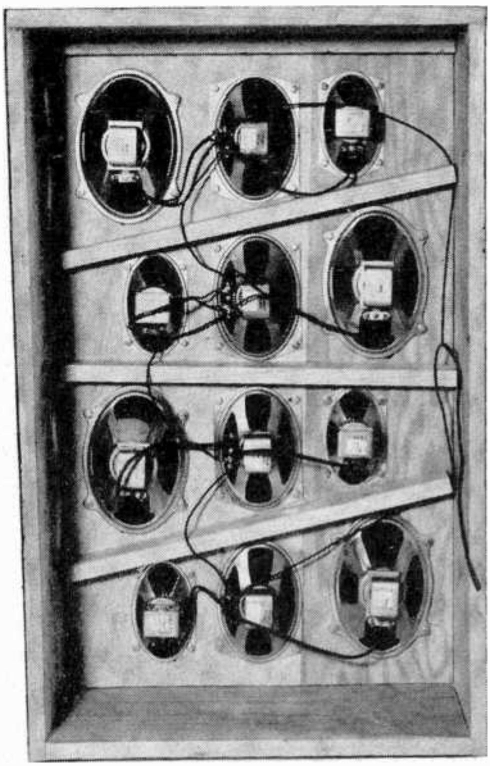


Fig. 5. Glue cleats between rows of speakers. Sturdier cabinet construction can be obtained if cleats are also used for mounting front board in place.

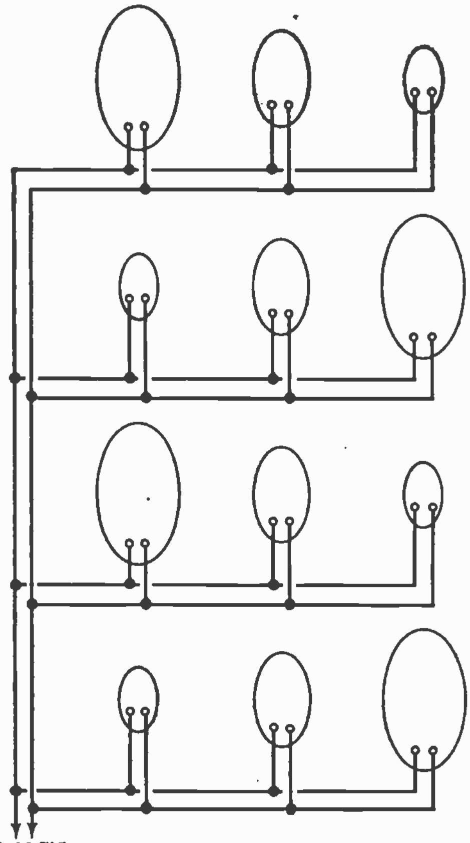


Fig. 6. Double-check wiring to make sure that all speakers are connected in phase. Simple battery test described in text can be used for this purpose.

STEREO PREAMPLIFIER

(*Continued from page 72*)

unwanted feedback, crosstalk, and stray leakage paths. Component layout on the printed circuit boards is shown in Fig. 6.

The photographs (Figs. 7, 8, and 9) show the preamp mounted in a metal cabinet, but you can house the circuits in any type of enclosure. The input and output jacks are mounted on the back panel. Wire them in and leave enough length to reach the selector switch (*S1*) on the front panel.

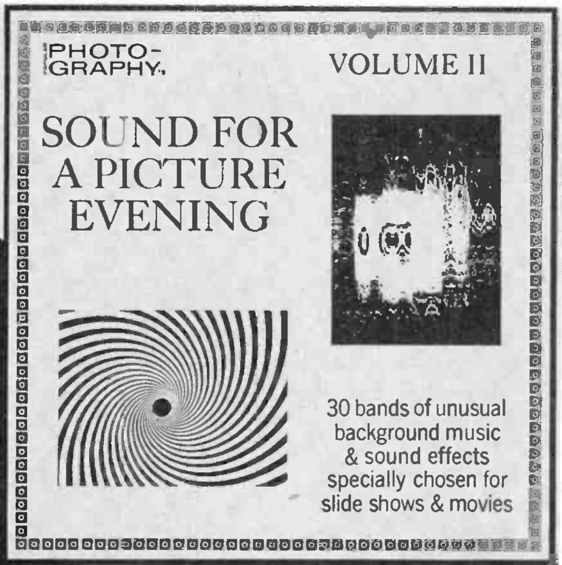
Connect the voltage divider resistors (*R27* and *R29*) directly to the AM and FM inputs respectively. One end of resistors *R28* and *R30* can be tied to a

SPECIFICATIONS

Frequency Response	10 to 100,000 Hz ± 1 dB (tone controls set for flat response)		
Sensitivity (input needed for 1.0 volt rms output)	Phono:	20 millivolts	
	Tape:	12 millivolts	
	Mic:	15 millivolts	
	AM-FM:	0.95 volt	
Maximum Input (before clipping occurs, measured at 1 kHz)		12-Volt Supply	24-Volt Supply
	Phono:	30 mV	60 mV
	Tape:	25 mV	50 mV
	Mic:	25 mV	50 mV
	AM-FM:	1.25 V	2.5 V
Maximum Output	12-Volt Supply: 1.5 V rms 24-Volt Supply: 3.0 V rms		
Distortion (measured at 1 volt rms output)	Less than 0.06%, any frequency from 20 to 20,000 Hz		
Noise	Phono, Tape, Mic Inputs:	−65 dB	
	AM, FM Inputs:	−70 dB	
Input Impedance	At least 200,000 ohms, any input		
Output Impedance	Less than 10 ohms		
Without Compensation Networks	Frequency Response:	50 to 10,000 Hz ±3 dB	
	Gain:	60 dB	
	Input Impedance:	10,000 ohms	
	Output Impedance:	100 ohms	
Power	12 to 24 volts, d.c., 4 to 8 milliamperes		

Bring your slides and movies to Life...

(and your audience, too!)



WITH VOLUME II

SOUND FOR A PICTURE EVENING

This superb 12-inch, 33⅓ rpm record brings you 30 selections of sparkling, mood-setting off-beat music and hard-to-find, sound effects. For use "as is" by playing the appropriate tracks as your slide or movie show proceeds or for editing your selections and recording them on tape, "Sound For A Picture Evening" adds another dimension to your photography—high fidelity sound.

19 Bands of mood and special-situation music...

11 Bands of unusual, hard-to-find sound effects...

MADE WITH PHOTOGRAPHERS IN MIND

Photographers are travelers . . . are parents . . . are sportsmen . . . are restless experimenters with the unusual. And so the editors of POPULAR PHOTOGRAPHY have produced this second volume of unusual music and sound effects expressly to match the activities and moods in the most popular types of pictures shown in slide and home movie shows. These are melodies and sounds selected from the vast resources of the Capitol Record Hollywood Library to fit the special needs of photographers. The 30 bands of "Sound For A Picture Evening, Vol. II" supplement but do not duplicate any of those in the first edition of this popular record.

A POPULAR PHOTOGRAPHY EXCLUSIVE

The "Sound For A Picture Evening, Vol. II" album has been produced by the editors of POPULAR PHOTOGRAPHY exclusively for our readers and is prepared by the Custom Services Division of Capitol Records. This outstanding album, which cannot be purchased in any store, is available by mail only to the readers of Popular Photography and other Ziff-Davis magazines.

YOU GET 30 SPECIAL MUSIC AND SOUND TRACKS

There are 19 bands of mood and special-situation music . . . 11 bands of unusual, hard-to-find sound effects.
MOODS: Majestic, Backyard Nature, Experimental, Mysterious, Music of the Spheres • NATIONAL PORTRAITS: Vive la France, German Village Band, Soul of Spain, American West, English Countryside, Buon Giorno, Italia •
SOUND EFFECTS: Bass Drum, Bassoonery, Cathedral Bells, Galloping Horses, Zoo Noises, Children at Play, Cocktail Party, Birds on a Spring Morning, Outboard Motor, Oars in Water, Skis on Snow, Trumpet Fanfare, Solo Violin • SPECIAL PURPOSE MUSIC: Music From Silent Movies, Music for Slow-Motion Movies, Music for Speeded-Up Motion, Music for Stop-Motion Movies, Underwater Music, Music for Old-Time Footage.

For photographers with wanderlust, you'll find the "National Portraits" to be authentic melodies to go with your vacation pictures of England, France, Germany, Italy, Spain and the American West.

There are also those special bands to accompany the kind of pictures sportsmen take: The sound of galloping horses, of boat motors, of skis on snow, of oars in the water. You'll even find other-wordly mood-music chosen especially to go with underwater pictures.

Experimental photographers will find the electronic music ideal accompaniment for abstract pictures. The music for stop-motion, slow-motion and speeded-up-motion pictures is fanciful and imaginative in helping to present the unusual scenes being portrayed on your screen. And there is even mood music to convey the visual grandeur of ancient museum relics and photographs of the stars and planets.

To these add many other tracks of carefully selected music and sounds—and you have "Sound For A Picture Evening, Volume II."

COMPLETE WITH INSTRUCTIONS AND BAND POINTER **FREE!**

A comprehensive instruction booklet comes with your record, showing you how to make a successful sound-and-music tape track for your slide or movie show, or to use the record alone as background, even if you're a rank beginner. An ingenious band pointer which fits on top of your record instantly locates any band you want. No guessing, no wasted motion, no false starts.

This 12" long playing vinyl album consisting of selections from the music masters of the Capitol Record Hollywood Library is available to you for

only $3.98 POSTPAID!

It's a must for every slide and film show impresario and an album you will enjoy for many years to come.

PLACE YOUR ORDER NOW

"Sound For A Picture Evening, Volume II"
Popular Photography, Dept. SD
One Park Avenue, New York, N.Y. 10016

Please send ________ "Sound For A Picture Evening, Volume II" albums at $3.98 each, postpaid. My check (or money order) for $________ is enclosed. (Outside U.S.A. please send $5.00 per record ordered.)

N.Y. State residents please add local sales tax.

Name ____________________

PE-37

Address ____________________

City ____________ State ________ Zip Code ________

Sorry—No charges or C.O.D. orders

"SOUND FOR A PICTURE EVENING, VOLUME I" still available.

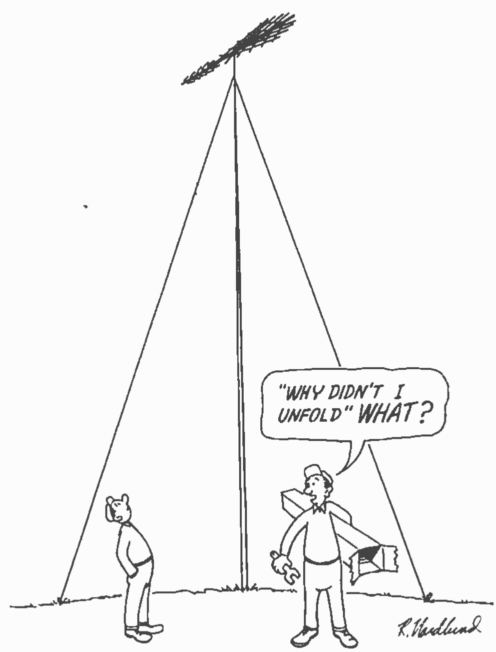
I missed this first release containing 17 specific mood music backgrounds and 8 tracks for special sound effects. Please send ________ "Sound For A Picture Evening, Volume I" albums at $3.98 each, postpaid. (Outside U.S.A. send $5.00 per record ordered.)

single ground terminal mounted on the chassis next to the input jacks. It's a good idea to use shielded leads between the input jacks and the switch. If you do use shielded wires, connect only one end of the shields to ground, near the input jacks. Do not connect the shields to ground at the switch end of the wire.

Drill holes in the chassis to mount the circuit boards, using the boards as templates. Cut a notch in the chassis to clear the selector switch and wire the input leads to the switch before assembling the chassis to the front panel. The boards are mounted on ½-inch threaded spacers. Wire the controls and upper section of the rotary switch and the job is done.

Finishing Touches. A balance control could be included in the "Two-By-Two" to optimize adjustments for stereo programs. However, adjustment for balance is easily obtained by the use of concentrically-stacked volume controls which can be individually adjusted.

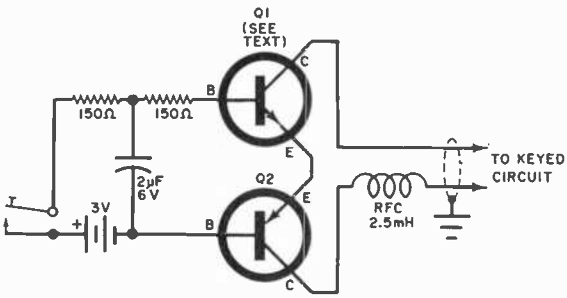
And, of course, you can dress up the front panel of the cabinet with self-sticking vinyl plastic such as the material used for shelf covering. Decals can be applied and sealed with a clear plastic spray. —30—



INFORMATION CENTRAL

(*Continued from page 68*)

Eliminating key clicks is not all that simple, but you might try the circuit shown in the accompanying diagram. I have used this method to key a CW transmitter and it sure helps to cut down on key clicks—depending on the keying circuit. Transistor *Q1* can be a 2N438, 2N579 or 2N316; for



Q2 I recommend trying a 2N595, 2N446, 2N377, or 2N585. You may also find it advantageous to vary the capacitor value for best results.

Quickie Electronics Course. *Is there a cheap refresher electronics study course I can buy?*

There are many courses that would fit the bill, but your best bet might be the brand-new 3-part self-study course offered by Westinghouse. There are three separate instructional handbooks and all of the fundamentals are covered—including molecular electronics. The complete course is $3 and should be ordered by requesting handbooks SA-9498, SA-9498 Pt.A, and SA-9498 Pt.B. Write to: Basic Electronics Course, Westinghouse Electric Corp., Printing Division, Box 398, Trafford, Pa. 15085. -30-

SOLID STATE

(*Continued from page* 79)

ing is critical, good wiring practice should be observed during assembly, with signal leads kept short and direct and adequate separation provided between the two channels to minimize cross-coupling. The circuit can be assembled on a suitable etched circuit board, on a perforated phenolic board, or on a small metal chassis, as preferred.

Manufacturer's Circuit. Ever since the "great blackout," there has been an increasing interest in emergency lighting equipment. A unique, maintenance-free emergency light circuit is shown in Fig. 2. One of several circuits described in GE's Specification Note 150.9 (General Electric, Semiconductor Products Dept., Electronics Park, Syracuse, N.Y.), the unit keeps battery *B1* constantly charged, and operates automatically with an SCR in place of the more common electromagnetic relay to switch on the lamp when primary power fails. It can be used in elevator cars, corridors, basements, or any other area where a loss of light—even temporarily—is undesirable.

With the unit operating, the 12 volts a.c. across the transformer secondary is half-wave-rectified by *D2*, and provides a changing voltage for the battery through *R2*, which regulates the charging current. The battery, of course, serves as the emergency power source to light the lamp, in series with *SCR1*, only when there is a power failure. To keep the lamp from being turned on at other times, capacitor *C1*—in series with *R1* and *D1*—acts as a trigger. The charge on *C1* puts a negative voltage on the SCR gate to counterbalance and thus neutralize the positive battery voltage applied to the gate across *R3*. This keeps the SCR from switching on.

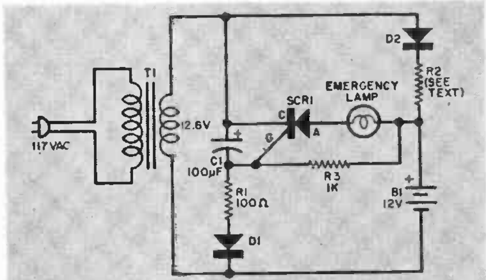


Fig. 2. This emergency light circuit, described in General Electric's Specification Note 150.9, keeps reserve battery (B1) fully charged and turns on an emergency lamp in case of primary power failure.

If line power fails, $C1$ discharges gradually, and $SCR1$ is triggered by the positive voltage which now remains on its gate. The SCR then switches on and conducts fully, applying power to the lamp. Reset operation is automatic once line power is restored, since $C1$ recharges to again neutralize the SCR gate voltage.

Standard parts are used in the design. Transformer $T1$ is a 12.6-volt, 1-ampere unit, $C1$ is a 100-μF, 18-volt electrolytic capacitor, and all resistors are rated at 1 watt. The SCR is a GE C106Y, $D1$ an A14F diode, and $D2$ an A40F rectifier. A GE 1073 lamp serves as the emergency light. Any standard 12-volt storage battery can be employed for $B1$. Since $R2$ serves to limit $B1$'s charging current, its value must be determined by the requirements of the battery used.

The individual builder can follow his own inclinations as far as construction and wiring are concerned but a heat sink should be provided for the SCR.

Product News. A 14-transistor receiver for $6.95 or a 6-transistor set for $8.95 . . . which is the better buy? Off-hand, the 14-transistor set seems like the better buy. But there's a good chance that the 6-transistor set might be a superior product, for, according to the National Better Business Bureau, a number of foreign manufacturers are producing sets with "dummy" (non-functioning) transistors to raise the "count," and thus gain a competitive edge. This practice is reminiscent of that used by several radio manufacturers during the mid-30's who offered 20- and 30-tube receivers in which only 4 or 5 tubes actually performed useful functions.

A probe-like general-purpose transistor tester is now being offered by Jensen Tools & Alloys (3630 E. Indian School Rd., Phoenix, Ariz. 85018). Battery-operated, the instrument is designed for in-circuit as well as out-of-circuit tests and, with pin-like probes, is quite suitable for use on etched circuit boards. Transistor (or diode) condition is indicated by a pilot lamp. Identified as Model SC-4, the tester sells for $89.00.

Aul Instruments, Inc. (24-13 Bridge Plaza North, Long Island City, N.Y. 11101) has introduced the Model RS-30 low-voltage-regulated power supply suitable for transistor circuit tests and experiments. The instrument can supply from 1.4 to 30 volts d.c. at currents of up to 500 mA, and features short-circuit protection and a metered output. It sells for $5.00.

Problems! Problems! Not too long ago, reader Emil E. Knospe of Depew, New York, sent us the following letter:

"Wow! I was really surprised to see the

flasher circuit I sent you printed in the June 1966 issue. Actually, I've intended for months to write to you but just now got around to it. I've been running the flasher in my '63 Ford for almost a year now and it works just fine . . .

"Last September, a POP'tronics reader in Florida called me, said he built the flasher from the magazine article but it wouldn't work. I told him to send it to me and I found that:

"(1) Transistor *Q1* was inoperative, probably wrecked from the heat of soldering;

"(2) He had switched *Q3* and *Q4*, and also had incorrectly mounted them to the heat sink;

"(3) Transistor *Q3* had low *beta* and wouldn't cut off power switch *Q4*;

"(4) Resistors *R1* and *R2* were 1.0 megohm instead of 1000 ohms.

"In other words, it didn't have a chance of working. I repaired it, sent it back, and got a nice letter from him saying that it works fine now. Just thought I'd pass the story along . . ."

And so, dear readers, let that letter be a lesson to you.

Transitips. As we all know, the letter "Q" is used to identify a transistor. It is also used to designate the selectivity or figure of merit of a coil or tuned circuit. Quite often, the two Q's do not go together. A high-Q (tuned) circuit may become a low-Q circuit when coupled to a Q (transistor).

In a coil, Q is equal to the inductive reactance (X_L) of the coil, at a given frequency, divided by the resistance acting in series with the inductance. Since the resistive component represents a circuit power loss, anything which increases power loss acts to reduce the coil's Q, and hence the Q (and selectivity) of the tuned circuit in which the coil is used. Similarly, any external series or shunt resistance loads the tuned circuit and reduces the Q.

A junction transistor has a low input impedance which is essentially resistive. When a tuned circuit is coupled to the input of the transistor, as in Fig. 3(a), severe loss of Q usually results. Tuned circuit *L1-C1*, coupled to *Q1* through *C2*, is loaded by *Q1*'s base-emitter resistance shunted by bias resistor *R1*. This accounts for the relatively poor selectivity of many home-built receivers.

If tuned circuit loading is reduced, then the effective circuit Q will go up. A technique to reduce loading is shown in Fig. 3(b). Here, the transistor is coupled to a tap on *L1*. Thus, the coil serves as an impedance-matching autotransformer. Circuit loading is reduced and overall selectivity (Q) is improved, even though the circuit may seem

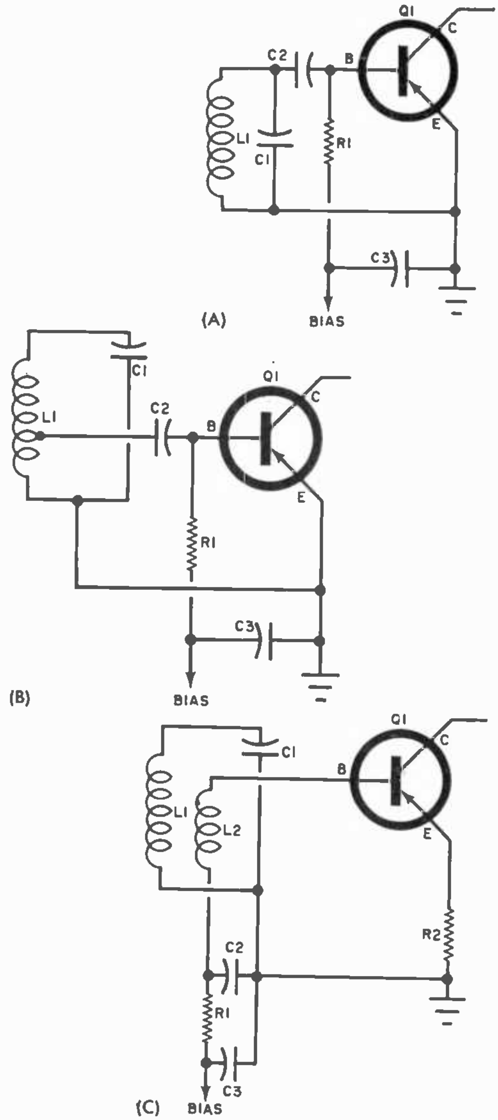


Fig. 3. Poor selectivity of some home-built receivers is sometimes due to loading of a tuned circuit—see C1-L1 in (A) above—by a transistor's base-emitter resistance. Loading can be reduced by coupling the circuit to Q1 through a tap on L1 (B). In (C), a step-down transformer serves the purpose.

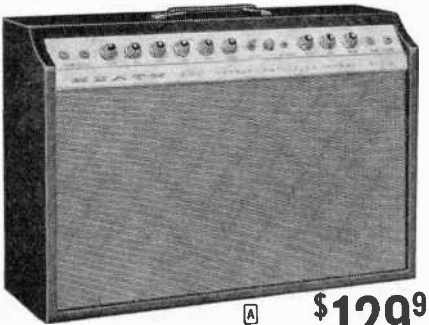
less sensitive due to the reduction in the signal voltage applied to *Q1*.

Another technique is given in Fig. 3 (c). Step-down transformer secondary winding *L2* serves to reduce tuned circuit (*L1-C1*) loading. At the same time, a series-fed—rather than shunt-fed—bias arrangement is used, with *L1* loaded only by *Q1*'s base-emitter resistance. In addition, an unbypassed emitter resistor, *R2,* acts to raise *Q1*'s effective input impedance, with a cor-

(*Continued on page* 110)

How To Have Fun While You Save...

Harmony-by-Heathkit® Electric Guitars & Heathkit Guitar Amplifier



A Kit TA-16 $129.95

B Kit TG-46 $219.95 (save $111.55)

C Kit TG-26 $99.95 (save $47)

D Kit TG-36 $119.95 (save $40.55)

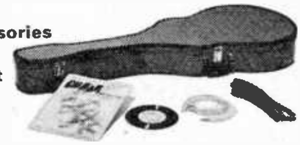
A NEW Heathkit Transistor Guitar Amplifier

60 watts peak power; two channels — one for accompaniment, accordian, organ, or mike, — the other for special effects... with both variable reverb and tremolo; 2 inputs each channel; two foot switches for reverb & tremolo; two 12" heavy-duty speakers; line bypass reversing switch for hum reduction; one easy-to-build circuit board with 13 transistors, 6 diodes; 28" W. x 9" D. x 19" H. leather-textured black vinyl cabinet of ¾" stock; 120 v. or 240 v. AC operation; extruded aluminum front panel. 52 lbs.

American Made Harmony-By-Heathkit Guitars

All wood parts factory assembled, finished and polished . . . you just mount the trim, pickups and controls in predrilled holes and install the strings . . . finish in one evening.

These Valuable Accessories Included With Every Guitar Kit



Each guitar includes vinylized chipboard carrying case, cushioned red leather neck strap, connecting cord, Vu-Tuner® visual tuning aid, tuning record, instruction book and pick . . . worth $19.50 to $31.50 depending on model.

B Deluxe Guitar . . . 3 Pickups . . . Hollow Body

Double-cutaway for easy fingering of 16 frets; ultra-slim fingerboard — 24¼" scale; ultra-slim "uniform feel" neck with adjustable Torque-Lok reinforcing rod; 3 pickups with individually adjustable pole-pieces under each string for emphasis and balance; 3 silent switches select 7 pickup combinations; 6 controls for pickup tone and volume; professional Bigsby vibrato tail-piece; curly maple arched body — 2" rim — shaded cherry red. 17 lbs.

C Silhouette Solid-Body Guitar . . . 2 Pickups

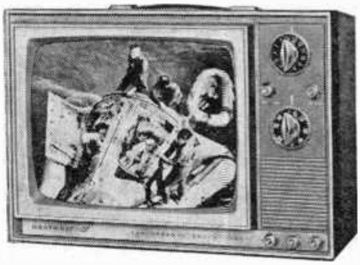
Modified double cutaway leaves 15 frets clear of body; ultra-slim fingerboard — 24¼" scale; ultra-slim neck for "uniform feel"; Torque-Lok adjustable reinforcing rod; 2 pickups with individually adjustable pole-pieces under each string; 4 controls for tone and volume; Harmony type 'W' vibrato tail-piece; hardwood solid body, 1½" rim, shaded cherry red. 13 lbs.

D "Rocket" Guitar . . . 2 Pickups . . . Hollow Body

Single cutaway style; ultra-slim fingerboard; ultra-slim neck, steel rod reinforced; 2 pickups with individually adjustable pole-pieces for each string; silent switch selects 3 combinations of pickups; 4 controls for tone and volume; Harmony type 'W' vibrato tailpiece; laminated maple arched body, 2" rim; shaded cherry red. 17 lbs.

NEW 12" Transistor Portable TV — First Kit With Integrated Circuit

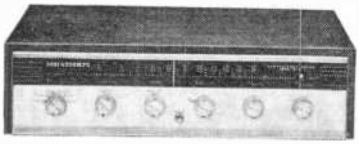
Unusually sensitive performance. Plays anywhere . . . runs on household 117 v. AC, any 12 v. battery, or optional rechargeable battery pack ($39.95); receives all channels; new integrated sound circuit replaces 39 components; preassembled, prealigned tuners; high gain IF strip; Gated AGC for steady, jitter-free pictures; front-panel mounted speaker; assembles in only 10 hours. Rugged high impact plastic cabinet measures a compact 11½" H x 15¾" W x 9⅜" D. 27 lbs.



Kit GR-104 $119.95

Build Your Own Heathkit® Electronics

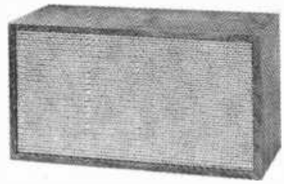
30-Watt Solid-State FM Stereo Receiver



Kit AR-14
$99.95
(less cabinet)

High Performance At Lowest Cost. Features 31 transistors, 10 diodes for cool, natural transistor sound; 20 watts RMS, 30 watts IHF music power @ ±1 db, 15 to 50,000 Hz; wideband FM/FM stereo tuner, plus two preamplifiers; front panel stereo headphone jack; compact 3⅞" H x 15¼" W x 12" D size; simple 20-hour kit assembly. Custom mount it in a wall, or either Heath preassembled cabinets (walnut $9.95, beige metal $3.95). 16 lbs.

NEW Miniature 2-Way Speaker System



Kit AS-16
$49.95

Acoustic Suspension Design. Handles 10 to 25 watts. Features 45 to 20,000 Hz response; 8" acoustic suspension woofer; 3½" tweeter; 1500 Hz crossover; 8 ohm impedance; high frequency level control; walnut veneer cabinet with clear vinyl covering. 10" H x 19" W x 8½" D. Assemble in 1 to 2 hours. 17 lbs.

4-Speed Transistor Portable Phonograph

Kit GD-16
$39.95

Worth At Least 50% More! Assembles in 1 to 2 hours . . . just wire one small circuit board, mount the 4" x 6" speaker and plug in the preassembled changer! Features automatic mono 4-speed play; dual sapphire styli for 78's or LP's; 45 rpm adapter; olive and beige polyethylene over sturdy, preassembled cabinet; 117 v. AC operation. 25 lbs.

2-Watt Walkie-Talkie

Assembled GRS-65A
$99.95

New . . . Factory Assembled. Up to 6 mile range; rechargeable battery; 9 silicon transistors, 2 diodes; superhet receiver; squelch; ANL; aluminum case. 3 lbs. 117 v. AC battery charger & cigarette lighter charging cord $9.95. Crystals $1.99 ea.

23 Channel, 5-Watt Transistor CB

23 channel crystal-controlled transmit & receive; compact 2⅞" H x 7" W x 10½" D size; "S" meter; adjustable squelch; ANL; built-in speaker; PTT mike; aluminum cabinet; 12 v. DC operation. 8 lbs. GWA-14-1 AC power supply, 5 lbs. . . . $14.95. GWA-14-2, crystals for all channels, 1 lb., $79.95. GWA-14-4, 6 to 12 v. DC converter, 3 lbs., $14.95.

Assembled GWW-14
$124.95
(Kit GW-14, $89.95)

FREE

World's Largest Electronic Kit Catalog!

Describes these and over 250 kits for stereo/hi-fi, color TV, amateur radio, shortwave, test, CB, marine, educational, home and hobby. Save up to 50% by doing the easy assembly yourself. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022

HEATHKIT

HEATH COMPANY, Dept. 10-3
Benton Harbor, Michigan 49022

☐ Enclosed is $____________, plus shipping.

Please send model (s)____________________

☐ Please send FREE 1967 Heathkit Catalog.

Name____________________

Address____________________

City____________ State____________ Zip________

Prices & specifications subject to change without notice. CL-276

CIRCLE NO. 16 ON READER SERVICE PAGE

responding reduction in loading. This circuit, therefore, provides an even better selectivity, although overall stage gain (sensitivity) may be less, due to the negative feedback signal developed across *R2*.

As a general rule, one must "trade off" sensitivity for improved selectivity. A three-stage r.f. amplifier, with each stage having good selectivity, but only moderate gain, may provide better overall performance than a two-stage high-gain design, although both circuits have the same overall gain.

That covers the "solid state" picture for now. Until next month . . .

—Lou

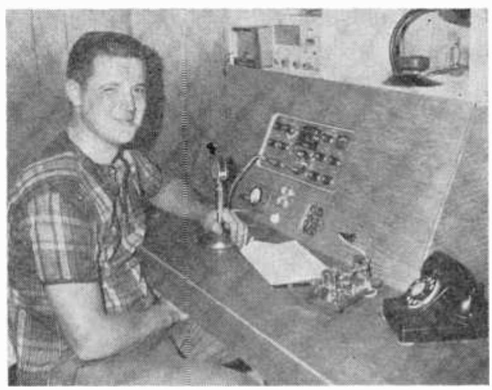
AMATEUR RADIO

(*Continued from page* 85)

Kit TR-108 transceiver performs well and is competitively priced at $144.95, complete with microphone but less crystals and antenna. The V-107 VFO kit is $19.95. The table-top mounting base is $6.95, and a mobile mount is available for $7.50.

Code Practice Transmissions. The only known way to increase one's code copying speed above a few words per minute is with regular copying practice. As a public service, the stations listed below send copy practice material at the times and on the frequencies given:

W1AW, ARRL, Newington, Conn., daily at 7:30 p.m., EST (0030 GMT), and 9:30 p.m., EST (0230 GMT). Speeds on the early sessions are 10, 13, and 15 wpm. Speeds on the later sessions are 5-25 wpm



Michael R. Hagans, WA4ZGI, of Panama City, Fla., will soon be sharing this attractive station with his wife, Peggy, who is presently waiting for her Technician license. The Heathkit SB-100 transceiver, "Twoer," and "Sixer," and Lafayette HE-50 feed assorted antennas supported on a 65-foot tower.

(Sundays, Tuesdays, Thursdays and Saturdays) and 15-35 wpm (Mondays, Wednesdays, and Fridays). Frequencies used: 1.805, 3.55, 7.08, 14.1, 21.1, 50.7, and 145.6 MHz.

W2--, Rochester Amateur Radio Association, Rochester, N.Y., Monday through Thursday, at 7 p.m., local time, on 21.15 MHz. A different club member transmits each night.

W3CL, The Mount Airy VHF Radio Club, Philadelphia, Thursdays, from 7 to 7:30 p.m., local time, on 50.2 MHz.

WØFA, Denver Radio Club, Tuesdays and Thursdays at 7:30 p.m., local time, on 3.755, 29.53, and 145.5 MHz. Speeds are 10 to 13 wpm the first half hour, and 20 wpm the second half hour.

WØOUI, Denver Radio Club, Mondays and Wednesdays, at 7:30, local time, on 28.7, 50.4, and 144.94 MHz. This is a beginner's course. It starts from "scratch," and builds up to 10 wpm using mixed voice and modulated CW.

NEWS AND VIEWS

Mike Campbell, WA4IUH, 206 Goff Drive, Leitchfield, Ky., started his amateur career as a Novice at the age of 13. Two years later, he is now a General with 49 states and 30 countries worked. The hold-out state is Alaska. A 2-element, home-built, 15-meter quad antenna and a 40-meter dipole accept power from a Knight-Kit T-150A transmitter for world-wide distribution. A Hallicrafters S-76 receiver completes the station . . . **Jon Hunter, WA7DYH,** 397 West 400 South, Cedar City, Utah, is another 49-state man. He needs New Hampshire; I wonder how many hams need Utah? Jon has 15 countries worked. A Heathkit "Marauder" transmitter and a Drake 2-B receiver handle the inside job. A Mosley TA-33 tri-band beam; a Hy-Gain 14-AVQ vertical; and a 40-meter, inverted-V do the outside work . . . Going still further west, **Mike Flavin, WN6TQS,** 10730 Dempsey Ave., Granada Hills, Calif., has really kept the electrons in his dipole agitated during his three-month amateur career. Using a Johnson "Ranger" transmitter and a Drake 2-B receiver, Mike has 39 states and seven countries, plus Hawaii and Alaska worked. Since Alaska and Hawaii are considered both states and countries, his country total may actually be nine.

Daniel Goodman, WA9QJW, 4044 Greenwood St., Skokie, Ill., uses a National NCX-5 transceiver to drive a home-built 2-element beam, 25′ high. Dan usually works 15-and 20-meter CW with the aid of an electronic keyer, but he does switch to 10-meter phone when "10" is really hot—which means he has been doing a lot of 10-meter work this winter. His record is 67 countries and 24 states worked. Dan is also trustee of the Niles North High School Amateur Radio Club Station, WA9RZF, which is on the air every day after 3:30 p.m. Equipment at the club includes a Johnson "6-N-2" transmitter, Hammarlund HQ-170 receiver, and a Mosley TA-33 rotary beam . . . **Murray Fortune, VE3FMF,** 139 Little John, Dundas, Ont., Canada, worked 13 states in four weeks on 80 meters running 125 watts into a surplus BC-457 transmitter feeding a 125′ long-wire antenna and receiving on a huge army-surplus job. The transmitter then became very sick; so he built a 2-watt, 40-meter transmitter from "junkbox" parts and bought an old Hallicrafters S-38 receiver. With this equipment and the old antenna, he has added six states to his total and he works the West Coast frequently. Murray enjoys the surprise that his power brings to the operators he contacts—but he has been bitten by the high-power bug again. He is planning a 15-watter now!

Andrew Furlong, WA2FGK, 6 Evagrod St., Somerville, N.J., works everything from the "d.c. bands" up. He is WAS on the lower frequencies and has worked 55 countries on "20" with a dipole antenna. But it is on the VHF's and UHF's that Andy's station and records are outstanding. He runs a kilowatt on 144 MHz, 250 watts on 220 MHz, and 50 watts on 432 MHz, using home-built equipment. His antennas are impressive; they include a 196-element beam on 432 MHz, 15 elements on 220, and 80 elements on 144 MHz. WA2FGK has worked 24 states on 144 MHz and keeps "moon-bounce" skeds with VK3ATN in Australia, although they have not yet established successful two-way contact. In addition, WA2FGK is always very near the top in VHF and UHF contests. When you read this, Andy will have just graduated from college and will be starting his career as a high-school teacher of electricity and electronics. Bet he organizes a ham club, too . . . **James Thompson, WA3FXW,** 266 W. State St., Oakdale, Pa., credits his father, George, WA3CGY, for getting him started in amateur radio. Dad George was active way back in 1925, when he worked the world on 20 meters with a 7½-watter and has the cards to prove it! He is still active on 40-meter CW with a 150-watter, a National NC-77X receiver, and a 40-meter dipole. Son Jim works 80-, 40-, and 20-meter CW using a 150-watt home-built transmitter and a Lafayette HA-63 receiver in conjunction with a 3-band dipole and a 40-meter vertical.

Jim Jerzycke, WN9THB, 1004 Winthrop, Joliet, Ill., is the first product (he says) of the radio club organized by WA9NVF and other amateurs. Jim runs 74¾ watts to a Heathkit DX-60A transmitter and receives on a Hallicrafters SX-146. His antenna is a 40-meter dipole which works best on 15 meters. Fifteen meters is Jim's favorite band, but he claims it suffers from underpopulation. Join him . . . **Dave Grossman, WN2ZFC,** 39 Joan St., Elmont, N. Y., also sports the CB call of KMD4202 and P.E.'s SWL monitor identification, WPE2OPQ. As WN2ZFC, he has worked 18 states with his Globe HG-303 transmitter and Lafayette HE-30 receiver. Dave uses a 1-element, 15-meter rotary "beam" turned by an AR-22 rotator for "15" and a Hy-Gain 18-V on 80 meters.

Now would be a good time to send us your "News and Views" and a clear picture of you and your station. Thanks for keeping the club bulletins coming. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, *Herb, W9EGQ*

"It's a real fine gift, Ma. But what could I do with a WALKIE-talkie?"

SHORT-WAVE LISTENING

(*Continued from page 83*)

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333, Cherry Hill, N.J. 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to all contributors.

Ascension Island—A letter from Richard Buckby, ZD8RB, of the *BBC,* here, lists this schedule as being in effect at press time: 15,180 kHz at 2000-2245 with Eng. World Service, and 15,375 kHz at 2300-0015 in Portuguese (both beamed to 207°); 15,105 kHz at 1745-1830 with Eng. World Service, at 1830-1930 in French, at 1930-1945 in Hausa, and 15,140 kHz at 2000-2245 with Eng. World Service (both beamed to 27°). Late listening indicates two additional frequencies in use: 15,140 kHz at 2143 with the World Service, and 21,610 kHz from 1628 to past 1645 with a relay of the N. A. Service.

Bolivia—A station noted on 5112 kHz around 0100 may possibly be *R. Universidad Zenica,* Oruro. Other Bolivians logged recently include *R. Emisoras Bolivia,* 4760 kHz, and La Paz stations *R. La Cruz del Sur,* 4985 kHz, *R. Universo,* 5015 kHz, *Radiodifusoras Altiplano,* 5045 kHz, and *R. Fides,* 6154 kHz, all around 0100.

Brunei—A surprising logging in the Midwest was "This news is coming to you from *Radio Brunei*" noted at 1315-1328 in Eng. on 4865 kHz.

Bulgaria—*R. Sofia* has Spanish at 0000-0030 and Bulgarian to 0100 to South America on 5920 and 9817 kHz, both of which are new channels. Each segment features news, commentary, talks, and music.

Cambodia—Phnom-Penh has extended its schedule and possibly raised power. The 9695-kHz outlet is noted now from 1130 s/on to as late as 1500 s/off, with all local programs.

Canada—DX'ers needing Newfoundland for the DX Awards Program should try for CBT, Grand Falls, 540 kHz, in the medium-wave band. This 10-kW station can often be logged evenings (local time) in Eastern N. A.

China—*People's Liberation Army (Chungkuo jen min fan chun fuchien chien hsien jen min kwang po tien tai),* Fukien Province, 5900 kHz, is noted at 1055-1130 with "human-wave-type" bugle marches, screaming, and talks in Chinese. Does anyone know the exact location of this station in the province?

Costa Rica—Religious programs in Eng. are given by TIFC, *Lighthouse of the Caribbean,* San Jose, 9645 kHz, from 0300 to 0405 s/off. Reports should be sent to TIFC, Box 2710, San Jose.

Cuba—Havana's often-changing Eng. schedule now reads: to Europe at 2010-2140 on 6015 kHz; to South America at 2050-2150 on 15,270 and 15,300 kHz and at 0100-0600 on 11,760 kHz; to N.A. at 0100-0600 on 6170 kHz, at 0330-0600 on 6135 kHz and at 0630-0800 on 9655 kHz; and to Africa at 1800-1900 on 15,340 kHz.

Ecuador—Station HCJS1, *Ondas del Angel,* was noted on 4830 kHz at 0200 requesting reports to

Apartado de Correos 16, El Angel; it can also be heard well opening at 1100, though it fades rapidly shortly thereafter. Station HCVA4, *La Estacion de la Alegria,* is on 2495 kHz after 0200 with listeners' request music and Ecuadorian folk songs.

Germany (East)—*R. Berlin International,* 17,755 kHz, presents an Eng. DX program on Saturdays at 1553 but may have QRM from WNYW, New York.

Greenland—Mainly for DX'ers in Europe but possibly receivable by listeners in Northeastern U. S. & Eastern Canada is Godthab, 570 kHz, and Godhavn, 650 kHz, both medium-wave channels. Tune carefully from 0030.

Guatemala—*R. Santa Cruz,* Santa Cruz del Quiche, has reactivated the 4872-kHz channel; first heard during the 1965 Christmas season, it was silent during most of 1966 and is now back on the air around 0000 and later with religious talks and marimba music.

Hungary—*R. Budapest* has an outlet on 3995 kHz, noted at 2230 tuning; this xmsn is beamed to Europe in German. You're likely to find considerable QRM from the 75-meter amateur phone stations when you look for it.

India—The present schedule from *All India Radio,* Delhi, to the United Kingdom and Europe is: 1745-2230 on 7215 kHz, 1745-2030 on 11,905 kHz, and 1945-2230 on 9912 kHz. One West Coast reporter listed 11,760 kHz at 2300-2330 in Eng., but with a poor signal that soon faded out.

Korea (North)—Pyongyang has been logged as follows: on 11,763 kHz from 0125 to 0151 s/off with news; on 9875 kHz (replacing 9935 kHz) from 2330

The listening post of David Pollick, WPE2ONO, Long Beach, N.Y., features a Lafayette HA-230 receiver. His antenna is a 80′ long-wire "T." David has 29 states, 19 countries, 5 continents verified.

to 2355 in Korean, opening with a seven-note IS, a short anmt, then a short march, and news; on 6250 kHz with second Home Service program in Korean from 1645 to 1700 s/off; on 6540 kHz in Russian at 1705-1735; and on 17,920 kHz at 2300-2347 with a test xmsn in Spanish, and at 0020-0126 with Korean to 0051, open carrier (no s/off) to 0100, then into Spanish.

Monaco—*Trans World Radio,* Monte Carlo, was

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

ALL radio listeners interested in furthering the hobby of SWL'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

All certificates are filled in and lettered before mailing; they are mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the application blank below. Mail with 50 cents in coin (or stamps) to: MONITOR, P.O. Box 333, Cherry Hill, N.J. 08034. (Personal checks will not be acceptable). Canadians should use their own currency, and other applicants not in the U.S.A. should use 10 International Postal Reply Coupons. Allow 4-6 weeks for processing.

(Do not fill out)

(Please Print)

Name ....

Street, City and Zone ....

State and Zip ....

Receivers in use — Make .... Model ....

Make .... Model ....

Age .... Occupation ....

Ham/CB call-letter assignment(s) ....

I listen mostly to SW Broadcast .... Hams .... CB .... BCB .... VHF .... VLF ....

I use the following antennas ....

I have .... QSL cards and .... countries verified. .... Check if subscriber to P.E. ....

Signature .... Date ....

logged at 0429 with a Russian ID after a religious program on 9545 kHz, and later on 9540 kHz. Neither frequency is listed officially.

Norway—*R. Norway* can now be heard on two different frequencies in the 11-meter band: on 25,900 kHz at 0745-0815, 1100-1230, and 1300-1430; and on 25,730 kHz at 1100-1230, 1300-1430, and 1500-1630. The station reports good reception in the U.S.A., Europe, and Australia.

Pakistan—Karachi has Eng. dictation-speed news at 1355 on 21,590 kHz, replacing the former 17,948-kHz outlet.

Rumania—*R. Bucharest* has Eng. to Europe at 1930-2030 on 9510, 7225, and 5990 kHz and at 2230-2300 on 7195 and 6190 kHz; to Asia at 1500-1530 on 15,250 kHz; to Africa at 1500-1530 on 15,380, 11,885, and 11,810 kHz; and to N. A. at 0130-0230, 0300-0330, and 0430-0500 on 11,940, 11,885, 9590, 9510, 6190, and 6150 kHz. The station is inviting all listeners to apply for its six new QSL cards; to obtain them you must submit six different reception reports, marking them from 1 to 6.

SHORT-WAVE CONTRIBUTORS

Arthur Delibert *(WPE2HJR)*, Lynbrook, N. Y.
Robert Kaplan *(WPE2MJR)*, Bronx, N. Y.
C. N. Coombe *(WPE2MOB)*, Trenton, N. J.
Roger Greene *(WPE2NFC)*, Bronx, N. Y.
Karl Halpern *(WPE2NOB)*, Flushing, N. Y.
John Zapisek *(WPE2OKD)*, Wading River, N. Y.
David Pollick *(WPE2ONO)*, Long Beach, N. Y.
Frank Modico *(WPE2ONY)*, Corona, N. Y.
Philip Humphreys *(WPE2OOV)*, Farmingdale, N. Y.
Peter Macinta, Jr. *(WPE2ORB)*, Kearny, N. J.
Bruno Coiapietro *(WPE2OWO)*, Endicott, N. Y.
Bernie Lansing *(WPE2PBA)*, Rochester, N. Y.
Ed Kowalski *(WPE3AK)*, Philadelphia, Pa.
Kenny Stern *(WPE3FDZ)*, Philadelphia, Pa.
Bob Huber *(WPE3GUN)*, Wilmington, Del.
Brian Skowron *(WPE3HAL)*, Pittsburgh, Pa.
Robert Wilkner *(WPE4ACP)*, Pompano Beach, Fla.
John Cobb *(WPE4AJ)*, Cartersville, Ga.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Dan Henderson *(WPE4GW)*, Laurel, Md.
David Meisel *(WPE4IRS)*, Charlottesville, Va.
Glenn Jenkins *(WPE4IVJ)*, Camp Lejeune, N. C.
Jimmy Eppright *(WPE5ELM)*, Dallas, Texas
Stewart Mac Kenzie *(WPE6AA)*, Huntington Beach, Calif.
Shaler Hanisch *(WPE6BPN)*, Pasadena, Calif.
Trevor Clegg *(WPE6FAF)*, Fresno, Calif.
John Conder *(WPE6FTE)*, Paramount, Calif.
Robert Palmer *(WPE7BB)*, Spokane, Wash.
Michael Clapshaw *(WPE7BSJ)*, Port Angeles, Wash.
L. E. Kuney *(WPE8AD)*, Detroit, Mich.
Ray Wasky *(WPE8FCK)*, Cleveland, Ohio
Gary Draper *(WPE8GCW)*, Farmington, Mich.
Robert Meden *(WPE8JCN)*, Cleveland, Ohio
Richard Riedel *(WPE9GTQ)*, South Bend, Ind.
David Conder *(WPE9IHV)*, Centralia, Ill.
Bill Vogt *(WPE9IND)*, Tinley Park, Ill.
John Vodenik *(WPE9IQF)*, Gary, Ind.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Cecil Waugh, Jr. *(WPEØCKU)*, St. Joseph, Mo.
Allen Windhorn *(WPEØEPJ)*, St. Peter, Minn.
Jack Perolo *(PY2PE1C)*, Milwaukee, Wis.
Kenneth Watson *(VE3PE2JX)*, Thornhill, Ont., Canada
Ron Hopkins *(VE7PE7P)*, Trail, B. C., Canada
William Adams, Redlands, Calif.
David Alpert, Morton Grove, Ill.
John Banta, Bay Shore, N. Y.
Robert Brown, Rantoul, Ill.
G. Chadderton, Paterson, N. J.
Donald Cheney, Jr., Corvallis, Ore.
Andrew Cooper, Garden City, Mich.
Glenn Hauser, Albuquerque, N. M.
Bob Hill, Riverdale, Md.
Bruce Horlick, Los Angeles, Calif.
William King, Panama City, Fla.
Robert Klatskin, Hamden, Conn.
George Kowalczyk, Brooklyn, N. Y.
David Palfrey, Kearny, N. J.
Edward Shaw, Roanoke, Va.
Bob Sutton, Wilbraham, Mass.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

Saudi Arabia—Late listening indicates that Riyadh is being heard on 7220 kHz from 0345 with native and pop music; this is a high-powered xmtr but the frequency is heavily QRM'ed.

South Africa—*R. RSA,* Johannesburg, at press time, has changed frequencies to 15,205, 11,785, 9720, and 9675 kHz (replacing 15,220, 11,900, 9690, and 9525 kHz, respectively). The current schedule reads: at 2100 to Ghana on 15,205 kHz; at 2200 to United Kingdom and Europe on 11,785 and 9720 kHz; at 2330-0025, 0030-0125, 0130-0225, and from 0230 to 0325 s/off to N.A. on 9675 and 11,880 kHz. Other frequencies logged include: 15,285 kHz with Eng. news at 2100; and 7185 kHz (Commercial Service from *Springbok Radio*) at 0350-0410 with commercials in Eng. and Afrikaans, pop music to 0430, then a newscast.

Surinam—Paramaribo is being reported on 725 kHz (medium wave) at 0100-0130 with Eng. ID's every 15 minutes. Further details are requested.

Switzerland—Berne is using two new 250-kW xmtrs for overseas services. An experimental Eng. program (with non-directional antennas and a power of 250 kW) is being aired weekdays only at 0700 on 6165 kHz, and reports are requested. The station also states that 3985 kHz, an unlisted channel, is used at times for portions of the European Service (this service is listed for 0600-2300 but no specific times for the use of the 3985-kHz outlet are given); the xmtr is an old 350-watter—has anyone ever logged it?

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	N.A.—North America
BBC—British Broadcasting Corporation	QRM—Station interference
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
IS—Interval signal	s/on—Sign-on
kHz—Kilohertz	VOA—Voice of America
kW—Kilowatts	xmsn—Transmission
	xmtr—Transmitter

Trucial Coast—*The Voice of the Coast from the Trucial Amirates* at Sharjah broadcasts at 1230-1330 on 6183 kHz. (This is an overseas listing and is *not confirmed* as yet; can anyone provide further information on this station?)

U.S.A.—The *VOA* is using a pair of 11-meter channels: 25,670 kHz to 1530 s/off in Indonesian and 25,950 kHz at 1500 in Urdu. The VOA's present low-powered schedule reads: Munich, on 3980 kHz (8 kW) at 0300-0730 and 1400-2345 to Europe; Philippines, on 6170 kHz (7.5 kW) at 2100-0330 to Philippines, on 7135 kHz (15 kW) to S. E. Asia, and on 7275 kHz (7.5 kW) at 1000-1600 and 11,735 kHz (15 kW) at 0900-1630, both to South China (the latter also to Indonesia & E. Asia); Colombo, 7275 kHz, at 1700-1800 and 15,285 kHz, at 1130-1700 (both 10 kW), both beamed to S. Asia; and Okinawa, 9740 kHz (15 kW) at 1000-1600 to S. China.

Station WWV, the National Bureau of Standards Time and Standard Frequency station, is now operating from Fort Collins, Colo. (as announced by voice) with the time being given in GMT (in Morse code) and Mountain Standard Time (in voice). Operation is on 2500, 5000, 10,000, 15,000, 20,000, and 25,000 kHz.

U.S.S.R.—*R. Tbilisi,* Georgia, was noted at 0159 with chimes and anthem, and to 0259 (more chimes) with Russian talks and music; news is given at 0400-0410, music to past 0430. Two long-wave xmsns noted on the West Coast are from Vladivostok on 245 kHz to 1400 s/off and Petropavlovsk-Kamchatka on 182 kHz to 1300 s/off. The Soviet time station, RWM, Moscow, was logged on 10,000 kHz at 0600-0605, completely overriding WWV and WWVH; the voice anmt, in Russian, is evidently given only on the hour.

A West Coast monitor made a check for us on Soviet stations being heard there. A partial resume is given here: *R. Moscow,* on 9810 kHz at 2100-2125 in Arabic to Algeria, at 2205-2300 in Spanish, then Portuguese; on 9675 kHz at 2205-2305 in Eng. to N.A., Sundays only; on 9775 and 9785 kHz at 2205-2300 in Spanish, then Portuguese; on 9793 kHz at 2205-2305 with the Russian Home Service; and on 15,505 kHz at 0210-0230 in Russian with classical music (all from European xmtrs). Numerous outlets were noted to N.A. at 0100-0600 from European xmtrs. Khabarovsk, on 7200 kHz, was noted at 1725-1735 with the Russian Home Service and on 17,880 kHz at 0120-0235 in Spanish to West Coast N. A.; *R. Moscow,* on 7445 kHz, in Eng. to Africa at 0450-0505; RV102, *Stantsiya Imeni,* Petropavlovsk-Kamchatka, on 4485 kHz at 0735-0745 with Russian local service; RV441, Vladivostok, on 5015 kHz at 0740-0750 with Russian local service; Khabarovsk, on 9375 kHz, and Magadan, on 9500 kHz, both at 0445-0550 in Russian relaying Moscow's Home Service program to Far East and Siberia.

Venezuela—A new station announcing as *R. Mundo,* Maracaibo, has been noted opening at 1000 on 4860 kHz in Spanish, with a good signal until 1145. —30—

ON THE CITIZENS BAND

(Continued from page 81)

1967 OTCB CLUB ROSTER

In order to keep our roster of active clubs current, all CB clubs, rescue teams, and special police groups who have not reported to us in the last 12 months should do so now. Include your current membership totals, officers, club activities, and sample decal and membership card, if available. Groups are urged to enclose photos of activities, emergency teams, and any unusual applications that would interest other CB users. And be sure to send us your club newspaper or bulletin on a monthly basis. Forward all material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016.

Fort Lauderdale, Florida—*Hurricane Citizens Band Assn.* This club recently published its first newspaper: *The Eye.* The publication is well prepared, interesting, and backed by a number of advertisers to keep it afloat. Club officers are: Bill Walker, KKP4058, president; Deb Gaddy, KMP3689, vice president; Betty Gaddy, KMP3689, secretary; Tom Towsley, KMP4612, treasurer; Ron Peeling, KOP0829, sergeant-at-arms; plus a 3-man board of directors, and a 6-man editorial staff led by co-editors Bob Palmer, KKX8613, and Frank Kamarata, KMP5229.

Brantford, Ontario—*Telephone City CB Association.* In operation for 2½ years, this club's motto is: "In the Public Interest." Its search and rescue team coordinated with over 500 mobiles last November in a search for two Department of Lands and Forests game wardens who drowned. The group also took part in four other searches for lost children in the fall of 1965. Last year they relayed federal election returns for the Brant County area to the local radio station and to the Brantford *Expositor* newspaper. Club membership is currently 45. Officers: Morley Van Sickle, XM-43-1760, president; James Turvey, XM-43-2700, vice president; Don McCormick, XM-43-1750, secretary; and E.L. Van Sickle, XM-43-220, chairman of search and rescue.

Prince Albert, Saskatchewan—*Northern Citizens Communications Club.* In addition to its monthly bulletin, this club recently printed a clean-cut, pocket-sized call book for Prince Albert and the surrounding area to raise funds for club crests to be worn by the membership. Club president is O. J. Borrowman, XM-34-807.

I'll CB'ing you, —*Matt, KHC2060*

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. $1.00 per word (including name and address). Minimum order $10.00. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.

READER RATE: For individuals with a personal item to buy or sell. 60c per word (including name and address). No Minimum! Payment must accompany copy.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Radios, Parts, Picture Catalog 25¢. **Meshna**, Nahant, Mass. 09108.

CANADIANS—GIANT Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio. Rush $1.00 (Refunded). ETCO, Dept. Z., Box 741, Montreal, **CANADA.**

WEBBER LAB'S Police—Fire Transistorized Converter kit 30-50mc. & 100-200mc. (1 mc. spread) $5.00 each. 26-200mc. on broadcast band using any type radio, crystal controlled $23.00 wired pp. tunable—crystal controlled $11.00 kit. 72 Cottage Street, Lynn, Mass.

JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

CANADIANS, TRANSISTORS AND PARTS. Free catalogue contains reference data on 300 transistors. J. & J. Electronics, Dept. PE, Box 1437, Winnipeg, Manitoba.

INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONIC SURVEILLANCE EQUIPMENT, ACE ELECTRONICS, 11500-L NW 7TH AVE., MIAMI, FLA. 33168.

CB-WPE-QSL CARDS. Same High Quality, Beautiful, Glossy multi-color cards. New **LOW PRICES. 26 SAMPLES,** 25¢. Dick, W8VXK, 19QA0625, Gladwin, Mich. 48624.

R.F. CONVERTERS. World's largest selection. Also CCTV cameras, etc. Lowest factory prices. Catalog 10¢. Vanguard 196-23 Jamaica Ave., Hollis, N.Y. 11423.

GIANT TESLA COIL—FORTY-INCH SPARKS! Complete plans $5.00. Details, color photo 50¢ (deductible). Huntington Electronics, Inc., Box 9 Huntington Station, Shelton, Conn. 06484.

ELECTRONIC "CRACKAJACKS," relays, transistors, photocells, etc. Guaranteed prizes. $1.00 ppd. **DART ELECTRONICS,** Box 214, Jericho, N.Y.

RECTIFIERS, transistors, other components. Catalog free. Electronic Components Co., Box 2902C, Baton Rouge, La.

TELEPHONE VOICE SWITCH: (LS-500). ACTUATES AUTOMATICALLY AND UNATTENDED ANY TAPE OR WIRE RECORDER. PICTORIAL INSTALLATION INSTRUCTIONS INCLUDED. $23.75. POST PAID USA, WJS ELECTRONICS. 737 NORTH SEWARD, HOLLYWOOD, CALIF. 90038.

INVESTIGATORS: KEEP IN STEP WITH ADVANCEMENTS IN THE ART OF ELECTRONICS FOR THE PROFESSIONAL. SEND $1.00 FOR EQUIPMENT BROCHURE. WJS ELECTRONICS, 737 NORTH SEWARD, HOLLYWOOD, CALIF. 90038.

CLOSED-CIRCUIT TV—industrial, educational. Factory-direct prices. Write for particulars. **ATV RESEARCH,** Box 396P, Industrial Division, South Sioux City, Nebr. 68776.

SEE YOURSELF ON TV! Exciting hobby lets you televise live pictures right in your own home. Kits from $18.95 to $149.50. Catalog 10¢. **ATV RESEARCH,** Box 396P, Amateur Division, South Sioux City, Nebr. 68776.

BUG DETECTOR: WILL DETECT AND LOCATE SURREPTITIOUS TRANSMITTING DEVICES IN CONFERENCE ROOMS, HOME AND OFFICES, ETC. WRITE FOR DETAILS. WJS ELECTRONICS, 737 NORTH SEWARD, HOLLYWOOD, CALIF. 90038.

HOBBYISTS, EXPERIMENTERS, AMATEUR SCIENTISTS, STUDENTS . . . CONSTRUCTION PLANS—All complete including drawings, schematics, parts lists, prices, parts sources . . . **LASER**—Build your own coherent-light optical laser. Operates in the pulsed mode, in the visible light range—$6.00 . . . **DIODE LASER**—Invisible light (infrared) can be continuously modulated—$3.00 . . . **REVERBERATOR (ECHO) UNIT**—Build your own. Use with your automobile radio, home radio or hifi, electric guitar, etc.—$3.00 . . . **RADAR**—Build your own ultrasonic doppler radar. Detect motion of people, automobiles, even falling rain drops. Transistorized, uses standard small 9-volt battery—$4.00 . . . **TV CAMERA**—Build your own. The real thing—no rotating disc. Uses 5 tubes plus videcon tube. Output: 72 ohms or receive on any TV set channel 2-6. Excellent circuit—good picture—$6.00 . . . **STROBOSCOPE**—Flash rate variable from about 10 to 1,000 flashes per second. Stop effect will allow you to view rotating or oscillating objects while in motion —$3.00 . . . **STEREO AMPLIFIER**—Uses two 6T9 compactrons—for stereo phono, tuner, etc.—$3.00 . . . **TWO-WAY TALK OVER FLASHLIGHT BEAMS**—Hand-held microphone, loudspeaker volume. Use in daylight or darkness —$3.00 . . . **VIBRATO UNIT**—Use with electric guitar and other musical instrument amplifiers. Uses two transistors and two 9V batteries—$3.00 . . . **VOLUME COMPRESSOR/EXPANDER**—Use with your HiFi—$4.00 . . . **LONG-RANGE "SOUND TELESCOPE"**—This amazing device can enable you to hear conversations, birds and animals, other sounds hundreds of feet away. Very directional. Transistorized. Uses 9V battery—$3.00 . . . **CIGAR BOX ELECTRIC ORGAN**—Portable, self-contained battery. Eight notes, one octave. Two transistors, 9V battery—$3.00 . . . **ANALOG COMPUTER**—Multiply, divide, add, subtract, square and find square roots. Uses two flashlight batteries—$3.00 . . . **BINARY READOUT**—Program in decimal numbers and readout binary—$3.00 . . . **SOLID STATE BINARY COUNTER (COMPUTER-ADDER)**—Uses transistor flip-flop stages. Lightbulb readout. Punch in pulses, read binary count. Five stage. Includes easy to understand discussion of decimal to binary arithmetic conversion. Excellent start in digital computer technology—$6.00 . . . **TECHNICAL WRITERS GROUP, Box 5501, STATE COLLEGE STATION, RALEIGH, N.C. 27607.**

DYNAMITES LISTENING DEVICES. Silently jams all Mikes, Plans $8.50. MORE Construction Plans: Telephone Equipment: $40 Answering Machine, $15 Bell System Speaker-phone, $10 Legal Telephone Connector. **NEW:** Telephone Scrambler, Call Limiter, Laser Communication System, $25 Automatic Dialer, Central Dial System. **TELEVISION:** $50 Camera, 3DTV Converter, $35 All Electronic Color Converter, Video Recorder, Hobbyist: Ultrasonic Dishwasher, Transistorized Teletype, Morse Code Copier, $75 Electron Microscope, Electronic Tranquilizer, Private Eye Tail Transmitter, Police Radar Detector plus legal jammer. Plans $4.95, each. Telephone Engineering Course $39.50. **NEW SUPER HOBBY CATALOG 25¢;** Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood, Calif. 90046.

TV CAMERA PLANS. Best available. Tube model, vidicon —$3.00; transistor—$5.00 (deductible). Flying spot scanner—$2.50. **ATV RESEARCH,** Box 396P, So. Sioux City, Nebr. 68776.

TRANSISTORIZED Products Importers catalog. $1.00. Intercontinental, CPO 1717, Tokyo, Japan.

RADIO – T.V. Tubes—33¢ each. Send for free catalog. Cornell. 4213 University, San Diego, Calif. 92105.

CIRCUIT Boards, Parts for "Poptronics" projects. Free catalog. **DEMCO,** Box 16297, San Antonio, Texas 78216.

ROCKETS: Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, rocket aerial cameras, technical information. Fast service. Estes Industries, Penrose 18, Colorado 81240.

LOWEST Prices Electronic Parts. Confidential Catalog Free. **KNAPP,** 3174 8th Ave. S.W., Largo, Fla.

SURVEILLANCE EQUIPMENT—NEW HIGH PERFORMANCE SUBMINIATURE MODELS. ELECTRONIC COUNTERMEASURE DEVICES TO PROTECT PRIVACY. FREE DATA: SECURITY ELECTRONICS-PE, 15 EAST 43RD STREET, NEW YORK, N.Y. 10017.

CB-QSL CARDS, New Designs, Record Books, Blabbermouth Awards, Gag Signs, Warning Decals, Novelties. Free Brochure. **WOODY,** 8474 Watson, St. Louis, Mo. 63119.

CRYSTALS . . . largest selection in United States at lowest prices. 48 hr. delivery. Thousands of frequencies in stock. Types include HC6/U, HC18/U, FT-241, FT-243, FT-171, etc. Send 10¢ for catalog with oscillator circuits. Refunded on first order. Jan Crystals, 2400F Crystal Dr., Fort Myers, Fla. 33901.

McGEE RADIO COMPANY. Big 1966-1967 catalog sent free. America's best values. HiFi Amplifiers—speakers—electronic parts. Send name, address and zip code number to McGee Radio Company, 1901 McGee Street, Dept. EG, Kansas City, Missouri 64108.

DETECTIVES! Free Brochures! Electronic Surveillance Devices. **SILMAR ELECTRONICS,** 3476 N.W. 7th Street, Miami, Fla. 33125.

FREE ELECTRONICS (new and surplus) parts catalog. We repair multimeters. Bigelow Electronics, Bluffton, Ohio 45817.

NEW supersensitive transistor instrument detects buried gold, silver, coins. Kits, assembled models. $19.95 up. Free catalog. Relco-A33, Box 10563, Houston 18, Texas.

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco-A33, Box 10563, Houston 18, Texas.

ELECTRONIC Ignition Kits, Components, Free Diagrams. Anderson Engineering, Epsom, New Hampshire 03239.

COMPONENTS? Kits? Hardware? For catalogue write Trans-Vu-Pacs, Box 267, Chelsea, Mass. 02150.

DIAGRAMS—Radios $1.00, Television $2.50. Give make and model. Diagram Service, Box 1151PE, Manchester, Conn. 06042.

MUSIC LOVERS, CONTINUOUS, UNINTERRUPTED BACKGROUND MUSIC FROM YOUR FM RADIO, USING NEW INEXPENSIVE ADAPTOR. FREE LITERATURE. ELECTRONICS, 11500-Z NW 7th AVE., MIAMI, FLORIDA 33168.

QUALITY PRINTED CIRCUIT boards **AND** artwork. **SEMICONDUCTOR** curve tracer and wideband **EXPERIMENTERS** preamplifier. Construction plans and kits. **CATALOG** —25¢. Universal Development Company, Box 26, Dept. 1017, Oak Creek, Wisconsin 53154.

UNIQUE relay to build variety of remote controls, model railroads, liquid level control, weather detector, burglar alarm, games, trick circuits. 20 design ideas included free. $3.95 prepaid. Dept. A, Alco, Lawrence, Mass.

DIAGRAMS, servicing information, Radio $1.00, Television $1.50. **BEITMAN,** 1760 Balsam, Highland Park, Ill. 60035.

DECALS, "Emergency Mobile Radio Unit", 2"x8½", Red on White, $1.00. Warren Straw, 61-A Presidio Avenue, Mill Valley, Calif.

IBM TRANSISTOR CIRCUIT BOARDS, 6 for $2 ppd. L. Short, Box 332, Kennesaw, Georgia 30144.

GRUBBY GRABBER Mechanical Drafting Pencil Holder and Point Cleaner. $1.00 Postpaid. Grubby Grabber, 10907 Manchester, St. Louis, Mo. 63122.

ELECTRONIC SURVEILLANCE EQUIPMENT—Hottest on market today. Schematics—Brochure $1.00. 330 Casa Linda Plaza, Dallas, Texas 75218.

TV CAMERA, BUILD YOUR OWN. Cheap! Send 10¢ for details. WTV, 6024-10th Ave. So., Minneapolis, Minn. 55417.

FREE CATALOG Transistors, Diodes, Parts. Solid State Pax, P.O. Box 206, Dorchester, Mass. 02124.

RESISTORS—UNBEATABLE LOW PRICE! $.05 each, famous brands, factory fresh, standard values, ½ watt 10% carbon. Minimum order $1.00 ppd. Specify assortment. Crown TV Service, 175 Davey Street, Bloomfield, New Jersey 07003.

JAPANESE DIRECTORY, 200 Firms $1.00. Sierratronics, Box 7497, Las Vegas, Nevada 89101.

GREAT BUYS Electronic Catalog 10¢. Relays, latching, sensitive, mercury, miniature, rotary switches, silicon rectifiers 750 PIV-750 MA 35¢, **FERTIK'S,** 5249 "D", Philadelphia, Pa. 19120.

PLANS AND KITS

"CRYSTAL SET CONSTRUCTION" Handbook—50¢. Catalog. Laboratories, 12041-L Sheridan, Garden Grove, Calif. 92640.

ALLWAVE RADIO KIT. Tube, transistor included $5.00. Headset $2.50. Ekeradio, Box 131, Temple City, Calif.

SUPER SNOOPER, Printed circuit Kit $5.95. Others. Lectronix, Box 42, Madison Heights, Michigan 48071.

INSTRUMENT to Measure High Voltages up to 50 KV. can be built for $3. Plans and instructions $2. Redmond, 42 Dean Close, Portslade, Sussex, England.

INTEGRATED Circuit experiment kit, 2 IC's, Parts, Instructions, many Pages Experiments, Projects, Theory. $6.95. Other Construction Plans, Kits, P. C. Boards, Parts. Catalogue 10¢, Kaye, Box 3932, Long Beach, California 90803.

BUILD Melody Organ, Reverb, other projects. Complete plans. Free folder. Solotron Company, 29641 Gilchrist, Farmington, Michigan 48024.

SHORTWAVE LISTENING

1967 SWL PROGRAM GUIDE, listings by the hour, $2.00. **ALL** books for SWLs. SWL Guide, 218 Gifford, Syracuse 2, N.Y.

POLICE—FIRE—AIRCRAFT—MARINE—AMATEUR CALLS on your broadcast radio with **TUNAVERTER!** Tune The Band! Economical! Guaranteed! Free Catalog! Salch Co. Dept. PE3, Woodsboro, Texas 78393.

SWL SUPPLIES. World Radio TV Handbook $4.95. 1967 How-To Listen to the World $3.50. N.A. Radio TV Station Guide, log sheets, reporting forms, calculators, 24-hour clocks, etc. Catalog. Gilfer Associates, Box 239 N, Park Ridge, New Jersey 07656.

PRINTING

EMBOSSED business cards, $2.99—1,000, free samples. Gables—405T Clifton, Glenshaw, Pa. 15116.

HIGH FIDELITY

FREE! Send for money saving stereo catalog #P3E and lowest quotations on your individual component, tape recorder, or system requirements. Electronic Values, Inc., 200 W. 20th St., New York, N.Y. 10011.

HI-FI Components, Tape Recorders, at guaranteed "We Will Not Be Undersold" prices. 15-day money-back guarantee. Two-year warranty. No Catalog. Quotations Free. Hi-Fidelity Center, 239 (P) East 149th Street, New York 10451.

SEND us $9.95 and any old cartridge. We will ship you prepaid any one of these cartridges New—Shure M3D, Empire 880P, ADC 770, Pickering VI5AC2, Empire 808, Pickering VI5AT2, Shure M7/N21D. Grado BTR. Write for lowest quotations all stereo components. Defa Electronics, 2207 Broadway, N.Y., N.Y. 10024.

"LOW, Low quotes: all components and recorders. HiFi, Roslyn 9, Penna."

HAM EQUIPMENT

CBers, HAMS, SWL's! 3-30 MC Preselector kit, $18.98. CB booster Kits. Novice transceiver kit, $29.95. Free catalog. HOLSTROM, Box 8640-E, Sacramento, Calif.

WANTED

CASH Paid! Unused tubes, electronic equipment. Barry, 512 Broadway, N.Y.C. 10012.

QUICKSILVER, Platinum, Silver, Gold. Ores Analyzed. Free Circular. Mercury Terminal, Norwood, Mass.

MILITARY SURPLUS EQUIPMENT NEEDED: ARC-34, ARC-38, ARC-44, ARC-52, ARC-54, ARC-55, ARC-66, ARC-73, ARC-84, ALSO ARN-14C, ARN-54, ARN-59. COLLINS 51X-2, 51V-3, 51Y-3, 51R-3, 17L-4, 17L-7, 618S-1, 18S-4. BENDIX TA-21, RA-21. APR-14, PRC-25, RT-66 THRU RT-70/GRC. APN-22, APN-117, APN-133. TEST SETS WANT WITH ARM, UPM, URM, USM, SG PREFIXES. TOP CASH DOLLAR PAID IMMEDIATELY. SLEP ELECTRONICS CO., DRAWER 178-PE; ELLENTON, FLORIDA 33532, PHONE (813) 722-1843.

ANTIQUE RADIOS. Pre-1925. Grebe, Kennedy, Tuska, etc. Must be in good condition. Also need tubes, parts, books and magazines. Gilfer, P.O. Box 239, Park Ridge, N.J. 07656.

TUBES

TUBE Headquarters of World! Send 10¢ for Catalog (tubes, electronic equipment) Barry, 512 Broadway, N.Y.C. 10012.

TUBES "Oldies", latest. Lists free. Steinmetz, 7519 Maplewood, Hammond, Indiana 46324.

FREE Catalog. Electronic parts, tubes. Wholesale. Thousands of items. Unbeatable prices. Arcturus Electronics ZD, 502-22 St., Union City, N.J. 07087.

RADIO & T.V. Tubes—33¢ each. Send for free list. Cornell, 4213 University, San Diego, Calif. 92105.

RECEIVING & INDUSTRIAL TUBES, TRANSISTORS. All Brands—Biggest Discounts. Technicians, Hobbyists, Experimenters—Request FREE Giant Catalog and SAVE! ZALYTRON, 469 Jericho Turnpike, Mineola, N.Y. 11501.

TAPE AND RECORDERS

BEFORE Renting Stereo Tapes try us. Postpaid both ways —no deposit—immediate delivery. Quality—Dependability —Service—Satisfaction—prevail here. If you've been dissatisfied in the past, your initial order will prove this is no idle boast. Free Catalog. Gold Coast Tape Library, Box 2262, Palm Village Station, Hialeah, Fla. 33012.

RENT 4-TRACK STEREO TAPES—Dependable service our keynote—ALL MAJOR LABELS—FREE CATALOG (48 States)—TRIMOR Company, P.O. Box 748, Flushing, N.Y. 11352.

STEREO TAPES. Save up to 60% (no membership fees, postpaid anywhere U.S.A.). Free 60 page catalog. We discount batteries, recorders, tape accessories. Beware of slogans "not undersold," as the discount information you supply our competitor is usually reported to the factory. SAXITONE, 1776 Columbia Road, Washington, D.C. 20009.

AUTOMATIC telephone connection for Concord and other transistorized recorders. SURVEILLANCE and Privacy Protection Devices. Free Data: Security Electronics-PER, 15 East 43rd Street, New York, N.Y. 10017.

TAPE transport. NAB recording studio quality. Build yourself for amazingly low cost. Detailed plans $5.00. Free particulars. Pepke Laboratories, 309-B West 19 Street, New York, N.Y. 10011.

TAPE RECORDER SALE. Brand new, latest models, $10.00 above cost. Arkay Sales, 1028-C Commonwealth Ave., Boston, Mass. 02215.

RENT Stereo Tapes—over 2,500 different—all major labels—free brochure. Stereo—Parti, 1616-PE Terrace Way, Santa Rosa, California.

TAPE RECORDERS, Hi-Fi, components, Sleep Learning Equipment, tapes. Unusual Values Free Catalog. Dressner, 1523R, Jericho Turnpike, New Hyde Park, N. Y. 11040.

RENT CAR TAPES by mail. 4 Track and STEREO-8 cartridges. All brands. Free information. Autotapes, Box 19086-E, Indianapolis, Ind. 46219.

REPAIRS AND SERVICES

TV Tuners rebuilt and aligned per manufacturers specification. Only $9.50. Any make UHF or VHF. We ship COD. Ninety day written guarantee. Ship complete with tubes or write for free mailing kit and dealer brochure. JW Electronics, Box 51C, Bloomington, Indiana.

PERSONALS

INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONIC SURVEILLANCE EQUIPMENT. ACE ELECTRONICS, 11500-K NW 7th AVE., MIAMI, FLA. 33168.

BORROW $1,205 AIRMAIL! Repay $47 for 36 months. State licensed. Postal Finance, Dept. 84-A, 200 Keeline Building, Omaha, Nebraska 68102.

VOTE—Hams—National Incentive Licensing Poll. Send card to SCCARC WB2NOD, Dept. P.E., Box 685, Moravia, N.Y. 13118.

BILL PROBLEMS? Poor credit no trouble. Not a loan company. Send for free application. Automatic Acceptance, 318PE Broadway Blvd., Reno, Nevada or 307PE Pocasset Ave., Providence, R.I.

INSTRUCTION

LEARN While Asleep, hypnotize with your recorder, phonograph. Astonishing details, sensational catalog free! Sleep-Learning Association, Box 24-ZD, Olympia, Wash.

"FEMALE HYPNOTISM" Exposed, explained! "Secret Method"—they never know! $2, rushed. Guaranteed! Isabella Hall, Silver Springs, Florida.

FREE TRIAL!! Sensational self-hypnosis record kit improves memory, concentration, personality. Results guaranteed! Forum, 333-AA3 Michigan, Chicago 60601.

SELF-HYPNOTAPES. Send for **FREE** brochure, **"WHAT'S IT ALL ABOUT." PERSONALIZED TAPES,** Box 190PE, Quincy, Massachusetts 02169.

RUBBER STAMPS

RUBBER Address Stamp $1.50. Signature $2.88. Free catalog. Jackson Products, 1433 Winnemac, Chicago, Ill. 60640.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

MEDICAL Film—Adults Only—"Childbirth"—1 reel 8mm $7.50—16mm $14.95. International-E, Greenvale, L.I., New York.

SCIENCE Bargains—Request Free Giant Catalog "CJ" —148 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. War surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

REAL ESTATE

FREE!!! Big **SPRING** catalog! Compare exciting real estate ownership opportunities in 29 states coast to coast! Hundreds of farms, ranches, homes, businesses, vacation, retirement and waterfront properties described and **PICTURED!** Mention type property and location preferred. Zip code, please. **UNITED FARM AGENCY,** 612-EP West 47th St., Kansas City, Mo. 64112. PLaza 3-4212.

CANADIAN VACATION LANDS: Full price $385.00. 40 acres, $10 month. Suitable cottage sites, hunting, fishing, investment. Free information, Land Corporation, 3768-P, Bathurst, Downsview, Ontario, Canada.

EDUCATIONAL OPPORTUNITIES

LEARN While Asleep. Remarkable, Scientific, 92% Effective. Details Free. ASR Foundation, Box 7021, Dept. e.g., Lexington, Kentucky.

CORRESPONDENCE COURSES—B.Sc., Engineering, Electronics. Catalog $1. Canadian Institute of Science & Technology, 263H Adelaide St., W., Toronto.

LEARN TECHNICAL WRITING—qualify at home for high paying prestige career not requiring college. Growing demand in all industries for tech writers now. Low monthly tuition. American Technical Writing Schools, Dept. PEC-37, 5512 Hollywood Blvd., Hollywood, Calif. 90028.

WANTED! TV—Radiomen to learn aircraft electronics servicing. Numerous job openings everywhere. Write: Academy Avionics, Reno/Stead Airport, Reno, Nevada.

DO-IT-YOURSELF

SAVE! Build Transistorized Treasure Finder. Details Free. Del Research, Box 436A, Centerville, Georgia 31093.

BUSINESS OPPORTUNITIES

CITIZENS BAND Radio Dealerships Available. Sell Full or Part Time. Knox Electronics, Dept. 274, Galesburg, Ill. 61401.

INVESTIGATE Accidents—Earn $750 to $1,400 monthly. Men urgently needed. Car furnished. Business expenses paid. No selling. No college education necessary. Pick own job location. Investigate full time. Or earn $6.44 hour spare time. Write for Free literature. No obligation. Universal, CZ-3, 6801 Hillcrest, Dallas, Texas 75205.

ELECTROPLATING Equipment and supplies. All types for home workshops and industrial. Send $1.00 (refundable) for equipment guide formulas, operating data, catalog. HBS Equipment Division 90, 3543 East 16th, Los Angeles, California. 90023.

RAISE RABBITS for us on $500 month plan. Free details. White's Rabbitry, Mt. Vernon, Ohio.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, 715PE Ensor Street, Baltimore 2, Md.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolco, 2016 Canton, Dallas, Texas 75201.

I MADE $40,000.00 Year by Mailorder! Helped others make money! Start with $10.00—Free Proof. Torrey, Box 318-N, Ypsilanti, Michigan 48197.

FREE Book "990 Successful, little-known Businesses." Work home. Plymouth 145W, Brooklyn, N.Y. 11218.

PIANO TUNING learned quickly at home. Tremendous field! Musical knowledge unnecessary. GI Approved. Information free. Empire School of Piano Tuning, Box 327, Shenandoah Station, Miami, Florida 33145.

$200.00 DAILY in Your Mailbox! Your Opportunity to do What Mailorder Experts do. Free Details. Associates, Box 136-J, Holland, Michigan 49423.

$650 MONTH in mailorder business—600 page course $5.95, Ronald, 2835 Lincoln, Idaho Falls, Idaho.

EARN $240.00 a Month at home, spare time, doing only two $5.00 Invisible Mending jobs a day. Big money paid for service that makes cuts, tears disappear from fabrics. Steady demand. Details free. Fabricon, 1572 Howard, Chicago, Ill. 60626.

STAMPS

FREE—Mint British Colonials from Antarctic Territory, Dorneo, Brunei, St. Christopher, Nevis, Caymans, Trengganu, Pitcairns. Free with approvals. **VIKING,** Great Neck 50, N.Y.

450 FINE MIXED U.S. 15¢. Wright, Box 753-X, Hagerstown, Maryland.

EMPLOYMENT OPPORTUNITIES

TRAINING INSTRUCTOR (ELECTRONICS) Immediate openings. Need at least 3 years electronic or electrical experience and pass electronics test. As civilian instructor of military electronic technicians for fleet service, you'll enjoy career civil service status, equal employment opportunity, good pay, and other liberal benefits. Navy Employment Center (CIRD), Building 3400, Great Lakes, Illinois 60088. Phone (312) 688-3672.

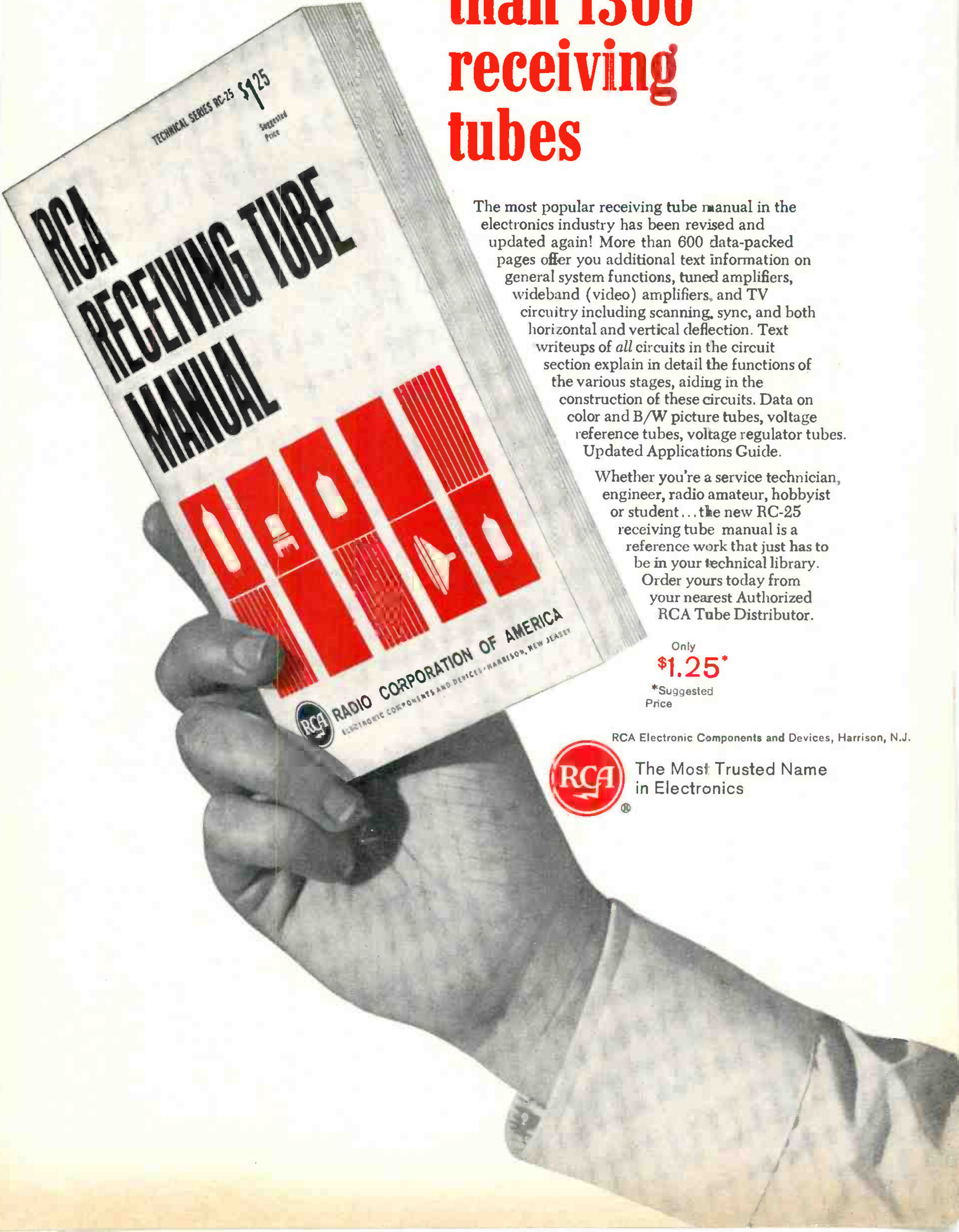
MOVIE FILMS

EMPLOYMENT INFORMATION

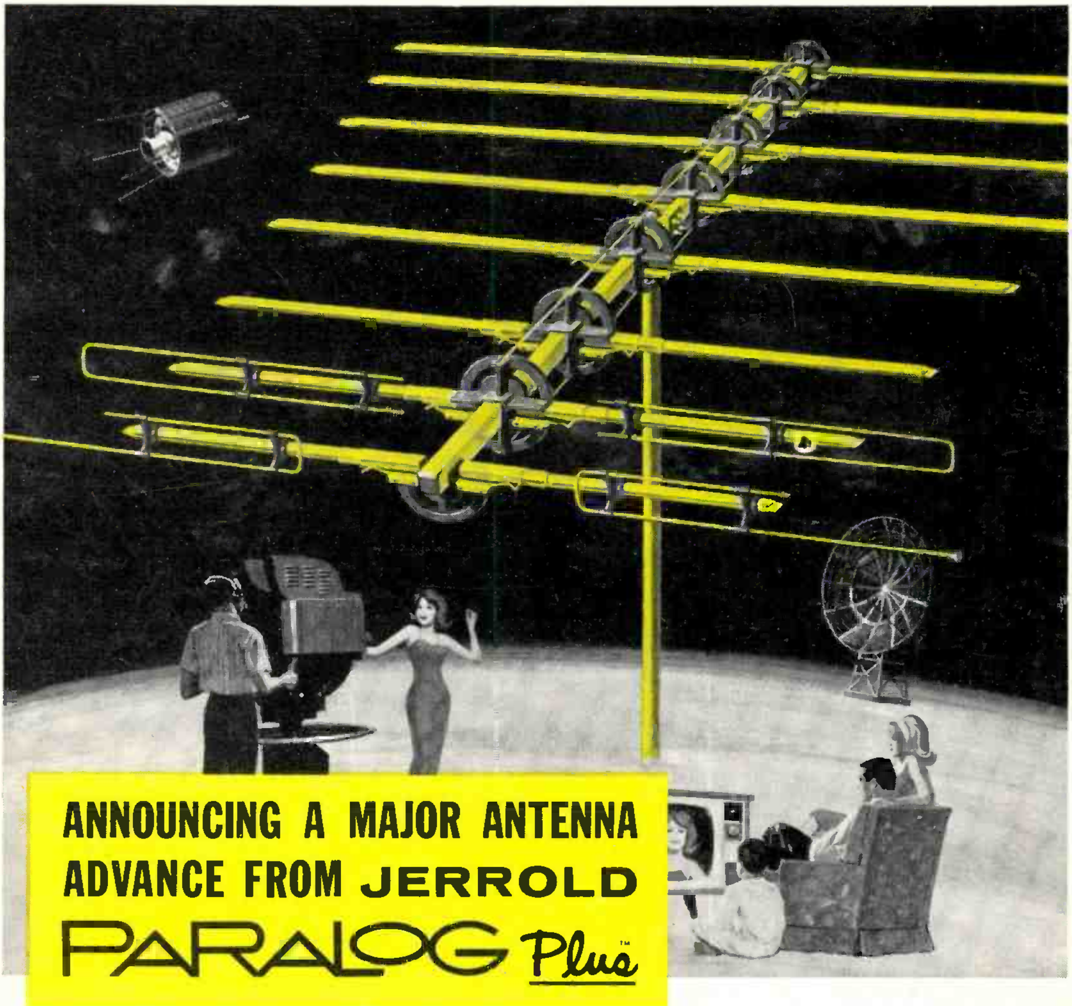
MISCELLANEOUS

POPULAR ELECTRONICS MARCH 1967 ADVERTISERS INDEX

Printed in U.S.A.



TECHNICAL SERIES RC-25 $1.25 Suggested Price
RCA RECEIVING TUBE MANUAL
RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES · HARRISON, NEW JERSEY



Plus GAIN • Plus FLATNESS • Plus MATCH

Why is color harder to receive than black & white? Because color detecting circuits cannot tolerate phase shifts caused by multipath reception, tilted response, or mismatch.

The new Jerrold Paralog-Plus improves color reception three ways:

1. **Plus Gain**—to provide sharper directivity to eliminate multipath reception.
2. **Plus Flatness**—to eliminate tilts which cause incorrect colors on the TV screen. Industry experts say that color antennas must be flat within ±2 db. Paralog-Plus antennas are flat within ±1 db per channel.
3. **Plus Match**—to prevent color-distorting phase shifts.

How does Paralog-Plus give you these exclusive color features? A unique Bi Modal Director system actually works on high and low band channels simultaneously, making each element serve double duty.

Also, you get choice of 75 and 300 ohm coaxial outputs, plus excellent gain over the entire FM band.

For life-like color in your home, try the Paralog-Plus.

CIRCLE NO. 25 ON READER SERVICE PAGE

JERROLD

DISTRIBUTOR
SALES DIVISION
401 Walnut St.
Phila., Pa. 19105