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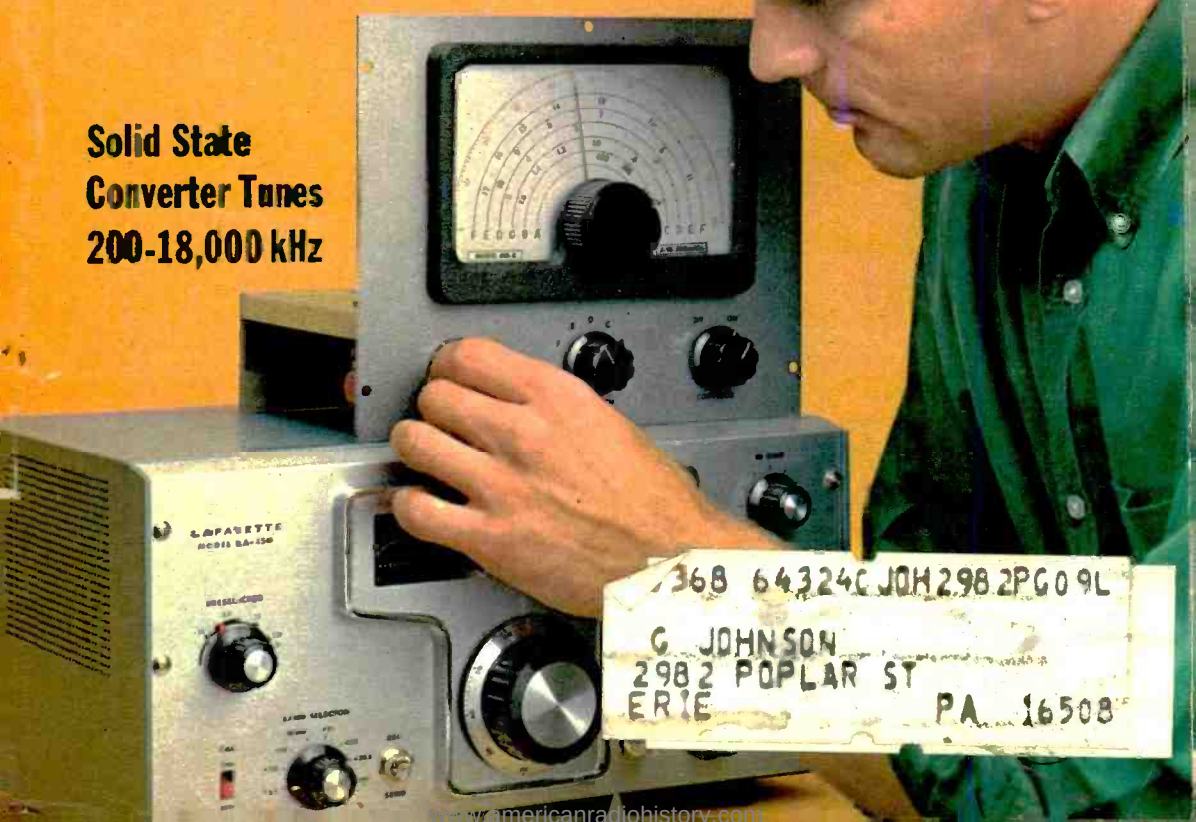

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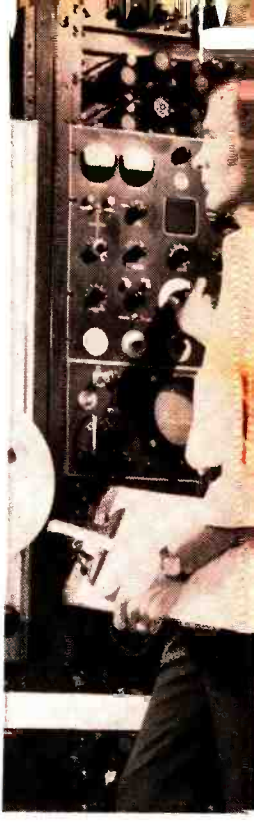

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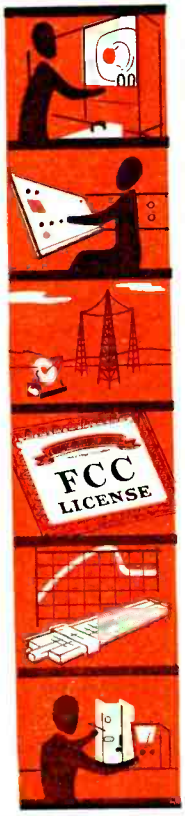

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VOLUME 25 **NOVEMBER, 1966** NUMBER 5

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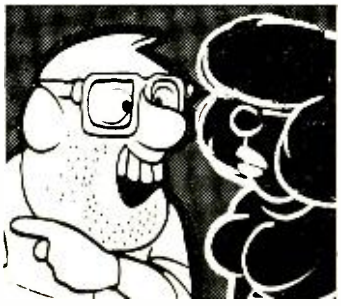
FEATURE ARTICLES

DEPARTMENTS



Look, Mrs. Kohler, learn the code or else! **79**

"Would you believe I'm Cinderella?" **74**

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

This month's cover photo by Bruce Pendleton

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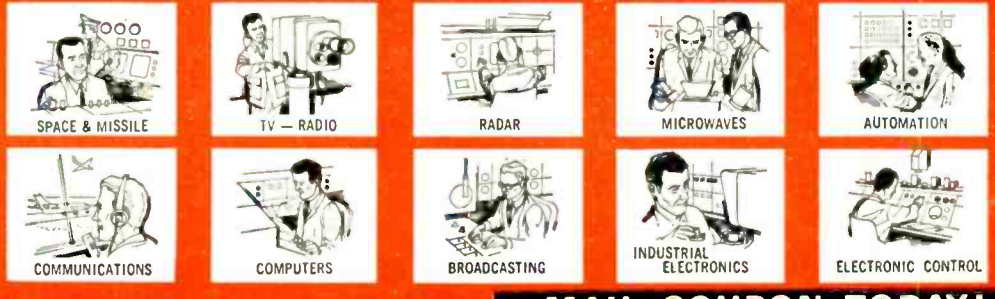

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CIRCLE NO. 4 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

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

CATV REVOLUTION

The article "Will CATV Revolutionize Your Viewing Habits?" (September, 1966) neglected to mention that we should lose most of our favorite programs that we see today for free! That fact was most conveniently overlooked.

FRANK SLOAN
San Jose, Calif.

Can you tell me whom to contact about CATV? I would like to get in on this.

BILL MASTERSON
Cleveland, Ohio

Bill, try contacting the author, Lon Cantor at Jerrold Electronics, 4th and Walnut Streets, Philadelphia, Pa. 19105. Frank, there's no evidence of a loss in favorite programs as a result of CATV. As it looks right now, CATV promises to make more programs available. Chances are that with more programs competing for your attention, more programs will become your "favorites."

SURPLUS TRANSISTORS

I took your article on "Computer PC Salvage" (June, 1966) seriously, and I am the proud owner of well over $100 worth of transistors in addition to other components. Now that I have them, what can I do with them? Would you please tell me of some circuits they

will work in or at least how to find their types from the numbers that are sometimes stamped on them?

CHARLES KAUFMAN
Shrewsbury, Mass.

You can separate them into pnp and npn types, Charles, by using your ohmmeter or a transistor checker. If they have 2N numbers, almost any transistor handbook will provide you with specifications. Practically all issues of POPULAR ELECTRONICS *have transistor-*

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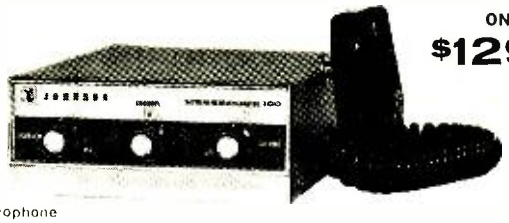

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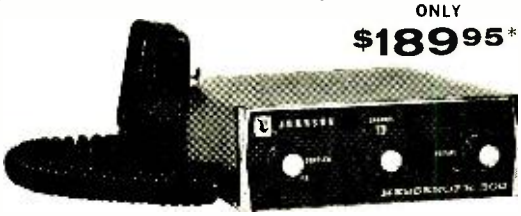

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CIRCLE NO. 26 ON READER SERVICE PAGE

LETTERS

(*Continued from page 6*)

ized projects, and a great many transistors are interchangeable.

BROADCASTS FROM ISRAEL

There is an omission in the "English-Language Broadcasts to North America" by Robert Legge. The state of Israel has had regular broadcasts for many years, and I think it would be a valuable service to your readers if you were to include the time and frequency of these broadcasts.

EUGENE KLINE
Rockville Centre, N.Y.

Eugene, according to the information we have, there are no broadcasts from Israel beamed to North America. However, you can often hear programs on 9009 kHz between 2040 and 2100 GMT.

NO PLACE FOR RAG-CHEWERS

While leafing through some old issues of P.E. (circa 1961), I came across something that struck me very funny. You informed a CB'er that CB was not the place for rag-chewing and that he should study up and get an amateur radio license, so that he could talk to his heart's content. Last week, on 15 meters, about five of us Hams were having a good time talking it up. Then we had a breaker who told us that we were "lids" and that we should use amateur radio the way it was meant to be used. If amateur radio is just for hello-goodbye contacts, then let's all move back to CB.

EUGENE SCHWARTZ
Bronx, N.Y.

OM, while there are many hams who also work CB, we don't think you are going to find many moving back to CB, at least not for rag-chewing.

"NO GUN," THRUSH, AND TRANSITIPS

How about those "No Gun" remarks which occur where you would least expect them? For example, take the recent rerun of a "Man From UNCLE" TV episode where the THRUSH bad guy triumphantly announced that THRUSH had succeeded in transistorizing the hydrogen bomb; as he was holding it proudly for all to see, a vacuum tube was plainly visible at either end of the propman's nightmare.

Some "No Gun" remarks creep into electronics magazines too, such as in "Transitips" in *Solid State* (July, 1966). Here we are told to use bypass and coupling capacitors whose reactance (X_c) is less than 1/10 of the im-

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You already know that the British are experts at building the world's finest changers. And now there's a new automatic turntable available in America from BSR Limited. It's the McDonald 500 Automatic Turntable—$74.50 features for $49.50.*

The reason it's on its side? The McDonald 500 has a truly adjustable, counter-balanced arm . . . a feature you would expect to find only on the $74.50 model. Look over the other McDonald 500 features, too. Think about all the records you can buy with the money you save by getting the McDonald 500—precision crafted in Britain.

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BSR McDONALD 500

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CIRCLE NO. 8 ON READER SERVICE PAGE

LETTERS (*Continued from page 8*)

pedance to be bypassed. This approximation works fine for vacuum tubes but the common emitter transistor circuit is more complex. Low frequency roll-off can occur due to the change in stage input impedance (which also depends upon X_{c_1}).

A slightly more detailed investigation into the above subject reveals that across the emitter resistor there is an apparent impedance, made up of the emitter resistor and the input resistance of the transistor in parallel. The emitter resistor in parallel with the 2000 ohms or so of the transistor would therefore require a larger bypass capacitor.

CHARLES CROSKEY
Fredonia, Pa.

From a practical point of view, Charles, many designers use a "cut and try" technique; they select a component value in accordance with theoretical concepts, and then

promptly change it when the circuit is "breadboarded" and checked out. Chances are that when the nearest commercially available capacitor size is selected, especially if you are headed in the right direction, you will find that—by accident or otherwise—the circuit works.

INDIAN TRINKETS FOR COMPONENTS

I am a regular reader of your magazine and find it interesting and helpful. The projects described are very good. They challenge an experimenter's skill and satisfy his desire to create things. Our American brothers (experimenters and hobbyists) are lucky because they can get all the parts they need. In India, it is difficult to get certain types of components, such as CDS photocells, relays, SCR's, etc. Whenever they are available, the cost is very high. I would like to correspond with experimenters in the United States who would be interested in receiving Indian novelties as gifts in return for electronic components and other spare parts.

K. B. TENDULKAR
94/3 Jaiprakash-Nagar
Goregaon (East)
Bombay 63 (NB) India

K. B., we have listed your complete address to give other readers an opportunity to contact you. Good luck. —30—

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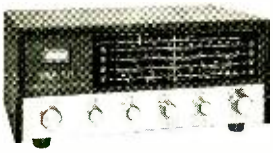

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The EICO 888 comes complete with a comprehensive Tune-up and Trouble-shooting Manual including RPM and Dwell angle for over 40 models of American and Foreign cars. **The Model 888 is an outstanding value at $44.95 kit, $59.95 wired.**

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There's more **PUNCH** in the new EICO "Sentinel-Pro" 23-channel Dual Conversion 5-watt CB Transceiver. New advanced Big-Reach **"Range Plus"** circuitry lengthens "talk-power" reach. Automatic noise limiter super-sensitizes for weak signals. "Finger Tip" antenna loading and transmitter tuning controls. 23 crystal-controlled transmit and receive channels — **all crystals supplied.** Rear-illuminated S/RF meter. Transistorized 12VDC and 117VAC dual power supply. **Wired only, $169.95.** Positive-Negative Ground/Mobile Marine Modification kit (optional $5.95).

Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. **$99.95 kit, $139.50 wired.**

FREE 1967 CATALOG

PE-11

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Model 232 Peak-to-Peak VTVM. A must for color or B&W TV and industrial use. 7 non-skip ranges on all 4 functions. With exclusive Uni-Probe.® **$29.95 kit, $49.95 wired.**

CIRCLE NO. 13 ON READER SERVICE PAGE

JUST WHEN I FORGOT MY (SOLDERING) GUN

Sequel 2

SINCE our last report in the September issue (page 81), we have received about 600 additional entries for the contest on nonsensical remarks about electronics. If you have not been following this contest, POPULAR ELECTRONICS is sending a soldering gun to every reader who submits a publishable "quote" that he or she has overheard. The "quote" must be a wild, inane, or implausible explanation of something electronic. Entries should be addressed to: "Gun Contest," POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016. Postmarks will determine the winners of duplicate entries.

Back to the Store. One reader writes that he overheard a little old lady explain to a clerk what was the matter with her defunct AM receiver in this way, *"There's nothing too much wrong with it—if you plug it in, you'll see that the motor is still humming loudly, but the set won't talk."*

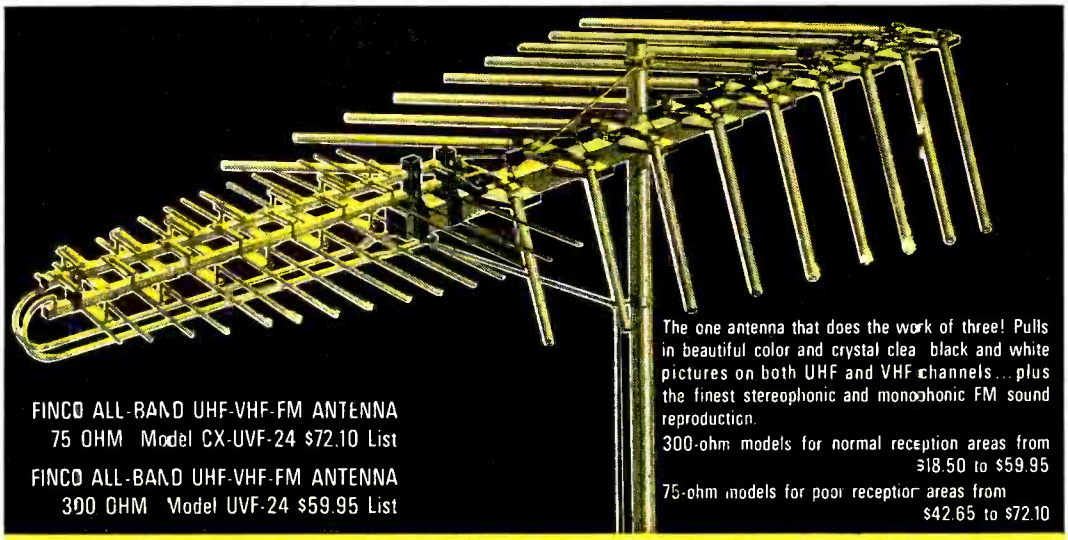
Another reader stood silently by while a dumbfounded clerk heard a customer tell his friend, *"Don't waste money on 5 amp fuses—buy 15 or 20 amp fuses—they cost the same and you get more fuse for your money."*

In a hi-fi salon, a wife who expressed interest in a transistorized FM receiver but was perplexed by the term "solid state" was told by her husband, *"Oh, that's the latest name those manufacturers are using for high fidelity."*

Off the Air. Hams and CB'ers have a lot of fun telling tales on one another. Last summer two CB'ers were comparing signal strength reports and one told the other, *"Okay, your meter is probably right—a 3-inch meter is always better than a 2-inch meter because the needle is longer."* And one prospective ham exclaimed on hearing his first SSB signal, *"How in the world do they learn to talk like that?"*

The son of the father who made the following prize remark was probably left speechless by the irrefutable logic of *"If that VOM reads infinity at full scale, then half-scale must be half of infinity."*

Winners. This month soldering guns went to Ralph Burbank, Tom Garrard, G. Linwood, Philip Taylor, and Steve Wozniak. More "quotes" and a new list of soldering gun winners next month. -30-



FINCO ALL-BAND UHF-VHF-FM ANTENNA
75 OHM Model CX-UVF-24 $72.10 List

FINCO ALL-BAND UHF-VHF-FM ANTENNA
300 OHM Model UVF-24 $59.95 List

The one antenna that does the work of three! Pulls in beautiful color and crystal clea black and white pictures on both UHF and VHF channels... plus the finest stereophonic and monophonic FM sound reproduction.

300-ohm models for normal reception areas from $18.50 to $59.95

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FINCO

introduces / 75-ohm COLOR VE-LOG ANTENNAS FOR UHF-VHF-FM RECEPTION

Finco's Swept-Element Antenna challenges all competition. Its unique design assures the finest color and b ack and white TV reception—plus superb FM and FM Stereo tone quality.

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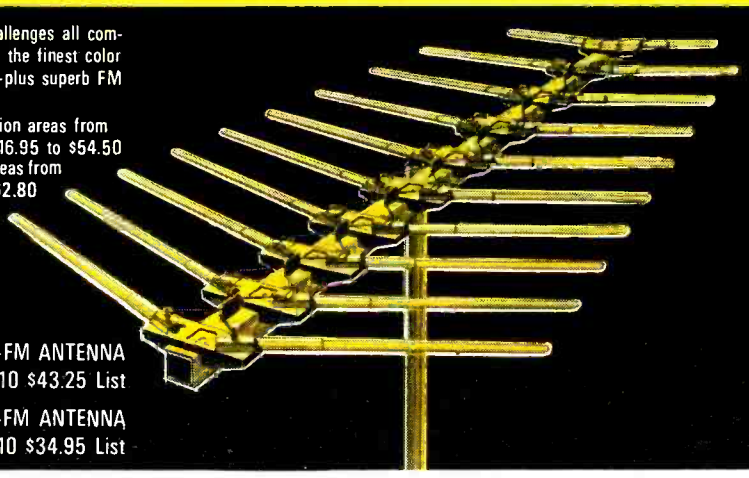

FINCO SWEPT-ELEMENT VHF-FM ANTENNA
75 OHM Model CXVL-10 $43.25 List

FINCO SWEPT-ELEMENT VHF-FM ANTENNA
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FREE! ALL FINCO CX-VL, CX-UVF AND UVF ANTENNAS COME WITH A FREE INDOOR SET-MOUNTED TRANSFORMER, VHF-UHF TRANSFORMER SPLITTER OR VHF-UHF SPLITTER.

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CIRCLE NO. 17 ON READER SERVICE PAGE

PARTS
METHODS
IDEAS
GADGETS
DEVICES

TIPS & TECHNIQUES

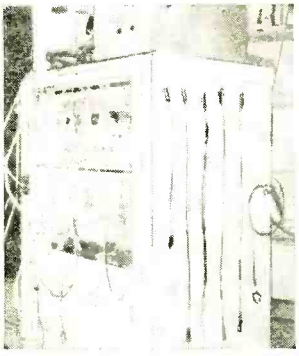
PRETTY IT UP WITH SPRAY PAINT

How about that last project? It didn't look so hot in that transparent plastic box, did it? But it might have looked a lot better if the box had been painted. Next time, spray the *inside* of the plastic box (before mounting the components) with one of those plastic paints which come in a spray can. Special paints are available in a wide variety of colors that will adhere to plastic. Painting the *inside* of the box hides all those scratches you might get on the outside, and prevents loss of coloration from handling the project.

—William S. Gohl

OLD TV CABINETS NEVER DIE— THIS ONE BECAME A MOBILE LAB

A compact test equipment center on wheels can be housed in an old TV cabinet. Remove the chassis from the cabinet, and install oversized casters to facilitate mobility. Leave the speaker in the lower section of the cabinet, and hook up a universal output transformer with a suitable switching arrangement and a set of long leads. Add another shelf to divide the upper section into suitable compartments for your test equipment, tools, spare parts, etc. Several a.c. receptacles can be located on the front and rear of the cabinet. Leave the back of the cabinet open for more test equipment or easy access to stored items.



—Robert J. Taylor

(*Continued on page* 20)

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

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51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
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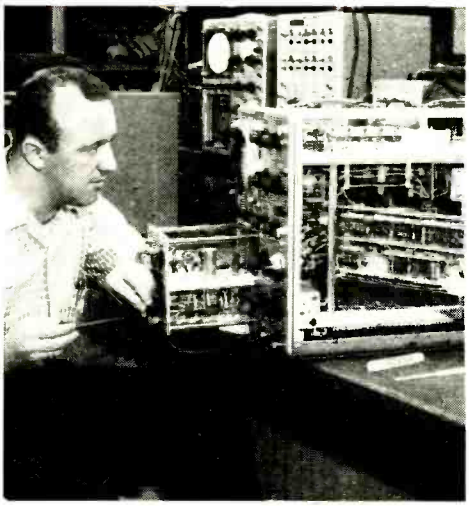
TAKE THE FIRST BIG STEP TOWARD A REWARDING CAREER IN ELECTRONICS



Mail card to RCA Institutes today

Thousands of well paid jobs for Electronics Technicians are unfilled now

RCA Institutes Can Train You— At Home—And Help You Qualify For This Work

It's a sad, but true, fact that today, with so many men yearning for better jobs and better incomes, thousands of well paid jobs are unfilled in the vast electronics industry.

Many of the men who could fill these jobs—that is, men with the aptitude and native interest to enjoy a career in electronics—are handicapped because for one reason or another they have not had the opportunity to train themselves for these lucrative positions.

NOW— THANKS TO RCA INSTITUTES HOME STUDY— YOU CAN TRAIN FOR A CAREER IN ELECTRONICS

Realizing that thousands of technical jobs—well paid jobs—in electronics are going unfilled each week, RCA Institutes has done something positive about the problem. To benefit the electronics industry, with its crying need for trained men . . . and to help men who really want to move into a well paid electronics job, RCA Institutes offers an ideal home training program!

HOME STUDY CAN PROVIDE CAREER OPPORTUNITIES!

To help meet the need for qualified men in the electronics field, RCA Institutes has created a wide variety of Home Training Courses, all aimed toward a profitable, exciting electronics career in the shortest possible time. Included are exclusive "Career Programs" designed to train you quickly for the job you want! Your study program is supervised by RCA Institutes experts who work with you, help guide you over any "rough spots" that may develop along the way.

OFF TO A FLYING START WITH AMAZING RCA "AUTOTEXT" METHOD

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RCA INSTITUTES ENGINEERED KITS SPEED YOUR PROGRESS

To speed you on your way to a successful electronics career, your "Career Program" will include a variety of RCA Institutes engineered kits at no extra cost—each complete in itself. As a bonus, you will also receive and build a valuable Oscilloscope. You'll get the new Programmed Electronics Breadboard for limitless experiments, including building a working signal generator and a fully transistorized superheterodyne AM receiver and Multimeter.

CHOOSE YOUR CAREER PROGRAM NOW

To get a head start today on the electronics career of your choice, look over this list of RCA Institutes "Career Programs", pick the one that appeals most to you, and check it off on the attached card:

- Television Servicing
- Telecommunications
- FCC License Preparation
- Automation Electronics
- Automatic Controls
- Digital Techniques
- Industrial Electronics
- Nuclear Instrumentation
- Solid State Electronics
- Electronics Drafting

To meet other specific needs, RCA Institutes also offers a wide variety of separate courses which may be taken separately from the "Career Programs". These range from Electronics Fundamentals to Computer Programming. They are described in the material you receive.

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If you are already working in electronics or have some experience but want to move on up, you may start RCA Institutes training at an advanced level. No tedious repetition of work you already know!

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RCA Institutes Resident School is one of the largest schools of its kind in New York City with classroom and laboratory training available in day or evening sessions. Coeducational classes start four times a year. Just check "Classroom Training" on the attached card for more details.

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In recent years, 9 out of 10 Resident School students who used the Free Placement Service have been placed before or shortly after graduation. This Service is now available to Home Study students.

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

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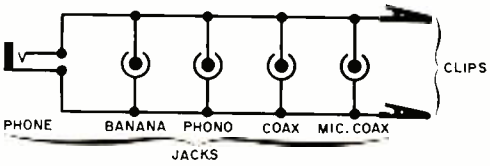
The Most Trusted Name in Electronics

TIPS

(*Continued from page* 14)

UNIVERSAL MATCH-PATCHBOX QUICK-RIGS MIKES, PHONES, AND ANTENNAS

Have you ever found yourself hastily resoldering your microphone plug to go from that super deluxe breadboard project back to your rig, only to find that you have muffed your schedule? Don't scrap your creative urges or get a new mike. Build a match-patchbox and install as many different kinds



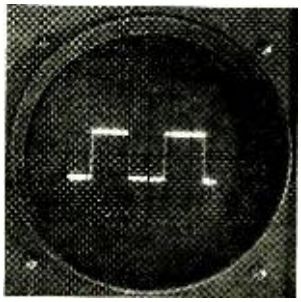
of jacks as you are likely to need—there's no law against including duplicates. Almost any kind and size of box can be used to patch in your mikes, antennas, headphones, etc. For critical circuitry, shielded cable can be used to prevent crosstalk, hum, and on-the-air unmentionables. —*D. E. Hausman*

CURRENT-LIMITING RESISTOR REDUCES ARCING FOR LONGER SWITCH LIFE

Switches that fail to operate after only a few short weeks can be rather expensive to replace. However, if a surge resistor is installed between the switch and the a.c. power source, much of the problem can be eliminated. The surge resistor limits the initial current to a low value (usually about 25% of the current normally drawn by the unit). This reduces harmful arcing which is the major cause of switches going bad. After a few seconds, the current-limiting resistor heats up, and full current is passed. When selecting the surge resistor, make sure it can handle the current drawn by the unit. —*John Akers*

TAKE THE REFLECTION OUT OF SCOPE TRACE PHOTOS

For reflection-free photographs of oscilloscope traces, cut a piece of clear acetate to the diameter of the oscilloscope screen. Coat one side of the acetate with artist's matte spray. When you are ready to snap a photo, place the acetate in front of the screen, sprayed side out. The trace will be slightly subdued, but perfectly readable. *Tri-X* film, shot at f3.5, and 1/15-second shutter speed produced the photo shown with only normal room lighting. —*William S. Gohl*



NEW! LAFAYETTE HB-525
Solid State 2-Way Radio

OBSOLETES ALL 23 CHANNEL CB TRANSCEIVERS!

- Size: 2⅜" by 6¼"

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149.95

All 25 Channels Crystal Controlled

- 25 Channel Crystal Control
- 19 Transistors, 7 Diodes, Thermistor
- Dual Conversion Receiver for Extra Selectivity and Sensitivity
- Full 5-Watt Input
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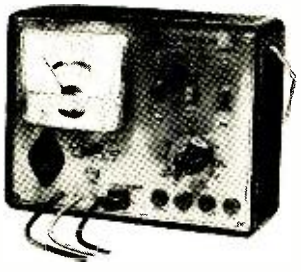
CIRCLE NO. 79 ON READER SERVICE PAGE

NEW PRODUCTS

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

TRANSISTOR TESTER/SET ANALYZER

Actually eight testing units in one instrument, the Model 1000 transistor tester and set analyzer announced by *Semitronics Corp.* consists of a transistor tester, diode tester, voltmeter, ammeter, signal generator, in-circuit tester, battery tester, and a.c. and d.c. *beta* tester. The Model 1000 checks direct current gain to 400, and also tests for transistor or diode leakage. It supplies a test signal for a.f., r.f., or i.f. circuits. In addition, it can be used as a signal tracer, measure supply voltages on a 20-volt scale, and measure circuit current drain to 100 mA. All types of transistors can be tested, in or out of circuit.



Circle No. 75 on Reader Service Page 15

SSB/AM/CW AMATEUR RECEIVER

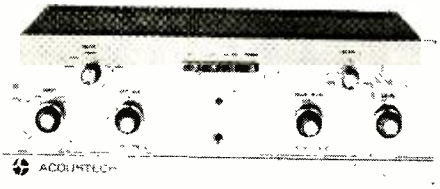
Covering 80 through 6 meters in six tuning ranges, the Model HA-500 receiver announced by *Lafayette Radio Electronics* has 10-tube superheterodyne circuitry which utilizes dual frequency conversion on all bands. The tuned

r.f. and first mixer stages combine with two mechanical filters to provide excellent sensitivity and "skirt" selectivity. Sensitivity is less than 1 μV for 10-dB signal-to-noise ratio on all bands. Image rejection and i.f. rejection are both −40 dB. Audio output is 1 watt; output impedance, 8 and 500 ohms. The full-time automatic volume control is automatically set to provide standard operation on AM and fast attack/slow decay on CW and SSB operation.

Circle No. 76 on Reader Service Page 15

STEREO "ADD-A-KIT" AMPLIFIER

Another "Add-A-Kit" power amplifier is being produced by *Acoustech, Inc.*—this one a solid-state unit for stereo. The "Acoustech XII" is rated at 100 watts (50 watts per channel for under ¼% I.M.). Both the "XII" and the



"XI" can accommodate the same preamplifier module (P/M) which can be added to the power amplifier chassis to complete the amplifying system. The instruction book has full color drawings and a two-part countdown to catch any wiring errors. Plug-in printed circuit boards have been assembled and tested at the factory.

Circle No. 77 on Reader Service Page 15

"STARTER" SPEAKER SYSTEM

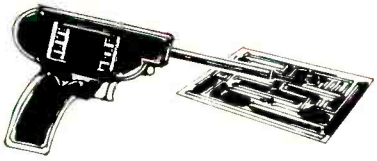
If you are still in the "thinking" stage so far as assembling a stereo component system is concerned, here's a speaker that was designed with you in mind. *University Sound*'s UR-4 compact, 2-way speaker system is said to offer maximum versatility of installation without sacrificing essential performance. It employs an 8" high-compliance woofer, tuned enclosure, hi-pass network, and a 2½" direct radiator tweeter. Woofer and tweeter are both laboratory-adjusted for optimum frequency balance over the usable spectrum. The system has a frequency response of 30 to 20,000 Hz and a power-handling capacity of 30 watts IPM (Music Power). Impedance is 8 ohms.

Circle No. 78 on Reader Service Page 15

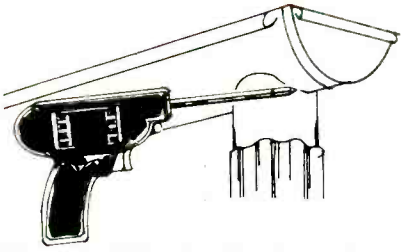
CB BASE STATION ANTENNA

Ever see an antenna that glows in the dark? The "Speakin' Beacon" put out by *Antenna Specialists* is a 27-mc. omnidirectional coaxial antenna with a permanent-circuit neon light built into its tip. Whenever the transmitter is keyed, the neon tube glows, visually verifying r.f. power output. A "Stati-Light" ball surrounding the neon tube dissipates static elec-

Wen soldering guns make anyone an expert! They're "GOOF-PROOF!"



Never too much heat . . . even for delicate printed circuits



Never too little: handles the most rugged heavy-duty jobs.

No matter who you are . . . or what you're soldering . . . you can't miss with a WEN! A built-in brain *automatically* controls the flow of heat! Delivers just the right amount for perfect soldering every time. No other soldering gun offers "goof-proof" accuracy like this. And no other gun has the easy-to-use "slim-line" single post; so compact you can solder through a keyhole. Find out today why WEN "automatics" are the hottest thing in soldering. 25 up to 450 watts of heat power . . . as low as $4.95.

WEN "HOT ROD" GUN KIT
Model 222 gun. Two tips, two accessory items, solder, case.
$11.95 (suggested list price)

JUST SAY **WEN**

For free brochure write Dept. 411,
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5810 Northwest Highway, Chicago, Ill. 60631

CIRCLE NO. 54 ON READER SERVICE PAGE

PRODUCTS (*Continued from page 22*)

tricity and helps eliminate noise. The 19′ 3″ "Speakin' Beacon" is made of heavy-gauge polished aluminum, built to withstand winds up to 80 mi/h.

Circle No. 79 on Reader Service Page 15

REGULATED POWER SUPPLY

Usable current outputs of up to 250 mA, plus stable, constantly variable output from 0 to 15 volts, are available with the Model PZ-121

power supply introduced by *Viking Engineering of Mpls.* Produced both in factory-assembled and simplified kit form, this unit is claimed to be the first truly low cost transistorized zener reference regulated power supply. It provides regulation better than ± 0.2 volt and a.c. ripple of less than 5 mV for outputs to 100 mA. Features include burnout-proof circuitry and transformer isolated output.

Circle No. 80 on Reader Service Page 15

TRANSISTORIZED BATTERY INVERTER

Said to be specially designed to compensate for the low power factor in tape recording, *Electro Products Laboratories'* T1-100TR inverter delivers 125 watts continuous a.c. power to a tape recorder from a 12-volt battery in a car, boat, plane, or from any 12-volt d.c. source. This transistorized unit also provides power for TV sets, lights, tools, and many household appliances. Features include automatic overload protection and a charge indicator light that shows condition of battery and gives low-charge warning. The T1-100TR inverter plugs conveniently into a cigarette lighter socket, but a battery clip adapter kit is available for connecting it directly to the battery terminals if desired.

Circle No. 81 on Reader Service Page 15

MOBILE MICROPHONE

The first base station microphone with a volume control, *Turner Microphone Company*'s "+2," now has a mobile counterpart, the "M+2." Output level can be adjusted by means of the "fingertip" volume control on the back of the case. The "M+2" was designed particularly for use with mobile transceivers that need more output or must work under conditions requiring a variable output level. It contains a two-transistor preamp, and has a 300-3500 Hz voice response range.

Circle No. 82 on Reader Service Page 15

BALL-POINT HEXHEAD WRENCH

Yes, that's right, ball point. The *Bondhus Tool Company* is making a "ball-point screwdriver" for installing socket head screws in tight locations. Both 6″- and 10″-long blades are available in a variety of different widths. All blades are made of high quality alloy steel and milled and generated to close tolerances on size and hardness to give maximum strength and workability.

Circle No. 83 on Reader Service Page 15

"LAB-TESTER" VOM

Lafayette Radio's "Lab-Tester" is a deluxe lab-type volt-ohm-milliammeter. The 33-range meter features a unique yellow function indicator which tells you the exact range being used, eliminating chance of error. Easy to read, the meter is 6½″ wide and has a two-color, full-range 90° arc. Protection against burnout and bent pointers has been built in. Input resistance on d.c. is 100,000 ohms per volt; on a.c., 5000 ohms per volt. Meter movement sensitivity is 9 μA for full-scale deflection. Measuring 7⅛″ x 6⅞″ x 3⅛″, the "Lab-Tester" comes in a convenient carrying case.

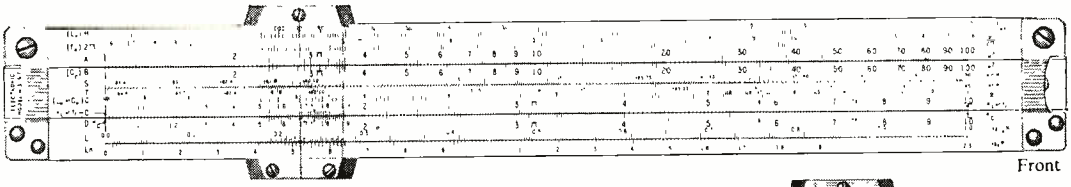
Circle No. 84 on Reader Service Page 15

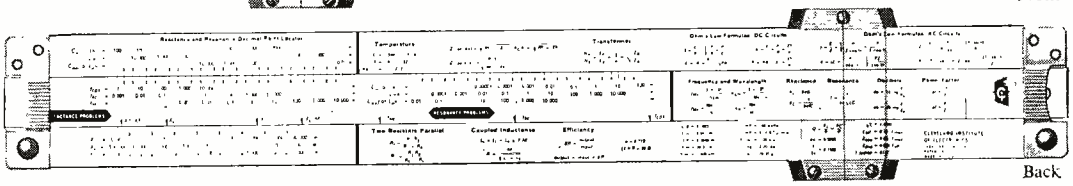
STEREO TAPE RECORDER

Three motors are incorporated in the three-speed, four-track, solid-state stereo tape recorder announced by *Viking of Minneapolis*. The advantages of the three motors, heretofore found only in much higher priced units, are in the dynamic braking system and in the elimination of all the complicated mechanical linkages which cause frequent service problems with single-motor recorders. Other features include two hyperbolic heads which do not require pressure pads, and easy, straight-line tape loading by means of a swing-away pinch roller. Frequency response is 50-15,000 Hz at 7½ in/s, 50-10,000 Hz at 3¾ in/s, and 60-5000 Hz at 1⅞ in/s.

Circle No. 85 on Reader Service Page 15

LOOK!
A New Electronics Slide Rule with Instruction Course


Front


Back

This amazing new "computer in a case" will save you time the very first day. CIE's patented, all-metal 10″ electronics slide rule was designed *specifically* for electronic engineers, technicians, students, radio-TV servicemen and hobbyists. It features special scales for solving reactance, resonance, inductance and AC-DC circuitry problems . . . an exclusive "fast-finder" decimal point locater . . . widely-used formulas and conversion factors for instant reference. And there's all the standard scales you need to do multiplication, division, square roots, logs, etc.

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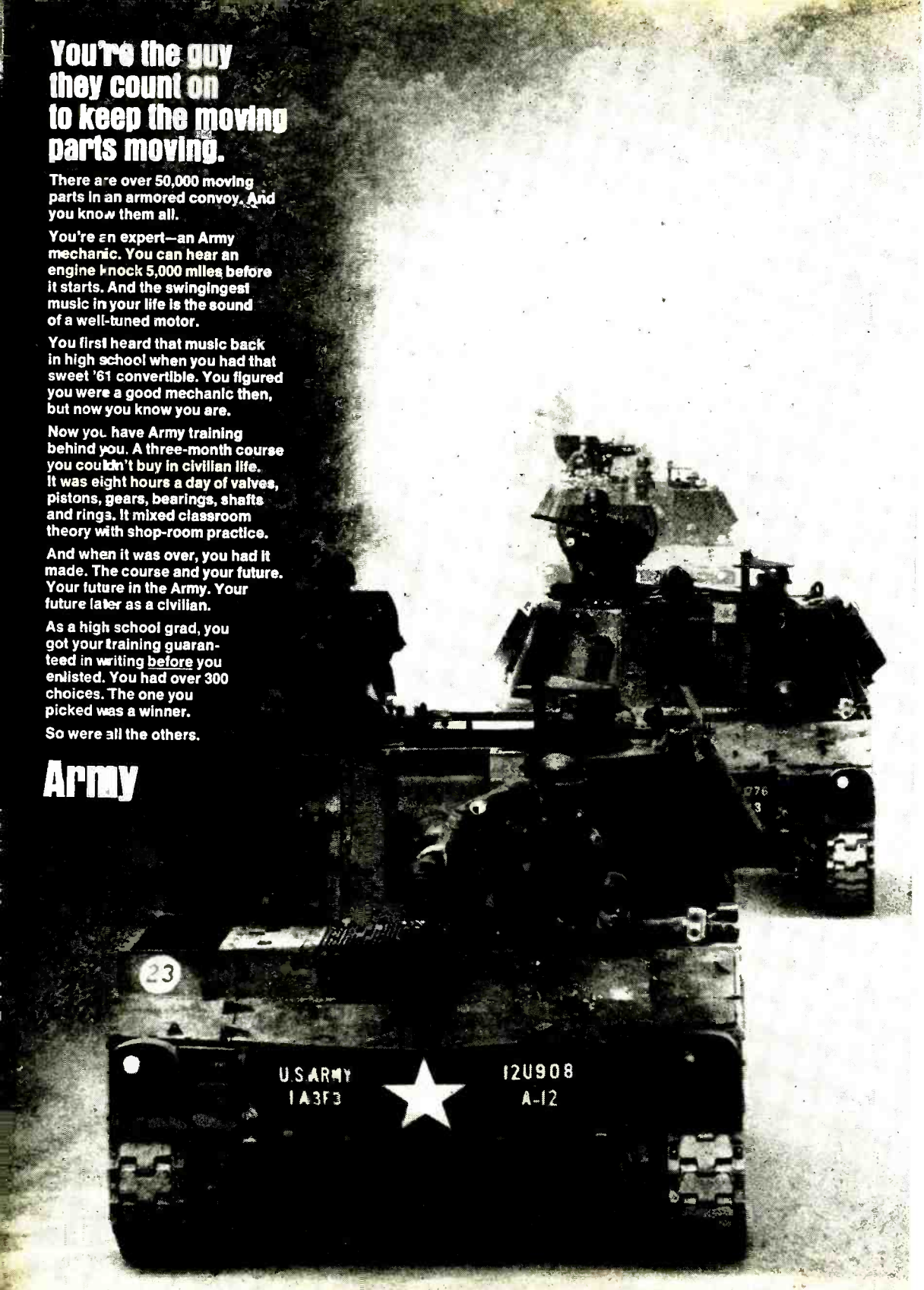
Now you have Army training behind you. A three-month course you couldn't buy in civilian life. It was eight hours a day of valves, pistons, gears, bearings, shafts and rings. It mixed classroom theory with shop-room practice.

And when it was over, you had it made. The course and your future. Your future in the Army. Your future later as a civilian.

As a high school grad, you got your training guaranteed in writing before you enlisted. You had over 300 choices. The one you picked was a winner.

So were all the others.

Army



ELECTRONICS LIBRARY

RCA LINEAR INTEGRATED CIRCUIT FUNDAMENTALS, IC-40

This RCA manual is the first of its kind to appear on the market. Although it is intended primarily for equipment and system designers, anyone who is concerned with integrated circuits will find it useful. With its schematic diagrams, operating characteristics, performance data, and the mathematical formulas needed to compute the electrical characteristics of integrated circuits, the manual is virtually a condensed course in IC electronics. And it can also serve as a guide for engineers and designers in determining optimum design specifications.

Published by Radio Corporation of America, Harrison, N.J. 07029. Soft cover. 240 pages. $2.00.

CATV SYSTEM MANAGEMENT AND OPERATION

by Robert B. Cooper, Jr.

Another first to hit the market is Robert Cooper's authoritative guide to cable television (CATV) operation and management. The material contained in the guide is taken from actual experiences of successful CATV system owners. It should prove a worthwhile yardstick for anyone planning on "going CATV," and it is also a good general-interest text to enable the layman to keep abreast of this fast-growing industry.

Published by Tab Books, Thurmont, Md. 21788. Soft cover. 256 pages. $12.95.

ADVANCED ELECTRIC CIRCUITS

by A. M. P. Brookes

The person who has a firm background in electronic theory and wants to supplement his knowledge of networks, transmission lines, tuned circuits, and other related subjects, should find this book of value. It tackles these subjects with mathematics which becomes rather involved, but you should have no problem in solving the equations if you have a working knowledge of algebra and trigonometry.

Published by Permagon Press, Inc., Long Island City, N.Y. 11101. Soft cover. 183 pages. $2.95.

ELECTRONIC TROUBLESHOOTING: a Self-Instructional Programmed Manual

by Philco Technical Institute Staff

This book tells how you can put your training in electronics theory into practice. If you

LIBRARY (*Continued from page 27*)

have a good grasp of theory, the next step is to apply it logically and systematically. Maintenance and troubleshooting can best be performed if a technician analyzes what the malfunctioning equipment is supposed to do, what makes the operator think the gear is malfunctioning, and what is the most likely trouble spot. The key to troubleshooting—according to this book—is to think logically. By means of a systematized approach (called the "half-split" technique), the reader is "programmed" through a variety of situations involving malfunctioning equipment. Orderly thought processes are emphasized, and even following the text will be a challenge to many readers—but this book should point would-be troubleshooters in the right direction.

Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Hard cover. 276 pages. $12.50.

ALTERNATING CURRENT CIRCUITS AND MEASUREMENTS

by Charles J. Anderson, Anthony Santanelli and Fred R. Kulis

The authors, all recognized authorities in programming study material, have prepared this text as a companion to their *Direct Current Circuits and Measurements* with the same comprehensiveness and stress on practical applications as in the previously published volume. The text starts by covering fundamentals of magnetism and becomes progressively more involved. Only a basic knowledge of algebra and the ability to read trigonometric tables are needed to work the mathematical computations. Anyone who has mastered d.c. circuit principles will appreciate the step-by-step logic used in the new way of teaching the subject of a.c. circuits.

Published by Prentice-Hall, Inc., Harrison, N.J. 07632. Hard cover. 369 pages. $12.00.

FUNDAMENTALS OF ELECTRICITY, Volume 1: Basic Principles

by Consumers Power Company

This eight-chapter programmed instruction course in basic electricity is intended for anyone who is *not* an electrical engineer. Upon its completion, the reader should be familiar with basic terms and symbols, understand fundamental electrical laws, and have a general knowledge of how electricity is generated, transmitted, and used. Originally written to provide employees of the Consumers Power Company (Jackson, Mich.) with a basic understanding of electricity, the program was so successful that it was revised and adapted for more general application.

Published by Addison-Wesley Publishing Company, Inc., Reading, Mass. 01867. Soft cover. 156 (8½" x 11") pages. $6.50. —30—

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CIRCLE NO. 21 ON READER SERVICE PAGE

NEW LITERATURE

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

"The World's Most Complete V-O-M Line" is the title of a 12-page, 2-color test equipment catalog offered by *The Triplett Electrical Instrument Company*. In addition to the various volt-ohm-milliammeters and combination VOM-VTVM's presented, transistor and tube analyzers and signal generators are described. There is also a variety of carrying cases and accessories.

Circle No. 86 on Reader Service Page 15

Specification sheets on *Amphenol Corporation*'s "Commander" line of color television test equipment are now available. The three 2-color sheets, all punched for standard 8½" x 11" ring binders, cover features, accessories, and applications of the Color Commander color generator, Signal Commander field strength meter, and CRT Commander cathode-ray tube checker/rejuvenator.

Circle No. 87 on Reader Service Page 15

Switchcraft, Inc. has announced a 14-page illustrated Audio Accessories Catalog, the accessories being audio mixers, speaker controls, couplers, adapters, selector switches, molded cable assemblies, and a wide variety of audio connectors. Detailed electrical and mechanical specifications are provided.

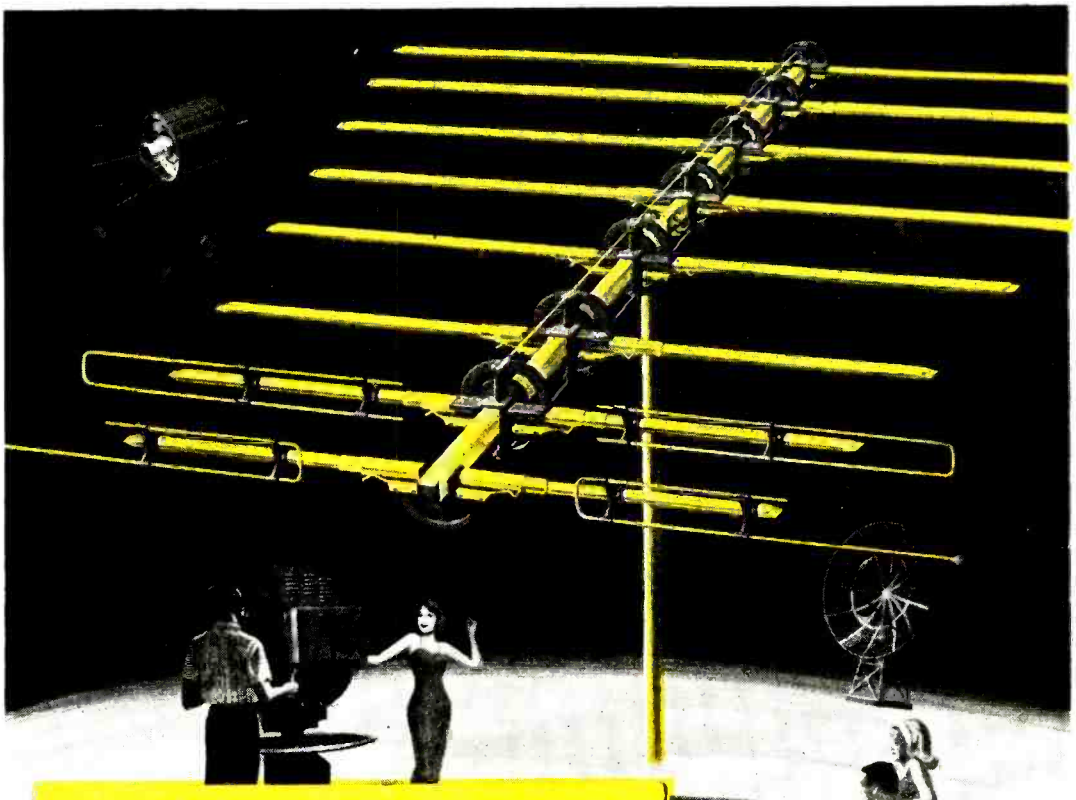
Circle No. 88 on Reader Service Page 15

Useful information on the many versions of "Versa-Tennas," which are magnetically mounted portable whip antennas, is presented in six catalog pages put out by *Versa-Tronics*. The pages contain complete description, assembly and installation data, VSWR, and other information. Models are available for all CB, amateur, and other mobile frequencies from about 27 MHz to 1000 MHz.

Circle No. 89 on Reader Service Page 15

Featured in a two-color Citizens Band equipment catalog by *Mark Products* is the new MJ-27 "L-O-N-G Ranger" base station antenna, a vertical dipole which is said to provide the maximum possible omnidirectional signal. Other base station and mobile antennas, mounts, and accessories are also covered.

Circle No. 90 on Reader Service Page 15



ANNOUNCING A MAJOR ANTENNA ADVANCE FROM JERROLD

PARALOG Plus

Plus GAIN • Plus FLATNESS • Plus MATCH

Why is color harder to receive than black & white? Because color detecting circuits cannot tolerate phase shifts caused by multipath reception, tilted response, or mismatch.

The new Jerrold Paralog-Plus improves color reception three ways:

1. **Plus Gain**—to provide sharper directivity to eliminate multipath reception.
2. **Plus Flatness**—to eliminate tilts which cause incorrect colors on the TV screen. Industry experts say that color antennas must be flat within ± 2 db. Paralog-Plus antennas are flat within ± 1 db per channel.
3. **Plus Match**—to prevent color-distorting phase shifts.

How does Paralog-Plus give you these exclusive color features? A unique Bi Modal Director system actually works on high and low band channels simultaneously, making each element serve double duty.

Also, you get choice of 75 and 300 ohm coaxial outputs, plus excellent gain over the entire FM band.

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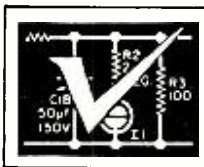

OPERATION ASSIST

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

Admiral Model RC-321 record player. Spindle =G400B329 for 45-r/min records needed. (C. T. Neifert, 303 Lafayette St., Tamaqua, Pa.)

IP-111/ART-26 radar pulse analyzer oscilloscope; has 12 tubes. Schematic needed. (Bill Springer, 7805 W. National, Millington, Tenn.)

RME Model 4350-A receiver, circa 1960.; covers 80 to 10 meter amateur band. Tuning knob assembly needed. (Kenneth C. Parker, 345 E. Railroad Ave., Cotati, Calif. 94928)

Philco Model 70 receiver, circa 1929; tunes AM from 550 kHz to 15 MHz; has 7 tubes. Schematic and parts list needed. (J. T. Cousineau, Box 25, CFB Borden, Ont., Canada)

Arvin Model 480TFM receiver; tunes AM and FM. Cabinet and dial scale needed. (Stanley Malko, 208½ North St., Salem, Mass. 01970)

McMurdo Silver Model 700 transmitter; tunes 144 to 240 MHz; has 6 tubes. Schematic needed. (Douglas M. Coyne, 122 Thompson Ave., Glendale, Calif. 91201)

Crosley Model 5VI receiver, ser. A858250; tunes from 550 kHz to 5.0 MHz on two bands; has 5 tubes. Schematic needed. (Paul Lista, 38 White St., Ludlow, Mass. 01056)

CBY-46108 ARC-5 receiver, ser. =3, made by Aircraft Radio Corp; tunes 13.5 to 20 MHz; has 5 tubes. Schematic and set of i.f. cans needed. (Bill Deters, 6811 Aurora Ave., N. Seattle, Wash. 98103)

Crosley "PUP" receiver. WD-12 and UV-199 tubes needed. (George F. Marts, 4201 Colvin Dr., St. Louis, Mo. 63123)

WD-11 tube needed. (Eddie Gibson, 626 Fairway Ave., Lakeland, Fla. 33801)

Hallicrafters Model S-22-R receiver; tunes 110 kHz to 20 MHz on 4 bands. Alignment procedure needed. (Gene Barden, 110 Mehrhof Rd., Little Ferry, N.J. 07643)

BC-454 receiver; tunes 3 to 6 MHz; has 5 tubes. Schematic and instructions for bandspreading 3.5 to 4 MHz needed. (S. Chaiken, 1717 E. 18 St., Brooklyn, N.Y. 11229)

Brunswick Model AC-10 receiver, circa 1934; tunes BC; has 5 tubes. **Silvertone** Model 5772 receiver, circa 1940; tunes BC; has 7 tubes. Schematics needed. (D. K. Maxon, 4 Stanly Rd., Cherry Point, N.C. 28533)

Philco Model 41-240 receiver, code 121; tunes BC and s.w. from 9 to 12 MHz; has 7 tubes. Schematic, parts list and operating manual needed. (Ronnie Tamagni, Pennsylvania Ave., Vineland, N.J.)

(*Continued on page* 38)

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CIRCLE NO. 19 ON READER SERVICE PAGE

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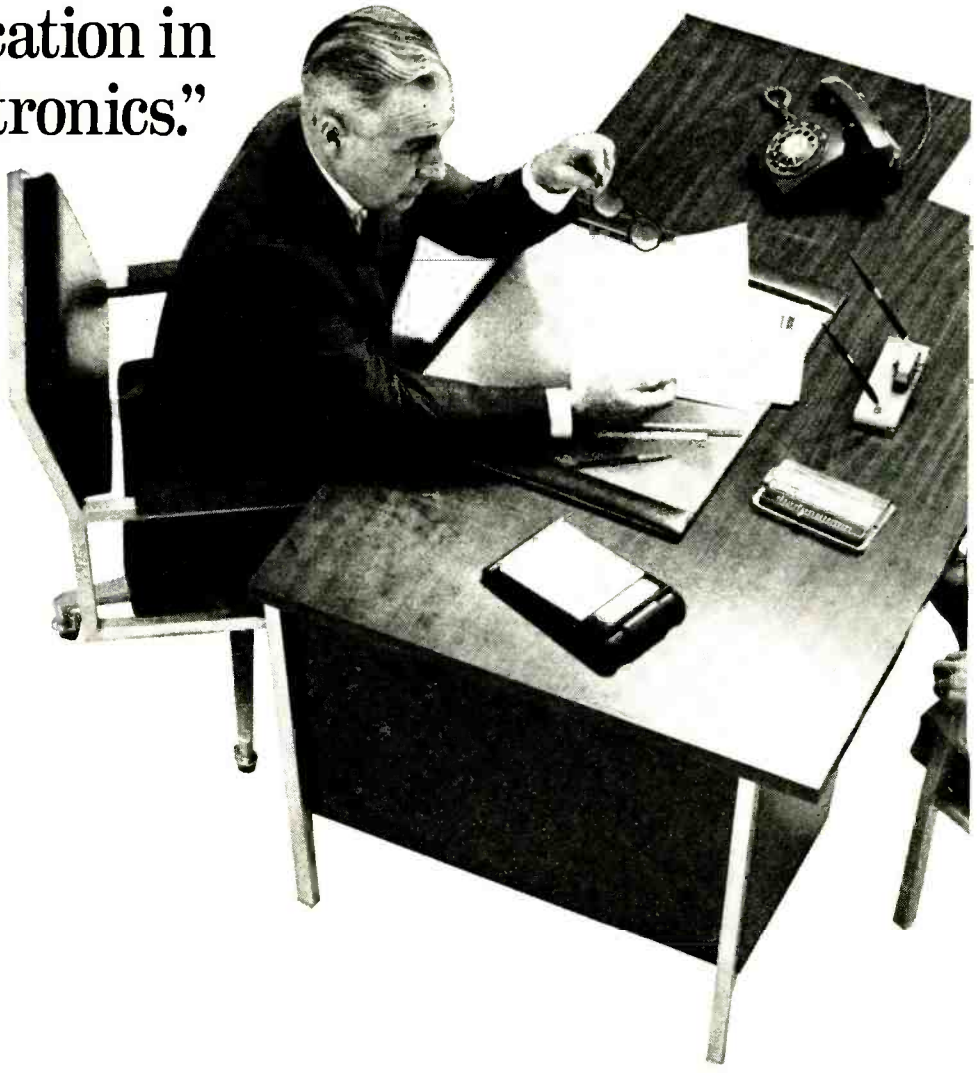
I'd promote him right now
if he had more
education in
electronics."



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ASSIST (*Continued from page 32*)

CFN-46ADT r.f. to i.f. converter made by Farnsworth. Schematic and instruction manual needed. (John Keiser, 12365 Ramona Blvd., El Monte, Calif. 91732)

Philco Model 38-12 receiver, code 121, circa 1937; has 5 tubes. Parts source needed. (Philip McDonald, 2601 Benvenue Ave., Berkeley 4, Calif.)

Saba Model S-457-WK receiver, ser. 74865; tunes 150 kHz to 92 MHz on 4 bands; has 5 tubes. Schematic and parts source needed. (Herbert D. Petty, 29 Manchester Circle, Poughkeepsie, N.Y. 12603)

Stewart-Warner Model G972800 receiver, ser. A-101100; tunes 550 kHz to 15.5 MHz. Schematic and power supply information needed. (Kurt Leopold, Jr., Rt. 1, Cobalt, Ont., Canada)

Pilot Model TV-37 TV receiver, circa 1949; has 21 tubes and 3" screen. Horizontal output inductor needed. (Ernest Williams, 1122 Meridian, S. Pasadena, Calif. 91030)

E.H. Scott receiver, ser. V-231; tunes 550 kHz to 22.5 MHz on 4 bands; has 12 tubes. Schematic and power supply information needed. (Walter R. Keevil, 1503 Lincoln, Evanston, Ill. 60201)

Hallicrafters Model 5R40 receiver; tunes BC and s.w.; has 4 tubes. Schematic and parts list needed. (Michael Wright, 229 Coosawattee Ave., Rome, Ga. 30161)

E.H. Scott Model SLRM receiver, surplus, circa 1945; tunes 540 kHz to 18 MHz on 4 bands; has 11 tubes plus magic eye. Schematic needed. (Ed Suhaka, 650 Huff Ave., Manville, N.J. 08835)

E.H. Scott Model RCK, ser. 9, circa 1944; tunes 110 to 160 MHz; has 14 tubes. Schematic and operating manual needed. (Clarence W. Flick, Box 921, Martinsburg, W.Va. 25401)

BC 348-R receiver, surplus; tunes 200 kHz to 18 MHz; has 8 tubes. Schematic needed. (Jesus Pulgar, Box 120, Santo Domingo, Dominican Rep., S.A., and Reginald Brown, 3 MacArthur St., Fairfield, N.S., Wales, Australia)

Philco Model 40-180 receiver. Schematic and parts list needed. (J. F. Easton, 271 E. Main St., Nanticoke, Pa. 18634)

Hickok Model 546 tube tester; has 83 and 5Y3 tubes. Roll chart number and updating modification notes needed. (S. N. Arrington, 1560 Keeven Ln., Florissant, Mo. 63031)

Precision CR oscillograph, series E.S.500, ser. 4587; has 8 tubes. Schematic and source for transformer needed. (Eugene F. Dennis, 2232 Lee Ave., Granite City, Ill.)

F.M. Link "Pack Set 1810" receiver, ser. 56759. Schematic, alignment information, and crystal needed. (Ralph R. Messer, 308 Cherry St., Belmont, N.C. 28012)

Stewart-Warner Model R500A, ser. A47552, circa 1941; tunes s.w. and BC; has 6 tubes. Glass dial plate needed. (Frank Rose, 11 Grange Dr., Brampton, Ont., Canada)

Hickok Model RFO-5 oscillograph, ser. 4-3954. Operating manual needed. (William Mehlman, 52 Clarendon Ave., Montpelier, Vt.)

Sears Roebuck Model 101599 receiver; tunes 550 kHz to 18 MHz; has 8 tubes and tuning eye. Schematic, operating manual and dial scale needed. (Keith Botts, Box 24, Custer, Mont. 59024)

Majestic Model G-L super dynamic speaker, ser. G.B.-894252; Power supply information needed. (William Grant, Box 312, Kents Hill, Me.)

Metz "Babyphon" S156, ser. 22118; tunes s.w.; has 5 tubes. Schematic and tube layout needed. (Chas. R. McNutt, 5815 Darby Rd., N.W., Roanoke, Va. 24012)

G.E. Model OD-5 tube tester, surplus. Schematic and operating manual needed. (Peter J. Elkowitz, 51 Ontario St., Terryville, L.I., N.Y. 11776)

Hickok Model RFO 5 oscillograph, series "E," circa 1941. Instruction and service manual needed. (J. E. Forester, 10870 Dehmel Rd., Birch Run, Mich.)

RCA Model 527 receiver, circa 1942; tunes 540 kHz to 12 MHz. Dual-gang variable capacitor needed. (George S. Ingalls, 3190 Machado Ave., Santa Clara, Calif.)

Firestone "Air Chief" receiver, stock S7406-7, code F-C-58; tunes 55 kHz to 18 MHz on 3 bands; has 11 tubes. Schematic and operating manual needed. (Richard Johnson, Box 22, Malden, Ill. 61337) —30—

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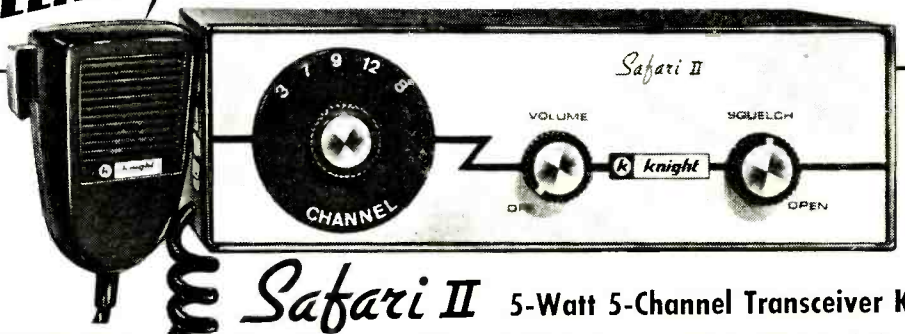

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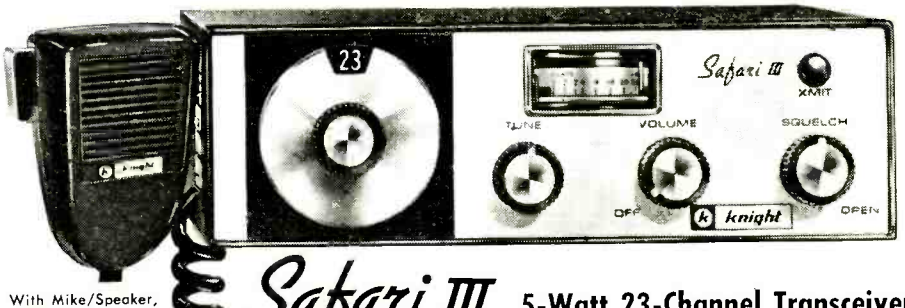

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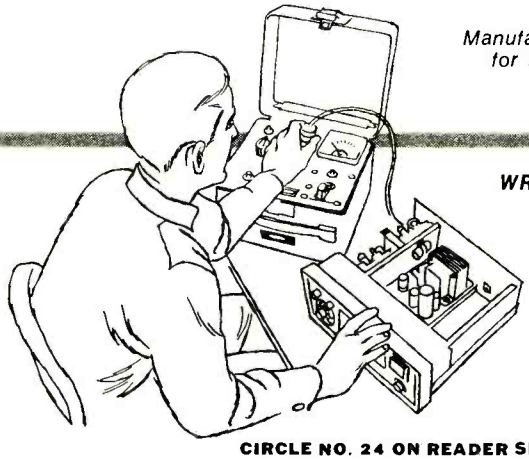

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BUILD A

GC-2 DELUXE CONVERTER

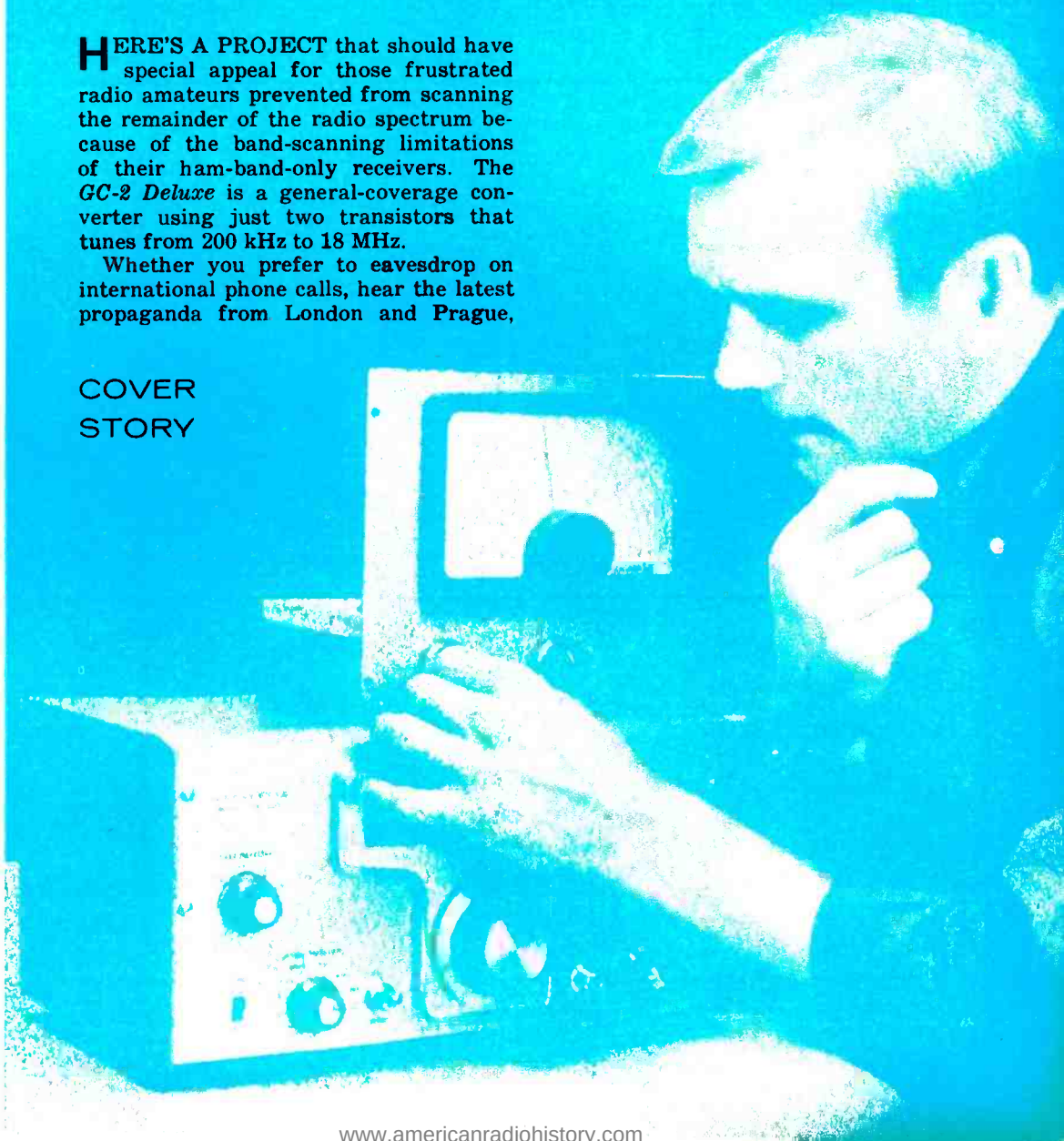
FOR THOSE HAMS WITH RADIO AMATEUR BAND COMMUNICATIONS RECEIVERS WHO WANT GENERAL COVERAGE FROM 200 KHZ TO 18.0 MHZ

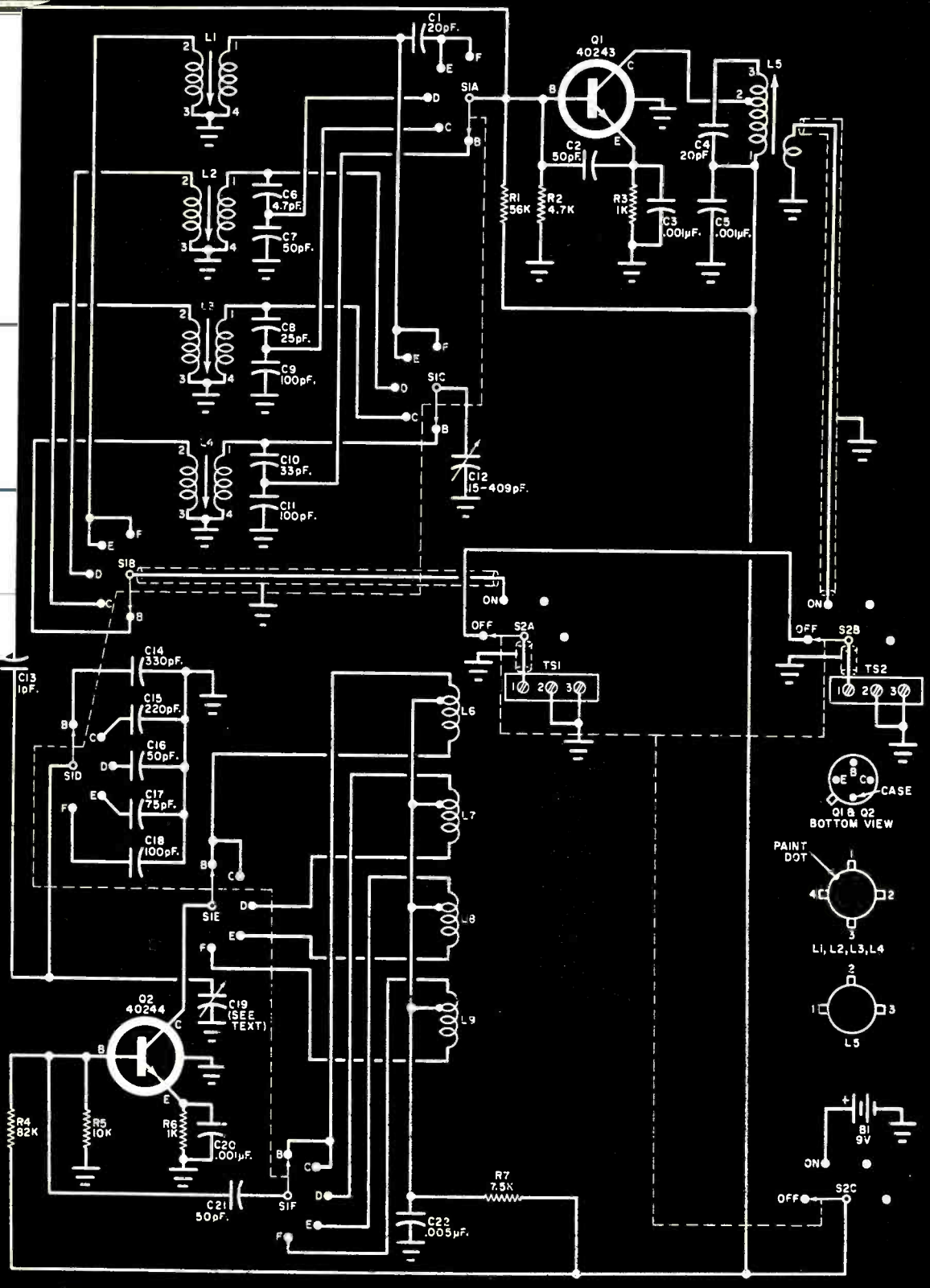
By **HARTLAND B. SMITH,** W8VVD

HERE'S A PROJECT that should have special appeal for those frustrated radio amateurs prevented from scanning the remainder of the radio spectrum because of the band-scanning limitations of their ham-band-only receivers. The *GC-2 Deluxe* is a general-coverage converter using just two transistors that tunes from 200 kHz to 18 MHz.

Whether you prefer to eavesdrop on international phone calls, hear the latest propaganda from London and Prague,

COVER STORY





GC-2 Deluxe Converter uses two low-cost transistors in conventional circuit. Output is tuned to 3.5 MHz for feedback, has only communications style receivers. Coverage is 200-400 kHz and 0.55 to 18.0 MHz.

If you house the converter in the cabinet recommended by the author, a chassis must be formed from sheet aluminum as shown in the drawing above.

keep track of NASA ground-to-space communications, pick up the latest weather reports from an FAA station, check your watch against CHU, work MARS or CAP stations, or if you merely want to listen in on the Beatles' latest disc, the *GC-2 Deluxe* will admirably fill your needs.

The Circuit. Two inexpensive silicon planar transistors are used in the converter. The mixer, *Q1*, is an RCA 40243, and *Q2*, an RCA 40244, is the high-frequency oscillator. Any one of four factory-wound antenna coils (*L1* through *L4*) can be switched into the mixer's base circuit. The coils are resonated to the desired frequency of the incoming signal by *C12*.

The oscillator is tuned 3.5 MHz above the desired frequency in the *GC-2*. Unlike the mixer coils, the oscillator coils (*L6* through *L9*) must be hand-wound. Tuning capacitor *C19* is driven via a large two-speed Miller MD-8 vernier dial which supplies the smooth action and bandspread required for comfortable tuning on the crowded short-wave bands.

A 3.5-MHz signal appears in the collector circuit of *Q1*. Tank circuit *C4, L5* resonates at 3.5 MHz, and by means of the link on *L5*, the converter is fed to the antenna connector of the companion receiver which remains fix-tuned to 3.5 MHz whenever the converter is in use.

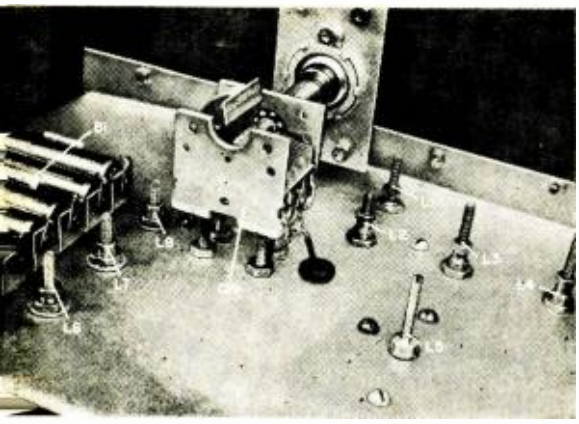
At very high frequencies, *C2* offers a low impedance between the base and emitter of *Q1* to minimize TV and FM signals which have a tendency to creep into the converter when it is operated within 5 or 10 miles of these super-powered broadcasters. Without *C2*, TV signals would mix with harmonics of the oscillator to produce unwanted birdies in the output of the converter.

Power for the *GC-2 Deluxe* is supplied by six penlight cells wired in series. Because of the converter's very low power requirements, an ordinary 9-volt transistor battery could be used for the purpose. However, penlight cells were chosen for the prototype because of their long life.

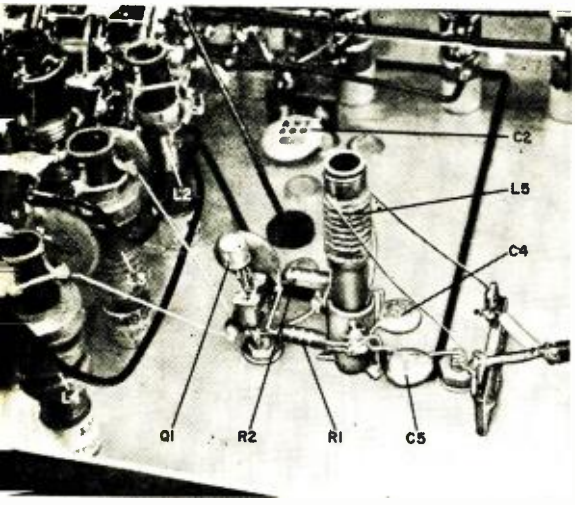
PARTS LIST

B1—9-volt battery (6 penlight cells in series)
*C1, C4—20-pF, NPO disc capacitor**
*C2, C7, C16, C21—50-pF, NPO disc capacitor**
C3, C5, C20—0.001-μF disc capacitor
*C6—4.7-pF, NPO disc capacitor**
*C8—25-pF, NPO disc capacitor**
*C9, C11, C18—100-pF, NPO disc capacitor**
*C10—33-pF, NPO disc capacitor**
C12—15-409 pF variable capacitor (similar to Allied Radio 13 U 524)
*C13—1-pF, NPO disc capacitor**
C14—330-pF silver mica capacitor
*C15—200-pF, NPO disc capacitor**
*C17—75-pF, NPO disc capacitor**
C19—15-409 pF variable capacitor (similar to Allied Radio 13 U 524) altered as described in text
C22—0.005-μF disc capacitor
Q1—RCA 40243 transistor
Q2—RCA 40244 transistor
R1—56,000-ohm, ½-watt resistor
R2—4700-ohm, ½-watt resistor
R3, R6—1000-ohm, ½-watt resistor
R4—82,000-ohm, ½-watt resistor
R5—10,000-ohm, ½-watt resistor
R7—7500-ohm, ½-watt resistor
S1—6-pole, 5-position miniature phenolic switch (similar to Centralab PA1021)
S2—3-pole, 4-position single-gang switch (similar to Mallory 3134J)
TS1, TS2—3-screw terminal strip
1—10" x 8" x 7" utility cabinet (similar to Bud CU-879)
1—9" x 10" piece of aluminum sheet for fabricating chassis
1—2-speed vernier dial (similar to J. W. Miller MD-8)
Misc.—Grommets, 6-32 machine screws and nuts, solder lugs, wire, solder, decals, transistor sockets, knobs (3), battery holder

**All NPO disc capacitors similar to Sprague 10TCC*



These close-up photographs show the locations of the principal components. Lead lengths are not critical, but should be direct and point-to-point.



Construction. Since the large tuning dial makes it necessary to house the converter in a fairly big cabinet, there is room to spare for all components. Unfortunately, no company seems to manufacture a suitable chassis, so the builder must fabricate one from sheet aluminum. Its dimensions are shown on p. 43. Bend the front lip of the sheet aluminum upward, and the side lips and rear apron downward.

Layout of the components should, in a general way, follow the prototype model. Orient *C12* as shown on p. 45. Fasten *C12* to the front panel with three *6-32* x ½″ screws that pass through the tapped holes in the capacitor's frame. You'll have to grind (or cut) down these screws until they are short enough so that they will not interfere with the action of the rotor.

Support *C19* on four *6-32* x ¾″ screws. Tap the holes in the bottom of the capacitor frame to accept the screws. WARNING: Don't screw them in so far that they contact and short out the stator plates of the capacitor! Remove ten of the 17 rotor plates from *C19* (five plates from the front of the rotor and five plates from the rear), leaving the remaining seven in the center of the shaft.

Do *not* connect the capacitor shaft to the dial mechanism with the insulated flexible coupling supplied with the MD-8 dial. Only a solid metal shaft coupler should be used at this point. Otherwise, you'll be plagued with backlash.

After adjusting the stops for 5-position operation, mount *S1* exactly as pictured at right, with the wafer support rods along the top and bottom of the switch.

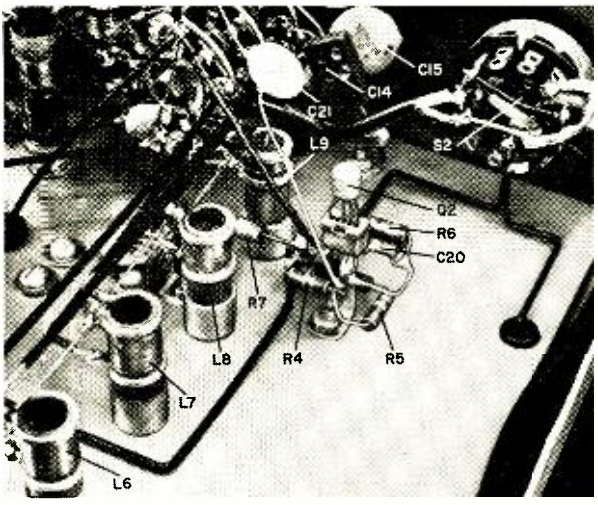
The transistor sockets are self-supporting. The case terminal of *Q1* is soldered directly to a ground lug, while the case terminal of *Q2* is soldered to the grounded mounting foot of a one-terminal insulated tie point. See photos on next page for details.

Shielded wire must be used wherever shown in the wiring diagram. Although ordinary RG-58/U coax can be used, it is rather bulky. A much better job will result from using RG-174/U, which is just 1/10 of an inch in diameter.

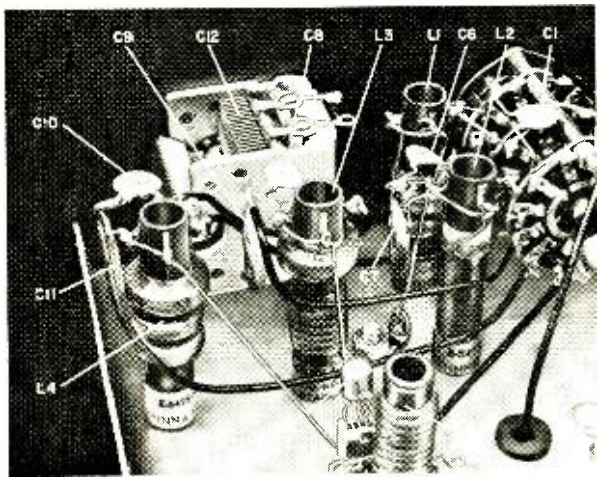
The Coils. As supplied by the manufacturer, *L4* has a 10-pF disc capacitor wired between terminals 1 and 2. Clip this capacitor out and discard it. Don't try to unsolder it, because you might damage the coil in the process!

Snip off the short antenna wire supplied with *L5*. Wind a 9-turn link with No. 28 enameled wire over the end of the coil form and fasten it in place with coil dope or polystyrene cement.

Wind coils *L6, L7, L8* and *L9* as specified in the Coil Table. When you reach the point on a particular winding where a tap is called for, scrape the enamel from the wire for approximately one-half inch. Make a "U"-shaped loop at this point, twist the loop several times, and then continue the winding. This operation will provide you with a tap



Transistor sockets are used in the GC-2 Deluxe as shown in these photos. The sockets are soldered in place (use case terminal) and are self-supporting.



approximately ½" long that you can solder to after the coil is mounted. A liberal application of cement will prevent the turns from shifting, once the coils are wound.

Only four sets of coils are required to cover the five tuning ranges of the *GC-2 Deluxe*. This is because a single oscillator coil is used for bands *B* and *C*, while a single antenna coil suffices for bands *E* and *F*. Why is there no band A? Well, the J. W. Miller dial has six semicircles already drawn on it, labeled *A* through *F*. However, the *A* portion of the dial was omitted by the author, who preferred to start with larger band *B* instead.

Adjustment. After carefully checking your wiring, plug in the batteries, attach an aerial to *TS1* and run coaxial cable between *TS2* and your ham-band-only receiver's antenna terminals. Then turn on the receiver and converter.

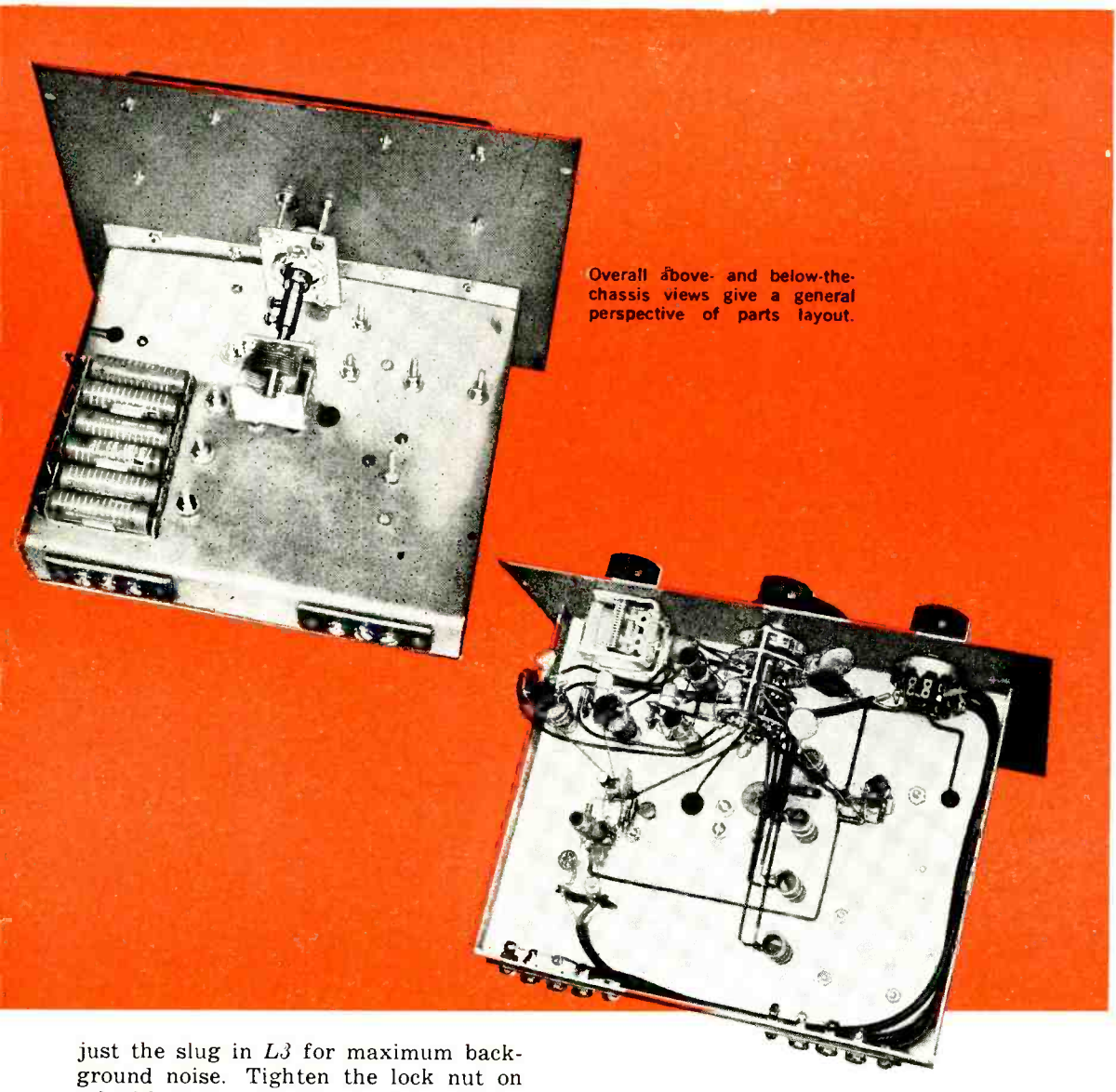
Set the receiver dial to 3.5 MHz and switch the converter to *Band C* (broadcast range). Mixer tuning capacitor *C12* should be at full capacity. The slugs in *L3, L5* and *L6* should be turned fully counterclockwise. If your ham-band receiver has an r.f. trimmer on the front panel, peak it for maximum hiss in the loudspeaker.

Now tune the converter oscillator main tuning capacitor, *C19*, through its range. If the oscillator and mixer are working, you should hear some weak broadcast signals. Tune in one of these and adjust the slug in *L5* for maximum receiver S-meter reading. You should be able to bring the signal in with a roar by rotating "Mixer Tuning" for maximum response. As you tune the main capacitor, you should hear other strong stations. It will be necessary to repeak the "Mixer" from time to time as you tune across the band.

Tune in a station near 1600 kHz and screw the slug into *L6* while rotating the main tuning capacitor until the station comes in at approximately 11 on the red logging scale which is printed near the edge of the dial. Tighten the lock nut on *L6*. Then set the two panel tuning controls at minimum capacity and ad-

COIL TABLE

L1—3.5-18 MHz antenna coil (similar to J. W. Miller C-5495-A)
L2—1.7-5.5 MHz antenna coil (similar to J. W. Miller B-5495-A)
L3—550-1700 kHz antenna coil (similar to J. W. Miller A-5495-A)
L4—140-420 kHz antenna coil (similar to J. W. Miller X-5495-A)
L5—Ferrite loop antenna (similar to J. W. Miller 2002)—see text
L6—22 turns of No. 28 enameled wire tapped 4 turns from base end, close-wound on a ⅜"-x 1⅛" J. W. Miller 21AOOORBI form (cataloged by Allied Radio as 54 D 3900, 90¢)
L7—21 turns of No. 28 enameled wire tapped 5 turns from base end, close-wound on a ⅜"-x 1⅛" J. W. Miller 21AOOORBI form
L8—10 turns of No. 28 enameled wire tapped 3 turns from base end, close-wound on a ⅜"-x 1⅛" J. W. Miller 21AOOORBI form
L9—7 turns of No. 28 enameled wire tapped 3 turns from base end, close-wound on a ⅜"-x 1⅛" J. W. Miller 21AOOORBI form



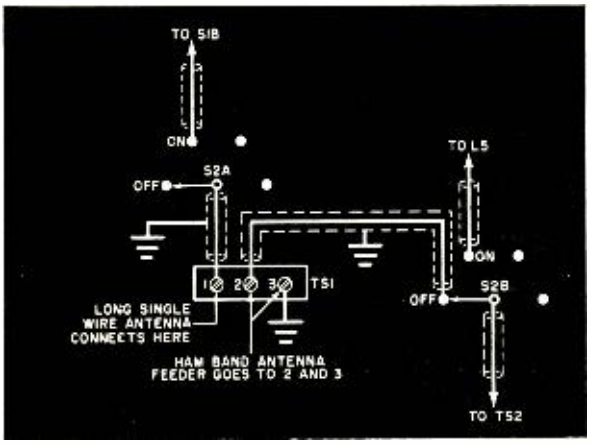
Overall above- and below-the-chassis views give a general perspective of parts layout.

just the slug in *L3* for maximum background noise. Tighten the lock nut on *L3*. The converter is now aligned for the broadcast band.

As you tune back and forth across the dial, bear in mind that you must repeak "Mixer Tuning" for optimum reception of a specific station. And always approach this point by tuning the "Mixer" from maximum toward minimum capacity. Otherwise, you may be peaking an image rather than the desired station.

The Higher Bands. Alignment of the converter on the higher bands is done in a similar manner. Use the output from an r.f. signal generator to find the proper settings for the oscillator coil slugs. On *Band D*, adjust *L7* so that 4.0 MHz falls at 24 on the logging scale. On *Band E*, adjust *L8* for a 7.0 MHz logging scale reading of 53. *Band F* requires *L9* to be adjusted so that 14.0 MHz appears at 39.5 on the logging scale. No oscillator coil adjustment is required for *Band B*.

You should be able to hear airways beacons on a portion of *Band B*, and also some broadcast signals when the main capacitor is near minimum capaci-

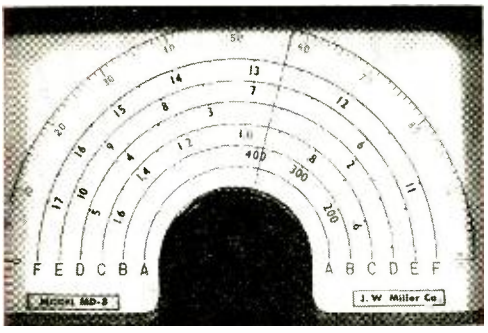


Alternative output switching arrangement will permit use of separate long-wire antenna for converter.

ty. Adjust *L4* so that the highest frequency beacon you hear (around 400 kHz) is loudest with "Mixer Tuning" at minimum capacity.

On *Band D*, *L2* should be set for maximum hiss when both panel controls are at minimum capacity. No antenna coil adjustment is required for *Band E*. On *Band F*, peak *L1* for maximum ignition noise with both panel controls at minimum capacity.

Your regular amateur transmitting and receiving antenna can be used with the converter. Results will be excellent if it is a 40- or 75-meter dipole. However, if you use only a 10-, 15- or 20-meter beam, performance on *Bands B*, *C* and *D* may be quite disappointing. Under these circumstances, use a separate single-wire antenna for the converter. Make it as long and high as possible and rewire the input sections as shown at left.



The author calibrated the dial using paste-up numerals supplied by the manufacturer. Its appearance is quite professional-looking. The "A" band on the dial was not used because of space limitations.

Results. Despite its low cost and relative simplicity, the *GC-2 Deluxe* will provide results comparable to those you'd expect from a general-coverage receiver.

At the author's lower Michigan QTH, the original unit has picked up aircraft weather forecasts on *Band B* from Detroit, Pittsburgh, Indianapolis, Cleveland, Milwaukee, and Windsor and Wiarton, Ontario. The broadcast band is alive with signals.

Interesting Great Lakes, Mississippi, and Coastal traffic is heard on *Band D*. *Bands E* and *F*, besides carrying International Broadcasting, are loaded with point-to-point telephone conversations. These latter signals are mostly SSB—a natural for the *GC-2*.

Anyone who has ever used a simple mixer-oscillator combination, without preselection, has experienced problems with images and other spurious responses. The *GC-2 Deluxe*, while not completely immune to these difficulties, is not seriously affected by them. However, on the rare occasion when a birdie does happen to fall right on top of the station you want to hear, merely move the receiver dial about 10 kHz and retune the converter dial to the desired signal. This will completely remove the offender. —30—

ALIGNMENT DATA

BAND	FREQUENCY RANGE	WHEN LISTENING TO A STATION ON	ADJUST OSCILLATOR COIL	FOR A LOGGING SCALE READING OF	WITH "MIXER" OPEN, ADJUST ANTENNA COIL	FOR MAXIMUM NOISE AT A DIAL SETTING OF
B	200-400 KHz	— — —	— — —	— — —	L4	56 (approx.)
C	5.5-1.7 MHz	1.6 MHz	L6	11	L3	0
D	1.6-5.5 MHz	4 MHz	L7	24	L2	0
E	4.5-11.5 MHz	7 MHz	L8	53	— — —	— —
F	10.5-18 MHz	14 MHz	L9	39.5	L1	0

ELECTRONIC SAXOPHONE DEBUT

FINGERTIP CONTROL OF VOLUME AND TONE PLUS VIBRATO, REVERB, AND SUB-OCTAVE NOTES CREATES NEW DIMENSIONS IN MUSIC CIRCLES

Saxophone artist Boots Randolph demonstrates the new "Varitone" with its unique electronic "tone prism" which enables a player to produce over 60 tonal effects.

TWO YEARS AGO, an idea to provide the saxophone with electronic "voicing" was born. Now musical instrument manufacturer H. & A. Selmer, working in conjunction with Electro-Voice, has announced the "Varitone"—an electronic sax which will enable the saxophone to compete with the electronic guitar.

Although the Varitone can be used as a conventional 75-watt amplifier fed from a microphone in the throat of the sax, a variety of musical effects give new sounds to the instrument. Tremolo and reverberation can be added as the musician desires; the saxophone's tone can be "brightened" or "darkened" by a 10-dB boost or cut in either the high or low frequencies; and the volume can be raised or lowered.

Unusual side effects are created by the musician with the aid of the unit's "Octamatic" circuit—which halves the frequency of the musical notes being played and feeds them through the amplifier along with the original notes. The resulting sound is such that the player seems to be accompanying himself on another instrument.

Successful operation of the 21-transistor, 14-diode Varitone hinged on the design and development of a suitable microphone. Old-style contact microphones could not be used, and only a special mike impervious to moisture and extremely high pressure inside the throat of the sax would work properly.

Musicians who have heard and tried the Varitone are enthusiastic over the likelihood that new and exciting jazz and pop music involving the saxophone looms on the horizon. It will soon be available wherever Selmer instruments are sold. Prices start at $530 for converting existing Selmer instruments, and $1020 for the complete system, including microphone.

The addition of the electronics package to the instrument in no way impairs its ability to play and sound like a regular saxophone. -30-

This is part of a hi-fi speaker?*

WHY ARE THEY STILL INVENTING SPEAKERS?

A REVIEW OF PAST ACHIEVEMENTS AND SOME EDUCATED GUESSES ABOUT THE FUTURE

By HANS FANTEL

"FRANTICALLY SEARCHING" are the key words in speaker design. Audio engineers are still in pursuit of the "perfect" speaker—one that translates electrical impulses into mechanical motion without loss, without distortion, and which reproduces every note just as it entered the microphone. The real surprise, in view of all these efforts, is that basic speaker designs haven't changed much since the first cone-type speakers replaced the goose-neck horns back in the early days of radio.

About 99.99% of the speakers sold today use an electromagnetically-powered cone pushing on the surrounding air in rhythm with the electric signal from the amplifier. But in their battle for improvement, audio engineers are constantly experimenting with new variations on this old principle. They're testing new materials and techniques—still chasing after methods that, they hope, will make small speakers sound like big speakers, that will result in speakers which scatter the sound more evenly throughout the room, speakers that squelch false resonances, reduce distortion and increase clarity, or speakers with a lower price tag. So, they're still inventing loudspeakers.

What Makes a Speaker "Good"? When two hard-bitten hi-fi'ers get into a hassle, it's a safe bet they're arguing about speakers. Even engineers can't agree on what makes a speaker sound good. The reason is that speaker designs just can't be pinned down to a formula.

Fundamentally, a speaker is more like a musical instrument than a piece of electronic gear. Its purpose, after all, is to make musical sounds just like those of true instruments. A speaker also resembles a musical instrument in its structure: a vibrating element (the cone) is set in an acoustically matched enclosure. The science of electronics and the art of instrument-making find a meeting ground in speaker design. For this reason, purely technical tests of quality are not good enough. Personal taste—simply listening—has the final vote.

No two speakers ever sound exactly alike—just as no two violins or pianos

**This is a piece of the woofer cone (18") in the Electro-Voice "E-V Six" loudspeaker system.*

are identical in sound. One speaker designer may favor a warmer, more mellow sound, while another stresses brilliance and brightness. Thus, the listener has an opportunity of choosing from among various manufacturers the tonal coloration that most closely matches his preference.

But don't jump to the conclusion that one speaker is just as good as any other and that good sound is just a matter of taste. There are a number of objective standards by which you can judge a speaker. A good speaker should meet four basic requirements:

(1) It should cover the range from at least 50 to 15,000 Hz. Within this range, its response should be as "flat" as possible. Every note, regardless of its pitch, should get its due; it should be neither over-emphasized nor swallowed up.

(2) It should leave tonal color unchanged. Poor speakers add their own tonal "coloration" to the music, altering the character of the various instruments.

(3) It should not blur the music or make it sound shrill and harsh.

(4) It should scatter sound evenly over a wide angle.

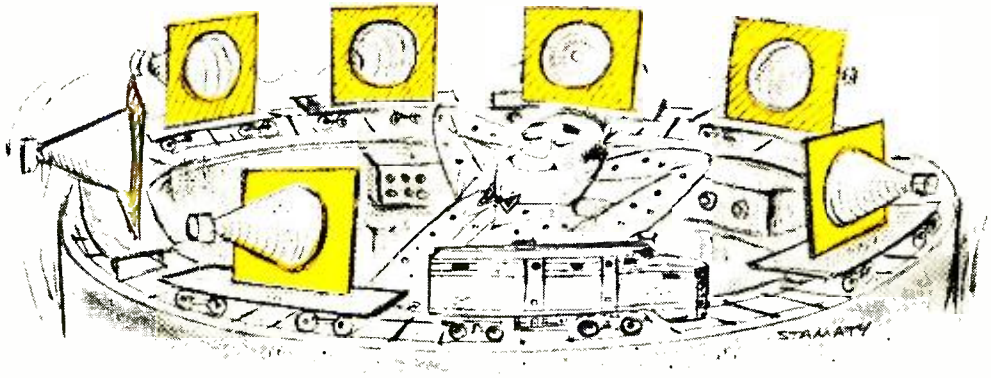
Pointless Specs. Unfortunately, the technical specifications of most loudspeakers don't really give you much of a clue as to how well any given speaker meets these requirements. Often the stated specs are downright misleading. That's why some speaker manufacturers refuse to list any performance specs at all.

If you're comparing speakers in a catalog, for example, you may find a $20 speaker boasting the same frequency response as a $500 speaker. The specs may be perfectly correct as stated, but they don't mean that the $20 speaker sounds as good as the $500 job. If the specs say that a speaker has a frequency response from, say, 30 to 15,000 Hz, all this really tells you is what the top and bottom notes are that the speaker can squeeze out. It tells you nothing about the quality of sound. That bottom bass, for instance, might just be a hoarse rattle instead of a deep, rich tone, and that top treble might screech like an old-time streetcar on a curve. All the specs mean is that you get some kind of response from the speaker between 30 and 15,000 Hz.

What is much more important is the *uniformity* with which the speaker handles the notes *between* the upper and lower extremes of the audio spectrum. Every speaker has resonances of its own that result in peaks at certain frequencies. A "peaky" response tends to make certain musical notes sound boomy, honky, or shrill. But in topnotch speaker designs, an effort is made to dampen down response peaks to the point where they can't be heard. Conversely, a speaker may have a null or blind spot for certain frequencies. Then musical notes are weakened and the music sounds thin and hollow.

Some of the current experimentation in speaker design is concerned with find-

SOUND ON A MERRY-GO-ROUND
To give the listener that feeling of being surrounded by sound, the idea of moving the speaker fascinates most inventors.



ing new materials for speaker cones that, hopefully, will rid the speaker of response peaks or dips.

New Cone Materials. Manufacturers are making speaker cones both lighter and stiffer. Lightness reduces inertia, so that the cones can follow the electronic commands from the amplifier faster and more accurately; stiffness keeps the cones from buckling and flapping as they jiggle back and forth. It's mainly the buckling and flapping—called cone breakup—that causes response peaks and other kinds of distortion. Ideally, the cone should pump air like a berserk piston, zooming back and forth without any elasticity or flexing. This would eliminate false tone coloration.

It's tough to find materials for speaker cones that can live up to the above requirements. But cones made of rigid polystyrene foam seem promising. To make these cones, liquid plastic is bubbled up into something like whipped cream and poured into the cone molds. When it hardens, the foam material is extremely rigid; and because of all the trapped air bubbles, it is also extremely light.

Plastic foam is not the only cone material that can reduce cone breakup and unwanted resonance. Just about every major speaker manufacturer is cooking up his own pet recipe for speaker cones. Some manufacturers mix batches of cone material from flocked fiber with various adhesive binders. Other designers experiment with metal foil or phenolic films. Most speaker makers are as closemouthed about their particular blend of cone material as a German brewmaster is about his beer.

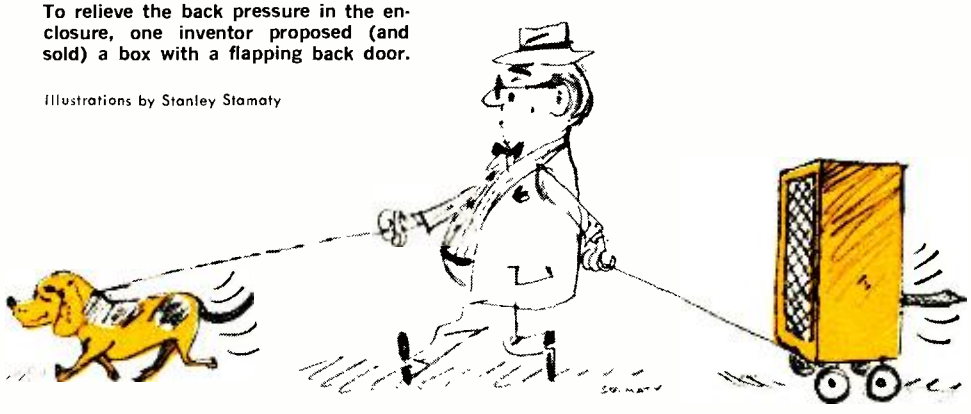
Improved Transient Response. Great advances have also been made within recent years in improving the transient response of speakers. Transients are short bursts of sound that start and stop very suddenly. Drumbeats, the plucking of a string, the clicking of woodblocks, or the first clang of a bell are good examples of this type of sound. Many subtle musical details are mostly transients. If a speaker has a poor transient response—that is, if the cone is slow to respond to a sudden sharp impulse and keeps on jiggling after the impulse has stopped—the sound is soggy and blurry.

One good test for transient response is to play music with plenty of percussion and listen for the sharpness of the individual notes. Another good test is to play a heavily orchestrated symphonic record. A speaker with good transient response keeps the individual instruments distinct and recognizable even in heavily scored passages when all the instruments are playing together. The whole texture of sound remains clear and transparent.

Transient response of speakers depends on (a) the strength of the magnet and (b) the lightness of the cone. A strong magnet helps the cone get moving without delay when a sudden transient impulse signal arrives. It also prevents the cone from overshooting or from jiggling after the signal stops. In short, the stronger the magnet, the tighter the control it keeps over cone motion. A light cone, having less inertia, is easier

THE SPEAKER THAT WAGGED ITS TAIL
To relieve the back pressure in the enclosure, one inventor proposed (and sold) a box with a flapping back door.

Illustrations by Stanley Stamaty

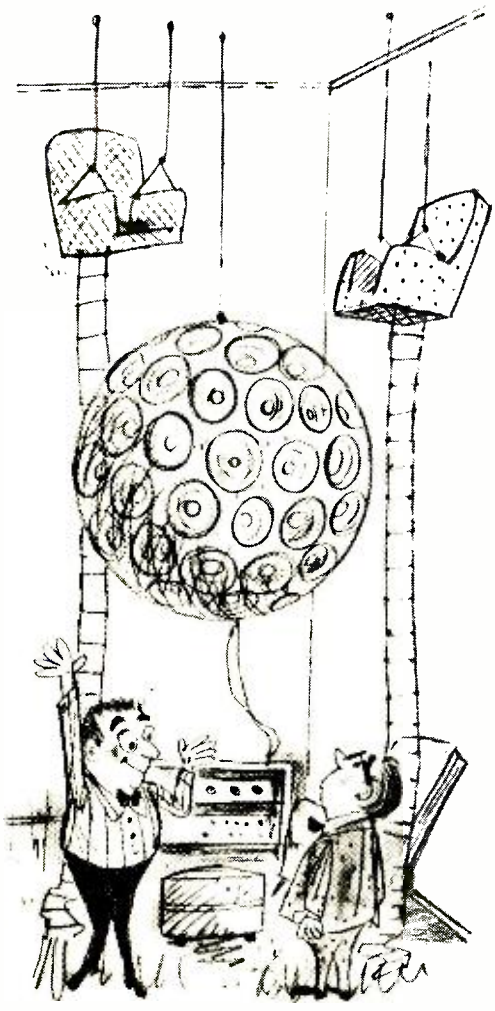


to control than a heavy one during these sudden starts and stops.

Thanks to the development of new magnet shapes that keep the magnetic field more uniformly distributed over the entire length of cone travel, transient response in the 1966-67 speakers is far better than it was five years ago. As a result, most modern speakers score a noticeable gain in clarity.

Speaker manufacturers find it difficult to give an indication of transient response in their published specifications. A few show oscilloscope traces of tone bursts (sudden, short tones from an audio oscillator) as reproduced by the speakers. Such data are helpful but not really conclusive, because test signals aren't like musical waveforms. If a speaker shows up badly in lab tests, your ears will probably confirm the poor transient response. On the other hand, anyone who has ever designed a speaker can testify that a good-looking scope trace is no guarantee of happy listening. The final decision must still be made by ear.

THE GOLF BALL SOUND
Improved spatial distribution of sound was the claim of the inventor who mounted several dozen small speakers in a sphere enclosure.

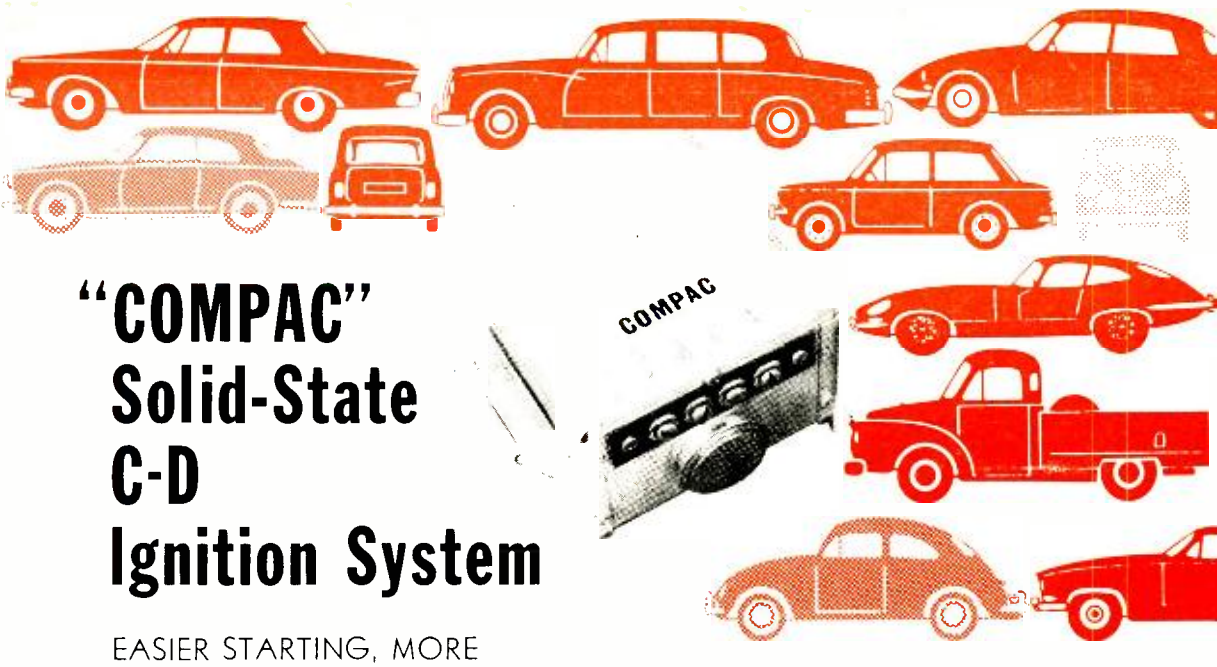


Woofers and Tweeters. A single speaker cannot efficiently cover the whole musical range from the deep growl of the double bass to the uppermost overtones of the piccolo. Thus, the total frequency range is split up between separate speaker units. Woofers specialize in bottom notes, tweeters pipe the top ones. In elaborate speaker systems, a special mid-range unit is added to tackle the frequency range from about 800 to 30,000 hertz.

This division of labor among separate speakers makes it easier to reach extreme highs and lows. It also keeps down distortion. When a single speaker is used to reproduce both treble and bass, the heavy bass thrusts of the cone sometimes mangle the more delicate treble vibrations if they are going on at the same time. The result is intermodulation distortion—"IM" for short—a subtle unpleasant harshness of sound that grates on the ear after an hour or so of listening. Manufacturers usually consider the amount of distortion generated by their speakers as "top secret." But if you're comparing speakers at an audio shop, careful listening to a good orchestral recording lets you tell the sweet-sounding speakers from the rough ones.

In construction details, woofers and tweeters are complete opposites. Woofers are heavily constructed so that their own natural resonance lies far down in the low range which they must reproduce. Woofer cones are loosely suspended so that they can travel without restriction over the wide swings demanded by heavy bass amplitudes. The aim is to reach down to the lowest notes of the orchestra (around 35 hertz). This lends

(Continued on page 94)



"COMPAC" Solid-State C-D Ignition System

EASIER STARTING, MORE HIGH VOLTAGE, LESS BATTERY CURRENT DRAIN, AND FEWER MISFIRES

By MURRAY GELLMAN

SMALL enough to fit on a motorcycle or scooter, yet powerful enough to drive a Cadillac, this "Compac" solid-state capacitor discharge ignition system can be put together for almost half the price of its big brother (see June, 1965, issue of POPULAR ELECTRONICS). Improved gas mileage, increased life of breaker points and spark plugs, faster cold-weather starting, low battery current drain, and sustained high voltage at high engine speeds can be achieved with this new ignition system in any make of car, truck, or boat using a negative-ground 12-volt battery and a conventional ignition coil; and you can get more out of a two-cycle engine, too.

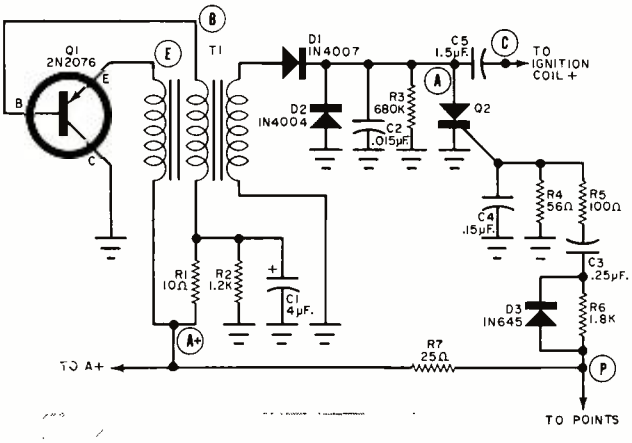
Conventional—and some transistorized—ignition systems draw more than 10 amperes of battery current; this CD system pulls only 0.5 ampere. Because of the low current drain, a small 12-volt motorcycle battery and an ordinary automobile ignition coil can be used to give a Go-Kart more "go." If you remove the coil from the flywheel housing, you will keep the magnets from loading down the engine on account of magnetic flux drag, and be able to get more useful power out of your engine.

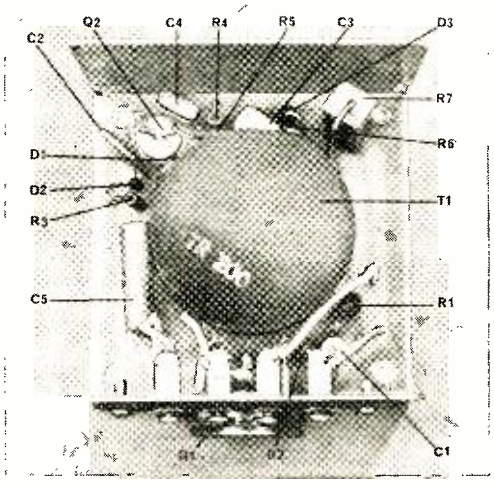
Two Compacs were installed on a 110-horsepower, 6-cylinder outboard engine that kept fouling up the spark plugs about every 10 hours. This engine has two ignition coils, one for each three cylinders. Seventy-five hours of engine time have elapsed so far, and the spark plugs are still in use.

How It Works. Transistor *Q1* and the first and second windings of transformer *T1* work as a blocking oscillator and act like a switch (chopper) to alternately switch the battery current on and off. The "stop and go" current flow permits transformer action, and because of the step-up turns ratio, about 600 volts peak-to-peak is developed across the secondary winding.

This stepped-up voltage is rectified by *D1*, and appears across *C5* in series with the primary winding of the ignition coil. Capacitor *C5* charges up to about 300 volts and holds this charge until silicon-controlled rectifier *Q2* conducts. When *Q2* conducts, the energy stored up in *C5* is "dumped" very rapidly into the primary winding of the ignition coil. The 300 volts is stepped up to more than 30,000 volts by the ignition coil. And herein lies the reason for several features which make the CD system more desirable than the conventional ignition system.

One transistor chopper and transformer steps up voltage and charges C5. Ignition occurs when the points open and Q2 conducts. Trigger circuit is immune to point bounce, prevents false firing.



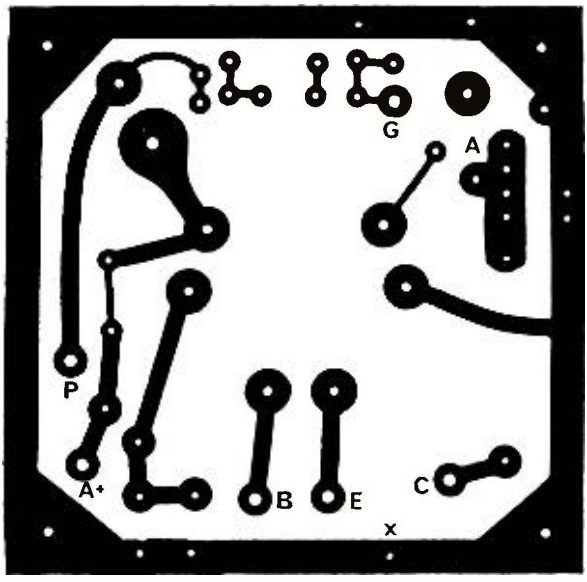


Complete unit is shown mounted in custom-built case to obtain minimum external dimensions. Any standard case can be used. Actual-size wiring layout (below, right) can serve as template to make printed circuit board.

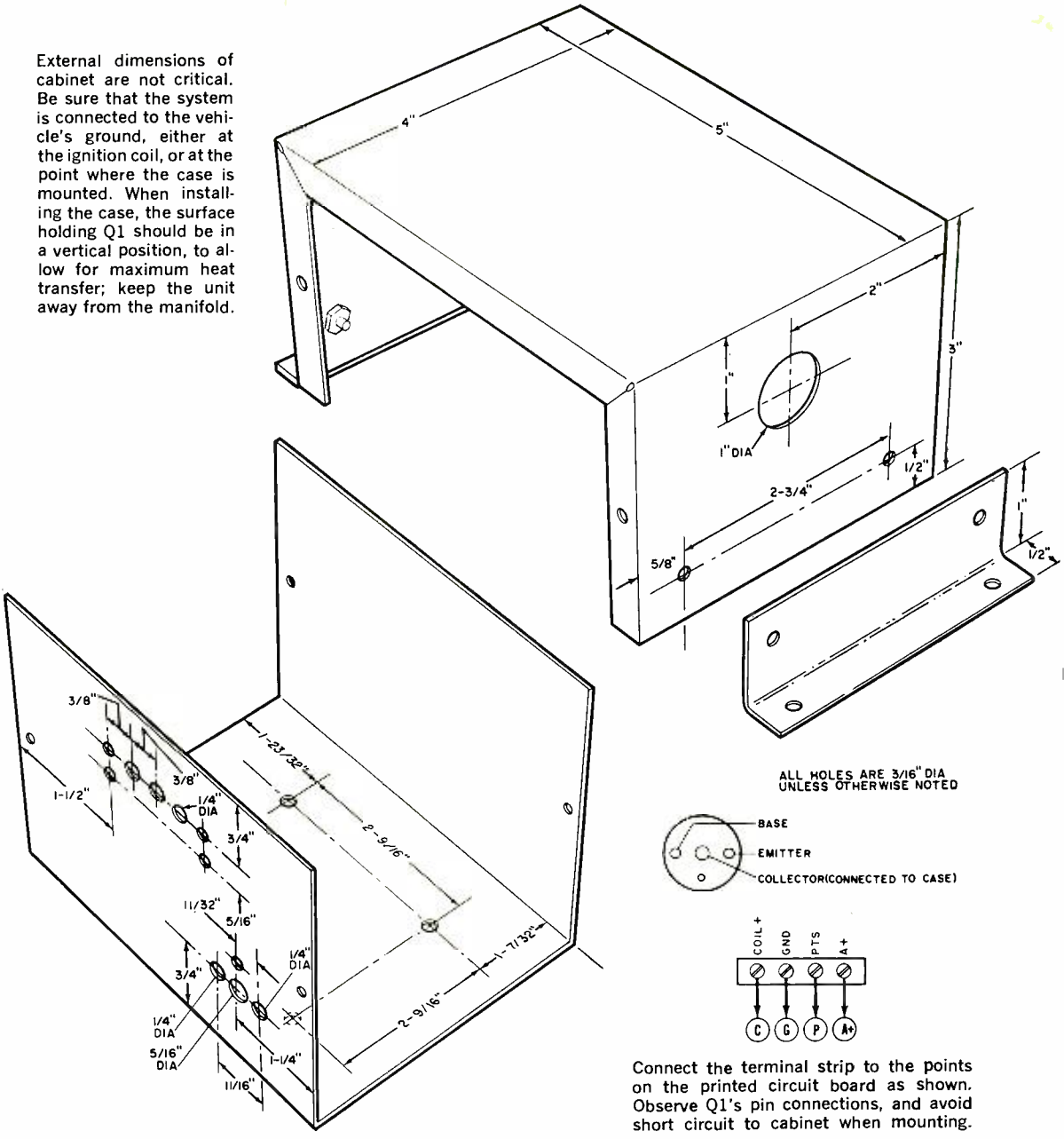
PARTS LIST

C1—4-μF, 50-volt electrolytic capacitor
C2—0.015-μF, 600-volt capacitor
C3—0.25-μF, 25-volt capacitor
C4—0.15-μF, 25-volt capacitor
C5—1.5-μF, 250-volt capacitor
D1—1N4007 diode, or similar
D2—1N4004 diode, or similar
D3—1N645 diode, or similar
Q1—2N2076 pnp transistor, or similar
*Q2—MCR2305-5-R silicon controlled rectifier (Motorola)**
R1—10-ohm, 2-watt resistor
R2—1200-ohm, 1-watt resistor
R3—680,000-ohm, ½-watt resistor
R4—56-ohm, ½-watt resistor
R5—100-ohm, ½-watt resistor
R6—1800-ohm, ½-watt resistor
R7—25-ohm, 5-watt resistor
*T1—TR-200 transformer (SYDMUR)**
1—3" x 4" x 5" cabinet
*1—Printed circuit board**
Misc.—Four-screw terminal strip, threaded 6-32 x 3/16" rivet-on spacers, machine screws, wire, solder, etc.

*The following parts are available from SYDMUR, 1268 E. 12 St. (or P.O. Box 25A, Millwood Station) Brooklyn, N.Y.: transformer *T1*, $10.95 plus 50 cents for shipping; silicon-controlled rectifier *Q2*, $5.95; and printed circuit board, $3. A complete kit is available for $24.95, a factory-wired and tested unit for $34.75. Add 75 cents for shipping either kit or wired unit.

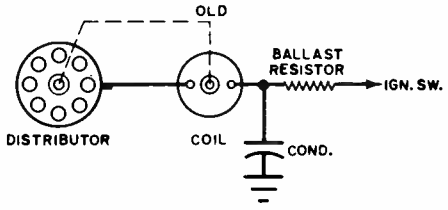


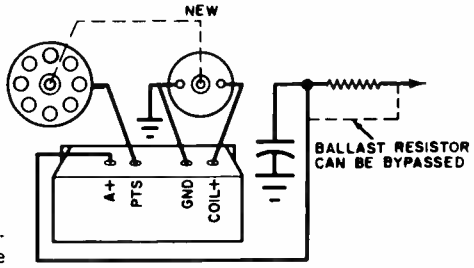
External dimensions of cabinet are not critical. Be sure that the system is connected to the vehicle's ground, either at the ignition coil, or at the point where the case is mounted. When installing the case, the surface holding Q1 should be in a vertical position, to allow for maximum heat transfer; keep the unit away from the manifold.



ALL HOLES ARE 3/16" DIA UNLESS OTHERWISE NOTED

Connect the terminal strip to the points on the printed circuit board as shown. Observe Q1's pin connections, and avoid short circuit to cabinet when mounting.





New connections between the distributor and ignition coil are easy to make. Ballast resistor can be left in, or bypassed. Use original ignition coil.

When the ignition points open, a positive pulse is applied to *Q2*'s gate, and with the speed of a fast-acting electronic switch, typical of solid-state devices, *Q2* conducts and the spark occurs. The positive pulse is developed simply enough, but the system's immunity to point-bounce is interesting.

When the points are closed, the voltage at point *P* is zero; but when the points open, battery current through *R4*, *R5*, *C3*, *D3*, and *C4* makes the gate end of *R4* positive, and it remains so until the capacitors become fully charged. When the capacitors are fully charged, essentially no current flows through *R4*. But once *Q2* is conducting, it is no longer dependent upon its gate pulse, and it continues to conduct until its anode voltage is removed or reversed. When the points close, *C3* discharges, but it does so more slowly since the discharge path now includes *R6*.

Should the points open relatively too soon, as in the case of point-bounce, not enough current can flow through *R4* to false-fire *Q2*, because of the charge still on *C3*. Capacitor *C4* stabilizes the voltage built up across *R4* and maintains the gate voltage just long enough to insure firing action.

As in any inductive circuit, a substantial reactive kick takes place which could be quite destructive. Instead of fighting this kick, which is of opposite polarity to the initially developed voltage, it is passed to ground through *D2*, but before it goes, it is put to work to turn off *Q2*. The circuit is now just about back to its starting point and is ready to go again the next time the points open.

This kick doesn't always go in one direction; the actual action is more like ringing, and when the polarity of the kick swings back to agree with the original polarity of the power supply, *C5* gets a head start and starts to charge up again.

Perhaps just as unique and interesting as point-bounce immunity is the squelching action of *Q2* and *T1* to stop oscillation of *Q1* while the circuit is firing. When *Q2* conducts, it loads down *T1*, reduces the *Q* of the circuit and damps out the oscillations. Not until *Q2* "opens" does *Q1*'s circuit start to oscillate again. The transformer is designed to prevent the self-oscillation of *Q1* and the large transients that occur in the circuit from destroying *Q1*. When *Q1* is "quiet," there is no current from the transformer and *D1* circuit to compete with the discharge of *C5*, and a greater amount of energy is released to the ignition coil in a shorter period of time.

Resistor *R3* serves as a bleeder to slowly discharge *C5* when the ignition system is shut down. Capacitor *Q2* slows the rate of speed of reapplication of a positive voltage across *Q2* to prevent it from firing without a gate pulse. Resistor *R7* allows a minimum of current (about 0.48 A) to flow through the points to help keep them clean, as well as completing the *C3* charge circuit. Resistors *R1*, *R2* and capacitor *C1* maintain proper bias conditions for *Q1*.

Construction. Assembly time is less than 20 minutes, once you have all the parts in front of you. Use a printed circuit board made of G 10 fiberglass material with 2-oz. copper foil to hold the components. A phenolic board may warp and split the foil after exposure to the normally high temperatures found in an automobile's engine compartment, and should not be used.

All of the parts are stock items and can be purchased locally, except *T1* and the printed circuit board. (See Parts List.) Should you decide to make your own board, follow the actual-size drawing and layout shown. Do not change the position of any of the conductors on the board to prevent false-triggering of *Q2*.

Mount all of the components on the board, observe polarity of the diode and capacitors, and solder. Cut the excess lead lengths from the components after soldering; the leads thus serve as a heat sink. Be careful not to bridge-solder over adjacent conductors on the board—to prevent shorts and other wrong connections.

Solder four 1½"-long leads into holes *A*, *B*, *E* and *G* and four 4-inch leads into holes *A+*, *C*, *P* and *X*. Apply a small amount of silicon grease to the mounting surface of *Q1* and to the surface of the case to improve heat conduction. Apply just enough pressure to the transistor nut to have the grease

(*Continued on page* 100)

IN THE DAYS OF SPARK -A RESCUE AT SEA

THE SINKING OF THE SS REPUBLIC IS RETOLD

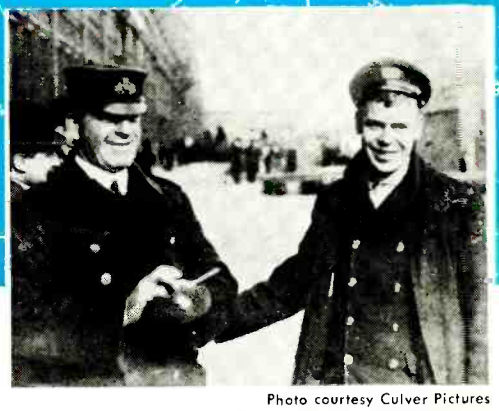


Photo courtesy Culver Pictures

Wireless operator Jack Binns (right) and Third Officer Tubbs of the "Republic" played a decisive part in events which occurred on January 23, 1909.

By HENRY E. CHURCH

AROUND the turn of the century, radio was generally considered a "new-fangled" invention by the few people who had even heard of it. Still fewer people displayed an active interest in radio —which was then called wireless. Nevertheless, its value was not overlooked by safety-conscious people in the marine industry and the various radio pioneers.

Behind the scenes, powerful transmitting stations were built in strategic locations on the shore, and more and more ships were outfitted with transmitting and receiving equipment. But, more than any other single event in its short history, an accident which occurred in the early hours of January 23, 1909, dramatically shaped radio's destiny and enlightened the world to its existence and potential.

The American-owned White Star liner, *Republic,* under the command of Captain Inman Sealby, departed from New York City in the late afternoon of January 22 bound for Gibraltar. Shortly after clearing Sandy Hook, she was enveloped in a blanket of fog, and the automatic fog horn was switched on. Jack Binns, the only radio operator aboard, busied himself with routine traffic. At midnight, after switching off his radio equipment, Binns retired to his cabin for a few hours of sleep.

Meanwhile, at the Siasconsett wireless station on Nantucket Island, Jack Irwin had just relieved Jack Cowden for the midnight to 8 a.m. watch. The *Republic* was the only ship in transmitting range at the time. Later, still early in his watch, Irwin exchanged messages with the *La Tourraine* and the *Baltic* as they came into range. He knew the *Republic* had only one operator aboard who would most likely be in his bunk, so he settled down with a book to wait the night out. No other ships were due within range before dawn.

At the same time, through thick fog and darkness, the Italian liner *Florida* steamed toward New York Harbor with her cabins filled to capacity with immigrants, refugees of a Messina earthquake. No radio was aboard, and Captain Angelo Ruspini was unaware that his ship was on a collision course with the *Republic*.

When Captain Sealby heard an approaching fog horn, he ordered the Republic's engines shut down. Jack Binns was awakened from his light sleep (by the absence of engine noise), and suddenly the sound of tortured metal filled the air, followed by a jarring shudder which sent Binns sprawling to the deck. Regaining his footing, he rushed to the radio cabin only to find it badly damaged. He closed the transmitter key. The spark was there!

But the ship's main electric generator ground to a halt before Binns could get a message out. Switching to storage batteries, he was concerned that his sending range was now reduced to between 50 and 60 miles, but his fingers began tapping out CQD (the SOS call-sign of the day).

The *Florida,* which had sustained a crushed bow but apparently was still afloat, drifted back into the fog.

At Siasconsett, Jack Irwin was dozing when the early morning cold brought him abruptly to wakefulness. A few minutes later he heard a weak CQD, followed by MKC—the *Republic's* call-sign. He answered immediately.

With radio contact established, Binns reported that the *Republic* was sinking rapidly 26 miles southwest of Nantucket. Irwin acknowledged the message and asked Binns to remain at his post until help could be summoned.

After answering Irwin's general call from the powerful Siasconsett transmitter, the *La Tourraine* and the *Baltic* changed course and headed for the stricken ship. The nearest of the two, the *Baltic,* was 64 miles from the *Republic,* and her top speed of 22 knots compounded with the fog made rescue seem impossible.

The *Republic,* drifting hopelessly and now sinking about a foot an hour, drifted close to the *Florida.* Two anxious hours were spent by both crews as they transferred the passengers from the *Republic* to the smaller ship. There was much concern because the damaged *Florida* became dangerously overloaded.

By noon, on January 23, Binns judged the *Baltic* to be within ten miles of the *Republic* by the strength of her radio signals. The rescue ship, running in soupy fog, had to reduce speed to prevent running into the *Republic,* and signal bombs were decided upon for final guidance. By 6 p.m., the last of the *Republic*'s bombs was detonated, but it went unheard by the would-be rescuers. Only one bomb remained on the *Baltic.*

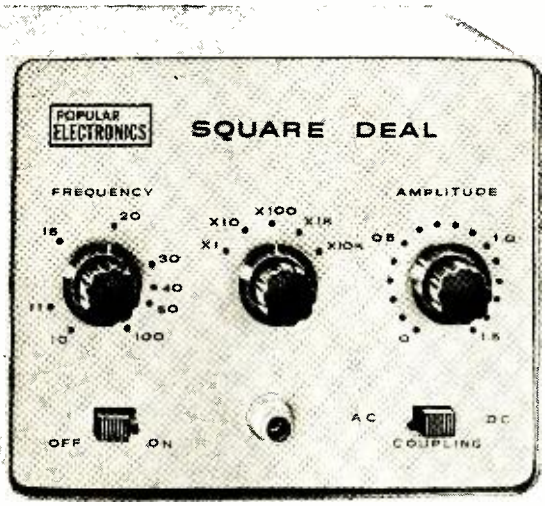
Radio communication permitted the chronometers on the *Baltic* and the *Republic* to be synchronized. On the sinking ship, the quartermaster stood ready to give the signal the instant the last bomb was detonated. His arm fell and 45 crewmen, including Binns who had been called away from his radio, strained their ears to hear the explosion. About five seconds later, Binns, whose long hours of listening to weak and fading signals had sharpened his hearing, and Third Officer Tubbs, standing beside him, thought they heard a muffled sound. Taking a chance, Binns rushed to the radio cabin to give instructions to the rescue ship based on the bearing estimated by himself and the Third Officer.

About 15 minutes later, the *Baltic* came into sight and hove to beside the sharply canted deck of the *Republic.* With the exception of Captain Sealby and Second Officer Williams, the *Republic*'s crew was transferred to the *Baltic.*

The *Florida* was located shortly afterward, and in rain, darkness, and heavy sea swells, the *Republic's* passengers were taken aboard the *Baltic* without loss of life. Only three passengers and two crewmen from the ships involved in the collision had been killed, crushed by the initial impact.

As the dawn of January 24 crept into the sky and the rain which cleared the fog away ceased, a veritable armada of ships stood by to give assistance. The *Baltic,* with the limping *Florida* and several other ships in her wake, set out for New York harbor. The rescue had been accomplished against almost insurmountable odds.

(*Continued on page* 113)



"SQUARE DEAL" AUDIO GENERATOR

PROFESSIONAL-TYPE TEST EQUIPMENT FROM INEXPENSIVE INTEGRATED CIRCUITS

By DON LANCASTER

LOOKING for a good audio generator? Here's a portable space-age, transformerless, integrated-circuit instrument with performance features not found even in commercial test gear. The *Square Deal* puts out symmetrical, high-rise-time square waves ranging in amplitude from 0 to 2.5 volts and in frequency from 10 Hz to 1 MHz. The output signal can be a.c.- or d.c.-coupled to equipment being tested, timed, triggered, or sounded.

Signal frequency is entirely independent of output loading; you can drive a speaker directly, or place a dead short across the output without "phasing" this project. You can use the *Square Deal* for general-purpose audio work—to make tone and hearing studies, and to test amplifiers and speakers. Add a phone jack and a speaker, and you'll come up with a code practice oscillator that is loud enough for group practice. And if you want to use the *Square Deal* as a remote annunciator, or as the heart of a burglar alarm, you can.

It will also serve as an oscilloscope calibrator to give you time and amplitude references accurate enough for practically all experimental purposes. When used with a scope, it easily reveals such dynamic amplifier characteristics as frequency response, damping, overshoot, ringing, and phase distortion. You'll also find it handy for digital logic experiments and demonstrations where you need a d.c.-coupled trigger source.

Best of all, the *Square Deal* is unexcelled for field operation; you can use it to check out those tricky mobile or marine installations. Only two D-size flashlight batteries will power the unit continuously for 40 hours or more.

Inside the case you'll find $2.30 worth of semiconductors and a special $2 potentiometer in a simple circuit easily put together in a few hours. Depending upon how fancy you get, and the parts you have on hand, your parts cost will run from $6 to $18. A professional precalibrated and imprinted aluminum front panel is available. (See Parts List.)

How It Works. Two of the four transistors "housed" in an integrated circuit (*IC1*), no larger than a few match heads, are hooked up in an astable multivibrator circuit that puts out a good, clean square wave which is direct-coupled to *Q1*, as shown in Fig. 1. Transistor *Q1*, hooked up as an emitter follower, serves as a buffer to prevent output loading conditions from affecting the oscillator frequency.

The signal from *Q1* is direct-coupled to the base of transistors *C* and *E* in *IC2*, where it is further isolated from the oscillator. Transistor *C* reverses the phase of the signal and passes it on to transistor *D*. Transistors *D* and *E* drive the load in a push-push manner. Operation is similar to a push-pull class B amplifier, but a push-push circuit is single-ended. The output signal appears across

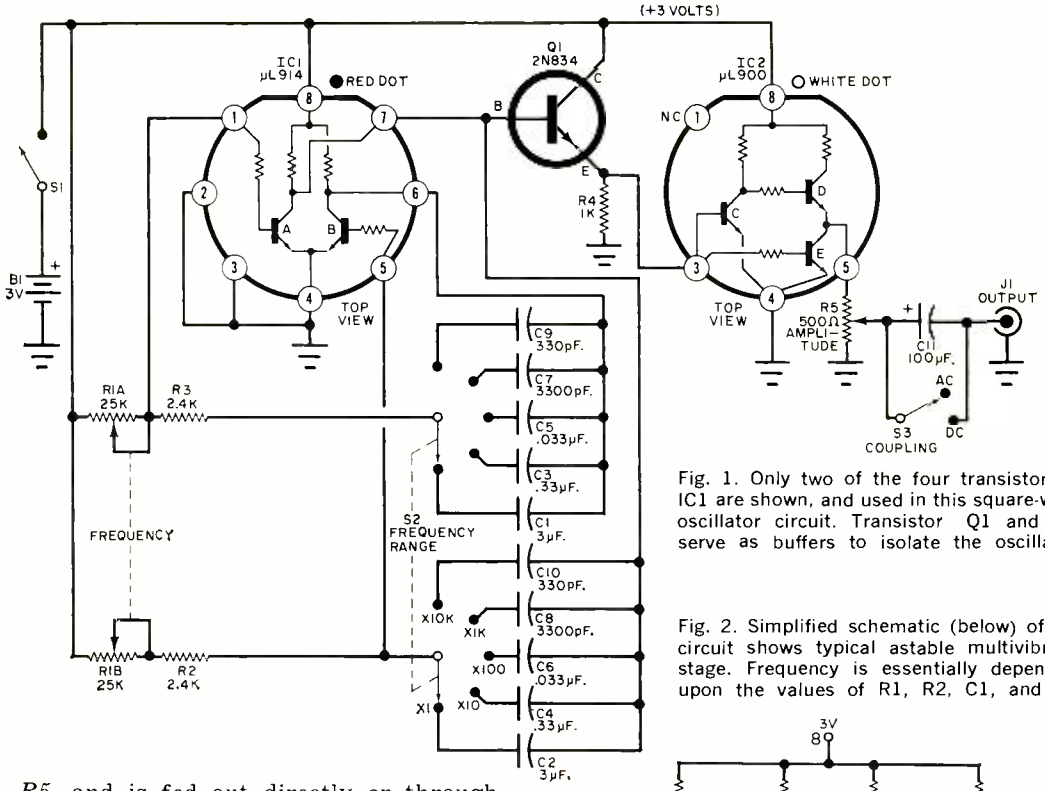
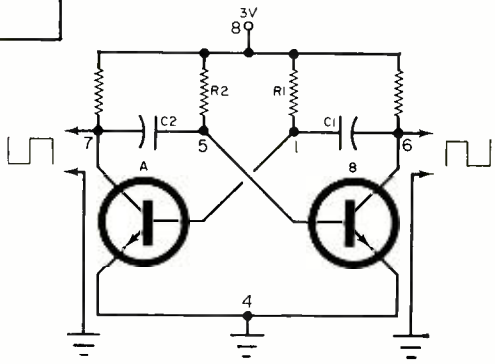


Fig. 1. Only two of the four transistors in IC1 are shown, and used in this square-wave oscillator circuit. Transistor Q1 and IC2 serve as buffers to isolate the oscillator.

Fig. 2. Simplified schematic (below) of IC2 circuit shows typical astable multivibrator stage. Frequency is essentially dependent upon the values of R1, R2, C1, and C2.



R5, and is fed out directly or through coupling capacitor *C11*, depending upon the position of *S3*. Integrated circuit *IC2* contains the equivalent of three transistors and five resistors.

Figure 2 is a simplified drawing of the multivibrator and some of the waveforms it generates. The multivibrator is free-running and does not require an external signal. When transistor *A* is conducting, transistor *B* is cut off, and when transistor *B* is conducting, transistor *A* is cut off.

The signals at the collectors of transistors *A* and *B* are identical, but of opposite polarity, as shown at terminals 6 and 7. Capacitors *C1*, *C3*, *C5*, *C7*, and *C9* in the project are represented by *C1* in the simplified drawing, and *C2*, *C4*, *C6*, *C8*, and *C10* are represented by *C2*. The length of time each transistor remains in the off state is a function of the values of *C1* and *R1* (for transistor *A*), and *C2* and *R2* (for transistor *B*). Because the values of the components are the same in both transistor circuits, the output waveform is symmetrical.

To change the repetition rate or frequency of operation, simply change the values of either or both of the capacitors or the resistors. In the actual circuit, capacitors *C1* through *C10* provide different frequency ranges in five decade steps from *X 1* to *X 10,000*, and the ganged potentiometer (*R1a* and *R1b*) provides a continuously variable selection of frequencies within each range.

Construction. Almost any type of chassis construction can be used to assemble the *Square Deal*. A deep-drawn aluminum case and a homemade aluminum chassis are shown in the photos. The chassis is a 10″ x 6⅜″ x $^{3}/_{64}$″ piece of aluminum, cut, bent, and drilled as shown in Fig. 3.

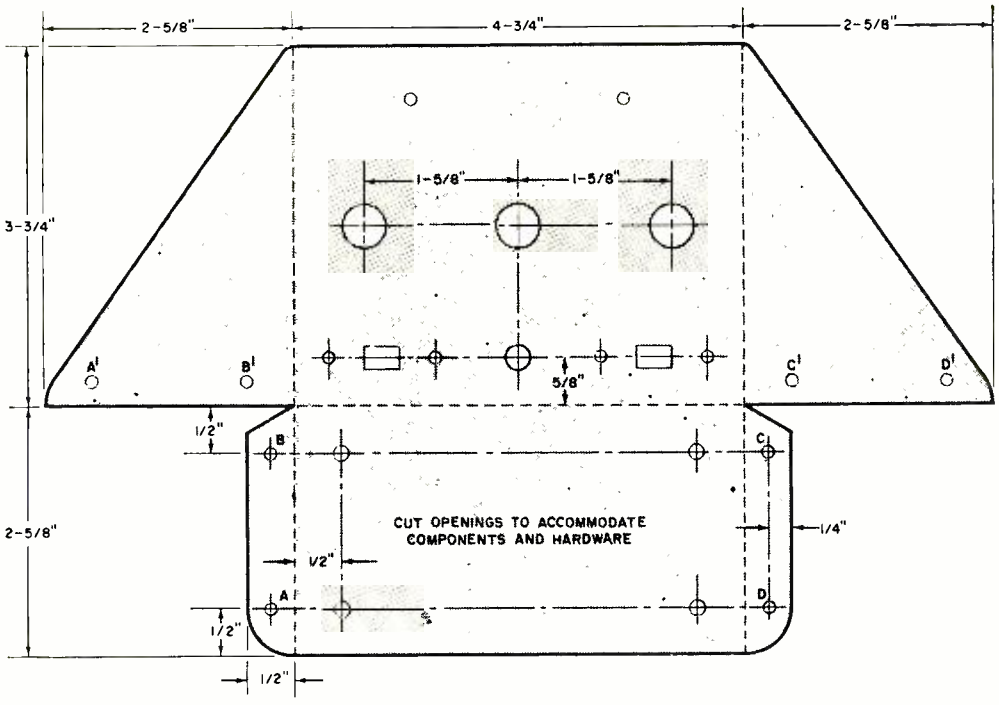


Fig. 3. Chassis can be formed from a thin piece of sheet aluminum. Drill and shape to size as shown.

Layout is not critical. If you get the ready-made front panel, you can use it to locate the holes on the front of the chassis. Pop rivets, or 6-32 x 3/8" machine screws and nuts can be used to hold things together. A 4½" x 1½" x ⅛" piece of aluminum is used as a spacer to "pull" back the controls so that the control knobs will fit closer to the panel, but you can mount an extra nut on the bushings before installing the controls, and adjust the nuts to obtain the proper spacing.

If you wish to conceal the screw heads or rivets that hold the terminal strip and switches in place, you will have to

PARTS LIST

B1—Two 1.5-volt, D-size cells
C1, C2—3-μF, 6-volt electrolytic or Mylar capacitor
C3, C4—0.33-μF, 100-volt Mylar capacitor
C5, C6—0.033-μF, 100-volt Mylar capacitor
C7, C8—3300-pF mica or polystyrene capacitor, any working voltage
C9, C10—330-pF mica or polystyrene capacitor, any working voltage
C11—100-μF, 6-volt electrolytic capacitor
IC1—μL914 epoxy micrologic dual two-input gate (Fairchild)*
IC2—μL900 epoxy micrologic buffer (Fairchild)*
J1—Phono jack (RCA type)
Q1—2N834 transistor (Motorola MPS 834)
R1—Dual 25,000-ohm carbon potentiometer, linear taper (similar to IRC 45-D253-MD253)
R2, R3—2400-ohm, ½-watt resistor
R4—1000-ohm, ½-watt resistor
R5—500-ohm, ½-watt potentiometer, linear taper
S1, S3—S.p.s.t. slide switch
S2—Two-pole, five-position, rotary switch, nonshorting type (similar to Mallory 2236J)
1—3" x 4" x 5" case (similar to Zero Z64-80A-48 or Bud Minibox CU-2105A)
1—10" x 6⅜" piece of 3/64" aluminum stock
1—1½" x 4½" piece of ⅛" aluminum stock (optional—see text)
1—Front panel (an anodized hard-aluminum METAL-PHOTO dialplate is available from Reill's Photo Finishing, 4627 N. 11 St., Phoenix, Ariz. 85014; in silver color for $2.75; in red, blue, or copper for $3.25, postpaid in USA)
Misc.—Insulated Teflon standoffs (3) optional; Sealectro's 8-lead IC sockets for TO-5 case (2), optional, available from Arrow Electronics or Joseph Kurzan, Inc., both in New York City; 5-lug terminal strip; battery holder for 2 D-size cells; small knobs (3); nylon cup washers for feet (4), wire, solder, spacers, screws, etc.

*Appropriate data sheets and distributor lists are available from Fairchild Semiconductors, 313 Fairchild Dr., Mountain View, Calif., and Motorola Semiconductor, P.O. Box 955, Phoenix, Ariz. 85001

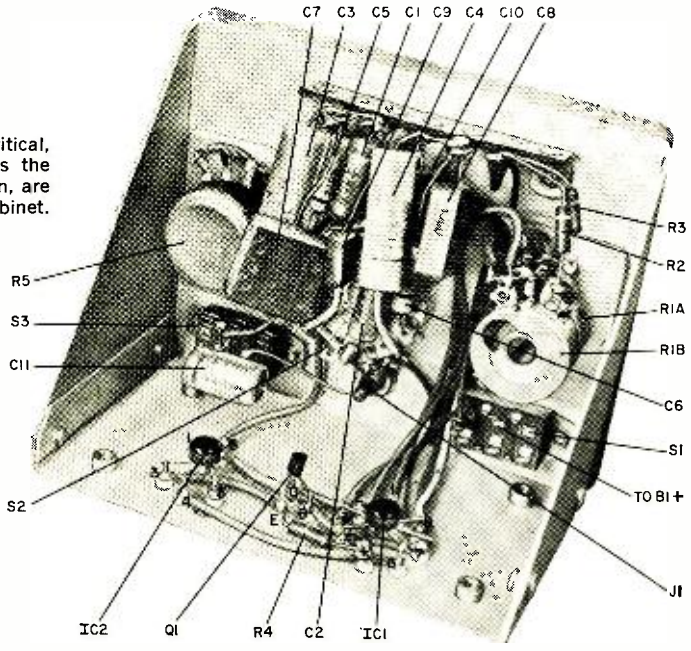


Fig. 4. Layout of parts is not critical, but be careful not to crisscross the connections. Batteries, not shown, are mounted on the back of the cabinet.

indent (dimple) the chassis sufficiently to clear the panel. Use flat-headed machine screws and countersink the holes if you are not equipped to do a good dimpling job. It's worth the extra effort . . . the front panel will lie flat, hide the hardware, and will provide you with a neat, professional-looking instrument.

Temporarily place the chassis inside the cabinet and drill four holes through the bottom of the cabinet and the chassis to accommodate suitable protective feet; nylon cup washers can be used. By drilling the cabinet and the chassis at the same time, you simplify hole alignment when the job is completed. You can use self-tapping screws, or install threaded rivet-on spacers on the chassis. Either way, the size of the holes should be appropriate for the hardware used. The screws that hold the feet in place also hold the cabinet and chassis together.

Mount a two-cell flashlight battery holder on the back of the cabinet in any convenient manner, but be alert to any clearance problems that may arise when the components are installed. Press-fit terminals, sockets, or a perforated board can be used to hold the transistor and the integrated circuits—modify the chassis to accommodate your fittings. Note: the flat, or color dot, on the integrated components identifies terminal 8; the other terminals are numbered clockwise when you're looking at them from the bottom of the epoxy case. The IC's are not interchangeable.

Rotary switch *S2* and a five-lug terminal strip anchor the capacitors. Be particularly careful not to confuse the circuit by wiring *S2* or *R1* to *IC1* improperly. If your project fails to operate, there's a good chance that you crossed the wires to these components. Follow the schematic and you won't have any trouble.

Instrument accuracy depends upon proper values of *C1* through *C10*. Without a special selection, you'll probably wind up with a full-scale accuracy of about $\pm 15\%$. You can improve this figure by making a careful selection of capacitors. The *AMPLITUDE* scale is relative, and depends upon output loading and battery conditions.

Do not allow the instrument's output circuit to come across any external voltage while in the *DC* position, nor more than the rated voltage of *C11* while in the *AC* position. If you must couple into higher voltage ridden circuits, insert a suitable capacitor in series with *J1*.

Operation. There is a slight difference between *AC* and *DC* outputs. In the *DC* position, the signal is direct-coupled, and the square wave is clamped to the instrument's ground (0 volt). In the *AC* position, the signal is made to pass through a capacitor (*C11*), and the d.c. component is lost. There is as much

signal above the zero-reference line as there is below it. In either case, the peak-to-peak voltage is the same.

If the d.c. component is not needed for your application, take advantage of the built-in coupling capacitor—it serves as a d.c. block, and minimizes upsetting voltage and resistance conditions in the input circuits of the equipment being worked by the *Square Deal,* as well as in the instrument's own output circuit. Audio equipment, amplifiers, speakers, etc., can be driven from the *AC* position. For logic experiments, counter circuits, and other pulse circuits, you will most likely use the *DC* position.

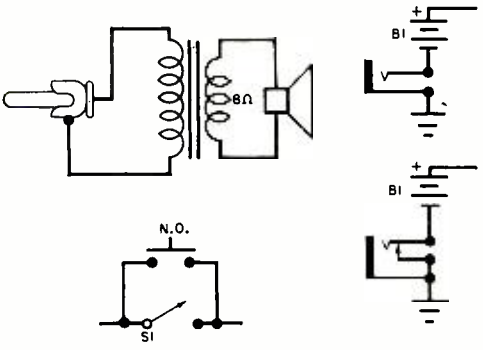


Fig. 5. Simple modifications you can make to extend the utility of the "Square Deal." See text below.

Modifications. If you add a phone jack in series with the battery, you can turn the multivibrator on and off with almost any switching device, for use in a code practice rig, annunciator, burglar alarm, or to make tone-burst tests (see Fig. 5). If you use a non-shorting type jack, the circuit will work only when the key, switch, thermostat, etc., is plugged in and completes the circuit. However, if a shorting-type jack is used, the circuit will work both ways.

Of course, you will have to plug a speaker or a set of headphones into *J1* to be able to hear the signal. Speaker volume can be increased by the use of a matching transformer. If the output of the instrument is allowed to "look" into, say, a 50-ohm load instead of an 8-ohm load, its amplitude will be significantly greater. You can use a multitapped transformer such as Stancor's TA39 for this purpose. -30-

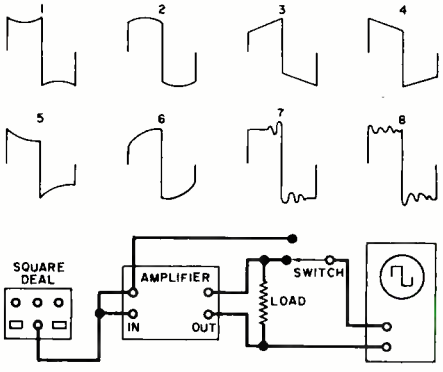
TESTING WITH SQUARE WAVES

A rapid indication of frequency response can be obtained by using two test frequencies; one low enough to reveal low frequency response and phase shift, and one high enough for some of the harmonics in the square wave to reach the upper limits of the amplifier under test. Other characteristics such as ringing or parasitics, damping, phase shift, and transient response can be determined.

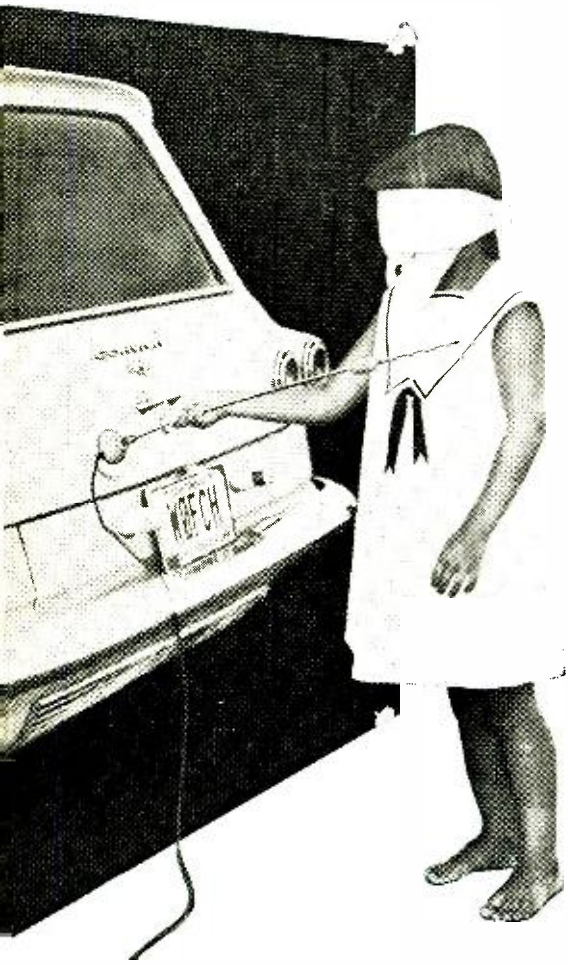
Frequency response ranging from 1/10 to 10 times the fundamental frequency of the square wave can be predicted in one "shot." For example, if a 1000-Hz square wave is passed through the amplifier without distortion, the frequency response is at least 100 Hz to 10,000 Hz. To check the scope, to see that it does not distort the waveform, connect the scope directly to the generator. If the scope distorts the waveform, you can overcome this shortcoming by feeding the signal directly to the vertical deflection plates of the CRT.

An easy way to interpret the waveforms is to look for tilt and curvature. Tilt is primarily an indication of phase shift of the fundamental frequency. Square-wave testing for phase shift is quite sensitive. A 10% slope represents about a 2° phase shift. Curvature shows frequency response; a convex shape indicates good lows, a concave shape shows loss of lows. It is not unusual for the waveform to show both tilt and curvature.

Ringing is a piggyback oscillation (parasitic) sometimes caused by overboost of highs or other resonant conditions in the circuit. Not all ringing is parasitic. Some circuits, such as the horizontal deflection stage in a TV set, purposely set up a ringing condition. Damping is simply the ability of the amplifier to suppress ringing when it does occur.



Basic waveforms. Ideal shape is shown on scope. Other shapes are: (1) loss of lows; (2) boosted lows; (3) low-frequency phase lag; (4) low-frequency phase lead; (5) combination of loss of lows and phase shift; (6) combination of loss of highs and phase shift; (7) ringing, with good damping; and (8) ringing, with poor damping.



A BLINDFOLDED CHOICE IS NO CHOICE AT ALL

WØFCH, KGI-3471

EVERY HAM or CB'er with a mobile rig should be aware that antenna placement is equally as critical as selecting the mobile antenna itself. Furthermore, neither the antenna nor the mounting position should be chosen independently and without due consideration of the other. When a position is arbitrarily selected, the results may be disappointing. If they are, many hams and CB'ers start grumbling about the manufacturer of the antenna, or even the qualities of the transceiver, whereas the fault is simply that not enough thought was given to the actual placement of the antenna on the automobile body.

The Best Positions. No matter how you look at it, the best possible position for a mobile antenna is in the middle of the roof of a sedan or station wagon. When mounted in that position, the antenna "sees" the car body as a large mass of metal permitting symmetrical radiation of your signals*. This effect is shown graphically in the drawings at right. Note that the signal is fairly uniform in all directions, and turning the car should introduce little signal fading or sudden signal drop-outs.

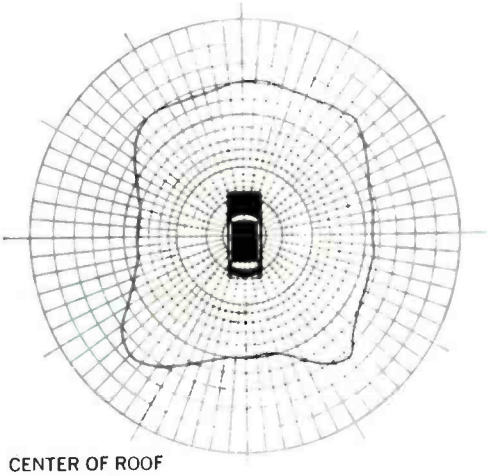
Many people cannot bring themselves to drill even a small hole in the middle of their car roof**. If this is a consid-

(*Continued on page* 106)

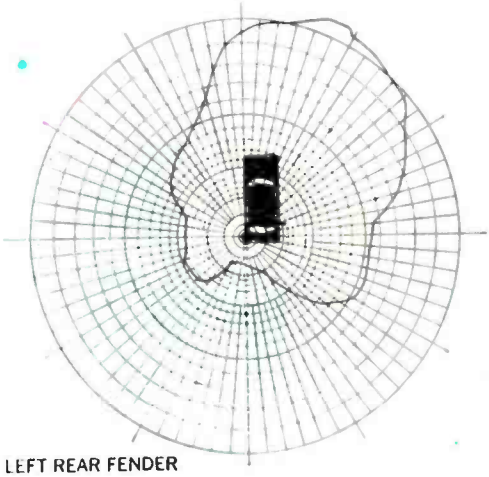
*Although reference is made in this article to transmitting, the identical effects are observed when receiving a base station on your mobile rig. The lobe patterns then show the extent and azimuth of maximum signal pickup.

**At least one manufacturer has a roof-top antenna that does not require a hole—the antenna being held in place by a powerful circular magnet.

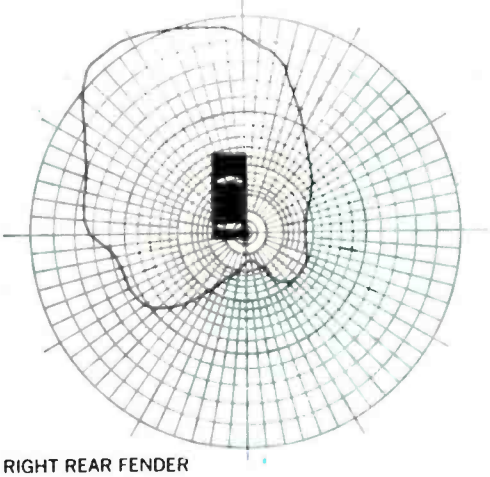
The illuminated areas below represent actual intensity and azimuth measurements made at the testing facilities of Hy-Gain Electronics. The antenna used was a full-length 108-inch whip tuned to 27.065 MHz. The roof-top mount is the best position for all-round radiation, the left rear bumper just about the worst—except in its favored direction where the lobe is substantially stronger. When the car is in motion and turning, you can see why there are extreme variations in signal strength.



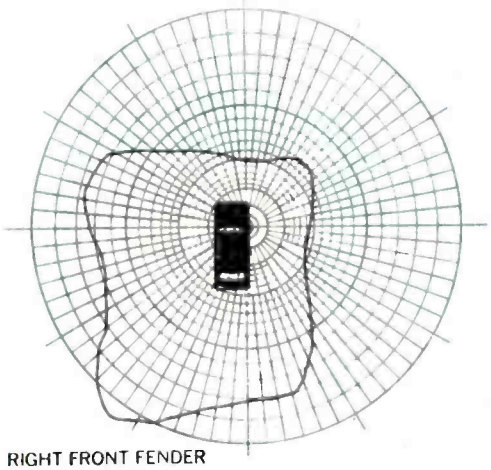
CENTER OF ROOF



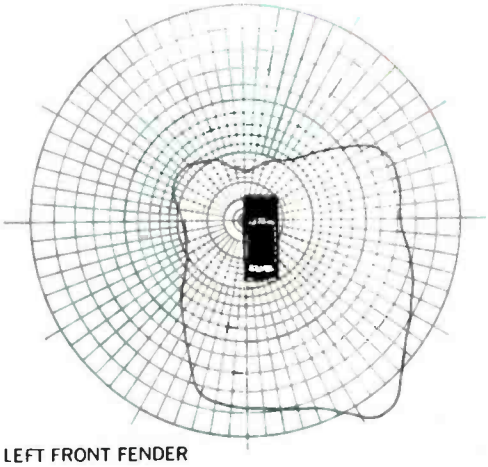
LEFT REAR FENDER



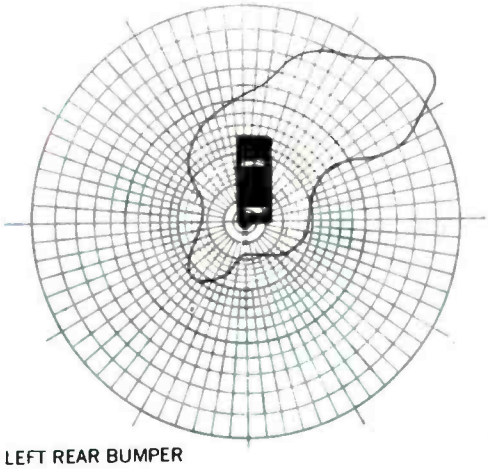
RIGHT REAR FENDER



RIGHT FRONT FENDER



LEFT FRONT FENDER



LEFT REAR BUMPER

HOW TO Install Automobile Stereo Tape Players

BEST RESULTS ARE OBTAINED ONLY WHEN THE SPEAKERS ARE PROPERLY PLACED

By HOMER L. DAVIDSON

The Lear Jet "Stereo 8" (trademark) tape player provides up to 1 hour and 20 minutes of stereo music.

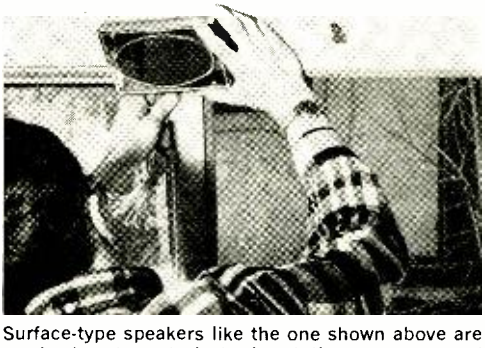
ONE of the hottest consumer electronic products to hit the market is the automobile stereo tape player. New-car dealers are offering a variety of players as optional equipment, and a recent report shows that electronic equipment suppliers are cashing in on this new fad.

There are tape players with two, four, and even eight tracks. Some have separate balance and tone controls while others combine everything into a single control. You also have a choice of two to eight speakers, depending on how elaborate an installation is desired. And you can get a radio-tape player combination that has been custom-designed for your particular make of car. Select the one that best fits your needs—or your fancy—and your pocketbook. Prices range from about $69.95 to $199.95.

Installing the Speakers. Figure 1 is the wiring diagram of a typical four-speaker stereo installation. These speakers can usually be obtained as matched sets from the tape player distributor, or they can be selected from dealer stock. Where speakers are purchased separately, identical sets should be chosen for each channel. For example, if you select a woofer-tweeter combination (Fig. 2) for one channel, you should do the same for the other channel. Do not put a woofer in one channel only, and a tweeter in the other channel only.

In general, the smaller speakers are mounted in the front doors while the larger speakers are mounted in the rear deck behind the back seat. For best results, the rear speakers should be of

Stereo speakers are positioned to produce optimum stereo effect from any passenger position in the automobile. In this installation, two small speakers are installed in each front door while a large speaker is mounted on each side of the rear deck.



Surface-type speakers like the one shown above are used almost exclusively in station wagons, and are installed over the door posts of the vehicle.

The mounting bracket for the tape player is installed under the dash just over the hump. Then the unit is mounted and secured firmly in position.

good quality and of the 6″ x 9″ oval type, the front speaker can be any size from 3½″ to about 5″ in diameter.

For installation in compact cars, only one speaker is usually required for each stereo channel, and the two speakers are placed in the front and rear of the car instead of in the doors. As a general rule, speaker balancing for the driver's position will usually be adequate for all passenger positions.

If you are installing a tape player in a station wagon, use surface-type speakers. Two speakers—one on each side—can be mounted above the door posts just behind the front seat, and the remaining two are mounted at the same height towards the rear of the wagon.

After mounting the speakers, connect the hookup wires and run them through concealed openings or under the floor mat to the dash. For best results, the speakers should be properly phased. The simplest approach is to listen for best sound as you reverse the connections to a speaker. There will be a difference, but you have to listen carefully to catch it. If you can't tell the difference, forget it; you'll still enjoy your system.

The exact wiring configuration will depend on the number of speakers used, as well as on the tape player requirements. Use of solderless connectors eases speaker hookup.

Installing the Tape Unit. When you install the tape player, it is best to follow the directions provided with the unit. In most installations the unit is bracket-mounted under the instrument dash. The best location is usually just over the hump in the floor.

After the unit is mounted, connect the fuse-protected power "accessories" terminal on the ignition switch. The power lead to the radio will usually lead you to the right terminal. Then, connect the speaker leads to the appropriate speaker terminals. After completing and checking all wiring, you are ready for a dry run.

(*Continued on page* 101)

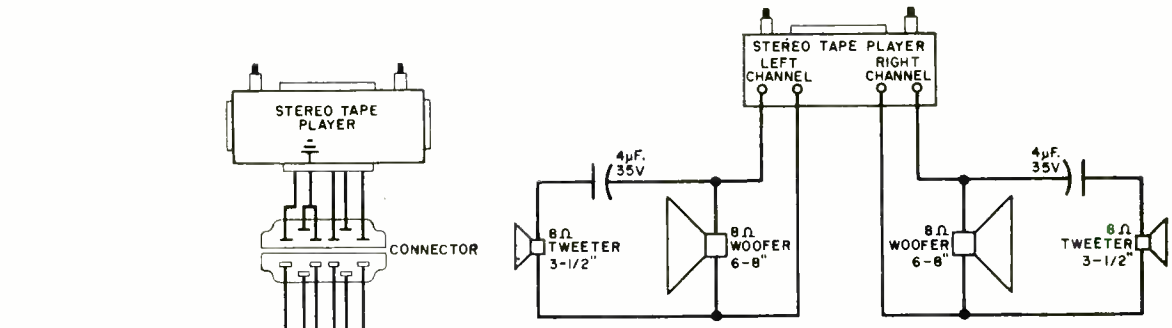


Fig. 2. Performance quality can be improved by adding tweeter to each channel. A 4-uF capacitor can serve as a crossover device.

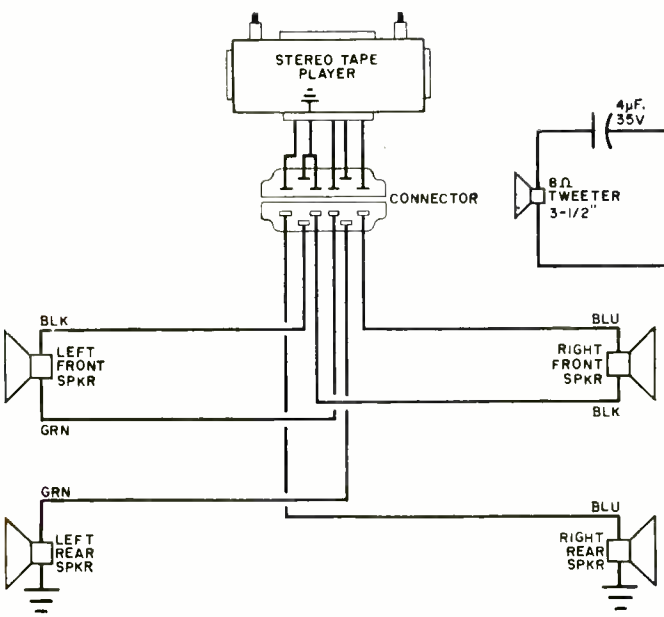
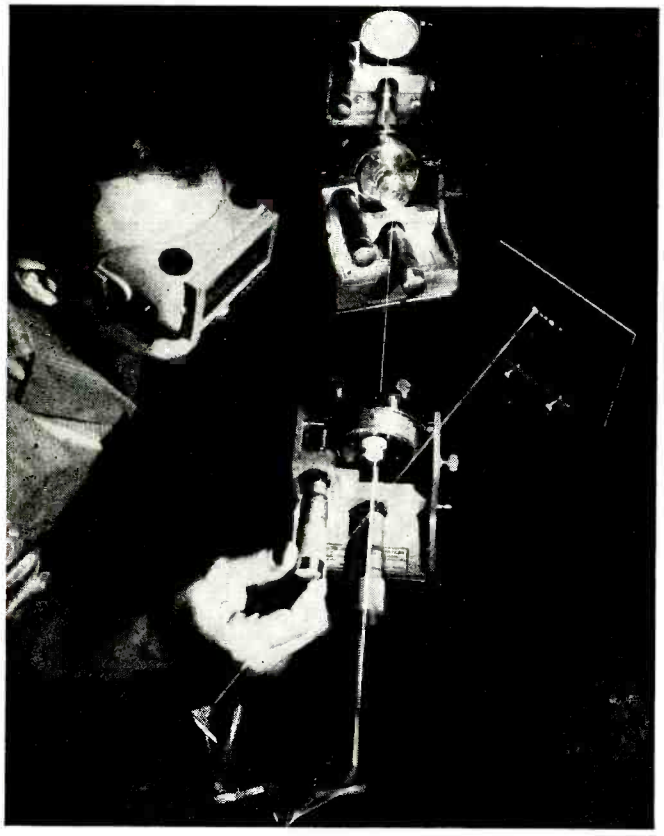


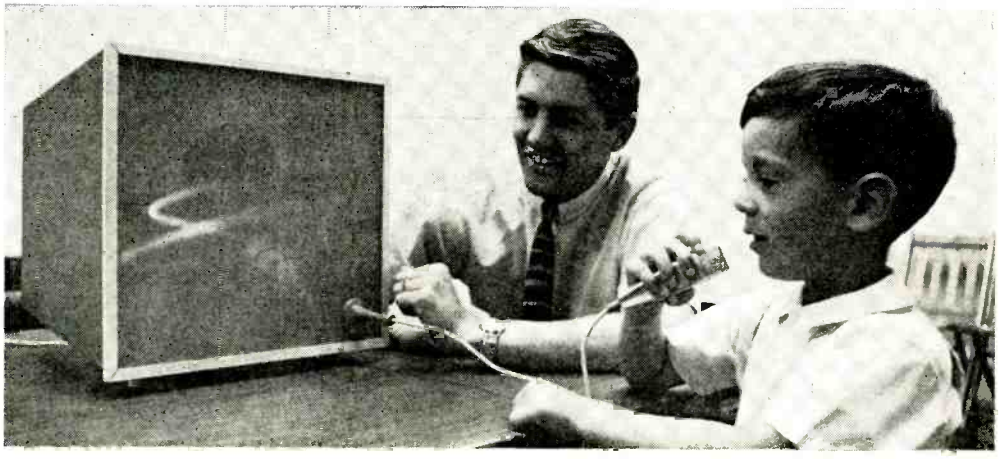
Fig. 1. A standard stereo installation employs 4 speakers arranged as shown at left. Rear speakers are grounded to frame; front speakers are grounded through tape unit.

ZERO-BEATING THE NEWS



LASER SHRINKS COMPUTER—Under development by IBM, a device consisting of special crystals and prisms for changing the color of a laser beam "color-codes" the memories of a computer with up to 100-million bits of information on a one-square-inch piece of film. The color selector makes possible information storage in layers, according to color, at a feasible rate of 125,000 characters per second. Colors can also be selected so that one records the information, another reads it out, and a third erases it altogether—all at time-saving speeds.

VISIBLE SOUND—Deaf children at the Stanford University Medical Center are eager to imitate teachers' voice patterns because of the game-like quality of this device invented by William C. Hayes. Dancing light lets children know that their voices can actually do something they can see.



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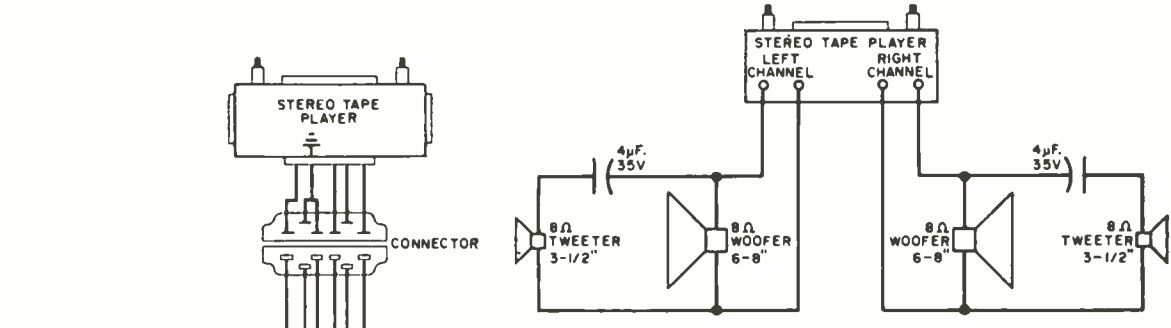

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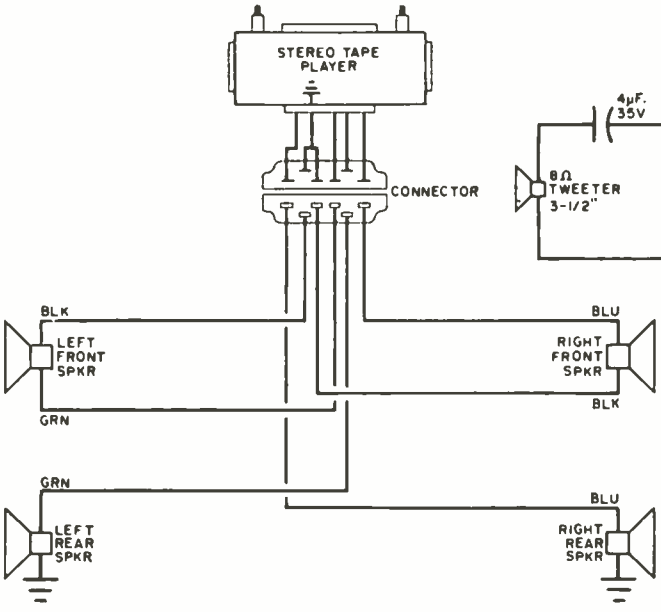

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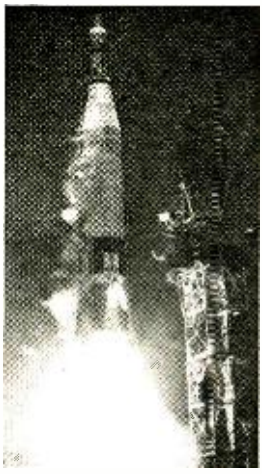

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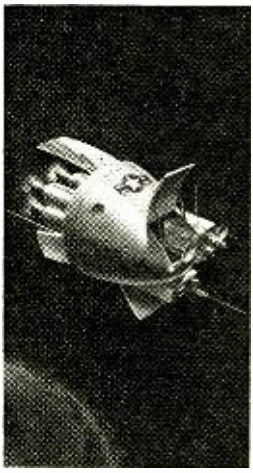

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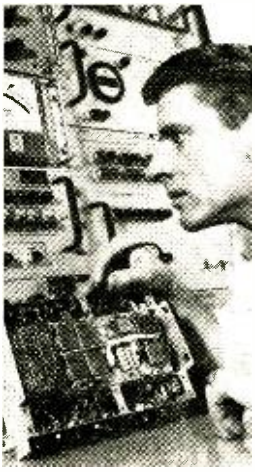

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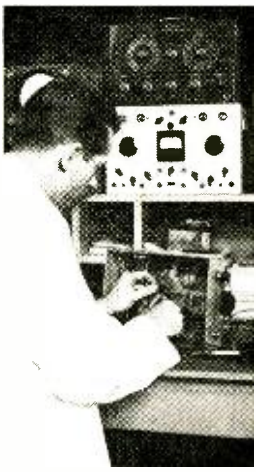

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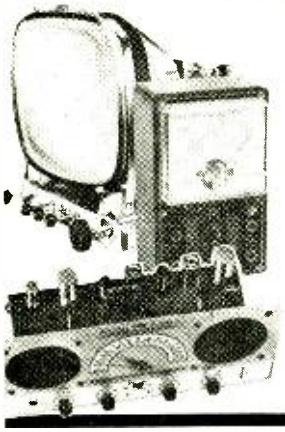

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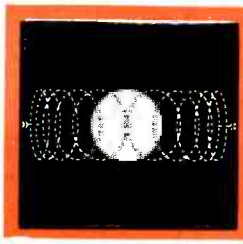

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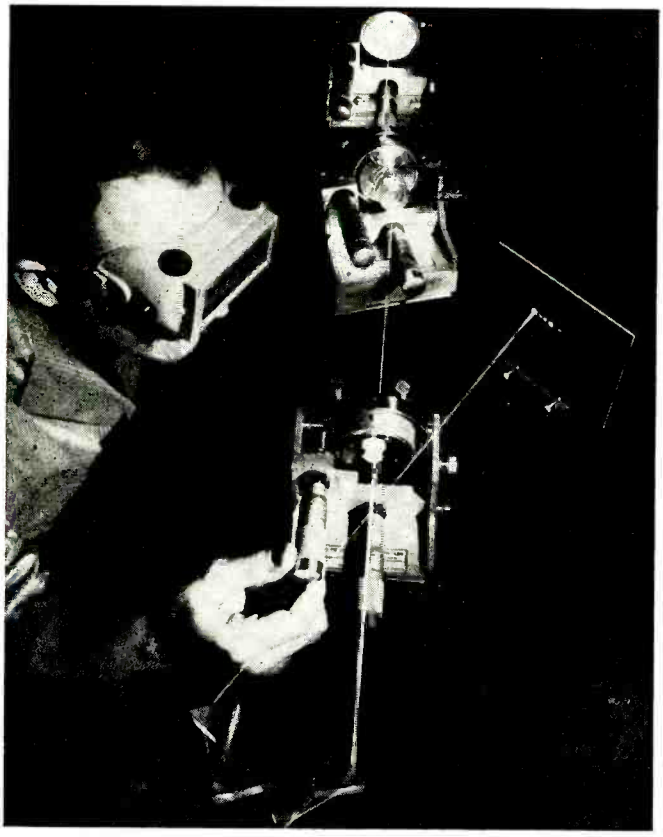
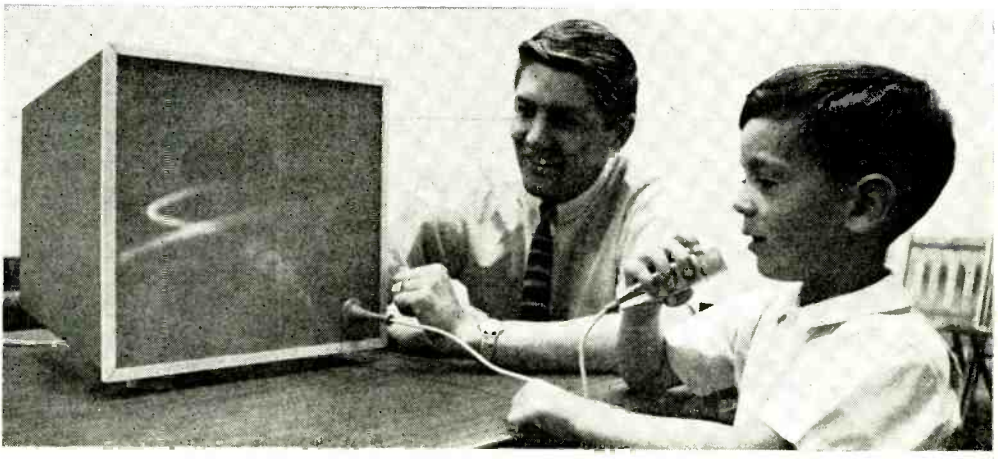
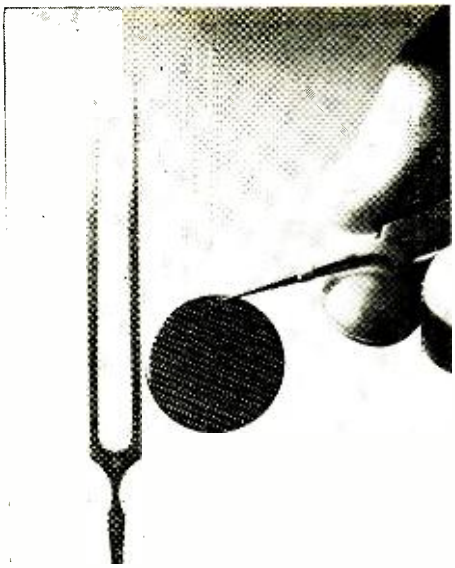


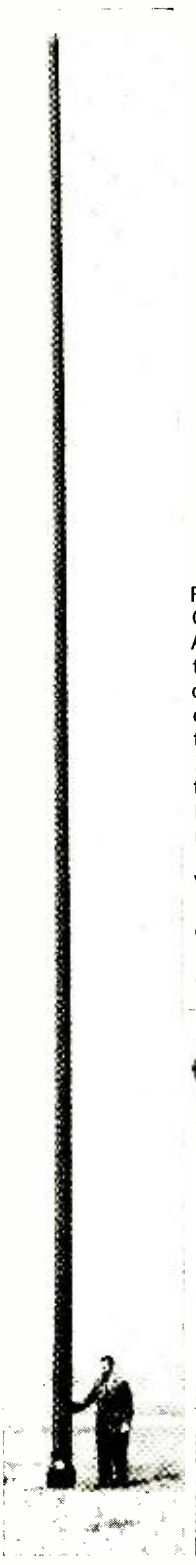
LASER SHRINKS COMPUTER—Under development by IBM, a device consisting of special crystals and prisms for changing the color of a laser beam "color-codes" the memories of a computer with up to 100-million bits of information on a one-square-inch piece of film. The color selector makes possible information storage in layers, according to color, at a feasible rate of 125,000 characters per second. Colors can also be selected so that one records the information, another reads it out, and a third erases it altogether—all at time-saving speeds.

VISIBLE SOUND—Deaf children at the Stanford University Medical Center are eager to imitate teachers' voice patterns because of the game-like quality of this device invented by William C. Hayes. Dancing light lets children know that their voices can actually do something they can see.





MICRO TUNING FORKS—Wafers of silicon, about the size of a quarter, containing 500 Resonant Gate Transistors (RGT's), are under joint development by Westinghouse and the Air Force Avionics Laboratory. The heart of each RGT is a tiny solid-gold tuning fork, 50-million times smaller than the one shown at left. These tiny devices make it possible to tune an integrated circuit without using bulky coils. The mechanical resonance of the tuning fork can be determined by its dimensions, and fabrication techniques for the RGT are compatible with those used at present in the construction of integrated circuits. Ultra-miniature electronic filters, telemetering circuits, two-way wrist radios, etc., are just a few of beneficiaries of the RGT's.



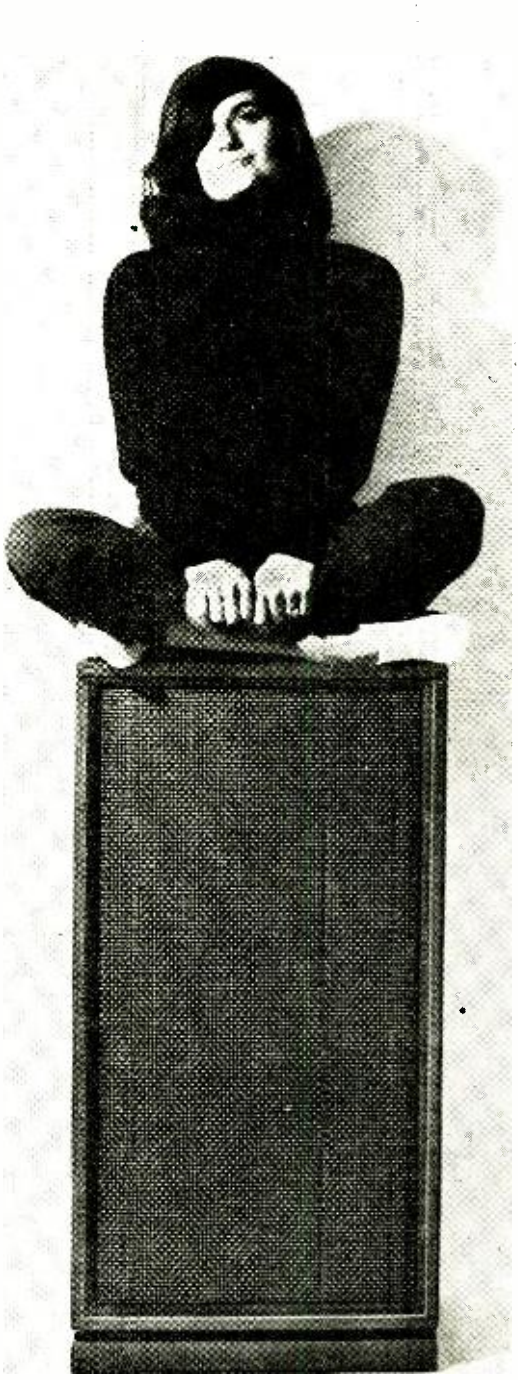
RISING TO THE OCCASION—Constructed by Goodyear Aerospace for the Air Force, the plastic reinforced column of a new type antenna can be inflated to a 60-foot height (left) in about 15 minutes with a simple foot-operated pump. At full height, line-of-sight range is about 25 miles, even in the dense jungles of Vietnam. The new antenna can be folded into a one-cubic-foot package to fit into a back-pack (below) for easy deployment in the field.

DEEP SEA POWER PLANT—Development of Systems for Nuclear Auxiliary Power (SNAP) is being carried out by the 3M Company for the Atomic Energy Commission to produce a deep sea power plant which will meet the technological demands of oceanographic research. The heat generated by the decay of Strontium 90, a radioactive element, will be used to power the plants. They will be encased in a special pressure chamber to withstand the high pressures on the ocean floor.

FOUR ON THE FLOOR

IMPROVED SPEAKERS PUT "CINDERELLA" IN A BIGGER CARRIAGE

By DAVID B. WEEMS



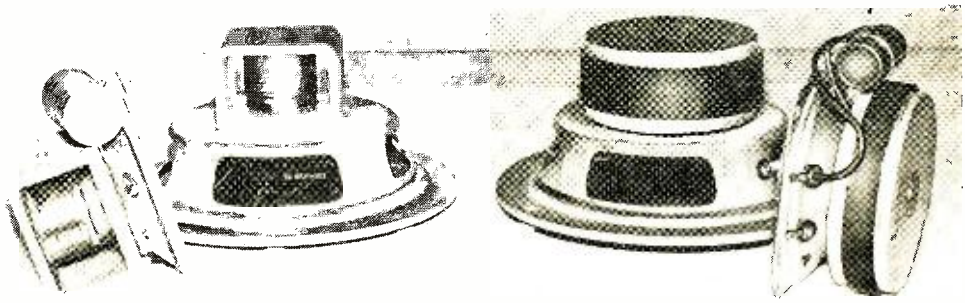
A QUICK GLANCE at a hi-fi catalog would probably reveal that you would have to plunk down $100 to $150 for a quality speaker system containing four woofers and two tweeters in handsome furniture cabinetry. But, for a few well spent hours and about $40, you can get your own system rolling. Four woofers, each rated at 12 watts, do for the "Four On The Floor" what the four-gear "stick-shift" on the floor of a sports car does for a hot-rodder: the woofers add that extra sense of presence when it's needed.

Improved versions of the 6″-diameter acoustic suspension woofer used in the "Cinderella" enclosure (October, 1965, issue of POPULAR ELECTRONICS) are now available. While the original woofer and tweeter each had a 4.6-ounce alnico V magnet, the new model woofer has a 20-ounce ceramic magnet, and the tweeter has a 10-ounce ceramic magnet. The new speakers sport better damping and improved transient response.

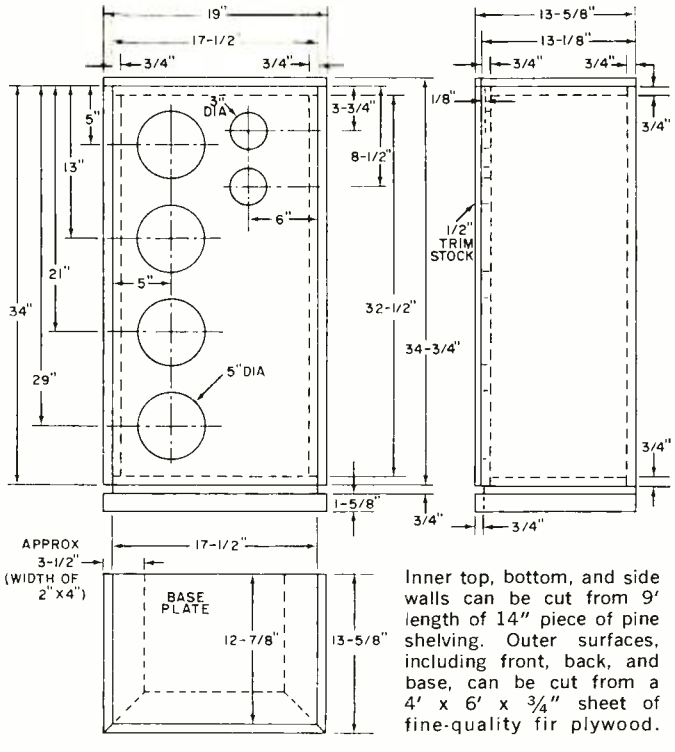
In the same way that multiple woofers beef up the low end of the audio spectrum, two tweeters bring the highs along. The net result is a more sensitive speaker system that will work off as little as a 10-watt amplifier, and yet handle a lot more power; overall response is smooth, and pleasing even to the most discriminating ear.

The Enclosure. A "box-within-a-box" design or double-thick walled construction provides a rigid enclosure to let the speaker's energy drive the air rather than the wood. Glue and screw the outer walls to the inner walls. Secure the front of the cabinet in the same way. Be sure to seal all the joints with glue. However, do not glue the back in place.

First assemble the interior frame and cabinet frame as shown, then finish off



Earlier models (at left) had 4.6-ounce Alnico V magnets; newer versions (at right) sport a 10-ounce ceramic magnet in the tweeter, and a 20-ounce unit in the woofer to provide better damping and transient response.



Inner top, bottom, and side walls can be cut from 9' length of 14" piece of pine shelving. Outer surfaces, including front, back, and base, can be cut from a 4' x 6' x ¾" sheet of fine-quality fir plywood.

Enclosure should be airtight. Except for the back, glue all joints and sides. Carefully mount plywood sides and top after inner box is assembled.

BILL OF MATERIALS

*4—XS-6071 woofers (4 for $25)**
*2—TS-6070 tweeters (2 for $7.50)**
2—17½" x 34" pieces of ¾" fir plywood for exterior front and back
2—13¼" x 34" pieces of ¾" fir plywood for exterior sides
1—13¾" x 19" piece of ¾" fir plywood for exterior top
1—13" x 17½" piece of ¾" fir plywood for exterior bottom
*2—11½" x 32½" pieces of ¾" pine shelving for interior frame sides***
*2—11½" x 17½" pieces of ¾" pine board for interior top and bottom***
1—2" x 4" x 48" piece of pine for footing
1—10' length of ½" quarter-round molding
1—10' length of 1" x ¾" fine grain pine
Misc.—#8 x ¾" sheet metal screws, #8 x 1¼" flat-head wood screws, #8 x 2" finishing nails, two-terminal screw-type terminal strip, 2"-thick x 12"- to 18"-wide fiberglass or quilted cotton batting, grille cloth, glue, small finishing nails

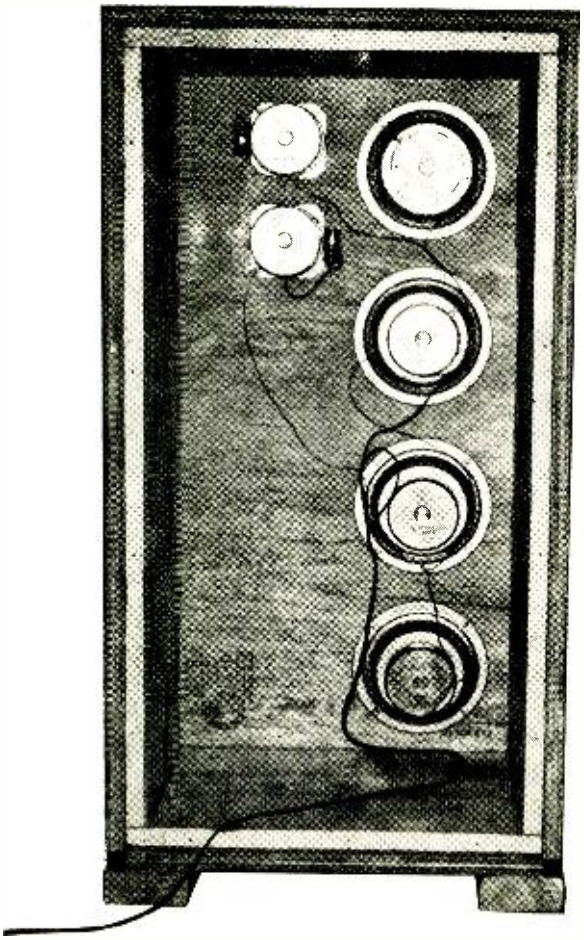
**Available from McGee Radio Co., 1901 McGee St., Kansas City, Mo.*

***Sold as 1" x 12" pine board*

with the exterior top and sides. Use 1¼"-long flat-head wood screws from the inside to hold the exterior walls in place. Pilot-drill the screw holes before securing the sides to the frame, to position the sides precisely. The sides should overlap the rear and bottom by ¾" and the front by ⅛". The top fits squarely over the sides. Be careful to finish and dress the side edges of the top so that they are flush with the sides and back.

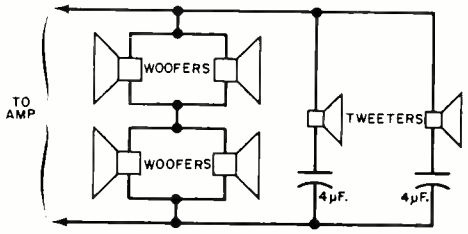
The base consists of a ¾"-thick piece of plywood mounted on a 2" x 4" frame which serves as a footing. Carefully miter (45°) the ends of the footing to obtain a smooth, professional appearance. (If desired, a square cut will suffice, but the exposed ends will have to be sanded smooth.) Join these pieces with #8 x 1¼" finishing nails, and nail or screw the frame to the bottom of the cabinet. A little glue won't do any harm, but be sure to keep things squared off.

Trim the front of the cabinet with ¾" x ½" fine grained wood and quarter-round molding. Do not nail the molding in place until the entire cabinet has been sanded and stained and the grille cloth has been tacked in place. Apply a coat of flat black paint to the front of the cabinet before installing the grille cloth. Use fine finishing nails on the molding.



Double-walled construction and multiple speaker system reinforce sound output and provide authoritative smooth response. Pad speakers and walls to dampen and break up standing waves within the enclosure.

Mounting and Wiring. Mount the speakers over their respective holes on the front of the cabinet with #8 x ¾" sheet metal screws. Pad the inside top, bottom, back, and side walls of the cabinet with 2"-thick fiberglass or quilted cotton batting. To provide the correct amount of damping for optimum performance, fold a three-pound roll of 18"-wide cotton batting in half and tack this to the top of the cabinet so that it forms a thick "blanket" over the speakers.

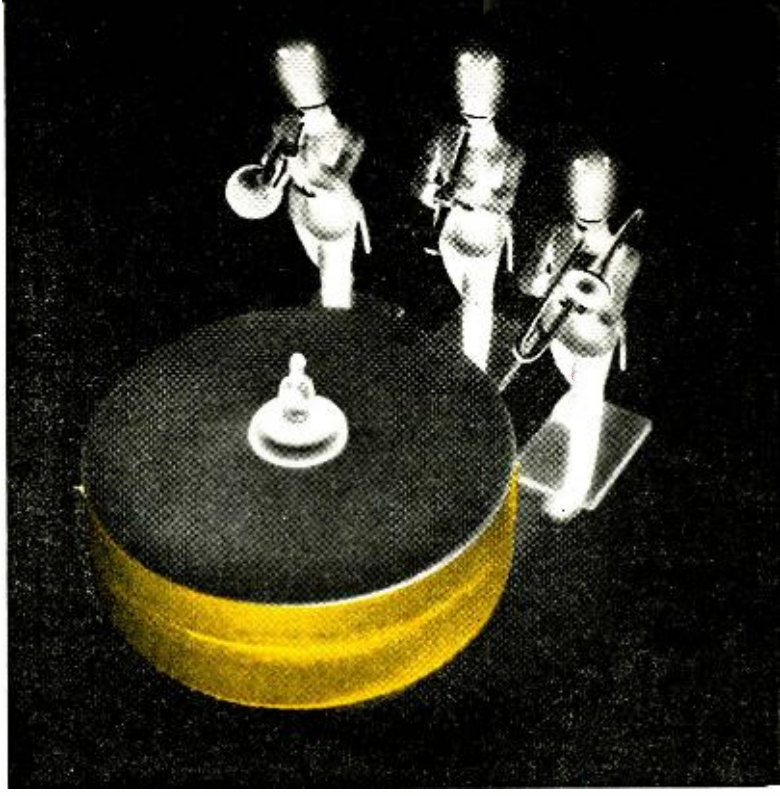


Hookup shown is for an amplifier's 8-ohm impedance tap. To maintain the proper phase, the top leads are connected to the terminal marked with a red dot.

Drill a hole in the back of the cabinet, just large enough to pass the wires through, and seal the hole with any suitable caulking material. Mount a terminal strip on the back to accommodate the wires.

Wire the speakers as shown. Observe the red dots to obtain proper phase, and solder all connections. You can color-code the terminal strip to show which terminal is connected to the red dots, just in case you decide to build two units for stereo. The back panel should then be screwed tightly in place; space the screws about 6" apart. Now hook up your amplifier. -30-

A LIGHTHOUSE FOR SHORT PEOPLE

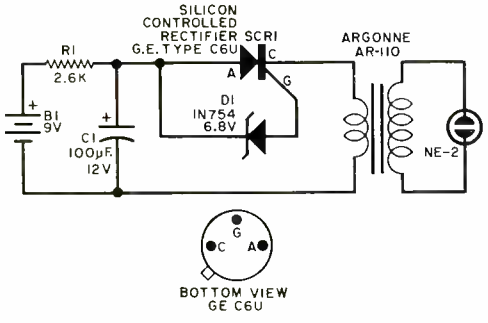


By **RUSSELL J. BIK**

WHAT IS THAT?
IT'S A FLASHING LIGHT
YES, BUT WHY DOES IT FLASH?
SO YOU CAN FIND IT WHEN YOU LOSE IT AT NIGHT

YOU CAN have lots of fun with the *Lighthouse for Short People*. A conversation piece for electronic buffs, it is small enough to fit in the palm of your hand and will flash continuously for weeks before exhausting a single 9-volt battery. It can even be made to "go to sleep" (stop flashing) at night.

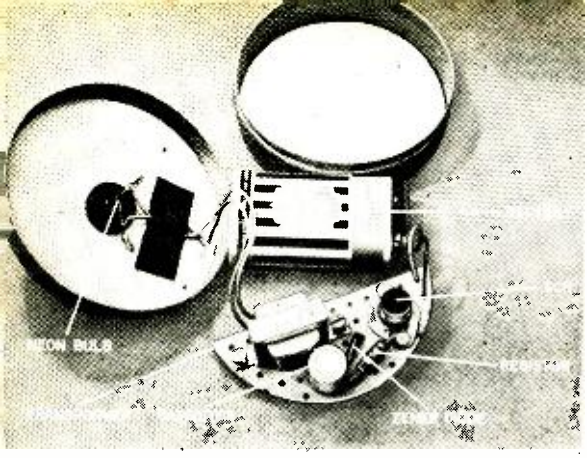
The *Lighthouse* also has practical uses. For example, its flash rate can be varied so that it functions as a strobe, light source, or timer. And, by placing an earphone in series with the neon bulb, an audio output can be obtained, making the *Lighthouse* useful as a visual-aural metronome.



Battery-powered flashing circuit consists of only seven miniature parts. See photo on next page for layout of components. Transformer is rated with a 10,000-ohm primary winding and 16-ohm secondary.

How It Works. The *Lighthouse* circuit consists of a high-voltage output relaxation oscillator coupled to a neon bulb. Capacitor *C1* is charged through resistor *R1* by the 9-volt battery. At 6.8 volts, the zener diode, *D1*, avalanches, triggering *SCR1*. The SCR, in turn, discharges *C1* through the transformer primary. Once the capacitor has discharged, the sudden cutoff of power causes the transformer to produce a counter e.m.f. (electromotive force) which turns off the SCR. The cycle is then repeated.

The *Lighthouse* circuit has a very high efficiency due to the almost complete lack of bias current. The only current greater than 0.1 μA flowing is that charging the capacitor.



The "Lighthouse" can be fitted into a metal can if care is taken not to short-circuit the active components. The best method to prevent a short is to line bottom of can with a cardboard sheet cut to fit. Tape wire leads of neon bulb to inside of lid so that lid can be lifted off to expose circuit.

Construction. A small, round, metal can (of the type that once contained shoe polish or electrical tape) was used to house the *Lighthouse* prototype. However, anything suitable—including a small plastic box—could be employed. If a similar metal can is used, cut and fit a circular piece of cardboard to the inside bottom of the can to prevent circuit board shorts.

Layout is not critical, but care should be taken when soldering the diode and SCR leads to avoid overheating. A transistor socket is convenient to use and eliminates the possibility of ruining the SCR.

The polarity of the diode and capacitor leads must be observed. Also, use of a cheap poor-quality zener diode is not advisable as the reverse conduction current may exceed that charging the capacitor.

Operation. The flash intensity is proportional to the size of *C1* and the flash rate to *C1* and *R1*. With the values specified, a flashing rate of 40 times per minute is obtained. However, by changing the value of *R1*, it can be varied from one flash every couple of minutes to nearly 60 flashes per second.

An interesting characteristic of the *Lighthouse* is that it has two modes of operation. When in the presence of day or room light, neon bulbs become partially ionized. Thus, the amount of power required to ionize (light) neon bulbs in total darkness is greater. The *dark effect*, as it is called, varies with each bulb and changes as the bulb ages.

Unless you happen to get a neon bulb in which the dark effect is not prevalent, using the component values specified will cause your light to "go to sleep" at night. If you would rather have it flash, you can do so by increasing the flash rate. In tests made at the editorial offices of POPULAR ELECTRONICS, a "regular" 9-volt battery lasted about five weeks and an alkaline battery was going strong after seven weeks. —30—

COMBO TELEPHONE AMPLIFIER/AM RADIO

A telephone amplifier is only a "useful sometime" thing. When you need it to amplify a telephone conversation so that a group of people can hear, the separate amplifier is handy to have around. But, since it is unlikely that the amplifier will be put to everyday use, most telephone amps gather dust.

One solution to the problem of space vs. usefulness has just been introduced by Avanti International Traders (68-03 Cooper Ave., Glendale, New York 11227). A regular 12-transistor AM radio was modified so that an inductive pickup could be switched into the audio amplifier. The pickup is attached to the telephone and the conversations amplified by the audio stages in the receiver.

The Combo sells for $13.95, complete with battery and pickup inductor. —30—

DI-DI-DI-DI-DI-DI-DI-DI-DIT*

FRIEND WIFE IS INVEIGLED INTO A NEW LANGUAGE

STORY AND ILLUSTRATIONS
By CARL KOHLER

I WAS COZILY gnawing upon a buck's worth of licorice whips and browsing through my bound-file of rare old *Mad* Magazine editions when Goodwife Kohler wafted into the room, her girlish features a study in tense caution.

"Whatever shorted-out will have to *stay* that way," I bantered warningly. "The old soldering iron and yours truly are taking the day off, kiddo."

"Eepkay ouryay oicevay ownday!" she hissed.

"Watch that dirty mouth! Just because we've lived intimately, lo, these past twenty years is no reason for you to sully our meaningful relationship with questionable language!"

"Libis-tiben tiboo mibee," she squeaked, switching from plebian pig-Latin into aristocratic carny without dropping a syllable in the process.

"Hold everything, right there!" I favored her with a stern glance of disapproval. "First, you burst in here on tippytoes, ordering me to keep my voice down—and in sophomoric pig-Latin yet. Now you're emphatically suggesting, in cornball carny, that I listen to you. What's with all this wry-lingual action, anyway?"

She peered nervously through the doorway, then silently closed the door. "Communication is going to be a problem for you and me, I'm afraid."

"I thought I burned your copy of *The Feminine Mystique,* baby. Don't tell me that we still haven't resolved all that nonsense about communication between the sexes."

"I'm talking about *ordinary* communication like holding everyday conversations without giving *It* away, see?"

"Your quasi-logic is, as usual, cloaked

**Author's note for new readers: Morse Code for "Error"*

"Even a cretin can master the code . . ."

in utter confusion. Precisely *what* are we trying to avoid giving away?"

"The Christmas presents," she muttered tersely. "I'm talking about the Christmas gifts and our four nosey sons who have every intention of finding where I've hidden them and—"

"Okay," I said cheerfully, "I'll bite! Where *did* you hide the kids?"

"Not the kids. The *gifts*. The kids are trying to *find* the gifts."

"That figures. Sounds natural enough."

"Well, we might give the hiding-place away in a careless moment of daily conversation, so I got this *marvelous* idea!" She *twinkled* at me. If ever there is a clear-cut sign of impending trouble, it's when she twinkles at me.

"Whatever it is—*forget* it!"

"No, *really*!" she crooned gaily. "How can they possibly be tipped-off to the whereabouts of all those yuletime goodies—if we simply speak something *other* than English whenever we discuss the subject?"

I pondered the point. Occasionally—just occasionally, mind you—she comes up with an idea more sound than I enjoy admitting. I try to discourage this practice on the grounds that it could lead to Thinking.

"Ummm," I ummed noncommittally.

"We both know pig-Latin," she said brightly.

"So do the kids."

"Carny?"

"I taught it to them for laughs."

She went silent, looking baffled. Apparently, we'd reached the limit of her language ability. Unfortunately, I found myself fascinated by the concept now.

"What are they taking in school—*besides* Advanced Civil Disobedience and Elementary Sullenness?"

"Spanish, French and German," she replied.

"Okay, scratch the easy tongues."

"Well, how can we keep from accidentally spilling the beans about the hidden gifts unless we find a way to discuss it so the boys can't possibly understand what we're saying?"

"A good question. Not that I'm glad you asked it, you understand, but it's exactly the sort of problem *my* supple intelligence best grapples with, so why don't you go make it some coffee while I sit here and grapple a little?"

She traipsed away in the direction of the coffeepot and my eyes began roving the shelves of books I've splurged my life's savings upon all these long, thriftless years. Suddenly, my gaze was braked to an abrupt stop by a title that fairly hurled itself into my vision: *Morse Code Made Easy.*

"Why, of *course*!" I chuckled. "The grand old *Code!* Simplicity itself!"

I took the book in hand, memories flooding back of those halcyon days when I sought a Novice Class license, diligently practicing hammering out the 26 letters, the 10 numerals, and the sundry punctuation marks as I spent hour after hour, day upon night, clicking the key in boyish hopes of developing a distinctive "fist" by which I would be known to the world of those who magically talked with their fingers across vast distances.

"Here's your java," interrupted my wife, placing a cup of something murky before me.

"Dah-di-dah!" I trilled.

"Huh?"

"Dah-di-dah!" I repeated, my knowing smile widening into a triumphant leer. "I'm merely *inviting* you to *Transmit,* gorgeous!"

"Now, none of *that!"* she said crisply, stepping away from me rather hastily. "Drink your nice coffee-royal and *behave* —or I'm putting you on Sanka!"

"Listen, I've found the language in which we can discuss Christmas and anything else you prefer to cover in front of the boys without them having the foggiest notion of what we're chatting about. Naturally, it'll require some study and practice on your part, but even a cretin can master the Code, given a bit of time and patient instruction."

"Code? *What* Code?"

I explained the Morse code to her, showing her the dot-and-dash graphics, detailing the structure of this form of signal, and concluding with an enthralling history of the entire subject. She sat with slightly glazed eyes, frowning into space.

"Sounds hard," she remarked.

"Not a bit."

"I'm no good at languages."

"No grammatical pitfalls in Morse, sweets."

"Sometimes, I even have trouble *think-*

ing in English, and I'm always mispronouncing words."

I sighed. "No accent variables in the Code."

"Maybe we could both sign up at night school and study Sanskrit together or something?"

"Listen, sister," I insisted flatly, "you are going to learn to speak Morse like an *expert*! I'll be patient and kind and calm as you struggle toward a total mastery of this simple communicatory system, but you *shall* learn it!"

"And what if I still don't get it right?"

Bending a steely smile of determination upon her, I said hoarsely: "*You* started this whole gig. *You* put this challenge in front of me. You're going to dit-and-dah like you were born with a bug for tonsils even if I have to cut a hickory switch—and *use* it!"

The ensuing weeks gradually became a flamboyant carnival of daily sessions in which we checked out her memorization of the code symbols. Laboriously, she managed—at length—to memorize all of them, and promptly scrambled the entire combinations of dots and dashes into possibly the most unlikely language ever to contaminate the human mind.

I introduced learning aids, such as the *Allied Radio Code Course,* and forced her to sit with a numb expression on her face—absorbing the actual *sound* of the code being transmitted at various speeds—while I washed the dishes, scrubbed floors and tidied up the place. Slowly, unbelievably, she began responding to the steady barrage of dots and dashes.

"This . . . is . . . fun!" she ditdahed, finally, one morning. *"I . . . think . . . it's . . . great!"*

"Vunderbar!" I rejoiced Teutonically. "I was just about ready to put the project aside and go for a cram-course in Urdu!"

"Please . . . speak . . . Morse," she requested.

"Oh, come off it! The kids aren't around. We can converse safely enough in—"

"No . . . speaka . . . da . . . English. Confine . . . all . . . messages . . . to . . . code . . . or . . . sign . . . off!"

"Not quite so fast," I implored. "I'm afraid—heh! heh!—my ears are a trifle rusty, and you've been picking up speed quite magnificently until you're starting to sound like a semiautomatic machine!"

She smirked a filthy smirk at me.

Another week passed and the rotten little student achieved a delivery speed that left my ears echoing with an un-

(*Continued on page* 109)

"A good group but hardly a reliable source."

SOLID STATE

By LOU GARNER, Semiconductor Editor

Do the newspaper and magazine reports of electronic "bugs," hidden transmitters, long-range microphones and other electronic snooping devices make you long for the free pioneer days of our forefathers? Do you yearn to go back to nature . . . to enjoy the freedom and privacy of the Great Outdoors —the forests, the streams, the bush, the plains . . . to share the secret hiding places of the prairie chicken, the bobwhite, the grouse, and other unspoiled creatures?

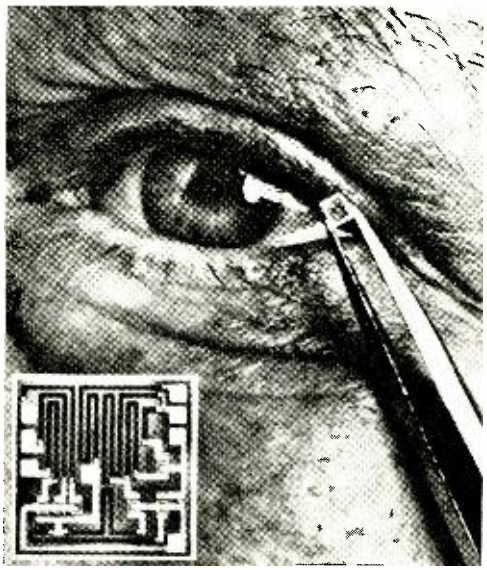
Forget it! You won't be safe there, either. Zoologists and nature students all over the world are using the most advanced electronic techniques and devices to seek out the hiding places of wildlife, to discover their migration habits, to follow their feeding patterns and, in general, to do a thorough job of snooping into their private lives. All of this scientific detective work has been made possible by the availability of compact, efficient, and lightweight solid-state telemetry equipment.

Although exact *modus operandi* vary with the type of game and local conditions, the techniques used by graduate students at Kansas State University are typical. As reported in *Kansas Fish and Game*, students of the Department of Zoology are studying the living habits of *Tympanuchus cupido pinnatus*—prairie chickens—by using subminiature transistorized transmitters and a combination of both fixed-base and portable receivers.

First, wild prairie chickens are captured in the study area by means of a cannon-net trap. Selected birds are then equipped with a radio telemetry pack consisting of an epoxy-cased transmitter about the size of one's little finger, a fine whip antenna, and a mercury battery with an operating life of about two months. Held in place by a simple harness made of plastic tubing, the transmitter and whip antenna are strapped on the back of the bird between its wings while the battery rests over the breast. The entire assembly weighs less than an ounce.

Next, the "bugged" birds are released at the trap site. Each transmitter operates at a different frequency, permitting easy identification of individual birds up to a half mile away from the receivers.

The birds are tracked using direction finder receivers and triangulation techniques. As an antenna is rotated, the direction it is facing is indicated by a pointer and compass card. A whistling tone is heard through headphones connected to a receiver when the antenna points toward a radio-tagged bird.



Smaller than the pupil of a human eye, a Telefunken DCTL gate, shown magnified five times, is held by tweezers. In the inset at left, the same microcircuit has been amplified 50 times to show three inputs and a driver with 15 different components.

For purposes of the study, fixed-base receivers and high-gain directional antennas are set up at eight locations within the research area. In addition, portable "bird dog" receivers are available for use by individual investigators who wish to make direct field studies. The researchers believe that the transmitters have little or no effect on the natural behavior of the prairie chickens since the birds have incubated, boomed, and otherwise behaved in a normal manner.

But Kansas is not the only state using transistorized telemetry equipment for wildlife studies. Minnesota has used similar methods on ruffed grouse while South Dakota has "bugged" some of her pheasants. Other states and universities have also used related methods to study the natural habits

of game mammals, fur-bearers, waterfowl and other types of game birds.

Looking to the future, the day may come when integrated circuit transmitters and minute batteries will be used to check on the natural habits or various types of insects, leading to more effective pest control methods. Now watch that fly . . . that bug may be "bugged!"

Readers' Circuits. It has been quite a while since this column has featured a transistorized power megaphone circuit. And although there are a number of inexpensive factory-built units on the market, many experimenters and do-it-yourself'ers derive a certain amount of added satisfaction from building things that are sometimes cheaper to buy ready-made. If you're one of this group, you might enjoy trying the circuit illustrated in Fig. 1.

Submitted by reader Jim T. Fields (2404-29th St., Columbus, Nebr.), this circuit requires just one low-cost power transistor (*Q1*) and a minimum of additional components. It can be assembled in an hour.

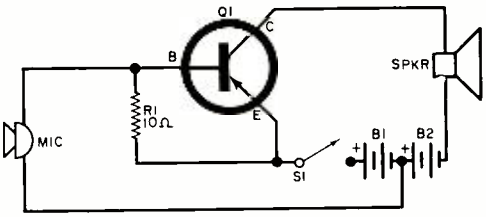


Fig. 1. A single power transistor in a common-emitter arrangement supplies driving energy for power megaphone circuit submitted by reader Jim Fields.

Jim has used a *pnp* power transistor in a common-emitter configuration as a direct-coupled power amplifier. The drive signal is furnished by a carbon microphone which, in conjunction with fixed resistor *R1*, also serves to establish base bias. The speaker's voice coil winding acts as *Q1*'s collector load. Operating power is supplied by tapped battery *B1-B2*, controlled by push-to-talk switch *S1*.

Readily available components are used. Transistor *Q1* is a general-purpose *pnp* power unit (2N301, 2N554, or similar). Resistor *R1* is a 1-watter and the microphone is an ordinary carbon type. Either a paging trumpet or standard PM loudspeaker with a 3.2- to 6-ohm voice coil can be used. Switch *S1* is a s.p.s.t. normally-open momentary-contact push-button type. Power supply *B1-B2* consists of four size "D" flashlight cells connected in series to supply 6 volts, and tapped to provide a 3-volt bias source.

Packaging and physical design are left strictly up to the builder. For example, if a trumpet-type speaker is used, you may wish to assemble the amplifier, microphone cartridge and battery pack in a small metal case that can also support the speaker.

Unless you're a rank beginner, you've probably assembled a number of crystal receivers in your time. And if you did, chances are they used a single crystal diode as a detector. In such circuits, the diode acts as a half-wave rectifier. Full-wave rectification (or detection) is more efficient, however, and recognizing this, reader William H. Witt, WA2AFW (101 Overlook Rd., White Plains, N.Y.), has suggested the circuit shown in Fig. 2. Bill writes that he was prompted to experiment with various diode circuits after reading our discussion on the "evolution" of a single-transistor receiver in the January 1966 column.

The receiver consists of an antenna, tuned circuit (*L1-C1*), diodes *D1-D4* arranged in

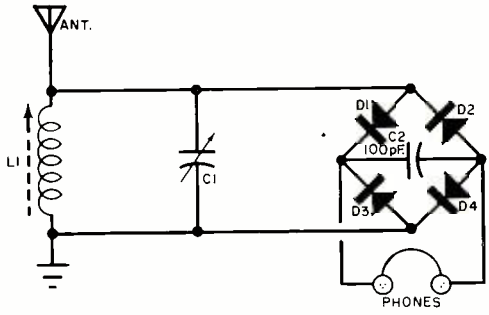


Fig. 2. Greater efficiency from full-wave detection of an AM r.f. wave is claimed by reader William H. Witt, who has submitted this TRF receiver circuit.

a bridge configuration, r.f. bypass capacitor *C2*, and a pair of headphones. Signals picked up by the antenna are selected by *L1-C1* and applied to the detector. The detected audio signal is applied directly to the headphones.

If you'd like to try your hand at Bill's circuit, you can assemble it either breadboard fashion or in a small plastic, metal, or wooden case. Naturally, the tuned circuit component values will be determined by the frequencies to be covered. For AM broadcast-band reception, *L1* is a standard ferrite loopstick coil and *C1* a 365-pF tuning capacitor. Capacitor C2 is a 100-pF mica, ceramic, or tubular paper type. The four diodes are general-purpose types such as 1N34's. For best results, use a pair of high-impedance magnetic or crystal headphones.

Manufacturer's Circuit. Frequency multiplier circuits have been in use for years in transmitters and signal generators. In these circuits the frequency of the output signal

is an integral multiple of the input signal frequency. On the other hand, frequency divider circuits—those in which the output signal frequency is an integral submultiple of the drive signal frequency—had not been used extensively until the past few years. Today, however, frequency dividers are being utilized in ever-increasing numbers in computers, counters, and electronic musical instruments. In an electronic organ. for example, frequency dividers are sometimes employed to provide octave stops to simulate the effect of organ pipes (or "voices") of increasing length.

An interesting frequency divider circuit providing a 100:1 division is illustrated in Fig. 3. Suitable for use in experimental work or in, say, a science fair project, the circuit utilizes cascaded interlocked unijunction transistor (UJT) relaxation oscillators. It is one of several such circuits described in *The Unijunction Transistor Characteristics and Applications*, an application note published by the General Electric Company (Semiconductor Products Dept., Electronics Park, Syracuse, N.Y.).

In Fig. 3, *Q1* is connected as a relaxation oscillator operating at approximately 5 kHz, or one-fourth the nominal input frequency of 20 kHz. Its natural operating frequency is determined primarily by the *R1*, *R2-C1* time constant. With a 20-kHz input signal, the circuit is triggered by every fourth cycle of the applied frequency, developing a pulse-like signal across *R5*, the base-2 load resistor, which is also common to the succeeding stages. The second divider stage, *Q2*, is almost identical to the first, except that its emitter resistor, *R3*, has nearly five times the resistance of *R1*, and hence the natural frequency of the stage is approximately one-fifth that of the first stage, or 1 kHz.

With *Q2*'s *base-2* load shared with *Q1*, the second stage locks in with the first stage's output signal, and hence with the original input signal. Similarly, *R4*, *Q3*'s emitter resistor, is about five times the value of *R3*, and the natural frequency of this stage is one-fifth that of the second stage, or 200 hertz. As before, the last stage locks in with the previous stages and the output pulse developed across *R6*, *Q3*'s *base-1* load. has a frequency of 200 hertz, or one-hundredth that of the input signal. At the same time, a *combined* output signal is developed across *R7*, the *base-2* load, which is common to all stages.

All of the resistors are half-watt types, while the three capacitors can be either disc ceramics or tubular paper units. General Electric suggests the use of 2N491 UJT's throughout, but other types can be used if the supply voltage and circuit component values are readjusted for optimum performance.

Transitips. One of the questions most frequently asked by readers of this column is: "How can a high input impedance be obtained in a transistor amplifier?" Although we have discussed this topic in past columns, it might be helpful to review it.

A conventional common-emitter amplifier stage has a low-to-moderate input impedance because its base-emitter junction is forward-biased. The actual impedance may range from less than 10 ohms in some power transistors to as high as 5000 or 10,000 ohms in small signal types with relatively low base bias.

Unfortunately, tuned circuits, crystal microphones, ceramic phono cartridges, and other popular pickup devices have high output impedances. And if these are coupled to low-impedance circuits, there may be a considerable power loss as well as a deterioration of signal quality.

A simple, but useful, technique for in-

(*Continued on page* 114)

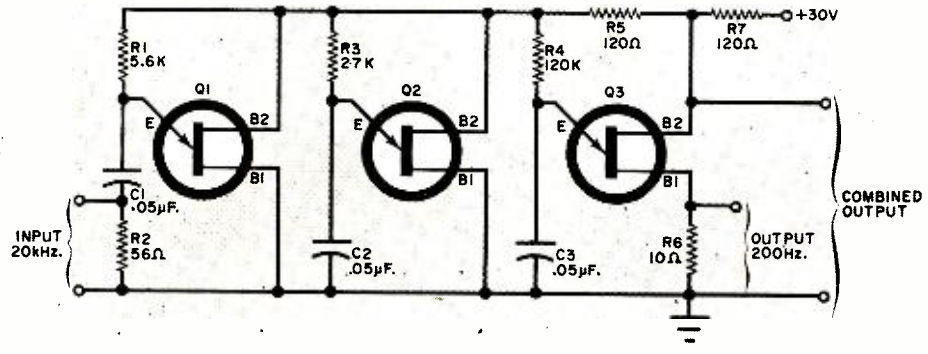
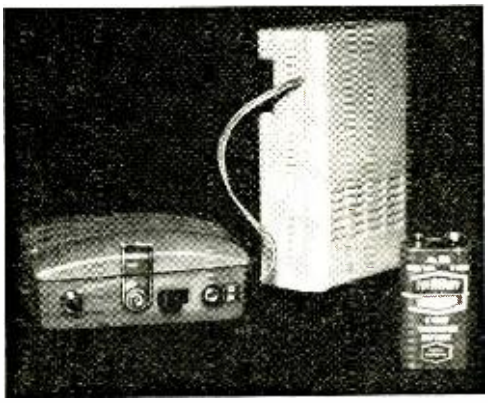
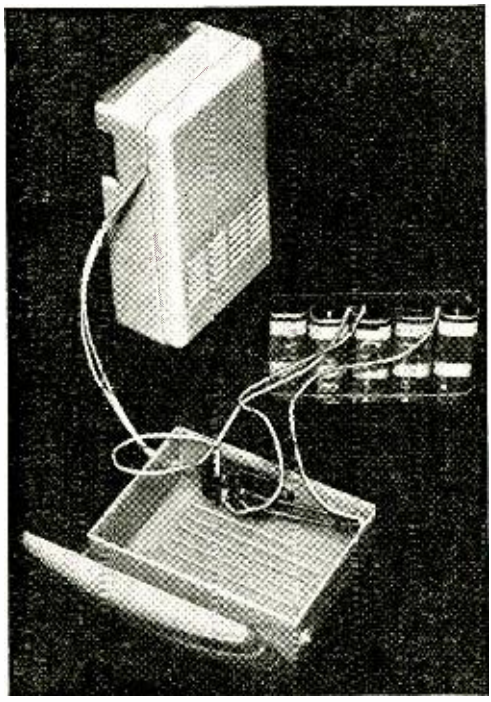


Fig. 3. Fully described in a recent application note from General Electric Company, this frequency divider employs cascaded interlocked unijunction transistor oscillator circuits (Q1, Q2, and Q3) to provide a 100:1 frequency division. Its natural operating frequency is determined by the R1, R2-C1 time constant.

VOLTAGE-REGULATED BATTERY POWER SUPPLY





Simple "soap dish" battery pack can be assembled in minutes, and attached with rubber bands, or in any convenient manner, to equipment to be powered.

HOW TO OVERCOME INITIAL DECLINE OF PEAK VOLTAGE AND GET MORE BATTERY LIFE

By FRANK G. STIVER

HOW MANY TIMES, in an effort to achieve peak performance, have you prematurely replaced batteries in your transistor radio, tape recorder, or CB equipment, only to find that the peak voltage falls off again in a very short time? In a battery-operated tape recorder, where tape speed is a function of battery voltage, it is important that a constant voltage be maintained for as long a time as possible. Citizens Band units, whose range and sensitivity are affected by battery voltage, should have the maximum rated voltage available when needed.

You could parallel a number of batteries and extend the time it takes for the voltage to reach its mean level, but the drop still occurs at a relatively rapid rate. It's no secret that the output of a carbon-zinc type of battery drops rapidly after a few hours of operation, then levels off at a lower voltage, and maintains that level for about 75% of its useful life. The "Voltage-Regulated Battery Power Supply" will furnish a constant 9-volt output and extend useful battery life well beyond "end-point" voltage.

Essentially, the circuit is a series-type transistorized voltage regulator which compensates for variations in both load and voltage source. This type of regulator has inherently high-efficiency characteristics, especially in small-current applications, and because of transistor gain (only microamperes of base-emitter current are needed to control milliamperes of collector-emitter current), sensitive, quick-responding voltage regulation is obtained. However, care must be taken not to short out the regulated output even momentarily—to prevent destruction of the transistor.

How It Works. Four 9-volt batteries (*B1* through *B4*) connected in series-parallel serve as a power source and provide about 18 volts when new. Transistor *Q1*, (a 2N321, or similar unit) is in series with the load and the power source, and acts like a variable resistor, the value of which depends upon the 9-volt bias battery (*B5*) and the voltage across either or both the load and the power source. Regulated output voltage is essentially equal to battery *B5* voltage under reasonably normal load conditions.

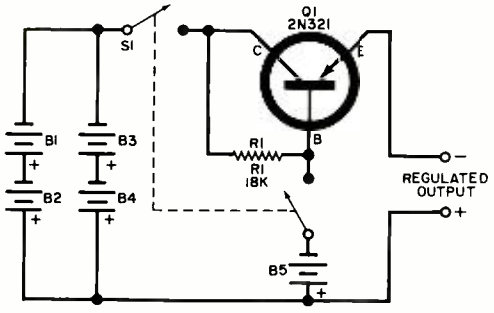
A drop in negative voltage at the collector or the emitter of *Q1* makes the base look more negative and increases the forward bias, which allows the transistor to conduct more readily, and effectively reduces its dynamic resistance. The resulting reduced voltage drop across *Q1* compensates for the initial reduced voltage condition and restores the output to 9 volts.

Conversely, if the negative voltage at either input or output increases (or both), *Q1*'s base looks more positive, reduces its forward bias, increases the voltage drop across the collector-emitter, and restores the output voltage to its regulated value. Note that output voltage will tend to increase or decrease according to load conditions. Input voltage, of course, depends upon battery condition.

A 9-volt zener diode could be used instead of battery *B5*, but the diode would draw some current (about 4 or 5 mA) and reduce efficiency. The use of a bias battery provides better regulation at low values of collector voltage. This battery also goes to work when the power source drops down to 9 volts. As the collector voltage approaches the base voltage, the base-emitter junction—acting as a diode—lets current from *B5* get to the load and effectively places *B5* in parallel with the voltage source across the load.

Resistor *R1* preserves *B5* in a unique manner. During the useful life of the power source, a small current flows through *R1* which is available for base current and, if necessary, to charge *B5*. The result is that *B5* supplies almost no current until the power source approaches 9 volts; when the power source is 9 volts, each individual battery (*B1, B2, B3,* and *B4*) is down to 4.5 volts. It should now be evident that the output voltage will remain at 9 volts during the entire lifetime of the batteries, and then some.

Of course, the circuit would work the same way if only two batteries, say *B1* and *B2,* were used for the power source. However, this modification would require more frequent replacement of batteries. Standard 9-volt transistor radio batteries are used because they are readily available and they fit into a small case.



Highly responsive, efficient series-type voltage regulator depends upon dynamic resistance of Q1 to compensate for load and battery voltage changes.

Construction. Almost any type of container that will hold the five 9-volt batteries can be converted for use as a "cabinet." The "unbreakable" soap dish (see p. 85) is just the right size for the job and looks clean. Both the transistor and the d.p.d.t. switch (*S1*) are mounted on the side of the soap dish. Wiring is straightforward and not critical, but pay close attention to polarity when interconnecting the batteries and output leads to the radio or other load. The output leads should be long enough

(*Continued on page* 108)

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

NEW NOVICE EXAMINATION QUESTIONS

WITHOUT FANFARE, the Federal Communications Commission recently added eight questions and answers to its Novice study guide to cover new material which might be included in future Novice examinations. If you are planning to take the Novice exam soon, or are teaching a Novice course, be sure to add these questions to those in the Novice section of the "License Manual" or other amateur study guides. While they are not too difficult, we wager that even some General Class amateurs will have to think twice before answering one or two of them. Here are the questions—and the answers.

How are amateur signals propagated over great distances? Amateur high-frequency signals are normally propagated over great distances by being reflected (refracted) by an electrified region called the "ionosphere" 50 to 250 miles above the earth.

International communications by amateur radio is subject to what restrictions? (1) Such communications must be authorized by the governments involved; (2) the communications must be of such nature that they would not normally be sent by existing commercial means of communications; (3) unless special agreements have been made between the governments involved, only licensed amateurs may communicate with each other internationally via amateur radio (no communications by or in behalf of third parties).

What is the basic usage of a capacitor? A capacitor permits the passage of alternating current through it without passing direct current; it also stores and releases electrical energy upon demand.

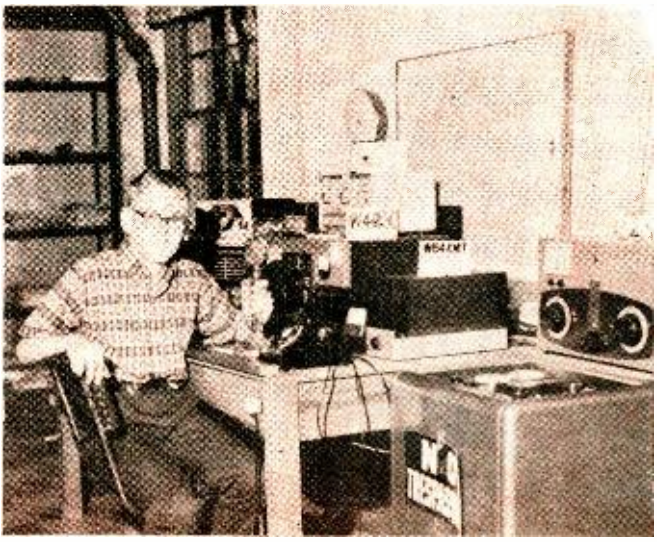
For what reason are height restrictions placed on antenna structures for amateur stations? The Commission places restrictions on antenna height for reasons of aircraft safety.

What methods are available for determining whether the transmitter output frequency is within the authorized frequency band?

(*Continued on page* 116)

AMATEUR STATION OF THE MONTH

Jimmy Hall, WB4AMT, Richmond, Va., started his Novice career at the age of 11, working 44 states and 7 countries with a Hallicrafters HT-40 transmitter and a SX-101 receiver. With the incentive of using his dad's (W4BLX) 1000-watt station when he got his General ticket, it didn't take Jimmy long to make the grade. Part of the equipment package is a Mosley TA-33 tri-band beam 90' high! Jimmy will receive a one-year subscription for submitting the winning photo for November in our Amateur Station of the Month contest. If you would like to enter the contest, send us a clear picture of your station with you at the controls, and some details on your ham career and the equipment you use. Mail your entry to: Amateur Radio Contest, c/o Herb S. Brier, P.O. Box 678, Gary, Indiana 46401.



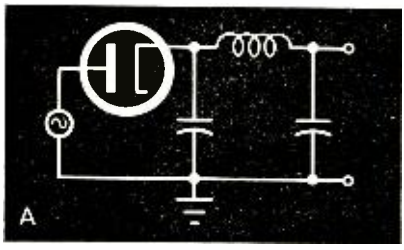
ELECTRONIC FACTOR QUIZ

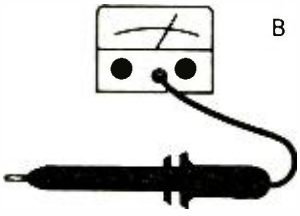
By ROBERT P. BALIN

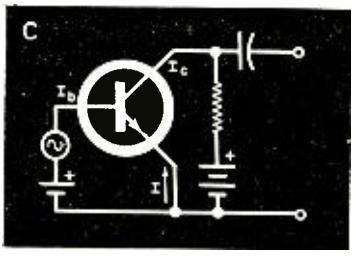
Most electronic technicians are familiar with such common expressions as "safety factor" and "conversion factor." But how many are sure of the meaning of terms like "power factor" and "duty factor"? See if you can associate the electronic FACTOR expressions below (1-10) with the sketches (A-J) that suggest their application or meaning.

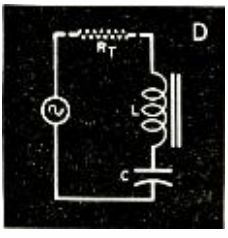
1 Current amplification factor _____
2 Damping factor _____
3 Modulation factor _____
4 Duty factor _____
5 Form factor _____
6 Quality factor _____
7 Ripple factor _____
8 Velocity factor _____
9 Voltage amplification factor _____
10 Scale factor _____

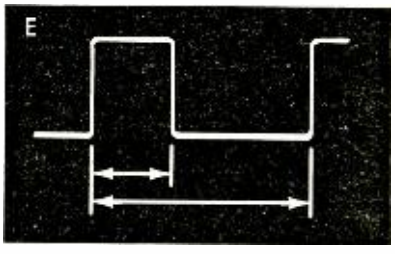
(*Answers on page* 112)

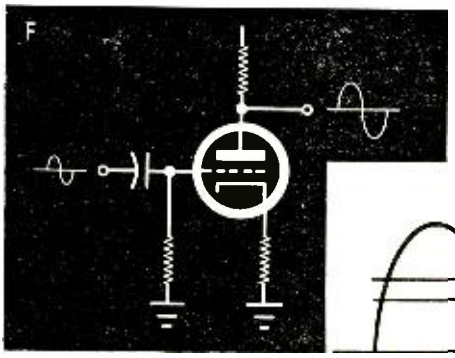


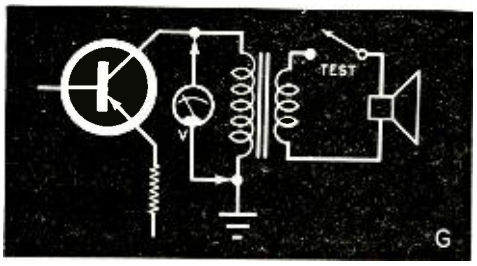


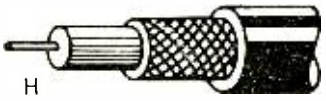


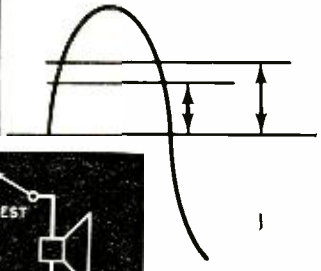


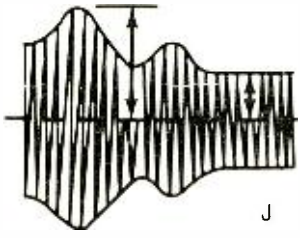












ON THE CITIZENS BAND

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

AN EXPERIMENTAL road-vehicle communications system has been developed by General Motors that would enable CB-equipped motorists to summon help in an emergency. Called DAIR (for Driver Aid, Information, and Routing), the system would also provide automatic routing for extended trips and advise motorists of speed and traffic signs. Since it would be an expensive project, GM proposes that it be implemented in a series of "building blocks" to spread the costs. Here is what DAIR would offer the motorist on a block-breakdown basis:

DAIR ROAD/ VEHICLE SYSTEM

BLOCK 1: *Two-Way Communication.* About 900,000 CB'ers are equipped with transceivers, the heart of the first building block. Federal and state highway agencies would build *Aid and Information Centers* for communications under the plan. Two new CB channels near the present channels would be allocated for national highway safety use by the FCC.

BLOCK 2: *Audio Signposts.* The *Audio Signposts* building block would be added to mobile CB transceivers. The equipment required would be a loop antenna on the vehicle frame, a decoder, and a circuit to mute the standard car radio speaker when *Audio Signpost* voice messages were received. Highway agencies would supply roadside magnetic triggers and milliwatt transmitters with remote connection to a *Traffic Central.*

(*Continued on page* 118)

Increased safety on the highways would be possible with the DAIR communications system—based on the use of CB transceivers—which has been developed at General Motors Research Laboratories. One "building block" in the system would permit the CB motorist to use a dial encoder (see inset at right) to call for an ambulance, fire truck, tow truck, or the police. The call for help would be picked up by a console at one of many Aid and Information Centers (below) and appropriate aid dispatched.

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF NOVEMBER

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MHz)
		MORNING BROADCASTS		
AUSTRALIA	Melbourne	7:15-8:15 a.m.	1215-1315	9.58
CANADA	Montreal	7:15-8:15 a.m.	1215-1315	5.97, 15.32
DENMARK	Copenhagen	7:30-8 a.m.	1230-1300	15.165
FINLAND	Helsinki	7:15-7:45 a.m.	1215-1245	15.185 (Tues., Sat.)
GREAT BRITAIN	London	10:30 a.m.-12:30 p.m.	1530-1730	15.35, 17.81
SWEDEN	Stockholm	9-9:30 a.m.	1400-1430	15.195
		EVENING BROADCASTS		
ALBANIA	Tirana	7-7:30 p.m.	0000-0030	7.265
BULGARIA	Sofia	7-8 p.m.	0000-0100	6.07
CHINA	Peking	8-10 p.m.	0100-0300	11.945, 15.06
CUBA	Havana	8-11 p.m.	0100-0400	6.17
CZECHOSLOVAKIA	Prague	8-9 p.m.	0100-0200	5.93, 7.115, 7.345
ECUADOR	Quito (HCJB)	9-11:30 p.m.	0200-0430	9.745, 11.915
EGYPT	Cairo	8:30-10 p.m.	0130-0300	9.595
GERMANY	Berlin	8-9 p.m.	0100-0200	6.16, 9.73
	Cologne	8:30-9:50 p.m.	0130-0250	6.075, 9.64
GREAT BRITAIN	London	4:15-9:45 p.m.	2115-0245	6.195, 7.13, 9.51
HUNGARY	Budapest	8:30-9:30 p.m.	0130-0230	6.235, 9.833
ITALY	Rome	8-8:20 p.m.	0100-0120	5.96, 9.63
JAPAN	Tokyo	6:45-7:45 p.m.	2345-0045	11.78, 15.135
LEBANON	Beirut	9:30-10 p.m.	0230-0300	9.575
NETHERLANDS	Hilversum	8:30-9:30 p.m.	0130-0230	9.59 (Bonaire relay)
PORTUGAL	Lisbon	9-9:45 p.m.	0200-0245	6.025, 6.185
ROMANIA	Bucharest	8:30-9:30 p.m.	0130-0230	6.15, 9.57
SOUTH AFRICA	Johannesburg	7:30-8:30 p.m.	0030-0130	9.525, 11.90
SPAIN	Madrid	8-9:30 p.m.	0100-0230	6.13, 9.76
SWEDEN	Stockholm	8:15-9:45 p.m.	0115-0245	9.705
SWITZERLAND	Berne	8:15-9:15 p.m.	0115-0215	6.12, 9.535
U.S.S.R.	Kiev	7:30-8 p.m. (Mon., Thurs., Fri.)	0030-0100 (Tues., Fri., Sat.)	7.12, 7.31, 9.665
	Moscow	5-5:30 p.m. & hourly to 12-1 a.m.	2200-2230 & hourly to 0500-0600	7.15, 7.31, 9.665
VATICAN	Vatican	7:50-8:10 p.m.	0050-0110	5.985, 7.25, 9.645

TO WESTERN NORTH AMERICA

COUNTRY	CITY	TIME—PST	TIME—GMT	FREQUENCIES (MHz)
ARGENTINA	Buenos Aires	10-11 p.m. (Mon.-Fri.)	0600-0700 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	5-7 p.m.	0100-0300	15.22, 17.84
BULGARIA	Sofia	8-8:30 p.m.	0400-0430	6.07
CHINA	Peking	7-9 p.m.	0300-0500	9.457, 11.82, 15.095
	Taipei	6:50-7:50 p.m.	0250-0350	11.86, 15.345
CZECHOSLOVAKIA	Prague	7:30-8:30 p.m.	0330-0430	5.93, 7.115, 7.345
GERMANY	Berlin	7:45-8:15 p.m.	0345-0415	6.16, 9.73
	Cologne	9-9:40 p.m.	0500-0540	6.145, 9.735
HUNGARY	Budapest	7-8 p.m.	0300-0400	6.235, 9.833
JAPAN	Tokyo	6-7 p.m.	0200-0300	11.78, 15.135
KOREA	Seoul	7-7:30 p.m.	0300-0330	11.925
PORTUGAL	Lisbon	8-8:45 p.m.	0400-0445	6.025, 6.185
SOUTH AFRICA	Johannesburg	6:30-7:30 p.m.	0230-0330	9.525, 11.90
SWEDEN	Stockholm	7:15-7:45 p.m.	0315-0345	9.705
SWITZERLAND	Berne	8:15-9:15 p.m.	0415-0515	6.12, 9.535
U.S.S.R.	Moscow	7-10:30 p.m.	0300-0730	9.54, 9.735, 11.755

SHORT-WAVE LISTENING

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

THOSE NON-VERIFYING POINT-TO-POINT STATIONS

"WE REGRET that the transmission you heard and reported was not intended for reception by the general public. Unauthorized interception is prohibited according to the International Radio Regulations. Therefore, we are not able to send you a QSL card."

These, or similar words, denote that a listener has heard and logged one of the many point-to-point stations generally used for overseas telephone communications, and that the listener has sent a reception report to the station. This form of QSL refusal letter is used justifiably by a utility station when the reception report contains information of a confidential nature. However, the same letter is used by such stations to deny the listener a QSL when he has reported on an entirely different type of transmission.

It is true that a point-to-point station cannot, according to international regulations, verify a reception report of a telephone communication in progress. The station is obligated to send this refusal notice to the listener. But such a station will often run a test marker during those periods when confidential communications are not being relayed. It is far easier to log and identify these utility stations during their running marker transmissions than it is to try to identify them during confidential transmissions. During the running marker ("This is a test transmission from a station of the ..... telephone company located ....."), there is nothing of any confidential nature being transmitted.

Many SWL's have logged and identified utility stations during these testing periods and have sent reception reports in proper form to the stations, complete with return postage, only to be refused QSL's. And these SWL's want to know why the stations continue to refuse to verify reception reports for the logging of such non-confidential transmissions. Your Short-Wave Editor hereby offers equal space to any bona-fide station representative for an explanation of this practice.

Incidentally, the station that sent the letter quoted at the beginning of this column was in error. There is no regulation that prohibits anyone from *listening* to confidential conversations. The prohibition is against the passing on of any information that the listener may have heard. In short, you *may* listen to these transmissions; you *may not* comment on what you have heard nor are you permitted to send reception reports based on these transmissions.

Station News. In last month's column, HCJB, Quito, Ecuador was listed as signing off at 0357. Unfortunately, letters in the call-sign were transposed. The station that

(Continued on page 126)

Mitchell Hyman, WPE2OPK, located in Brooklyn, N.Y., does his DX'ing with a Grundig Majestic 21470. To date, he has 24 countries verified out of 35 logged. Mitchell is a member of the Radio Portugal DX Club and the Radio Canada Short-Wave Club.

Leo Stowell, WPE9HTU, has a well-equipped listening post in Chicago, Ill. In addition to a Hallicrafters S-108 receiver, there is an antenna tuner, an S-meter, a nuvistor converter, a 6-meter converter, and another Hallicrafters receiver, an S-120.

BROADCASTS FROM CENTRAL AND SOUTH AMERICA

Prepared by BOB HILL and BILL LEGGE

Most of the countries of Central America, South America, and the West Indies do not operate international broadcasting stations. Nearly all of the short-wave broadcasts in these countries are intended for reception within a country. These stations therefore operate with relatively low power, generally use nondirectional antennas, and transmit in the language of the country. It is possible to hear stations in most of these countries by knowing when and where to tune. The following listing gives the best times and frequencies.

COUNTRY	STATIONS & CITY	TIME-GMT	FREQUENCIES (MHz)	LANGUAGE
ARGENTINA	R.A.E., Buenos Aires	0300-0400	6.09, 9.69	English
BOLIVIA	R. Universo, La Paz	1100-1130	5.017	Spanish
BRAZIL	R. Excelsior, Sao Paulo	2200-0400	9.585	Portuguese
	R. Cl. Pernambuco, Recife	2200-0300	11.865	"
	R. Bandeirantes, Sao Paulo	2200-0300	11.925	"
BRITISH HONDURAS	R. Belize, Belize	0300-0400	3.30	English
CHILE	R. Pres. Balmaceda, Santiago	0000-0500	9.60	Spanish
	R. Cooperativa, Santiago	0000-0430	9.70	"
	R. Nuevo Mundo, Santiago	2300-0430	11.74	"
COLOMBIA	R. Nacional, Bogota	0000-0500	4.955, 6.18	Spanish
	R. Sutatenza, Sutatenza	2300-0315	5.075, 6.075	"
COSTA RICA	R. Reloj, San Jose	2300-0600	6.21	Spanish
	TIFC, Faro Del Caribe, San Jose	0000-0400	9.645	"
CUBA	R. Havana, Havana	0330-0600	6.135	English
		2050-2150	15.135	"
DOMINICAN REPUBLIC	R. TV. Dominicana, Santo Domingo	0000-0500	6.09, 9.503	Spanish
ECUADOR	HCJB, Voice of the Andes, Quito	1830-2030	15.325, 17.88	English
		0200-0430	9.745, 11.915	"
EL SALVADOR	R. Nacional, San Salvador	2200-0400	9.555	Spanish
FRENCH GUIANA	RFT, Cayenne	1030-1130	3.385	French
GUATEMALA	R. Nacional Tikal, Flores Peten	0200-0500	6.205	Spanish
GUYANA	R. Demerara, Georgetown	0000-0215	3.265	English
HAITI	4VEH, Cap Haitien	1130-1400	6.12, 9.77, 11.835	English
HONDURAS	HRRH, Santa Rosa De Copan	0000-0500	5.96	Spanish
	HRQ, R. Suyapa, San Pedro Sula	1200-1300	6.125	"
MARTINIQUE	R. Antilles-Guyane, Fort De France	0000-0230	3.315 4.895	French
MEXICO	XEWW, Mexico City	1155-0500	6.165, 9.515	Spanish
	XEHH, Mexico City	1200-0600	11.88	"
NETHERLANDS ANTILLES	Trans World Radio, Bonaire	0230-0355	11.825	English
NICARAGUA	R. Zelaya, Bluefields	1100-1200	5.95	Spanish
	R. Mundial, Managua	0000-0400	5.965	"
PARAQUAY	R. Teleco, Asunsion	2100-2300	11.852	Spanish
	R. Encarnacion, Encarnacion	2200-2400	11.947	"
PERU	R. Nacional, Lima	1145-1300	6.082, 9.562	Spanish
	R. Atlantida, Iquitos	0200-0500	9.625	"
SWAN ISLAND	R. Americas, Swan Island	1000-1300	6.00	Spanish
URUGUAY	El Espectador, Montevideo	0000-0500	11.835	Spanish
VENEZUELA	R. Caracas, Caracas	0000-0500	4.92	Spanish
	R. Rumbos, Caracas	0000-0600	4.97	"
WINDWARD ISLANDS	Windward Islands BC Service, Grenada	2240-0215	3.28	English

Some plain talk from Kodak about tape:

Double or nothing... or the noble art of dubbing

One good tape deserves another. That's another way of saying that half the fun in having a good-quality, home tape-recording system should consist of being able to make tape duplicates. The reasons for dubbing can be as varied as you want. Perhaps as simple as sending your Aunt Mabel a particularly good tape of the kids — a tape you also want for your own tape library . . . or because you want to exchange tapes with a fellow audiophile . . . or because you want to edit a tape to go along with a movie or slide film without chopping up the original tape . . . or simply to preserve your early tape recordings on modern, more efficient KODAK Sound Recording Tape.

Takes two to swing. If you already have a second tape recorder on hand, you're ready to get started. If not, find a good friend that will lend you his. But do be particular about your friend. Because that old cliché about the weakest link applies in spades as far as dubbing equipment goes. Also be particular about the tape you use . . . but as they say on radio, more on this later.

Read the instructions. First off—and though it may seem obvious — make sure your two tape systems are in the best possible condition. Look at it this way — the dubbed recording will be at best a second generation recording . . . it's going to combine all the deficiencies present in your original tape recording, in the playback recorder, and in the recording equipment. So read both instruction books . . . then clean the heads with one of the commercial preparations available for that purpose . . . and demagnetize the heads if you can lay your hands on a degausser.

Next, connect your two tape machines — the "master" and the "slave." If you have a choice, take your output from the master at the pre-amp stage rather than at the amplifier. No reason to add its distortion to your dubbing. For the input to the slave, you usually have a choice—one marked "mike" or "high-impedance" (usually in the 50,000-200,000 ohms range), the other marked either "radio," "phono," "tuner," "tape" or "low-impedance" (in the 500-ohm range). You want the latter one.

Choose your tape. Signal-to-noise is the touchiest area in dubbing. Picking a tape that will give you the lowest noise level on the duplicate without lowered output makes a lot of sense. We've got just the tape for you: KODAK Sound Recording Tape, Type 34A. It packs five or more additional decibels of undistorted output than the usual low-noise tapes. When dubbing on KODAK Sound Recording Tape, Type 34A, set the recording level on your slave unit at 4 decibels over your normal level—that's just slightly higher than normal if you set your level by a VU meter. Because you can put a lot of signal on this tape, you can play it back at lower gain . . . and, Eureka, there's your low noise!

KODAK Tapes — on DUROL and Polyester Bases — are available at most electronics, camera, and department stores. To get the most out of your tape system, send for free, 24-page "Plain Talk" booklet which covers the major aspects of tape performance. Write: Eastman Kodak Company, Department 940, Rochester, N.Y. 14650.

EASTMAN KODAK COMPANY, Rochester, N. Y.

CIRCLE NO. 14 ON READER SERVICE PAGE

STILL INVENTING SPEAKERS

(*Continued from page* 52)

a special feeling of warmth and depth to reproduced music. Unfortunately, only the best speakers manage to pump out bottom bass convincingly and without unnatural booming.

Most recent design work on woofers has tended to make small, inexpensive speakers project better bass. Granted, the new bantam speakers based on these developments don't quite match the quality of a full-sized bookshelf model or a large floor-standing speaker, but some of them come amazingly close. The "bantams" may falter before the thunder of a full symphony orchestra, but most music comes through these little speakers with amazing fullness of sound.

Tweeters, by contrast, use very light, small moving parts to reach the uppermost frequencies of the audible range. In the tweeter department, much current work concentrates on gaining better dispersion of high-frequency sounds. Dispersion is too often neglected in evaluating speakers, yet it vitally affects the fidelity of the sound you hear. In poorly designed speakers, the treble emerges in a narrow beam, like the beam of light from the headlights of a car. This leaves wide areas in an "acoustic shadow" on either side of the beam and makes the sound cramped and strident, lacking natural warmth and spaciousness.

To spread the treble more evenly throughout the listening area, tweeter designers use various devices, such as flared horns, special dispersing cones (sometimes called "whizzers"), or tweeter cones in the shape of semicircular domes. A lively dispute ranges among the partisans of these various methods.

Good treble speakers now attain dispersion angles as wide as 120 degrees, i.e., 60 degrees to each side of the center line. Again, this information is not always published, and only the exceptional manufacturer publishes a clear statement or—better yet—a graph of treble dispersion.

Fortunately, there is a simple way in

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The Claricon "RANGEMASTER" by TOKAI is a professional transceiver with every feature necessary to insure dependable long range communication. Dynamic microphone cartridge delivers 100% modulation. Interchangeable plug in crystals permit use of all 23 CB channels. Housed in a rugged drawn metal case. Jacks for earphone and AC adaptor.

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SPECIFICATIONS: 11 Transistors and 1 Diode; Input to final Amp. 100MW; Audio 130MW: IF Frequency, 455 KC; 30db Signal to Noise Ratio; 18db selectivity. Uses 6 Penlites. 8" x 2½" x 3"; Weight 1½ lbs.

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CIRCLE NO. 10 ON READER SERVICE PAGE

which you can gauge any speaker's treble dispersion. Just walk around and observe changes in the tone color of the speaker in different parts of the room. Compare the sound directly in front of the speaker ("on axis") with the sound you get standing about 60 degrees to one side. If the off-center sound is noticeably duller than on axis, the speaker has poor treble dispersion. Speakers with wide-angle dispersion not only sound better, but they are also more easily adaptable to the acoustics of different rooms.

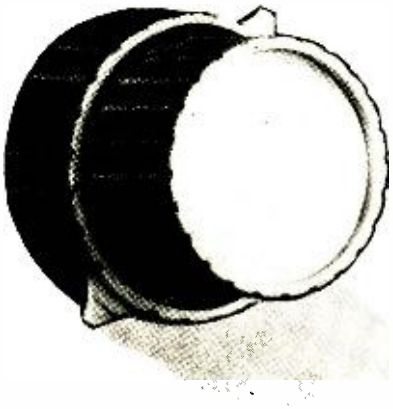
Enclosures. A vital element in speaker design is the enclosure. Far from being just a box to mount the speaker, it is a vital partner in the business of making sound. The enclosure interacts with the speaker in the same way that the body of a violin interacts with the strings. Without a proper enclosure, even the best speaker sounds tinny. A good enclosure is essential to proper bass projection.

There are various types of enclosures —infinite baffles, sealed enclosures, vented enclosures, and—in very big speaker systems—folded horns. Since many speakers nowadays are sold as part of a complete system, with matched woofers and tweeters pre-mounted in suitable enclosures, you no longer need concern yourself with that aspect of design. Just make sure your amplifier delivers enough wattage to drive the kind of speaker you choose. This "minimum power requirement" is usually stated on the speaker specs.

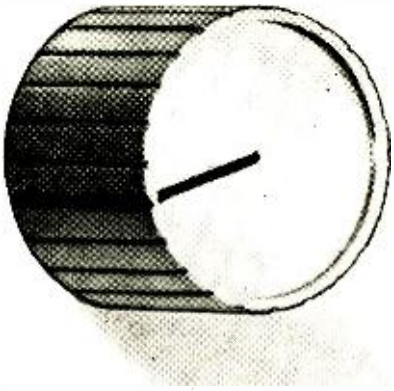
There's one catch, though. Don't count your wattage by the total amplifier output. For stereo, *each* of the two channels must deliver the minimum number of watts required to drive the speaker.

Shopping Hints. If you're out shopping, or maybe just sizing up the new crop of speakers, here are a few pointers that will help you when you make your own "ear test":

(1) Don't expect a $50 speaker to perform like a $250 speaker, but keep in mind that price alone is no key to merit. A good $60 speaker may sound better than a so-so $100 speaker.



On-Off
Volume
Squelch



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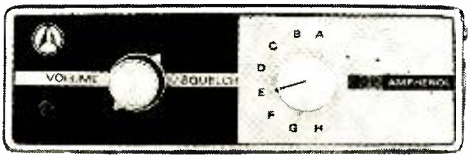
The **new** 725 is two knobs simple. Push the left one, it's on; turn the right one to any of 8 channels. Now you're ready to broadcast on the first 5 watt mobile transceiver designed to be operated by any member of the family. Forget about noise. A built-in jack lets you use it with your headset to eliminate loud outside noises.

The 725 is packed with performance, too. Inside, this compact (8½" x 6" x 2") is loaded with solid state circuitry and 14 silicone transistors. Outside, it's designed with the high-style of standard dashboard equipment. At $119.95, it looks like the 725 belongs under the dashboard of your Ferrari, T-Bird . . . or your Chevrolet!

To learn more about the new 725—and the entire Amphenol solid state line—just drop into your nearest Amphenol two-way radio headquarters.

Or write Amphenol, Box 134, Broadview, Illinois 60153.



AMPHENOL™

CIRCLE NO. 3 ON READER SERVICE PAGE

(2) With speakers priced at $60 or less, you might as well forget about extreme bass. Unless you have a super-critical ear, chances are you won't really miss those rock-bottom lows. After all, the lowest notes of the organ or the deepest reaches of the contrabassoon don't occur often in musical scores. Also, inexpensive speakers won't let you shake the walls with Wagnerian thunder. But the best models in the $40-$60 class will give you highly enjoyable, balanced, clear sound at moderate volume levels. Watch out for speakers with fuzzy sound—disqualify them immediately.

(3) Among medium-priced speakers, ranging from about $80 to $120, you have a wide choice of excellent designs. Beware of flashy-sounding models that exaggerate either bass or treble. Such a speaker may sound impressive at first hearing. It's been designed that way for just that reason; it will catch your ear. But flashy speakers are like flashy blondes. They dazzle at first, but you'd soon get tired of them if you had to live with them day-in day-out. Simple naturalness pleases most in the long run. The same is true of loudspeakers. Most listeners are entirely satisfied with the quality of a good speaker in the medium-price range. In general, speakers priced beyond this level offer little improvement in relation to the added cost. But if you are an uncompromising perfectionist and don't blink at the prospect of shelling out anywhere from $400 to upward of a thousand bucks for a pair of speakers, you can enjoy the assurance of knowing that you own the best there is.

(4) There is one important rule for comparing speakers: play them all at the same volume. If one speaker is louder than another, the ear fools you and invariably makes the louder speaker seem better. If a salesman, for reasons of his own, wants to push a certain speaker on you, he always plays it a little louder than the others. It's an old trick of the trade. Don't let him get away with it.

(5) Take your time. Relax, sit down, and make yourself comfortable in the shop. Pretend you're at home in your favorite chair—and you'll be in the best possible frame of mind for judging loudspeakers. —30—

what do you expect for $99.95, miracles?

YES

New Cobra V, 5 watt solid state CB. Created to perform miracles in performance.

Just what you'd expect from B&K, the people who developed and built the famous Cobra CAM 88: new standards of performance in selectivity, in sensitivity, in miniaturization. Talk power? Dependability? Beauty? This one you've got to see and hear . . . to believe. Cobra V, the neatest little package of punch, power and performance to hit the CB industry yet. 5 channels, 100% modulation . . . it's a miracle for only $99.95. You can hear it demonstrated at your B&K Distributor.

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CIRCLE NO. 7 ON READER SERVICE PAGE

"COMPAC" IGNITION SYSTEM

(*Continued from page* 56)

ooze out and keep the transistor securely in place.

Do not use an insulator when mounting *Q1;* its collector is grounded to the case. However, use an ohmmeter on the low ohms scale to check for clearance (short) between the case and the base and emitter elements of *Q1.* Depending upon the polarity of the meter, it may show a reading, but should not show a dead short. If a dead short is noted, move the transistor a little to clear up the condition.

Do not make the holes in the metal any larger than necessary; the more metal there is, the better the heat sink capability. The wires from the board can be connected to the terminal strip after the board is in place.

Connect the wires as follows: from *B* to the base, and from *E* to the emitter on *Q1;* from *A+* to *A+* on the terminal strip; from *P* to *PTS;* from *C* to *Coil +* and from *X* to *GND.* Connect another wire from the transistor lug to *GND* on the terminal strip.

A 3″ x 4″ x 5″ standard stock box can be used as a cabinet to hold all the parts. However, the original unit is shown in a special cabinet built for the purpose.

Final Check And Installation. Before installing the Compac, you may want to bench-check it. All you need is a 12-volt battery and an ignition coil.

Hook up the system in the same way as it would be connected in the car, except for the points. A wire from the high-voltage terminal should be gapped about ¾″ away from the ground lead of the coil. Instead of using breaker points, connect a wire from the *GND* terminal and brush it along the *PTS* terminal. Do not touch the ignition coil or high-voltage lead when making this test, or you will get a nasty jolt.

You can make the same test while the unit is installed in the car. Install the unit as far from the manifold as possible. A good place is in front of the radiator or in the air stream of the fan.

Up to 12 feet of wire can be used to connect the system. Although the unit works well at higher than normal engine compartment temperature, never mount it with the transistor facing up toward the hood. The transistor should be on a vertical surface when the unit is mounted.

To connect the unit, remove all the wires and capacitors from the ignition coil. Connect the wire and capacitor that were on the plus mark of the coil to *A+* on the terminal strip. Connect a wire from the distributor to *PTS*. Connect a wire from the ignition coil plus to *Coil +* on the terminal strip. And connect a wire from *GND* on the terminal strip to the other terminal (negative) on the ignition coil.

Check the wiring, and make sure that the connections are tight and well insulated. The low current drain of the new ignition system will not be affected by a ballast resistor; if one is used in the car, it can be left in. A slight hum will be heard from the unit when the ignition key is turned on.

Start your engine. -30-

AUTOMOBILE TAPE PLAYERS

(*Continued from page* 67)

Checkout and Operation. Before inserting a cartridge in the player, turn on power and make sure that the drive motor is running. Select a tape cartridge and insert it—label side up, and open end first—into the tape slot. Push the cartridge in until it is firmly seated; the tape unit should now play.

Adjust volume, tone, and balance for best listening. The balance control equalizes the outputs from the right and left channels for the most pleasing stereo effect. A word of *caution*: Before turning the unit off, always pull out the cartridge completely or at least an inch away from its seated position.

Most tape players are essentially immune to interference from the car's ignition system or other electrical or mechanical devices in the car. Noise picked up by the tape player can be suppressed by installing standard radio noise suppression accessories. -30-

You can earn more money if you get an FCC License

...and here's our famous CIE warranty that you will get your license if you study with us at home

NOT SATISFIED with your present income? The most practical thing you can do about it is "bone up" on your electronics, pass the FCC exam, and get your Government license.

The demand for licensed men is enormous. Ten years ago there were about 100,000 licensed communications stations, including those for police and fire departments, airlines, the merchant marine, pipelines, telephone companies, taxicabs, railroads, trucking firms, delivery services, and so on.

Today there are over a million such stations on the air, and the number is growing constantly. And according to Federal law, no one is permitted to operate or service such equipment without a Commercial FCC License or without being under the direct supervision of a licensed operator.

This has resulted in a gold mine of new business for licensed service technicians. A typical mobile radio service contract pays an average of about $100 a month. It's possible for one trained technician to maintain eight to ten such mobile systems. Some men cover as many as fifteen systems, each with perhaps a dozen units.

Coming Impact of UHF

This demand for licensed operators and service technicians will be boosted again in the next 5 years by the mushrooming of UHF television. To the 500 or so VHF television stations now in operation, several times that many UHF stations may be added by the licensing of UHF channels and the sale of 10 million all-channel sets per year.

Opportunities in Plants

And there are other exciting opportunities in aerospace industries, electronics manufacturers, telephone companies, and plants operated by electronic automation. Inside industrial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal government's FCC exam and getting your license is widely accepted proof that you know the fundamentals of electronics.

So why doesn't everybody who "tinkers" with electronic components 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 the Cleveland Institute of Electronics.

CIE courses are so effective that better than 9 out of every 10 CIE-trained men who take the exam pass it... on their very first try! That's why we can afford to back our courses with the iron-clad Warranty shown on the facing page: you get your FCC License or your money back.

There's a reason for this remarkable record. From the beginning, CIE has specialized in electronics courses designed for home study. We have developed techniques that make learning at home easy, even if you've had trouble studying before.

In a Class by Yourself

Your CIE instructor gives his undivided personal attention to the lessons and questions you send in. It's like being the only student in his "class." He not only grades your work, he analyzes it. And he mails back his corrections and comments the same day he receives your assignment, so you can read his notations while everything is still fresh in your mind.

Mail Card for Two Free Books

Want to know more? The postpaid reply card bound-in here will bring you free copies of our school catalog describing opportunities in electronics, our teaching methods, and our courses, together with our special booklet, "How to Get a Commercial FCC License." If card has been removed, just send your name and address to us.

Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE

"I give Cleveland Institute credit for my First Class Commercial FCC License. Even though I had only six weeks of high school algebra, CIE's AUTO-PROGRAMMED™ lessons make electronics theory and fundamentals easy. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises."

Chuck Hawkins, Chief Radio Technican, Division 12, Ohio Dept. of Highways

"My CIE Course enabled me to pass both the 2nd and 1st Class License Exams on my first attempt... I had no prior electronics training either. I'm now in charge of Division Communications. We service 119 mobile units and six base stations. It's an interesting, challenging and rewarding job. And incidentally, I got it through CIE's Job Placement Service."

Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company

"There's no doubt about it. I owe my 2nd Class FCC License to Cleveland Institute. Their FCC License Course really teaches you theory and fundamentals and is particularly strong on transistors, mobile radio, troubleshooting and math. Do I use this knowledge? You bet. We're installing more sophisticated electronic gear all the time and what I learned from CIE sure helps."

NEWS FOR VETERANS: New G.I. Bill may entitle you to Government-paid tuition for CIE courses if you had active duty in the Armed Forces after January 31, 1955. Check box on bound-in reply card for complete information.

CIE Cleveland Institute of Electronics

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WARRANTY

of success in obtaining a Government FCC License

The Cleveland Institute of Electronics hereby warrants that upon completion of the Electronics Technology, Broadcast Engineering, or First-Class FCC License course, you will be able to pass the FCC examination for a First Class Commercial Radio Telephone License (with Radar Endorsement);

OR upon completion of the Electronic Communications course you will be able to pass the FCC examination for a Second Class Commercial Radio Telephone License;

AND in the event that you are unable to pass the FCC test for the course you select, on the very first try, you will receive a FULL REFUND of all tuition payments.

This warranty is valid for the entire period of the completion time allowed for the course selected.

G. O. Allen

G. O. Allen
President

ANTENNA PLACEMENT

(*Continued from page* 64)

eration, or if you have a convertible, the next best position is in the middle of the trunk lid. Of course, there will be a slight shift in the radiated pattern as more metal is toward the front of the car than toward the sides or rear. However, this causes little decrease in antenna efficiency. A second factor favoring the trunk lid position is the height of the antenna. A center-of-the-roof-top antenna might be troublesome if taller than 18" or 20". A trunk lid mounting permits use of a 40" antenna, which increases the radiating efficiency over a broader bandwidth.

Fender Mounting. In an effort to simulate the appearance of cars with commercial radiotelephone installations, a favored spot for many CB antennas is either of the rear fenders. Shifting the antenna to either the right or left fender moves the metal mass and, as can be seen in the antenna pattern drawings, maximum signal radiation crosses diagonally through the car and out toward the opposite front fender.

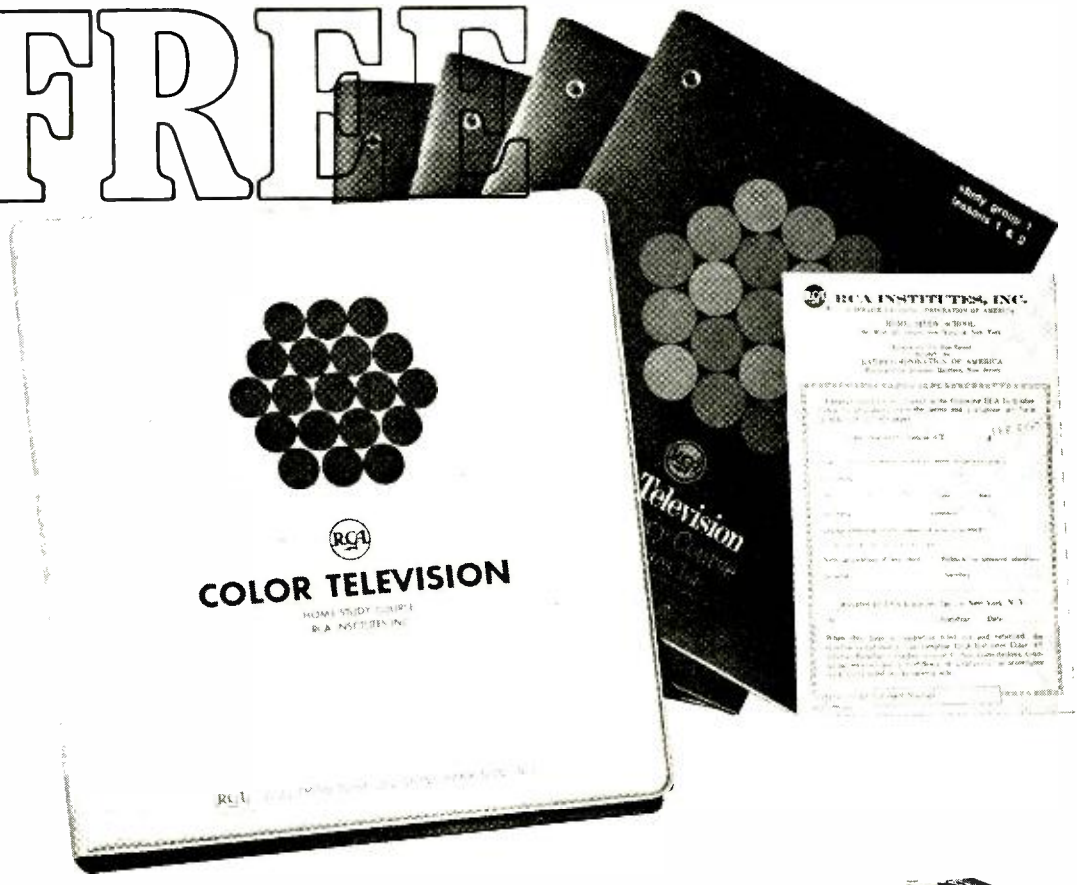
Cowl or front fender mounting is becoming quite common—especially in view of the availability of combination AM radio/CB antennas. Locating the antenna on either front cowl reverses the metal mass distribution and the signal is pulled toward the rear of the car and opposite to the front mounting.

Note that in all of the antenna pattern diagrams the scale is constant, and it is really true that more signal is concentrated in the direction of the lobe. But, this is a tremendous disadvantage *if the car is moving and not aimed in the direction of that lobe.* For example, compare the left-rear-fender mounting pattern with the roof-top mounting pattern. The signal strength through the right front fender is somewhat above that radiated by the roof-top antenna, but from azimuth 130° to around 325°, the radiated signal is substantially weaker.

Worst Possible Placement. Pity the unfortunate soul that cannot bring himself to drill a hole in his car body. This fel-

Get this $65 RCA color TV course

FREE



when you buy this

WR-64B RCA Color Bar/Dot/Crosshatch Generator

or this

WR-69A RCA TV-FM Sweep Generator

or this

WR-99A RCA Marker Generator

or this

WO-91B RCA 5" Scope

That's right! RCA Institutes famous Home Study Color TV Servicing Course FREE, when you buy ANY ONE of the instruments shown here. Buy all four...get four courses. Enroll all your technicians while you equip your shop with the instruments you'll need for color TV servicing anyway.

Here's how it works: Simply buy one, or all, of the four instruments shown, the WR-64B, WR-69A, WR-99A, or WO-91B—ALL essential color TV test instruments—from your Authorized RCA Test Equipment Distributor between now and November 15, 1966. Fill out your warranty registration card and attach the white identification label on the carton. Send them to RCA, Test Equipment Headquarters, Bldg. 17-2, Harrison, New Jersey. We will send you the enrollment form and a binder containing the first two lessons. When you complete the lessons and forward them to RCA Institutes for grading, the next lessons will be supplied to you directly from RCA Institutes, all without charge to you.

But do it now. This offer is good only for equipment purchased between September 1, and November 15, 1966. To allow for postal delay, we will honor cards received up until December 1, 1966. Here's your chance to equip your shop for color servicing while we train your people for FREE!

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CIRCLE NO. 37 ON READER SERVICE PAGE

low frequently chooses a rear bumper mount. Results to be expected from such a mounting appear in the last drawing on page 65. The lobe pattern has been distorted and the car body is now absorbing some of the radiated signal. If this pattern is compared with the left fender mounting pattern, it is easy to see how positioning the base of the antenna lower on the car body has adversely affected the pattern.

All of the tests illustrated in this article were made with the cooperation of Hy-Gain Electronics and through the use of its testing facilities. The antenna used in each instance was a 108″ whip. All of the patterns would be influenced to some extent by the substitution of a different antenna. —30—

BATTERY POWER SUPPLY

(*Continued from page* 86)

to prevent stressing connections and wires. Clips for the batteries can either be salvaged from old batteries or purchased separately. The output leads can also be equipped with appropriate snap-on battery terminals.

Operation. From time to time, measure the voltage (under load) across the collector of *Q1* and the positive side of the regulated output. For peak performance, a reading of 10 volts or more is desirable.

To obtain full benefit from the voltage-regulated power supply, replace the batteries when the power source voltage drops down to about 10 volts. Do not put good and bad batteries in parallel with each other; the bad battery would rob power from the good one. Occasionally move *B5* to one of the other battery positions and substitute a new battery for it. Switch *S1* should be in the "off" position when the unit the power supply is serving is not in operation.

The power supply can be attached to the back of your radio or recorder with an elastic band or in any other convenient manner. And if you want to go back to the original battery setup in the equipment at any time, you can. —30—

DI-DI-DI-DI-DI-DI-DI-DI-DIT

(*Continued from page* 81)

decipherable chaos of dits and dahs, reducing my aplomb to a shattered wreck of its former glory. Nothing I could say would induce her to ease up a bit so I could exchange messages with her at a decent tempo.

"*Dit-dit-dit, di-dah-di-dit, dah-dah-dah, di-dah-dah, di-dah-dah-dit, dah-dah-dah, dah-di-dah, DIT!*" she staccatoed just slowly enough to be insulting.

"Slowpoke, indeed," I murmured, crushed. "Well, now I know approximately how Dr. Frankenstein felt when *his* mistake turned on *him!*"

Sadly enough, we were now back to the same communicatory gap as before, except the problem was that of a tempo barrier. Consequently, we spent no time at all discussing better hiding-places for the gifts which I assumed (since Smartypants had a monopoly on throwing money away, said practice commonly known as Shopping) were steadily piling up somewhere about the premises.

I checked the situation out, surreptitiously, with my offspring.

"Ya got me, man!" chortled #1 Son. "I ain't been clued to the gig!"

"I don't know," sneered #2 Son haughtily, "and I wouldn't discuss it with an adult if I did, see?"

That one's definitely executive material.

My #3 Son was no help: "I'm still looking, but I'm getting real discouraged."

And #4 (age seven) assured me: "Santy's gonna bring everything on Chrismuss night unless your credit rating's down the old tubes, pop!"

A good group but hardly a reliable source.

Then, a few days later, Fate had pity on me and The Code Lady began infrequently mis-sending, her cockiness leading her into unwitting errors. At the same time, my ears finally adjusted to the tremendous speed of her fantastic Morsese.

I, of course, stoutheartedly refused to reply to her jibes and inanities in anything except my own superb command

of tarnished English, this ploy being a certainty to regain the upper hand.

She dit-dahed vociferously, head held high, her tone that of a Vibroplex Bug with a snob complex.

I laughed into her stunned face. "You may not realize it, toots, but you've just finished telling me that you've stashed *'400-yards of pigmy thimbles northeast of the driveway valley'* whatever and however that may or may not mean!"

"I *d-did?"* she Englished uncertainly. "I meant to say I've stashed four dollars worth of wrapping paper in our closet until I can gift-wrap that Heathkit transceiver we're giving our eldest boy."

Which—heh! heh!—is actually what she *did* transmit, roughly, but I had her off-balance now, and too bad for The Code Lady.

"Well, sweetheart," I said genially, "try again. Don't get rattled. You're an expert, remember?"

This time, she dit-dahed a flawlessly detailed description of an Xcelite set of color-coded nutdrivers that ±2 Son, despite his considerable contempt for authority figures, was giving me. Secretly, I ached with envy at her splendid command of vocalized Morse. Outwardly, I managed an ill-concealed sneer.

"What do you mean, *'a rolling discount gathers no diode logics?'* It's a pretty phrase but the intrinsic meaning escapes me."

Despair washed over her stricken eyes and engulfed her entire face. I was sorely tempted to stop this dastardly game but I am chronically disinclined to quit when I'm winning.

"Is *th-that* what I said?" she moaned.

"Ummm," I nodded, looking slightly over her head as the falsehood hummed out of me. "Perhaps you've overloaded your mental circuits with the intensity of your enthusiasm for talking in Code. Might be a theraputic idea to lapse back into clumsy old English for, say, a few weeks."

"It's a deal," she intoned Englishly.

"By the by," I chirped as casually as possible, "where *have* you hidden all the Christmas gifts away these many weeks, dear?"

A crafty glint appeared in her eyes.

"Di-di-dah-dah-di-DIT?" she inquired.

"Nothing but English, remember?" I chided gently. "Mustn't break our word of honor, must we?"

"Yeah, but how do I know you won't go groping around, snooping into gifts that *you* have no right to see until Christmas?" she demanded. "After all, all men are boys at heart!"

"Perish the juvenile thought!" I descried.

"Well, I haven't hid a single present in the house, if you must know. Everything I've bought is safely tucked away elsewhere."

"And where, precisely, might 'elsewhere' be?"

"Dah-dah-dit, di-di-dah, dit, di-di-dit, di-di-DIT!"

Realizing she had no intention of ever telling me where all those goodies were being kept, I then proceeded to say *several* things—all of which were too unspeakably *spirited* even to be repeated in respectable Morse code.

So I shouted them in butchered Esperanto yet. —30—

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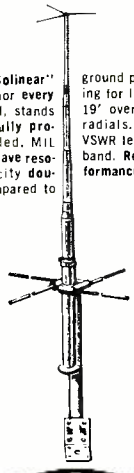
C-B "Super Neptune" Model M-29, unequalled for marine C-B. White insulating base supports a white fiberglass whip, contains the sealed-in matching network. **5/8 wave resonance doubles effective power.** 52 coax feed w/low VSWR. **No ground needed.** Fully treated for marine environment. 15' coaxial line is furnished.

C-B Base station "Colinear" Model BCL-1, superior **every way!** Sturdy, rugged, stands 100 mph winds. **Fully protected.** Epoxy sealed. MIL SPEC coatings. **5/8 wave resonance** w/top capacity **doubles sky power** compared to ground plane. Direct grounding for lightning. 4 sections, 19' overall . . . 4, rigid 5' radials. 52-ohm coax feed. VSWR less than 1.2 over C-B band. **Real peak power performance!**



C-B "Top-sider" Exclusive! Ultra "Q" loading coil w/top "Ultimizer" element gives higher efficency, stronger signals. The hinged yoke below coil allows laydown for clearance, storage. 2 models: **MA-530,** 93" w/ strap mount and **MA-540,** 77" w/universal ball mount, 15' coax supplied.

C-B "Blue seal" series. High efficiency antennas, "Blue sealed" with epoxy in tough protective outer jacket. Set-resistant SS whips are 42", 1/8"D. Hardware is polished chrome. Impedance matcher assures full power transfer, lowest VSWR. Supplied with 15' RG-58/U coax. 3 models: **MA-100 roof mount, MA-110 roof mount w/shock spring, MA-300 trunk lid mount with shock spring.**

"Patrolman"—"Sidekick" C-B antenna only 18" high. Has 1/8"D SS whip, power capsule, ultimizer and shock spring. Two models: **MA-120, rooftop—MA-130, gutter clip.**

"Tandem" for C-B and BC. Model MA-500. One brilliant antenna does double duty—gives big boost to C-B signals—provides clear reception for car BC radio. Tandem network separates the channels cleanly. Telescoping antenna is chrome plated brass, has power capsule and signal ultimizer. Base mount is standard cowl type. Supplied w/15' coax, hardware.

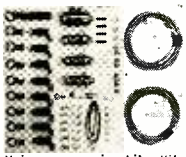
C-B white fiberglass mobiles Handsome, white fiberglass column with a Radiant Red Power Capsule and signal ultimizer. Full peak power on all C-B channels. Sealed—virtually rustproof. Ready to assemble with all hardware, 15' RG-58/U coax. **MA-310 w/trunk lid mount, Model 510 w/universal cowl mount.**

Single hole mobile mount SHM, de luxe single hole mount with chrome plated bronze split ball, tenite base and coax fitting. **Also THMD** de luxe and **THM** standard 3-hole mounts. 3/8-24 thread.

White fiberglass—SS whips A-48, 96" white fiberglass for C-B. **A-49,** white fiberglass column w/power capsule, ultimizer. Covers full C-B band. Low VSWR. Premium quality SS whips, **A-50, 103"—A-52,** 72"—**A-53,** 96". **A-51,** cut at factory to any length 36" to 58".

Strap mount BSM fits bumper of any size, width and contour. Chrome plated brass w/SS takeup band. Fitting threaded 3/8-24.

Mobile springs, heavy duty. HDCS, de luxe with knurled ends, heavy chrome plating. **HCAS,** cadmium plated, hex ends. Both threaded 3/8-24.



Noise suppression kits. Kits provide elements needed for ignition noise suppression in normal vehicles. Two kits: **ES-200 Standard** and **ES-201 De luxe.** Fully described in brochure. Complete Electroshield systems are available.

Bumper chain mount BCM, heavy duty w/removable links and threaded takeups. Will fit most bumpers. Insulated stud is threaded 3/8-24. (Spring not included.)

Mobile springs . . . medium duty. CAS, cad. plating, hex ends. DCS de luxe w/heavy chrome plating. Threaded 3/8-24. MIS, spring 2½"L . . . chrome plated. Thread 1/4-20.

Cowl mounts TLC fits a groove in closed trunk—has 2-way swivel action. Coax fitting matches Blue Seal antenna. Heavily plated. **TLS** . . . same as **TLC** except has insulated stud threaded 3/8-24.

Many of these superior antennas and mounts are available in money-saving, ready-to-install "bubble pack" assemblies. Be sure to see them at your Webster distributor.

RAYTHEON

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Please send Webster C-B antenna/accessories brochures.

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CIRCLE NO. 58 ON READER SERVICE PAGE

FACTOR QUIZ ANSWERS

(*Quiz appears on page 88*)

1 — C The CURRENT AMPLIFICATION FACTOR, or d.c. beta, of a transistor common emitter circuit is the ratio of the collector current (I_c) to base current (I_b). Thus, $\beta = \frac{I_c}{I_b}$.

2 — G The DAMPING FACTOR of an amplifier is the ratio of its output voltage under normal load conditions to the measured change in the output voltage when the load is removed.

3 — J The MODULATION FACTOR of an AM waveform is the ratio of the maximum excursion of the modulation envelope to the level of the unmodulated carrier. (Percent modulation is obtained by multiplying the modulation factor by 100.)

4 — E The DUTY FACTOR of a pulse is the ratio of its "on" time to the total duration of its "on-off" cycle.

5 — I The FORM FACTOR of a waveform is the ratio of its effective or r.m.s. value to its average value.

6 — D The QUALITY FACTOR, or simply Q, of a series-resonant circuit is the ratio of either its inductive or capacitive reactance (X_L or X_C) at resonance to its d.c. resistance.

7 — A The RIPPLE FACTOR of a filtered power supply is the ratio of the r.m.s. value of the a.c. components to the average value of its d.c. output voltage.

8 — H The VELOCITY FACTOR of a transmission line is the ratio of the velocity of the r.f. energy along the line to the velocity of the same energy traveling in free space.

9 — F The VOLTAGE AMPLIFICATION FACTOR or mu (μ) of a vacuum-tube amplifier is the ratio of the amplitude of the output signal appearing at its plate to the amplitude of the input signal applied to its grid.

10 — B The SCALE FACTOR of a high-voltage probe is the constant by which the meter reading must be multiplied to obtain the actual value of the voltage measured with the probe.

A RESCUE AT SEA

(*Continued from page* 58)

A last attempt was made to save the *Republic* by towing her to the shallows off Nantucket Island. This operation was doomed to failure because of the large volume of water weighing her down and adverse currents in the area. She disappeared into the murky waters before reaching her destination. Captain Sealby and Second officer Williams were rescued as the ship went down.

The role that radio played in this rescue was publicized around the world, and Jack Binns stepped ashore to find himself a hero. He later became, successively, flying and radio instructor for the Canadian Flying Corps and Radio Editor for the New York *Tribune*. Siasconsett grew to become one of the most important radio stations on the Atlantic seaboard. Among its distinguished alumni of operators is David Sarnoff, now a brigadier general and Chairman of the Board for the Radio Corporation of America.

The rescue of January 23-24, 1909, may sound like a work of fiction, but what might the outcome have been if neither the *Republic* nor the *Florida* had radio facilities? Or if the collision had occurred a few short months earlier, before the *Republic* was equipped with radio? The collision (similar to that of the *Andrea Doria* and *Stockholm* some 47 years later) might have gone down in history as one of the great maritime disasters of our time. -30-

SOLID STATE

(*Continued from page 84*)

creasing the effective input impedance of an amplifier stage is the use of a high value resistor in series with the circuit's input lead, as indicated by *R*, in Fig. 4 (a). The resistor forms a voltage divider with *Q1*'s input impedance (including shunt resistor *R1*) proportionally reducing the signal level at *Q1*'s base and causing an appreciable loss of signal strength. As a result, an additional amplifier stage may be required to compensate for the signal drop across R_s.

A more efficient technique is illustrated in Fig. 4(b). Here step-down transformer *T1* is used to match the high impedance source to the transistor's moderately-low input impedance. But although power losses may be negligible, if a good-quality transformer is used, the circuit's frequency response will be narrowed.

If voltage gain is less important than impedance matching, an emitter-follower can be used as shown in Fig. 4(c). Here, the circuit's basic input impedance is determined by such factors as the value of *R1*, *Q1*'s gain (*beta*), and the value of emitter resistor *R3*. In general, the input impedance is approximately equal to *Q1*'s *beta* multiplied by *R3*'s resistance, and the product of this combination is used to calculate the shunt impedance with *R1*. For example, if *Q1* has a *beta* of 50 and *R3* has a value of 1000 ohms, then *Q1*'s approximate base-emitter impedance becomes 50,000 ohms. This impedance is shunted by resistor *R1*, however, and if *R1* has a typical value of, say, 50,000 ohms, then the circuit's overall input impedance is 25,000 ohms.

Input impedances approaching those of vacuum tube circuits can be obtained by using a Darlington emitter-follower, as shown in Fig. 4(d). The effective input impedance of this circuit is approximately equal to *Q1*'s gain multiplied by *Q2*'s gain, multiplied by *R3*'s value and the product in shunt with *R1*. Therefore, if *Q1*'s *beta* is 20, *Q2*'s is 50 and *R3* has a value of 1000 ohms, the circuit's basic input impedance becomes 20 x 50 x 1000 or 1,000,000 ohms. If *R1*'s value is 1 megohm, then the circuit's effective input impedance is 500,000 ohms!

Unfortunately, an emitter-follower, whether conventional or a Darlington type, always has a voltage gain of less than unity. Thus, the output signal voltage developed across emitter resistor *R3* is always less than the applied signal voltage. However, due to the impedance differences, the power gain may be considerable.

Until next month . . . —*Lou*

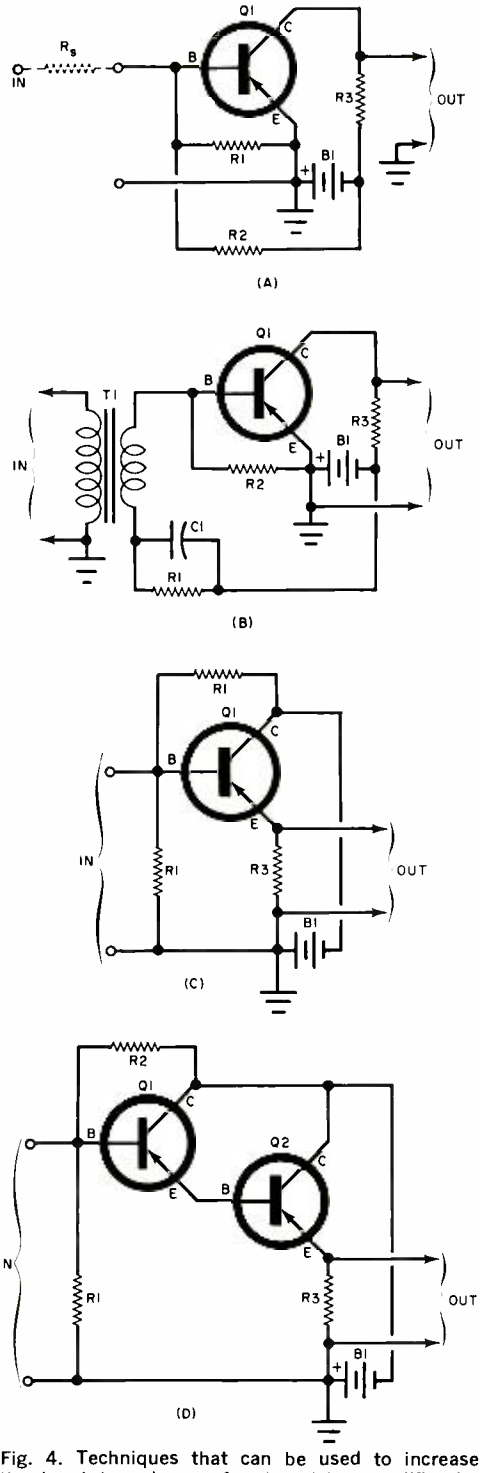


Fig. 4. Techniques that can be used to increase the input impedance of a transistor amplifier include: (A) input series resistor R_s; (B) step-down transformer T1; (C) a conventional emitter follower; and (D) a Darlington pair emitter follower circuit.

AMATEUR RADIO

(*Continued from page 87*)

The amateur regulations specify that a means independent of the transmitter frequency control device be used to determine that an amateur transmitter is on frequency. This device may be a calibrated frequency meter or monitor or a calibrated receiver (whose calibration may be checked against a crystal-controlled frequency calibrator).

What is the most likely defect of a tube which has proper heating voltage at the socket but which fails to warm up? An open (broken) heater conductor.

What precautions can be taken to reduce the possibility of shock hazard in electrical equipment? Enclose the equipment so that no circuits carrying electrical currents are exposed. Connect all exposed metal surfaces to a common ground terminal. Use interlock switches that remove all power when access doors are opened. Disconnect the equipment completely from the power lines before working on it. In electronic equipment, be certain all power supplies have "bleeder resistors" across the power supply output terminals. Use a grounding stick to make sure all power supply capacitors are discharged before working on the equipment. Think!

The plate voltage in the final stage of an amateur transmitter is normally measured between what points in the circuit? Between the positive (+) and negative (−) direct-current, plate power supply terminals.

We would like to thank the American Radio Relay League for its courtesy in supplying us with a copy of these questions before they became available from the Federal Communications Commission.

Upcoming Contests. You may still have time to participate in the CW weekend (October 22-23) of *CQ*'s World-Wide DX Contest. The "Phone" weekend is November 26-27. Object of this contest is to work foreign DX stations and exchange signal reports and DX "Zone" numbers with them. Send a stamped 4¼" x 9½" envelope to *CQ* World-Wide DX Contest, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050, for contest log sheets and contest rules.

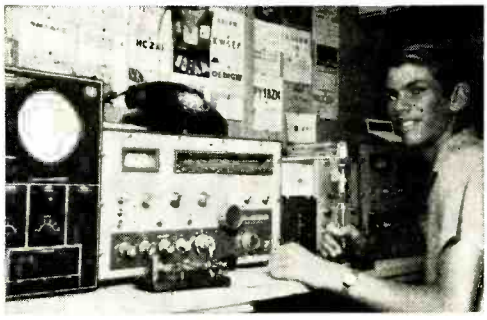
Dates of the ARRL "Sweepstakes" Contest are: Phone, November 12-14; CW, November 19-21. The object in the "SS" is to work United States and Canadian amateurs and exchange information with them in the form of message preambles. Contestants using a transmitter power under 150 watts are allowed a power multiplier of

1.25 on CW and 1.5 on phone. Low power, therefore, is not much of a handicap in the Sweepstakes; in fact, the high scorers usually operate in the low-power bracket. Log sheets and contest rules are available upon request plus a stamped return envelope sent to: The American Radio Relay League, Inc., 225 Main St., Newington, Conn. 06111.

NEWS AND VIEWS

Marvin, WN4CIE, and **Dave, WN4CHC, Luse,** 402 N. W. 8th Ave., Mulberry, Fla., work 40 meters, using either a 40-watt or a 5-watt transmitter—both home-brew. Their receiver is a Heathkit GR-64, and the antenna is a 40-meter dipole. With this equipment, Mary and Dave have worked 33 states, Canada, Cuba, and Puerto Rico. They didn't give us particulars but report that the five-watter works quite well . . . **Mike Rhodes, WA8NBO,** RFD 5, Box 305, Celina, Ohio, says: "Don't let anybody tell you you've got to have a beam to work DX." In five weeks, using a 20-meter dipole 25' high, running NE by SW, fed by an EICO 720 transmitter, Mike has worked 16 countries. Fourteen of the countries were in Europe, which sort of proves that you can work DX off the end of a dipole—Europe is northeast of Ohio, you know. The WA8NBO country total is now 23, all worked with dipoles and 90 watts or less. The receiver is a Drake 2A . . . **Kenneth R. Birkmann, WNØNVT,** 8353 Fullerton, University City, Mo., works the lower frequencies with a Heathkit DX-40 transmitter and a National NC-98 receiver. For 144 MHz, he has a war-surplus SCR-522 transmitter and an AMECO converter to bring the receiver up to the 2-meter band. Using either a 40-meter dipole or a 15-meter inverted-V antenna, he has 40 states and four countries worked. His 144-MHz antenna is an 8-element beam. Ken will sked you if you need a Missouri contact.

Walter W. Frank, WB2OVV, 1735 Madison Ave., #17E, New York, N.Y., also holds CB call KBI2173 and is an SWL, but it is his General license that he talks about. Living on the 17th floor of a tall apartment building gave Walt something of an antenna problem—a problem he solved by sticking a Hy-Gain 18V vertical antenna out of the window. Feeding the antenna with an EICO 720 transmitter and receiving on a Lafayette HE-80 has given WB2OVV a record of 39 states and 10 countries worked. Walt and other amateurs using window antennas are attempting to organize the Window Whippers Club of America (WWCA). Drop Walt a note if you are eligible . . . **Guy K. Sueoka,**



Bill Peyton, now KH6GAJ, of Kailua, Hawaii, is ex-WB6HKS. In eight months in Hawaii, Bill's Heathkit "Apache"/SB-10 transmitter and "Mohawk" receiver worked 60 countries but only 25 states!

WH6FQW, 3328 Makini St., Honolulu, Hawaii, must like mail. He offers to sked anyone needing a Hawaiian QSL card! Guy has had several transmitters, but at present he uses a "Globe Chief" running 50 watts. It feeds a Hy-Gain 14-AV vertical antenna. His receiver is a Lafayette HA-230. Working only 40 meters, Guy has logged 30 states and four countries, including American Samoa and Puerto Rico . . . **Les, W9EBQ,** suggested that we put a word or two in "News and Views" about SWL cards to amateurs. He says that any time he gets on the air he can expect to receive a handful of SWL cards a day or two later. Of course, every SWL wants a QSL card in return, but it costs about 10 cents every time you send a card. We have heard SWL's say: "What's a dime?" The answer to this is: "If it is such a small amount, send me one with your SWL card, or include return postage, at least."

Ronald D. Ottman, WN6SQP, 1620 Ottman Ave., Red Bluff, Calif., used to sneak through his fence to visit a neighbor's ham shack when he was nine years old. That was 20 years ago. But he moved fast when he got his ticket, working 38 states and Canada in about two months. He also passed (he thinks) his General Class exam. Ron uses a Heathkit DX-60 transmitter and a Hallicrafters SX-101 receiver and has his eye on a Heathkit SB-400 transmitter . . . **Dave Sarault, WA1DWE, NØFKU,** 197 Main St., Danielson, Conn., made the journey from Novice to General in six months. Now he likes contests, chasing DX, and chasing new states; he does take an occasional break for leisurely ragchews with the local gang on 10 meters. Dave has a complete Heathkit station: DX-60A transmitter, HG-10 VFO, GR-91 receiver, and HD-10 electronic keyer. With it, he has racked up 47 states and 43 countries—he still needs Asia for WAC. Oh, yes, NØFKU is his Navy MARS call . . . **H. Vance Mosser, K3ZAP,** Route 3, Box 88, Washington, Pa., works 40, 15, 10, 6, and 2 meters, using a Knight-Kit T-150A, a Heathkit HX-11, and surplus 6- and 2-meter transmitters. Included on his antenna farm are dipoles for 40 and 10 meters and beams for 15, 6, and 2 meters—all home-brew. If Vance has ever worked anyone, he didn't mention who it was . . . **Chase E. Elsasser, WAØMNW,** 6207 S. 41st St., Omaha, Nebr., celebrated getting his General by writing us a letter. As a Novice, Chase made 450 contacts in 41 states, Canada, and Puerto Rico, all on 40 meters. A Knight-Kit T-60 transmitter, feeding a 60′ "long wire" through a WRL antenna coupler or a Hy-Gain 14-AVS vertical, and a Knight-Kit "Star Roamer" receiver did the work.

Remember, the first step towards seeing *your* "News and Views" and pictures in this column is up to you. Thanks for sending us your club bulletins. If your club sponsors regular on-the-air code practice sessions, please tell us about it. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, *Herb, W9EGQ*

ON THE CITIZENS BAND

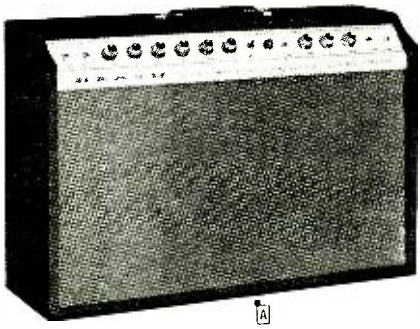
(*Continued from page* 89)

The mobile CB transceiver would be turned on when a vehicle passed over a magnetic trigger and would remain on for 6-10 seconds to receive a taped *Audio Signpost* message. Typical taped messages would cover road conditions and accommodations; live voice messages would be used for spe-

(*Continued on page* 124)

What's New With Heath These Days?

Harmony-by-Heathkit Electric Guitars & Heathkit Guitar Amplifier



Kit TA-16
$129.95

[B] Kit TG-46
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[C] Kit TG-26
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(save $38.55)

[A] NEW Heathkit Transistor Guitar Amplifier
60 watts peak power; two channels — one for accompaniment, accordian, organ, or mike, — the other for special effects . . . with both variable reverb and tremolo; 2 inputs each channel; two foot switches for reverb & tremolo; two 12″ heavy-duty speakers; line bypass reversing switch for hum reduction; one easy-to-build circuit board with 13 transistors, 6 diodes; 28″ W. x 9″ D. x 19″ H. leather-textured black vinyl cabinet of ¾″ stock; 120 v. or 240 v. AC operation; extruded aluminum front panel. 44 lbs.

American Made Harmony-By-Heathkit Guitars
All guitars include instruction book, tuning record, pick, connecting cord, deluxe red leather cushioned neck strap and chipboard carrying case. All wood parts assembled and factory finished — you just mount metal parts, pickups & controls in pre-drilled holes and install strings.

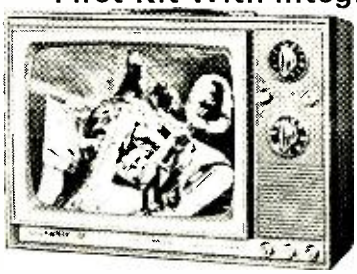
[B] Deluxe Guitar . . . 3 Pickups . . . Hollow Body
Double-cutaway for easy fingering of 16 frets; ultra-slim fingerboard — 24½″ scale; ultra-slim "uniform feel" neck with adjustable Torque-Lok reinforcing rod; 3 pickups with individually adjustable pole-pieces under each string for emphasis and balance; 3 silent switches select 7 pickup combinations; 6 controls for pickup tone and volume; professional Bigsby vibrato tail-piece; curly maple arched body — 2″ rim — shaded cherry red. 17 lbs.

[C] Silhouette Solid-Body Guitar . . . 2 Pickups
Modified double cutaway leaves 15 frets clear of body; ultra-slim fingerboard — 24½″ scale; ultra-slim neck for "uniform feel"; Torque-Lok adjustable reinforcing rod; 2 pickups with individually adjustable pole-pieces under each string; 4 controls for tone and volume; Harmony type 'W' vibrato tail-piece; hardwood solid body, 1½″ rim, shaded cherry red. 13 lbs.

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

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

Unusually sensitive performance. Plays anywhere . . . runs on household 117 v. AC, any 12 v. battery, or optional rechargeable battery pack ($39.95); receives all channels; new integrated sound circuit replaces 39 components; preassembled, prealigned tuners; high gain IF strip; Gated AGC for steady, jitter-free pictures; front-panel mounted speaker; assembles in only 10 hours. Rugged high impact plastic cabinet measures a compact 11½″ H x 15¾″ W x 9⅜″ D. 23 lbs.



Kit GR-104
$119.95

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13 New Kits You Can Build . . .

NEW! Deluxe Solid-State FM/FM Stereo Table Radio

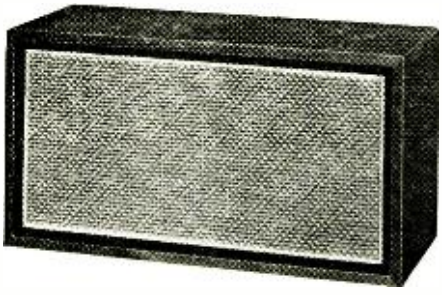
Kit GR-36
$69.95

Tuner and IF section same as used in deluxe Heathkit transistor stereo components. Other features include automatic switching to stereo; fixed AFC; adjustable phase for best stereo; two 5¼" PM speakers; clutched volume control for individual channel adjustment; compact 19" W x 6½" D x 9¼" H size; preassembled, prealigned "front-end"; walnut cabinet; simple 10-hour assembly. 24 lbs.

NEW! Compact 2-Way 2 Speaker System With Acoustic Suspension Design

Handles 10 to 25 watts of program material. Features wide 45 to 20,000 Hz response; 8" acoustic suspension woofer with 6.8 oz. magnet; 3½" tweeter with 4.8 oz. magnet; high frequency level control; 8 ohm impedance; 1500 Hz crossover frequency; assembled walnut veneer cabinet has scratch-proof clear vinyl covering for easy cleaning. Measures 10" H x 19" W x 8½" D. Speakers are already mounted; just wire the crossover and connect cables — complete in one or two hours! 17 lbs.

Kit AS-16
$49.95



NEW! Amateur Radio Single-Bander Transceivers . . . New Features . . . Choose 75, 40 or 20 Meters

Kit HW-12A
75-Meter
$99.95

Now features upper or lower sideband operation on all models; new deluxe styling; more convenient control locations; 200 watts P.E.P. input; single knob tuning with 2 kHz dial calibration; new ALC input for use with external linear amplifiers; improved audio and AVC response; crystal filter type SSB generation; built-in S-meter, VOX, PTT and ALC; fixed or mobile operation. 15 lbs. Kit HW-22A, 40-meter, $104.95. HW-32A, 20-meter, $104.95.

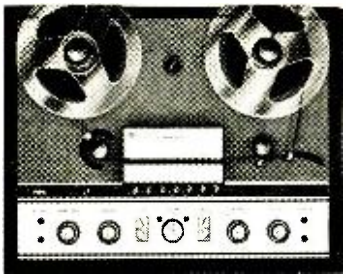
NEW! Deluxe Amateur Station Console . . . 4 Separate Units In One!

Includes 24-hour clock, SWR meter, hybrid phone patch and an all-electronic 10-minute timer with audio/visual signaling in one compact unit. Matched in styling and performance with the famous Heath Deluxe SB-Series amateur radio equipment. Measures a compact 6" H x 10" W x 11⅛" D. 9 lbs.

Kit SB-630
$74.95

Plus FREE 1967 Heathkit® Catalog!

NEW Heathkit® /Magnecord® 1020 4-Track Stereo Recorder Kit



Kit AD-16
$399.50
(less cabinet)

Save $170 by doing the easy assembly yourself. Features solid-state circuitry; 4-track stereo or mono playback and record at 7½ & 3¾ ips; sound-on-sound, sound-with-sound and echo capabilities; 3 separate motors; solenoid operation; die-cast top-plate, flywheel and capstan shaft housing; all push-button controls; automatic shut-off; plus a host of other professional features. 45 lbs. Optional walnut base $19.95, adapter ring $4.75

NEW Deluxe SB-301 Amateur Receiver Kit
NEW Deluxe SB-401 Amateur Transmitter Kit

Kit SB-301
$260.00
(less speaker)

New SB-301 receiver for 80 thru 10 meters with all crystals furnished, plus 15 to 15.5 MHz coverage for WWV; full RTTY capability; switch-selected ANL; front-paneling switching for control of 6 and 2 meter plug-in converters; crystal-controlled front-end for same rate tuning on all bands; 1 kHz dial calibrations, 100 kHz per revolution. 23 lbs. Matching SB-401 Transmitter, now with front-panel selection of independent or transceive operation... $285.00

2-Watt Walkie-Talkie

Assembled
GRS-65A
$99.95

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

NEW Portable Phonograph Kit

Kit GD-16
$39.95

All Transistor. Assembles in 1 to 2 hours. Preassembled 4-speed automatic mono changer; 4" x 6" speaker; dual Sapphire styli; 45 rpm adaptor; olive & beige preassembled cabinet; 117 v. AC. 23 lbs.

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CIRCLE NO. 22 ON READER SERVICE PAGE

cial instructions and emergency situations.

BLOCK 3: *Coded Transmission.* The third building block would aid the stranded motorist. With a flick of a finger on a dial encoder, the motorist could call for traffic information, police, an ambulance, a fire truck, or a tow truck with gasoline and a mechanic. Coded messages would be acknowledged by voice from the *Aid and Information Center.* Highway agencies would provide repeater receivers for message reception where long distances existed between service points.

BLOCK 4: *Visual Sign Minder.* The fourth building block would "preprint" upcoming traffic signs. The driver would install a special display panel activated by a three-magnet trigger in the roadway. A tone signal "beep" would direct the driver's attention to the panel, which would display posted speed limits and such traffic signs as STOP, YIELD, RAILROAD CROSSING, and CURVE. The system is designed to supplement—rather than replace—existing traffic signs and would prevent the loss of direct visual information due to obstructions.

BLOCK 5: *Route Minder.* With the fifth and final building block, motorists could forget about maps and route signs by adding a route decoder and a *Route Minder* display unit which would be integrated with the *Visual Sign Minder.* The motorist would select a route and receive a punched card from an *Aid and Information Center* for his destination. The card would be inserted into a slot in the DAIR console, and whenever the car approached a major intersection, panel lights would indicate whether the driver should turn right, left, or go straight through.

General Motors states that the DAIR system is based on existing technology, and the present hardware could be mass-produced. The system is flexible enough to meet both current and future highway requirements. DAIR is the result of more than nine years of work in the Electronics and Instrumentation Department at the GM Research Laboratories. The ultimate goal: increased safety and convenience for the motoring public.

CB Emergency Assists. Members of the Withlacooche River Basin Citizens Band Radio Club, Brooksville, Fla., went into action last June when Hurricane Alma blew into the area. Under the direction of liaison officer Ellwood J. Franklin, KKP5630, a network control center was set up at Lake Lindsey. The net handled communications from city and state police, civil defense, highway patrol and sheriff's departments. Coverage was extended to four counties:

Hernando, Sumter, Citrus and Pasco, with CB'ers manning CB gear at individual shelter areas and wherever needed. Mobile units patrolled, delivered needed items in emergency situations, and investigated power failures. The CB'ers were highly commended by local authorities and civil defense coordinator Pat Brewer.

On a trial basis, to ascertain the effectiveness of CB radio coverage, members of the Dixie Communications Club, Decatur, Ga., recently turned out to patrol ten primary roads in DeKalb County. The CB'ers reported malfunctioning traffic signals, abandoned vehicles, and dangerous holes or obstructions to motorists. They were especially helpful when a major accident occurred involving five vehicles.

1966 OTCB Club Roster

The following clubs have reported to the OTCB club roster for the first time. Active CB clubs not yet registered with this column are urged to submit complete details about their operation: membership totals, officers, club history, emergency and public service assists, and planned activities. Photographs, a sample club decal, and a monthly issue of your club paper would also be appreciated. Send the works to: Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Siluria, Alabama—*Shelby County REACT Team.* Chartered by the national headquarters, January, 1966, the team is supported and sponsored by C. P. Walker, Sheriff of Shelby County. Membership: 15. Officers: Paul Perry, KOM0459, director; Johnny Mathis, KKN1401, assistant director; Larry Revis, KKN0446, secretary/treasurer.

Monroe, Georgia—*Citizens Radio Emergency Service, Inc.* Dubbed "CRES," this club was chartered by the state in January, 1966, for a period of 35 years. It is governed by a set of bylaws adopted by its original 13 charter members. Present membership: 19. Officers: Lester N. Brown, KDB2289, president; Jim Johnson, KKN3803, vice president; Bill Durden, KKM8437, secretary/treasurer; Wm. L. Willard, KMM2095, public relations; Barney Manders, KKM7038, sergeant-at-arms; and a three-member board of trustees. Club has purchased a 1960 VW bus which is being readied for rescue work, in addition to a 1964 heavy-duty rescue truck. Any licensed CB'er residing in the state is eligible for membership. Every member is trained in all phases of rescue, police work, and communications by club's own instructors before he is permitted to make a transmission. CRES answers all emergency calls and also has courtesy patrols manning principal highways during weekends and holidays to assist motorists. Active in the Greater Georgia CB Council, the club participates in district and interstate communications relays and offers assistance to any state, county, or federal agency that may need their help.

Everett, Massachusetts—*Everett REACT Team, Inc.* Sporting the call-sign KOA2855, this club has been in operation since February, 1965, in metropolitan Boston, North Shore area. Team is member of the Emergency Radio Council composed of six emergency groups in the area having REACT or HELP affiliation. Officers: John F. Laing, KBC8765, captain; Harry J. Cochran, KKA6469, first lieutenant; Peter G. Coburn, KKB0704, lieutenant/operations; George E. Tieri, KBD3856, lieutenant/adjutant; and Mary A. Coburn, KBB0704, lieutenant/finance.

I'll CB'ing you.

—*Matt, KHC2060*

SHORT-WAVE LISTENING

(*Continued from page* 91)

signs off at 0357 is HJCB, *Voz Tolima*, Ibague, Colombia, on 6040 kHz. The sign-off, incidentally, is in English.

The British Guiana United Broadcasting Co., Ltd., is now officially known as Guyana Broadcasting Co., Ltd., according to information from General Manager E. Saul. At press time, two stations are operating: *R. Demerara* on 760, 3265, and 5980 kHz, and *Station G.B.S.* on 560 kHz. Reports go to P.O. Box 561, Georgetown, Guyana.

Those Delayed QSL's. Have you ever wondered why it seems to take so long to get a reply to some of your reports to distant stations? According to an official United Nations source, delivery time to some distant points is as follows:

Location	Airmail	Surface Mail
Cairo, Egypt	5 days	25 to 30 days
Karachi, Pakistan	5 to 7 days	5 to 8 weeks
New Delhi, India	5 days	4 to 6 weeks
Teheran, Iran	6 to 10 days	3 to 5 months
Bangkok, Thailand	7 to 10 days	6 to 10 weeks

The above information was sent to us by the North American Shortwave Association.

CURRENT STATION REPORTS

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

Ascension Island—The South Atlantic BBC Relay is now in operation with first of four new 250-kW xmtrs. The World Service is relayed in Eng. at 1745-1830 and 1945-2245, in French at 1830-1930, and in Hausa at 1930-1945. They are using 15,350 kHz at present, but plans call for the use of 11,820, 9510, and 7120 kHz in the future, beamed to Australia.

Bolivia—Station CP48, La Paz, 5017 kHz, was noted with Spanish ID of *R. Universo* at 1006; a portion of Handel's "Water Music" is used as theme. Clear of Vladivostok on 5015 kHz, the signal faded badly by 1030.

Brunei—*R. Brunei*, 4865 kHz, is being logged on the West Coast at 1317 with Eng. news and at 1330 with classical music.

Burma—Rangoon has been logged on 4795 kHz (XZK2) with man talking in Burmese at 1207, and

SHORT-WAVE ABBREVIATIONS

BBC—British Broadcasting Corporation	QRM—Station interference
Eng.—English	QSL—Verification
ID—Identification	R.—Radio
kHz—Kilohertz	s/off—Sign-off
kW—Kilowatts	s/on—Sign-on
N.A.—North America	xmsn—Transmission
	xmtr—Transmitter

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

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

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

(Please Print) (Do not fill out)

Name . . . . . .

Street, City and Zone . . . . . .

State and Zip . . . . . .

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

Make . . . . . Model . . . . . .

Age Occupation . . . . . .

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

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

I use the following antennas . . . . . .

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

Signature . . . . . Date . . . . . .

on 5040 kHz (XZK9) at 1243 with woman announcing in Burmese, and native vocal and instrumental music to past 1310.

Burundi—According to a recent verification, *R. Cordac* operates on 3985 kHz with 500 watts and on 4920 kHz with 2500 watts. No schedule was given.

Canada—*R. Canada*'s newest schedule has Eng. as follows: Afro-European Service at 0730-0800 on 9625 and 5955 kHz; Australasian Service at 0830-0930 on 9625 and 5970 kHz; European Service at 1215-1313 on 15,320 kHz, and at 2115-2150 on 15,320. 11.720, and 9630 kHz; African Service at 1833-1915 on 17,820, 15.320, and 11.720 kHz; N. A. and Antilles Service at 1215-1313 on 11,720 and 5970 kHz; Caribbean and Latin American Service at 2300-2330 on 11.725, 9625, and 5990 kHz; to Northern Canada at 0100-0706 on 11.720 and 9625 kHz (and to 0230 on 5970 kHz), at 1100-1214 (Eng. and French) on 5970 kHz, at 1631-1659 (Eng. and French) on 11.720 kHz, and at 2200-2245 (Eng. and Eskimo) on 15.190, 11.720, and 9625 kHz.

Cyprus—The BBC Relay was logged on 11.905 kHz in Eng. at 0615, mixing with *Deutsche Welle* relay, Kigali, on the same frequency, also in English.

Denmark—Here is the latest schedule from Copenhagen for Eng.: to N.A. at 0145-0215 on 9520 kHz; and to N.A. at 1245-1315, to Far East at 0745-0815, to S. Asia at 1445-1515, and to South Africa at 1915-1945, all on 15,165 kHz. A test program is scheduled in Eng. on Saturdays at 1045-1100 on 9520 kHz. On Sundays, Danish is broadcast exclusively. The North Africa and Middle East services have been deleted due to "severe competition from higher-powered stations and poor reports."

Dominican Republic—Listeners trying for HIBE, *R. Mil*, Santo Domingo, 4940 kHz, should be extremely careful in tuning, for *R. Nacional del Ecuador*, Quito, is only 1 or 2 kHz higher at the same time and both stations broadcast in Spanish.

Ecuador—Station HCOT1, *R. Zaracay*, Santo Domingo de los Colorados, has finally verified after many reports for the 3391-kHz outlet. The schedule is given as 1000-0700, but "upon request" they will run past 0700. Power listed is 5 kW.

Egypt—Cairo was noted on "reactivated" 11,980 kHz at 0200-0230 and on "new" 9460 kHz around 0230, both with Arabic.

Formosa—Taipei is usually good at 1015-1030 on 11.825 kHz and from 1030 to 1045 s/off on 11,860 kHz, both xmsn's in English.

France—An Eng. xmsn to Africa and Madagascar is given at 0515-0530 on 9500 and 11.960 kHz. Reports go to English Language Service, Room 6535, Maison de l'O.R.T.F., 116, Avenue du President Kennedy, Paris 16e, France.

Hong Kong—Station ZBW3 was heard at 1223 with a woman in Chinese and at 1120 with traditional Chinese music, on 3940 kHz.

India—*All India Radio*, Delhi, has been logged in a new General Overseas Service on 15,230 kHz at 1420 with brief Eng. news summary and some Indian music; reception, at best, was only weak to fair.

Indonesia—*Banding Technological Institute Radio* is a new station operating Saturdays and Sundays at 0500-0700 and 1000-1300, and other days irregularly, on 6204 kHz with 200 watts.

Djakarta operates in Eng. at 1100-1200 and 1430-1530 on 9865 and 11.795 kHz, and at 1900-2000 on 9865 and 11.715 kHz. Station YDQ4, Makassar, 4750 kHz, was heard at 1115, and YDP4, Medan, 5030 kHz, at 1205, both with talks.

Italy—Rome has been noted on 15.390 kHz, a new channel, in Italian to N.A. at 2230-0000 with news, pop and light music, talks, and variety.

Japan—*R. Japan*, Tokyo, was found on 11.805 kHz at 1755-1830 in General Overseas Service, dual to 9505 and 9560 kHz, in Eng. (to 1815) and Japanese.

The 75-meter outlets on 3925 and 3945 kHz were both logged at 0935 with man talking.

Korea (South)—Seoul has been heard on 9640 kHz

The listening posts of Jim Lacalamita, WPE2NOH (above), and Dennis McCabe, WPE1GVB, both feature a Hallicrafters S-120 receiver and at least one transistorized tape recorder. The records of these two SWL's are almost the same: Jim has 16 countries verified, Dennis has 17. However, their antennas differ: WPE2NOH uses an inverted V, 55' high, and WPE1GVB uses a 135' long-wire antenna.

with Chinese at 0800-0830; Eng. news at 0830, followed by "Music of Korea;" and from 0900 to 1000 in Japanese.

Lebanon—Eng. from Beirut on 11.760 kHz at 0230-0300 is usually excellent. There is Arabic music and talks at 1915-1950 on the "new" 15.200 kHz channel, news to 1995, then French. Close is at 2026, after a march.

Malaysia—The BBC Far Eastern Station, Tebrau, 17.890 kHz, is irregularly received relaying the BBC World Service news at 0100-0130; a woman identifies at the beginning and end of the xmsn.

R. Malaysia, Kuching, Sarawak, was logged on 4835 kHz at 1040 with native chanting; on 5037 kHz at 1010 with native music—it abruptly left the air at 1020 but was heard again at 1135 with light music; and on 4950 kHz at 1125 with an Eng. press conference and at 1130 with sports news.

Mauritius—Forest Side was noted on 4850 kHz with s/on at 1030, then Indian music and commercials in Indian vernaculars. Best reception time is around 1200-1230 and as late as 1415. This channel does not parallel 9710 kHz.

Netherlands Antilles—Here are two new frequencies for *Trans-World Radio*: 15.130 kHz, opening at 2330 in German or Dutch; and 11,815 kHz (replacing 11.820 kHz) at 0030-0125 and 0230.

New Zealand—Station ZL8, Wellington, 9620 kHz, was noted with music at 1040-1100.

Peru—A Peruvian station has been heard on 2946 kHz to 0600 s/off with typical music. It is believed to be located in the fourth call area.

Reunion—St. Denis, 3215 kHz, was heard signing on at 0230 with "La Marseillaise," then news in French. The xmsn on the dual 2446-kHz channel was also heard. Both faded by 0237.

Singapore—Forces Broadcasting Station, 5010 kHz, has been heard with pop music at 1140 and Eng., and at 1400 with Indian music and Gurka. *R. Singapura*, 5052 kHz, was heard at 1145 with an Eng. discussion period.

Solomon Islands—Station VQO4, Honaira, 3994 kHz, has been heard at 0940 with pop music and commercials and at 1100 with semi-classical music. Station VQO5, 7115 kHz (replacing 3205 kHz), has news in Eng. at 0930.

South Africa—The Commercial Service from Paradys can be tuned around 0107 on 3220 kHz, dual to 2376 kHz; both were heard until past 0200. The xmsn for East Coast N.A. on 7270 kHz was noted from 2200 to 2255 s/off.

Switzerland—Berne was noted on 11,775 kHz at 2255-0000, dual to 15,305 kHz, in Spanish to South America.

Thailand—Station HSK8, Bangkok, is definitely the station noted on 4830 kHz at 1100 s/on with chimes, then Home Service.

Timor—*Emissora de Radiodifusao Do Timor Portugues*, Dili, is a very infrequently reported station. It has been logged on the West Coast around 1215 in Portuguese but was virtually unreadable due to static and QRM. Look for it on 3268 kHz.

U.S.A.—Station WBBH, New Brunswick, N. J., 4970 kHz, is not a pirate station. It is operated by the Courtland School of Music with 50 watts and is on the air during the school year at 1900 weekdays (EST) and on weekends at 1500 (EST). Reports go to RPO 914, New Brunswick, N. J. Listeners in the Middle Atlantic states may log this one; others will probably not be able to hear it.

U.S.S.R.—Vladivostok, 5015 kHz, was noted at 1145 with Home Service in Russian. Ulan Bator, 4070 kHz, was heard around 1230 in an unfamiliar language, possibly Mongolian or Kazakh.

Vatican City—*R. Vaticano* is on 15,140 kHz with a new xmtr for the 1700-1715 Eng. xmsn to Africa.

Venezuela—*Radiodifusora Venezuela, Caracas* has moved from 4890 to 4916 kHz, and was heard brilliantly at 0145-0200 with Arabic, Near East music, and mentions of Air France. This may be a regular Monday feature.

Vietnam (North)—Hanoi has added 7215 kHz (replacing 11,760 kHz) for Eng. from 1000 to 1030; then Vietnamese. Dual channel for Eng. is 9760 kHz.

—30—

SHORT-WAVE CONTRIBUTORS

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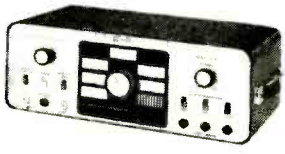

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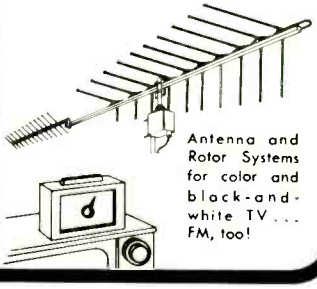

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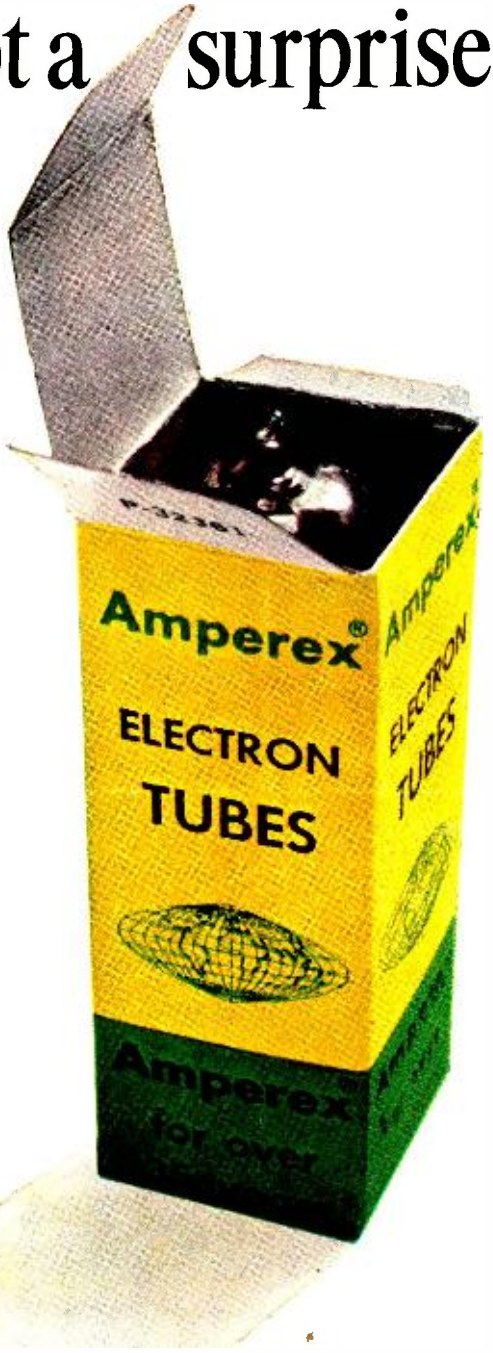

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