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FALL-WINTER 1974 $1.35

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Conserve gas, tune up your car, and do it right, today!

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Switch AC power on time for lab, darkroom and kitchen use.

Vehicular Voltmeter
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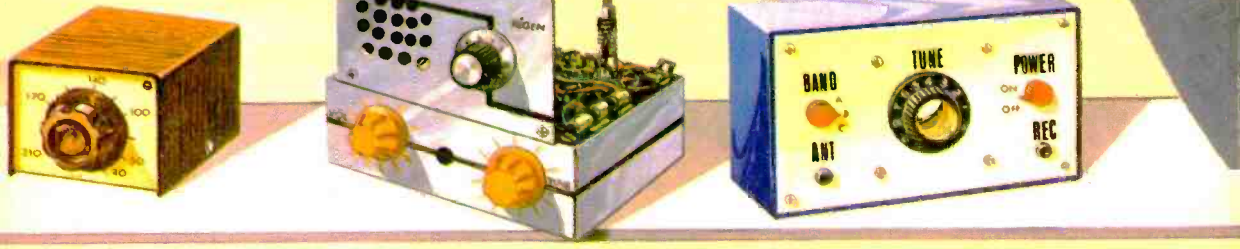

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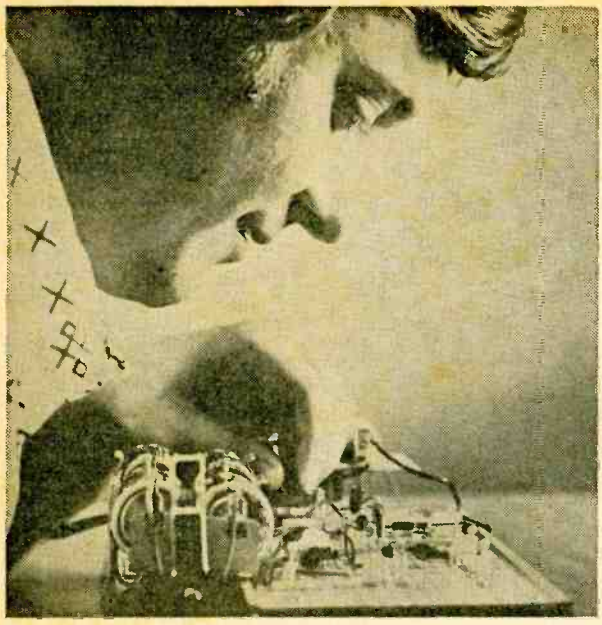

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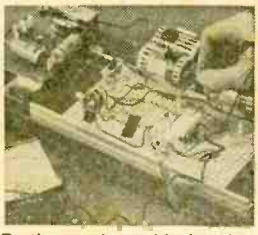

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CIRCLE NO. 5 ON PAGE 17 OR 114

ELECTRONICS HOBBYIST

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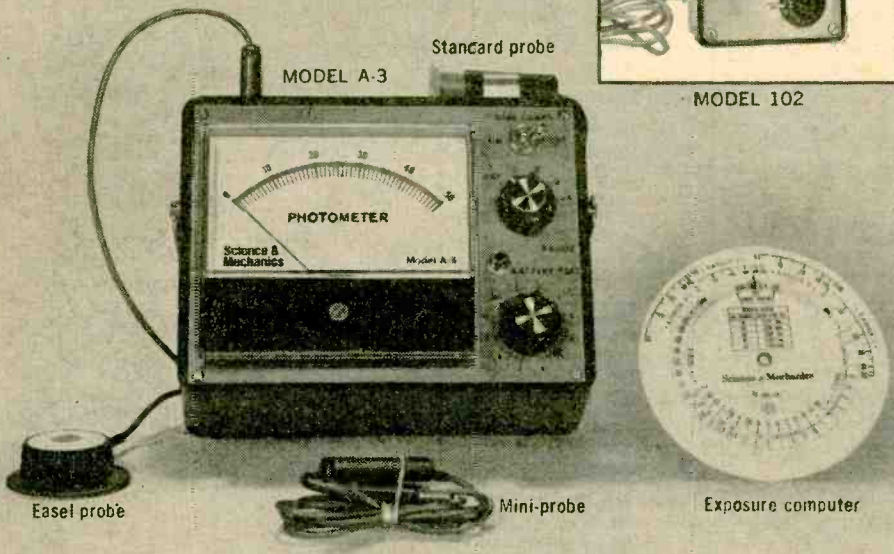

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FALL/WINTER 1974 EDITION

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Dedicated to America's Electronics Hobbyists

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Biofeedback Monitor

With the ever increasing interest in biofeedback monitoring (listening to one's alpha and theta brainwaves for greater relaxation, concentration, and other possible benefits), Edmund Scientific Co. has produced a highly sophisticated monitor especially designed and economically priced for serious amateurs as well as professional researchers and clinicians. This deluxe, high quality instrument has a built-in scoring device that enables the

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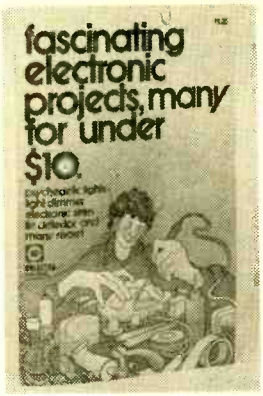
user to observe the exact degree of progress being made in alpha/theta production. Highly sensitive, Edmund's "On-Time" monitor provides the user with reliable audio and visual feedback in the alpha/theta brainwave spectrum, simultaneously keeping an accurate electronic record of the alpha/theta response during a specific training session. A front panel switch permits control of the system to begin tracking time (0 to 20 minutes) whenever the user generates alpha or theta rhythm. It is available by mail (Stock No. 1652, $349.50 postpaid) from Edmund Scientific Co., 380 Edscorp Bldg., Barrington, NJ 08007. Complete instructions are included.

Projects Book

Thirteen easily assembled electronic projects are featured in the new *Fascinating Electronic Projects* book, No. FR-174, offered by GC Electronics, Calectro Division. The book includes easy-to-follow schematics and instructions on how to build such interesting and useful devices as an Emergency Lamp Flasher, Metal Locator, Rechargeable Lantern, Psychedelic Lights, Hobby Lie Detector, and eight others. Most are battery operated, feature solid-state design, and can be constructed for less than $10.00. The book also contains an introduction that offers valuable

NEW PRODUCTS



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construction tips and techniques that are beneficial when constructing any electronic project. As well as *Fascinating Electronic Projects*, GC Electronics offers a *Digital Handbook*, No. FR-169, a *FET Circuit Book*, No. FR-172, and hundreds of electronic accessories and components under its Calectro label. For more information, write to GC Electronics, 400 South Wyman, Rockford, IL 61101.

Needs No Batteries

Circle No. **25** on Reader Service Coupon

The Model ASM-105 compact portable field strength meter introduced by Ascom Electronic Products, a division of The Antenna Specialists Company, is designed for handy field checks of antenna radiation. It can be used to tune antennas for peak radiating efficiency, as well as making comparative tests of many transmitters and antenna system installations. The ASM-105 requires no internal power, operating entirely from the RF field, and covers the frequency range from 27 MHz through 225 MHz. This includes the Class D citizens band, low band and high band VHF land-mobile channels, as well as the amateur 10, 6, 2, and 1¼-meter bands. Price of the ASM-105 is $15.95. Complete details are available from Ascom Electronic Products, 12435 Euclid Avenue, Cleveland, OH 44106.

Electret Condenser Microphone

A multi-purpose electret condenser microphone with 140 dB sound level capability is available from Group 128, Incorporated. Designated SD140, the new omni-directional microphone is built around a rugged minature electret condenser element. The microphone weighs less than two ounces, which simplifies mounting hardware requirements. The small size of the SD140 eliminates both the visual and mechanical problems of mic placement. The unit is supplied with a ballast counterweight and universal stand adapter with standard ⅝-in. x 27 thread. The SD140 has a wide dynamic range coupled with a high sound level capability of 140 dB without

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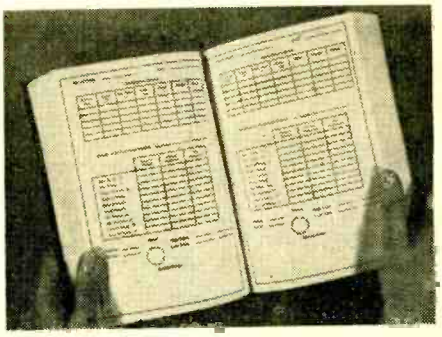
overload or distortion. This permits its use in closer proximity to the sound source than in any other microphones. The American-made SD140 is available from audio dealers or direct from the manufacturer at a price of $134.50. For complete product specifications and buying information contact Group 128, Incorporated, 50 Sun Street, Waltham, MA 02154.

Weather Log

Millions of people listen to the daily weather reports and observe local weather conditions with no place to keep daily weather records. The Edmund Daily Weather Log (No. 9462)



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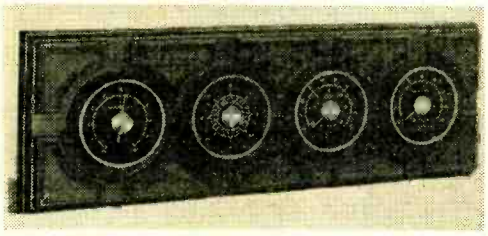
lets you keep the daily weather patterns for one full year in an organized book! A great way for amateur weather forecasters to learn to predict future trends. Farmers, scouts, hunters, fishermen, and others engaged in outdoor activities will also find the Log valuable. Each page lets you record detailed information on temperature, humidity, pressure, wind, clouds, etc. There's even a spot for comparing your prediction and the official prediction against the actual weather! This 372-page Log is available for $4.95 postpaid and is filled with weather facts, tips, and interpretation as well. To order your Weather Log, just send your name, address, and check or money order to: Edmund Scientific Co., 555 Edscorp Bldg., Barrington, NJ 08007.

Weather Station

The kit-form ID-1290 Weather Station with barometer, lighted wind direction indicator, wind-speed gauge, and indoor/outdoor thermometer has been introduced by Heath Com-



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pany. The weather station features a solid-state thermometer that displays either indoor or outdoor temperature at the flip of a switch; solid-state wind-speed gauge with switch-selectable ranges for 0-30 and 0-90 mph; a unique electronic wind-direction indicator with pointers that light up individually or in combination to give 16-point resolution around the compass. The barometer has an exclusive precision movement that provides 2½-times greater pointer deflection than conventional barometers. Sensing devices for the Heathkit Weather Station are mounted on single horizontal mast that easily attaches to a TV antenna mast or tower. The wind vane and wind cup use hermetically sealed reed switches for trouble-free operation in all kinds of weather. All connecting wires are contained in one handy cable for simple installation. Priced at $89.95 mail order, the Heathkit Weather Station can be built with conventional hand tools and a soldering iron. Installation cable can be ordered in lengths of 50 ft. (IDA-1290-1, $5.95), 100 ft. (IDA-1290-2, $9.95), and 150 ft. (IDA-1290-3, $14.95).

Thumb-Slide Adjustable Wrench

Thumb-slide on the side of the handle makes this adjustable wrench simple to operate.

NEW PRODUCTS

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It Repeats

The Hustler two-meter colinear antenna, Model G6-144-A, is expressly designed for repeater or any fixed station two-meter operation. FCC accepted for repeater application, the antenna is conservatively rated at 6 dB gain. Special features are built into this 117-in. antenna including high power capability, shunt feed with DC grounding, easily accessible SO-239 connector, four radials, heavy duty construction, and double "U" bolt mounting. Price is $49.95 amateur net. For additional information, contact Sales Department, New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark, OH 44142.

Circle No. **17** on Reader Service Coupon

Tunes in Weather

Your own shirt-pocket size Weather Bureau is what Radio Shack is offering with their new Mini Weatheradio which is about the size of a pack of cigarettes and capable of pulling in the National Weather Service reports being broadcast 24 hours a day in many parts of the country. It provides up-to-the-minute weather information and forecasts for campers, boaters, pilots, farmers, motorcyclists —anyone outdoors. National Weather Service broadcasts are provided by the National Oceanic and Atmospheric Administration as part of the nationwide Natural Disaster Warning System (NADWARN). Although designed primarily for public safety, to speed warnings of environmental hazards to threatened areas, routine weather reports and special information such as a travelers weather outlook and recreational forecasts are also concontinously broadcast. The Realistic Mini Weatheradio, with battery and wrist strap, is priced at $14.95. Realistic products are available from Radio Shack stores and Authorized Sales Centers in all 50 states.

Circle No. **28** on Reader Service Coupon

Portable Shortwave Receiver

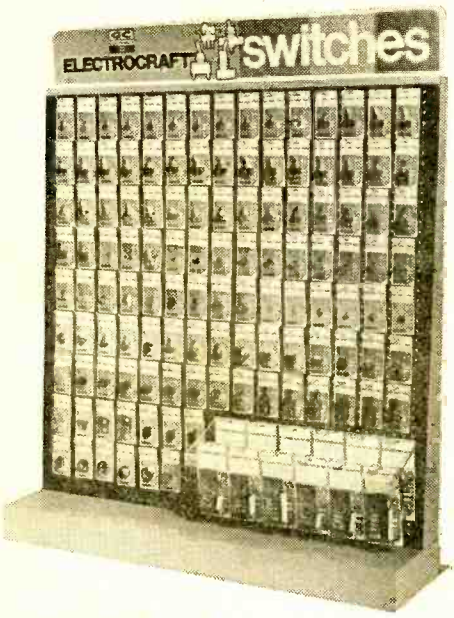
Barlow Wadley's XCR-30 receiver is the first moderately-priced (about $260.00) all solid-state portable (requires six D cells) to feature direct frequency readout. Using a multiple heterodyne circuit (interpolation and crystal

Circle No. **12** on Reader Service Coupon on page 17 or 114

oscillators), the XCR-30 is a high sensitivity receiver designed to provide precision no-gap tuning form 500 kHz to 30 MHz. A 1-MHz crystal—in conjunction with the famous Wadley Loop circuit (Racal)—stabilizes the received frequency and eliminates drift. The tuned frequency is displayed mechanically as a composite function of two dials; the whole number (in MHz) shown on one dial drum, and the decimal portion (in kHz) shown on the second. Reception modes include AM, CW, and switchable (LSB or USB) single sideband. There are provisions for an external 9-12 volt DC supply, earphone reception, and an external antenna (there is a built-in collapsible whip antenna). A spec sheet on the XCR-30 is available from the distributor, Gilfer Associates, Inc., 52 Park Avenue, P.O. Box 239, Park Ridge, NJ 07656.

Rack Full of Switches

A specially selected assortment of switches and switch accessories is offered by GC Electronics distributors. Over 120 different switch types individually carded are displayed on a space saving, self-service peg-board rack.



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Here you can find the most popular toggle, slide, reed, key, paddle, rocker, multiple pushbutton and appliance switches, and accessories such as vinyl caps, colorful lenses, replacement keys, and on/off face plates. Also available on the rack is an attractive catalog, complete with cross reference, mounting templates, and descriptive information and specifications on each item. To get more information, write directly to GC Electronics, 400 South Wyman, Rockford, IL 61101 and tell 'em Elementary Electronics sent you!

Solid Receiver

The Lafayette HA-600A general coverage receiver covers 150 kHz to 30 MHz in five bands, making it ideal for the shortwave listener. It features a large illuminated slide-rule tuning dial with calibrated band-spread for the 80, 40, 20, 15, and 10 meter amateur bands, and 0-100 logging scale. The HA-600A

Circle No. **11** on Reader Service Coupon

receives AM (phone), CW (code), and SSB (single-sideband) signals. The variable BFO permits selection of upper or lower-sideband in SSB mode, and pitch of CW signals. The HA-600A employs a tuned RF and mixer stage, two IF stages, and a mechanical filter for maximum sensitivity, high signal-to-noise ratio, and fine selectivity. Solid-state circuit design includes a product detector for CW and SSB reception, and a separate diode detector for AM reception. Other features include an S-meter, RF gain control, ANL, antenna trimmer, front-panel headphone jack, rear panel tape recorder output, external speaker, and antenna connections. Priced at $137.50. Available by mail order or from any Lafayette store.

"I figured there was a simple explanation. Your antenna touched the power line."

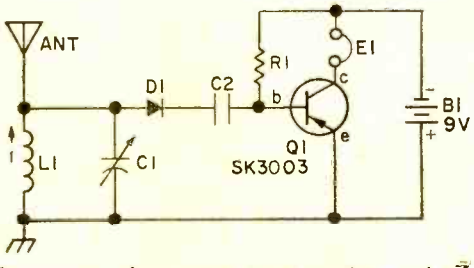
SIMPLE PROJECTS

• BEGINNER'S RADIO

That old favorite, the crystal radio, becomes more than just a weak voice buried in the headphone when it's amplified with a "junk box" amplifier.

Transistor Q1 can be just about any general purpose pnp germanium type such as the 2N107, 2N109, etc. The SK3003 specified gives a little extra gain to give you an edge when tuning in DX.

L1 is any ferrite antenna coil for the broadcast band, while E1 must be a magnetic headset for maximum output level. To align the receiver, set C1's dial to the known



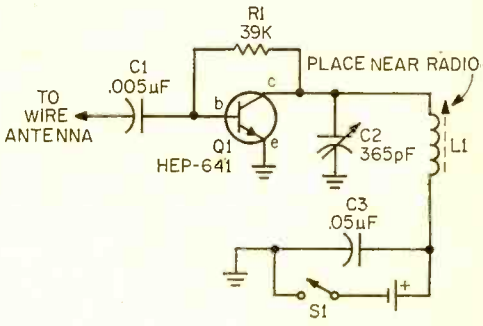
frequency of a strong local station and adjust L1's slug until you hear the station in the phones.

For reception of weaker signals the receiver should be connected to an earth ground such as the cold water pipe. The longer the antenna, the better the reception. Try 20 feet or more.

B1—9-V battery
C1—365-pF tuning capacitor (Calectro A1-227or 232)
C2—0.2-uF, 10-VDC capacitor
D1—1N60 diode
E1—Hi-impedance magnetic earphone (Calectro J4-825)
L1—Ferrite antenna coil (Calectro D1-841)
Q1—SK3003 (RCA); Calectro KA-500
R1—100,000-ohm, ½-watt resistor

• POCKET BCB BOOSTER

Here's a low cost project that can pack a lot of extra sensitivity into a ordinary transistor pocket radio. You'll be able to do some extensive broadcast band DX'ing with

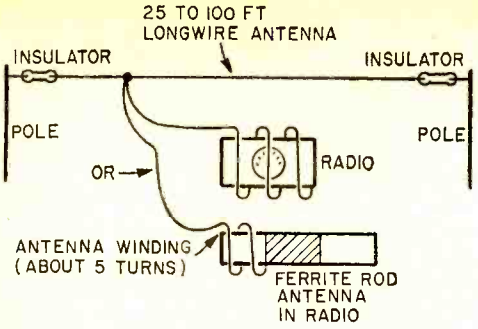


that pocket portable the bank gave you when you opened an account. Assemble the unit in a small plastic cabinet with coil L cemented to the side or back of the cabinet; use an adhesive such as General Electric's RTV. Connect from 10 to 80 feet of antenna wire to the input, and position this pocket booster flat against the radio with L1 directly behind the lopstick antenna built into the radio. Tune capacitor C2 to the approximate frequency you want to receive, then turn on the radio and listen to the signals boom in. Keep in mind that the receiver's normal AVC action will mask any boost applied to strong signals you receive.

B1—15 volt penlight AA battery
C1—0.005 uF disc capacitor, 25 VDC or better
C2—365 pF miniature tuning capacitor with dial (Calectro A1-232)
C3—0.05 uF disc capacitor, 25 VDC or better
270-1430, Calectro KA-501 or equiv.)
L1—Loopstick (Calectro D1-841)
Q1—NPN transistor, Calectro KA-501
R1—39,000-ohm, ½-watt resistor
S1—Switch, SPST (on-off)

• NO PARTS BCB BOOSTER

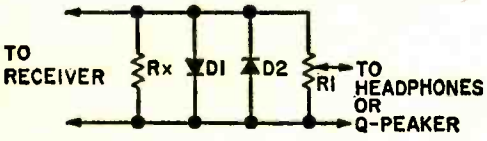
Just about any transister radio can be made a "DX hound" with the No Parts BC Booster. Simply bring in the end of an outdoor "longwire" antenna and wrap the end around the radio about 5 times. Even better reception is possible if you open the



radio and wrap about 5 turns around the rod antenna immediately adjacent to the antenna coil mounted on the rod. Make certain the ends of the antenna are insulated with glass or ceramic insulators.

• HEADPHONE LIMITER

Most receivers don't provide automatic volume control on code reception. Thus a CW signal that blows your headphones off one moment might lie buried on the threshold of hearing the next. The Headphone Limiter chops those S9-100 signals down to size until they equalize with weaker signals, giving relatively constant headphone volume. Because the clipping action produces

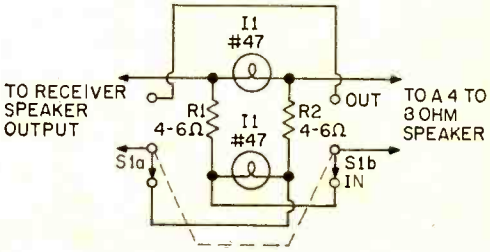


some distortion, the limiter should feed a headphone Q-peaker (described in another circuit). The value of Rx should match the existing speaker impedance and power. In most cases this will be equal to 4 ohms at 2-5 watts.

D1, D2—1N60 diode (Calectro K4-550)
R1—5000-ohm audio taper potentiometer (Calectro B1-681 or equiv.)
Rx—See text

• SPEAKER SQUELCH

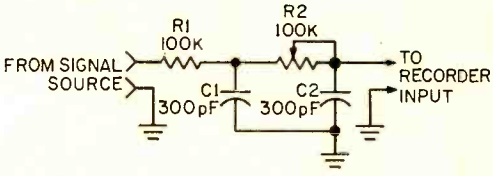
It's almost a universal rule that two-way radios have a squelch control, a device that mutes the background noise until a station is received. Even public service radios now include a squelch, so why put up with ear-jarring noise when listening on your SWL receiver. Just a couple of #47 pilot lamps scrounged from old tube radios and two resistors are all that's needed to squelch your SW receiver. And if you can't scrounge the lamps, they're available at just about every radio parts distributor and service shop. Switch S1 is needed only to bypass the squelch for very weak signals. In many instances, the circuit will provide a basic attenuation of the noise background, not complete squelch. But it's a substantial squelch considering the low cost and ease of construction. Just about any enclosure, plastic or metal, can be used. The components can even lie on the table.



I1, I2—#47 pilot lamp (Calectro E2-442)
R1, R2—4 to 6-ohm resistor, 1-watt, 10 percent
S1—Switch, DPDT

• TAPE DUBBING FILTER

Next time a friend asks you to dub his old 78 or worn 45 record collection on tape, don't start telling him how it will come out with more scratch and noise than music. No need to apologize. Just pass his records through the Tape Dubbing Filter and



he'll never know *wh' hoppen'* to the noise —it will all be gone. The filter connects between the signal source such as a record player and your tape recorder. It's cut-off frequency starts at about 5000 Hz, attenuation increasing at the higher noise producing frequencies. Control R2 allows you to shift the "corner" frequency slightly up or down to obtain more or less high frequency attenuation as needed. For proper operation, the recorder input impedance should be at least 100,000 ohms. Some solid state recorders with input impedances

(Continued on page 15)

LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO*'s 1975 catalog takes care of both breeds of buyers at prices you will like.

102. *International Crystal* has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).

103. See brochures on *Regency*'s 1975 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service/emergency broadcasts).

104. Dynascan's new B&K catalog features test equipment for industrial labs, schools, and TV servicing.

105. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

106. Get *Antenna Specialists*' cat. of latest CB and VHF/UHF innovations: base & mobile antennas, test equipment (wattmeters, etc.), accessories.

107. Want a deluxe CB base station? Then get the specs on *Tram*'s super CB rigs.

108. You want *Xcelite*'s new ratchet socket wrench set the moment you lay eyes on it. It has eleven sockets from 3/16 inch through ½ inch. The set includes a reversible ratchet handle with two spanner extensions—2 inches regular and 5¾ inches.

109. *Bomar* claims to have C/B crystal for every transceiver . . . for every channel. The catalog gives list of crystal to set interchangeability.

110. A *Turner* amplified mike helps get the most from a CB rig. This free brochure describes line of base & mobile station models.

111. *Midland*'s line of base & mobile CB equipment, marine transceivers & accessories, and scanner receivers are illustrated in a new full-color 16-page brochure.

112. *EDI (Electronic Distributors)* has a catalog with an index of manufacturers' items literally from A to Z (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or $699.95 for a stereo AM/FM receiver, you'll find it here.

113. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

114. From *Olson* get their new, bargain-packed 36-page, full-color tabloid (a new issue every 2 months). It contains their latest electronics parts, supplies, and hi-fi components. Pick up a copy at Olson stores coast-to-coast or send for a free copy today.

115. *Trigger Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

116. Get the HUSTLER brochure illustrating their complete line of CB and monitor radio antennas.

117. *Teaberry*'s new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the innovative "Crime Fighter" receiver and a pocket-size scanner).

119. Besides *Browning*'s colorful leaflet on their Golden Eagle Mark III base station, their packet includes other surprises. The SST transceiver is claimed to have unparalleled design in the CB world. The LTD is pictured in actual size on a card for you to test on your car's dash. Specifications are given for both the SST and LTD. All literature is in full color.

120. *Edmund Scientific*'s new catalog contains over 4000 products that embrace many sciences and fields.

121. *Cornell Electronics*' "Imperial Thrift Tag Sale"-Catalog features TV and radio tubes. You can also find almost anything in electronics.

122. *Radio Shack*'s 1975 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. It's just off the press—*Lafayette*'s all-new 1975 illustrated catalog packed with CB, hi-fi components, test equipment, tools, ham rigs, and more.

124. *Mosley Electronics* reports that by popular demand the Model A-311 3-element CB beam antenna is being reintroduced. Send for the brochure.

125. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.

126. *B&F Enterprises* has an interesting catalog you'd enjoy scanning. There are geiger counters, logic cards, kits, lenses, etc.

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

128. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

129. Semiconductor Supermart is a new 1975 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. *Heath*'s new 1975 full-color catalog is a shopper's dream—chockful of gadgets everyone would want to own.

more at right →

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SIMPLE PROJECTS

(Continued from page 13)

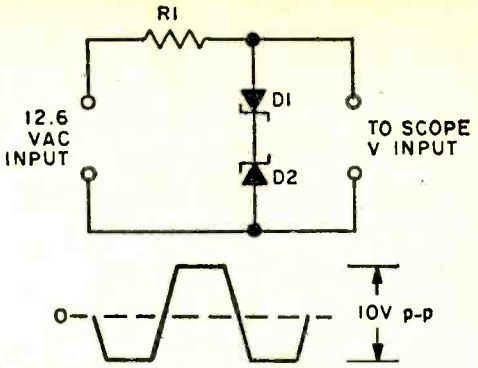
less than 100,000 ohms will reduce the degree of high frequency noise filtering. This unit should be built in a metal enclosure.

C1, C2—330 pF disc capacitor, 50 VDC or better (Calectro A1-011)
R1—100,000-ohms, ½-watt resistor
R2—100,000-ohm potentiometer, any taper (Calectro B1-686 or equiv.)

● SCOPE CALIBRATOR

Back-to-back zener diodes provide a scope calibrator with a zero reference output. Whether the calibration voltage is fed to a scope's AC or DC input, the baseline will not have to be readjusted.

When the top of D1 goes positive D1 conducts current through to the D2 cathode. The voltage across D2 builds until 5 V is reached and the output waveform is 5 V positive. The reverse action takes place when the top of D1 goes negative, providing an output waveform of 5 V negative. The total result is a 10 V peak-to-peak square wave to calibrate the scope face.



D1, D2—5-V, ¼-watt Zener diode
R1—270-ohm, ½-watt resistor

(Continued on next page)

Use Coupon on Left!

131. *E. F. Johnson's* 1975 full line of CB transceivers and accessories equipment is featured in a new 16-page brochure. A 4-color folder on monitor scanner line is also offered.

132. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

133. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

134. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

135. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

136. *Leader's* catalog features "Instruments to Believe In." They have a complete line for industry, education and service, featuring oscilloscopes/vectorscopes, many generators, accessories, etc.

137. *Pace Communications* has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will cost to operate. A booklet on Pace's scan/monitors to keep you informed is included.

138. *Pearce-Simpson* has a booklet, "Citizens Band Radios & Scanners," which pictures and describes the various models in this line. A section on CB antennas is included.

139. For the latest information on CB transceivers by *Courier*, send for their literature.

140. Featured in *Siltronix's* brochure are single sideband/AM citizen band transceivers, pictured and described with extra features and specifications listed. VFO sliders for monitoring are pictured as well as export models of linear amplifiers.

141. *Lee Electronics Labs* has an inexpensive circuit analyzer, which is featured in this catalog.

142. Available from *Royce Electronics* (a new name in electronics manufacturing) is a 16-page catalog for CB'ers. See their base and mobile transceivers, accessories and test instruments.

143. A set of Abraxas/4 speakers contains a rugged 12-inch long-throw woofer with a 22-oz. Alnico magnet, a 5-inch sealed-back rubber-damped midrange, and two 3-inch dome tweeters from *Designers Audio Products*.

144. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CB'ers from *Hy-Gain Electronic Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

146. *Robyn International* has 4-color "spec" sheets for each model of their CB (base and mobile) transceivers and monitor-scanner lines.

147. *Telex's* 4-page, 2-color folder illustrates their new line of boom microphone head-sets for CB'ers and hams, as well as their line of communications headphones.

148. *American Trading Corp.* offers you two catalogs in 4-color. One features their Electronics 2000/Contact CB, pictured with descriptions and specifications. Their Monitor/Scanner, Surveyor Model 4H 4U, is featured in the second catalog.

149. *Cush Craft* has a catalog on Citizens Band Antennas for every purpose. The Ringo base antenna is featured, as is the new Superfire 8-element horizontal/vertical power beam.

150. Get the most out of your CB rig or scanner receiver with *ASCOM* accessories. An 8-page brochure illustrates antenna matcher, antenna switch, modulation bridge, monitor/scanner, preamps, translators, and other equipment performance helpmates.

151. For a complete audio accessory line-TV, tape, phono and radio for home and auto, send for *Audiotex* catalog FR 73-A.

152. Operating two (or more) TV sets plus your FM stereo receiver from one outdoor antenna? Find out how to improve your reception with a *Finco* multiple-set amplifier in this booklet of detailed specs of five models.

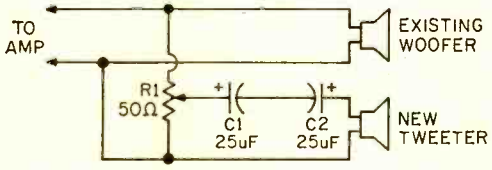
153. A full-color brochure on *Tennelec's* scanners is available. They have portables, 3 bands—12 channels and 3 bands—16 channels. Outstanding features and specifications of the tri-bands are listed.

SIMPLE PROJECTS

(Continued from page 15)

● ADD A TWEETER

Any single voice coil speaker is hard pressed to handle both low and high frequencies simultaneously—and it's the highs that suffer most. A much cleaner sound can usually be obtained from speakers 6 inches or larger if the highs are pumped through a tweeter. It can be any small speaker rated 4 to 6 ohms of approximately 2 to 3 inches in diameter. The back-to-back capacitors, C1 and C2, permit only the highs from about 1500 Hz up to pass into the tweeter. By keeping the lows



out of the tweeter, the highs come out cleaner, and there's no chance of the greater low frequency power "blowing" the tweeter. Potentiometer R1 is used to match the tweeter's output level to that of the woofer—because small speakers are generally much more efficient than large speakers. If you eliminate R1, the highs will literally scream in your ears.

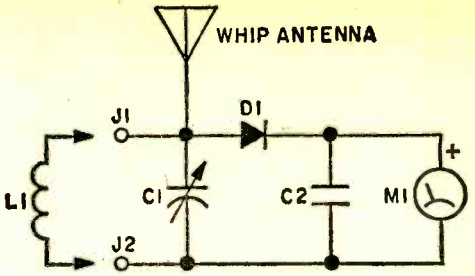
C1, C2—22-uF electrolytic capacitor, 50 VDC (Calectro A1-152)
R1—50-ohm wirebound potentiometer, 1 or 2 watts.
Misc. Cone type tweeters such as the Lafayette 99-01562 are suitable for use with this circuit.

● FIELD STRENGTH METER

High sensitivity without amplification is obtained when a field strength meter (FSM) is tuned to its operating frequency. With a *poly*-type miniature capacitor for C1, the FSM can be built in a pocket-size cabinet.

Tuning range is from 1.5 to 144 MHz, depending on the choice of coil L1. The coil can use phone tip jacks for a plug-in connection for band changing. Consult any coil table for L1's winding data since coil construction depends on the type of wire and frequency.

Even greater sensitivity is obtained if a



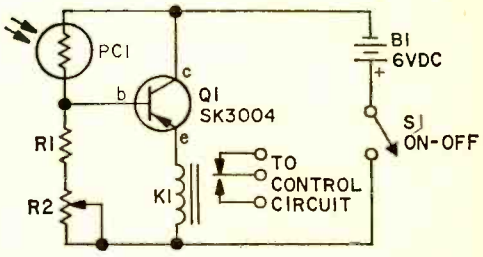
more sensitive meter is used. A 50-uA meter, M1, provides maximum sensitivity combined with reasonably rugged construction.

C1—365-pF variable capacitor (Calectro A1-233 or equiv.)
C2—.005-uF disc capacitor
D1—1N60 or Calectro K4-550 diode
J1, J2—Phone tip jack
J1—Coil (see text)
M1—0-1 mA DC meter (Calectro D1-938)

● LIGHT CONTROLLED RELAY

With only a handful of low-cost components this photo relay turns a light on or off according general room illumination.

Q1 can be any general purpose pnp transistor of the 2N109 or 2N217 variety, though greater sensitivity is obtained with the 2N2613 type. Relay K1 is a high-sensitivity type like the Sigmas used by model



radio control hobbyists.

Potentiometer R2, part of a voltage divider consisting of photocell PC1, R1 and R2, is set so that with normal illumination falling on PC1 the base bias current (through PC1) is just below the value needed to generate the collector-emitter current required to activate relay K1. When additional light falls on PC1, photocell resistance decreases, thereby increasing the base bias, which causes greater collector current to flow and the relay closes.

This circuit can be controlled by sunlight so K1 drops out at dusk to turn on a night

(Continued on page 18)

ELECTRONICS HOBBYIST

READER SERVICE PAGE

• The Editor of ELECTRONICS HOBBYIST offers readers an easy way to get additional information about products and services advertised in this issue. Also, if you would like more information about any new product mentioned in our new products column, it's yours for the asking. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost.

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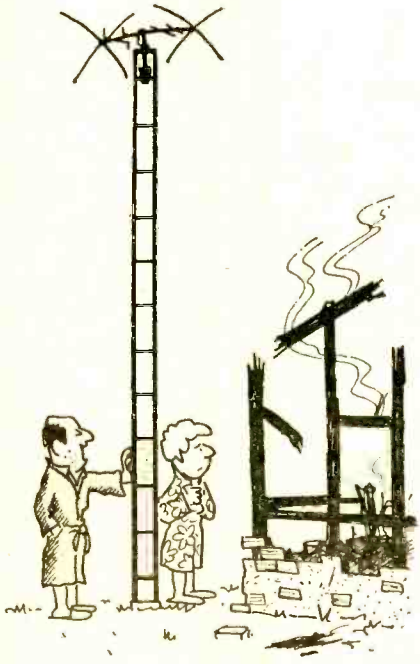
ELECTRONIC FUNDAMENTALS

By Jack Schmidt

"According to this, the guarantee becomes null and void upon application of electrical power."



"... like I told you before, the lightning arrestor carries the bolt away from the tower and ..."

"... they're very strict about things like antenna height, power output, frequencies, etc."

"I don't believe you're monitoring anything. You're just wearing those so you can ignore me!"

"I've checked everything three times, but it still won't work."

ELECTRONICS HOBBYIST
FALL-WINTER 1974

Shortwave Listeners...

Gain-A-Boost

By Charles Green, W6FFQ

Add pep to your receiver from 1.7 through 36 MHz!

A PRESELECTOR is a tuned RF amplifier unit separate from the receiver. The preselector is tuned to the received signal to give a greater signal to noise ratio and a better image rejection. In the old days of ham radio and SWLs, commercial preselectors were available, but now the emphasis on compact solid-state shortwave receivers has nearly made the preselector a kin to the extinct dodo bird.

But many solid-state SW receivers have fairly broad tuning in their front ends and can use an additional stage of selectivity. Also, many older lower-priced receivers can use a bit more gain and an increased image rejection to dig out the DX stations.

Our preselector project will add both selectivity and additional gain to both SWL and ham receivers, as well as to the experimenter's home-constructed SW regen receivers. This preselector has a resistance-coupled output (the signal for your receiver is developed across R1) and can be connected to all types of receiver antenna input terminals and impedances.

Normally, construction of a tuned RF amplifier is difficult for the average experimenter and SWLer. But our project uses an integrated circuit that is designed for IF or RF amplification with the equivalent of three transistors, two diodes and two resistors included inside its miniature package. It has low internal feedback that provides a highly stable amplifier for RF. This integrated circuit is the type 703.

The preselector project covers a frequency range of approximately 1.7 MHz to 36 MHz in three bands. A bandswitch is included for easy operation instead of plug-in coils. Construction is simplified by the use of commercial SW coils, so that you don't even have to wind coils.

Gain-a-Boost

With perf board and push-in clip construction used for easy building, most of the components mount on the board. This unit is an ideal first construction project for the novice. The preselector is built in a compact box with a battery power supply.

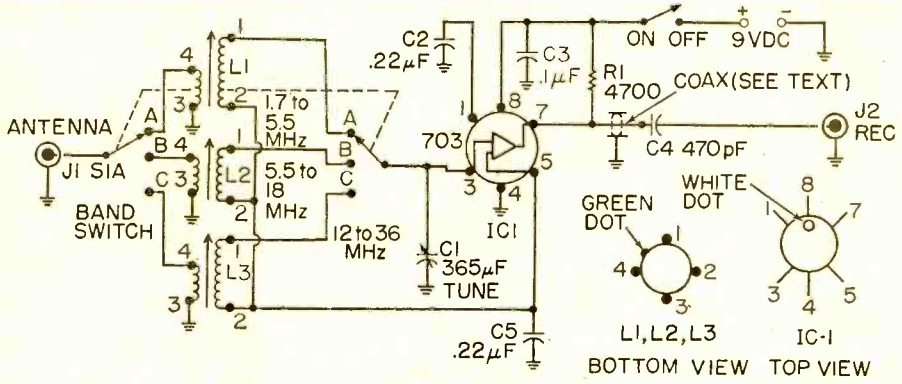
About The Circuit. Signals from the antenna at J1 are coupled via S1A to the primary winding of one of the antenna coils L1, L2 or L3; Band A (L1) is tuned by C1 from approximately 1.7 MHz to 5.5 MHz, Band B (L2) from 5.5 MHz to 18 MHz, and Band C from 12 MHz to 36 MHz.

S1B (ganged with S1A) connects C1 and the input circuit of IC1 to the secondary winding of the antenna coils where the signals are tuned. Amplified signals from IC1 are connected via C4 to the external SW receiver via J2. S2 controls the DC power to the IC1 circuits from B1. Capacitors C2, C5 and C3 act as RF bypass capacitors for the internal amplifiers of IC1, and R1 is the output load resistor.

Construction. The preselector is built in a 7¾-in. long by 4⅜-in. wide by 2⅜-in. deep bakelite utility box with an aluminum panel. All of the components (with the exception of B1) are mounted behind the aluminum panel which provides some RF shielding for the circuits. Most of the components are installed on a 4¼-in. by 3½-in. section of perf board with push-in clips for easy construction. Because of the high frequency operation of the circuits, the parts placement is critical, and for best performance follow our component layout and wiring placement.

Begin construction by mounting C1 in the center of the aluminum panel as shown in the front panel photo. Then, cut the perf board section to size and mount it with ¾-in. metal spacers at the board corners over C1. Locate and mount the switches S1A,B and S2 as shown in the photos and then install J1 and J2 on the panel below the switches.

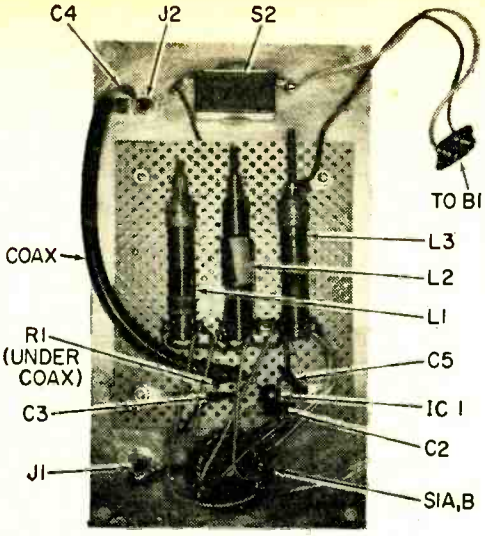
The three antenna coils L1, L2 and L3 are mounted on the perf board by soldering #2 and #3 terminals to push in clips, and the top end of the coils are held on with a single turn of wire around the threaded bushing and soldered to a push in clip. Connect the push in clips holding the top end of the coils to a ground lug mounted on one of the screws holding the perf board. Make sure that the coils are positioned with the

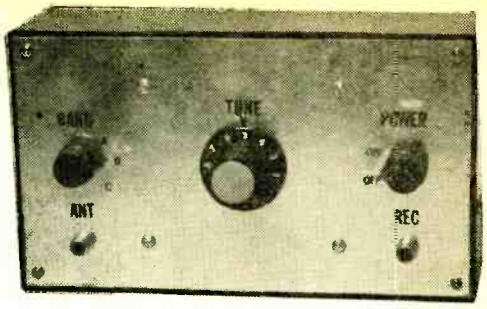


PARTS LIST FOR GAIN-A-BOOST

B1—9-volt battery or DC power supply (see text
C1—365 pF miniature variable capacitor
C2, C5—0.22 uF capacitor, 12 VDC or better
C3—0.1 uF capacitor, 12 VDC or better
C4—470 pF capacitor, 12VDC or better
IC1—703-type integrated circuit
J1,J2—Phono jacks (see text)
L1—1.7 to 5.5 MHz antenna coil J.W. Miller B-5495-A)
L2—5.5 to 18 MHz antenna coil (J.W. Miller C-5495-A)
L3—12 to 36 MHz antenna coil (J.W. Miller D-5495-A)
R1—4700-ohm, ½-watt resistor
S1A,S1B—2-pole, 3-position rotary switch (Mallory 3223J or equiv.)
S2—SPST rotary or toggle switch

Misc.—Cabinet and metal panel 7¾-in. x 4⅜-in. x 2⅜-in. deep, perf board and push-in clips, ¾-in. metal spacers, coax cable (RG-59A or equiv:, battery connector, knobs, wire, solder, etc.





This full range 3-band booster gives a kick to shortwave receivers; it can also be put together for just one band. Eliminates the bandswitch S1A, B and two unused "L" coils. Use parts layout photo when building yours.

green index dot on the top and as shown in the board photo.

Next The IC. Fan the leads out of IC1 as shown in the drawing on the schematic and locate the white index dot marking the #8 lead. Mount IC1 on the lower left section of the perf board (on the side just below S1A,B), with #4 lead connected to a ground lug and the remaining leads connected to push in clips positioned around the IC as shown in the board photo. Make sure that the connecting leads are as short as possible and cut off the excess lengths.

Mount and wire the remainder of the components on the perf board as shown in the board photo and schematic. Then, one lead of C4 is mounted to the center terminal of J2 with the other lead connected to a length of coax whose remaining end is connected to the junction of R1 and #7 lead of IC1. Ground the coax at the ground lug of J2, and position the other end over R1 to act as an electrostatic shield for this lead connection to IC1. Connect the S1A,B terminals to L1, L2 and L3 with short, direct leads spaced over IC1 as shown in the board photo.

Complete the wiring of the preselector circuits, and then mount B1 with a metal strap on the bottom of the box so that it will not touch any of the board components or wiring. If desired, you can connect the B+ and B— lead to a terminal strip mounted on the side of the box for connection to an external 9-volt DC power supply in place of B1.

Hook Up. The preselector unit should be connected to your receiver antenna and ground terminals with as short a section of coax as practicable. We used a 6-inch section of RG-59A soldered to a phono plug at one end and with 1½-inch leads at the other. For intermittent use of the preselector, the internal battery will be ok. But for long term operation, a 9 VDC external power supply should be used. The preselector draws approximately 7 mA at 9 VDC.

Connect your SW antenna to the center connector of J1, and connect an external ground to the outside (shell) of J1. Connect J2 to your receiver external antenna terminals with a short section of coax (do not use the audio type of shielded cable). If your receiver does not have external antenna and ground terminals, try a turn of hook up wire around the receiver internal loop antenna. Or, if your receiver uses a built-in whip antenna, clip the center conductor of J2 (through the coax) to the whip, and push down the whip to its shortest length. If the receiver is an AC-DC type (with a "hot" chassis) connect the outside shield of the coax from J2 in series with a 470 pF capacitor and the receiver chassis. Do not connect the shield directly to the chassis in this type of receiver or there may be a electrical shock hazard.

Operation. Set S1A,B (*band switch*) to the desired band of operation that your receiver is tuned to, and set S2 to *on* position. Tune C1 (*tune control*) for maximum received signal. If you have a problem with oscillation on the highest frequencies of Band C, reduce value of R1 and adjust the coil slugs as necessary for band coverage. ■

Give Your Plants A Voice

by Joe Rolf, K5JOK

CAN PLANTS REALLY TALK? That was the subject of a report by M. Gronk in the November/December 1972 issue of e/e. Of course, no one knows for sure; but *this* author's experience with this project indicates some basis for recent articles on the subject ranging from e/e to the Ann Landers column! So that you can investigate this intriguing subject yourself, e/e presents an easy experimenter's project. It can help you make up your own mind while providing a multitude of interesting experiments related to plant response.

A Type Of Lie Detector. Proponents of the idea that plants have feelings—that plants can respond to human thought and may even have the ability to remember and think—have found that by measuring plant skin resistance, in much the same manner as the polygraph measures human skin resistance, changes are detected that can be interpreted as logical responses to psychic and physical stimuli. The instrument in this project is a high sensitivity ohmmeter which, when connected across a resistance of from 100,000-ohms to 1-megohm, will detect resistance changes in the order of 0.5 percent.

Checking the schematic we see the circuit is simply a battery-operated "709" operational amplifier in a differential configuration across an adjustable bridge. Bridge imbalance is amplified by the op-amp and displayed on a sensitive meter or, if you're lucky enough to have a borrow one, a chart recorder.

One half of the bridge consists of the speciman resistance connected to terminals J1 and J2, an adjustable coarse zero control, and R1 and R2. The second arm of the bridge consists of R4, R6, and the fine zero control, R5. Since the resistance across J1 and J2 can range from 100,000-ohms to 1-megohm, R1 (in combination with R2) is adjusted to equal the resistance of the speciman. Control R5 permits final zero adjustment of the bridge. Once balanced, any change in speciman resistance will apply a voltage change to the amplifier which is amplified and displayed by the meter or other indicating device.

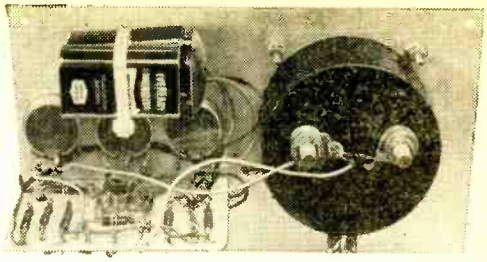
Selecting A Meter. R10, in series with the meter movement, permits adjustment of the meter sensitivity. Diodes D1 and D2 protect the movement during zero adjust and provide a nonlinear meter function which makes the meter more sensitive near zero than at full scale.

Since the most expensive component in this project is the meter movement, two meter options are given. You may want to use a 50-0-50 millivolt movement in your model, or a re-scaled 0-50 millivolt movement as used by the author. The latter is more easily obtained, and has the advantage of providing a 0-25 millivolt indication when re-scaled to put zero in the middle of the scale. Since the bridge can be balanced at any point on the meter scale, it is a simple matter to carefully re-scale a 0-50 millivolt movement. If you are not inclined to make this modification, which entails removing the meter face and relabeling the scale, a 50-0-50 millivolt movement can be used.

Construction For Good Looks. The polygraph is compactly constructed in a readily available 7¾-in. x 4¾-in. x 2⅜-in. experimenters Mini Utility Box (Radio Shack 270-232) with all components mounted to the aluminum front panel. Batteries B1 and B2 are secured to the top of the front panel with a plastic cable tie and adhesive pad to permit easy removal of the entire unit from the back enclosure.

The amplifier circuit, for simplicity of construction, is built on a 2 x 3½-in. perfboard chassis and mounted to the front panel with a small aluminum bracket. Construction is simple and straight forward and can be accomplished with simple hand tools.

A test stand, such as that illustrated, is suggested and can be constructed of plywood, a piece of lucite, and two banana jacks. Connections to the plant are made by fine phono wire and two gold or silver plated "earring findings" obtained from a local hobby supply house. Another photo illustrates the connection made to the speciman used by the author. A good steady connection to the speciman is important since the response and sensitivity of the instrument can render readings useless if there is the slightest movement of the speciman probe. Adjust the earring finding so that it holds the leaf tightly and firmly between its

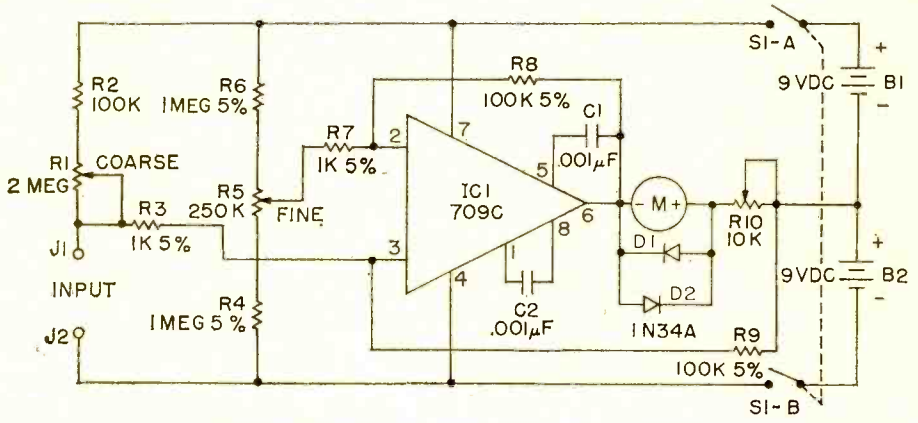


All electronic wiring and components can be easily assembled on a single perfboard. Bi-polar battery supply simplifies project

jaws. Conventional banana leads can be used to connect the instrument to the jacks of the test stand.

Operational Set-Up. With a speciman in place and connected, set the meter *sensitivity* control to full counter-clockwise and turn the plant polygraph to the *on* position. Set the *fine* control knob at center position, and slowly adjust the *coarse* zero adjustment until the meter is near center scale. Make the final adjustment to zero with the *fine* control. The full scale sensitivity of the meter can now be adjusted by rotating the meter *sensitivity* control clockwise and readjusting to zero with the *fine* zero control.

Some experimentation may be necessary in adjusting the meter sensitivity and fine zero adjust control, depending upon the

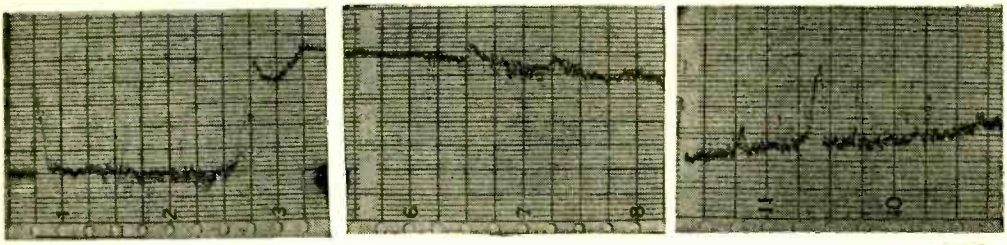


PARTS LIST FOR GIVE YOUR PLANTS A VOICE

B1, B2—9-volt battery
C1, C2—0.001 uF (10,000 pF) disc capacitor, 50, VDC or better
D1, D2—1N34A diode
IC1—Type 709 integrated circuit
J1, J2—5-way binding posts
M1—Meter, 0-500 μAmpere DC, Triplett 320G or equiv. (see text)
R1—2-megohm potentiometer, linear taper
R2, R8, R9—100,000-ohm, ½-watt resistor
R3, R7—1,000-ohm, ½-watt resistor
R4, R6—1-megohm, ½-watt resistor
R5—250,000-ohm potentiometer, linear taper
R10—10,000-ohm potentiometer, linear taper
S1—DPDT toggle or slide switch
Misc.—Perfboard, push-in clips, battery connectors, wire, solder, plastic cabinet with aluminum cover (8x4½x2½-in.), etc.

PLANT A BUG

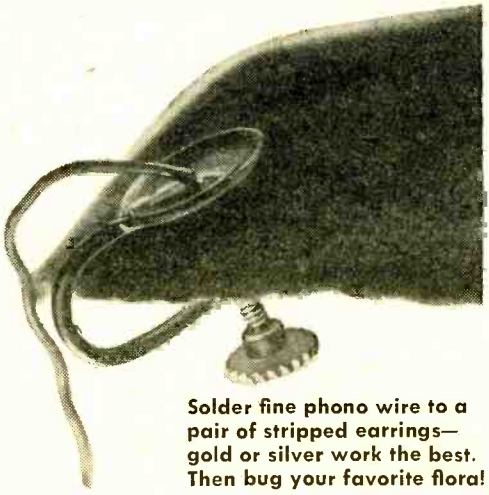
These graphs were made with an automatic chart recorder. On left, major change at 2:45 AM was unexplained by author. However, center graph at 6:30 AM peaks when author's family had breakfast. Plant showed major change when watered at about 10:30. Plant subject was an African Violet



speciman and the resistance across the two test points. The author found that plants in poor health make very bad subjects, while the responses of healthy plants is much more pronounced and rapid.

A good indication that meter sensitivity is properly adjusted is when a slight bouncing of the meter movement is noted either side of zero. If the meter movement continually goes off scale during your experimentation, reduce the meter sensitivity and re-zero the bridge.

What You See. Interpretation of meter fluctuations is largely a matter of experience and repeated experimentation. The figures give some indication of the types of responses you will see. Most of the characteristic resistance changes illustrated in these photographs can be observed by recording meter fluctuations of fixed time intervals, or through a graphic recording instrument such as the one used by the author (borrowed from a friendly high school teacher). The latter is invaluable in making long term observations.



Solder fine phono wire to a pair of stripped earrings—gold or silver work the best. Then bug your favorite flora!

Many short term experiments, however, are possible without the aid of a recorder. You may water the plant, for instance, and

(Continued on page 117)

The February 1973 *Readers Digest* reprinted an article by James Lincoln Collier from the *Baltimore Sunday Sun*. The article describes experiments since 1966 by Cleve Backster of New York indicating the ability of plants to respond to human actions as well as possibly possessing some forms of biological memory and thought processes.

Botanists have long acknowledged the ability of plants to respond to external stimuli as light, temperature, and moisture but the strange results of the Backster experiments in plant response may have startling implications. Consider, for instance, several of Backster's experiments as reported in the *Reader Digest* article:

In one experiment, Backster attached a polygraph to a plant to determine if the rate at which water rose from the root to the leaves could be measured in terms of plant skin resistance. He found that it could. But, more startling, in a subsequent experiment, he decided to stimulate the plant by burning a leaf and found that a dramatic and prolonged polygraph response occured at the exact moment he made his decision. In other words, it appeared as though the plant had actually read his mind!

In a second experiment, two plants were put in a room and, by means of secret instructions, one of six persons was instructed to enter the room alone and destroy one of the plants. Later, each person was brought into the room separately and, unerringly, the remaining plant identified the murderer!

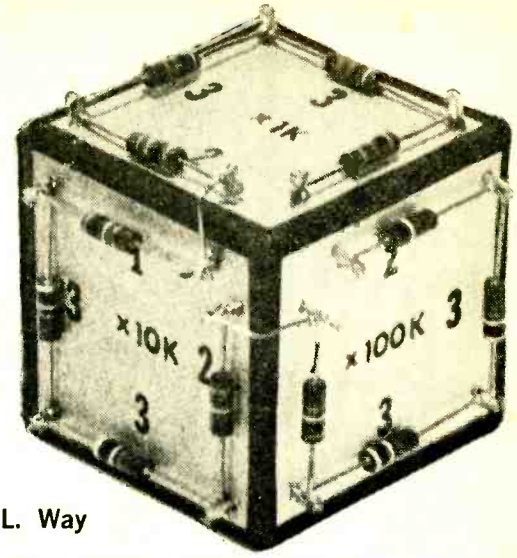
Other Backster experiments seem to indicate that plants can determine whether a person is telling the truth or not, and can even respond to human thoughts at great distances!

What do these experiments imply? In the first, it implies that plants may actually have the ability to respond to human thought processes. In the second, and even more fantastic, it implies that plants may possess some type of memory, and thus biological thought process!

To date, these experiments and the possible implications have not been scientifically proven or fully explained. Consider, however the practical application of this knowledge if plants can, in fact, respond to humans or have basic thought processes. One application is a whole new world of electro-biologic sensors that could be employed by science.

Do plants feel? Can they think? They might, as experiments by people such as Cleve Backster indicate, but at the present the question goes unanswered and the concept is only a theory!

R-Cubed lets you Shoot the Works



by R. L. Way

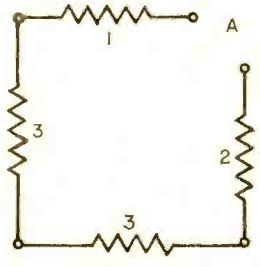
LOOKING for the right resistor during a circuit mockup, or breadboarding, sometimes becomes annoying: dim light makes color band reading impossible; fumbling fingers can't pick up ¼-watt resistors fast enough; and, of course, you are always out of the resistance size you want to use. So get with it with R-Cubed—the experimenter's toy block that makes bench work seem like child's play.

R-Cubed is not so much a device as it is a method for keeping on hand, in an orderly manner, a collection of standard-value resistors that can be used singly with clip-leads, or in series with clip-leads to provide most needed values of resistance. The 24 resistors that can be mounted and series-connected on the faces of a small cube will give resistance values of 1 to 9 ohms and all multiples of 10 of these values through 100,000. Thus, if all 24 resistors are used, resistance values from 1 ohm to 900,000 ohms will be available. The author's unit contains only 12 resistors, since only values from 1000 to 100,000 ohms were desired. In addition, some intermediate values of resistance (for instance, 42 ohms, 780 ohms, 95,000 ohms, etc.) can also be obtained from the R-Cube arrangement, as will be explained later.

One-half-watt, 5% resistors were used to keep down the cost, but the same idea can be applied to 1% resistors, or to 1- or 2-watt resistors. The only other expense, aside from cardboard for the cube, paint, etc., is for a box of vector-board mini-clips, and a pair of alligator clip-leads. (The Editors took exception to the author's construction technique and went their own way using a child's toy play block and some brass brads —but more on this later.)

Knocking It Together. Four resistors form a *decade* (10, 100, 1000, 10K, 100K, and 1M), and each decade is mounted on one of the six faces of the cube. The resistors are all multiples of 1, 2, and 3 (that is, 10. 100, 1000, etc., 20, 200, 2000, etc., and 30, 300, 3000, etc). Henceforth, all numbers in a

The resistors in each set for each face are valued at 1, 3, 3, 2-ohms each multiplied by a factor for that face. The diagram at right is for the X100K face of the cube. Therefore each resistor is valued at 100,000-ohms or a multiple thereof.



TO OBTAIN	CONNECT LEADS AT
1 ohm	A and B
2 ohms	D and E
3 ohms	B and C
4 ohms	A and C
5 ohms	C and E
6 ohms	B and D
7 ohms	A and D
8 ohms	B and E
9 ohms	A and E
10 ohms	Go to next higher decade

R-CUBED

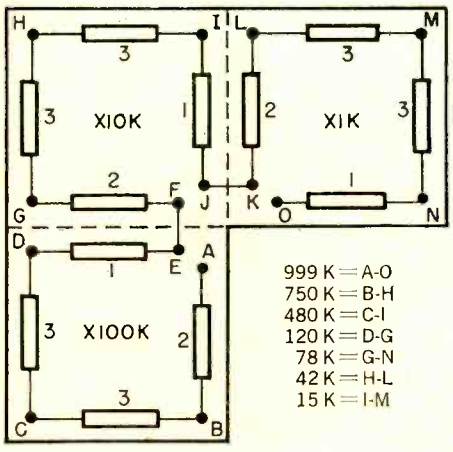
decade will be stated as 1-digit numbers, with the understanding that they are multiples of 10, 100, 1000, etc., according to the decade in which they are used. By wiring the four resistors of a decade end-to-end in the order 1, 3, 3, 2, as shown in Fig. 1, any value of 1 to 9 can be obtained by connecting clip-leads between the appropriate mini-clips. This can be better understood by looking at Fig. 1 and its accompanying table.

In order to get resistance values between those available on a single decade, the decades are connected to each other end-to-end. The following intermediate values (and all their multiples of 10) are thus available: 12, 15, 18, 19, 42, 45, 48, 49, 72, 75, 78, 79, 92, 95, 98, and 99. Fig. 2 shows how the decades should be laid out on a flat piece of cardboard before assembling the cube so that the proper ends of the decades are adjacent, and the connections to make between the faces. The accompanying tables give a few examples (but not all of the combinations possible) of terminal connections for obtaining different intermediate resistance values.

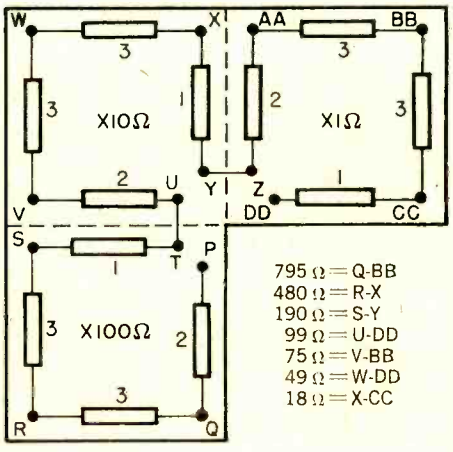
The cube is constructed of "artist-board" since it is inexpensive and easy to work with, but wood, plastic, or any other insulating material can be used. The mini-clips press fit into the artist-board without requiring glue or crimping, and provide convenient right-angle mounting of two resistors and a good electrical connection for the clip-leads. The cube in the photo measures two inches on a side, but could be made either larger or smaller. Measure an equal distance in from each corner and drill a 1/16-in. pilot hole for each mini-clip, push the clip in with a pair of pliers, and orient each one so that it is parallel to the others.

The cube is best laid out in two flat pieces, as shown in Fig. 2, then cut and scored, and the two pieces glued together. Each face of

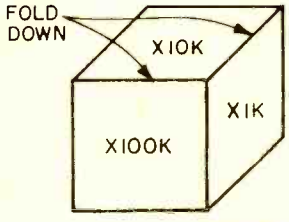
(Continued on page 117)

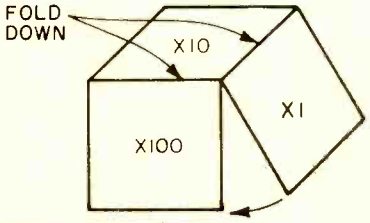


999 K = A-O
750 K = B-H
480 K = C-I
120 K = D-G
78 K = G-N
42 K = H-L
15 K = I-M



795 Ω = Q-BB
480 Ω = R-X
190 Ω = S-Y
99 Ω = U-DD
75 Ω = V-BB
49 Ω = W-DD
18 Ω = X-CC





Here's how the cube fits together and what resistors go on what face. Note that terminals E-F, J-K, U-T and Y-Z are connected by means of a jumper. Not shown is jumper for O-P.

Tune This Radio with a Voltage Divider!

by Charles Green W6FFQ

TUNE IN with the new space-age solid-state components that have transformed receiver technology. The old reliable tuning capacitor that was used in the old tube receivers is still with us and is still almost as large in size. Attempts at size reduction, decreasing the air gap between plates or using a mica dielectric, still are not enough.

But in the last few years, a solid state equivalent to the tuning capacitor has been developed to the point of enough capacity to tune the broadcast band and will be put into use soon. This solid-state device is called the Varactor, and is a type of semi-conductor diode.

You can experiment with varactors with our simplified broadcast band receiver. The old reliable regenerative detector circuit is used for simplicity, and is brought up to date with a field effect transistor (FET) used as the detector. An audio amplifier module is included that drives a small speaker mounted on the front panel. The receiver is built using an rf breadboard style of construction

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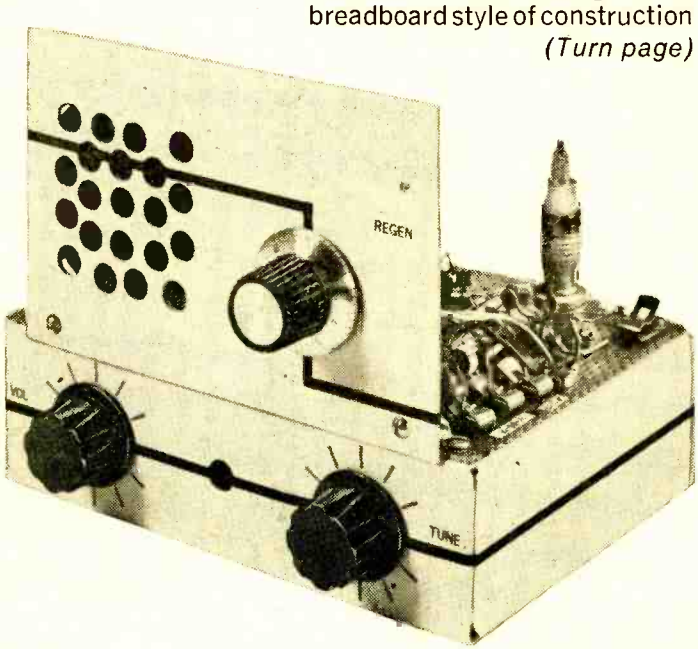


VARI-CAP TUNING

for some very easy experimentation on a 7-in. x 5-in. x 2-in. metal chassis. Information is given for the use of selected silicon diodes as varactors in addition to commercial varactors.

About The Circuit. RF signals from the antenna are connected via J1 to the primary winding of coil L1 which, in turn, is tuned by the varicap diode with tuning control R4. Signals from the tuned circuit are detected and amplified by a FET version of the grid-leak—the *gate-leak* detector Q1. Some of the rf energy from the source circuit of Q1 is fed back from the tickler winding, detected, and re-amplified. When there is too much feedback, the gate-leak detector circuit of Q1 will oscillate. The amount of feedback is therefore controlled by the *Regen* control R2 and adjusted to just below the point of oscillation for maximum sensitivity and selectivity of BC band signals.

The detected signals from Q1 are coupled via T1 to volume control R6 and the amplifier module. Further amplification of the signals is performed by the module and the signals are heard on the 8-ohm speaker.

What's a Varactor? The varactor diode is a semiconductor junction diode that behaves like a capacitor when reverse voltage bias is applied. The capacitance is formed by the space charge or depletion region around the internal P-N junction of the diode, and the amount of capacity is changed by varying the reverse voltage bias. This type of diode is also known as a voltage-variable capacitance diode or as a vari-cap.

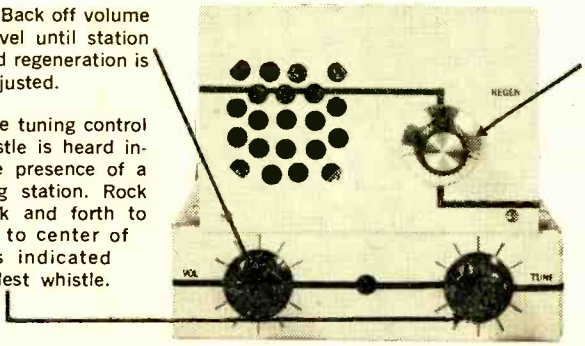
The basic semiconductor junction diode is formed of a material such as silicon that has two portions of the material *doped* in manufacturing by adding controlled amounts of chemicals. The doped portions have opposite electrical characteristics; "P" type with an excess of positive electrical charges (or hole) and "N" type with an excess of negative electrical charges (electrons). As shown in the drawing, the boundary between the two types is called a P-N junction, and there is a depletion layer (or region) that is also called the space charge region. This region is in an area along both sides of the P-N junction.

This space charge region is an area that acts as an electrical insulator (electrons will not normally flow across it) when no external bias voltage is applied, and therefore bars the passage of an electric current through the P-N junction. When an external voltage bias is applied the space charge region will narrow and disappear. This will permit the diode to conduct (electrons will flow across the P-N junction). As shown in the drawing of a diode being used as a rectifier; the space charge region will vary from very narrow (and disappearing) to very wide, when the alternating voltage changes polarity and gives the diode a reverse bias.

Solid Tuning. As also shown in the drawing, a diode has an internal capacity between the P and N type materials with the non-conducting space charge region acting as the capacitor dielectric. When the diode has a low reverse bias voltage, the space charge region is narrow, and the capacity effect is the same as if the plates of a tuning capacitor are close together—high capacity. If the diode has a high value of reverse bias voltage, the space charge region is wide, and the effect is as if the plates of a tuning capacitor were moved apart—low capacity. The actual capacity depends upon the physical and electrical

Start Here. Back off volume to a low level until station is tuned and regeneration is properly adjusted.

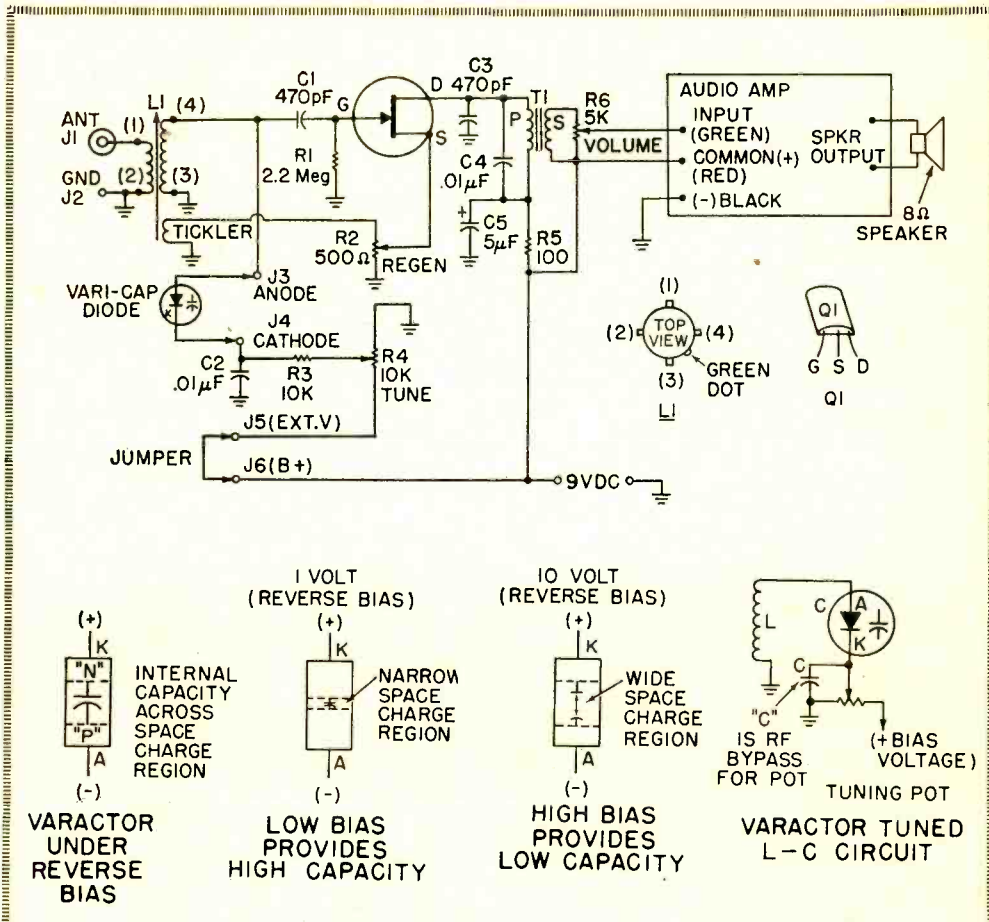
Then. Rotate tuning control until a whistle is heard indicating the presence of a broadcasting station. Rock control back and forth to tune radio to center of channel as indicated by the loudest whistle.



Finally. Back off the regeneration control until the whistle just disappears. This control should be adjusted as near to the point of oscillation (audio whistle) as possible. Increase volume control as required. If the unit again breaks into oscillation, back off the regeneration control to a stable setting.

characterists of the particular diode, and commercial varactors are specially manufactured and selected semiconductor diodes.

When a varactor diode is connected into a tuned circuit as shown in the diagram, the capacity of the diode can be varied by a tuning potentiometer which changes the value of the reverse bias voltage of the diode. When the bias voltage is high, the tuned circuit is at the highest frequency of operation, and when the voltage is low, the frequency is low. Capacitance "C" is an rf bypass capacitor for the tuning potentiometer.



PARTS LIST FOR VOLTAGE-TUNED RADIO

AA1—Audio amplifier, 100 mW, 4 to 8-ohm output
C1, C3—470 pF disc capacitor, 12 VDC or better
C2, C4—.01 uF disc capacitor, 12 VDC or better
C5—5 uF electrolytic capacitor, 12 VDC or better
J1—Phone jack or binding post for antenna terminal
J2 to J6—Fahnestock clips for binding posts
L1—BC Band antenna coil with three-turn tickler winding; see text (Miller A-5495-A)
Q1—FET, HEP-802 (Motorola)
R1—2.2-megohm, ½-watt resistor
R2—500-ohm potentiometer, linear taper
R3—10,000-ohm, ½-watt resistor
R4—10,000-ohm potentiometer, linear taper
R5—100-ohm, ½-watt resistor
R6—5,000-ohm potentiometer, audio taper
T1—Transformer, 10,000-ohm primary, 2,000-ohm secondary

Misc. 8-ohm speaker, 7-in. x 5-in. x 2-in. chassis, 5-in. x 7-in perfboard, push-in clips, 4-in. x 7-in. front panel (metal or copper-backed phenolic), knobs, Vari-cap diodes (see text), 9-volt battery or 9VDC power supply, hookup wire, solder, etc.

VARI-CAP TUNING

When a varactor is used in a tuned circuit, the amount of the change in capacitance of the semiconductor diode with the applied reverse bias voltage becomes important. In a tuned circuit (LC) the frequency ratio varies directly as the square root of the capacitance ratio. A varactor must therefore have a capacitance ratio of 4 to 1 if the tuned circuit is to be tuned over a range of 2 to 1.

Simple Building Hints. The receiver is built breadboard style with the components mounted on a perf-board. Even though the receiver operates on the BC band, wiring of the Q1 regenerative detector circuit may be critical. For best results, follow our photos for parts placement.

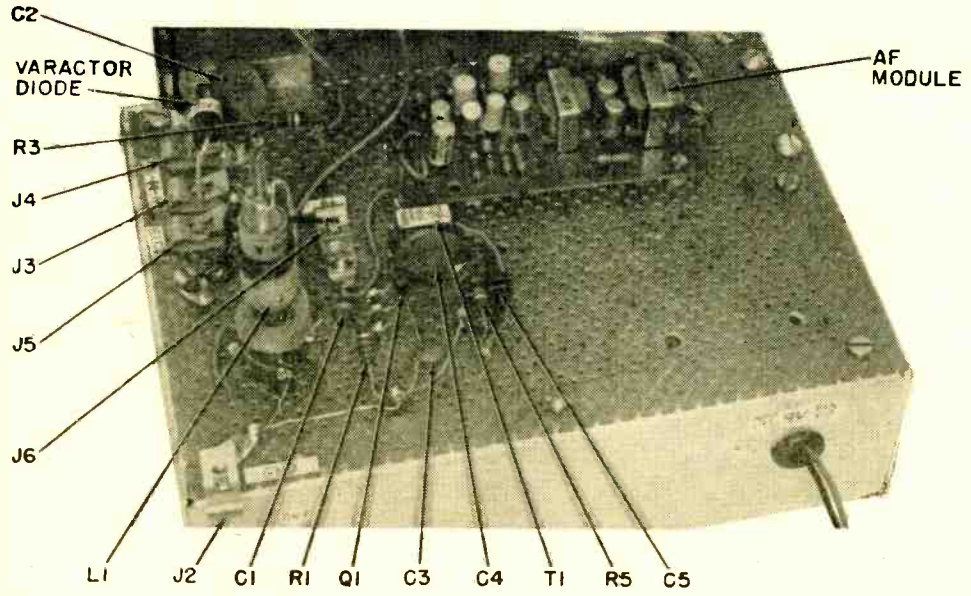
Start construction by cutting out the top of a 5 x 7 x 2-in. aluminum chassis to a ½-in. rim all around. Slot and bend up two 1½-in. tabs at each end of the front rim of the chassis and drill mounting holes for the front panel. Our front panel is a 4 x 7-in. copper-backed phenolic section of the type used for printed circuits, but any size metal panel can be used as well. Cut a perf board section to size to fit the top of the chassis and install it with sheet metal screws to the rim of the chassis.

Coil L1 is mounted on the perf board by soldering the terminals to push-in clips. Remove the 10 pF ceramic capacitor supplied with the coil before mounting, and make sure that the coil is positioned for the shortest connections (as shown in the schematic). Q1 is also mounted with push-in clips soldered to the leads and positioned close to L1. T1 is installed on the board with push-in clips soldered to the transformer mounting tabs.

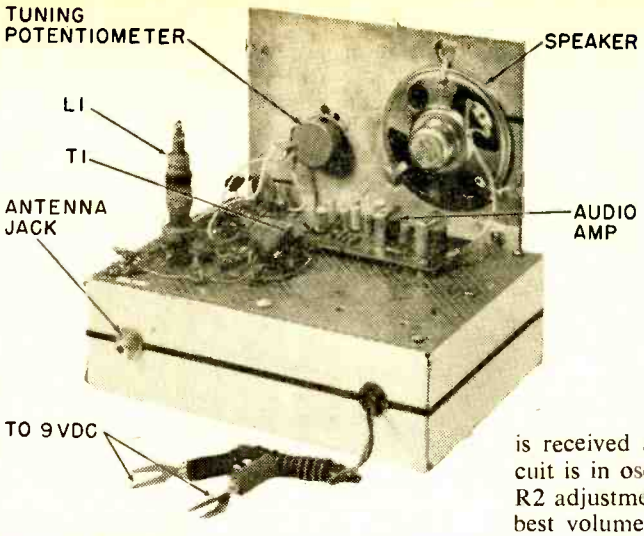
Install the remainder of the parts on the perf board and chassis, then wire them as shown in the schematic. Wind three turns of hookup wire around the top end of the L1 secondary winding for the tickler and twist the leads together to hold them in place on the coil.

The amplifier module is mounted on the perf board with machine screws and ¼-in. spacers. Make sure that you connect the common (+) red wire to B+ as shown in the schematic. Clip off the unused red wires that normally are connected to a switch. (See the schematic supplied with the module for details.) The amplifier module black (−) wire should be centered to B− (common ground).

Check The Tickler. Connect a good outside antenna to J1 and a ground connection to J2. Connect the red wire (B+) to the (+) terminal of a 9-volt battery or dc power supply, and connect the black (B−)



If you place your components in approximately the same location as the author, you will have an excellent chance for success with your project. Note "tickler" at top of L1.



To this simple circuit tuning in stations means varying a reverse bias voltage to the varactor diode which increases capacitance in proportion to the decrease in reverse bias. Varactors are solid-state variable capacitors that can take the place of the usual mechanical variety.

receiver wire to the (−) terminal. Connect a 100 pF capacitor to J3 and J4 (in place of a varactor), and adjust the tuning slug on L1 until you hear a received signal in the speaker. Adjust R6 for a convenient audio volume, and then adjust R2 until the signal is received as a whistle (the Q1 regen circuit is in oscillation). Then back off on the R2 adjustment until the signal is received at best volume and selectivity. It may also be necessary to readjust the L1 tuning slug. If the signal can not be received as a whistle, reverse the connections to the tickler winding.

You can connect a 365 pF variable tuning capacitor in place of the 100 pF capaci-

TUNING THE 50 STATES ON MEDIUM WAVE

Because the BCB band is so crowded with stations, logging all 50 states is tougher than it used to be. But, with patience and luck, you can do it. Here are your best bets.

State	Call	Freq. (kHz)	State	Call	Freq. (kHz)
Alabama	WYDE	850	Montana	KXLF	1370
Alaska	KFQD	750	Nebraska	KFAB	1110
Arizona	KTAR	620	Nevada	KOH	630
Arkansas	KAAY	1090	New Hampshire	WKNE	1290
California	KFBK	1530	New Jersey	WPAT	930
Colorado	KOA	850	New Mexico	KOB	770
Connecticut	WTIC	1080	New York	WABC	770
Delaware	WDOV	1410	North Carolina	WBT	1110
Florida	WQAM	560	North Dakota	KFYR	550
Georgia	WSB	750	Ohio	WLW	700
Hawaii	KORL	650	Oklahoma	KOMA	1520
Idaho	KGEM	1140	Oregon	KEX	1190
Illinois	WLS	890	Pennsylvania	KDKA	1020
Indiana	WOWO	1190	Rhode Island	WPRO	630
Iowa	WHO	1040	South Carolina	WCSC	1390
Kansas	WREN	1250	South Dakota	WNAX	570
Kentucky	WHAS	840	Tennessee	WSM	650
Louisiana	WWL	870	Texas	WOAI	1200
Maine	WCSH	970	Utah	KSL	1160
Maryland	WBAL	1090	Vermont	WHWB	1000
Massachusetts	WBZ	1030	Virginia	WRVA	1140
Michigan	WJR	760	Washington	KGA	1510
Minnesota	WCCO	830	West Virginia	WWVA	1170
Mississippi	WOKJ	1550	Wisconsin	WKOW	1070
Missouri	KMOX	1120	Wyoming	KWYO	1410

VARI-CAP TUNING

tor for easier signal tuning or to allow reception of signals at the lower end of the band for this test. This test will show that the basic receiver circuits are operational. At the conclusion of the test, remove the capacitor from J3 and J4, and then connect a short jumper wire between J5 and J6. This jumper is necessary to provide a B+ connection to the R4 tuning control.

Selecting Your Varicap Diode. The receiver can be used with either commercial varactors or selected ones from your stock of surplus or used semiconductor diodes. Some transistors will also operate as varactors. The commercial varactors may not be easily available to the experimenter, as they may have to be specially ordered from local parts houses that handle industrial electronic components.

The following are some varactors that can be used with this receiver: Motorola—MV1401 ("EPICAP") 550 pF at 1-volt bias, 10:1 ratio; Motorola MV1405 250 pF at 2-volt bias, 10:1 tuning ratio; HEP R2505 100 pF at 4-volt bias, 3:1 ratio; and Radio Shack; 276-676 (5 varactor diodes kit) 10 to 50 pF. There are many more types by different manufacturers, but at this time not much information is available for the experimenter. Unfortunately, most of the commercial varactors do not have enough capacity to tune over the complete BC band; they are more suitable for short wave and UHF operation. But industry is still in the process of developing varactors for use in home radios (as well as TV sets) and more varactors should be available for experimentation.

You can also experiment with ordinary silicon rectifiers used as varactors with this receiver. Since the properties of a diode that go to make a good varactor are not necessarily that of a good rectifier, it is necessary to test the diodes for varactor operation. Also varactor qualities may vary a lot. Even when one of a particular type or manufacture is found to have varactor operation, other diodes of the same type may not work at all. It may be considered to be a sort of treasure hunt to find varactors among your surplus and used diodes.

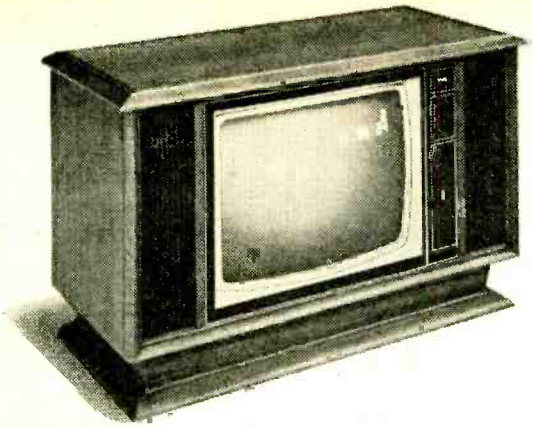
Best way to test diodes for varactor operation is to connect them to the receiver—the diode anode to J3 and the cathode to J4. Then, tune R4 and see if signals can be received over the BC band for a rough check.

It was found that a GF-X4 rectifier diode worked ok, and several of the Radio Shack 276-599 kit of untested diodes operated as varactors. Disconnect the connection between J6 and J5 and try operating the varactors with the external dc power supply (+) terminal connected to J5, and the (−) terminal to J2 for a greater capacity-tuning ratio range. Try various higher voltages within the maximum voltage rating of the diode.

Try experimenting with transistors as varactors. Connect them as follows: *emitter* of an NPN type to J4, *base* to J3; or *collector* to J4 and *base* to J3. Connect the *base* of a PNP type to J4, *collector* to J3; or *base* to J4 and *emitter* to J3. ■

AM CLEAR CHANNELS FOR NORTH AMERICA

540 Clear (Canada)	780 Clear	1010 Clear (Canada, Cuba)	1170 Clear
640 Clear	800 Clear (Mexico)	1020 Clear	1180 Clear
650 Clear	810 Clear	1030 Clear	1190 Clear (U.S., Mexico)
660 Clear	820 Clear	1040 Clear	1200 Clear
670 Clear	830 Clear	1050 Clear	1210 Clear
680 Clear	840 Clear	1060 Clear (U.S., Mexico)	1220 Clear (Mexico)
690 Clear	850 Clear	1070 Clear (U.S., Canada)	1500 Clear
700 Clear	860 Clear (Canada)	1080 Clear	1510 Clear
710 Clear	870 Clear	1090 Clear (U.S., Mexico)	1520 Clear
720 Clear	880 Clear	1100 Clear	1530 Clear
730 Clear (Mexico)	890 Clear	1110 Clear	1540 Clear (Bahamas)
740 Clear (Mexico)	900 Clear (Mexico)	1120 Clear	1550 Clear
750 Clear	940 Clear (Mexico, Canada)	1130 Clear (U.S., Canada)	1560 Clear (Cuba)
760 Clear	990 Clear (Canada)	1140 Clear (U.S., Mexico)	1570 Clear (Mexico)
770 Clear	1000 Clear (U.S., Mexico)	1160 Clear	1580 Clear (Canada)



The editors' choice: Heathkit Digital Design Color TV!

At **ELEMENTARY ELECTRONICS** they said: "The fact is, today's Heathkit GR-2000 is the color TV the rest of the industry will be making tomorrow...there is no other TV available at any price which incorporates what Heath has built into their latest color TV."

The **FAMILY HANDYMAN** reviewer put it this way: "The picture quality of the GR-2000 is flawless, natural tints, excellent definition, and pictures are steady as a rock. It's better than any this writer has ever seen."

POPULAR SCIENCE pointed out "more linear IC's, improved vertical sweep, regulators that prevent power supply shorts, and an industry first: the permanently tuned I.F. filter."

The **RADIO-ELECTRONICS** editors said the Heathkit Digital TV has "features that are not to be found in any other production color TV being sold in the U.S.:

"On-screen electronic digital channel readout...numbers appear each time you switch channels or touch the RECALL button...*On-screen electronic digital clock*...an optional low cost feature...will display in 12- or 24-hour format...*Silent all-electronic tuning.* It's done with uhf and vhf varactor diode tuners...*Touch-to-tune, reprogrammable, digital channel selection*...up to 16 channels, uhf or vhf...in whatever order you wish...there's no need to ever tune to an unused channel. *LC IF amplifier* with fixed ten-section *LC IF bandpass filter* in the IF strip...eliminates the need for critically adjusted traps for eliminating adjacent-channel and in-channel carrier beats. No IF alignment is needed ever. *Touch volume control*...when the remote control is used...touch switches raise or lower the volume in small steps."

POPULAR ELECTRONICS took a look at the 25-in. (diagonal) picture and said it "can only be described as superb. The Black (Negative) Matrix CRT, the tuner and IF strip, and the video amplifier provide a picture equal to that of many studio monitors..."

Furthermore, the Heathkit GR-2000 is an easier kit-form TV to build. **POPULAR ELECTRONICS** pointed out that "Each semiconductor has its own socket and there are 12 factory-fabricated interconnecting cables...The complete color adjustments can be performed in less than an hour."

To sum up, **POPULAR ELECTRONICS** concluded its study by stating, "In our view, the color TV of the future is here—and Heath's GR-2000 is it!"

Why not see what the experts have seen? The Heathkit Digital Design Color TV—without question the most remarkable TV available today.

Mail order price for chassis and tube, $659.95. Remote Control, $89.95 mail order. Clock, $29.95 mail order. Cabinets start at $139.95. (Retail prices slightly higher).

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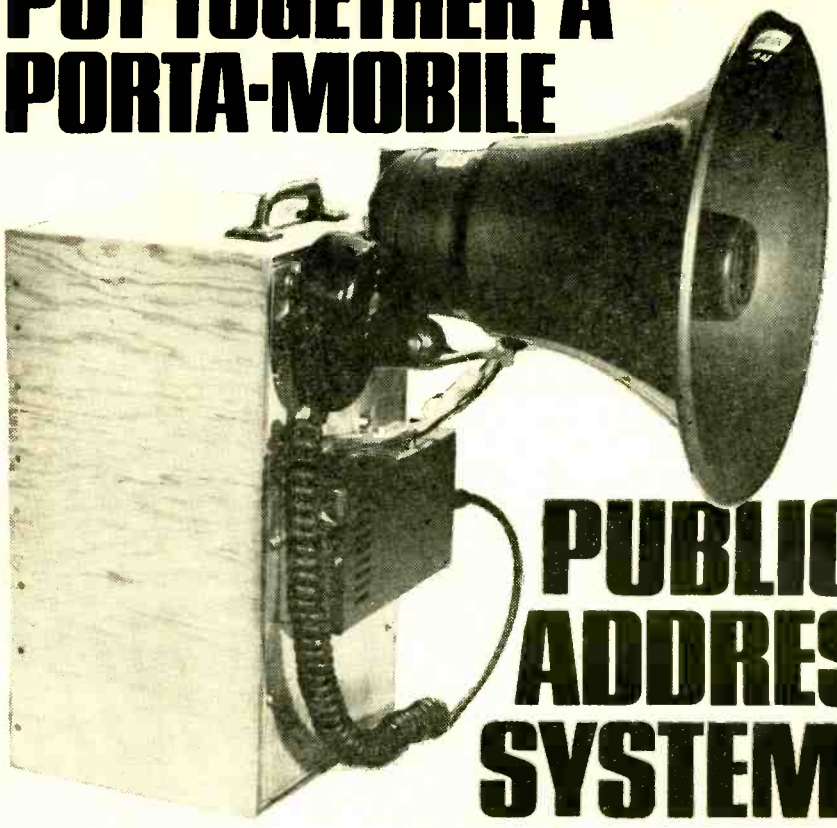
CIRCLE NO. 1 ON PAGE 17 OR 114

PUT TOGETHER A PORTA-MOBILE PUBLIC ADDRESS SYSTEM



by Marshall Lincoln

WITHOUT EXTENSIVE KNOWLEDGE of electronics, you can easily build this go-anywhere portable public address system.

You can carry it easily when you need a battery-powered portable PA, and you can quickly plug it into your car or truck, where it will be instantly usable, no matter whether you're driving or parked.

You'll find it handy for use at meetings, sports events, outdoor activities, school or civic club functions, recreational outings, parades, or emergency situations.

This simple and useful workshop project enables you to take advantage of modern solid state technology which has shrunk audio amplifiers from the cumbersome, suitcase-sized units of former years to tiny boxes that fit the palm of your hand. This same technology has freed public address systems from the necessity of an electric power outlet, so they can be operated from batteries.

Modern, compact, efficient speakers make the old-fashioned trunk-sized bass-reflex cabinet or washtub-sized trumpet speakers unnecessary for any public address requirements of the average person.

Transistors can pump out a considerable audio punch without requiring a high voltage power supply, which was a necessity with the old, bulky vacuum tube amplifiers. Consequently, transistor PA systems can be built to operate from 12 volts, making them usable in a motor vehicle without any special batteries or generators. Since transistors don't require power for heating filaments or operating high-voltage supplies as tubes do, a moderate power public address amplifier can be operated from dry batteries, with the entire system light enough for you to carry in one hand.

And Easy Assembly. Add to all these advantages the fact that such amplifiers are

available at moderate prices already built, requiring a bare minimum of wiring and assembly work on your part to put them to use, and you have the modern ideal situation whereby you can easily rig up your own anywhere-anytime public address amplifier.

A number of companies make versatile amplifiers which you could use for such applications. One illustrated here is the Lafayette "Tiny Mite" 16-watt amplifier (catalog 99—45890). It operates on 12 volts, so you can hook it directly to your car or truck electrical system, and put an outdoor speaker on the roof or under the hood.

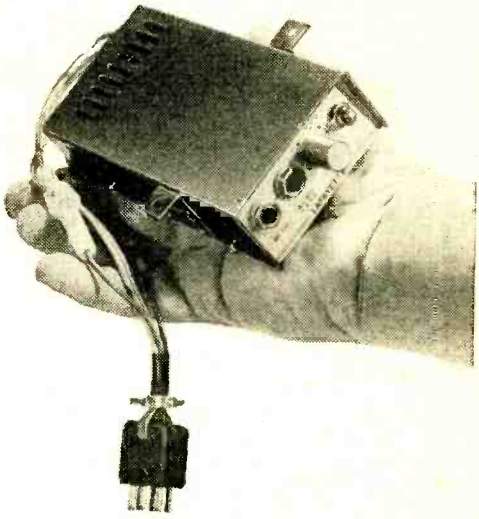
It may be used with a hand-held mike, or will accept the output from a record player, tape deck or radio receiver.

Since these amplifiers draw only about 2 amperes (under average public address conditions, considerably less) you can operate from a pair of 6-volt lantern batteries connected in series if you need the added convenience of a fully portable PA system.

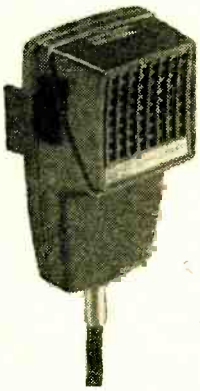
By using four lantern batteries, wired in series-parallel, you will get double battery life, with only a little additional weight.

As shown here, the same amplifier can be used both in your car or truck, and as a hand-carried portable unit. The amplifier may be easily removed from your vehicle and attached to the portable battery pack in less than a minute when you need to make the switch from mobile PA to portable PA.

Select-A-Mike. For a rugged yet low-cost microphone, the Heath model GH-12A ceramic hand-held microphone was chosen. It has a built-in push-to-talk switch which can easily be re-wired to cut off the output from the mike at all times except when you hold the button depressed. Since the amplifier shown here has inputs for both high and low impedance input devices, you actually can use virtually any mike you wish, except a carbon mike, which requires a special transformer and battery.

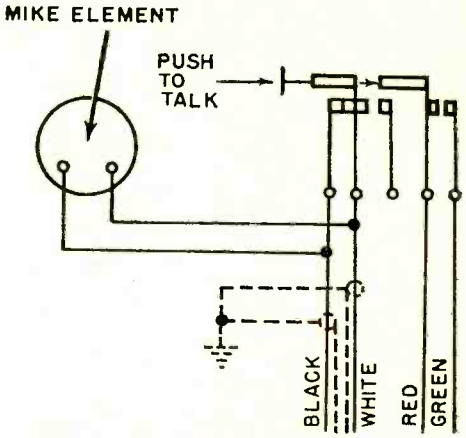


Adding this connector to your system gives convenience and versatility. Plug it into your auto or portable battery/speaker pack.



Model 202 ceramic mike from Shure. Circle No. 164 on Lit-Lib page.

Model 602F dynamic mike from Electro-Voice. Circle 163 on Lit-Lib page.



Typical wiring diagram of PTT (push-to-talk) communications microphones. This hook-up shorts out mike when not in use.

PORTA-MOBILE PA

Like many mobile-type push-to-talk mikes, the Heath GH-12A contains a double-pole switch, with one pole intended to key on a transmitter, and the other pole intended to mute the mike or the transmitter's audio section during non-transmit periods.

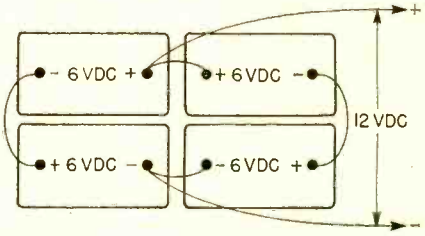
For this application, you're only concerned with the portion of the switch which mutes the mike when the button is released. To re-wire the switch in the Heath mike for that purpose with a PA system, open the mike by removing the screws from the back, then remove the white mike cord wire from switch contact 3 and connect it to switch contact 2.

The result of this change is to cause the switch to short the mike element when the button is released, so you can lay the mike down with the amplifier still turned on, and not have the mike pick up any sound.

When you install the phone plug on the opposite end of the mike cord, connect the white wire to the plug "tip" and the shield braid to the plug "sleeve." Cut off or tape the red and black wires—these are not used by the PA—they are intended only for radio transmitter operation.

This Midland unit is typical of the mobile PA amplifiers on the market today. Circle 152 on the Reader Service Coupon.

Squawker. For a speaker you have a wide range of choices, since the amplifiers will accommodate either an 8-ohm or 16-ohm speaker. Some have a switch recessed in the bottom of the amplifier to switch the amplifier output circuit to match either kind of speaker. If you wish to use two speakers simultaneously, wire 8-ohm speakers in series and then set the amplifier switch for 16 ohms output impedance, or wire two 8-ohm speakers in parallel and connect to a 4-ohm top.

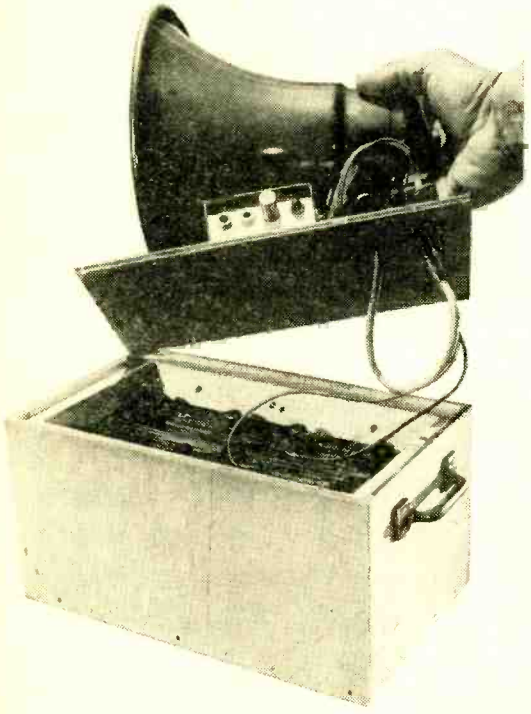


Series-parallel four 6-volt lantern type batteries for extended life during portable operation. However, a new battery will try to charge an old one. You must replace all batteries at the same time.

An Electro-Voice IB-A8 speaker is shown on the portable amplifier unit illustrated here—this same speaker may be mounted under the hood of your car if you have enough room there, but the Heath GDA-18-2 speaker designed especially for under-hood applications will fit into smaller spaces.

Whatever speaker you use, be sure you

(Continued on page 116)



Speaker wire goes down through panel from top and connects to solder lugs on bottom of socket. Battery also connects to socket.

Hang an... EXPANDED SCALE VOLTMETER From Your Dash

by Martin W. Bajor

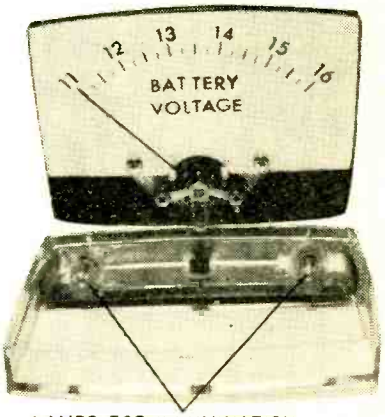
PROFESSIONAL DRIVERS in big over-the-road rigs depend on an ammeter *and* a voltmeter to gauge electrical operating conditions in their vehicles. How about you?

With this zener-regulated expanded scale voltmeter you can forget the idiot light and measure operational voltage fluctuations that can tell the real story.

Sure, an ammeter can be installed. After all, that's what most vehicular electrical gauges measure, if one is there at all, so why not install what manufacturers do?

Why? Because you don't have the problem of installing a meter in series with the primary power cable as with an ammeter. Just a simple tap to the ignition switch or even to an accessory power cable such as the radio or heater line will do for a voltmeter. And for a plus in performance, you have a new sensitivity to electrical system operation—battery, alternator, voltage regulator and more—that only an expanded scale voltmeter can conveniently provide.

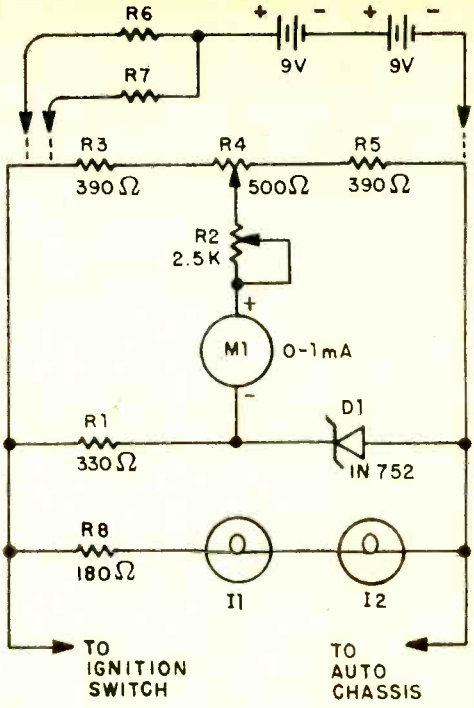
What Expanded Scale? An expanded scale meter is one on which the lowest reading is not zero volts but the lowest voltage of interest to the user. A conventional voltmeter has a scale reading from zero to a specified maximum voltage. On a typical meter with a full scale reading of 15 volts it would be difficult to read the difference of a few tenths of a volt that can be significant in the automotive electrical system. The range for this meter was chosen to be 11 to 16 volts. This covers the levels in which we are most interested.



LAMPS FOR ILLUMINATION

Drill two small holes for lamp wire, then cement, glue, or use selastic to secure a pair of series-connected 6-volt mini lamps.

Expanded Scale



PARTS LIST FOR AN EXPANDED SCALE VOLTMETER

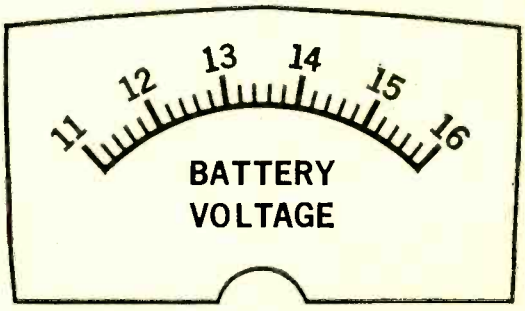
D1—Zener diode, 5.6 volts, ½-watt, 1N752 (Motorola HEP-Z0212 or equiv.)
I1, I2—Miniature lamps, 6 VDC, 25 mA
M1—Meter, 0 to 1 mA movement
R1—330-ohm, ½-watt resistor
R2—2500-ohm potentiometer, PC-type
R3, R5—390-ohm, ½-watt resistor, 5%
R4—500-ohm potentiometer, PC-type,
R6—820-ohm, ½-watt resistor, 5%
R7—160-ohm, ½-watt resistors, 5%
R8—180-ohm, ½-watt resistor

Misc.—Case (3 x 3¼ x 2-in. deep), perf board, push-in clips, 2U6-type 9-volt batteries (for calibration, see text), wire, solder, hardware, etc.

Look at the schematic. The negative terminal of the meter is connected to the junction of R1 and the zener diode, D1. Voltage at this point remains constant at 5.6 volts when the voltage across the circuit varies from 11 to 16. The positive meter terminal is connected through variable resistor R2 to the wiper of potentiometer R4. Network R3, R4, and R5 make up a voltage divider that is adjusted so 11 volts applied by the vehicle results in no current flow through R2 and the meter. Variable resistor R2 is set, when 16 volts is applied to the circuit, for a full scale meter deflection.

Building It. To insure accuracy only 5% tolerance (gold band) resistors should be used for R3, R5, and the calibrating resistors R6 and R7. If you can not obtain a 160-ohm resistor, two values totaling 160 may be connected in series—150 and 10 or 120 and 39. Be certain that the zener diode is installed in the proper direction. If a type other than the one in the parts list is substituted, the end with the band must go to the junction of the meter and R1. It must be a 500 milliwatt (½ watt) rating. A higher power rating will not properly regulate the voltage in this circuit. Provisions to conveniently disconnect the R3 end of the voltage divider for calibration should be made.

The meter face must be modified for meaningful readings. If you use the meter called for in the parts list cut out and cement in the pattern provided. Carefully pry the faceplate off the meter. The meter face can be removed by taking out the two screws; slide it out taking extreme care not to damage the pointer. If you use a different meter you can remove the unwanted numbers on the dial by gently rubbing them with a pencil eraser taking care only to erase the black lettering and not the white paint underneath. New numbers can be put on with dry transfer letters available from



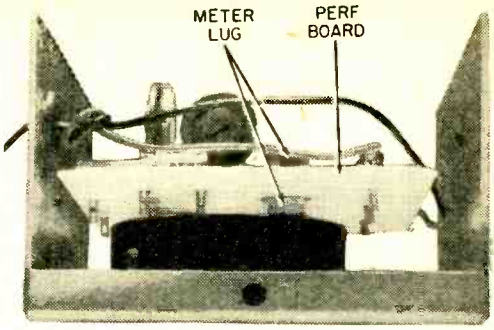
Copy or cut out this exact-size meter face.

art supply stores or electronic distributors.

If your installation requires lights, miniature bulbs can be built in behind the meter faceplate. While the faceplate is removed carefully drill a 3/32-in. hole about 1/4-in. in from each bottom corner. Drill two matching holes in the chassis so the wires can go through to the circuit board. Cement the bulbs in place with silicone adhesive. Connect the bulbs in series as shown in the schematic. The 180 ohm resistor is to drop the voltage slightly so lamp life is extended.

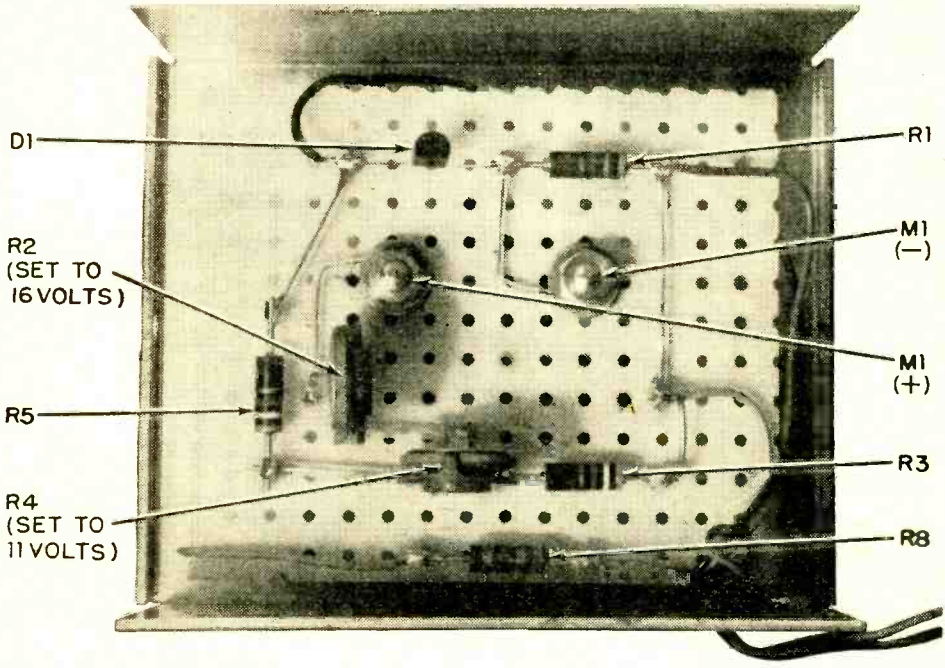
Calibration. If you have a variable power supply and an accurate voltmeter such as an automotive analyzer you may calibrate as follows. Apply 11 volts DC across the circuit and zero the meter with R4. Turn the supply to 16 volts and adjust the meter to full scale using R2. Repeat the procedure to be sure the settings are correct. Remember you must set R4 first then R2.

If you don't have a power supply use the following procedure. Disconnect the R3 end of the voltage divider. Connect R1 to the positive terminal of your car battery and the circuit ground to the negative terminal. Connect two 9-volt batteries in series with the negative end going to ground. Connect the positive end of this 18-volt battery through the 820-ohm resistor to the open end of R3. Adjust R4 to zero the meter; then connect the 18-volts through the 160-ohm resistor and set R2 to make the meter read full scale. Repeat to check settings. Using silicone adhesive or other suitable glue, cement the knobs of the potentiometers in place. Reconnect R3 to the circuit.



Pre-drill a pair of holes in the perf board; slip it over the meter lugs. The two nuts on each lug permit varying the mounting height.

Installation And Use. Connect the positive lead of the meter circuit to a spare accessory terminal on the ignition switch. If this is not available, the lead to the radio will do. The ground lead goes to some con-



Very simple layout uses push-in clips for stable mounting of the few parts used.

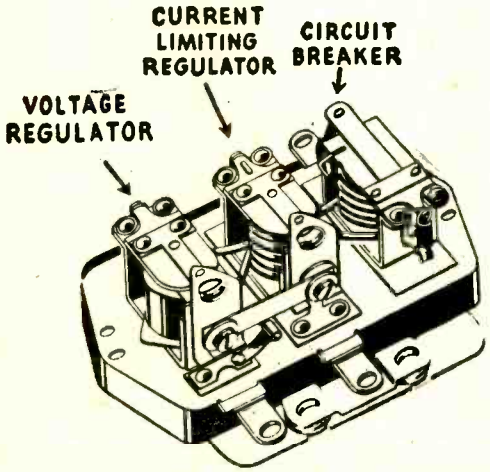
Expanded Scale

venient chassis ground point; try under the head of a screw in the dash. When the key is turned to the accessory position (with none of the car's electrical equipment turned on) the meter will read the battery voltage. A fully charged battery will be above 12.5 volts. A reading of less than 11.5 volts (with no load) indicates a discharged battery.

Start the engine and run it for a few minutes at moderate to high idle. The meter reading under these conditions should be 13.5 to 14.4 volts for most cars. In colder temperatures the readings will be higher. A reading of over 15 volts indicates the regulator probably needs adjustment. Rapid fluctuations in the reading while driving could mean a loose alternator drive belt or an open stator winding or even an open diode.

A test of the battery's capacity can be performed as follows. Crank the engine with the starter for three seconds. If the engine starts turn it off immediately and turn the key to the accessory position. Turn the lights on low beam and watch the meter reading slowly drop. If, after one minute with the lights still on, the voltage drops below 11.7 the battery should be checked.

Vehicle Maintenance. Fan belt tension is critical with the alternator. Always make sure the belt is in good condition and adjusted to specification.



Three-unit regulator used with a generator consists of sections that provide limiting of current and voltage, and circuit cutout.

Following adjustment of the fan belt, turn your attention to the regulator. Make sure all connections at this unit are tight. Then check the battery terminals where high resistance could be causing the trouble. Remove the cables and clean the terminals and posts. Make sure the ground cable is clean and tight. Finally, check at the alternator for loose connections.

If trouble still persists, replace the brushes in the alternator since poor contact between brushes and slip rings is a major factor for a low charging rate. In some cars, the brushes can be removed from the alternator with the unit in the car. This is done by unscrewing the external cap screws to which the brushes are attached. In other cars, the unit must be removed from the car to reach the brushes, which can then be unscrewed.

If you still have poor alternator performance remove the alternator from the car and check the stator. Open windings cause an unsteady, low charging rate. If it is necessary to take the unit apart, remove it from the car and split it open, separating the stator from the rotor. Test the rectifiers first. This can be done with a commercial diode tester, although you can also use any continuity tester, such as an ohmmeter or a test lamp.

If a diode is defective, it must be replaced. This requires special tools and should be left to a professional shop.

If the meter indicates low charge rate at all speeds and you get a run-down battery, which indicates low voltage output, hook the negative voltmeter lead to the battery's negative post and the positive to the positive post. Connect a jumper wire from the ignition terminal to the field terminal on the regulator and then start the engine. The voltmeter should read about 14 to 15 volts for a 12-volt charging system. If not, the regulator is faulty. If you have a mechanical regulator, try adjusting the regulator points; if that does not increase the voltage output, you probably need a new regulator.

But if the regulator does check out, go to the alternator and tighten all connections. The trouble could also be a shorted rectifier, or grounded or open stator, so check them as well.

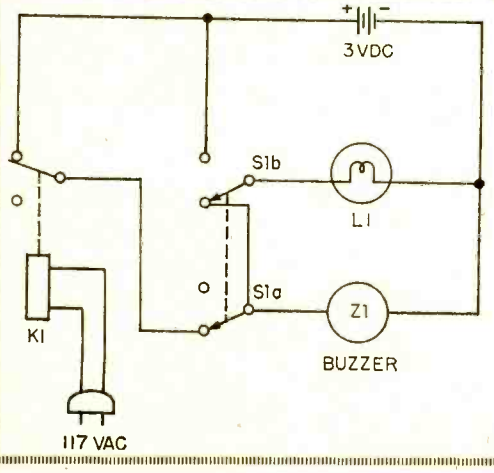
I'm sure that when trade-in time for your car comes one of the first things removed will be the voltmeter. ■

by Robert L. Way

A Nightlight Blackout Alarm

HEAVY rains, electrical storms, drifting snow, and high winds and the energy shortage can cause a power failure to your home just when you urgently need electricity to operate your furnace, freezer, sump pump, clocks, etc. After I experienced a flooded basement due to a power failure during a heavy rain, I built this power failure alarm.

This small and inexpensive device will *1*—sound a battery-operated buzzer to wake you up, *2*—light a pilot lamp (flashlight bulb) so that you can locate the unit in a darkened room (you will want to shut off that darn buzzer!), *3*—remind you to "reset" it after power is restored (the lamp stays lighted continuously until house current is applied to the device), and *4*—provide you with a portable trouble-light (you can unplug the alarm and take it anywhere).



PARTS LIST FOR POWER LOST

B1—Batteries, two C cells in series (see text)
K1—Relay, normally closed or DPST contacts
L1—Lamp, PR-2 flashlight lamp
Note: You can also use a 222-type prefocussed penlight lamp (Radio Shack 272-1124 or equiv.) in a Calectro E2-400 socket. It draws one-half the battery power of a PR-2 and beams the light for a flashlight effect.
S1—DPDT toggle switch
Z1—Buzzer for 3-volt operation

Misc.—Wire, power cord, battery holder for C cells, solder, plastic cabinet with aluminum cover (5x2¾x1¾-in.), etc.

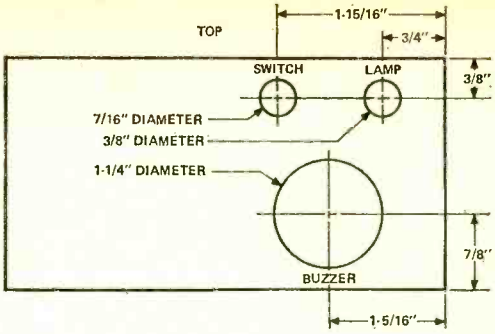
POWER LOST

After you have built the alarm and installed it (under your bed is a good place), how do you know that it will work OK when that power failure hits? Testing its operation is quick and easy. Simulate a power failure by momentarily disconnecting the unit from the wall socket. If the buzzer and lamp both come on, plug it back in and rest assured that it's ready to alert you when a real power failure occurs.

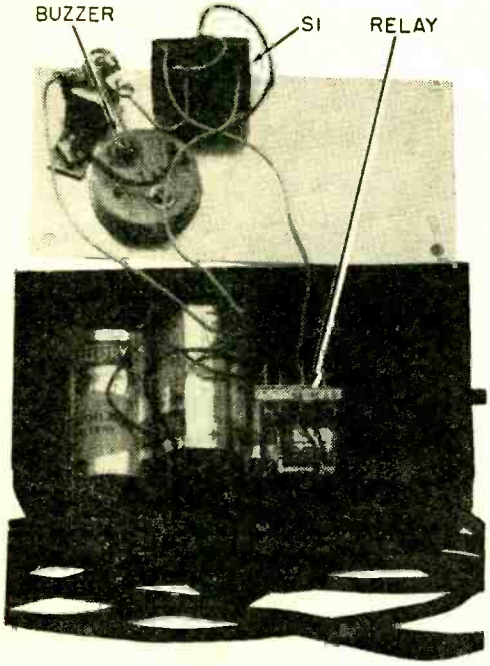
The alarm is built into a ready-made box that measures 2⅝-in. x 5⅛-in. x 1⅝-in. It costs about $10 to build, if all new parts are purchased, and about 6¢ per month to operate. It can be built for even less if you have on hand any parts that can be used, if you elect to fabricate your own box, or if you solder the batteries and lamp permanently into the circuit, thus eliminating the cost of a battery holder and lamp socket.

The gadget uses about 2 kilowatt-hours (kWh) of electrical power per month; in many localities electric power costs about 4¢ per kWh (most electric bills show the number of kilowatt-hours used per month—divide this figure into the amount of your bill to get your effective rate).

How It Works. As shown in the schematic diagram, the buzzer and lamp are wired in parallel and are connected, through the switch and normally-closed relay contacts, to the battery (two C cells). When the power cord is plugged into any household outlet, the relay coil is energized and the contacts open to interrupt battery power to the buzzer and lamp. When a power failure occurs, the relay contacts close and complete the buzzer-lamp-battery circuit.



Cut out the top metal plate of your box to these specifications. One additional hole is drilled in the side for the power cord.



Section A of the DPDT switch opens the buzzer circuit to shut it off; simultaneously, section B applies battery power directly to the lamp, which cannot be switched off. The lamp is wired in this manner to provide a reminder to switch the buzzer back to the *on* position after power is restored so that the alarm will be ready for the next power failure. If a switch were connected between the buzzer and lamp to turn just the buzzer off, you might forget to turn it back on after the emergency (the lamp would go out when the relay was energized again).

If parts are substituted for those shown in the parts list, first check to see that all components will fit in the box or case to be used, including clearance for those parts that will be mounted on the cover. In the unit shown there is adequate room for everything, of course, but it's a reasonably tight squeeze and even a slightly larger part might give you a packaging problem. Also, if you've substituted parts it would be well to hay-wire everything together to see if the battery(s) you've chosen will deliver enough current to operate both the buzzer and lamp consistently and reliably. The buzzer in the

(Continued on page 115)

Inside the black box a couple of parts can give you instant blackout warning. A buzz alerts sleepers during nighttime failures.

Stretch more miles from your gas supply . . .

BUILD A PROFESSIONAL DWELL/TACH

Plus tune-up tips by C. R. Lewart

With gasoline prices going up, and with the growing concern about air pollution caused by automobile exhaust, a well tuned car becomes a must. One of the essential tools for a tune-up is a dwell/tachometer that helps you adjust your engine to its optimum specs. What we describe here is a dwell/tach based on a newly-developed integrated circuit. It's easy and inexpensive to build, but with the IC it will also be more precise and easier to handle than most currently available commercial units. You may either put the unit in a portable case, as we have done, for use as a diagnostic tool, or you may mount it permanently on the dashboard.

The main advantages of the circuit are readings basically independent of the battery voltage, temperature, and the shape of the voltage at the points.

How Does It Work? First let's consider the shape of the voltage at the distributor points. When the points open there is a sharp spike of 100 to 300 volts followed by damped oscillation settling at the battery voltage as shown in the illustration. When the contacts close, ground is applied to the bottom of the ignition coil, and voltage across the points drops to zero as current flows in the ignition coil primary.

In the integrated circuit there is a temperature-compensated monostable pulse generator section, an amplifier-limiter section, and a voltage regulator section.

For the tachometer mode, the input circuit (R1, R2, R3, D1 and C1) assures that only the initial high-voltage spike caused by the opening points triggers the pulse generator. The generator produces a single rectangular pulse whose amplitude is determined by the IC parameters, and whose pulse width is determined by R4, R5, and C2. The pulses are amplified and fed into a one-milliampere meter which reads the average current. The higher the RPM, the more pulses, and the higher the meter reading.

In the dwell meter mode we bypass the pulse-generator section of the IC and apply the signal directly to the amplifier-limiter section. The meter reading then corresponds directly to the percentage of time the points

DWELL/TACH

are closed.

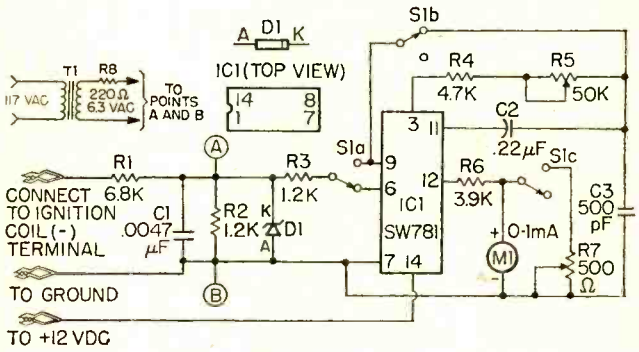
Calibration. The easiest way to initially adjust your unit is to connect it to a 12-volt battery and use a small 6.3-volt filament transformer to supply 60 pulses per second from the power line. *A 60-Hz line frequency corresponds to the following meter reading in rpm.* Set meter to the proper reading with calibration control R5. A 4-cylinder engine scale would read *1800 rpm* with the 60-Hz input, a 6-cylinder engine would read *1200 rpm*, and an 8-cylinder engine, *900 rpm.*

If, for example, you decide on a 2000-rpm full scale for a 6-cylinder engine (equivalent to 3000 rpm for a "4-banger" and 1500 for a V-8), set calibration control R5 for a 0.6 mA reading. The calibration reference for a 6-cylinder engine in rpm (1200) divided by the full scale in rpm (2000) times the full scale meter reading (1 mA) equals the calibration point meter reading in current (0.6 mA). Once calibrated, the rpm value is determined by multiplying the meter reading and the full scale. In this example the full scale is 2000 rpm, so a meter reading of, say, 0.4 mA would mean an engine rpm of 800. Once R5 is set it should not require recalibration unless accidently moved. If you prefer several ranges on a tachometer, or if you would like to use the same scale for 6- and 8-cylinder engines, switch-select a second pot of the same value as R5. Use one switch setting to calibrate for 6-cylinder engines, then throw the switch and use the second pot to calibrate for 8-cylinder engines.

It might be a good idea to tape a small mA-to-rpm conversion chart to the back of your meter. Compute rpm values for major meter divisions to give yourself a quick conversion capability, particularly if you choose a full scale of other than 1000 rpm. If you select a 1000-rpm full scale for V-8 engines, the meter will read directly in rpm. Just ignore the decimal point. For example, .55 would be 550 rpm.

With the values of components shown, you can adjust R5 for a full scale reading for a 6-cylinder engine between approximately 1200 and 6000 rpm.

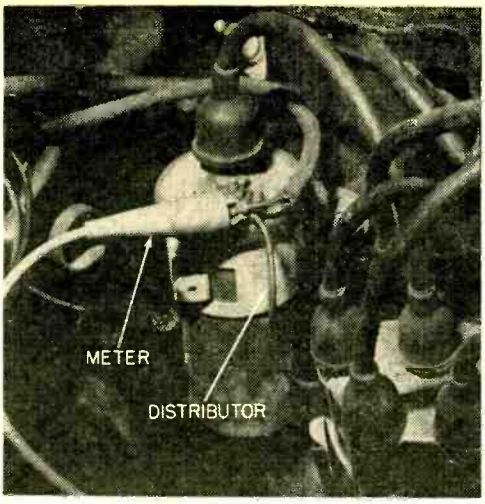
A dwell meter adjustment is done with R7. When the input (points) lead is disconnected, the meter should read full scale. Due to excellent voltage regulation in the IC, this potentiometer should not need adjustment after your initial setting. Full scale automatically corresponds to a 45-degree angle for an 8-cylinder engine, 60 degrees



PARTS LIST FOR DWELL/TACH

C1—0.005-uF capacitor
C2—0.22-uF capacitar
C3—470 pF-capacitor
D1—Zener diade, 9-volt, ½-watt
IC1—SW781 (available directly from the manufacturer, Stewart Warner Corp., 730 E. Evelyn Ave., Sunnyvale CA 94086, for $5.25 postpaid)
M1—0-1 mA meter
R1—6200-ohm, 1-watt resistor (you can use two 12,000-ohm, ½-watt resistors in parallel)
R2, R3—1200-ohm, ½-watt resistor
R4—4700-ohm, ½-watt resistor
R5—50,000-ohm potentiometer
R6—3900-ohm, ½-watt resistor
R7—500-ohm potentiometer
R8—220-ohm, ½-watt resistor
S1—3PDT switch, 3 sections used
T1—Transformer, 117 VAC to 6.3 VAC

Misc.—Perf board, clip leads, wire, solder, metal cabinet (5¼x3x6-in.), etc.



Clip "meter" wire from dwell/tach to ignition coil minus terminal. Look for "distributor" wire. It runs from the (—) terminal to the base of your distributor.

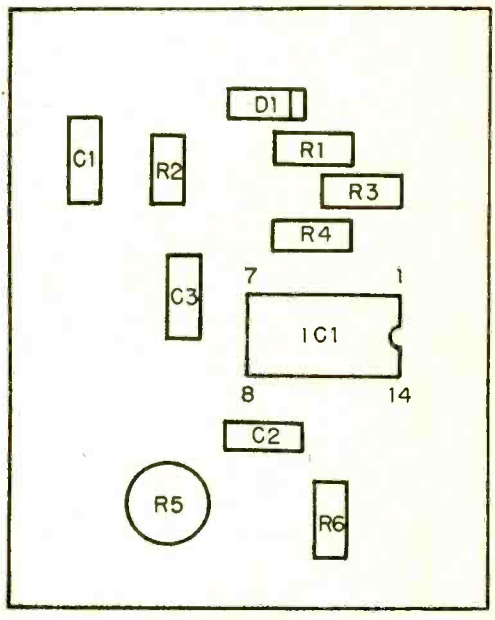
for a 6-cylinder, and 90 degrees for a 4.

Operation. Connect plus and minus power input leads to your 12 volt car battery. Switch S1 to the dwell function and adjust if necessary for a full scale meter reading, then connect the third lead to the points (thin wire going from coil minus to the distributor housing). Now you are ready to take measurements.

Auto Ignition Info. Let's define some of the points about ignition points. A term used very widely is distributor contact dwell. Degrees of distributor dwell are the degrees of rotation during which the breaker, or contact points, remain closed. This is commonly referred to as dwell angle or cam angle. Correct distributor contact dwell is essential for good ignition performance and point life. Distributor contact dwell in effect is the amount of time that the points remain closed; during this interval of time, magnetic energy builds up in the ignition coil which, when the points open, generates the high voltage pulse that *arcs* across the spark plug electrode. Generally a longer dwell period (larger dwell angle) is more advantageous for high speed operations.

Replacing ignition points is a simple matter of unscrewing the point retaining plate and screwing down the new one. This is just the beginning of a good tune-up. To check dwell reading you should have a dwell meter. Like most, ours is combined with a tachometer. With the engine running and the dwell meter/tachometer connected you should observe the dwell meter reading. If the dwell reading is within specifications for the engine then you can assume you have the correct gap, and that point contacts are in satisfactory condition. If the dwell reading is not within specifications, the point gap may be incorrect, the cam worn, the rubbing block worn or the moveable contact arm may be distorted.

Mini Lube Job. Distributor lubrication is something which is usually overdone. If the distributor has an oiler on the outside of the distributor base add three or four drops of SAE10W motor oil to the oiler. If there is a felt wick under the rotor at the top of the distributor cam, use three to six drops of SAE 10W oil. All grease should be wiped from the distributor cam and rubbing block. It's very important that the ignition points be free of grease or oil.



Use perfboard construction and lay out circuit components as shown. Components R7, S1, and M1 are located on front panel.

Many ignition systems use dual breaker points. These dual breaker point systems are designed for long life and good high speed performance. They are handled in the same way as single ignition points with the following exceptions: One set of contacts should be blocked open with a clean insulator. A match book section makes a good clean insulator for this. Adjust the opposite set of points to specifications using a dwell

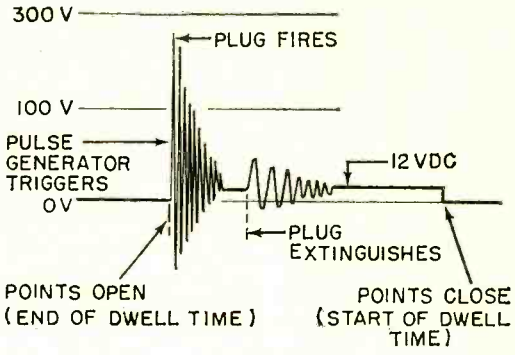
meter. Loosen the stationary contact block screw just enough so that the stationary contact can be moved with a light touch otherwise it will be difficult to set the contacts accurately. When the one set of contacts has been adjusted for the correct clearance, tighten the stationary contact lock screw. Block the adjusted set of contacts with an insulator and adjust the other set of contacts in the same manner as the first set. Remove the insulator and recheck the tightness of the stationary contact lock screw. If the contacts have been properly adjusted the dwell should be as specified for both contact sets. Again you must make sure that the gap and the dwell specifications are met for both sets of points.

Don't Overlook The Carb. A list of malfunctions caused by a sick carburetor reads like a "Who's Who of Auto Ailments." It includes hard starting, flooding, delayed acceleration, poor gas mileage, stalling, rough running, fouled spark plugs, and the gas leaks at the carburetor.

Not all of these problems, however, result only from an ailing carburetor. For this reason you should make sure spark plugs, ignition parts, compression, and timing are all in good condition before beginning carburetor service. In short, make sure your engine is correctly tuned, because your carb depends on proper operation of the rest of the engine.

All types of carbs—no matter how many barrels—have only one throttle adjusting screw. Two- and four-barrel units, however, have two idle adjustment screws—one for each idle system.

Warm the engine to operating temperature and have the choke valve completely open when adjusting. Start the engine and let it idle. If it stalls, turn the throttle screw in until the engine is running steady without any foot pressure on the accelerator.

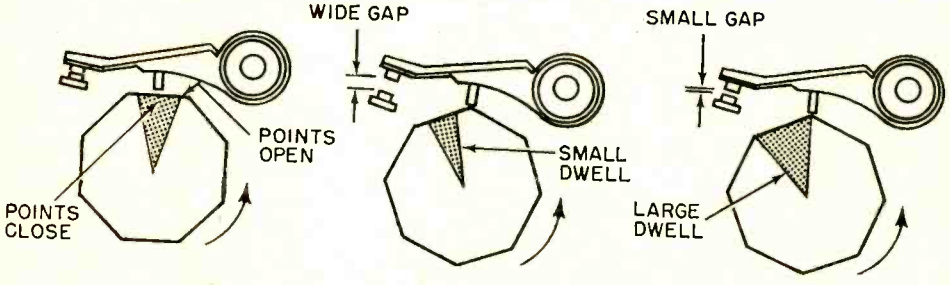


A pulse generator in your dwell/tach is designed to trigger just once each time the points open and a plug fires. Often, erratic behavior in some non-electronic tachometers is due to this complex wave.

The idle mixture should be adjusted to give a smooth idle. Missing is a sign of too lean an idle mixture while rolling or loping indicates too rich a mixture. Turning the screw in leans the mixture. It may be necessary to readjust the idle speed and mixture after the air cleaner is installed.

(Note: late model smog-controlled cars usually have a plastic limiter that restricts the movement of the mixture screw. An acceptable mixture adjustment should be possible within its limits.)

Turn the idle adjusting screw in slowly



As a gasoline engine runs, a normally closed switch called the "points", is constantly being pushed open by a cam. Whenever the points open, a high voltage is generated by the ignition coil to "fire" a spark plug. Dwell shows how many degrees the cam turns before it opens the points. Cam shown is for 8 cylinder car. Six cylinder motor has hexagon cam.

until the engine is about to stall. At this point, turn it out about a half-turn. If the engine seems to race, turn the throttle adjusting screw out slowly until the speed comes down.

Tune-up helped this overdrive equipped '68 Rambler increase mileage from 21 to over 25 mpg at todays 50-mph speeds. They laughed when I ordered overdrive back in 1968. Now one tank gives us a 375-mile driving range!

Service Your Plugs. Be extremely careful how you apply the socket wrench over the spark plug insulators. While they can resist the sledge-hammer blows under extreme temperatures and load that take place inside the cylinder each time they fire, they can be cracked by carelessly banging them with a wrench either taking them out or putting them in.

After removing your spark plugs, you have three things you can do: put them right back in the engine, have them cleaned and regapped and reinstalled, or replace them with new spark plugs.

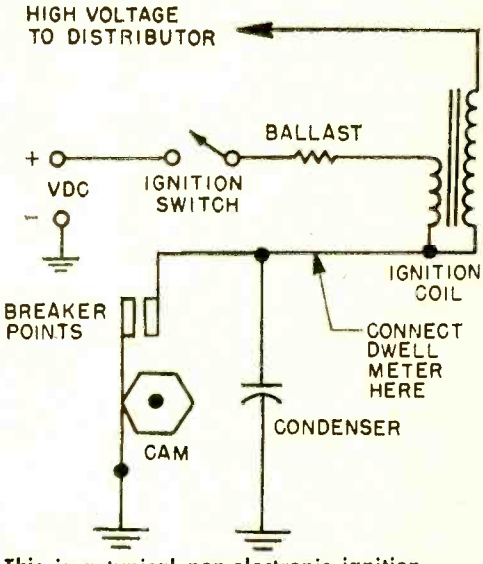
In the first case, you may merely want to examine the general condition of the plugs or check to see if the heat range is correct for the particular engine. Choice number two would be normal if spark plugs have only been used for around 5,000 miles and show normal wear. Clean and regap after 5,000 miles of use. Choice three would normally apply to spark plugs that have 10,000 miles of use or more on them.

Assuming that no particular complications exist, soak the spark plugs in a good parts cleaner for a few minutes to remove any oily deposits that exist.

To remove carbon deposits, use a small knife or any other small tool which will fit up inside the plug along the insulator. Be careful not to chip the ceramic and avoid the use of a wire wheel, which will completely ruin the plug.

Hard carbon formations are often impossible to remove. As you examine the plugs, you may notice such a condition, or possibly a burned condition of the electrodes. In such a case, it's advisable to install a new set of spark plugs as you'll need them soon anyway.

If the condition of the spark plugs is satisfactory after cleaning, open the gap. File the electrode sparking surface with an ignition point file before opening up the gap. You will get better firing from clean, flat surfaces, so this is an important part of spark plug servicing. Finally, adjust the gap to the manufacturer's specifications (Check the owners manual).



This is a typical non-electronic ignition system used for nearly all auto and truck engines since Henry Ford dropped buzzer ignition for his Model A. Additional part of ignition switch usually shorts out the ballast for more spark during starting.

Making sure you have the right spark plugs installed and that they are in good condition is vital to good ignition system performance. But it's only part of the story. Other parts of the system must be working properly if the plugs are to do their job. Wiring, distributor components, and coil condition all affect the production of a healthy spark. ■

TAKES TWO TO COUPLE

by William R. Shippee

Gotta be! Just about every home has two TVs. Gotta be! But the number of homes with two set couplers falls way short of what would be considered a reasonable number. So let's equalize the situation a bit by offering our readers a simple, easy-to-build two-set coupler that everyone can build and use with delightful reception results. We call it the TSC—obviously from *T*wo-*S*et *C*oupler.

The TSC may be used to couple two TVs, two FM sets, or a TV and an FM set from a single antenna. Several of these couplers may be connected to a single antenna system for more than two receivers. Insertion loss is less than 2.5 dB and the set-to-set isolation is about 6 dB.

Start building the TSC by winding coil L1 as shown in the drawing and with the information given in the Coil Data. Close-wind (no space between turns) the No. 22 enamel wire, and use care when making the taps to assure a good connection, since the signal level is very low. Check the completed coil with an ohmmeter to make sure the taps are soldered properly. Check the coil visually to be certain that none of the turns are shorted! A shorted turn in coil L1 will make it practically useless.

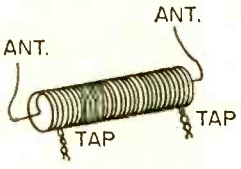
Keep all leads as short in length as practical, make sure all connections are mechanically sound before soldering, and, if an enclosure is to be used, make it wood or plastic or some other non-metallic material. Coil L1 is designed to be non-resonant when operated in a twin-lead, 300-ohm antenna line, but there is some possibility that resonance may occur. This will either give much greater signal on one channel (frequency) or drop the signal level appreciably. To remedy this, simply install a resistor valued at approximately 300 ohms from one tap to the other. The author has constructed several TSCs and has run into this problem only once.

Best way to hook up the antenna is to solder directly to the coil ends. Alas, some people like screw posts, so spring for some brass screws (aluminum or nylon are also o.k.) to keep down magnetic fields near the coupler. Solder the leads from the TV antenna terminals directly to the TSC for the same reason.

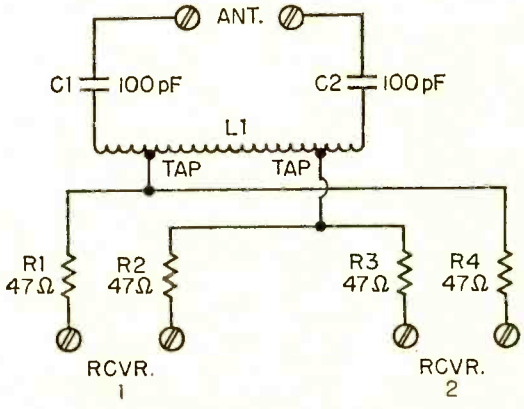
Parts are easy to come by. No. 22 enameled wire is available in ¼-pound spools (Radio Shack 287-003). 47-ohm resistors (Radio Shack 271-1800 ¼-watt jobs are best) and 100 pF disc capacitors (Radio Shack 272-123) are available everywhere and are probably in your spare parts box right now. So get on with it, boy, for the TSC has got to be! ■

CONSTRUCTION DETAILS

COIL DATA FOR L1

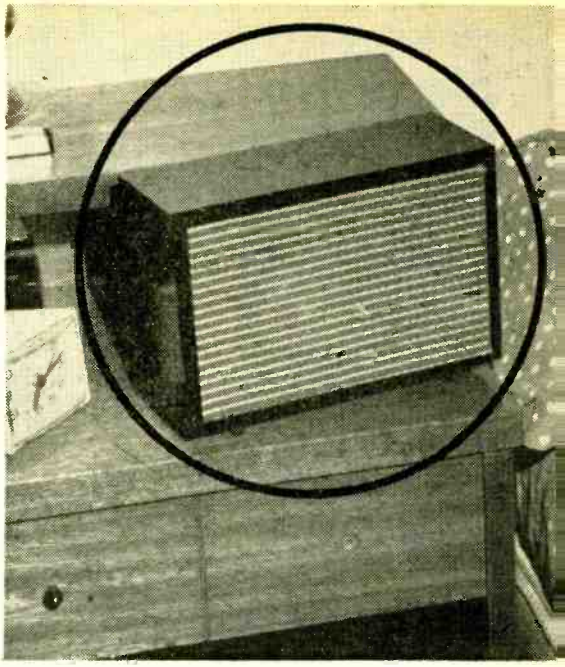


Use Bakelite or wood form ⅝-in. diameter about 1-in. long. Use No. 22 enamel copper wire close-wound for 24 turns. Taps located at 3 and 21 turns.



Construction is simple provided you keep it simple! Avoid iron hardware—brass is best, but keep its use down. Install the coil and resistors in a plastic box and fill with "gunk" after wiring is complete. Resistors need be 10% tolerance only.

KLAXON FIRE ALARM



The next "Wheep, wheep" you hear

☐ A fire in your home can mean more than just a monetary loss or the loss of irreplaceable family heirlooms; if the fire breaks out at night while your family is sleeping it can mean the loss of life. Yet a fire alarm is one of the least expensive and easiest to install of all home protection systems.

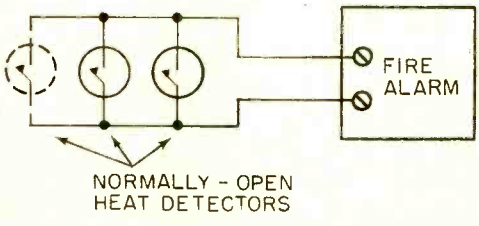
Basically, a fire alarm consists of one or more low-cost normally-open heat detectors, a 6-volt battery, and an alarm horn or bell. When heat in the room becomes excessive the detector's contacts close, thereby completing a circuit, and the alarm-horn sounds. Even if there is an outdoor alarm bell, a horn should be positioned in the sleeping area to wake the occupants in time to get out safely. Unfortunately, any continuous noise (such as a steady tone from a horn) is not likely to wake a sound sleeper. What's needed is a horn that *pulsates*—similar to the warning horns and klaxons used on boats.

The Klaxon Fire Alarm project is just such a device. When triggered by a heat detector, the horn produces a raucous *wheep, wheep, wheep,* and keeps producing the sound until heat is removed from the detector.

The basic alarm consists of the alarm horn and pulsation relay, which is mounted on a scrap of plastic or wood (not metal) approximately 3 x 4 inches. The power supply is a 6-volt lantern battery which has a shelf life of at least one year. The alarm requires no standby current.

The alarm and the battery can be mounted in any suitable enclosure—metal, wood, or plastic. Since the alarm should be mounted in the general sleeping area, or perhaps directly at a child's bedside (several alarms can be connected in parallel), you might prefer an enclosure that blends in with the general decor. Our alarm is shown in an attractive speaker enclosure purchased locally for $2.

For More Noise. If you wish to add an outdoor alarm bell, or additional horns (up



Yes, you can also connect normally open smoke detectors to this alarm system.

FOR YOUR HOME

by Herb Friedman

will save your life and maybe your home!

to three total), simply connect them across the horn (BU1) at points A and B. However, if you add any additional horns or bells you must substitute a relay for RY1 with contacts rated at least one ampere. Any 6-VDC general purpose relay can be used, such as the Potter & Brumfield KA5DY (Allied Radio 886-0389).

Horn BU1 requires a 1⅝ in. mounting hole. It is cemented to the board with epoxy or one of the "miracle" adhesives such as *Permabond*. Relay RY1 is supplied in a plastic case which should not be removed. Position RY1 in relation to the horn as shown in the photo and cement the case to the board. Position RY1 so its leads stick out from the top.

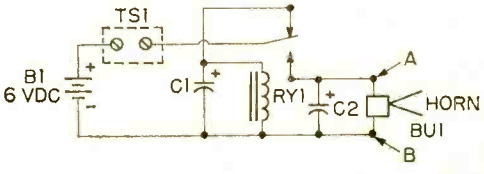
The 5-terminal strip is cut down from a larger strip, or you can use two smaller terminal strips—the important thing is to have five terminals. Capacitor C1 is required; C2 might not be needed and there's no need to purchase it in advance.

To avoid shorts between RY1's leads, place insulation on every wire from RY1. The wire leads are extra-thin, so you can use the insulation stripped from ordinary "radio" hook-up wire.

Horn BU1 is supplied with only one terminal wire; the metal case is the other terminal. Using a soldering iron or gun rated at least 100 watts, "tin" a small area on the horn's case with solder—using a noncorrosive soldering paste. Then solder a 2-in. wire to the case. This wire must connect to C1's negative terminal.

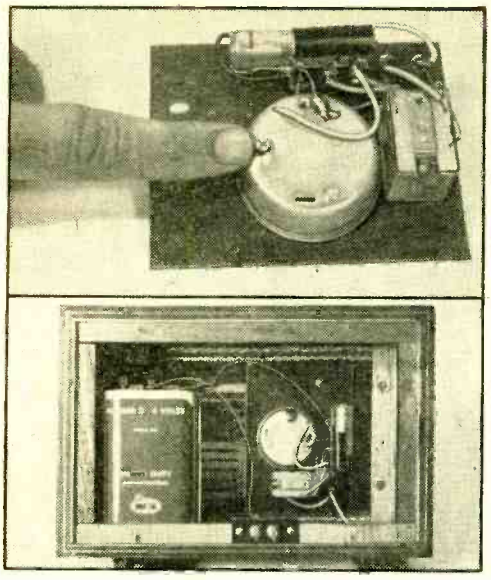
The terminal wire supplied with the horn is very delicate and almost impossible to shorten without damage, so use it full length.

Checkout Before Installation. Connect a wire from the terminal to which C1's negative lead connects to a 6-volt battery's negative terminal. Connect a wire from the terminal with RY1's wiper contact to the battery's positive terminal. This should cause the horn to sound. If it doesn't sound, rotate the small screw sticking out the back of the horn until the horn sounds. Then carefully adjust the screw until the sound is as



Note the very simple schematic. Normally open detectors, left, connect to TS1, right.

Klaxon Fire Alarm



A complete alarm circuit is easily put together on a small plastic or wood board. A finger points to the loudness-adjust screw. Place the entire circuit in any convenient enclosure such as this surplus speaker box.

Keep in mind that heat rises. You must not install fire detectors near, of course, the floor. In the furnace room, secure a heat detector directly above the furnace. Look to the parts list for detector availability.

loud as possible. The horn should pulsate as it sounds. If the sound pulsates but the horn sounds as if it is sticking—barely getting enough energy to sound loudly—install capacitor C2. The negative terminal of C2 connects to the same point as C1's negative terminal.

Completing the Fire Alarm. Install the horn assembly in the enclosure, making certain you leave enough room for battery B1. Install a 2-terminal screw-type strip at the back of the cabinet and then install the battery, securing it with a metal, string, or wire strap.

Connect the battery's positive terminal to one screw terminal on the strip. Connect the remaining strip terminal to the alarm. Connect the battery's negative terminal to the alarm. The system is ready for use.

The heat detectors must be the normally-open type, where the contacts are open until excessive heat causes them to close. Any number of heat detectors can be used—they are all connected in parallel. Two wires (lamp cord or equivalent) can be run from any of the heat detectors to the fire alarm terminals.

Standard heat detectors will protect an area up to 20 x 20 feet (400 sq. feet). They can be positioned in the center of a ceiling, or even near a corner with the walls. If installed near a corner keep in mind that protection does not extend beyond 20 feet. If necessary, use two detectors in opposite corners.

Heat detectors used for the general living area should be rated 135° F. Detectors used for furnace rooms and attics should be rated 190° F.

For added protection a dated label should

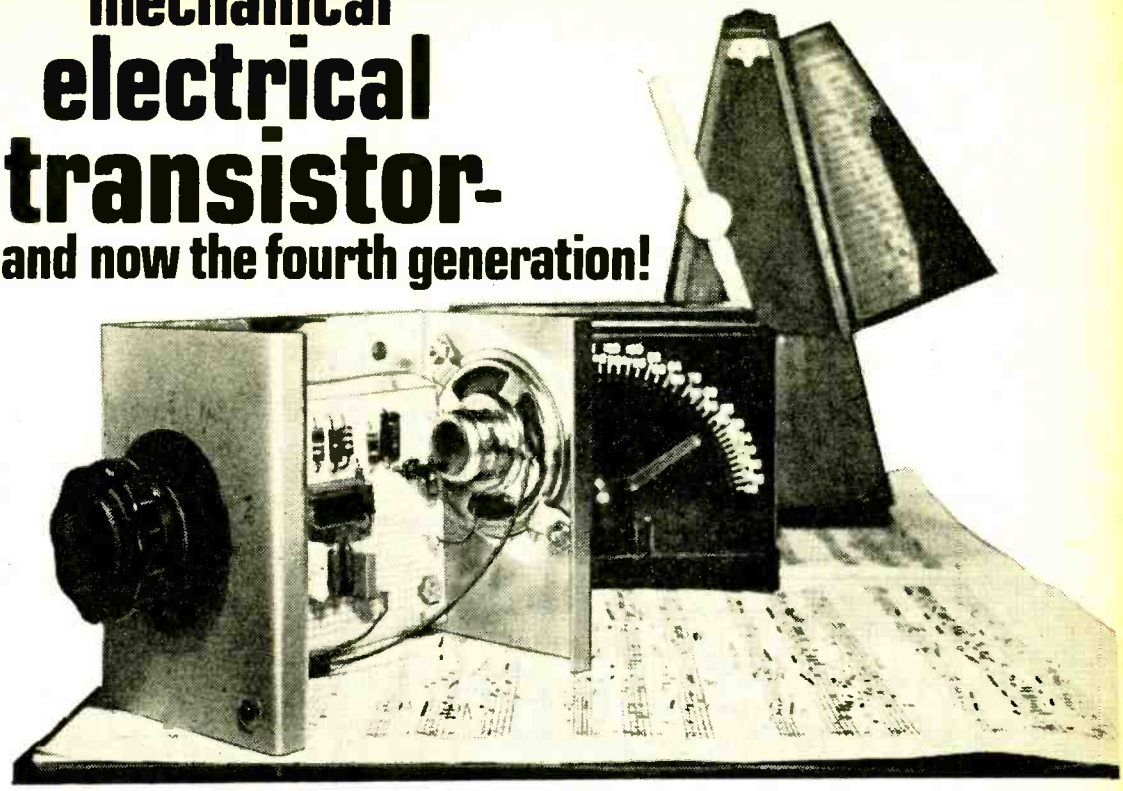
(Continued on page 116)

PARTS LIST FOR KLAXON FIRE ALARM

B1—6-VDC lantern battery
BU1—6-volt alarm buzzer (horn)
C1—500 uF, VDC electrolytic capacitor
C2—100 uF, 15 VDC electrolytic capacitor, see text
RY1—SPST, 6-volt DC relay
TS1—2-terminal, screw-type terminal strip

Note: Heat detectors are available for $3.50 each from Custom Components, Box 153, Malverne, N.Y. 11565. Specify either 130° F. or 190° F. heat rating. Add $1 postage and handling to total order. N.Y. State residents must add sales tax. No foreign orders.

mechanical electrical transistor- and now the fourth generation!



IC METRONOME

It's stable, portable, economical and is the only *simple* metronome we found that keeps its beat for wide voltage and temperature changes.

by C. R. Lewart

WHAT, ANOTHER METRONOME PROJECT? They've been around for years, you say. Why another one then? Well, as far as we're concerned, currently popular versions of the electronic metronome —a unijunction relaxation circuit—simply aren't in the picture anymore.

With this project, you can have a metronome that will run on a single 9-volt transistor radio battery for *thirty* to *fifty* hours and keep the beat accurate throughout the useful battery life, even under wide temperature variations.

Unijunction transistors are extremely dependent upon supply voltage. So either you power the unit with 117 VAC (which means it's tied to a not-always-convenient outlet), or you regulate the battery voltage—a practice that is expensive both in parts and battery power. You either suffer a change in tempo in step with battery aging, or tie yourself to a power socket.

In addition to battery voltage and temperature independence, the sound this metronome makes is a dry *snap* or *click* much like the mechanical variety. The sound of the click does not change as you vary the beat frequency, and the dial is not squeezed at either end. An optional light-emitting diode (LED) flashes with each click to give a visual beat indication.

When we went to press the 556 IC was new, so you may not be able to obtain it through the regular hobby channels. You can, however, use two individual 555-type IC timers which are much easier to find.

IC Metronome

The only disadvantage to using two 555 ICs compared to a single 556 is a slightly higher battery drain with its associated, slightly lower, battery life. Check the table for equivalent pin connections if you use the two 555s.

Why It's Better. The first IC, a 555-type timer, is connected as an astable multivibrator, which is something like an automatic switch that turns itself on-off-on-off.

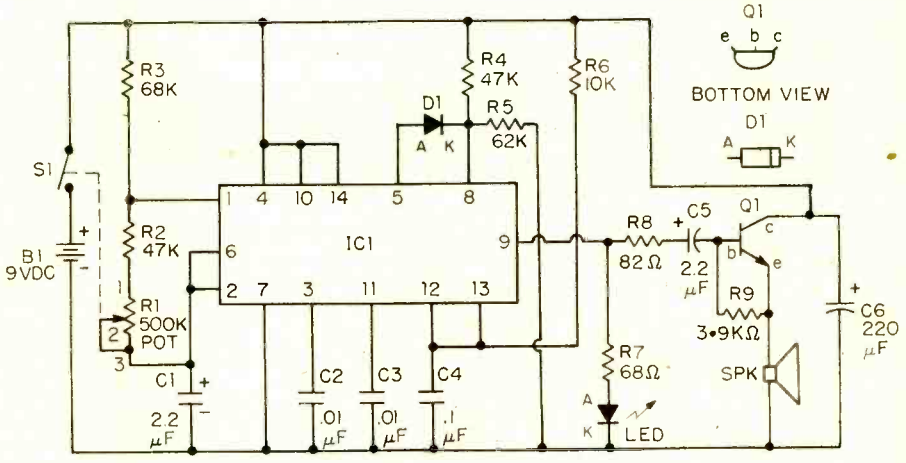
This generates the basic metronome beat frequency, which is determined by C1, R1, R2, and R3. Variable resistor R1 determines the time necessary to charge capacitor C1 to approximately two-thirds the battery voltage. By specifying R1 with an audio taper, you have a fairly uniform beat frequency scale without crowding at the high end.

Each on-off cycle of the first IC triggers the second IC (an identical 555-type unit) for a short, fixed on-off cycle. It is the output of the second IC that produces the waveform ultimately used to drive the speaker. This "click" stage lights the LED and, with additional amplification by transistor Q1, drives the speaker.

A critical component in the circuit is C1, which determines the beat frequency. A ceramic or mylar capacitor would be best here. Though an electrolytic will also work, it will make you lose some of the inherent voltage and temperature accuracy of the circuit.

Construction. Install the components on a 2½-in. x 3-in. piece of perf board, following the layout shown. Then mount the perf board on spacers in a 3 x 4 x 5-in. cabinet. Make a bracket for the 9-volt battery. Cut a hole in the cabinet wall for the speaker, and cover the hole with a piece of speaker cloth or perf board. Mount the speaker with small brackets or attach it with epoxy glue.

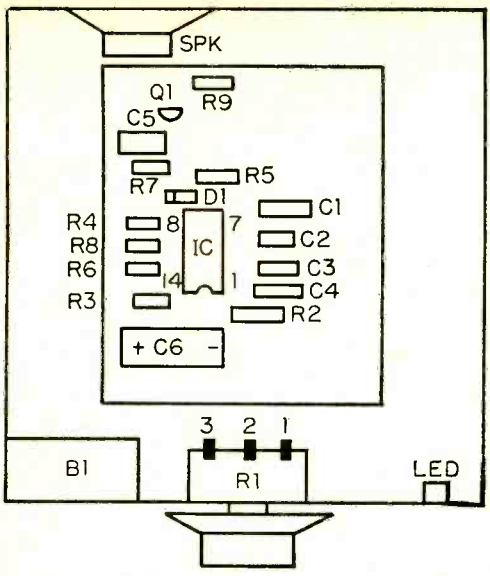
When you're ready to calibrate, use press type or cut out a round piece of white cardboard to make the dial. Mark the beats-per-minute by counting them for sixty sec-



PARTS LIST FOR AN IC METRONOME

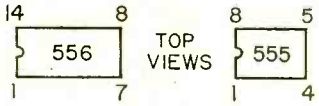
B1—9-volt transistor radio bottery
C1—2.2 uF capacitor, ceramic or mylar, (Centralab UK225 or equiv.)
C2, C3—0.01 uF capacitor
C4—0.1 uF capacitor
C5—2.2 uF electrolytic capacitor
C6—220 uF electrolytic capacitor
D1—Silicone diode, 1-amp, 50 PIV or better
IC1—Dual IC timer, Signetics or Raytheon type 556
Note: You can use two 555-type IC timers in place of the 556, see text.
LED—Light emitting diode, 20 mA
Q1—npn transistor, Motorola HEP735
R1—500,000-ohm potentiometer, audio taper w/SPST switch
R2, R4—47,000-ohm, ½-watt resistor
R3—68,000-ohm, ½-watt resistor
R5—62,000-ohm, ½-watt resistor
R6—10,000-ohm, ½-watt resistor
R7—68-ohm, ½-watt resistor
R8—82-ohm, ½-watt resistor
R9—3900-ohm, ½-watt resistor
SPK—Small 3.2 to 8-ohm speakers; salvage from discarded transistor radio

Misc.—Wire, solder, 3 x 4 x 5-in. cabinet, perf-board, knob, etc.

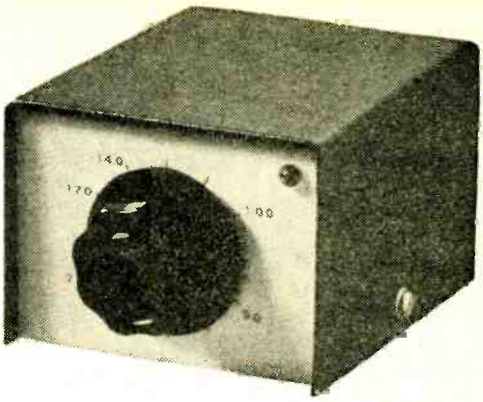


Tempo-set potentiometer R1 drawn in birds eye view above, shows solder lugs facing up. It can be wired as indicated on the schematic so clockwise rotation will decrease tempo, or by moving the lug no. 2 connection from 3 to 1, for increasing tempo.

IC	PIN EQUIVALENTS
556	1 2 3 4 5 6 7 8 9 10 11 12 13 14
555 (NO.1)	7 6 5 4 3 2 1 8
555 (NO.2)	1 2 3 4 5 6 7 8



The layout shown above is for the single IC version. If you use two 555s, convert from the 556 numbers with the chart above.



A musical tool for budding Beethovens.

onds at various settings of R1, or compare with a well-calibrated mechanical metronome. The range should be between approximately 40 and 210 beats-per-minute. If you would like a different range, change C1 to affect low beat frequencies and R2 for high frequencies. To change the sound of the metronome you may want to vary R6. You may also want to write the musical terms for various beat frequency ranges on the dial. They are:

Tempo Beats/Minute

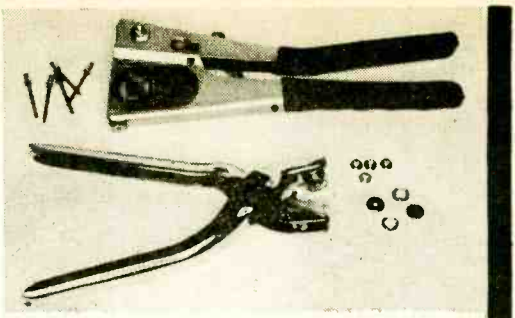
Presto	208—182
Allegro	182—154
Andante	154—124
Adagio	124—98
Larghetto	98—69
Largo	69—44

Perhaps that tall pyramid-like box which all music teachers once carried in their music case will become a thing of the past following the introduction of electronic metronomes. The old box is up against some stiff competition. ■

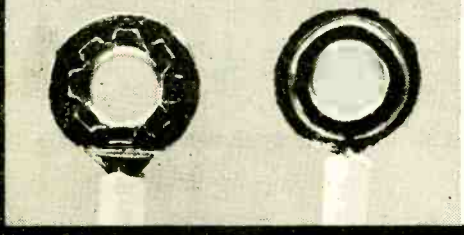
☐ Mechanical vs. electronic is not the first controversy surrounding the metronome (originally called the *chronometer*). There is a long-standing duel among musical historians that surrounds the name of the inventor. The actual date of the invention is thought to be around 1815. This is determined by the fact that Beethoven republished eight of his Symphonies in 1817; all were marked with metronome time. In fact, the Eighth Symphony has a series of staccata sixteenth notes in the allegretta movement that are thought to represent the tick of the metronome. Some historians believe it was Beethoven's feeling that no accomplished musician required the use of a metronome; apparently, any orchestra that could properly play the Eighth, was accomplished. It is believed that Beethoven learned of the metronome from his friend Johann Maelzel. However, in some musical records it appears that the actual inventor was one Dietrich Winkel. Whichever of these two gentlemen was actually responsible for the metronome may never be determined, but we're sure he would be pleased with the electronic advancements made to improve his tick-tock wooden pacesetters.

Eyelet-Popping Connectors

by Jorma Hyypia

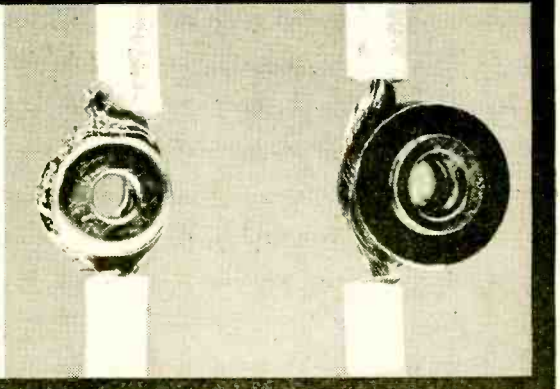


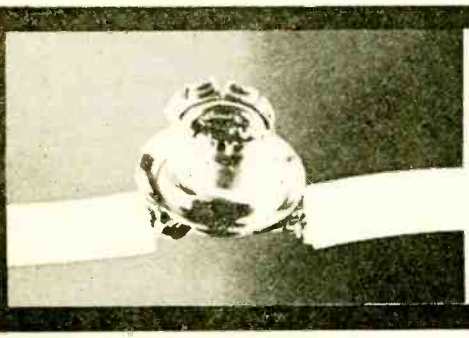
☐ Here are several handy ways to use a "pop" rivet tool and an eyelet tool to make solderless connections when building electronic gadgets and when repairing home appliances. Obtain several sizes of rivets and a stock of washers that will slip neatly over the rivet shanks. If a rivet is too long for a particular job, slide it off the long pin and file or hack saw to the desired length. Your eyelet fastening tool will be doubly useful if you obtain one that is also capable of setting snap fasteners. Although these are basically solderless joints, you can add solder to obtain better electrical connection between joined wires. However, remember that you cannot solder to the eyelets which are of aluminum, and that you should **not** use colored eyelets which would not conduct electricity. If in doubt, check conductivity with an ohmmeter.



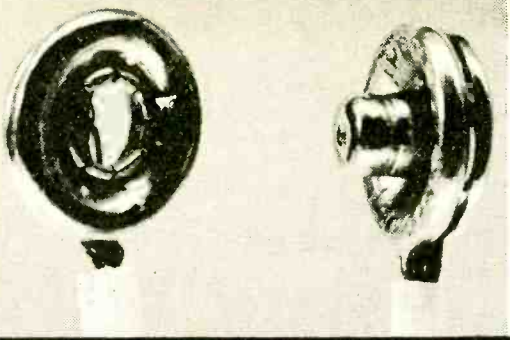
Wire-End Eyelet. Divide the conductor strands in the wire into halves and wrap around two sides of the eyelet shank. Twist the wire ends together to keep tight fit. Set eyelet with tool to lock in wire, trim off excess wire strands. The eyelet is a perfect fit on terminal bolts. For a rugged terminal eyelet sandwich the wire strands between two washers that fit snugly on the eyelet shank. Set eyelet and trim off excess wire.

Rivet Wire Connectors. To join two wires quickly without soldering, wrap the bared wire ends around the shank of a "pop" rivet, add a small washer, and set the rivet with the rivet tool. For a stronger connection, or when using heavier gauge wire, sandwich the wire ends between two washers that just fit the rivet shank. The handiest rivet size for most applications is ⅛" diameter with a ⅛" work thickness rating. This is a handy way to connect a line cord to iron wires found in older appliances. Note that the "pop" rivet has a hole in the center through which you can insert a screw, bolt or nail to mount the connector to a panel.



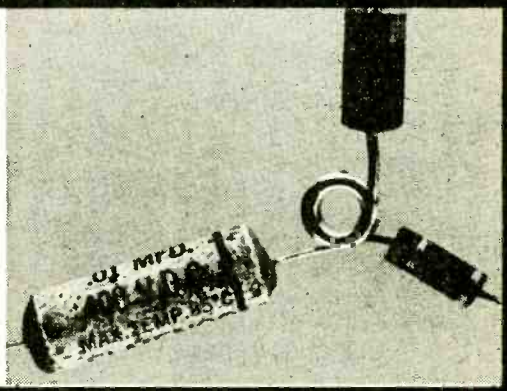


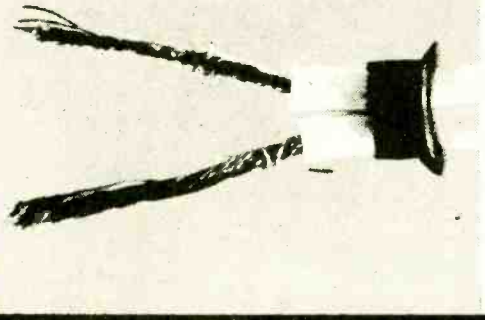
Rivet-Eyelet Connector. Insert the bared wire ends into an eyelet from the flange side, then add a ⅛" x ⅛" "pop" rivet from the same side. Set the rivet with the rivet tool. The wire ends are thus pinched between the rivet and inside of the eyelet for a tight fit. Note that this connector provides a stand-off shank with a hole rhrough the middle that can be used to mount the wire joint a fraction of an inch off the assembly panel on which it is used.



Take-Apart Connector. Where you anticipate the need to disconnect joined wires, try this trick. Just attach the bared wire ends to the two halves of a clothing snap fastener using an eyelet setting tool having this capability. For example, place the socket portion and its mating prong ring into the tool jaws, run the bared wire strands (flatten the bundle) **completely across** the prong ring, and mate the socket and prong ring by squeezing the tool. Attach the other wire to the stud section in the same manner. A handy connector for breadboarding or wherever the connection needs to be taken apart frequently.

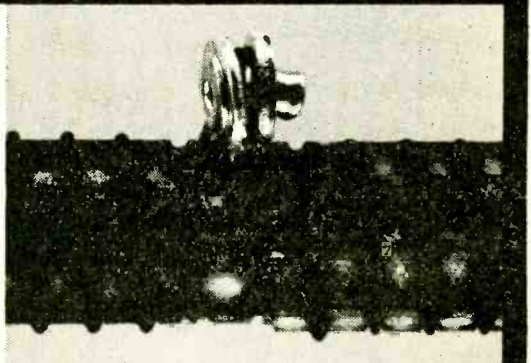
Components Joiner. Want to join several resistors, capacitors or other electronic components together in a jiffy? Just wrap each lead a full turn around the shank of an eyelet, and pinch the eyelet shut with the tool. This provides a good mechanical joining of the wires, but you can run in some solder if you like. The eyelet ring is handy for mounting the assembly on a bolt or other support.





Wire Clamp and Strain Relief. An easy way to bind two separate insulated wires together is to slip them through an eyelet and pinch the eyelet shank with pliers. To fashion a strain relief that will keep a wire from being pulled through a chassis hole, use **two** eyelets with their flanges facing each other and a washer between them. Lock the washer in place by pinching the shanks of both eyelets.

Hot-Wire Connector. The burned-apart ends of a heating coil in a space heater or other appliance obviously cannot be soldered together. For an emergency repair, try this: form loops on the ends of the wires that just fit the shank of a "pop" rivet and place the loops between two washers slipped on the rivet. Set the rivet to make a really tight physical connection. To ensure good electrical contact, be sure to brighten the heater wire loops with sandpaper or light filing.

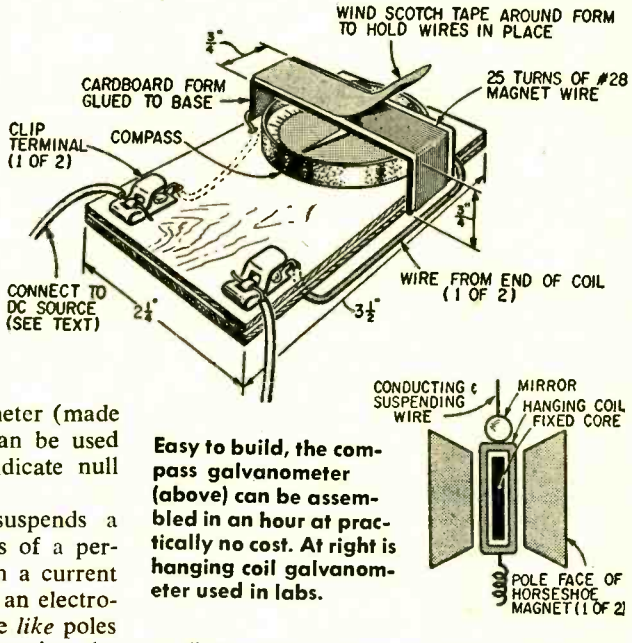


COMPASS GALVANOMETER

by T. A. BLANCHARD

Many electrical measuring instruments today are based on the design of the d'Arsonval *String Galvanometer*, but substitute a needle-suspended coil riding on jeweled bearings for the hanging coil employed in the original precise lab instrument.

The galvanometer is not often used to measure quantity of current flowing in a circuit, but rather to indicate the polarity and presence of small currents by comparison to null methods. The compass galvanometer (made from the illustration at right) can be used with a Wheatstone bridge to indicate null points.



Easy to build, the compass galvanometer (above) can be assembled in an hour at practically no cost. At right is hanging coil galvanometer used in labs.

The d'Arsonval instrument suspends a small coil between the pole faces of a permanent *horseshoe* magnet. When a current flows through the coil it becomes an electromagnet and its *like* poles repel the *like* poles of the horseshoe magnet, thus causing the coil to turn on the connecting wire. The strength of the current through the coil determines the extent of the coil's rotation.

A small pointer attached to the moving coil registers on a curved dial, or a tiny mirror is attached to the galvanometer string. A beam of light is aimed at the mirror, bouncing the beam off to a wall screen or chart to give great magnification of tiny current changes in a darkened room.

Making A Simple Galvanometer. A small amount of insulated magnet wire, any Boy Scout pocket compass and a 2¼ x 3½-in. scrap of plywood is what you need to make the compass galvanometer. Cut a strip of cardboard ¾-in. wide and 3¾-in. long. Score the cardboard ¾ in. from each end, with a dull knife blade and crease so the cardboard form resembles a C or bridge shape. Now glue the cardboard to the edges of the wood base. Do not use tacks!

Bind the cardboard with a rubber band until glue or cement dries. Wind 25 turns of #28 magnet wire around the cardboard. Heavier wire and fewer turns will work, too, with a slight drop-off in sensitivity.

Scotch tape is wound around the finished coil to keep the wire turns in place. Connect the ends of the coil to screw terminals or clips. Slip the compass under the coil in a position where its needle comes under the coil and parallel to the coil turns.

Connect the galvanometer in series with a flashlight battery and bulb, a buzzer or a toy motor, etc. When the circuit is closed, the compass needle will be drawn so that it is at right angles to the coil. A slow swing of the needle indicates the circuit is drawing little current. A rapid swing denotes an increase in current flow.

To show how sensitive this simple galvanometer is, connect what appears to be a dead flashlight cell across the terminals, immediately breaking the circuit. The compass needle will spin at a merry clip, indicating there is still some life in the "dead" cell. ■

BUILD THIS VERSATILE SOLID-STATE DARKROOM/KITCHEN TIMER . . .

UNIVERSAL POWER TIMER

Switch up to 300 watts to a photo enlarger or use a built in buzzer to time a 3-minute egg!

by C. R. Lewart

THE PROJECT described here should result in an extremely versatile darkroom timer with features not available even in commercial units. The timer can be used to turn on your enlarger for a specified number of seconds; it can also be used as a kitchen timer to sound a buzzer after a specified time has elapsed. The timer has a number of convenience features, such as cycle interrupt (*RESET*), manual override (*MAN/AUTO*), optional buzzer (*BUZZER ON*), touch setting (*START*) and selection of three timing ranges. These features should make this simple-to-build inexpensive timer a welcome addition to your dark room.

Here now are the main features of the timer in more detail. The solid-state design without relays does away with contact arcing problems. When the timer is set for a specified time period, the time-set control does not have to be returned to zero for subsequent use as is the case with some mechanical timers. Thus, the timing cycle is exactly reproducible!

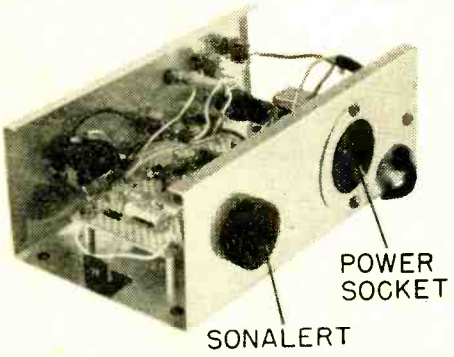
The touch of a ring on your finger (a push button is optional) will start the timer. This method of operation prevents any shaking of the enlarger. The timing cycle can be set in the following three ranges which are the most convenient for photographic work: 0 - 15 seconds (normal enlarger timing), 0 - 150 seconds (special enlarger timing), 0 - 20 minutes (developer and fixer timing).

One mode of the operation of the timer is to have the enlarger light on *during* the timer cycle. Another mode of operation, se-

Universal Power Timer

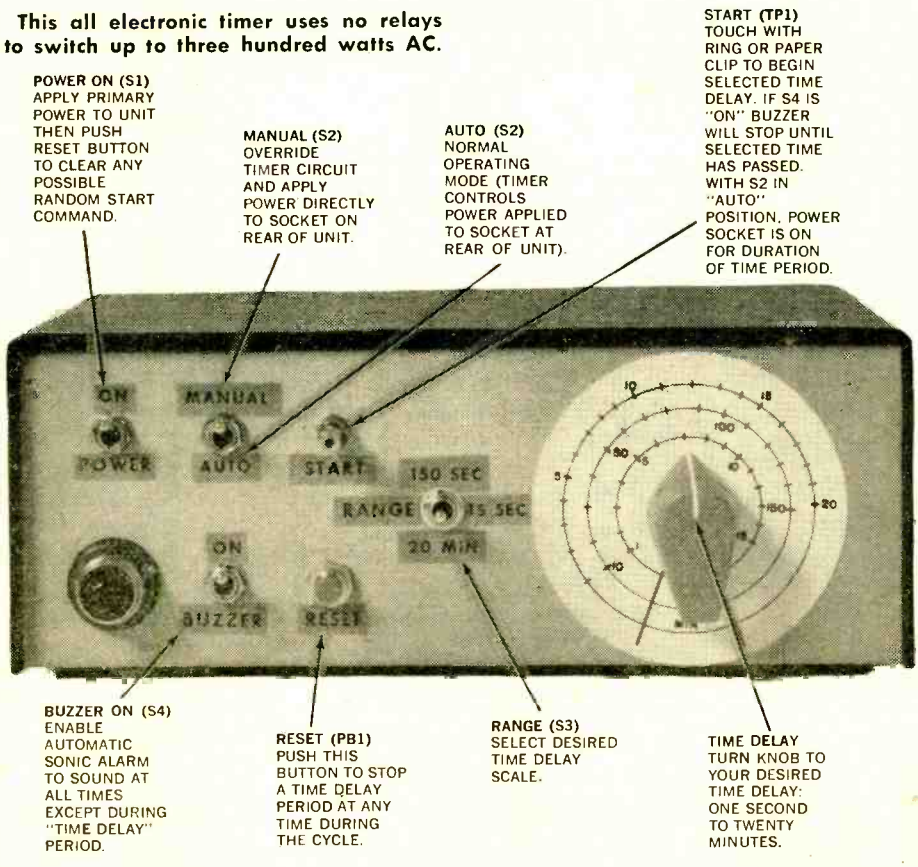
lected at the flip of a switch, is to energize a built-in buzzer *after* a specified time period has elapsed at the end of the timing cycle.

The timing cycle can be interrupted and reset to zero with a push-button switch. A separate switch (*Manual/auto*) connects ac power directly to the enlarger outlet thus bypassing the timer while you focus and plan your burning and dodging.



How Does It Work? The brain of the timer is a recently developed integrated circuit. This circuit consists of 23 transistors and over a dozen resistors and diodes. The timing cycle is determined by the external resistor R2 and the capacitors C2 through C4, where the timing cycle in seconds equals approximately the value of the resistor in megohms times the value of the capacitor in microfarads, times 1.5. The output of the integrated circuit (Pin 3) is normally low (at the ground potential); it is high (at the positive battery potential) during the timing cycle. The low current buzzer is operated directly from this output to battery plus. The same output also operates a light coupler to ground potential. The coupler consists of a low voltage, low current lamp and a photo cell in one envelope. When the output of the IC is high, the lamp

This all electronic timer uses no relays to switch up to three hundred watts AC.

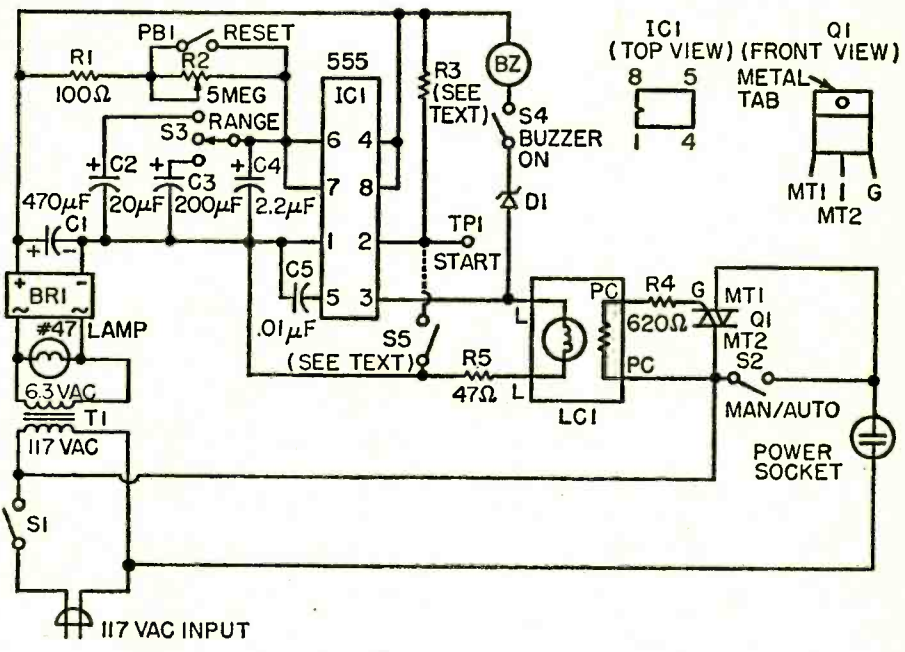


lights, the photocell lowers its resistance, and the Triac conducts the ac power to the enlarger outlet.

Transformer T1 with the diode bridge BR1 and capacitor C1 provide the dc voltage for the integrated circuit. The switches S1 through S4 select the timing range and the various options. Switch S5 can be added in place of touch-to-start if you wish.

Construction. The unit as constructed by the author fits comfortably in a 8-in. x 3-in. x 5-in. cabinet. If you select the touch option for starting the timer, make sure the case is grounded and that you use three-conductor cable for the ac connection. (the green "neutral" wire is connected to the chassis.) The touch button consists of a metal jack insulated from the cabinet. Body pickup should be sufficient to start the timing cycle. If you plan to use two-wire ac plugs and cables, use the pushbutton option for starting the timing cycle.

Electronic components fit on a 3-in. x 4-in. piece of perf board. We recommend using a socket for the IC. The Triac can handle a 300 watt lamp without a heat sink.



PARTS LIST FOR UNIVERSAL POWER TIMER

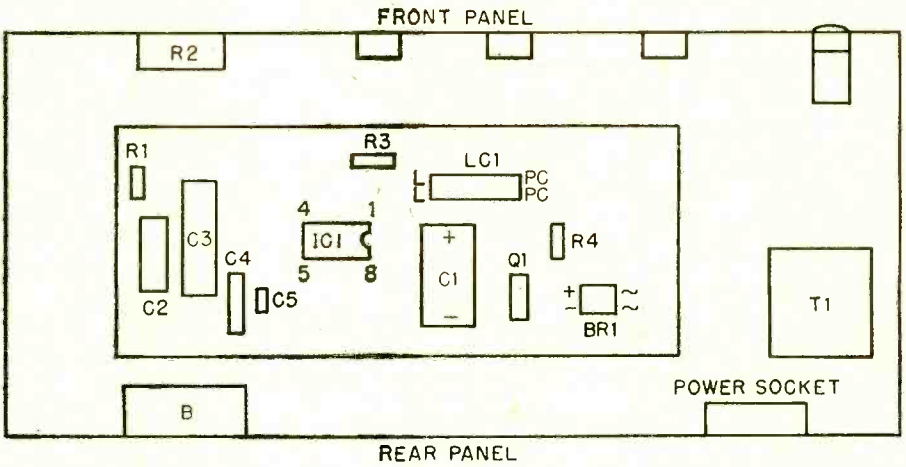
BR1—Bridge rectifier, ½-amp or better
BZ—Buzzer, low current sonalert, Mallory type SC628
C1—470 or 500 uF, capacitor, electrolytic, 16 to 55 VDC
C2—20 or 22 uF, capacitor, electrolytic, 10 to 50 VDC
C3—200 or 220 uF, capacitor, electrolytic, 10 to 50 VDC
C4—2 to 2.2 uF, capacitor electrolytic, 10 to 50 VDC
C5—0.01 uF, capacitor, 50 VDC or better
D1—Zener diode, 3 to 4 volts, ½-watt
IC1—Integrated circuit timer, Signetics 555 type
L1—Pilot light for 6.3 VAC such as Radio Shack 272-318 with No. 47 bulb.
LC1—Light coupler, Sigma 301T1-6B1 (available from Allied Radio, their number 917-1417)
PB1—Pushbutton, normally open
Q1—Triac, GE SC141 type, 200-volt, 8-amp
R1—100-ohm, ½-watt resistor
R2—5-megohm potentiometer, linear taper
R3—33,000 to 470,000-ohm, ½-watt resistor, see text
R4—680-ohm, ½-watt resistors
R5—47-ohm, ½-watt resistor
S1, S2, S4—Switches, SPST
S3—Switch, center-off SPDT
T1—Power transformer, 117 to 6.3 VAC, 250 mA or better
Misc.—Knobs, cabinet, single flush-mounted grounded outlet, wire, solder, etc.

Universal Power Timer

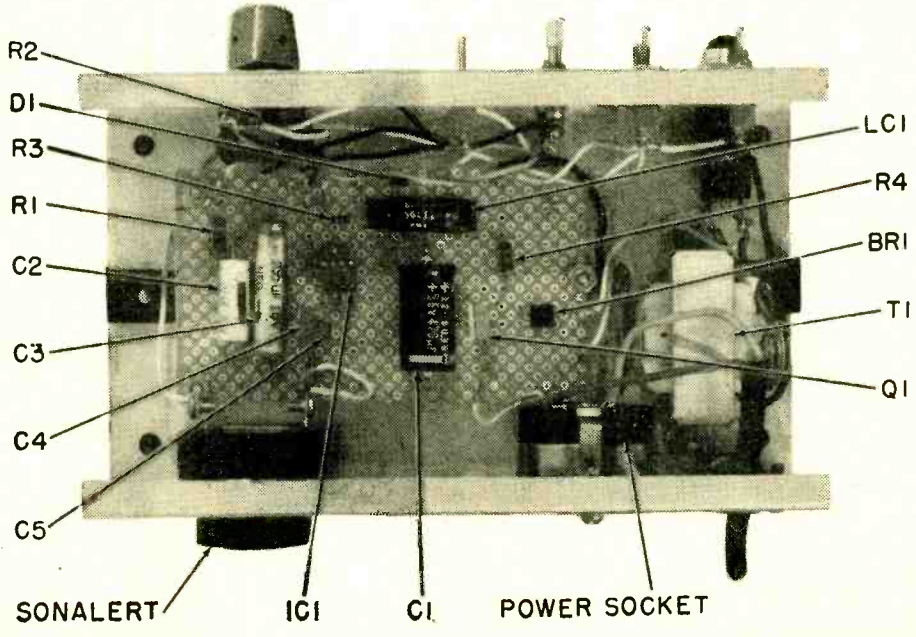
If you plan to use a larger lamp, use a heat sink. Make a dial out of a piece of white cardboard with three concentric circles for the three timer ranges.

Calibration. Calibrate the three timer ranges separately. Use a stopwatch or a watch with a second hand. Make marks on the dial with a pencil to indicate minutes and seconds.

If you use the touch option to start the timer, choose the value of R3 between 33K and 470K. A larger resistor will make the starting button more sensitive to the touch, however, if the sensitivity is too high, the timer may start unexpectedly when there is a "spike" on the ac line. We found the value of 47K best (this value should also be used for the push-button option). The "touch" sensitivity is then such that the starter will not operate if your finger is dry, but if you wet your finger, or even better, if you touch the button with a metal object (coin, key chain, ring, etc.) the timer will start reliably. ■



Component layout of the author's timer is shown in drawing and photograph. Place front panel switches according to photo on the second page of this article.



SOUND OFF WITH THIS NOISEMAKER

ELECTRONIC ALARM GENERATOR

by Gary McClellan

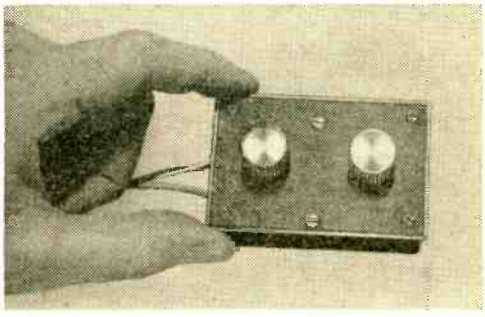
There *are* times to make noise in these days of noise abatement concern. Of course, an ambulance must have a wailing siren to help clear traffic. A volunteer fire department depends on a raucous blast from a horn for its efficient operation. And certainly no one would deny a new-year's eve merrymaker his hour to howl. So whatever your interest—burglar alarm to wake-up alarm—here's an electronic alarm generator with an extra low-frequency modulation oscillator that produces a "yelp-yelp-yelp" that's sure to attract plenty of attention.

Both the pitch and repetition rate of this generator are variable over a wide range, so you can create other unusual sounds. If you want to experiment with the circuit, you will probably discover other hookups that give even more strange sounds.

What Is It? It's an electronic alarm generator that's inexpensive and easy to build. The parts are all common and inexpensive. There are no oddball integrated circuits to buy, and you will probably have most of the parts in your junkbox. If not, you shouldn't have to spend more than $4 for new parts. Construction? It's very easy! The parts layout is noncritical and you can build it in any way, shape, or form you wish. Our generator uses two unijunction transistor oscillators which are DC coupled to produce the strange sounds.

Electronically, the first oscillator (which consists of C1, Q1, R1, R2 and R3) generates a series of low frequency pulses. The output of this oscillator appears across R3 as a corresponding series of voltage fluctuations. R3 also biases the second oscillator (consisting of C3, C4, Q2, R4, R5 and R6) to a point just below oscillation. This resistor must be adjusted to suit the characteristics of the unijunction used for Q2. As the voltage across R3 drops, it will reach a level where the second oscillator fires and its output frequency starts to rise with the voltage. As the voltage across R3 increases, the output frequency drops. Potentiometer R1 controls the *repetition rate* of the output, while pot R5 controls the *frequency*.

Putting It Together. I built my version on



Great for attention-getting emergency type alarms. So easy to build, it's recommended for beginners. Inside the case just a dozen parts put a warbling squawk of a sound into your hi-fi, PA amp—even drives earphones!

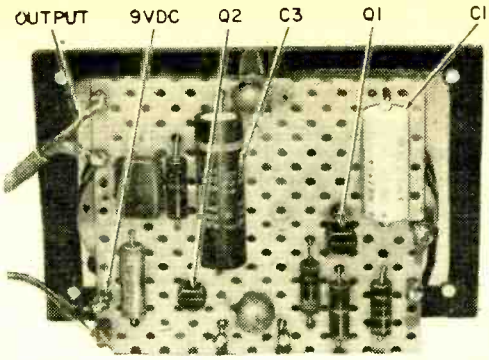
ALARM GENERATOR

a 1⅞-in. x 2¼-in. scrap of perfboard and enclosed it in a Radio Shack Mini Case. This arrangement worked very well and you might want to duplicate it.

Start construction by laying out the capacitors on the perfboard. Note that C1 and C4 are positioned near the ends of the board. Next, insert all of the resistors but R3. The value of R3 will probably have to be optomized by experiment, so just ignore it for now. On our version potentiometers R1 and R5 were left off the board to save space. These pots are mounted on the front panel of the box and connected to the circuit via short leads. You should now be able to wire up most of the circuit, and you might want to add push-in terminals for the pots, output, and power leads. These terminals will make external connections to the board much easier.

When you have finished the wiring, insert the unijunctions. Be careful to check out the leads on your particular unijunctions before you solder them in. The location of the E, B1, and B2 leads may vary with the type of unijunction you use.

Finish the construction by "working" the box. Drill two ¼-in. holes in one side of the box for the power and output leads.

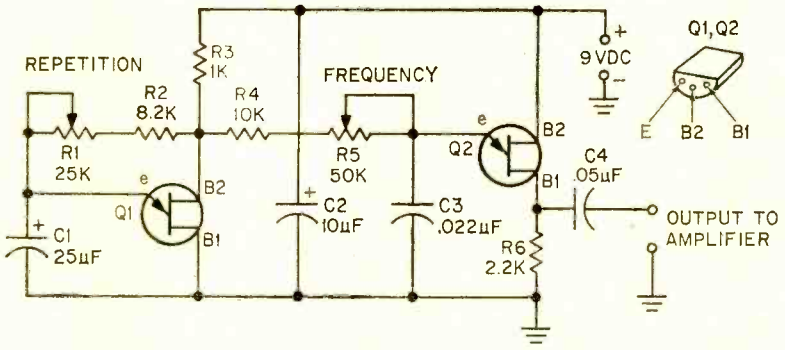


Locate parts on this photograph as you put parts together. Also, see page 115 for the complete wire layout under the perf-board.

Next, the front panel: drill two holes for the pots and two holes to mount the board. Clean up the panel and apply decals if you wish. Install the two pots and temporarily wire them to the rest of the circuit with long leads. Also connect the power and output leads to the module. This completes your mechanical construction of the generator.

Putting It To Work. By now you should be all set to fire it up. In place of R3 connect a series combination of 330-ohm resistor and a 5000-ohm pot. Connect a pair of 2000-ohm headphones (or the AUX input of an amplifier-speaker combination

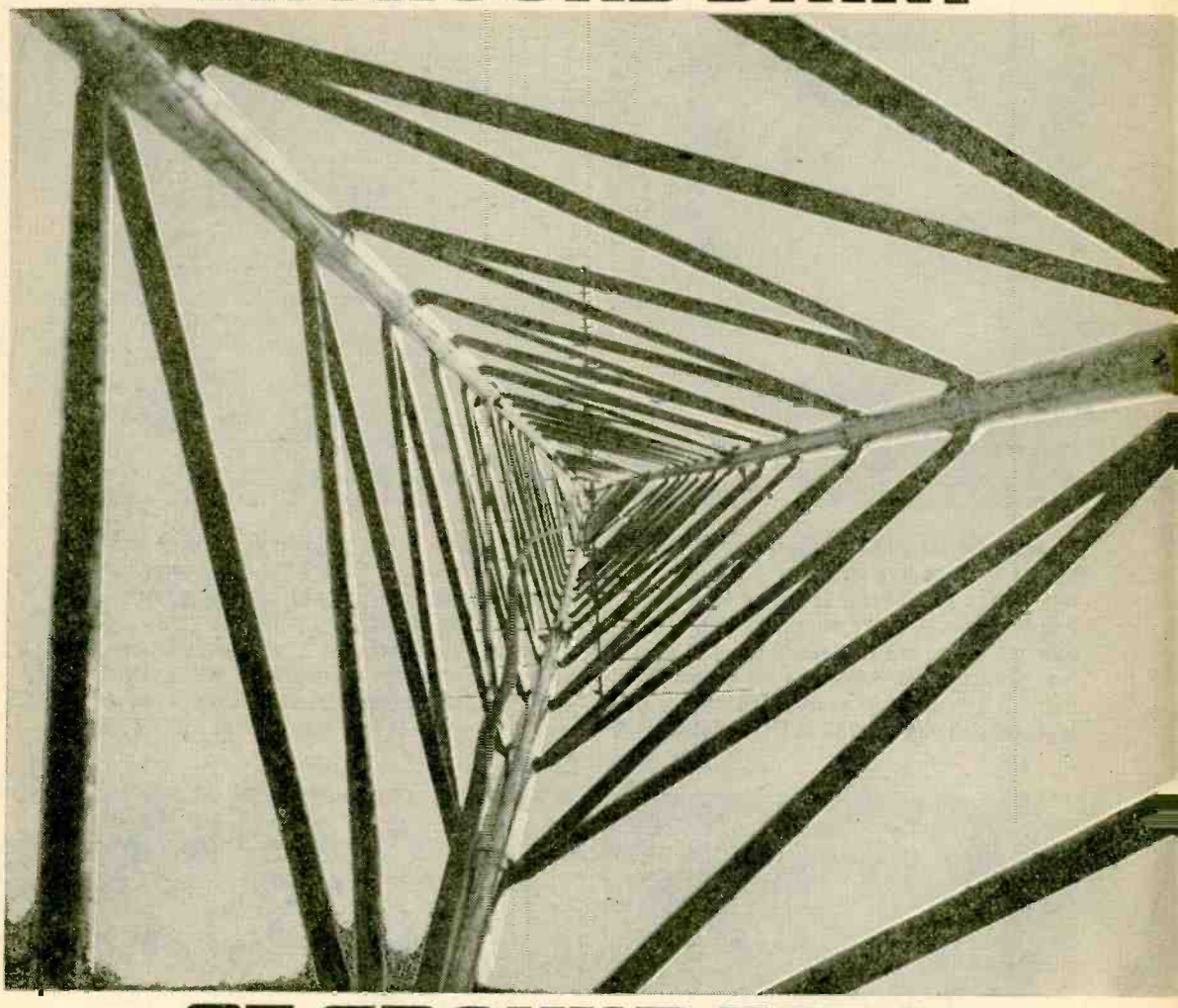
(Continued on page 115)



PARTS LIST FOR ELECTRONIC ALARM GENERATOR

C1—25 uF electrolytic capacitor, 12 VDC or better
C2—10 uF electrolytic capacitor, 12 VDC or better
C3—0.022 uF tubular capacitor, 50 VDC or better
C4—0.05 uF capacitor, 12 VDC or better
Q1, Q2—Unijunction transistors, exact type not critical
R1—25,000-ohm potentiometer, linear taper
R2—8,200-ohm, ½-watt resistor
R3—1000-ohm, ½-watt resistor, see text
R4—10,000-ohm, ½-watt resistor
R5—50,000-ohm potentiometer, linear taper
R6—2,200-ohm, ½-watt resistor
Misc.—Perfboard, knobs, spacers, wire, solder, case, 9-volt battery or power supply, etc.

SKYHOOKS START



AT GROUND ZERO!

Here's a maintenance free antenna tower you erect yourself...with your feet on the ground

by Peter L. Dexnis, WA3LOQ—Technical Editor

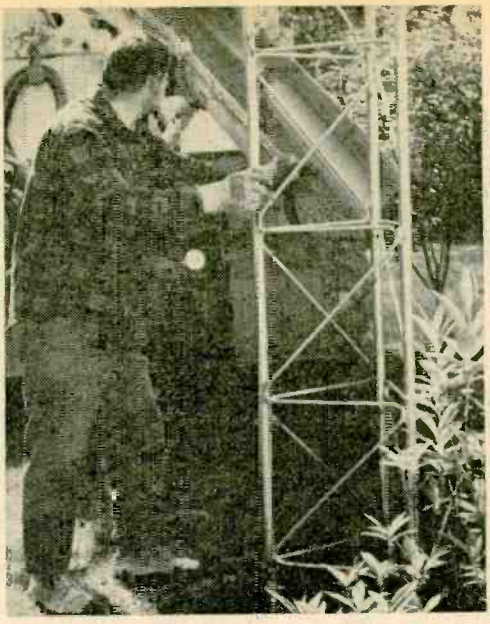
"HOW CAN I IMPROVE MY TV RECEPTION?" To look for an answer to this key question often asked by readers, let's go to the TV transmitter site. A broadcaster knows that ERP (effective radiated power, a product of antenna gain and transmitter power) and antenna height above average terrain play important parts in his station's coverage area. Broadcasters' antennas must be high because VHF and UHF wavelengths assigned to TV broadcasters by the FCC cannot travel (propagate, as radio engineers say) much beyond the horizon seen by the antenna. If a broadcaster increases the height of his transmitting antenna, the distance to his "radio horizon" increases and a greater coverage area for his station exists.

We can't do much about ERP at our end,

(Continued on next page)

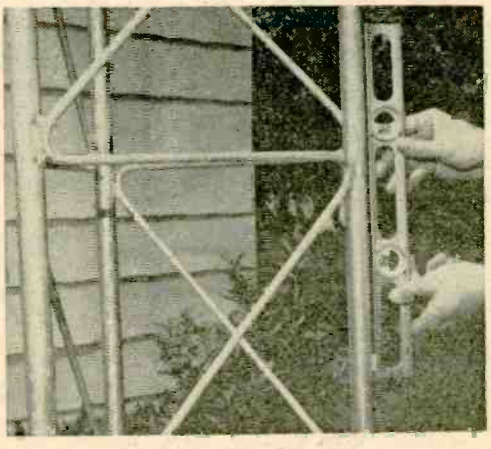
Antenna Tower

Ascom/Universal aluminum towers come in various heights and wind load factors ranging from 30-ft. with a 35-sq ft. wind load to a giant 90 feet and 2 sq ft wind loading. We selected a 50 ft model delivered as you see it above, telescoped into two packages easily carried by one person. Total weight is only about 97 pounds. Full information is yours by circling No. 166 on Lit-Lib Coupon. ▼

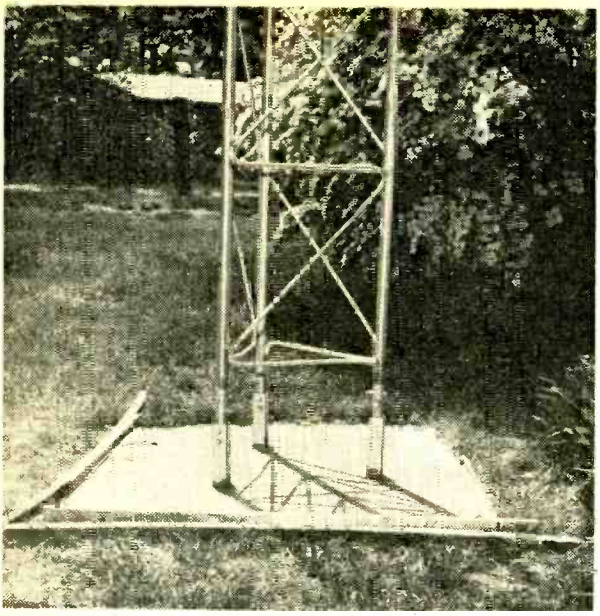


Bolt the lower 10 feet of tower to the base and place it in the hole. Be sure tilt direction is common for all base legs and oriented properly as concrete is poured. Here you have a choice. An average tower requires 2 cubic yards or less of concrete. You can mix your own, but having ready mix delivered costs about the same if you consider the cost of renting equipment. ▼

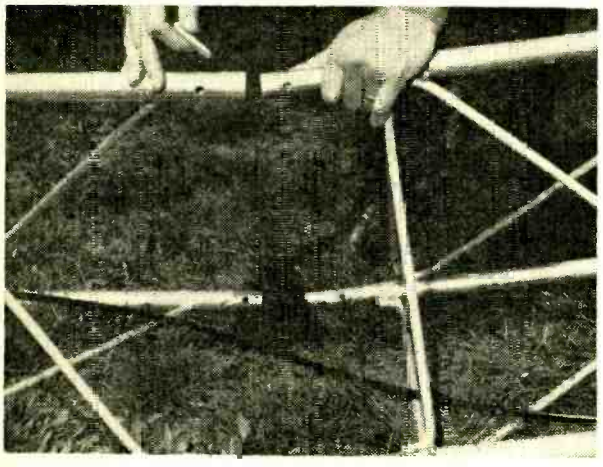
Cut or unwind the wire binding each package and lay out each ten foot section end to end in proper sequence; begin by placing the bottom section where the tower will stand. This checks for enough clearance when you later walk the tower up to standing position. Digging the proper size hole, here a 3 x 3 x 4 foot deep pit, is the most energetic part of your project.



Get it plumb! This very important step insures your vertical dimension. You have a good hour, under normal circumstances, to plumb (make perfectly vertical) the lower 10 feet of tower. Remember it's important to keep the base pivot points three inches above the concrete. Also, be sure to use the 3500 mix concrete for your base. It usually costs no more than a lighter mix.



Do a neat job of smoothing the top of your concrete base, and shore up the sides with pieces of flat molding, before or after the concrete has been poured, for neat edges. Remember your first ten feet of tower hold tripod base poles in the correct position during 3 to 4 day wait for the concrete to set. Do not put undue pressure on this first assembly. ▼



When concrete has set, fit and lock the ten foot upper sections together. Run cable inside tower and fasten your antenna to the upper section with a 5-foot steel pipe. Taping at intervals keeps cable still during windy weather. But be sure to use proper lead in. Do not use 300-ohm ribbon cable. Use only 75-ohm coax—if antenna accepts it—or shielded 300-ohm twin lead.

but if we boost our antenna *height* just a little, we may be able to snag some of his signal as it propagates out into space beyond his radio horizon.

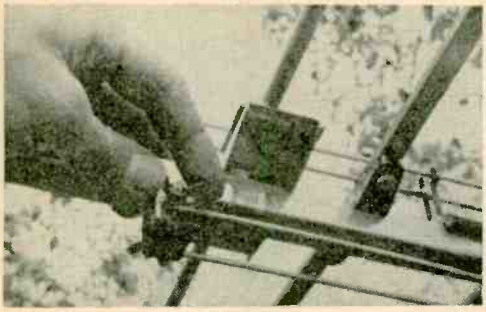
Fortunately, you don't need the kind of height he has to greatly improve your fringe area reception. The broadcaster did most of the work already. Unless you're way down the wrong side of a mountain, a better signal is up there—often just a few tens of feet above the surface—waiting to be grabbed by the electronic tentacles of a multi-element antenna.

Incidentally, there's nothing in the rule book that says you can't mount your Action Band monitor antennas on your tower. You can benefit from the extra antenna height when copying mobile stations on the move. Characteristic flutter on mobile VHF transmissions, coupled with the relatively low power of mobiles, can interrupt reception to the point of "closing over" the signal by your receiver's own squelch. If that's your problem, a thirty foot or more boost to a gain-type antenna can make a big, big difference. Also, as this is being written, there is a docket before the FCC to raise the 20-foot height restriction of CB transmitting antennas to a towering 60 feet! (There's no general restriction, by the way, on CB antennas used for receive only.)

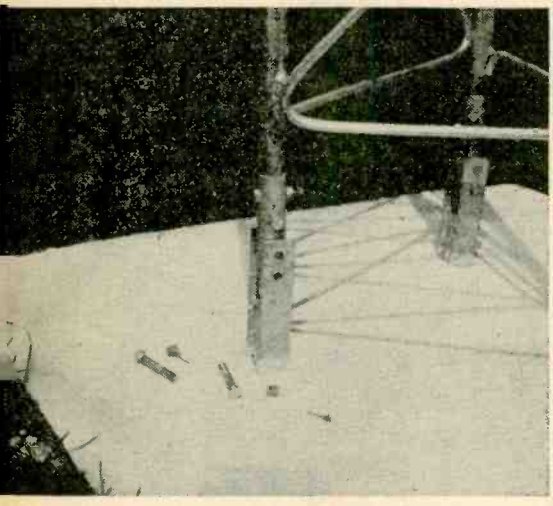
On the following pages we show how easy it is to erect a sturdy ASCOM antenna tower. Based on a simple two-point pivot and aluminum construction, it gives you a tilt-up tower that can be assembled on the ground and "walked up" into position by one, two at the most, people. You can also order tower accessories for roof guyed towers, and rotor mounts to support popular antenna rotators.

Take a tip from broadcasters. Boost *your* antenna and give a natural boost to fringe area reception. And remember, if you're fifty, sixty or more miles from a large metropolitan area—even though you may have a local station or two—there's a good chance a whole 'nother set of channels is up there just waitin' to be plucked! Take a drive through the Northeast section of Philadelphia, PA. You'll see a large number of tall skyhooks and super-fringe antennas pointed to good old NYC ninety miles away. Guess the Mets have some mighty loyal fans even in Philly land! *(More photos next page)*

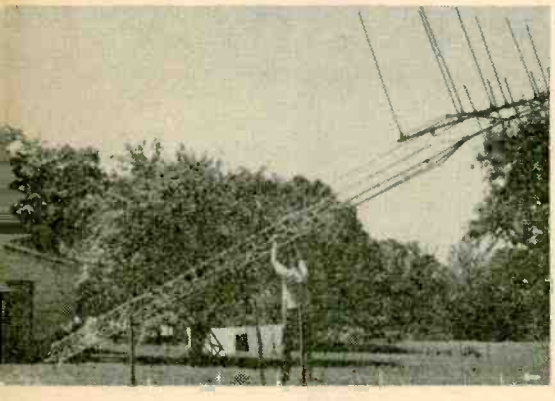
Antenna Tower

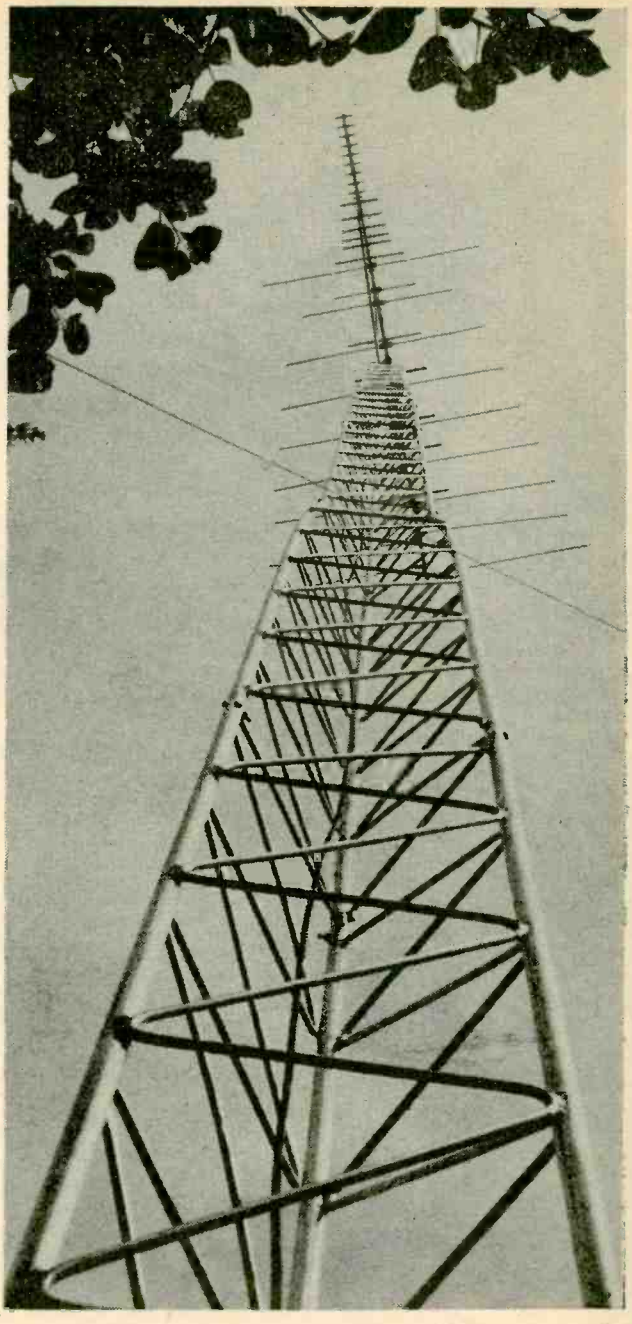


Poor connections at the antenna can make your entire system inefficient. Tighten securely and use tape to remove all pressure from connection.



Remove bolt from each front leg and both from rear as shown. Tilt 10 foot section to ground and make final connection to upper part of tower. Walk up tower after orienting antenna in direction of distant station. Replace bolts.





Perched a full 53 feet above ground zero, a long range UHF/VHF TV antenna "looks" over nearby trees to provide full-time reception from transmitters 70 miles away. Antenna model 70-23B is one of the 70 Series color spectrums from Finco. Get more info from Finco, circle No. 39. For more Ascom/Universal tower products info, circle No. 40 on Reader Service page 17 or 114. ■

POT BOX

Resistance, resistance everywhere, and every value handy!

by R. L Way

FREQUENTLY you could save time and effort on projects you are designing if you had a resistance substitution box. But those handy gadgets, with their many switches and precision resistors, are expensive, whether store-bought or homebuilt. Also, they usually take up too much room on the workbench, and often are not really convenient to use (all those switches to set and reset!) The *Pot Box* described in this article is a "quick-and-dirty" approach that lacks the accuracy of his big brothers. But the device has these advantages: small size, easy operation, inexpensive—usually costs less than $5, and sufficient accuracy for most projects.

What's Inside. The *Pot Box* is not, as the name might imply, a container for marijuana cigarettes. It is an enclosure containing three potentiometers (or pots) wired in cascade, with alligator clip leads attached at each end for connection to the circuit in which it is to be used.

The author's version of the *Pot Box* measures 2¼ in. x 5 in. x ¾ in. The pots could have been mounted in an even smaller case; the size selected was a compromise between compactness and scale readability. The schematic drawing of the *Pot Box* shows how simple it really is!

Picking Parts. The potentiometers have values of 10,000, 100,000 and 1,000,000 ohms. With these values you can "dial in" approximate resistance values of from 200 ohms or so to greater than 1.1 megohms with 10 percent or less accuracy. If your projects generally call for small resistance values, use pots of 100, 1,000 and 10,000 ohms, to give a total resistance range of from about 2 ohms to better than 11,000 ohms. Linear potentiometers are obviously best for this application; audio taper ones will do, but will result in some scale compression with clockwise rotation. The optional binding posts shown in the schematic diagram for the *Pot Box* provide convenient terminals (BP2, BP3) for connecting a voltmeter to monitor the voltage drop across the substituted resistor or to measure the voltage from either end of the *Pot Box* to ground; or, with no power applied, an ohmmeter can be connected between

POT BOX

these posts to more precisely set the resistance to any desired value. Terminals BP1 and BP2, which are normally jumpered with a length of wire, can be used to insert a milliammeter "in-line," an "on-off" switch, a diode if desired, etc. These binding posts were not included in the *Pot Box* shown in the photos, and if you don't want them, just omit them and solder point *x* to point *y* in the schematic diagram.

If you are going to use a ready-made box, the only thing you'll have to fabricate is the face-plate with the 3 resistance scales on it; this can be cut from opaque cardstock or heavy paper. The front and back of the unit are cut from "artist board" and glued to a hollow wooden frame.

After completing the face-plate and mounting the pots, turn the assembly over and do the wiring. For clockwise rotation of the shafts, you need to use the center terminal and the left-hand terminal (as viewed from the back), the right-hand terminal of each pot is *unconnected*. Tie a knot in each clip-lead where it passes through the hole drilled in the end of the box, to provide strain relief.

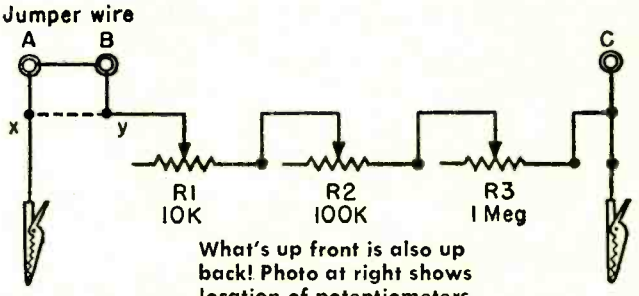
The Checkout! Now we're ready for calibration. Turn all 3 pots fully counterclockwise. Mount the knobs on the pot shafts and set the index or pointer of each to the same position at the "0" point, which will be at about the 7 o'clock position on the circles. Connect the alligator clips to an ohmmeter, and slowly advance the knob of the lefthand pot until the ohmmeter reads 1000 ohms. Put a light pencil mark on the circle opposite the knob index, advance the knob until the ohmmeter reads 2000 ohms, mark the circle at this point, and continue on in this manner until the clockwise limit of the pot is reached. Then turn this pot fully counterclockwise, and calibrate the middle pot in the same manner, and finally do likewise with the right-hand pot. Reset the ohmmeter range switch when calibrating each pot to get accurate readings.

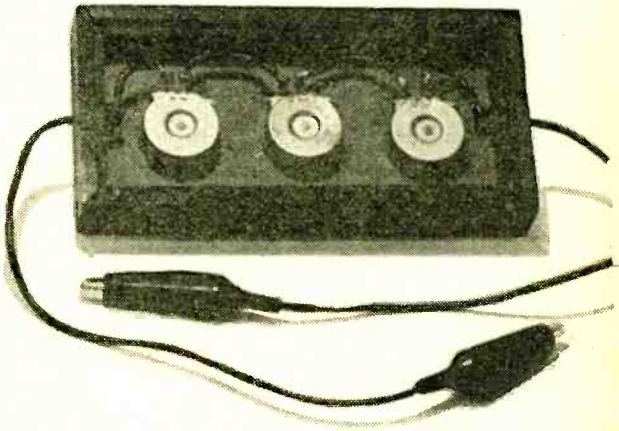
When calibration of the *Pot Box* is completed, check each setting again; as a final check, set in values on each potentiometer, read the total resistance as closely as possible from the scales, and compare with the ohmmeter reading. (For instance, with the right-hand pot set at 8, the middle one at 3, and the left-hand one at 5, your ohmmeter should read 835,000 ohms). When all is well, remove the pots from the face-plate and carefully ink in the scales and erase all pencil lines. The lettering can best be done with press-on type letters and the entire face sprayed or painted with a clear fixative.

One word of caution about using the *Pot Box:* carbon composition potentiometers will not dissipate much power; about a quarter of a watt or one-half watt intermittently. If you want greater power-handling capability, use wire-wound potentiometers. ■

PARTS LIST FOR POT BOX

BP1, 2, 3—Binding post, 5-way
R1—10,000-Ohm potentiometer, linear taper
R2—100,000-Ohms potentiometer, linear taper
R3—1,000,000-Ohms potentiometer, linear taper
2—Alligator clip, insulated
Misc.—3 knobs, wire, box, solder, etc.





What's up front is also up back! Photo at right shows location of potentiometers mounted in position. The 1000-ohm pot is at the extreme right and 100,000-ohm potentiometer is far left. Hookup is simple.

Build our TV HAZARD ALARM

Sleep tight tonight knowing your TV will not go in for barbecuing!

by Tony Mancuso

IT FIRST APPEARED as infrequent news items buried in the back pages of some newspapers; but now *we know* that thousands of TV color receivers are possible fire hazards, for the announcement to that effect was made by a major manufacturer. And if all the talk of possible color TV fires has got you worrying at night, long after Johnny Carson has faded to black, you can put your mind at ease by installing our TV Hazard Alarm on the back of your color set.

The TV Hazard Alarm is triggered by a standard 190 F fire detector S1, such as used to protect furnace rooms and attics in the home. When excessive heat causes the normally open fire detector contacts to close relay K1 is activated, simultaneously causing bell Z1 to ring while power to the TV set is removed. In the event an electrical fire short-circuits the receiver's power supply before the heat builds sufficiently to trip the fire detector, fuses inside the Alarm disconnect power from the TV. The fuses, however, are after the alarm circuit so the warning bell will ring even though power is removed from the TV.

Relay K1 is a special hysteresis controlled type; it closes (switches) only when its two control leads are shorted, either by test switch or the fire detector. The control lead voltage is about 30 VAC at very

TV HAZARD ALARM

low current, generated by the relay, and any type of insulated hook-up wiring can be used for connections.

Construction. The Alarm is assembled in a plastic cabinet approximately 4½-in. wide x 2⅜-in. high x 7¾-in. deep. Do not use a smaller cabinet! There will be no room for the alarm bell in a smaller cabinet. Mount bell Z1 within about ½-in. of the cabinet top; allow enough room for a hole in the back of the box so a screw can be used to mount the Alarm to the back of the TV set. Relay K1 and the fuse block are installed near the bottom of the cabinet. Jack J1 and test switch S1 are installed on the side of the cabinet.

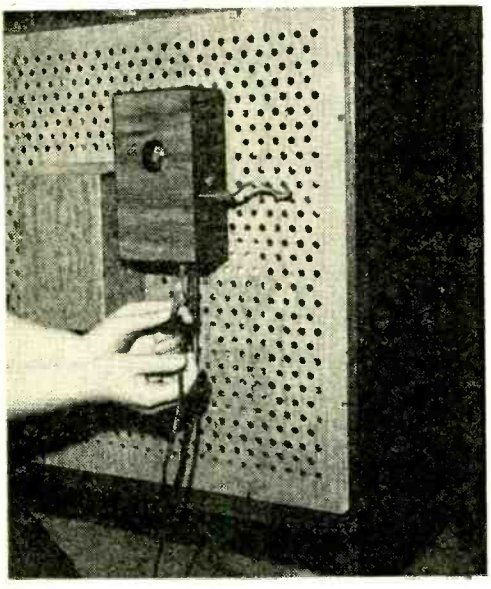
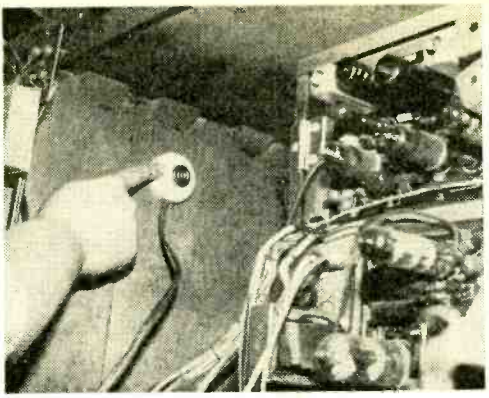


Table top color TV sets are too compact to mount the TV Hazard Alarm inside the cabinet. Mount on rear panel. TV power cord plugs into receptacle in alarm unit.

Nothing about the wiring is tricky, but make certain you do not connect the Alarm's power wiring *after* the fuses; you want the bell to ring even though the fuses blow out. We suggest the wires be connected in the following order to avoid confusion. Yellow wires from K1 to J1 and P1 (no polarity necessary). Blue wire from K1 to one of the wires from the bell. Black wire from K1 and other bell wire to one side of the



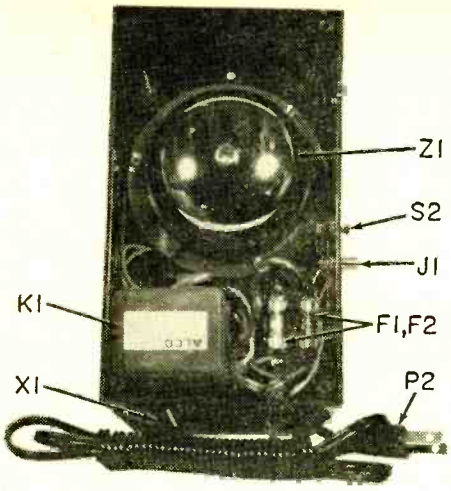
The fire detector, S1, is installed inside the cabinet preferably near the hottest location at or near the top of the side wall. Test S1's action with a match.

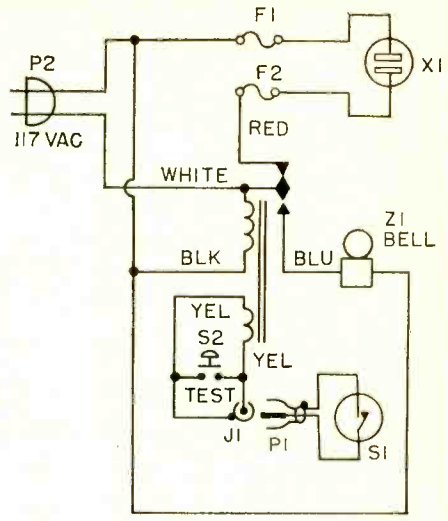
AC power line. Red wire from K1 to the fuseholder. The final assembly is socket X1 which provides power to the TV; note that both sides of the line are fused. Socket X1 is an ordinary "line tap" available from most hardware stores; the type you simply press-fit onto a length of ordinary *zip* (lamp) cord.

Open Fire Detector. The only critical part of the TV Hazard Alarm is the fire detector, S1, which must be of the *open circuit type*. This means the detector's contacts are normally open, closing only when the ambient heat reaches the rated value of the detector—in this instance 190° F. Make absolutely certain you do not use a *closed circuit* or *supervised* detector which has normally closed contacts that open when the ambient temperature reaches the rated value.

To check the fire detector, S1, simply connect an ohmmeter across its terminals. If the ohmmeter shows zero or almost zero ohms (a short circuit) you have the wrong detector. The correct detector should indicate infinite resistance across the terminals; heating the detector with a match held nearby will cause the contacts to close. When the detector cools down, the contacts will automatically open and be ready for use again.

Checkout. Temporarily connect detector S1 to jack J1. Connect any houselamp to socket X1 and connect the TV Hazard Alarm to the AC power line. The lamp should go on immediately. (A slight hum from relay K1 is normal.) Pressing test switch S2 should cause the lamp to go out and the bell to sound. If all this doesn't





Parts location is not critical but placement is difficult considering small plastic box.

PARTS LIST FOR TV HAZARD ALARM

F1, F2—Use 3AGC fuses; 3A or 5A. See text for details.
2—Clip-in fuse holders for F1 and F2.
J1—RCA phono jack
K1—Alco FR-102 control relay (Lafayette Radio 301-12010) Caution. there are no substitute relays on the marketplace—make no substitutions!
P1—RCA phone plug
P2—AC line plug
S1—Normally-open fire detector, rated at 190°F (Lafayette Radio 14/13715 or equiv.)
S2—Normally-open pushbutton switch
X1—AC power receptacle for standard line plug
Z1—Alarm bell (Radio Shack 273-020 or equiv.)
1—Bakelite box with removable aluminum cover; 7¾-in x 4⅜-in. x 2⅝-in.
Misc.—Wire, hardware, solder, etc.

happen, you have made a wiring error. Finally, apply the heat of a match to the fire detector. The lamp should go out and the bell should sound off. As soon as the detector cools down (blow on it to hurry things along) the bell, Z1, should stop ringing and the light should go on.

If everything checks out, disconnect the bell, Z1, and test lamp, and drill or punch a hole approximately 1½-in. diameter in the cabinet's metal cover; do not install the cover at this time.

Remove the back cover from the TV and install fire detector S1 inside the cabinet with mounting screws (wood cabinet) or an adhesive such as G.E.'s *RTV*. Make certain the wires from the detector (ordinary *zip* cord) do not short to a metal cabinet.

Position the detector, S1, as far as possible from large tubes, or local areas of high heat. A good location is on or near the top of the cabinet near the rear removeable cover.

Pass the connecting wires from the fire detector through a hole in the TV receiver's rear cover and secure the cover.

Mount the Alarm on the back of the TV cover—a single mounting screw is sufficient—and connect the heat detector's wire to jack J1. Install the alarm's cover. Plug in the TV's line cord to socket X1 and connect the Alarm to the power line.

Turn the TV on, then check operation by pressing test switch S2, which should cause the TV to go off and the bell to ring.

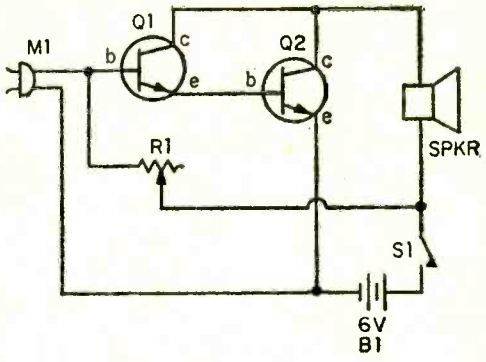
Selecting the correct fuse. Fuses F1 and F2 should be the slow-blow 3AG type (or equal) rated slightly above the TV receiver's power rating. For example, if the TV is rated for 340 watts (almost 3 amperes) use a 5 ampere fuse; if the receiver is rated for 210 watts (almost 2 amperes) use a 3 ampere fuse. Receiver current can be determined by Ohm's law: $I = W/E$, where I is in amperes, W is the rated wattage of the receiver, and E is the line voltage rating. S, not in the equation, is for Safety—install our TV Hazard Alarm and sleep tight tonight! ■

BUILD IT FAST...

Get out your tools, clean up a soldering iron and try your hand at one or both of these quick projects now!

BIG VOICE

☐ Build this loud hailer into a small cabinet and you'll be able to outshout nearly everyone at the next free-for-all. The microphone should be mounted or held behind the front facing speaker to reduce the possibility of feedback. The speaker must be rated no higher than 8-ohms, though best results are obtained with speakers in the 3.2 to 4-ohm range. Adjust potentiometer R1 for minimum distortion coincident with maximum volume while speaking into the microphone.



PARTS LIST FOR BIG VOICE

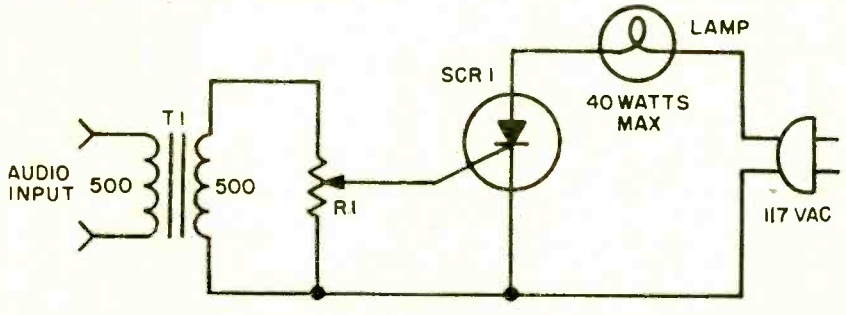
B1—6VDC lantern battery
M1—Carbon microphone (telephone type)
Q1, Q2—NPN transistors, (RCA 2N1486 or equiv.)
R1—5000 ohm potentiometer, any taper
SPKR—3.2 or 4-ohm speaker
S1—spst toggle or slide switch

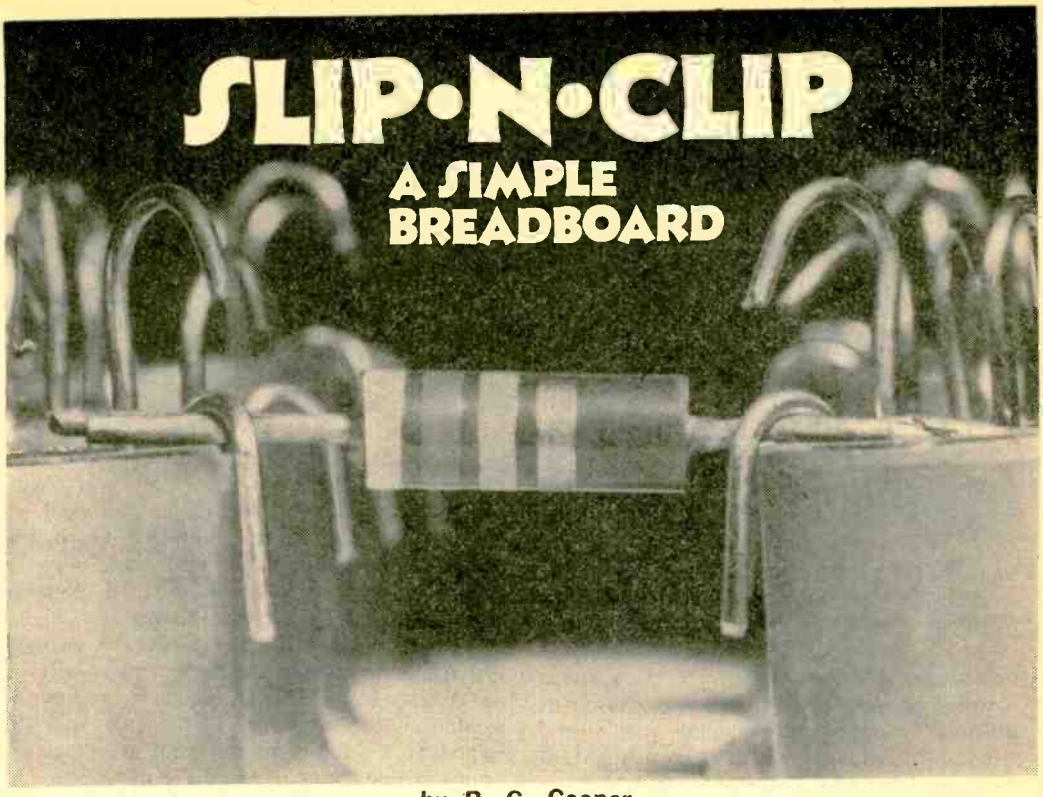
BASIC COLOR ORGAN

☐ This simple color organ is certain to keep your party from becoming a drag. Connected to your hi-fi amplifier's speaker output (across the speaker terminals) it will throb in time to the music. Paint the bulb red or deep blue and your party room will take on the atmosphere of a rock club. Transformer T1 can be any matching transistor type in the range of 500/500 to 2500/2500 ohms. Note that none of the connections from SCR1 or its components are connected to ground. For safety's sake, you must keep the 117 volt line voltage from the amplifier connections; that's the reason for T1. To adjust, set potentiometer R1 "off" and adjust the amplifier volume control for a normal listening level. Then adjust R1 until lamp I1 starts to throb in step with the beat.

PARTS LIST FOR BASIC COLOR ORGAN

I1—117V lamp, not to exceed 40 watts
R1—Potentiometer, 500 to 5000 ohms
SCR1—Silicon Controlled Rectifier (HEP-R1221 or equiv.)
T1—Transistor output transformer, see text





SLIP·N·CLIP A SIMPLE BREADBOARD

by R. G. Cooper

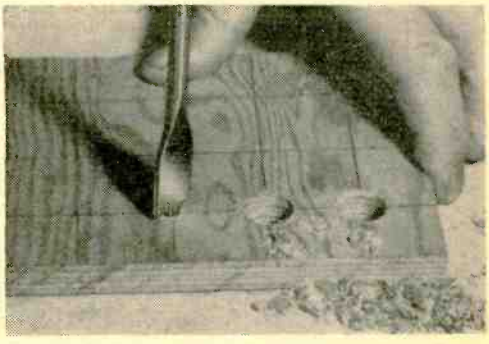
A dyed-in-the-wool, like me (and maybe you) experimenter/hobbyist doesn't always need a simple breadboard. He has the wire, push-in clips, perfboard and solder needed to whip up a quick project. But if you're just starting in the fascinating area of hobby electronics, this no-solder, matrix style rubber band and copper pipe-type breadboard may just be for you. It goes together quickly, parts are simple to find, and it's handy to use. Here are some of the features it has to offer.

Connections are solid and always make very good contact. Each lead is clamped independently. Making one connection does not disturb another. The completed circuit is solid and can be used *as is* if desired. When the circuit has been optimized it can be lifted component by component to an identical configuration on one of the island type circuit boards. This is as near as you can get to a gilt-edged guarantee that the circuit will perform.

A two foot length of ½-in. copper pipe, a package of rubber bands, a box of regular size (No. 3) paper clips, and a small piece of ½-in. or ¾-in. plywood, are all the materials you need.

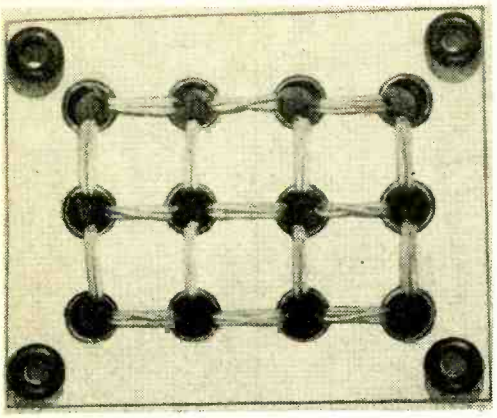
The 4 x 3 board used as an illustration can be made quickly with a minimum cost. After you've used it you will very likely want to make a number of different sizes. Once you've boarded a circuit you might just want to leave it that way. A 6 x 8 matrix will accommodate quite an elaborate circuit and is probably as big as you will ever need. Very complex circuits are best split into a number of sub-circuits on smaller boards.

Construction. The author's boards were



Twelve holes on one-in. centers make a base for the short pipe lengths that form your junction points. Auger type drill is used.

SLIP-N-CLIP



Bottom of 3 by 4 board shows rubber bands looping through adjacent copper junctions. Modified paper clips hold wires to pipes.

drilled on a 1¼-in. grid giving a ⅝-in. space between pipes. This distance was chosen to utilise a junkbox of components with somewhat short leads. If you will be using standard lead lengths you could increase the center-to-center distance to 1¾-in. and make it easier to install components at the cost of a larger board. Leave a ½-in. margin around the outer pipes to protect the circuit and provide a space for labelling.

For ½-in. plywood 1-in. pipe lengths are about right. If you want to utilise some ¾-in. plywood scraps, increase the pipe lengths to 1¼-in. If you wish, you can use an adjustable bit to drill holes of just the right size to enable you to force-fit the pipe into place.

By using a standard ⅝-in. bit, and epoxying the pipe in the holes, you eliminate the slight possibility of shorting between pipes. Whichever method you use, be sure to drill only until the pilot penetrates the far side, then complete the drilling from the reverse side to eliminate splintering.

Any finishing on the board should be done after drilling and before installing the pipe sections. Spraying with white enamel is one approach that adds to the visibility and looks neat. When you're using fast-setting epoxy, mix only enough for three or four junctions at a time. Lay the board on a sheet of plastic—some epoxy is bound to leak through.

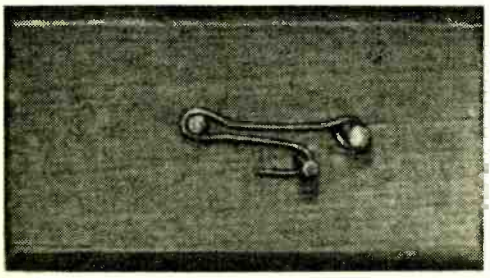
The component clamps are easy to make once you have constructed a simple jig with three beheaded nails and a scrap of wood. Open up the large loop of a No. 3 paper clip. Place the small loop on the center nail and bend the large loop backwards, first around the bottom and then around the top nail. Trim with needle-nosed pliers and snip both ends with diagonal cutters in the general form shown.

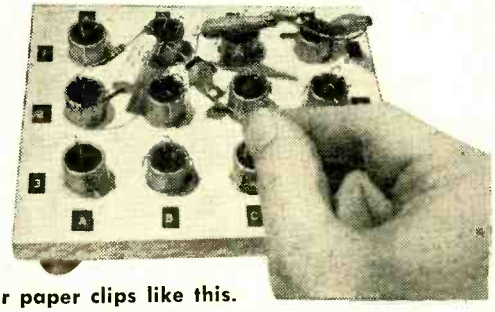
The rubber bands should be such as to provide good tension on both clamps without overstraining them. A band 1½-in. long, used doubled, is about right. Two clamps joined by a double rubber band are placed opposite one another in adjacent pipes.

When you have completed all adjacent pairs you will have two clamps on each corner, three on the remaining side junctions, and four on all the remainder. This is normally ample, but if you need an extra pair while breadboarding it's a simple matter to add one. Rows and columns should be identified with a label maker and rubber feet added to provide clearance for the rubber bands.

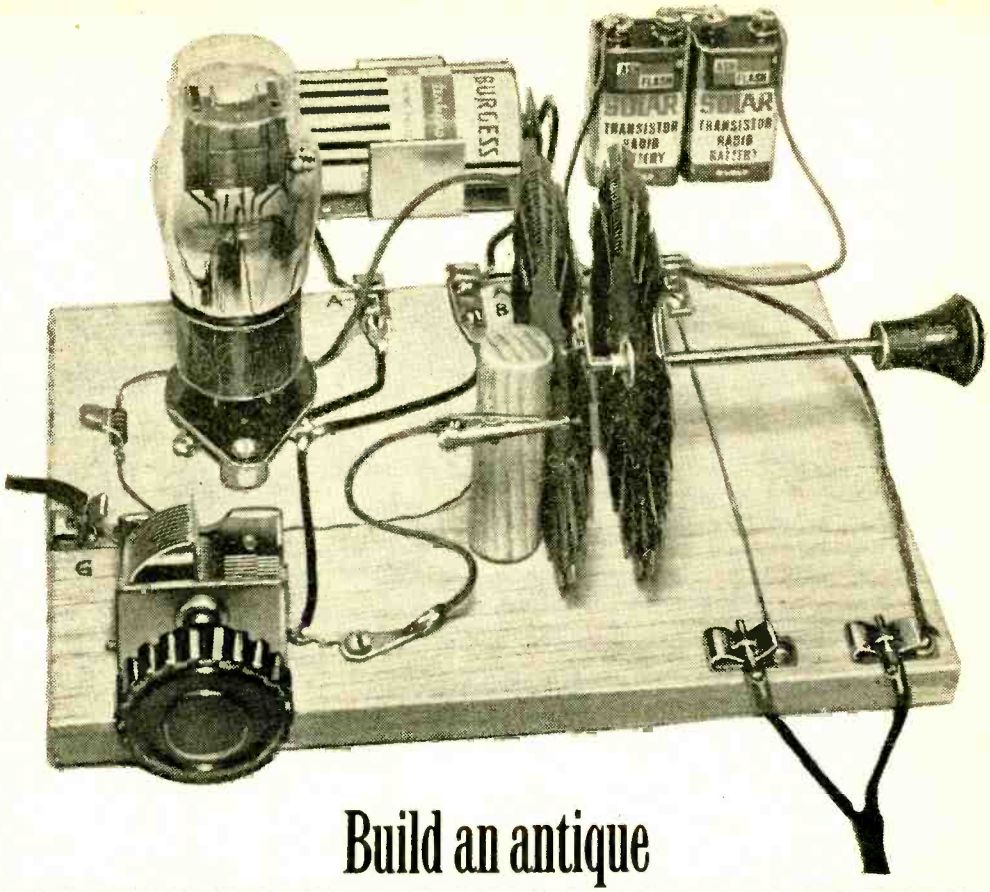
You will probably need some outboard accessories such as battery clips, pots., and relays. These are best made up as you have need of them and then kept on hand. The

(Continued on page 113)





Three old nails and a block of wood form your paper clips like this. The use of both copper pipe and copper paper clips provides low resistance junction points while still maintaining enough flexibility to make quick component changes.



Build an antique
ANTENNALESS 1-TUBE REGEN RECEIVER

A model-maker's delight that actually works!

by Art Trauffer

☐ A number of people would like to build a one-tube regenerative receiver, similar to the popular one-tubers of the early 1920s, but they hesitate, thinking that a long outdoor antenna is needed. So here's a novel receiver, resurrected from an item in Hugo Gernsback's RADIO NEWS magazine of the early 1920s, which requires no antenna and works well with only a connection to your water pipe! As a bonus, you will get less man-made and natural static!

This breadboarded regen receiver is beautiful in its simplicity, and you can probably find most of the parts in your "junk box." Coils L1 and L2 are the highly efficient "spiderweb" type of coils that were popular in the old days, and for capacitor C1 you could use the RF section of a gang capacitor salvaged from a junked AC-DC table radio. You can use any low-filament-voltage, low-filament-drain triode tube for V1. The writer used a type 30 in this project, since it has a filament drain of only .06 amps making it easy on the "A" battery. For a "B" battery, you need only two or three 9-volt transistor batteries connected in series!

Spiderweb Coils. The drawing of the coil form is an *actual size* pattern for making the two spiderweb coil forms. The writer used gray sheet fiber used for electrical insulation, but if you cannot obtain this use stiff cardboard and two coats of shellac.

1-Tube Regen Rig

Spiderweb coil form shown at right is same-size pattern. You'll need two.

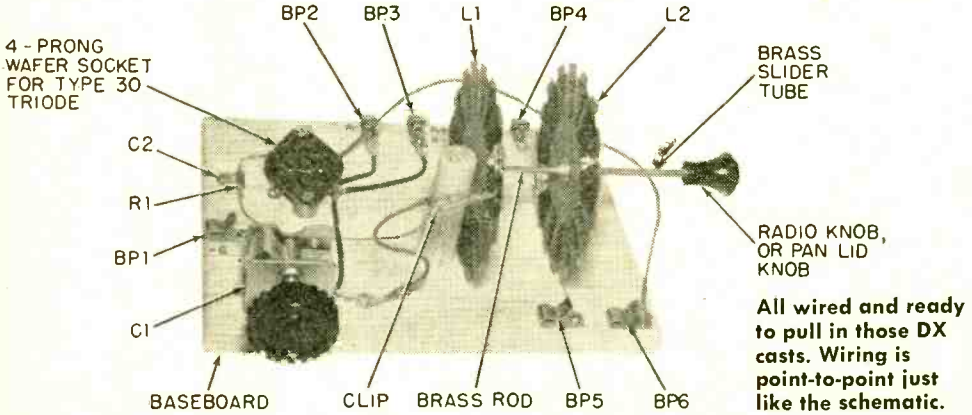
Stationary coil L1 consists of 55 turns of #26 gauge enameled copper magnet wire, having three taps near the outside of the coil. In winding the spiderweb coils you start on the inside of the forms and wind to the outside. Punch two small holes in the form and anchor the end of the wire in these holes, allowing six inches of wire for connections later. Wind about 25 turns on the form; then twist a small loop in the wire for a tap; then wind 15 more turns and make another tap. The 55th turn (outside end of winding) will be tap number 3. Put a little Dupont Duco cement on the twist of each tap to make the taps rigid so you can scrape off the enamel on the taps for clip connections later on.

Spiderweb coil L2 is the feed-back coil, or "tickler coil" as it was sometimes called in the old days. L2 has about 50 turns of #26 wire, and no taps. Note that both coils should be wound and mounted so the turns of wire are in the same direction.

Putting It Together. Referring to photo of the regen radio, the hardwood baseboard (oak, walnut, maple, etc.) is 7½ in. by 5½ in. by ½ in. The supporting upright for the coil assembly is a 2½ in. length of ½ in., or ⅝ in. round or square wood dowel, screwfastened at the bottom using a 1 in. flat-head wood screw and glue.

To make the adjustable assembly for the coils, use small diameter brass tubing (two telescoping lengths) obtainable at hobby and crafts supply stores. The author used ⅛ in. diameter tubing for the stationary support "rod," and mating tubing for the sliding "rod," but you may want to use larger, more rigid pieces. The stationary member is about 3½ in. long, and the sliding member is about 3 in. long.

Drill holes of the required size through the center of coil L1 form, and through the wood upright dowel near the top. Pass the stationary brass rod through the hole in the coil form and into the hole in the dowel. Glue or Duco cement is used to hold coil L1 securely to the wood upright.

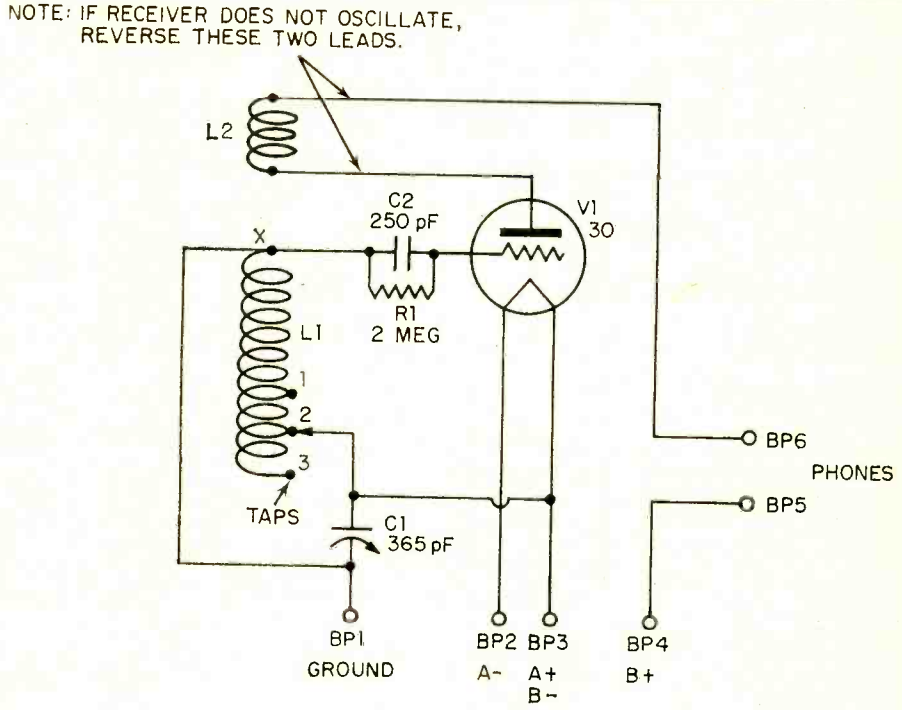


All wired and ready to pull in those DX casts. Wiring is point-to-point just like the schematic.

Drill a hole of required size through center of coil L2 form, and cement the coil form securely to one end of sliding brass tube. A knob goes on the other end of this brass tube.

The tube socket (type depending on tube used) is supported by two stand-off metal collars, as shown.

The schematic diagram shows the simple hookup. Connections should be soldered wherever possible. Use a sensitive pair of high-impedance magnetic earphones when listening. A size D flashlight cell will last for a while with a type 30 tube, but a No. 6 ignition battery will last longer. No switch is used—simply disconnect the "A" battery! For the "B" battery, connect two or three 9 volt transistor batteries in series. ■



PARTS LIST FOR ANTENNALESS 1-TUBE REGEN RECEIVER

C1—One 365 pF variable capacitor
C2—One 250 pF ((.00025 uF) ceramic disc capacitor
R1—One 2-megohm, ½ watt resistor.
V1—Any low filament voltage, low filament drain, triode vacuum tube (Author used type 30)
1—One baseboard-mounted socket for vacuum tube (V1).
BP1-BP6—Six medium-size Fahnestock clips.
L1—Home-made spiderweb coil, with three taps (see text)
L2—Home-made spiderweb feed-back ("tickler") coil (see text)
1—¼ lb. #26 gauge enameled magnet wire for L1 and L2
1—4-in. by 8-in. piece gray sheet fiber, for making coil forms (see text)
1—Wood baseboard, 7½-in by 5½-in. by ½-in. hardwood
1—Round or square ½-in. wood dowel, 2½-in. long (holds spiderweb coil assembly)
2—Round or square telescoping brass tubing, for spiderweb coil slider (see text)
Misc.—hardware: Knob for C1. Mounting screws for C1. Mounting screws for Fahnestock clips. Soldering lugs. Mounting screws and stand-off collars for tube socket. Hookup wire. Flexible wire for "tickler" coil (L2) pigtail leads. Small alligator clips. Pair high-impedance magnetic earphones. "A" battery for V1. "B" battery for V1. Two or three 9-volt transistor batteries connected in series. (see text)

For type 30 tubes, try the following sources:
Mr. George Haymans, WA4NED, Box 468, Gainesville, Georgia 30501.
Modern Radio Labs., P.O. Box 1477, or 10322 Ballard Drive, Garden Grove, California 92642.
Other low filament voltage, low drain, triode tubes that may be used are: 1H4-G. 1G4-GT. VT-24/864. 1B5/25S. 1H5-GT. 1LE3. 1LH4.

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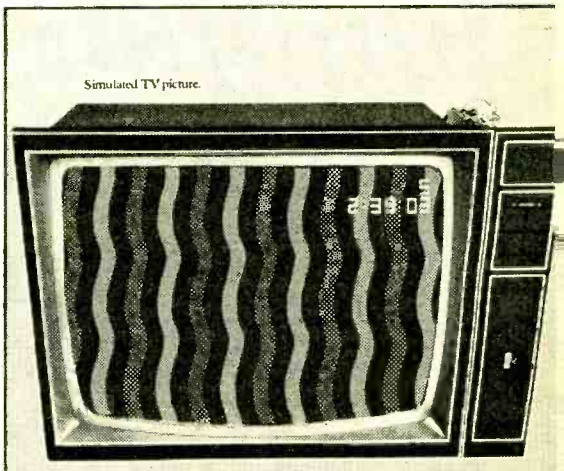

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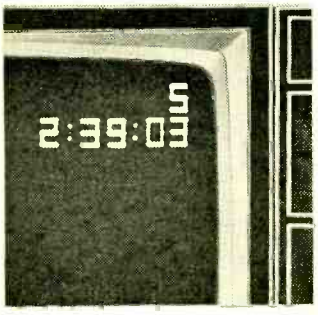

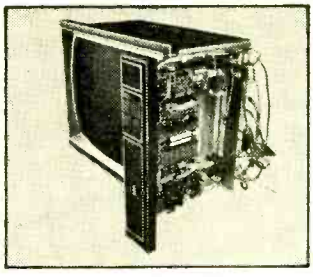

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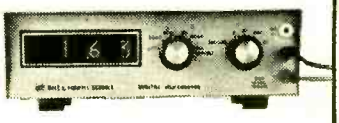

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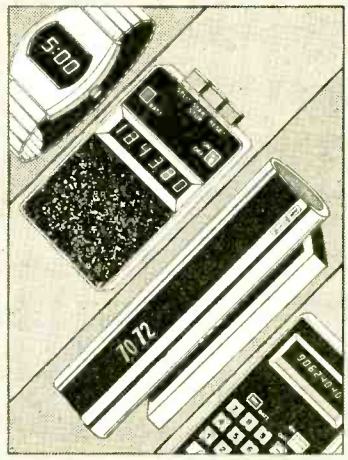

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597R6

Antiquing an Old Tube into Antiquity

by Art Traufer

Many antique radio collectors have one or more early battery radios in their collections which have bayonet shell-type sockets made for O1A type tubes. The O1A tubes require 5 volts on the filament and draw a hefty .25 amps each. Since these tubes were out of production many years ago and are becoming hard to find, it is desirable to use more modern tubes having lower filament voltages and less "A" battery drain. One such tube is the type 30 tube, which requires only 2 volts on the filament at only .060 amps!

Type 30 tubes have the same four pin arrangement as the old O1A tubes. However, the 30's base is smaller in diameter than the O1A's base and it also does not have the metal pin for use in bayonet sockets. The 30 tubes were made for use in "push-in" type sockets.

To use a 30 in an O1A bayonet socket it isn't necessary to make an adapter or to "re-tube" an O1A base with a 30 glass envelope. All you have to do is build up the diameter of the 30 base so that it fits the bayonet socket and then put small metal pins in the base.

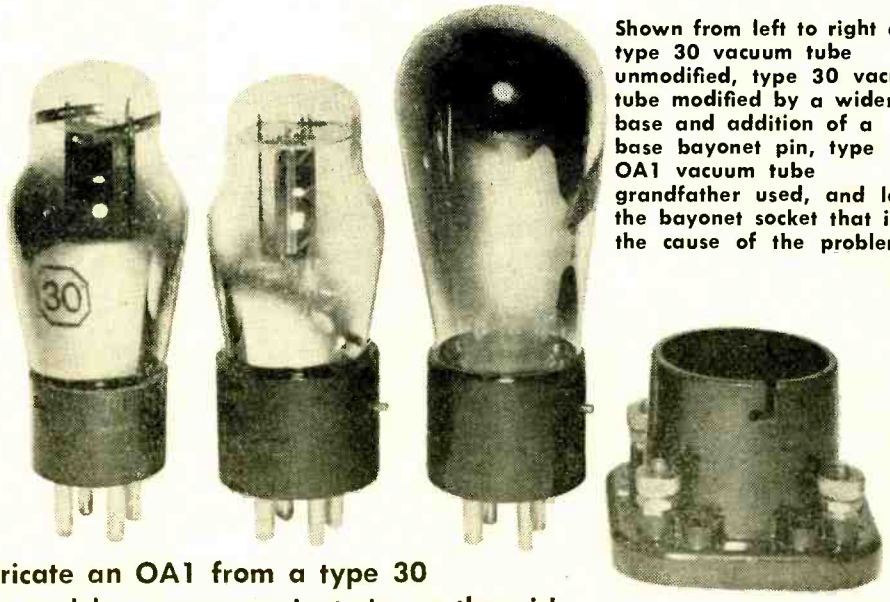
How To Do It. Buy a 12″ length of Crown Line PCV-1120 1″ white plastic pipe at a plumbing supply house, or buy any other plastic pipe having an inside diameter the same (or slightly larger) than the diameter of the 30 tube base. Be sure the outside diameter is the same (or slightly smaller) than the opening in the O1A bayonet tube socket.

Saw off a 1″ piece from the plastic pipe, then file the tough sawed edges smooth and glue the 1″ piece on the base of the 30 tube. If the plastic fits a little too loose on the tube base simply wrap a turn or two of *Mystik* cloth tape around the tube base before you apply the glue. Let the glue harden.

If the modified 30 base now fits a little too loose in the O1A bayonet socket wrap a turn or two of the cloth tape around the base.

To complete the job fasten a small metal pin in the base. To do this drill an undersize hole through the plastic and into the tube base and then twist in a machine screw

(Continued on page 112)



Shown from left to right are : type 30 vacuum tube unmodified, type 30 vacuum tube modified by a wider base and addition of a base bayonet pin, type OA1 vacuum tube grandfather used, and last, the bayonet socket that is the cause of the problem.

Fabricate an OA1 from a type 30 tube and keep your ancient rig on the air!

BUILD OUR...

POT-POWER 360

Build our speaker in a pot—then you'll be turned on whenever you want.

An original speaker system designed and custom made by Herman F. Johnson

BET we fooled you with that title—we're not advocating that our readers smoke pot 'round the clock but that you sink your speaker into an insulated pot. We've been *turned* on by the possibilities of those recently-introduced 360-deg speaker systems and have come up with this project for those of you who are likewise intrigued but wouldn't dream of going commercial. We realize many of you feel that if it can be made in the home workshop you won't go near crass, factory-built gear. Well, here's an easy, relatively inexpensive way to make a pair of 360-deg speakers for your stereo system that'll look as professional and work as well as (maybe even better than) the commercial products now on the market.

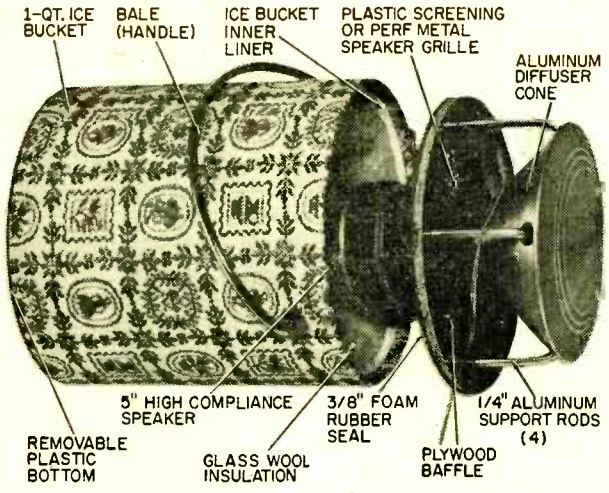
(turn page)

POT POWER 360

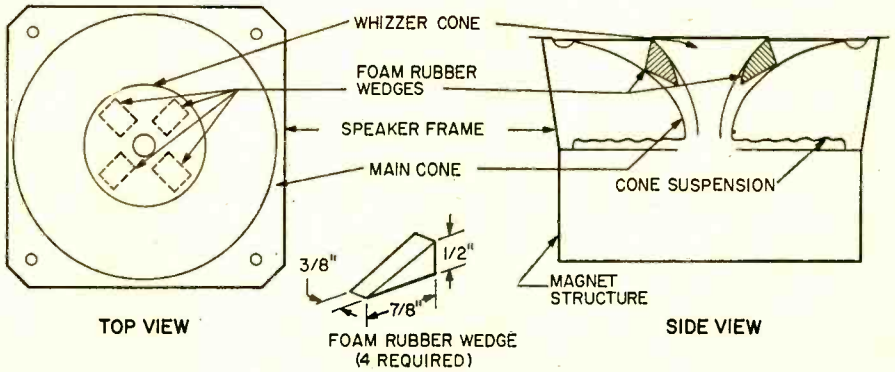
All you'll need for this project is an attractively decorated insulated ice bucket (yes, we mean ice bucket); a small- to medium-sized wide-range, high-compliance speaker; a yard or so of 1-in. thick fiberglass insulation batting; an aluminum wedge-shaped cone sound diffuser; and a little of your time to fabricate our Pot-Power 360 speaker. For stereo, of course, you need doubles on materials to wind up with a matched pair.

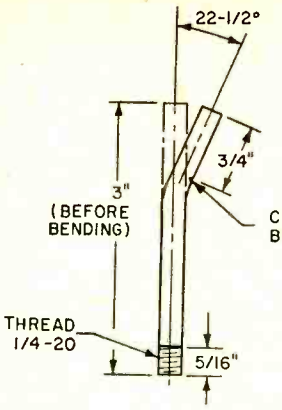
Let's Get Going. We procured a 7½-in. diameter x 8½-in. high ice bucket, which has a volume of approximately 378 cubic inches. If your local supplier prices his stock on the quality of heat insulation, buy his lowest priced one having the least amount of heat insulation. A minimum enclosed volume of 270 cubic inches is the recommended loading volume for a 4- to 6-in. high-compliance speaker to assure good low-frequency response. In addition to having a bail-type handle that we use to clamp the speaker and baffle in place, the ice bucket we selected has an easily-removed plastic bottom. That's an admirable feature for our project because you'll have to reinforce the bottom with hardboard or plywood to change the normal resonance of the bucket.

We just pried off the bottom plate, cut a piece of hardboard ¾-in. thick in a circle sized to just fit inside the bottom of the bucket, and cemented the hardboard circle to the plastic bottom plate. We left the plastic, heat-insulator inner liner inside the bucket and further lined it with a sheet of fiberglass batting. Then we filled the remaining space with 2-in. squares cut from the fiberglass batting by dropping them haphazardly into the empty area, making certain that it was completely filled. This helps out

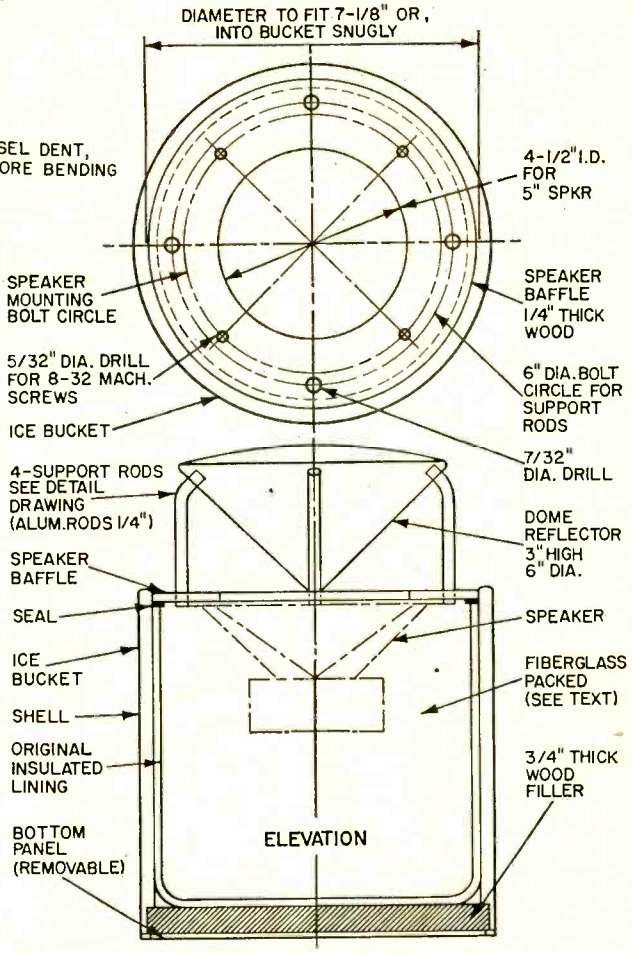


View to left shows speaker, enclosure just before you complete construction. Speaker grille can also be made out of nylon mesh screening if you experience difficulty trying to find metal stock with sufficient perforations in it. Bottom drawings show how foam rubber wedges are placed between speaker whizzer cone, main cone. Best bet when starting speaker modification is to connect speaker to amp, listening for accentuated or extreme high frequencies. Then wedge foam pieces between whizzer, main cone until these disturbances can't be heard.





Aluminum support rods are made by lightly tapping chisel touching stock with hammer, then bending metal on dented surface to angle as shown. After rods are dented, bent into shape, secure each rod in vise, thread with ¼-20 die for total length of 5/16-in. If your lumber supply yard doesn't stock sheet fiberglass insulation, you may obtain this material from Lafayette Radio; it's listed as their part number 20E15014. By no means should you skimp on bucket seal, for without it your PP 360 will sound underfed in bass department.



BILL OF MATERIALS FOR POT-POWER 360 SPEAKER

1—5-in. high-compliance speaker (Lafayette 99-0170 or equiv.)
1—Dome reflector (Lowell AL8A ceiling baffle for 360° sound dispersion or equiv.—see text)
1—Ice bucket, 1 gal. or larger (West Bend Thermo-Serv or equiv.)
4—¼-in. aluminum rods—see drawings for details
1—¼-in. plywood speaker baffle (see text)
1—Fiberglass screen material or perf metal from Lowell baffle
4—Foam rubber cone damper for item 1—see drawing
1—⅜ x 23-in. plastic foam weather stripping for speaker baffle seal
1—2 sq-ft fiberglass damping material (see text)

Misc.—Hookup wire, resin sealant, screws, bolts, washers, etc.

in the loading of the speaker cone.

Now for the Speaker. There are several sizes of high-compliance speakers on the market today that are ideal for this application and will perform well when housed in an enclosure having a loading volume of a mere 178 cubic inches. We selected a high-compliance, 5-in. extended-range speaker as the best one for the ice bucket we purchased. This particular speaker has a published response range of 38 to 19,000 Hz, achieved by special treatment of the cone suspension as well as special cone material for the low frequencies and a second *whizzer* cone for

POT POWER 360

the mid-range and high frequencies.

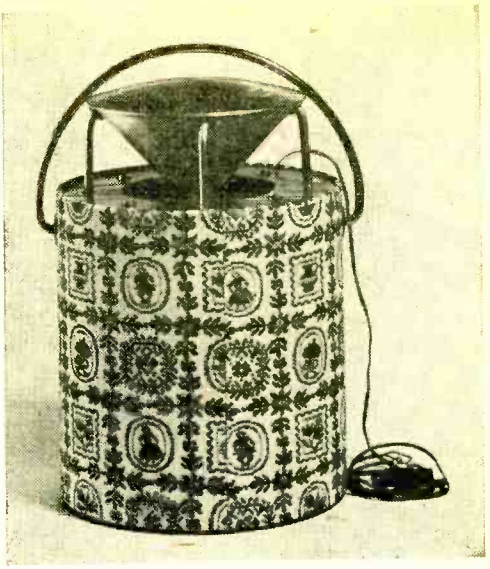
Many *whizzer* cones have a tendency to sing at their resonant frequency in the vicinity of 2500 Hz which may introduce annoying peaks, particularly on speech. It's a simple matter to insert foam rubber wedges between the whizzer and the main speaker cone that will dampen the whizzer at this peak point, thus greatly improving overall high-frequency response. Four wedges ⅞ x ⅜-in. each are cut from ½-in. thick foam rubber as shown in our drawing. These are spaced equidistant around the circumference of the whizzer as detailed in the drawing.

The 360° Diffuser. Easiest way to get a suitable aluminum wedge-shaped cone to disperse the sound all around is to purchase a Lowell Model AL8A brushed-aluminum ceiling baffle that has a properly formed spun aluminum cone-shaped wedge as part of the baffle assembly. If you're handy with tin snips, you may be able to trim this baffle down to just fit in place of the lid on the ice bucket. If this isn't possible, remove the dome and mount it on a circle of ¼-in. plywood or pre-finished wood paneling that will become the speaker baffle.

Cut the circle so that the outside diameter just fits snugly into the bucket and then cut out the center to the diameter of the speaker cone. Once you've cut the wood baffle to size you're ready for the next step. Incidentally, even though you use the complete aluminum baffle as is (except for trimming to size) you'll need the wood baffle just described.

The aluminum dome is supported by the baffle via ¼-in. diameter aluminum rod bent as shown in our drawing. We threaded the free end of these rods so they could be literally screwed into the wood baffle for added support and to withstand the pressure when the complete assembly is clamped into position by the bail of the ice bucket. Opposite ends of these rods are inserted in the rubber grommets in the aluminum wedge and hold it at a proper distance from the speaker to disperse the sound evenly. After assembling the rods and the aluminum dome, seal the threaded portion of the rods to the wood with resin sealer.

Finishing the Job. Now's the time to mount the speaker, connect it to a suitable length of hookup cable, install the sealing gasket on the bottom of the baffle, and you're ready to sit back and enjoy the sweetest music this side of heaven. The sealing gasket is made from a length of ⅜-in. self-adhesive foam rubber used for weatherstripping windows. Fasten it around the circumference of the bottom of the baffle just even with the edge of the wood so that it will seal off the baffle when it's positioned in the bucket. See our drawing for details. Drill a small hole near the edge to pass the hookup wire to the outside, and after connecting to the speaker, seal off the hole with resin sealer.



Decorating your Pot Power 360's most interesting facet of construction. Speaker shape blends well with other home furnishings.

How about speaker placement? After all, this speaker enclosure works like no other that's ever tickled your ears. As you may have already imagined, our Pot Power 360 does its thing just about anywhere in your living room or den. But there are two critical points we want you to remember. First, you'll need to place the speakers so they remain relatively clear of treble-trampling window drapes. And both speakers—if you've built two—must be phased properly for proper stereo perspective. For best results, place our Pot Power 360 in the middle of your room. Then walk around both beauties as they sing in stereo. The result's positively surrounding! ■

SUPER SCA ADAPTOR

by Herbert Friedman

Hot Enough For DXing

You can build a Super SCA detector that's powerful enough for DXing! It's a two-IC circuit in an *amplifier* and *phase locked loop* detector configuration. And it's superior to many other PLL detector circuits because it has an IC amplifier to boost and *lift* the relatively weak 67 kHz sub-carrier signal from the FM signal. That makes it a must for fringe areas.

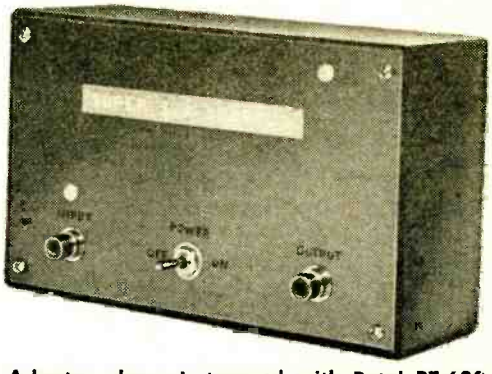
But let's go back to what SCA is. When a Subsidiary Communication Authorization (known as SCA) is granted to an FM station by the FCC, that station is permitted to transmit a second program *in addition* to its regular program by a special method of modulation. A standard FM radio, even a stereo radio, cannot detect these special broadcasts. The regular listening audience hears only the standard mono or stereo programming. In fact, there is no way of even telling whether or not a station engages in SCA programming. That is, not without a special SCA adaptor that you can build!

If you think you'd like to tune to these hidden broadcasts, we've provided this special project. Special because its high sensitivity permits reception of SCA signals that other low cost adaptors miss.

What You Can Hear. For some time now, SCA has been used to transmit educational programs and continuous weather reports to specialized audiences; however, it is *primarily* used for background music—the type heard in restaurants and shopping centers. For example, in the New York City area there are FM stations with SCA programming in light popular music, while others specialize in music of India and Greece. Best of all, this pleasant, interesting music is never interrupted by an endless barrage of commercials or the patter of an announcer in love with his own voice.

How it's done. SCA programming is transmitted by a 67 kHz FM sub-carrier that is impressed on the main FM carrier. When a station broadcasting SCA is received by a standard FM tuner, the SCA sub-carrier is simply wiped out—the listener has no idea it exists. To receive SCA, the FM tuner's output is usually passed through a filter that wipes out everything except the SCA sub-carrier and it's modulation. When the sub-carrier is demodulated, the output is only the SCA program; to the SCA listener, the standard programming doesn't exist.

Until recently it took a lot of expensive hardware to receive SCA programs: a very sensitive receiver and a rock-steady detector. (A good receiver is needed because the SCA carrier is only 10% of the total FM signal.) Though many low cost SCA



Adaptor above is teamed with Rotel RT-620 AM/FM tuner and Dynaco SCA-80Q amplifier

SUPER SCA ADAPTOR

adaptors have been available in project or wired form, most had a tendency to burp, gargle or distort on the very weak signal level of the SCA.

While the radio-astronomy crowd had a great weak-signal detector known as the phase locked loop, it was also true that the astronomical phase lock detector was astronomical in price. But thanks to modern solid-state techniques, the Signetics Corporation has come up with a phase locked loop detector specifically intended for SCA detection that is priced well under ten dollars.

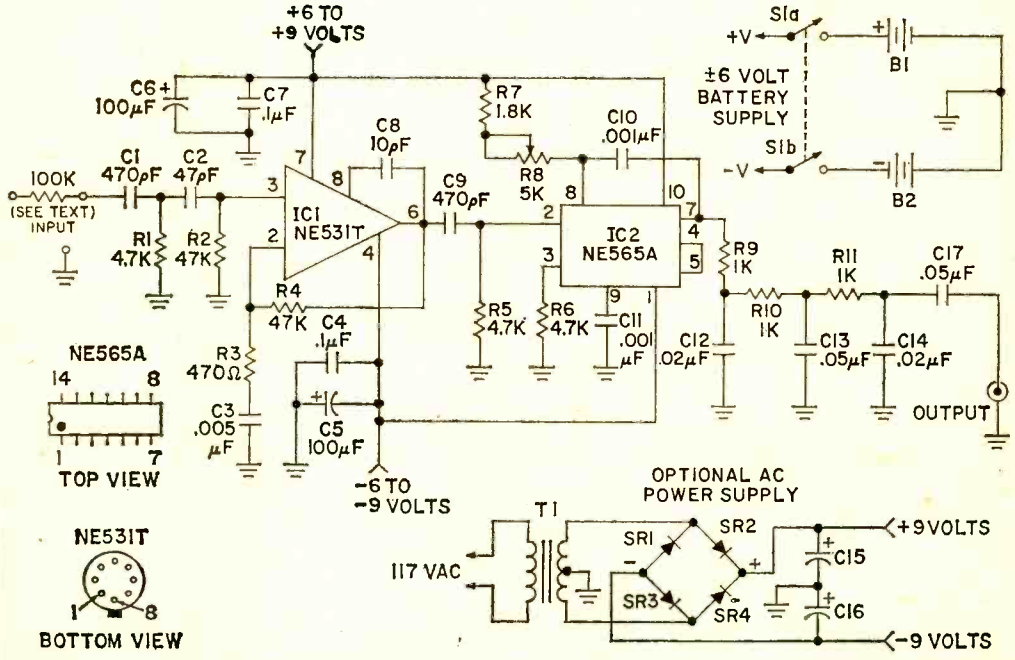
Available in the standard 8 pin round and 14 pin DIP IC packages, the Signetics SE/NE565 requires virtually no external hardware for SCA detection. Most important, since the phase lock detector automatically locks on the incoming SCA carrier frequency, the Signetics SE/NE565 will demodulate SCA subcarriers of either 65 kHz or 67kHz without adjustment; whichever subcarrier frequency the broadcasting station uses will be received equally

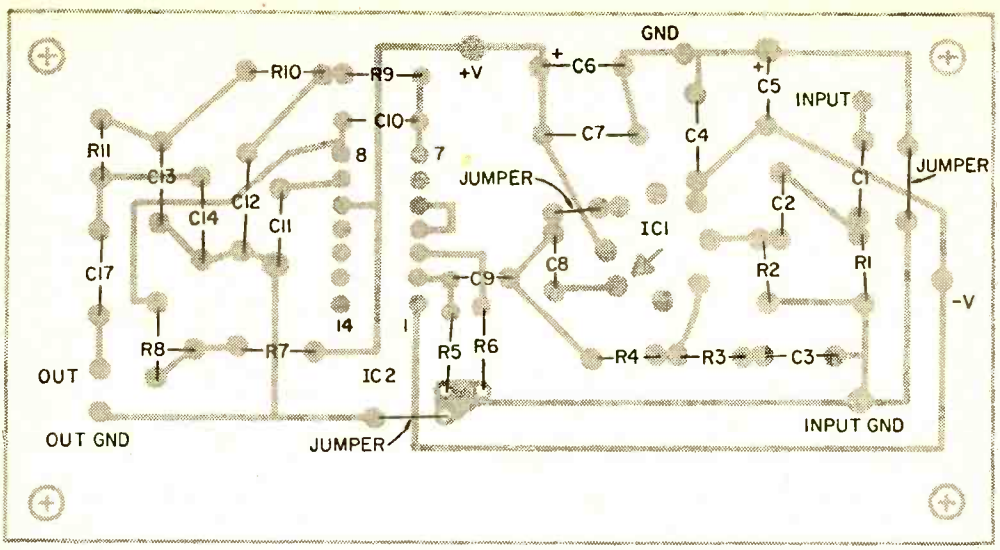
PARTS LIST FOR SUPER SCA ADAPTOR

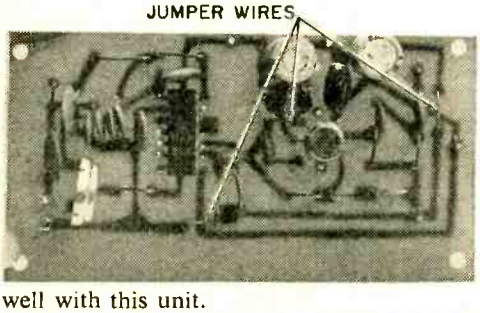
B1,B2—6-volt battery, RCA VSO68 or equiv.
C1,C9—470 pF disc capacitor, 15 VDC or better
C2—47 or 50 pF disc capacitor, 15 VDC or better
C3—0.005 uF disc capacitor, 15 VDC or better
C4,C7—0.1 uF disc or Mylar capacitor, 15 VDC
C5,C6—100 uF electrolytic, 15 VDC or better
C8—7 or 10 pF disc capacitor, 15 VDC or better
C10,C11—0.001 uF disc or Mylar, 15 VDC
C12,C14—0.02 uF disc, 15 VDC or better (see text)
C13,C17—0.05 uF disc or Mylar, 15 VDC or better
C15,C16—2000 uF electrolytic capacitor, 15 VDC or better
IC1—Integrated circuit amplifier, NE531T (Signetics). Write to Circuit Specialists Co., Box 3047, Scottsdale AZ 85257 for IC prices.
IC2—Integrated circuit PLL, NE565A (Signetics)
R1,R5,R6—4700-ohms, ¼-watt resistor, 5%
R2,R4—47,000-ohms, ¼-watt resistor, 5%
R3—470-ohm, ¼-watt resistor, 5%
R7—1800-ohm, ¼-watt resistor, 5%
R8—5000-ohm potentiometer, PC board mounting
R9,R10,R11—1000-ohms, ¼-watt resistor, 5%
SR1 to SR4—Silicon diodes, HEP-154 or equal
S1—Toggle or slide switch, SPDT
T1—Small filament transformer, 12.6 volt center tapped

Misc.—6 x 3½ x 2-in. case, printed circuit material, etchant, RCA phono jacks, push-in clips, hardware, wire, solder, etc.

The printed circuit board far the Super SCA project is available direct from Electronics Hobby Shop, Box 192, Brooklyn NY 11235 for only $6.49 (includes pastage and handling). New York state residents must add sales tax. No foreign orders, please. Postal money orders will speed delivery af Super SCA PC board. Otherwise allow 6-8 weeks far delivery.







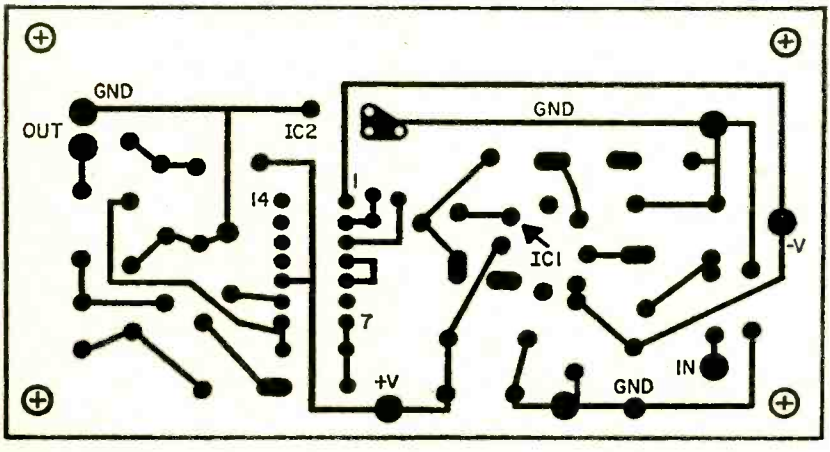
Strong backlighting, left, shows printed circuit wiring through a completed circuit board. Layout above and photo on next page show where to place components.

well with this unit.

Combination Gets Results. Unfortunately, the phase lock detector requires at least 80 mV for good reception, and this means that usually only one or two stronger or local SCA stations can be received. To make our SCA adaptor the best there is, we have combined the phase lock detector with a high gain operational amplifier. The result is a Super SCA Adaptor that can receive SCA programs on a real cheap FM tuner and an indoor rabbit-ear antenna.

Another plus feature for our Super SCA Adaptor is that no large filter coils are needed to suppress the main channel program. Even SCA programming on stereo stations is received cleanly and with no trace of stereo hash. And because large, bulky coils are not needed, the entire adaptor can be assembled on a 2 ¼-in. x 4 ¼-in. printed circuit board for which we provide the template.

Because our adaptor gain is high, it must be assembled on a PC board exactly as



Exact PC board size. Transfer image to copper clad board using carbon paper. This is the bottom (copper) side of your board.

described to insure complete stability.

Some Tech Talk. The signal from your FM tuner's detector before de-emphasis is applied to operational amplifier IC1 through a high pass filter consisting of C1, C2, R1 and R2. The filter's rollover frequency is 60 kHz, which removes a substantial part of the main channel information. Frequency response of the amplifier is tailored by the feedback loop through R3 and C3 to further supress main channel information. IC1's output is fed through high pass filter C9 and R5 to IC2, the phase lock loop detector. IC2's output is passed through a low pass filter consisting of C12, C13, C14, R9, R10 and R11 which provides de-emphasis and noise supression. The output level at C15 is about 50 to 100 mV, depending on the signal, and can be fed to your hi-fi or utility amplifier.

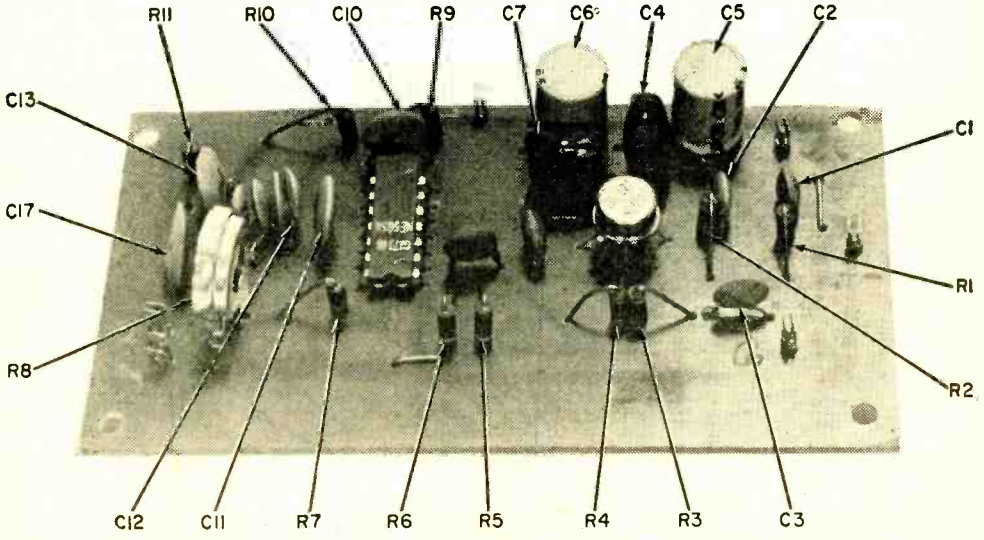
Since SCA frequency response is limited to 7 kHz, just about any amplifier can be used.

Note that the adaptor requires a bi-polar power supply in the range of ±6 to ±9 volts. The power supply can be either batteries or a power line bridge rectifier using a center-tapped 12 volt filament transformer as shown on the schematic. Since the adaptor requires only about 10 mA of current, any small transformer can be used.

How to Etch a Circuit. Your first step is to prepare the PC board. Since the board must be precise, we suggest you work directly from the supplied template rather than through an intermediate tracing. Cut a section of any type copper clad board to 2 ¼-in. x 4 ¼-in., clean the copper surface with a strong household cleanser such as Ajax or Comet and place a piece of carbon paper, carbon side towards the copper, on the board. Tape the board under the template and, using a sharply pointed tool such as a scribe, indent the copper foil at each component mounting hole by pressing the point of the tool through the template into the foil. (Each indent will serve to mark the hole's location when the board is drilled.) Using a ball point pen and firm pressure, trace the outline of the foil areas.

Continue. . . . Remove the board from under the template, discard the carbon paper and, using a resist pen such as the Kepro RMP-700, available from Allied Radio, fill in the foil areas with resist. Note that some of the IC1 and IC2 pins are not used, though they must pass through the board. Place a drop of resist over the indents so you'll know where to drill after the unwanted copper is etched away. Similarly, mark the indents at the corner mounting hole locations. Make certain you mark IC1 terminal number 8; you can use a drop of resist.

Immerse the PC board under at least ¼-in. of etchant for about 45 minutes and then inspect the board. If all the unwanted



Completed circuit board. Resistor R8 easily adjusts frequency of PLL to 67 kHz.

copper has not been etched away, re-immerse the board in five minute intervals until all the copper not protected by resist has been removed. Then rinse the board under running water and remove the resist by scrubbing briskly with a steel wool pad such as Brillo.

Using a #56 drill bit, drill the holes for the connecting terminals (push-in terminals) and trimmer potentiometer R8. Drill the corner mounting holes to clear a #4 or #6 screw and drill the remaining component holes with a #58, #59 or #60 bit.

You Can Buy the Board. You don't have to make a printed circuit board for the Super SCA—you can buy one. The Electronics Hobby Shop is offering the PC board completely etched ready for drilling and assembly. This beats trying to copy the author's board layout exactly, and the mess and expense of etching copper.

Mount the Components. Install IC1 and IC2 before any other components. Note that the IC1 lead opposite the case tab is number 8. Insert the leads (begin with number 8) and push IC1 toward the board until there is about ⅜-in. between IC1 and the board. Solder the wires and cut off the excess.

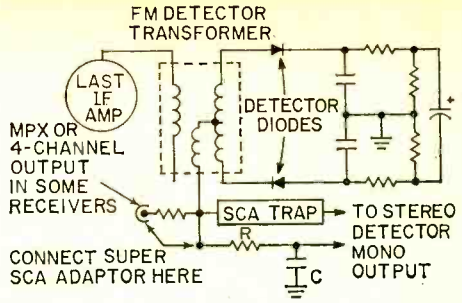
Hold the PC board so you are looking at the top with IC1 to the left. Hold IC2 so the notch is away from you and insert IC2's leads into the matching holes. *Doublecheck the notch before soldering.* It is correct if the distance from the notch to the edge of the PC board is greater than that of the unnotched end to the opposite edge of the PC board. If all is okay, solder IC2.

Install trimmer potentiometer R8 and solder. Make certain you use sufficient soldering heat to flow solder to R8's terminals.

Then install the three wire jumpers and, finally, the remaining components taking extreme care that the polarity of capacitors C5 and C6 is correct. Note that C5 has the positive lead connected to ground.

While capacitors C12 and C14 are indicated as 0.02 *u*F, they are not the easiest to obtain in miniature size. You can substitute two parrallel-connected 0.01 *u*F capacitors. Simply twist their leads together and insert them into the matching holes. Do not tin the twisted leads prior to soldering as they will not fit into the holes if tinned.

Set-up and Checkout. Either a bi-polar battery power source or a standard bi-polar power supply can be used. Since there is



Always connect SCA adaptor before de-emphasis network R, C as shown above. Most tuners, receivers do have an MPX jack for a home SCA, or 4-channel use.

essentially no difference in performance between a ±6 V and ± 9 V power supply, use whatever you have available. For long-term battery life we suggest Burgess type Z4 6 volt batteries (or their equivalent).

The Super SCA adaptor connects to your mono FM tuner or receiver detector *before* the de-emphasis. If you connect after the de-emphasis network, you will find the 67 kHz subcarrier has been filtered from the signal, so you will get nothing but noise from the adaptor. The figure shows a typical FM detector output, the de-emphasis network and the correct connecting point for the adaptor. Since it is possible the adaptor might load down the detector for normal FM reception, we suggest a switch be installed, so the adaptor can be removed from the circuit for normal FM listening.

The adaptor is most conveniently connected through a phono jack installed in the tuner's rear apron, though you can use a direct wire connection.

Note that if you have one of the older mono FM tuners with an "MPX output" you already have the correct connection as the MPX output is the non de-emphasized detector output. Similarly, if you have a modern FM Stereo tuner with a "4-channel decoder" or a "quadrasound decoder" output you also have the correct connection; they are also non de-emphasized detector outputs.

Connect the tuner's detector output to the adaptor with the shortest possible length of shielded cable or ordinary zip cord, or install the adaptor directly in the receiver if there is sufficient room. Connect the adaptor's output to any high gain amplifier; for example, the microphone input of your hi-fi amplifier, or a utility amplifier is fine, or maybe an old tape recorder. *(See page 100)*

SUPER SCA ADAPTOR

R8 Locks Loop. Tune in a station you know is transmitting an SCA program (a call to your local station should get you the info.) and adjust trimmer potentiometer R8 for best sound quality. Normally, the reception will be almost completely garbled, then fade into a clean signal as R8 is adjusted, then fade into garbling again as R8 is further adjusted. Set R8's wiper so it is approximately midway between the two points of garbled sound. Usually, the best sound will occupy a broad part of the R8 adjustment range, so don't try to be too fussy.

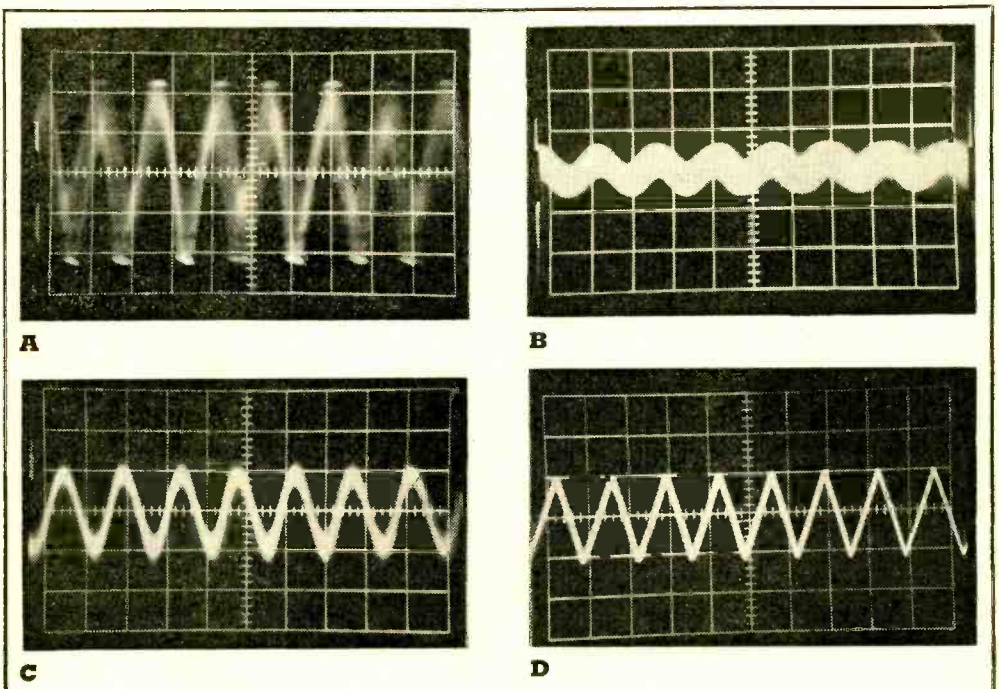
If you don't know which station(s) are transmitting SCA, set R8 to the mid position and tune every station very carefully and slowly. When you hear anything that sounds like distorted music, try adjusting R8; if it is real SCA, it will turn *clean* as R8 is adjusted. Some stereo stations might cause sound bursts that you think are SCA. If adjusting R8 doesn't bring in a clean signal, it's not SCA. Note that once R8 is adjusted there is no stereo hash interference on SCA signals. Hash will only be heard from non SCA signals.

Problems? The high sensitivity of this system may require desensitizing procedures; in the event you cannot receive *any* SCA stations, you either have none in your area or you have made a construction error. If the non-SCA program from the tuned-in station is heard breaking through the SCA programming, follow the suggestions in our troubleshooting box. If your adaptor doesn't work at all, beg, borrow or steal an oscilloscope and check input and output waveforms as shown in the scope photos. Just be sure to return the scope so we don't get in trouble with John Law for inciting a felony!

What's Your Beef? Here are some hints to help you steer clear of trouble—straight toward your musical enjoyment and SCA DXing!

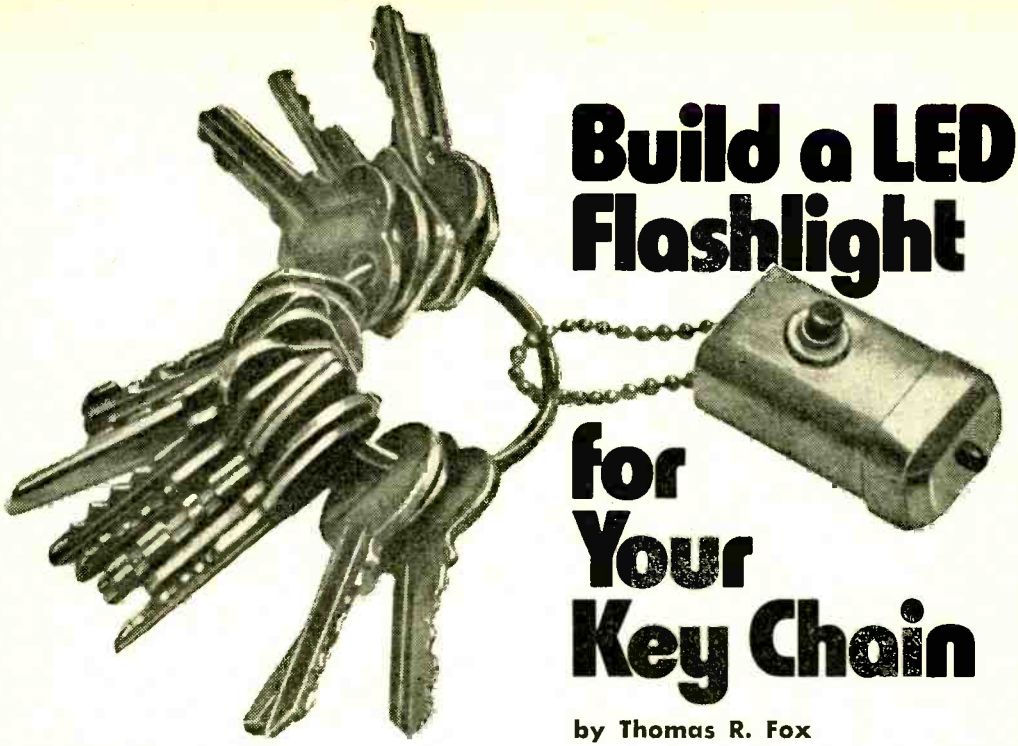
☞ *If your problem is a weak signal re-*

(Continued on page 112)



A **B** **C** **D**

Oscilloscope patterns quickly locate any possible difficulty. You can use a general purpose scope since the signals are under 100 kHz. With "triggered" scopes, set the time base to 10 u sec/cm, Photos B and C are input and output of IC1, the 67 kHz amplifier. If signal is clipped as in A, main channel program may break through—see text for cures. Normal IC2 pin 9 waveform at D. Vert. sens: B, 20mV/cm; C, 1V/cm.



Build a LED Flashlight for Your Key Chain

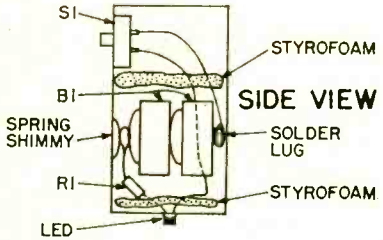
by Thomas R. Fox

A miniature flashlight, attached to a key chain, is an extremely useful device. The trouble is, most key chain flashlights use standard filament light bulbs, which are notorious current hogs and have rather short lifetimes. Because of its minute size, almost unlimited lifetime and very low current consumption, the LED (Light Emitting Diode) is, to date, the best device to use in such a flashlight.

The LED is a revolutionary new solid state lighting device that has no filament to heat up and burn out. Instead, it produces a 'cold light' like fireflies do. It is basically a forward-biased diode composed of gallium arsenide instead of the more usual silicon or germanium. Since it generates most of its light in a narrow bandwith, the LED is only a step away from being a LASER. Also, its nearly monochromatic properties, the color of the LED is quite unusual and many have a rubylike appearance. See light chart.

Many types of LED's are suitable for such a miniature flashlight. Motorola's MLED600 is a good choice to use in a miniature flashlight since it provides a high light output at a low voltage—1.55 volts is enough to turn it on.

The power supply B1, for the device is two 1.35-volt mercury button cells connected in series to give a total voltage of 2.7 volts. This voltage is then dropped to 2.3 volts by the addition of a 15-ohm resistor. With normal use, these mercury cells should

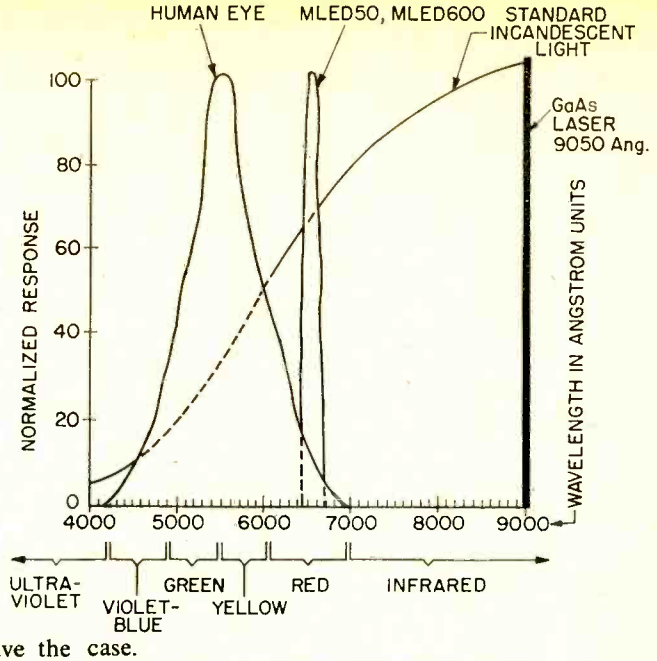


PARTS LIST FOR LED FLASHLIGHT

B1—1.35-VDC mercury button cell, 2 required (Mallory RM-635TR2, or any pair of cells thin enough to fit the plastic toothbrush tube you use)
LED—Motorola MLED600, HEP-P2000 or equiv.
R1—15-ohm, ½-watt resistor
S1—Subminiature, momentary-contact s.p.s.t. pushbutton switch (GC Electronics 34-002 or smaller)
Misc.—Toothbrush plastic container, solder lugs, wire, styrofoam, silver paint, etc.

LED Flashlight

The visible light spectrum shows the colors we see and the narrow band of light the LED generates.



last at least a year. Assuming 20 seconds of use a day, the batteries in the LED flashlight might last as long as their shelf life.

Building It. The case for the LED flashlight can be made from the plastic container in which a toothbrush comes. Either the heavy-weight plastic container or the flexible one can be used.

Cut this plastic container 1¼-in from the bottom and save the cover. You now have the case.

Follow the wiring diagram to complete construction. Styrofoam is used as an insulating material and the specified piece of sheet metal is used as a spring shimmy to get a good connection between the solder lugs and the batteries. Since you can't solder to the batteries directly, pressure contact is required.

Before fastening the cover, check out the flashlight to see if everything is working properly. If the LED lights when the switch is pressed, fine; if not, reverse the batteries or solder lugs. LED's, unlike common incandescent lights, are polarized. If it still doesn't work, check battery contacts, mercury cells, switch and LED in that order.

If everything works okay, finish construction by drilling a small hole in the cover. Put a small piece of styrofoam between the batteries and LED. From the inside of the cover, stick the LED through the hole you drilled. Fasten the cover (it might need to be cut down to size) to the case using small sheet metal screws (or even glue, since the batteries rarely need to be replaced). To appear professional, paint the plastic case with aluminum paint. For the final touch, drill two small holes in the bottom of the case and string a key chain through the holes.

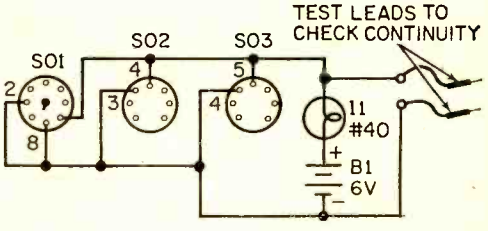
Total cost of this ultra-modern miniature flashlight can be as low as $3.50 including batteries, and it weighs less than 0.5 ounce. ■

Quicky Vacuum-Tube Filament and Continuity Checker

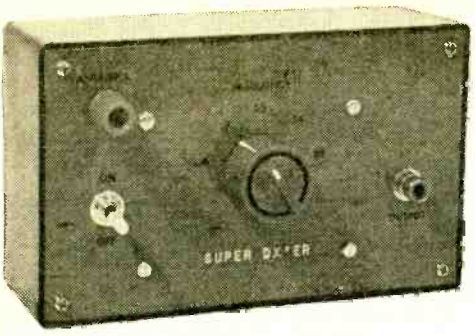
☐ Most tube failures are caused by open filaments, so you can save a lot of time when troubleshooting radios and TV sets by using this instant tube checker. Simply plug a tube into the matching socket; if the filament is okay, lamp I1 will light. If you have any odd-ball tubes that use sockets other than the standard three shown, simply build them into the checker. The continuity test leads allow you to check TV picture tubes. ■

PARTS LIST FOR TUBE CHECKER

B1—6-VDC lantern battery
I1—#40 pilot (Calectro E2-437 or equiv.)
SO1—8-pin octal socket
SO2—7-pin socket
SO3—9-pin socket



a DX central project



SUPER DXER

Our outboard rig makes QSL waves—
adds 20 dB minimum gain
to any shortwave receiver

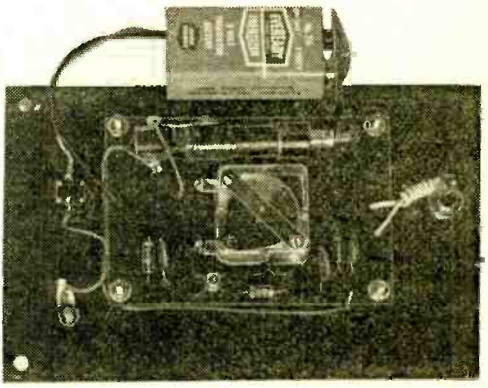
CAN YOU REMEMBER back to the early days of TV—back to the mid and late 1940's—when the Jones' who had the only TV in the neighborhood would strain to clean-up a snowy, flickering picture by adjusting a "booster" that sat on the top of their 12-in. phosphor cyclops?

Well, more often than not, those outboard boxes, with their 6J6's in push-pull tuneable circuits, didn't amount to the proverbial hill-of-beans! Those World War II vintage tubes were not well suited to the new-fangled wide-band requirements of TV. But later on as the technology advanced, and more powerful transmitters were built, good, solid pictures became the rule.

Unlike old TV boosters, today a good booster for short wave receivers, a preselector, can be designed with all the advantages of the latest solid-state devices—and, to boot, can be simple and very easy to build. It's the easiest way to turn any receiver into an even hotter signal sniffer. You use a booster (a very high gain RF amplifier) between the antenna and the receiver antenna terminals. A good one will also provide sharp image rejection by adding a relatively hi-Q circuit to the receiver input. Image signals (that often take the pleasure out of receivers with low frequency single-conversion IF amplifiers by jamming desired signals) vanish as if by magic when passed through a hi-Q booster or preselector. In short, a top quality super booster such as the SUPER DXER, will add another dimension of performance to any shortwave receiver.

What It Can Do. The SUPER DXER provides from 20 to 40 dB of signal boost—the exact amount is determined by the particular input characteristics of your receiver. Figuring on 6 dB per S-unit, that's an increase of better than 3 to 6 S-units. In plain terms, the SUPER DXER will bring in stations where all your receiver will pick up running barefoot is its own noise.

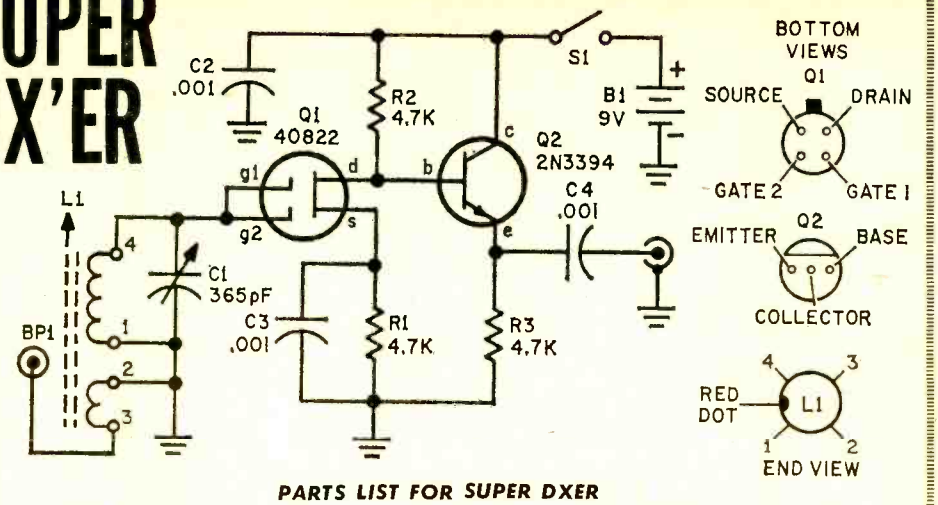
The SUPER DXER's input is a diode protected FET (field effect transistor); the protection diodes are built into the FET so that excessively strong input signals, and even static discharges, will not destroy Q1. Since the FET input impedance is many thousands of megohms, there is virtually no loading of the L1/C1 tuning circuit; its "Q" remains high and provides a very high degree of image-signal attenuation.



Add an extra 20+ dB gain to your shortwave receiver. Simple kit-of-parts is available. You supply just the outer case and a knob. Note: Wrap J1 ground wire as shown above.

The SUPER DXER output circuit is a low impedance emitter follower, and it will match, with a reasonable degree of performance, just about any receiver input impedance. As long as your receiver has two antenna terminals, one "hot" and one ground, you can use the SUPER DXER.

SUPER DX'ER



PARTS LIST FOR SUPER DXER

B1—9-volt battery (Eveready 216 or equal) and connector
BP1—Insulated binding post
C1—365 pF tuning capacitor, subminiature
C2, C3, C4—0.001 uF ceramic disc, 25 VDC or better
J1—RCA type phono jack
L1—5-20 MHz antenna coil, Custom Components SW-520
Q1—MOSFET, RCA 40822
Q2—NPN transistor, 2N3394
R1, R2, R3—4700-ohms, ½-watt resistor
S1—Switch, SPST (power on-off)

A kit of all the above components including the printed circuit board is available from the Electronic Hobby Shop, Box 192, Brooklyn, N.Y. 11235. Price of $20.95 includes postage. New York State residents must add sales tax. No foreign orders. Allow 6-8 weeks for delivery. Postal Money Order speeds delivery.

Optimum performance will be obtained if your receiver is equipped with an antenna trimmer. Just as the antenna trimmer peaks the receiver for use with any type of antenna, so too does it add something extra when matching the SUPER DXER.

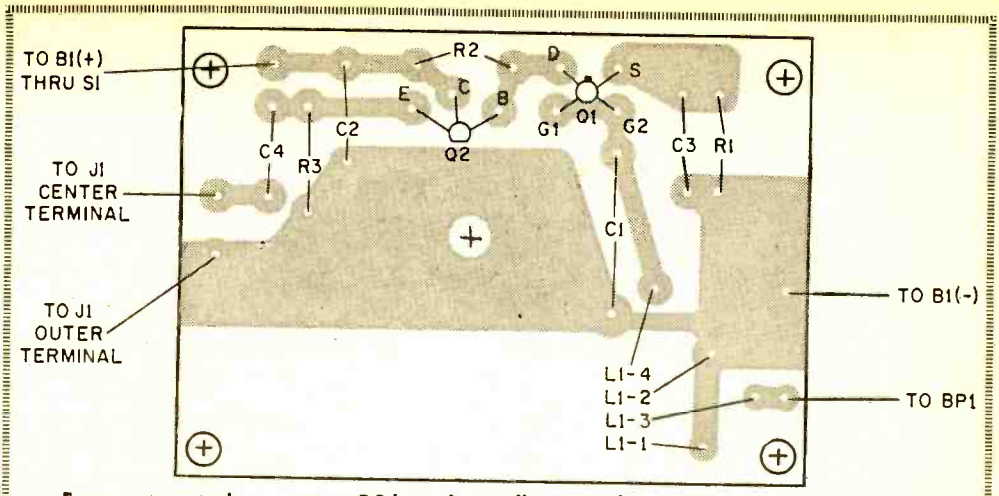
Set Bandpass. The SUPER DXER has a tuning range of slightly more than 3-to-1 between 5 and 21 MHz. That means if the low end is set to 5 MHz, the upper limit will be slightly higher than 15 MHz (3 times 5). If the lower limit is set at 7 MHz, the upper frequency limit will be slightly higher than 21 MHz. Since the slug in tuning coil L1 is adjustable, you can select any operating range between 5 and 21 MHz.

SUPER DXER, though a very high gain device, is absolutely stable if built exactly as shown and described. There will be no spurious oscillations or response. It is possible that changes in the component layout or construction will result in self-oscillation at certain frequencies; hence, make no modifications or substitutions unless you are qualified.

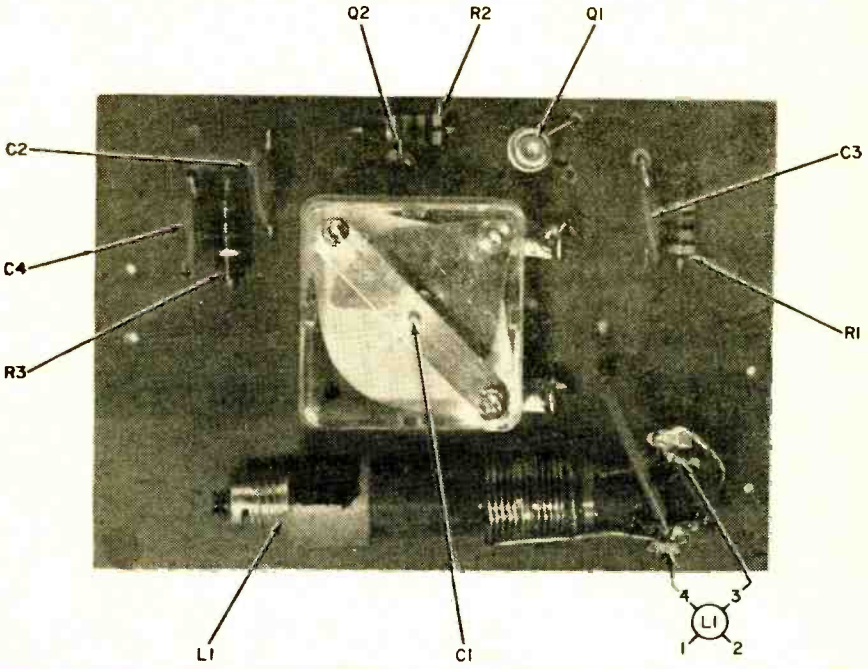
Getting Started. Your first step is to prepare the printed circuit board. Using steel wool and a strong household cleanser such as Ajax or Comet, thoroughly scrub the copper surface of a 2¼-in. x 3¼-in. copper-clad board. Any type will do—epoxy or fiberglass; the type of board is unimportant. Rinse the board under running water and dry thoroughly.

Cover the copper with a piece of carbon paper—carbon side against the copper—and place under the full-scale template we have provided. Secure the PC board in position with masking tape. Using a sharp pointed tool such as an ice pick, indent the copper foil at each component mounting hole by pressing the point of the tool through the template and carbon paper. Next, using a ball point pen and firm pressure, trace the foil outlines on the template.

After all foil outlines have been traced, remove the PC board from under the template and, using a resist pen, fill in all the desired copper foil areas with resist. Make certain you place a dot of resist over the indents at each of the corner mounting holes. Pour about one inch of etchant into a small container and float the PC board—copper foil down—on top of the etchant. Every five minutes or so gently rock the



For exact part placement on PC board, see diagram above. View is from component (top) side of your Super DXer board. Layout below shows a completed Super DXer. Pins 3 and 4 of the dual winding coil L1 are shown in an end view for clarity.



container to agitate the etchant. After 15 or twenty minutes check the PC board to see if all the undesired copper has been removed. When every trace of the undesired copper is gone, rinse the board under running water, and then remove the resist with steel wool or a resist "stripper."

Continue. Drill out all the mounting holes marked by an indent with a No. 57, 58 or 59 bit—this includes the corner mounting and C1 mounting holes. Then drill the corner mounting holes for a #6 screw, and use a 5/16-in. bit for the C1 mounting hole.

Install tuning capacitor C1 first. Tuning capacitor C1 should be the type provided in the kit of parts. It has a plastic dust cover and a long shaft. Do not use the type supplied with a short shaft to which a tuning dial for the broadcast band can be attached. Remove the mounting nut and ground washer from C1's shaft. Then make

SUPER DX'ER

certain the shaft's retaining nut is tight. It is usually supplied loose. Discard the ground washer and secure C1 to the PC board with the mounting nut. Then install tuning coil L1. Make note of two things about L1. The terminal end of L1 has a large *red* dot (ignore any other marks). L1 must be positioned so the red dot faces the bottom edge of the PC board—the edge closest to the coil. Also note that the lug connected to the top of the fine-wire primary is adjacent to the bottom of the heavy-wire secondary. When the red dot is facing the edge of the PC board, both these lugs are against the board. Solder the lugs to the matching holes in the PC board. Use the shortest possible length of wire to connect the remaining primary (fine-wire) terminal to the antenna input printed foil. Connect the remaining L1 terminal (heavy wire) to its matching hole with solid, insulated wire—form a right angle bend in the wire so it doesn't touch L1. Now mount the remaining components.

Orienting Q. Note that Q1 is positioned properly when the small tab on the case faces the nearest edge of the PC board. Also note that the round edge of Q2 faces the nearest edge of the PC board. The flat edge of Q2's case should face C1.

Because the printed copper foil faces the front panel when the assembly is mounted in the case, and is therefore inaccessible for soldering, the connecting wires to front panel components should be installed at this time. Solder 6-in. solid, insulated wires to the antenna, output and output ground, and + 9V foils. Solder the negative (usually black) wire from the battery connector to the ground foil.

The SUPER DXER is mounted in a standard plastic or Bakelite case approximately 6⅜-in. x 3$\frac{3}{16}$-in. x 1⅞-in. The front panel must be aluminum. If the cabinet is not supplied with an aluminum panel, obtain an optional or accessory metal panel. Do not use a plastic panel.

Drill a ⅜-in. hole in the center of the front panel. Position the PC assembly over the hole with C1's shaft fully inserted through the hole, and mark the locations for the four PC board mounting screws. Drill the panel and temporarily secure the PC board to the panel. Then locate the positions for power switch S1, antenna input binding post BP1 and output jack J1. Make certain J1 is as close to the PC board output terminals as is possible—within 1½-in.

Remove the PC board and drill the holes for the panel components. Power switch S1 can be any inexpensive SPST type such as a slide switch. Install the panel components and then the PC board. To prevent the copper foil on the underside of the PC board from shorting to the panel place a ⅜-in. plastic or metal spacer, or a stack of washers, between the PC board and the panel at each mounting screw. Connect the panel components to the appropriate wires extending from the PC board and the

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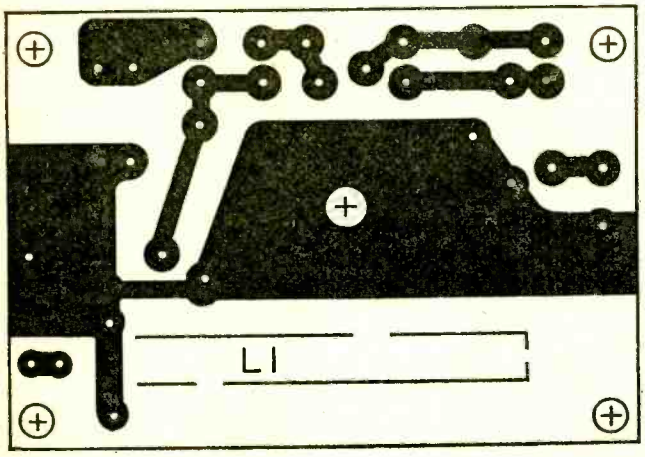


Exact PC board size. Transfer image to copper clad board using carbon paper. This is the bottom (copper) side of your board. Mount it to the front panel with ¼-in. spacers between board and panel at each mounting screw. Secure the battery to the back of the cabinet with tape.

WHERE TO SEND YOUR DX REPORTS

Argentina—Radiodifusora Argentina al Exterior, Sarmiento 151, Buenos Aires
Australia—Radio Australia, Box 428G GPO, Melvourne 3001
Austria—Austrian Radio, P.O. Box 200, A-1043 Vienna
Belgium—Belgian National Broadcasting Service, Box 26, Brussels 1
Canada—Radio Canada International, Box 600, Montreal
China—Radio Peking, Fu Hsin Men, Peking
Colombia—Radio Santa Fe, Apto. Aereo 9339, Bogota
Cuba—Radio Havana Cuba, P.O. Box 7026, Havana
Czechoslovakia—Radio Prague, Prague 2,
Denmark—Radio Denmark, Rosenornsalle, Copenhagen
Ecuador—HCJB, Voice of the Andes, Casilla 691, Quito
Egypt—Radio Cairo, P.O. Box 566, Cairo
Finland—Finnish Broadcasting Co., Helsinki 26
France—Office de Radiodiffusion-TV Francaise, 116 Avenue du President Kennedy, Paris XVI-eme
Germany, East—Radio Berlin International, 116 Berlin, Nalepastrasse 18-50, German Democratic Republic
Germany, West—Deutsche Welle, 5 Cologne, P.O.B. 344, Federal Republic of Germany
Great Britain—British Broadcastlng Corp., Broadcasting House, London W1
Hungary—Radio Budapest, Brody Sandor 5-7, Budapest VIII
India—All India Radio, External Services, Box 500, New Delhi 1
Israel—Israel Broadcasting Authority, Box 1082, Jerusalem
Italy—Italian Radio and TV Service, Viale Mazzini 14, 00195 Rome
Japan—Radio Japan, Uchisaiwai-cho, Chiyoda-ku, Tokyo
Mexico—La Voz de la America Latina, Apto. 7892, Mexico City
Netherlands—Radio Nederland, Box 222, Hilversum
New Zealand—Radio New Zealand, Box 2396, Wellington
Norway—Radio Norway, Bj. Bjornsons Plass 1, Oslo
Portugal—Radio Portugal, Rua do Quelhas 21, Lisbon
Rumania—Radio Bucharest, P.O.B. 111, Bucharest
South Africa—Radio RSA, Box 4559, Johannesburg
Spain—Radio Nacional de Espana, General Yague 1, Madrid 20
Sweden—Radio Sweden, S-10150, Stockholm 1
Switzerland—Swiss Broadcasting Corp., CH-3000, Berne 16
Turkey—Radio Ankara, TRT, Genel Mudurlugu, Ankara
U.S.S.R.—Radio Moscow, Moscow
U.S.A.—Voice of America, U.S.I.A., Frequency Division, Washington DC 20547
Vatican—Vatican Radio, Citta del Vaticano, Vatican State
Venezuela—Radio Rumbos, Apto. 2618, Caracas DF
Yugoslavia—Radio Belgrade, 2 Hilendarska, Belgrade

NOTE: Addresses of other stations may be found in World Radio-TV Handbook or the SWL Address Book, available from Gilfer Associates Inc., P.O. Box 239, Park Ridge, NJ 07656.

SUPER DXER is ready for alignment.

Alignment. Prepare a length of 50 or 52 ohm coaxial cable (such as RG-58) that will reach from the SUPER DXER's output jack to the receiver antenna input terminals. Solder a standard phono plug to one end. Take care that you do not use ordinary shielded cable such as used to interconnect hi-fi equipment; coaxial cable is a must.

Connect the coax between the SUPER DXER and your receiver. Rotate the C1 shaft fully counterclockwise and install a pointer knob so that the pointer extends to the left (9 o'clock position). Connect your antenna to binding post BP1. Then, set L1's slug so the *bottom* of the screwdriver slot is level with the very *top* of L1. This will provide a frequency range of approximately 5 to 15 MHz. If you back out the slug ¼-in., the frequency coverage will be from approximately 7 to 21 MHz. You can use any in-between slug adjustment.

Turn on the receiver and booster, and set the receiver tuning to 5 MHz, or whatever frequency you selected for the "bottom end." Adjust C1 for maximum received signal or noise and mark the panel accordingly. Repeat the procedure at approximately 7, 10, 14 and 15 (or 20) MHz. The panel markings are important because the SUPER DXER tuning is so sharp it must be preset to near the desired frequency or you'll receive nothing—neither signal nor noise. The panel markings complete the adjustments.

Pull 'em In. To prevent self-oscillation, you must keep the antenna wire as far as possible from the coaxial output cable. To receive a signal, set C1 to the approximate desired frequency and then tune-in the signal on the receiver. Finally, peak C1's adjustment for maximum signal strength as indicated on your receiver S-meter, or listen carefully for an increase in speaker volume. Keep in mind that, if the signal is sufficiently strong to begin with, the receiver AVC will "absorb" the SUPER DXER's boost, and the speaker volume will probably remain the same, though the S-meter reading will increase. SUPER DXER's boost will be most apparent on very weak signals, digging out those signals below the receiver's usual threshold sensitivity, making them perfectly readable.

Don't worry about strong signals overloading your SUPER DXER; it is virtually immune to overload even from excessively strong signals. However the booster's output can be so high as to overload the input of some budget receivers. If this occurs simply reduce the booster's output by detuning C1 just enough to drop the overall signal strength below the receiver's overload value. Happy DX'ing. ■

This Disaster Alarm Can Save Your Life

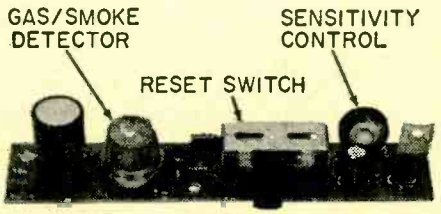
by Herb Friedman

It used to be that the average homeowner wanting early warning of impending fires through smoke detection either had to go the expensive commercial-equipment route or build a not-to-reliable homebrew device. In between the two extremes was nothing on which you'd stake your life. Fact is, in most instances "Joe Average" is still being sold expensive smoke detectors for home use he'd have to throw directly into a fire before it sounded an alarm.

But times change, particularly when it comes to solid state devices, and a small *ionization detector* designed to detect gas fumes and smoke is now available for little more than the cost of a transistor. Though the device is often termed a "smoke detector" it also sniffs out carbon monoxide, methane and Iso-Butane gases, in fact, any ionized gas. A small alarm system such as the Radio Shack Disaster Alarm Kit (#28-4006) which incorporates this detector can be used as a smoke detector in the home to warn of impending fires, as a carbon monoxide detector in the garage for those of you who insist on working on a running engine with the garage doors closed, or as a gas fume detector in closed areas.

The Disaster Alarm Kit has an approximate sensitivity to carbon monoxide of 500 PPM, and 2% to 4% smoke. Unfortunately, it does not incorporate heat detection—for there can be fire before smoke. However, we'll show you how, for just pennies and two extra wires, the Disaster Alarm can be converted to a *smoke, gas, heat* and *burglar alarm.*

Start With a Prefab. The basic Radio Shack Disaster Alarm Kit is AC powered and is housed in a small white plastic cabinet that is mounted high on a wall near the bedroom area (or inside a garage or closet). The alarm sound is produced by a loud, raucous buzzer, similar to the warning horns used as interior remote fire alarm horns in commercial equipment. Once triggered, the



Assemble the printed circuit board exactly as described in the manual. Modifications are added to a complete and tested board.

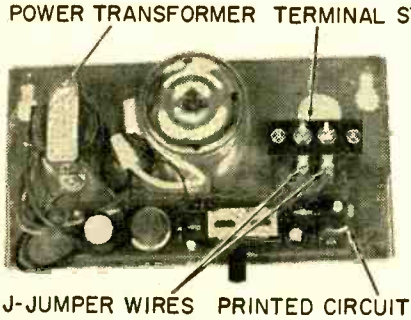
alarm can be silenced only by operating a reset switch. Should the gas or smoke be temporarily blown away by wind the alarm will not be silenced: only the user can silence the alarm.

The kit consists of the plastic housing, power transformer, buzzer-horn, a small printed circuit board and much less than a handfull of components. Construction time takes about one hour.

On the PC board is a small wire jumper labled "J" that is used only for initial setting of a sensitivity control. After the sensitivity is adjusted the J-jumper is normally cut through. However, by bringing out the two J-jumper connections to a screw type terminal strip positioned near a hole pre-drilled on the alarm's back panel both fire and intruder detectors of the *open circuit type* can be connected into the Disaster alarm. Thus, the buzzer-horn sounds when there is gas, smoke, excessive heat or a forced entry through a door or window.

The alarm must be completed and tested before the fire/intruder modification is made. Only after you are *absolutely certain* the alarm is working properly should the following modifications be added to the alarm.

Fire-Intruder Modifications. The PC board is held to the cabinet by three plastic studs, Gently snap the board off the studs and flip it over. Unsolder the J-jumper which is now cut in two. In its place solder a 6 in. pair of insulated twisted wires. Then, re-install the board on the studs. Position a two terminal strip so it half covers the "extra" hole in the cabinet's rear cover, mark the mounting holes and drill for #4 or #6 screws. Bend the terminal strip's solder lugs outward so they will be horizontal to the cabinet and install the terminal strip using



Best location for alarm is high up in the bedroom area. Make certain resetting switch points down so that it is very convenient.

DISASTER ALARM

a ½ in. spacer or stack or washers between the terminal strip and the cabinet. (You must be certain the terminal strip does not short to the metal cabinet cover.) Solder the two wires from the J-jumper connections to the terminal strip. That's the entire modification.

The Disaster Alarm will work normally with or without connections to the terminal strip. If you connect *open circuit* type heat and fire intruder detectors (such as magnetic switches) to the terminal strip the alarm will sound when ambient heat is excessive or when an intruder forces a door or window.

The heat and intruder detector switches are connected in parallel as shown in the schmatic diagram. Because it's a parallel connection there is no practical limit to the number of protective devices you can use. You can place a heat detector in every room and a magnetic switch on every window. Heat detectors come in two standard values: 135°F which is used in the living areas and 190°F (or 195°F) used in furnace rooms and attics.

Take extreme care that you do not obtain *closed circuit* detectors for these cause the alarm to continuously sound. The magnetic detector usually sold in electronic parts stores is the closed circuit type. Do not let a salesman talk you into these devices. The heat and magnetic switch specified as *open circuit* has its contacts *open when safe* and *closed when activated.* If you or the salesman are in doubt as to whether you are getting the correct detector simply check it out with an ohmmeter. Open circuit detectors are usually available from security equipment distributors and many electrical supply houses.

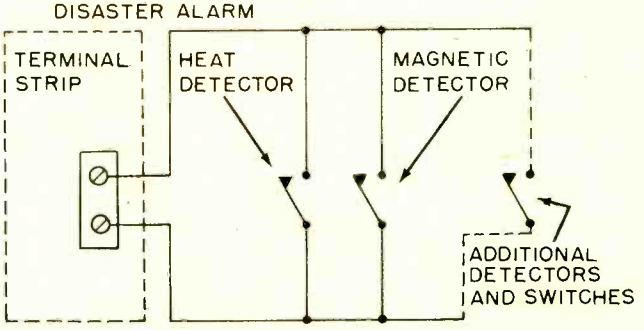
Standard open circuit heat/fire detectors can be installed in all living areas, above the furnace and in cellar and attic.

***Final* Set-up.** After your complete security system is installed, check it out in the following manner. Blow some cigarette smoke at the alarm. If the alarm doesn't trip calibrate the unit as specified in the supplied instructions, but where the instructions call for a J-jumper simply connect a clip lead across the terminal strip. Similarly, where the instructions call for cutting the J-jumper just remove the clip lead.

Applying a match near the heat detector should sound the alarm. If it doesn't you have made a wiring error. (As soon as the detector cools off it automatically resets itself.)

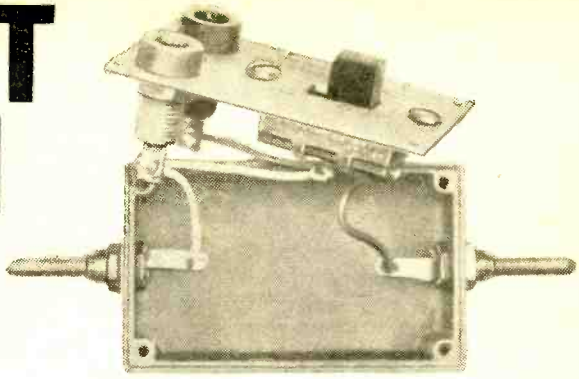
Check a magnetic switch by opening the door or window. If the alarm doesn't sound, look for a wiring error.

It is a good idea to periodically check the system by deliberately tripping each detector—contacts do go bad. If you discover an inoperative detector replace it immediately. ■



The alarm system with modified circuits can have any number of additional detectors added to expand system to cover the entire house, even the garage. Terminal strip is added, after alarm is built, in place of jumper "J".

INSTANT PATCH BOX

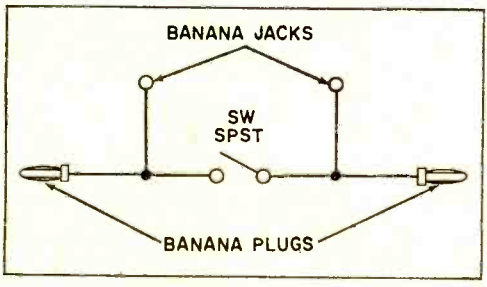


Speed up substitutions with this builders aid

by James A. Fred

The INSTANT PATCH BOX is one of the little luxuries that simplifies electronic experimenting and makes it more enjoyable. Haywire lash-ups often get the job done, but feedback, oscillation, or inaccurate meter readings sometimes make the end results worthless. This little blue box provides a shielded, no-nonsense method of substituting resistance, capacitance, or inductance into a circuit with a minimum of problems.

Essentially, the INSTANT PATCH BOX consists of a small metal box with a cover in which are mounted a SPST slide switch, two banana jacks, and two banana plugs. The box is the smallest that will do the job and keep distributed capacitance and inductance to a minimum. The circuit is extremely simple as you can see from the schematic diagram. A voltage is fed into one banana plug and either through the switch or through the component plugged into the banana jacks. The switch allows conduction through the plugged-in component, or provides a shorted path across the banana jacks.



You will not find a parts list with this article since you should select parts to fit your needs. Check your junk box for parts on hand, and pick up what you can't find at your local electronics shop.

When . . . you have built the instant patch box, what can you do with it? Let us suppose for a minute you have an experimental circuit you are working on. You are trying to determine the correct size bias resistor to use. Connect the box into the circuit with the banana jacks and alligator clips. You can now plug different size resistors into the banana jacks and short out the jacks if you wish. All this is possible without touching a soldering iron to the circuit. Once you get into the habit of using this builders aid, you may wonder how you got along without it!

Construction is simple. Secure the parts listed, make the proper size holes, and mount the parts. There is only one precaution to take and that is to be sure to use insulating washers when mounting the banana plugs. They must not short to the metal box.

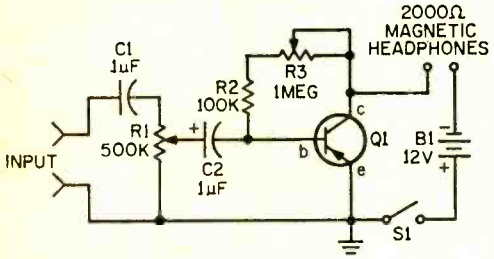
This almost too easy circuit gives you the option of (1) adding an extra component to your haywire circuit or (2) shorting across the component at the flip of a switch. You can vary the terminals to suit your needs.

Incidentally, you don't have to use the same combination of input plugs or component jacks that I did. You can use 5 way binding posts, BNC connectors, tip plugs and jacks, or other types of hardware. Just be sure and use connectors that are compatible with your other test equipment. ■

HEAD-AMP FOR THOSE MINI-SOUND PROJECTS

☐ Quite often the audio output from small projects is just barely sufficient to produce a recognizable signal in standard experimenter magnetic earphones. Yet a handful of surplus components will provide enough gain to turn that whisper sound into a roar. Specifically intended for use with magnetic earphones of from 1000 to 5000 ohms impedance, the Head-Amp can do double-duty as an audio signal tracer when troubleshooting.

Transistor Q1 can be any PNP of the 2N2613 variety. Even the 10-for-a-buck kind will work. Volume control R1 should have an audio taper. Distortion control R3 can have any taper. Make certain C2's polarity is correct; the positive terminal connects to volume control R1 (wiper terminal). Adjust distortion control R3 for best sound quality. If you use a jack and plug to connect your headphones to this amp, you can eliminate on-off switch S1 because power is removed whenever the headphones are disconnected. ■



PARTS LIST FOR HEAD-AMP

B1—Battery, 12 volts (two Eveready 5105 in series or equiv.)

C1—0.1 uF capacitor, 15 VDC or better

C2—1 uF capacitor, 15 VDC or better

Q1—PNP transistor, 2N2613 or HEP-632 or equiv.

R1—500,000-ohm audio taper potentiometer with on/off switch S1

R2—100,000-ohm, ½-watt resistor

R3—1 megohm potentiometer, any taper, no switch required.

Antiquing an Old Tube

Continued from page 90

about 3/32-in. in diameter letting the screw cut its own threads in the hole. Clip off the screw leaving about ⅛" projecting from the base and then file the clipped end of the pin smooth.

Caution: Do not drill too deep into the tube base or you might strike the glass inside the base and ruin the tube. Use a depth marker on the drill so you will not drill too deep.

Who Has It? Possible sources for type 30 tubes or other battery tubes having the same type bases as the 30s and having low filament voltages and low filament drain:

George Haymans, WA4NED, Box 468, Gainesville GA 30501. George has a good stock of new type 30 tubes at this writing. Write him for prices. He also has type VT-25 tubes which are similar to type 30s.

Barry Electronics, 512 Broadway, New York NY 10012

Cornell, 4213 University Ave., San Diego CA 92105

Steinmetz, 7519 Maplewood, Hammond IN 46324

Transelectronic, Inc., 1306 40th St., Brooklyn NY 11218

United Radio Co., 56 Ferry St., Newark NJ 07105

Zalytron, 469 Jericho Turnpike, Mineola NY 11501

A purist collector may say that you are cheating when you substitute a 30 for an 01A job. Maybe so, but your restored ancient receiver will be operative, and if you're lucky, you may uncover an O1A. ■

Super SCA Adaptor

Continued from page 100

sulting in high frequency noise. Change C12 and C14 to 0.05 uF.

☞ *If your problem is background breakthrough from the main program.* This problem is caused by clipping (white lines on waveform A). Simply change C1 and C9 to approximately 300 pf. This will attenuate the subcarrier and clean up the breakthrough on very strong signals, though

very weak signals may get lost (well you can't win or hear em all!).

A second and simple corrective procedure is to put a 100,000-ohm resistor in series with the input from the FM radio. This effectively cuts down on the input signal to eliminate overload.

☞ *If your problem is an inoperative adaptor (even after you've checked components, made sure power supply polarity and receiver connection are correct), you must determine at what point in the circuit your signal is at fault or is lost.*

The three oscilloscope traces show what you can expect to get if you are tuned to an SCA station. Photo B is the input, IC1 pin 2; note the presence of a 67 kHz carrier. Photo C is IC1 pin 6; note the very strong 67 kHz carrier. Photo D is IC2 pin 9, the phase lock detector's voltage controlled oscillator triangular wave output.

If you don't get photo B, the trouble is the connection between the tuner and the adaptor. If you get photo B but not photo C, the trouble is in the IC1 circuit. If you get photo C but not photo D, the trouble is in IC2.

If you don't get photos C and D, there is most likely a major fault in the assembly; we have specifically designed the adaptor so a defective IC cannot disable another IC. ■

"Look, fiber optics!"

Snip & Clip

Continued from page 82

leads of all accessories are terminated by soldering on a No. 3 paper clip.

You may want a few transistor sockets and jumpers though, before you start breadboarding. Make all the leads of solid wire of sufficient length to span the board. Jumpers between adjacent junctions are of stiff uninsulated wire and are installed the same as components.

Planning The Layout. You will save a great deal of time by doing your trial layouts on paper first. Squared paper is handy for this, or you could make a replica of each board using white sheet plastic, such as is used for siding. With holes drilled to represent the junctions, and rows and columns marked identically to the breadboard, you could pencil in and erase component placement.

Working from the schematic, first reduce it to a set of junctions. The number of junctions will tell you the minimum size of board you need. Disregarding transistors and outboard components, plan the layout for economy of junctions and jumpers. While it is not easy to obtain the simplest layout, your ability will improve with practice and the task is not nearly as difficult as designing even the simplest printed circuit.

Using The Board. Installing components on the board is easy and fast. Resistors, capacitors, diodes and other small two-lead components are mounted first. Resist the temptation to lift clamps with your fingers. If the clamp tension is right they may tend to slip through your fingers and you'll end up fishing for them. By using a coathanger-wire loop, you will have no problems and can easily position the component with your free hand.

The outboard accessories are added next. The paper clip terminals should be turned so that the longer loop goes inside the pipe. If you leave an apron on the front of your boards the outboard components can be mounted here using contact cement. Auxiliary equipment may be connected with clip leads. Transistors and long jumpers are added last. The solid wire allows them to bridge the board without interference.

With a few of these boards on hand you'll quickly be turning out simple circuits. ■

ELECTRONICS HOBBYIST

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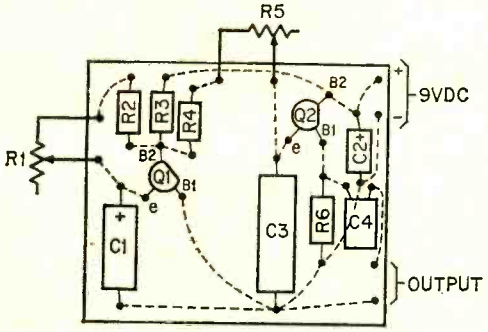
Alarm Generator

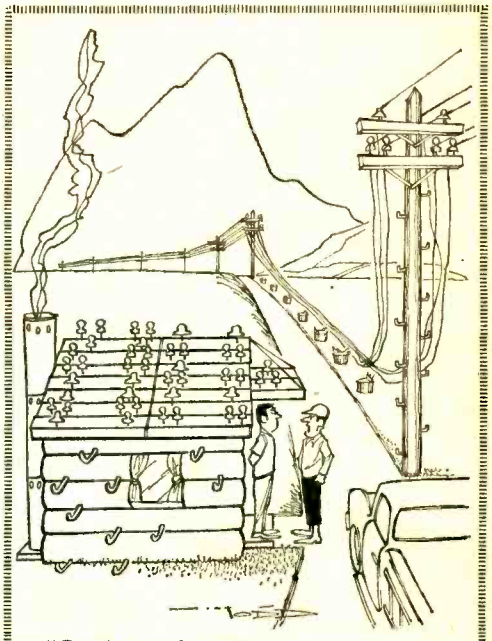
Continued from page 70

to the output and connect a 9 volt power supply to the power leads. Now adjust the pot until you get a good sound. If all's well you should be able to get an attention grabbing sound by adjusting the pots on the front panel. If not, try interchanging the unijunctions. When you are satisfied with the results, remove the pot/resistor combination, measure it with an ohmmeter, and replace it with a resistor of the closest value.

In operation, the ELECTRONIC ALARM GENERATOR works very well as an alarm device with just headphones as a reproducer. If your application calls for more volume, connect it to an amplifier. Just be careful with the special effects. You wouldn't want to attract a flight of passionate wild ducks winging it south this fall! ■



Top view of the Electronic Alarm Generator Dashed lines represent wiring underneath a completed board. Unit will drive headphones



"Good morning, Sir, I represent your local telephone company!"

Power Lost

Continued from page 46

parts list draws about 500 mA of current and the lamp about 50 mA less.

The buzzer selected may require some adjustment. As shown in the photo, there are two adjustment screws on the back of its case. Tighten or loosen these screws as required for best operation (tightening the screws will raise the pitch of the note emitted, but if they are too tight the buzzer will not operate).

Put It Together. Start actual construction by drilling a 3/16-in. hole in one end of the box, threading the line-cord through the hole, tying a knot in the cord for strain relief, and soldering the conductors to the relay coil terminals. A diagram of the terminals comes with the relay. The box in the parts list is made of plastic and aluminum. The relay case and battery holder are plastic. Therefore the latter parts are best mounted by gluing them to the bottom of the box. With sandpaper, roughen up the bottom of the box, the bottom of the battery holder, and one side of the relay case to provide a better surface for the glue. Spread a couple of drops of Testors model cement (or Ducco cement or Elmer's Glue) on the roughened surfaces, press into place in the positions shown in the photo, and let them dry while mounting the other parts. You can put the batteries in the battery holder to help weight it down while the glue dries.

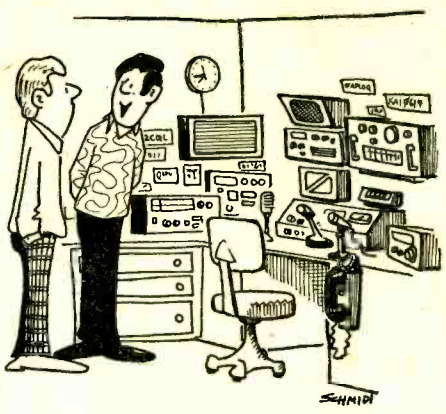
The buzzer, switch, and lamp are mounted in holes drilled in the aluminum cover, and are positioned as shown in the drilling template and photo. Then, interconnect all components as shown in the schematic diagram. Wire those on the cover first, and make the 3 leads that go into the box long

Klaxon Fire Alarm

Continued from page 58

be affixed to the battery, and the battery should be changed at least once a year. It is also suggested that the alarm be checked periodically, say once a month, by simply shorting the connecting terminals with a screwdriver and seeing that the horn really sound off loudly. Alternately, you can connect a normally-open push-button test switch across the heat detectors.

The Editors would like to point out that this system is not suggested as a replacement for a primary fire alarm which should use only U.L. (Underwriter's Laboratories) listed components. This system is suggested only if you can not afford a U.L. listed fire alarm, for something is better than nothing. If you desire maximum reliability, we suggest substitution of U.L. listed equipment for relay RY1 and horn BU1. U.L. listed components are available from your local burglar-fire equipment dealer. ■



"It's Helen's hobby . . . not mine!"

Porta P.A.

Continued from page 40

never turn on the power to the amplifier unless you have a speaker connected to the amplifier output. If you fail to observe this precaution, you may burn out the output transistors in the amplifier.

This cannot happen if you use the plug system illustrated here, which incorporates the amplifier's battery wires and speaker wires into the same multi-contact plug. This means you will be automatically connecting the speaker to the amplifier at the same time you connect the amplifier to its battery power, no matter whether you're using the unit in your vehicle or with a portable battery pack.

Any available set of male and female cable connectors having four or more connector pins may be used for connecting the amplifier to the speaker and batteries. The plug shown here connected to the amplifier is a Cinch-Jones metal cable plug such as often used in mobile radio equipment. A six-pin plug was available in the author's junk box, but four pins are all that are required. (The 4-pin male plug is Cinch-Jones type P-304-CCT and the matching female socket is the S-304-CCT.) Use the male plug on the wires from the amplifier, and a female socket on the wires going to the portable batteries and speaker, and another female socket on the wires to the car's electrical system and under-the-hood speaker. In this way, when the unit is unplugged, the battery terminals will not be exposed. (For the flush-mounted female socket on the portable battery box, use a Cinch-Jones S-304-AB socket.)

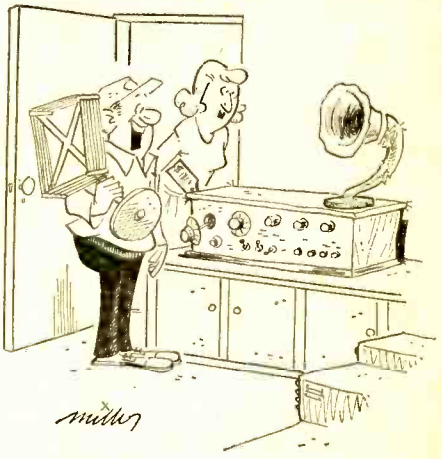
Four Ray-O-Vac No. 918 6-volt lantern batteries or their equivalent will provide ample power for the portable PA. Construction of the battery box can be varied to suit your own preference and your choice of available materials. The box shown is made of ¼-in. plywood, reinforced with ¾-in. pine cleats glued and nailed in the corners. Spacers of ¾-in. pine attached to the inside provide ample material for gripping the wood screws which are inserted to hold the top panel onto the box. The speaker and amplifier each are supplied with mounting brackets which may be attached to the top panel. The amplifier can be attached with thumb nuts, if desired, so it can be removed easily and transferred to your car, truck, or even a boat. Most mikes come with a hanger bracket which may be attached to the wood top panel. A duplicate hanger bracket may be obtained at most radio and audio stores for installation in your vehicle. A male phone plug is included with the amplifier for installation onto whatever mike you use. ■

R-Cubed

Continued from page 28

the cube is painted with the appropriate color-code to indicate the decimal multiplier (same as the last color band on each resistor in the decade), and the numbering is all done with press-on numbers. One or more decades can, of course, be omitted, and can always be added later if desired.

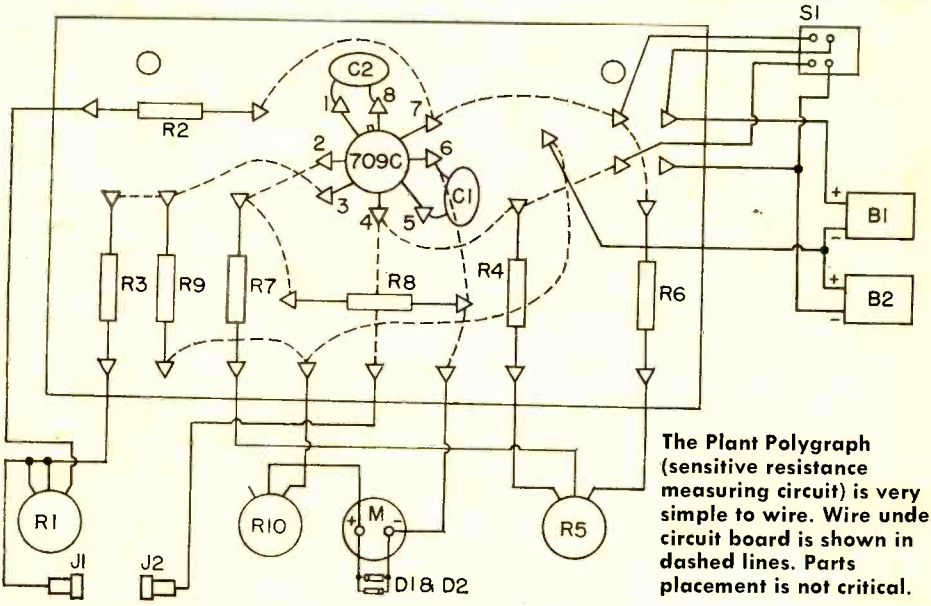
Had to Be Different. The Editor's approach to building R-Cube was similar, but we used a wooden block. Brass brads about ¾-inch long were used in place of the flea clips. Before you hammer them in place, practice on a scrap piece of wood. If all the brads were inserted at the same location on the three faces at each corner, they would meet, bend and chip the wood. A bit of offset is required. We licked the problem by hammering the brads in at an angle to avoid in-wood collision of brad points. The brads make good mechanical and electrical connections. In fact, it withstood the 10½ EEE crunch of some klutz. That's ruggedness! Build your R-Cube today, build two, build several—they beat resistor substitution boxes and stack even better. ■



"It was a steal—39¢ a pound."

Give Your Plants a Voice

Continued from page 26



The Plant Polygraph (sensitive resistance measuring circuit) is very simple to wire. Wire under circuit board is shown in dashed lines. Parts placement is not critical.

observe the same type of resistance change shown. A gradual rate of change will be noted with temperature and light intensity changes as well as rapid changes from abrupt stimuli. As to whether plants can read thoughts, like some people and dislike others, react to people miles away, or remember an experience, you'll have to devise your own experiments and make your own deductions. But be careful, you may be pleasantly surprised at what you come to see and to believe! ■

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Ask Hank, He Knows

Continued from page 19

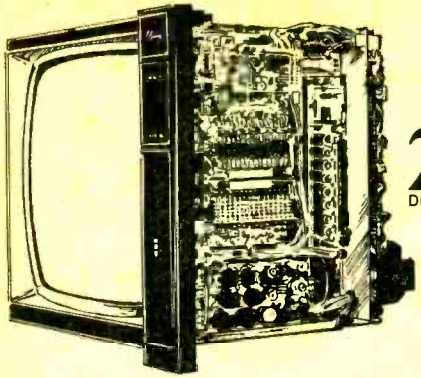
tape recorder and play them back. A child's cap pistol can be very realistic when the microphone position is "guessed" at. Record in a room with little, if any, furniture and no drapes or curtains.

High Cost of Experimenting

I walked into my parts dealer and discovered him increasing the value of some peg-board marked parts to almost double. Who should I report him to?

—C.H., Terre Haute, IN

The poor guy is just trying to stay in business. If he were to sell you the parts at the old price, he probably would have to pay the same amount or more to restock his shelves. There will be nothing left for his rent, taxes, salaries, etc. We all lose when inflation strikes. To save on fixed resistor prices, buy assorted value resistor kits. Lafayette stores sell a kit of 100 ½-watt resistors (32E99047) for only $2.98—that's about 3¢ each. Also, if you are forever building projects, double up your orders. Prices will continue to increase—hoard! ■



You get the same 25" DIAGONAL hobby-kit color TV from three different schools.

You get this designed-for-learning 25" DIAGONAL color TV only with NRI training.

No other home-study school gives you a TV like the one you build with NRI's Master Course in Color TV/Audio servicing. Some schools give you three or four plug-in sub-assemblies off the production line to put together a commercial set. Others give you a hobby-kit bought from outside sources. And because neither type was originally designed to train people for TV servicing, lessons and experiments must be "retro-fitted" to the set as it comes.

That's why we went to the trouble to engineer our own, exclusive solid-state TV. It's the only way a student can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building a complete set from the "ground" up, (3) perform over 25 "inset" experiments during construction, and (4) end up with a beautiful 25″ diagonal solid-state color TV with wood-grain cabinet and all the modern features for top performance. Nobody else can give you this combination of advantages because nobody else invested the time and money to design a set with learning in mind.

More know-how per dollar

That's what it all boils down to, the quality of training you get for the money you spend. In our 60-year history, almost a million students have come to NRI and we're fully approved for the G.I. Bill. We must be teaching something right.

Some of those "right" things are bite-size lessons to ease understanding and speed learning... personal grading of all tests, with comments or explanations where needed... a full-time staff of engineer/instructors to help if you need it... plenty of "real-life" kits and experiments to give you hands-on training... and fully professional programs oriented to full- or part-time career needs.

NRI passes the savings on to you

This unique TV doesn't cost you more... it costs you less, because NRI engineering eliminates the extra cost of buying from an outside source. NRI training also costs less because we sell only by mail. No salesmen. We pass the savings along to you in the form of lower tuition fees, extras like the TV cabinet (another $140 with other courses) and a solid state radio you learn on as you build, plus the actual instruments you'll need to service TVs... triggered sweep oscilloscope, integrated circuit TV pattern generator, and digital multimeter. You can pay as much as $800 more for a similar course and not get a nickel's worth extra in training and equipment.

Widest choice of career opportunities

NRI offers not one, but five excellent TV/Audio servicing courses so you can tailor your training to your budget. Or, you can study other opportunity fields like Computer Electronics, Communications, Aircraft or Marine Electronics, Mobile Radio, and more. Free catalog describes them all, showing lesson plans, equipment and kits, and career opportunities. There's no obligation and no salesman will ever call, so send for your copy today. See for yourself why NRI experience, selection, and exclusives give you something no other school can.

If card is missing, write to:

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Training Electronics Technicians Since 1946

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YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

- SET OF TOOLS
- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

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