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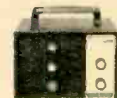
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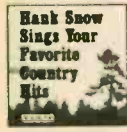
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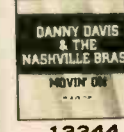
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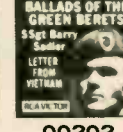
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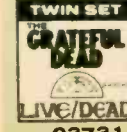
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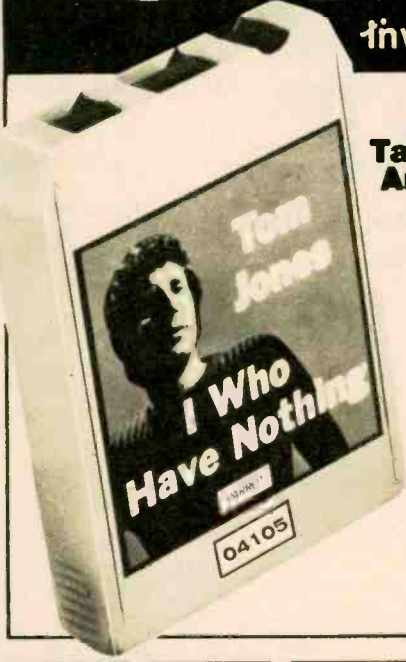
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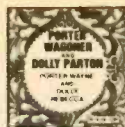
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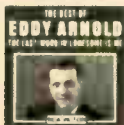
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TAPE CLUB

Spectacular Get-Acquainted Offer

Enjoy Fabulous Savings From the World's FIRST Stereo 8 Tape Cartridge Club!

NOW! Enjoy top Stereo 8 hits by top stars . . . at top savings! Choose from renowned labels: RCA, Warner Bros., London, Mercury, Reprise, Atlantic, Alco — in every music category. Look at these exclusive benefits:

SAVE NOW! Choose FIVE tapes for only \$6.95 (worth up to \$49.90 at regular Club prices). After trial membership, under the Club's generous dividend plan, you may choose one tape of equal value FREE for every two you buy at regular Club price (usually \$6.98). That's a 33 1/3% average saving!

Keep posted! MEDLEY — the Club's free magazine — brings news of almost 350 Stereo 8 releases, featuring a Selection of the Month in the musical category you prefer. If you want this tape, do nothing — it will be shipped auto-

matically. If you want other tapes, or no tapes, indicate your choice on the card always provided, and return it by the date specified.

All tapes guaranteed! Club's own Warranty unconditionally guarantees all tapes against defects for 1 full year after purchase, regardless of label.

Charge them! Pay only after you receive tapes and are enjoying them!

Send no money! Choose 5 of 82 hits shown here; we'll bill you \$6.95 plus small shipping-service charge later. You may cancel membership after accepting 6 more, or continue to enjoy savings of one-third for years to come, with no obligation to buy! Mail the coupon right now to: RCA Stereo 8 Tape Club, P.O. Box 26878, Lawrence, Ind. 46226



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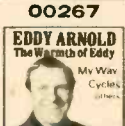
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12141

MAIL THIS COUPON TODAY!

Mail to: RCA STEREO 8 TAPE CLUB, P.O. BOX 26878, Lawrence, Indiana 46226

Yes, please accept my application for membership in the RCA Stereo 8 Tape Club, and send me the 5 cartridges I have selected for only \$6.95. I understand I may refuse the automatic shipment of each month's Main Selection, or order other selections by returning the dated card always provided. I agree to buy as few as six more cartridges within a year to fulfill my trial membership, after which, under the Club's dividend plan, I may choose one tape of equivalent value FREE for every two I buy at regular Club prices. (A small shipping-service charge is added to each order.)

MAIL ME THESE FIVE CARTRIDGES (indicate by number):

--	--	--	--	--

I am most interested in the following type of music (check one only):

- Popular (Instrumental/Vocal Moods) Classical
 Country & Western Today's Sound (Rock/Soul/Folk)

Mr. _____
Mrs. _____
Miss _____
(Please Print)

Address _____

City _____ State _____

Phone _____ Zip _____
Area Code

Limited to new members; Continental U.S.A. only; one membership per family.

4-35

T-3

What is EI?

HUNDREDS of magazines are published in the United States. The editor of each one likes to think his publication is different from any other, that it has a unique personality.

The editors of EI believe this to be true about our publication. We want to be outstanding as a publication devoted to you—a singular audience made up entirely of electronic hobbyists. Sometimes we discuss military and industrial electronics and we now and then delve into the facts of management or production to keep you abreast of what's happening in the world of electronics. But our uniqueness lies elsewhere.

For the editors and our readers, electronics represents a fascination, a hobby that brings pleasure and satisfaction into our lives. For many in our audience, electronics also is a profession. But we leave professional advice and high-level technical discussions to the several fine publications that specialize in those subjects. Again we say, EI is a publication for electronic hobbyists. Perhaps not surprisingly, the editors who put EI together are also electronic hobbyists. *So ours is a publication by electronic hobbyists for electronic hobbyists.*

We try in every issue to include articles for the beginning hobbyist—someone like a son of ours; for the hobbyist of average skills—someone like most of us; and for the advanced hobbyist—perhaps the man of high technical achievement in the profession of electronics who also finds time to be a hobbyist. Most of our readers, we know, have greatest interest in articles and projects involving average skills. But we feel strongly about the other types of articles, too.

Advanced hobbyists need involved and sometimes difficult projects and stories to challenge their abilities. And editorial matter presented with the beginner in mind is just as important if not more so. Every electronic hobbyist becomes to some extent an evangelist. He *knows* his hobby is the very best in the world and he wants to talk others into enjoying the same hobby. We are no different. As hobbyists, we want to make converts. As editors, we also are aware that young converts represent our readers of tomorrow.

There are several specialized hobbies within the big hobby. As every reader must be aware, we go to great lengths to produce articles and projects to satisfy these specialized appetites. The specialists in our audience include amateur-radio hobbyists, Citizens Band licensees, hi-fi and stereo fans, short-wave listeners, full-time and part-time servicemen, theorists and experimenters—those who will try nearly any circuit just to see whether it will work and whether they can improve it—and hobbyists who are becoming interested in the possibilities of pursuing electronics as a career . . .

Above all, we want to produce for you the best articles and construction projects possible to fulfill the obligation represented in that line on our cover that says, *Consistently the Best in Hobby Electronics.* ●

Robert G. Beason

Editor

FIX your appliances,
car,
house,

SAVE

on home improvements,
air conditioning,
power tools and more

WITH THIS
FREE \$3.49
VALUE
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Just look back over the past few years and figure how much you have spent on repairs for your home, your car, your appliances. Wouldn't you like to keep these high-priced repair fees for yourself? Well, now you can.

As a reader of *Popular Mechanics* the chances are that you already have a considerable degree of skill with tools. Nevertheless, you may have hesitated to tackle more complicated repairs, improvements or hobby projects.

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These are just a few of more than 6,000 exciting "how-to" ideas, plans, and valuable projects you'll find in *POPULAR MECHANICS DO-IT-YOURSELF ENCYCLOPEDIA*. You'll learn how to get more professional-looking results than ever before in your carpentry, metalwork, plumbing, masonry, electrical wiring, electronics, hi-fi, stereo, car repair, painting, decorating... PLUS exciting new ways to help you get more fun out of your hobbies, sports, vacations. Experts lead you step-by-step through every project you select. Without question, here is the most helpful, reliable, "how-to-do-it" guide you've ever seen—and Volume 1—a \$3.49 value—is yours ENTIRELY FREE!

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- Build a gas-fired barbecue for more back-yard fun

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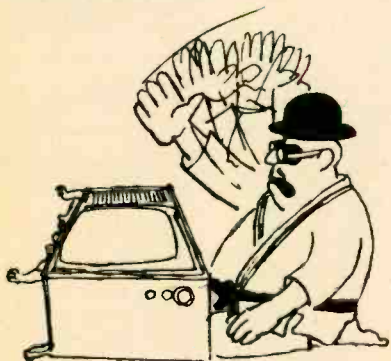
CIRCLE NUMBER 18 ON PAGE 15

March, 1971

Feedback from Our Readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036

● CRT KARATE



Your article HOW TO CHANGE A COLOR PICTURE TUBE (Jan. 71 EI) made mention of the fact that some new tubes are implosion proof and thus don't require the kid-gloves treatment. Just how do you tell if the CRT will blow or not? The only way I can see it to give it a shot right in the mouth.

Nelson Buckley
Billings, Mont.

Implosion-proof tubes are like fireproof buildings—good to know but unwise to test. All picture tubes should be handled with the utmost care.

● FOREIGN AID

I have been a reader of EI for quite some time. It has been a prime reason for my great interest in ham radio. Unfortunately, gear is scarce in these parts and I was hoping that some of your readers would like to work out some kind of an agreement for exchange.

Felix Quashie, Jr.
Box 59, Koforidua
Ghana, West Africa

I am very interested in corresponding with some of your American readers on the subject of electronics. It is becoming a popular subject here and we need some expertise.

D. Roberts
155 1st N. Block
Ratatinagar
Bangalore-10
India

The spirit of ham radio and electronics

has always been international—so let's give these guys a helping hand.

● TO ERR IS HUMAN

Thank you for your kind review of our book, Small Appliance Repair Guide. Please note that the book sells for \$4.95 not 95¢ as the review stated.

Verne M. Ray
Tab Books

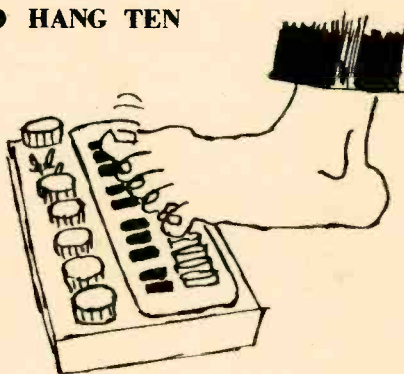
We've got to do something about our prof reader.

● ALL IN FAVOR

Your story on the video gramophones (COMING!?) . . . THE VIDEO GRAMOPHONE, Jan. 71 EI) was well done. Since the first broadcast of TV back in the Forties I have been waiting for a way to get good programs on a regular basis. I hope the manufacturers don't sell out to commercialism here, too.

Arnold Rinse
Danbury, Conn.

● HANG TEN



Your piano adaptor (OUR SYNOVOX ADDS ORGAN TONES TO YOUR PIANO, Jan. 71 EI) is sure to produce overtones in the music industry. I am a professional accordionist and would like to know how I can utilize the Synovox with my present instrument—hands free.

Bob Colombo
Decatur, Ill.

Well Bob, you can always try hoofing it or, better yet, you could attach it to your accordion and play it with your nose



THE GREAT NEW "45"

Looking for the mobile antenna that outperforms the others? Get the "Super 45". You'll see why Shakespeare, the fiberglass pioneer, is the leader in fine antennas.

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CIRCLE NUMBER 2 ON PAGE 15

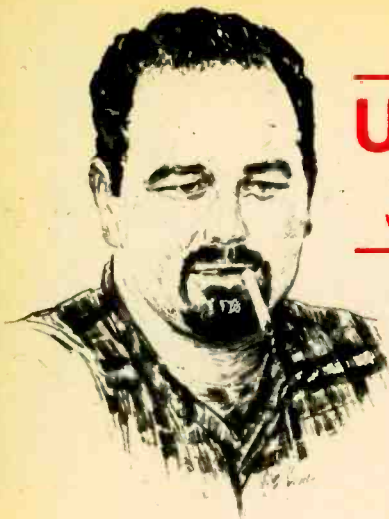
March, 1971

www.americanradiohistory.com

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

Uncle Tom answers his most interesting letters in this column.
Write him at Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036.



★ *OK, your Long Nights (Nov. '70 EI) sold me on the prospect of Ouija boards being the answer to no-license hamming. How do you make the first contact, though? Do you rap out CW with your knuckles or just call CQ?*

*Arnold P. Rettig
Gallatin, Tenn.*

The secret of Ouija board hamming is that you can't act like a ham. Remember, if you are trying to raise somebody who's been gone 200 years, he's not going to be in any hurry—so you don't need to use shorthand.

★ *With this recent contact in the world of the unknown, you must have set the DX record of all time.*

*Hal Springer
San Jose, Calif.*

Sure Hal, but would you mind going and picking up my QSL?

★ *Between 13.7 and 13.9 mc I have received a mystery station calling itself KC2X10. No location is given. What is it, and where?*

*Richard Brennan
Chicago, Ill.*

On 13.580 mc I logged KC2X10. I know it's an experimental station but can I get a QSL from it?

*Joe D. Rippe
Chagrin Falls, Ohio*

KC2X10 is an experimental station on about 12.75 mc. . .

*Terry O'Laughlin
W. Allis, Wis.*

What is KC2X10, which I heard on 13 mc. . . ?

*Larry Waterson
Ft. Wayne, Ind.*

I don't think any station has created so much reader interest since the days of Radio Swan Americas or the old Blue Eagle. I have a mountain of mail on KC2X10. A check with the FCC office in Washington drew a blank. They went into shock and told me that it was a "classified U.S. Government operation." Using some of my own contacts elsewhere, I learned that it is operated by the National Bureau of Standards, Boulder, Colo. The correct frequency is 13.560 mc (Joe Rippe, yours was the only good guess). The station won't be on long and may have been shut down by the time you read this. A prepared reply card with your reception report might get you a QSL.

★ *Very often while I'm listening to my FM broadcast receiver I hear aircraft communications cutting in right on top of the FM station. What causes this?*

*Grant Laughton
Skokie, Ill.*

This is caused by poor image rejection in the RF stage of your receiver. The FM receiver uses a 10.7-mc IF, and what you are hearing are aircraft signals which are being transmitted at twice the IF frequency added to the frequency to which the FM receiver's dial is set. This occurs when an aircraft is close to you and puts out a signal which is in excess of the image rejection capabilities of the FM receiver.

★ *Because of the inherent qualities of metals, it seems to me that it should be possible to locate underground metal objects without complicated and expensive solid-state devices.*

*Art Marcovese
Alomogordo, N. M.*

Have you considered a shovel? —

The Army can take your hobby and turn it into a career.

Tear down an engine or snap a picture or solder some wires to a speaker to rock the room.

Maybe you call it a hobby or a knack or maybe even your thing.

And, you know, the Army can take that favorite talent of yours and turn it into a rewarding, lifetime career.

We have more horsepower than the Motor City.

We have cameras that can take a portrait of a bird a half mile away.

We have electronic equipment so new that it hasn't even been named yet. The Army needs people to run it all and keep it running.

We can train you to be an expert. What's more, we'll guarantee this training in writing before you enlist.

Send for our free book.

Use the coupon or write:
Army Opportunities, Department 200A, Hampton, Virginia 23369.

It's full of things. Maybe yours is one of them.

Your future, your decision.
Choose ARMY.



Army Opportunities _____ Date _____
Dept. 200, Hampton, Va. 23369

I'd like to find out more about how the Army can turn my hobby into a career. Please send me your free booklet.

Name _____ Date of Birth _____

Address _____

City _____ County _____

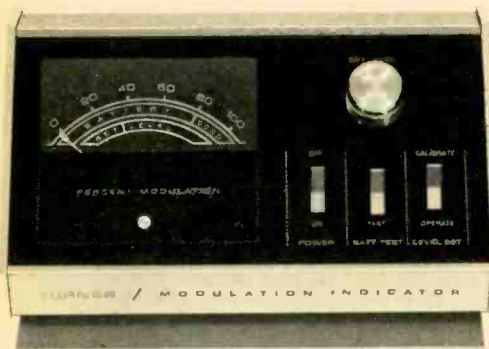
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CB gets a first ever from Turner

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Get the most out of your base rig. Put something new into it. Buy a Turner Modulation Indicator and be sure of full modulation every time. There's no other way to keep a steady eye on your signal. And nothing could be easier to operate. Just work the volume control on your Turner +2 or +3 microphone until the indicator shows 100%. You'll get a clearer signal. You'll send it a lot farther. Buy now. Be among the first to own this handsome instrument with a black-lucite and brushed-aluminum finish. Works with all CB sets, comes with complete operating instructions. Features solid state construction, plug-in installation, self-contained standard 9-volt battery operation. CB users net price \$39.50. Manufactured in the United States by the Turner Company, A Subsidiary of Conrac Corporation, 909 17th Street N.E., Cedar Rapids, Iowa 52402.

The Turner Company

CIRCLE NUMBER 4 ON PAGE 15

Broadsides

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

USUALLY when you hear of a good bargain available across the border, your mind conjures images of Cuban cigars and untaxed rum from down Mexico way. While the Mexicans have this working for them, the Canadians are working on good deals in **electronic gear for the hobbyist**. Gladstone Electronics offers many unusual pieces ranging from Canadian-made speakers to English experimenter's kits. The catalog is free from Gladstone Electronics, 1736 Avenue Rd., Toronto 382, Ontario.

If you're going prematurely grey trying to keep track of all the types and numbers of **semi-conductors** available, the GE Entertainment Semiconductor Almanac has enough info to keep you from the toupee parlor for years. Components covered in this catalog (ETRM-4311F) include light-activated SCRs, transistors and thermistors. There are also cross references to match practically any part with the GE equivalent. Write to GE Tube Dept., Distributor Sales, 316 East Ninth St., Owensboro, Ky. 42301.

There comes a time when you find something that requires a **special tool**. The Electronic Tool Co. enters to save the day. They have a special IC cutting and forming tool in addition to a whole line of specialized electronics tools that will handle many special situations. Request catalog No. 770 from Electronic Tool, 3324 White Plains Rd., Bronx, N.Y. 10467.

When the time comes that your test bench can no longer service anything made after World War II, it might be good for business to pick up some new equipment. Dynascan has just released a catalog of **B & K test equipment** incorporating the latest in solid-state design. Included are an FET VOM, and a tube tester with lockout pushbuttons that provide positive short indications. The updated version of the Television Analyst can now check every stage of any set. Write for catalog BK-71 from Dynascan, 1801 W. Belle Plain Ave., Chicago, Ill. 60613.

If you've suffered the limit of broken fingernails and scratched front plates on your homebrew and kit equipment, maybe you've come to the realization that you need a set of **nutdrivers**. The King of this field of ratcheted **nut and screwdrivers** is Xcelite. They have published a bulletin (N670) describing all their helpful tools and it may be obtained from Xcelite, Inc., Orchard Pk., N.Y. 14127.

Shopping around for bargains is good business sense. Among mail-order houses in electronics, World Radio has a number of good bargains in their entire line of **ham, CB, hi-fi** and parts. Get a free catalog from World Radio, 3415 Broadway, Council Bluffs, Iowa 51501

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If you want more information about one or more of the products advertised in **ELECTRONICS ILLUSTRATED**, this service is for your convenience. The product information you request will be sent to you promptly free of charge.

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NATIONAL RADIO INSTITUTE, Washington, D.C. 20016.

OVER 50 YEARS OF LEADERSHIP



IN ELECTRONICS TRAINING

Accredited by the Accrediting Commission of the National Home Study Council



March, 1971



Transistor Service. As part of the war against bad transistors, Sencore has announced the TF17 transistor/FET tester which makes fast checks in- or out-of-circuit of AC beta and out-of-circuit for ICBO leakage. Other functions enable the serviceman to check all FETS in-circuit for gain and out-of-circuit for leakage. It also provides an increased current check for high-power devices. Sencore, Inc., 426 Westgate Dr., Addison, Ill. 60601.

Beginning Ham. Hams with an eye for performance and low cost will appreciate the RX10 receiver from Ten-Tec. Covering the 80-, 40-, 20- and 15-meter amateur bands, the RX10 has a direct-conversion Synchrony circuit which is effective in eliminating images and birdies. \$59.95. Ten-Tec, Inc., E. Sevierville, Tenn. 37862.



Electronic Marketplace



Economy Model Rolls. The Model 27 Marantz receiver is the culmination of an effort to bring high-quality Marantz hi-fi gear within the price range of the average buff. It offers 30 watts rms per channel at 0.3 per cent distortion. Included is the patented Variable Overlap Drive circuit which eliminates crossover notch distortion. \$319. Superoscope, Sun Valley, Calif. 91352.

[Cont. on pg. 22]

Timely CB. Automatic turn-on when it's time to monitor the band? It's possible with the Courier Citation base-station CB transceiver. It has a programmable digital clock and a safety feature preventing antenna mismatch. \$229.95. Courier Comm., 100 Hoffman Pl., Hillside, N.J. 07205





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Find *your* sound! The Starmaker collection not only includes microphones for many different applications, but—even more important—microphones to enhance the personal techniques of professional performers as well.

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To get specific, ask for the new Starmaker brochure 1S1056 at your RCA microphone distributor or, write: RCA Electronic Components, Commercial Engineering, Section 72-C/J10, Harrison, New Jersey 07029.

And, remember, for further professional needs, RCA also produces the renowned BK and SK microphone lines.

CIRCLE NUMBER 19 ON PAGE 15

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Electronic Marketplace

Down for the Count. A frequency counter kit employing computer-like circuitry has been released by Heath Co. The IB-101 is the first digital-indicating counter in the hobby field. An over-range indicator and Hz/kHz (cps/kc)



switch give the IB-101's five cold-cathode display tubes the equivalent capability of many eight-tube models. Readings to the nearest kHz are made with the range switch on kHz and a change to the Hz position results in an indication down to the nearest Hz. \$199.95. Heath Co., Benton Harbor, Mich. 49022.

Advanced Transceiver. Allied Radio Shack has introduced a new 80- to 10-meter SSB/CW ham transceiver that is sure to please the most demanding hams. The dual-conversion rig covers 3.5 to 29.7 mc in seven bandswitched ranges. Features include a built-in 25-cps calibrator and receiver incremental tuning that tunes the re-



ceiver ± 3 kc without change in main tuning knob. It also has built-in VFO, crystal transmit/receive filters, amplified AGC for control of variety of signals without blasting or distortion and selectable sidebands. Input power is 160 watts from 3.5 to 21 mc and 120 watts at 28 mc. Also available are a matching speaker-power supply and an external VFO. The A-2517 is \$400. Speaker: \$99.95. VFO: \$89.95. Allied Radio Shack, Chicago, Ill. 60680.

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CIRCLE NUMBER 14 ON PAGE 15

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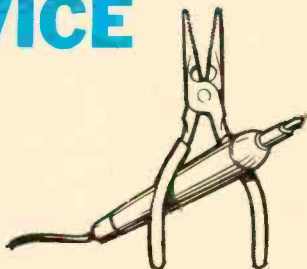
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State _____ Zip _____

CIRCLE NUMBER 8 ON PAGE 15

SERVICE TIPS

By
ART MARGOLIS



TELEVISION manufacturers are now installing capacitors and resistors inside CRT sockets. Should you take a socket apart for troubleshooting, all of the pins are likely to pop out unless you keep a thumb on them. Avoid this inconvenience by leaving the socket attached to the CRT. That way when you remove the socket back, the CRT's pins will keep everything in place.



When placing a stranded wire on a nut-bolt connection, be sure to use a washer on each side of the wire so you can tighten the bolt without fraying or disconnecting the wire (see diagram at left).

Going to work on your automatic electric toaster? If so, be sure to keep it up-

right during testing. If the toaster is lying on its side or upside down, some of the arms or levers might appear to be inoperative. That's because a lot of the mechanical movements depend on gravity and you can't have toast if you ignore Newton's apple.

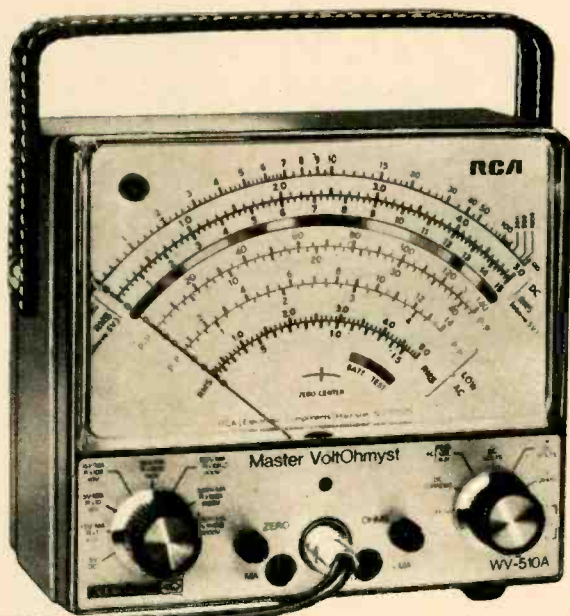
Getting a transistor off of a crowded printed-circuit board is no great problem. But putting the replacement part back on the board can be. The replacement is made easier if you use one of your hexhead nut drivers to guide the transistor to its destination instead of using your fat fingers. Most transistors will be held snugly in 3/16 in., 7/32 in. or 3/8 in. drivers.

An infallible in-circuit test for silicon rectifiers used in TV and radio power supplies can be made with an ordinary flashlight continuity tester. Check continuity one way, then reverse the leads and check the other way. The bulb should light one way and not light the other way with a good rectifier. An open one will not light the bulb at all and a shorted rectifier will cause the lamp to light in both directions.

When you find burned or broken wire inside your waffle iron when the iron stops producing, new wire is in order. Be sure to replace the wire with tightly woven asbestos-insulated wire. Never use rubber, plastic or cloth replacement wire for it will melt or burn on the first batch of Aunt Jemima's.

If you scratch the plastic face on your TV or radio dial there's an easy remedy. Take a mild abrasive such as toothpaste (any brand will do) and rub out the gouge marks

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The best you need is the new solid-state RCA WV-510A Master VoltOhmyst®. The most functional VOM we've ever produced, the 510A has all the features you'll ever need no matter what your requirements may be.

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For example: RCA WV-510A operates from batteries or AC. Remove the detachable AC line cord while you're taking a measurement and the batteries take over immediately without a flicker of the pointer. And you'll get maximum life from the batteries because they're always on trickle charge during AC operation. Stability? Switch from range to range and watch a whole series of measurements without constantly zero-adjusting the meter.

Some statistics:

Current:

0.01 milliampere to 1.5 amperes in 8 ranges.

Resistance:

0.02 ohm to 1000 megohms in 7 ranges.

DC Volts:

0.01 volt to 500 volts in 8 ranges.

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21 megohm resistance on all DC ranges.

And it's only \$128,† complete with DC/AC ohms probe and flexible shielded input cable with BNC connector, and removable AC line cord.

Some statistics! For complete details, contact your local RCA Distributor.

RCA Electronic Components Harrison, N. J. 07029

CIRCLE NUMBER 7 ON PAGE 15



A Direct-Reading Sound Meter You Can Build

By WALT HENRY



AS they roar through the air over your home, the big jets spew out enormous quantities of harmful pollutants. One is exhaust gasses, which affect the eyes and lungs. The other is noise, which assaults the ears and may deafen you temporarily.

After an evening at the discotheque you arrive home with ringing ears and can't even hear the phone (see CAN HARD ROCK MAKE YOU STONE DEAF?, Jan. '69 EI).

Those are just two instances of the noise barrage we're all subjected to each day. But sound and noise tend to be relative. A clang that a boiler-factory hand wouldn't even notice may scare the contact lenses off a librarian. The ears themselves are noticeably inaccurate and unreliable when it comes to sound-level readings. What sounded as loud as heck yesterday may not make you turn a hair today.

So how does one make accurate and reliable sound-level readings? With a sound-level meter, that's how. The performance of our instrument compares to that of those costing up to \$200, but you can build it for less than \$25. The simple circuit uses four transistors and an integrated circuit. The meter's response is about 40 to 10,000 cps and it can measure the intensity of sound up to +144db. An output jack allows the meter to be used as an audio preamp and an input jack enables you to make measurements with a remote microphone.

A sound-level meter measures the intensity of acoustic levels over a wide frequency and dynamic range. Such measurements are useful in homes, factories, schools and concert halls. In the home measurements can be made on an entire music system including the room. Noise levels in factories and schools can be monitored and correlated with worker or student performance. In concert halls and recording studios the meter is an aid in finding optimum microphone placement.

A Direct-Reading Sound Meter You Can Build

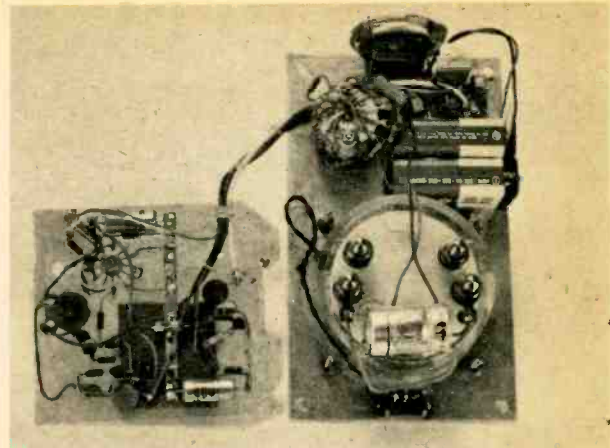
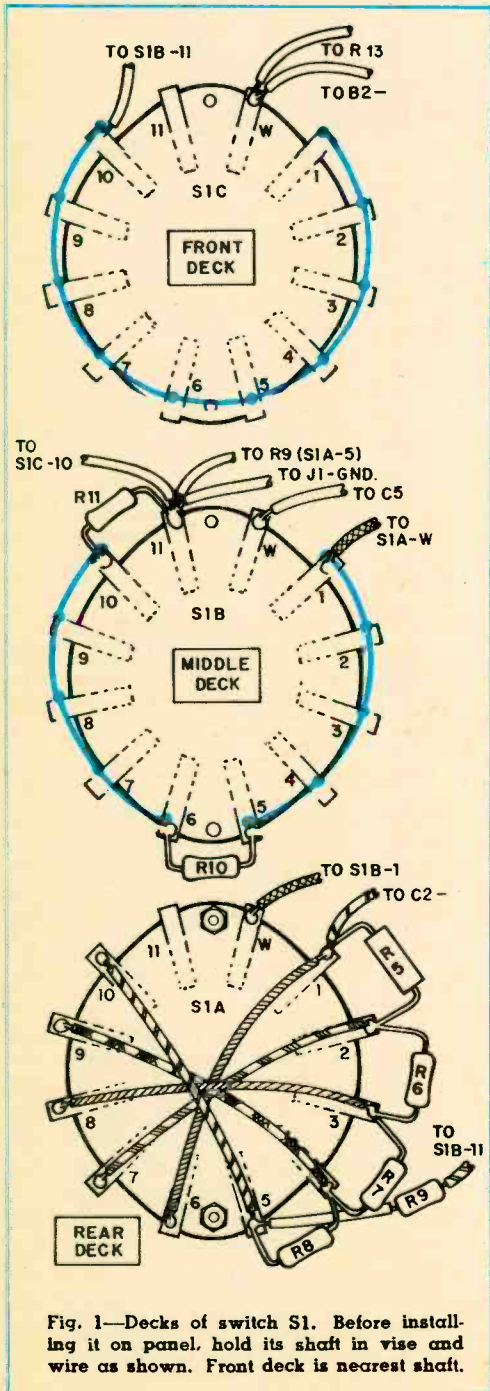


Fig. 2—Board has been removed and turned 90° clockwise. Large screws at top of meter (for unused illuminating lamps) hold board at bottom.

PARTS LIST

B1, B2—9 V battery (Eveready 216 or equiv.)

Capacitors:

- C1—.02 μ f, 100-V disc
- C2—1 μ f, 20-V electrolytic
- C3, C9—10 μ f, 20-V electrolytic
- C4, C7—100 μ f, 20-V electrolytic
- C5—.05 μ f, 100 V-disc
- C6—100 μ f, 100 V-disc
- C8—500 μ f, 10-V electrolytic
- IC1—CA3018 or CA3018A integrated circuit (RCA)

J1—Miniature closed-circuit phone jack

J2—Miniature phone jack

M1—VU meter (Lafayette 99 F 50437)

Misc.—Miniature crystal microphone cartridge (Lafayette 99 F 45098)

Q1, Q2—2N5089 transistor (Motorola)

Q3—2N3905 transistor (Motorola)

Q4—2N4126 transistor (Motorola)

Resistors: $\frac{1}{4}$ watt, 10% unless otherwise indicated. Values are in ohms.

R1—1 megohm

R2—68,000 (5%)

R3, R10—100,000 (5%)

R4, R15, R18, R22, R25—10,000

R5—6,800 (5%)

R13—100,000

R6—2,200 (5%)

R14—390,000

R7—680 (5%)

R16—56,000 (5%)

R8—220 (5%)

R17—68,000

R9—100 (5%)

R19—10

R11—330 (5%)

R20, R24—2,200

R12—100

R21—15,000

R23—100-ohm trimmer pot (IRC U-201R101B)

S1—3 pole, 11-position subminiature ceramic rotary switch (Centralab PS-106, Allied 56 D 5306. \$7.56 plus postage. Not listed in Consumer catalog)

S2—Normally-open pushbutton switch (Switchcraft 951 or equiv.)

S3—SPDT miniature slide switch

Misc.— $\frac{6}{32}$ x 3 $\frac{3}{16}$ x 1 $\frac{1}{8}$ -in. Bakelite utility case with aluminum panel (Lafayette 99 F 62721 or equiv.), flea clips, perforated circuit board

We have provided a decibel scale for you to cut out and glue over the scale of the VU meter specified in the Parts List. The sound level is obtained by reading the decibel value on range-selector switch S1 and *adding* the meter indication if the pointer is to the right of zero, or *subtracting* if it is to the left of zero. For example, if S1 is at 80 and the

meter points to +5, the sound level is 85db. Sometimes it is desirable to read an average sound level rather than trying to follow fast pointer fluctuations. The *fast/slow* switch (S3) causes the meter to be highly damped so the pointer moves very slowly, and the indication thus is the average sound level.

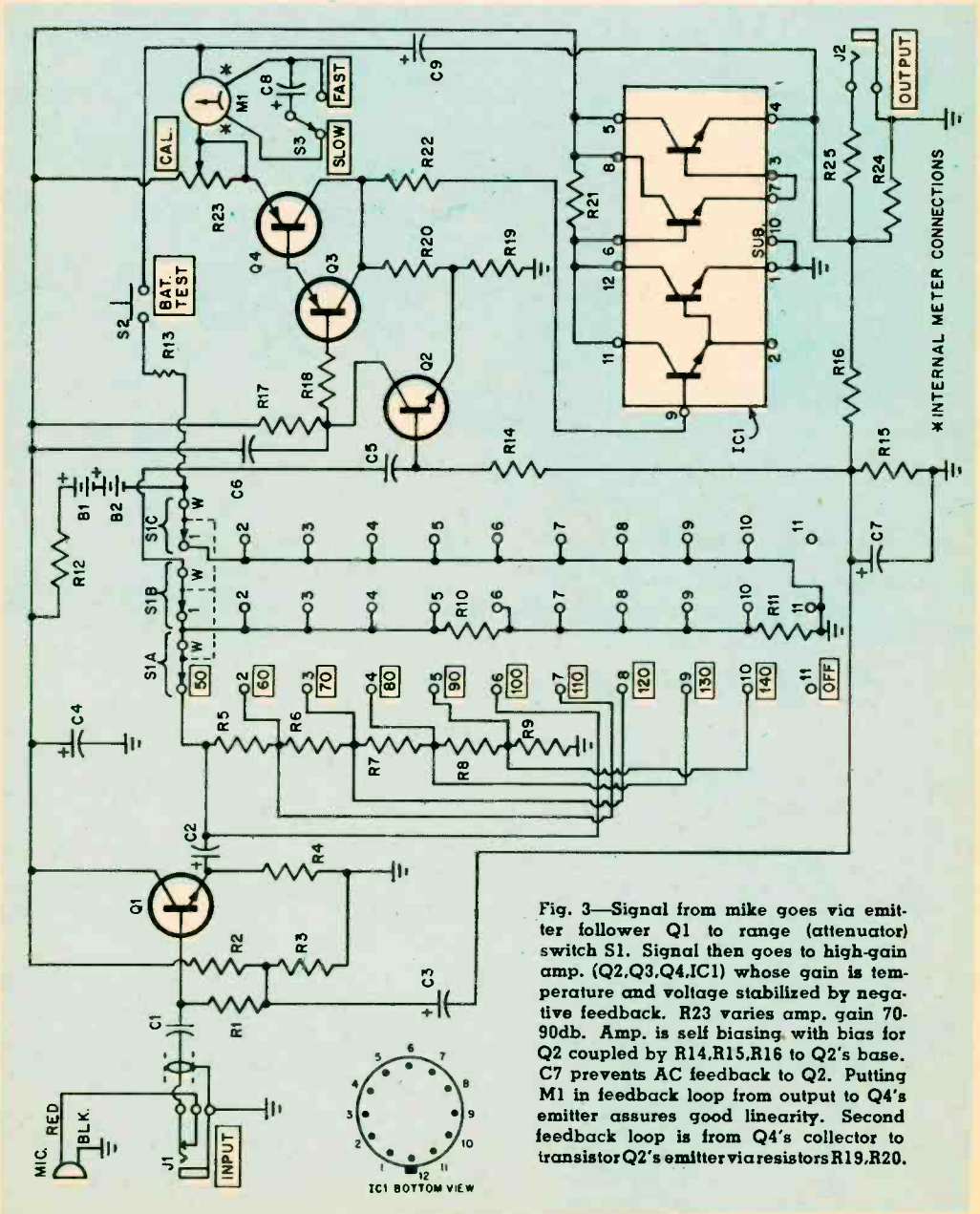


Fig. 3—Signal from mike goes via emitter follower Q1 to range (attenuator) switch S1. Signal then goes to high-gain amp. (Q2,Q3,Q4,IC1) whose gain is temperature and voltage stabilized by negative feedback. R23 varies amp. gain 70-90db. Amp. is self biasing with bias for Q2 coupled by R14,R15,R16 to Q2's base. C7 prevents AC feedback to Q2. Putting M1 in feedback loop from output to Q4's emitter assures good linearity. Second feedback loop is from output to transistor Q2's emitter via resistors R19,R20.

A Direct-Reading Sound Meter You Can Build

To protect the instrument against overload, we've put the on/off switch on deck S1C of range switch S1. Therefore, after you turn the meter on, S1 is in the 140db range to prevent damage should the sound level be high.

To check the batteries, you simply press switch S2 with S1 in the 140db position. If the pointer lands in the red area of the meter's scale, the batteries are good. Amplifier gain changes less than 2db when battery voltage drops to 10 V. This corresponds to about a half-scale meter indication. Since the current drain is less than 3 ma, the batteries last a long time.

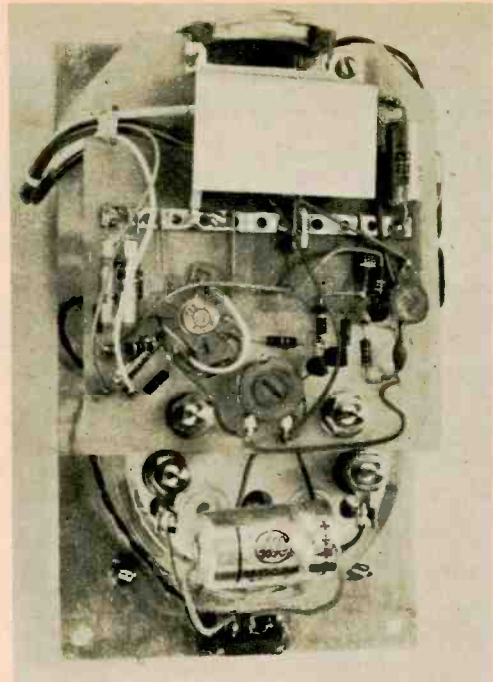


Fig. 4—Photo at right shows board mounted on meter. Aluminum shield at top is over Q1 to prevent hum pickup. See "top plate" in Fig. 6 for dimensions. Circuit board is below. Multiply its dimensions by 0.77 to get the actual dimensions.

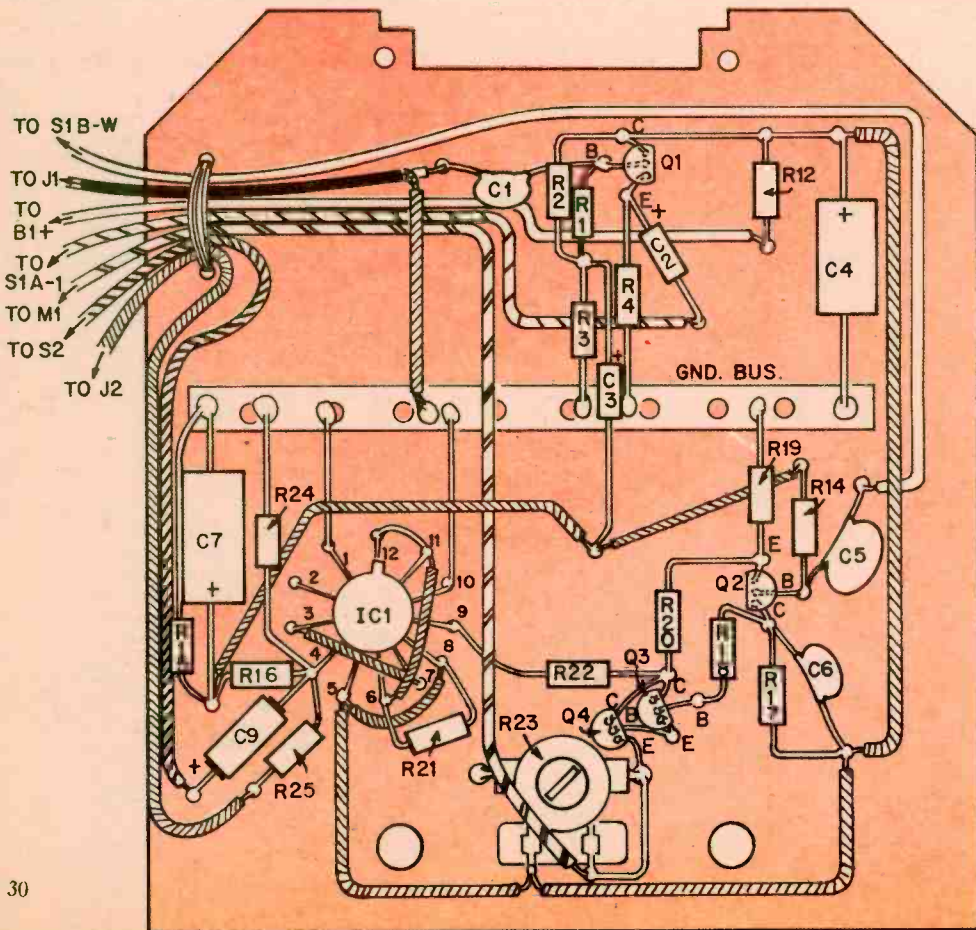


Fig. 5—Cut out scale at right and paste over meter's scale. Black circles must also be cut for mounting holes and unused illuminating lamps. Area in color is for battery test. If pointer falls in this area when S2 is pressed, batteries are good.

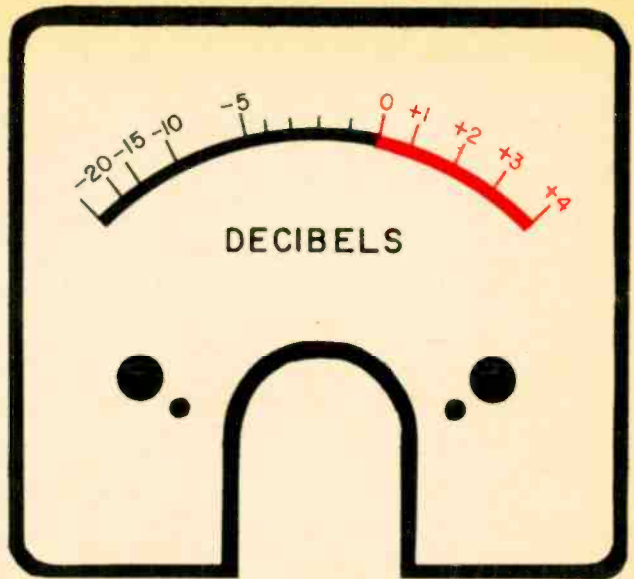
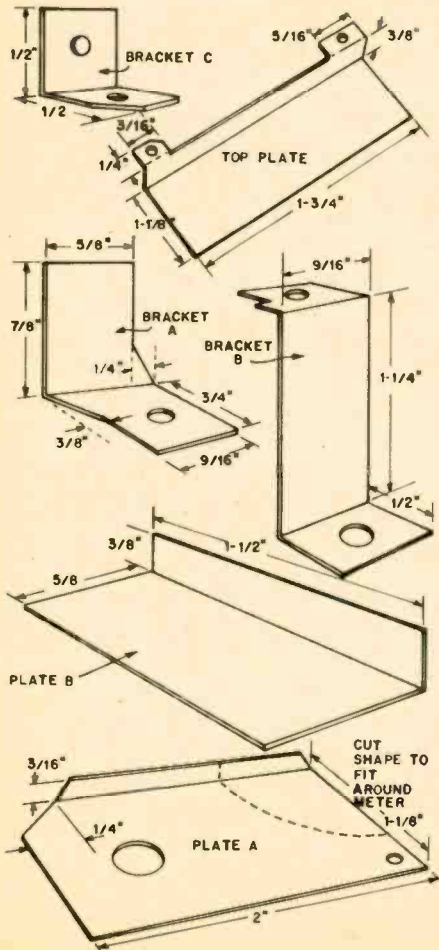


Fig. 6—Dimensions of brackets and plates used in our model. All are made of 1/32-in. thick aluminum. Their locations are shown in Fig. 8. Top plate goes at top of board over Q1 as shown in photo in Fig. 4.



Construction. Circuit layout is not critical but care should be exercised. Keep all leads on the circuit board (Fig. 4) short. Note that the input signal to Q1 is via a shielded wire. This is necessary since all leads are bundled in our model. The shielded wire and the small metal shield shown in Fig. 4 are required if the circuitry is to be enclosed in a plastic box as ours is. The aluminum shield (*top plate*, Fig. 6) can be omitted if you use a metal case. Note that the shield is grounded through the circuit-board support bracket (bracket B, Fig. 6).

The Lafayette VU meter we specify has four screw terminals—two for the input signal (bottom of meter) and two for the internal illuminating lamps (top of meter). The lamp terminals hold the circuit board. There is no electrical connection to them. The board is further supported by the two screws that hold S1's decks together (see S1, Fig. 8) and by a small support bracket (bracket B, Fig. 6).

To duplicate the performance of our model you *must* use the microphone specified in the Parts List. The black lead is connected to the mike's metal case; make sure this lead is the one connected to circuit ground at J1 (Fig. 8). The mike should be mechanically isolated from the case and the circuit board with sponge-foam material to avoid extraneous noise pick-up (See Fig. 7).

All the transistors should be low-noise high-gain types. The integrated-circuit tran-

A Direct-Reading Sound Meter You Can Build

sistor array is connected to form two darlington-amplifier stages. Use two 9-V batteries in series to get the required 18-V supply.

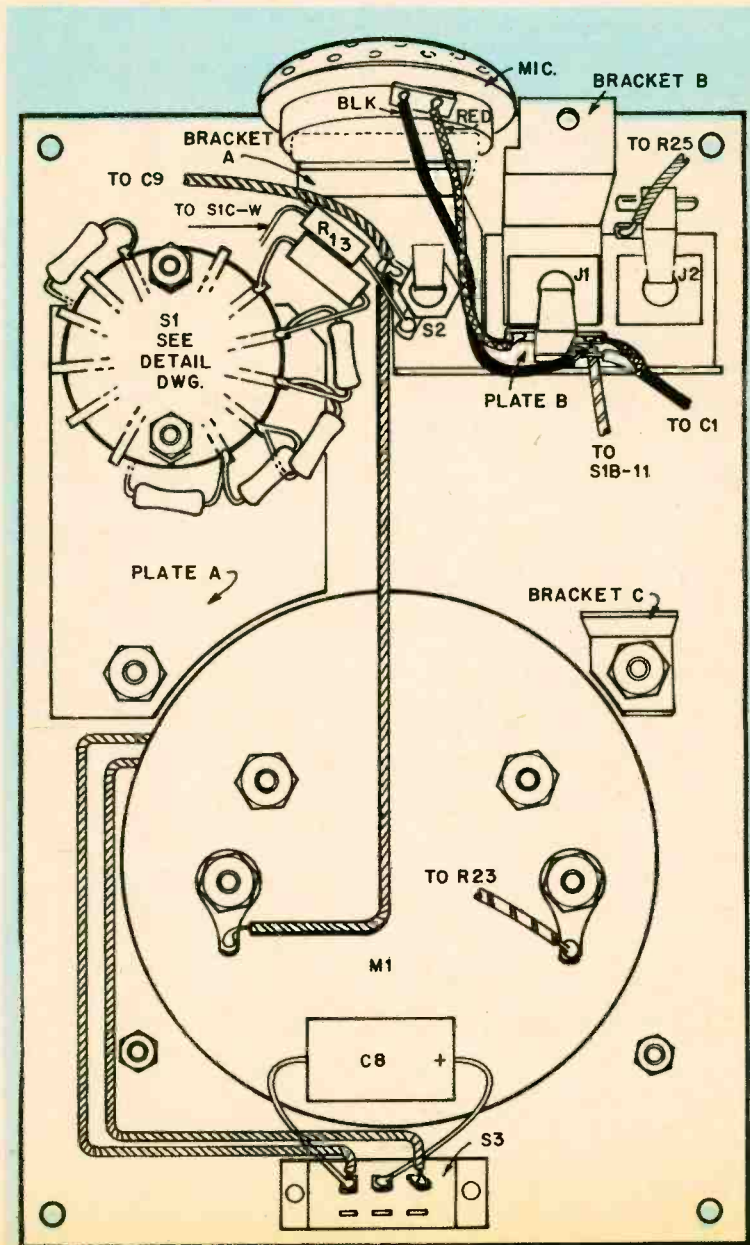
Because the VU meter has a built-in bridge rectifier it is necessary to connect wires directly to the meter movement to provide the

[Continued on page 94]



Fig. 7—View of inside of front of cabinet shows how piece of sponge material with hole in center is used to physically isolate mike from cabinet.

Fig. 8—View of aluminum panel (3 9/16 x 6 in.) shows location of input and of the output jacks, the mike, C8, M1, S1 and S3. Circuit board is held firmly in place by two upper screws on meter and bracket B. It is also held by S1. To attach it to S1, drill holes in board directly over two screws on S1 that hold decks together. Slip it over screws and tighten added nuts. Bracket C holds batteries against plate B.



Hi-Fi Today

By John Milder

* Madison Ave. vs Hi-Fi

ALL of the feelings I've been having for the last few months over four-channel stereo—annoyance, frustration, anger, you-name-it—finally came together a few days ago. What did it was an ad from a big California chain of hi-fi stores that purported to offer "A Four-Channel Stereo Sound System" for \$249.95. What the ad actually offered was a cheap record changer, four tiny house-brand speaker systems, and a Japanese receiver. The ad, though long on copy, didn't make it clear whether the receiver itself was even legitimately four-channel. But it did tell the listener he could expect four-channel sound from ordinary two-channel recordings and broadcasts. Of course, this miracle four-channel rig provided *no* four-channel program material of any kind.

This is just another addition to the great American tradition of deceptive advertising. But it's also sublimely illustrative of the present confusion over four-channel sound and of the terrible botch that the audio industry is making of the whole thing. There are, at last count, eight different systems for recording, encoding (in some cases) and playing back four-channel stereo. There is also a ton of four-channel products hitting the market with the claim that a particular manufacturer invented the whole four-channel idea.

We probably aren't too far from the point where one or the other of the competing systems will assert itself, but in the meantime many customers are being sold four-channel equipment that will prove severely deficient or cumbersome in operation. All for a system for which there is a pathetically small amount of program material available. Ironically, the best deal for the consumer right now is prob-

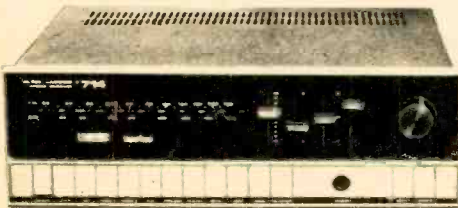
ably the mediocre-quality but ready-to-play RCA and Motorola systems, which will have the greatest selection in the near future.

The Institute of High Fidelity has yet to do any of the technical spadework needed to establish credentials for an industry-approved system. The process that will finally establish one predominant four-channel process for component users is not guaranteed to shake out the one that may be the best overall.

It is, to say the least, damned disappointing that an industry which has an image of quality beyond the norm is again failing in its real responsibility to consumers. Manufacturers don't see it that way and would undoubtedly contend that four-channel gear that later becomes obsolete because a different system employs new standards is just part of the on-going quest for higher and higher fidelity. The kids have a reply to that kind of statement.

One of the more interesting audio entries—or rather, re-entries—in a long while has been that of Altec Lansing into the electronic component area. Altec speakers have been around for as long as I can remember (the famous A-7 Voice of The Theater has enjoyed a resurgence during the rock era in Fillmore-style auditoria and studios). The company has made brief forays into receivers and such, but the new Altec line looks more diverse and solid than before. It includes very specialized products such as room equalizers and a good-looking group of receivers and amplifiers. I haven't had a chance yet to listen to the new components such as the 714A receiver, but they have some interesting specifications, things like slide volume and tone controls (a trend these days that I'm not sure I really like) and a very crisp professional look (see photo). So, a welcome is in order.

Also welcome is Sherwood's new entry in the growing category of \$200 receivers. As I've said before, I think that the \$200 receiver is one of the most important audio phenomena in a long time and Sherwood's new S7100 seems to be in the same surprising performance class—especially in FM performance—as the Sony, Kenwood and others I've mentioned earlier. If you don't need wall-opping power, the S1700 is an unusual buy —



Altec Lansing's new 714A stereo receiver is rated at 44 watts (rms) per channel and has slide controls and black-out dial for a sleek professional look.

New Heathkit® Solid-State

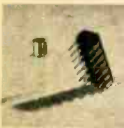
Design and performance features add up to one-of-a-kind superiority.

Over five years were spent in research and development to achieve the notably superior performance, improved convenience features, and ease of service now embodied in the new GR-270 and GR-370. They are premium quality receivers in the truest sense, and, we believe, the finest color TV's on today's market. Here's why ...



Compare these features:

- Modular plug-in circuit board construction.
- MOSFET VHF tuner and 3-stage IF.
- Adjustable video peaking.
- Sound instantly, picture in seconds.
- Built-in Automatic Fine Tuning.
- Pushbutton channel advance.
- Tilt-out convergence and secondary controls.
- Hi-fi sound outputs — for amplifier.
- Virtually total self-service capability with built-in volt-ohm meter, dot generator, and comprehensive manual.
- Premium quality bonded-face etched glass picture tubes.
- Choice of 295" or 227" picture tube sizes.



Exclusive solid-state circuitry design... total of 45 transistors, 55 diodes, 2 silicon controlled rectifiers; 4 advanced Integrated Circuits containing another 46 transistors and 21 diodes; plus 2 tubes (picture and high voltage rectifier) combine to deliver performance and reliability unmatched by conventional tube sets.



Exclusive design solid-state VHF tuner uses an MOS Field Effect Transistor for greater sensitivity, lower noise, and lower cross-modulation ... gives you sharply superior color reception, especially under marginal conditions. Gold/Nioborium contacts give better electrical connections and longer wear. Memory fine tuning, standard. Solid-state UHF tuner uses hot-carrier diode design for increased sensitivity.



3-stage solid-state IF has higher gain for better overall picture quality. Emitter-follower output prevents spurious signal radiation, and the entire factory-aligned assembly is completely shielded to prevent external interference.

Automatic Fine Tuning — standard on both sets. Just push a button and the assembled and aligned AFT module tunes in perfect picture and sound automatically ... eliminates manual fine-tuning. Automatic between-channel defeat switch prevents tuner from locking in on stray signals between channels. AFT can be disabled for manual tuning.

VHF power tuning ... scan through all VHF and one preselected UHF channel at the push of a button.

Built-in automatic degaussing keeps colors pure. Manual degaussing coil can be left plugged into the chassis and turned on from the front panel ... especially useful for degaussing after the set is moved some distance.

Automatic chroma control eliminates color variations under different signal conditions.

Adjustable noise limiting and gated AGC keeps pulse-type interference to a minimum, maintains signal strength at constant level.

High resolution circuitry improves picture clarity and new adjustable video peaking lets you select the degree of sharpness and apparent resolution you desire.

"Instant-On". A push of the power switch on the front panel brings your new solid-state set to life in seconds. Picture tube filaments are kept heated for instant operation, and extended tube life. "Instant-On" circuit can be defeated for normal on-off operation.

Premium quality color picture tubes. Both the 227 sq. in. GR-270 and 295 sq. in. GR-370 use the new brighter bonded-face, etched glass picture tubes for crisper, sharper, more natural color. And the new RCA HiLite Matrix tube is a low cost option for the GR-370. See below.

Adjustable tone control lets you choose the sound you prefer ... from deep, rich bass to clean, pronounced highs.



Hi-fi output permits playing the audio from the set through your stereo or hi-fi for truly lifelike reproduction. Another Heath exclusive.

Designed to be owner serviced. The new Heath solid-state color TV's are the only sets on the market that can be serviced by the owner. You actually can diagnose, trouble-shoot and maintain your own set.

Built-in dot generator and tilt-out convergence panel let you do the periodic dynamic convergence adjustments required of all color TV's for peak performance. Virtually eliminate technician service calls.



Snap-out glass epoxy circuit boards with transistor sockets add strength and durability and permit fast, easy troubleshooting and transistor replacement. Makes each circuit a module.



Built-in Volt-Ohm Meter and comprehensive manual let you check circuits for proper operation and make necessary adjustments. The manual guides you every step in using this built-in capability. Absolutely no knowledge of electronics is required.

Easy, enjoyable assembly ... the Heathkit way. The seven-section manual breaks every assembly down into simple step-by-step instructions. With Heath's famous fold-out pictorials and simple, straightforward design of the sets themselves, anyone can successfully complete the assembly.

Heathkit Solid-State Modular Color TV represents a significant step into the future ... with color receiver design and performance features unmatched by any commercially available set at any price! Compare the specifications. Then order yours today.

Kit GR-270, all parts including chassis, 227" picture tube, face mask, UHF & VHF tuners, AFT & 6x9" speaker, 114 lbs. \$489.95*

Kit GR-370, all parts including chassis, 295" picture tube, face mask, UHF & VHF tuners, AFT & 6x9" speaker, 127 lbs. \$559.95*

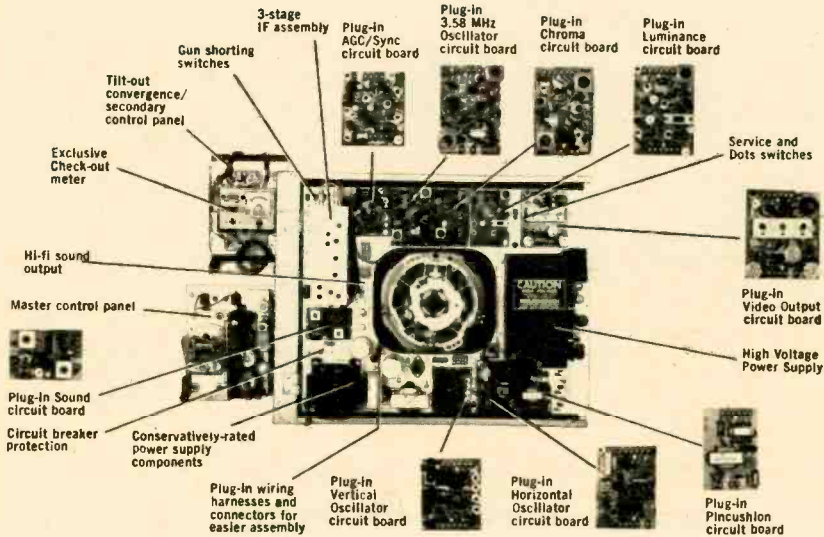
Kit GR-370MX, complete GR-370 with RCA matrix picture tube, 127 lbs. \$569.95*

GR-270 AND GR-370 SPECIFICATIONS — PICTURE TUBE SIZE: GR-370 Approximate Viewing Area: 295 Sq. In. GR-270 Approximate Viewing Area: 227 Sq. In. **DEFLECTION:** Magnetic, 90 degrees. **FOCUS:** Electrostatic. **CONVERGENCE:** Magnetic. **ANTENNA INPUT IMPEDANCE:** VHF 300 ohm balanced or 75 ohm unbalanced. UHF: 300 ohm balanced. **TUNING RANGE:** VHF TV channels 2 through 13. UHF TV channels 14 through 83. **PICTURE IF CARRIER:** 45.75 MHz. **SOUND IF CARRIER:** 41.25 MHz. **COLOR IF SUBCARRIER:** 42.17 MHz. **SOUND IF FREQUENCY:** 4.5 MHz. **VIDEO IF BANDWIDTH:** 3.58 MHz. **HI-FI OUTPUT:** Output impedance — 1 k ohm. Frequency response — ±1 dB 30 Hz to 10 kHz. Harmonic distortion — less than 1% at 1 kHz. Output voltage — 0.3 V rms nominal. **AUDIO OUTPUT:** Output impedance — 4 ohm or 8 ohm. Output power — 2 watts. **POWER REQUIREMENTS:** 110 to 130 volts AC, 60 Hz, 240 watts. **NET WEIGHT:** GR-370, 114 lbs.; GR-270, 101 lbs.

CIRCLE NUMBER 3 ON PAGE 15

Modular Color Television!

Exclusive Modular Design... Circuit Boards snap in and out in seconds for easy assembly, simple servicing



New Expedited 48-Hour No-Charge Warranty Service Plan for Solid-State TV Modules! Special service facilities have been established at the factory and all Heathkit Electronic Centers to expedite service and return of Solid-State TV circuit modules within two working days. During the 90-day warranty period, TV modules will be serviced or replaced with no charge for labor or parts. After the initial 90-day warranty period expires, TV modules will be serviced or replaced at a fixed charge of \$5.00 per module for labor and parts for a period of two years from date of original kit purchase.



Add extra convenience and versatility to your new GR-270 or GR-370 Solid-State Color TV with this new ultrasonic remote control kit. Lets you turn the set on and off, adjust volume, change VHF channels and adjust color and tint from the comfort of your chair. Assembles and installs complete in just a few hours and the built-in meter on the receiver makes final adjustment a matter of minutes.
Kit GRA-70-6, 6 lbs. \$44.95*

Choose One Of These Handsome, Factory Assembled Cabinets

3 models in 295 sq. in.

Luxurious Mediterranean Cabinet... factory assembled of fine furniture grade hardwoods and finished in a flawless Mediterranean pecan. Statuary bronze trim handle. 30-1/32" H x 47" W x 17 3/4" D. Assembled GRA-304-23, 85 lbs. \$129.95*



Deluxe Early American Cabinet... factory assembled of a special combination of hardwoods & veneers and finished in classic Salem Maple. 29-21/32" H x 37 3/4" W x 19 3/4" D. Assembled GRA-303-23, 67 lbs. \$114.95*



Contemporary Walnut Cabinet... factory assembled of fine veneers & solids with an oil-rubbed walnut finish. 29-17/32" H x 35-13/16" W x 19 3/4" D. Assembled GRA-301-23, 56 lbs. \$74.95*



3 models in 227 sq. in.

Exciting Mediterranean Cabinet... assembled using fine furniture techniques and finished in stylish Mediterranean pecan. Accented with statuary bronze handle. 27-31/32" H x 41 7/8" W x 19-5/16" D. Assembled GRA-202-20, 70 lbs. \$114.95*



Contemporary Walnut Cabinet and Base Combination. Handsome walnut finished cabinet sits on a matching walnut base. Cabinet dimensions 20-31/32" H x 31-7/16" W x 18 3/4" D. Base dimensions 7 3/4" H x 27 3/4" W x 18 3/4" D. Assembled GRA-203-20 Cabinet, 45 lbs. \$49.95* GRS-203-6 above cab. w/ matching base, 58 lbs. \$59.95*



Handy Roll-Around Cart and Cabinet Combination. Features the GRA-203-20 walnut cabinet plus a walnut-trimmed wheeled cart with storage shelf. Assembled GRA-203-20 Cabinet, 45 lbs. \$49.95* GRA-204-20 Roll-Around Cart, 18 lbs. \$19.95* GRS-203-5 Cart & Cabinet Combo, 58 lbs. \$59.95*



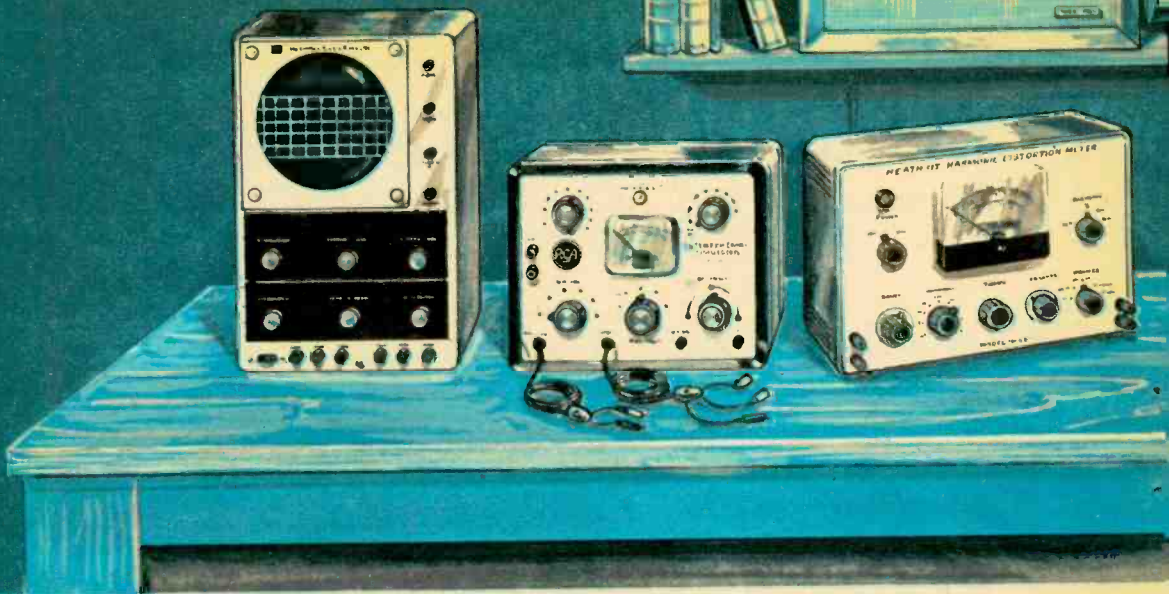
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FREE 1971 CATALOG!
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Benton Harbor, Michigan 49022

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CIRCLE NUMBER 3 ON PAGE 15



By HERB FRIEDMAN,
W2ZLF

Basic Equipment

Hi-fi servicing can be a lucrative sideline for hobbyists, but you need the right kind of equipment to do the job.

PEOPLE are finding that they have more and more leisure time on their hands and one place they are turning for diversion is music. Sales of audio equipment have shot through the sky in the last ten years. Much of this gear is going to need servicing, or already needs it—which means a lucrative sideline for many electronic buffs. But before you can become the Dr. Kildare of the amplifier set, you'll need a basic workbench of audio test equipment.

As a hobbyist, you will probably have some of the necessary equipment such as a VTVM and an oscilloscope in your shop, thus trimming your initial investment. It is a good idea to go out and buy what you don't have right away. If your customers learn that you can only fix some problems but not others, they will look elsewhere for their service needs.

The most important piece of equipment in the service field is your old reliable VTVM. You'll be using it to find 25 per cent of the troubles that you encounter.

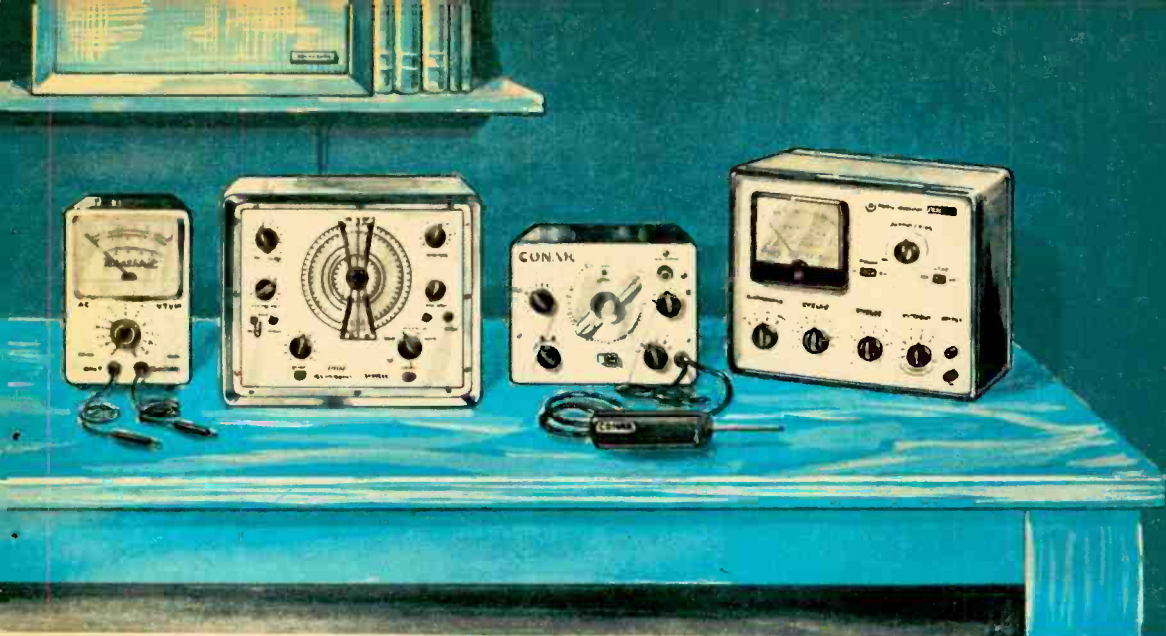
The next piece of equipment that you'll need is an oscilloscope. The scope gives you a visual representation of a signal so that you may observe it for distortion and other tests.

An old, general-purpose scope with a 500-kc upper-frequency limit will be sufficient for all the audio servicing jobs that you may have to perform. A wideband scope, which is normally used for TV servicing, is not required.

If you don't own a scope, you will save money by buying a scope in this general-purpose category. Unfortunately, there are only a few GP scopes available as many manufacturers have found that scopes designed for TV servicing are in greater demand.

In the scope category, as with almost all other categories mentioned in this article, you will save the most money if you get a kit. Two good scope kits are the Heathkit IO-18 (\$92.50) and the Knight-Kit KG-635 (\$139.95). Another good scope kit, the Eico 430, was recently discontinued but some dealers may still have it in stock. If not, the 427 (\$99.95) is a good substitute.

If you think that there may be some TV servicing in your future and want to get a wideband type, you'll find that the 3 in. models such as the RCA WO-33A (\$139.00) are a good choice because their small size makes them relatively inexpensive and easy to



for Audio Servicing

carry around with you.

Perhaps the most important instrument to the audio serviceman is also the most specialized. Whether you're working on just audio equipment or RF gear also, the desired end result is that the equipment reproduce sound as faithfully as possible. To do this you need an instrument which will produce a test frequency with as little as 0.1 per cent distortion. The instrument that does this is the audio generator. The audio generator is used to make frequency-response checks and to provide a highly accurate signal source for checking various stages of the equipment.

There are many different models available, but audio generators tend to fall into two distinct groups. First, there are those with a relative output attenuator that indicates a specific output range such as .1 to 1 V, 1-10 V, etc. Second, there are those that have a fully metered output so that the output level can be exactly determined from a meter indication. Because of practical considerations, in servicing, it is wise to obtain the fully metered variety at the outset. Of this group, any instrument that covers a frequency span of 10 cps to 50 kc will be adequate.

Two low-cost, fully metered audio generators are presently available. These are the Heathkit IG-72 (\$46.95) and the Eico 378 (\$59.95). These models are known as discrete-frequency generators, for they are set to an exact frequency with three switches,

something like the way resistance values are shown with three color bands. Continuous-frequency generators, utilizing approximate settings on a dial, are available, but not with the metered output feature.

Next on your equipment list is the AC VTVM. While your scope can indicate low AC voltages, such as the output of a phono pickup or preamp, you'll need something that's fast and doesn't require converting from peak-to-peak to RMS. AC VTVMs can indicate down to 1 mv (millivolt) full scale and can be used to check the performance of phono pickups, tape heads and microphone output levels. It can also trace very low signal levels common in solid-state equipment.

There are several AC VTVMs available which meet the qualifications of service-grade equipment. Among them are the Simpson 715 (\$80) and the Triplet 601 (\$150) which is an FET VOM but goes down to 10 mv AC. In the lower price field there is the excellent Heathkit IM-38 (\$41.95) and the exceptional Eico 250 (\$59.95) which has a built-in amplifier so that headphones can be used with the instrument for signal tracing.

Speaking of signal tracing, you will find that in audio servicing, the signal tracer is worth twice its weight in gold. There is nothing faster at locating troubles in an inoperative or distorted amplifier or other bugaboos like broken connections, open pickups and bad tape heads. Basically the

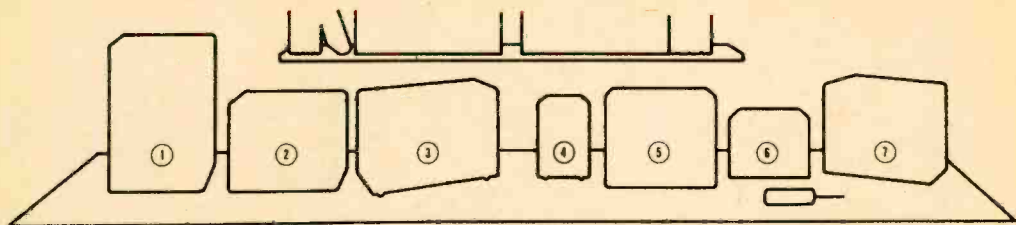


Fig. 1—Equipment appearing in drawing on previous pages: 1. Knight-Kit KG-635 oscilloscope (\$139.95), a general-purpose scope for observing signals and measuring voltage. 2. RCA WR-52A Stereo Simulator (\$248) which supplies multiplex signal. 3. Heathkit IM-58 Harmonic-Distortion Meter. (\$65). 4. Heathkit IM-38 AC VTVM (\$41.95) to measure low AC. 5. Precision 200C RF Generator (\$160). 6. Conar 230 Signal Tracer (\$49.95 kit, \$69.95 wired). 7. The Eico Model 378 Audio Generator (\$59.95) is equipped with metered output.

Basic Equipment for Audio Servicing

signal tracer is a very-high-gain amplifier with loudspeaker output and a calibrated output attenuator that allows you to compare relative voltage levels. Signal tracers also have diode detectors that can be used to trace modulated RF signals through a receiver.

Signal tracers are always plentiful on the market, but many do not make the grade. Three of the perennial best are the Conar 230 (\$49.95 kit, \$69.95 wired) with a tunable RF detector for servicing AM radios, the Heathkit IT-12 (\$24.50) and the Eico 157 (\$34.95). The choice is up to you, but this is a *must* piece of equipment for audio servicing.

Another piece of equipment that is good to have is the harmonic-distortion meter. This little gem performs after you have effected repairs, for it allows you to compare the equipment's performance in terms of distortion to the original specifications.

You are limited in choice in this category. The only low-cost distortion meter available is the \$65 Heathkit IM-58. Eico has an assembled model on the market (902) but the \$250 price tag may stretch many budgets.

While many technicians and hobbyists can tackle audio gear, RF equipment—tuners, radios and receivers—are indeed a horse of a different color. If the manufacturer does not supply alignment instructions for its equipment, you're up the creek and the only thing you can do is send the equipment to the manufacturer and hope for the best. If you're lucky enough to have instructions, an RF signal generator will be needed. There is a good deal of acceptable equipment in this

category including the Eico 330 (\$59.95), the Heathkit IG-102 (\$31.95), the Knight-Kit KG-686 (\$99.95), the Lafayette 99-50155 (\$34.95) and the B & K 200D (\$159.95).

If you want to service the aforementioned RF equipment, you'll need some way to check the performance of the gear. Most of the equipment for this purpose is designed for the laboratory, with a price tag to match. Within the reach of most hobbyists is the RCA Stereo Simulator, Model WR-52A (\$248.00). The simulator makes it possible to check stereo separation up to about 30 db and can be used as a signal source for multiplex circuit alignment. The RCA model is the only service-grade simulator which fully meters RF deviation levels and the 19-kc subcarrier level. This is essential.

Once you've got your hi-fi service business on the road, you'll find several other accessories that will make life a little easier.

Among these are Ampex test tapes to compare a tape recorder's equalization to standard equalization, a tape strobe to keep tabs on a recorder's tape speed, CBS Laboratory test records (particularly the 100 and 150) to check phono pickups and equalization and the luxury of luxuries—a wow and flutter meter.

One thing is clear when arriving at a list of audio servicing equipment: there is no end to the list. There is always something coming out that will make life easier. But a penurious look at the list presented here will reveal that most hobbyists can have a complete bench for under \$200. Starting from there, you may make enough money to buy specialized gadgets that will do everything but write the bills. ●

Good Reading

By Tim Cartwright

USE OF THE OSCILLOSCOPE—A PROGRAMMED TEXT By Charles H. Roth, Jr., Prentice-Hall, Inc., Englewood Cliffs, N.J. 222 pages. \$5.95.

As circuits head toward greater miniaturization, they become tougher to service with the usual test instruments. Try thrusting voltmeter probes inside an IC or inserting an ammeter in series with the foil of a printed circuit. (You get shattered epoxy and shredded copper.) That explains why the oscilloscope, whose star began shining in the 1920s, is staging a big screen comeback. The scope displays a picture of waveform, voltage, frequency and phase angle at a touch of a probe. This book is an excellent guide through the green jungle of patterns that can confuse the beginner.

It uses a programmed approach. A bit of information within a certain framework is absorbed by the student, then a question is immediately asked. After filling in the answer, the student checks it on a following page. With constant reinforcement and correction, the student progresses at his own pace through the theory and operation of a lab-type scope. After completing the course, the student should be able to set up scope controls, hook into a test circuit with the least disturbance and interpret the display on the screen.

Since this text is written to accompany a lab course in basic electrical engineering, it assumes that the student has some knowledge of simple AC and DC circuits and has access to a triggered-sweep scope and other gear like oscillators and power supplies. Despite this specialization, any technician or experimenter who sees fuzzy images when near a CRT would do well to buy and follow this expertly-prepared manual.

SINGLE SIDEBAND FOR THE RADIO AMATEUR. *The American Radio Relay League.* Newington, Conn. 256 pages. \$3.00.

Communications on the HF band (3-30 mc) are drifting toward a complete change-over from regular AM to single sideband. SSB is an extraordinary power- and band-conserving technique that's growing rapidly among military, telephone and marine-air-

craft stations for trans-oceanic voice circuits. Hams discovered the benefits of sideband some 30 years ago and prove it with the Fifth Edition of this publication. It's one of the more authoritative collections of articles on sideband theory and practice you can find anywhere.

As in other ARRL publications, the material is delivered at hobby level. It assumes you know basic electronics, yet treads lightly on formulas and is loaded with helpful rules-of-thumb for building equipment and getting it to work. A first chapter on sideband principles is followed by construction of exciters, transceivers and accessories. There's valuable coverage of home-brew linear amplifiers (a tricky item) and their care and feeding, once you have them built.

A notable improvement in this edition, which is 60 per cent new material, is the added coverage afforded solid-state circuits. If you're a beginning ham, or simply want a thorough introduction to the mysteries of sideband, this book should be on your shelf.

RADIOTELEGRAPH OPERATOR'S LICENSE Q&A MANUAL. By Milton Kaufman. Hayden Book Co. Inc., New York, N.Y. 400 pages. \$11.95.

Your ship has split abaft the wheelhouse and threatens to founder in a wallowing sea. You're the operator on duty, so you hit brass and pound out: 142° W. Long. 150° N. Lat. . . 500 miles east of Tahiti. . .

If this sounds better than being a clerk in a local haberdashery, your first move should be to purchase this book. Author Kaufman is King of the question and answers manuals and his works have nurtured a generation of FCC Commercial Radio Operator exam-takers (your reviewer included). His latest effort consolidates study material for radiotelegraph exams into one edition. Earlier, the radiotelegraph material was combined in a volume with radiotelephone (the license needed by broadcast and two-way radio technicians).

The secret of Mr. Kaufman's success: his books are not straight, arid Q&A. His answers are followed by a concise discussion section that saves the text from the fate of other such study manuals. Too often, the bare Q&A treatment turns out to be an exercise in memory, not learning. Mr. Kaufman's discussion makes the mound of regulations, specialized theory and circuits much easier to read and absorb. Next stop: Pago Pago. —

By **VINCE DANIELS** ONE OF the reasons thinkers of ancient times are considered great is that what they said still may have truth. Aristotle once said, "For the things we have to learn before we do them, we learn by doing them." If you want a successful career or hobby in electronics, you'll have to learn electronics and a good way to do that is by using electronics on a limited scale. Many manufacturers have caught on to this idea and have produced educational electronic kits.

If you are interested in learning electronics, the kit you choose to teach you the fundamentals will make a great deal of difference in how you learn. There are many kits on the market that offer several projects and retail for under \$10. Most are more of an evening's fun than educational enterprises for, although several elementary circuits are offered, the low price generally precludes any

Can You Learn Electronics from Educational Kits?

great examination of theory, which is what electronics training is all about.

The kits that we will address most attention to are those that provide a system of programmed instruction in conjunction with a series of projects designed to illustrate the theory covered by the manual. Each manufacturer has tried to provide what he thinks is the best method for teaching, so it is impractical to compare one kit to the other. We will evaluate each kit on its own merit.

The kits reported on here have been tried by educators and technicians to test each kit's value as an instructional tool and by kids to determine the fun quotient and understandability.

Heathkit Model JK-18 Electronic Workshop 35. \$19.95.

This 35-project kit (Fig. 1) has parts which the user must assemble on a Masonite board with a spring terminal at each lead of the part. To build a project, the student follows a schematic and a wire table making wire connections between spring terminals.

One of the good things about the kit is that it is possible to build two projects at one time and interconnect them. Besides the usual two- or three-transistor radio projects, Heath's kit offers such interesting features as a Wheatstone bridge, a capacitor bridge and a phase-shift electronic organ.

The big asset of this kit is its construction manual. Although the authors approach the theory with an air of cuteness, it is well presented. Each project has application notes and optional circuit modifications that allow the experimenter to think creatively.

Raytheon Lectron Series 3, \$24.95.

This kit's approach is the most unique of all and has hooked just

about everyone who has seen it (Fig. 2). Instead of a terminal board or chassis with the components connected by wires, the Lectron consists of a metal base or sheet (like a cookie sheet) and individual component modules. Each module contains one component in a plastic box. The box has the schematic symbol on top, and the component is connected to magnetized contacts on the sides. To build a project the user assembles the module symbols just as they appear in the schematic. The magnetized contacts "lock" together, and when the last module is put down on the sheet the project operates. The modules form the schematic, and the user checks his wiring by comparing the module schematic against the instruction book schematic.

To allow for individual experimentation there are optional terminal modules that allow the user to connect any component into the module system.

The Lectron (see ELECTRONIC DOMINOES, Sept. '67 EI) is a growth system, for add-on-kits are continuously developed for the Series 1, 2 and 3 basic kits. The Series 3 kit with three transistors, diode

and break-in module is the basis for projects such as a phono amplifier, light-modulated organ and a light-modulated receiver. The Series 3 kit comes close to providing the learner with the same type of projects as the most basic spring-terminal kits. With the Add-On kits you get a chance to experiment with some fairly advanced circuits. The instruction manuals don't have an excess word—and are notably good for a giving an understanding of the circuit and its theory.

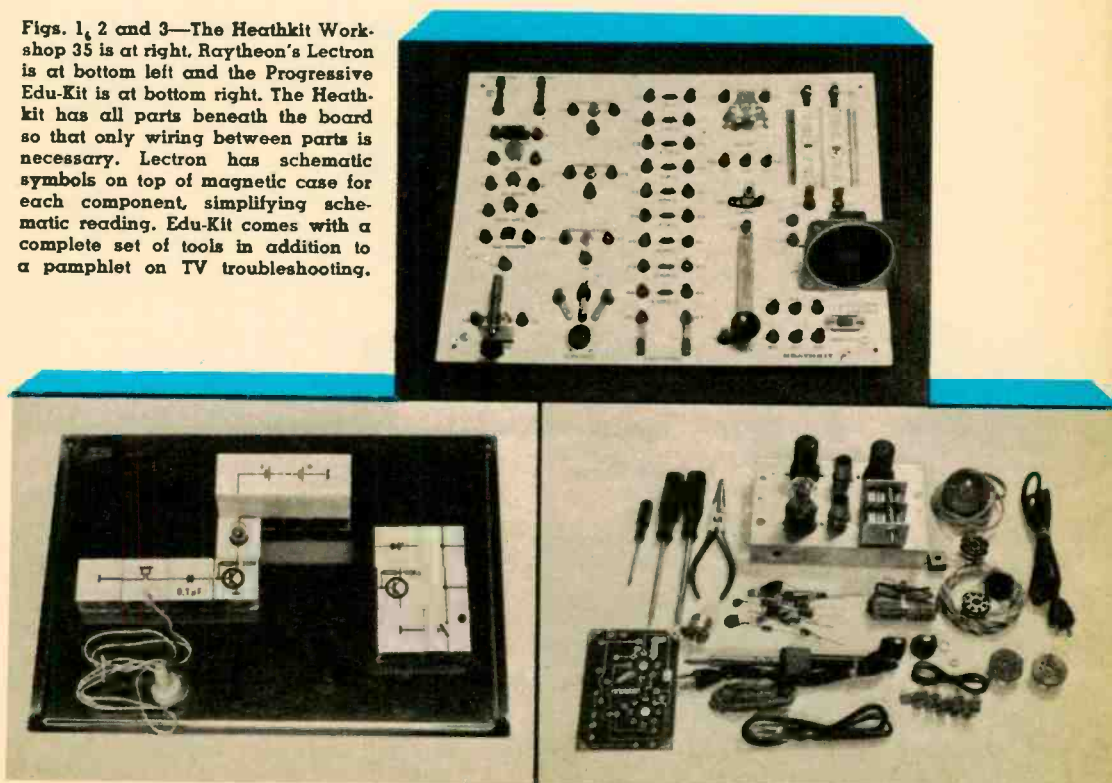
Conar's Adventures in Electronics. \$18.95.

The Adventures in Electronics kit contains only tube-type, line-powered projects. In addition to the tubes, punched metal chassis and components for the projects, the user is supplied with a screwdriver, pliers and soldering iron.

The student first mounts permanent chassis components such as a variable capacitor, broadcast-band loop antenna, speaker and IF transformer. He then assembles the power supply which is used for all the projects.

Unlike many of the transistor-kit projects, all the Conar projects are usable in the sense that they perform like commercially built circuits. For example, the phono amplifier,

Figs. 1, 2 and 3—The Heathkit Workshop 35 is at right, Raytheon's Lectron is at bottom left and the Progressive Edu-Kit is at bottom right. The Heathkit has all parts beneath the board so that only wiring between parts is necessary. Lectron has schematic symbols on top of magnetic case for each component, simplifying schematic reading. Edu-Kit comes with a complete set of tools in addition to a pamphlet on TV troubleshooting.



Can You Learn Electronics from Educational Kits?

theremin, broadcast-band transmitter and signal tracer can be separately assembled and used as full-performance equipment. A difficulty with the kit is its components, which are soldered into the circuit and reused as each new project is assembled.

The manual explains the theory of operation for each circuit, and also provides alignment instructions for the final project, which is a complete superhet radio. Although this kit has no solid-state projects, all the projects deliver a high level of performance and will prove useful to the beginner and advanced experimenter.

Radio Shack Science Fair Electronic Project Kit #201. \$17.95.

This is a spring-terminal kit (Fig. 4) in which two transistors and a host of other components are mounted on a 10½ x 14-in.

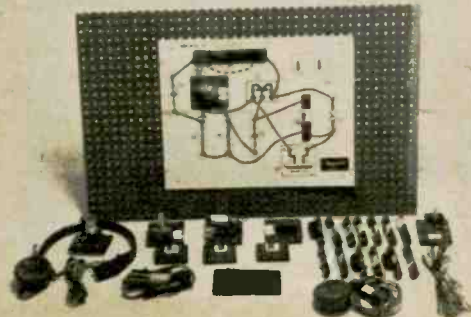
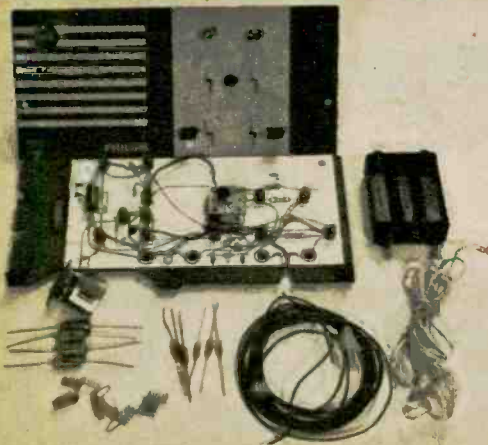
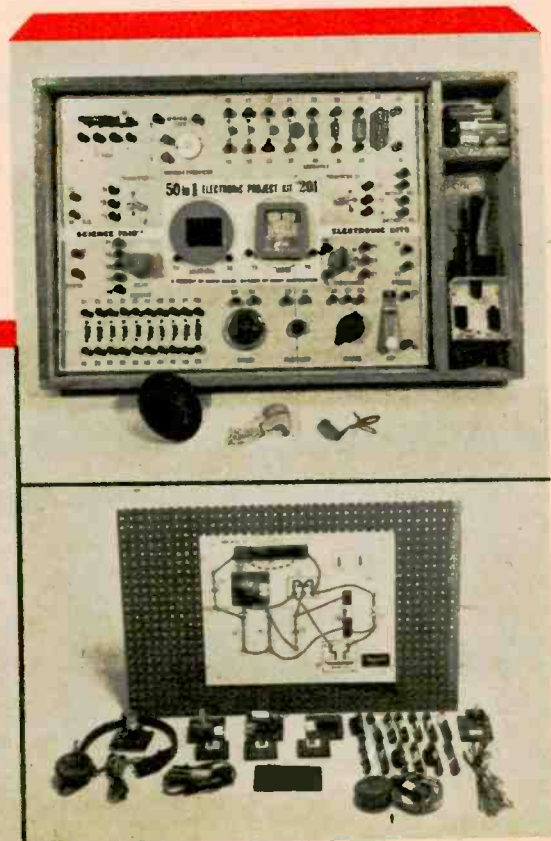
hardboard chassis. Each component is connected to spring-terminals. The entire chassis is supplied pre-assembled and no additional construction is required. The schematics for each project show the spring-terminal numbers for interconnection of the components. A pictorial wiring aid is also provided.

The well written instruction manual contains 50 projects, evenly divided between the action type, such as a crystal radio and phono amplifier; and experimental circuits that allow the user to try out his own ideas. Typical experimental circuits include an electronic metronome, a timing circuit, a tachometer and a water-purity indicator. Some of the projects are good enough for general use and their circuits can be lifted for an individual project assembly.

Progressive Edu-Kit. \$34.95.

This all-tube project kit (Fig. 3) is supplied with a punched metal chassis and a set of hand tools consisting of a soldering iron, long-nose pliers, three screwdrivers and solder. All projects except a signal injector

Figs. 4, 5 and 6—The Radio Shack Science Fair is at right, the Norelco EE 1050 is at bottom left and the Superex is at bottom right. Radio Shack kit has all parts mounted on the bottom of board to simplify wiring. Norelco kit is more complicated because all parts and wiring must be installed for each project. It uses double spring terminals. Superex has parts mounted on Masonite strips so that each part need only be pushed through large-scale template. Theory explanations are extremely basic in Superex kit.



are assembled on the chassis; the signal injector is assembled on a supplied printed-circuit board. Of the 16 projects—15 in the manual plus the signal injector—12 are variations of radio circuits with different applications of RF amplification, detection and other electronic principles. There is a code oscillator, broadcast-band transmitter and oscillator in addition to the signal tracer. Here again a major difficulty with the projects is that the components, which are soldered into the circuits, are used over and over again.

The instruction manual has a special section on tube and chassis wiring and basic theory for each project. Both a schematic and a general wiring pictorial (not exact parts layout) are provided for each project.

Also included in the kit are excellent pamphlets on television and radio troubleshooting for tube circuits. Another pamphlet is the instruction and operating manual for the signal injector, while another pamphlet provides instructions with schematics for four advanced tube projects: two transmitters, an audio amplifier and a square-wave audio generator.

Norelco Junior Master Kit EE 1050.
\$13.95.

The heart of this kit (Fig. 5) is a very slick, notably excellent instruction manual, most of which is devoted to a first-rate introduction to electronics.

The basic EE 1050 kit has 12 projects; 24 projects with the components from two add-on kits. While several of the projects are the usual type such as a flashing light or moisture indicator, there are some really outstanding and unusual projects, such as a medium-wave receiver and a real two-tone klaxon like the ones used by emergency vehicles. Each project contains a good theoretical explanation, sufficient to allow some individual experimentation.

The chassis is a 4 x 9-in. pegboard with a pre-punched Masonite front panel. A full-scale wiring template is provided for each project. The template is positioned over the pegboard and spring-terminals are installed at the indicated locations. Individual components are then connected between the terminals, as is the interconnecting leads (which are not pre-cut to size). Unfortunately, the spring-terminals are not the easiest things to install and remove, and they may be just a bit difficult for a young child to manipulate.

Superex Lab 35 Electronics Laboratory.

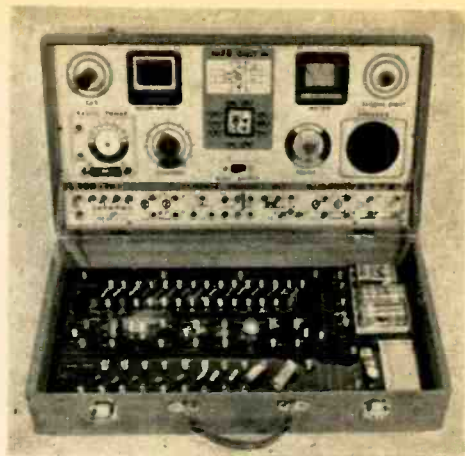


Fig. 7—Lafayette Radio's IC Experimenter's kit provides 150 different projects while allowing for interconnection of related circuits. \$24.95.

\$21.88.

Containing three transistors and other components typical of the spring-terminal type kit, the Lab 35 (Fig. 6) uses a rather unique assembly system for the projects, which results in a slightly easier-to-assemble and more reliable construction.

The chassis is a 12 x 19-in. section of pegboard. Each component is mounted on a fiberboard strip, and the ends of the components are pre-connected to oversize nuts permanently attached to the strip. On the underside of the strip are projections which match the pegboard hole spacing.

Each project is detailed in a full-scale pictorial. The user positions the pictorial over the pegboard and then plugs in the matching components, breaking through the pictorial template. The projections secure the component to the board. Following the pictorial template, pre-cut leads with spade lugs are secured to the appropriate terminal nuts.

There is no instruction manual in the true sense of the word as a majority of the information for each project is contained on the pictorial, including very rudimentary theory for some of the projects.

Lafayette Radio 99-35107 IC Experimenter's Kit. \$24.95.

This 150-project kit is supplied in a wood cabinet similar to that used for microscopes and science kits. A plastic panel mounted in the cabinet base contains a large quantity of resistors, capacitors, transformers, batteries and auxiliary terminals. A panel in the cabi-

[Continued on page 97]

The Insulation With the Shrinks

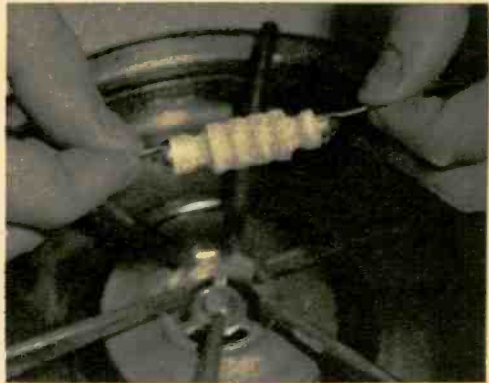
By RONALD LUMACHI, WB2CQM

USING electrical tape to insulate connections and cover components is about as modern a way of doing the job as designing an audio amplifier with tubes. The old sticky stuff should be replaced by heat-shrinkable tubing. The tubing, which is available in many lengths and diameters, looks like spaghetti insulation and is applied the same way then heated. Alpha Wire's Series FIT-221, for example, shrinks to half its original dia. when heated to 275°F. In length it shrinks only about five per cent.

Select the smallest dia. tubing that will fit over the part and heat using a cigarette lighter, propane torch or the flame of kitchen stove. Move the tubing slowly in the heat to insure even shrinkage. The tubing will not burn and will not change the RF characteristics of a circuit. It will not peel or unravel and does not permanently bond with the material being insulated. To remove it, simply slit lengthwise with a razor and peel away. The tubing can be purchased from Burstein Applebee, 3199 Mercier St., Kansas City, Mo. 64111 and others. BA also has a free Alpha Wire catalog (Stock No. 16A1152) of shrinkable tubing. For boxed assortments of 6-in. lengths, refer to BA's latest catalog.



Assortment of Alpha Wire shrinkable tubing and application bulletins. Material shown is available from Burstein Applebee and other distributors.



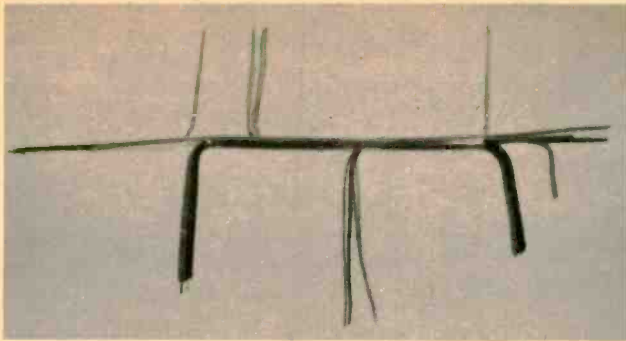
Using gas-stove flame to shrink tubing. Avoid prolonged application of extreme heat which will destroy tubing and melt a soldered connection.



Splice protected by a length of 1/8-in.-dia. tubing. For small applications such as this, a match will supply sufficient heat to cause shrinkage.

Tools are easily insulated with heat-shrinkable tubing. The outside dia. prior to shrinking is prominently marked on all Alpha Wire tubing.

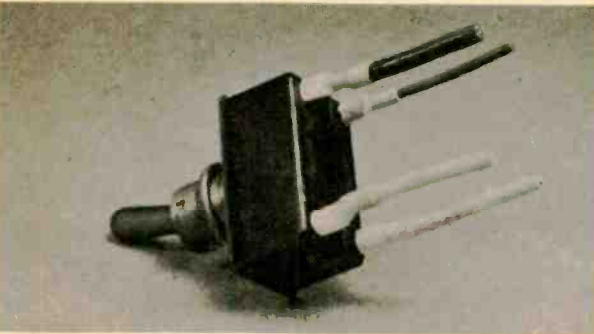




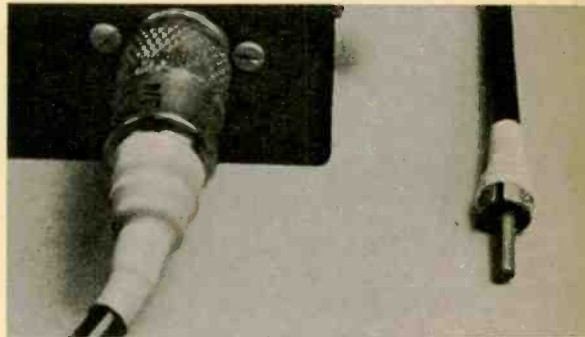
A wiring harness made with clear tubing. Simply puncture a small hole in the tubing wall and feed through the wires. When the harness is completely wired, subject it to heat for a good tight fit.



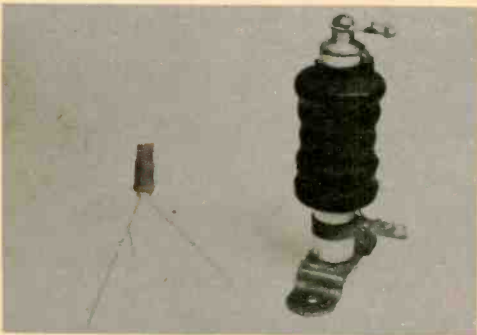
End caps, available in several sizes, are good for insulating tie points. Tubing has excellent high-voltage insulation characteristics.



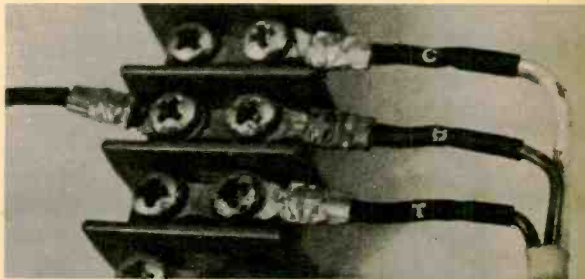
Use small lengths of tubing to protect solder or screw terminals on switches. To remove, slit lengthwise with a razor blade.



To waterproof PL-259 plug, use three sizes of tubing. $\frac{3}{4}$ -in. dia. goes on connector and $\frac{1}{2}$ -in. covers back end. Last piece has $\frac{5}{16}$ -in. dia.



Protect high-voltage chokes with tubing to prevent corona discharge. Tubing will not change RF characteristics. Transistor is protected with cap.



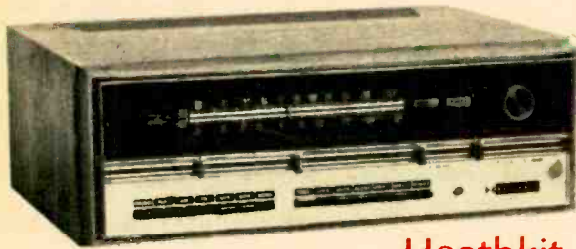
Code your wires. Numbers or letters are available hot stamped in white. Markings are permanent and will not wear off even under severe use.

Hand-wound or commercially-made coils to be used outdoors can be protected from weather with tubing. Tubing won't change inductance of the coil.

Metal-cased capacitor covered with $1\frac{1}{2}$ -in. dia. tubing. In crowded circuits it's good idea to cover case to prevent other parts from shorting to it.



Better than First Rate



Heathkit AR-29 Stereo Receiver

IN our September 1968 issue we published a report on the \$330 Heathkit AR-15 stereo receiver kit titled *A First-Rate Stereo Receiver*. Its performance put it (and us) in orbit. Since then we wondered what Heath would ever do for an encore. It turned out to be the \$285 AR-29.

If there had never been an AR-15 we would describe the AR-29 with the same superlatives. But in comparison to its predecessor the AR-29 easily can be called better than first rate. Considering the AR-29's simple mechanical design, ease of construction and top performance, we'd rate it as the finest stereo-receiver kit on the scene today.

In terms of circuitry the AR-29 represents a high level of state-of-the-art design, featuring an FET FM front-end, overload-protected dual-gate FET AM front-end, three IC FM-IF strip and total-IC multiplex decoder. Because the FM IF amplifier is wide-band ICs, essentially all the selectivity is achieved by a permanently-tuned L/C filter whose performance is almost the equal of the AR-15's crystal filter. There are also 15-kc and 38-kc filters to prevent 15- and 38-kc signals from leaking into the tape-recorder output. The 19-kc filter has absolutely no effect on the FM frequency response.

Except for the tuning control there are no knobs; all functions from power switch to input selector to speaker selector are controlled by pushbutton switches (14) and linear slider controls (4).

Selector switches are provided for phono, tape AM, FM and aux program sources. Individual level controls for the left and right channels are provided for all inputs as well as the tape monitor. These adjustments

are accessible through holes in the bottom cover plate. Outputs are provided for two speaker systems, a center channel at speaker level, tape recorder and phones (front-panel jack).

There are push switches for the tape monitor, mono and stereo modes, tone (controls either in or completely out), FM muting, blend, speaker 1, speaker 2 and power. A center-channel selector switch is mounted on the rear apron. The blend switch reduces high-frequency noise from stereo-FM signals (it may reduce stereo separation). There is no FM stereo-only mode as on the AR-15. The AR-29 has non-defeatable AFC.

Other features include a stereo beacon that comes on when a stereo station is tuned, a center-channel tuning meter, a signal-strength meter and one the most adjustable AM rod antennas we've seen. By means of built-in test leads and switches the signal-strength meter also serves as a volt-ohmmeter for circuit checks and alignment.

From the viewpoint of construction and service the AR-29's plug-in board design is



AM-FM IF circuit board. At upper right is L/C filter. At right and upper-left edges are board's 18 connectors. Construction time was 3½ hours.

superior to the AR-15's hinged, overlapping circuit boards. All critical circuits are factory or permanently aligned; the few builder adjustments are easily made with the built-in meter circuit.

We built the AR-29 in 26 hours. (The AR-15 took 34 hours.) You start by assembling eight printed circuit boards. The largest, the AM-FM IF board is shown on the first page. Following that is the main chassis in which you install circuit-board plugs, two cable harnesses, the power transformer, rear-apron parts, the front-panel pushbutton-switch assembly, power-supply filter capacitors and the front-end. The front panel, other hardware and only a few things remain.

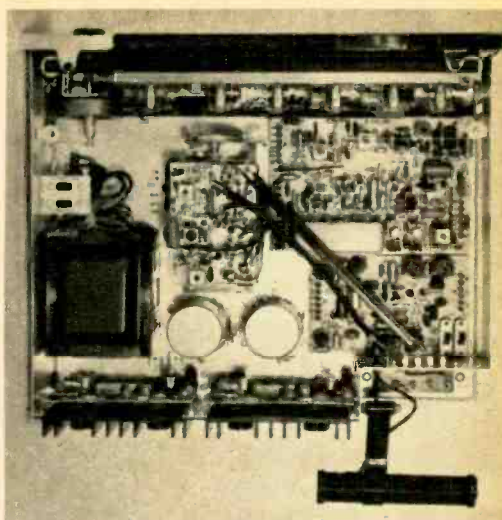
Then comes resistance checkout using the built-in test meter. At this point you move the chassis aside and put six of the boards on the bench to make quick measurements by touching the test leads to the circuit-board connectors. By the way, they're clearly marked for fast, easy identification (50 VDC, GND, B+, B-, AM OUT, AGC, IF IN, etc.) The remaining boards are then installed on the chassis, voltage checks are made, then the first six boards are installed. In the home stretch are the FM adjustments (less than a page), multiplex (about a page) and AM (one page). No hang ups.

We had only one problem. When we started the multiplex adjustments, things didn't go right. Because of the well-marked circuit-board connectors, we discovered a low voltage in a matter of minutes. Working back to the power-supply board we found a defective voltage-amplifier transistor in the voltage regulator. A replacement did the trick and we proceeded with the remaining adjustments, which went without a hitch.

Both specific and overall performance is strictly first class even with the builder alignment. Instrument alignment did not improve performance significantly.

The FM sensitivity checked out at $1.6\mu\text{v}$ IHF (for 30db suppression of noise, hum and distortion). Full limiting in terms of output-level change was obtained at $2.2\mu\text{v}$. Maximum noise suppression was obtained at $3\mu\text{v}$. FM total harmonic distortion measured a very low 0.3 per cent. Following the builder adjustment of the internal muting (squelch) control, full override of muting was obtained with a $10\text{-}\mu\text{v}$ input signal. (The muting can be disengaged if you insist on listening to weak signals.)

The signal-strength meter is hot, meaning



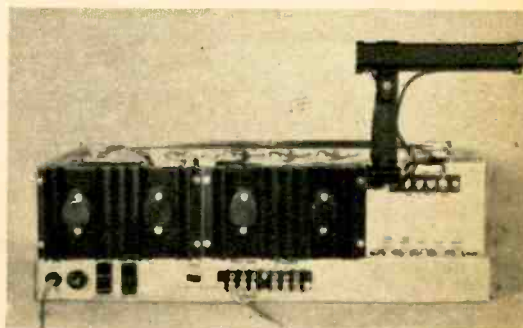
Top view. Test-switch bracket is above power transformer (left). Front-end is in center. At right are AM-FM (top) and multiplex (bottom) boards.

it pins on any input signal in excess of $120\mu\text{v}$ (which normally represents a somewhat weak signal). The FM frequency response measured $\pm 1\text{db}$ from 20 cps to 15 kc. Stereo separation exceeded the test equipment's limit of 39db at 1 kc and was 32db at 5 kc.

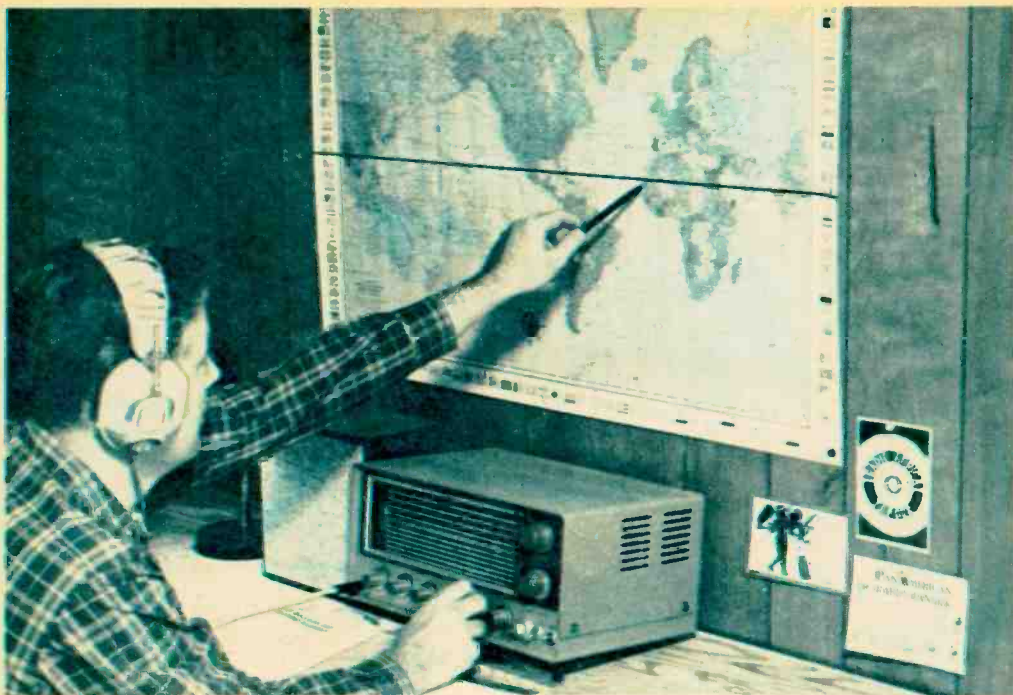
The AM section was outstanding, too, with better-than-average sensitivity, low background-noise level and a good 10-kc whistle filter.

The amplifier performance also, proved outstanding. The power output per channel at the clipping level with both channels driven (the roughest test) was 50 watts (rms) into 4 ohms, 38 watts into 8 ohms and 20

[Continued on page 97]



Back. Output transistors' heat sinks (left are attached to output circuit boards. AM antenna (right, top) can be positioned for best reception.



How to Win Our New DX Award

Secrets of those rare catches on the Tropic of Cancer.

By C. M. STANBURY II

WERE you one of those who uttered a large groan when you read about the Tropic of Cancer Award in the Jan. '71 EI? It's a great award, you say, but how do I get those exotic countries? It's really quite easy. Many of the areas have full time broadcast outlets with programs beamed toward North America. Knowing where to look and when to listen will enable you to have that award for your shack in no time at all.

First, let's recap what you're after. We have established 16 DX areas along the latitude known as the Tropic of Cancer. These areas are: The Pacific Ocean, Mexico, The Atlantic Ocean, Spanish Sahara, Mauritania, Mali, Algeria, Libya, United Arab Republic, Saudi Arabia, Oman, India, Pakistan, Burma, Formosa and Mainland China. To qualify for the award, participants must have verified contact with eight of these areas.

When you're after the Oceans, remember that any DX country within these oceans is eligible, even though it may not fall on the Tropic.

One of the rare catches in SWLdom is also a qualifier for this award. It is the Voice of the Coast (Sawt es Sahil) transmitting on 6040 kc with a sign-on at 2130 EST. This station has had DX experts scratch- [Continued on page 101]

EI'S TROPIC OF CANCER DX GUIDE				
STATION	LOCATION	KC	TIME (EST)	NOTES
XERMX R. Mexico ZNS	Mexico, D.F., Mexico	9745, 11720, 15125	Evenings Night	Apartado 20-100
EAJ202 R. Villa Cisneros	Nassau, Bahamas Villa Cisneros, Spanish Sahara	998	1700-1800	Status uncertain
Radiodiffusion Nationale de Mauritanie	Nouakchott, Mauritania	4850	0200 & 1700	
R. Mali	Bamako, Mali	11960, 15145, 17765	1545	11715 & 17710 also reported
R. TV Algerienne	Algiers, Algeria	6080 9510	1700-1900 0100-0200	Carries Portuguese identity at 1900.
Libyan BC & TV Service	El Beida, Libya	9685 1124 7165	0100-0200 1630-1800	Reports to Triopoli
R. Cairo	Cairo, Egypt (UAR)	9475 9740 1106	Evenings 1700 1630-1800	To North America
Voice of the Arabs Saudi Arabia Broadcasting	Cairo, Egypt (UAR) Jeddah	7215 7220 11855 15150	2200 2200 1200-1500 Various	Reports to Riyadh English
B.B.C. Voice of the Coast	Masira Is., Oman (See text)	6000 9720, 11950 701 6040	2230 S/on 1500 2245 2130 S/on	Reports to London Reports c/o Trucial Scouts Camp, Sharjah
All India Radio	Delhi, India	9912 11850 15335	1630-1730 0730 0830-1000	
R. Pakistan	Bombay, India Dacca, East Pakistan	15080 15520	1300 2115	Reports to Delhi Transmitter frequency drifts
Burma Broadcasting Service	Rangoon, Burma	9725	0200-0230	
R. Peking	Peking, China	Many	Various	Evening transmissions to America on 7125 and 9780 (approx) come from the Tirana relay and are not eligible.
V. of Free China	Taipeh, Taiwan	15125, 15345, 17720, 17780, 17890	2100-2250	To North America
KAIM KORL WWVH	Honolulu, Hawaii Honolulu, Hawaii Puuneme, Maui, Hawaii	870 650 5000, 10000, 15000	0400 0400 Night	Best Sunday AM Best Sunday AM Nat. Bur. of Standards



In your race around the world on the Tropic of Cancer, you'll be running through the Middle East. These are two of the more exotic QSL cards that this area has to offer: E. Cairo on the left and Saudi Arabia on right.



الاذاعة العربية السعودية
SAUDI ARABIAN BROADCASTING



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The Ham Shack

By Wayne Green
W2NSD/1



SLOW-SCAN TV is not really new, yet few amateurs know much about it and hardly any at all are experimenting with it. As more amateurs find out about it, more will try it.

SSTV is a system for sending individual television pictures using a bandwidth of only a couple of kc. This is narrow enough so it is permitted right in the 20-meter phone band. And that is where a good deal of the activity is these days.

It takes eight seconds to receive each picture. This means that you must have a monitor with a very long-persistence phosphor so the top of the picture won't fade out by the time the bottom is received. Since only audio tones are used in the process, the equipment involved is relatively simple to build and the signals can be recorded on a regular tape recorder. Two companies have already come out with monitors, one for \$569 that is solid state, and one for \$298 with tubes (Robot Research, Inc., 1250 Prospect St., La Jolla, Calif. 92037). There are circuit boards available for the roll-your-owners.

The 120-line picture lacks something in definition when compared with 525-line commercial television, but it is adequate for most things.

There are two basic types of cameras being used so far. One is a regular television camera with a converter which uses one frame every eight seconds and just ignores all the rest. This camera, like the monitor, is solid state and sells for \$569. A much less expensive camera system can be made with a flying-spot scanner. This type of pickup can only be used with photographs, drawings and such. The amateur interested in sending his photo, a picture of his shack, his antenna and a QSL card over the air will have no problem with the scanner.

It is likely that as interest in SSTV grows there will be more equipment on the market and that the prices will go down. In the meantime this is an area for the tinkerer to have a lot of fun by building his own monitor and

scanner. It is no more difficult than building an RTTY converter. For that matter, it isn't all that different in design.

Pretty fair pictures can be had by taking a Polaroid of the monitor, using an eight-second exposure, of course.

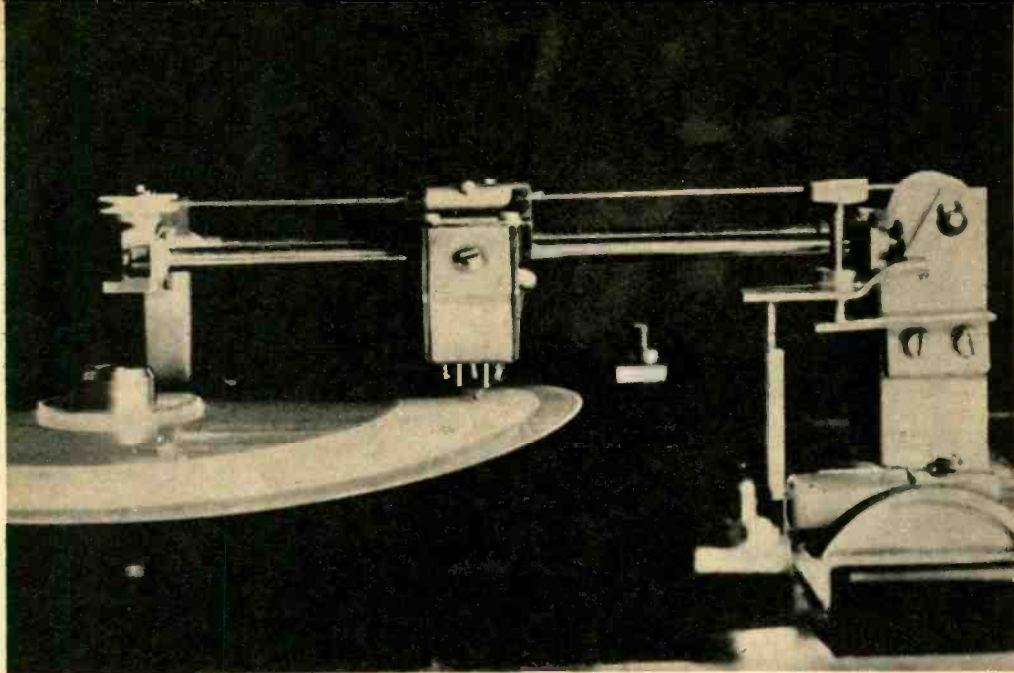
There has been some activity in several countries with SSTV and it should spread rapidly. That is one very nice thing about being able to use this on our DX bands. If you listen around 14230 in the evenings and weekends you will hear the SSTV fellows talking with each other and then switching on their cameras or scanners and sending a few pictures. The SSTV signals sound something like RTTY, going *beedlebeedlebeedle*.

More on the hobby band. By ignoring the nice things that I have to say about them and concentrating on the criticisms that I have leveled, many ARRL members and particularly the folks at HQ have managed to work themselves into an anti-Wayne Green attitude. It is true that I have been critical of some of the things that ARRL has done or hasn't done down through the years. I am beginning to feel that I am about the only person in the world that has had the gumption to say what I think about the ARRL.

One unfortunate aspect of this negative ARRL attitude is that I think that it can be counted upon to wield its influence to sabotage the hobby-band petition, RM-1633.

I really don't know what the ARRL has to kick about. I am having a ball with FM on 146 mc and can hardly wait for the day when 220 is opened to the same kind of operation. I keep a little hand unit by my desk with the squelch turned up so I can hear when anyone comes on any of the repeaters within 50 mi. or so. I often hear passing amateurs break through on 146.94 and talk them in for a visit. No matter where I go in New England I can work out through the nearby repeaters. In Northern New Hampshire I make contacts up to 200 mi. with a hand-held two-watt transceiver. These are through the W1KOO repeater some 50 mi. away. Through central New Hampshire the contacts are through W1ALE in Concord. In the Southern end it's through K1JZH.

Just as I was writing this paragraph my little hand unit spoke up with K6MVH/1 calling in from his car in a town six mi. away. He wanted to know where to find a particular store. I told him. What a wonderful system. Won't it be great when anyone can do something like this? —



Electronics in the News

THE DISC RIDES AGAIN. Not to be outdone by tape, AEG-Telefunken has developed a TV recording system that uses a special turntable and disc. The record turns at 1,500 rpm and will provide a 12-min. color program with stereo sound on a 12-in. disc. The new system has 100 times the storage capacity of a normal LP.



The Growing Cassette. The audio scene has been revolutionized by the introduction of the cassette. Now Video Systems Corp. has introduced a computer tape memory recorder that employs the standard Philips C-60 cassette used in audio equipment. The Termicord can handle 850,000 bits of information. This may open the way for computers in the home.

Breadbox Pinger. Finding your way in a small boat is just as important as it is in an ocean liner. Unfortunately it used to require an enormous amount of space to house a radar system. Raytheon's 2900 radar is fully transistorized and weighs only 48 lbs. so that it can be mounted conveniently right on deck. The antenna assembly is equally compact—only 33½ in. in dia.





Say Ah and Hold It. One of the most elementary measurements a doctor makes is often the hardest to take. Waiting for a conventional thermometer is time consuming and often dangerous. Diagnostics Inc. has a new electronic thermometer that uses a thermistor contained in a sterile probe which gives an accurate indication of body temperature in less than five seconds. —♦—



CB Corner

By Len Buckwalter, KQA5012

CB Lobby in Washington

THE Electronic Industries Association (EIA), an influential organization of manufacturers, is about to call for major changes in CB rules. It's too early to know what exact recommendations the group will present to the FCC, but informed sources say that ham radio and frequency allocations could be part of the recommendations. The move is designed to soothe CB's chronic illness—overcrowding.

It is not likely that the EIA will call for a bigger slice of the frequency pie. Any such demand would surely fizzle because ambulances and airplanes are also crying for more channels. EIA's approach may be more like the lady squeezing into last year's corset—she disappears in one area, but pops out in another.

One possible suggestion that the EIA might offer is a tightening of CB rules, with a simultaneous loosening of amateur requirements. This could tip the numbers balance toward ham radio and infuse it with former CBers. The belief is that this move would relieve overcrowding and abuse which now abound on 27 mc. The ex-CBers could ragchew endlessly or work skip (winning certificates, not condemnation) while the CB band could be a medium for short-range communications as originally designed by the FCC. It's an old proposition with much merit, but one that'll have to overcome monumental obstacles in Washington.

The killer, it seems, is the code requirements for a ham ticket. It's only 5 wpm for the Novice license and it can be mastered in about six hours by nearly anyone. Yet, mention code to CBers and you trigger instant apathy.

Meanwhile, good luck to the EIA. Although it has a difficult case to prove, the organization is becoming somewhat of a champion of CB causes. (It has, of course, a stake in keeping the marketplace healthy.) One EIA spokesman reports he receives many letters for help from CB clubs around the country. The reason, he believes, is that CBers have no other place to turn to. He pointed out one issue now bothering CBers—widespread discontent over the recent Channel 9 ruling. Since the FCC has set aside the

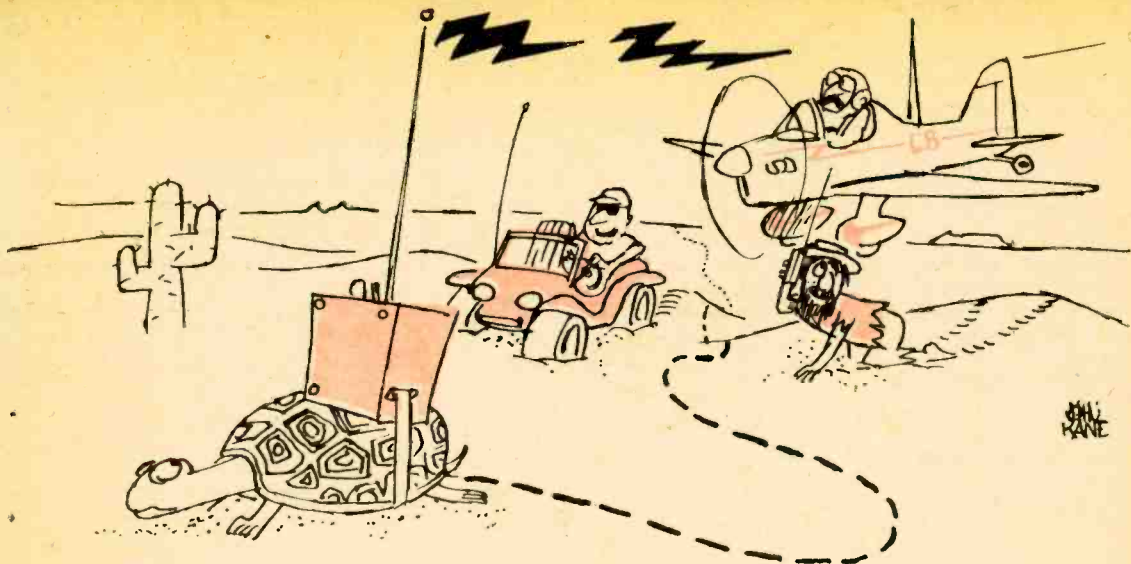
frequency solely for emergency and related traffic, a station cannot call an operator engaged in steady monitoring. CBers would like to see a modification in the rule that would at least allow one station to call another, then both would move from 9 to another channel. The only relief in sight is a new generation of receivers that automatically insert 9 into the speaker, even when the rig is communicating on another frequency.

Besides involvement in CB's operational problems, EIA will soon make news in the purely technical area. It's preparing a set of technical standards for CB equipment. It will be an industry, rather than governmental action, but it could have a beneficial effect on the products of all CB manufacturers. We'll report on the new specifications as soon as they're released.

Whip Tip . . . Most CB operators boast a directional mobile antenna but few are any the wiser. For though the car's whip is intended to transmit equally well in all directions, this happens only in books. Trouble is that unless the car roof is distributed equally under the whip, it acts as a lopsided groundplane (the signal builds up over the longest metal path). The result is that if the antenna is mounted at the front right of the car, the strongest signal is directed to the rear left.

While there's no great range difference in any direction, there could be just enough to get a message through when conditions really are rough. This means that it well could prove important to know your most favorable transmitting direction in case of emergency. Finding out is as easy as flipping a switch.

Simply drive away from your base station until your signal reads about S3 or S4 on the base receiver. This done, try to locate a nearby area where you can drive in a tight circle. As you turn slowly, ask base for S reports. Readings at about eight points around the circle should reveal which direction the car should face (in relation to base) to make the most of your mobile's built-in beam effect. Just take care to conduct the test away from overhead power lines, which could misdirect the signal and give false results. —



The CeeBeeper

It's a fun game—like looking for a needle in a haystack. Here you must find the hidden flea-power transmitter.

By LESLIE POWELL

NEXT time the CB club has a special meeting, extended coffee break or a jamboree and there's a door prize, make the winner work for his bounty by holding a treasure hunt.

Here's how you do it. Hide the CeeBeeper (a pulsed-output 100-mw transmitter) in some far-off place and let the members hunt for it using walkie talkies or full fives to pick up the signal. First person to find the Beeper gets the prize. If you hide the Beeper well, you're in for hours of fun.

What adds extra challenge to the hunt is that the Beeper doesn't put out a continuous signal which could be tracked down easily. Instead, it transmits a signal for about three seconds and then goes off for five seconds. Even the best S-meter jockeys aren't going to make much headway in three seconds.

If you find the club members can't even move in three seconds, a simple part change will lengthen the on-time to five seconds, while retaining the off-time ratio. To avoid confusing the Beeper's signal with heterodynes on the channel, the Beeper's tone sweeps up in frequency when the signal goes on to produce a *weee-ooop* sound.

Contacts between mobiles are permitted, but the Beeper's channel should be kept clear. The mobiles will be working on the Citizens Band but because the Beeper's power is less than 100 mw, it operates in the parallel License-Free Band. This makes such hunts legal.

You could even put the Beeper in the car of a non-CBer (so the car can't be identified) and feed its signal out the car's antenna. Then have the mobiles try to find him while driving through town.

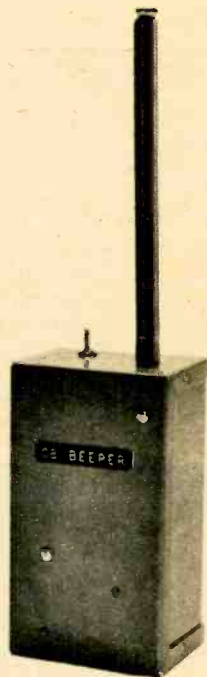
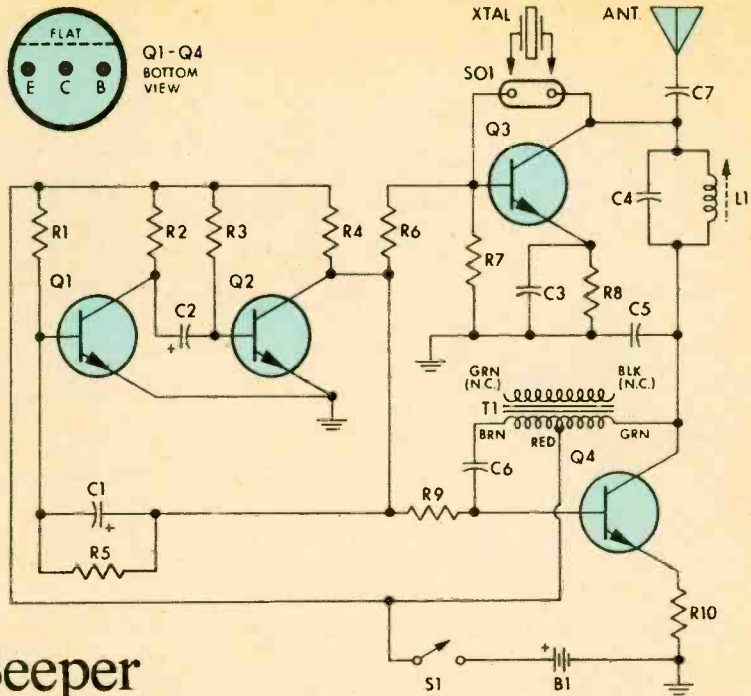


Fig. 1—100-mw crystal-controlled transmitter is built in small Mini-box. The collapsed whip antenna extends to 5 ft., the maximum length which is permitted by the FCC.

Fig. 2—Beeper consists of RF oscillator (Q3) that uses third-overtone CB crystal, audio oscillator/modulator (Q4) and multivibrator timer (Q1, Q2). Q3, Q4 get turn-on base bias from Q2's collector via R6, R9. When Q1 is on its collector voltage is almost zero and Q2 is off. Q2's collector voltage is high and it biases Q3, Q4 on. When multivibrator flips, Q1 goes off, Q2 comes on and its collector voltage drops turning Q3, Q4 off. Parts specified give approximate three-second on, five-second off ratio. On time can be increased to about seven seconds by using 15,000 resistor for R5.



The CeeBeeper

And the Beeper is ideal for CB Civil Defense searches and rescue drills.

In order to comply with the FCC's non-interference rules, don't let the Beeper or the hunt activities interfere with normal CB communications.

The Beeper is a license-free transmitter whose design and operation are subject to the FCC's Part 15 Regulations. This means input power must be less than 100 mw (it is) and the antenna must be no longer than 5 ft. It can operate on any of the CB channels (except channel 1) using a third-overtone CB

crystal. Be sure to sign and paste the Certificate of Compliance in Fig. 6 on the back of the Beeper's case.

Construction. The circuit is assembled on a 2¼ x 3 in. printed-circuit board which is mounted in a 5¼ x 3 x 2⅞-in. aluminum cabinet. The board is a stock size supplied in the Calectro 22-296 printed-circuit kit; the remaining kit supplies are used to make the board.

Using steel wool or a household cleanser such as Ajax or Comet, scrub the copper foil

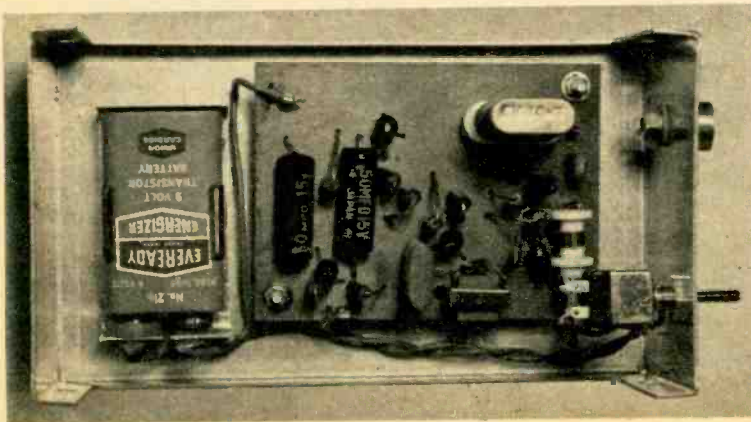


Fig. 3—Mount board toward top (right edge) of cabinet to allow room for L1's adjustment screw on opposite side of board. Keep S1 as far as possible from coil L1

PARTS LIST

B1—9 V battery (Burgess 2U6 or equiv.)
Capacitors: 100 V mylar unless otherwise indicated
 C1,C2—50 μ f, 15-V electrolytic
 C3,C5—.001 μ f
 C4—39 μ f, 100-V silvered mica
 C6—.25 μ f
 L1—1.0-1.25 μ h sub-miniature adjustable RF coil (J. W. Miller 40A106CBI)
 Q1,Q2—2N3394 transistor (GE)
 Q3—2N3860 transistor (GE)
 Q4—2N3393 transistor (GE)
Resistors: $\frac{1}{2}$ watt, 10%
 R1,R3,R6—100,000 ohms
 R2,R4—1,800 ohms
 R5—27,000 ohms (see text)
 R7—10,000 ohms
 R9—22,000 ohms
 R8—150 ohms
 R10—15 ohms
 S1—SPST switch
 SO1—HC-6/U crystal socket (Lafayette 42 F 09011 or equiv.)
 T1—Transistor output transformer; primary: 500 ohms center tapped; secondary: 3.2 ohms (Lafayette 99 F 61277)
 XTAL—Third-overtone CB transmit crystal
 Misc.— $5\frac{1}{4}$ x 3 x $2\frac{1}{8}$ -in. Minibox, 43-in. telescoping antenna (Lafayette 99 F 30405)
 (Note: Coil L1 is available for \$3.70 plus 50¢ for postage and handling from Custom Components, Box 153, Malverne, N.Y. 11565. Canadians add \$1. N.Y. State residents add sales tax. No foreign orders.)

so it is spotlessly clean. Then place a piece of carbon paper, carbon side against the foil, over the board and tape the board in place under the full-scale template in Fig. 5. Using a sharp punch or ice pick, indent the copper at the indicated component lead locations by forcing the point of the tool through the template, through the carbon and into the copper foil.

Then, using a ball-point pen, trace the outlines of the foil areas. Remove the carbon from the board, and using a fine-point artist's brush and the resist supplied in the Calectro kit, cover the desired foil areas with a layer of resist. Immerse the board under about $\frac{1}{4}$ in. of resist solution for 45 minutes and agitate frequently. Then check to determine if all undesired copper is removed.

If it isn't, reimmerse the board for five-minute intervals. When all the undesired copper is etched away, rinse the board thoroughly under running water and remove the resist by scrubbing with steel wool or use a rag dipped in acetone. Then drill the component mounting holes.

Drill the holes for transformer T1's mounting tabs with a No. 27 bit. Crystal socket SO1 requires a No. 36 bit. The output and power-supply connections use a No. 48 bit (for Vector T28 terminals). All other com-

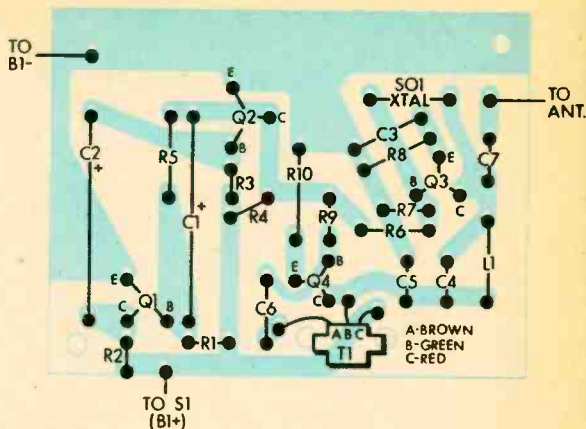


Fig. 4—X-ray view of board shows location of parts. Mount resistors vertically to conserve space. Note how they're mounted in photo in Fig. 3.

ponent holes should be drilled with a No. 58 bit.

Assemble the board in the following order to avoid damage to the transistors. (Do not use a soldering iron rated higher than 50 watts.) Solder 1-in. solid No. 20 or No. 22 wires to L1's lugs and then install L1 on the board; press L1's terminals against the board. Position T1's tabs in the mounting holes and then fold the tabs over with long-nose pliers. Check to see that T1's tabs do not touch the foil. If they do, cut the foil away so there is no contact with T1's tabs.

Install Vector T28 terminals for the supply — and + and the output terminal.
 [Continued on page 100]

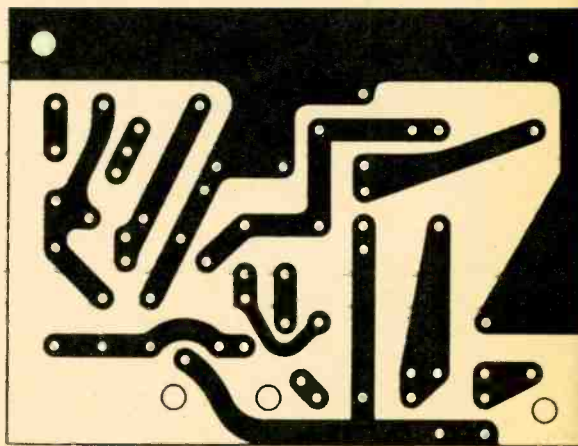
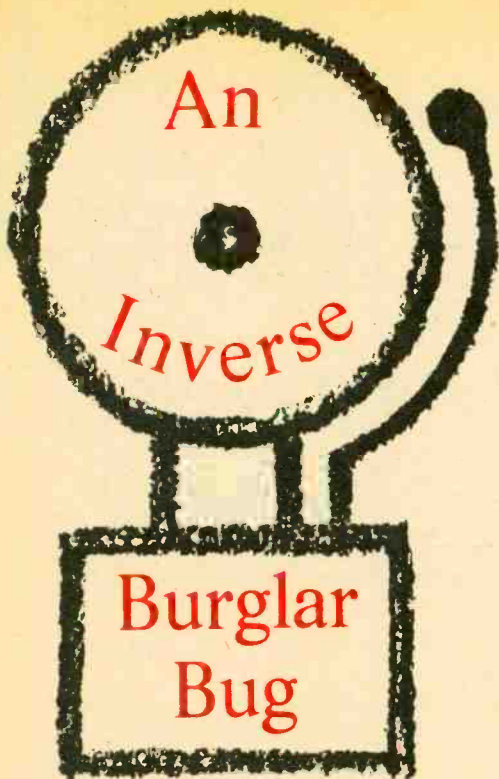


Fig. 5—Full-scale board template. Two large holes at bottom (left of center) are for T1's tabs. Upper-left and lower-right holes are for mounting.



By **JOSEPH RITCHIE** ANY cop will tell you, the number of burglaries—by both pros and amateurs—is going sky high. Even if your house doesn't have a giant color antenna and a Cadillac parked outside, it is still fair game for the hophead out for anything that can be converted to cash.

EI's alarm will not only give you the protection you should have, it offers several features not available at ten times its cost, and is as reliable as the best commercial alarm. First, the cost. The alarm can be brought in for well under \$5, excluding the box and battery. You can customize any installation with no difficulty. Second, the alarm will handle both closed- and open-circuit bugs (intruder detectors).

Most intruder detectors are for normally-closed or series circuits. This means every bug, switch, wire, etc. is connected in series. Breaking the series connection trips the alarm. Since burglars are just as smart as you, they have learned to short the circuits; therefore, some new systems use normally-open circuits where all normally-open switches, etc., are connected in parallel. A forced entry, or a deliberate short, trips the alarm. But you cannot protect glass or wall

areas with open-circuit bugs such as a length of wire.

For maximum protection you need an alarm that will turn on a bell when either a normally-open switch is closed or a normally-closed switch is opened. Our alarm is set off by either condition, hence we call it an Inverse Burglar alarm. To illustrate: with our alarm, doors, basement windows and hallways can be protected with open-circuit bugs. An ordinary matswitch placed under the carpet at a patio door would be closed by an intruder walking through the doorway.

Conversely a glass window can be protected by a series-connected foil, while a wall (that could be broken through) can be protected easily by stretching a series-connected fine wire across it. Someone breaking through the window, or even the wall would break the series (normally closed) circuit.

The alarm is completely solid state. There are no relays to develop intermittent contacts (contact resistance) because of lack of use. The control device is a silicon controlled rectifier, SCR1, which locks-up the alarm bell once a bug is tripped. Even if the protective wiring is cut, the alarm bell cannot be silenced other than by master switch S1. Power for both the control unit and the alarm bell is provided by lantern battery B1. Since the normally-closed circuit requires less than 180 μ a standby current, B1 will deliver its shelf-life of at least one-year in standby service.

Construction

The circuit is built on a 3¼ x 4½-in. piece of Keystone G-pattern perfboard. Vector

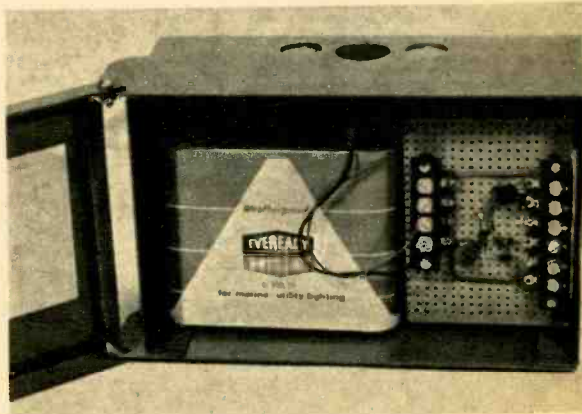


Fig. 1—A standard 4 x 6 x 9-in. electrical box will easily accommodate control board and lantern battery. Connections are shown on box's cover.

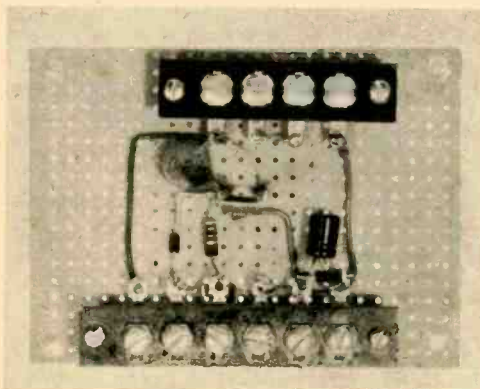
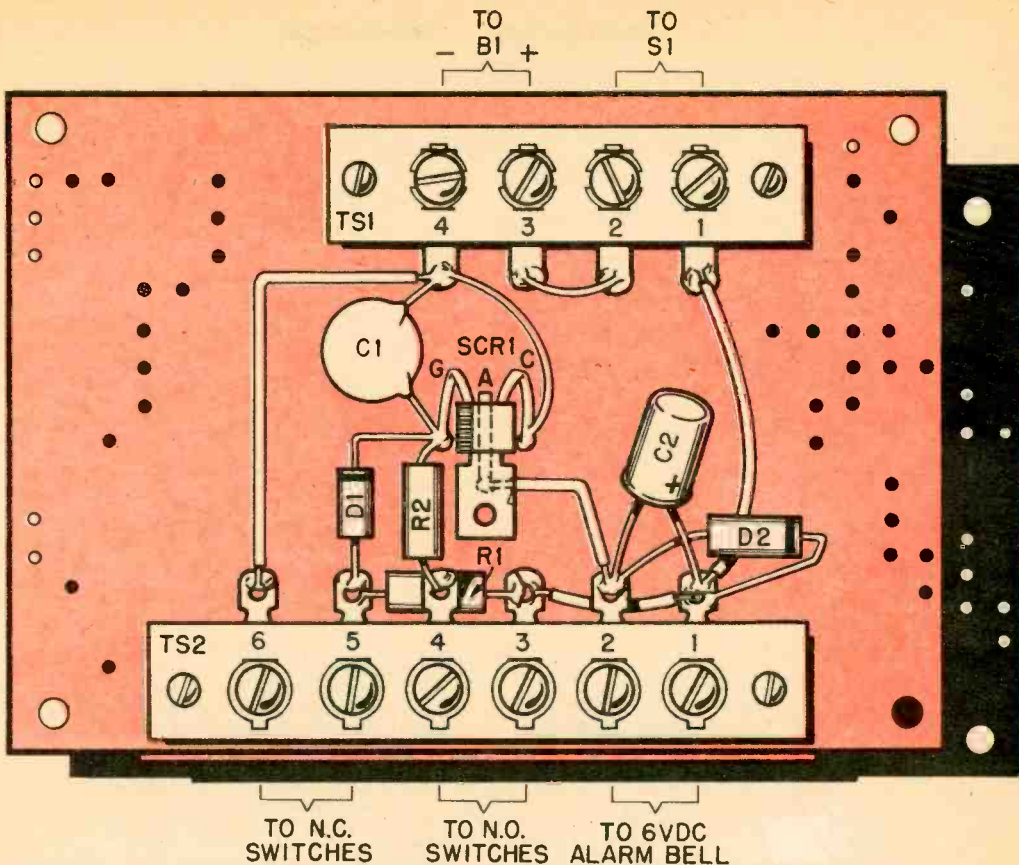


Fig. 2—Complete circuit is built on 3½ x 4¼-in. piece of perforated board. Mount screw-type terminal strips above the board using ½-in. spacers.

type T28 terminals are used for tie points, and screw-type terminal strips used for the external connections. The cabinet shown in Fig. 1 is a standard 4 x 6 x 9-in. electrical box.

Mount the terminal strips on both sides of the board as shown. It is easier to install them by using ¼- or ½-in. standoffs under

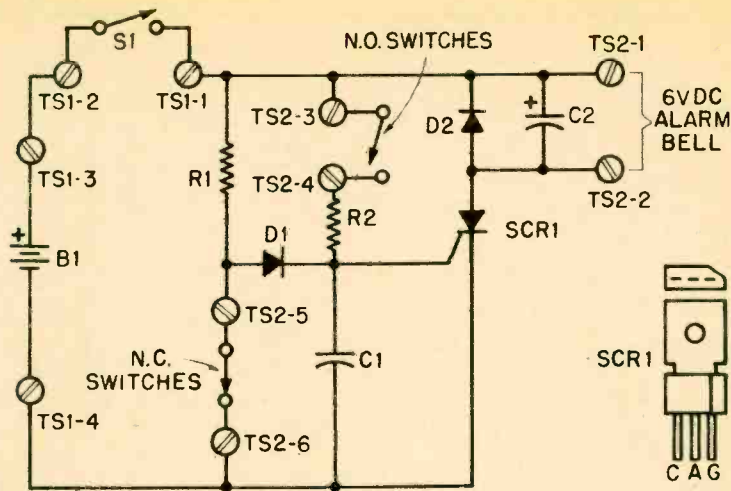
Fig. 3—SCR's lead spacing just matches the G-pattern perf-board hole spacing. Use just enough fan-out to allow the SCR's leads to drop in T28 terminals. Watch polarity when connecting C2, D1, D2.

the mounting holes rather than cutting through the board for each individual terminal.

Position SCR1 midway between the terminal strips. Carefully note the SCR's connections; the tab sticking out the top is connected to the anode lead and must not touch any other lead, component or the cabinet. Looking at the bottom of the SCR you will note that one end is flat and the other has a point. The lead closest to the point is the gate. To simplify the SCR's mounting, fan-out the leads so that the gate and cathode face the four-screw terminal strip while the SCR's center (anode) lead faces the six-screw terminal strip.

Carefully note D1's and C2's connections. Diode D1's cathode end, the end marked with a band or symbol, must connect to the SCR's gate. Capacitor C2's positive terminal connects to the battery power source while its negative end connects to the SCR anode. Also take extra care with D2's polarity: if it

Fig. 4—Normally-open bugs hooked to TS2-3, TS2-4 prevent trigger current flow through R2. Normally-closed bugs hooked to TS2-5, TS2-6 short R1 to ground to keep trigger current off SCRs gate. When normally-open bugs close, current flows through R2, SCR turns on, bell rings. When normally-closed bugs open, current flows through D1, R1, SCR gate and SCR turns on. D2 protects SCR against bell's kick-back voltage. C2 provides hold current so SCR won't turn off after break of bell current.



is reversed the alarm-bell current will be bypassed by the diode and the bell will not ring.

While any 6-V power source can be used, a lantern battery is suggested as it will deliver at least one year's dependable standby service. The alarm's 180- μ a standby current is insignificant and a lantern battery will last almost its rated shelf life.

Installing the System

Locate the control box in the basement, a closet or any other concealed place. The master switch can be located anywhere in

Fig. 5—Use button switches on windows and doors if wiring can be concealed. When door or window is closed, button is held in off (open) position.



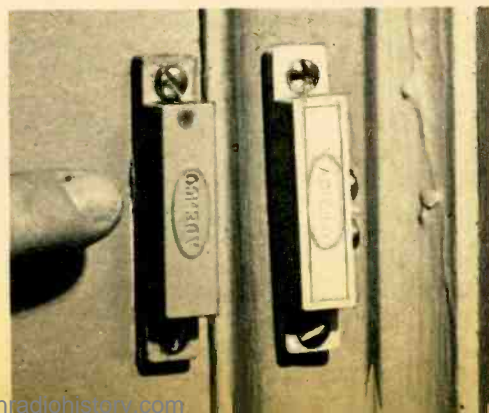
PARTS LIST

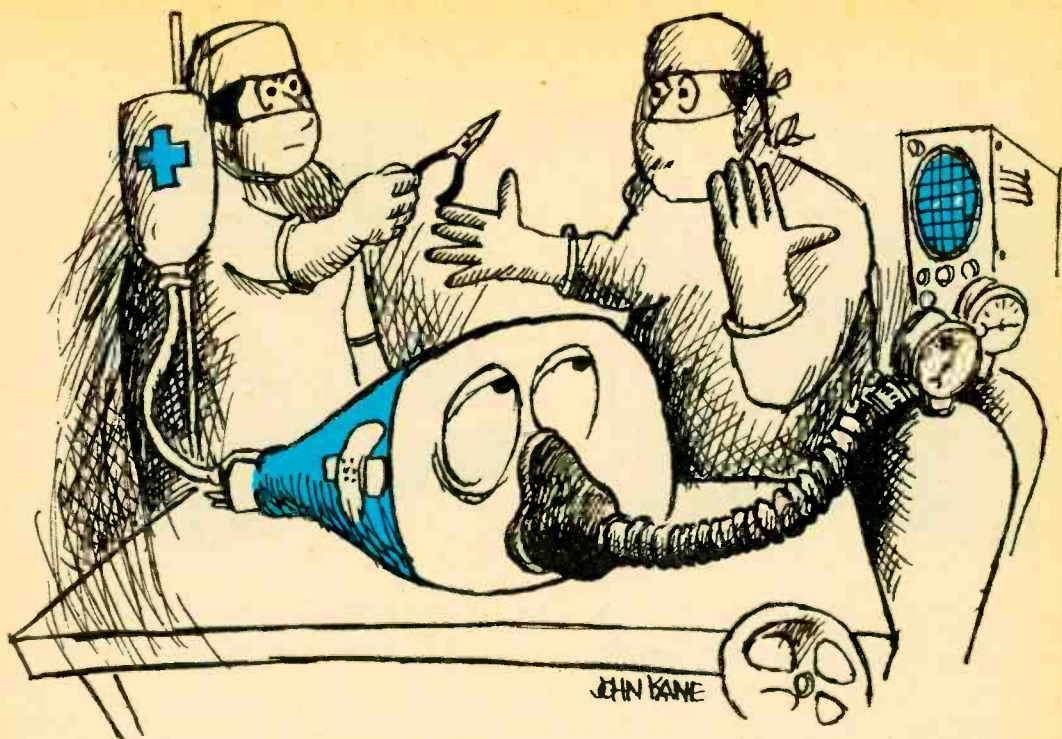
- B1—6 V lantern battery (see text)
 - C1—1 μ f, 100 V disc capacitor
 - C2—30 μ f, 15 V electrolytic capacitor
 - D1, D2—Silicon rectifier; minimum ratings: 200 ma, 200 PIV
 - R1, R2—47,000 ohm, 1/2 watt, 10% resistor
 - SCR1—C106Y1 silicon controlled rectifier (GE)
 - TS1—Four-screw terminal strip
 - TS2—Six-screw terminal strip
 - Misc—cabinet, perf. board
- (An alarm installation manual is available for \$2 plus 50¢ postage and handling from Custom Components, Dept. 32, Box 153, Malverne, N.Y. 11565. N.Y. State residents add sales tax. No foreign orders.)

the house, with its leads run to the control box. Install protective devices on the doors and windows shown in Figs. 5 and 6. Use either a keyswitch at the entrance door to bypass the door's circuit, or make the door switch the master switch.

Bugs are available from Allied Radio Shack and Lafayette Radio Electronics.

Fig. 6—Two-piece magnetic bugs are the easiest to install. The bug will trip when an opening door or window moves magnetic piece out of way.





How to Stretch the Life Of a Picture Tube

When the picture tube is going, you're in for a big pinch in the pocketbook. Your old tube can live again with a CRT rejuvenator.

By ART MARGOLIS

YOU'VE heard the story. The picture tube goes on a guy's set so he spends the rest of the football season at the tavern because he can't afford a new tube. His kids forget what he looks like and, well, like that. Too bad the chap didn't know about CRT tester/rejuvenators. Those little miracle makers can give the senile tube and its morose owner a shot right from the fountain of youth.

A CRT tester/rejuvenator performs three basic functions with a bad tube. First, it analyzes exactly what the defect in the CRT is; second, it provides the necessary voltages to effect the repair and, third, it makes a life expectancy test that tells you whether the repair is going to be permanent.

A good CRT tester is relatively inexpensive and can be purchased for an outlay of between \$70 and \$130. Five excellent testers are the \$129.95 B&K Model 466 (Fig. 1), the Eico 633 (\$99.95) shown in Fig. 2, the Lectrotech CRT-100 (\$89.50), the RCA WT-509A (\$118.00) and the Sencore CR143 (\$119.50).

How to Stretch the Life Of a Picture Tube

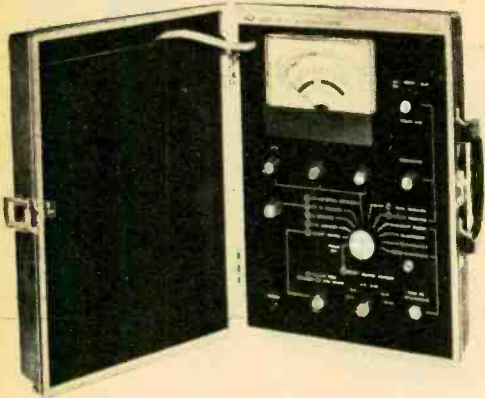


Fig. 1—Model 466 CRT tester/rejuvenator from B&K. The 466 offers monitored rejuvenation which permits a direct reading of the cathode emission.

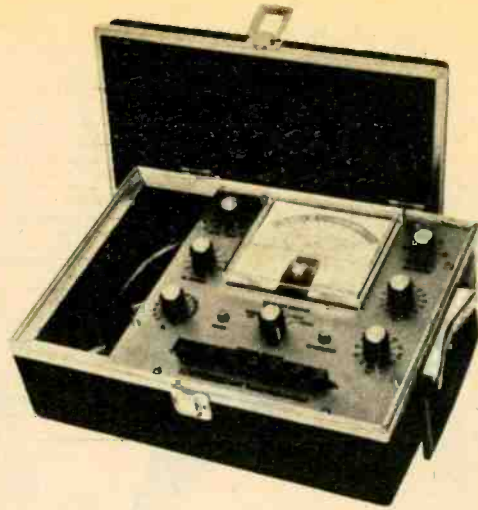


Fig. 2—The Eico 633. This tester is available in both kit and wired form for \$69.95 and \$99.95 respectively. The 633 will work with most new tubes.

The Eico 633 also comes in kit form for only \$69.95. The kit is a good idea since in addition to the saving you'll gain that much more familiarity with your tester if you build it yourself.

You can repair those troubles that occur due to defects in the CRT's electron gun or electron guns in the case of color tubes. The troubles that cannot be fixed are those that occur in the rest of the CRT, like a buckling shadow mask or high-voltage shorts in the anode-well area. Fortunately most CRT failures fall in the electron-gun category.

In each electron gun there is a heater winding that is built to glow hot with 6.3 V applied to it. Around the winding is a ceramic sleeve (Fig. 3) that gets hot from the heaters. Around the sleeve is the cathode structure. Coated on the cathode is a chemical such as barium oxide.

The cathode is thus electrically insulated from the heater but thermally attached. It gets hot and the chemical coating releases electrons into the vacuum around the cathode. In a color picture tube there are three such guns with their heaters wired in parallel.

A heater-to-cathode short occurs when a hole develops in the ceramic sleeve and permits the heater to contact the cathode. The heater circuit's DC voltage level is at ground level while the cathode DC level is up above 100 V. The short brings the cathode down to the heater (ground) level. What happens to the TV picture?

In a b&w TV, the picture becomes overly bright, gets retrace lines, loses some focus and manipulation of the brightness control produces no reaction. In a color TV, the b&w components of the picture disappear and only a smeary color picture remains. It is called *No Y Signal*.

Sometimes the trouble is constant, but most of the time the trouble is intermittent. If you tap gently on the CRT neck you can get the short to clear and reappear at will. Unfortunately though, you can't get it to clear permanently.

The CRT tester becomes useful at this point. It will analyze the CRT gun for you and tell you definitely whether or not you have a heater-to-cathode short. This is important because there are lots of other causes for these symptoms. The tester is attached to the CRT and indicates short or not. If it's an intermittent trouble, gentle tapping of the neck of the CRT or waiting for the trouble to occur is necessary. If the tester blinks *short*, you've got yourself a short.

That's all you do with the tester. Don't try to relieve the short with any of the tester's special voltages! All you'll do is blow a bigger hole in the ceramic. These voltages are for another type of short.

The repair is easy. You must isolate the heaters from the DC (ground) level. If you can do that, the cathode DC voltage will return to normal and the heaters will then be at the cathode level because of the short.

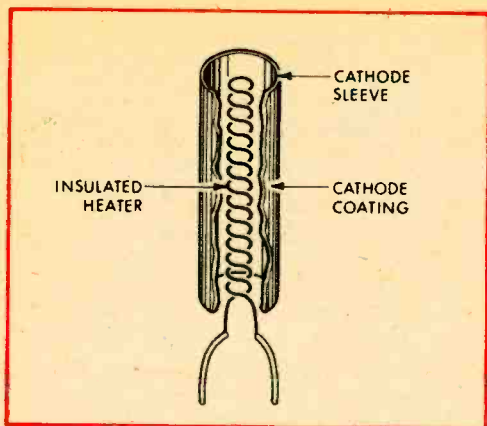


Fig. 3—An artist's rendering of the cathode and heater of a tube. It is between these two parts that a lot of difficulties with shorts will occur.

You can use either a filament transformer that will step 117 V down to 6.3 V at 1 A in b&w sets or a 2 A version for color (Fig. 4). You can also use a CRT isolation transformer that plugs between the CRT's socket and base. Either one will isolate the heaters. The difference being that with a filament transformer you are giving the heaters their own private heater supply, while the isolation transformer uses the TV's own supply provisions.

CRT isolation transformers can cost you about \$5 for a b&w model or up to \$15 or \$20 for a color type. To purchase it, take the number of the picture tube and buy the transformer that is made for that number tube. This is important for there are many types of transformers. Only the right one will physically fit your particular CRT. Typical brand names are Perma-Power, Telematic, Antronics and CBC. They can be purchased from electronic supply houses like Lafayette Radio, Allied Radio Shack, etc.

This heater-cathode repair is instantaneous and permanent. However on some occasions you might run into one of two complications. The first is, once you install the isolation transformer, you lose your brightness altogether. Don't get scared. It can be remedied quickly.

What has happened is, the cathode has become broken at the point of the short. There was brightness on the screen due to the fact that the cathode circuit was completed through the short. When you isolated the heaters you opened up the cathode circuit. All you have to do is take a little piece

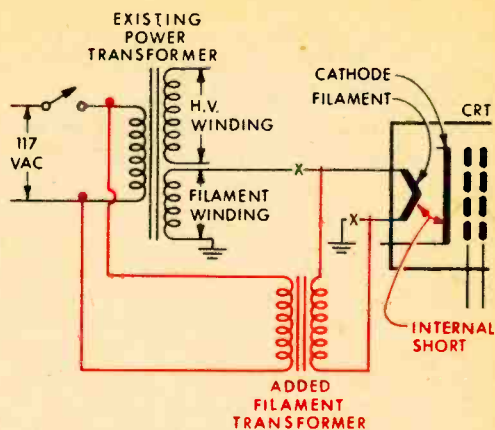


Fig. 4—Procedure for fixing a filament-cathode short is shown. Isolation of heater by added transformer brings cathode DC level up from ground.

of wire and short the cathode pin on the CRT to one of the heater pins (Fig. 5). That restores the cathode circuit.

The second complication happens when the short introduces unwanted capacitance into the electron gun. You'll see it, because every time it shorts, the picture smears and defocuses. When this happens, give up, your repair is not taking.

While the heater-to-cathode short requires you to halt and isolate, other shorts in the electron gun dictate further action with the CRT tester. This is due to the reason for the shorts.

While the heater and cathode have a ceramic sleeve separating them, the rest of the elements have a vacuum separating them. The spaces are tiny, but these spaces must be maintained. They are designed to within a few thousandths of an inch.

During manufacture guns are assembled in an atmosphere as dust free as possible. The same goes for the rest of the CRT assembly. As careful as manufacturers are, pure dust-free conditions are impossible. As a result, minute bits of dust, chemicals and metal do end up inside the picture tube.

As a picture tube is used, the electrical activity causes movement of the components. Eventually some particles may end up in the spaces between the elements in the electron gun. When they lodge solidly you have a short. What happens on the TV screen?

It's all according to the severity of the short and where it is. When a short develops between the cathode and control grid an overly bright picture can develop. If the

How to Stretch the Life Of a Picture Tube

short is between the control grid and screen grid an overly bright picture can again occur. Should a short get between the screen grid and focus grid you can lose the brightness altogether.

At any rate, when you suspect a short in the electron gun you can analyze with the CRT tester. The tester will show where the short is, such as cathode to control grid, control grid to screen grid, etc. When you are sure of the fact that a short does exist in the picture tube gun—prepare to blast. The machine has different blasting voltages available.

First, you can raise and lower the heater input voltages. The range is from 2 V to 12 VAC. Second, you can charge up an electrolytic capacitor inside the tester, that will give you a discharge of about 1,000 VDC.

The machine puts the 1,000-V discharge into the electron gun through the control grid. That way a short to the cathode or a short to the screen grid is dispatched with the same control settings (Fig. 6).

There is usually a setting called *remove shorts*. The procedure is simple. Once it is determined a short other than heater-to-cathode exists in a gun, set the function switch to *remove shorts* and press the red blasting button. A 1,000-V shot will flash across the material that is causing the short and will burn it away. The *remove short* function turns off the heater voltage so the short is blasted in a cold electron gun. If the short is stubborn you can heat up the electron gun with a higher than normal voltage, say about 9 V, then turn the switch

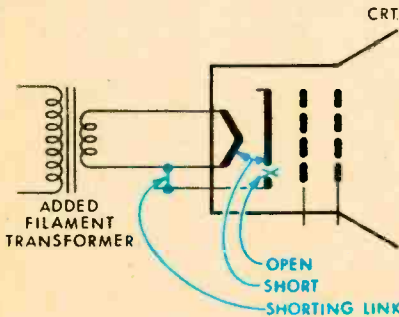


Fig. 5—After filament-cathode short has been taken care of, an open cathode circuit may result. Fix with shorting link from cathode to filament.

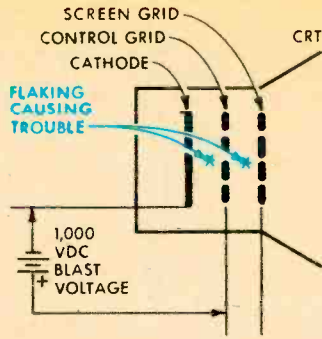


Fig. 6—Because of impurities in manufacture, dust may be in tube. When this shorts the elements, a 1,000 VDC blast from rejuvenator will clear path.

to the *remove short* position.

Wait for the heaters to go out and press the blasting button. Most of the time a cold or hot blast will do the trick. When it won't, the elements themselves have actually shorted and the tube must be discarded. In fact the elements are probably welded together.

Rejuvenation. The commonest way a picture tube dies is simply that the picture gets darker and darker. There is a full picture, good sync and all controls work except the brightness will not reach a comfortable viewing level. Usually you'll notice that as you advance the brightness control the white portion of the picture becomes a shimmering silver.

The first time that happens chances are better than nine to one that you can rejuvenate the tube and restore brightness to normal. That is, if you have a CRT tester/rejuvenator. What has happened in these cases is a poisoning of the top layer of the barium oxide coating on the cathode. Also some of the corrosion has gotten onto the control grid and the screen grid.

The corrosion is very porous and although it has formed in the electron stream path of the gun, some of the electrons do manage to work their way through the mess and reach the phosphor on the CRT screen. This is enough to give some light but not enough.

The rejuvenation procedure is similar to the short-removal procedure but not the same. You should not rejuvenate a tube during a short procedure unless it really needs it. Otherwise you'll burn off some of the good cathode-coating material. A tube can only take a rejuvenation once or twice. More than that takes you down to the bare cathode which kills emission altogether.

Anyway, here's the rejuvenation procedure. Inject about 9 or 10 VAC into the heaters instead of its designed 6.3 V. Don't worry about burning out the heaters. They are rated 100 per cent over 6.3 V and can take 12.6 V easily. Should they burn out during this procedure they were going to blow shortly anyhow.

The heaters will glow much brighter than usual. Let them glow like this for at least 30 seconds. The overheating causes the cathode coating to boil a bit, which reshuffles its layers and drops off some of the corrosion. Also the rest of the gun gets hot which boils off the corrosion on the control and screen grids.

Next turn the function switch to *remove shorts*. The heaters will lose their voltage and begin to go out. While the heaters are on, electrons are released from the cathode and form a space charge around it. As the heaters go dim the space charge gradually returns to the cathode. Just at the point where the heaters are about to be extinguished, press the blasting button.

This puts the 1,000 VDC instantaneously on the control grid. The 1,000 V attracts the balance of the space charge and all the electrons that are settling back into the cathode material. The electrons, to say the least, are attracted mightily toward the control grid. As they zoom toward the control grid, much faster than normal, they strip the top layer off the cathode material. Since the top layer containing the corrosion has been removed, a fresh layer of barium oxide is exposed. The cathode can now emit electrons in normal fashion.

The 1,000 VDC also burns off most of the other grid's corrosion as it arcs across the vacuum. If you are watching the CRT neck, you'll see the sparking. At this point, stop! Don't do it again hoping to get even better results. Turn on the TV and watch. A normally bright picture should appear on the face of the CRT.

On some occasions, the CRT is too old or rejuvenation has been tried before, and although an improvement has been made, the picture still is not as bright as you like. In these cases install a CRT brightener. Chances are good this will restore brightness. If it brings it up somewhat, but still not enough, try two brighteners in series. Sometimes that will do the trick.

Brighteners are readily available and are sometimes called boosters, although this

name is misleading. They can be purchased from the same parts supply houses mentioned above and usually cost about \$3 for b&w versus \$10 or \$15 for color CRT types. Again you must have the CRT number in order to be able to purchase the right brightener. There are many different types for parallel heaters, series heaters, different size CRT bases, and different deflection angles for both monochrome and color. The key to it is the CRT number.

Life Expectancy. After rejuvenation you can give the tube a life expectancy test. Simply check the emission. The needle should rise well into the *good* range. Then flick the *life expectancy* button. This removes the heater voltage.

If the needle slowly heads for zero the tube has a good thick cathode coating and its future life looks good. Should the needle quickly head for zero, the cathode is shot and the rejuvenation won't last long. Anything in between rates the tube accordingly.

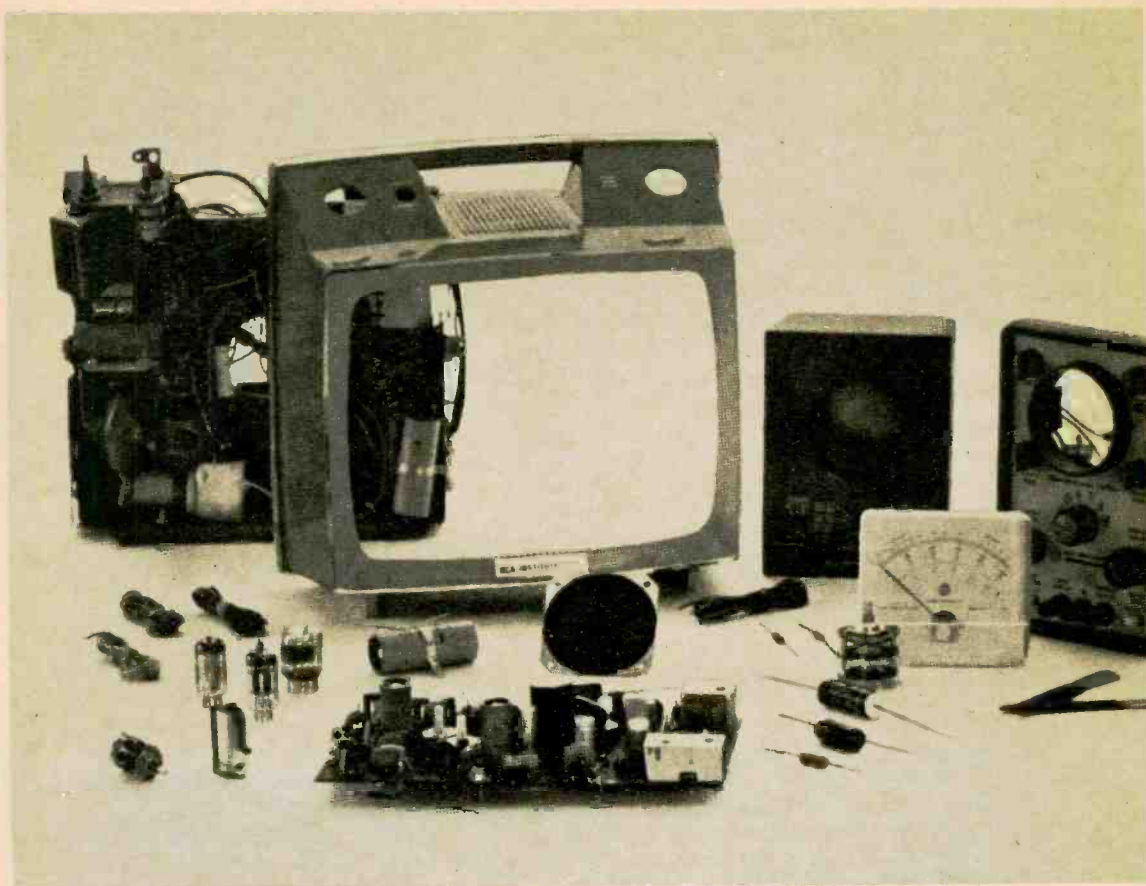
The last kind of trouble that can befall a picture tube is an open element. If there are open heaters inside the picture tube there is no choice except to replace the tube. If the heaters disconnect from the pins in the plastic base, reattach the heater wire to the pin with a drop of solder.

When the cathode, control grid or screen grid has opened up inside the CRT, you have a 50-50 chance of effecting a repair with the help of the CRT machine. The machine will blink its neons and tell you if there is an open element and which one it is. It doesn't matter though, the repair is the same.

While watching the neon, tilt and rotate the tube to see if there is any point in the tilting that clears the open condition. If there is, fix the tube in that position. The open connections will be touching. If not, any position will do.

Next, turn the heater voltage to 9 or 10 V. Then take a pencil or ruler and begin tapping the neck of the tube. The idea is to get the gun vibrating mechanically. Next start pressing the blast button. You might be rewarded with a flash. If all the heat, vibration and blasting voltages have worked together to cause the open elements to touch and weld themselves together the tube is repaired.

Yes, you probably have rejuvenated the tube too, and perhaps reduced its life somewhat. But the tube was dead to start with so whatever you get out of it is gravy.



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Jesus de Leizaola, president of the Basque government-in-exile, stands before his Paris headquarters. The photo below is of the lost Basque homeland.



The Radio Euzkadi Mystery—Solved!

By DON JENSEN

IN an age when broadcasting is used to sell politicians and sway people's minds, it is unusual to find a station that is trying to bring a race of people together with their lost ancestry. Such a station is Radio Euzkadi.

It is also the most easily heard and the most mysterious of clandestine broadcasters. Though it pretends to be hidden away in the mountains of southern Europe, it's actually located on another continent, 5,000 mi. away.

R. Euzkadi (pronounced ooze-kahdie) broadcasts to the Basques, a strange people with an even stranger language, whose traditional homeland is the Pyrenees Mountain region straddling the Spanish-French frontier. Though most live south of the line, calling a husky young Basque a Spaniard is an invitation to a brawl. For over a century,

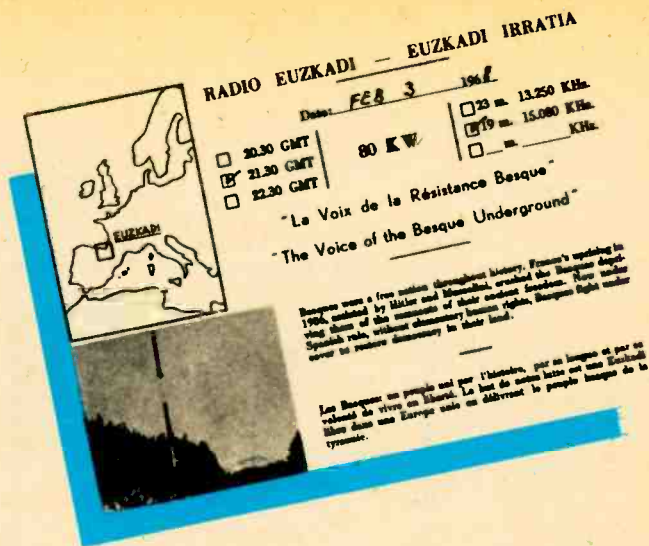
but especially since the Spanish Civil War, they've tried to regain their lost autonomy.

R. Euzkadi broadcasts three daily, but repeated, half hour programs on two frequencies at 2030, 2130 and 2230 GMT. To escape Spanish jamming, it frequently shifts and slides a few kc. Programs are in Spanish and Euzkera, the Basque language, but there are English and French sign-on announcements too. It operates near 13250 and 15083 (sometimes 15060) kc.

To understand the mystery, one must know something about the Basques themselves. Some people claim they were the last survivors of legendary Atlantis. Others hold that the cradle of the Basque civilization was ancient Peru, or perhaps Canada.

Today, most scholars believe it all began 4,000 years ago, when a Bronze Age people

Fig. 1—A rare QSL card from R. Euzkadi. The photo showing the transmitter located in snowy mountains is meant to give the impression that the station broadcasts from inside Spain. Information indicates that the true location of the station is South America. Reported transmitter power of 80 kw is doubted by most DXers.



began a slow migration westward from Asia Minor. Millenia passed and their descendants, the Aquitani, settled in the Pyrenees during the reign of Julius Caesar. The Basques evolved from these early Europeans.

In 1936, in a bid for Basque loyalty in the civil strife, Madrid's republican government granted the Basques semi-autonomy. Under the Tree of Guernica, traditional assembly spot, a swarthy hawk-nosed young lawyer, Jose Antonio de Aguirre y Lecube was sworn in as Basque president. Ten months later, the Basque government was in ruins and the short-lived republic had crumbled with it before the armies of Franco and his German and Italian allies.

Aguirre and his cabinet fled to Paris and set up shop as the Basque government-in-exile. When the Nazis came it was exile again, this time in New York, where Aguirre took a teaching post. After the war he returned to France to continue the struggle. It was then, sometime in 1947, that R. Euzkadi was born.

Bayonne, a fishing port in the extreme southwestern corner of France, and its neighboring town of St.-Jean-de-Luz have long been Basque resistance centers. Several Basque cabinet ministers live in Bayonne, and R. Euzkadi maintains a postal drop for its listeners at 16 rue Garat in St.-Jean-de-Luz.

R. Euzkadi first broadcast from an old, weatherbeaten fishing trawler, tied up in Bayonne's harbor. Though not heard in North America, some European SWL's caught a few shortwave transmissions on 6300 and 7000 kc. But most of the broadcasts were aired by a medium-wave station

just powerful enough to reach Basque audiences across the border.

In the early '50s, two incidents caused diplomatic riffs. A Basque priest named Onaindia was hired by the official Radiodiffusion Francaise to broadcast to Spain during a daily 45-minute European Service transmission. While more theological than political, his talks did point up the problems of the Basque minority and made Madrid decidedly unhappy.

Even more provocative was an incident involving EAJ8, a station of the Sociedad Espanola de Radiodifusion in the northern Spanish city of San Sebastian. One night, the Basque underground cut the power circuit to EAJ8. For half an hour, R. Euzkadi replaced the Spanish station on 1068 kc. The broadcast, widely heard in Basque country, thoroughly embarrassed the Franco regime.

Under strong diplomatic pressure, France cracked down on the exiles. Father Onaindia was fired and R. Euzkadi was shut down. The medium-wave transmitter was dismantled and shipped to Paris, where it still remains, unused, in the basement of the exiled government's headquarters.

A reborn R. Euzkadi returned to the air early in the summer of 1965, with a short-wave transmitter on about 13250 kc, a frequency still in use. One Illinois listener heard the now familiar eight-note tuning signal—the opening bars of the Basque anthem—and the Euzkera and Spanish identifications, "Euzkadi Iratita. . . Radio Euzkadi, La Voz de la Resistencia Vasca." In January 1966, 11290 kc also was in use, but by midyear it was shifted to the 19-meter band.

R. Euzkadi's location has been particu-

The Euzkadi Mystery— Solved!

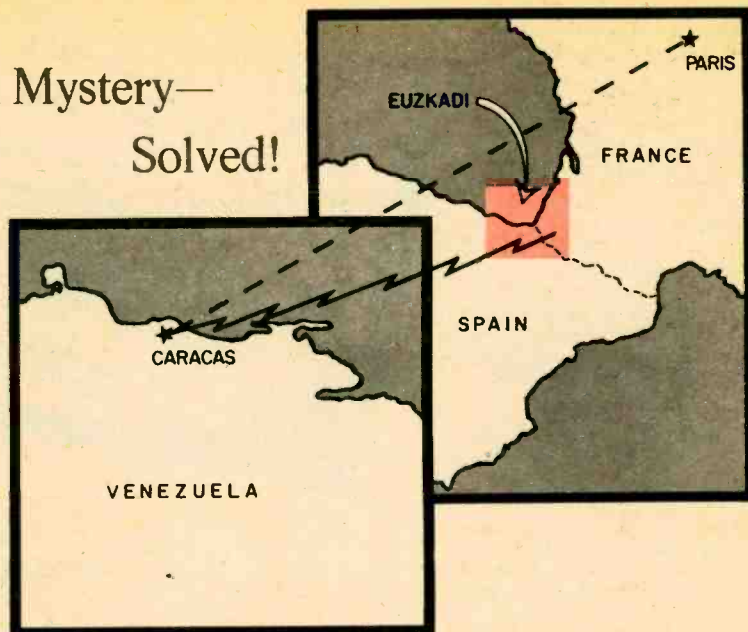


Fig. 2—Map shows the clandestine chain in the operations of R. Euzkadi. Material for programs is prepared in the Paris office of the station. It is then sent to a blind postal drop in Caracas (dotted line). Programs are recorded and beamed toward the Basque audience which still remains in Euzkadi, the Basque homeland.

larly puzzling. QSL cards from the station (Fig. 1) show an antenna, backgrounded by snowcapped mountains, implying a secret transmitter high in the Pyrenees. The Basques would have listeners believe it is a mobile operation shipping around under the very noses of Spain's Guardia civil police.

In reality, however, R. Euzkadi broadcasts from a secret site in Venezuela, not far from Caracas. Direction-finding experiments by a European agency and by an American expert in New Hampshire, originally spotted the location along the north coast of South America. The more precise location came from an off-hand remark by a Basque official during an unguarded moment.

Venezuela, which has harbored clandestine broadcasters before, is a natural site. There's a large and active group of Basque immigrants, more than 5,000 living in Caracas. They publish a regular newspaper, *Sabindara*.

Some SWL's think R. Euzkadi is a Red clandestine, like the Soviet-backed Radio España Independente. But most Basques, devout Roman Catholics, are staunchly anti-communist.

"Radio Euzkadi does not harm any true democrat," a Basque spokesman averred.

Other listeners suspect it is linked to the U.S. Central Intelligence Agency, as allegedly was the secret Radio Libertad a few years ago. But there is no evidence to sup-

port either of these theories.

R. Euzkadi's programs apparently are tape recorded in Caracas, but news items for its daily, *Noticias de Espana y El Mundo*, are culled from newspapers at the Paris headquarters. An entire room is stacked with old papers clipped by the press officer. News scripts are airmailed to a blind postal drop in Venezuela. Other material comes from Basque communities around the world.

One typical program began with a reply to a Spanish television program, followed by a sad folk song about a faithful burro who carried his master's body to the grave. After another Spanish language commentary, the program switched to Euzkera and a talk about anti-Franco posters which mysteriously appeared on walls in Bilbao. A ten-minute newscast wrapped up the half hour program.

According to the QSL card, transmitter power is 80 kw and Basque sources swear this is so. Some SWL's doubt the station is this powerful, though.

The Spanish reaction to R. Euzkadi? Jamming! At least three multi-beepers are used against the two outlets. They are believed to be located near Arganda, 17 mi. southeast of Madrid.

The technique is to place a beeper, sometimes a bracketing pair, a few kc from R. Euzkadi's signal. The constant beeping, and an annoying heterodyne, are supposed to

[Continued on page 99]

Our electronic antenna for the broadcast band will pack at least 40db more signal into your receiver.



Big Booster for the BCB

By HERB FRIEDMAN, W2ZLF **THOUGH** you may live in a valley, be using a crummy receiver, or have a landlord that won't let you stretch an antenna out the window, you can now DX the broadcast band and receive crunching S9 signals. Our Big Booster makes it possible. It will pack your receiver with signals from one end of the dial to the other.

The booster consists of an oversize ferrite-rod antenna, a high-gain preamp and a low-impedance emitter-follower output stage that matches the relatively low-impedance inputs of most receivers (50 to 1,000 ohms).

The circuit is powered by a 9-V transistor-radio battery. Since current drain is a low 2 ma, the battery will give several months of service. The circuit has been designed to operate at almost 100 per cent efficiency with as little as 3 V.

Construction

All component values and the parts layout are critical; substitutions should not be made. The booster is rock stable, but changes can cause the circuit to oscillate and block the receiver.

First step is to make the printed-circuit board, for which a full-scale template is provided in Fig. 2. Cut a 2 x 2 $\frac{3}{4}$ -in. piece of copper-clad board and scrub the copper clean with a cleanser such as Comet or Ajax. Rinse the board under running water, dry thoroughly and then place a piece of carbon paper—carbon side toward the copper—over the board. Position the board under the template and tape it in place.

Using a pin punch, center punch, ice pick or a similar tool, force the point of the tool through the template at each component mounting

Big Booster for the BCB

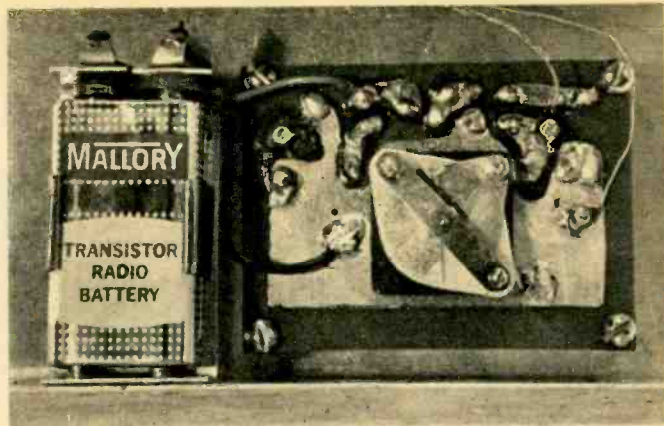


Fig. 1—Leads to ferrite-rod antenna (right) go straight up and out top of cabinet. Board is mounted away from front of cabinet with 3/4-in. standoffs. Battery can be mounted with Keystone 203P holder. S1 is behind battery.

hole so the copper foil will be indented. Using a ball-point pen, trace the outline of the foil areas. Remove the board from under the template, strip off the carbon paper, and using a resist pen, fill in the copper foil areas to be protected. Make certain you place resist dots over the indents at the corner mounting holes.

Let the resist dry thoroughly and then immerse the board in at least 1/4 in. of etchant solution. Agitate the board frequently by rocking the container. After about 40 minutes, check to see if all the unwanted copper has been etched away. If it hasn't, reimmerse the board for five-minute intervals until all the unwanted copper is removed. Then rinse the board thoroughly under running water and remove the resist with a resist solvent or acetone.

Next, drill the holes for the components. For the shaft of tuning capacitor C1 you'll

need a 5/16-in. bit. Drill the component-lead holes with a No. 56 bit. If you want to use push-in terminals for the power, input and output connections, drill the appropriate size holes: type T28 terminals require a No. 48 bit.

Install C1 on the board and carefully bend the two solder tabs down to the matching copper foil pads. Solder the tabs to the foil with an iron rated no higher than 50 watts. Install all the other board components leaving Q1 and Q2 for the last.

Note that Q1 is supplied with a shorting clip around its leads. Leave the clip in position until antenna L1 is installed. If the clip is removed before L1 is connected, the static charge at the tip of the soldering iron may destroy Q1. Push Q1's and Q2's leads through the board and allow about 1/4 in. between the bottom of the transistors

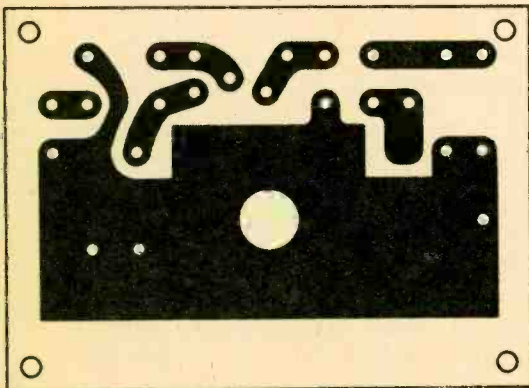


Fig. 2—Use this full-size template to make board. Put carbon paper over copper, tape template over it and then transfer the pattern onto the copper.

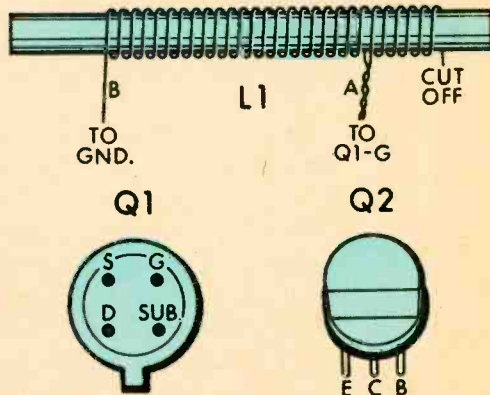
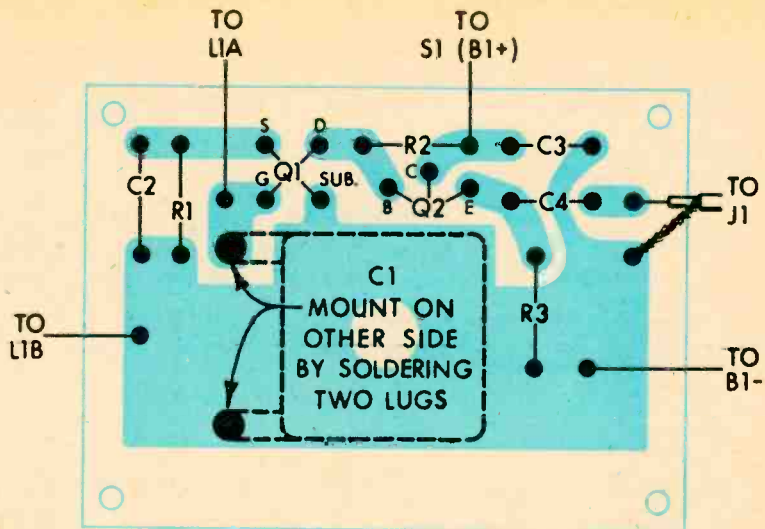


Fig. 3—On ferrite-rod antenna L1, use double twisted tap leads and lead farthest from it. Cut off lead nearest the tap. Do not shorten leads.

Fig. 4—Diagram of parts side of circuit board shows where to mount all parts. Foil pattern is X-ray (mirror-image) of pattern shown in Fig. 2. Mount C1 on copper-foil side of the board as shown in the photo in Fig. 5, below.



and the board.

The circuit board can be installed in any cabinet— $5\frac{1}{4} \times 3 \times 2\frac{1}{8}$ in. or larger—following the layout in Fig. 1. (The cabinet we used is a Calectro J4-741.) Make certain you leave room for power switch S1 and the battery.

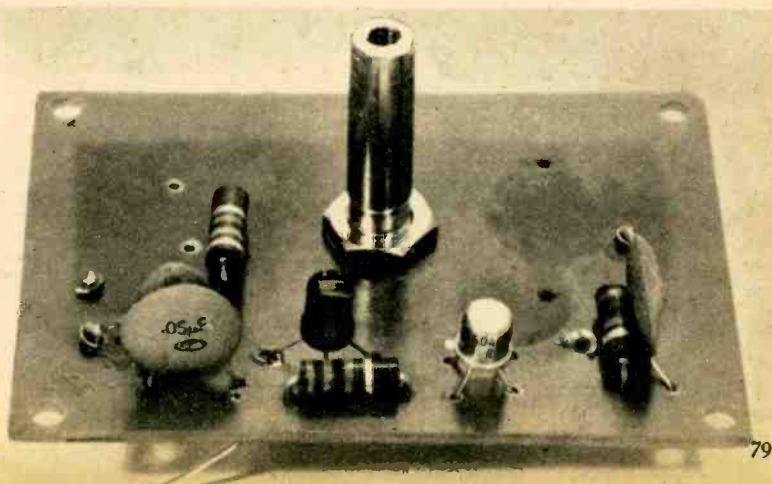
Ferrite-rod antenna L1 is a $7\frac{1}{2}$ -in. transistor-radio antenna, J.W. Miller type 2000. Any similar loop antenna can be used, as long as it is at least 6 in. long. For protection, and to provide a rotating mount, L1 can be mounted inside a plastic toothbrush holder or a round plastic battery (penlite size) holder. Drill a $25/32$ in. hole in the center of the holder's base (for a $3/8$ -in. rubber grommet), and a matching hole on the rear (center) of

the top of the cabinet. Secure the loop in the holder with GE's Silicone seal or any similar GE RTV adhesive. *Do not use any other silicone adhesive such as Silastic or other bathtub caulk as they will affect L1's inductance.*

The adhesive will not stick to the plastic toothbrush holder, so simply put a generous quantity around L1's rod at each end where the rod sticks through or rests against the holder. The adhesive will stick to the rod and prevent it from moving around. Use L1's tap for one lead and cut off the end lead closest to the tap. The tap lead connects to the gate of Q1.

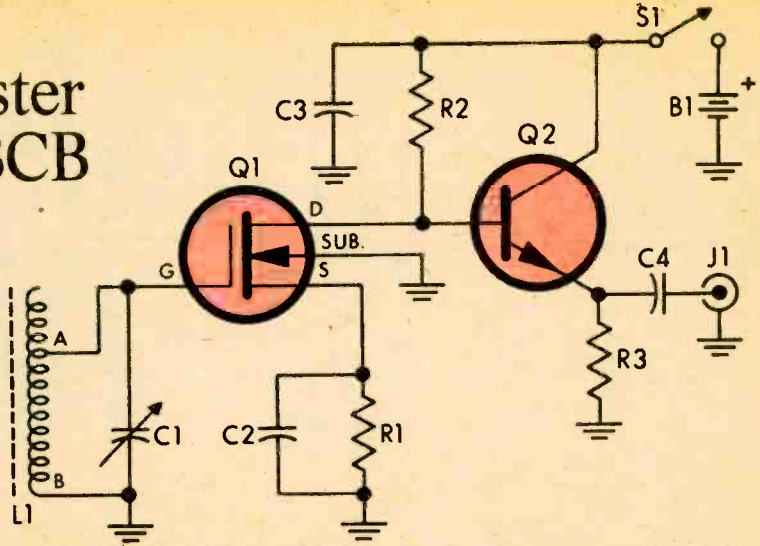
Secure the holder to the cabinet by passing a $3/8$ -in. rubber grommet through both the cabinet and the holder. Do not cut L1's lead

Fig. 5—Parts must not touch cabinet, so use miniature capacitors and keep them close to the board. Note that the bottom of both transistors should be about $1/4$ -in. (no less) above board. Tapped extension is attached to C1 so its shaft protrudes through the cabinet.



Big Booster for the BCB

Fig. 6—There's no bypass switch because FET Q1 is immune to strong-signal overload. Because of Q1's high input impedance, L1's Q remains very high and it is possible to use booster to peak a weak signal that is being blocked by a strong adjacent signal on the dial.



short. Fold the excess into a wide loop inside the holder and connect the free ends to the appropriate points on the board. Position L1's lead so they run from the board straight up to the top of the cabinet. Make a right-angle bend in the leads and force the slack up into the holder through the grommet.

The leads must be kept away from the booster's output terminals. Use a 4½-in. length of either 50- or 75-ohm coax to connect the output on the board to output jack J1, which is located on the cabinet's back cover.

Mount the board behind the cabinet's front panel on standoffs. Any type will do as long as the components on the top of the board do not touch the cabinet. The shaft of variable capacitor C1 is too short and will not stick through the cabinet, therefore, cement (epoxy) a ½-in long shaft from a scrapped volume control to C1's shaft.

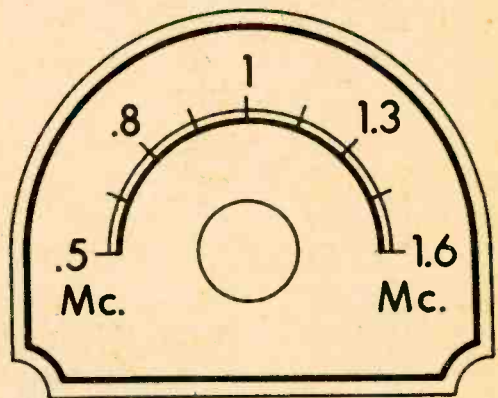
Tune-Up

Alignment is not required. Cement the dial in Fig. 7 on the front of the cabinet. Depending on the construction, the actual calibration will be equal to or close to that of our dial.

Connect the booster to your receiver's antenna terminals through a short length of 50- or 75-ohm coax. Set C1 to approximately the frequency you wish to tune and set S1 to on. Tune in a signal on the receiver and then peak the signal with C1. Additional signals can be obtained by rotating L1. If you want to receive a weak signal which is next to a strong blocking signal, tune C1 to the opposite side of the strong signal.

PARTS LIST

- B1—9 V battery (Burgess 2U6 or equiv.)
 - C1—13.365 μ f single-gang variable capacitor (Calectro A1-232 or A1-233 or equiv.)
 - C2,C3—.05 μ f, 100 V disc capacitor
 - C4—.001 μ f, 100 V disc capacitor
 - L1—Ferrite rod antenna (J. W. Miller Type 2000, Lafayette 34 F 88194)
 - Q1—40468A field-effect transistor (RCA)
 - Q2—2N3394 transistor (GE)
 - R1—1,000 ohm, ½ watt, 10% resistor
 - R2—2,200 ohm, ½ watt, 10% resistor
 - R3—4,700 ohm, ½ watt, 10% resistor
 - S1—SPST toggle or slide switch
 - Misc.—5¼ x 3 x 2½-in. aluminum chassis box, printed-circuit material
- (All parts except those under misc. Are available for \$6.75 plus 75¢ postage and handling from Custom Components, Box 153, Malverne, N.Y. 11565. N.Y. State residents add sales tax. Canada, \$1 additional. No foreign orders)



CUT ALONG OUTER LINE

Fig. 7—Tuning dial for booster. Cut it out and paste on front panel of cabinet over C1's shaft.



On Being a Buyer in Electronics



If you are a technician looking for a step upward in your career, you can use your training to move into management as an electronics buyer.

By HAROLD F. SCHELL AFTER a few years on the job, technicians often wonder if there are career opportunities available that will allow them to become part of the management of a company. Unless you can take the How to Succeed in Business Without Really Trying route, you'll have to think of a more practical way to scale the corporate ladder. Electronics buyers, the guys who find the best value in purchasing for their companies, are often technicians who have used their knowledge to progress in the corporate hierarchy.

The buyer is in a unique position, for he is responsible, at least in part, for a company's expenditures. As he is in the business of saving money, he will find a large audience for his professional opinion if he has shown that he is technically competent and can exercise sound business judgement.

Procurement positions are as varied as the electronics industry itself. In the small shop, the buyer, or purchasing agent as he is more often called, may wear many hats. Buying may just be a part of his job. He will be responsible for the supply of everything from paper clips to printed circuit boards.

In large companies there are many buyers, so each man usually has an area of speciali-

zation. A good buyer will know all there is to know about his specialties.

If your specialty is printed circuit boards, for example, you'd read everything you could find on the subject. You'd visit local PC board manufacturers and become familiar with their processes, techniques and limitations (see Fig. 1). You'd talk about PC board quality and reliability with your company's quality control and engineering experts. You'd keep posted on state-of-the-art developments in the field. Flexible circuitry, multi-layers and the like would all become a part of your territory.

As your expertise develops, you'll find your company's technical people coming to you for advice on their PC board procurement problems. Your answers would save the company money and at the same time make its product more reliable.

It's the desire for this sort of performance that causes many electronics companies to seek technically trained personnel for at least some of their buying positions. But it also creates problems. As a technically knowledgeable buyer you are in a position to advise and recommend to those who requisition, but not to dictate. Engineering toes are easily stepped upon and a wise buyer develops ways

On Being a Buyer in Electronics

of presenting his ideas without offending.

You should be able to write effectively. You don't have to be another Hemingway, but your purchase orders and correspondence must be clear and without ambiguity. Your writing reflects on your company and you can't always depend on a secretary to clean up your disjointed prose. Buyers view English much as technicians do algebra. However, with a little effort high school English can be mastered. That's all that's necessary. I took an evening course aptly called bonehead English. It got me by.

A confident speaking voice is as important in this job, as your equipment was in the last. You spend a lot of time on the telephone and in face-to-face contact with requestors, salesmen and manufacturers. You attend many meetings and in some of them you are expected to have something to say.

Many purchasing supervisors like to have



Fig. 2—Much of the work in procurement is done with people. You must be able to communicate with others clearly—both in writing and verbally.

their buyers know a little something about business law. The fine print or boilerplate on the back of your purchase order is a measure of protection, but it's nice to be able to understand the seller's boilerplate too. A course or two in business law—which is a whole lot simpler than it sounds—is helpful.

These days most large purchasing departments are in some way involved with data processing, and a prospective buyer familiar with it has a little something extra working for him.

You don't have to go far afield to get your purchasing education. Most junior colleges offer purchasing courses as do some correspondence schools. The National Association of Purchasing Management (NAPM, 11 Park Pl., N.Y. 10007) has developed a suggested curriculum culminating in certification. This curriculum is an excellent guide for anyone pursuing a career in purchasing. For the non-college man the electronic purchasing field is still wide open. Many large firms prefer to hire only college grads, but have difficulty finding them with both business and technical competence.

If you are a trained technician, neat and personable and willing to school yourself in purchasing needs, you should have little difficulty finding an electronic purchasing po-

COST REDUCTION WORKSHEET

PART NO. 1156B2 -1	DESCRIPTION PLUS- IN DOUBLE-SIDED PRINTED CIRCUIT BOARD W/ PLATED THRU HOLES	QUANTITY 1100
PURCH. ORD. NO. 031858	PURCH. ORDER NO. 720B9-07	SUPPLIER QUICKIE CIRCUIT BOARD, INC.
DATE 8/17/70	DATE 9/14/70	DIVISION 3
PURCHASE COST \$ 12.52 EACH	UNIT COST \$ 12.00	TOTAL SAVINGS (\$) \$ 3,938.00
	FINAL COST \$ 6.44	TOTAL SAVINGS (%) 33.52%

METHOD - SAVINGS ACCOMPLISHED:

- SUBSTITUTION
- STANDARDIZATION
- NEW SOURCE
- E.O.O.
- PROGRAMING

PRELIMINARY COSTS

- TERMS
- MAKE OR BUY
- VALUE ANALYSIS
- TOOLING

NEGOTIATION

CHANGE IN SPECS

OTHER (EXPLAIN)

DATE	PO NO.	QUANTITY	UNIT PRICE	TOTAL PRICE	SUPPLIER
8/5/69	6807-07	500	\$ 12.96	\$ 6,480.00	QUICKIE BOARD CO.
11/6/70	10587-07	500	\$ 12.72	\$ 10,176.00	QUICKIE BOARD CO.
5/14/70	91785-07	900	\$ 12.52	\$ 11,268.00	QUICKIE BOARD CO.

PREVIOUS PROCUREMENT (IN CHRONOLOGICAL ORDER - 12 TO 24 MONTHS)

BUYER - SIGNATURE
C. F. Beaver

DATE
9/14/70

AUTHORIZED BY
D. J. Cheek

DATE
9/14/70

REMARKS:
ORIGINAL P.C. BOARDS WERE GOLD PLATED WITH PLATINUM
PLATED FINISH. HOLES WERE OF SEVERAL DIFFERENT DIMENSIONS
REQUIRING USE OF MANY DRILL SIZES. COST REDUCTION MADE
BY THU-PLATING ENTIRE BOARD AND REPLACING PLATED-THRU HOLES
WITH SLEETS OF ONE DIMENSION ONLY. TECHNICAL DETAILS WERE
WORKED OUT W/ NEW SELLER AND RESULTS PROVED SATISFACTORY
TO OUR P.C. TEAM.

PUR-102

Fig. 1—As a buyer you will seek to save your company money. One way is cost analysis as in pricing of circuit boards.



Fig. 3—As a buyer you will be constantly looking for better buys. Attendance at trade shows is one of the many responsibilities of a buyer.

sition—even in those firms that profess to hire only grads.

Take Hewlett-Packard for example. This growing young corporation did business amounting to nearly \$324 million in 1969. Robert Cornell, materials manager for the company's manufacturing division told us, "We do not hire only college graduates, but we prefer them. If a person doesn't have a college degree, he must have equivalent experience. Actually, the important considera-

tion is whether the person can understand the parts he buys."

Mr. Cornell suggested that the ideal electronics buyer might have an A.A. degree in electronics and a B.A. in business administration with a little understanding of data processing tossed in for good measure. However, the ideal buyer, like the ideal woman, often is hard to find.

Educational requirements are usually less for junior positions. Recently Spectra Physics, a big name in the laser manufacturing world, ran an ad for a junior buyer. Scott McClellan, the firm's Purchasing Agent, had not yet hired a man when I talked with him and he was a trifle disappointed over the number and quality of his applicants. "We'd prefer someone with a couple years college," he told me. "But we'll settle for less. Actually we're willing to take a man without any experience and train him, although some experience would be an asset." They were prepared to pay the right man between \$600 and \$700 per month to start. His duties would be split between buying and expediting.

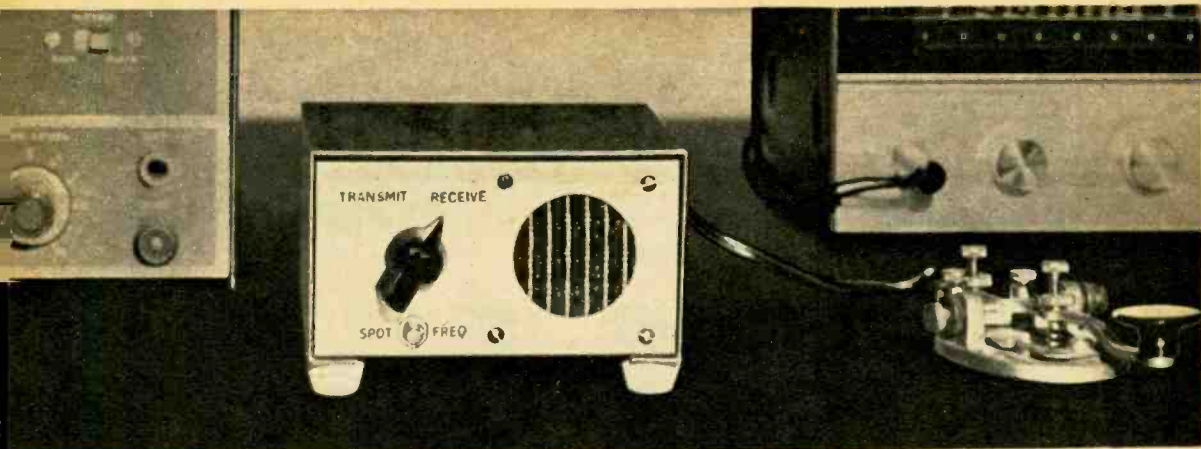
It's customary for new buyers, regardless of experience, to start by expediting overdue purchase orders. It gives them a chance to learn which suppliers are not performing. They become familiar with the company's paperwork flow without being thrust into the buying position cold.

Buyers must know their business like the back of their hand, so if you have the idea that an electronics buyer is the guy who comes into work at 9:30 AM to have coffee before going out for a three-hour martini with one of the salesmen, think again.

[Continued on page 99]

Fig. 4—A buyer, especially in electronics, is always in need for further education. Rather than going back to school, this buyer education takes the form of informal trade gatherings where new developments are discussed and advice on making the best buys for your company is exchanged among fellow buyers.





Ham Station Switchbox

By CHARLES GREEN, W6FFQ

AFTER setting up your CW transmitter and receiver you suddenly realize several things are missing. First off, you'll need something to switch the antenna to the transmitter or receiver. Coincidental, with this, you must simultaneously turn the receiver off when the transmitter is on and vice versa.

Then you discover the transmitter lacks a side-tone generator to produce an audio tone as you operate the key. Lastly, you long for a way to feed some of your signal into the receiver so you'll know exactly where you are on a poorly-calibrated dial.

Our switchbox does all these things. It is designed to tie together a low-power CW transmitter (see *SOLID-STATE HAM TRANSMITTER FOR 40 AND 80*, Jan. '71 EI), receiver and antenna. One section of a switch connects the antenna to the receiver or the transmitter. Another section controls the standby functions of the receiver and transmitter.

A transistor audio oscillator provides a side-tone when you send CW. *Spot-frequency* switch S2 causes the transmitter to feed a very-low-power signal into the receiver so you can find your signal on the receiver's dial.

The Circuit. Transistor Q1 and transformer T1 are connected in a Hartley oscillator circuit whose output drives a small speaker. Volume is controlled by R5. When S1 is set to *transmit*, 9-VDC from B1 is con-

nected via switch section S1A to the oscillator.

When PL1 is plugged in the transmitter's (either tube or high-voltage transistor) key jack (across which there's a positive voltage of about 200 V) the voltage biases Q1 to cutoff via R1 and R2. Potentiometer R1 is so adjusted that the voltage just cuts off Q1. When the key is closed, the bias is removed and an audio tone is produced.

Switch section S1C switches the antenna from the receiver to the transmitter. Sections S1D and S1E, respectively, turn the receiver off and the transmitter on.

Pushbutton-switch S2 turns on the transmitter's oscillator so that the receiver can be tuned to the exact frequency of the transmitter (by zero beat). Resistor R6 limits the power of the transmitter oscillator to prevent the receiver from being overloaded.

Construction. Our switch box is built in a 4 x 4½ x 2⅝-in. aluminum cabinet. Most of the components are installed on a 3 x 2¼-in. piece of perforated board, with the remaining parts mounted on the sides and bottom of the box. Component placement is not critical, and a larger box can be used.

The two-wafer switch (S1) must be modified so the rear deck is enclosed in an RF shield box. Using the dimensions in Fig. 2, locate and drill holes on the 2½ x 1½-in. front panel of a 2½ x 1½ x 1⅜-in. aluminum box. Also drill a ½-in. dia. hole in the back of the box for the coax cables to SO1,

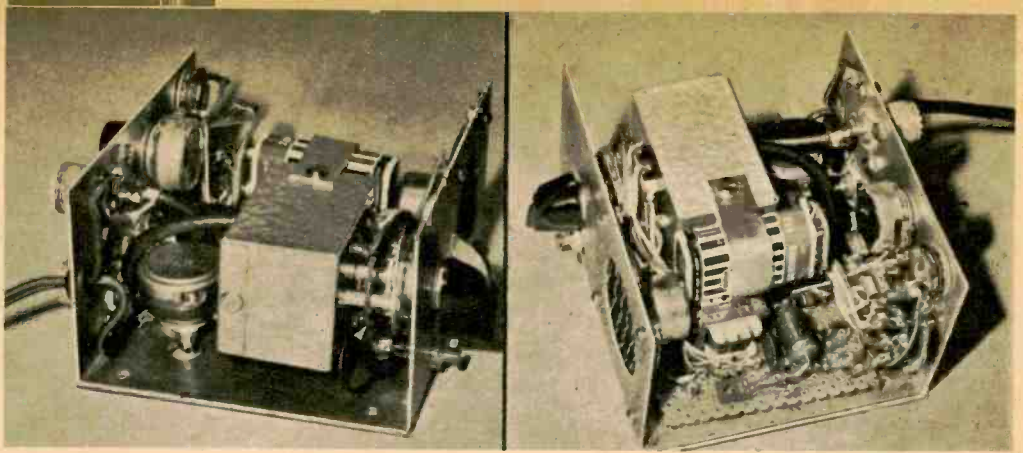
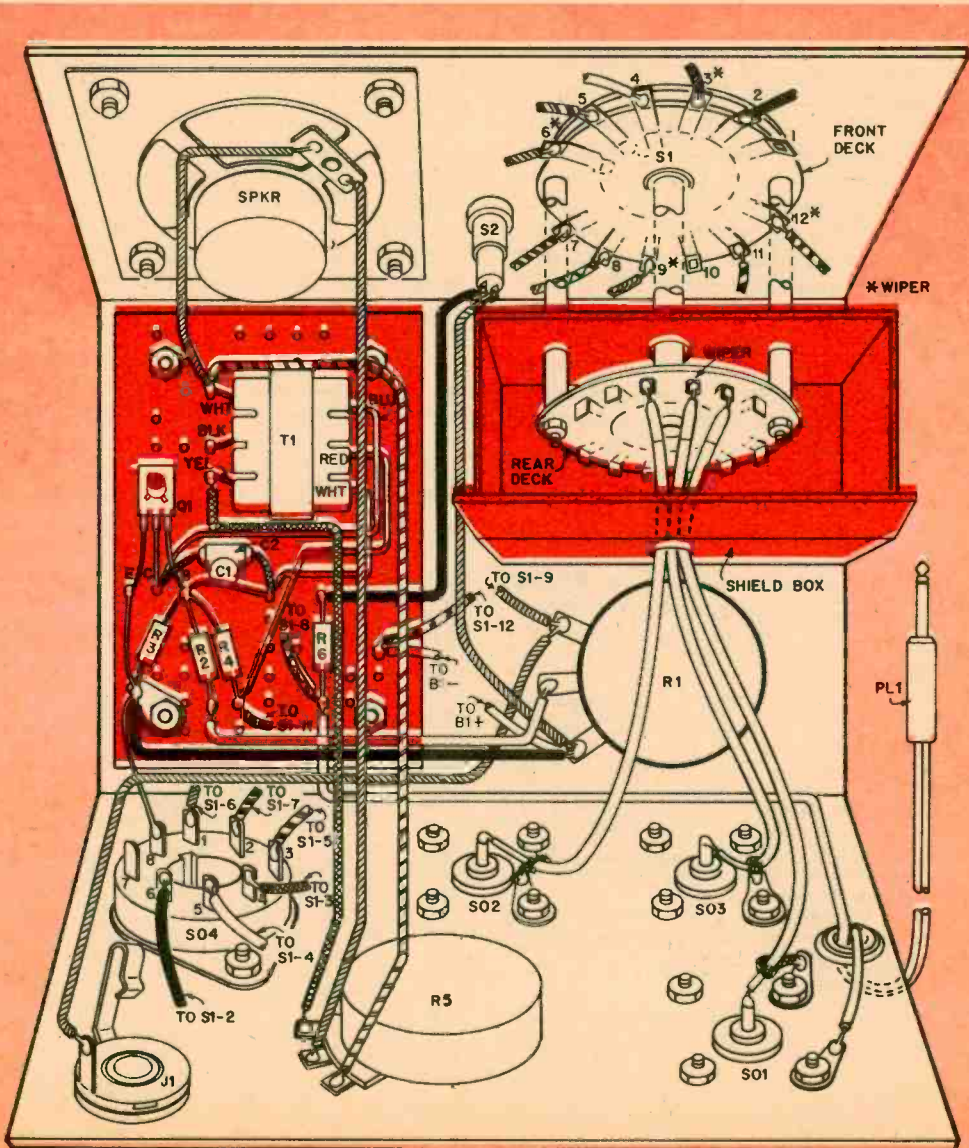


Fig. 1—Photo at top, left, is of left side of switch box. Note how screwdriver-adjust pot R1 is mounted behind shield box. Photo at right is view of right side of box. Note here how battery B1 is attached to shield box with aluminum strap. Pictorial below shows location of parts on board and front and rear panels. Switch S1 must be disassembled, then reassembled with rear wiper in the small metal shield box.



Ham Station Switchbox

SO2 and SO3, Disassemble the switch and substitute 1/4-in. metal spacers for the 3/8-in. spacers between the wafers. Reassemble the switch with the rear wafer inside the box as in the pictorial in Fig. 1.

Cut the speaker hole in the front of the large cabinet and drill the remaining component holes in the front and rear panels. Mount the panel components as shown.

To simplify matters, mount the parts on the board before installing it in the box. Drill holes for T1's mounting tabs and bend the tabs back under the board to hold T1 in place. Wire the board and cut off the push-in terminals under the board to prevent shorts. Mount the board in the cabinet using 1/4-in. metal spacers at each corner.

Mount R1 on a small sheet-aluminum bracket between the rear panel and the back of the switch shield box. Cut a hole in the bottom for adjustment of R1.

The rear wafer (in the box) of S1 has four single-pole, two-position switches, but only one switch is used. Cut the RG58/U coax to size and solder the inner leads (cut off the shields) to the lugs shown in Fig. 1. Slip the coax through the hole in the box before soldering the other ends to SO1, SO2 and SO3. Solder the coax shields to solder lugs mounted on SO1, SO2 and SO3. Fasten the box cover in place over the rear wafer. Battery B1 is fastened to the shield box with a sheet-aluminum strap as shown in the right photo in Fig. 1.

Check-Out. Turn volume control R5 full clockwise and set S1 to *transmit*. You should hear a loud tone from the speaker. Turn R5

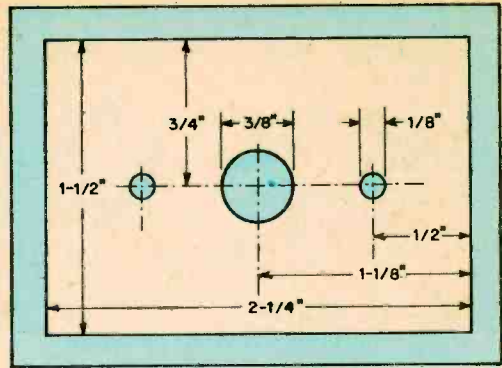


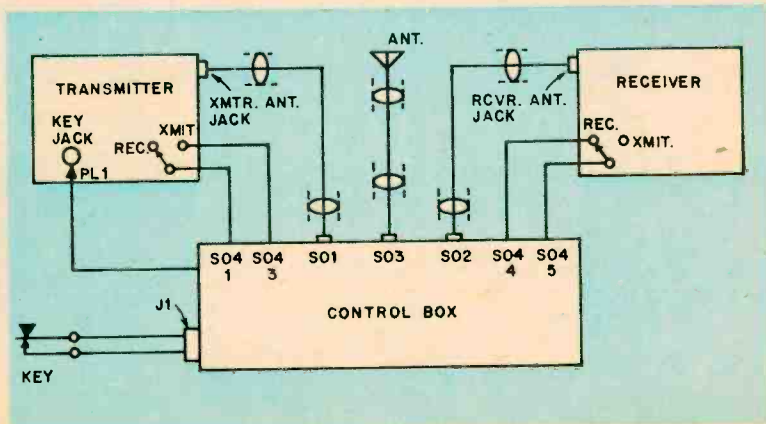
Fig. 2—Drilling template for switch shield box. Center hole is for shaft and two smaller holes are for screws that hold the two wafers together.

counterclockwise and note that the volume diminishes. For a different tone, change the value of C2. Increasing C2's capacitance will lower the tone. Set S1 to *receive*. There is no separate power switch as a section of S1 turns off DC power when S1 is in the *receive* position.

Operation. The switchbox is designed to work with low-power CW transmitters (either tube or high-voltage transistor types) in which a positive voltage appears across the key contacts. This would be developed from cathode keying or emitter keying of NPN transistors. The value of R2 must be changed to a lower value if your transmitter has less than 200-V across the key.

Plug PL1 in your transmitter key jack and plug the key into J1. Connect the transmitter's output to SO1, and connect either a transmitting antenna or a dummy load to SO3. Turn the transmitter on, and set S1 to *transmit*. Adjust R1 until the tone just stops.

Fig. 3—Diagram shows how to connect the switch box to your transmitter, receiver and antenna. Connections to transmit/receive switches in receiver and transmitter must be made internally.



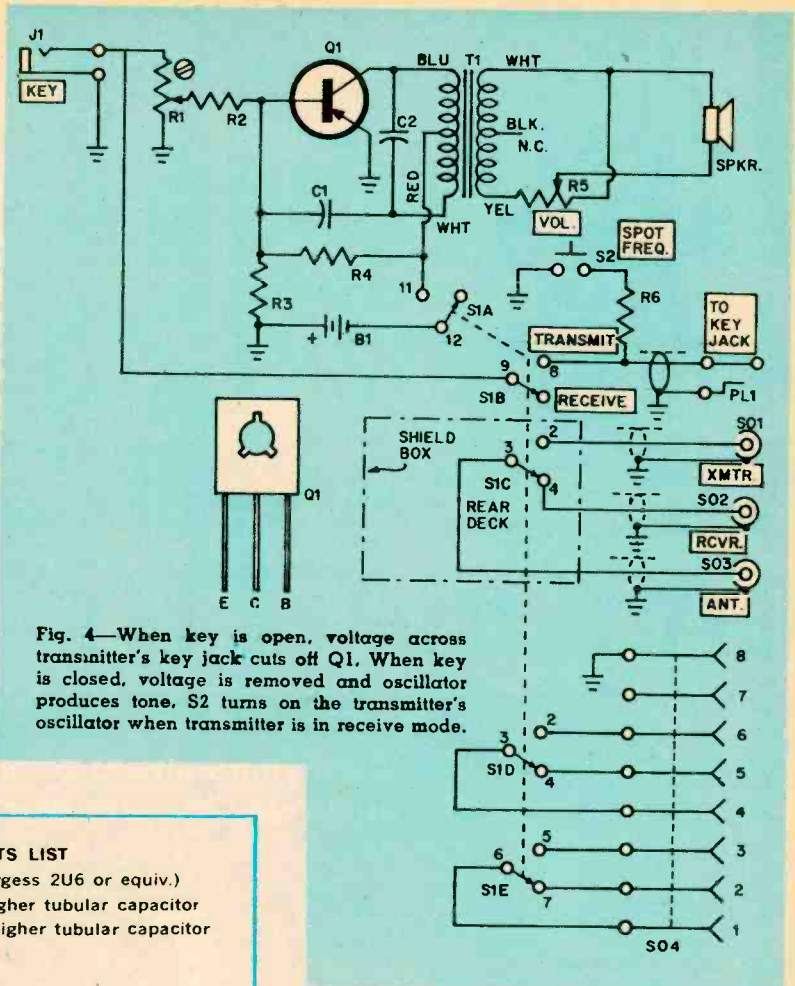


Fig. 4—When key is open, voltage across transmitter's key jack cuts off Q1. When key is closed, voltage is removed and oscillator produces tone, S2 turns on the transmitter's oscillator when transmitter is in receive mode.

PARTS LIST

- B1—9 V battery (Burgess 2U6 or equiv.)
- C1—.1 μ f, 25-V or higher tubular capacitor
- C2—.25 μ f, 25-V or higher tubular capacitor
- J1—Phone jack
- PL1—Phone plug
- Q1—HEP-246 transistor (Motorola)
- R1—250,000 ohm linear-taper pot
- R2,R6—47,000 ohm, 1/2 watt, 10% resistor
- R3—1,000 ohm, 1/2 watt, 10% resistor
- R4—4,700 ohm, 1/2 watt, 10% resistor
- R5—200 ohm audio or linear-taper pot
- S1—Eight-pole, two-wafer, two-position miniature rotary switch (Centralab PA-1025. Modified with 1/4-in. spacers, see text)
- S2—SPST normally-open pushbutton switch
- SO1,SO2,SO3—SO-239 coax connector
- SO4—Octal socket
- SPKR.—2 1/4-in., 8-ohm speaker (Calectro S2-203)
- T1—Transistor audio transformer; primary: 200 ohms center tapped. Secondary: 3.2 and 8 ohms (Calectro D1-729)
- Misc.—4 x 4 1/2 x 2 5/8-in. aluminum cabinet (LMB 442-N), 2 1/4 x 1 3/8 x 1 1/2-in. aluminum chassis box (Calectro J4-735), perforated board, RG58/U coax, 1/4-in. metal spacers, sheet aluminum

Press the key and you should hear the tone. Set S1 to *receive*.

Connect two wires in parallel with the transmit-receive switch in your receiver and to an octal tube base. Plug the base in SO4. The leads should be connected to pins four and five. Set the transmit/receive switch on the receiver to transmit and tune the receiver to the approximate frequency of the transmitter.

Press S2 and tune the receiver for zero beat (with the receiver BFO operating). Make sure that S1 is set to *receive* while pressing S2. (The transmitter's final will not be on, but S2 will turn on the oscillator.) For better reception of the zero-beat signal, the value of R6 can be reduced for greater RF output. Set S1 to *transmit* and you'll be ready to operate

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The Listener

By C. M. Stanbury II

Moon Walk with the VOA

WITH so much coverage being tendered to United States efforts in space, it is interesting to observe the Voice of America's coverage of these events.

Apparently, the space mission is no more than a good propaganda story for the VOA. At least that's the indication it gives. The deciding factor is what it covers and doesn't cover.

No one would expect the VOA to broadcast everything about the space voyage, but when it reduces its schedule suddenly when something goes amiss, you know that all it is trying to protect is the nation's image. When the men of Apollo 13 were facing dire consequences, the news of it was scarce on VOA. Perhaps the mere fact that VOA has dropped 24-hour coverage of the event will be a good indication in the future if anything is wrong.

To determine if the VOA has gone to a 24-hour schedule, check 5995 kc between 1930 and 2055 EST. VOA's English language transmissions in the 41-meter band will give you an indication of what the schedule is like.

Soul Sound. Among my collection of prize catches on BCB are those QSLs which verified reception of rhythm and blues programs in the early 1950's. It was this music that had a lot to do with bringing young people into the civil rights movement.

Although the sound is hard not to find these days, the music of many of the rhythm and blues greats was at that time heard only on black-oriented stations like WLOK (1480 in Memphis), WAOK (1380 kc in Atlanta), KATZ (1600 in St. Louis) and WMSN on 800 in Miami. WMSN, by the way, was then only a daytime, but has now gone to 24-hour operation as WFUN on 790 kc.

There were also a handful of outlets which devoted a portion of their schedule, usually after midnight, to black-oriented programming. I recall rising every Sunday morning to hear a wild rhythm and blues session from KROP out in Brawley, Calif. I must say that coast-to-coast BCB DXing was easier in those days.

Now there are a great many stations playing this kind of music non-stop, but it must be said that those pioneer broadcasters did a

lot to change the shape of music and the entire thinking of the country.

For those of us who were lucky enough to catch the stations and get a QSL, the letters and cards have special meaning.

Short-wave power. Imagine if you will, two Indians in a village, each building a tall totem pole. As soon as one gets higher than the other, the Indian climbs up and adds a couple of feet so that he can say that he has the biggest pole in town. You might expect that international broadcasters are beyond this, but they aren't. As it gets harder for a station to be heard, they simply boost power and hope for the best.

Several countries have employed this method recently, so you should be able to pick up several exotic stations, that is, before someone else goes on the boost. One of these stations is the Solomon Islands Broadcasting Service transmitting from Honiara on 7115 kc. Some reports indicate a shift in this frequency to 7235. Listen at around 0300 EST.

R. Noumea, the ORTF station on New Caledonia, can also be included in this category. As early as their 0100 sign-on, the new power is evident. Also check La Voix de la Renovation at Libreville, Gabon on 4777 kc, with a 2330 EST sign-on and R. Rumbos at Caracas, Venezuela on 9660 with a new 10-kw transmitter.

Your best chance for these stations will be when ionospheric disturbances knock out QRM from the upper and middle latitudes.

Propagation Forecast. As the days get longer in these spring months, the higher frequencies will remain open for DX longer than in the earlier winter months. During the daylight hours, 15-, 17- and 21-mc DX will be possible from early morning until several hours after sunset in your local time. The amateur 10-meter band will not open regularly to Europe, but openings to South America and Africa should become a regular occurrence. In the late afternoon and evening local time, Trans-Pacific openings will occur.

Due to approaching summer conditions, noise levels in the broadcast band will begin to increase, making BCB DX more difficult than it has been during the past several months —

DX Letter from Britain

CLAY HALL, ILFORD, ESSEX



THE surprising thing about the DX scene in Britain is the very small number of DXers here among a population of 50 million. Recent estimates suggest that the figure might be as low as 1,000 and it certainly doesn't exceed 2,000. These enthusiasts are split among a large number of clubs, with

considerable multiplicity of interests—many DXers belonging to many clubs, both in the U.K. and abroad.

The result is that broadcast DXers in Britain are in no way so powerful a body as the amateurs, who have the Radio Society of Great Britain to speak on their behalf. This has caused difficulties. Until recently the European DX Council permitted only country membership, so that Britain could not be represented. Late in 1969, however, the Council's constitution was altered to admit club membership and Britain has been brought into its orbit. Complications are likely to arise in the case of hybrid organizations, like the International Short Wave League. Ninety per cent of the League's members are radio amateurs with the remaining 10 per cent practising DXers, yet the I.S.W.L. exercises full voting rights in the European DX Council.

The International Short Wave League publishes a bulletin called *Monitor*, primarily devoted to amateur DX. There is, however, a broadcast DX section, produced by Desmond Colling, who is well known on both sides of the Atlantic.

Another club often confused with the I.S.W.L. is the International Short Wave Club, at least 40 years old and currently under the control of Arthur Bear. Little is known regarding its size and membership, but this organization has always pursued a very strong line, advising its members not to report to countries which have indulged in jamming of broadcast transmissions from other stations.

World DX Club publishes a monthly bulletin called *Contact*, also edited by Colling. Incidentally the address given in standard reference works, such as *World Radio &*

TV Handbook, is incorrect. Enquiries should be sent to 11 Wesley Grove, Portsmouth, Hampshire, PO3 5ER, England.

The greatest problem here is the tendency for DXers to be very young schoolboys and junior students, whose interests change as they grow older—and for DXers to remain in the hobby for only a few years. This is noticeable when one peruses a journal like the *Short Wave Magazine*, which is perhaps the best marketplace for second-hand equipment. Of course many DXers look on their period in the hobby as merely an apprenticeship before graduation into the ranks of full amateur.

The equipment used by British DX enthusiasts varies, but still depends a great deal on the enormous amount of government surplus gear which came onto the market at the end of World War II. The most popular second-hand surplus receiver is probably the AR88-D, made by R.C.A. during World War II. Prices vary according to condition and range around the \$100 mark. What are described as brand-new AR-88's are on the market at about \$200 but little is known about their conditions.

There's a substantial following for the old Marconi CR-100, now available very cheaply, at about \$40-50. The old HRO 5R or 7T was a great favorite but this receiver seems to have seen its last days. Ads still appear in the current magazines seeking information on converting the HRO to modern miniature tubes.

In the modern category all the well-known names are represented—Hallicrafters, Heathkit, National, Trio, Eddystone and Knight. The Hammarlund SP 600 is very desirable but very expensive, costing about \$240, which is more than most British DXers are prepared to pay for their receivers. The same applies, of course, to Collins. The 75A2 and 75A4 are the rarest second-hand receivers on the U.K. market.

A particularly good receiver is the Eddystone, acknowledged to be the most reliable and well-built British-made receiver. There are commercial models 40 years old that are still in regular use and giving a good account of themselves. The new, all-transistor EC-10 is very popular, with its famous slide-rule dial nearly the full width of the receiver and its accurate logging scale.

It should be remembered that, although all these prices seem low by U.S. standards, money in Britain. [Continued on page 94]

DX Letter From Britain

Continued from page 93

whether you call it wages, salary or income, is less than half what it is in the United States. There's little to spare for hobby expenditure.

The problem of aerials in Britain is one of space. Britain is a very crowded island and getting more so. Few DXers live in that isolation which would be ideal for the hobby. With increased housing density there are few who have enough room to erect aerials as long as they would like. So you find an increasing number of folded long wires. Whilst these may have been originally cut to a nominal 130 ft. or so, limited space in a backyard will often mean that there is only a 50 or 60 ft. run. Height is often very restricted, by practical problems or by zoning laws.

The optimum direction for any long wire would run approximately north-south, so that the maximum pick-up of the antenna would be in the direction of South, Central and North America on the one hand, and virtually the whole of Africa, Asia and the Soviet Union on the other. About the only part of Africa that would then lie on the line of the aerial would be the bulge on the west coast. Many DXers solve this problem by having a second aerial at right angles to the first, purely for reception of stations in this area, e.g. Gambia, Angola, Dahomey, etc.

Understandably then, there is a degree of awe, if not downright envy, expressed when British DXers hear New Zealander Arthur Cushen talk about his aerial system that extends over a whole city block and consists of six entirely separate aerials!

The fact that restrictions are imposed on British DXers by the amount of wire they can put into the sky does not stop them from achieving quite creditable DX results. It's accepted that the average DXer, who has been at the game for six or seven years consistently, would think he wasn't doing very well unless he had managed to record perhaps 150 countries as definitely heard. His QSL return might be about 80 per cent.

British DXers follow with enthusiasm the popular radio programs, Sweden Calling DXers S.B.C.'s Swiss Short-Wave Merry-go-round and B.B.C.'s World Radio Club.

Even though the DXer is in a minority in this country, one can honestly say that there is more to DX here than the gong of Big Ben.

—*Sylvia Margolis* —

Direct-Reading Sound Meter

Continued from page 32

fast/slow feature. Modify the meter by drilling a small hole in its case and run two wires to the lugs on the rectifier to which the leads from the meter's coil are connected. These leads go to S3. While the meter is open glue the scale in Fig. 5 over the face. Panel markings can be made with dry transfer type and sprayed with clear lacquer. The range-marking disk can be lettered in the same way, or the markings can be put on the panel and a conventional pointer-knob used.

Checkout and Calibration. After you have double-checked all wiring, connect the batteries and turn S1 to the 140db position. Check the voltage between the emitter of Q1 and ground. With fresh batteries it should be between 8 and 11 V. Next, check voltage across R24. It should be between 3 and 5 V. There should be no meter deflection except when S2 is pushed. Connect a milliammeter in series with the battery to check current drain. It should be between 2 and 3 ma.

To be sure the amplifier has low internal noise, put a shorted plug (short the plug right at its lugs) in jack J1, then switch to the 50db range. There will be some meter deflection as the switch is rotated but the pointer should quickly settle back. On the 50db range a perceptible vibration of the pointer is acceptable. If the deflection is greater than 30db (−20 on the meter) then Q1 or Q2 may be noisy and should be replaced. Be certain 60-cps hum pick-up is not the problem by making sure the hum shield (metal plate at top of photo in Fig. 4) is grounded and the meter is not close to an AC power line.

Set a signal generator to 1,000 cps and adjust its output level to 3 V peak-to-peak (1.06 V rms). Set S1 to 130db and feed the signal to J1. Adjust R23 for a 0db indication. To check operation, disconnect the external signal and switch S1 to a suitable range to measure voice or background-noise levels. *Fast/slow* switch S3 should have a very noticeable effect on voice measurements.

The Decibel. To get the most out of your meter you should understand the unit of sound intensity, the decibel. It is also used to express a *ratio* between two powers, voltages, pressures or other units. The equation for finding this ratio is:

$$\text{db} = 10 \log_{10} P2/P1$$

[Continued on page 96]

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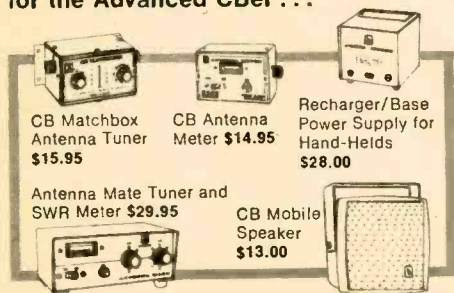
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CIRCLE NUMBER 15 ON PAGE 15

Direct-Reading Sound Meter

Continued from page 94

The lower power is P1 and P2 is the higher power. Suppose the power output of an audio system is measured at a level P1. If the power output is doubled this corresponds to a 3db increase. If the power is increased 10 times this would be a 10db increase.

This might seem like an inconvenient and rather complex way of measuring but you must consider the human ear. Actually the ear can perceive sound level over a wider range than other human senses, such as the eye. 0db is considered to be the threshold of hearing. The ear will not overload (a sensation of pain rather than hearing) until +130db, or a range of 3 million to one. Measuring audio-level differences of 1db makes little sense since the ear can only detect changes of about 2db or more. For example, if an amplifier is delivering 10 watts to a speaker you could not hear a volume change until the power is either increased to about 15 watts or decreased to about 6 watts.

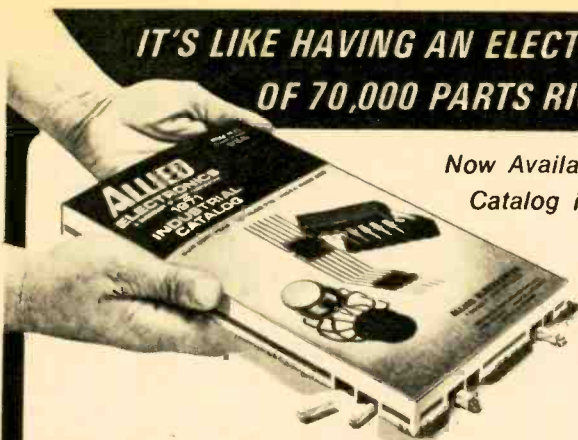
On a sound-level meter, the decibel indication is a ratio based on a standard of *physical* pressure. The standard is about the threshold of hearing and is defined as 0db = 0.0002 dynes/cm². Textbooks go into detail on this but for our purposes 0db is the point where the ear begins to perceive sound. Note the intensity of common sounds in the table below. Long listening at levels over 105db can permanently damage hearing.

LEVELS OF COMMON SOUNDS

Whisper at 5 ft.	20db
Conversation at 3 ft.	60-70
Typewriter	65
Average traffic at 100 ft.	70
Office tabulating machines	80
Alarm clock	80
Heavy traffic at 25 ft.	90
Very loud classical music	95
Food blender	100
Rock music	105
Thunder	107
Threshold of pain	130-140
Jet plane at takeoff	150
Rocket launching	175

The human ear is far from flat in frequency response. You may perceive musical sound at, say, +10db from 200 to 10,000 cps. But a 50-cps sound will not be heard until +50db and a 20-cps sound won't be heard until +70db. Hence, the reason many amplifiers have loudness controls which boost the bass level as volume is decreased.

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Heathkit AR-29 Stereo Receiver

Continued from page 49

watts into 16 ohms. The midband total harmonic distortion at these power levels was no higher than 0.09 per cent.

Since the maximum power output at 10 cps is down approximately 1.5db (25 watts into 8 ohms per channel), the frequency-response and distortion measurements were made at the 25-watt level (rather than at the usual 1-watt level).

At 25 watts per channel (sustained power output with both channels driven) the frequency response with the tone controls out of the circuit was essentially ruler flat from 20 cps to 20kc. The total harmonic distortion at any frequency did not exceed 0.09 per cent. The phono input hum and noise was -63db (just noise, no measurable hum).

The tone control and loudness performance is impressive. There's a semi-plateau bass boost which fills out the upper low end without producing juke-box bass at the extreme low end. The loudness compensation also plateaus, below 300 cps, producing a mellow sound at low volume levels without a deep thumping bass.

As for faults, we could find none. From the superb construction manual to the outstanding sound quality the AR-29 is a best buy in stereo receivers . . . no matter how you slice it.

Can You Learn Electronics?

Continued from page 45

net cover contains large hardware such as relays, CdS and solar cells, meter, etc. The cover also contains an exposed integrated circuit. All connections are through spring terminals.

The notably large assortment of components and the auxiliary terminals allows two projects to be interconnected, as well as allowing connection of the user's solid-state devices.

The instruction manual is jam-packed with projects such as radios, AC bridges, dark-room meters and electronic bongos. Though the circuit descriptions are short on theory, they are very good in terms of applications. Many projects are good enough to be lifted and put to use.

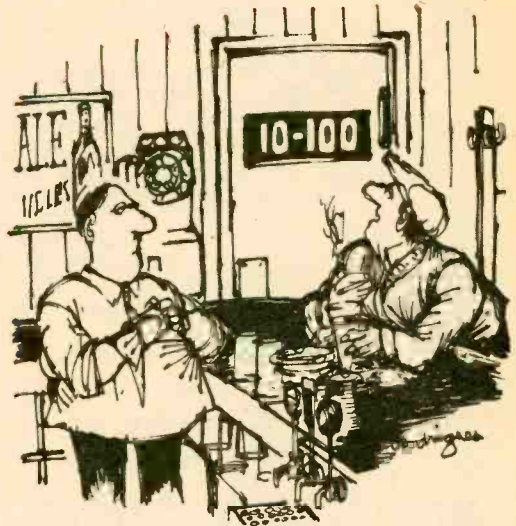
This kit is notably easy for handling by young children.

Over and Out

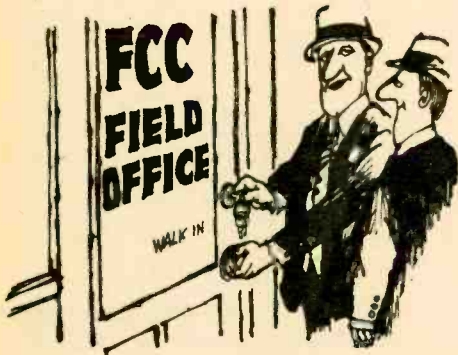
rodriguez



"You know the rules, Frank. Any member who works skip 100 consecutive times is suspended for two weeks."



"... a lot of CBers hang around here?"



"Well, we had a pretty good roundup this week; five phantoms, three whisperers, two big daddies, and a Woody Woodpecker."



"... and if there is any further complaint about your operating illegal CB equipment, your 10-20 will be Leavenworth."



"It's guys like him that give CBers a bad name."

Electronics Illustrated

On Being A Buyer In Electronics

Continued from page 83

How do you get started in the field? Begin by looking around where you presently work, that's where you have the most value. You should already know a little about how the company operates. "Sure we fill some purchasing positions from within the company," says one purchasing agent. "Personnel in production control or stores or anywhere else in the material chain can work out quite well. They're already supply oriented."

However, before you go knocking on the purchasing agent's door, have something extra to offer. Take a few purchasing-oriented courses first. Learn all you can about your firm's purchasing department and how it operates.

If you find inside doors closed to you, start looking around. Don't ignore the little shop—maybe you could start by working part of the time as a technician and assist with buying. Let it be known that you're looking. Many of these jobs are filled by word-of-mouth. Salesmen are often the first to know of an impending opening.

Pay? Well, electronic purchasing doesn't yield instant money, but within just a few years your salary will likely outstrip those of the technicians you know. Starting annual salaries range between \$7,200 to \$9,000 depending on your geographic location, education and experience. Seasoned buyers earn \$12,000 to \$15,000 or more. The higher figures may require some supervision of junior buyers, expeditors or clerks.

Happily, management positions aren't limited to just the overly educated few, although training and education are prime prerequisites to success. Many of the profession's most respected men made it the hard way.

You may be perfectly happy with the job you have now. If so, congratulations. But if you feel that you can't see the light at the end of the tunnel and wish for a job where your good sense will be rewarded, you might try a career spending someone else's money.

The Radio Euzkadi Mystery

Continued from page 76

make the programs unlistenable. But because of evasive tactics and sloppy jamming, the
[Continued on page 100]

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ELECTRONICS ILLUSTRATED

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(Act of October 23, 1962)

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 I certify that the statements made by me above are correct and complete.

(signed) GORDON W. FAWCETT,
 Business Manager

station is heard in Spain.

In North America, R. Euzkadi is audible nearly every day, and with careful tuning, jamming is not a major problem. Listeners reports are appreciated, though replies are few. Sr. Priscilliano Garcia keeps a careful file of DXer's letters. He's particularly proud of those which represent really long haul reception. Radio Euzkadi's mailing address is Boite Postale 59, Poste Centrale, 75 Paris (16) France.

As it has for so many years, R. Euzkadi goes on broadcasting, keeping alive the flickering hopes of the Basques that someday, somehow, they will regain independence for their homeland

The CeeBeeper

Continued from page 61

Using the long-nose pliers, flatten the terminals on the foil side of the board and then solder them in place. Cut off the excess terminal protruding through the foil side of the board. Then install all other parts.

Next, install the transistors, leaving approximately 1/4 in. between the base of the transistors and the board.

When the board is finished, position it about 1/2 in. down from the top of the cabinet as in Fig. 3 and as far to the right (crystal side) as is possible. Make certain there is sufficient clearance for the cover. Mark the mounting holes but do not install the board yet. Install the holder for battery B1, power switch S1 and the telescoping antenna.

Finally, install the board using 1/4 in. metal

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ELECTRONICS ILLUSTRATED certifies that this low-power transmitting device can be expected to comply with the requirements of Paragraph 15.205 of the FCC Regulations under the following conditions:

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- (b) When used for the purpose and in the manner indicated in the instructions.
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Robert G. Beason

ELECTRONICS ILLUSTRATED, New York, N. Y.

dated: November 5, 1970

I hereby certify that I have assembled and adjusted this device in strict accordance with the above.

Owner's signature

Date

Fig. 6—Sign certificate and paste on the cabinet.

standoffs or a stack of washers between the cabinet and the board. Metal standoffs or washers must be used as the ground connection between the board and cabinet is provided by them. Connect the battery's negative lead to the board and the positive lead to S1. Do not connect the lead from S1 to the board's positive terminal yet.

Tune-Up. Connect a DC milliammeter rated at 20 ma or higher between S1 and the board's positive supply terminal. Insert a CB crystal for any channel except 1 in S01 and then turn on power. If the meter indicates reverse scale simply reverse its connections. The meter will indicate somewhere between 7 to 11 ma. Using a clip lead, turn on oscillators Q3 and Q4 by shorting C2's negative lead to the board's ground point. Extend the antenna fully and then adjust L1's slug with an insulated alignment tool until the meter indicates 10 ma higher than the idling current. Under no circumstances adjust L1 so the meter indicates more than 20 ma. This adjustment will result in a input power well under 100 mw—approximately 40 to 60 mw.

The tune-up is completed. Turn off S1, remove the meter, unground C2's negative lead and solder the lead from S1 to the board's positive power terminal. Install the cover and the Beeper is ready to go.

New DX Award

Continued from page 50

ing their heads for some time, because no one is quite sure where it is. Although it has been inconsistently on the air since 1966, the inability to pinpoint the location suggests a mobile operation. For award purposes we will accept this station for Saudi Arabia or the State of Oman, a recent merger of Middle East countries under the son of a deposed king. It is interesting to note that this new ruler has said that communications are one of his prime priorities, so DXers may be getting a little more action from Oman in the future.

Two other international broadcasting voices can be readily heard from the Middle East. Saudi Arabian Broadcasting operates two SWBC outlets, each with an array of 50-kw transmitters. SAB has transmissions on 6000, 9720 and 11950 kc which they list as originating from Riyadh and on 7220,

[Continued on page 102]

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New DX Award

Continued from page 101

11855 (English reported at 1200-1500 EST) and 15150 the point of origin is said to be Jeddah, a port on the Red Sea. Saudi Arabia verifies all correct reports, but they are usually a long time in coming.

If you find, like many other DXers, that The Voice of the Coast does not respond to your report, there is an alternative to log for Oman. The BBC operates one of the most powerful MW relays in the world there, consisting of two 750-kw transmitter for an effective radiated power of one-and-a-half million watts when they are on the same frequency. Sunspot activity has kept these monsters from North America for a while, but you might try on 701 kc at 2245 EST and if your shack is near the Eastern seaboard try at 1600 also.

After you've had it up to your earlobes with minarets and chanty Eastern dialects, you might move on to the island DX countries in the Pacific.

Hawaii, of course, is one of those 50 stars on our flag, but its distance from the mainland qualifies it as a separate DX country. There are rumors jumping about that the Billy Graham organization might try and build their own SW outlet there in conjunction with KAIM, a Honolulu BCBER on 870 kc. If this does not come to pass you might try for WWVH, the standard time and frequency station on 5000, 10000 and 15000 kc. This station is readily receivable in hours of darkness when it slips in under WWV.

Looking for a shot at the Mexican part of the qualifications might lead you to XERMEX which identifies itself as R. Mexico. It went on the air in 1969 and is the Mexican government's first attempt in the international arena. XERMEX is easily logged in the evenings with some English transmission on 9745 kc (sometimes switching to 9540) and 11720 and 15125 kc (which is also replaced at times, here with 6055 kc). The Mexican station is very good about verification.

As for some of the other stations on your route, R. Mali has been testing some medium-powered transmitters on the international bands. R. Cairo's transmissions may end up with a different ID like the Voice of the Arabs, but all reports go to R. Cairo's propagation department.

Bon Voyage! —

Weird New Sonic Lure Caught Fish Like Crazy!

New vibrating lure gives loud gurgling, splashing, bubbling sounds as you skitter it along the surface of the water! Sends out up to 200 vibrations every minute underneath that water! Looks completely unlike anything that a fresh water fish has seen before.

This weird sight and weird sound and weird sonic vibrations — in one of its very first Summer trials — lured fish into attacking so savagely that they actually knocked it out of the water. Hauled in trout, bass, muskie, walleye, and pike, even when other lures had caught little or no fish right next to it! Here's why —

CAUGHT! 120 FISH IN ONE HOUR!

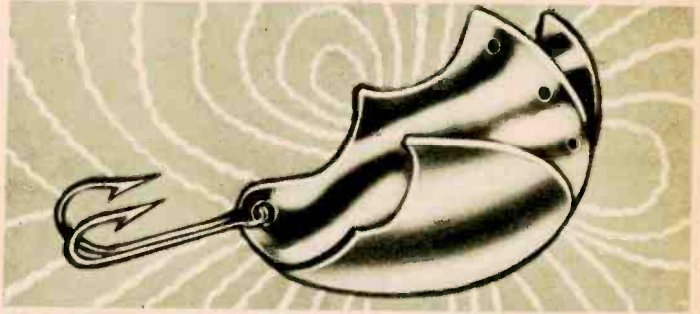
At Cattail Lake, Illinois. A hot summer day! A beautiful stream-fed pond—90 by 60 feet wide! Fishermen trying lures, flies, natural bait! But there is only an occasional strike. It looks like a wasted day!

Then, three die-hard friends try their luck with me! We cast from the edge of the water. At the end of our lines is an entirely different lure — a weird little metal monster that casts like a bullet and flutters back through the water like a drowning bat!

FISHERMEN SURPRISED

Almost at once that quiet water explodes into action! The first strike causes a shout of excitement! And then a second strike! A third, fourth, sixth, seventh, eighth! Beautiful rainbows and browns still shimmering from the water — being pulled in at the rate of more than one every minute!

Now the water almost explodes with fish striking! Sometimes four and five trout savagely attack one lure at the same time! Fifty — seventy — ninety fish are caught and released! People



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FANTASTIC CATCHES

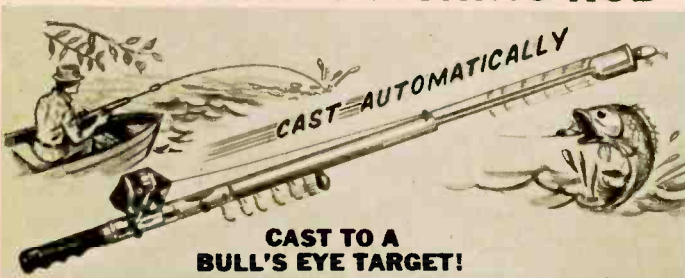
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Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the wiring 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."

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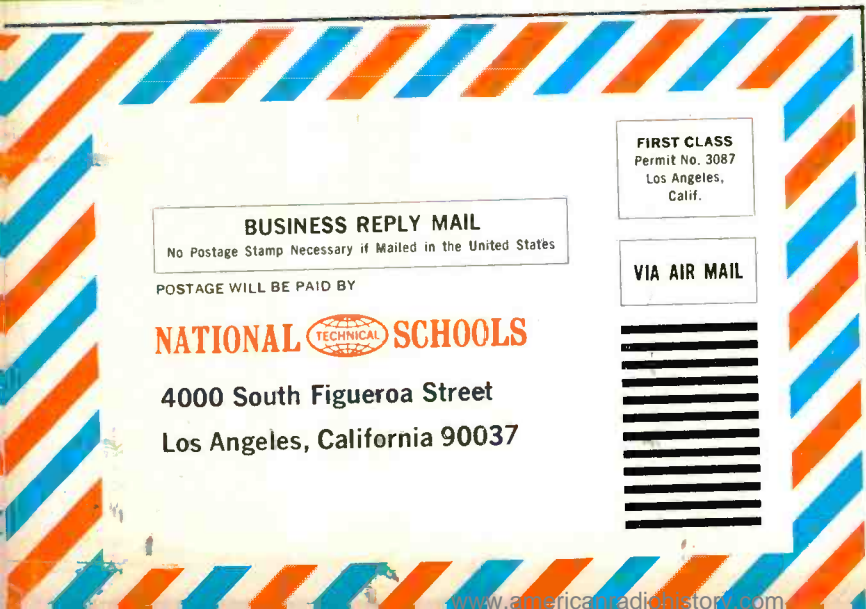


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