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MAY 1971 50¢

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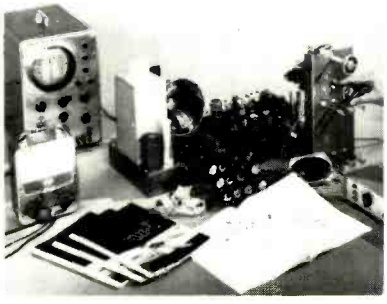

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RONALD L. WOOD, Fargo, N.D., holds a First Class FCC License and is employed as a studio and master control engineer/technician with station KXJB-TV. He wrote to NRI to say, "Many thanks to NRI for the Electronics training I have received."

RANDY ACERMAN, Camden, N.J. has his own TV service business. He is the official TV repair center for the Radio Shack store and Goodyear Tire Co. in his area. He says, "I have seen other schools' texts and most can't hold a candle to NRI lessons."

CRAIG D. SPARKS, Cambridge, Mass., is a Communications technician for AT&T Long Lines Dept. "I was hired because of my NRI training. I was given credit for 18 months experience and my starting pay raised. They were impressed NRI trained me well enough to get a First Class FCC License."

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May 1971 Vol. 14 No. 3

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32 PAGE EICO CATALOG

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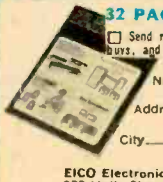

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Feedback from Our Readers

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

● MAE WEST FOR CRTs

Your article HOW TO STRETCH THE LIFE OF A PICTURE TUBE (March '71 EI) really was a lifesaver. I saved over $200 on the cost of a new tube by using the procedures that were outlined in the article.

Paul Dahlen
Pittsburg, Pa.

Say Paul, how about splitting the difference with us?

● SOUNDS LIKE DEWEY DECIMAL

I greatly enjoyed Walt Henry's latest project, A DIRECT-READING SOUND METER YOU CAN BUILD (March '71 EI). Having built it without difficulty, I would like to say that I was amazed at the constant presence of noise in everyday surroundings as shown by the meter. Even our local library had as much noise as might be expected in a traffic jam.

Arvin Saunders
Duluth, Minn.

● DIFFERENCE OF OPINION

Your LETTER FROM GEORGETOWN (Nov. '70 EI) was interesting to read, but I must take issue with your reference to station SWA. R. SWA is operated by the Greek government in Athinia, Athinia Ellini and Athinia Kavour. It is not located in the Caribbean.

F. Raymond Dewey
Bennington, Vt.

Well, F., you're right in a way, we suppose. If you want to split a gnat's hair, that is. Under the ITU hooha the callsign SWA could be given only to stations Over There. So now one goes to Swan and picks up the omni station and—guess what it says in Morse. SWA, that's what. But Swan's SWA is an identifier, not a callsign. So . . . you met any gnats lately?

● READER'S REPORT

I would like to express my sentiments of total agreement with your evaluation of the Heathkit AR-29 stereo receiver (BETTER THAN FIRST RATE, Mar. '71 EI). My finished version reproduces sound better than anything I have ever seen on the pre-assembled market. For the record, I thought you would like to know that those filters are 19 kc and 38 kc, not 15 and 38. Right on, Heathkit!

A. M. Catledge
New York, N.Y.

● CHRISTMAS IN JULY

I'm confused. I have just received your March issue on New Year's Eve, after having bought your January issue on Thanksgiving. Something must have gone awry in your offices or don't you believe in calendars?

John Kiver
San Francisco, Cal.

We celebrate Christmas in July, too.

● MINI OR MAXI?

I'm really excited about your picture story on heat-shrinkable tubing (THE INSULATION WITH THE SHRINKS, March '71 EI.) Considering how tight ladies are wearing their fashions lately, I was wondering if you saw any future in the possibility of using this stuff as fabric for dresses and the like.

Joe Cassini
Chicago, Ill.

We see more than that.

MASTER of All Trades. The Hallicrafters CR-44A Ranger portable short-wave radio has more jammed into it than a can of sardines. Its all-transistor circuitry can receive 30 short-wave services, AM, FM, marine and aviation, police and fire, time signals and ship-to-shore. A direction finder works for three bands. $149.95. Hallicrafters, 600 Hicks Rd., Rolling Meadows, Ill. 60008.

The Daring Digit. In what may seem like a paradox of sorts, Hickok has introduced a multimeter that has no meter. Instead, the Model 3300 employs four readout tubes to give up to a 3-digit reading on any of 26 ranges. $395. Hickok Electrical, 10514 Dupont Ave., Cleveland, Ohio 44108.

Electronic Marketplace

A CB Tiger In Your Tank. The latest in the world of CB sallies forth from Pearce-Simpson in the form of the Tiger 23. It has 23 channels and all crystals are included in the price. A three-position Delta tune switch corrects for off-frequency transmission on the other end. $149.95. Pearce-Simpson, Box 800, Biscayne Annex, Miami, Fla. 33152.

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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 13

Electronic Marketplace

Circuit Scanner. Electronic Tool's Comscan is a handy tester for solid-state devices and circuit continuity. The Comscan indicates circuit condition by means of an audible tone. A change of as little as 1 ohm in circuit resistance pro-

duces a change in pitch. The device draws about 50 ma from a circuit, insuring that no harm will not come to those delicate semiconductors. $19.75. Electronic Tool, 18531 Ventura Blvd., Tarzana, Calif. 91356.

A Noval Bias. One strong point of this Kenwood KW-5066 deck is the recording-bias adjustment system which allows you to select the most desirable bias for full-fidelity recording by using a test-signal oscillator. With four ferrite

heads, the machine has a 25-20,000 cps response and a signal-to-noise ratio of better than 50db at 7½ i.p.s. $199.95. Kenwood, 15711 Bway., Gardena, Calif. 90247.

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CIRCLE NUMBER 17 ON PAGE 13

Electronic Marketplace

Speak To Me With Thine Clock. Pansonic has developed a clock radio which will literally tell you the time. The experimental AM/FM radio, model RC-6900 uses two magnetic disk sheets which are synchronized with the clock timer.

When the call switch is pressed, a motor drives a magnetic head about the disk sheet to pick up the recorded voice. One sheet is for hours, one is for minutes. Matsushita Electric, 220 Park Ave., N.Y., N.Y. 10017.

Unlimited Supply. For those with audio and communications equipment designed for mobile use that you would like to use at home, there is the Stinger PS-11 power supply. The 12-V supply will handle any load up to 4A and is intended primarily for car stereo tape players.

and CB transceivers that pull 0.5 to 2.5 A. The Stinger is designed to eliminate voltage dip that causes fading when tape players change channels. Unicom Electronics Corp., 20426 Corisco St., Chatsworth, Calif. 91311.

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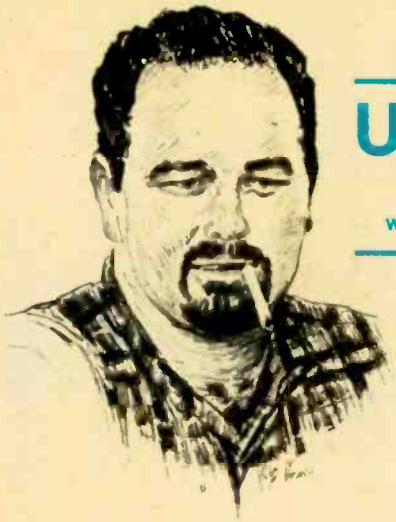

Uncle Tom's Corner

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.

★ *I have an old AM/SW push-button radio. One button is marked for station WEAF. I believe that this was a New York City station and I'm curious to know whatever became of it.*

Rick Weibezahl
Washington, N.J.

Rest your fears, Rick. WEAF is alive and well in New York. Over the years they have had a few callsign changes but now they call themselves WNBC. The station is the flagship of the NBC radio network.

★ *This is the sixth letter I've written to you to complain about certain practices of hi-fi equipment manufacturers. Didn't you receive my last letter?*

G. R. Hollingsworth
Covington, Ky.

That's what I thought it was, G. R.

★ *I built a CW transmitter from plans I found in an old ARRL Handbook. Whenever I try to transmit there are sparks jumping all over the place from the tank coil. I've checked and rechecked all of the circuits but I don't see anything wrong. Now where do I stand?*

Alvin McReady
Bristol, Mass.

About 6 ft. from the thing.

★ *I'll bet you're a pretty clever guy.*

Allan Salomon
Providence, R.I.

The truth wins out.

Hint to FM Broadcasters. Did you ever notice how, while FM music sounds out of this world, the announcers often sound like they're at the bottom of an Artesian well? I wonder why the broadcasters don't de-emphasize everything below 300 cps when voices are being transmitted.

★ *I have a Mexican peso with the word* Libertad *printed on the edge, does this refer to R. Libertad? It also has the words* Estados Unidos Mexicanos *on it, and these words appeared on an envelope from R. Havana. Also on the R. Havana envelope were the words* Par Avion, *which appear on R. Moscow envelopes. What does all this mean to you?*

Bill Capper
Naperville, Ill.

I think you've got the makings of one dilly of a good story there, Bill. Keep checking out those envelopes and coins, and did you ever notice that R. Moscow transmits on megacycles, same as the Voice of America? Hmmmmm.

★ *Sometimes the planes are stacked up for what seems like hours waiting to land at Los Angeles International Airport. Is there any way I can tune their control tower so I can listen to the pilots haggling for permission to land?*

Larry Fellows
Los Angeles, Cal.

The tower uses 118.9 mc to talk to planes south of the field, 120.8 mc for planes on the north side, and 119.8 mc for helicopters. Also dig 121.6 mc and 121.8 to listen to them trying to unravel the traffic jam on the ground as the taxiing aircraft play who's next to take off?

★ *Are there any subjects about which you aren't a self-ordained expert?*

Mark Landau
Gooding, Idaho

Yes, I never heard of Gooding, Idaho.

[*Continued on page* 20]

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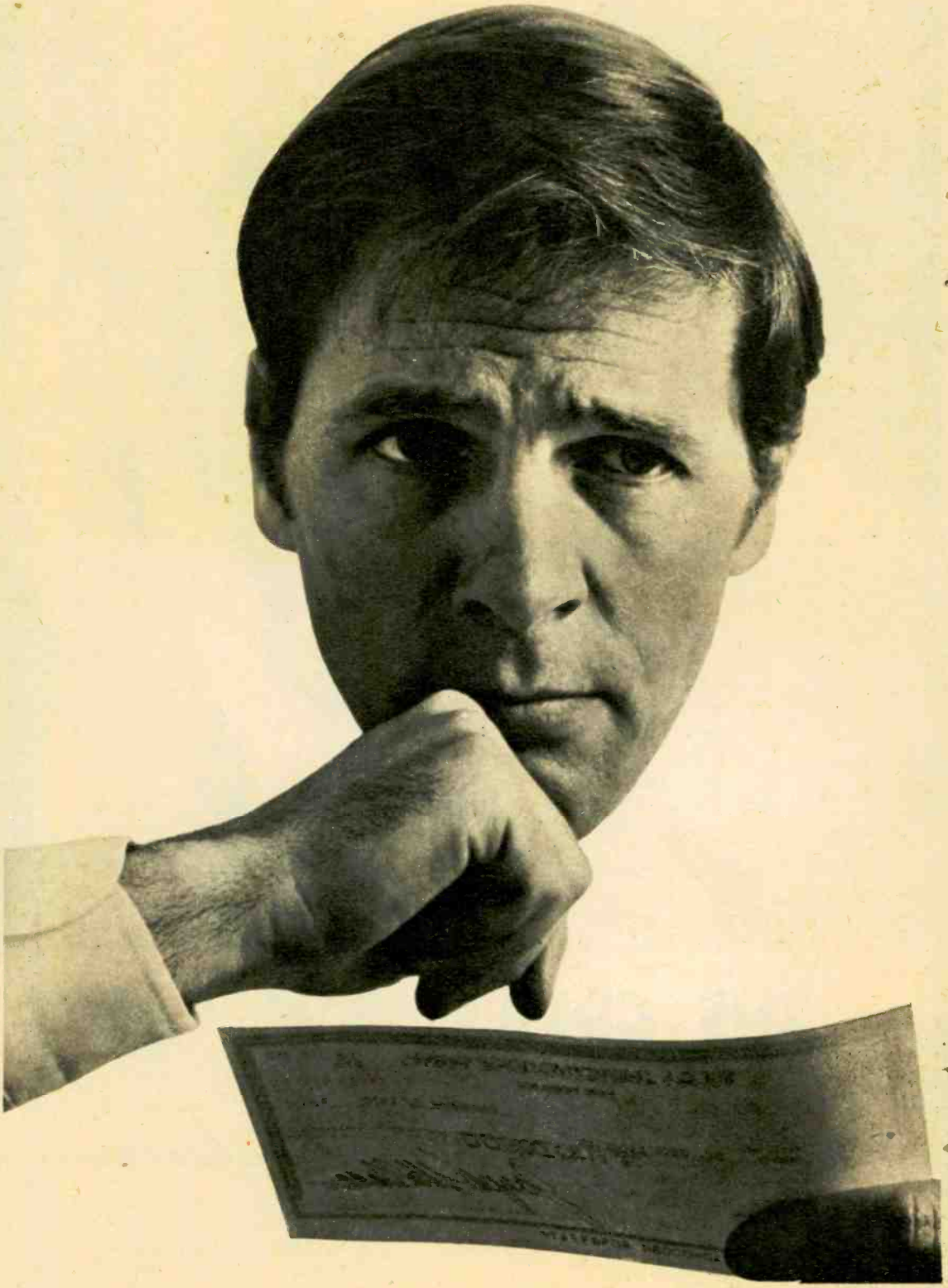

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Uncle Tom's Corner

Continued from page 14

★ *Why do our military aircraft so often accidentally stray over hostile borders? Hard to believe they don't carry radio direction finders.*

Terrence Hulling
Covington, Ky.

In some instances it's the radio direction-finding gear that leads them astray. The Russians, for instance, are expert at a game called spoofing. This consists of luring aircraft over their borders with false radio signals in order to create an incident. In 1960 an American military cargo plane veered over the Russian-Turkish border and was shot down by MIG fighters. After he was released, the pilot reported that the radio beams he had been using "seemed to be all askew" and it became impossible to determine his true position. As his plane approached the beacon at Trabzon (Turkey) the ID was replaced by stronger signal with the same ID and beckoning the plane to the east. Later investigation by military intelligence located false beacons with Trabzon's ID in the Russian towns of Batumi and Poti on the Black Sea. A false beacon signal with the ID of Van (Turkey) is in Erevan, Armenia. The Russians have denied knowledge of these goings-on but refuse to listen to our tapes of the signals. Although our pilots are now watching for these beacons the spoofers continue to mislead our planes from time to time.

★ *I have written to you three times but you have not used my question in your column. Is it because I didn't make myself clear?*

Edward Tinsman
Sunnyvale, Calif.

No.

★ *Ham radio has many codes and signals to help people communicate under different circumstances. Now, if this is recognized as a cause that brings distress to people because of misunderstanding or misinterpretation, don't you think these people should be enlightened?*

R. Howard Rickert
Springfield, Mo.

By all means.

Uncle Tom's Corner

★ *What did you do before you became a writer?*

Harry Relatiner
Woburn, Mass.

I grew a beard.

★ *Someone told me that the Houston Fire Dept. is adding two new channels, but several people at Fire Dept. Headquarters say that they know nothing about this. Are they or aren't they?*

Harry MacDonald
Houston, Texas

Are they fibbing? Yes. Are they changing? Yup. They're adding 453.95 mc and 460.525 mc to their other six channels.

★ *I replaced the S-meter in my communications receiver. When the receiver is on, the new meter keeps pinning all the way over at the maximum reading. The meter zeroing control has no effect. What will remedy this?*

Jay Carpenter
Berryville, Va.

Sounds like you have the polarity reversed on the meter. But something may be out of whack in the meter control circuit, which may be the reason why the set's original meter had to be replaced.

★ *At a ham-radio auction I recently picked up a new condition (but oldish) military surplus rig marked as a BC-375, although I can't find a surplus dealer who ever heard of it. It's a transmitter—I think.*

Mike Gelber
Towson, Md.

That's what the Army said. This transmitter is an archaic behemoth built by GE about 35 years ago. Millions of them were made for use in planes, cars, and other expendable war vehicles. GE had fits when, before the BC-375's could be put into use, someone else came up with the little ARC-5—a fraction of the size and weight with better stability and more output.

★ *Can you find out the frequency of the police department in Muncie, Indiana.*

James Landess
Winchester, Ind.

[*Continued on page 22*]

Uncle Tom's Corner

Continued from page 21

Muncie can be heard dispatching on 155.73 mc as KSB276 and also (in their inter-agency net) on 155.37 mc. Also listen on 155.97 for Muncie PD mobile units.

★ *The electronics industry has provided excellent radio communications between earth and the moon using only a few watts of power. Yet, here on earth we lowly consumers must be content with portable radios that fizzle at the task of receiving 50-kilowatt stations if the receiver is held even slightly in the wrong direction. Why don't they design a portable which would play in or among tall buildings, or which wouldn't poop out when you're facing in the wrong direction?*

Ken Greenberg
Chicago, Ill.

We have a different outlook, Ken. I've always felt that it was the broadcast station that was facing in the wrong direction.

★ *I'm a CB operator who wonders when the FCC will let us talk skip and give us more than a miserly 5-watt output.*

Ronald D. Allius, KBZ4763
N. Grosvener Dale, Conn.

My advice is to not sit by your rig in anxious anticipation.

★ **Cybernetics Dept.** While it's reassuring that much of the defense deployment in our nation is free from human failing because of the miracle of the computer, it came as a bit of a shock when I recently saw a batch of foul data run off on a government computer. Never have I seen such a hodgepodge of incorrect information all in one binding. Poorly programmed? Maybe. I just hope they have more than one programmer in Washington.

★ **Things That Bug Me Dept.** Hams who call "CQ-Dog X-ray," who laugh by saying "Hi-Hi," who say "negative" instead of using the word "no," who ask you something by starting off with the word "question:", and all hams who proudly announce over the air that they refuse to talk to "kids, lids and space cadets."

★ *Do you pay for ideas?*

Harry Frankovich
Morristown, N.J.

I've paid dearly for some bad ones I've had.

★ *At the top end of the 75-meter ham band there is an intermittent white noise (like a rushing sound) which sometimes peaks at S-7. The darn thing really chops out all communications when it's on and many of the local fellows here are wondering what it is. Any clues?*

Ed Harmet
Wheeling, W. Va.

I've heard this, too, and several other East Coast readers have reported it. This signal has been heard as far as 25 kc down into the band and its comings and goings are apparently tied in with the operations of station NSS, operated by the U.S. Navy in Washington. NSS operates on about 4005 kc with 200 kilowatts of multi-channel teletype. Several hams tell me they are calling on the Navy to investigate the situation.

★ *In a recent column you told a TV DXer how to snap photos from his TV screen for QSL purposes. What about us Polaroid fans? Your instructions don't seem to be valid for my Polaroid 210.*

Arlo Elkins
Wichita, Kans.

The Polaroid people forgot to take you into account when they designed the 210 and most of their other cameras. Stopping TV action calls for a 1/25-sec. shutter speed and a lens opening that varies with the brightness and contrast of the TV image (combined with the speed of the film). Most Polaroid Land cameras operate automatically, with both lens opening and shutter speed determined by light conditions. Since you can't set the shutter to the necessary 1/25 sec. you can't be sure you won't get hopelessly blurred pictures. Only those Polaroid cameras with fully adjustable settings (like the 110A and 110B) can be used for this—and they take only black-and-white film.

Broadsides

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

"WE may live without friends, we may live without books; but civilized man cannot live without cooks." The man who said this may have had an eye on his stomach but he certainly knew little of electronics. To keep your head above water you really have to know all there is about the latest developments in the field. A good place to turn for this info is the library of **electronic and electrical books** available from Tab Books, Blue Ridge Summit, Pa. 17214. A catalog is free on request.

If your Hibitzu radios has gone on the fritz you might get some satisfaction by yelling *Banzai!* at the rising sun. Chances are you'll be more rewarded if you can find a replacement part and get the thing working again. Motorola has just released a cross-reference and substitution guide, HEP HMA-07, which puts special attention on hard-to-find consumer **semiconductors,** including those with Japanese, 2N and all other numbers. The guide is available at Motorola dealerships.

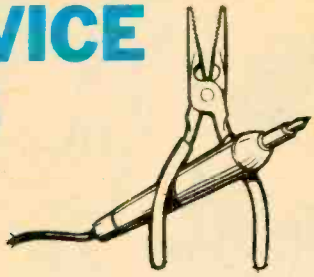
In the spirit of Phineas T. Barnum, Triplett has come out with what it calls the "World's most complete VOM guide" and, since the catalog is free, you couldn't find a better bargain. Included in catalog 57-T are the new digital VOMs and the latest in **multi-purpose, FET and laboratory-accuracy meters.** Much of the equipment comes with such added attractions as Auto-Polarity, which eliminates probe switching. Write the Triplett Corp., Bluffton, Ohio 45817.

You open up the center-fold and there she is in big, blushing color. The latest **short-wave receiver** from Hallicrafters. What may seem like a let-down at first actually becomes a pleasant lift with this new booklet, *Short-Wave Puts You Where It's At.* Intended primarily as a guide for the beginner in communications, it has simple descriptions of what one may expect to hear on short wave and the ham bands. For a free copy write to Hallicrafters at 600 Hicks Rd., Rolling Meadows, Ill. 60008.

One way to judge a company is by how much it tells you about itself. With this as a yardstick, Blonder-Tongue must be right up there for it has just issued catalogs detailing its complete line of **home and MATV products.** The Home Products Catalog (No. 70-62) has specs and photos of mast-mounted preamps, broadband amps, signal dividers and other accessories for the home system. The MATV Products catalog (70-72) has the dope on filters, traps, multiplexers and other MATV items. Write Blonder Tongue Labs, One Jake Brown Rd., Old Bridge, N.J. 08857.

SERVICE TIPS

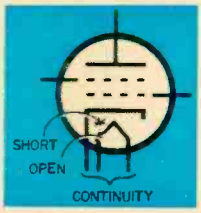
By
ART MARGOLIS



IF you replace a flyback transformer in a color TV and find that the set produces a color rainbow or no color at all, you have interchanged the leads to the color-burst amplifier. Or it is possible that the transformer was incorrectly manufactured. In any case, reverse the winding's leads to cure this difficulty.

—

If you are trying to find a break in a series-heater string with one of those little filament testers and you find no indication of an opening any place, double-check the tubes on a regular tube tester. Sometimes a tube develops a heater-to-cathode short in such a way that the heater circuit is returned through the cathode, even though the other side of the heater is open. The filament tester can't find the trouble because it just reads continuity.



—

Be sure to keep plenty of those little wire nuts around if you do a lot of appliance repair. Those plastic gadgets are very efficient when used on a joint where a few wires come together. 60/40 solder will melt during the operation of lots of appliances and tape will not hold the wires together.

—

If you have fluctuating audio, listen closely to determine if it's a volume change or a tone variation. Bad components in the tone circuit will produce sound similar to that produced when a volume problem exists. You can waste time searching the volume circuit if you don't recognize this.

—

It's good technique to use a back-to-back cheater cord during radio and TV repairs. It gives you a quick check of the line cord and you are less likely to leave your cheater behind.

—

During servicing there are many moments when you would like to leave your VTVM or scope probe attached to a test point. Make up an alligator clip with an attachment that will fit onto the probe. Try using a female connector that you have previously found the probe will fit into.

—

You probably don't know it, but you have a monitor that can constantly check the amount of wear on your appliance motors such as those found in sewing machines and vaccum cleaners. In the time the appliance is turned on, there is a certain amount of interference generated in your radio and TV. The interference will get gradually worse in direct proportion to motor wear.

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Reach for the finest solder gun yet, at your nearest electronic distributor or dealer. Prove for yourself that in the age of solid-state Ungar really outguns the heavyweights.

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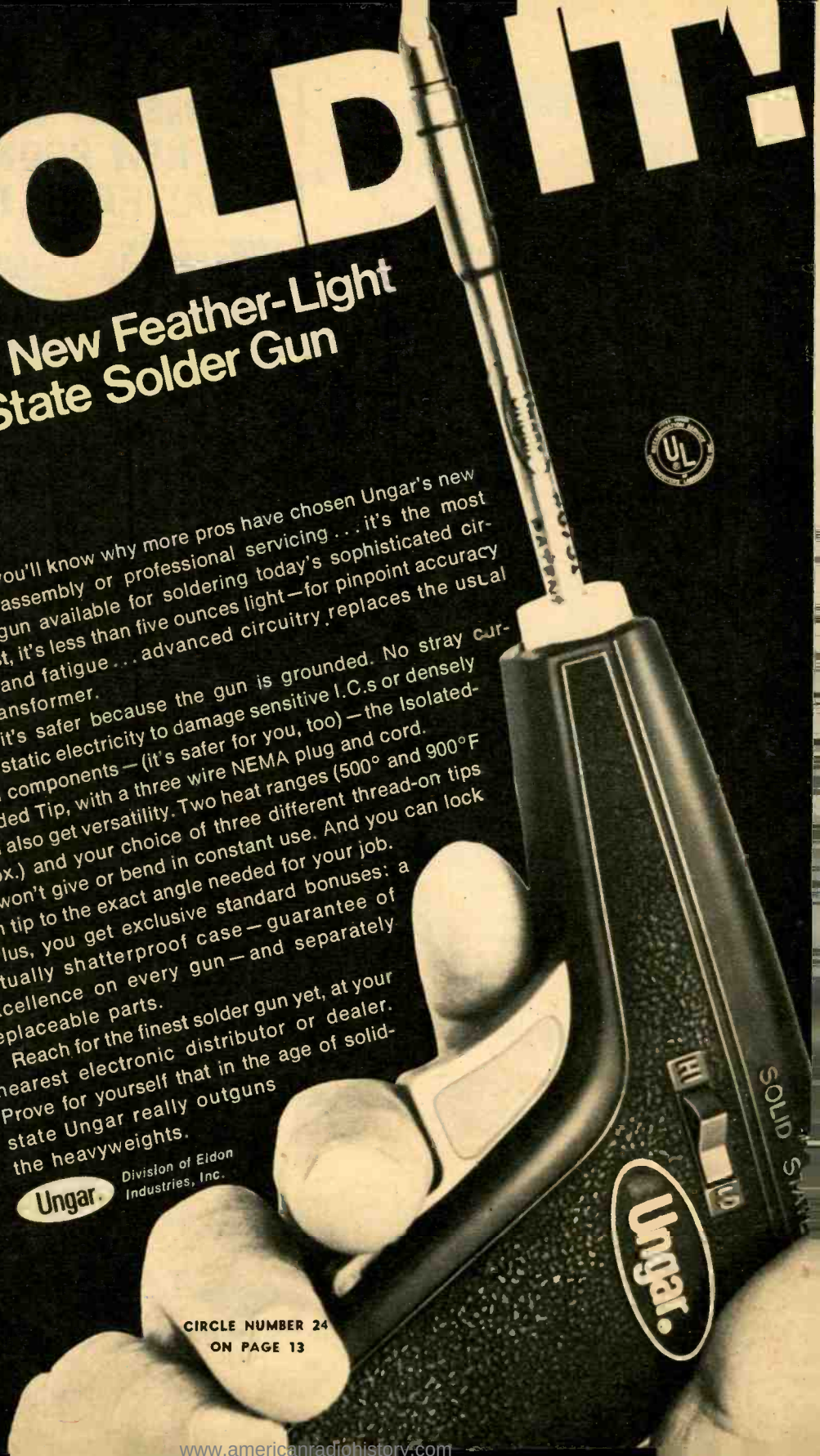


CIRCLE NUMBER 24
ON PAGE 13

Drawing by Chas. Addams;
©1959 The New Yorker Magazine, Inc.

For Soothing Music Around the Clock... Build an SCA Adaptor

By CHARLES GREEN
W6FFQ

"MUSIC hath charms to soothe the savage breast," a sage once said. But that was long before commercial radio broadcasting began. Whether you listen to AM or FM you'll find that current pop music is frequently distracting, unsuitable as low-key background sound or attention-demanding. And the commercials aren't all that pleasant, either.

One way to put a pleasant, commercial-free music background in your home is to build up a library of records or prerecorded tapes. This, however, runs into

Build an SCA Adaptor

money and is a never-ending occupation. And when tastes in music change you end up with a lot of dead inventory.

You may not realize it, but there's a large source of commercial-free popular music right inside your FM tuner (or receiver). It's that music you hear in restaurants, cocktail lounges, banks, supermarkets, office-building elevators (the reason why it's often called elevator music) and other public places.

For music that smooths the ruffled brow, makes monotonous work pleasanter and never requires attention, the SCA (Subsidiary Communications Authorization, the FCC calls it) variety is a guaranteed product. A serious listener could be driven up the wall by the bland, similar, repetitive style of SCA music. But for unconscious consumption, you can't beat it.

Only certain FM stations transmit such music (about a half dozen in the New York City area). It goes along on their carrier in sort of piggy-back fashion (see Fig. 1). Normally you'd never know it's there when you listen to the stations' regular mono or stereo programs.

Connect our SCA adaptor to your set and it will open the window on commercial-free music you never knew existed. Depending on the programming hours of the stations in your area, you could hear it around the clock.

But there's a legal hang-up to all this. You may not use the music in a public place for the entertainment of others because this is considered stealing and using private music transmissions for profit (even though you don't charge anyone to listen to it). There is no problem, however, if you merely listen to the music at home for your own personal entertainment.

Our adaptor is designed to operate with your stereo FM receiver or tuner and audio amplifier. The construction of the adaptor is not complicated. Most of the parts are mounted on a perforated board. An integrated circuit simplifies the design.

Fig. 2—SCA adaptor ready to be connected to FM tuner. Tuner must have wide-band ratio detector or discriminator that handles stereo-FM broadcasts.

Construction

The adaptor is built in a 4-in. deep x 6-in. wide x 3-in.-high aluminum cabinet. The size isn't really important as long as the components are kept in the same position as in our model. Even though the adaptor operates at a very low RF frequency, follow our layout for best results.

Most of the components, except J1, J2 and S1, are mounted with push-in terminals on a 3¾ x 5½-in.-piece of perforated board. Begin construction by cutting the perforated board to size. You will find it easier to mount the board components before installing it in the cabinet.

Drill four mounting holes on the board's corners and temporarily install the board in the cabinet with ⅜-in. spacers. Also drill the mounting holes for J1, J2 and S1 on the front of the cabinet. Remove the board and cut the holes in the cabinet.

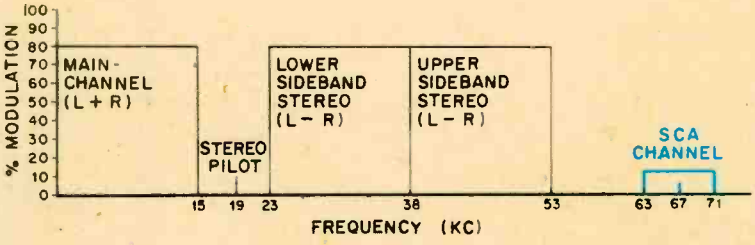


Fig. 1—FM-channel spectrum. SCA program frequency modulates a 67-kc carrier which modulates station's main carrier. Modulation is low so you will need good antenna and receiver. When the SCA music stops, the 67-kc SCA carrier is turned off.

Wire the board components as shown in Figs. 3 and 4. Carefully bend the leads of IC1 outward, and mount it upside down on the board as shown with a spaced-out push-in terminal for each lead. Use push-in terminals to mount the remaining components on the board keeping the leads short. Use spaghetti insulation where necessary and cut off the push-in terminals (after wiring) below the board.

Mount the board in the cabinet with the ⅜-in. spacers, and then install J1, J2 and S1 on the front panel. Connect J1 and J2 with short leads to the board and space the leads to S1 up and away from the board components. Install a rubber grommet in the rear panel hole for the leads from the power supply and tie a knot in the leads. Before connecting the power supply to the board, check the polarity of its output to make sure that the positive lead is connected to

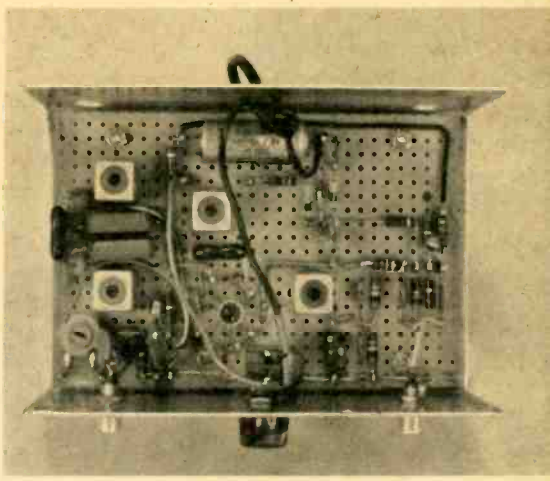


Fig. 3—Top view of adaptor shows circuit board installed in cabinet. Wire at top comes from 6-VDC power supply that plugs in AC outlet. Power switch, input and output jacks are on front panel.

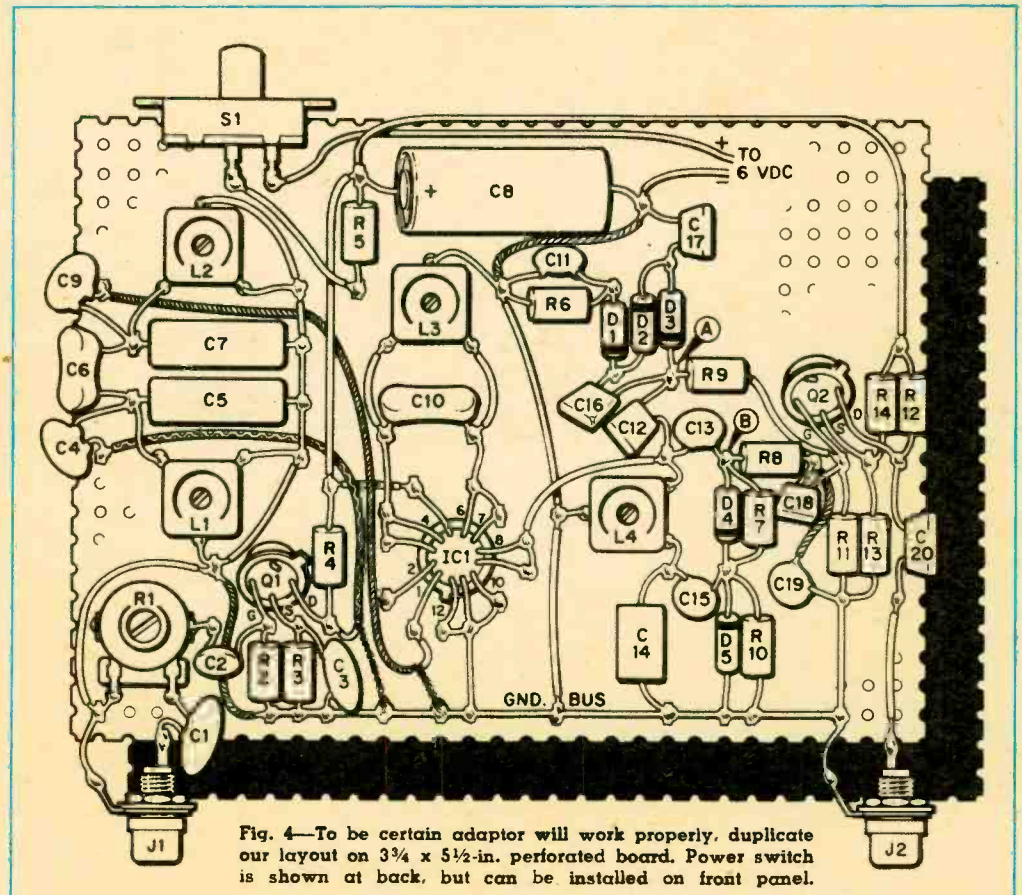


Fig. 4—To be certain adaptor will work properly, duplicate our layout on 3¾ x 5½-in. perforated board. Power switch is shown at back, but can be installed on front panel.

Build an SCA Adaptor

S1 and the negative lead to ground.

Receiver Connections

If your FM tuner has a multiplex-output jack, connect it with shielded cable to J1. If it does not have such a jack, a connection must be made to the tuner's (or receiver's) detector. The tuner or receiver must have a wideband ratio or discriminator detector that is capable of receiving stereo FM broadcasts. Narrow-band IF strips and detectors (common in low-price FM tuners) will not be suitable for SCA reception.

As shown in the typical FM detector schematics (Figs. 7 and 8), make a connection at the junction of the detector output and the R/C de-emphasis network. We installed a phono jack on our receiver for easy connection to the adaptor. If possible, use coax or shielded wire for the connection from the jack to the detector.

If your receiver has an aux input (or phono or tape) that allows connection to the receiver audio system *while the FM tuner section is in operation*, you're in luck. If not, you'll have to rewire the receiver power-switching circuit to operate the FM section when the set is in the phono, aux or tape mode. If that's too complicated, use an external audio amplifier connected to J2.

Alignment

1. Set the slugs in L1, L2, L3 and L4 flush with the top of the coil form.

2. Turn the coil slugs *clockwise* the following number of turns: L1—3½; L2—4¾; L3—3¼; L4—4.

3. Connect the adaptor to your FM tuner, an amplifier and AC power. Turn on the adaptor and tune a station that is broadcasting an SCA program.

PARTS LIST

Capacitors: 50 V or higher
C1—.005 μf disc
C2—100 μμf silvered mica
C3—.1 μf disc
C4,C9—.01 μf disc
C5,C7—.01 μf silvered mica
C6—1,800 μμf, silvered mica
C8—500 μf electrolytic
C10—5,100 μμf silvered mica
C11,C12,C16,C17,C18—.002 μf disc
C13,C15—.001 μf disc
C14—430 μμf silvered mica
C19—6,800 μμf silvered mica
C20—.02 μf disc
D1 through D5—1N270 diode (RCA)
IC1—CA3023 integrated circuit (RCA)
J1,J2—Phono jacks
L1,L2—280-650 μh shielded subminiature adjustable RF coil (J. W. Miller 9057)
L3—.65-1.3 mh shielded subminiature adjustable RF coil (J. W. Miller 9058, Lafayette 34 F 89614)
L4—8-20-mh shielded subminiature adjustable RF coil (J. W. Miller 9061, Lafayette 34 F 89648)
Q1—2N4221 transistor (Motorola)
Q2—2N4220 transistor (Motorola)
Resistors: ½ watt, 10% unless otherwise indicated
R1—500,000 ohm audio-taper pot
R2—5.6 megohms
R3,R13—560 ohms
R4—2,200 ohms
R5—220 ohms
R6—10,000 ohms
R7,R10—100,000 ohms
R8—22,000 ohms
R9—1.2 megohms
R11—10 megohms
R12—6,200 ohms
R14—1,500 ohms
S1—SPST toggle or slide switch
Misc.—6 VDC power supply (Allied Radio Shack 12-702), perforated board, ⅜-in. spacers, 4 x 6 x 3-in. aluminum cabinet (LMB 463-N)

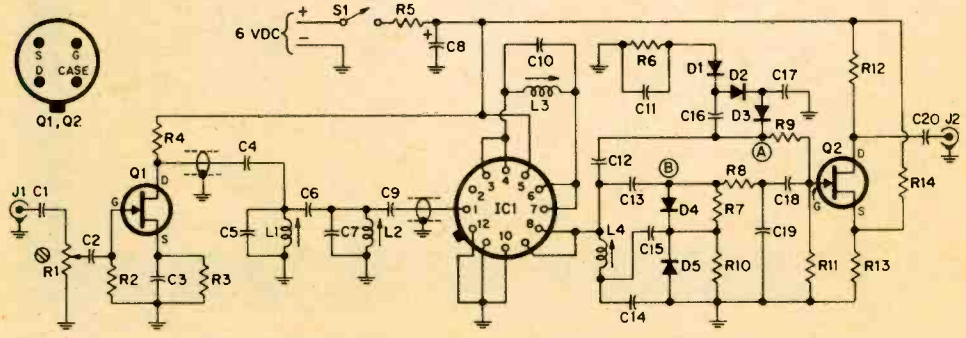


Fig. 5—Adaptor is FM tuner tuned to 67 kc. Bandpass filter C5, C6, C7, L1, L2 passes SCA signal only and rejects main channel and stereo subchannel. IC1 is high-gain amplifier. Detector is C14, D4, D5, L4, C11, C16,C17,D1,D2,D3 form voltage tripler that biases Q2 on when the SCA music starts.

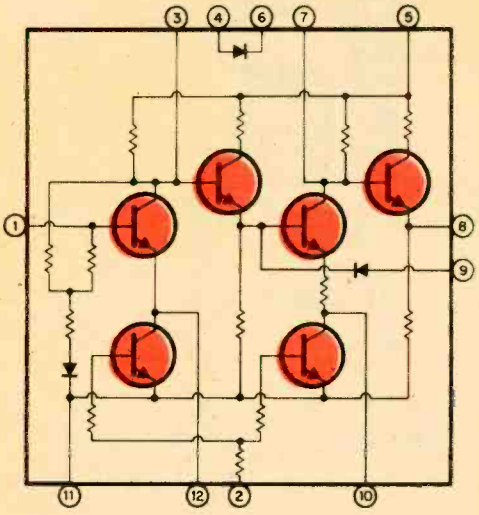


Fig. 6—Schematic of CA3023 IC. IC amplifies 67-kc signal and it also provides additional rejection of unwanted signals and limiting.

4. Connect a VTVM to point *A* (Figs. 4, 5) and adjust R1 for an indication of 1.0 to 1.3 V.

5. Connect the VTVM to point *B* and adjust L4 for a 0-V indication.

6. Connect the VTVM to point *A* and back off R1 for an 0.8 to 1.0 V indication. Adjust L3 for a peak indication. If the voltage at *A* rises above 1.0 V, back off R1.

7. Use R1 to keep the voltage at point *A* between 1.0 and 1.1 V and adjust L1 and L2 for peak indications.

8. Adjust R1 for a peak indication at *A*.

9. Connect the VTVM to *B* and, if necessary, readjust L4 to 0 V.

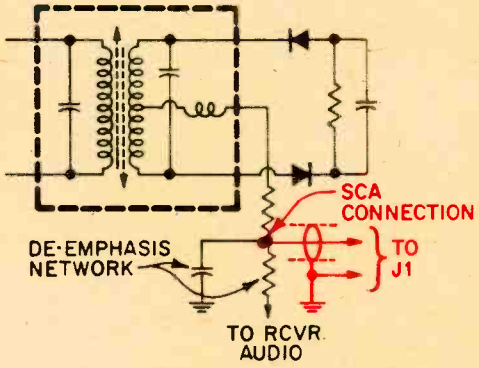


Fig. 7—Schematic of typical ratio detector found in many FM tuners and receivers. SCA adaptor should be connected before de-emphasis network.

10. Adjust R1 for best sound (minimum noise and subchannel crosstalk). Very slight adjustment of L1 and L2 may be made for the same purpose.

Operation

For best reception, the tuner should have low-drift and AFC. The adaptor will work best with strong local FM stations. If you know that an FM station is transmitting an SCA program, tune your receiver to this station and switch on the afc.

If you do not know of an FM station transmitting SCA, tune in each strong station on your receiver, then switch on the adaptor, and listen for a program.

Inasmuch as SCA programs are low-volume, non-distracting background music, the fidelity is not high. Normally, frequencies above 5,000 cps are not transmitted. Therefore, for best reception, keep the treble control on your receiver or audio amplifier cranked down.

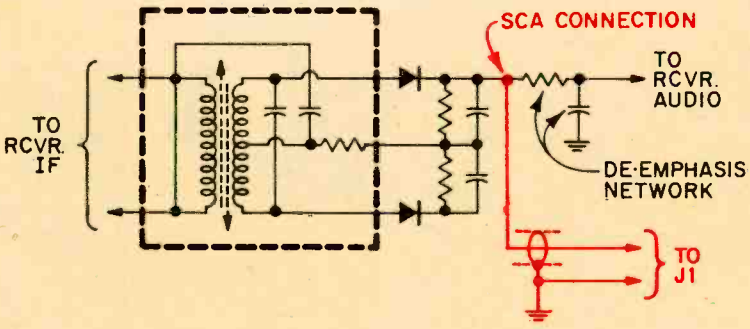
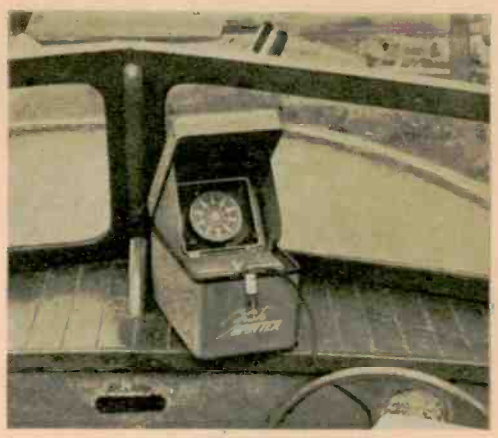


Fig. 8—Schematic of typical discriminator detector found in many FM tuners and receivers. SCA adaptor input should be connected where shown, before de-emphasis network. If possible, use shielded wire from connection to the jack.

EI Kit Report

Heathkit MI-29



Fish-Finding

WHEN running a boat on open ocean, inland waterways or through a harbor where bottom conditions are constantly shifting, one question is always on your mind. How deep is the water and what is the bottom like?

Charts give some information if you know your exact position. But you still wonder whether you are over the soft bottom you were looking for, a wreck, deep hole, or if there is a school of fish below. Then again you may like to know if it is suddenly getting too shallow or if you have strayed out of the safe channel. The best way to get the answers to these questions is to have a depth sounder on board.

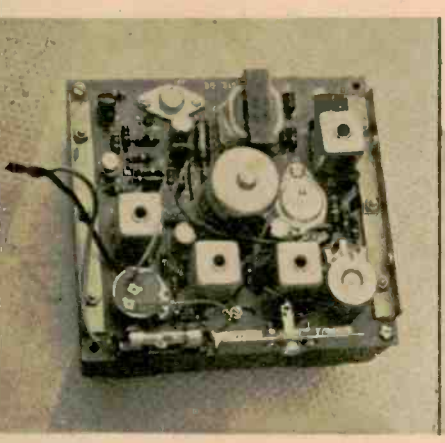
Such a marine accessory generates an ultrasonic signal that travels down from a transducer in the boat, hits the ocean bottom, fish or other submerged objects and returns to the transducer. The time for the trip is converted to depth (in feet) and is indicated on a dial.

Two low-cost depth sounders/fish finders that we built and tested are the $89.95 Heathkit MI-29 Fish Spotter and the $74.95 Knight-Kit KG-711 Depth Meter. Both have a clock-like dial with a spinning neon lamp that lights as it passes the marking for the depth of water under the boat.

The Heathkit operates on two 6-V lantern batteries. The Knight-Kit can be powered by eight internal C cells or by a boat's 12-V battery. Both instruments transmit a 200-kc ultrasonic beam at a rate of 24 pulses-per-second. Both claim a sounding depth of 200 ft. on a hard bottom or 100 ft. on soft bottom.

In building the Heathkit everything went smoothly; the construction time was four or five hours. The construction and installation instructions were clear, easy to follow and accurate. It worked well and accurately the first try—in a swimming pool. The Heathkit is self contained and designed for portability. (You can pack it up and take it off the boat at night.) The transducer and its wire, batteries, operating booklet (printed on waterproof paper), and depth indicator all store conveniently in one case.

The Knight-Kit, which was our builder's first kit, went together in five or six hours. He reported no problems and found the man-



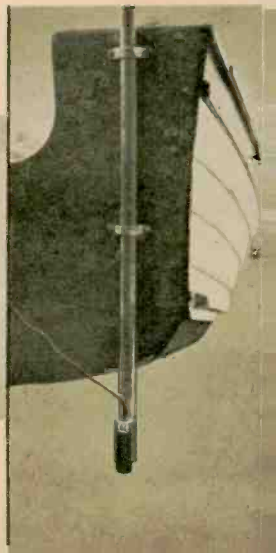


Fig. 1—Heathkit circuit board (left). Case (below) holds batteries and stores transducer. Right photo shows our method of mounting transducer on end of 4-ft. pole that can be lowered into water.

Depthometers

Knight-Kit KG-711

ual's illustrations and step-by-step instructions very clear and easy to follow. It, too, worked the first try and indicated precisely the physically-measured water depth off a dock.

The Knight-Kit mounts on a gimbal bracket which makes it a semi-permanent installation. However, it can be removed by simply loosening two thumbscrews.

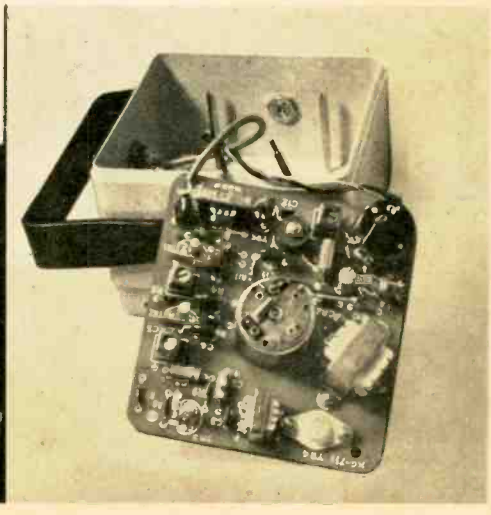
We felt the Heathkit transducer mount was somewhat impractical. It consists of two suction cups on a piece of wood on which there's a clip for the transducer. The suction cups hold the wood on the side or transom of a boat. However, the water pressure against a boat under way is fairly great. Because of this, the mount was pulled off the first time out. While the safety cord kept the mount from being lost, the outboard's prop sliced the transducer wire costing us our transducer. If you use the Heathkit mount make sure that if it does pull loose it can't reach the prop.

We took the transducer clip off the mounting board and attached it to the end of a 1-in. dia. wood pole about 4-ft. long as shown in Fig. 1 (right). We fastened the pole to the transom with two pipe straps so we could pull up the transducer for fast running of the boat. For someone who just rents a boat and must depend on mounting the transducer on the transom, or perhaps an old chipped wood hull he would find the suction cups a losing proposition. Mounting the transducer clip on a board and using C clamps to hold it to the transom would be better, we felt.

The Knight-Kit transducer is well mounted, but not portable. One way of mounting it is shown in the bottom photo in Fig. 2. You could also mount the transducer with its through-the-hull fitting, but you'd have to use leveling blocks to offset any angle of the hull. This would be a permanent installation. Alternatively, the transducer could be mounted on a bracket that can slide in and out of another bracket fastened to the transom. But you must get the

[*Continued on page* 97]

Fig. 2—Photo below shows how we installed Knight-Kit transducer on transom of boat. Alternatively, threaded construction allows it to be mounted through bottom of the hull. Photo at right shows circuit board. Eight C cells fit in back of case.



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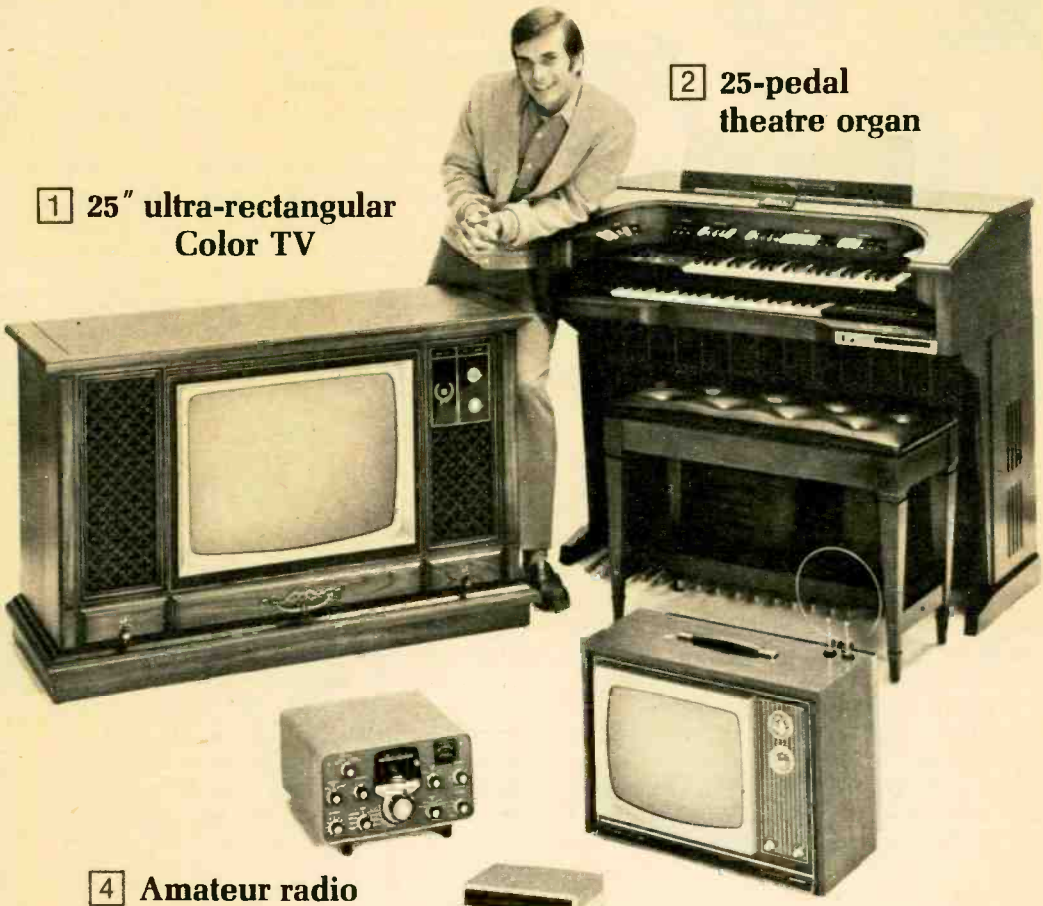

1 25″ ultra-rectangular Color TV

2 25-pedal theatre organ

4 Amateur radio receiver

3 14″ portable Color TV

5 15 MHz frequency counter

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CIRCLE NUMBER 3 ON PAGE 13

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CIRCLE NUMBER 3 ON PAGE 13

The Listener

By C. M. Stanbury II

News of the Baltic

THE Fourth Estate of short wave and DX, we all know, is fond of plying readers with tales of exotic ports and the tropical seas which caress them. These locales appeal to a romantic streak found in most of us. It also is true that tropical locations are easier to log than frigid transmitter sites nearer the auroral zones. Even though the Indian Ocean and Arabian Sea are considerably farther from North America, Baltic ports, including those on the gulfs of Bothnia and Finland, are just as challenging as SW targets.

If you're a novice, you might start with R. Sweden, whose studios and mailing address are in Stockholm although the transmissions actually come from Horby—an inland site.

R. Sweden is best known for its program, Sweden Calling DXers, which airs a multitude of DX tips every Tuesday. Unfortunately, its producers don't often check the accuracy of SW items they receive and, therefore, SWLs should not believe all they hear on this program. English broadcasts are presently beamed to North America on 5990 kc, beginning at 1930, and on 9725 kc at 2230 EST. The latter frequency probably will be replaced by 11705 kc shortly.

Turning to the most difficult SW challenge in the Baltic region, Leningrad on the Gulf of Finland is one of the many transmitter sites which comprise the vast Soviet international network. One of the frequencies listed by the Soviets for Leningrad is 15375 kc, where DXers can hear a Spanish broadcast at 2100 EST which is beamed toward Latin America for Radio Moscow. All Russian transmitter sites seem to be as interchangeable as the identities they broadcast under—a point many DXers have lost sight of recently. Those of us outside governmental snooper agencies have no way of knowing exactly where any Soviet transmission above 5500 kc is originating from.

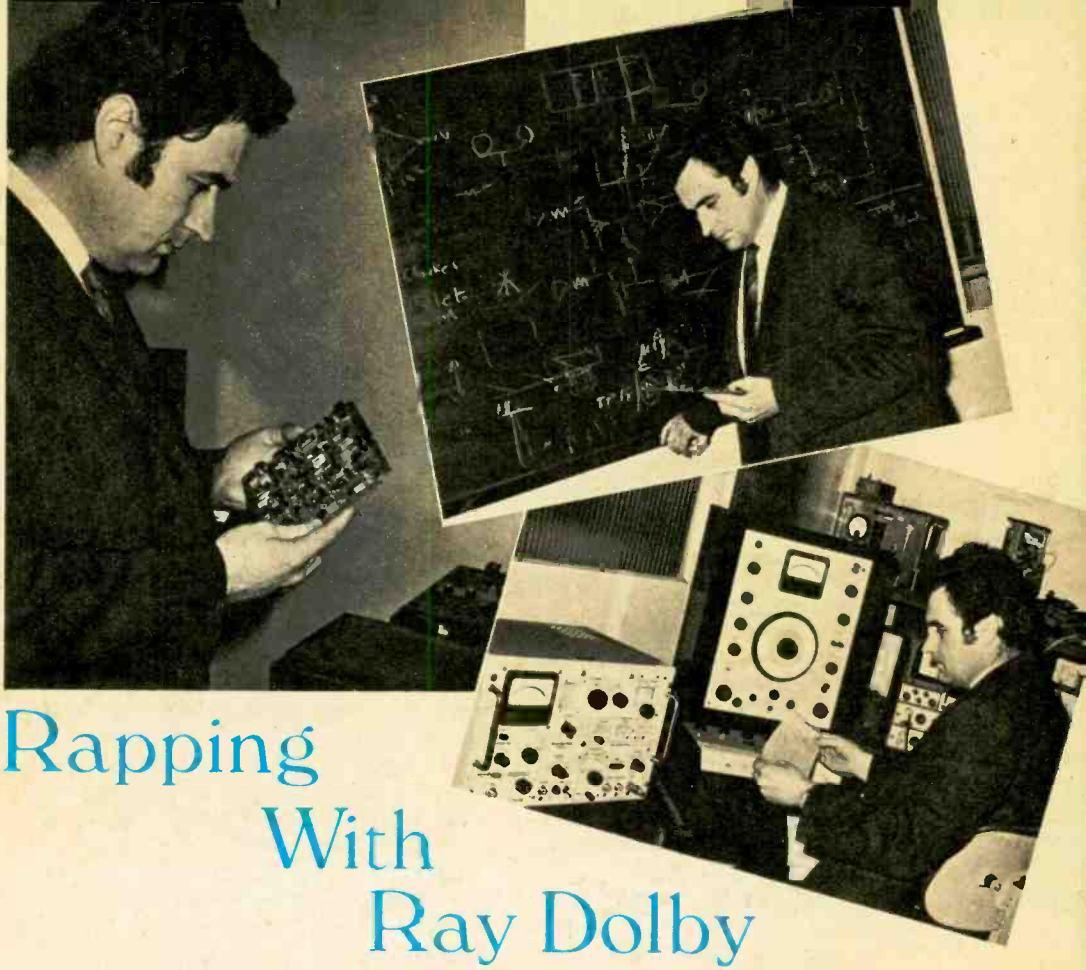
Between these two extremes of DX expertise lie R. Denmark and the Finnish Broadcasting Corp., both of which are government owned, as are all broadcast stations along the Baltic. FBC once featured one of the most interesting DX programs I've ever heard—they were the only SWBC station ever to discuss the explosive and multi-faceted R. Americas mystery on the air. Various political considerations eventually forced the production off FBC's English language schedule. The station can be heard on 15185 kc with various English and Finnish offerings during the day. FBC transmits from Pori on the Gulf of Bothnia. Mailing address and studios are in Helsinki. Like R. Sweden, FBC continues to be an excellent verifier.

R. Denmark discontinued international service about a year ago. Many SWLs, this writer included, never considered RD's English productions exciting, but in the bureaucratic world of SW broadcasting, services seldom are cancelled because of dullness. R. Denmark departed from the international media wars for economic reasons and because the aging 50-kw rig at a remote northern site could no longer compete with the QRM. Ironically, had R. Denmark been transmitting from a tropical locale they might still be in the international broadcast business. R. Denmark has Danish transmissions for its seamen at various times of the day on 15165 kc. You might also try 11790 during evening hours. The station is not issuing QSLs but this policy could change at any time.

Propagation Forecast. Since the end of 1967, sunspot numbers have not changed much, remaining in the vicinity of 100 during the entire period. As a result, propagation conditions have remained stable from one year to the next and this situation is likely to continue until a substantial downturn in sunspot numbers occurs.

To illustrate, the maximum of the current sunspot cycle appears to have occurred in November 1968, with a total sunspot count of 111. In January 1970, the most recent month for which definitive information is available, the monthly number was over 106. Furthermore, the number as early as March 1968 was 105; in nearly two years the sunspot count has varied by only five.

As a result, radio conditions this summer will remain much the same as they were last year, with daytime DX best on the 13-, 16- and 19-meter bands, and nighttime DX possible in all bands from 16 to 49 meters, depending on the location of the station being monitored.



Rapping With Ray Dolby

There is more to Dolby than getting rid of hiss.

By SYLVIA MARGOLIS

LONDON

THE name of Dolby is rapidly becoming a byword in audio circles and the term is even finding itself in the category of household words—at least in households which take pride in their tape recording equipment. The name, of course, is that of the renowned system for noise reduction. It is also the name of Dr. Ray Milton Dolby, the American engineer who first devised and now holds the patent for the noise-abatement technique.

Little is known of Ray Dolby in the U.S. because he has chosen to establish his remarkable organization, Dolby Laboratories, in London. The factory is small by American standards, a four-story modern building on a busy road 4 mi. southwest of downtown London, at Clapham. The photos on this page show Dolby in his serene environment: first examining a production-line PC board, theorizing over new problems and then bringing his supposition to test in the lab.

Ray Dolby was born in 1933, the son of a real estate salesman who had a passion for all things mechanical. In regard to his father Dolby told EI, "Having the father that I had was the most important thing that happened to me. He inspired my interest in electricity, electronics and photography but, just as important, he taught me always to be skeptical of any kind of established wisdom! He provided my imagination. Then there was my mother—she provided the discipline. She taught me to finish one project before I begin another."

Hard work was part of Ray Dolby's life, beginning with early childhood. Before he was 11 years old he was mowing neighbours' lawns at 25¢ an hour, in the tradition of the all-American boy. During the summers

Rapping With Ray Dolby

Ray Dolby shows his wares. On the table in front of him are several of the new consumer products incorporating his special Type B Dolby system. Although most of these products are of American manufacture, Dolby works from headquarters in London.

he was 11, 12 and 13 he worked on a celery ranch. The work was concerned with irrigation, which suited Ray completely. He recalls, "I liked irrigation because you would let the water in at the top end of the row and then go down to the bottom of the row and wait about ten minutes. It happened that in the loft of the ranch pumproom I found a windfall—piles of copies of Popular Mechanics and Scientific American, some going back to the beginning of the century which I would read in that ten minutes."

Not only did Ray earn $200 to $300 a summer to finance his hobbies, but those old magazines were a catalyst for his hobbies and work of the present day. Very early on he started to work with electronics and electricity. He built the usual kind of TRF radio sets, 10-W amplifiers and phonographs and had his own darkroom, where he and his father made prints and enlargements and also experimented with emulsions, putting photographic images onto any arbitrary surface.

Ray went to Sequoia Union High School on the San Francisco peninsula. It was a good school for Ray, particularly oriented for technically inclined children. Ray, one of 3,000 students, took the school's excellent courses in electronics, electricity, physics and chemistry, as well as a general college-preparatory course.

During these years he had never been tempted to take a radio amateur course, although he did play around a bit with Morse code. He organized an electronics club with the neighbourhood kids. It is still vivid in his memory: "I used to teach them about electricity and electronics, although sometimes I had to learn the next day's lesson the night before, to keep ahead. . . ."

He exhausted his supply of magazines, so during the summer he washed dishes, worked as a building labourer, until the summer he was 16 years of age. By then he was the technician for the Sequoia High School projection crew. The work involved keeping the school's Bell & Howell and Ampro equipment in good working condition. Occasionally somebody inquired if the school equipment could be hired for an outside performance. Ray went with the installation, as engineer and projectionist, at $5 per engagement.

One such inquiry came in the spring of 1949 from a man called Alex Poniatoff, who wanted a movie run for the Mental Health Society of San Carlos, Calif. The projectionist would receive $5 plus a free meal. The performance was to be at a plant called Ampex, where about 20 people worked.

After the film had been shown, Ray expressed interest in the Model 200 tape recorder to Mr. Poniatoff. He recalls the conversation: "I didn't know who Alex was. I just wanted a demonstration. I'd heard hi-fi before but only half-baked hi-fi. This was the real thing, for the first time. I was thrilled and tremendously impressed. I asked Alex what his job was at the plant and was quite floored when he said, 'This is my company.' I'd never met any company owners before."

Ray agreed to Alex's suggestion that he work for Ampex some time. The opportunity came that July. Things weren't easy for Ampex in those days and they couldn't take on as many people as they wanted. The company's Chief Engineer was doubtful about taking on a school kid but Alex persisted and

[*Continued on page* 94]

Mr. Dolby's wonderful System

Taking hiss out of recordings is easier than most people think.

By LEN BUCKWALTER

RAY DOLBY's system of noise reduction, in addition to making him a rich man, has heralded a new era in hi-fi. The Dolby system has become one of the most-talked-about developments in audio in many years. Yet few people really comprehend what his rather simple circuitry achieves and how it goes about reaching that end.

When Dolby first discussed the premise of his system, it curiously resembled that of the well-known compressor-expander. A close look reveals that he began with standard circuits and built them into a new configuration to get rid of the well-known problems associated with this circuitry.

If you've operated a tape recorder you've probably demonstrated the concept of audio compression and expansion. You know that hiss is most annoying with low-level signals, especially soft passages of solo instruments. Hiss is apparent at playback because the recorder produces a fixed white-noise level from the tape due to inherent properties of magnetic recording material. Weak audio passages get mixed in with this noise. The system suffers from a poor signal-to-noise ratio. Loud sounds, on the other hand, override this fixed noise and during playback the hiss usually is not heard.

A simple trick to defeat hiss is to manually ride gain. When a soft passage comes along, you crank up the recording level, then reduce for fortissimo or loud sounds. This manual technique of audio compression may sound primitive but it's done by skillful audio men in professional studios with some degree of success. The expander part of the operation occurs further along the process to restore the original balance between loud and soft sounds.

The same effect can be done electrically with audio compressor-expander circuits. They sense audio level at an early stage and develop control signals to vary the gain of subsequent amplifiers. When a low-level passage comes along, the amplifier bias is altered for higher gain or throttled back during powerful sounds. The total effect is to compress the performance into the hiss-free region and do it hands-free, not unlike automatic volume control in a radio.

To the maestros of the mixers, compression is a dirty word. First, it may wreck the dynamic range of music because of poor balance between loud and soft sounds. (Music is simply too complex in waveform for electronic circuits to follow with precision.) With this approach a tinkling triangle

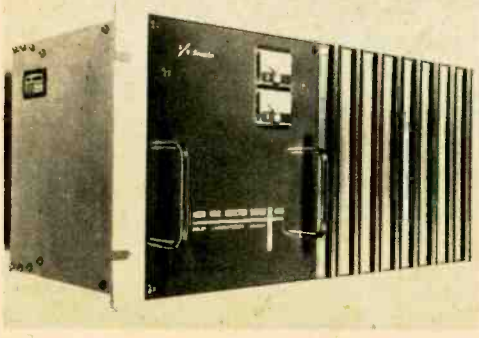


Fig. 1—The Dolby Type-A system of noise reduction. This four-band instrument is used in recording studios to make noise-free master tapes.

Fig. 2—Advent's Model 100 Noise Reduction Unit is a Dolby Type B system intended for consumer use with any kind of tape-recording equipment.

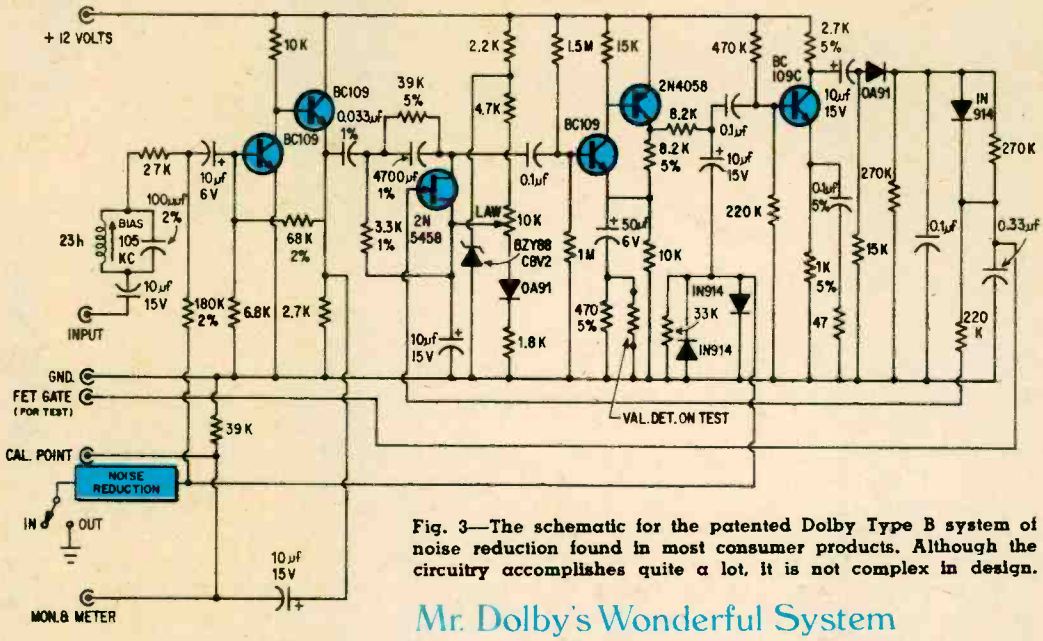


Fig. 3—The schematic for the patented Dolby Type B system of noise reduction found in most consumer products. Although the circuitry accomplishes quite a lot, it is not complex in design.

Mr. Dolby's Wonderful System

could deliver the sock of a bass drum.

Another problem is that the processor must be adjusted for a rapid attack—a loud signal must trigger the compressor into a response within a few milliseconds. But after the passage has subsided, the compressor must not turn off instantaneously but trail away over several seconds. This slow delay is necessary to prevent an unpleasant surging in the music as the background noise-level changes. The engineers call this annoying modulation pumping, breathing or swishing. Yet another demerit for the conventional system is accuracy. There's distortion if the expander fails to reconstruct a perfect mirror-image of the compressor signal.

These are the problems that Dolby has succeeded in solving. His product meticulously attacks these faults in several ways.

First, he breaks with tradition and declares that it's wrong to touch every part of the audio signal. Loud sounds don't need any boost to reduce noise, so why tamper with them? This is a major key to the Dolby concept: it operates only for soft sounds where signal-to-noise ratios start to deteriorate. Not only does this lower the chance for distortion to creep in, but that pumping sound is eliminated. Strong audio is now diverted around the compressor so it can't dominate the amplifier and cause it to breathe.

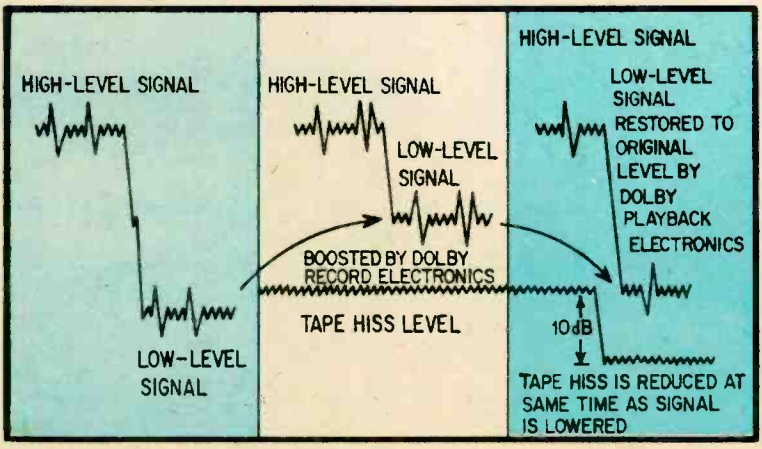


Fig. 4—Audio signals are treated by the Dolby system as shown in the chart. While this system does not eliminate hiss and noise, it can be seen that during playback, restoration of dynamic range suppresses the undesirable recorded sound.

Another key to the Dolby system is that it is a four-band setup. Strong and weak signals easily co-exist in a musical performance and cause confusion in the compressor. So Dolby splits all incoming audio into four frequency bands (80 cps low pass, 80-3,000 cps band pass, 3,000 cps high pass, 9,000 cps high pass) so the noise reduction can be channelled to where it's needed. This is done by audio-splitting frequency filters and four compressors during record and four expanders during playback.

Because of its multiband construction (see Fig. 1), the system also attacks other disturbances in the recording process. Hum and rumble are handled in the low band, along with thumps and plops of an irregular tape surface. Crosstalk between heads or circuits and print-through are treated in the frequency bands where they occur. But it is mainly in hiss reduction that Dolby turns in its celebrated performance. Hiss is reduced by as much as 15db and actual listening tests support these specs. Phono disks whose master tapes were Dolbyized are remarkably quiet and clear in the high-frequency region.

Since the Dolby machine which does all this is strictly professional, the consumer has enjoyed only indirect benefits. Phonograph records are better because master tapes had superior processing at the studio. The system, nevertheless, recently entered the consumer market with similar noise-reduction techniques (see Fig. 2). How is this possible with

[*Continued on page* 94]

Listening With Dolby... a Personal Report

WHEN someone grows up with a case of poor eyesight, he begins to think that everything is naturally out of focus or otherwise distorted. If he gets that needed pair of eyeglasses, everything appears unreal for a while, until he realizes the real beauty he has missed as a result of poor vision.

This is the same feeling one gets when listening to tapes that have been made and played back on equipment utilizing the Dolby system. This Advent tape deck produces such clear and undistorted sound as to cause EI's listening panel to imagine that something wasn't in the recording—something must have been left out. And it had been. Noise and tape hiss were virtually non-existent in all the tests that were conducted with the Advent.

First, we played the Advent Crolyn (cromium dioxide) demonstration cassetts which has several short passages of music—each sounded surrealistic in its clear-as-a-bell reproduction.

A recording was made of a complete symphonic piece using the Dolby system and Crolyn tape. The original source was a new record and the resulting tape was equal to the first playing of the disc.

For our next test we made a simultaneous dubbing of classical organ music (which had a wide dynamic and frequency range) with a TDK type SD cassette on the Advent and on a $570 Magnecord reel-to-reel machine using Scotch 203 tape. The TDX cassette is a high-quality cassette recommended by Advent for use until Crolyn tape becomes available in sufficient quantities. We then played both tapes back, alternating from the cassette to the open-reel recording. In our judgment, there was no difference.

What else can one say? The people at Advent have utilized the new recording discoveries of the Dolby System and Crolyn tape to their best advantage: not only is this the best cassette recorder on the market, it is one of the best recorders around regardless of format.

EI'S WIN THE WORLD CONTEST!

Name Your Favorite Country... And We Will Fly You There

HAVE you ever listened to Radiodiffussion Francaise and begun to yearn to visit the City of Light and Love—Paris? Maybe your interests lean toward current events and you want to see those Kremlin walls from which issue continuous reports of the people's revolution via Radio Moscow. The world is a big place and few of us ever get to see much of it. Your chance to see the city of your dreams has arrived.

ELECTRONICS ILLUSTRATED is conducting the world's greatest communications contest ever! Instead of getting a mere certificate for your wall, the grand prize winner of EI's Win The World Contest will be flown by Pan Am to the country of his choice.

About the contest. It will begin shortly after the publication of the complete rules and prizes in the July issue of EI, which goes on sale at your newsstand on May 15. The contest is a DX contest where every fan of radio will have a chance to use his hobby to compete for prizes—no matter whether it is hamming, SWLing, CBing or whatever.

The winners of the contest will be those people who have the highest number of confirmed contacts with transmitting stations around the world. The Grand Prize winner will select a QSL card from his entry that represents the country that he would most like to visit. Before you know it, our gallant DXer will be aboard a spanking new

Pam Am 747 on his way to the country of his choice. The remaining prizes will be given in descending order.

The prizes. EI has assembled the greatest and most expensive list of prizes that we could lay our hands on. In addition to the trip of your choice there are 99 other exciting and valuable enticements. There is a Model 2000 RCA color TV, the $2,000 set of the future which RCA is making in a limited quantity—only 2,000.

Next on our list is a Heathkit-Thomas organ kit, worth over $1,000. It is designed to give hours of pleasure in assembling and after that years of listening enjoyment with sound the same as that heard in many concert halls.

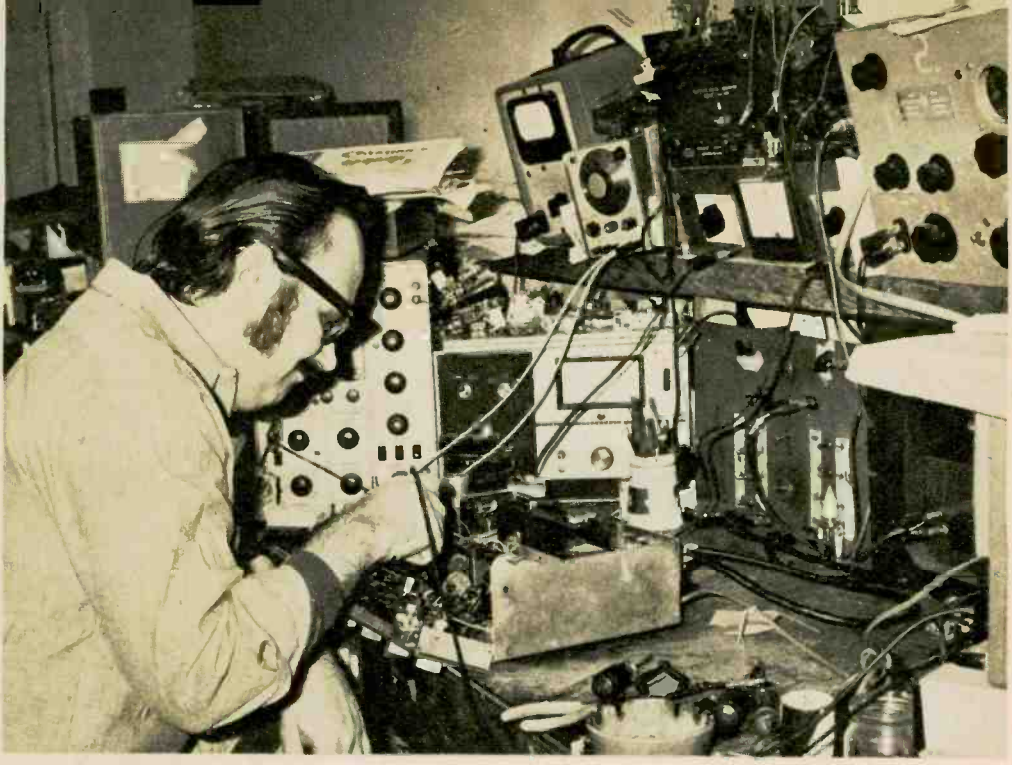
Next on our giant prize list is the Heathkit GR-370 color-TV kit. Boasting modular snap-on circuit board design and a 23-in. Matrix picture tube, the 370 ranks as one the engineering pinnacles in kit design.

The next stop on our prize list is at the latest in portable color-TV from Conar, a division of the National Radio Institute. This compact marvel has a lightweight solid-state power supply instead of a bulky transformer, making it easily totable from drawing room to boudoir.

The list of valuable prizes that will be given away is enormous—far too much to describe in detail at this time. Other prizes will include new ham stations, CB rigs, electronics libraries and your choice of course at one of several renowned electronics correspondence schools.

All the prizes and complete rules and information about the contest will be in the July EI. If you've ever wanted to be in a communications contest, you won't want to miss this one.

ELECTRONICS ILLUSTRATED



How to Service Stereo Amplifiers

By JOSEPH RITCHIE

YOUR stereo amplifier is working like a dream. Output power is more than adequate, there's no background noise or hum in quiet music passages, no distortion at any volume level and balance is perfect. Then . . . zap! Silence. One channel is dead and the other won't deliver enough power to drive headphones. You've got a service job ahead of you.

You put the amplifier on the bench and proceed to touch parts for signs of life—hum. Right approach? Not exactly. That technique passed with the tube amplifier.

In this era of solid-state amps, the index-finger serviceman is a has-been. Reason is low-impedance solid-state circuits don't respond that conveniently to finger-hum injection techniques. Solid state is a different world—symptoms aren't the same, things don't look at all familiar and your thinking and approach to servicing must be reshaped.

Your ears won't be able to isolate a leaky coupling capacitor because in solid-state amplifiers such a capacitor can knock out one, two, three or more circuits. Fact is, solid-state circuits with their combination of voltage and current drive, multiple DC voltage buses and feedback loops as well as unique circuits rarely seen in tube gear prevent classification of troubles by symptoms.

Examples of tube troubles and old-fashioned quick remedies are: hum with the volume control down means a defective filter capacitor. Distortion on signal peaks means a leaky coupling capacitor. Motor-boating means a defective decoupling network, etc. These old bromides are just not applicable to solid-state gear.

A defective filter capacitor in one amplifier might have no effect until the day it explodes. In another amplifier power-supply hum might be caused by a defective capacitance-amplifier (Fig. 1, center) rather than the filter capacitor. In a third amplifier a defective power-supply filter capacitor will never produce hum—but the output voltage might be off 2 or 3 V. In short, solid-state

servicing has no short cuts. It's all brainpower, hard facts and careful circuit analysis.

The first order of business and this is a must, is to get a schematic of the amplifier that shows voltages and resistances throughout the circuit. If this isn't available from the manufacturer or importer, refer to the Howard W. Sams Co. (4300 W. 62 St., Indianapolis, Ind. 46268) Photofact Annual Index to determine which Photofact Folder has the service notes.

Before you can tackle a solid-state amplifier first make certain the correct fuses are installed. Except for the AC-line fuse, solid-state amplifier fuses must be fast acting so they blow before the transistors or diodes. Generally, the fuses are the 8AG type. If you plugged in a 3AG you will zap a handful of components.

Turn the volume control down, make certain all other controls are centered and turn on the amplifier. If the pilot light doesn't come on, check the AC fuse. A replacement that blows instantly generally indicates a shorted power transistor. When the pilot light comes on keep your fingers on the power transistors. If they start to warm up or get hot instantly shut off the power and start looking for defective transistors. Then make a quick check of the power supply to see if all voltages are correct.

If you can keep the power on without smoke, localize the defective circuit(s). Is one or both channels out? Is the distortion or hum in one or both channels? If both channels are inoperative the problem is most likely in the circuit common to both—the power supply, so start there.

The most important thing in solid-state

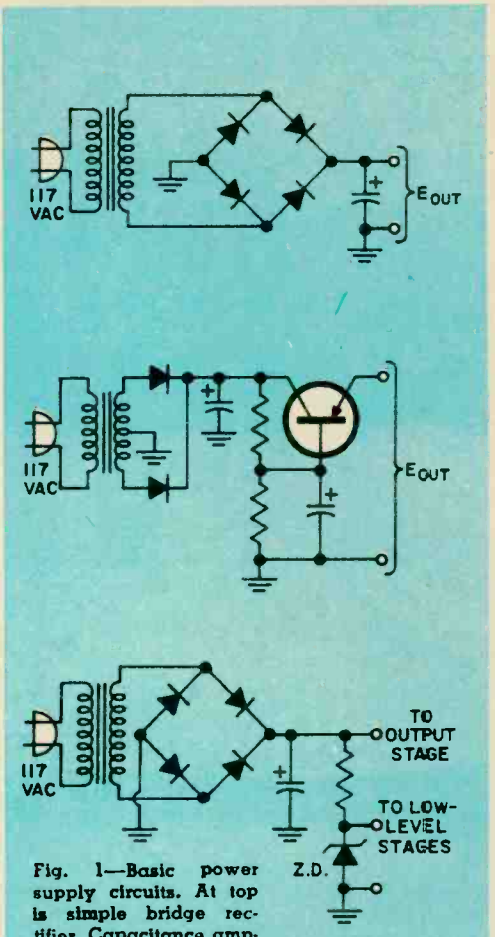


Fig. 1—Basic power supply circuits. At top is simple bridge rectifier. Capacitance amplifier is at center. Effective filter capacitor is transistor's gain multiplied by capacitance of base electrolytic. At bottom, Zener provides regulated voltage to low-level stages.

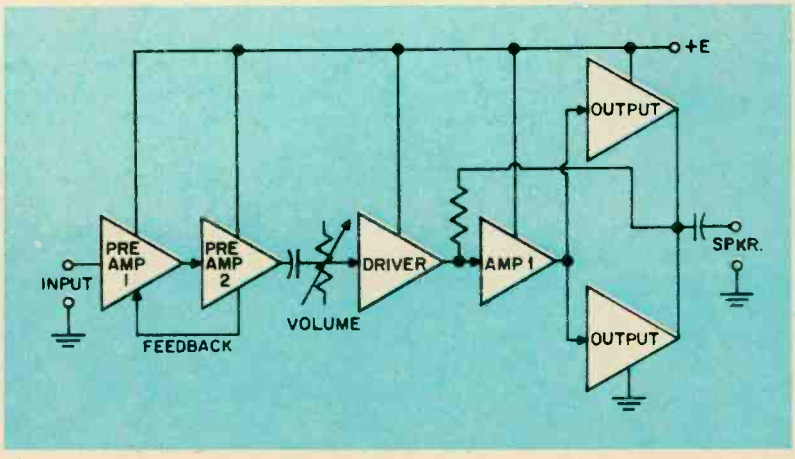


Fig. 2—Block diagram of one channel of typical stereo amplifier. Many, if not most magnetic preamps, use two transistors to provide gain and equalization. Note that bias to "amp 1" is derived from output transistors. Defect in output transistors would affect circuits back to driver output. Scope would show distortion at driver output even though the defect was in output stage.

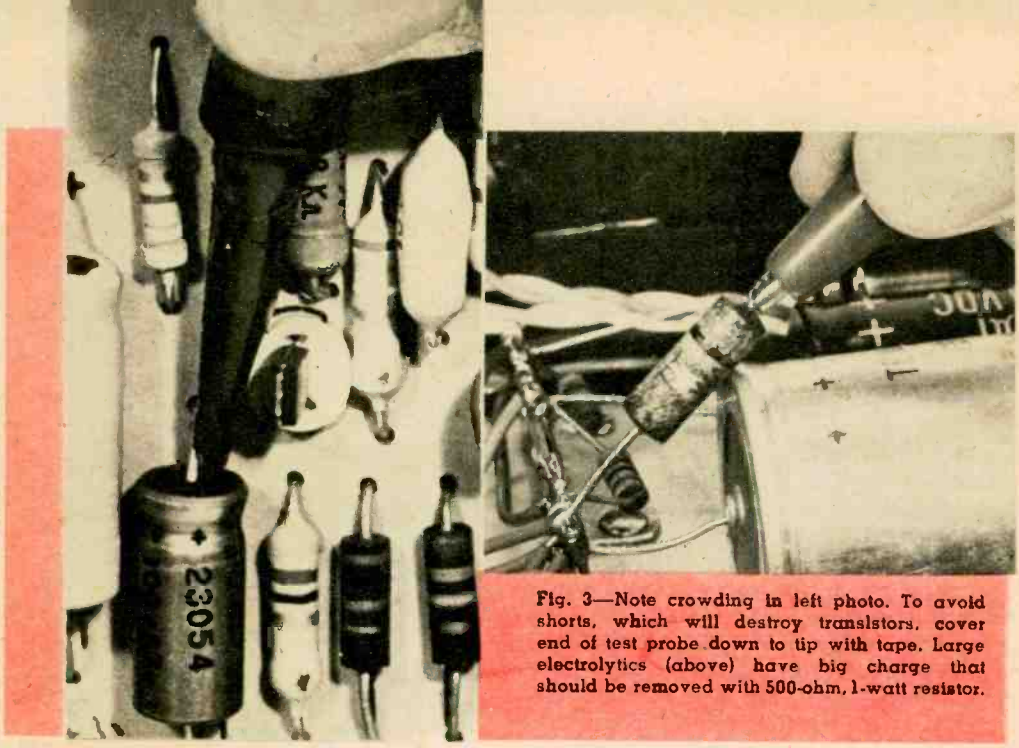


Fig. 3—Note crowding in left photo. To avoid shorts, which will destroy transistors, cover end of test probe down to tip with tape. Large electrolytics (above) have big charge that should be removed with 500-ohm, 1-watt resistor.

How to Service Stereo Amplifiers

amplifiers is DC voltage, and just about any trouble will be reflected as a DC voltage change. The place to start checking DC voltages is the power supply, for a shift of just 2 V is often all it takes to disable an amplifier. Power-supply circuits come in many different configurations: some are straight rectifiers, some capacitance-amplifiers, some Zener regulated, some are feedback regulated and some are the remote-sensing type. It is possible that if you handle five amplifiers none will have the same circuits.

Figure 1 (top) is a simple bridge rectifier. You will find this circuit is generally used to supply power to the output transistors. If you have good ears, a defective electrolytic might cause a very low hum.

Figure 1 (middle) is a capacitance-amplifier, where most of the filtering—usually for low-level stages is achieved by multiplying the capacitance of the base-connected capacitor by the gain of the transistor. For example if the capacitor is 100 μf, and the transistor's gain is 200, the effective capacitance is 100 μf, x 200 or 20,000 μf. The other capacitor, which could be, say, 500 μf, has little effect on the filtering.

Figure 1 (bottom) is a Zener-regulated power supply. It might be used to provide regulated voltage to the low-level stages. The filtering can be done either before or after the Zener diode, whose primary purpose is to provide a regulated voltage.

When precise regulation and overload protection are incorporated, the power supply has a feedback regulator generally employing up to five transistors. There is no point showing a typical circuit because there is none. Each manufacturer does it a different way. All you can do is measure the regulator's output voltage. If it is too low or too high the easiest procedure is to check every component in the circuit.

Also keep the power supply in mind when checking an amplifier that at least works, but poorly. If both channels have hum or buzz the problem is likely a filter capacitor in the power supply. Distortion in both channels might be caused by low supply voltage.

Troubleshooting should be started only after you are absolutely certain the power supply is delivering the correct voltages. The easiest way to troubleshoot an amplifier is to trace signals. Note we say *trace* signals, not inject them. In tube amplifiers it was common to inject a signal into a grid and see if the output was clean. You cannot do this in solid-state equipment unless you are very skilled, for the 0.5 to 1-V output of most probe-type signal injectors is often enough to blow a low-

power transistor. While you might try signal injection from an audio generator having an adjustable output, the low-impedance loading of transistor circuits might distort the generator's signal. Best bet is to stick with signal tracing.

If only one channel is defective, localize the area by comparing all voltages in the nonworking channel with the working channel. The *tape-out* jack will help in localization because it is after the magnetic-phono preamp, and generally before the tone controls.

Feed a signal into the *phono-input* jacks and pick it off at the *tape-out* jack. The signals at the *tape-out* jacks should be within a few db of each other with the balance control centered. If one channel is lower than the other you can safely assume the lower-output channel is defective—in most instances a bad transistor. If it is clean, the problem is farther along in the driver or output stages. If the signals are distorted or don't appear at the *tape-out* jack the problem is most likely in the preamp.

If you can get clean signals through both channels, try running the amplifier at full rated power. Connect a load resistor across the amplifier output and connect an AC voltmeter and scope across the resistor (wirewound and large enough to handle the amplifier's full output).

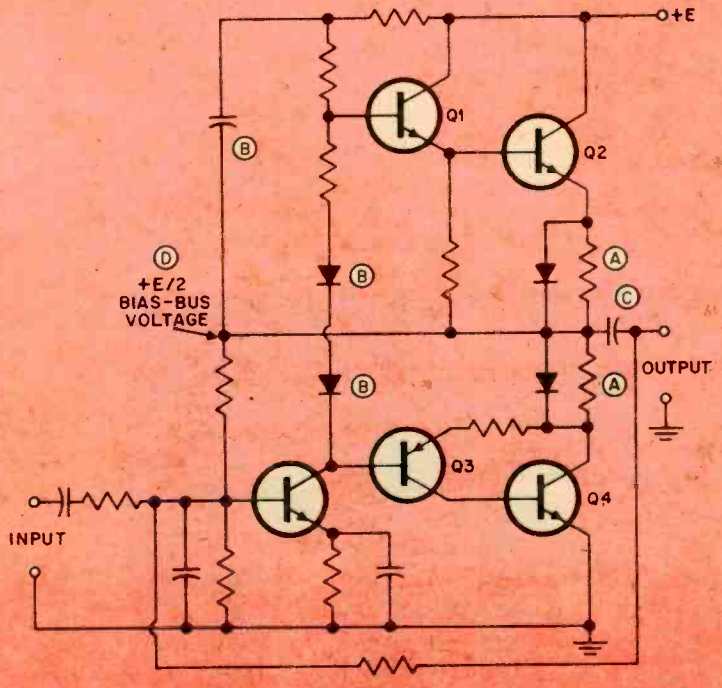
Then feed a signal into the amplifier as close as possible to the output stage—generally the *aux* input. For example, if the amplifier is rated at 20 watts (rms) into 8 ohms, the AC voltmeter would indicate 12.6 V at 20 watts ($E=\sqrt{WR}$).

With the amplifier's gain controls wide open, adjust the signal generator output level until the AC voltmeter indicates 12.6 V. The scope waveform should be absolutely clean. The reason for making this check is that a pair of headphones in the headphone jack can often sound good at low output levels, but the amplifier may fall to pieces when called on to deliver a few watts.

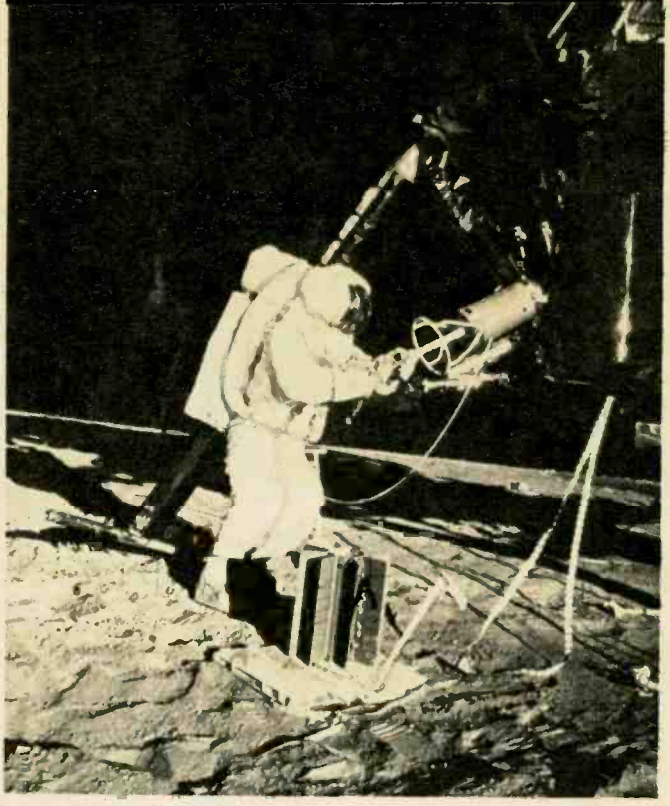
Then, using a scope or a signal tracer, work from the input to the output. The trouble exists between the last checkpoint that was clean and the distorted checkpoint. Because the scope and signal tracer are voltage-sensitive devices, some transistor base circuits, which are current driven, might indicate distortion falsely. It is best, therefore, to make the checks in *collector* or *emitter* circuits.

Once you have located the defective stage the real hard work begins, for most amplifier circuits are DC interlocked to another circuit. Though it might [*Continued on page* 97]

Fig. 4—A typical quasi-complementary-symmetry output stage. Transistors Q1 and Q3 are drivers. Transistors Q2 and Q4 are outputs. When checking diodes (B) with ohmmeter, always disconnect one end of each.



Ⓐ BURNED RESISTOR MEANS DEFECTIVE OUTPUT TRANSISTOR
Ⓑ FREQUENT CAUSES OF TROUBLE
Ⓒ IF SHORTED, CAN DESTROY BOTH OUTPUT TRANSISTORS
Ⓓ DEFECTIVE Q1/Q2 OR Q3/Q4 WILL CHANGE BIAS-BUS VOLTAGE



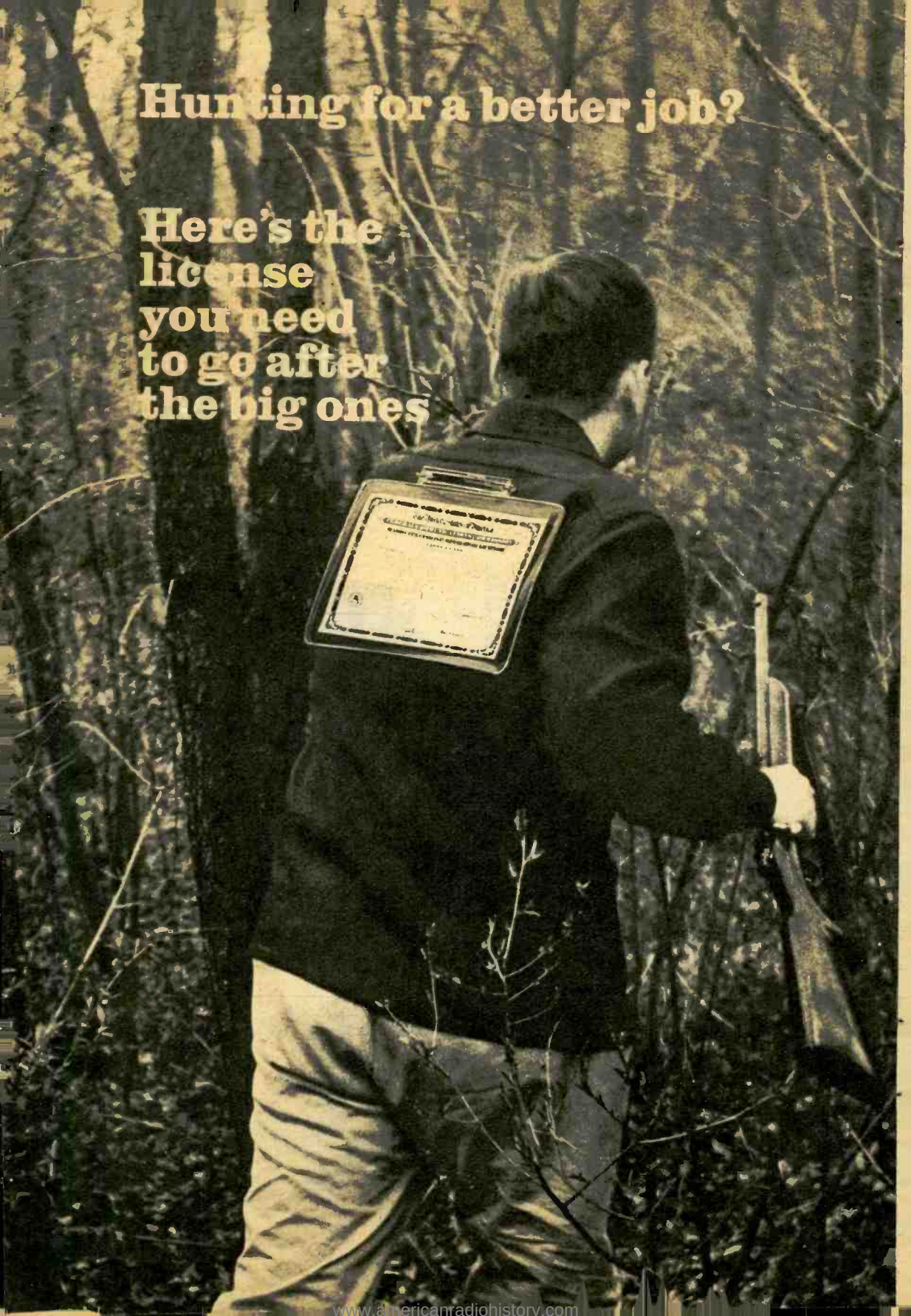
ONE YEAR OLD AND STILL GOING STRONG. Amid cries of pollution on the moon comes a report from GE that their atomic battery—left on the lunar surface more than a year ago by the astronauts of Apollo 12—is still going strong. The diminutive SNAP-27 weighs in at 7 lbs. in the low gravity of the moon's surface. SNAP-27 was designed to produce 63.5 watts of power but is now outdoing itself daily with reports of more than 73 watts in output.

Electronics in the News

What, no fertilizer? Not in this case. Engineers of Raytheon's Crystals Materials Laboratory have developed a process for growing crystals for use in laser research. The substance, known as Triamonds, not only sounds but looks a lot like diamonds and it's almost as hard. Grown at 3,578°, these beauties sell for only $60 a carat.

Five in one. RCA now is showing a $250,000 prototype of a color TV that has five screens. The futuristic Showcase '70 has provisions for simultaneous viewing of five different programs and a remote control that will switch the program on one of the small monitors to the large center screen.

Do you make house calls? Computers are usurping professionals in many walks of life and now they have turned their attention to Doctors. Actually the computer is speeding diagnosis of patients in two particular areas. The photo below shows a Varian mini-computer helping to diagnose an electro-cardiogram for heart trouble while the computer at right checks for pulmonary abnormalities.



A Government FCC License can help you bring home up to $10,000, $12,000, and more a year. Read how you can prepare for the license exam at home in your spare time—with a passing grade assured or your money back.

IF YOU'RE OUT TO BAG A BETTER JOB in Electronics, you'd better have a Government FCC License. For you'll need it to track down the choicest, best-paying jobs that this booming field has to offer.

Right now there are 80,000 new openings every year for electronics specialists—jobs paying up to $5, $6, even $7 an hour... $200, $225, $250, a week... $10,000, $12,000, and up a year! You don't need a college education to make this kind of money in Electronics, or even a high school diploma.

But you *do* need knowledge, knowledge of electronics fundamentals. And there is only one nationally accepted method of measuring this knowledge... the licensing program of the FCC (Federal Communications Commission).

Why a license is important

An FCC License is a legal requirement if you want to become a Broadcast Engineer, or get into servicing any other kind of transmitting equipment—two-way mobile radios, microwave relay links, radar, etc. And even when it's not legally required, a license proves to the world that you understand the principles involved in *any* electronic device. Thus, an FCC "ticket" can open the doors to thousands of exciting, high-paying jobs in communications, radio and broadcasting, the aerospace program, industrial automation, and many other areas.

So why doesn't everyone who wants a good job in Electronics get an FCC License and start cleaning up?

The answer: it's not that simple. The government's licensing exam is tough. In fact, an average of two out of every three men who take the FCC exam fail.

There is one way, however, of being pretty certain that you will pass the FCC exam. And that is to take one of the FCC home study courses offered by Cleveland Institute of Electronics.

CIE courses are so effective that better than 9 out of 10 CIE graduates who take the exam pass it. That's why we can back our courses with this iron-clad Warranty: Upon completing one of our FCC courses, you must be able to pass the FCC exam and get your license—or you'll get your money back!

They got their licenses and went on to better jobs

The value of CIE training has been demonstrated time and again by the achievements of our thousands of successful students and graduates.

Ed Dulaney, Scottsbluff, Nebraska, for example, passed his 1st Class FCC License exam soon after completing his CIE training... and today is the proud owner of his own mobile radio sales and service business. "Now I manufacture my own two-way equipment," he writes, "with dealers who sell it in seven different states, and have seven full-time employees on my payroll."

Daniel J. Smithwick started his CIE training while in the service, and passed his 2nd Class exam soon after his discharge. Four months later, he reports, "I was promoted to manager of Bell Telephone at La Moure, N.D. This was a very fast promotion and a great deal of the credit goes to CIE."

Eugene Frost, Columbus, Ohio, was stuck in low-paying TV repair work before enrolling with CIE and earning his FCC License. Today, he's an inspector of major electronics systems for North American Aviation. "I'm working 8 hours a week less," says Mr. Frost, "and earning $228 a month more."

Send for FREE book

If you'd like to succeed like these men, send for our FREE 24-page book "How To Get A Commercial FCC License." It tells you all about the FCC License ... requirements for getting one... types of licenses available... how the exams are organized and what kinds of questions are asked... where and when the exams are held, and more.

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Hi-Fi Today

By John Milder

* Cassettes: The New LP?

IF YOU'VE dipped into this column occasionally over the past few years, you will recall that I've been a reasonably stout defender of the photograph record as the primary medium for recorded music. Even lately, while predicting the imminent arrival of super-cassette recorders, I've had no feeling that the record was in real danger.

But now, I think, that this time has come. The record isn't about to disappear, but what I've seen and heard lately from cassettes convinces me that before long they are going to be the preferred medium for most serious listeners. There are now cassette recorders and cassette tape formulations that can record the best discs and broadcasts without any audible loss in quality. With the appearance of Dolby-ized pre-recorded cassettes, there are now commercial cassette releases of really top quality. Add those factors to the convenience and indestructibility of cassettes and you really do have a new kind of listening pleasure.

A scene which few get to see—the interior of a Philips-type cassette. The big question now is can Dolby and Crolyn make this device the new LP?

There are, however, still plenty of flies in the ointment. For one thing, the mechanical performance of cassettes themselves—not the machines, but those little plastic contraptions—is terrifically variable. They still jam now and then, and stick, and slip. They also produce wow and flutter when they're manufactured with less than loving care. If you're about to make a really critical recording, one that you can't do over if something goes wrong, you'd better fast-wind through the cassette first to make sure that adjacent layers of tape aren't stuck together from storage (on your shelf or the dealer's). As a mini-mechanism (see photo), the cassette can cause large audible problems with small departures from specifications.

As for the super-cassette machines, they are very much here. At this writing, Advent, Fisher, Harman-Kardon, and Vivitar all have machines employing the Dolby system, now identified as a must for wide frequency and dynamic range without the penalty of hiss.

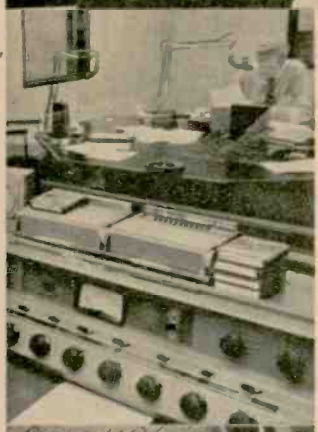
The Advent and Harman-Kardon machines provide for the use of chromium-dioxide (Crolyn) tape. After a good deal of experimentation, I would also put Crolyn in the must department for anyone wanting the best possible results in cassette recording. Used properly, it makes for extended high-frequency response and lower background noise. While it can be used with machines biased and equalized for conventional tapes, its full potential is not realized until you hear it on a recorder that has been designed to accept it.

If you can't use (or find) Crolyn, now marketed under the Advocate label by Advent (shortly to be marketed by Agfa, BASF, and Memorex) TDK's Super Dynamic tape seems to me the best of the conventional ferrous-oxide tapes. Again, you won't realize this tape's full potential unless your machine is properly biased and equalized.

With the comments I made a moment ago about cassette manufacturers, I think it's worth pointing out that the best-made cassettes per se I've seen are from Memorex and TDK. With the performance of the new Crolyn tape and the quality of the cassette construction by the brands just mentioned, I'd say that the big names in open reel tape are going to have to do some hard running to catch up with the ambitious newcomers in cassettes.

Although there is not a large tape library available at the moment, you can always tape off the air. There is no question that there are both cassette machines and cassette tapes that will do full justice to anything you're ever likely to record in your living room.






A Basic Guide to BCB DX

A ridiculously simple introduction to something we all know—or do we?

By ALAN LEVESQUE

THERE is an old rule of thumb in the Navy that says the hardest part of sailing ships is learning the lingo of the sailor. The rule is applicable in many areas, especially in the hobby of communications. If you're a newcomer to the hobby, don't let the language throw you—once you get down to the nitty-gritty you'll pick it up quickly.

Perhaps the most basic form of radio listening and a stepping stone to other parts of the hobby as well, is DXing on the BCB. The reason for this is that you don't need a truckload of equipment to begin. BCB stands for *broadcast band* and is the segment of the radio spectrum used by commercial *AM* (amplitude modulation) broadcasters for reception on your run-of-the-mill table radio. It extends from 535 kc to 1605 kc. Some people call kilocycles by the name of kiloHertz (Hz) these days. (See, we told you this was going to be ridiculously simple, didn't we?)

Almost everyone who listens to the radio

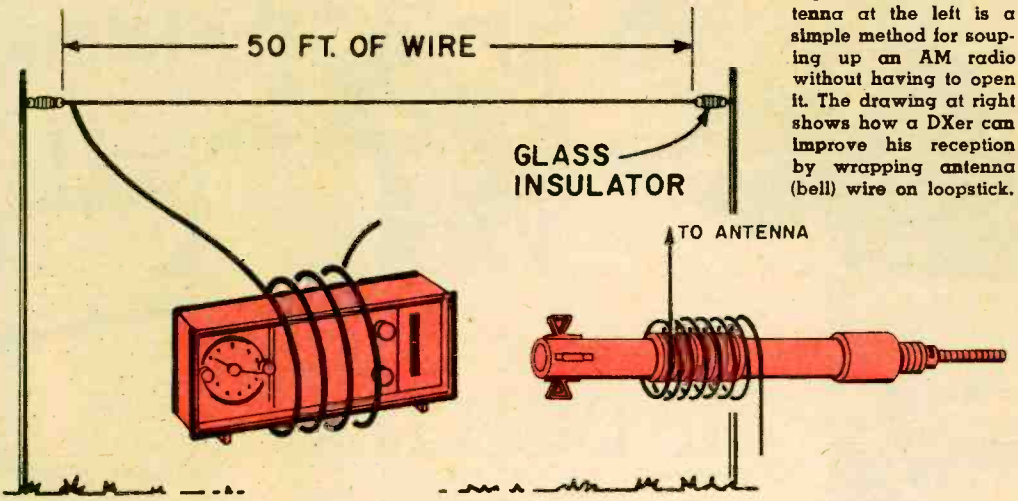


Fig. 1—The outdoor antenna at the left is a simple method for souping up an AM radio without having to open it. The drawing at right shows how a DXer can improve his reception by wrapping antenna (bell) wire on loopstick.

A Basic Guide to BCB DX

has been surprised at one time or another to find himself hearing a broadcast station that sounds like it is right down the block, only to discover that it is perhaps 2,000 mi. away. In radio lingo, DX means *distance* and a large hobby has sprung up with the common pursuit of trying to receive as many distant stations as possible. That's really all there is to BCB DX. There are, however, some tips which can make your DX life a whole lot easier.

Let's start by knocking over the widely circulated theory that when a broadcasting station decides to start doing its thing, it simply asks the FCC for any convenient frequency within the band. This is far from the truth—broadcasting stations are assigned to rigidly established channels, each with a specific frequency, and each having its own requirements for the type of station which can use the channel (see Table 1). In many ways, it's almost like the CB service, with channel assignments and FCC requirements. When you get a quickie picture as to how this FCC master plan works out on the broadcast band, you will then know which are the prime channels for DX as you progress from beginner to expert.

The top layer of stations and the easiest to log, are those operating in the FCC Class, 1-A. These are the clear-channel powerhouse stations which you may have accidentally heard on your car radio at night when tuning around. They run anywhere from 10,000 to 50,000 watts during the nighttime (DX) hours when they have the channel to themselves. This power, when combined with solitude on the channel, gives their signals an open door throughout North America and they are frequently heard in South America, Europe and even Asia. When you fill your log with enough of these stations to give you a taste for the hunt, you are ready to start seaching out other channels which are the home of low-power stations.

After a few years of experience, you will eventually wind up at the channels relegated to the most difficult stations of all to hear, Class IV. These are the local-coverage, low-powered stations which are shoehorned into the six graveyard channels. While some of these stations run 1,000 watts during the daylight hours, they drop down to 250 watts at night. Many of them simply run 250 watts during the day and call it quits at sunset. There are all sorts of weird power/schedule combinations making for plenty of good listening, with hundreds upon hundreds of stations to log. In one evening of listening on one of the graveyard channels you may log four or five different stations as they fight it out, with the aid of propagation conditions, to see who will be top dog. The very next night you can park your receiver on the same channel and hear another totally new assortment of stations. At times you are faced with listening to so many stations coming through simultaneously that it's almost im-

[*Continued on page* 99]

TABLE I
RADIO CHANNELS (kc)

540	Can. clear
550-630	Regional
640-680	Clear
690	Can. clear
700-720	Clear
730	Mex. clear
740-780	Clear
790	Regional
800	Mex. clear
810-850	Clear
860	Can. clear
870-890	Clear
900	Mex. clear
910-930	Regional
940	Can. & Mex. clear
950-980	Regional
990	Can. clear
1000	U.S. & Mex. clear
1010	Can. & Cuban clear
1020-1040	Clear
1050	Mex. clear
1060	U.S. & Mex. clear
1070	U.S. & Can. clear
1080	Clear
1090	U.S. & Mex. clear
1100-1120	Clear
1130	U.S. & Can. clear
1140	U.S. & Mex. clear
1150	Regional
1160-1180	Clear
1190	U.S. & Mex. clear
1200-1210	Clear
1220	Mex. clear
1230-1240	Local
1250-1330	Regional
1340	Local
1350-1480	Regional
1490	Local
1500-1530	Clear
1540	Bahama Is. clear
1550	Mex. clear
1560	Cuban clear
1570	Mex. clear
1580	Can. clear
1590-1600	Regional

TABLE II
BIG GUNS IN BROADCASTING

Freq. (kc)	Call	Location
540	CBK	Regina, Sask.
550	CFNB	Fredericton, N.B.
580	CKY	Winnipeg, Man.
640	KFI	Los Angeles, Calif.
650	WSM	Nashville, Tenn.
660	WNBC	New York, N.Y.
670	WMAQ	Chicago, Ill.
680	KNBR	San Francisco, Cal.
	WRKO	Boston, Mass.
	WPTF	Raleigh, N.C.
690	CBF	Montreal, Que.
	XETRA	Tijuana, Mex.
700	WLW	Cincinnati, Ohio
710	WGBS	Miami, Fla.
	WOR	New York, N.Y.
	KIRO	Seattle, Wash.
720	WGN	Chicago, Ill.
730	CKAC	Montreal, Que.
	XEX	Mexico City, Mex.
740	KCBS	San Francisco, Cal.
	KTRH	Houston, Tex.
	CBV	Edmonton, Alta.
	CBL	Toronto, Ont.
750	WSB	Atlanta, Ga.
760	WJR	Detroit, Mich.
770	KOB	Albuquerque, N.M.
	WABC	New York, N.Y.
780	WBBM	Chicago, Ill.
800	CKCW	Windsor, Ont.
	XELO	Juarez, Mex.
810	KGO	San Francisco, Cal.
	WGY	Schenectady, N.Y.
830	WCCO	Minneapolis, Minn.
840	WHAS	Louisville, Ky.
850	KOA	Denver, Colo.
	WHDH	Boston, Mass.
860	CJBC	Toronto, Ont.
870	WWL	New Orleans, La.
880	WCBS	New York, N.Y.
890	WLS	Chicago, Ill.
940	KFRE	Fresno, Cal.
	CBM	Montreal, Que.
980	CKNW	New Westminster, B.C.
990	CBW	Winnipeg, Man.
1000	WCFL	Chicago, Ill.
	KOMO	Seattle, Wash.
1010	WINS	New York, N.Y.
	CBR	Calgary, Alta.
1020	KDKA	Pittsburgh, Pa.
1030	WBZ	Boston, Mass.
1040	WHO	Des Moines, Iowa
1050	WHN	New York, N.Y.
	CHUM	Toronto, Ont.
	XEG	Monterrey, Mex.
1060	KYW	Philadelphia, Pa.
1070	KNX	Los Angeles, Cal.
	CBA	Sackville, N.B.
1080	WTIC	Hartford, Conn.
	KRLD	Dallas, Tex.
1090	KAAY	Little Rock, Ark.
	KBAL	Baltimore, Md.
	KING	Seattle, Wash.
1100	WKYC	Cleveland, Ohio
1110	KFAB	Omaha, Neb.
	WBT	Charlotte, N.C.
1120	KMOX	St. Louis, Mo.
1130	KWKH	Shreveport, La.
	WNEW	New York, N.Y.
	CKWX	Vancouver, B.C.
1140	KRAK	Sacramento, Cal.
	WRVA	Richmond, Va.
	XEMR	Monterrey, Mex.
1160	KSL	Salt Lake City, Utah
1170	KVOO	Tulsa, Okla.
	WWVA	Wheeling, W. Va.
1180	WHAM	Rochester, N.Y.
1190	KEX	Portland, Ore.
1200	WOAI	San Antonio, Tex.
1210	WCAU	Philadelphia, Pa.
1220	WGAR	Cleveland, Ohio
	XEB	Mexico City, Mex.
1260	CFRN	Edmonton, Alta.
1280	CJMS	Montreal, Que.
1310	CKOY	Ottawa, Ont.
1500	WTOP	Washington, D.C.
	KSTP	St. Paul, Minn.
1510	WLAC	Nashville, Tenn.
	KGA	Spokane, Wash.
1520	WKBW	Buffalo, N.Y.
	KOMA	Oklahoma City
1530	KFBK	Sacramento, Cal.
	WCKY	Cincinnati, Ohio
1540	KXEL	Waterloo, Iowa
	WPTR	Albany, N.Y.
1560	WQXR	New York, N.Y.
1570	XERF	Ciudad Acuna

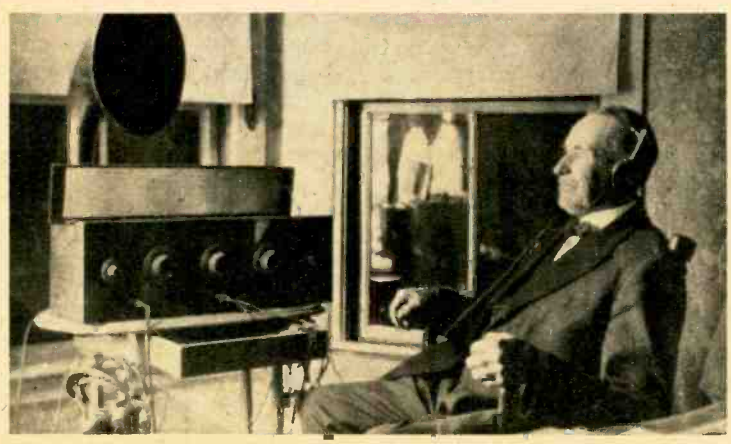
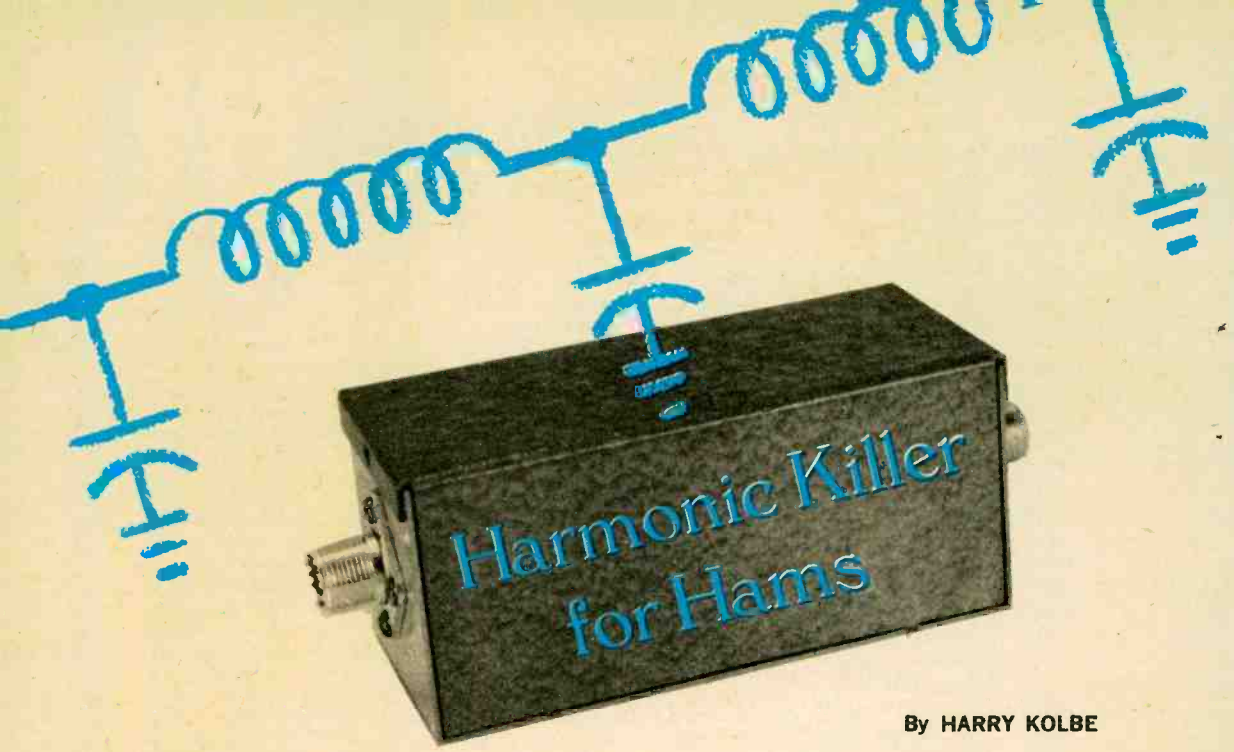


Fig. 2—An early practitioner of the art of BCB DX. This gentleman, who was Calvin Coolidge's father, probably had his DX a little easier. In those days, everything was a graveyard channel, but there weren't enough stations on the air anyway to make a great deal of difference.



By HARRY KOLBE

THE morning mail arrives. After looking over a few QSL cards and sifting through the usual clutter of bills and circulars you notice an envelope from the FCC. Surprise! It's a citation.

Vertigo sets in. If you don't find and eliminate the operating conditions that earned the prize your ham license will be suspended and you will have to shut down.

The majority of FCC citations are for the radiation of spurious signals which interfere with radio services outside the ham bands. All transmitters, commercially manufactured or homebrewed, are potential spurious-signal generators.

Our harmonic killer is a simple and inexpensive device that eliminates spurious radiation from any low-power transmitter (under 100 watts input).

Unlawful Signals

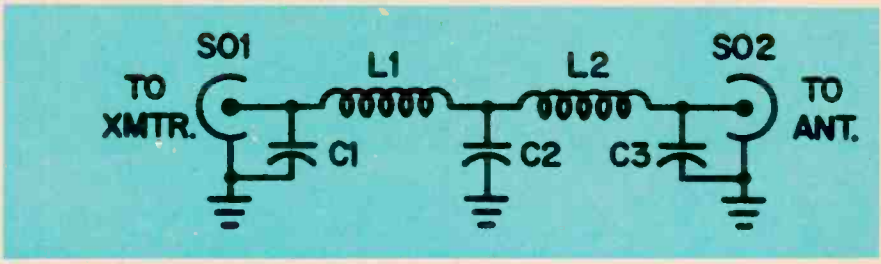
Before getting to the cure, let's see what spurious signals are. The only signal you're allowed to radiate is a fundamental. Any other signals radiated at the same time are called *spurious*. The most common types are harmonics. A harmonic always is an exact multiple of the fundamental operating frequency. Let's say you're operating on 80 meters—3.5 mc. If the transmitter also is producing harmonics you would find them at 7 mc., 10.5 mc., 14 mc and so on. The strength of harmonics diminishes as they go up in frequency.

Other spurious signals are parasitic oscillations. These are not frequency-related to the fundamental. Unlike the harmonic, which decreases in strength as frequency rises, the parasitic can be strong in relation to the fundamental, even at high frequencies.

The average ham transmitter normally has some harmonics present in the final. However, a properly designed transmitter has an output coupling network which attenuates the second harmonic of the fundamental by 20- to 30db.

Consider the situation where the transmitter is putting out 50 watts at the fundamental frequency and is attenuating the second harmonic by 20db. In this case the antenna is being fed a half-watt of power at the second harmonic. With a good antenna and ideal propagation conditions many hams have worked hundreds of miles with only a half watt.

Trying to listen for harmonics on your receiver won't work because it is practically impossible to prevent the receiver from being overloaded by the transmitter's fundamental frequency. Overloading the receiver causes harmonics to be generated within the receiver, which makes any reading unreliable.



Filter is a half-wave design consisting of two cascaded pi-sections. Signals up to cutoff frequency pass freely. Those above are attenuated as frequency goes up. Attenuation increases about 46db for each octave the signal increases in frequency.

Harmonic output from a transmitter can be reduced by inserting a frequency-selective filter between transmitter and antenna.

The least expensive and simplest to construct and use is the half-wave low-pass filter, which is exactly what our Harmonic Killer is. Although this type of filter is quite simple it is as effective a harmonic suppressor as more complicated and expensive devices. Its only drawback is that a different filter must be used for each ham band. Every time the transmitter is switched to another band a different filter must be used.

Our Harmonic Killer consists of cascaded pi-sections. This type of filter allows all frequencies up to the cutoff frequency to pass freely. Signals which are higher in frequency than the cutoff frequency for which the filter is designed are attenuated increasingly as the signal frequency goes up. The attenuation increases about 46db for each octave the signal frequency increases.

To the transmitter and feed line the filter looks like the electrical equivalent of a half-wavelength of transmission line. And a half-wavelength added to the transmission line does not change the impedance that the transmitter sees.

PARTS LIST

Part	80 meters	40 meters	20 meters
C1, C3	820 μμf	500 μμf	100 μμf
C2	1,500 μμf	1,000 μμf	200 μμf
L1, L2	11 turns (a)	8 turns (b)	7 turns (c)

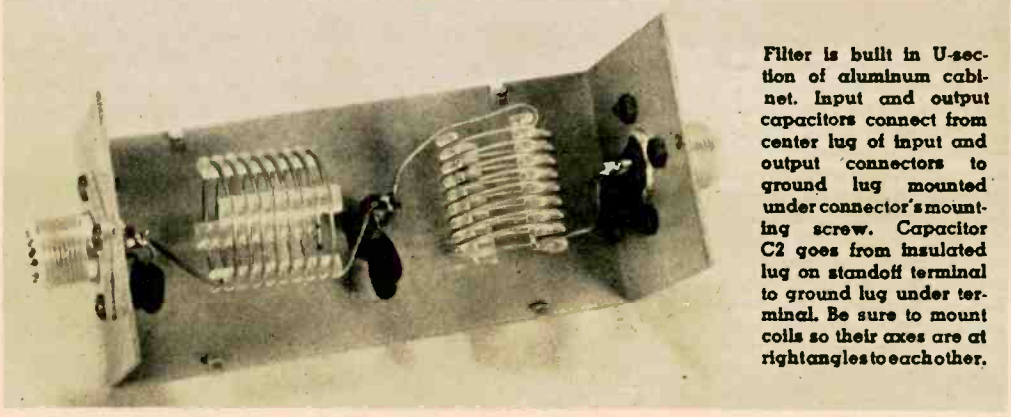
All capacitors: 500 V silvered mica
(a) Barker & Williamson 3015 or Air Dux 816T Coil
(b) Barker & Williamson 3014 or Air Dux 808T Coil
(c) Barker & Williamson 3001 or Air Dux 404T Coil

SO1,SO2—SO-239 coax connector (Calectro F3-123)
2¼ x 2¼ x 5-in. aluminum cabinet (Calectro JA-740)

Construction

Our Harmonic Killers can be built in 2¼ x 2¼ x 5 in. aluminum chassis boxes. UHF connectors are mounted on each end of the box. Mount a 1-in. high standoff insulator and a solder lug in the center of the box. Capacitor C2 is mounted between the top of the standoff and the grounded solder lug. Coils L1 and L2 are supported by the standoff and the connectors. The coils must be mounted with their axes at right angles to each other as shown in the photo.

To use the filter connect it to the transmitter with a short length of coax and connect the antenna feed line to the other side. Don't forget to change filters when you change bands.



Filter is built in U-section of aluminum cabinet. Input and output capacitors connect from center lug of input and output connectors to ground lug mounted under connector's mounting screw. Capacitor C2 goes from insulated lug on standoff terminal to ground lug under terminal. Be sure to mount coils so their axes are at right angles to each other.

The Ham Shack

By Wayne Green
W2NSD/1

"WHY don't you get your license?" I asked the son of a quite-active amateur. "Because ham radio is boring," he replied.

I have to admit amateur radio can be boring. But, as with just about anything else, the boredom is mostly self-imposed. If I get fed up with listening to two idiots jamming each other on 20 meters trying to work 5VZAT in Togo, I can always shake my head as I turn on my 2-meter FM rig and see who is coming through the many repeaters up here in New Ham Shire. I may contact a chap just coming back from a day of skiing in Waterville Valley or someone who is out snowmobiling and has paused for a snack.

Contests, if you are prepared for them, also can be tremendous fun. The preparation is a good part of the fun, too. The fellows who do so well in the VHF contests from the tops of mountains prepare months ahead. They round up their antennas, check them out, thoroughly test their transmitters and receivers for the VHF bands and then make the hundreds of arrangements which can culminate in a fantastic weekend of fun. They have to get an okay for using the mountaintop, they have to arrange for power, figure out antenna sites, come up with an operating schedule for everyone that is satisfactory, get logs ready and so on.

If you think contests are too much trouble it probably is because you've never seriously entered one. They can be an awful bore for the non-contestants on the band. Take the yearly Sweepstakes contest in which each contestant tries to see how many contacts he can make in the U.S. and Canada and how many ARRL sections he can work in one weekend. Most chaps who enter this contest have no intention of winning for their section—they just take advantage of the melee to make a few hundred instant contacts to see whether they can do it or to get WAS or just for the fun of the fray. Others are out for blood. They have potent signals on 75, 40, 20 and 15 and they keep right at it for every permitted minute. Actually you can win this contest with just 20 and 75 meter signals. This saves a lot of strain in preparation since you need only a 20-meter beam and a 75 dipole.

If you can't wait for a contest you can make your own. Many's the time that I have taken my VHF gear to a mountain and logged in page after page. It doesn't take all that much power for this, though I usually run at least 50 watts on two meters and have along a 5- to 16-element beam.

An airplane is even better if you have a friend with one. I worked a couple hundred miles with just five watts from a plane and my main problem was sorting out the hundreds of signals calling me. I had so much fun with this that I bought a plane and went up by myself to make contacts that way. I don't recommend buying, as flying is infinitely more expensive than amateur radio as a hobby.

160 meters is a great challenge. Antennas are simple but you probably will have to build your own equipment since activity on that band is so sparse that most manufacturers just pretend it doesn't exist. Some hams are working 100 countries on 160 but they are going bald doing it. You can bet they are enjoying every hair they lose in the process.

Admittedly, I am in the amateur radio hobby over my head. I have a DX shack on the first floor of my home, a 2-meter FM setup in a closet on the second floor, the RTTY in the cellar shack and a hand-held 2-meter transceiver in my pocket most of the time.

But I am not bored. My wife is a little bored with me when she gets interrupted in the middle of a question by my hand rig coming on with someone calling me. It is possible that she may solve this problem by getting her own license and transceiver and communicating with me that way. It might work.

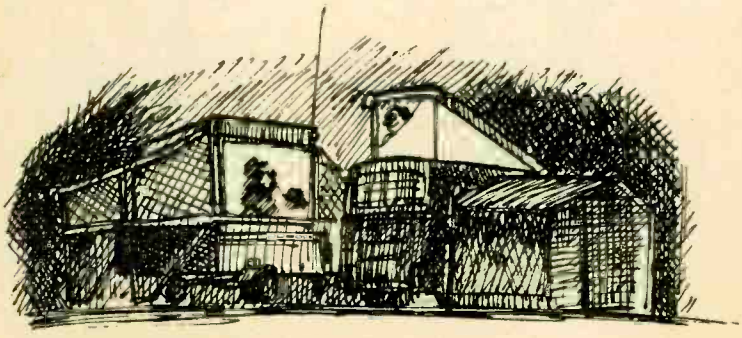
The only way to be bored with amateur radio is to be unfamiliar with it—the fury of battle for rare DX on 20 meters, the incredible jam-up of stations on the top end of 20 meters, relaying messages down on 80 meters, working sporatic-E skip on 6 meters, or 1000-mi. aurora contacts on 2 meters. If you find amateur radio boring you are in bad shape!

CBing the USA

John Kane, the upbeat cartoonist who has appeared in the pages of EI for several years, recently toured the U.S. with his family and used CB as his Indian guide. One look at these excerpts from his diary might make you wonder what ever happened to Tonto.

Thursday, July 9: What a day this was to start a camping trip. As soon as we pulled into the campsite--boom, the skies opened. My wife said, "Okay, John, you put up the tent." It was not until that moment that I realized that I didn't know a thing about camping. As the kids were making eyes at the glove compartment, I got on the rig and asked for help. Moments later a fellow camper reported that a neighbor of his had the same tent as us and he gave us a blow-by-blow on getting it set up.

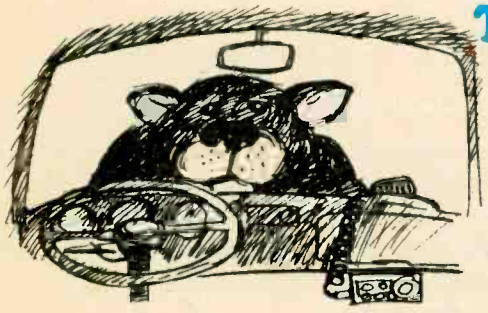
Sunday, July 12: The wife and I were busied with tasks back at the camp, so when the youngsters had to answer the call of nature, we sent them out with little walkie-talkies in case they encountered any difficulties. The only problem that arose was Southern phraseology, for when they hit the rest spot they were puzzled with who's is whose?



Monday, July 13: Tonight it looked like we were going to have a night's peace. As I climbed to my perch, I heard the squawking of a CB rig. I slipped around three snoring souls and reached the dashboard only to find my rig off. It turned out to be a CB neighbor, who, after a few unkind words finally turned in.

Wednesday, July 15:

We pulled into camp today with a full load of food and a quickly disappearing refrigeration system. I got on the rig and called for help and was directed to about 20 stores--each one fresh out of ice. As the milk was taking on the appearance of cottage chesse, we QSOd a man with two trays of cubes, which worked as good as the blocks.



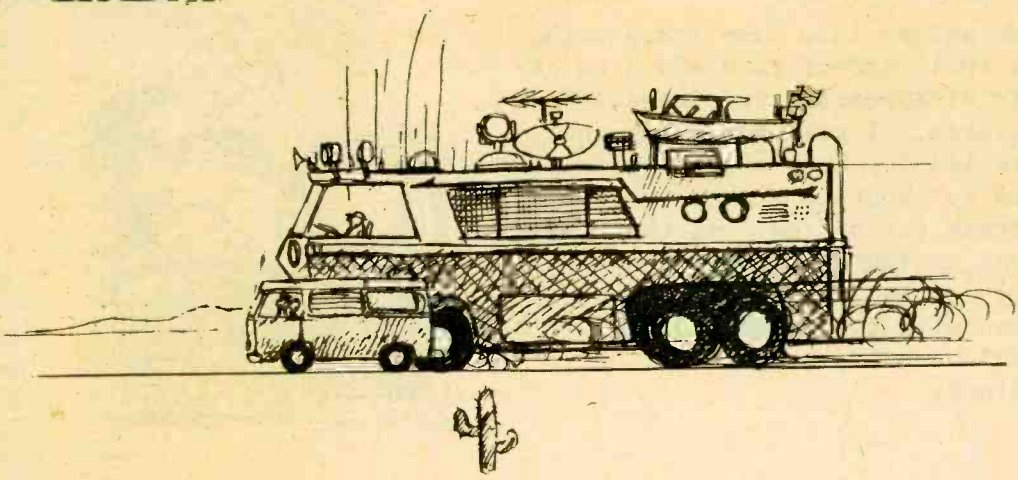
Thursday, July 16:

As we drove through the campgrounds today we were met by a surly looking bear. He didn't look like he was interested in stomping out any forest fires, so we cut out rather than rely on the local REACT team.

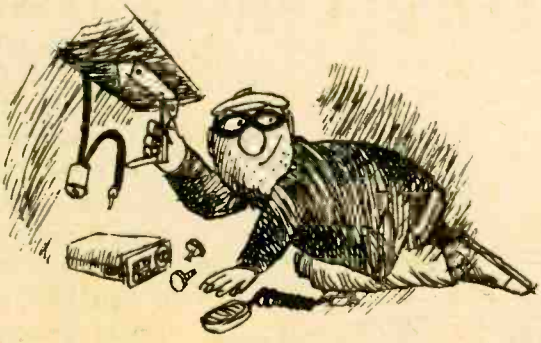
Friday, July 17:

Today I found out which sex predominates on the CB bands. I tried for about half an hour to raise someone for directions through a town--to no avail. My wife asked if she could try and I told her wisely that there must be no monitoring in these parts. Two seconds after she went on, about thirty guys were climbing over each other giving us driving instructions.

CB SPECIAL



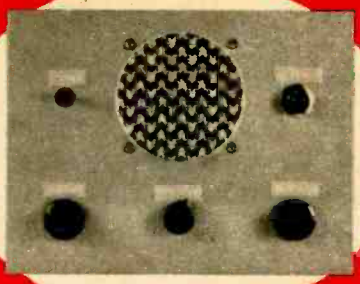
Sunday, July 19: I have a pretty good rig and I usually get good results. We were driving through a lonely stretch of the Midwest today when I picked up a signal so strong that my receiver was overloaded. "How about that" I bragged to my wife until she motioned to her side where a Rockefeller Center on wheels was rolling by at about 90.



Friday, July 24: All through this trip across this great land of ours I have noticed how valuable a side-kick a CB rig can be. Apparently someone else believes in CB's value, for on the first day home, some sneak made off with the entire rig including the walkie-talkies.

CB SPECIAL

Channel 9 Monitor



By CHARLES GREEN, W6FFQ

BY virtue of an FCC decree last year, Channel 9 can be used only for emergency communications (see CB Corner, Sept. '70 EI). Such calls are restricted to those involving safety of life, protection of property and requests for assistance from disabled motorists.

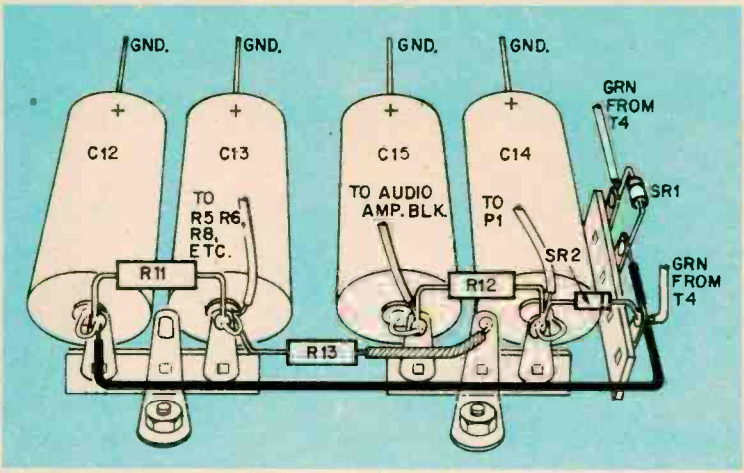
So you decide to be a good Samaritan—to get involved—by monitoring the channel. Great, except that this locks your transceiver out of other communications if it's constantly zeroed in on 9. Don't sweat it. You can monitor 9 with our single-channel crystal-controlled receiver while keeping your base-station transceiver available for reception and transmission on other channels. In other words, while listening to a distress call on our Monitor, you can simultaneously transmit assistance instructions to a third party on another channel using your regular rig.

Construction has been simplified by the use of a modular IF Amplifier and a preassembled audio amplifier. A front-panel light comes on when an emergency call comes through, allowing you to keep the volume down until there's trouble. The receiver is housed in an 8 x 6 x 4½-in. aluminum cabinet and has an AC power supply.

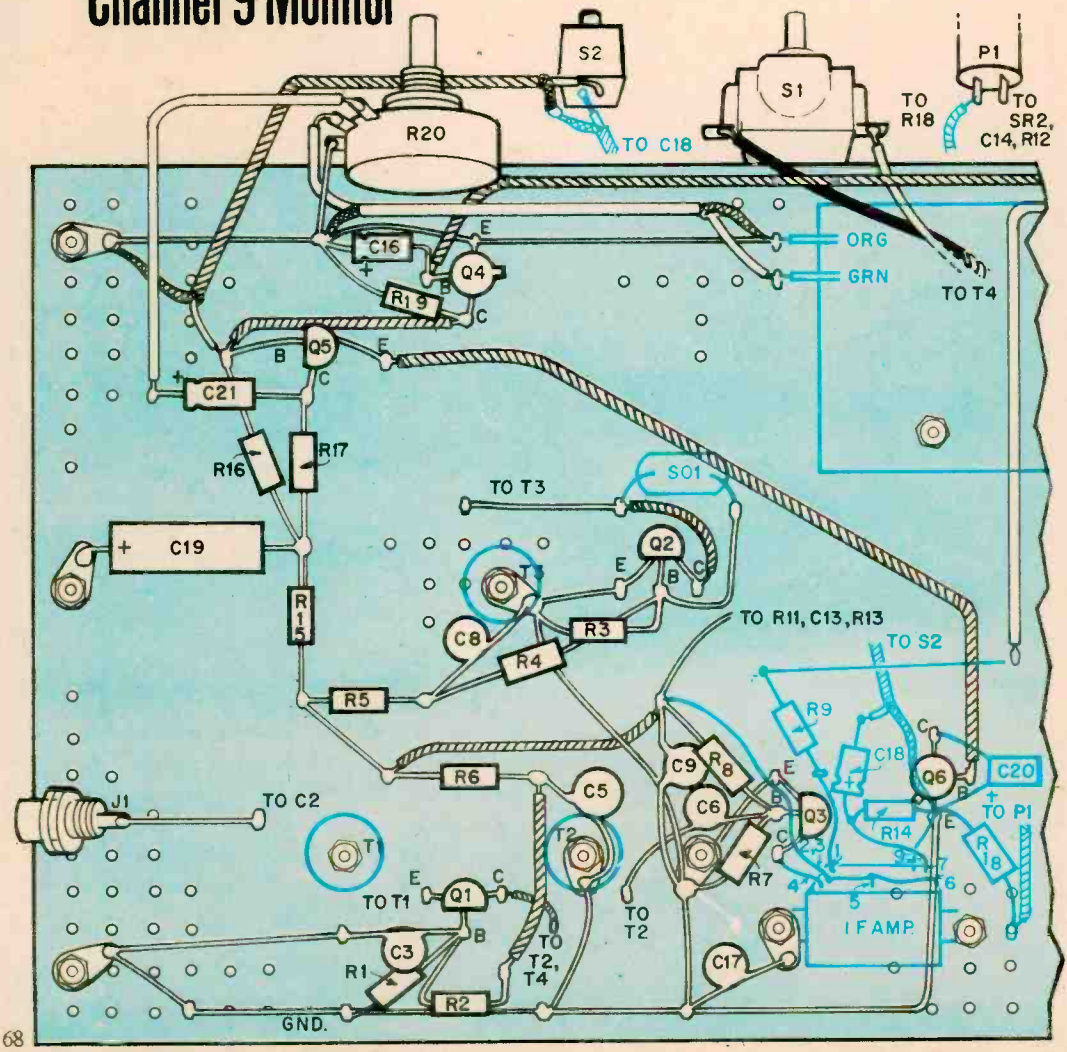
Most of the components are mounted on a 4¼ x 7⅞-in. piece of perforated board. The layout is critical because of the high operating frequency; parts should be kept in the same position as in our model.

Begin by cutting the board to size, and mounting it 2¼-in. up from the bottom of the cabinet with a ½-in. aluminum angle bracket at each side. After

Fig. 1—Pictorial at right shows power-supply parts which are mounted on side of cabinet as shown in Fig. 2 (left panel in top photo). Pictorial below shows location of parts on bottom of perforated board (see bottom photo in Fig. 2). Parts shown in color are mounted on other side of board (see top photo in Fig. 2). For connections to T1, T2, T3, use sketches in Figs. 3,5.



Channel 9 Monitor



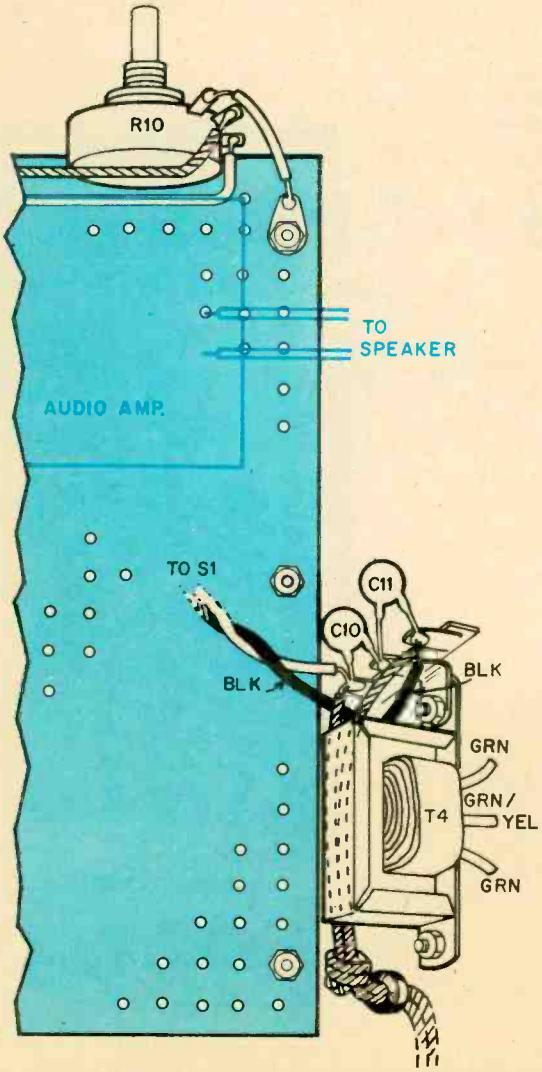
installing the board, mount the front-panel controls, P1 and the speaker in the locations shown in Fig. 2 (top). Mount T4 on the side near the bottom of the cabinet and drill a hole for the AC line cord. Mount power-supply silicon rectifiers SR1, SR2, filter capacitors C12, C13, C14, C15 and resistors R11, R12, R13 on three-lug terminal strips near the top of the right side panel. Connect the positive leads of C12, C13, C14 and C15 to ground lugs mounted on the board's aluminum bracket (adjacent to P1).

The RF circuits use a common-bus ground (No. 18 solid wire) which should be connected to a ground lug on the board's bracket (adjacent to S2), and positioned approximately ¼-in. from the back of the board. Mount J1 about 1-in. in from the back of the cabinet and up from the bottom (adjacent to the ground lug).

Layout and mount the circuit-board components on push-in terminals as shown in Fig. 1 (bottom). Cut the transistor leads short and mount them on push-in terminals as shown. Before mounting T1, modify it as shown in Fig. 3 by adding a one-turn winding of No. 22 solid wire to a solder lug mounted on its base. Also add a three-turn winding as shown.

Transformers T1, T2 and T3 are mounted in holes in the board and the coil connections are made to push-in terminals so that connections can be made to parts on the other side of the board (shown in color in Fig. 2, bottom). Make sure that the push-in terminals are close to the coils to prevent shorts to the shields over T1 and T2. Cut an opening in T2's shield for the connecting lead.

The IF-amplifier module is mounted on



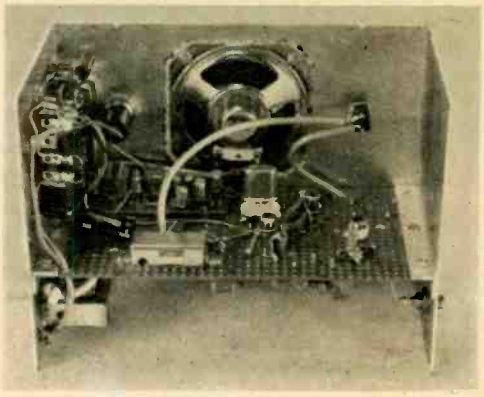
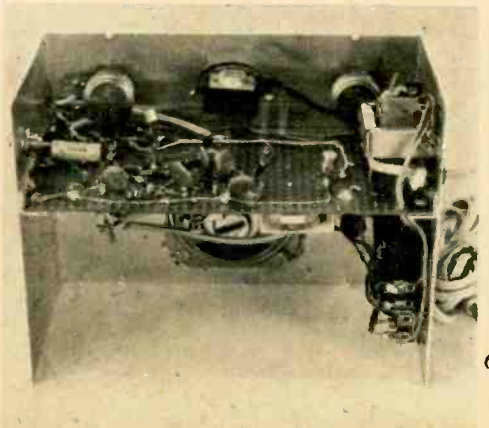


Fig. 2—Photo above is of top of receiver. Note power-supply parts on left panel above and below circuit board. Metal shields have been removed from transformers T1, T2. Audio-amp. module is behind speaker. IF-amp. module is at back edge (left) of board. Underside of board is shown below.



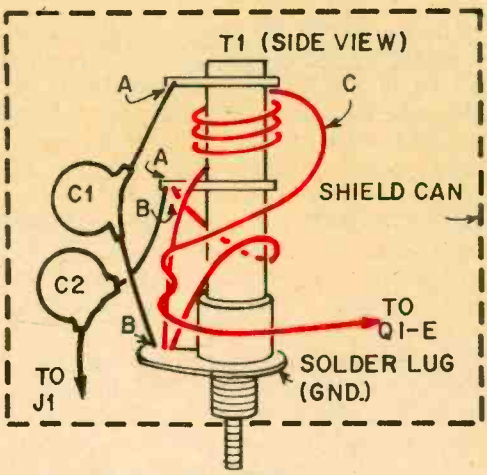
CB SPECIAL

Channel 9 Monitor

the top of the board with ground lugs that are soldered to its ends. Use heat sinks (or small long nose pliers) on the module's leads when soldering to them. This will prevent the soldered connections inside the module from coming loose.

Wire the remainder of the board components as shown in Fig. 1. Cut off the unused leads of the audio-amp. module, and wire the front-panel controls and speaker to the board. Use shielded wire to connect C18 to S2 and Q5's base, and to connect R2 to the audio-amp. module as shown in Fig. 1. Place a rubber grommet in the side-panel hole for the AC line cord. We cut three 1⅛-in. ventilation holes in the rear panel.

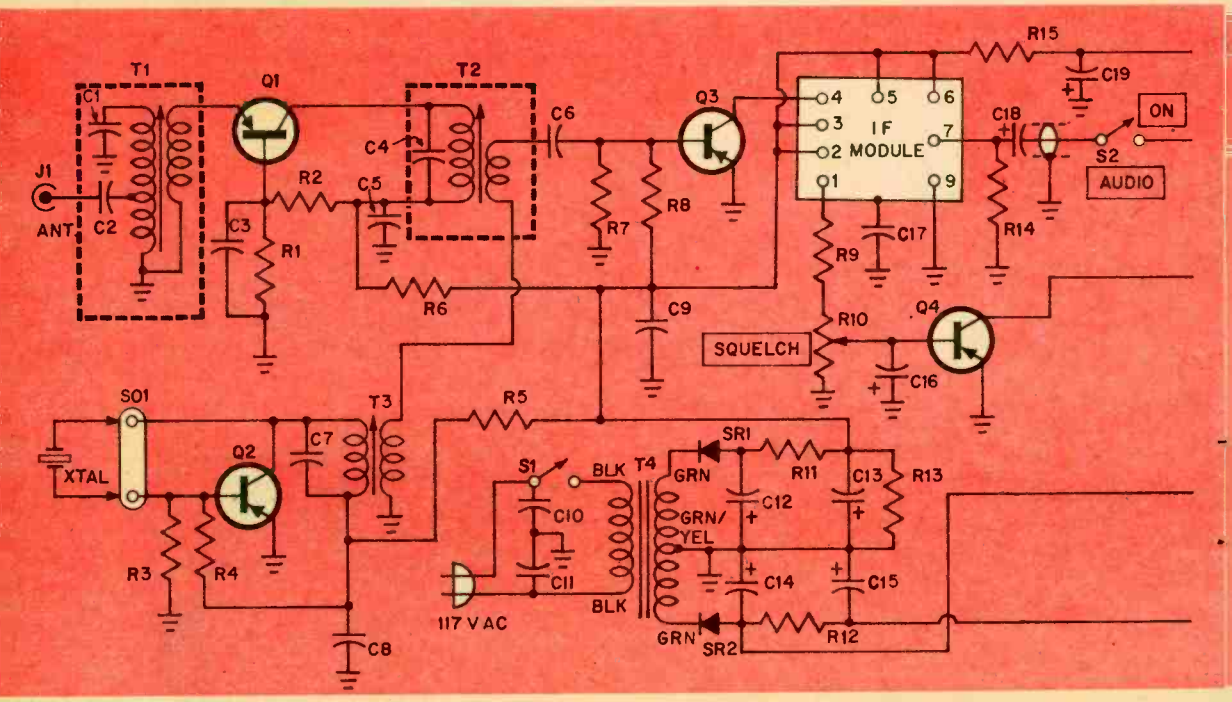
The crystal required should be a CB overtone type that oscillates at a frequency 455 kc *lower* than the Channel 9 frequency (27.065 mc). The crystal used in our model is a CTS Knights CH-9R BSRS. When order-



A–A – ORIG. COIL WINDING.
B–B – NEW 1-TURN OF NO. 22 WIRE SOLDERED TO GND. LUG.
C – NEW SEC. 3 TURNS NO. 22 HOOKUP WIRE WOUND OVER ORIG. COIL.

Fig. 3—Sketch above shows how a standard J. W. Miller coil is modified by adding two windings (shown in color). The broken line around the coil is shield can which must be installed over coil.

Fig. 4—Transistor Q1, Q2 and Q3 form superhet circuit whose IF output is 455 kc. IF-amp. module amplifies and detects IF signal. Audio goes to squelch circuit (Q5) which is activated by IF-amp's avc output to R10 and squelch gate Q4. Q5 controls Q6's input. Q6 lights P1 in proportion to strength of the signal.



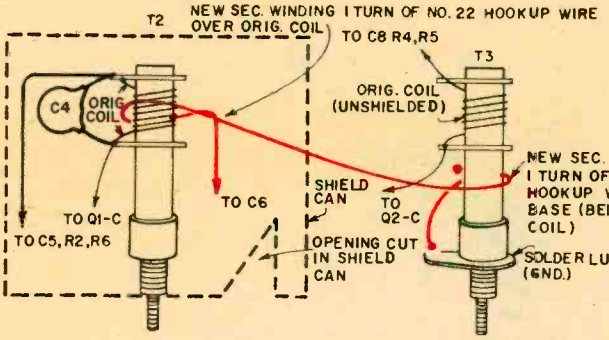


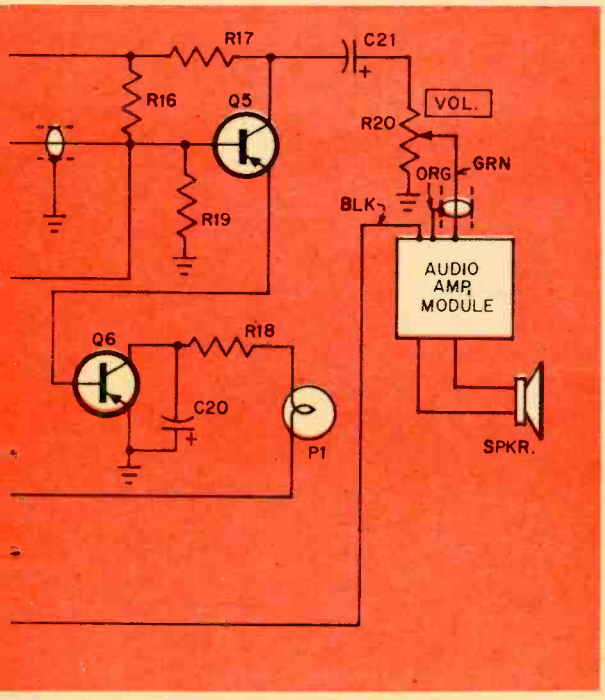
Fig. 5—Sketch shows how standard Miller coils are coupled by wrapping a turn of wire around each (color). Note that C4 is connected to T2's lugs. Shield can over T2 must have cut in it for the wire used to couple T2 to T3.

ing a crystal from a mail-order distributor, a CB transceiver model must always be specified. Therefore, specify a Channel 9 *receive* crystal for an E. F. Johnson Messenger I or II CB transceiver.

Alignment. Plug a crystal in S01, set S2 to *on*, and adjust *volume* control R20 to mid-range. Plug in the AC line cord and set S1 to *on*. Adjust *squelch* control R10 and observe that P1 will light at a certain point when you turn R10. Set R10 so P1 just glows dimly.

Connect a signal generator to J1 and set it up for a modulated output at 27.065 mc. (Or use a CB transceiver set to Channel 9.) Adjust T3 until you can hear the signal, then adjust T1, T2 and the slug in the IF-amp. module for maximum signal. Reduce the signal generator output as necessary to prevent overload. Disconnect the signal gener-

[*Continued on page* 98]



PARTS LIST

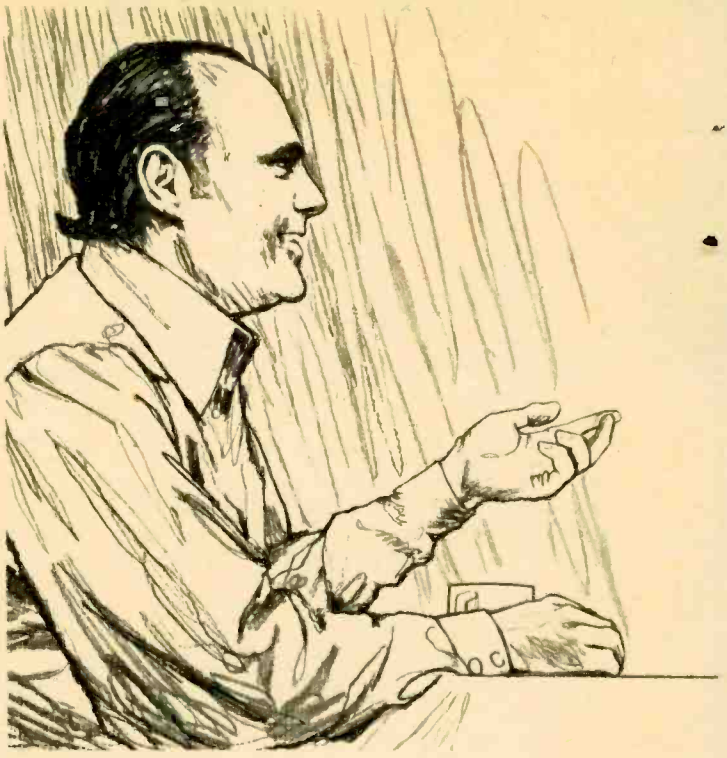
AUDIO-amp. module—Allied Radio Shack (277-1240 or equiv.)
Capacitors: 12 V, or higher, disc unless otherwise indicated
C1,C7—68 μμf C2,C8—1,000 μμf
C3,C6,C17—5,000 μμf C4—47 μμf
C5,C9,C10,C11—.01 μf
C12—2,000 μf electrolytic
C13,C14,C15—1,000 μf electrolytic
C16—2 μf electrolytic
C18,C21—5 μf electrolytic
C19,C20—100 μf electrolytic
IF module—455-kc IF amplifier (J. W. Miller 8902-B)
J1—Phono jack
P1—No. 49 pilot lamp (2 V, 60 ma)
Q1 through Q5—HEP-57 transistor (Motorola)
Q6—HEP-230 transistor (Motorola)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R3,R7,R16—22,000 ohms
R2,R4,R8—220,000 ohms R5—6,800 ohms
R6,R9,R17—220 ohms
R10—10,000 ohm linear-taper pot
R11—100 ohms, 2 watts R12,R15—33 ohms
R13—1,500 ohms, 1 watt R14—4,700 ohms
R18—62 ohms, 1 watt R19—10,000 ohms
R20—10,000 ohm audio-taper pot
S1,S2—SPST slide or toggle switch
SO1—Crystal socket
SR1,SR2—Silicon rectifier (Motorola HEP-154 or equiv.)
SPKR.—8-ohm speaker, 3-in. square
T1,T2,T3—.508-.816 μh miniature adjustable RF coil (J. W. Miller 20A687RBI, Lafayette 34 F 89374)
T4—Filament transformer; secondary: 12.6 V center tapped @ 100 ma (Calectro D1-750 or equiv.)
XTAL.—CB Channel-9 crystal minus 455 kc (CTS Knights CH-9R BSRS. Allied Radio Shack 20 B 1200 C. Specify receive crystal for E. F. Johnson Messenger I or II)
Misc.—8 x 6 x 4½-in. aluminum cabinet (LMB-145), 1-in. sq. x 1¼-in. high aluminum coil shield (J. W. Miller S-34), socket for P1, perforated board, push-in terminals, three-lug terminal strips, shielded wire.

CB SPECIAL

A Code Free

PRO:

By WAYNE GREEN, W2NSD/1



THERE has been little growth in amateur radio for almost ten years, despite the population growth and the increased importance of electronics and communications in the world of the 70s. Most amateurs agree that it is high time a major effort was made to attract newcomers to the hobby.

Obviously there is no shortage of people interested in amateur radio, as shown by the hundreds of thousands who have flocked to the 27-mc Citizens Band and plunged in for a strictly hobby use of that band, even though this is prohibited by regulation. The stumbling block is the degree of technical training and experience with Morse code required before a license can be obtained to operate an amateur phone station.

Code, once popular with amateurs in the 1920s and early 1930s, seems irrelevant to most youngsters today. Modern radio transmitters are all primarily designed for phone operation, with a few capable of code as an added feature. In areas other than the Novice Class licensees, who are not permitted to use phone, only about 10 per cent of the amateur operation is with code these days.

The Novice license is not a true step towards the higher class licenses in amateur radio and this has been largely responsible for the lack of interest in it. Being a code-only permit, supposedly preparing the holder for the higher class licenses which are essentially phone-only in practice, the newcomer to the hobby has more than enough reason to question the relevance of this class of beginner license and to look around for something better fitted to life as it is lived these days. We ignore irrelevance at our peril, as college administrators will testify.

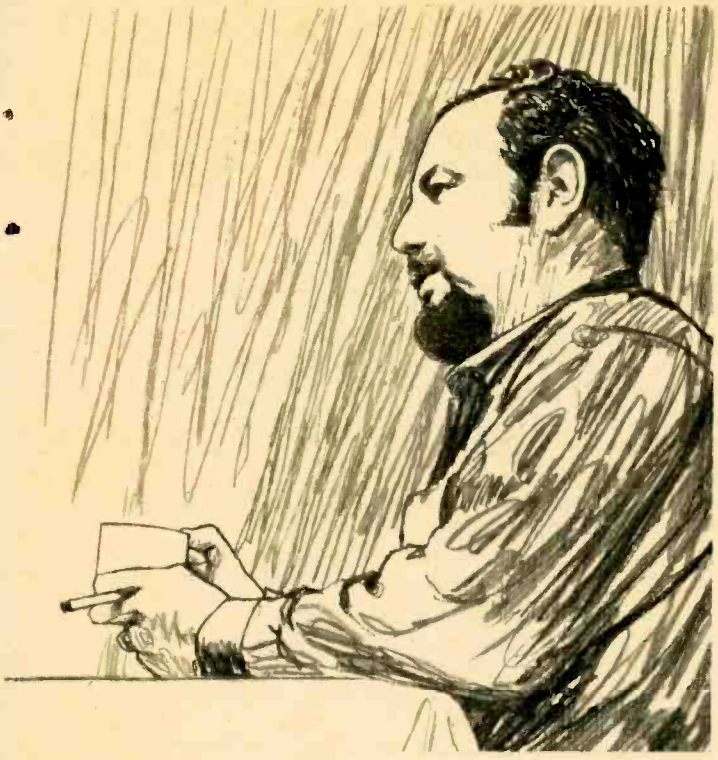
There does seem, therefore, some justification for the establishment of an amateur license which does not require a code or theory exam as a prerequisite for an introductory license.

Whether or not this will have any beneficial effect on the 27-mc Citizens Band matters little to most hobbyists, as this is not a hobby band, so let's not take that into consideration. The important factor to consider is the impact this new license will have on hobby radio and on the 220-mc band.

What about 220? How come this band has gone almost totally [*Continued on page* 74]

Hobby Band?

CB SPECIAL



CON:

By TOM KNEITEL, KQD4552

WHEN Wayne's proposal to dump the CB hobby problem square into the center of the 220-mc ham band was first published, the immediate reaction of most CBers and industry people was to regard it as either a hoax or an attention getting gimmick for his new publishing venture in the CB field. The second response was one of profound shock because it became clear that not only was Wayne deadly earnest, but that there were some CBers and even editors who entertained the possibility that this might be a feasible solution to existing problems.

The intent of the hobby-band petition, RM-1633, is not really clear. Is it meant as a shot in the arm for ham radio? Does it purport to be a nostrum for the ills of CB? Is it supposed to be both at once? My feeling is that somehow the candle is being burned at both ends.

Let's look at the spot in the spectrum which Wayne has selected as this potential communications oasis. The 220-mc ham band is a dud. In the entire country, where there are 290,000 licensed hams, there are less than 1,000 operators on 220. The only commercially manufactured gear for the band was offered several years ago by the Gonset Company, 20 watts with a $417.50 price tag. The rig was a flop and generated absolutely no interest in the band. It was hastily withdrawn from the market.

To most hams, VHF means 2 meters (144 mc). Experimenters wanting to tinker with high frequencies go on 432 mc (or the even higher frequency bands). That leaves 220 mc an unused, unwanted freak.

Wayne tells us that with your 100-watt potential, under his plan, you can expect "ground wave far more than that experienced on 27 mc." When you can get away with spanning the continent on 5 watts with (illegal) skip and ground wave (legally) to 150 mi., what advantage is there to going to 100 watts on a band where until 1954 the world DX record was only 700 mi., and that was a one-time pre-arranged contact established by engineers running sophisticated gear into super antennas? It took three more years of deliberate effort to stretch the world's 220-mc DX record another 40 mi.

There's an old ham-radio adage which says that if you can't hear 'em you can't work 'em. On VHF this means that sheer bone-crushing power isn't the answer [*Continued on page* 75]

CB SPECIAL

WAYNE
GREEN: PRO

unused? The next higher and lower bands are both being used by amateurs, so why not 220? Several things brought this about. Probably the most basic reason was the absence of surplus military gear for this band in the postwar years and the lack of surplus commercial FM equipment in the 1960s. 144 mc quickly developed after W.W. II when thousands of surplus units which could tune this band were made available at low cost. Later, the appearance of the Gonset Communicator took up the slack. This was followed by tons upon tons of first-rate commercial FM equipment, made surplus when the FCC changed the commercial bands beyond the capabilities of this gear. This opened up even more development of both 144 and 450 mc. Add to this the television and moonbounce operation on 450 and you see why this band grew so quickly.

Today there is far more activity way up on 1296 mc than there is on 220! The old rule that an unused band can soon become lost still holds true. Commercial mobile operation has grown geometrically in the last few years and the jamming of present mobile channels is almost beyond belief. The failure of UHF television to develop has turned the attention of highly paid lobbyists towards trying to get some of those nice TV channels for mobile use. This is possibly the only reason that they have not started digging away at our empty ham band.

The fact is, unless some development comes on the horizon that is entirely unpredictable at present, there is no prospective use in sight for 220 by hams. There would seem to be very little real reason for not using this band as a spawning ground for future hams by opening it up for a basic hobby license.

What would operation be like on 220? Would it quickly assume the horrible chaos we hear on 27 mc? Since the factors that seem to be the cause of the mess on 27 would not be present on 220, it seems unlikely that this phenomenon would repeat itself. We can better see what 220 might be like if we take a look at a comparable amateur subband, 146 mc, which is being used today almost exclusively by FMers.

This band, the most rapidly growing one in amateur radio today, has already attracted nearly 20,000 active amateurs. Operation on FM is entirely different from any other type in the history of the hobby, being set up on crystal-controlled channels, similar to those used by CBers. In most areas of the country groups have gotten together and established completely automatic repeater stations atop nearby mountains or tall buildings. The result of this is that all of the operators in that area are able to hear any of the others with no problem at any time. Even tiny handheld transceivers can be used to talk with any station in the repeater's service area.

A repeater consists of a sensitive receiver and a transmitter operating simultaneously. The two are on different frequencies, far enough apart so there is no interference between the transmitter and the receiver. They are connected so that any station transmitting on the receiver frequency is automatically retransmitted on the repeater transmitter frequency. The most popular channels for this at present are 146.34 mc for transmitting into repeaters and 146.94 mc for the repeater output.

Using a small transceiver from the living room of my folks home in northern New Hampshire I am able to talk through the repeater atop Mt. Mansfield, Vt., some 50 mi. away, and talk with amateurs in Montreal, Ontario and through much of New York State, covering up to 150 mi. or so. Two hundred miles with a hand transceiver is excitement to me. This is what we could expect on 220.

There are well over 750 repeaters on the 146-mc amateur band at present, with more going on weekly. And I am sure that we could expect the same development of 220 once activity started up there. The next step beyond that is a repeater in an amateur satellite. This is not as far off as you might sup-

[*Continued on page* 76]

TOM KNEITEL: CON

to a maiden's prayer. If you can hear only 20 to 30 mi. out, and can talk that far with a 30-watt transmitter, it doesn't pay to run a 50-, 75-, or 100-watt rig. Most VHF operators are content to run far less than 100 watts. The range is more dependent on the sensitivity of the receiver and the gain and height of the antenna. And don't have a rosy picture in your mind of running your coaxial cable to an antenna on a nearby mountain. Line losses in coax at 220 mc are three times what they are on CB. Even by using low-loss polyethylene foam RG8/U cable on the 220 mc band, you will find that your signal will attenuate more than 3db for each 100 ft., slicing your signal in half by the time it gets to the antenna if you use only 100 ft. of cable.

So unless you live on top of a mountain, you can hope for local coverage at best. Most 2-meter ham contacts, with average stations, are local. Anything more than 50 mi. is an exception rather than the rule.

Wayne's answer to the absence of the VHF skip is the use of repeater stations, such as are now coming into vogue with the 2-meter FM gang. Check the prices of this gear, a 2-watt, 2-meter FM rig runs over $225, a 12 watter costs a cool $875. There is no reason to expect that you will pay less for similar gear on 220; for a 100-watt rig—wow!

With these things considered, what would be the advantages of RM-1633 being approved? Wayne tells us that it will rid the 11-meter band of the hobbyists. But why should it? On 11 meters you have skip. Though illegal, thousands of operators have an absolute ball by working skip daily. The FCC is apparently powerless to take any significant action to halt this. Wrong as it is, the fact of the matter is that it is taking place daily. Inasmuch as Wayne's proposal makes no mention of the eventual phasing out of CB on 27 mc, I don't see that there would be any incentive to the hobbyists to sell their gear (to whom?) and head towards his new skipless hobby Mecca.

In order for the FCC to get these guys off 11 meters they would have to immediately cancel all 27-mc licenses, kill the sale of all CB gear, and then wait at least 15 years for the dust to settle.

Wayne tells us that the move to 220 will be a boon to ham radio, since the new VHF operators will actually be incorporated into the ranks of ham radio as a Hobby Class of license. But what kind of hams will these be; no code test, no contact with real ham communications? They will still be operating their open-the-box-and-plug-it-in transceivers without the slightest inkling or care of what makes them tick. This would not seem to be leading these fellows down the merry road to getting any class of real ham license; it would simply be CB business as usual, except on 800 new channels in addition to the 23 they've already got going for them now.

As a weird and ironic twist, Wayne's gaggle of Hobby Class hams will not even be able to take out Novice Class ham licenses until at least one year after their five-year Hobby Class ham licenses expire. This is plainly spelled out in FCC rule 97.4 (f). As it seems to turn out, today's 11-meter bootleggers would find it easier getting a Novice license because of that rule! In any event, CB radio has never proven itself to be a golden gate into ham radio, as many people used to hope for it. Many of the CBers who have gone into ham radio seem to have gravitated to the 6-meter band, home of some of the worst operators in the entire ham service. One can only speculate how many 6-meter lids are former CBers who went straight.

There is no doubting that the present situation on 11 meters needs fixing, the FCC's monitoring people already devote far more time than they want to running down CB linears and crackpots using funny names instead of callsigns. At least, thanks to skip, the handful of FCC monitoring stations scattered around the nation can potentially keep tabs on CBers in all areas. With CB on a strictly local coverage VHF band, the FCC would be faced with the problem of re-

[*Continued on page 77*]

WAYNE GREEN: PRO

pose. It is within the realm of possibility right now and merely awaits the interested group to undertake the effort. A satellite repeater would permit 220 operation over thousands of miles. The day of working 100 countries on 220 may not be far off!

The proposed regulations for the 220 hobby band call for the use of narrowband FM equipment. This has one major advantage over the AM equipment used on CB and that is what is called the capture effect. This means that when there are two stations on one frequency on FM you hear the stronger and the weaker is blocked out. This is much better than that chorus of heterodynes which sing out at you on the 23 CB channels.

FM also has several other good traits, such as freedom from noise interference, and a great reduction in the rapid fading of mobile signals that is experienced on AM.

Experience on 146 mc has shown that a great many stations can use one repeater without undue interference. The users soon get to know each other and the tendency for long boring conversations dies down. Little trouble has developed with individual operators monopolizing a channel.

Thus, with a 30-kc channel bandwidth there is room for 133 FM channels within this proposed 4-mc wide band. Narrow-band equipment might make it possible for the channels to be increased even further, allowing for several hundred channels. By using present day amateur standards and figuring about 30 stations per channel in any one area (it is rare for more than 5 per cent of the stations set up for a particular channel to be active at any one time), the 133 channels would permit an occupancy of over 40,000 per city. Few metropolitan areas other than New York would be likely to find this constrictive and New Yorkers are not unused to being limited by their sheer numbers. We might expect the band to be able to handle about 8,000,000 operators in the 200 major cities before interference started to become a serious difficulty.

Ten satellite channels would permit almost 3,000 five-minute contacts per day, with the possibility that a move towards time-division multiplex could give us 10 times that many contacts in a day.

Would the equipment for this band be prohibitively expensive? No, it would cost about the same as present-day CB transceivers. That is the magic of quantity building and marketing. With a number of manufacturers vying with each other for sales, the amateur wins by being able to buy better and better equipment for less and less.

The first units would probably use crystal control for the desired channels as is now used for 146-mc amateur equipment and commercial FM transceivers. But the need for 133 or 266 channel capability would force the quick development of frequency synthesizers at reasonable cost as has happened with aircraft equipment. We would soon see scanning receivers, autocall tone systems for altering the particular station you want to talk with and other goodies.

The antennas for 220 are small, measuring about one ft. high! They don't take up much room on a car roof or on a tower. And antennas capable of high gain are relatively small and easy to build. An antenna that increases the signal strength by a factor of 100X can be held up with one hand!

What are the drawbacks to amateur radio from the proposal? Would the bad operating endemic on 27 mc simply transfer itself to this nice band or would the new set of regulations and factors bring about a more orderly use of the band?

No, there doesn't seem to be any real reasons for alarm about this new proposal. It would seem to benefit amateur radio from just about every viewpoint. It also benefits the Citizens Band. And it would seem to solve a lot of the problems facing the FCC.

What will it be? Will we have a whole new amateur service on 220 or will we have to watch as the band is lost forever to other services because amateurs are so shortsighted?

TOM KNEITEL: CON

organizing their monitoring system. VHF monitoring has always been a sticky wicket to the FCC and they would have to figure out how to vastly increase their monitoring network to provide for hundreds of local VHF monitors. With the FCC's budget in a state of perpetual sag, they would have to take this point into serious consideration before approving any move of the boisterous CB hobby gang to VHF.

As a minor point, although probably no less ridiculous than anything else in RM-1633, I note that Wayne proposes (in the August, 1970, edition of his Radio Today Magazine), the assignment of the callsign block NA1AAA to NZ1ZZZ. Overlooking the fact that such oddball callsigns would attach a hideous second-class ham stigma to anyone caught wearing one on a lapel pin, it turns out that the FCC doesn't even control the assignment of N-series callsigns (except for aircraft phone stations). All N-series callsigns are doled out by U.S. military services, and callsigns within Wayne's specific block are used by the U.S. Coast Guard Auxiliary for their aircraft stations. Wayne's proposal gives the example (in the November, '70 EI) that if a 220-mc operator received the callsign NC2BDF (which is not within the callsign block he described in the August Radio Today), he would become WB2BDF upon the occasion of his converting to a higher grade of ham license. Unfortunately, Wayne makes no provision for giving a new callsign to the existing higher grade ham who happens to already hold the callsign WB2BDF (an Extra class licensee in Jamaica, N.Y.). These are minor points which could be surmounted should the FCC decide to approve RM-1633.

RM-1633 is, in fact, a very mild and vague re-hash of several previously presented (by others) proposals to get the hobbyists off 11 meters by moving them into a VHF ham band. In addition to turning down the earlier versions of this "new" proposal, the FCC has subsequently mixed numerous other assorted CB hobby proposals—including several of considerable merit which were presented by CB clubs and operators. It is difficult to imagine that anybody could actually believe that the FCC, in view of their past track record on CB hobby proposals and the awesome spectre of rampant idiocy on the CB channels, would now open Pandora's box to give an additional 800 channels to the CB three-ring circus.

Looking over Wayne's proposal, I can't help but wonder if he might have presented it differently had he ever been an active CB operator, or even a CB hobbyist. Certainly the problems facing the CB hobbyists are so complex that even the FCC cannot unsnarl them and they've lived with them for years. Being an active CB operator over a period of years, knowing other operators and how and what they think and want, would certainly mold one's opinions on such a highly volatile subject. As it happens, few CBers are rolling around on the floor in hysterical ecstasy at the prospect of becoming Wayne's instant mini-hams. One of the popular misconceptions that many hams have about CB is that any form of ham radio is a great and direct substitute for the entire CB service, a smashingly good step up for the lowly CB operator. Wayne fails to realize that neither service is a substitute for the other. All CBers look upon this smug benevolent big brother attitude of many hams with well deserved contempt.

As RM-1633 stands, there is not even the remotest chance that it will get any more than the FCC's usual thumbs down. It is only an exercise in futility. If it serves any purpose at all, it is only that it might confuse some of the operators and therefore blunt their efforts to get 11 meters straightened out. What CBers have been pushing for is a trial of two or three channels on 11 meters for skip, even if it's on a limited-hour basis. Despite the FCC's grumbling and sourness towards this idea, the crush of constant pressure from a united front of active CBers who want realistic regulations must eventually result in improved rules.

Sky-High Skyhook

By LAWRENCE M. KRUGER, KQX8217

MOST CBers will agree that mobile/base operation is almost always an unbalanced affair. That is, the range of the base station is generally much greater than that of the mobile. The reason for this is the less-than-ideal antenna installation on the car.

But think of the times that CBers are stationary at a campsite or acting as a field control for rescue or Civil Defense operations. Or maybe you are visiting a relative and want to get on the air at that temporary location for a few days. Voila! The Sky-High Skyhook.

Our reason for building the Sky-High Skyhook mobile-base antenna was to make contact with home some 12 mi. away. There's no phone at our job site and a conventional mobile antenna isn't able to overcome the background noise and skip.

By using a Cush-Craft *Ringo* (Model CB-1) base-station antenna that telescopes up to 17 ft. 10 in., and a 12-ft. supporting mast made of three lengths of pipe (3, 4 and 5 ft.), the total height of the Skyhook is almost 30 ft.! This makes it possible to have a portable base antenna that will fit in almost any car trunk (the Ringo is just under 5-ft. when collapsed) and can be erected in 10 or 15 minutes by one man using just a screwdriver.

The performance? We made some tests with a relative-signal-strength meter. While using the Ringo (1:1 SWR) on its 12-ft. mast and standing a distance away on a 6-ft. ladder, we adjusted the meter to arbitrarily indicate 2.5. We then switched over to our conventional mobile antenna (1.5:1 SWR) and got an indication of 0.25. We also set up the transceiver a short distance from home and had a friend check the signal at the base transceiver. The mobile antenna came in at +15 and the Skyhook scored with a +30.

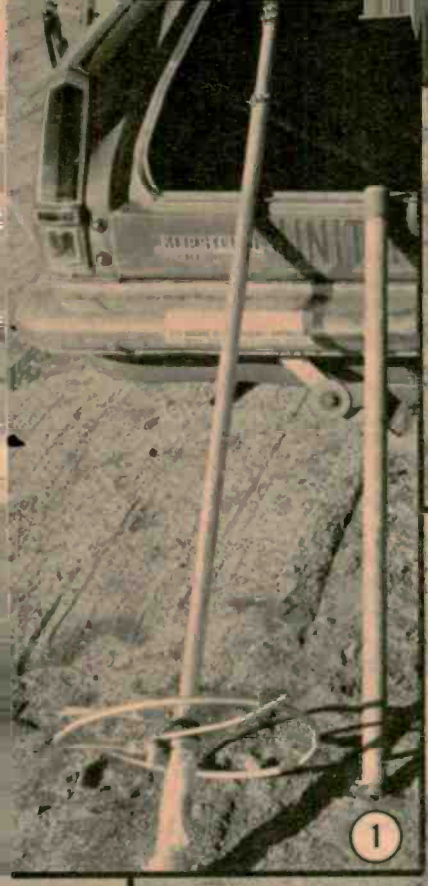
The supporting mast, in which the Ringo shown here is installed, is made with ordinary galvanized water pipe (1¼-in. o.d. will do). The pipe sections should have threaded ends so they can be joined together with pipe collars.

The base is made with a 1-ft.-long piece of 1½-in. (i.d) pipe that is welded to a ¼-in.-thick steel plate. And the base also requires two 8 x 24 x ¼-in. thick (approximate) plates notched to fit around the 1-ft. pipe as shown in Fig. 3. The antenna will stand well in brisk winds, but you might want to use a guy wire to the top of, say, a Camper for extra support.

As to the cost, the only item we had to buy was the $18.95 antenna. We were able to find pieces of pipe and metal plate around the house to make the base and mast. If you must buy that material, the pipe will run about 20¢ a ft.

The iron plates will cost about 30¢ per pound; ours are about 12 lb. The welding and cutting may run from $3 to $10. To save money you might try using a hack saw to cut the notches. By checking junk yards, you may find bits and pieces, much as we did and that will save you even more.

Our plates were a pipe rack from junked plumber's pick-up truck (only one set of notches is necessary, the others were just there). The base socket, already welded to our plate, was part of an old guard rail.



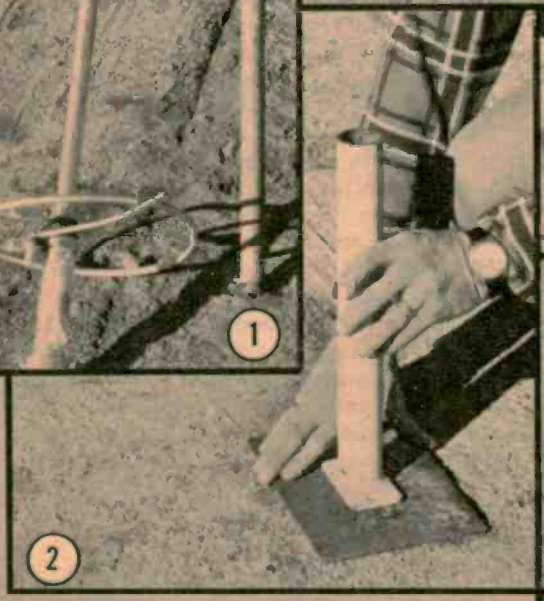


Fig. 1—Parts being removed from trunk. Collapsed Ringo antenna is at left. At its right is 3-ft. length of 1¼-in. galvanized water pipe—one section of the mast.

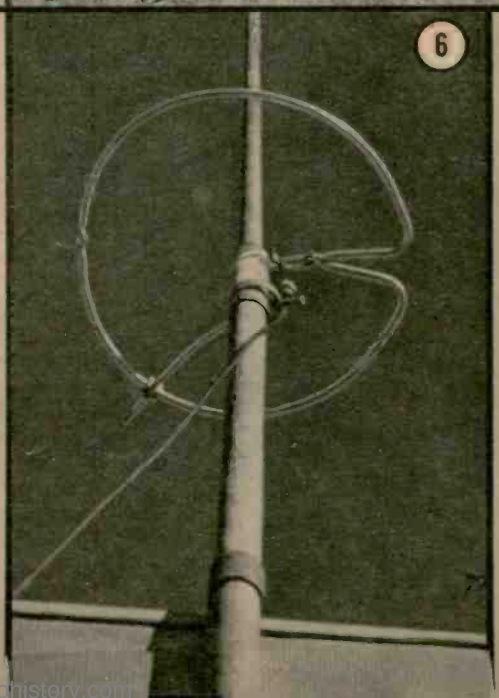
Fig. 2—Antenna base is a 12-in. length of 2-in. galvanized water pipe welded to a 6-in.-sq. plate. Always be sure to put the base on flat ground.

Fig. 3—Place large notched plates, one on top of the other, around pipe on base. Plates shown here are from the pipe rack in a junked plumber's truck.

Fig. 4—Base is firmly held by driving car's tire over plates. If this causes antenna to tilt, put scrap wood or metal under the tire end of the plates.

Fig. 5—Using pipe collars, screw three sections of pipe together, extend antenna, attach coax, slip antenna in mast and then put the mase in base.

Fig. 6—Installed on a Camper and ready to go. In light winds Skyhook is self-supporting. However, if breeze is too strong, add extra support.



CB Corner

By Len Buckwalter, KQA5012

CB SPECIAL

It's a Nice Place To Visit, But. . .

IT was a lovely day for a funeral. As the mourners spread out over 491 manicured acres of the cemetery in upstate New York, CB Corner did its first graveside interview. Yet there was nothing morbid about the occasion. We had heard that a club in the area was the first to attempt round-the-clock monitoring of Channel 9 and the search led us to the Poughkeepsie Rural Cemetery.

The group in question is the Mid-Hudson Radio Club and we talked to Pres. Jack Nace (left) and V.P. Fred Nero, the fellows in the photo below. To make the full-time system function, they've launched an ambitious scheme. By teaming up more than a dozen CB clubs, they hope to cover a huge swath of geography cut by the Hudson River along its 150-mi. course from Albany down to the northern reaches of New York City. If anyone shouts for help in that 40-mi. wide territory, he'd be assured of a quick rescue. The land is criss-crossed by busy interstate roads and needs all the assistance it can get.

The regional approach to monitoring could be the technique that succeeds. Nace is trying to pool the efforts of some 16 clubs to build up the necessary communicating range and personnel. With clubs operating under a regional banner, in this case, the Hudson Valley CB Association, they'd also link up by telephone if radio communications failed to provide a dependable relay. Each club will submit at least three telephone numbers to a master list. This might be critical for dispatching help beyond normal range or for bridging over adjacent areas. Each participating club would also submit a tally of its emergency gear: flares, oxygen, generators and other items that might be called up in a disaster.

What's that about CB on graveyard channels? Members of the Mid-Hudson Radio Club have found that a cemetery can be a great meeting place.

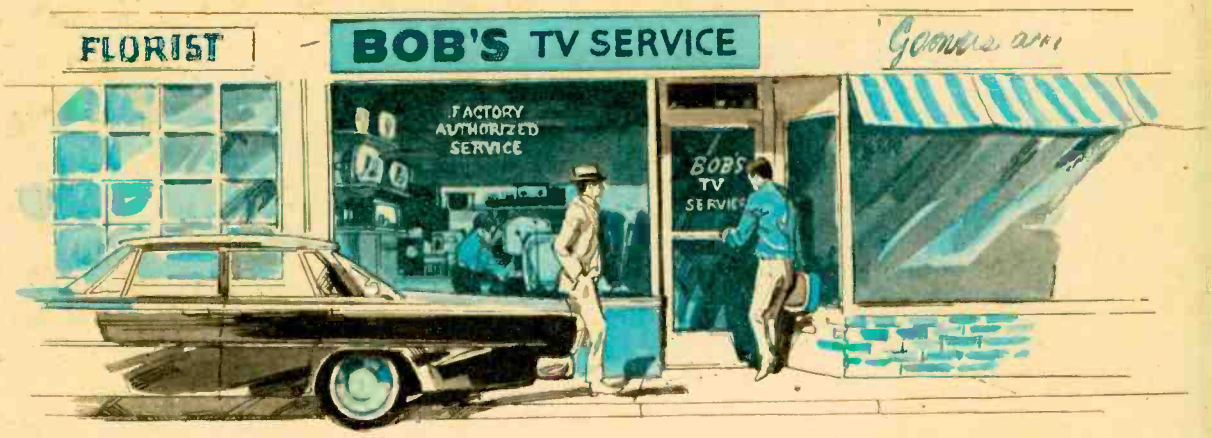
The 24-hour monitoring system is nearly established in the Poughkeepsie area on a local basis. About ten members continuously listen on 9 and the goal is to create six-hour shifts for solid coverage. About a dozen distress calls are received each month from the nearby New York State Thruway for the usual highway hang-ups—gas, mechanical difficulty and accidents. When the cry for assistance arrives, the monitor phones state police. CBers are becoming so proficient at the task that they can already tell police just what gear to dispatch to the scene, whether it be a tow truck or ambulance, so they've won plenty of appreciation for their efforts from local authorities.

There are, to be sure, some serious flaws to be overcome before the operation achieves the snap of professionalism. First, there's the problem of enlisting enough volunteers for a job best suited to insomniacs. There's no effective alarm for waking a sleeping monitor when an actual emergency call is transmitted. (Send an SOS at sea during the wee hours and you'll knock the radio operator out of his bunk, thanks to an automatic alarm that senses only distress signals.) Some CBers have developed the knack of turning the volume very low, ignoring the chatter on the channel, but reacting to a call for help.

Still another problem is the idle talk on 9. The channel has cleared somewhat as the local CB populace learns of Channel 9's new status. Some gabbers, on the other hand, think the increasing silence on the frequency is an invitation to redouble their chit-chat. Skip, too, is still a carrier of distant, interfering signals.

But why a meeting in a graveyard? That's easy to explain. Pres. Jack Nance, moonlights as a guard every Sunday amid these shady acres and it has become a weekend hangout for the local CB crowd. "Do you get any complaints from management?" I asked.

"None at all," replied Jack, "haven't heard one complaint from my customers yet."



On Opening Your Own TV Service Shop

With these facts, you'll be able to do your own thing in a TV service shop without suffering business lumps.

By ART MARGOLIS

PART-TIME servicemen usually reach a plateau in their careers. They become adept at fixing TVs, they build a list of clientele and perhaps begin to make more money on the side than at a full-time job. It is at this time that a decision must be made: Should you give up the 9-to-5 routine of your old job to open a full-time service shop?

This is a question that has caused courageous men to spend sleepless nights. A radical change in your career, no matter what stage of the game you're at, is a big decision to make.

If you think that a full-time shop will be easy to run or be a simple key to the door of success, you couldn't be further from the truth. But I will say that my life in TV servicing has been thoroughly rewarding—in all respects.

Before you decide one way or the other, there are some things you should know about a TV service business. If you decide to go ahead and open a shop, this information may save you some unnecessary lumps.

The ingredients that make for a successful operation are easy to describe. First, you have to control your business; second, you must have adequate financing; third, you have to be geared to attract business; fourth you must know how to purchase parts and equipment; fifth, you must have good personnel and sixth, you must tie in with the TV manufacturers.

Of course, there is a bit more to it than that, but these are the basics. Let's discuss them.

In any business venture there is risk. The security of owning a TV shop lies in the fact that your main assets are your head and hands. One way to cut risk is to be on top of the operation on a daily basis.

The way to keep on top of things is with a control book that you show to no one. My book opens every Monday morning and closes every Saturday evening. It sees each week as a pie (see third page of this article). All the money grossed or handled goes into the pie. Then slices come off the pie. One slice is the fixed expenses. These include the rent, truck expenses, lights, advertising, in-

On Opening Your Own TV Service Shop

surance, taxes, maintenance, etc. I calculate what the expenses are for a year and divide by 52. I think of this money as laid on the line every Monday morning when I open.

Another slice is the payroll. This is also considered spent Monday morning.

A third slice is the purchase of parts needed for repairs. This varies somewhat with the amount of business done for the week, so I calculate it as I purchase parts during the week.

Start off your service shop doing all the work yourself. You will save money on personnel and when you know what each job entails, it will be easier to hire someone later.

I constantly watch the first three slices, looking for ways to reduce them. That's because the fourth slice of the pie is the net profit and denotes what I can take home. The more I can reduce the other three slices, the larger the profit slice is. Also the larger I can make the total weekly pie, the larger my profit slice tends to be. The name of the game is profit!

This brings us to that familiar term, the break-even point. This is the point when sometime during the week your gross sales will add up to the amount of your total expenses. All the money that comes in after that time is your profit.

A service businessman who is truly on top of his business knows almost to the moment when the break even point arrives. The earlier in the week it occurs, the more profit you will enjoy. Let's go through a typical neighborhood TV shop's weekly financial picture.

With an average rent of $200 a month and average advertising and expenses, a two-man shop should gross about a $1,000 a week.

The two men are ideally, yourself as a benchman and a roadman employee. The pie should slice out like this: $200 a week salary for the roadman with $50 a week in salaries for supporting help such as a clerk or night man. This totals about 25 per cent of the pie.

This typical shop should do about 50 jobs a week for $1,000 in gross sales. To accomplish this, a shop that is buying judiciously will spend about $225 a week in parts. This takes a 22.5 per cent slice of the pie.

The fixed expenses, commonly called the nut, average the same as the monthly rental. Therefore $200 a week should cover these expenses and becomes a 20 per cent piece of the pie.

These three expenses total 67.5 per cent and leave a profit slice of 32.5 per cent, which translates to $325 a week for the owner. This includes his salary.

The break even point occurs when the weekly gross reaches $675. In my experience, this usually comes Friday evening at closing time. This means that the owner will work for nothing Monday through Friday and then keep all the money that comes in Saturday.

All weeks are usually not so nicely laid out. Some weeks gross more than a $1,000, sometimes reaching $2,000. When that happens the profits are enormous. Other weeks are not so pleasant and the gross may only reach $500 and the owner not only doesn't have any money to take home but must come up with $175 out of his pocket to keep things going.

After a year or two of operation your controls will paint a pattern for you and you'll know when the good season and bad season will occur. That way you can adjust purchases and payroll to match the amount of business so that you can keep expenses

low during the slow weeks.

Once you are living with the gross-receipts-pie idea and gearing your every move in relation to it, you are ready to finance the business. This way you'll be able to watch your bank balance and know the exact causes of its fluctuation. If you don't have this knowledge, financing can be treacherous and lull you into false confidence.

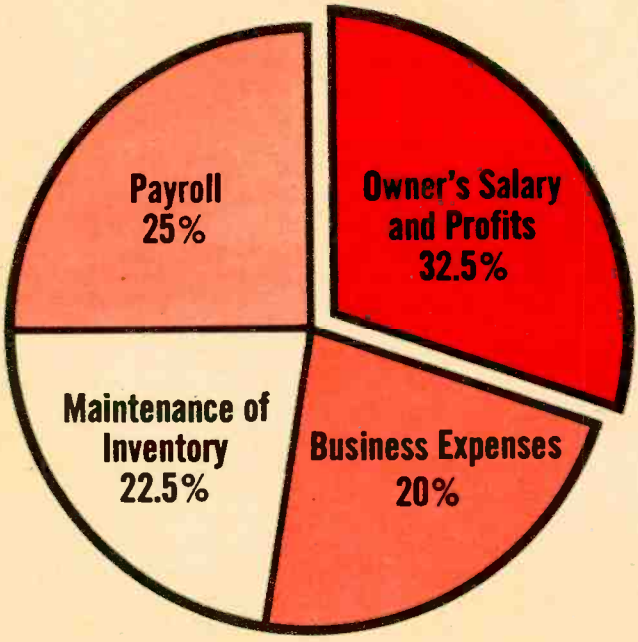
Getting financing is a problem that you must solve for yourself. Personal savings or borrowing from relatives or banks are all sources of funding. It is something that you have to work out for yourself. Taking money from personal savings, is the best way, for you do not have to pay it back. A long-term financing plan might be possible. Short-term loans are dangerous. It's better to wait a while and save the money than to take a plunge and then find you can't pay it back.

In the beginning of any operation, business is going to be slow. You must be able to carry yourself during this time. I'd say that after you have purchased all your initial inventory, equipment and fixtures and paid your rent and security deposit, $5,000 should be a minimum nest egg. Should you then run through that initial financing in six months or less it would be best to close shop and cut your losses for the operation is a loser.

However, should you find that you only go through a few dollars and then your bank account reverses itself and starts to build, you have a winner!

During the beginning months watch your nest egg like a hawk, hire as little help as possible and draw the smallest salary you can get by on. There's plenty of time to hire people and draw more money as you operate well in the black, week after week.

As soon as you open the doors you will be besieged by salespeople trying to sell you everything from paper clips to insurance. They get your name from new listings in the mercantile license files, sales-tax lists and legal newspapers that list your company name.

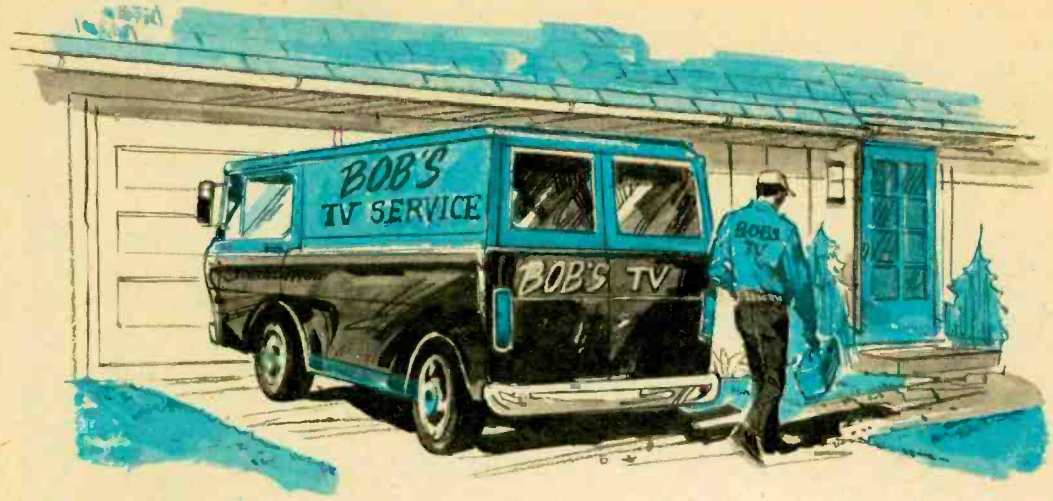


An average business expense and profit pie for a TV service business. Keep in mind that the smaller the size of the first three pieces, the more money you'll be able to take home.

Don't buy anything unless it's absolutely necessary. The best way to purchase for a TV service business is hand to mouth. As you need a part, piece of equipment or office supply, buy it. It is better for you to have to send your wife to a parts house for a special flyback transformer than stock a bunch of them and end up losing a few hundred dollars when they grow obsolete on the shelf.

You do need some inventory, of course. A stock of tubes, transistors, resistors, capacitors, circuit breakers, diodes, anode caps, etc. Be careful about stocking too many tubes since they are rapidly becoming obsolete and in a few years, who knows? In certain areas, particular tubes are more popular so before putting in an across-the-board supply find out which ones are used the most in your area.

Your most needed equipment, is of course, test gear. As a part-time serviceman you will undoubtedly have most



Your first employee should be a roadman. His work greatly influences customers—so choose him carefully.

On Opening Your Own TV Service Shop

of what you need in your home shop. There may be some pieces of equipment that will make the full-time load easier, but this expenditure can wait until you are sure that you will be needing it.

In the beginning, as I mentioned before, it's a good idea to do all the work yourself. Since you have the option as a self-employed person to work 24 hours a day, seven days a week if you want to, no one is going to object. In addition to saving money on the payroll, doing all the jobs yourself gives you a good idea of what each job is like and will enable you to intelligently choose the right person to fill it.

Once you get to the happy position of having more work than you can handle yourself, it's time to give thought to hiring someone to help handle some of it. Your first employee should be a roadman.

A roadman does not have to have the skills of a benchman, however the more technical he is, the better off you are. His most important asset must be a neat appearance and a pleasant personality. He will represent your business image in the customers house. His personal and technical skills are all the customer will see of your operation. He can either build upon the start you gave the business or quickly tear it down. He is going to be the main source of the word of mouth advertising that you need to flourish.

Assuming your business continues to build with a roadman outside and you in the shop, the phone is going to start ringing quite a bit and a lot of people are going to stop into your store. This means that you have to wait on the counter and answer the phone, cutting down on essential bench production. As soon as you feel you can't handle all three jobs anymore, it's time to hire a non-technical (low price) individual to clerk and answer the phone. The amount of time you save can be spent on the heart of the business—the bench repair work. But you must still be there to handle all the trying telephone calls and store customers.

Once you have reached this personnel setup, you should be well on your way to a successful operation. If you have the right type of location you could even open the shop in the evening and hire another person to man the counter and phones for the evening.

How can you get personnel? It's not easy. In today's labor market, electronically-inclined people are hard to find. Most experienced roadmen use offers of employment to get more out of their present employers. Placing ads in the newspaper yields little or no response.

The situation is far from hopeless. If you belong to local ham clubs, CAP chapter, etc., you will come in contact with many individuals with electronics background. Everybody is open to an interesting proposition.

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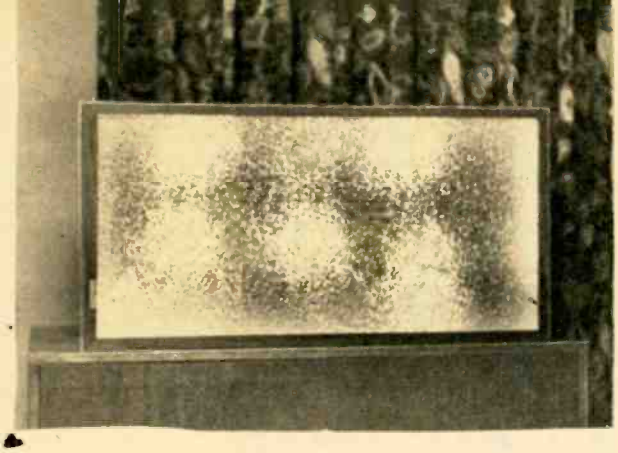

EI Kit Report

Four-Channel Color Organ

Eico 3450

GET turned on electronically? You might think of electrodes attached to your head for such an experience. Not so. A pair of Eico Model 3450 Audio Color Organs, dim room lights and appropriate music will make any dance party really take off. We built a pair and were overjoyed by their simple construction and exciting performance. The four-channel 3450 sells for $79.95 as a kit or $109.95 assembled.

What's four-channel audio color organ? It's a device that is fed a signal from the speaker terminals of your stereo amplifier or radio (its operating power is 117 VAC). Its filter networks divide the signal into four separate signals. These signals fire four SCRs which turn on four strings of colored light bulbs—blue, green, red and amber (60 watts per string). Which string lights depends on the frequency of the program material; the intensity depends on the volume. We found the lights came on at about the following frequencies: blue: 150 cps; red: 700 cps; green: 1,700 cps; amber: 2,500 cps.

The bulbs, shown in the photo below, are 117-V GE No. D15 outdoor Christmas lamps and there are six in each string. They are mounted on the back of what looks like a bookshelf speaker cabinet on the front of which is a sheet of plastic with a textured surface to diffuse the light. The result is large blotches of color that blend together beautifully.

We built the kit in five hours and had no problems with either the cabinet or the electronics. The cabinet sides, top and bottom, which come precisely cut to size, are glued together and reinforced with corner cleats.

Most of the electronic components are mounted on a printed-circuit board which is installed in a U-shaped chassis. The chassis is attached to the back panel. Electrical set up consists of turning a screwdriver-adjust pot for each string of lamps until the lamps come on, then backing off a bit until the lamps just go off.

Two external controls, *color balance* and *sensitivity* are adjusted to achieve different

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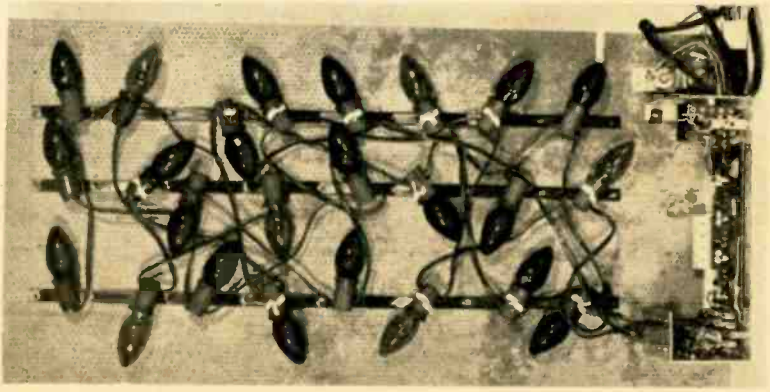

In photo at top you can see blotches of light produced by one string of lamps. When four strings are on, lights all blend together. Photo at right shows four strings of lamps (24 lamps) mounted on back panel. Random positions assure good color blend. Electronics is on U-shaped chassis at right of the panel.

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Good Reading

By Tim Cartwright

RCA SOLID-STATE HOBBY CIRCUITS MANUAL HM-91. RCA Distributor Products, Harrison, N.J. 368 pages. $1.95

Those experimenters who cut their electronic teeth on vacuum tubes may recall RCA's early tube manuals. They had a dozen or so schematics at the end of the book to demonstrate how the tubes could be used in circuits. A warning also appeared with the circuits. The author hinted that electronic quicksand lay before the inexperienced builder who was unfamiliar with layout and high frequencies. Scores of intrepid hobbyists built them anyway and had remarkable success. Maybe an amplifier hummed from poor lead dress or an oscillator took off on the wrong frequency, but getting the circuit to work was part of the game.

In its recent publication, RCA takes a different stance. Tinkerers today are given the royal treatment from theory and layout down to full-size drilling templates. The new manual presents circuit data in lavish, easy-to-follow style and the result is a whopping bargain in build-it books.

This edition covers 62 circuits useful in several areas. For motorists there's a tach, battery charger and alarm. Hams will find keyers, oscillators, a dip meter and a VFO. The photographer can build an exposure meter for his enlarger, a temperature alarm or interval timer. Audio fans can construct four amplifiers from .5 to 30 watts of either pure or fuzzy fi. There are gadgets for the home-owner—freezer alarms and lamp dimmers—and electronic dice for those who can't see their way to Vegas.

101 TV TROUBLES FROM SYMPTOM TO REPAIR. By Art Margolis. Tab Books, Blue Ridge Summit, Pa. $4.95 (paperbound)

This is an excellent book for the full-time technician, part-time fixer or anyone who knows the rudiments of TV circuitry. It has the rare flavor of the wise old journeyman gently leading the young apprentice through a tangle of TV troubles. Along the way there's neither tricky jargon nor flashy theory, but sensible steps to identify troublesome areas with classic symptoms like no brightness, poor contrast, slippery sync, missing or wrong colors.

Mr. Margolis, who's been writing about suf-TVs in EI for many years, fills his book with earthy suggestions. Did you know, for example, that bad focus rectifiers can smell like rotten eggs? Or when your picture starts taking deep breaths, you're lucky if it's only a bad vertical-output tube. The text has much practical wisdom on TV repair and could pay for itself the next time you run into *barber poles, bleeding or blooming.*

THE KEY TO BASIC ELECTRONICS. By Carlson Wade. Key Publishing Co., New York, N.Y. 182 pages, $4

The material in this useful volume is drawn from U.S. government publications. Thus the text is delivered in military tech-manual style and that's a good thing. Directed at the technician, straight-forward writing plays down mathematics and emphasizes circuit operation. Power and signal flows are traced in detail to give the reader a good understanding of how a circuit functions. This is a sound approach to training the man who fixes, rather than designs, electronic circuitry. The book starts with a chapter on basic power supplies, then continues with tubes, amplifiers, transistors, transmission and reception.

125 ONE-TRANSISTOR PROJECTS. By Rufus Turner, Tab Books, Blue Ridge Summit, Pa. $3.95 (paperbound)

Here's another cookbook of quickie electronic recipes. There is nothing new or novel about its circuits, and no such claim is made. Some transistors specified go back to the Flintstone era, and the experimenter may have to find current substitutes. Projects include a durable line-up of amplifiers, oscillators, control and alarm devices, instruments and power supplies. The short text which accompanies each schematic is better than average since Dr. Turner greases the pan with helpful hints on each circuit's current drain, frequency response and impedance.

Don't expect commercial-grade performance from these projects. They're more properly for demonstration, education or just plain dabbling on a transistor breadboard. You can lash together a dozen circuits for the sheer fun of experimenting.

And make note of . . .

104 SIMPLE ONE-TUBE PROJECTS. By Robert M. Brown. Tab Books. 192 pages. $6.95

Tightwad Tach for Tough Tune-Ups

By VINCE DANIELS

RUN to the junk box, men! We've got another budget project at hand that's worth its weight in gold in your garage. It's a tach designed for engine tune-ups. Instead of indicating a wide range of engine speeds (such as 0 to 8,000 rpm), our Tightwad Tune-Up Tach goes only to 1,600 rpm for six-cylinder engines and 1,200 rpm for eight-cylinder mills. The advantage? The all-important tune-up range of 500 to 1,200 rpm utilizes most of the meter's scale rather than just a small part of it.

As can be seen in the Parts List, all components are commonly found in old equipment and forgotten projects. There are no oddball values. In addition, many transistors can be substituted for the specified Q1 and Q2. Most any npn silicon small-signal type with a beta of 80 to 200 can be used.

While a meter scale is provided which you can cut out and paste on the specified Lafayette meter scale, note that the scale is linear. You could mark off the correct scale on any 0-1 ma DC milliammeter by simply dividing the scale into equally-spaced sectors.

Construction. The tach is built on the front panel of a 6¼ x 3¾ x 2-in. Bakelite box. The circuit is wired on a 3 x 3 in. piece of perforated board using Vector T28 terminals for tie points. Note in the pictorial that when the board is mounted on the back of the meter, the meter is automatically connected into the circuit.

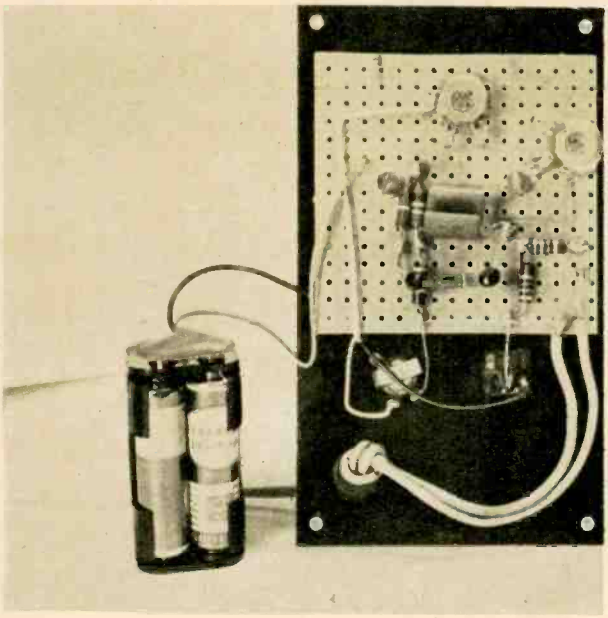
Calibration potentiometer R4 and battery-test potentiometer R3 are low-cost miniature printed-circuit types. Their mounting tabs are spaced the same distance as four holes in the board and they are mounted by simply slipping the tabs into the top of two T28 push-in terminals.

Capacitor C2, which determines the pulse width of the multivibrator, is some what critical and the value should be .5 μf. Since .5 μf may be somewhat difficult to obtain you can connect two .25 μf capacitors in parallel, or even five .1 μf capacitors in parallel.

Battery B1 is 6 V. Use either a Burgess type Z4, which fits a standard D-cell holder, or use four penlite cells. Diode SR1 must be a silicon rectifier, though a general-purpose, low-cost small-signal type can be used as long as it is rated at least 50 PIV. It protects Q1's base against excessive input voltage.

Finally, connect the test leads, which can be 15 to 25 in. of stranded wire; ordinary lamp cord will do. Connect alligator clips to the free ends and mark the ground lead (or use an insulated alligator clip on the wire connected to C1).

Calibration. First, adjust the battery test circuit. Set S2 to on, press S1 and then turn R3 so M1 indicates full scale. If you later test the battery and find the meter doesn't indicate exactly full scale replace the batteries. The meter *must* indicate full scale



The best way to calibrate our tach is with a test tach that you know is accurate. Let the car's engine warm up so it is running at low idle (curb idle) speed. Connect the test tach to the distributor side of the high-voltage coil and to the car frame and measure the engine rpm. Disconnect the tach —this is important, the test tach must be disconnected—and connect our tach. Set S2 to *on* and adjust R4 from the full counter-clockwise position until our tach indicates the same rpm as the test tach indicated. If our tach is connected at the same time as the test tach it is more than likely (depending on the design of the test tach) that our tach will not be correctly calibrated after the test tach is disconnected.

If you cannot obtain another tach for calibration the circuit shown in Fig. 2 (top) will provide a reasonably accurate calibration voltage. Transformer T1 can be any filament

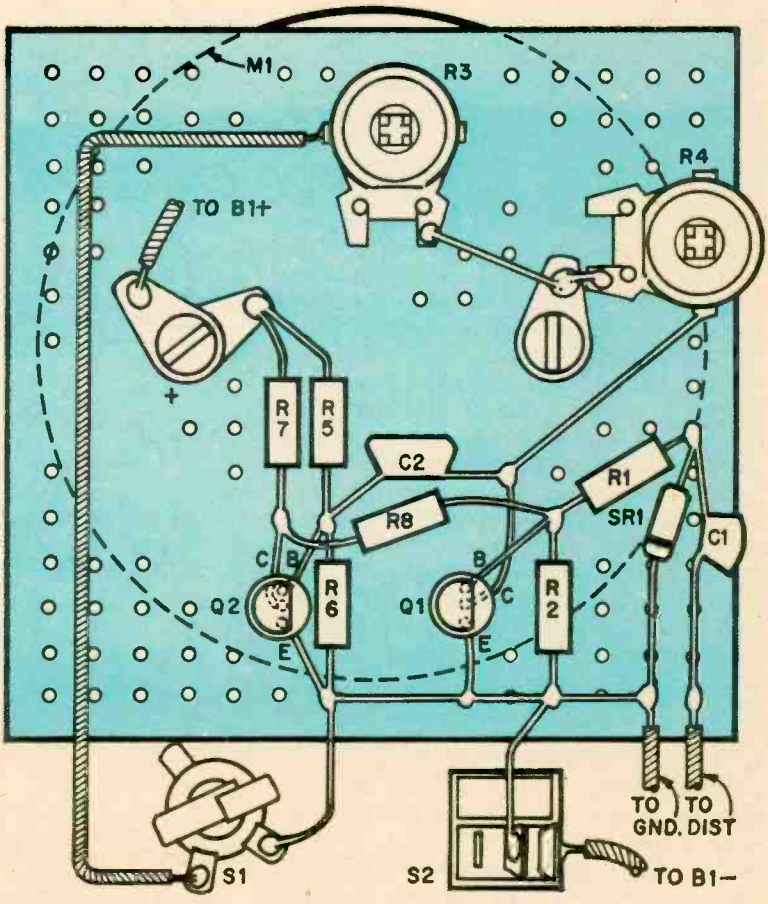


Fig. 1—Note in the photo above that the perforated board is mounted on the back of the meter by the meter's terminal screws. This also connects the meter to the circuit. In pictorial at right we show only one capacitor for C2. In photo, C2 is made up of two .25-μf capacitors in parallel.

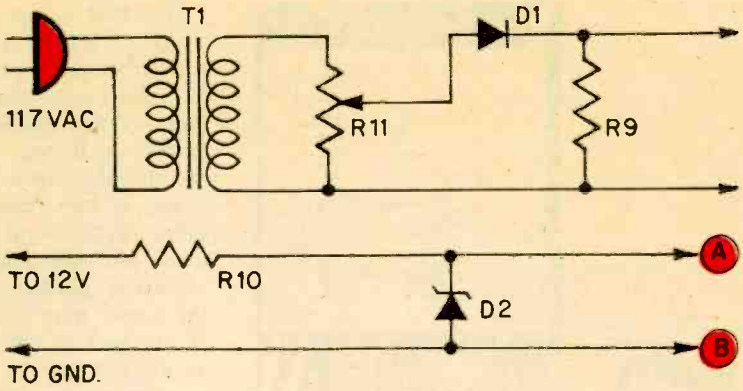


Fig. 2—Schematic at top is of 60-cps calibration circuit. Instructions for using it are in text. Bottom schematic is of optional power supply which permits you to use car's battery for operating power. Connect leads marked A and B to points A and B in schematic in Fig. 4 and eliminate B1, S2.

Tightwad Tach for Tough Tune-Ups

transformer with a 5 to 24-V secondary. Diode D1 can be any general-purpose germanium diode such as a 1N34, 1N60, or equivalent.

Temporarily connect a .25 μf capacitor across C1 and a 100 ohm, ½ watt, 5 or 10-per cent resistor across M1's terminals. Connect the output of the calibration circuit to the tach and very slowly advance the pot until M1's pointer kicks up. Using care not to change the pot's setting, adjust R4 for a full-scale indication. Then, recheck the calibration circuit. Turn the pot down so M1's needle falls to zero, then slowly advance the pot until M1's pointer suddenly kicks up. Do not advance the pot past the point where the meter pointer kicks up, as this will only drive M1 to a higher, incorrect indication. At the setting that drives M1's pointer up scale you should get a consistent full-scale indication. If you don't, try the adjustment several times, readjusting R4 until you obtain a consistent full-scale indication. Then, disconnect the calibration circuit, the .25 μf capacitor and the 100-ohm resistor.

In use, the M1's pointer will be almost rock-steady from about 400 rpm up. Below 400 rpm the needle might flutter from 50 to 100 rpm with the proper rpm being the value between the highest and lowest extremes. The exact nature and degree of low-rpm flutter will depend on M1's characteristics. Normally, the flutter will not be a problem as 400 rpm is below a car's minimum engine rpm.

If the project doesn't work when first tried, measure Q1's and Q2's collector voltages with no signal applied to C1. The collector voltage of Q1 should be equal to the power supply voltage (about 6 V). The voltage at Q2's collector should be zero. If either voltage is incorrect there is a wiring error or a defective transistor.

If the voltages are okay, connect the negative lead of a 9 to 12-V battery to the tach's ground lead and flick C1's input lead on the battery's positive terminal. At the instant of contact, Q1's collector voltage should rise and Q2's collector voltage should fall. If you are measuring the collector voltages with a scope, the change in voltage at both collectors will be 6 V either up or down.

If you are using a VTVM to check the

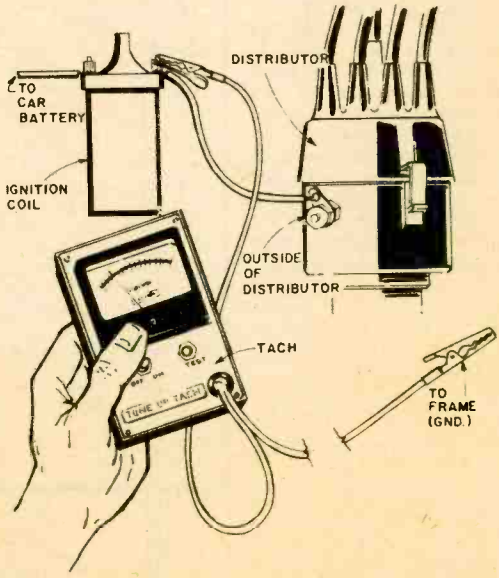


Fig. 3—The Tune-Up Tach is connected between the distributor side of the ignition-coil primary terminal and ground (clean spot on car's chassis).

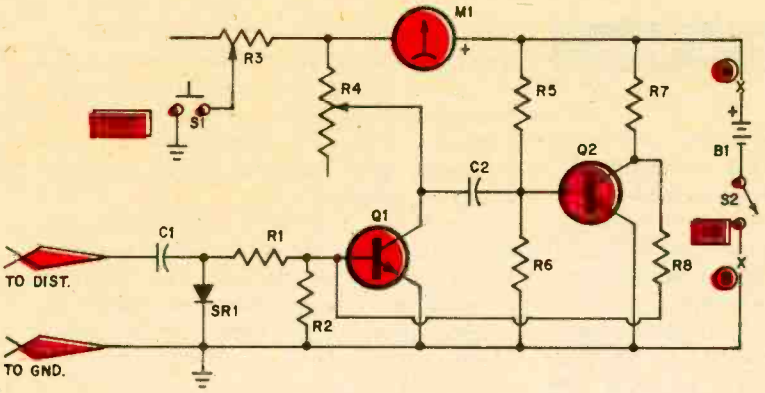


Fig. 4—Voltage from pulse on distributor points causes monostable multivibrator to produce string of uniform-width pulses whose frequency is proportional to engine speed. Meter M1, in Q1's collector circuit, indicates average total current flow through Q1's collector. The greater the speed, the greater the average current.

PARTS LIST

B1—6 V battery (see text)
C1—.005 μf, 75 V or higher disc capacitor
C2—.5 μf, 10 V or higher capacitor (see text)
D1—1N34 or 1N60 diode
D2—6 to 6.8 V, 400-mw zener diode
M1—0-1 ma DC milliammeter (Lafayette 99 F 50403 or equiv.)
Q1, Q2—2N3393 transistor (GE or equiv.)
Resistors: ½ watt, 10% unless otherwise indicated
R1—560 ohms R2, R6—4,700 ohms
R3—10,000 ohm trimmer pot (Mallory MTC-4, Lafayette 33 F 16783)
R4—5,000 ohm trimmer pot (Mallory MTC-4, Lafayette 33 F 16759
R5—15,000 ohms R7—2,200 ohms
R8—22,000 ohms R9—330 ohms
R10—330 ohms
R11—10,000 to 50,000 ohm linear-taper pot
S1—Normally-open pushbutton switch
S2—SPST toggle or slide switch
SR1—Silicon rectifier; minimum ratings: 50 ma, 100 PIV
T1—Filament transformer; secondary: 6.3 to 24 V
Misc.—Bakelite cabinet, alligator clips, perforated board

tor points (points open) is applied to C1, Q1 is turned on, and current flows in Q1's collector circuit.

When current flows the full B+ is dropped across R4 (the collector voltage falls from 6 V to 0 V). When Q1's collector voltage falls to zero, C2 discharges through Q2's base, reducing Q2's forward bias which causes Q2's collector voltage to rise. The rise in collector voltage is fed via R8 to Q1's base.

This holds Q1 in conduction even after the input trigger pulse is removed. When C2 discharges, the bias on Q2 returns to normal and the voltage at Q2's collector again falls to zero. This removes the holding bias on Q1, and Q2 is returned to cutoff. The next voltage pulse applied to C1 repeats the cycle. Since each pulse applied to C1 results in approximately equal current pulses in

[*Continued on page* 98]

collector voltages you will find the meter isn't fast enough to follow the change, and the meter will simply indicate an up or down direction. If the collector voltages do not change (particularly Q1's) when the test (battery) pulse is applied to C1, check C1, SR1, R1 and B2's wiring. Also check Q1.

How it Works. The tach's circuit is a monostable multivibrator that is triggered by a positive voltage pulse obtained from across the car's distributor points. Take a look at the schematic in Fig. 4. In the normal quiescent state, signal voltage is not applied input capacitor C1. Transistor Q1 is cut off (no collector current, therefore meter M1 indicates zero). However, transistor Q2 is biased by R5 and R6 into collector saturation (maximum collector current, limited by R7). When a voltage pulse from the distribu-

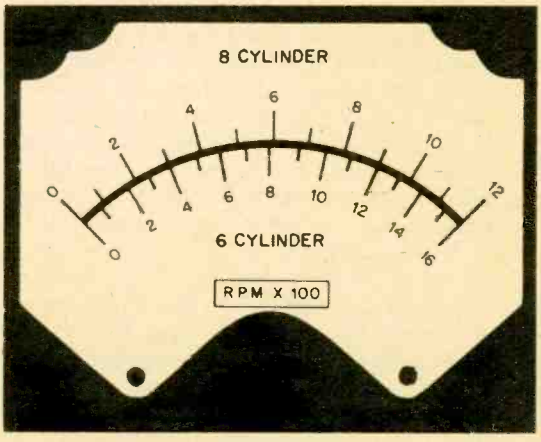


Fig. 5—Cut out scale and paste over scale of meter specified in Parts List. Read upper scale for eight-cylinder engines. Lower scale is for 6-cylinder engines.

Mr. Dolby's Wonderful System

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a circuit which contains nearly 300 semiconductors and gold-plated connectors?

The answer is that Dolby slashed his original Type A design—the professional version described to this point—and fashioned from it a Type B system for home equipment. The big difference is that Type B eliminates three channels and emerges as a one-band device. But it's not as skimpy as it appears (see Fig. 3). All the action is now concentrated solely on the major affliction of home tape equipment—hiss. The promise of less hiss provides for more than simple noise reduction at the ear. High-quality tape recording in the home could drop to 3¾ ips (from 7½ ips) and cut the cost of raw tape in half. Of far greater impact is what will happen to the lowly cassette. Crawling along at a snail-paced 1⅞ ips, cassettes hiss like a kettle at full boil.

Signal-to-noise ratios are poor with the cassette partly because of certain properties of magnetic tape. The tape is coated with particles of iron oxide and even though these are microscopic in dimension there are spaces between each particle. At the higher tape speeds each particle passes quickly enough so there appears to be no gap when examined by the human ear. As the tape speed drops these gaps become more and more evident. Another contributing factor to this poor noise ratio is the track width of the cassette—less than half that of a regular four-track recording on ¼-in. tape.

Dolby Type B has hit the consumer market in several forms (see the accompanying Listener's Report). There are cassette machines, an open-reel recorder and a novel add-on unit by Advent which can be attached to an existing recorder for Dolbyizing tapes made at home. The operating idea behind them all, however, is similar. The Dolby circuit is active at about 1,700 cps and higher to focus on the region where hiss becomes intrusive. As the machine records, audio is sensed for the same factors as the professional version: frequency and level. If level exceeds a given threshold (determined at the factory, or with a reference tape at home) the signal detours around the Dolby channel. Recall that strong signals need no boost to resist deterioration. Signals above 1,700 cps, however, are channeled into a high-pass filter. If they fall below the desired threshold, they're boosted by an amplifier, then returned to the recording process. (Powerful high-frequency tones will not be boosted.) It's this dual nature of Dolby—sensing both amplitude and frequency—that places it ahead of processors.

The Dolby Type B system thus doctors the audio in the recording phase when the hiss is recorded on the tape. This recording of noise is an unavoidable process as explained above. What then happens during playback is that the whole process is reversed. Frequencies and levels are perceived and restored to original status. But as the levels were all boosted when the unwanted noise was recorded at regular levels, the *unboosting* shoves the noise levels down to an unperceptable level on the audio spectrum (see Fig. 4).

But what happens if you record a tape on a Dolbyized machine and bring it to a friend with an older deck? This raises the matter of compatibility. Playback on a conventional machine is apt to sound extremely bright because those boosted highs are not being deemphasized. By simply adjusting the treble control on standard machines the Dolby version will sound compatible.

A leading tape producer doesn't see any compatibility problem. Ampex recently announced that all its recorded stereo cassettes will now receive the Type B process. It's one more sign that the Dolby circuit could become as essential to audio recording as a volume control knob.

Rapping With Ray Dolby

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Ray was allowed to join the engineering department. His first job was to make several hundred standard alignment tapes for the Model 200.

He put in a year at San Jose State College, studying electrical engineering. At the time he seemed to be spending more hours a day working for Ampex, part-time, than as a full-time student.

At Ampex, a man named Charles Ginsburg was just starting work on a brand new project—the design of a videotape recorder. Not much hardware had yet been built when Ray joined the project. The first experiments the two engineers collaborated on were designed to produce some kind of rotary-head device which could record and reliably re-

produce. They started off in a fairly modest way, with a 3,600-rpm motor and three heads with 2-in. tape. "We came up with a frequency response of 100 kHz or so." Ray recalls. "We moved on from there, refining techniques, adding a fourth head, developing methods for switching from head to head, working out modulation systems, both AM and FM and also servosystems."

Ray had to leave Ampex for Army service in the middle of the project but he followed the monochrome project right through to its conclusion on his return.

Two years in the U.S. Army ensued, in which he attained the rank of Corporal and ended up as an instructor of electronics, math and physics in St. Louis.

After the Army he went back to San Jose State College, again working intensively part-time for Ampex, did another year at San Jose, then two years at Stanford University where he gained his Bachelor's degree and won a Marshall Scholarship to Cambridge University in England.

His idea at first was to do an English Bachelor's in electrical engineering, but Ray quickly realised that he had already covered most of the relevant material. His supervisor advised him to go straight into research.

He spent six years at Cambridge, the last three as a Research Fellow at Pembroke College and as a researcher at the world-famous Cavendish Laboratory. During his last year there he was a Consultant to the U.K. Atomic Energy Authority. At Cambridge he completed his dissertation on long-wavelength X-ray microanalysis and received his PhD (hence Dr. Dolby).

In 1963, Ray Dolby went to India. Why? "I knew I had to get out of Cambridge because I knew that if I stayed there very much longer, I would stay forever," he says. "It's that kind of place. But I knew also that I wanted to travel. While I was in England I had covered most of Europe. So I went on this United Nations job with the vague idea of fulfilling my perpetual urge to see the rest of the world, to taste other cultures. It was a kind of open-ended thing. I knew that at some point I had to start my own company. The idea of starting on my own crystallized while I was in India. I got the idea for the *System* in India. I had to do a lot of driving and I used to think and calculate and work out problems during this time.

"I'd been concerned with recording problems and signal-to-noise ratio early on, particularly at Ampex. Indeed I did devise a noise-reduction system there. At Cambridge I was working on the problem of extracting signals from a very noisy background. This involved signal statistics and devices for optimising signals in any particular situation. This work doesn't apply particularly to sound recording. Remember I was working on X-rays at the time. But I was also interested in tape recording at Cambridge."

At Pembroke, which is one of the younger Cambridge colleges, only about 600 years old, he had a room which he turned into a kind of studio. He had permanent mike lines over to the College Chapel, so he could record some of the magnificent music coming from there. There was an excellent signal-to-noise ratio in the lines directly from the Chapel, but he could hear immediately the deterioration when he switched to the output of the recorder.

About this tape phenomenon Dolby says, "This bothered me. The before-signal was so glorious, but even with a good machine, a 7½ ips two-track Ampex, the result was awful. This spurred me to thinking about recording systems. It took about a year of concentrated thinking in India, during which I re-invented most of the existing noise reduction systems. Suddenly it struck me that all these distortion problems would disappear if one could deal with the high-level signals separately from the low-level signals."

Ray Dolby worked in India for two years, as a U.N. Adviser to the Central Scientific Instruments Organization. In 1965 he drove overland back to England (take a look at a map to see what that entails!) in the Volkswagen he still drives.

Dolby, nearly 38 years old now, is a large, attractive young man, looking, by haircut and dress, already more British than American although he returns to the U.S. about four times a year. His parents still live in San Jose. He's remarkably articulate for a scientist, gesticulates a lot with his fine hands, yet there's a listening, aware quality about him, an ability to appreciate a situation, a sensitivity and an enormous amount of gentle charm.

Four years ago he married a beautiful German girl called Dagmar, whom he met at Cambridge when she was there studying English. They live in an elegant apartment on the top floor ("it was the old servants' quarters, I guess") of an old house in Chelsea, which is one of the nicest parts of

[*Continued on page* 96]

Rapping With Ray Dolby

Continued from page 95

London to live. There are modern, abstract paintings and lots of souvenirs from India.

Of one thing Ray Dolby is certain. "There's always room for the individualist, the visionary, the loner, in technological invention. The loner has a great advantage over the clossetted employee of a big corporation, because he can make the quick decision that, in a big company, could never be decided without days of committee meetings. The loner has the agility of mind, the freedom of movement, to decide and to act without lengthy deliberation at every stage.

His advice to the young experimenter is to develop and maintain a healthy scepticism about established wisdom. "Established technology is like big corporations—it gets bogged down with its own weight," he says. He thinks that the young experimenter is much more likely to make that big contribution to progress if, from the earliest stages, he questions what he is being taught by his teachers and lecturers, even by the books he is reading.

"And the most important things that have happened to you?", I asked him. There was a very long pause. "As I said—being born to the parents I was born to. But then, also, there was Alex Poniatoff, who wanted only to hire a movie installation. He got himself a school kid to whom he gave the opportunity to work with enlightened and talented engineers before that kid had the disadvantage of being corrupted by formal education."

On Opening A TV Service Shop

Continued from page 84

Use your persuasive ability and get yourself a roadman from one of the fellows.

The non-technical personnel present no such problem. A well-placed ad for inexperienced or trainee help yields many applicants.

Getting business, strange as it may sound, is easy. Practically every home has one or more TVs radios and stereos. There are electronic problems just waiting to be solved.

The big problem once you get the business, is handling it properly. That means giving and sticking to estimates of how much and how long, keeping callbacks to a minimum and keeping customers content.

Business is drawn to you automatically as soon as you put up a sign on your store. The amount of business depends on your location. The better the location the more business you'll attract. In addition to being noticed in the neighborhood, you must take into consideration how much competition is around. The more competition you have, the more you have to split up the total service market in the area.

A second way to pull business is with advertising in the *Yellow Pages*. The more advertising you have in telephone books, the more business you'll pull. Extremely valuable are the listings under trade names. Lots of new customers look only under the trade name of their TV set for a serviceman. In order to get listed under a trade name you must qualify in some way for that particular brand. It is worth your while to qualify for as many of these trade listings as possible. Go to the various TV set distributors and find out what you should do.

A word of caution on advertising. Budget it carefully. You can go overboard and spend more than you should. The best way is to take a fixed percentage of your gross every week and put it into an ad fund. This percentage should never be less than 2 per cent or more than five per cent. If you spend more on rent than you normally would, due to an expensive location, consider part of your rent as advertising.

The most profitable portion of your business is the C.O.D. part. That is, the people who bring in work or need you for house calls. This work should come first.

If you still need work to fill out your week, you can solicit from the various TV dealers in your area. Chances are good, if you are set up in a good location and have a good *Yellow Pages* representation, that they will seek you out. Either way you can do their work and accept their service contracts, but the profit structure will be less than on regular work. Be careful of giving them 30-day credit because getting your money might be a problem.

The various TV distributors also set up warranty stations where they can channel work to you. Ask about this facet at the distributors when you set up your accounts and endeavor to qualify for their trade listings in the *Yellow Pages*.

I have talked a great deal here about procedures that you should follow in establishing and running a TV service business. The

information has been gathered from my experiences in running three separate shops along the Eastern seaboard. In each instance I employed the services of my family attorney in getting things started. I found in him a wealth of information and advice on how to proceed from one phase to another so that each of my shops would be a success. I heartily recommend this to you, in fact I will go as far as to say that it is a necessity to use an attorney right from the word go. Their fees are usually very reasonable for this kind of service. You might also make use of the government's Small Business Agency which endeavors, at no cost to you, to give advice on being a successful small businessman.

Although you might open your shop so that you can say at last that you are doing your own thing, remember that your emphasis should be on profit and thus all roads must eventually lead to your pocketbook.

How To Service Stereo Amplifiers

Continued from page 49

appear that a particular circuit is defective, the trouble might well be in a circuit before or after.

It is the interlocking of the DC voltages and currents which rules out lifting a few components to localize trouble, hence, the problem stage must be found by instrument analysis, and for this you must use a scope and signal generator.

Also note the connections from the drive-stage (Q1, Q3) to the output (Q2, Q4) in Fig. 4. Note that everything is DC (direct) coupled, and that the stabilizing bias is taken from the mid-point between the output transistors. A defective output transistor(s) would change this mid-point bias voltage affecting all circuits back to the driver input. A scope might show distortion at the driver input even though the defect was in the output stage.

Output stages generally have the most DC interlocks and interconnections. Figure 4 shows a basic quasi-complimentary-symmetry output stage. Note the series-connected diodes (B) connecting Q1's and Q3's bases. They're a common source of trouble and should only be replaced with their exact number. Do not use substitutes. These diodes set the proper bias for Q1 and Q3. While Q3's bias is but a few tenths of a volt above ground, Q1's bias is a few tenths of a volt above half the supply (+E) voltage. Reason for this is that Q1's emitter is returned to the midpoint voltage developed between Q2 and Q4. Often, the diodes are Zeners to give the precise voltage drop. In other cases the voltage drop is obtained through several series-connected silicon rectifiers whose individual voltage drops add up to the required value.

In Part 2 in our next issue, we'll discuss preamps and tone-control stages, wave forms and transistor substitution.

Fish-Finding Depthometers

Continued from page 33

transducer as low as possible so that when underway, the transducer is in the water.

Comparing the performance of the kits with two commercially-made depth sounders on a larger boat (a flashing-light model similar to the kits and a paper-recording type) the kits showed up one performance difference. On the larger boat we could measure depth at all speeds—wide-open throttle down to trolling speeds.

The kits could only measure depth at trolling and moderate speeds, and not at high speeds. Why? The transducers of both kits were mounted on the transom. The transducers of the sounders on the larger boat were through-the-hull-installations halfway up the boat's length with fairing blocks forward and behind them to smooth the flow of water. We feel that the lack of a sounding on the kits at high speeds was due to the water turbulence at the transom.

The Knight-Kit made accurate depth soundings but picked up what looked like ignition noise that appeared as scattered echoes around the dial. The depth indication was easy to pick out, but for more critical measurements the noise was a problem.

The Heathkit did not have this problem, because it had a *noise-reject* control (which neither the Knight-Kit nor the commercially-made sounders one on the larger boat had).

When we participated in the annual striped bass run at Montauk Point, L.I., several times while trolling we observed (on the Heathkit) scattered indications of something 5 to 10 ft. above the bottom. It turned out to be fish. When our lures passed over these spots we had hits every time. We didn't have this clarity on the Knight-Kit or the commercially-made sounders.

Four-Channel Color Organ

Continued from page 85

visual effects. When the 1,000-ohm *sensitivity* control is set so its resistance is out of the input circuit, the 3450's input impedance (which the amplifier sees) is the 8-ohm primary of the input transformer.

The final result. After using a pair of 3450s in a dark room at several parties over the Christmas holidays, we now find it's impossible to have people over without everyone immediately heading for the den, music and, of course, the lights. By the second record everyone is turned on.

Tightwad Tach for Tough Tune-Ups

Continued from page 93

Q1's collector, M1's indication is the total average current flow through Q1's collector. The scale of M1 can be calibrated in rpm.

Since Q1's collector current is very dependent on the battery voltage, a battery test circuit consisting of potentiometer R3 and S1 is included. However, if you prefer to eliminate the battery you can substitute the power supply circuit shown in Fig. 2 (bottom) and use the car's battery for power. Then eliminate S2 and B1 and connect the circuit in Fig. 2 to points A and B (schematic, Fig. 4). There is no need for two ground leads when using the car's battery for power. The tach's ground probe, which connects to the car frame, will also provide the grounded power connection.

Channel 9 Monitor

Continued from page 71

ator after tightening the locking nuts on T1's, T2's and T3's tuning screws.

Operation. For best reception you'll need a good CB antenna mounted up high. The receiver can be operated in two modes. *Squelch* control R10 can be turned down below the point of audio reception (with S2 set to on), or S2 can be set to *off*, and the *squelch* control set so that P1 glows dimly. When a signal is received, P1 will glow in proportion to the strength of the signal, then set S2 to *on*. The setting of R10 will have to be changed from time to time, as the background noise level and band reception conditions change

Continued from page 58

possible to figure out which one is playing which program.

There's an axiom amongst BCB DX fans which says that summertime and daylight DX is tried only by old timers who know enough or beginners who don't know any better. That axiom should have been tossed into one of the graveyard channels because, while there are certain hours and seasons which are preferred, there are no instances of a truly dead band as might be found on short wave. There is always a new station to hear, regardless of when you listen. Preferred DX hours are between sunset and sunrise, and the best hunting seasons for DX are the fall and winter.

If you are starting off your DX career on a table radio, you will eventually reach a plateau in your efforts where you won't receive any new DX stations without the addition of an external antenna. The little built-in loopstick antenna just isn't intended for real DX work and you will have to soup it up. This is done with about 50 ft. of wire strung as high as possible, away from power lines and aimed so that the largest number of stations will reach it broadside, that is, if you want to listen to stations east and west of your antenna, run the wire north to south (See Fig. 1).

The antenna need not consist of anything more than humble insulated bell wire, and the connection to your receiver's loopstick is no more than several wraps of the antenna wire around the loopstick (See Fig. 1). It is not necessary to remove any insulation from either the antenna wire or the loopstick. An even easier way of accomplishing all of this is to simply wrap the antenna wire several times around the entire receiver—cabinet and all. This method isn't quite as effective as wrapping directly around the loopstick, but it is an improvement. Wrap from front to back, and if you are going the internal wrapping route, don't forget to unplug the receiver when the engineering is under way. Never attempt to put a ground connection on an AC/DC set.

If you're looking for an even greater soup-up, try the BIG BOOSTER FOR THE BCB which appeared in the Mar. 1971 issue of EI.

Once you've got your station started and your channel chart hanging on the wall, what

[*Continued on page* 100]

A Basic Guide to BCB DX

Continued from page 99

do you do next?

Start logging the stations you hear, writing down all details of the programming and signal. If you want, you can use this logging data to make up a reception report to send to the station you have heard. Most stations, in return for correct reception reports, will send you a QSL card confirming your reception. These are nifty on the wall of any DX shack, and EI has a number of proficiency awards available to DXers who have confirmed reception of a certain number of stations.

For an adequate reception report you should have all details of a continuous 15 minute (minimum) programming segment. This should be locally originated program material rather than a network feed. Make note of all commercials, records, station breaks, etc., during the logging period.

Your reception report should consist of this information and the date and time of reception (don't forget to specify time zone in all reports). Also add technical data regarding the strength and quality of the received signals, interference from other stations, fading, and overall merit. Mention the type of receiver and antenna you have, and dash the whole thing off to the station's Program Director or Chief Engineer with a request (not a demand) for a QSL card or letter to confirm your reception. A street address is not necessary, just write to the Program Director, Radio Station W-----, (city), (state), (zip).

Within a week or two you will receive a card or letter confirming your reception, a valued merit-badge to mark the progress of your interest in DXing. Eventually you can start specializing in exclusive logging of only graveyard channels, state capitols, or even concentrating on logging (and QSLing) all stations in your own state. There are many self-imposed challenges, the possibilities are as limitless as the number of stations to be heard. The DX is there, all you have to do is seek it out.

But first things first. Let's get you started on some of those powerhouse stations. Some of the most often reported ones are listed in Table II, each has a power of 50,000 watts, except that the Mexicans run from 100,000 to 500,000 watts!

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No more messy paint jobs . . . just fill the container and squeeze the trigger—that's all there is to it! This remarkable trigger-fed roller paints interior and exterior surfaces without annoying dripping or splattering and no more dipping pans . . . uses all types of paint—water base or oil base. Specially designed trigger pump keeps roller pad filled. All you do is squeeze the trigger now and then—paint comes from within only when you need it. Comes with a detachable 2-foot extension tube so you can reach those hard to get at places with ease, and a washable, reusable 100% Dynel roller cover. Satisfaction guaranteed. **Only $14.95,** plus 50¢ for postage.

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Classified Ads

ELECTRONICS ILLUSTRATED

Your advertisement can reach this mail-buying audience for only 50¢ per word . . . payable in advance (Check or M.O. please) . . . minimum 10 words. Closing dates are the 20th of 4th preceding month i.e. copy for the September issue must be in our office by May 20th. Mail to ELECTRONICS ILLUSTRATED, 67 West 44th St., New York, N. Y. 10036. Word count: Zipcode number free. Figure one word: Name of state (New Jersey), name of city (New York); sets of characters as in key (14-O); also abbreviations as 35MM, 8x10, D.C., A.C.

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CONVERT ANY television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco A-19, Box 10563, Houston, Texas 77018.

FREE: JETCO Electronics Free 24 Page Treasure Finder Catalog. Find Metals, Minerals, Gold, Silver, Coins, and Relics. Jetco, Box 132EI, Huntsville, Texas 77340.

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INTEGRATED CIRCUIT Kits: Computer, Strobelite, Audio. Catalog Free. Kaye Engineering, Box 3932-C, Long Beach, California 90803.

CONSTRUCTION PLANS: Laser . . . $2.00. 2 FM Microphone Transmitters . . . $1.00. FM Telephone Transmitter . . . $2.00. Sound Telescope . . . $2.00. Space Monitor-Missile Tracker . . . $2.00. Equipment and Kits Available. Howard, 20174 Ward, Detroit, Michigan 48235.

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CIRCLE NUMBER 10 ON PAGE 13

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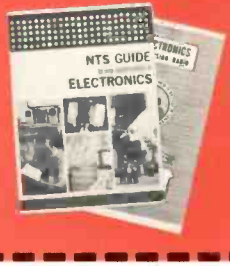

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