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POPULAR ELECTRONICS

MAY 1968

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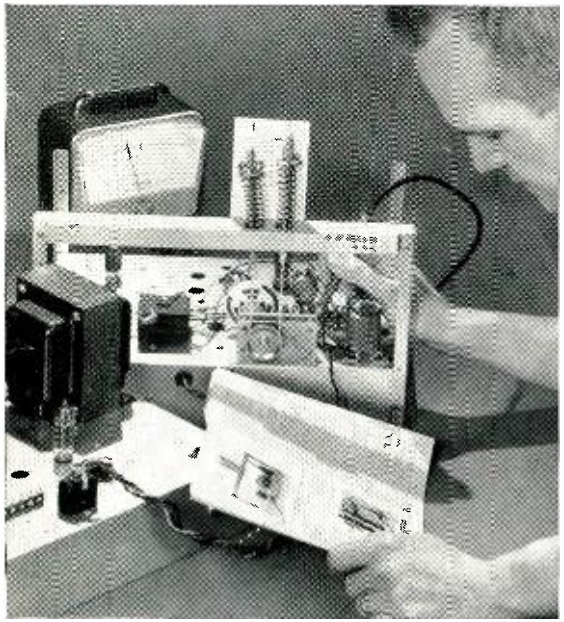

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L. V. Lynch, Louisville, Ky., was a factory worker with American Tobacco Co., now he's an Electronics Technician with the same firm. "I don't see how the NRI way of teaching could be improved."

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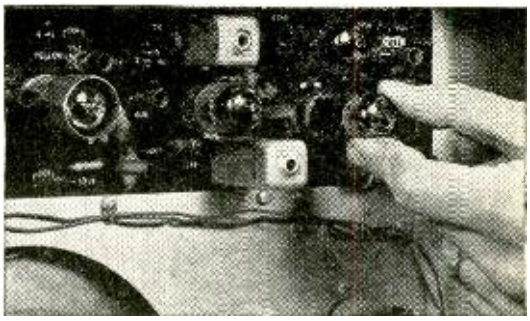

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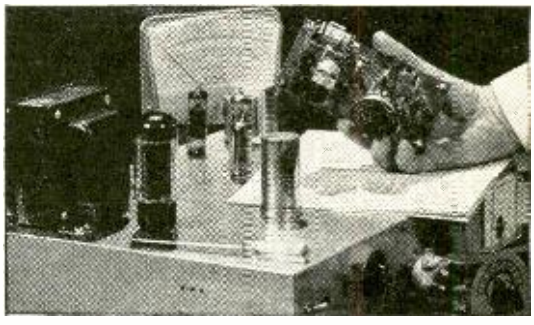

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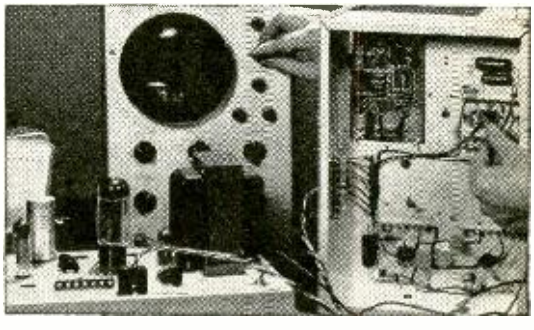
comparable to many months on the job is yours as you build and use a VTVM with solid-state power supply, perform experiments on transmission line and antenna systems and build and work with an operating, phone-cw, 30-watt transmitter suitable for use on the 80-meter amateur band. Again, no other home-study school offers this equipment. You pass your FCC exams—or get your money back.



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POPULAR ELECTRONICS

VOLUME 28 NUMBER 5

MAY, 1968

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

SPECIAL FEATURE

FEATURE ARTICLES

DEPARTMENTS

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

This month's cover photo by Bruce Pendleton

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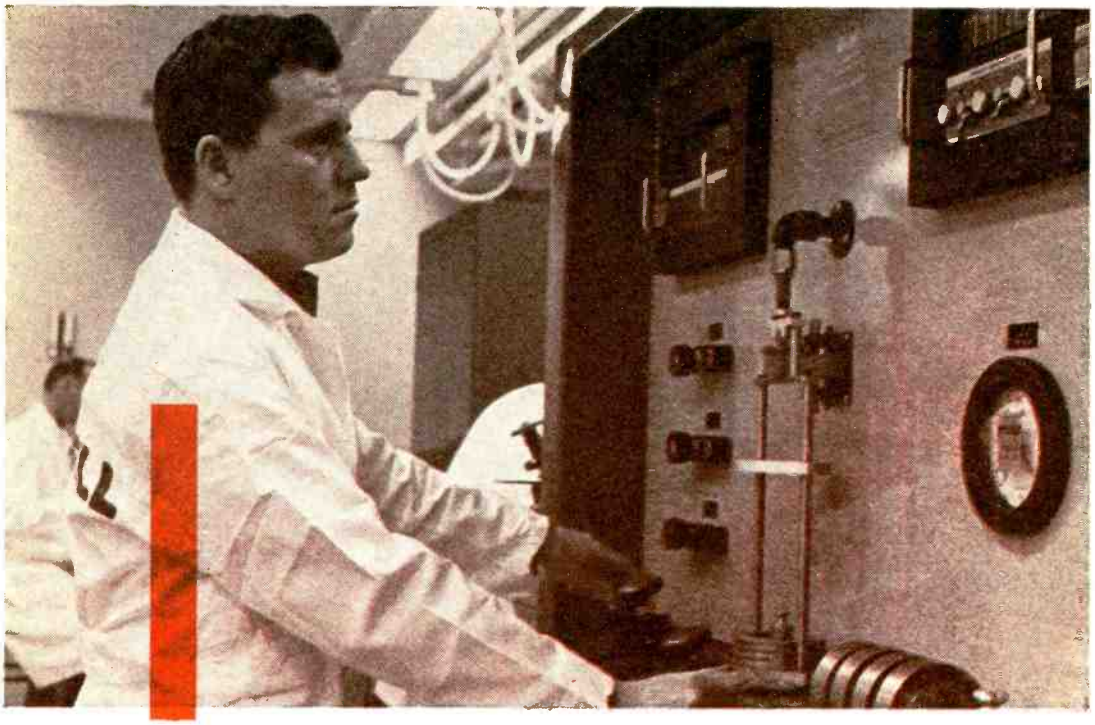

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THE ATTRACTIVE SWITCH

JIM LONG
Microphone
Engineer

One of a series of brief discussions by Electro-Voice engineers

In the design of a new general purpose microphone, the engineer must provide the features needed to make the unit practical for a broad variety of applications. In some instances, however, the switch normally provided is not desirable, since on-off control is provided remote from the microphone.

As a result, some basic microphones are offered in two versions (with and without a switch). Others are available only with a switch, leading to a variety of attempts to defeat the switch, ranging from the use of tape, bits of cardboard or metal that block it mechanically, to changing the internal wiring to bypass the switch.

In designing the new Electro-Voice Model 631 omnidirectional dynamic microphone, a means was devised to satisfy both needs with a single microphone, and without compromising performance. To accomplish this the use of a conventional slide switch was abandoned.

Instead, a computer-grade reed relay was installed inside the microphone barrel. The relay is simply a pair of contacts sealed inside a tube filled with inert gas, and actuated by an external magnetic field. A molded plastic actuator with a magnet embedded in it can be positioned over the relay. Sliding this actuator down the microphone barrel causes the contacts to close, shorting the microphone output. Sliding it upward moves the magnet away from the contacts, removing the short and turning the microphone on.

This actuator can be completely removed from the microphone without tools, so that the microphone remains "on" continuously. Replacement of the actuator again provides the switching function, thus the unit is instantly convertible to either mode at any time.

Mounting the reed relay inside the case posed a problem solved by nesting it inside a molded polypropylene insert. This permits accurate and positive location without the use of fasteners or cement. Shallow grooves in the diecast body of the microphone provide a "track" for the magnetic actuator. No holes are needed for the switch since the zinc alloy case material does not affect the switch operation.

Elimination of a hole for a switch permits the designer freedom to use the air volume in the microphone barrel to control acoustic stiffness without fear of an eventual leak around the switch that would affect frequency response. In addition, dirt and magnetic particles are effectively barred from entrance to the rear of the microphone element.

The sealed switch element also contributes to increased reliability, since the contacts are not exposed to contamination from dirt, corrosion, or oxidation. Indeed, a test switch was cycled more than 300,000 times without failure or measurable wear on the actuator, and seemed capable of virtually infinite operation.

This application of the reed relay to microphone design seems to have solved a major problem by permitting a single microphone model to serve the needs of users with opposing switching needs, yet without compromising the performance in either instance. Field performance indicates that the reed relay switch contributes to greater reliability, convenience and better acoustic performance than conventional switches.

For reprints of other discussions in this series, or technical data on any E-V product, write: ELECTRO-VOICE, INC., Dept. 583P, 630 Cecil St., Buchanan, Michigan 49107

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CIRCLE NO. 13 ON READER SERVICE PAGE

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CIRCLE NO. 14 ON READER SERVICE PAGE

letters

FROM OUR READERS

DCU BREAKTHROUGH CREATES A STIR!

I really do not believe that there is a word in the dictionary that can adequately express the quality of Mr. Lancaster's "Low Cost Counting Unit" and the "Electronic Stopwatch" (February and March, 1968, respectively). As a firearms enthusiast who likes to dabble in electronics, my plans for the DCU and "Electronic Stopwatch" will result in a chronograph I can use for some serious ballistics experimentation that I hope will eventually result in a topic for my master's thesis.

GERALD L. JAHNKE
Las Cruces, N.M.

Congratulations on the Decimal Counting Unit breakthrough! I have been waiting for someone to develop a DCU like the one in POPULAR ELECTRONICS.

R. L. POAD
Solon, Ohio

The problem of all the lamps glowing in your "Low Cost Counting Unit" can be remedied by placing ten low-current diodes in the positive leads powering the lamps. The diodes can be placed in the circuit in such a manner that they prevent reverse current from lighting the lamps. Such little current is drawn that almost any diode can be used and the two resistors, *R1*, and *R2*, can be dropped altogether. This will allow much more distinct readout, and the device will use less current.

KURT ZIERHUT
Granada Hills, Calif.

I would like to thank Don Lancaster for his "Low Cost Counting Unit" article. I am sure there will be a considerable amount of interest in this project and in those that follow. I am ordering a unit at this time and will be looking forward to the other articles that have been promised.

A project of this type, while interesting to the experimenter, is even more useful to the technician who wants to utilize the unit in making workbench tests. Before becoming too involved in the project, however, I would like to know if the DCU will do the job I want it to. I am aware of the cost of commercially manufactured digital readout units of this type, and I hope to effect considerable savings through the use of your articles.

WILLIAM A. HEITMAN
Carmichael, Calif.

From the enormous response we are receiving on the "Low Cost Counting Unit" and

CIRCLE NO. 9 ON READER SERVICE PAGE →

A product of small thinking.

We put everything into the new Courier Traveller to make it the industry's smallest 23-channel CB transceiver. And the smallest thing of all is its price—$149. Every feature you'd look for to assure total performance—honed down into a compact 5¾" W x 6¼" D x 1⅞" H. Start with silicon-transistors throughout. Exclusive incoming signal indicator, which lights up automatically when receiving S-6 or better signal—keeps your eyes on the road. Super efficient transmitter designed to help pierce "skip." Add illuminated channel selector, auxiliary speaker jack, modulation indicator, and single-knob tuning. Plus exclusive Courier "Safety Circuit" to protect against mismatched antenna, incorrect polarity, and overload. All packed into that remarkably small chassis that fits so conveniently into any auto.

Sorry. There's nothing small about Traveller's guarantee. It's so trouble-free, we had to guarantee it for 10 full years.

Just **$149**

Complete with crystals for all 23 channels. (Base station power supply available.)

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Yes, I'm thinking small. Tell me all about the new Courier Traveller.

Name PE-85

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LETTERS

(*Continued from page 8*)

"Ultra-Fast Electronic Stopwatch," it is evident that these articles have created quite a stir among our readership. The letters and telephone calls keep pouring in, and it is becoming increasingly difficult to answer all the questions being raised about the first articles in the DCU series. The letters above are a sampling of what readers think of these articles, and were all accompanied by numerous questions which we have not answered here due to space limitations. Any readers who have questions concerning the DCU projects will be answered individually as soon as we can work our way out from under the pile of mail.

Kurt's suggestion on how to eliminate the unwanted glow in the lamps is legitimate. The same result can also be obtained by placing load resistors in one of the lamp leads (use about 37 ohms resistance). As for Bill's need of assurance, we can only say that the DCU is the equal of and in some cases superior to commercially available units. The "Electronic Stopwatch" costs between $50 and $80 to build, yet it compares favorably with professional units priced at from $400 to $600.

CONSTRUCTION HELP

With regard to the letter in the February "Information Central" column requesting construction help, we would like to say that at various times in the past we have built POPULAR ELECTRONICS projects at a nominal price for labor, troubleshooting, testing, etc., for people in our immediate area. Can we be of help to any other readers?

C. ROSS and I. PATRICK
492 Riverview Dr.
Edgewater, Md. 21037

I will build projects for anyone for a small profit.

TIM PEREGOY
RFD 3, Box 283
Cockey's Mill Rd.
Reisterstown, Md. 21136

I have all issues of POPULAR ELECTRONICS from September, 1964, to the present, and I am willing to build and sell any projects that appeared in them.

DENNIS R. YELLE
6408 South Alder
Tacoma, Wash. 98409

I enjoy assembling your projects and would be very happy to build some for those of your readers who would like me to do so.

GARY WILSON
P.O. Box 417
Denison, Texas 75020

I have been a broadcast engineer for more than 20 years and will be pleased to build and

(*Continued on page 96*)

Now There Are 3 Heathkit® Color TV's

The NEW Deluxe Heathkit "227" Color TV

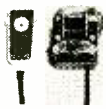
Exclusive Heathkit Self-Servicing Features. Like the famous Heathkit "295" and "180" color TV's, the new Heathkit "227" features a built-in dot generator plus full color photos and simple instructions so *you* can set-up, converge and maintain the best color pictures at all times. Add to this the detailed trouble-shooting charts in the manual, and you put an end to costly TV service calls for periodic picture convergence and minor repairs. No other brand of color TV has this money-saving self-servicing feature.

Advanced Features. Top quality American brand color tube . . . 227 sq. in. rectangular viewing area . . . 24,000 v. regulated picture power . . . improved phosphors for brilliant, livelier colors . . . new improved low voltage power supply with boosted B+ for best operation . . . automatic degaussing . . . exclusive Heath Magna-Shield to protect against stray magnetic fields and maintain color purity . . . ACC and AGC to reduce color fade and insure steady, flutter-free pictures under all conditions . . . preassembled & aligned IF with 3 stages instead of the usual 2 . . . preassembled & aligned 2-speed transistor UHF tuner . . . deluxe VHF turret tuner with "memory" fine tuning . . . 300 & 75 ohm VHF antenna inputs . . . two hi-fi sound outputs . . . 4" x 6" 8 ohm speaker . . . choice of installation — wall, custom or optional Heath factory assembled cabinets. Build in 25 hours.

Kit GR-227, (everything except cabinet) . . . $42 dn., as low as $25 mo. **$419.95**
GRA-227-1, Walnut cabinet . . . no money dn., $6 mo. **$59.95**
GRA-227-2, Mediterranean Oak cabinet (shown above), . . . no money dn., $10 mo. **$94.50**

Kit GR-227
$419.95
(less cabinet)
$25 mo.

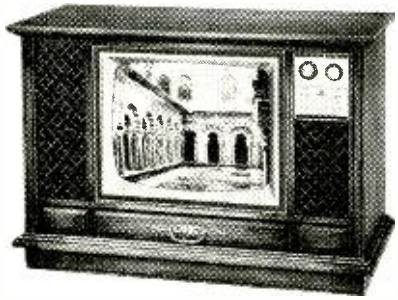
Kit GRA-27
$19.95



New Remote Control For Heathkit Color TV

Now change channels and turn your Heathkit color TV off and on from the comfort of your armchair with this new remote control kit. Use with Heathkit GR-227, GR-295 and GR-180 color TV's. Includes 20' cable.

Kit GR-295
$479.95
(less cabinet)
$42 mo.



Deluxe Heathkit "295" Color TV

Has same high performance features and built-in servicing facilities as new GR-227, except for 295 sq. in. viewing area (industry's largest picture) . . . 24,000 volt picture power . . . universal main control panel for versatile in-wall installation . . . and 6" x 9" speaker.

Kit GR-295, (everything except cabinet), 131 lbs. . . . $48 dn., $42 mo. **$479.95**
GRA-295-4, Mediterranean cabinet (shown above), 90 lbs. . . . no money dn., $11 mo. **$112.50**
Other cabinets from $62.95.

Kit GR-180
$349.95
(less cabinet & cart)
$30 mo.

Deluxe Heathkit "180" Color TV

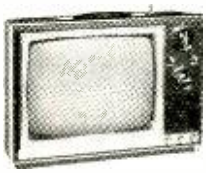
Same high performance features and exclusive self-servicing facilities as new GR-227 (above) except for 180 sq. in. viewing area.

Kit GR-180, (everything except cabinet), 102 lbs. . . . $35 dn., $30 mo. **$349.95**
GRA-180-5, table model cabinet & mobile cart (shown above), 57 lbs. . . . no money dn., $5 mo. **$39.95**
Other cabinets from $24.95

Deluxe 12" Transistor Portable B&W 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 15¼" W x 9⅞" D. 27 lbs.

Kit GR-104
$119.95
$11 mo.



Kit GR-104, 27 lbs. . . . no money dn., $11 mo. **$119.95**

No Money Down On $25 to $300 Orders — Write For Credit Form

CIRCLE NO. 17 ON READER SERVICE PAGE

11 New Kits From Heath . . .

New! Heathkit Wireless Home Protection System for Your Family's Safety

GD-97
Utility Transmitter
for Universal Protection

GD-87
Wireless Smoke/Heat
Detector-Transmitter

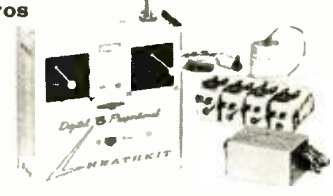
GD-77 Wireless Receiver/Alarm
fail-safe, always alert

Applications Unlimited . . . Customize Your Own System. Here's reliable, low cost, 24-hour protection for your family and property. System warns of smoke, fire, intruders, freezing, thawing, cooling, rising or receding water, pressures . . . any change you want to be warned about. Uses unique new signaling method developed by Berkeley Scientific Labs., exclusively licensed to Heath. Your house is already wired for this system, just plug the units into any AC outlet. "Load transmission" design (not a carrier type as in wireless intercoms) generates unusual signal that is practically unduplicable in other devices or random noise sources. Solid-state circuitry has built-in fail-safe capability to sound alarm if power fails, if power supply components in any unit fail, or if 50,000 hour bulb in smoke detector fails. Receiver/Alarm has 2800 Hz transistor alarm and receptacle for extra 117 VAC bell or buzzer to extend range, plus rechargeable battery (always kept charged) to sound alarm if power fails. Smoke-Heat Detector-Transmitter capability may be extended to other areas by adding extra heat sensors to its built-in sensor. Utility Transmitter accepts any type of switch or sensor for any purpose, examples: magnetic reed switches for doors and windows to warn of entry; step-on switches for door or driveway, micro switches with trip wire around yard; heat sensors; water pressure switches warn of pump failure; thermal switches warn of freezing in gardens, or thawing in freezers; two wires act as switch to warn of changing water levels in sump-pump wells, pools, etc. Units are small and unobtrusive in beige and brown non-reflecting velvet finish. Any number of units may be used in the system. All units feature circuit board construction, each unit takes only 3 hours to build. Operating cost similar to electric clocks. Invest in safety for your family now with this unique Heath system.

Kit GD-77, receiver/alarm, 4 lbs. **$39.95**
Kit GD-87, smoke/heat det.-trans., 5 lbs. **$49.95**
Kit GD-97, Utility trans., 4 lbs. **$34.95**
(numerous accessory switches available from Heath)

New! Heathkit/Kraft 5-Channel Digital Proportional System with Variable Capacitor Servos

System Kit GD-47
$219.95
$21 mo.



This Heathkit version of the internationally famous Kraft system saves you over $200. The system includes solid-state transmitter with built-in charger and rechargeable battery, solid-state receiver, receiver rechargeable battery, four variable capacitor servos, and all cables. Servos feature sealed variable capacitor feedback to eliminate failure due to dirty contacts, vibration, etc.; three outputs: two linear shafts travel ⅜" in simultaneous opposite directions plus rotary wheel. Specify freq.: 26.995, 27.045, 27.145, 27.195 MHz.

System Kit GD-47, all of above, 5 lbs. **$219.95**
Kit GDA-47-1, transmitter, battery, cable, 3 lbs. **$86.50**
Kit GDA-47-2, receiver, 3 lbs. **$49.95**
GDA-47-3, receiver rechargeable battery, 1 lb. **$9.95**
Kit GDA-47-4, one servo only, 1 lb. **$21.50**

New! Heathkit 2-Channel, 200 Watt SSB Transceivers for CAP, MARS & 160 Meters

Assembled
HWW-18-1
CAP model
with crystals
$179.95

Kit HW-18-1
CAP model
with crystals
$119.95

Kit HW-18-2
MARS model
less crystals
$109.95

Kit HW-18-3
160 Meter model
less crystals
$109.95

Good News For CAP, MARS And 160 Meter Ops. This unique series of Heathkit SSB Transceivers was designed with your needs in mind. No more adaptations, no more conversions, no more make-shift rigs. These new transceivers are tailored for your needs with the sensitivity, selectivity, power output and operating convenience that make for effective communications at a fraction of previous costs.

Compare. 200 watts PEP SSB input. 25 watts input with carrier for compatibility with AM stations. Crystal filter sideband generation. 2 channels, switch-selected, crystal controlled. Fixed tuned for easy PTT operation. Transmit and receive freqs. locked together for true transceive operation. Clarifier control adjusts transceiver frequency ±250 Hz. Relayless transmit-receive switching. Local-Distance switch prevents receiver overload from strong local stations. Built-in speaker. PTT mic. & mobilemount included. Carrier & sideband suppression 45 dB. Sensitivity 1 uV. Selectivity 2.7 kHz. 50 ohm coax output. Accessory power supplies (Kit HP-13, mobile, $64.95; Kit HP-23, fixed station, $49.95).

New! Solid-State Portable Volt-Ohm-Meter

Kit IM-17
$19.95

So Handy, So Low Cost we call it "every man's" meter. Just right for homeowners, hobbyists, boatowners, CBer's, hams . . . it's even sophisticated enough for radio & TV servicing! Features 12 ranges . . . 4 AC & 4 DC volt ranges, 4 ohm ranges; 11 megohm input on DC, 1 megohm input on AC; 4½" 200 uA meter; battery power; rugged polypropylene case and more. Easy 3 or 4 hour kit assembly. 4 lbs.

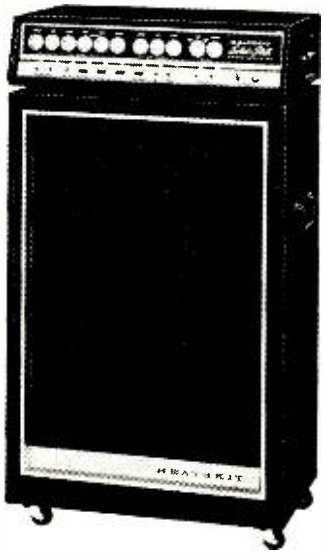
New! Heathkit Solid-State Utility Monophonic Amplifier

Kit
AA-18
$19.95

This amazing little amplifier accepts ceramic phono cartridges, AM tuners, FM tuners, tape recorders, etc., and delivers a solid 4 watts of music power from 20 Hz to over 100 kHz at a low 1.5% THD. Drives high efficiency speakers of 4 to 16 ohms. Ideal for small music system or testing amp. for service shops. Circuit board construction is easiest; just 5 short hookup wires and 6" cable. Single knob tone control. Headphone jack. Pilot lamp. Transformer operated, 120/240 VAC, 50-60 Hz.

See 300 More in FREE Catalog

What would you expect to pay for a Vox "Jaguar" Combo organ with a 180-watt 3-channel amp? $1000? $1250? $1500? More?



You can get both for only $598 during this Special Heathkit Offer!

Now you can get this famous professional combo organ with a versatile high-power piggy-back amp. and matching speaker system for just a little more than you'd expect to pay for the "Jaguar" alone! The Heathkit/Vox "Jaguar" is solid-state; two outputs for mixed or separated bass and treble; reversible bass keys for full 49 key range or separate bass notes; bass volume control; vibrato tab; bass chord tab; four voice tabs (flute, bright, brass, mellow); keyboard range C_2 to C_6 in four octaves; factory assembled keyboard, organ case with cover, and stand with case. Also available separately; you'll still save $150 (order Kit TO-68, $349.95).

The Heathkit TA-17 Deluxe Super-Power Amplifier & Speaker has 180 watts peak power into one speaker (240 watts peak into a pair); 3-channels with 2 inputs each; "fuzz", brightness switch; bass boost; tremolo, reverb; complete controls for each channel; foot switch; 2 heavy duty 12" speakers plus horn driver. Also available separately kit or factory assembled (Kit Amplifier TA-17, $175; Assembled $275; Kit Speaker TA-17-1 $120; Assembled $150; Kit TAS-17-2, amp. & two speakers $395; Assembled TAW-17-2, amp. & two speakers $545).

Kit TOS-1
Organ, Amplifier & Speaker Kits (240 lbs.)
$598.00

Kit TOS-2
Organ Kit, Assembled Amplifier & Speaker (240 lbs.)
$698.00

New! Heathkit Solid-State "Fuzz Booster" For Guitar Amplifiers

Kit TA-28
$17.95

"Fuzz" is what it's called, harmonic distortion is what it is, and you can add it to your guitar amp with this kit. Transistor circuit is contained in die cast footswitch housing and powered by internal battery (not supplied). Two controls adjust tone and intensity of "fuzz". Build it in one evening. 4 lbs.

New! Heathkit Guitar Headphone Amplifier

Kit TA-58
$9.95

Now you can play and practice your electronic guitar in private! Just plug this miniature amplifier into the jack of your guitar and use a pair of headphones. Solid-state circuit has tailored response; automatic off-on switching; self-contained battery (not supplied); and capability of operating one or two pairs of mono or stereo headphones of 4 to 2 meghohms. Ideal for practice or instruction. Easy to build.

Kit TA-58, 2 lbs.....**$9.95**

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Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, electric guitar & amplifier, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

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Prices & specifications subject to change without notice. CL-325

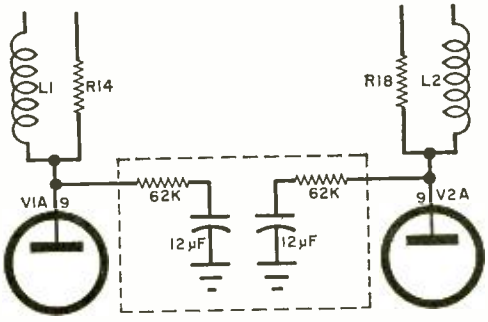
CIRCLE NO. 17 ON READER SERVICE PAGE

PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

LOW-FREQUENCY COMPENSATION FOR EICO MODEL 460 OSCILLOSCOPES

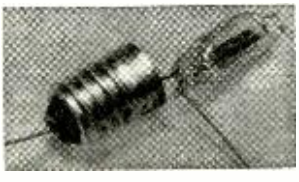
The transconductance of vacuum tubes changes between d.c. and low-frequency a.c. This effect is noticeable in EICO's Model 460 oscilloscope as a change in gain between d.c.



and a.c. signals, and a pronounced sloping of low-frequency square waves. The compensation network shown here will compensate for low-frequency losses in the Model 460. For best results, you might have to allow a slight variation in the value of the resistors for individual tubes. The easiest way to install the capacitors is to connect one lead of each to a ground lug held by terminal board TB-16, and the other lead directly to pin 9 on the respective tube sockets. —*Donald Stauffer*

ADD SCREW BASE TO NE-2 NEON LAMP

At one time or another you have probably had (or will have) a need for an NE-2 neon lamp with a screw base for one of your projects. Unfortunately, NE-2 lamps come with wire leads not designed for screwing into pilot lamp sockets. However, you can solve the problem quickly enough if you have an incandescent pilot lamp you're willing to sacrifice — or one that has burned out and you never threw away. Carefully break the glass envelope of the incandescent lamp, and remove the elements and whatever glass remains in the screw base. Insert one of the



READER SERVICE PAGE

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Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below... and the material will be sent to you promptly and free of charge.

1. Print or type your name and address on the lines indicated. Circle the number(s) on the coupon below that corresponds to the key number(s) at the bottom of the advertisement or editorial mention(s) that interest you. (Key numbers for advertised products also appear in the Advertisers' Index.)

2. Cut out the coupon and mail it to the address indicated below.

3. This address is for our product "Free Information Service" only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York 10016; circulation inquiries to Portland Place, Boulder, Colorado 80302.

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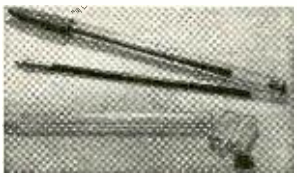
TIPS

(*Continued from page 14*)

wire leads on the NE-2 through the bottom contact of the lamp as shown in the photo; the other lead goes to the metal case. Insulate the leads from each other, solder both in place and, you'll have a screw-base NE-2 lamp. —*Hubert Melin*

BALL-POINT PEN BARREL DOUBLES AS INSULATING SPACERS

When the ink cartridge of your non-refillable ball-point pen dries up, don't throw the pen away. The plastic barrel can be cut down to make insulating spacers. Remove and discard the empty ink cartridge, pen point and plastic (or metal) end. Then, when you need spacers, simply cut the pen barrel to the desired lengths with a fine-toothed hacksaw. The dielectric strength of your fabricated spacers will compare favorably with the commercially available product. —*B. J. Thompson*



TWO BLOCKS OF WOOD BECOME WIRE LEAD STRAIGHTENER

Resistors, capacitors, diodes, and other small parts that have wire leads are easier to store and use if the leads are straight. After you breadboard a project or cannibalize parts from surplus equipment, there is often a considerable number of leads to be straightened. You can save a lot of time and effort if you place roughly hand-straightened leads between two blocks of hard wood, and stroke the top block back and forth a few times to get rid of bends and kinks. —*James E. Arconati*

NEOPRENE FAUCET WASHERS MAKE HANDY RUBBER FEET

Neoprene faucet washers are almost as handy in electronics as they are necessary in plumbing. They are fairly hard, will stand a lot of abuse, and do not leave "eraser" marks on polished surfaces when used as feet for the chassis of an electronic project. These washers are available in a variety of sizes, are relatively inexpensive, and can be obtained from all plumbing supply stores and many hardware stores. When you install them, use a good all-purpose household cement.

—*Robert E. Kelland*

DOES YOUR CB RADIO HAVE A BUILT-IN "TACHOMETER"?

CB-24 "REACTER III" $199.95

New 23 channel CB-24 from Hallicrafters with *exclusive* Dual Noise Suppression takes the "Needle Swinging Noise" out of mobile radio.

"S" meters in mobile radios need no longer swing back and forth with engine RPM. Communications range need no longer be stifled because the mobile receiver cannot hear the base. The superb, new Hallicrafters' CB-24 "Reacter III" citizens band radio ushers in a new state-of-the-art for suppression of wide-band noise.

Remarkable Dual Noise Suppression circuits in the "Reacter III" reduce both radiated and conducted noise to previously unattainable lows. Heart of the exclusive conducted noise filter is a 0Hz(DC) to 100MHz torroid that virtually eliminates all forms of ignition, regulator, generator, or alternator interference that is normally carried to the radio by the vehicle electrical system. Radiated interference is literally chopped from the signal by an advanced series limiting noise suppressor devised by Hallicrafters, the people who invented noise limiting in 1939.

Every detail of the CB-24, from the functional beauty of its professional styling to the costly ceramic filters, foretells of timeless endurance. If you are ready to buy a 23-channel radio, choose thoughtfully. Choose the brand backed by more communications experience than all others combined. Hallicrafters.

SPECIFICATIONS

25% smaller than all other leading radios. Has all 23 channels (ready to operate); dual-conversion receiver, costly ceramic filters for extra-quiet operation; increased transmitter range through an advanced "Expander" modulation system; illuminated channel selector; meter for checking signal strength and output. Built-in circuitry permits use as a public address system.

Sensitivity: 0.4 microvolt typical for 10 db S/N ratio.

Audio Power Output: 3.5 watts.

Semiconductor Complement: all solid state—21 transistors, 8 diodes, 4 thermistors.

Modulation: high level push-pull, Class B, limited to 100% with wave shaping.

RF Power Output: 3.5 watts typical.

Power Supply: 13.8 V DC. (AC supply optional accessory).

Dimensions: 2 3/16" x 6" x 8" HWD.

Weight: 5½ lbs.

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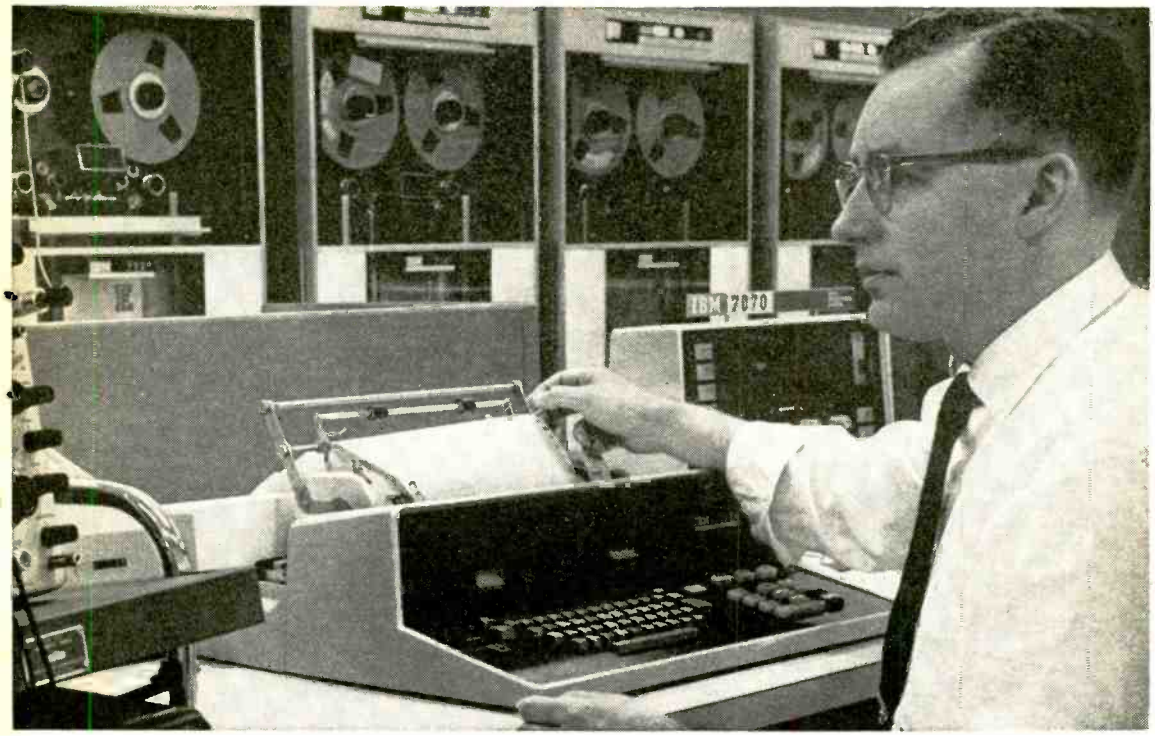
CIRCLE NO. 16 ON READER SERVICE PAGE

How to become a "Non-Degree Engineer"

In today's electronics boom, the demand for men with technical education is far greater than the supply of graduate engineers. Thousands of real engineering jobs are being filled by men without engineering degrees—provided they are thoroughly trained in basic electronic theory and modern application. The pay is good, the future is bright... and the training can now be acquired at home—on your own time.



The electronics boom has created a new breed of professional man—the non-degree engineer. Depending on the branch of electronics he's in, he may "ride herd" over a flock of computers, run a powerful TV transmitter, supervise a service or maintenance department, or work side by side with distinguished scientists on a new discovery.

But you do need to know more than soldering connections, testing circuits and replacing components. You need to really know the fundamentals of electronics.

How can you pick up this necessary knowledge? Many of today's non-degree engineers learned their electronics at home. In fact, some authorities feel that a home study course is the *best* way. *Popular Electronics* said:

"By its very nature, home study develops your ability to analyze and extract information as well as to strengthen your sense of responsibility and initiative."

Cleveland Method Makes It Easy

If you decide to advance your career through home study, it's best to pick a school that *specializes* in the home study method. Electronics is complicated enough without trying to learn it from texts and lessons that were designed for the classroom instead of the home.

The Cleveland Institute concentrates on home study exclusively. Over the last 30 years it has developed techniques that make learning at home easy, even if you once had trouble studying. Your instructor gives the lessons and questions you send in his undivided personal attention—it's like being the only student in his "class." He not only grades your work, he analyzes it. And he mails back his corrections and comments the same day he gets your lessons, so you read his notations while everything is still fresh in your mind.

Students who have taken other courses often comment on how much more they learn from CIE. Says Mark E. Newland of Santa Maria, Calif.:

"Of 11 different correspondence courses I've taken, CIE's was the best prepared, most interesting, and easiest to understand. I passed my 1st Class FCC exam after completing my course, and have increased my earnings by $120 a month."

Always Up-to-Date

Because of rapid developments in electronics, CIE courses are constantly being revised. This year's courses include up-to-the-minute lessons in Microminiaturization, Laser Theory and Application, Suppressed Carrier Modulation, Single Sideband Techniques, Logical Troubleshooting, Boolean Algebra, Pulse Theory, Timebase Generators...and many more.

CIE Assures You an FCC License

The Cleveland method of training is so successful that better than *9 out of 10 CIE men who take the FCC exam pass it—and on their first try.* This is despite the fact that, among non-CIE men, 2 out of every 3 who take the exam fail! That's why CIE can promise in writing to refund your tuition in full if you complete one of its FCC courses and fail to pass the licensing exam.

This Book Can Help You

Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed in Electronics." It tells of many non-degree engineering jobs and other electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you would like to cash in on the electronics boom, let us send you this 40-page book free.

Just fill out and mail the attached card. Or, if the card is missing, write to:

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All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

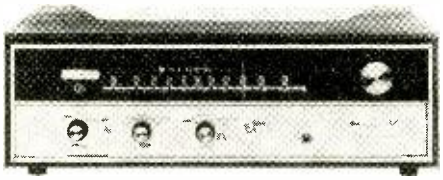
CIRCLE NO. 7 ON READER SERVICE PAGE

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 or 95.

FET FM STEREO TUNER KIT

It should take only one afternoon to put together the LT-112B-1 FM broadcast monitor kit announced by *H. H. Scott, Inc.* The kit incorporates both field effect circuitry for maximum sensitivity and selectivity with minimum cross-modulation and drift, and an integrated circuit i.f. strip for improved capture ratio. All difficult or critical circuitry is



pre-wired, pre-tested, and pre-aligned at the factory. An exclusive combination front panel meter is used initially to align the tuner, then to indicate signal strength, zero-center tuning, or multipath distortion. The LT-112B-1 comes with Scott's full-color, life-size construction book, with parts sealed in clear envelopes which are number-keyed to the book, and with all wires pre-cut and pre-stripped to the proper lengths.

Circle No. 75 on Reader Service Page 15 or 95

AUTOMATIC RATCHETING BOX WRENCH

For those hard-to-get-at places where there is not enough room to efficiently turn the handle of an ordinary box wrench, *Kenbil Engineering Company* is providing an "automatic" type wrench. It can be used in the conventional manner where possible, but in tight spots you just squeeze the spring-loaded plier-type handles to rotate a box socket. Each closing action rotates the socket 60°. To reverse the direction of socket rotation, the wrench is simply turned over. It's available in ¼" to ⅜" sizes.

Circle No. 76 on Reader Service Page 15 or 95

UNIQUE BASE STATION ANTENNA

"Power on top" could be the slogan for the *Avanti* "Astro Plane." An all-directional antenna, it packs maximum signal power at the highest, most efficient position—it has a power gain of 4 dB. The short, sturdy radials at the tip also direct an extremely low-angle signal take-off for maximum distance coverage. Designed for operation in a frequency band of 27 to 29.7 MHz, the vertically polarized, heavy-duty antenna has a VSWR of less than 1.4:1 on all 23 Citizens Band channels. CB'ers: take note.

Circle No. 77 on Reader Service Page 15 or 95

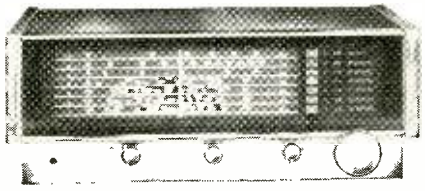
FOUR-WAY "BOOKSHELF" SPEAKER SYSTEM

Pioneer Electronics is presently marketing a four-way speaker system housed in what is believed to be the smallest enclosure ever used for this type of system. Designated the Model CS-63, the system sports a big 15" woofer, 6½" mid-range speaker, horn-type tweeter, and 2½" cone-type super tweeter. Frequency response is 25 Hz to 20 kHz, with crossovers at 600 Hz, 4 kHz, and 13 kHz. Input impedance is 8 ohms; power-handling capacity, 60 watts. Two tone controls are provided, one for the mid-range frequencies, and another for the high-frequency range. The system is housed in a 28" × 19" × 13" oiled walnut enclosure--small enough to fit on most bookshelves.

Circle No. 78 on Reader Service Page 15 or 95

SEVEN-BAND RECEIVER

The seven bands covered by *Lafayette Radio Electronics'* "Explor-Air™ VI" receiver are: weather/marine (150-400 kHz); standard AM broadcast; standard FM broadcast; and four short-wave bands (5.9-6.25 MHz, 9.45-9.85 MHz; 11.85-12.05 MHz, and 15.05-15.55 MHz). Features include individually tuned circuits



for each band, automatic volume control, 455-kHz mechanical filter, a tuned r.f. stage, and a shock-free high-voltage transformer-operated power supply. Special feature: an illuminated wide-view slide rule dial clearly labeled with names of primary cities and countries.

Circle No. 79 on Reader Service Page 15 or 95

MAGNETIC RECORDING TAPES

Two new series of audio tapes for the home recording enthusiast are available from *Ampex Corporation*. The 304 Series promises

NOW! THE BEST COSTS $40. LESS!

This special "get the best for less" offer available at the following KAAR dealers . . .

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Fresno, California
Squire Communications
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Buddy Sales
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Boise, Idaho
Allied Radio Corporation
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Peoria Heights, Illinois
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W. Lafayette, Indiana
Electronic Applications Co.
Burlington, Iowa
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Electronic Products Co. (EPCOR)
New Orleans, Louisiana
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Headquarters
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South Carolina
Electronic Equipment Co.
Nashville, Tennessee
Radio Communications Co.
San Antonio, Texas
Manwill Supply Co.
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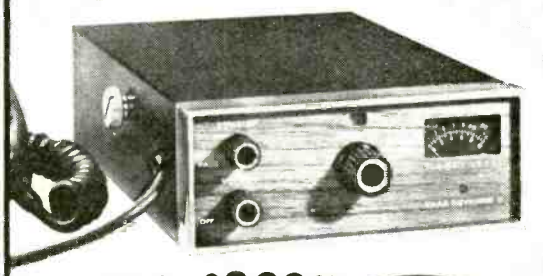
House of Insurance
Richmond, Virginia
E. Smola & Co.
Newport News & Norfolk, Va.
Photo-Tronics, Inc.
Seattle, Washington
Amateur Electronic Supply
Milwaukee, Wisconsin
Denco TV
Casper, Wyoming

KAAR Skyhawk

MARK II



regular $269.95

23 channels with all crystals included

yours for just $229.95

It's the new 5-year-ahead, 23-channel MARK II. Complete with the industry's only 2-year guarantee.

Now...move up to Skyhawk and save!

No other transceiver gives you all these space-age features

- Tantalum capacitors
- Sealed plug-in relay
- Filtered power leads
- Paging
- External speaker jack
- Illuminated signal level meter with dynamic modulation indication
- Glass epoxy circuit board
- Provision for plug-in selective call
- Amplified Zener diode voltage regulator
- 2⅝" high x 6½" wide 9¼" deep

You've always wanted Kaar quality . . . now get it at the price of an ordinary CB transceiver. Inside its handsome epoxy wood grain panel is the powerhouse of the CB world . . . **judged first in quality and beauty, by experts the country over.**

Save on KAAR Skylark!

Get all the features of the Skyhawk in this rugged 11-channel beauty. **Reg. $179.95,** now! **$159.95.** Includes channel 9 crystals.

KAAR ELECTRONICS CORPORATION
1203-P WEST ST. GEORGES AVE., LINDEN, N.J. 07036

CIRCLE NO. 20 ON READER SERVICE PAGE

PRODUCTS (Continued from page 22)

minimal background noise and improved high-frequency response at standard and slow recording speeds, and features a high-quality oxide binder similar to that used in Ampex's professional low-noise tapes. The 301 Series, which replaces the 500 Series in the Ampex line, provides excellent performance in voice recordings at slow speed, background music at intermediate speed, and hi-fi music at standard speed. Both series are available in acetate and polyester base materials, and 7" and 5" reel sizes.

Circle No. 80 on Reader Service Page 15 or 95

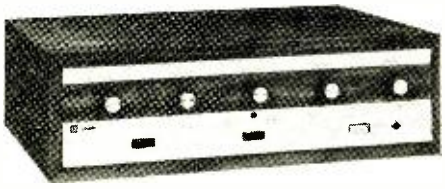
MOBILE AM-FM TUNER

Suitable for use with any 4- or 8-track cartridge, *GW Electronics'* "Auto Tuner" is a low-priced, high-quality AM/FM cartridge tuner. It will add AM-FM radio to any 4- or 8-track car stereo system, slipping in and out of the tape deck like a regular cartridge. The "Auto Tuner" uses the existing amplifiers and stereo system to produce a full sound comparable to stereo for AM and FM broadcasts, and is said to be the only cartridge tuner of this type on the market which contains a built-in a.f.c. in its all-solid-state circuitry.

Circle No. 81 on Reader Service Page 15 or 95

"STEREO COMPANIONS"

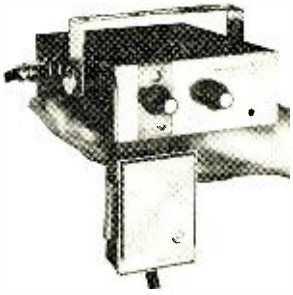
Priced within the reach of conservative budgets, the Knight-Kit "Stereo Companions" offered by *Allied Radio* also have sophisticated design features for sound purists. Both the KG-865 50-watt amplifier (shown in the photo) and the KG-795 FM tuner are solid-state units utilizing all-silicon transistors. The amplifier's frequency response is 20 to 20,000 Hz, full power, and within 1 dB from 18 to 30,000 Hz. The tuner boasts two tuned r.f. stages, a precision tuning indicator, automatic stereo switching and indicator light. Large printed circuit boards are provided for easy assembly, and the critical r.f. and i.f. stages of the tuner are factory-assembled. Walnut cases optional.



Circle No. 82 on Reader Service Page 15 or 95

MOBILE CB TRANSCEIVER

Low in cost, and small in size, *Amphenol's* Model 750 5-watt solid-state CB transceiver exceeds FCC Type Acceptance standards. In spite of its small size (4¾" x 2" x 5¼"), the transceiver boasts an adjustable squelch control for noise-free monitoring, an automatic noise limiter, and excellent sensitivity (0.5 μV for 10 dB signal-plus-noise/noise) and selectivity over the entire 27-MHz band. The Model 750's microphone doubles as a speaker in the "receive" position, and on "transmit" a bright panel light signals when the push-to-talk button is depressed. An illuminated and magnified channel selector switch reveals at a glance which channel is in use. The 750 comes complete with a set of crystals for channel 9 plus sockets for five more transmit and receive channels.



Circle No. 83 on Reader Service Page 15 or 95

DYNAMIC MICROPHONE

Tailored to amateur requirements, the Altec 687B available from *Altec Lansing* is a rugged moving-coil dynamic microphone. A continuously variable low frequency response is made possible by the rotation of a shutter on the rear of the mike housing, permitting reduction of interference while at the same time maintaining excellent speech reproduction. Other features include a built-in press-to-talk switch, and an extra set of contacts for other purposes; high sensitivity; uniform response over voice frequencies; and protection from metallic particles, dust, etc.

Circle No. 84 on Reader Service Page 15 or 95

SOLID-STATE STEREO RECEIVER

Although the *Olson* "Max-Cube" Model RA-25 stereo receiver lends itself to any kind of custom installation, it is especially suitable for bookshelf mounting. Frequency response is 20 to 20,000 hertz, power output 55 watts (27.5 watts per channel). Sensitivity is rated at 3 μV for 20 dB quieting, and multiplex separation is 25 dB. Features of the solid-state receiver include an illuminated slide rule dial and tuning meter, a.f.c., and a circuit-breaker-protected amplifier.

Circle No. 85 on Reader Service Page 15 or 95

CIRCLE NO. 34 ON READER SERVICE PAGE→

Learn I.C.'s...Build this new RCA Audio Amplifier Kit

RCA's new Integrated Circuit Experimenter's Kit, KD2112, is the first of its kind. You get a "short course" in integrated circuits, and you can build a 500-milliwatt audio amplifier or a variable-tone audio oscillator.

The heart of this new "all-parts-included kit" is an RCA linear integrated circuit – a multipurpose wide-band audio amplifier – containing the equivalent of 7 transistors, 11 resistors, and 3 diodes.

Each kit comes with a 20-page manual which gives complete step-by-step kit construction details. An extra I.C. "chip," with case removed, is also supplied so that its circuitry can be examined.

RCA's new Integrated Circuit Experimenter's Kit KD2112 is available from your RCA Distributor. Ask him for it, and learn more about I.C.'s.

RCA Electronic Components, Harrison, N. J. 07029

RCA

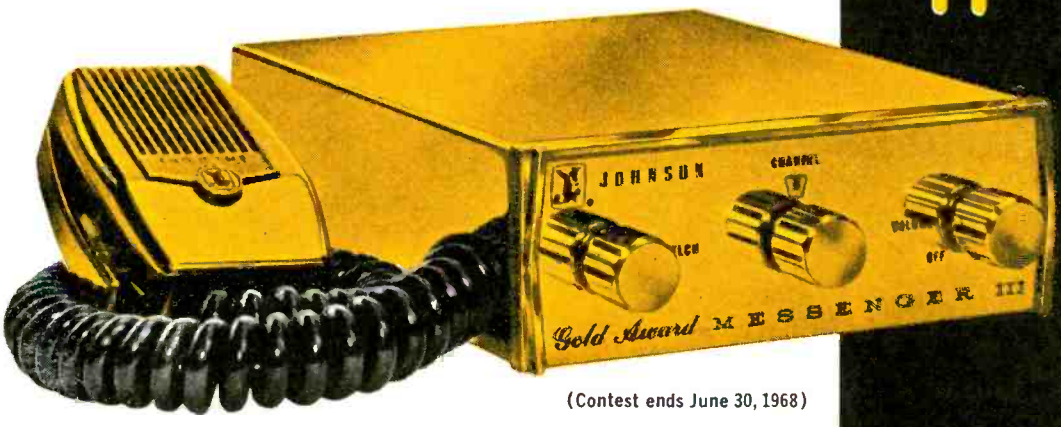
JOHNSON'S Spring GOLD RUSH

YOU MAY HAVE ALREADY

STRUCK IT RICH!

■ GOLD AWARD MESSENGER III's. Every CB call area will have a winner. YOUR call number may be lucky! See your Johnson dealer and find out if you have already won.

■ PLUS! Participating Johnson dealers in most areas will also give away Gold Award Messenger III's. See your dealer to find out how you can strike it rich! You have TWO chances to WIN!



(Contest ends June 30, 1968)

Hundreds of Winners

■ In commemoration of Johnson's production of its 100,000th Messenger III, the E. F. Johnson Company is releasing a limited number of 24-carat gold-plated Messenger III's to be given away free! Incorporating all the famous features that have made the Messenger III the standard of the industry, these Gold Award models will truly become CB collectors' items!

GOLD RUSH ACCESSORY SALE!

ANTENNA METER-MATCHBOX COMBINATION ($30.90 value) **(Expires June 30, 1968)**
Get maximum range from your CB unit—eliminate mismatch between transceiver and antenna. Either of above with purchase of Messenger I or 110; both with purchase of any other Johnson 5 watt transceiver—for only **$1.00***.

AC POWER SUPPLY ($32.95 value)
Converts any transistorized Johnson transceiver into a full-power base station. Mounts beneath transceiver. With your purchase of Johnson Messenger III, 100, 300, 320 or 323—for only **$1.00***.

HALF PRICE SALE

PORTABLE POWER PACK ($79.95 value)
Permits full-power, portable operation for up to 8 hours without recharging. With purchase of Johnson Messenger III, 100, 300, 320 or 323 for only **$39.97***.

*at participating Johnson dealers

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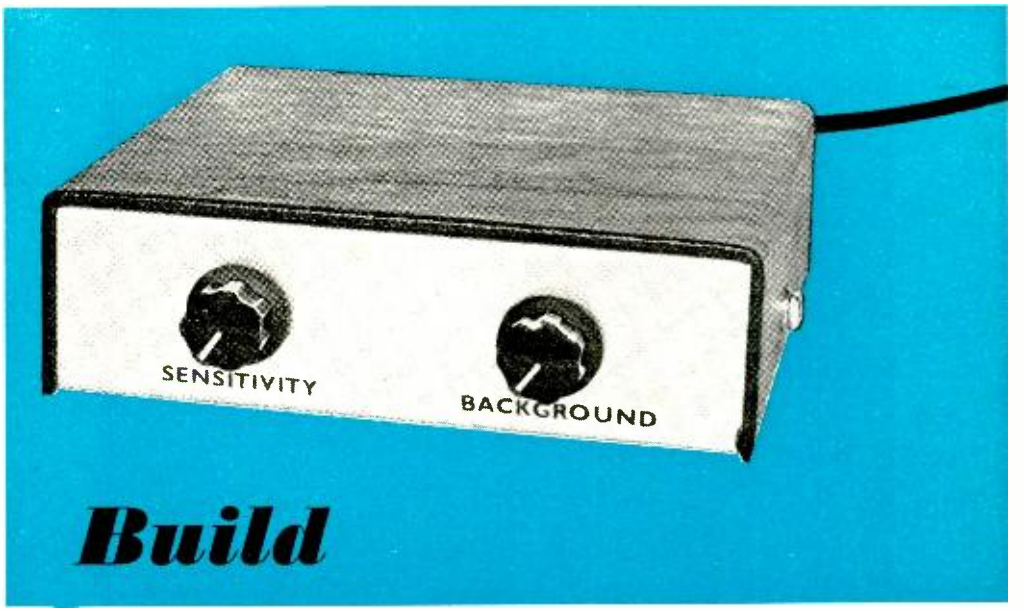
Providing nearly a half-century of communications leadership

CIRCLE NO. 18 ON READER SERVICE PAGE



The "Sonolite"

AUDIO-MODULATE 500 WATTS OF LIGHT, OR CONTROL THE SPEED OF A MOTOR— IT'S ALL THE SAME TO THIS DEVICE

BY DANIEL MEYER

DOUBLING IN BRASS as either the basis for a 500-watt color organ or as a general-purpose (up to five amperes) power controller, the "Sonolite" is easy to build and low in cost (approximately $10 per unit). For a home color organ, three "Sonolites" are required—one for the low audio frequencies, one for the mid-range, and the third for the high frequencies—plus suitable filtering.

If you have a musical group using electronic instruments, a really "far out" effect can be produced by connecting one "Sonolite" in parallel with a loudspeaker for each instrument, using a high-wattage lamp (preferably one having a built-in reflector) and a different color filter for each instrument, to illuminate the stage. The interplay of color and intensity variations as each instrument is played will produce a "wild" scene.

The addition of only a 200-ohm potentiometer and a flashlight cell will convert the "Sonolite" into a wide-range power controller, useful for controlling the power supplied to almost any device (500 watts or less) that can operate on 117 volts a.c.

Construction. The complete circuit (Fig. 1) can be mounted as shown in Fig. 2, with controls *R3* ("Background") and *R2* ("Sensitivity") mounted on one side, and the power outlet (*SO1*) and a.c. power and audio lines on the other side. The author chose to mount the circuit on two five-lug terminal strips.

Before drilling the mounting holes for

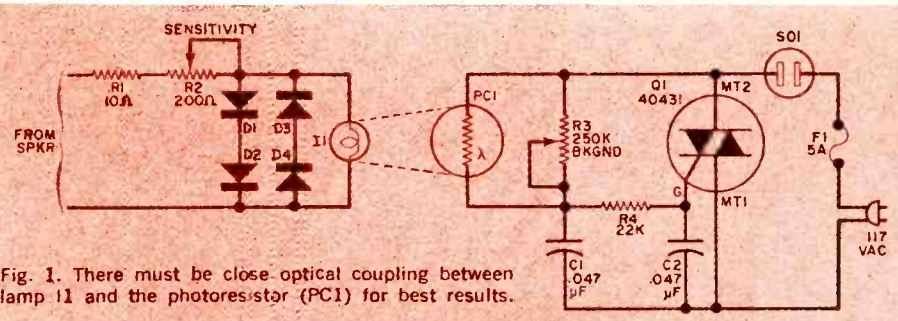


Fig. 1. There must be close optical coupling between lamp I1 and the photoresistor (PC1) for best results.

PARTS LIST

C1, C2—0.047-μF capacitor
D1, D2, D3, D4—50-volt PIV silicon diode
F1—5-ampere fuse
I1—#49 pilot lamp
PC1—Photoresistor (RCA 2529 or similar)
Q1—Triac (RCA 40431)
R1—10-ohm, ½-watt resistor
R2—200-ohm, 3-watt wire-wound potentiometer
R3—250,000-ohm potentiometer
R4—22,000-ohm, ½-watt resistor
SO1—117-volt a.c. socket
Misc.—Cabinet (Spectrum Products #533 or similar), plastic electrical tape, heat sink grease, two five-lug terminal strips, fuse holder, power line, audio line, knobs, etc.

Note: A complete kit of parts and the cabinet shown are available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216 (kit 147CSL, $10.50). Individual parts are also available.

the terminal strips, make up a heat sink for the Triac (Fig. 3) and then solder the Triac to the heat sink. The two mounting holes for the heat sink are also used for supporting the two terminal lugs. Use a piece of mica sheet, with both sides covered with heat sink grease to electrically insulate the heat sink from the metal chassis.

With the heat sink mounting holes as a guide, drill the holes in the chassis. Put the greased mica sheet down first, followed by the heat sink, with the terminal strips mounted above the heat sink. Use insulating washers on both sides of the mounting hardware. Remember at all times that the strip lug affixed to the Triac heat sink will be "hot" to the other

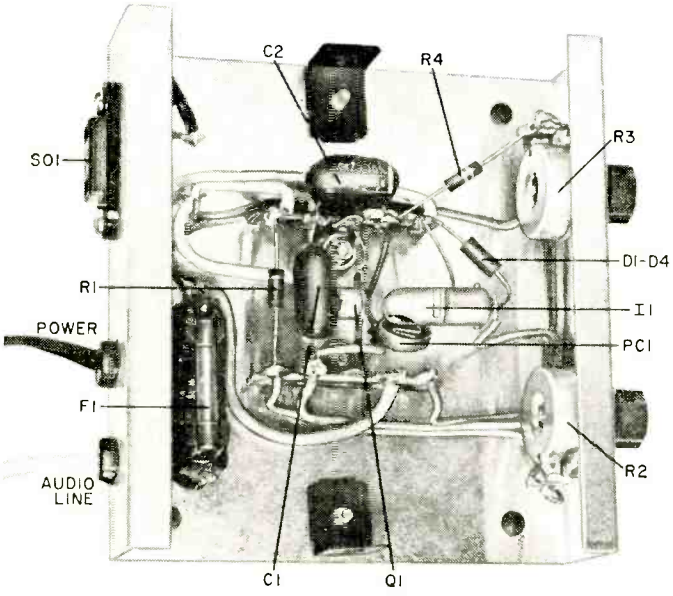


Fig. 2. The circuit is built up on two five-lug terminal strips (the type with center lug support, and two lugs on either side). The four diodes (D1 through D4) are enclosed in a piece of tubing. DO NOT use the metal chassis as a common tie point for any reason.

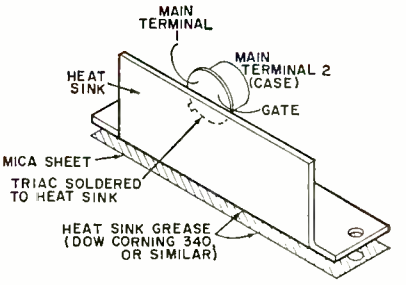


Fig. 3. The heat sink is two inches long with ½" lips. Don't forget to use heat sink grease.

side of the a.c. line. When wiring the "Sonolite," *do not* use the chassis as a common point for any part of the circuit.

Place the sensitive face of the photoresistor (*PC1*) against the pilot lamp (*I1*) at the filament end of the bulb, and wrap the pair with opaque plastic electrical tape so that only the leads of *PC1* protrude. In the "Sonolite" shown in the photograph, a metal pilot-lamp reflector was used to direct the light onto *PC1*. Although the author soldered the lamp wires directly to *I1*, a socket can be used if you prefer.

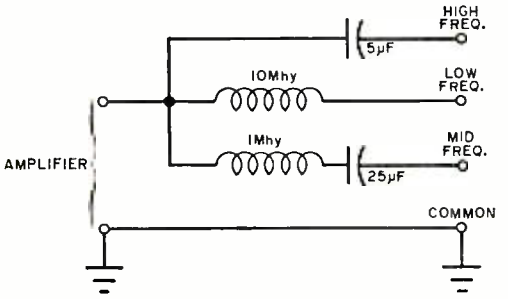


Fig. 4. Simple filter system for a three-channel color organ. Each output feeds a separate "Sonolite."

Testing. Connect a 500-watt (or lower wattage) lamp to socket *SO1* and plug the "Sonolite" into a 117-volt a.c. source. Rotating the "Background" control (*R3*) between its extremes should cause the lamp to go from completely out at one end to full on at the other end. Adjust *R3* until the lamp just goes out.

Now set the "Sensitivity" control (*R2*) to its maximum resistance position, and connect the audio input leads in parallel with a speaker. With the audio system operating, adjust *R2* until the lamp goes to full brilliance on music peaks.

To make a color organ, you will need three "Sonolites," as previously mentioned, with each supplying its own lamp. A suitable color filter for each lamp can be made from tinted plastic, with red, green, and blue being the most popular colors. The electrical filters for each group of frequencies can be made in accordance with Fig. 4.

The electrolytic capacitors in Fig. 4 can be either non-polarized types or two polarized units connected back to back. For example, the 5-μF unit in the high-frequency filter can be a pair of 10-μF electrolytics with their negative leads connected together, and the two positive leads representing a 5-μF non-polarized capacitor. Similarly, a pair of

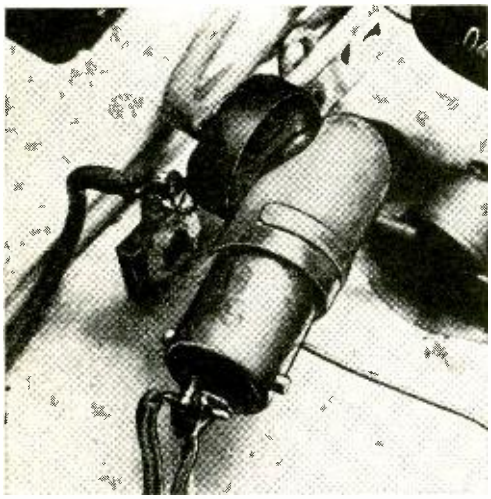
HOW IT WORKS

The "Sonolite" is a basic Triac power control system in which a low-level signal from an audio source controls the conduction time of the Triac, and therefore the amount of power supplied to the load. (A Triac is a four-layer semiconductor device, similar to an SCR, that can be switched between a conducting and non-conducting state by an external trigger voltage. Unlike an SCR, however, the Triac is a full-wave device and switches on both positive and negative half cycles of the applied a.c. power. As in SCR operation, by triggering the Triac on later in each half cycle less power is applied to the load, and conversely, switching it on earlier increases the power to the load.)

Resistors *R3* and *R4*, in conjunction with capacitors *C1* and *C2*, form a double time-constant circuit. By changing the resistance of *R3*, the firing point of the Triac can be set from about 15° to approximately 170° of the a.c. voltage cycle. In this circuit, *R3* ("Background") controls the amount of time necessary for the voltage across *C2* to reach the triggering requirement of the Triac. When the voltage across *C2* reaches this voltage point, the Triac fires, turns on the power to the load for the remainder of the cycle, and also discharges *C2*, making it ready for the next charging cycle.

Photoresistor *PC1* is connected in parallel with potentiometer *R3*. When the photoresistor is dark, it has a very high resistance, and therefore does not greatly change the effective value of *R3*. However, if *PC1* becomes illuminated, its resistance drops greatly, effectively changing the charging time of the time constant.

The light reaching *PC1* is generated by pilot lamp *I1*. This lamp, in turn, is powered by a voltage present at the audio input leads. The four diodes act as a voltage limiter to prevent blowing out the pilot lamp if the input voltage exceeds that required by the bulb. Sensitivity control *R2* determines how much of the input voltage reaches the pilot lamp.



The author elected to use a pilot lamp reflector to couple I1 and PC1. If you don't have a reflector, place I1 and PC1 in close contact and tape the two together. Ambient light must not reach PC1 as it will affect the background control operation.

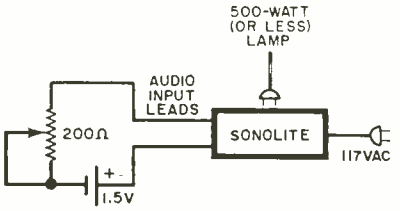


Fig. 5. Adding only two components makes the device a 500-watt power controller.

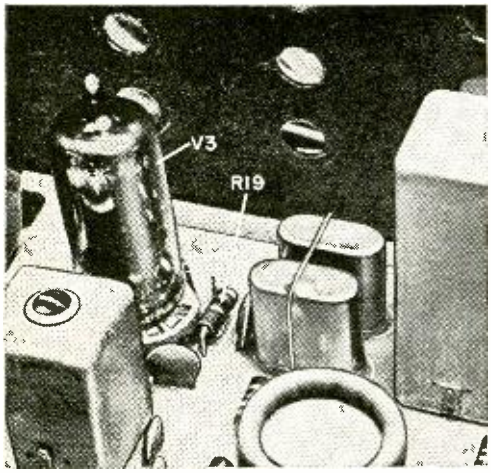
50-μF electrolytics can substitute for the 25-μF unit in the mid-range filter.

When the "Sonolite" is used in a musical group, with each instrument amplifier feeding a loudspeaker and a single "Sonolite" in parallel, each instrument can be identified with its own color.

The "Sonolite" can be turned into a general-purpose power controller (up to five amperes) by adding a 200-ohm potentiometer and a 1.5-volt dry cell as shown in Fig. 5. —30—

Souping Up The Heath GR-54

BY WALTER PFIESTER
W2TQK

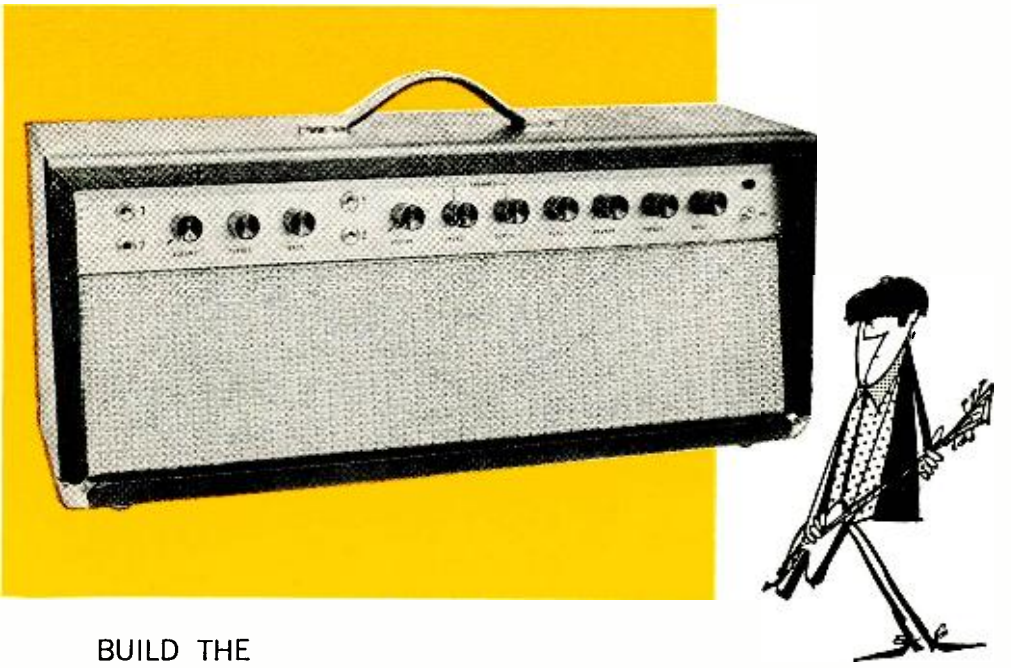


Resistor R19 is directly adjacent to tube V3, the first i.f. amplifier. After the overall conversion is completed, the GR-54 becomes a really "hot" set.

THE Heath GR-54 deluxe SWL receiver is a good general-coverage receiver that has found favor with hams and SWL's. With very little effort, the sensitivity of this receiver can be improved considerably at a cost of under $5 (only two tubes and two resistors are involved). There is no outward change either in the chassis or in the receiver's appearance or calibration.

Remove *V1* (6BH6 r.f. amplifier) and *V3* (6BA6 first i.f. amplifier) from the GR-54 and insert a 6DK6 at both sockets. Remove *R15* (470-ohm resistor) on the RF-Oscillator-Mixer circuit board and replace it with a 47-ohm, ½-watt resistor. Then remove *R19* (100-ohm resistor) on the Audio-IF circuit board and insert a 47-ohm, ½-watt resistor in its place.

Now realign the GR-54 as described in the Heath manual. If the test signal suddenly becomes weak or the set breaks into oscillation, slightly detune the antenna or mixer coil. You should find quite a difference in the sensitivity of the modified set, particularly on bands "C" and "D." —30—



BUILD THE

M/M/M Instrument Amplifier

60-WATT SOLID-STATE GUITAR AMPLIFIER WITH TREMOLO, REVERB, AND FUZZ

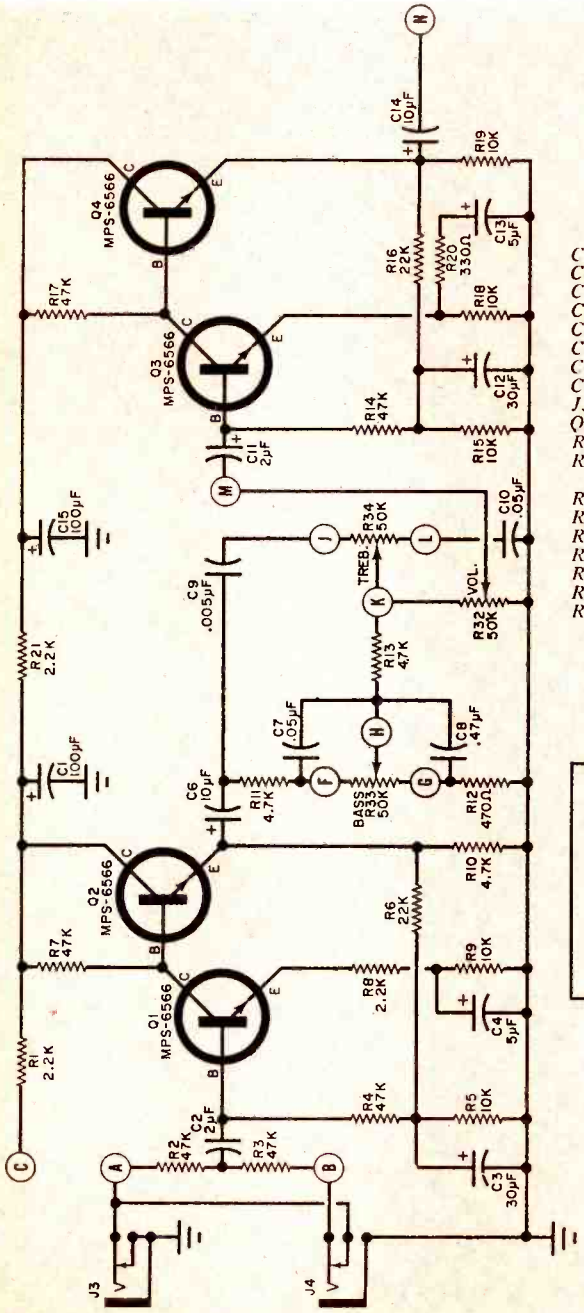
BY DANIEL MEYER

PART 1 of the "M/M/M Instrument Amplifier," presented last month, gave details on building a power amplifier and an instrument preamplifier for use either with a complete sound system or separately. Part 2 will cover a straight preamplifier, reverberation unit, a power supply capable of operating the entire system, assembly of the complete instrument amplifier, and it will provide some suggestions for using individual portions of the system with any other amplifier.

Incidentally, if you are interested in constructing a speaker system to go with the "M/M/M Instrument Amplifier," drop a line to the Advertising Department of Electro-Voice, Inc., Buchanan, Mich. 49107, and ask for plans for either the TB1 (a 30" woofer), or the TB2 (a pair of 15" woofers). These plans will be free while the supply lasts.

Straight Preamplifier. The circuit for the conventional straight preamplifier, useful for vocals or general announcement purposes, is shown in Fig. 9. It is basically similar to the instrument preamplifier without the special effects circuitry, and can make an excellent preamplifier for any hi-fi system. It incorporates both bass and treble tone controls and has its own volume control.

An actual-size printed board for the straight preamplifier can be seen in Fig. 10; the components are installed as in Fig. 11. A completed board, before semiconductor installation, is shown in Fig. 12.



STRAIGHT PREAMPLIFIER PARTS LIST

C1, C15—100-µF, 50-volt electrolytic capacitor
C2, C11—2-µF, 15-volt electrolytic capacitor
C3, C12—30-µF, 15-volt electrolytic capacitor
C4, C13—5-µF, 15-volt electrolytic capacitor
C6, C14—10-µF, 25-volt electrolytic capacitor
C7, C10—0.05-µF capacitor
C8—0.47-µF capacitor
C9—0.005-µF capacitor
J3, J4—Closed-circuit phone jack
Q1, Q2, Q3, Q4—MPS6566 transistor (Motorola)
R1, R8, R21—2200 ohms
R2, R3, R4, R7, R14, R17—47,000 ohms
R5, R9, R15, R18, R19—10,000 ohms
R6, R16—22,000 ohms
R10, R11, R13—4700 ohms
R12—470 ohms
R20—330 ohms
all ½-watt resistors
R32—50,000-ohm audio taper potentiometer
R33, R34—50,000-ohm linear potentiometer

The author's M/M/M Instrument Amplifier, shown on page 31, is assembled in a leatherette-covered, sloping-front wooden case measuring 25" long, 10" high, and 7" deep. The various electronic assemblies are mounted on a metal chassis as shown on page 40, running the length of the case, and the reverb spring unit is secured to the bottom of the case.

Fig. 9. The straight preamplifier is a high-quality unit having its own bass, treble, and volume controls. Components C5, J1, J2, and R22 through R31 are omitted from schematic and Parts List since they are not used here but in the instrument preamplifier (presented last month) which is built on a similar PC board.

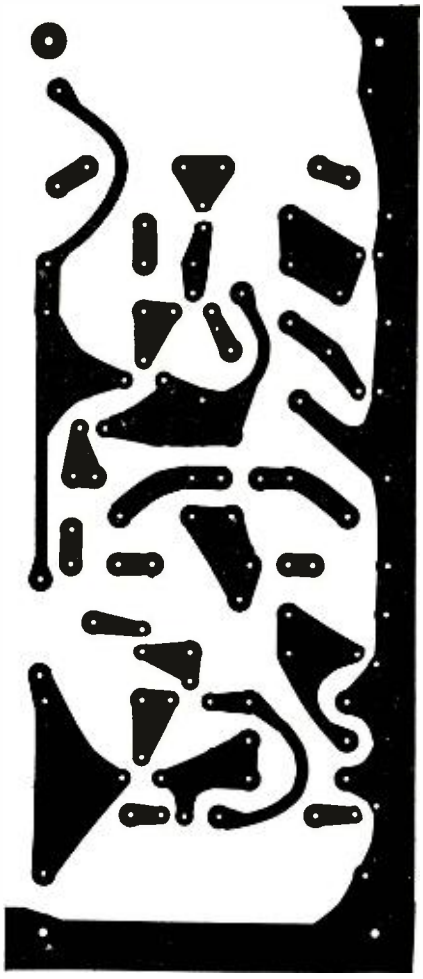


Fig. 10. You can make this actual-size printed board for the straight preamplifier yourself, or buy it etched and drilled.

Fig. 12. The author's prototype of the straight preamplifier before installation of transistors.

Reverberation Unit. This unit consists of a two-transistor driver for a spring-type reverb unit, and another two-transistor amplifier to make up the signal loss (typically about 40 dB) encountered in the spring unit. See Fig. 13.

The input signal for the reverb unit is taken from the output of the preamplifier. Because it is desirable to have as high an input signal to the spring unit as possible in a reverb system (to reduce hum and vibration noise), the input signal is amplified by *Q1*, while *Q2* is an impedance matcher used to drive the reverb spring unit. The echo signal at the other end of the spring is amplified by *Q3* and passed via emitter follower *Q4* as the output. Open-circuit jack *J1* is provided so that an external footswitch can be used to activate the reverb as desired.

An actual-size printed board for the reverb unit is shown in Fig. 14; the as-

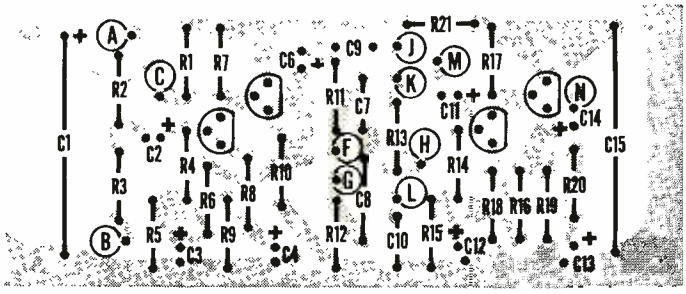
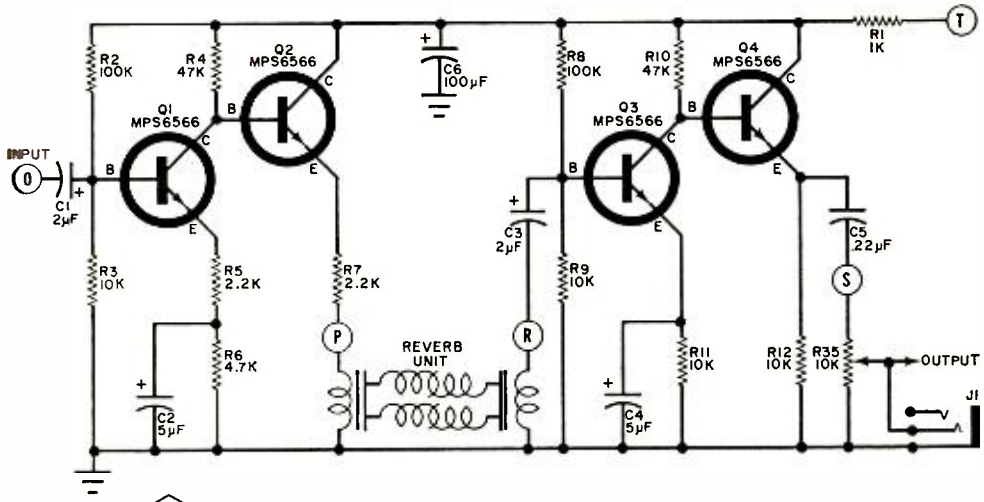


Fig. 11. Mount the components used in the straight preamplifier on the PC board as shown. The letter designations correspond to those in the schematic.



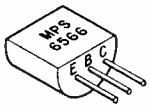
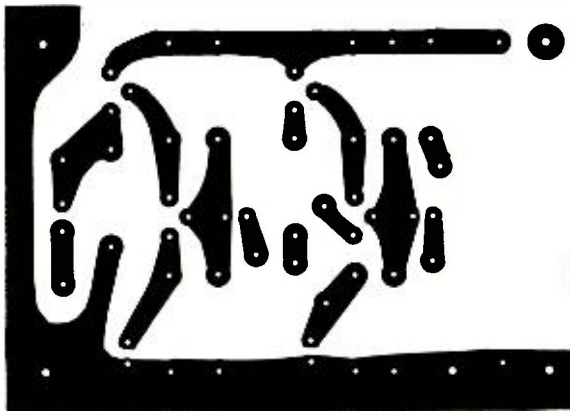


Fig. 13. Jack J1 connects to an external footswitch to turn the reverb on and off. Reverberation gain control R35 is not on the PC board but on the front panel.

REVERBERATION UNIT PARTS LIST

C1, C3—2-μF, 15-volt electrolytic capacitor
C2, C4—5-μF, 15-volt electrolytic capacitor
C5—0.22-μF capacitor
C6—100-μF, 50-volt electrolytic capacitor
J1—3-conductor phone jack
Q1, Q2, Q3, Q4—MPS6566 transistor (Motorola)
R1—1000 ohms
R2, R8—100,000 ohms
R3, R9, R11, R12—10,000 ohms
R4, R10—47,000 ohms
R5, R7—2200 ohms
R6—4700 ohms
(all ½-watt resistors)
R35—10,000-ohm linear potentiometer
1—Gibbs Type 1V-C reverberation spring unit



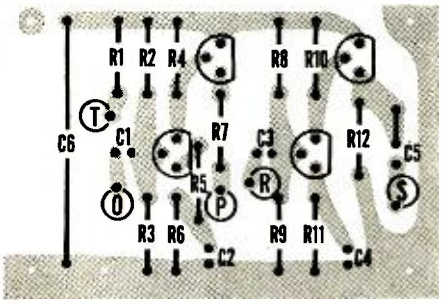


Fig. 15. Assemble the components on the printed circuit board as shown above.

Fig. 14. Actual-size PC board (left) contains the entire reverberation circuit.

sociated components are added as per Fig. 15. The completed board, before semiconductor installation, appears in Fig. 16.

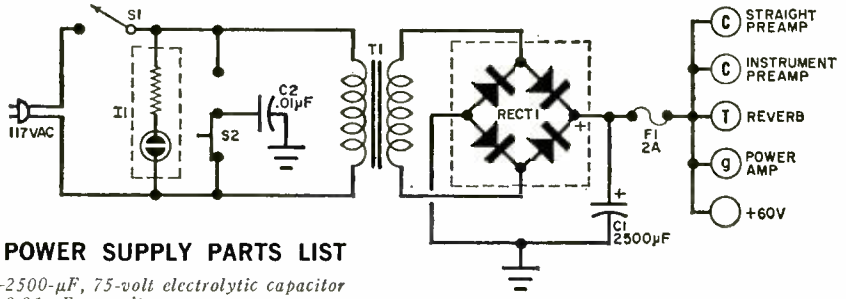
Power Supply. The circuit for a power supply capable of driving the complete system is shown in Fig. 17. It is a conventional full-wave rectifier and filter capacitor combination that will deliver 60 volts at the required current. Indicator *I1* tells when the power has been applied to the system, while *S2* is placed in the position that produces the lowest hum level (if any).

Assembling Complete System. The various components are interconnected as

Fig. 16. The reverberation PC board should look like this before you install the four transistors.

shown in Fig. 18. As shown in the photograph on page 31, the entire system can be mounted within a suitable case (partially sloping front), with the electronics all supported on a single cabinet-length metal chassis and with the reverb spring unit secured to the bottom of the case. The various potentiometers and switches can be mounted on the front apron of the chassis and transfer decals used to identify them. See Fig. 19 for the chassis arrangement used by the author; any other arrangement will suffice.

(*Continued on page* 40)



POWER SUPPLY PARTS LIST

C1—2500-μF, 75-volt electrolytic capacitor
C2—0.01-μF capacitor
F1—2-ampere fuse
I1—Neon lamp and limiting resistor
RECT 1—2-ampere silicon rectifier bridge, 100-PIV (Varo VS148 or similar)
S1—S.p.s.t. switch
S2—S.p.d.t. switch
T1—Power transformer: secondary, 45 volts at 2 amperes

Fig. 17. This power supply is capable of operating the entire instrument amplifier, or any one unit.

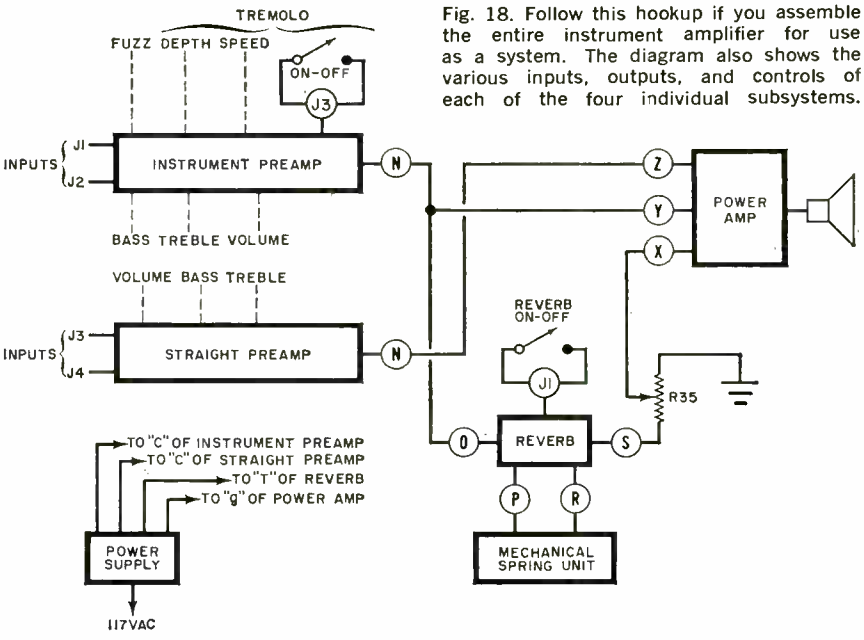


Fig. 18. Follow this hookup if you assemble the entire instrument amplifier for use as a system. The diagram also shows the various inputs, outputs, and controls of each of the four individual subsystems.

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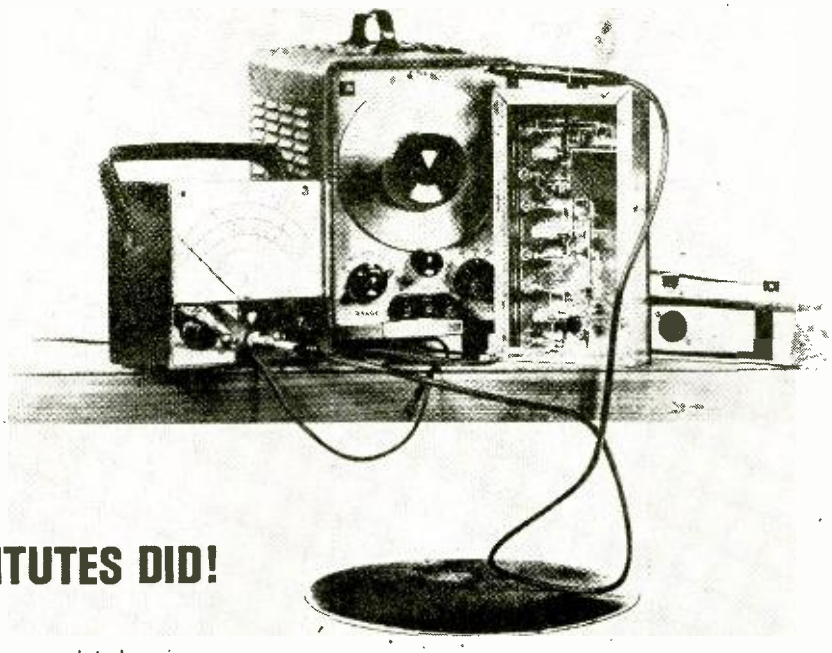

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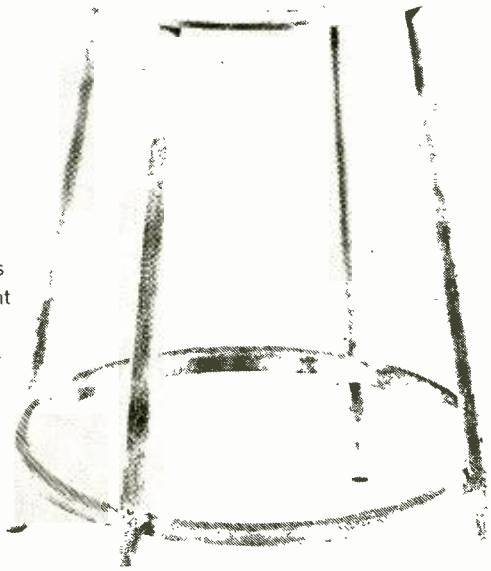

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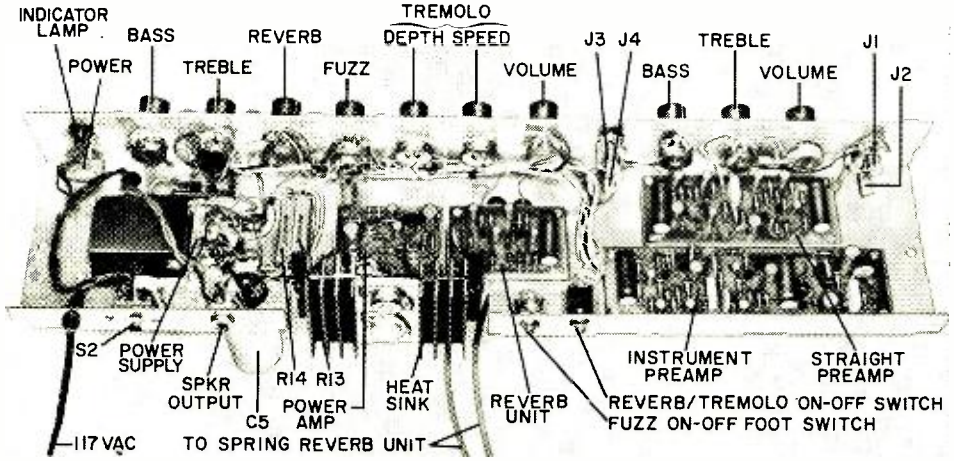


Fig. 19. The M/M/M Instrument Amplifier can be mounted on one long metal chassis. Note (below) that a complete amplifier kit is available as well as individual unit kits. All you need is a 60-watt speaker.

PC BOARDS AND PARTS KITS

The following are available from Southwest Technical Products: etched and drilled PC board for instrument preamplifier (#141), $3.00; straight preamplifier (#141P), $2.50; reverb unit (#141R), $2.10; and power amplifier (#141A), $2.10. A complete amplifier kit including all parts and punched chassis, less cabinet and panel markings (#MMC141) is $85.00. Send self-addressed envelope for price list on separate parts kits for each portion of the system to Southwest Technical Products Corp., 219 W. Rhapsody, Box 16297, San Antonio, Texas 78216.

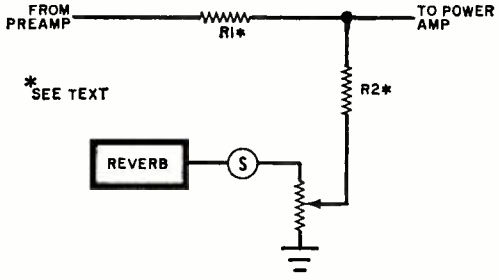


Fig. 20. Method of connecting reverb unit to any amplifier. See text at right for resistance values.

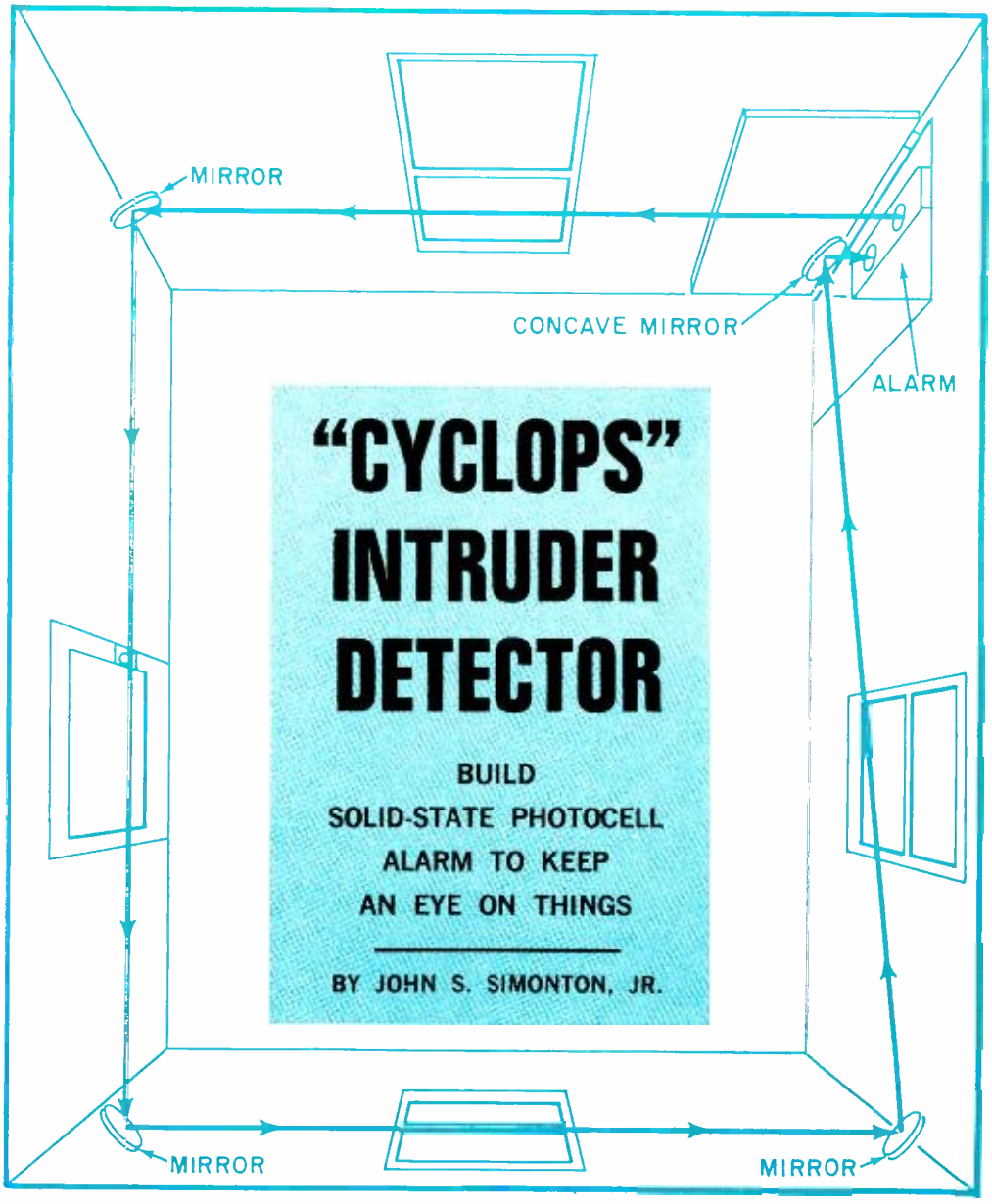
The speaker is connected to the amplifier via a telephone-type jack, as are the on-off footswitches that control fuzz, reverb, and tremolo circuits. The on-off footswitches are conventional instrument switches, available wherever electronic musical instruments are sold.

When the complete system is used, do not place it on a speaker enclosure as acoustic feedback can cause the reverb spring to produce a disturbing howl. Also, make sure that the speaker used can take the full 60-watt output of the power amplifier.

Set the guitar output control to maximum, plug it into the instrument preamplifier and make the desired volume, bass, and treble adjustments. Then set in the desired amount of fuzz, reverb, or tremolo, and use the external footswitches to turn them on or off as desired.

Individual Use. Either preamplifier can be used with any power amplifier merely by applying the correct d.c. voltage, and using the signal from terminal "N" of each printed board as the output.

The reverb unit can be installed in any audio system by following the arrangement in Fig. 20. In vacuum-tube systems, *R1* and *R2* will be between 47,000 and 100,000 ohms, with the exact values determined by tests; start with a 47,000-ohm unit, remembering that there will be some signal loss. In transistor circuits, *R1* and *R2* will be between 1000 and 4700 ohms (a good compromise is 2200 ohms); again remember that some signal loss will be introduced by these two resistors. -30-



"CYCLOPS" INTRUDER DETECTOR

BUILD SOLID-STATE PHOTOCELL ALARM TO KEEP AN EYE ON THINGS

BY JOHN S. SIMONTON, JR.

HERE IS a little unit that is about as useful as another pair of eyes when you want to protect an area from intruders. If anyone, or anything, crosses an invisible line formed by a beam of light, an alarm sounds and does not turn off even though the intruder backs away from the line. The only way to shut off the "Cyclops Intruder Detector" is to use a special "key" that will be in your possession.

This circuit has several advantages over most other optical intrusion alarms. It has no mechanical parts that might conk out when you need them most; when armed, but not triggered, power consumption of the alarm portion is very low and a set of batteries will last a long time; and, finally, it generates a distinctive sweeping audio tone that can be very easily heard even at low audio volume.

Sensitivity is quite good. You can de-

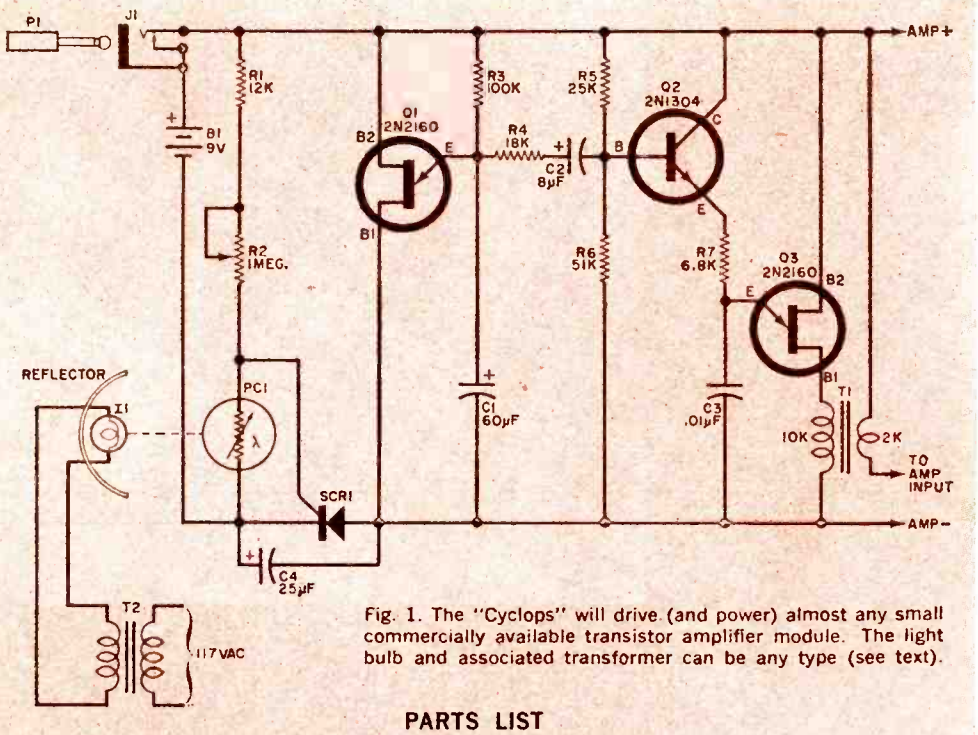


Fig. 1. The "Cyclops" will drive (and power) almost any small commercially available transistor amplifier module. The light bulb and associated transformer can be any type (see text).

PARTS LIST

B1—9-volt battery
C1—60-μF, 6-volt electrolytic capacitor
C2—8-μF, 6-volt electrolytic capacitor
C3—0.01-μF capacitor
C4—25-μF, 12-volt electrolytic capacitor
I1—Pilot lamp to suit T2
J1—Closed-circuit phone jack
P1—Mating plug for J1 (unwired)
PC1—Photocell (Clairex CL707L or similar)
Q1, Q3—2N2160 unijunction transistor
Q2—2N1304 transistor
R1—12,000-ohm, ½-watt resistor
R2—1-megohm potentiometer, linear taper
R3—100,000-ohm, ½-watt resistor
R4—18,000-ohm, ½-watt resistor
R5—25,000-ohm, ½-watt resistor
R6—51,000-ohm, ½-watt resistor
R7—6800-ohm, ½-watt resistor
SCR1—Silicon-controlled rectifier, 50 volts, 1 amp
T1—Miniature driver transformer, 10,000-ohm primary, 2000-ohm secondary
T2—Filament transformer to suit I1
Reflector—as desired—see text
Misc.—Transistor amplifier and speaker (if desired), printed circuit board, 1-1/16"-diameter pill bottle, flat black paint, plastic cabinet, solder, wire, etc.*

**An etched and drilled PC board is available from PAIA Electronics, Inc., P.O. Box 14359, Oklahoma City, Okla. 73114, for $2.50.*

termine just how much of an area you want to cover, and build a light source as needed. It is even possible to use a red filter over the light source so that it will be almost invisible at night.

The alarm is made up of three sections: the trigger circuit; the tone generators; and the audio amplifier. This latter unit can be any commercially made amplifier and is not considered as part of the alarm circuit in this article.

Construction. The alarm circuit appears in Fig. 1. To reduce the possibility of wiring errors, an actual-size printed board (Fig. 2) can be used. Install the components according to Fig. 3, observing the polarity of the electrolytic capacitors and the semiconductors.

Although the alarm output signal can be fed to any type of amplifier, the author used a low-cost transistor amplifier of the type available at almost any electronic distributor to permit the entire alarm to be mounted in a single package. After completing the alarm circuit, connect the alarm "Amp+" output to the amplifier positive-voltage lead, connect the alarm "Amp—" lead to the amplifier negative lead, and connect the alarm signal output to the input of the amplifier.

Photocell *PC1* is mounted inside a conventional 1 1/16-inch plastic pill bottle, the inside of which has been painted *flat* black. To mount *PC1*, first extend the leads of the cell by soldering a length of wire to each of the two cell leads (use a heat sink). At the rear of the pill bottle, drill a couple of 1/16" holes to accommodate the two cell leads. Place a couple of drops of adhesive on the rear of the cell, then slide it into the pill bottle (sensitive end towards the open end of the bottle), and secure the cell to the rear face of the bottle.

The light source in the prototype uses a reflector salvaged from an old flashlight with the associated bulb holder. The bulb can be powered either by a lantern battery or by a filament transformer from the power line. (If the a.c. supply is used, the alarm will signal the instant that the a.c. power is interrupted, either by accident or design.) In either case, make sure that the power supply and the bulb filament voltage agree.

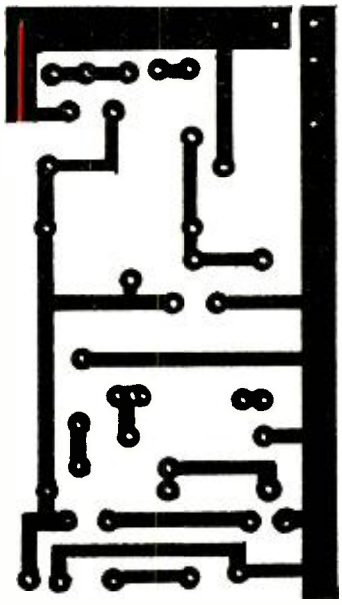


Fig. 2. Actual-size PC board for those who want to make their own. A commercial unit is available.

HOW IT WORKS

The trigger circuit consists of *PC1*, *R1*, *R2*, and *SCR1*. The SCR is normally in its non-conducting state; therefore, no power is supplied to the alarm. When *PC1* is illuminated by a beam of light from bulb *I1*, its resistance is low; essentially no voltage is applied to the gate of the SCR, and the SCR remains in the off condition.

If the light beam is interrupted, the resistance of the photocell increases and the voltage at the junction of *R2* and *PC1* goes up. If *R2* is properly adjusted, the increased voltage at the gate of the SCR will be enough to trigger the SCR on. Once this happens, power is applied to the alarm circuit. Because an SCR will not automatically turn off when operating on d.c., the alarm can only be shut off by inserting the proper plug in normally-closed jack *J1*.

The tone generator consists of unijunction transistor *Q1*, resistor *R3*, and capacitor *C1*. Before power is applied, *C1* is discharged. When power is applied, *C1* charges through *R3* until the UJT (*Q1*) fires, thus discharging the capacitor, and the process repeats itself as long as power is applied. This action produces a sawtooth voltage—a major fraction of a second long—at the junction of *R3* and *C1*, which is applied—via current limiter *R4* and d.c. blocking capacitor *C2*—to the base of *Q2*. Transistor *Q2* acts like a variable resistor whose value depends on the current flow between the base and emitter junction. This current is the sawtooth voltage created by *Q1*. The sawtooth output of *Q2* then charges *C3* which is the frequency-determining element of UJT tone generator *Q3*. The output, taken from *Q3*, via *T1*, is the sweeping frequency alarm signal which is coupled to the audio amplifier.

If a transistor audio amplifier is used for the alarm, it will receive its operating power at the same time as the alarm, and the entire system will go into operation almost instantaneously.

The author elected to package both the alarm system and the light source in the same plastic case (see illustration on page 44), although they can be separate if desired.

Installation. Regardless of where the alarm is to be used, the light beam is reflected by one or more mirrors so that eventually it shines on the photocell, thus keeping the alarm from sounding until the light beam is broken by an intruder. Physical arrangements can differ, of course, and Fig. 4 illustrates one method of protecting a room. Use the largest mirrors available, and if several different sizes have to be used, arrange them so that the light first falls on the smaller mirrors. The author has found that a concave mirror, of the type used for shaving, makes a good final mirror.

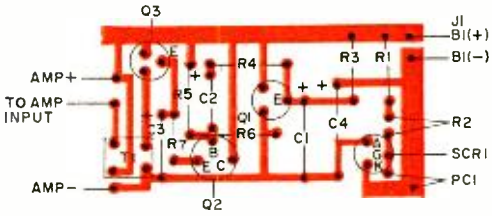
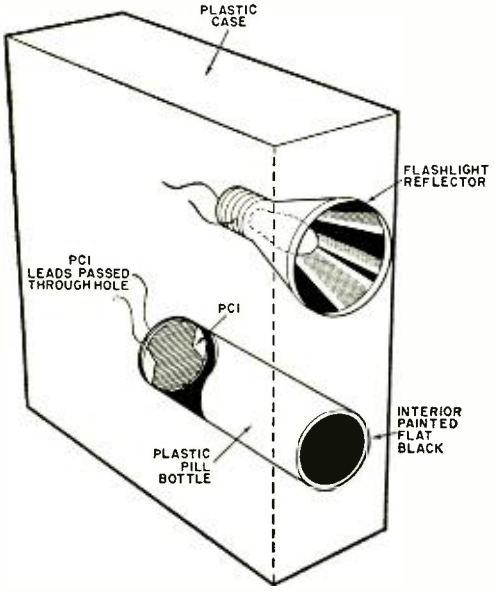


Fig. 3. Install the components as shown here, observing the polarity of semiconductors and capacitors.



Method of construction used by the author in which both light source and photocell are in a single case. Alarm circuit and audio amplifier can also be included in same housing.

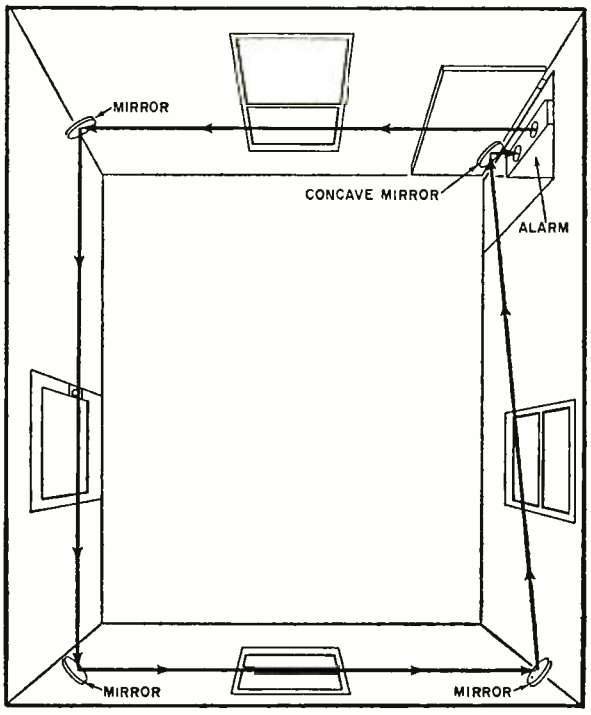


Fig. 4. Typical arrangement for protecting a room. The use of mirrors enables any shape of area to be protected. The concave mirror focuses the light on the photocell surface.

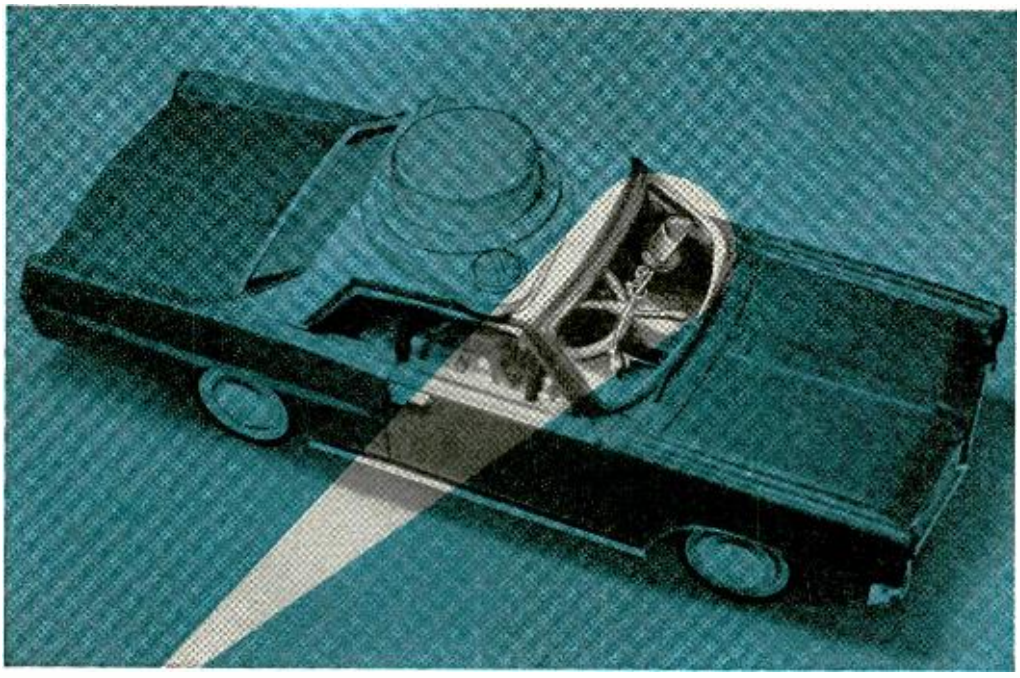
To cover just one opening (door, window, etc.), the light source can be either on one side of the opening shining into the alarm on the other side—if they are packaged separately, or both units can be on the same side of the opening with the light reflected off a mirror placed on the opposite side. The light can be "zigzagged" to fully cover the opening.

The amount of light required to keep the alarm from sounding is determined by the light beam length, the light output of the bulb, and the type of reflector used with the bulb. Obviously, a high-power bulb in an efficient reflector (or lens system) will produce a long and useful beam path, while a lower power bulb in a poorer reflector may be good only for a few feet. Also, if a bright light source is available, it is possible to use a red filter (tinted plastic) over the reflector output so that the light beam will almost be invisible during the night. The photocell called out in the Parts List will operate in the red portion of the visible spectrum.

Operation. After the apparatus is set up, turn on the light beam and rotate *R2* (sensitivity control) to its maximum resistance position. Then set up the optical path so that the light beam shines on *PC1*, and remove *P1* from *J1*. This arms the "Cyclops" system.

Now back down on *R2* until the alarm comes on. When this point is reached, turn *R2* very slightly back (towards a higher resistance), and reinsert *P1* in *J1*. When *P1* is removed at any time, the alarm is ready to go the instant that the light beam is interrupted. Once it sounds, the only way that the alarm can be cut off is to insert *P1* in *J1* again.

The alarm will give the best results when operated indoors or at night. The ambient light of a sunny day outdoors may not provide enough light differentiation to trigger the alarm when the beam is broken. Under sunny outdoor conditions, additional shading of the photocell by extending the pill bottle with an appropriately-sized cardboard tube may help. -30-



Add
LIGHT CONTROL
to Battery-Powered Toys

JUST TWO TRANSISTORS
AND A FLASHLIGHT
DO THE TRICK

BY WILLIAM S. GOHL

BY ADDING only two semiconductors to a miniature battery-powered toy car (or any other battery-driven toy), you can control its operation with a conventional flashlight at distances up to 15 feet or more. Two circuits are shown in Fig. 1, one for *pnp* power transistors (a), and one for *npn* power transistors (b). Regardless of which type of power transistor you elect to use, operation is similar.

Phototransistor *Q1* is an *npn* photo-Darlington amplifier (General Electric L14B) whose emitter-collector current is a function of the light level present on the active surface of the transparent-potted transistor. Power transistor *Q2* can be any type that will carry the motor current of the toy.

When *Q1* is supplied with enough light, it causes *Q2* to saturate and act as a closed switch for the battery-powered motor. The motor will operate as long as *Q2* is saturated, or as long as light is present on the sensitive surface of *Q1*. When the light is removed from *Q1*, *Q2* cuts off to break the circuit, just like an on-off switch.

Mounting of *Q1* and *Q2* is determined by the configuration of the toy to be controlled. A heat sink for the power transistor is not required for ordinary operation—however, it is important that the round portion of the phototransistor

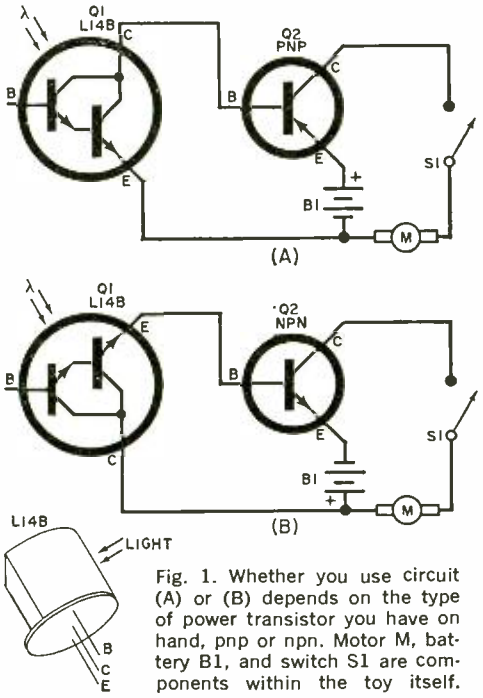
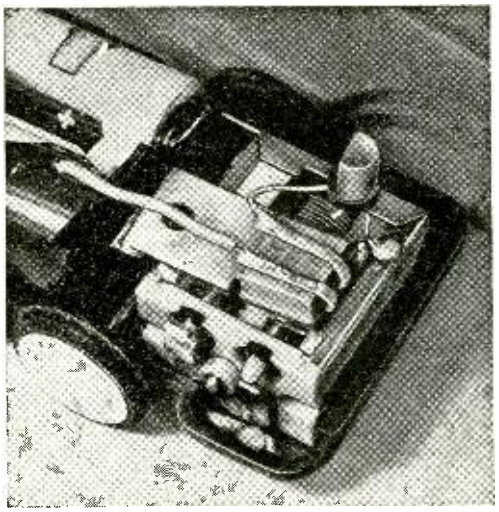


Fig. 1. Whether you use circuit (A) or (B) depends on the type of power transistor you have on hand, pnp or npn. Motor M, battery B1, and switch S1 are components within the toy itself.



Plastic-encapsulated transistor saves space and gives neat appearance to station wagon installation.

be exposed as this is the light-sensitive side.

The motor, battery, and on-off switch (*S1*) are an integral part of the toy. The easiest installation procedure is to break the lead from the battery terminal to the on-off switch and connect the power transistor as shown in either Fig. 1(a) or (b).

Approximately 52 footcandles are required to start the car, with 12 footcandles as a running minimum. The car should not be used in bright sunlight, as it will "run away" due to the amount of light striking the phototransistor. With artificial light, the problem is reduced.

As the average light level in a home is about 5 footcandles, the car can easily be controlled with a flashlight. A typical 2-cell flashlight has to be held about 3 to 6 feet away from the phototransistor to start the motor, but it will keep it running for about 15 feet. -30-

In the toy sports car at left, Q1 is bent to face through the rear window. In this toy, as in the station wagon shown above, the collector tab of the npn power transistor is soldered to the battery negative connector and the emitter lead is wired to a solder lug which fits between the battery case (negative) and its connector. The lug side facing the connector is insulated with tape. This puts the transistor in series with the battery, switch, and motor. The photo-transistor collector is soldered to the motor frame (positive), the emitter connects to Q2's base, while the base lead of Q1 and the collector lead of Q2 are removed to avoid accidental contact.

FLAME AMPLIFICATION

AND A BETTER HI-FI LOUDSPEAKER?

MUSIC FROM THE FIREPLACE MAY BE AROUND THE CORNER

BY JAMES JOSEPH

WE LIVE IN an era jaded by science's seemingly routine discovery of basic phenomena—coherent light and the laser; superconductivity and the super-cold realm of zero resistance; weightlessness and its impact upon space electronics. And now, *flame amplification.*

"Flame which behaves physically and electrically like a high-fidelity loudspeaker . . . and has inherent amplification besides," explains Dr. A. G. Cattaneo, manager of United Technology Center's Sunnyvale, Calif., Physical Sciences Laboratory, and one of flame amplification's three co-discoverers.

So saying, Dr. Cattaneo strikes a match to an acetylene-oxygen fueled welding torch poised on a test stand in one of UTC's highly classified and restricted

laboratories. Carefully, he adjusts the torch's flame until, blue-hot (about 4200°F), it burns with livid intensity.

"Notice the electrodes," Dr. Cattaneo continues, pointing to two small tungsten electrodes which, immersed in the flame, are set one above the other and separated by a few inches of fire.

Next, he indicates the high-fidelity sound system's handful of basic components: (1) a tape recorder which feeds a (2) power amplifier which, in turn, energizes the (3) primary windings of a transformer; and (4) a d.c. power supply whose negative and positive terminals are connected, through the transformer's secondary, to the two flame-immersed electrodes.

"Please observe that we have here all the necessary components of a high-fidelity sound system—everything, that is, except a loudspeaker," says Dr. Cattaneo as, deftly, he switches on the d.c. supply, then the power amplifier, and, finally, the recorder whose tape is transcribed with Beethoven's *Fifth Symphony*.

Suddenly, music inundates the lab.

"The flame," gestures Dr. Cattaneo, "is the sound system's loudspeaker. More correctly—although we're not yet certain precisely how or why it works—it is probable that ions in the two fuels, oxygen and acetylene, actually perform the power conversion. That is, ions in the burning gas stream convert the amplitude-modulated input signal to audio.

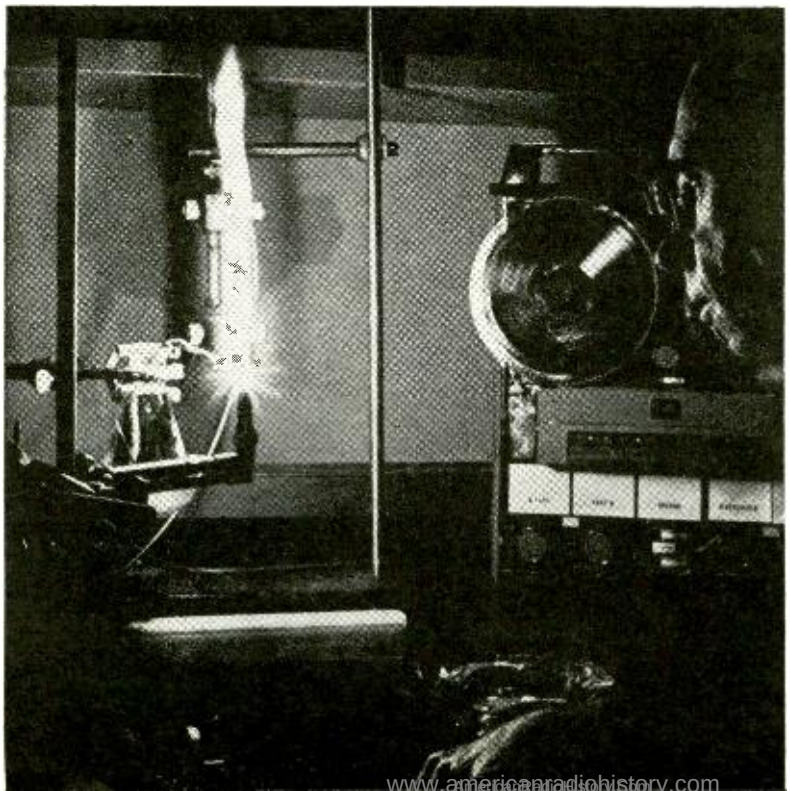
"Generally," he continues, "the hotter the flame, the greater the ionization of the fuels . . . and the louder and more faithful the sound reproduction."

To demonstrate, Dr. Cattaneo turns down the flame (reducing the oxygen-acetylene supply). Beethoven's *Fifth* is still audible, although muted in volume and far less faithfully reproduced than when the flame burned with blue-hot and ionizing intensity. He turns up the flame —and Beethoven comes on in volume and fidelity again.

Pluses of the Flame Speaker. Dr. Cattaneo might have added some other pertinent facts about flame amplification and the remarkable "ion speaker." For example, it is likely the world's first truly omnidirectional loudspeaker. The sound emitted from the flame is broadcast with equal force in all directions . . . spherically through a full 360 degrees.

Frequency range and fidelity are other

From the eerie glow of the flame from an ordinary welding torch comes Beethoven's "Fifth Symphony" in full fidelity—and the electrical flame loudspeaker is born.



sizable pluses of the flame speaker. Its frequency response range is three to four times that of any known mechanical speaker—and future tests, far beyond the audio spectrum, may well show even higher response. Where, for example, even the best and costliest of diaphragm-type speakers can reproduce, at their highest range, only about 30,000 Hz (at best, about 12,000 Hz above what even the most acute human ear can hear), the flame speaker has shown it can reproduce *at least* 100,000 Hz.

Moreover, where response of mechanical speakers begins to fall off toward the high audio side (beginning at about 10,000 Hz), the flame speaker shows no evidence of this defect at all. It reproduces with equal fidelity the lowest lows (down to 16-20 Hz) and highest highs thus far measured.

"Seeding" The Flame. Dr. Cattaneo had, thus far, demonstrated for POPULAR ELECTRONICS only part of the phenomenon of flame—its use as a high-fidelity sound reproducer. Now, to conclude an already profound visual and audio experience, he thrust a short length of sodium silicate glass tubing into the hot flame.

The reaction was immediate. The flame changed color, turning from blue to blaze orange. At the same instant the flame-speaker's volume seemed almost to double, until the lab fairly reverberated with sound.

"Amplification—in the order of 32 times," Dr. Cattaneo said. "By 'seeding' the flame with some easily ionized alkali metal—the sodium in this sodium glass tube, for instance, or even a pinch of sodium chloride, common table salt—many more ions are introduced into the flame-stream. Super-ionization not only permits the flame to carry more current, but quite significantly reduces the resistance between the electrodes—from a high of about 1 megohm when the gas stream is unignited to a low of 2500 ohms when the flame is super-ionized by 'seeding.'

"So more current flows through the modulating circuit and between the electrodes. And you have what you hear—real and basic amplification. The gain, insofar as we've been able to measure, is 15 decibels . . . amplification, as I say, in the order of 32 times."

Exciting, Yet Simple. Certainly one of the most exciting and significant physical science breakthroughs of the decade, flame amplification is also one with far-reaching application in electronics, physics and rocket research. For example, UTC plans to use a rocket's own fiery exhaust as a sound detector of internal rocket engine ailments. Such trouble—a potential rocket-destroying resonance, to name but one—likely modulates the rocket engine's flame-stream and can be readout and diagnosed by a "sound doctor" familiar with rocket ills.

The phenomenon is so basically simple and easy to duplicate that any electronics experimenter can concoct a flame speaker at home—using nothing more than a Bunsen burner, or perhaps one of those disposable fuel-cartridge welding tools. Even your kitchen stove's pilot flame will reproduce some sound, though the flame temperature is too low (being methane—natural gas—fueled, rather than fueled with hotter burning oxygen-acetylene) to give really good or faithful sound.

The members of United Technology Center's flame amplification team—headed by Dr. Cattaneo, with much of the theory put to lab practice by Wayne Babcock, a brilliant innovator, and K. L. Baker—were not the first or only experimenters through the years to recognize flame's audio response. Indeed, UTC's flame amplification team claims (and has patented) only one sizable advance in the state of the art: they were first to achieve *electrical modulation* of flame. Previous experimenters had merely physically modulated flame using various pressure-wave generating devices—a speaker diaphragm, for example. Such basic systems left much to be desired in acoustic output.

When It All Started. Back as far as 1858, British scientist John Leconte noticed, while at a concert, that the theater's gas lights responded to certain beats of the music. What Leconte observed was the gas light's response to the bottom end of the audio spectrum, on the order of a few hertz. For the unaided human eye cannot detect frequency response much above 16 or 17 Hz. It is noteworthy that very low frequency response can likewise be observed in the flame-speak-

er's flame. At any rate, Leconte reported his observations to the Royal Academy, declaring, "we must look upon all jets as musically inclined."

"Oscillatory Combustion" was the subject of a special session of the fourth symposium of the Combustion Institute, in 1952—where combustion experts discussed flame's response to external modulating pressures. Involved was some pretty basic physics, for it has long been axiomatic that combustion temperature increases as pressure increases. (Sound pressure in the flame loudspeaker, the UTC researchers report, gets the same—and expected—result: as sound pressure rises, so does flame temperature. And as temperature rises, ionization increases. This may be one factor in the flame-speaker's fidelity and amplification over so impressive a frequency spectrum.)

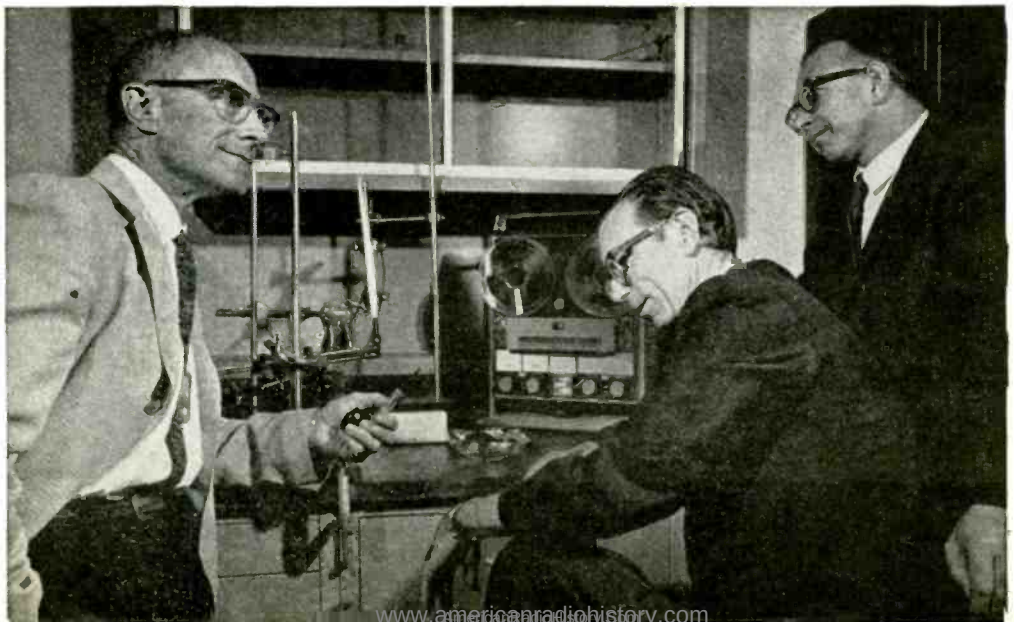
More recently, Stanford Research Institute came up with what its scientists dubbed a "dragon horn": a diaphragm-type speaker horn (the kind used in public address systems) screened at the end and through which, when additional volume was required, methane and air were introduced and ignited. The screened horn-end, converted to a burner, belched flame (thus, "dragon horn"), and, SRI found, effectively boosted audio output by some 15 dB. Significantly, this is precisely the gain of UTC's flame amplifier speaker.

The UTC's researchers probed deepest, however, and stumbled, quite by accident, upon the full significance of the phenomenon while trying to duplicate in the lab the jet-flame exhaust of rocket motors.

Experimental "Put-Together." Says Wayne Babcock, who did much of the experimental put-together, "One day, about two years ago, some of our people came in and asked if we could simulate a rocket's exhaust flame. The idea was to feed sound into the propulsive exhaust system at one place and take it out at another—for a better understanding of the relationship between rocket combustion and noise. For one thing, we hoped to discover what various noises told about a rocket's internal behavior. And especially if certain undesirable internal resonances could be detected by analyzing noise from a rocket's fiery exhaust."

Babcock's first "put-together" was purely mechanical (Fig. 1). Adjacent to and level with the visible part of the natural gas flame of a Bunsen burner, he set a "modulation unit"—nothing more than a loudspeaker voice coil attached to an air chamber, one of whose flexible sides could be vibrated by the voice coil. When hooked to an audio frequency source, the diaphragm responded, and "modulated" a stream of low-pressure

From left to right are Dr. A.G. Cattaneo, Wayne Babcock, and K.L. Baker—United Technology Center's "flame amplification" team—listening to their flame amplifying loudspeaker as it reproduces taped music.



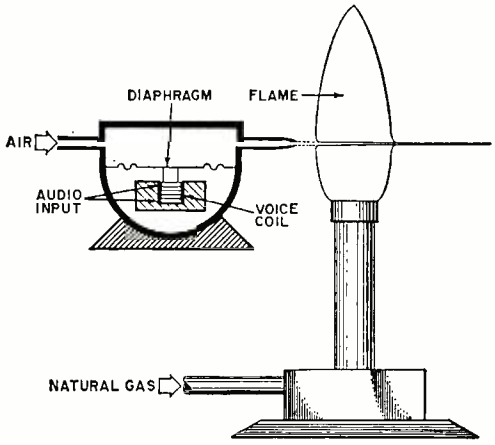


Fig. 1. Original mechanical "modulator" consisted of a speaker mechanism and a Bunsen-burner flame.

air jetted at the flame through the chamber and out a copper tube nozzle.

"If you put your ear to the flame, you could hear sound . . . quite good and faithful sound, considering so simple and loss-prone a flame-modulating device," remembers Babcock.

Babcock and Baker experimented with other mechanical modulators. In one, Fig. 2, they rigged a diaphragm to modulate the natural gas and oxygen supply to a welding torch. This hotter fuel mix (about 3200°F) produced louder sound and good fidelity over the diaphragm's limited frequency range. The hotter the flame, found the researchers, the more efficient the flame amplifier, and the louder the flame's audio output.

How, And Possibly Why. Combustion, by its very nature, produces ions. Ions are the stuff of electricity. The hotter the combustion, the relatively greater the number of ions that will be naturally produced. Moreover, this ionization of the combustion zone can be artificially increased by "seeding," as previously mentioned.

Given a highly ionized flame, the conditions would seem right for current to flow, ion-supported, between two electrodes immersed in the ionized combustion zone, thus completing an electrical circuit. Were this current externally modulated with a frequency within the audible range, it might naturally follow that the flame would reproduce the sound.

Why modulated ionized current might "couple" with adjacent air molecules in a power conversion of electrical energy to audible sound energy had already been suggested by some researchers who had explored the behavior of highly ionized gases. One researcher, as far back as 1951, came up with the following provocative theory:

Athough the molecules in a gas do not normally "hang together" as in a liquid, highly ionized gas molecules do. And thus, in such special cases of high ionization, the ions in gas exhibit cohesion much as in a liquid. Being cohesive, the ions have substance enough to exhibit "surface tension"—again, just as do ions and molecules in a liquid. As such, gaseous ions form a kind of *invisible diaphragm* which might logically be expected to couple with and to exert force upon adjacent air molecules. If such were, in fact, the case, a modulated highly ionized electrical current in a combustion zone might "beat" against adjacent air molecules, converting its electrical energy to audio energy, much like the physical behavior of a loudspeaker's solid diaphragm on the air around it.

The Present UTC Setup. Figure 3 shows the basic components and their hookup. The output of a Sony 365 tape recorder is fed to the input of a McIntosh 75-watt amplifier and the amplifier's output to the 8-ohm secondary winding of a reverse-connected power output transformer. A Hewlett-Packard Model 712-B

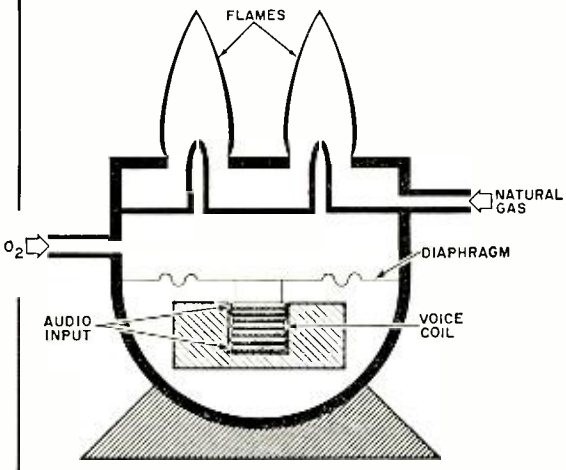


Fig. 2. Variation of mechanical flame modulator provided a louder sound and better audio quality.

(500 volts d.c. at 200 mA) power supply is connected through the transformer's primary winding to the two tungsten (or carbon) electrodes which, immersed in the flame, are spaced 2 to 4 inches apart. Neither the spacing of the electrodes nor their positioning within the flame zone is particularly critical.

The welding torch, fueled by acetylene and oxygen and fitted with a #0 tip whose small opening produces an almost hissless flame, is the kind any welder might use. How the easily ionized alkali metal is introduced to the combustion zone is relatively non-critical too, except that for best results super-ionization should take place below the lowest electrode. That is, the lower, hotter part of the flame should be ionized so that the ions "float" upward, past both electrodes. (Lacking a sodium glass rod, an asbestos wick drawing from a salt solution quite readily achieves super-ionization.)

Operationally, the procedure works like this:

The torch is lighted and adjusted slightly on the "rich" fuel-mix side (more oxygen than acetylene). This makes for a hotter flame. The flame itself is adjusted for minimum hiss. What you get is a quiet, brilliant blue flame.

Now the power supply is turned on. With one eye on a milliammeter connected in series with the electrodes, the flame-speaker's operator begins to "seed" (if he's "seeding" with a sodium glass rod, he gently intrudes its end into the base of the flame). As the flame turns brilliant orange, indicating super-ionization, he adjusts the power supply, flame controls, and the sodium rod for maximum current—which may go as high as 200 to 300 mA.

Finally, the tape recorder is turned on. And from the flame booms amplified sound.

Getting All the Frequencies Out. One critical factor is the physical height of the flame. Sound from UTC's 6-inch high torch flame, while good, obviously is missing some in the low frequencies.

"But," grins Babcock, "we *know* that the tape's every frequency is actually being reproduced in the flame. The flame's height is simply too short to make them all audible."

So saying, he turns to a 6-stage photomultiplier which, set on a tripod nearby, is focused like a telescope on the flame. With its photocell masked by a yellow Sodium-D line filter (5890 angstrom units), the multiplier "sees" only the light from the sodium ions. The multiplier is plugged into a Dynakit amplifier driving a hi-fi speaker. Now Babcock powers the hookup—and from the speaker comes a flame-rendition which contains *all* the lows missing in the flame reproduction itself!

"One way to explain our loss below about 2000 Hz," explains Babcock, "is this: physically, our 6-inch-long ionized flame-front—really, just 2 to 4 inches of modulated ions, depending on the distance between electrodes—simply isn't long enough and therefore hasn't either ions or energy enough to vibrate to audibility the far more numerous air molecules you'd need to excite in order to produce these longer wavelength, lower frequencies."

Continues Babcock, "There's just not flame length enough for a satisfactory flame-to-air molecule coupling when the wavelength you're trying to excite is

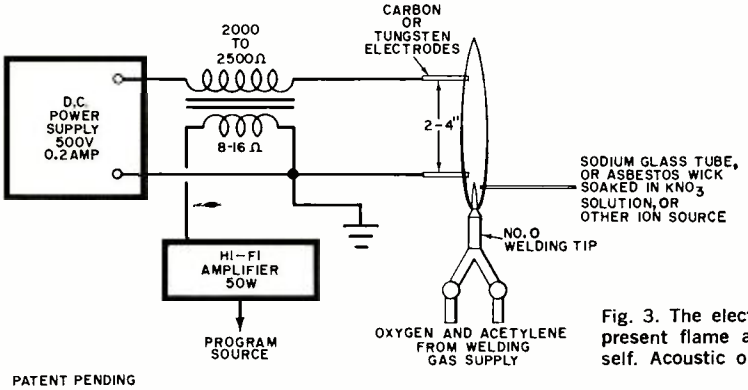
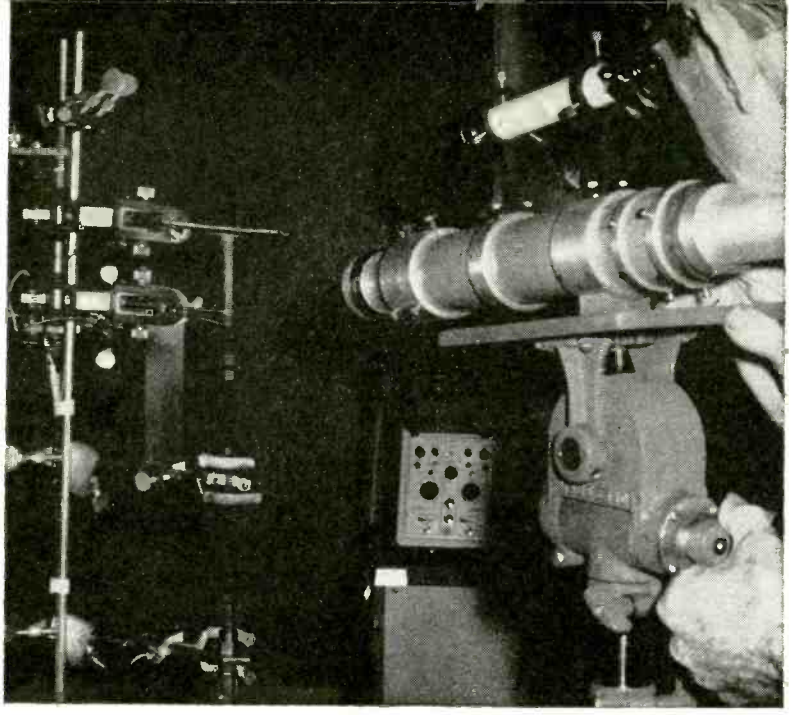
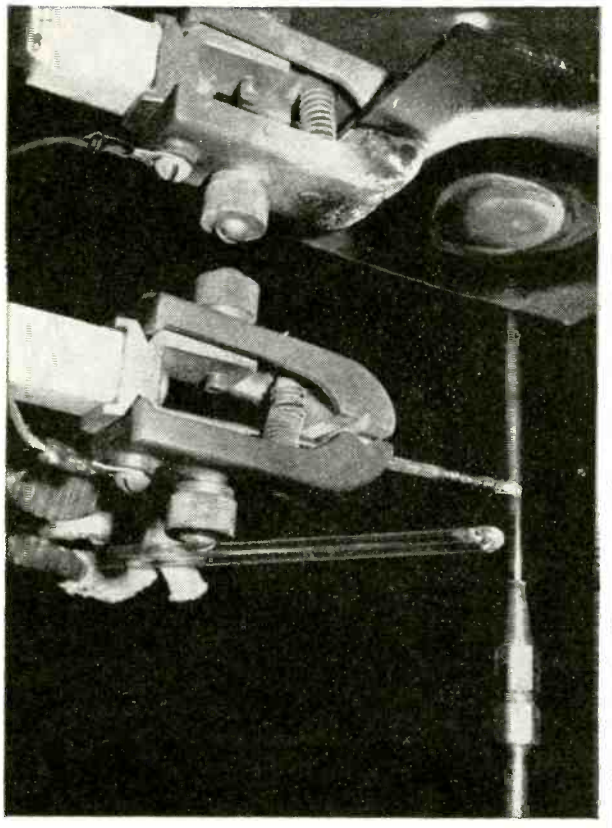


Fig. 3. The electrical arrangement of the present flame amplifier is simplicity itself. Acoustic output is omnidirectional.

PATENT PENDING



Because the welding torch flame is too small to support the low audio frequencies, a photomultiplier system "picks them out" and supplies them to a separate amplifier system. Overall frequency response is from a few cycles to well over 100 kHz at high sound level.



Electrical signals are fed in via two insulated alligator clamps while glass rod "seeds" the flame.

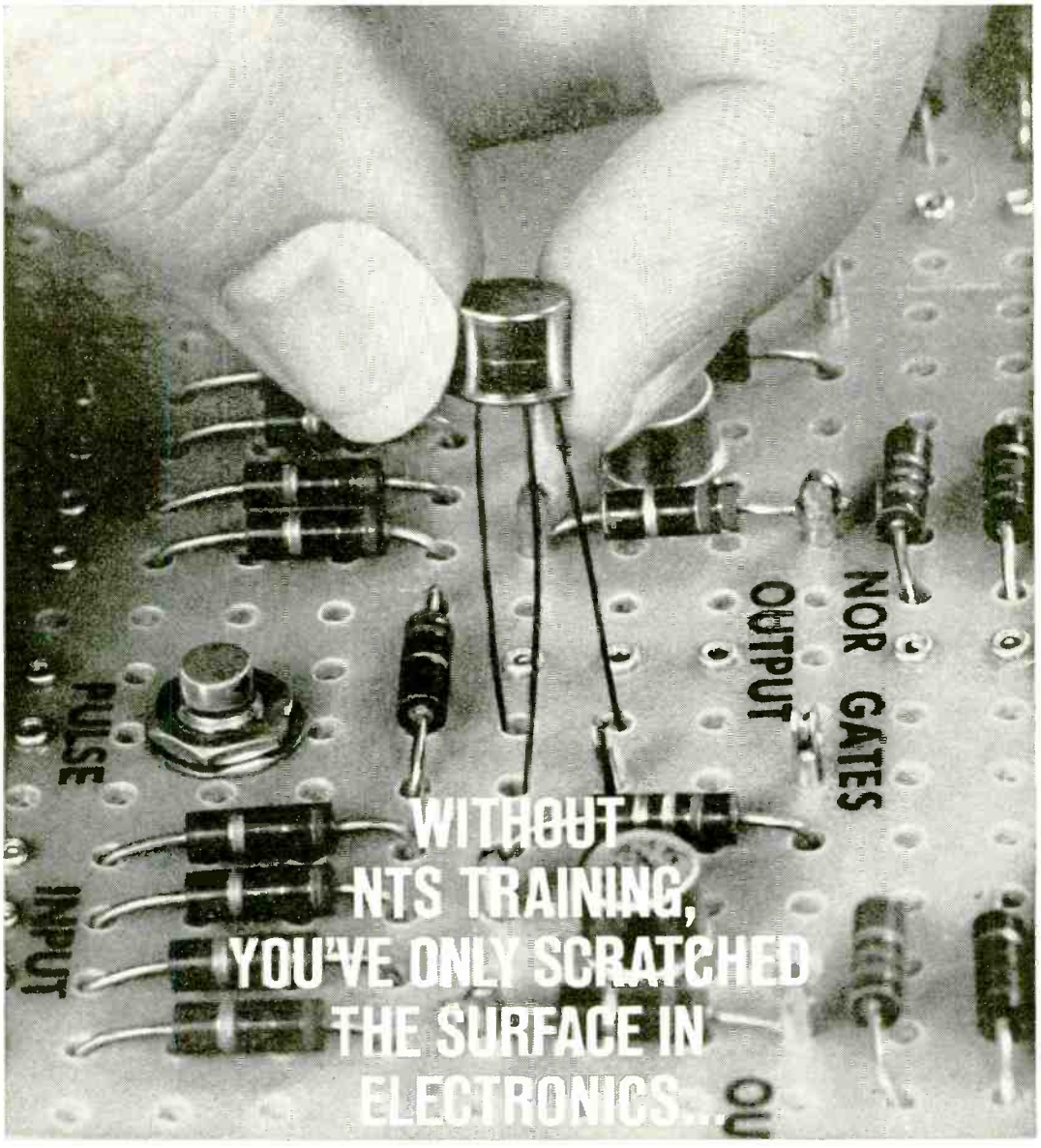
measured in inches and feet, and is far longer than the flame itself.

"We think there's an analogy here," he concludes, "between the kind of reproductive performance you get from a large-diameter diaphragm loudspeaker and from a small one. If we used a really long flame—perhaps one of those oil field gas flames which are sometimes 20 to 30 feet long, we would probably get out every frequency we put in."

Actually, of course, Babcock's team does get all the frequencies out—by using the photomultiplier to pluck unheard low frequencies from the flame itself.

Talking Flames. Flame amplification's most immediate uses are highly classified, involving missile and rocket engine research. But momentarily you can expect "talking flames" to make their appearances as crowd-pleasing oddities at fairs and trade shows.

Far deeper, however, will be the impact of flame amplification on the future of electronics. For flame has become an electronic component. —30—



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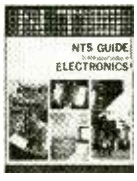

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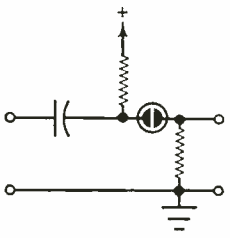
Neon Lamp Quiz

BY ROBERT P. BALIN

A neon lamp will not conduct until a specific minimum "firing" voltage is applied, after which a lower "maintaining" voltage can keep it on. A non-conducting lamp has high internal resistance but, when it is conducting, this resistance drops sharply and varies to keep the voltage across the lamp fairly constant even though the circuit current changes. The lamp goes out when the applied voltage drops below its "extinguishing" voltage level. Also, when the applied d.c. voltage contains a.c., the color of the glow depends upon the frequency. To test your knowledge of neon lamps, try to match the applications listed below (1-10) with the diagrams shown (A-J). (*Answers appear on page 88*)

1 CONDITION INDICATOR
2 COUPLING NETWORK
3 FREQUENCY DIVIDER
4 MEMORY ELEMENT
5 SAWTOOTH GENERATOR
6 STATIC DRAIN
7 SURGE PROTECTOR
8 TUNING INDICATOR
9 VOLTAGE LEVEL INDICATOR
10 VOLTAGE REGULATOR

A



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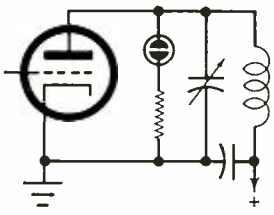

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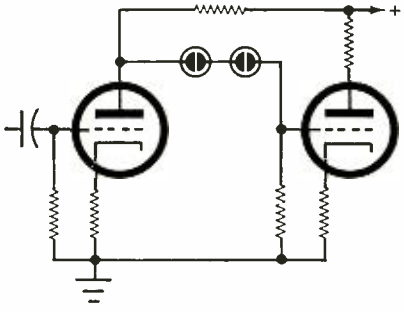

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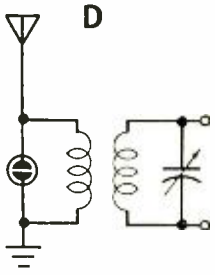

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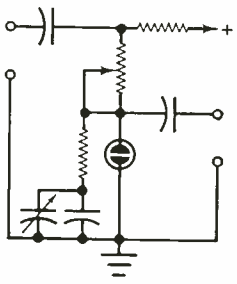

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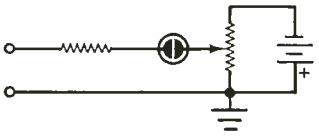

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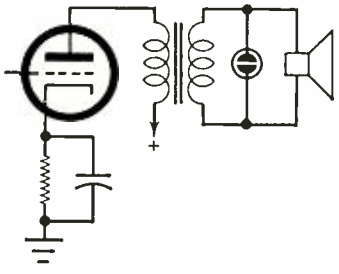

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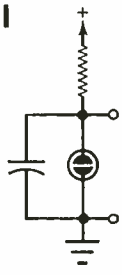

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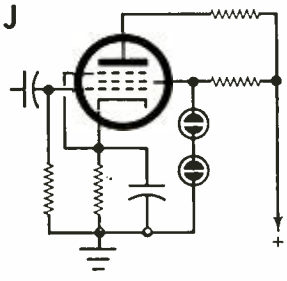
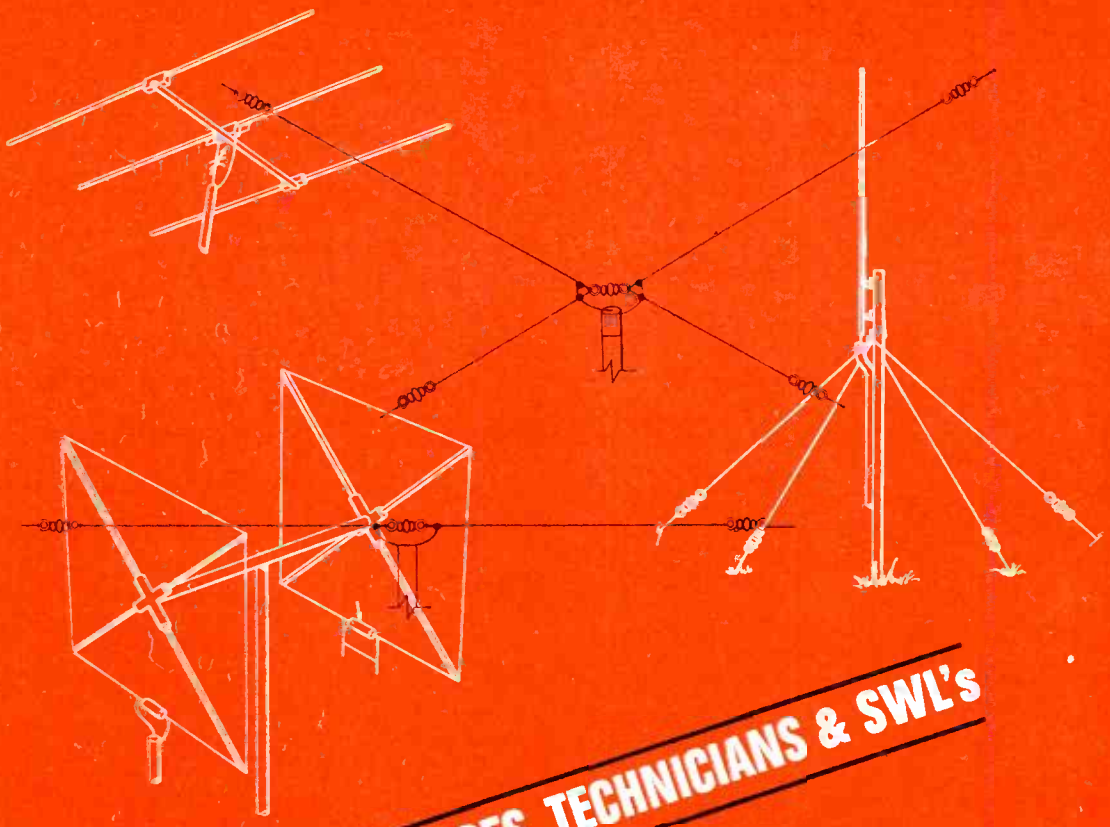




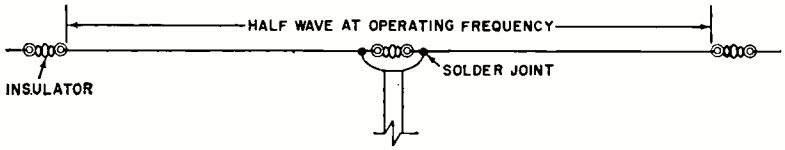
ANTENNAS FOR NOVICES, TECHNICIANS & SWL's

UP, UP, AND AWAY WITH YOUR SIGNAL

BY GEORGE COUSINS, VE1TG

ALTHOUGH a properly designed transmitting antenna is important to any amateur station, it is *vital* to the Novice who wants the most he can get out of his transmitter. The newcomer to amateur radio, limited to low-power operation, wants an antenna system capable of maximum radiation efficiency. He must, therefore, give prime consideration to the location of his station, the space available for his antenna, and the mode of operation he wants to use.

While there are literally dozens of different antenna designs from which to choose, almost all are derived from the horizontal half-wave, vertical quarter-wave, or a combination of these two elements. For the Novice just getting started, it is generally best to concentrate on one of the time-proved designs presented on the following pages.



BASIC HALF-WAVE DIPOLE ANTENNA

THE half-wave wire dipole shown above is usually hung in a straight line and center-fed with a coaxial or twin-lead transmission line. The collective length in feet of the two elements is calculated by dividing your operating frequency in megahertz into 468. A dipole for the Novice segment of 80 meters (3.7 to 3.75 MHz), for example, will be about 125′-long.

After computing the antenna length, measure off the proper amount of #12 or #14 solid or stranded wire for spans exceeding 100′; for shorter spans, a lighter wire will suffice. The wire for the antenna elements can be soft- or hard-drawn copper, or copper-clad steel. Soft-drawn copper is best since it has the lowest r.f. resistance and can be pre-stretched before being cut to final length. The only advantage to using hard-drawn copper or copper-clad steel is that smaller wire gauges can be used for a given span.

The center impedance of the half-wave dipole antenna varies with the antenna's height above the ground, proximity to other objects, wire size, etc. However, it is safe to assume a 73-ohm impedance and use a 75-ohm coaxial or twin-lead transmission line between the antenna and transmitter.

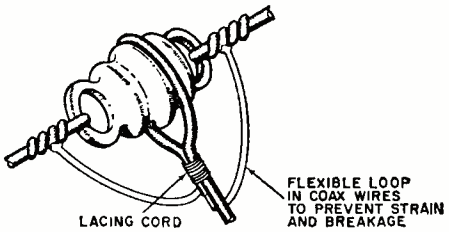
When hanging the dipole, set it as high as possible above the ground and away from other objects, and orient it to favor the direction you are interested in. It will radiate a certain amount in all directions, but maximum radiation is in a doughnut pattern at right angles to the plane of the wire.

Support both ends of the antenna with weather-resistant rope, and if you use pulleys, make sure they are brass or bronze. Avoid pulling the elements too tight; leave just enough sag to be noticed.

For improved low-angle radiation, use the inverted V configuration of the dipole (center insulator supported in the air and the element ends brought down close to the ground). In limited spaces, the center of the antenna can be hung horizontally between two closely spaced poles and the ends hung vertically.

All modern transmitters employ pi-networks that load into 50- to 75-ohm transmission lines. So you will not have any tuning or matching problems if you use 72- to 75-ohm coax or twin lead.

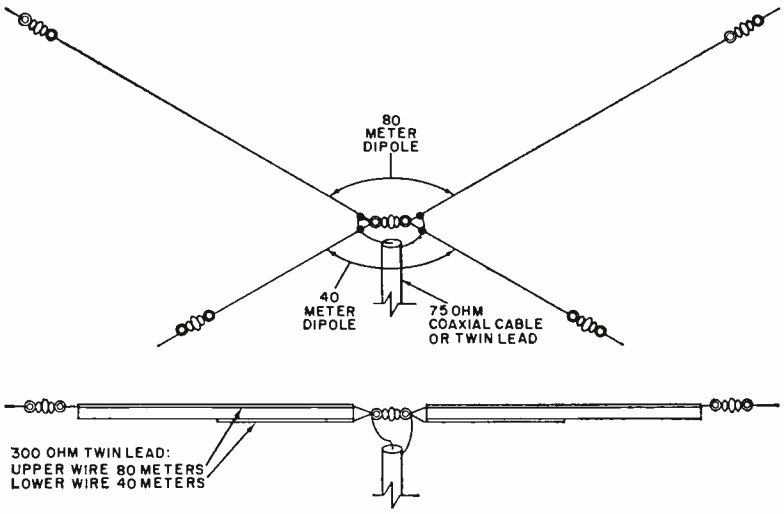
MECHANICAL SUPPORT AND ELECTRICAL CONNECTIONS



TO prevent the transmission line from breaking away from the antenna elements, it should be secured to the center insulator as shown here. Place the transmission line into one of the insulator's depressions, bend the line over double, and tie it securely in place with lacing cord.

Almost any glass or porcelain axial ribbed insulators will serve for low-power Novice transmitting antennas, but the insulators must be able to bear the antenna load under any wind and icing conditions. When securing the antenna elements to the insulators, twist and solder the element ends together to prevent them from separating under mechanical stress.

Finally, wrap about 2″ of bare wire from each of the conductors in the transmission line to the elements as close as possible to the center insulator. Solder them in place.



MULTIBAND DIPOLE ARRAYS

A separate antenna can be made for each band you want to work, although a 40-meter dipole will work on 15 meters as well (but not the other way around). This is the only case of a dipole cut for one frequency working properly on another. Any other combination will result in poor efficiency, large mismatches, and increased risk of TVI.

The elements of the multiband dipole array are hung one above the other and center-fed as shown in the drawing at the top of the page. An economy low-power array made from 300-ohm TV lead-in is shown in the drawing beneath it. If the longer dipole is cut for 80 meters and the shorter for 40 meters, operating capability for 80, 40, and 15 meters is provided for. This, however, introduces a problem of harmonic radiation.

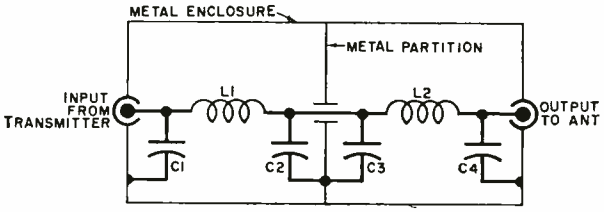
If, for example, a transmitter is operating in the Novice segment of 80 meters into a parallel-fed array, the second harmonic of 80 meters will radiate from the 40-meter elements—but completely outside the 40-meter band. Such operation is illegal and must be corrected immediately. By inserting properly designed filters between the transmitter's output connector and the transmission line feeding the antenna, the problem of harmonic radiation can be greatly reduced. The schematic diagram of a harmonic filter and a list of components that should be used for the 80-, 40-, and 15-meter bands are shown below. Construction is fairly critical, and a metal box and metal partition are needed for complete r.f. shielding of the circuit. The box must also be thoroughly grounded to provide high attenuation of all frequencies above the band being worked.

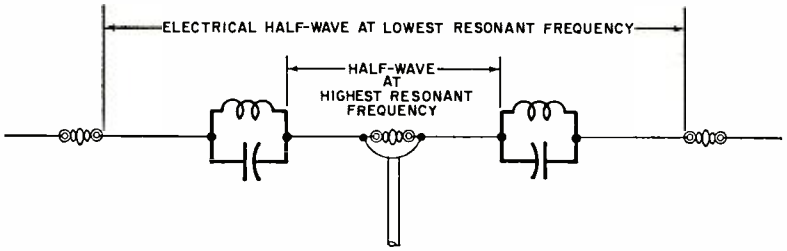
A separate filter is needed for each band you are interested in, but they can all be housed in a common box and switched into the line as needed. For proper shielding, it is necessary to use coaxial cable between filter and antenna.

80 METERS
L1, L2—13 turns of Miniductor #3014
C1, C2, C3, C4—850-pF silver mica or ceramic capacitor

40 METERS
L1, L2—8 turns of Miniductor #3014
C1, C2, C3, C4—440-pF silver mica or ceramic capacitor

15 METERS
L1, L2—8 turns of Miniductor #3002
C1, C2, C3, C4—150-pF silver mica or ceramic capacitor





TRAP ANTENNA

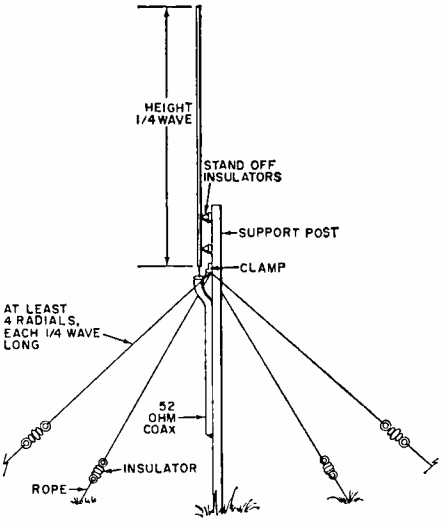
THE "trap" antenna is an excellent choice for the Novice who has plenty of space and wants multiband operating capability. It resembles a wire dipole with traps (tuned circuits) that isolate part of the antenna to the lowest band being worked. If the antenna length from trap to trap in the above drawing is cut for 15 meters, then from end insulator to end insulator the same antenna can also cover the 80-meter band.

Two traps are required for each band you want to operate on. Component selection should be made with care, and fine tuning will be required.

The traps are parallel-tuned circuits made to resonate at the frequency of the band for which they are designed. At resonance, they present a very high impedance (effectively act as insulators) to the signal so that any portion of the antenna beyond the traps will be out of the circuit. (For a more detailed explanation of the theory of operation and use of trap antennas, see *The Radio Amateur's Handbook* published by the American Radio Relay League, Inc.)

The advantage of the "trap" antenna over other multiband arrays are: a single antenna length will suffice for any number of bands; and there is no need for harmonic filters.

GROUND-PLANE ANTENNA

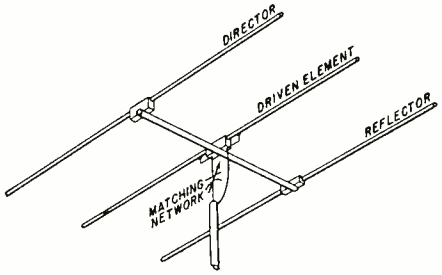


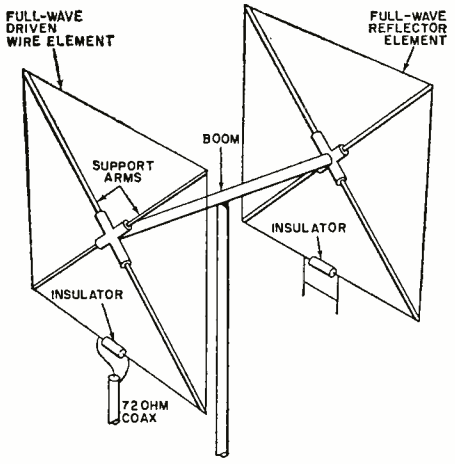
THE ground-plane antenna at left is a logical choice where space is at a premium and if you want to work DX. It has a low radiation angle, can be mounted in the air or on the ground, and can be fed with coax. Its disadvantages are the need for a good radial system and the fact that it is generally a single-band affair with a tendency to cause TVI and broadcast interference.

The quarter-wave vertical element must be insulated from ground to allow coaxial cable feeding. The feed impedance is between 35 and 50 ohms, so a 52-ohm coax will make a relatively good impedance match.

Since the height of the 80-meter vertical element will be about 66', ground mounting (via insulated standoffs between vertical element and mast) is the only practical method of erecting the antenna. The radials will, therefore, serve as guy wires for the antenna.

The radials must not touch any other metal objects—including the mast—or a r.f. arc will be generated when the antenna is powered. In connecting the transmission line, the center conductor goes to the vertical element and the shield goes to the common tie point of the radials. Tie coax to mast to serve as strain relief.





SINGLE-BAND MULTI-ELEMENT ARRAYS

THE yagi and cubical quad antenna arrays (left and right, respectively) are highly efficient units, providing considerable power gain not available from the simple dipole and vertical antenna. Both arrays are commercially available, but they can be fabricated by the individual with the help of *The A.R.R.L. Antenna Book*.

Of the two, the yagi provides the greater gain and front-to-back ratio. However, it is difficult to make into a multiband array without the use of traps that are too difficult to home-brew. On the other hand, the yagi is mechanically strong and features a very tight unidirectional radiation lobe for DX work.

The cubical quad is slightly better than the yagi for DX work. It can be easily built for single and multiband operation, but it is tricky to handle and mount in the air.

Both arrays are efficient, offering considerable power gain over the other antenna designs discussed in the previous pages. Since a power gain of only 3 dB is equivalent to doubling the radiated power from the antenna, an antenna capable of from 5- to 8-dB gain is highly desirable.

The front-to-back and front-to-side ratios of the yagi and quad considerably reduce the QRM from these directions while concentrating the transmitted signal into a unidirectional beam. As a rule, a three-element yagi will have about 8 dB gain and 20 to 28 dB front-to-back ratio. These figures are rather arbitrary since they can vary with tuning, height of the antenna above ground, proximity of the antenna to other objects, etc. However, they are representative of the desirable characteristics of the yagi.

In practice, there is virtually no difference between the three-element yagi and a two-element cubical quad array. But the Novice who wants to build or buy either type of array is advised to familiarize himself with antenna theory to determine which he needs or if he really needs either of these more sophisticated arrays.

For DX work, a properly designed and carefully built transmitting antenna is almost as important as the transmitter. It is impossible to obtain maximum transmitter efficiency and power output using a poorly designed antenna system. With the low power limitation imposed on Novices, a well-designed antenna is the only means by which the beginner can obtain maximum DX.

When fabricating the antenna, make all measurements carefully, and use the best quality materials available. Tune the antenna properly before going on the air. Hang or erect the antenna as high as possible above the ground and away from large objects that can affect its operation. However, don't be afraid to set up your antenna in a poor location if necessary. The simpler the antenna, the better the results and the fewer the problems you'll encounter. -30-

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

CB BASE STATION TRANSCEIVER (Tram "Titan II")

In the comparatively short life of the 11-meter Citizens Radio Service, a remarkable transformation has taken place with regard to optimizing transmitting and receiving equipment. It is unlikely that the end is in sight, but after using the Tram Corp. (Lower Bay Road, Box 187, Winnisquam, N.H. 03289) "Titan II," we can tell some of the other CB equipment manufacturers what roads they should be investigating. Here is a base station transceiver that meets its specs and fills every need in the book.

Unlike most of the other radio communications services, CB suffers from two major problems—popularity plus stringent frequency and power requirements. All CB transceivers must literally start at the same jumping off point—it's the transceiver that does something the others can't do, or just does it better, that separates the breed. Even in the face of "Type Acceptance," there are differing ways of accomplishing the same objectives. The "Titan II" just does 99% of them better.

From a circuit viewpoint, the "Titan II" consists of a 23-channel (individually crystal controlled) transmitter with a pair of 6GK6 output tubes producing either a double-sideband suppressed-carrier signal or a conventional 5-watt input carrier with straight amplitude modulation (AM). The choice of operating mode (DSB or AM) is switchable from the front panel. Before feeding the antenna, the output of the 6GK6's is sampled by a built-in factory-calibrated SWR bridge, affording a continuous check on the output power and the VSWR to the antenna.

The transmitter has plate and screen modulation, with attention given to shaping the voice frequency, passband, and simultaneously providing adequate speech compression to maintain the fullest possible modulation percentage. The microphone supplied with the "Titan II" is a desk-type Turner 254X high-output unit with a crystal element.

In the receiver section, the "Titan II" starts out with a low-noise cascade r.f. stage into a double-conversion superhet with i.f.'s at 4.4 MHz (tunable) and 455 kHz. Selectivity is optimized by a mechanical filter in the 455-kHz strip. Two different detectors follow the i.f.—a diode for AM and a product detector/BFO for selectable upper or lower SSB tuning. Separate a.g.c. time constants are used on AM and SSB receiving modes.

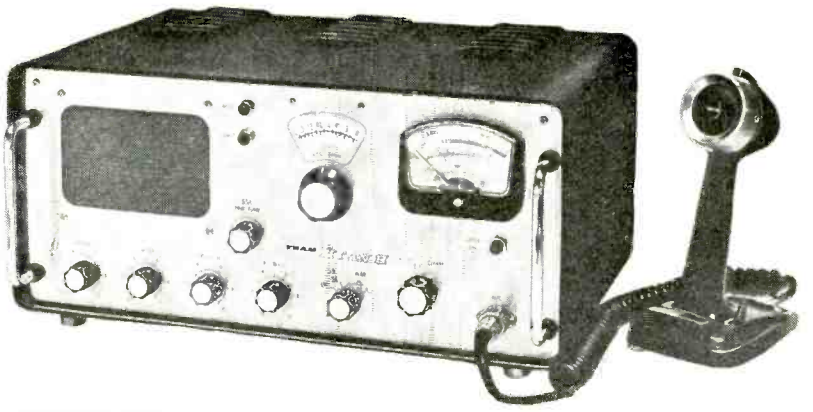
Squelch is controlled through a special dual triode tube circuit. A panel control for reducing the gain of the r.f. and i.f. stages is a handy item in areas where strong signals predominate. The S-meter is "notorious"—it's just plain honest and accurately set to read 6 dB per S unit. Don't expect every signal to be 20 dB over S9—in reality few are.

Receiver tuning is manual and the dial calibration accurate. A "spot" switch turning on the oscillator permits setting the receiver right "on the nose." Provision is also made for a single fixed frequency-receive crystal—switchable in and out of the circuit from the front panel.

In developing the "Titan II," the manufacturer has taken out all stops so far as quality control is concerned, and the transceiver practically shrieks ruggedness and stability. No matter how you look at it, the "Titan II" is big and apparently little effort was expended to reduce the physical size (it measures 16¾" W × 7¾" H × 12" D). As a result, the transceiver may occupy a little more desk space than solid-state transceivers with only half the features. Our only negative feeling about the "Titan II" has to do with the position of the S-meter/power output/SWR switch on the rear skirt—it's just a little inconvenient to get at.

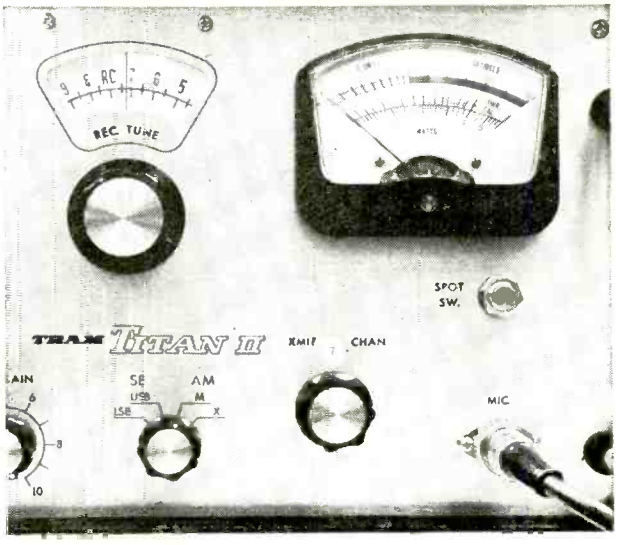
We maintain that the test of any CB unit is whether or not it will transmit an understandable female voice. Many transceivers will not respond properly to a woman's voice frequency pattern—it contains more highs and in compression and modulation circuits may only be able to push 30-40% modulation. The "Titan II"—possibly because it is a base station design—doesn't suffer from this common defect. In fact, on DSB women sometimes sound more intelligible than men!

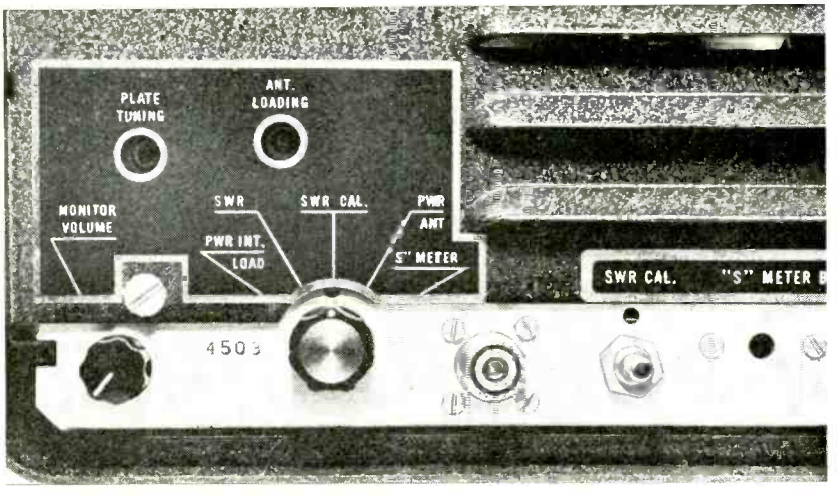
Your reviewer found it particularly difficult to adequately test the DSB transmitting and selectable sideband receiving characteristics of the "Titan II." POPULAR



TRAM "TITAN II" CB UNIT

If you judge by the physical size of the microphone, it becomes obvious that the Tram "Titan II" is a husky piece of CB equipment designed for base station use. The manufacturer has successfully combined quality and versatility in the "Titan II." Each transmit channel is individually crystal-controlled. The receiver is tunable and can be checked by the "SPOT SW" on the front panel. On receive, the "Titan II" tunes straight AM or either the upper or lower sideband. On transmit, the unit emits either a fully modulated AM signal, or a double-sideband signal with suppressed carrier. Some of the controls are on the rear skirt of the transceiver (see photo below), a fact that did not please your reviewer. Nevertheless, the "Titan II" is a great Citizens Band transceiver—and the only one of its kind on the market.





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CONTINUED

ELECTRONICS must assume that Tram intends to augment its CB line-up with an appropriate SSB or DSB mobile unit. However, in working base station to base station, it was possible to add 5 miles of range in an area where interference was bad.

Circle No. 86 on Reader Service Page 15 or 95

UPDATED SHORT-WAVE ANTENNA (Mosley Model SWL-7)

On occasion this department will review products that have been on the market for some years, particularly if a product has been noticeably improved or upgraded. A good instance is the Mosley Electronics (4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042) Model SWL-7 receiving antenna ($18.95).

This antenna has been a favorite of short-wave listeners for several years. A few months ago your reviewer had the opportunity to erect a "new" SWL-7 to replace one that had collapsed last fall during a severe windstorm. We were surprised to find several important improvements.

Basically, the SWL-7 is a trapped dipole with a flat-top length of just under 40 feet. It is fed by 75-ohm twin lead. Each half of the dipole is divided into five sections by four preassembled and pretuned traps. The traps are parallel resonant circuits and are either isolators (electrical) or help resonate the sections to one of seven bands (roughly the 11-, 13-, 16-, 19-, 25-, 31-, and 49-meter international broadcast bands).*

In the years between erecting the original SWL-7 and the present-day version, we note that Mosley has switched from hand-drawn stranded copper wire to solid aluminum. Although this change may have been necessary for economic reasons, the aluminum wire is easier to handle and just as sturdy.

Of far greater importance, Mosley has vastly improved the construction of the traps. Gone are the dipped traps with 6-32 bolts, and in their place are encapsulated traps designed to absorb the strain of being up in the outdoor weather year after year. A fine design change.

Does the SWL-7 work well? Definitely, yes; compared with a 125-foot flat-top, the SWL-7 raised the average signal 2 to 3 S-units on a Drake SW-4A receiver.

Circle No. 87 on Reader Service Page 15 or 95

Two bands are resonant because of the harmonic relationship of some of the broadcast bands, e.g., 49 and 25 meters.

BATTERY INVERTER/CHARGER (Knight-Kit Model KG-666)

If your family is one of the hundreds of thousands of families that spend some part of their summer vacation in the great outdoors, get busy—you'll want to take this inverter/charger along. The KG-666 (sold by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680) costs only $44.95 and will "up" 12 volts d.c. to 120 volts a.c. or d.c. with a continuous power rating of 200 watts. Obviously, this is more than enough "household-type" electricity to operate a variety of items—TV sets, CB rigs, tools, etc. If you're camping in a spot where there is partial electric service, the KG-666 will recharge its own wet cell battery at a top rating of about 6 amperes per hour.

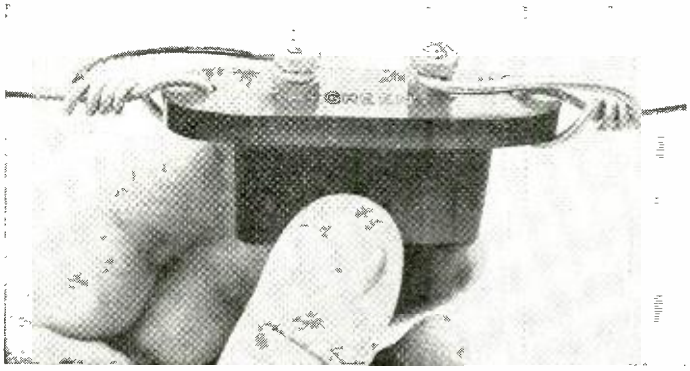
Assembly of the KG-666 kit is relatively trouble-free and consumes between four and five hours. Be careful when mounting the power transformer (T1); the varnish on the mounting bolts must be thoroughly removed before mounting or the nuts will force the bolts to rotate in the transformer frame. Also, if you have some difficulty with the plastic protectors that supposedly slip over the 12-volt wing-nut connections, soften the protectors in boiling water beforehand.

The usefulness of the KG-666 is dependent on the ampere-hour rating of the 12-volt wet battery. On the average, consider that for each 10 watts of drain at 120 volts you will be demanding 1 ampere/hour from the battery. In other words, don't attempt to run a 120-watt TV set for seven or eight hours on a single 60-ampere-hour battery—it can't be done. And the KG-666 must always be turned off when not in use—it has a static drain of about 3 amps when not supplying a.c. to a 117-volt device.

Although the a.c. waveform output of the KG-666 is a square wave, this seems to have little effect on most TV receivers and portable record players. The frequency of the square wave is normally 60 hertz at 12.6-volt input, and a voltage change will drive this frequency up or down by about 2 to 5 hertz.

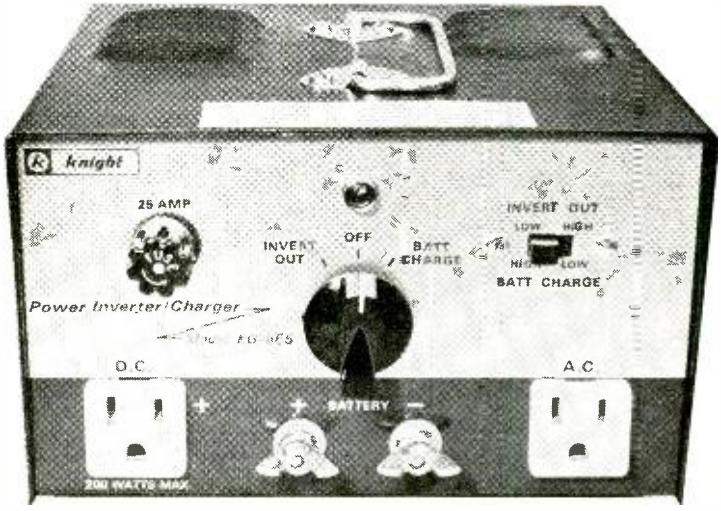
A 120-watt output version of the inverter/charger is sold by Allied Radio Corp. as the KG-662 ($34.95).

Circle No. 88 on Reader Service Page 15 or 95



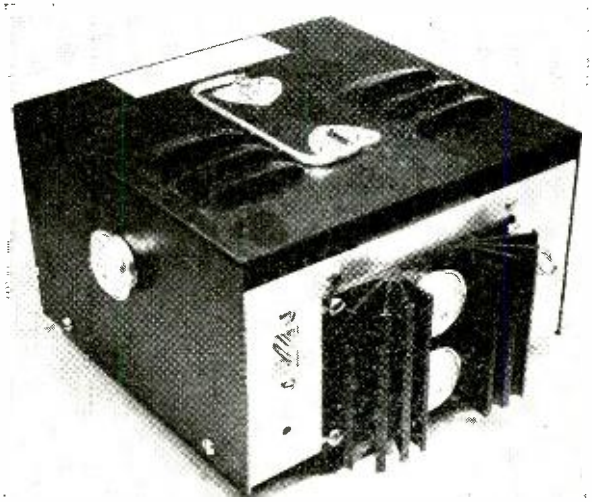
MOSLEY
SWL ANTENNA

On the market for several years, the Mosley SWL-7 receiving antenna is a trap dipole resonant to seven different international broadcasting bands. Mosley now uses heavy-gauge aluminum wire and plastic-encapsulated traps —a significant improvement. Each trap in the antenna is identified by a particular color.



KNIGHT-KIT
INVERTER/CHARGER

You can assemble this kit in under five hours, and you may find it one of your more worthwhile investments. The KG-666 is operated from, or will charge, a 12-volt wet cell battery. The inverter output is about 120 volts, a.c. or d.c., at 200 watts, maximum. The charging rate is around 6 amperes. Pictured here is the high-power model with four transistors. A low-power version (125 watts), with only two transistors, is sold as the KG-662. The flat-laying handle on top of the sheet metal case is just above the center of gravity, making the inverter/charger very easy to carry.



INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

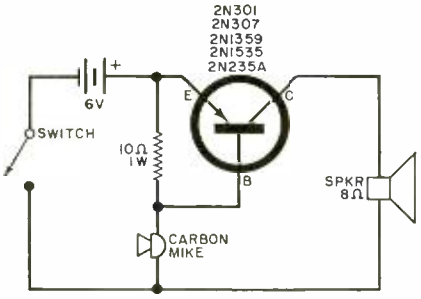
EACH MONTH *Information Central* receives many troubleshooting questions, and although we cannot answer them all, we do our best to come up with correct advice. Not all problems encountered in electronic equipment can be solved merely by reference to an instruction manual. However, if you will describe the malfunctions and the steps you have taken to find the trouble, there is a good chance that we may be able to help.

Please do *not* send original manuals or schematics to *Information Central*, since they cannot be returned. Send *copies* of schematics or other information.

We continue to receive requests for specific design assistance, but time does not permit this kind of work. We do, however, attempt to publish design information when we believe that it will interest the majority of our readers.

Simple P.A. System. *I would like to build a bull-mike public address system but, being a student, do not have much money. The sound output need not be great, for I plan to use it during a church bazaar in a booth to attract customers. Any suggestions?*

You can build the bull mike shown below for less than $8. If you wish, you can mount



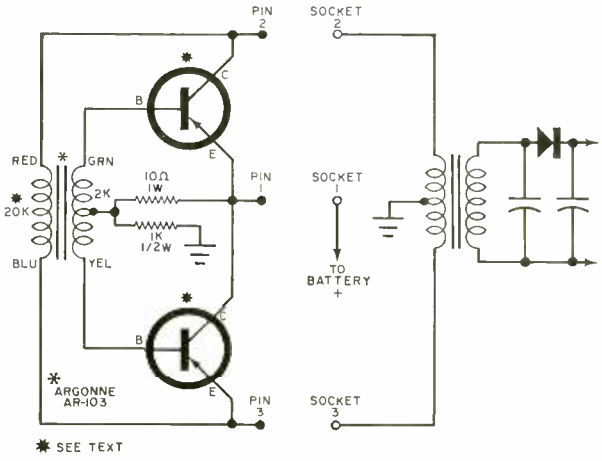
the speaker on the booth front and run a long mike line. The mike is a carbon unit and can be found in surplus stores or in inexpensive telephones. The old military T-17 mike will work fine. (Any one of the transistors listed above is suitable.)

Light Dimmer. *I need a light dimmer for two lights totaling 150 watts, and I would like to have an electronic dimmer. Can you help?*

See the "Sonolite" article starting on page 27 of this issue.

Vibrator Replacement. *Is there a solid-state unit which can replace an old electromechanical vibrator in a mobile radio set? If there is, can you provide a diagram of such a unit?*

A typical circuit is shown below. The transistors can be 2N277's, 2N278's, GE-4's, SK-3012's, DS-501's, or any other good power transistor having similar gain and current handling ability mounted on a heat



sink. The transformer can be any unit having a 20,000-ohm primary and a 2000-ohm center-tapped secondary—an Argonne AR-103 is recommended. This device will operate on 6-, 12-, or 24-volt d.c. systems. Note that the ground is *negative*.

TV-AM Interference. *Our black-and-white TV set operates perfectly but raises havoc with all the AM radio sets in the house. The noise seems to be strongest when the AM set is tuned to a station. What could be causing it?*

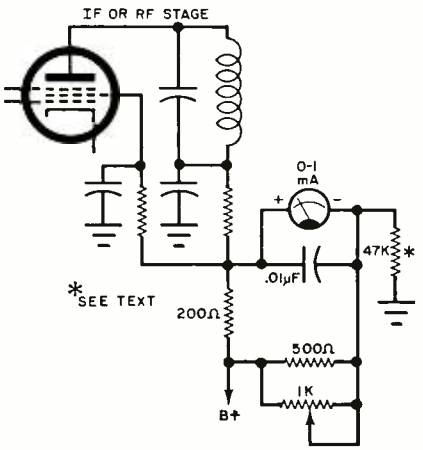
Usually the horizontal oscillator of the TV set can be blamed for radiated interference. First, install a coaxial capacitor (0.1-μF) in series with each side of the a.c. line to the TV set. The outer shell of each capacitor is connected to the chassis, and the chassis is grounded. If the noise persists, shield the inside top, bottom, rear, and sides of the TV set with copper screening. Make sure that *all* sections of the screens are con-

nected together and grounded to the TV chassis. If this does not solve the problem, extra shielding may be required on the back of the set: the screen for this purpose must also be connected to all of the other screens.

S-Meter Circuit. *I am sure that you receive many requests for information as to how to add the easily obtainable 0-1 milliampere S-meter to popular radio receivers. Can you suggest a circuit that will work and yet not require a lot of skill for its installation?*

See the circuit below. It is a forward-reading circuit and can be installed in either an r.f. or i.f. stage. This unbalanced S-meter scheme works very well and will accommodate any of the small 0-1 mA S-meters obtainable from Allied Radio, Lafayette, Radio Shack, Olson Electronics, etc.

To install the circuit, disconnect the B+ line going to the r.f. or i.f. stage (plate and screen), and insert the S-meter circuit between the B+ line and the stage. Use the second r.f. stage if your set contains two r.f.



stages, or use a second or third i.f. stage. The pot zeros the meter with *no* signal.

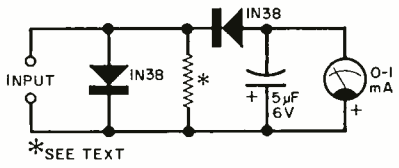
Some adjustment in value of the resistor between the meter minus side and ground may be required. Also, it may be necessary to adjust the values of screen and plate feed resistors (up or down) by a *few* thousand ohms for proper S-meter action.

Low or High Impedance Mike? *I acquired a used tube-type audio amplifier from a friend. How can I find out what kind of a mike (high or low impedance) to use with it?*

Trace the wires from the mike jack to the first amplifier stage. Usually, if a high-impedance mike is required, you will find that the shielded wire from the mike jack goes to the grid of the first amplifier, either through a small coupling capacitor or directly, the grid being connected to ground through a high value resistor. If the input impedance is *low*, you will probably find a transformer connection to the grid of the first stage. However, many low-impedance microphones (dynamic type) contain a matching transformer within the case.

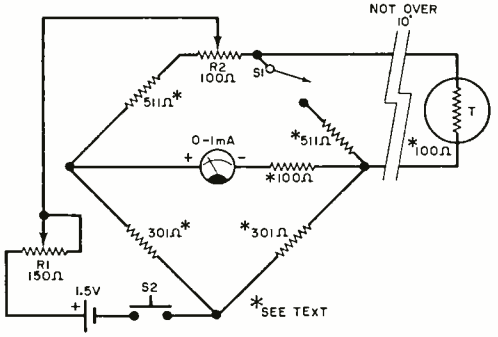
Zero Beat Indicator. *I have a frequency meter that uses headphones for zero beat indication. Can you come up with a visual null (zero beat) indicator that will work with it?*

The circuit below is self-explanatory. It will work with most frequency meters that have a headphone jack. You plug in the unit and adjust your frequency meter. As you approach zero beat, the needle will begin to move and vibrate at the null. With a constant signal (not null), the meter needle will remain steady, its deflection being proportional to the amount of signal available. The resistor across the plug should match the output impedance of the headphone jack, which can be 2000, 4000, or 8000 ohms.



Remote Thermometer. *I know that electronic thermometers are available on the market, but I would like to build my own. What I want is one that will read the outside temperature at the push of a switch. Is there a simple circuit for this purpose?*

The diagram below shows a circuit that will do the job. For the thermistor, a GE 3D054 or similar unit valued at 100 ohms ± 1% at 25° C can be used. All resistors are precision units (IRC 1% metal film) which can be obtained from most supply houses; they cost less than a dollar each.



(*Continued on page* 89)

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA FOR THE MONTH OF MAY

Prepared by ROGER LEGGE

TIME EST	TIME EDT	TO EASTERN AND CENTRAL NORTH AMERICA STATION AND LOCATION	FREQUENCIES (MHz)
6 a.m.	7 a.m.	Stockholm, Sweden	15.24
6:15 a.m.	7:15 a.m.	Melbourne, Australia	9.58, 11.71
7:15 a.m.	8:15 a.m.	Montreal, Canada	9.625, 11.72
6 p.m.	7 p.m.	Helsinki, Finland	15.155
		London, England	11.78, 15.26, 17.79
		Montreal, Canada	9.625, 11.945, 15.19
6:45 p.m.	7:45 p.m.	Tokyo, Japan	15.135, 17.825
7 p.m.	8 p.m.	Moscow, U.S.S.R.	9.685, 11.735, 11.90
		Sofia, Bulgaria	9.70
7:30 p.m.	8:30 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
		Johannesburg, South Africa	9.705, 11.875
		Kiev, U.S.S.R.	
		(Mon., Thurs., Fri.)	9.685, 11.735
		Stockholm, Sweden	11.805
7:50 p.m.	8:50 p.m.	Vatican City	9.69, 11.76, 15.285
8 p.m.	9 p.m.	Berlin, Germany	9.73, 11.89
		Havana, Cuba	9.525
		Madrid, Spain	6.13, 9.76
		Peking, China	15.06, 17.68, 17.90
		Prague, Czechoslovakia	7.345, 11.99, 15.365, 17.84
		Rome, Italy	11.81, 15.41
8:30 p.m.	9:30 p.m.	Berne, Switzerland	9.535, 11.715, 15.305
		Bucharest, Rumania	11.94, 15.25
		Cologne, Germany	9.64, 11.945
		Tirana, Albania	7.30, 11.92
8:45 p.m.	9:45 p.m.	Copenhagen, Denmark	9.52
9 p.m.	10 p.m.	Cairo, Egypt	9.475
		Lisbon, Portugal	6.025, 9.68, 11.935
		London, England	6.11, 9.58, 11.78
		Melbourne, Australia	15.32, 17.84
		Moscow, U.S.S.R.	9.685, 11.735, 11.90
		Stockholm, Sweden	11.805

TIME PST	TIME PDT	TO WESTERN NORTH AMERICA STATION AND LOCATION	FREQUENCIES (MHz)
7 a.m.	8 a.m.	Tokyo, Japan	9.505
6 p.m.	7 p.m.	Melbourne, Australia	15.32, 17.84
		Taipei, China	15.125, 15.345, 17.89
		Tokyo, Japan	15.135, 15.235, 17.825
6:30 p.m.	7:30 p.m.	Johannesburg, South Africa	9.705, 11.875
7 p.m.	8 p.m.	London, England	6.11, 9.58, 11.78
		Madrid, Spain	6.13, 9.76
		Peking, China	11.945, 15.095, 17.68
		Seoul, Korea	15.43
7:30 p.m.	8:30 p.m.	Bonaire, N. Antilles	11.82
		Prague, Czechoslovakia	7.345, 11.99, 15.365
		Stockholm, Sweden	11.705
7:45 p.m.	8:45 p.m.	Berlin, Germany	11.84, 11.97
8 p.m.	9 p.m.	Havana, Cuba	6.135, 9.525
		Lisbon, Portugal	6.025, 9.68, 11.935
		Moscow, U.S.S.R. (via Khabarovsk)	15.18, 17.775, 17.88
		Peking, China	11.945, 15.095, 17.68
		Sofia, Bulgaria	9.70
8:15 p.m.	9:15 p.m.	Bangkok, Thailand	11.91
8:30 p.m.	9:30 p.m.	Bucharest, Rumania	11.94, 15.25
		Budapest, Hungary	9.833, 11.91, 15.16
		Kiev, U.S.S.R.	9.665, 11.735
8:45 p.m.	9:45 p.m.	Berlin, Germany	11.84, 11.97
		Cologne, Germany	9.545, 11.945
9 p.m.	10 p.m.	Havana, Cuba	6.135, 9.525
		Tokyo, Japan	15.105
9:15 p.m.	10:15 p.m.	Berne, Switzerland	9.695, 11.715
10 p.m.	11 p.m.	Moscow, U.S.S.R. (via Khabarovsk)	15.18, 17.775, 17.88

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

THE HIGHER FREQUENCIES ARE "COMING BACK"

WITH the continuing increase in the number of sunspots, DX'ers have been noticing a similar increase in the use of higher frequencies by short-wave broadcast stations. A couple of years ago, when the sunspots were at a minimum, it was a rarity to hear stations operating for any length of time in the 13-meter band. Although a scattered few did maintain schedules in that band, most transmissions were in the 11-, 15-, and 17-MHz bands during daylight hours and in the 6-, 7-, 9-, and 11-MHz bands during the dark hours.

Nowadays, with a sunspot maximum approaching, many of the stations have resumed transmissions not only in the 17-MHz band (16 meters) and the 21-MHz band (13 meters) but as far up into the spectrum as the 25- and 26-MHz band (11 meters). Your Short-Wave Editor has picked up the VOA station in Munich, Germany, on 26,150 kHz (from about 1500 to 1650) relaying dispatches for use by other VOA stations.

The band to watch now is 40 to 44 MHz. During the last sunspot maximum, the audio channels of several European TV stations were logged with regularity. Among them were Mt. Pincon (Caen), France, on 41,250 kHz and Crystal Palace, England, and Divis, Northern Ireland, both listed for 41,500 kHz but actually a few kHz apart so that both stations were clearly audible. German stations were heard on approximately 41,800 and 42,800 kHz, several British stations on 48,250 kHz, and one British station on 58,250 kHz.

Not everyone can tune in these extremely high frequencies but those of you who have equipment capable of tuning above the 10-meter amateur band might well keep an ear open for the 41-MHz stations. The best tuning time is around mid-morning to early afternoon (your local time). Few, if any, ID's will be heard, but a British accent may be a clue.

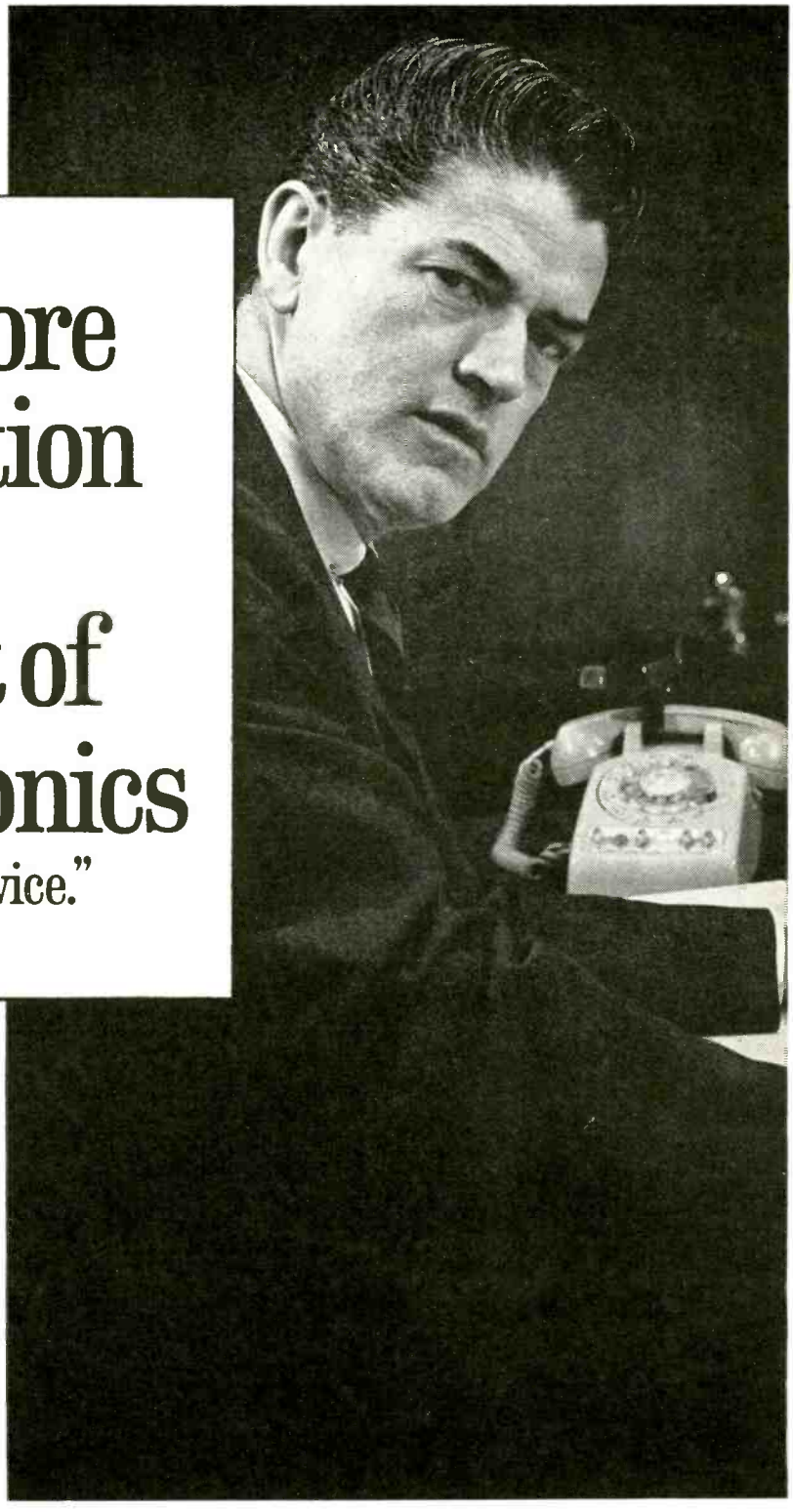
Finally, during the last sunspot maximum a number of stations were heard in the range from 28,125 to 28,480 kHz, broadcasting in Russian, Arabic, and other Eastern languages. These stations were believed by some DX'ers to be sub-harmonics of Russian TV stations. Let us know if you're able to hear any of these transmissions.

Short-Wave Re-Runs? Speaking of TV, we all know that one of the surest things on earth, besides death and taxes, is an endless number of re-runs on TV. But have you

(*Continued on page* 100)

Martha Freeman, WPE4JQH, Reidsville, N.C., has a wealth of equipment in her listening post: a National NC-240-D, a Hallicrafters S-200 "Legionnaire" and a Heathkit GR-64. Martha has logged 43 countries, but so far only 17 veries have come in. She plans to become a ham as well as an SWL.

Rick Collier, WPE3HIE, New Carrollton, Md., now has a Hallicrafters SX-122, but all of his DX-ing until just recently was done with a Hallicrafters "Sky Buddy." Rick reports considerable difficulty in getting veries from Cairo and Beirut—his current record is 43 countries heard, 39 verified.



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APPROVED FOR TRAINING UNDER NEW G.I. BILL

SOLID STATE

By LOU GARNER, Semiconductor Editor

JUST A few short years ago, it would have been difficult to find a microwave design engineer who would even consider using solid-state devices—other than diodes—in his work. Most would admit that transistors were fine for audio and low-frequency r.f. circuits, but at microwave frequencies? "Don't be ridiculous! Ask anybody—semiconductors will *never* replace vacuum tubes in UHF and SHF applications!"

Today, however, a quiet, but far-reaching revolution has taken place in microwave design, and engineers who once would have chuckled at the mere thought of using transistors are now boning up on semiconductor design techniques. Specialized transistors and related semiconductor devices are even beginning to challenge the more exotic vacuum tubes.

In a single recent issue of one microwave engineering journal, for example, there were fifteen full-page and a half dozen smaller advertisements offering solid-state microwave devices or equipment items. In the "New Products" section, the solid-state products announcements outnumbered the new tube products by almost two to one, while, more significantly, *not one* technical article in the journal discussed vacuum-tube circuitry or design methods. At a solid-state circuit conference held in Philadelphia last February, some *thirty-three* technical papers and reports were devoted to microwave applications.

The solid-state microwave products now being offered as stock or "off the shelf" items cover the full range from individual devices, such as special diodes, transistors and varactors, to sophisticated systems. One firm, for example, is offering a series of self-contained UHF oscillators, with a typical unit delivering 100 mW at 390 MHz—all in a *1-cubic-inch* package! Another manufacturer can supply transistorized amplifiers offering 16 dB gain at 1 GHz (1000 MHz), while a Florida-based company catalogs a whole series of solid-state signal sources, including a crystal-controlled unit capable of supplying 50 mW at 16.5 GHz.

If you are beginning to wonder how these advances in technology will affect you personally, don't forget that microwaves are used in small boat radars, police radar speed meters, home and commercial r.f. ovens, planned "safety radar" systems for passenger cars, new types of burglar alarms, experimental radio "eyes" for the blind, radio and TV relay networks, and in a variety of consumer-oriented products now undergoing development.

One-cubic inch package contains a solid-state 100-mW oscillator operating at 390 MHz.

Reader's Circuit. Professor Raoul J. Fajardo, of Pasadena City College's Engineering Department (1570 E. Colorado Blvd., Pasadena, Calif. 91106) is becoming one of the more prolific contributors to this column. His latest circuit (Fig. 1) is an inexpensive two-transistor audio-visual metronome. Professor Fajardo writes that he developed the circuit to satisfy a music teacher's requirements.

Transistors *Q1* and *Q2* are connected in a direct-coupled complementary relaxation oscillator configuration. The collector load for *Q2* consists of a loudspeaker voice coil and series resistor *R6* shunted by (pilot-lamp) bulb *I1*, while a bypass capacitor (*C2*) serves to shape the output signal waveform and thus to insure the "tic-like" sound characteristic of a traditional mechanical metronome. Capacitor *C1* provides the interstage feedback needed to start and maintain oscillation. Operating power is supplied by *B1*, controlled by *S1*.

In practice, the circuit's operating frequency (or rate) is determined principally by the *RC* time constant of the feedback network, hence by *C1*'s value in conjunction

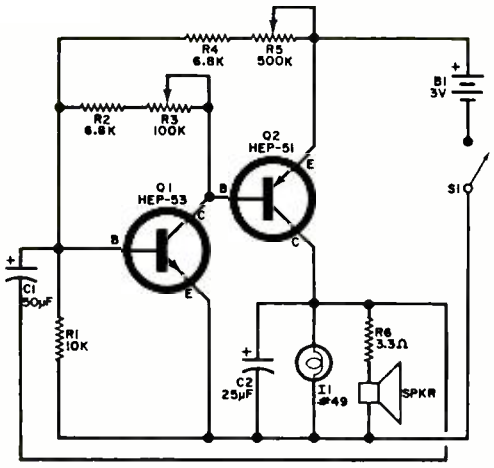


Fig. 1. Unique metronome devised by Prof. R.J. Fajardo has simultaneous visual and audible outputs.

with *Q1*'s effective input impedance. The latter value, in turn, is determined by shunt base resistor *R1* and *Q1*'s base bias. The variable resistors in *Q1*'s bias network (*R3* and *R5*) serve as the "Rate" and "Calibration" controls, respectively.

Capacitors *C1* and *C2* are 6- to 10-volt electrolytics, *R1*, *R2*, *R4* and *R6* are half-watt resistors, while *R3* and *R5* are conventional volume-control potentiometers. Professor Fajardo used a speaker with a 3.2-ohm voice coil in his model but suggests that *R6* could be eliminated if a speaker with an 8-ohm voice coil is substituted.

The audio-visual metronome can be assembled on a perforated board, etched circuit board, or small chassis, depending on individual construction tastes. It can be housed as desired with the cabinet size being determined principally by the dimensions of the speaker.

Final adjustment is simple. First check for wiring errors, making sure that all d.c. polarities have been observed. Second, set *R3* and *R5* to their maximum resistance positions. Third, with switch *S1* closed, adjust *R5* until the desired minimum beat rate is achieved (corresponding to *adagio* tempo). Both an audible "tic" and a visual light flash should be obtained.

Variable resistor *R3* will select any speed from *adagio* to *allegro*, as needed. If you wish, a pointer knob can be used on *R3*'s shaft, with a small dial added for actual beat rate calibration, which can be easily accomplished by using a stopwatch or another metronome as a reference standard.

Manufacturer's Circuit. If you've been hesitating to work with integrated circuits because of cost or lack of knowledge, a new item recently introduced by Radio Corporation of America should enable you to "take the plunge" with minimum effort and at comparatively low cost. Dubbed the RCA "Linear Integrated Circuits Sampler," Model QK2200, the new item is a "package deal" consisting of 26 IC devices representing some 11 different circuit configurations. Included in the deal is a well-written 350-page linear IC design and applications manual (which normally sells for $2 as a separate item), a complete set of specification data sheets, and a goodly assortment of detailed application notes.

The entire QK2200 package—virtually a practical lab course in linear IC applications—sells for $39.95 and can be obtained from most franchised RCA semiconductor distributors. Unless my slipstick is off, this figures out to about a buck-fifty *per IC device*, a price many of us would consider reasonable for a single good-quality transistor.

Among the devices included in the QK2200 sampler are d.c., i.f., r.f., and general-purpose audio amplifiers, transistor and diode arrays, video and operational amplifiers, and even a dual Darlington array. Dozens of practical applications are suggested or described in the application notes and manual furnished in the package.

The circuit in Fig. 2 is typical of the practical applications described in the QK-2200 IC sampler's literature. A general-purpose audio amplifier delivering better than half a watt to a PM speaker, this circuit has an input impedance of 50,000 ohms, a signal-to-noise ratio of 77 dB, and, with an idling current of only 22 mA, can deliver its full output when driven with a 45-mV signal. It can be used in portable phonographs or tape recorders, in intercoms, in receivers, in audio signal tracers, or in any similar application requiring moderate power levels.

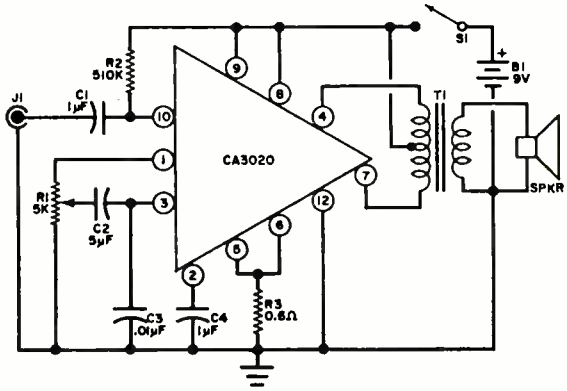


Fig. 2. This 500-mW audio amplifier is one of many circuits that can be made with RCA's QK2200 kit.

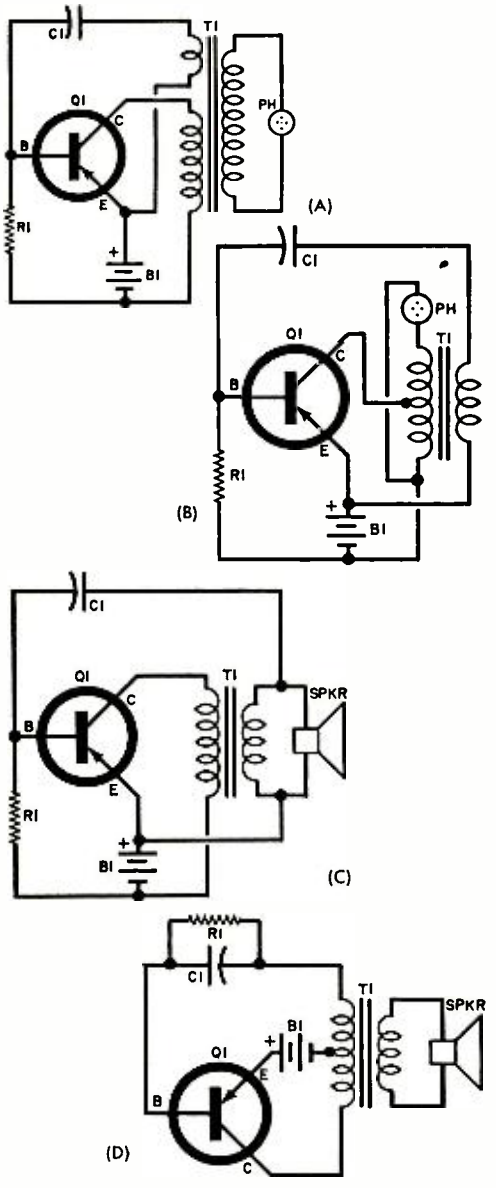


Fig. 3. Evolution of a new design: (a) basic circuit; (b) use of a different transformer; (c) modification to enable speaker operation; and (d) the same basic circuit in yet another configuration.

An RCA Type CA3020 IC multipurpose power amplifier serves as the heart of the unit. Assembled in a 12-lead TO-5-style package, the CA3020 includes 7 transistors, 3 diodes, and 11 resistors on a single monolithic silicon chip. Inherently a wideband amplifier, the CA3020 has a 3-dB response to 6 MHz, but its actual response, in practice, will vary with the characteristics of the external components.

Potentiometer *R1* is an audio taper unit; *R2* and *R3* are half-watt resistors; *J1* is a phono, coaxial microphone, or similar jack; and *C1, C3,* and *C4* are low voltage paper, plastic film, or ceramic capacitors. Capacitor *C2* should (preferably) be a low-voltage metallized paper or plastic film unit, but could be a low-leakage 10- to 15-volt electrolytic. Power switch *S1* can be a rotary type mounted on *R1* or a separate toggle or slide type, as preferred. The 9-volt d.c. power source, *B1,* can be a line-operated power supply, a moderate-size 9-volt battery, or six flashlight cells connected in series. Any of several output transformers can be used for *T1*, depending on speaker voice coil impedance. Typically, an Argonne Type AR-122 is suitable for 3-4 ohm voice coils, an Argonne Type AR-139 for 8-ohm speakers.

Transitips. "You and many of your readers must be geniuses. I've been studying electronics for two years, understand it easily, but how do you design those circuits? I've tried my hand at circuit design but I can only design switching circuits. You people come up with amplifiers, radios, and even lie detectors. For once, I would like to design an original circuit." Thus reads, in part, a recent letter from a reader in the Midwest. And his problem is not unique; many readers have written similar letters.

Circuit design, like medicine, can be practiced at different levels. Almost anyone can practice First Aid with a minimum of training, but college training, advanced study, and years of experience are needed before one becomes a physician or surgeon. By the same token, almost anyone with a basic knowledge of electronics can design and redesign circuits, but advanced training and experience are needed to become a design engineer.

In practice, very little truly "creative" design takes place, even among advanced engineers. Rather, most circuit design involves the direct adaptation and modification of known circuit configurations to meet special needs. A practical example will help illustrate the methods and thought processes involved.

Consider the typical "tickler feedback" audio oscillator circuit illustrated in Fig. 3(a). Component values are not given, for these will vary with the type of transistor, supply voltage, transformer characteristics, operating frequency, and other factors. But the basic circuit is, or should be, a familiar one. A small winding on transformer *T1* provides the feedback needed to start and sustain oscillation; *C1* serves as a d.c. blocking and a.c. coupling capacitor; *Q1*'s base

(*Continued on page* 89)

ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

IN FEBRUARY your CB Editor announced plans to visit several parts of the United States throughout the year to meet with CB'ers and to monitor their operations. The first stop on the POPULAR ELECTRONICS "Monitour" (*moni*toring *tour*), was Denver, Colorado. The second collection of "statistics" was compiled on a recent Sunday/Monday weekend visit to Kansas City.

MISSOURI MONI-TOUR

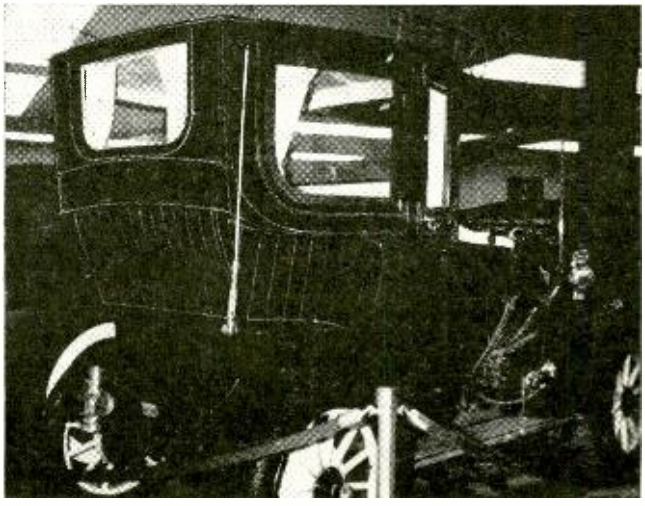
Thanks go to Mike Barelli, George Martin, and Chris Whitehead, WØKCM, for directing us to local CB and amateur contacts who provided off-the-cuff information regarding the Kansas City, Missouri/Kansas, area. Ironically, none of these three is a licensed CB'er. Mike is in the process of being licensed; George is in close contact with CB and amateur operators in the area; and Chris is a licensed amateur. Their knowledge of CB communications and operators in the area, however, enabled us to gather information from local CB'ers, and to compare their comments with actual on-the-air monitoring.

Daytime messages in Kansas City are mostly legal. Your CB Editor heard several transmissions that were made to dispatch service and delivery vehicles. These calls were interspersed, however, with housewife gabfests by women who apparently find gossiping on the Citizens Band more fun than watching TV soap operas.

Evening transmissions are surprisingly few, with legal calls running a close second to those which might be labeled "questionable" in a roundtable discussion. Near midnight we heard a local station give directions to an out-of-state mobile. Then a woman driver contacted her home to announce she would be stopping on the way to pick up sandwiches. Both calls were short, to the point, and legal.

The average illegal "breaker" usually attempts to color his conversation with worn and torn phrases like "you betcha, by golly," and "you better believe it." Kansas City has a mobile operator with a different (but equally trite) approach. As his verbal gimmick, he employs the word "mercy" several times within *each* sentence. "Mercy-mercy," he might say, "you're comin' in like a thousand watts; mercy, it's good to hear you; mercy, mercy!"

At no time during our monitoring sessions in the Kansas City area did we note the use of code names in place of call-signs. There was no intentional carrier jamming to block transmissions, and there were no souped-up rigs or linear boosters.



There are no FCC restrictions on how new an auto must be to qualify as a CB mobile unit. Although the dash isn't visible in this 1905 renovated "White Steamer," the car must be CB-equipped since it sports an Antenna Specialists' M-176 on the rear right fender.

1968 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet, or picnic? Send the details to: 1968 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016. For more information on the jamborees listed below, contact the clubs or club representatives at the addresses given.

Lawrenceville, Georgia — **May 4-5**

Event: CB Jamboree. Location: City Park, Highway 29. Sponsor: The Gwinnett Communications Club of Georgia. Contact: William L. Bell, R.F.D. 4, Lawrenceville, Ga. 30245.

Rockford, Illinois — **May 19**

Event: Fourth Annual RRVCBC Jamboree. Location: Rockford Armory, 605 N. Main Street. Sponsor: Rock River Valley Citizens Band Radio Club. Contact: Pierre LaBounty, KPK3273, 2015 Glenwood, Dept. AP, Rockford, Ill.

Wooster, Ohio — **May 31-June 2**

Event: Annual Wayne County REACT Campout and Jamboree. Sponsor: Wayne County REACT. Contact: Jamboree, P. O. Box 281, Wooster, Ohio.

Middlesex, Vermont — **June 1-2**

Event: Third Annual Jamboree of Central Vermont. Location: Middlesex Campgrounds. Sponsor: Central Vermont CB Club, Inc.

Lockport, New York — **June 9**

Event: CB Jamboree. Location: Cinderella Park on Niagara Street. Sponsor: Western New York Pioneer Radio Association. Contact: Sue Isele, 2789 Quaker Rd., Gasport, N. Y. 14067.

Lexington, Massachusetts — **June 16**

Event: CB Jamboree. Location: Suburbs of Boston, Mass. Sponsor: Paul Revere Emergency Radio Service. Contact: Robert Sweet, Secretary, P.O. Box 495, Lexington, Mass.

London, Ontario, Canada — **June 29-30**

Event: Campout '68, held in conjunction with London's Annual Fortnight Festival. Sponsor: South Western General Radio Association. Contact: Peter Harding, Campout '68 Chairman, 26 Grosvenor St., London, Ontario, Canada.

Warminster, Pennsylvania — **June 30**

Event: First CB Jamboree. Location: Willow Grove Amusement Park. Sponsor: Eastern Pennsylvania REACT, Inc. Contact: Eastern Pennsylvania Jamboree, Box 309, Warminster, Pa. 18974.

Louisville, Kentucky — **July 28**

Event: Third Annual Jamboree. Location: Funland Amusement Park, Louisville. Sponsor: Iroquois Gentlemen CB Club. Contact: Ronald Zibart, 111 Juneau Dr., Middletown, Ky. 40043.

Lexington, North Carolina — **August 17-18**

Event: First CB Jamboree. Location: Davidson County Fairgrounds. Sponsor: Pioneer CB Club. Contact: Virginia Athay, KOK3171, 11 Hawthorne Lane, Lexington, N.C. 27292.

Among our off-the-air discussions with CB'ers, the one with Elmer Leonard, Jr., KPH5286, was most profitable. It seems that skip transmissions from California play more of a part in disrupting Kansas City CB operations than the local interference created by chit-chat. Local gabbing does appear on the band late at night, but clears immediately for emergency traffic.

Elmer indicated that conditions on the band over a two-year period have improved considerably. He believes part of the problem was solved when CB'ers in Kansas City, Kansas, and Kansas City, Missouri (separated only by a state line) decided to use channel 11 for monitoring on the Missouri side and channel 9 on the Kansas side.

How important two-way radio is to Elmer (he drives to work every day from the northernmost corner of Kansas City, Missouri, to the southern tip) might be summed up in a recent incident in which he was involved. At 6:25 a.m. one morning, while parked at a stoplight, Elmer noticed an auto switching lanes. He tried to move his car far enough out of reach, but the oncoming vehicle drove a second car into Elmer's, severely damaging the car in the middle. Aware that Betty Willar, KRH6702, monitors the band from approximately 5 a.m., Elmer contacted her and passed on the information. By 6:28 a.m. the police had arrived. And by 6:35 a.m. the wreckage (there were no injuries) had been cleared and traffic was back to normal.

Club activity appears somewhat limited in the Kansas City area. The Kanmo Headquarters Group of REACT has been lauded in this column for its emergency activities. But the North Area Emergency Radio Team and the CB Association of Greater Kansas City are teams that have not been heard from here for several years. If these groups or newer organizations are active in the Kansas City, Kansas/Missouri area, we would like to have the details.

REACT Reacts. On a recent Thursday, KOX7865, of Whittier, Calif., indicated to the San Gabriel Valley REACT monitor that he had urgent traffic and requested he be called by phone. The message revealed that the Hoffmans, KQX3283, were on vacation in the state of Oregon, that their son had been hurt in California, and that authorities needed permission to operate. The caller requested that the information be relayed only as an accident, with the request that the Hoffmans contact the proper authorities.

A 10-17 (urgent) call was put out. REACT member Bob Clark, KQX5402, made contact with ham operator Bob Smith, WA6WPP. After compiling as many of the details as possible, Smith, a member of the West Coast

(*Continued on page 94*)

AMATEUR RADIO

By **HERB S. BRIER,** W9EGQ
Amateur Radio Editor

NEWS ON LICENSING FROM THE FCC

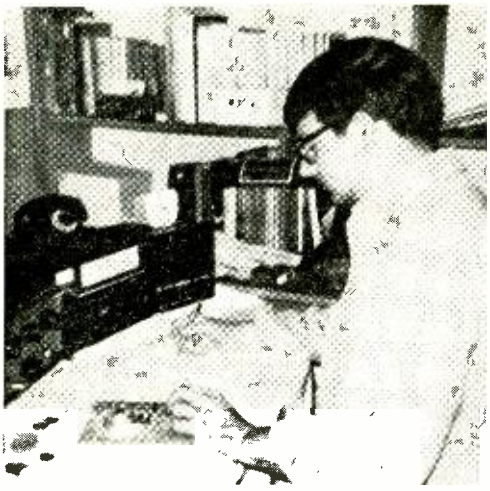
DID you know that, although the Technician Class license is normally issued by mail, under special circumstances an applicant can qualify for it at an FCC office? James E. Barr, Chief of the Safety and Special Services Bureau of the Federal Communications Commission explains how it is done.

If an applicant applies for a General Class license in the normal manner but fails the 13-wpm code test, *upon request* the examiner will check to see whether the applicant copied 25 consecutive letters without an error. If he did, he may immediately modify his application for a General Class license to apply for a Technician Class license, pass the code sending test, and take the written Conditional/General/Technician Class examination (they are all the same). If the applicant passes the written examination, he will be issued a Technician Class license. Furthermore, he can return later, pass the General Class code test, and be issued a General Class license without taking the written test again. These procedures are in accordance with Section 97.25 of the FCC amateur rules.

Since the FCC reinstated the Advanced Class license and revamped the Extra Class license last August, most amateur club papers have been full of plans and methods for coping with the new situation. Many clubs, including the Aeronautical Center

AMATEUR STATION OF THE MONTH

One of the approximately 10,000 licensed women radio amateurs in the United States, Sue Yerian, WA1IHD, Loring Air Force Base, Maine, has run up a rather impressive record since last July. She has worked 43 countries and all states except Virginia and West Virginia. Her Heathkit-equipped station contains an SB-100 transceiver, an SB-200 amplifier, SB-610 monitor scope, and a phone patch. The antennas in service are a Mosley TA-33 tri-band beam up 55 feet for 20, 15, and 10 meters, and inverted V's for 80 and 40. Sue will receive a one-year subscription for submitting the winning entry in our Amateur Station of the Month Photo Contest. To enter the contest, send a clear photo of your station with you at the controls and some details on the equipment you use and your ham radio career to: Amateur Photo Contest, c/o Herb S. Brier, P. O. Box 678, Gary, Indiana 46401.



Phil Yukovich, WN9UNL, Chesterton, Ind., reached his goal of working all states as a Novice with months to spare. He worked most of Canada, too. An EICO 720 transmitter driving a Mosley NS-3 antenna and a Drake 2-A receiver are his tools.

Amateur Radio Club, Oklahoma City, the Denver Amateur Radio Club, the Garland, Texas, Amateur Radio Club, and the Rochester, N.Y., Amateur Radio Club, have been conducting advanced code and theory classes in addition to their beginners' courses. Some amateur phone nets have been devoting part of their regular net periods to acquiring the knowledge required to pass the new examinations. And thousands of amateurs are studying alone with the same aim.

As a result of all these activities, on the days when amateur examinations are scheduled, the various FCC offices are crowded with applicants for General, Advanced, and Extra Class licenses. The experiences of these applicants stress the wisdom of basing one's preparation for any amateur radio written examination on the latest study guide, because the new examinations ask questions not covered in older study guides. For example, all amateur examinations—including the Novice exam—contain questions about transistors. The most easily obtained source of the study guides for most people is the *Radio Amateur's License Manual*, published by the American Radio Relay League, Inc., Newington, Conn. 06111, and available from the ARRL or amateur supply houses for 50 cents, postpaid.

In general, the consensus is that any General Class amateur should be able to pass the new Advanced Class exam after a few weeks of study. But the main reaction to the Extra Class exam is surprise at the wide range of amateur radio subject matter it contains. Fortunately, few of the individual questions are difficult in themselves, but several months of conscientious spare-time study of the "License Manual" and the "Handbook" plus a quick review of elementary algebra in the old high school math book are required for the average General Class ham to pass the Extra Class exam.

The Indianapolis 500 Festival. Each spring, a 2-mile parade is held as part of the events climaxing in the Indianapolis 500-mile automobile race. This year's parade will be held on the evening of May 28 and will be covered nationwide by over 100 TV and broadcast stations. The Marion County CD Amateur Radio Communications unit will furnish communications under the direction of Dick Andrews, K9SVB.

At least 26 mobile and portable stations and 16 fixed stations will be used in the operation. Units will be available at major intersections along the parade route to furnish communications for police officers stationed at these points. Other units will be placed at high lookout points to relay information about the parade and crowd conditions to officials on the ground.

(*Continued on page 97*)

David Daniel, WAØSVO, Lawrence, Kansas, operated as a Novice with the ARC-5 war-surplus transmitter and Lafayette receiver shown at the left in the photo. He now uses a National NCX-3 transceiver on CW and SSB phone.

Squires Sanders

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NOW HEAR THIS . . . the all new Squires-Sanders fleet of top performance CB transceivers is now being launched. Shiver-me-timbers, you've never seen such an array of fine CB equipment this side of Davy Jones' locker. This is the ALL SOLID STATE fleet – with the best in performance, features, and styling at prices to suit every requirement or desire. Top deck is the luxurious ADMIRAL 23 channel base station . . . then the COMMODORE mobile with the patented Pulse Eliminator. On the bridge the SKIPPER is blasting out on all 23 and in the wheelhouse is the terrific 2 channel 3 watt YEOMAN portable. The SS all solid state fleet is for you . . . from port to portable! You are invited to the launching – Ask your distributor for details and write today for full color literature.

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$329.95

The SKIPPER: new low priced solid state 23 channel CB transceiver ● superb dual conversion FET/IC no-overload receiver ● advanced design noise limiting ● illuminated S meter and channel ● solid state T/R switching ● Speech Clipping ● 100% modulation ● P.T.T. mike ● Local/Distant sensitivity ● external speaker jack ● Public Address ● Exclusive "All Position" Safety Breakaway Mount ● only 3 lbs.: 1¾ x 6 x 8"

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The COMMODORE: 23 channel, solid state mobile CB transceiver ● Ultra sensitive ½ μv double conversion receiver ● crystal filter, 7 KC selectivity ● adjustable squelch ● flat AGC ● Pulse Eliminator removes ignition noise ● 3 watts audio ● 5 watts input ● 100% modulation ● PTT mike ● 26 transistors, 7 diodes ● 4 lbs, 3½ x 7 x 8

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The YEOMAN: fine, powerful portable CB transceiver ● 2 channels, equipped with ch 7 ● Sensitivity ½ μv ● AGC ● Adjustable Squelch ● Noise Limiter ● 3 watts input, 2½ watts output ● Operates on 8 pen-lite batteries ● Battery/RF Power ● Call signal ● 54" whip antenna ● Earphone ● under 2 lbs 3 x 8 x 1¾

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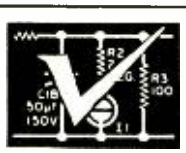
CIRCLE NO. 33 ON READER SERVICE PAGE



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 and model number of the unit. If you don't know both the maker's name and the model number, give 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.*

Philco Model 38-3 receiver, circa 1930's; has 9 tubes; tunes 550-1700 kHz and 2.2-22.0 MHz. Schematic, operating manual, parts source, and any other available information wanted. (Karl Salmon, 2915 5th Ave., York, Pa. 17402)

Atwater Kent Model 20 receiver. Schematic, service data, operating instructions, and tubes needed. (W. Hoyt Poston, Rte. 2, Box 156, Pamplico, S.C. 29583)

Crosley Model 66CT receiver. Schematic and parts list needed. **RCA** Model 7-EY-2HH 45 r/min automatic turntable and amplifier. Schematic needed. (Cliff Briere, RFD #4, Box 283, Mechanicsville, Va. 23111)

RCA Victor Model D 22-I all-wave radio-phono combination. Schematic needed. (T.L. Pettit, Box 284, Lewisburg, W. Va. 24901)

Precision Apparatus Model P-25 battery eliminator and charger. Operating manual needed. (Erwin Stanley, Benton, Ark. 72015)

Radiation Instruments Model 117B "Scintillator." Schematic and operating manual needed. (A. Anderson, 13931 102 Ave., North Surrey, B.C., Canada)

Hallicrafters Model S-38D receiver. Schematic and alignment data needed. **Clough-Brengle** Model CRA 3" oscilloscope. Schematic needed. (Dennis Tolomei, 577 Carlisle Way, Sunnyvale, Calif. 94087)

Hoffman TV receiver, circa 1955; chassis #704-21. Schematic and service information needed. (R. Cartier, 1035 Cilley Rd., Manchester, N.H. 03103)

Allen B. DuMont Labs Type 164-E 3" cathode ray oscillograph. Schematic and operating manual needed. (Bryant Hudson, 1321 SW 67 St., Oklahoma City, Okla. 73159)

Majestic Model 360-B receiver. Schematic needed. (Louis R. Altazan, Jr., 368 Avenue E, Port Allen, La. 70767)

Atwater Kent Model 427 receiver, circa 1935. Schematic needed. (James L. Bochantin, Rte. 1, Box 54, DuBois, Ill, 62831)

Gonset Model 3316 CB transceiver. Power cable assemblies for 12 volts d.c. and 117 volts a.c., operating manual and schematic needed. (Paul H. Gorrell, P.O. Box 228, Mashpee, Mass.)

National Model SW-54 receiver, 1951. Tuning/band-spread shaft needed. (Wayne Korn, 3318 W. Bertona, Seattle, Wash. 98199)

Fujiya Corder Model 555. Schematic needed. (Joseph M. Tucci, Jr., 49 Albro St., Pittsfield, Mass. 01201)

Supreme Model 1604 electronic volt-ohmmeter. Schematic or manual needed. (William F. Pommerening, Box 211, Milton-Freewater, Ore. 97862)

Westrex Type 524A "VOGAD" automatic gain control unit. Schematic needed, especially connector wiring for input, output, and power. (William Wokoun, Box 413, Aberdeen, Md. 21001)

Pierson Model KE-93 SW receiver, made by Automation Electronics. Schematic and manual needed. (Tim Hain, Box 88, Nachusa, Ill.)

Moss Model TV-50 "Genometer." Schematic, operating manual, and source for 6B-1000 tube needed. (Robert Wurth, 495 Myrtle, Florissant, Mo. 63031)

E.H. Scott Model 510 radio-phonograph. Schematic needed. (Timothy G. Walnati, 12 Griffin Terrace, S. Weymouth, Mass. 02190)

Setchell Carlson Model 591 receiver. Instruction manual or schematic needed. **Barker & Williamson** Type JEL 3102, 3104, and 3105 coils. Source needed. (Mark T. Colan, 2305 W. Wagner, Peoria, Ill. 61614)

Knight-Kit C-22 CB transceiver. Schematic needed. (Jim Bobal, 842 Tombler St., Bethlehem, Pa.)

Hammarlund Model HQ 129 X receiver. Cover or case, and service manual needed. (Roy Carroll, 1315½ Eighth Ave., Neptune, N.J.)

Philco Model 7005 VOM, circa 1945. Meter and manual needed. (Daniel Gibbons, Apartado No. 84, Talara, Peru)

Dokorder Model 7020 stereo tape recorder. Schematic and operating manual needed. (Lester R. Naylor, RR #1, Hastings, Minn.)

Ambassador (JVC) Model 4T-40 UHF transistor TV receiver. Source for antennas and power adapter needed; also address of distributor of Ambassador parts and schematics. (Gary DuFour, 14 Gilmore St., Uniontown, Pa. 15401)

Silver-Marshall 225 audio transformer. Four-gang, .00035-μF capacitor and General Radio "Variometer" needed. (William Greig, 80 Coney St., E. Walpole, Mass. 02032)

Heathkit Model AR-3 receiver. Manual needed. (Greg Scoggan, 712 Fernwood Ave., W. Covina, Calif. 91790; and Joe Hutnick, RD #2, Catawissa, Pa. 17820)

Jewel radio test set, 1926, pattern 95. This or closely related meter by Jewel Electrical and/or instruction manual needed. (Mark J. Hagmann, 7030 S. 260 East, Midvale, Utah 84047)

Solar Model CF "Capacitor Exam-eter." **Simpson** Model 310 signal generator. **Clough-Brengle** Model OC signal generator. Schematics and operating manuals needed. (Francis S. Lewis, Hebron, Ohio 43025)

Crosley "Bandbox" Model 601 neutrodyne receiver. circa 1923-26. Schematic and operating manual needed. and especially source for tuning capacitors. (Darcy Brownrigg, Chelsea, Quebec, Canada)

Sylvania Model 3305BL AM (transistor) receiver, circa 1953. Schematic needed, or will buy good used set for best offer. (Billy Flynn, 77 School St., N. Woburn, Mass. 01801)

Superior Instruments Model 82A tube checker. Up-to-date tube socket and test chart needed. (Alfred Beckman, 88-14 183 St., Jamaica, N.Y. 11423)

Hallicrafters Model SX-25 "Super Defiant," 1945. Source of parts needed. **Sparton** Model 1072 a.c. receiver, 1948. **Atwater Kent** Model 86. **Victor Radio** Model R-15 receiver unit RC 3. **Earl Radio** Model 31 or 32 electric neutrodyne receiver. Schematics needed. (Charles C. Dedon, Rte. 1, Box 199, Walker, La. 70785)

Webster-Chicago Model 800 wire recorder. Recording head and wire needed. (Roman Kochan, 18-V, 331 Blake St., Winnipeg 3, Manitoba, Canada)

Western Electric BXX-410430-X-61713B oscilloscope. circa 1945 or 1950. Instruction manual needed. **Hallicrafters** Model T-54 television receiver, 1948. Schematic and instruction manual needed. (Ed McGarry, Jr., 2228 S.E. 10 St., Pompano Beach, Fla. 33062)

Temco Model 75A, amateur AM-CW transmitter. Schematic and/or instruction manual needed. (Paul F. Grimes, 3591 W. National Rd., Springfield, Ohio 45504)

Precision Model 912 tube checker. Schematic and operating manual needed. (Peter D. Hipson, P.O. Box 981, New Port Richey, Fla. 33552)

Waterman Model S-14A pocket scope. Schematic and technical manual needed. (Irving W. Wood, 156 Sandy Hollow Rd., Northport, L.I., N.Y. 11768)

"Candle" Model MT-510A micro TV receiver; manufactured by Tokyo Transistor Ind. Co., Ltd. Schematic and/or parts list needed. (G. Hallett, 8 Old Shawnee Rd., Milford, Del. 19963)

Lavoie 259 oscilloscope. Instruction manual and/or schematic needed. (Charles Byers, RD #5, Dover, Pa.)

Superior Instruments Model 450 tube tester. Up-to-date tube list needed. (Geo. Miller, 916 Wabunk Rd., Lancaster, Pa. 17603)

RCA Victor tuner, chassis RD-117; has 7 tubes; tunes AM, FM, and SW. Schematic and operating manual needed. (Danny Ehrenfreund, Cordial Rd., Yorktown Heights, N.Y. 10598)

Paco Model T60 tube tester. Operating manual needed. **Triplett** Model 2432 signal generator. Schematic needed. (T.A. Cummings, 7024 W. 17 St., Little Rock, Ark. 72204)

4RHH2 vacuum tube for Japanese TV receiver (Hitachi) needed. (James E. McBride, 141-A Jones Franklin Rd., Raleigh, N.C. 27606)

Essco "Mac II" 5-watt tube R/C transmitter, circa 1950. Two 3D6 tubes, and source for 1AG4, RK66, and RK61 tubes needed. (Steven Terry, 147 Columbia Heights, Brooklyn, N.Y. 11201)

Webster-Chicago Model 80-1 wire recorder, circa 1945. Schematic, specifications, operating manual, wire, and heads needed. (John Pelham, 45-303 Success Park, Bridgeport, Conn. 06610)

Bell Sound Systems Model 374SS intercom. Schematic, servicing data needed. (Fred Provine, Box 465, Capitan, N.M. 88316)

Grundig-Majestic TK-819 tape recorder. Schematic needed. (P. Christie, 3604 31st Ave., Flushing, N.Y.)

Supreme Instruments Model 546 oscilloscope. Operating manual and schematic needed. (Arnold Hirsch, 27 S. West St., Allentown, Pa. 18102)

DeForest's Training 2" CRT oscilloscope; has 3 tubes. Schematic needed. (Carl Preddy, 129 W. Park Dr., Charlottesville, Va. 22901)

General Electronic Model 200 signal generator. Schematic and any available information wanted. (Gerry Kosoris, 642 S. Franklin St., Fort William, Ont., Canada)

Geloso receiver, circa 1950; has 14 tubes, crystal filter, dual conversion, variable ANL; covers 80-10 meters and 11 meters. Schematic or tube line-up needed. (Doug Tabor, 1964 John, Layton, Utah 84041)

Fada Model 32L AM receiver. Schematic needed. (Vernon H. Wood, 1800 Corbett, Las Cruces, N.M. 88001)

Paco Model SA-40 stereo amplifier. Manual needed. (Frank R. DeWald, 190 Knickerbocker Rd., Englewood, N.J. 07631)

Hallicrafters Model S20R "Sky Champion." Operating manual, alignment instructions, and schematic needed. (Tommy Skelton, 280 Forest Heights Dr., Athens, Ga.)

SOURCES OF INFORMATION

"Operation Assist" is published as a service to the readers of POPULAR ELECTRONICS who cannot find schematics, parts, etc., for old or no-longer-manufactured equipment. Military—or Government surplus—equipment is not itemized in this column, since schematics and copies of Tech Manuals for military equipment can be obtained from a variety of independent sources: Slep Electronics, Drawer 178, Ellenton, Florida 33532; Quaker Electronics, P.O. Box 215, Hunlock Creek, Pa. 198621; etc. Unusual or difficult-to-find schematics and servicing information can frequently be obtained from Supreme Publications, 1760 Balsam Rd., Highland Park, Ill., for a slight charge.

ELECTRONICS library

QUIET

ELEMENTS OF RADIO SERVICING, Third Edition

by William Marcus and Alex Levy

This third edition of a remarkably concise textbook on the servicing and repair of AM, FM, and auto (or what have you) radio receivers brings the state of the art up to date. Because the book is written only for those interested in learning the fundamentals of servicing and repair, there is very little math and absolutely no design theory. Of course, a book like this cannot possibly diagnose all the individual problems or variations of problems that the technician may encounter, but the background is here, and with a little thought, most receiver problems can be solved. This book is highly recommended.

Published by McGraw-Hill Book Co., 330 West 42nd St., New York, N.Y. 10036. Hard cover. 426 pages. $6.95.

HOW TO USE SIGNAL GENERATORS IN RADIO/TV/HI-FI SERVICING

by John D. Lenk

If you work on hi-fi, radio, or TV equipment, this book can help you do your job better. It is devoted entirely to the practical uses of r.f., sweep, marker, FM-stereo, and audio signal generators. Employing a format that is easily understandable by even the novice technician, this book is illustrated with simplified block diagrams—thus avoiding the possibility of confusion presented by unnecessary and elaborate schematic drawings.

Published by John F. Rider Publisher, Inc., 116 West 14 St., New York, N.Y. 10011. Soft cover. 128 pages. $3.25.

RCA LINEAR INTEGRATED CIRCUITS, IC-41, Second Edition

This manual has been expanded and updated to include the latest available information on design, packaging, and application of linear IC's. Design equations and performance criteria are given for basic circuit configurations. Circuit diagrams, descriptive data, and applications information are provided for a broad family of IC's designed for a large variety of uses. Almost 50% larger than the first edition, the new manual covers almost everything you might want to know about the as-of-now IC's.

Published by Commercial Engineering. RCA Electronic Components and Devices, Harrison, N.J. 07029. Soft cover. 352 pages. $2.00.

TAKE ONE new literature

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15 or 95.

Contained in the 132 pages of *Lafayette Radio Electronics'* 1968 Spring Catalog are the latest electronics and stereo hi-fi home entertainment products. Garden tools and accessories, power tools for the home workshop, and marine equipment are featured. As usual, many other major manufacturers are represented.

Circle No. 89 on Reader Service Page 15 or 95

A new line of slim box-joint pliers is covered in a free 80-page catalog put out by *Techni-Tool, Inc.* There are three basic styles—chain, round, and flat-nose pliers—and the thickness at the joint in each case is only $\frac{3}{16}$".

Circle No. 90 on Reader Service Page 15 or 95

Twenty-four different low-cost semiconductor heat sinks are illustrated in a four-page catalog published by *Accel Electronic Products Company.* Dissipation data, dimensions, and weight are given for all models.

Circle No. 91 on Reader Service Page 15 or 95

Radio amateurs will be interested in a brochure available from *Main Electronics, Inc.,* which describes a new CW audio filter with high selectivity. The device can be switched in or out of the circuit as needed.

Circle No. 92 on Reader Service Page 15 or 95

For the CB'er, *Mosley Electronics* has a 12-page catalog on antennas intended to fill every need, plus accessories. There is also a helpful theory section called "The CB Operator and His Antenna Problems," which covers such topics as the meaning of standing wave ratios and gain figures, transfer of power, antenna mismatch, etc.

Circle No. 93 on Reader Service Page 15 or 95

The 1968 32-page catalog of the *Clarostat Mfg. Co., Inc.,* illustrates and describes this company's full line of potentiometers, field-assembled controls, power rheostats, and resistors. A special section on military-qualified pots includes a complete listing of off-the-shelf types.

Circle No. 94 on Reader Service Page 15 or 95

NEON LAMP QUIZ ANSWERS

(*Quiz appears on page* 58)

1 — E As a CONDITION INDICATOR, a neon lamp connected across a good fuse will not fire due to the small voltage drop across the low resistance of the fuse element. If the fuse opens due to overload, and the line voltage exceeds the lamp's firing voltage, the lamp will glow.

2 — C As a COUPLING NETWORK, neon lamps are fired by the d.c. voltage between the plate of a tube and the grid of the next stage. The constant current characteristics of the lamps prevent further d.c. variations while passing a.c. signal changes due to the low a.c. impedance of a conducting lamp.

3 — F A FREQUENCY DIVIDER is a sawtooth generator in which the neon lamp is fired whenever small amplitude input signals superimposed on a low-frequency sawtooth waveform reach a pulse height equal to the firing voltage of the lamp.

4 — A In a MEMORY ELEMENT, the supply voltage is set between the firing and maintaining voltages of the neon lamp, and a positive "set" pulse used to turn the lamp on. A positive "read" pulse applied to a lamp that is already on causes a positive pulse to be read out, but if the "read" pulse reaches a lamp that is off, no output pulse is produced. A negative "reset" pulse is used to turn the lamp off.

5 — I In a SAWTOOTH GENERATOR, a neon lamp, while nonconducting, permits a shunt capacitor to charge exponentially to the lamp's firing voltage. The lamp then conducts, discharging the capacitor to the lamp's extinguishing voltage to repeat the cycle.

6 — D As an antenna STATIC DRAIN, a neon lamp fires when high static voltages are picked up by an antenna. The low-resistance path then shunts the unwanted current harmlessly to ground.

7 — H As a SURGE PROTECTOR, a neon lamp connected across a transformer will conduct when high-voltage signal or transformer kickback peaks exceed the lamp's firing voltage.

8 — B As an r.f. TUNING INDICATOR, a neon lamp connected between the plate and ground of an r.f. amplifier will glow orange while d.c. is applied, but change to a deep purple as the stage is tuned and r.f. signals increase.

9 — G In a VOLTAGE LEVEL INDICATOR, a neon lamp will glow when the input signal level reaches the sum of the lamp's firing voltage plus a calibrated bias voltage.

10 — J As a VOLTAGE REGULATOR, the constant voltage drop across one or more neon lamps in series is used to regulate screen voltages.

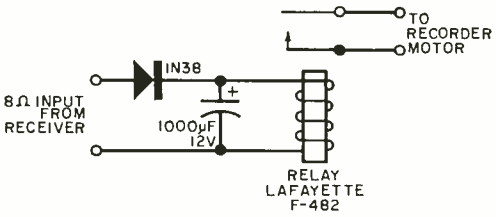
INFORMATION CENTRAL

(*Continued from page 69*)

To calibrate the unit, merely close both switches (*S1* and *S2*), and adjust the thermistor pot (*R2*) for a minimum meter reading. Then open *S1* and adjust the battery pot to calibrate. Compare readings with a good standard thermometer using similar cold and heat sources, i.e., refrigerator cold compartment, electric heater, or radiator, etc. *S2* is a push-button switch for temperature readout.

Recorder VOX. *How can I connect my recorder to a monitor receiver (with squelch) so that it will operate only when signals are received? I'm not a good technician, but I can handle a simple circuit.*

See the circuit below. The output should be connected across the speaker terminals of your set. The relay will close and stay closed during speech intervals and for about



one second after the speech ceases. The relay contacts are connected to the recorder motor circuit. Adjust the a.f. output of the receiver (on signal) so that the relay will close and turn on the recorder motor. If you experience too short a delay, increase the size of the capacitor to 2000 μF.

SWB-2 Meter Problem. *I own a dual-meter standing-wave bridge, the Quement SWB-2, and use it to check output and SWR at my CB base station. It worked all right when I got it but now I get no reading on the power meter. What could be wrong?*

It might be burned-out meter, a shorted 0.001-μF capacitor across the meter, or a defective 10,000-ohm pot. Or it could be a burned-out diode (1N34, *CR-2*). Remember that 10 watts is required for operation of the meter around 7 MHz but it should operate with a CB transmitter with 5 watts input on 27 MHz. -30-

SOLID STATE

(*Continued from page 78*)

bias is furnished through *R1*; a step-up secondary winding furnishes a drive signal to the headphones; and, finally, operating power is supplied by *B1*.

A typical experimenter might see a circuit similar to the one in Fig. 3(a) in a circuit booklet or magazine. He would like to duplicate it, but he doesn't have the special three-winding transformer (*T1*) and, for one reason or another, is unable to obtain a duplicate unit. But he *does have* a push-pull interstage transformer in his lab stock.

Necessity, then, inspires him to try the circuit arrangement shown in Fig. 3(b). Here, he has used the center-tapped (push-pull) winding as a step-up auto-transformer to drive his headphones, but the basic arrangement is unchanged. He might even decide to use a different transistor for *Q1*.

At this point, a design engineer might pull out transistor data sheets, characteristic curves, a handbook of design equations, and a slide rule and calculate component values, operating conditions, power output, and similar values. A practical engineer, technician, or hobbyist, on the other hand, probably would determine these values empiri-

(*Continued on page 94*)

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28-103, Wireless AM Mike Kit	**3.95**
28-104, AC/DC Power Supply Kit	**6.95**
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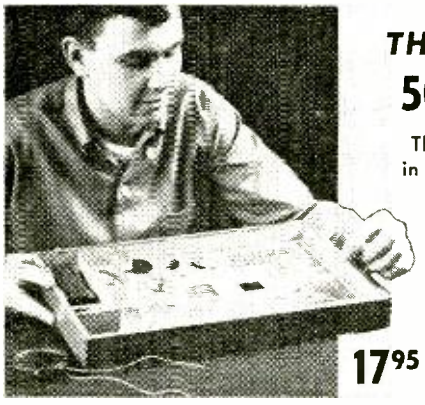
28-112, Bell/Buzzer/Code Key Kit	**1.49**



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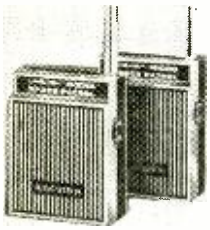

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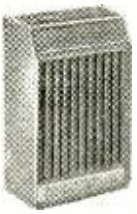

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RADIO SHACK EXPERIMENTERS' PERF-BOX: Professionalizes project building; eliminates chassis cutting, drilling. Removable 3½ x 6" perfboard front makes component wiring faster, easier! Drilled 2¼" speaker grille in rear. Sturdy bakelite case is 3¾ x 6⅛ x 2". Hole diameters: 0.062". Ideal for hobbyists. #270-097

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RADIO SHACK DUoFONE STEREO OR MONO HEADSET: For classroom or broadcast use, anywhere you need a wide-range under-chin dynamic headphone! 2 switches in the plug select stereo or mono at either 600 or 2000 ohms. Lightweight (8 oz.), comfortable, amazing clarity of sound. For any solid state device. #33-197

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CIRCLE NO. 26 ON READER SERVICE PAGE

cally, i.e., by experimentation. He would actually try different bias resistors, feedback capacitors, and transformer lead connections, working with a breadboard circuit, and, sooner or later, would determine the proper values for circuit operation.

Another experimenter, working from the circuit shown in Fig. 3(a), might take a different approach. He may decide he would like loudspeaker output. His approach, then, might be to use a power transistor, a power output transformer, and the modified circuit illustrated in Fig. 3(c). Again, a few experiments with a breadboarded circuit to determine component values could result in yet another circuit design.

The first experimenter, impressed by the performance of his circuit, Fig. 3(b), might submit it to a magazine, where it is duly published as a "Reader's Contribution." Later, a third hobbyist, reading about the circuit, might well decide to modify it for use with a speaker and power transistor, and come up with the design in Fig. 3(d).

Note that the *original* circuit, Fig. 3(a), theoretically has been modified by two different experimenters, each developing a new design to meet his own needs. In addition, one of the modified circuits, Fig. 3(b), was changed again by a third experimenter.

Other design changes are possible, of course, even while retaining the basic configuration of the original circuit. For example, proper choice of component values could permit the basic circuit to be used as a code practice oscillator, a test oscillator, an ultrasonic signal source, a power converter (by replacing the headphones with a rectifier and filter), a metronome (by increasing feedback until blocking occurs, adjusting the rate by changing the *RC* feedback time constant), or even a lamp flasher.

Basic circuit design, then, is not as difficult as it seems at first glance. In fact, *it can be fun!* Until next month, then, have fun!

—Lou

ON THE CITIZENS BAND

(*Continued from page* 80)

Amateur Radio Service, and MARS radio, went on the West Coast Net at 4:30 p.m. All ham operators were alerted from San Francisco to the Canadian border, in addition to 120 CB units, to pass the information throughout Oregon.

As the story was written up in the S.G.V. REACT news, the most gratification came to those who participated in the search when the Hoffman family was located, and more important, when the son recovered.

Courtesies Rewarded. The South Western General Radio Association, London, Ontario, rewards its members for courtesies extended to motorists in need. In a membership packet received from the club by each member at the start of the year, are six wallet-sized cards with club identification and room for the member's name, his address, and his call-sign.

When assisting a motorist, a member presents him with one of these cards. If the motorist writes to the SWGRA regarding the member's aid in his time of need, the member receives one point toward a year-end trophy. In just one issue of the *SWGRA Bulletin,* the club's official news vehicle, eleven letters of thanks were reprinted. Those who had been helped ranged from people whose cars had flat tires or were out of gas to drivers with motor problems—or wheels coming off.

One fellow sent two cards back to the club. He reasoned that when he had a flat tire, an SWGRA member gave him a hand but forgot to leave a card. Many months later, the same man ran out of gas, and the same member came to the rescue!

I'll CB'ing you,

—Matt, KHC2060

READER SERVICE PAGE

free information service:

Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below... and the material will be sent to you promptly and free of charge.

1. Print or type your name and address on the lines indicated. Circle the number(s) on the coupon below that corresponds to the key number(s) at the bottom of the advertisement or editorial mention(s) that interest you. (Key numbers for advertised products also appear in the Advertisers' Index.)

2. Cut out the coupon and mail it to the address indicated below.

3. This address is for our product "Free Information Service" only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York 10016; circulation inquiries to Portland Place, Boulder, Colorado 80302.

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5 b

LETTERS (*Continued from page 10*)

sell your projects to help others interested in any form of electronics. Tell anyone who wants to obtain "constructed" projects that I'll be glad to help.

FRANK W. KING
1180 South 8 West
Salt Lake City, Utah 84104

For the past few months I have been building and selling completely assembled and tested versions of POPULAR ELECTRONICS projects. I can give fairly fast delivery on almost any project your readers might want.

GUY WELCH
227 Evergreen Ave.
Blakely, Ga. 31723

I am willing to sell ready-made projects for a reasonable price. However, since I am a private individual, I may not be able to fill all orders—but I will try my best.

MICHAEL EVANGELIST
2040 Inca Lane
New Brighton, Minn. 55112

I have been an electronic technician for quite a few years, so I have the experience and knowhow to build and troubleshoot projects. I have many good sources of electronic components and would be willing to supply assembled projects or individual parts at a reasonable cost.

VERNON T. ARNY
7052 Sophia Ave.
Van Nuys, Calif. 91406

Any reader who would like to purchase ready-made projects can write directly to any of the above would-be builders.

TRANSMITTING ANTENNAS FOR NOVICES

Can you suggest a simple, inexpensive, and efficient antenna for 40 or 80 meters? The antenna will be used with a transmitter (65 watts input) in a Novice station.

RICHARD JAVGREN
Phillips, Nebr.

You are asking this question at exactly the right time. For some good information on transmitting antennas for a Novice station, see "Antennas for Novices, Technicians and SWL's" on page 59 in this issue.

OUT OF TUNE

Experimenter's Short-Proof Power Supply (*February*, 1968, *page* 54). In Fig. 1, the solder dot at the junction where the base of *Q2*, the collector of *Q3*, and the collector of *Q4* meet was accidentally omitted. This is a common point for these three transistors and their associated components. The printed circuit board in Figs. 2 and 3 is correct. -30-

AMATEUR RADIO

(*Continued from page* 82)

Virtually all Indianapolis and central Indiana amateur radio clubs are supplying equipment, operators, and technical know-how for the operation. Amateurs in the area who want to help make it a success are invited to contact Dick Andrews, K9SVB, 3146 N. Kenwood Ave., Indianapolis 46208, or Jim Jimerson, W9FXC, 1820 Fairhaven Dr., Indianapolis 46229.

One Land QSO Party. All amateurs are invited to participate in the One Land QSO Party between 0000 GMT, April 27, and 2400 GMT, April 28. You operate any 24 hours during this period. New England amateurs work each other and the world; other amateurs work New England. A complete contact requires the exchange of QSO numbers, reports, names of county and state (or country) and operators' names.

Contacts between U.S. stations count one point, except that Novice contacts count five points; DX contacts are worth three points. Stations outside New England multiply contact points by the number of countries worked and again by the number of states worked. New England stations multiply contact points by the number of states and Canadian provinces worked and again by the number of countries worked. The same station may be worked once per band and mode. Frequencies that can be used are: 3575, 7030, 14,075, 21,090, and 28,090 kHz on CW; 3810, 7235, 14,230, 21,330, and 28,800 kHz on AM; 3990, 7210, 14,340, 21,440, and 28,690 kHz on SSB; all Novice frequencies.

Logs and summary sheets go to: Carl Porter, W1ZLX, 19 Penniman Terrace, Braintree, Mass. 02184. Send them no later than June 16 to be eligible for awards.

Items of Interest. In the January issue of *Spurious Radiations* put out by the Rockaway, N.Y., Amateur Radio Club, Andy Cola, W2VZQ, objects to Advanced Class licenses issued before November 22, 1967, being called by that name. He claims that the correct name of the earlier license is "Class A license." Out of curiosity, your Amateur Radio Editor checked his old amateur licenses. Sure enough, the FCC called the one issued in 1946 a Class A license, but it was renewed in June, 1951, as an "Advanced Class" license. Andy seems about 17 years late with his objection.

According to Howard, W7OE, in *Random Radiations,* which he publishes for the Western Division of the QRP-International Club,

the Pontiac Motor Company has withdrawn its offer of free QSL cards to all licensed amateurs who requested them. (This offer was mentioned in our October, 1967, column.) W7OE surmises that Pontiac was snowed under with requests and had to write off the program.

NEWS AND VIEWS

Todd Henry, WN6VUS, 3128 Camino Ave., Hacienda Heights, Calif., is waiting for his "big ticket" to arrive. His record to date is 44 states and ten countries—including Russia—worked. The Heathkit twins, DX-60A transmitter and HR-10 receiver, plus a home-brew electronic keyer do the inside work. A 40-meter dipole and a home-built 2-element, 15-meter beam antenna do the outside work . . . **John Kaufmann, WA1CQW,** 224 Country Club Rd., New Britain, Conn., works CW on all amateur bands from 40 through 10 meters with a Johnson "Adventurer" transmitter. With 50 watts input, a "trap" dipole, and an old Hammarlund HQ-129X receiver, John has worked all continents (WAC) and all states (WAS). In his quest for a DX Century Club (DXCC) certificate, he has worked 110 countries and has cards from 87 of them. John also has a 35-wpm code certificate . . . **Gary F. Willett, WN9WIK,** Box 329, North Manchester, Ind., blew up the final stage of his commercial transmitter shortly after getting his Novice license. But this misfortune didn't slow him down. He built a 10-watt transmitter and now has 20 states and Canada confirmed, mostly on 40 meters. Gary receives on a Knight-Kit R-100A, and a dipole antenna does the radiating.

Michael J. Hagen, II, WB2PPE, NØXFO, RD #2, Box 233, Brewer Road, Waterloo, N.Y., could compile a rather complete amateur equipment catalog by listing the equipment in his station. Hitting the major items, he has a Hallicrafters HT-44 transmitter, Hammarlund HQ-150 receiver, Harvey-Wells KM antenna coupler, Hy-Gain tri-band beam with rotor, 80-, and 40-meter dipoles, etc., etc. He has worked all states and 35 countries, but he would rather rag-chew on CW or SSB than chase DX. Mike is net control station for a Navy MARS net and edits the Navy MARS magazine *The Kilowatt.* All this activity, plus earning a living as an accountant, is from a wheel chair . . . **Mark Connelly, WN1TON,** 86 High Haith Rd., Arlington, Mass., became interested in amateur radio via the SWL route, as WPE1HGI. As a Novice, he has quite an impressive record—46 states and 29 countries worked. A Johnson "Challenger" trans-

Mike Hagen, WB2PPE, Waterloo, N.Y., has an RCC certificate and rag-chews on CW at 35 wpm. Details on his equipment and activities appear above.

Eddie Williams, WB4GDH, Rockmart, Ga., likes to chat about unidentified flying saucers, astronomy, science fiction, and psychic phenomena on phone or CW with his Hallicrafters SX-130 transmitter and his Knight-Kit T-60 receiver. See text below.

mitter and a Lafayette HA-700 receiver do the bench work, and Mark changes antennas about once a month. He still SWL's occasionally with an old Lafayette HA-63A receiver and has heard 182 countries—148 verified. Although Mark expects to have his General ticket before these words are printed, he wishes that some of the DX-peditions would slide down to the Novice band and work a few Novices from time to time . . . **Mike Beal, WN9UJZ/WA9UJZ,** 19247 Wolf Rd., Mokena, Ill., works 40 meters with a Knight-Kit T-60 transmitter tied to a dipole only 12 feet high. A Hallicrafters SX-110 receiver completes the present picture. Mike is not too well satisfied with his present total of seven states confirmed, but he expects to do better when he gets his new Gotham V-40 vertical antenna in operation. Also in the planning stage is a 6-meter station—so that he can schedule his brother, WA9UKH, in Wisconsin.

Bill Wolverton, WN7IOK, P.O. Box 648, Philomath, Ore., decided that his home-brew, 3-element, 15-meter beam was going to work when JA1DDZ, Tokyo, called him while he was testing it. The beam was six feet high on a ladder at the time! . . . **Eddie R. Williams, WB4GDH,** Route 1, Rockmart, Ga., worked Newfoundland and England on 10-meter phone for his first and second contacts as a General Class amateur. Eddie transmits on a Knight-Kit T-60 and receives on a Hallicrafters SX-130. Besides 10-meter phone, he operates CW on 80, 40, 20, and 15 meters . . . Space doesn't permit listing the over-56 licensed members of the Rochester, N.Y., Amateur Radio Club, who—with the aid of their families and others—collected over $1100 in pennies in three hours for the "Eddie Meath Christmas Fund" program broadcast over WHEC, Rochester, last December, but congratulations to them all . . . **Kurt T. Meyers, W8IBX/W3DPR,** Apt. C-102, 2160 E. Main St., Columbus, Ohio, spent 11 months as a student in Baltimore. As an experiment to see what could be done with relatively simple gear, he operated from there with his Collins 75A4 receiver, Johnson Viking "Valiant" transmitter, and a 135-foot end-fed antenna. Results: 130 countries, 50 states, and the winning of several contests. He also worked seven states and Canada on 160 meters with 40 watts.

Your "News and Views," station photos, club bulletins, and announcements of various activities are all "meat" for *your* amateur radio column. Mail them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ

SHORT-WAVE LISTENING

(*Continued from page 71*)

ever heard a re-run by a short-wave broadcaster? Bill Smith, WPE1FZ, Uxbridge, Mass., and your Short-Wave Editor both heard YVMS, *R. Universo*, Barquisimeto, Venezuela, recently operating on 4850 kHz with an all-Spanish transmission. The program was obviously taped and about 15 minutes in length, starting with "The Tennessee Waltz." At the end of each 15-minute segment, an ID would be given, and the entire program would be re-run!

Red Cross Test. The third in a series of test transmissions on behalf of the International Committee of the Red Cross will be broadcast on May 20, 22, and 24. Tests were conducted in January and March, and are also planned for July, September, and November. Reception reports are desired to check on world-wide receiving conditions in case of an international emergency.

The tests are broadcast over the transmitters of the Swiss Broadcasting Corp. on 7210 kHz. Each one-hour test is in three languages (English, French, and Spanish), and starts at 0600, 1130, 1700, and 2300 GMT. Special verifications are available from the Red Cross, Radio Communications Service, 7 Ave. de la Paix, 12211, Geneva 1, Switzerland.

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 identification, and the make and model number of your receiver. We regret that we are unable to use all the reports received each month, due to space limitations.

Albania—Eng. xmsns from Tirana have been reported on 11.855 kHz until 1126 s/off; on 7310 kHz, at 0030-0100; and at 6195 kHz at 2200-2230.

Angola—Stations being heard in the East and Middle West include: CR6RD, *R. Clube de Huambo*, Nova Lisboa, on 3704 kHz around 2130, generally with heavy ham radio QRM; CR6SG, *R. Clube da Huila*, Sa Da Bandeira, on 3970 kHz from 2135 to 2150 fade or s/off, with xylophone music and anmts in Portuguese; CR6RY, *R. Clube de Cuanza Sul*, Novo Redondo, on 4840 kHz from 2225 to 2300 s/off with pop music and commercials (surprisingly good for the listed 2000 watts); and CR6RN, *R. Clube do Angola*, Luanda, on 4867 kHz from 2230 to 2300/close, with music and news headlines in Portuguese; do not confuse this one (as your Short-Wave Editor did at first) with Ponta Delgada, Azores, on 4865 kHz.

Antarctica—DX'ers needing this country might try for VLV, Mawson Base, during the periodic

contact with McQuarie Island on 12.255 kHz around 0100-0105. No definite daily schedule has been noted as yet.

Australia—*R. Australia,* Melbourne, is on 11,820 kHz at 2000-2010 with Eng. news and to at least 2040 with pop records in the Pacific Island Service.

Austria—While preparing this column, your Short-Wave Editor enjoyed Vienna's uninterrupted semiclassical music programs at 2315-0000 on 6155 kHz (dual to 9525 kHz to South America; ID at 2330 and 0000) and at 1925-1950 on 15,210 kHz.

Brazil—*R. Nacional de Brasil,* Rio de Janeiro, was tuned at 2330-0030 and around 0645 with Brazilian music, news bulletins, some drama and light music; all-Portuguese. Station ZYB9. *R. Difusora,* Sao Paulo, is again active on 15,155 kHz as noted from 2355 to 0130 with dance music and all-Portuguese anmts. *R. Cultura Sergipe,* Aracaju, 3293 kHz, is noted at times around 2230 in Portuguese but two other Brazilians on 3295 kHz offer heavy QRM.

Canary Islands—*R. Nacional Espana,* Tenerife. is good on 11,800 kHz around 0115-0300 with music and news in Spanish. A clear ID is given at least every half hour..

Ceylon—*R. Ceylon,* Colombo, 15.230 kHz, is heard well with the Commercial Service in Eng. from 0300 to 0330 s/off.

China—*R. Peking* has Eng. at 0305 on 15,165 kHz, at 0330 on 9780 kHz, and at 0300 on 7120 kHz, all new channels. Your Short-Wave Editor has tuned the 0000, 0100, and 0200 xmsns on 15,060 kHz, also in Eng. to N. A. with the *R. Peking* version of the news, home-brewed musical selections, and talks.

Costa Rica—Gold Coast B/C Station, *R. Casino,* Puerto Limon, has Eng. on 5954 kHz at 0440-0540; pop records and commercials. An overseas source states that *R. Atenea,* San Jose, has purchased a xmtr for use on 6150 kHz with a probable 24-hour schedule.

Cuba—"The Voice of Vietnam" is the name of a new program being aired by *R. Habana Cuba* at 0210 and 0340 on 9525 kHz, at 0440 on 6135 kHz, and at 1940 on 9655 kHz.

Dominican Republic—*R. Mil,* Santo Domingo, has moved to 4929 kHz as noted at 0130, leaving 4940 kHz clear for *R. Yaracuy,* Venezuela.

Ecuador—Station HCVC3, *R. Centinela del Sur,* Loja, is being heard on 5121 kHz, a move from 5035 kHz, in Spanish around 0300 with infrequent ID's.

Ethiopia—Station ETLF, *R. Voice of the Gospel,* Addis Ababa, has been heard here at fair level from 0430 to 0500 s/off with news and commentary to W. Africa. This station has been testing on 11,920 kHz at 0345 with religious subjects and requests reports.

Faroe Islands—Look for OYY39, Thorshavn, with a telephone test around 0245 on 9880 kHz—a good chance to log this rare country.

France—Paris has opened a xmtr on 15,370 kHz as noted with Eng. news from 1915 to 1930 s/off.

Germany (East)—*R. Berlin International* has Eng. to N. A. at 0100 and 0230 (German at 0145) on 9730 and 9500 kHz and to Western areas in Eng. at 0330 (German at 0415) on 9560 and 9650 kHz; to Latin America in Portuguese at 2315 and in Spanish at 0000 on 9500, 9600, and 11,785 kHz, in Portuguese at 0130, in German at 0045, and in Spanish at 0215 on 9600 and 11,785 kHz. Your Short-Wave Editor also found a Portuguese xmsn to

SHORT-WAVE ABBREVIATIONS

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

Latin America at 2230-2300 on 9530 kHz (confirmed by one of our Western monitors).

Mexico—Station XERR, Mexico City, 15.110 kHz, was heard at 2230-2345 with uninterrupted semi-classics; no ID or anmts were given until 2345.

Mozambique—*R. Clube de Mocambique,* Lourenco Marques, is good on 11,780 kHz at 0300-0700 with Eng. and Afrikaans, dance music and many commercials. The outlet on 15.295 kHz (100 kW) has Portuguese daily at 1800-2000 in the "C" program. This station has also ordered 25-, 50- and 500-kW xmtrs for its Commercial Service.

Nigeria—*V. of Nigeria,* Lagos, is heard around 2115 on 15,120 kHz with Eng. and music; ID's are given after almost every musical selection.

Panama Republic—A new radio service to give exact times every minute on a 24-hour schedule, with commercials and constant ID's, is the format of *R. Minutera,* Balboa, on 1115 kHz (medium wave). Comparisons made with WWV have indicated a discrepancy of one and one-half minutes!

Peru—Loggings from the far south include: OBZ41, *R. Erpa,* Canete, on 3320 kHz after 0100, fair with frequent ID's, all-Spanish (verification is prompt); OBX70, *R. Onda Imperial,* a new station in Cuzco listed for 5045 kHz, but heard on 5056 kHz, fair to good until 0400 with ID's and music, no Eng. noted; OAX7Z, *R. Juliaca,* Juliaca, on the same frequency (5082 kHz) since 1962—s/off time is 0400 but the xmsn may run to 0500; OCX4M, *R. Cerro de Pasco,* Cerro de Pasco, listed for 6135 kHz, but heard on 6129 kHz, with usual Latin American programming—heavy QRM noted around 0130; and OAX5C, *R. Ica,* Ica, listed for 9590 kHz, but heard on 9587 kHz, good at times around 0100 with request music, time checks, and ID's—again, no Eng. was noted.

Philippines—Far East B/C Corp., Manila, was observed on 15.440 kHz with religious programs in native language until 0100; an Eng. ID was given, a change in antenna beam made, and a much stronger signal in Eng. heard.

Portugal—"Radio Safari" will *not* close as reported in some quarters last year. The present schedule for this program over *R. Portugal,* Lisbon, is every fourth Monday of the month during Eng. xmsns at 0730-0815 and 0815-0900 on 11,840, 17,740, 17,890, and 21,495 kHz, at 1345-1430 on 17,895 and 21,495 kHz, at 1815-1915 on 17,880 and 21,490 kHz, at 2045-2130 on 6025, 7130, and 9740 kHz, at 2245-2330 on 755 and 1061 kHz, at 0200-0245 and 0345-0430 on 6025, 9635, 9680, and 11,935 kHz, and at 0300-0345 on 5985 kHz.

Senegal—*R. Senegal,* Dakar, is being tuned at 0600 weekdays on 4890 kHz in French and at 2100 on 15.115 kHz with music and anmts in French but with an occasional Eng. ID.

South Africa—A new program, "QTH South Africa," has started on *R. RSA,* Johannesburg, which is intended to explain the Internal Service of this country. *R. RSA's* new N. A. antenna array is scheduled to be finished shortly; when completed, it will be capable of being turned 180° to provide service to Australia. This station has been heard consistently well at your Short-Wave Editor's home during the 2330-0020 and 0030-0120 xmsns in Eng. to Eastern and Central N. A. with news, commentaries, stamp news, and some music.

Radio South Africa (not R. RSA) has been noted on 9570 kHz with the Commercial Service to Africa with ads, lively music, and time checks.

Spain—*R. Nacional Espana,* Madrid, was heard on 9352 kHz, beamed to Latin America with classical Spanish music, news, and talks at 2330-0015, and Spanish folk music to 0030.

St. Helena Island—*R. St. Helene,* Jamestown, is a new station on 1511 kHz, with 500 watts. It has been heard in Africa broadcasting in Eng. until 0030. A rare country.

Switzerland—*R. Switzerland,* Berne, is broadcasting in Portuguese to South America at 2310-0000 on 9590 kHz (replacing 9535 kHz).

Tahiti—Best tuning time is 0300-0330 on 11,825 kHz. The schedule calls for French and Tahitian on weekdays at 1615-1815, 2100-2330, and 0300-0800, and on Sundays at 1900-2330 and 0300-0800 with 6135 kHz operating in parallel. A correct reception report may gain you a lovely Tahitian mermaid riding in a shell through the air—pictured on a QSL card, of course.

Uruguay—Station CXA6, Montevideo, has been audible almost nightly around 0250 on 9621 kHz, with all-Spanish xmsns. Tune carefully; a Russian on the low side provides QRM.

U.S.S.R.—*R. Kiev,* Ukrainian SSR, has Eng. on Mondays, Thursdays and Saturdays to Europe at 1900-1930 on 11,760 & 9610 kHz and to N. A. at 0030-0100 on 12,030, 11,970, 11,900, 11,760, 9710, and 9610 kHz, and at 0420-0500 on 12,030, 11,900, 11,890, 11,850, and 9610 kHz.

Vatican City—*Vatican Radio* has been tuned at 0100 in Eng. on a new frequency of 7255 kHz, and at 1915 in French on 17.730 kHz. The language on the latter channel changed to Eng. from 1930 to 1945. Your Short-Wave Editor logged the 21,485-kHz outlet at 1515 with a short address in Eng. by the Holy Father.

Windward Islands—Windward Islands B/C Service, St. Georges, Grenada, is being heard as early as 0000 on 11.970 kHz. A new frequency in use is 11,700 kHz, noted at 1950 with music, at 1955 with ID, at 2000 with BBC news, at 2010 with commentary; heard until 2130, the xmtr is beamed to the British Isles.

Yugoslavia—*R. Beograd,* Belgrade, has opened on a very seldom used frequency, 9620 kHz, from 2315 s/on in French with news. —30—

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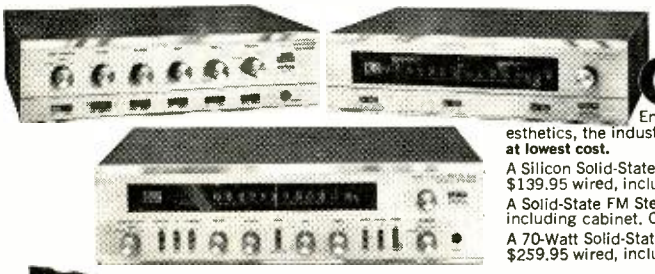

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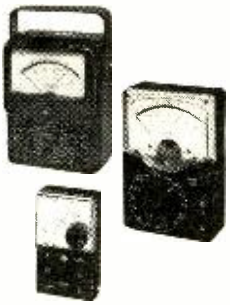

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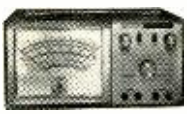

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