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POPULAR ELECTRONICS

NOVEMBER 1965

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Tubes to Transistors—Mono to Stereo (1)

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J. E. Smith, Founder—1914.

Fifty years ago, a school teacher named James E. Smith started giving extra instruction to four of his students in the "mysterious" new field of radio. From that small beginning, National Radio Institute has grown to be America's largest home-study school in the many fields of Electronics. Nearly three-quarters of a million students have enrolled over the years. This vast experience is behind NRI's meaningful, interesting, easy-to-understand methods of training; methods that make Electronics a practical subject for almost anyone to learn no matter how much or how little formal education he has.

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DON HOUSE, Lubbock, Texas

"Many thanks to NRI for the Electronics training I received. I hold a first class FCC License and am employed as a studio and master control engineer/technician with KXJB-TV."

RONALD L. WOOD, Fargo, N.D.

"I am a Senior Engineering Aide at Litton Systems, in charge of checkout of magnetic recording devices for our computers. Without the help of NRI I would probably still be working in a factory at a lower standard of living."

DAVID F. CONRAD, Reseda, Calif.

"NRI training enabled me to land a very good job as Electronic Technician with the Post Office Dept. I also have a very profitable spare-time business fixing Radios and TV."

NORMAN RALSTON, Cincinnati, Ohio

POPULAR ELECTRONICS

POPULAR ELECTRONICS is Indexed in the Readers' Guide to Periodical Literature
This month's cover photo by Bruce Pendleton

VOLUME 23 NOVEMBER, 1965 NUMBER 5

Special Hi-Fi/Stereo and Audio Features

Electronic Construction Projects

Communications

Electronic Features and New Developments

Departments

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POPULAR ELECTRONICS

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After we put our new line of walkie-talkies together, we take them apart.

Tough on our talkies? You bet we are.

Maybe 99 out of 100 are ready to leave the Fanon plant in perfect condition, but we know there's always the chance of a fluke slipping through. That's why we don't believe in "quickie" shipments to your electronics dealer. We prefer to take an extra look into things first. So we take every single Citizen's Band transceiver apart and give it a rigorous going-over: instrument testing, air testing, the works. Want to do a little investigating of your own? We'll gladly provide the screwdriver.

Start at the top of our line. The Fanon "Commander" offers ¼-watt power from 13 powerful transistors, with our exclusive "Free-call" standby circuit to save battery power when the unit isn't in use. Next in line is the 11-transistor "Pathfinder", with 240 milliwatt power, in a rugged, die-cast housing. Or you may want to take a look at our budget 11-transistor model, the 100-mw. output "Outrider", with its own built-in squelch circuit. There's also our new "Scout" model, ruggedly built to take outdoor abuse, with a 100-mw., 9-transistor circuit; and the popular "Trail-Blazer", our 9-transistor best-seller for the past three years. In the economy price range are the "Ranger", a 5-transistor superhet with an excellent signal-to-noise ratio, and our 3-transistor "Explorer", the perfect talkie for family fun.

For outdoor sports, construction work, or general family use, there's a Fanon CB walkie-talkie to fit your needs—and your budget, too. They're priced from $9.95 to $64.95*.

Isn't it comforting to know that whatever your needs in a walkie-talkie, you can rely on a manufacturer who takes extra pains to insure quality?

We think so.

But don't take our word for it. See for yourself.

The next time you drop by your electronics dealer, bring a screwdriver.

FANON

Fanon Electronic Industries, Inc.
439 Frelinghuysen Avenue, Newark, New Jersey

CIRCLE NO. 15 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

IN THE BEGINNING THERE WAS AN "AM"

Mr. Loniak's explanation "Letter" (June, 1965) of the origin of the term "ham" was very interesting and is certainly more credible than many other explanations that I have read. However, I believe radio amateurs have always been called "amateurs," and since there is a tendency in our language to shorten often-used words of more than one syllable, it seems reasonable to assume that the term "amateur" might have been shortened to simply "am." For a short time, amateurs might have been calling themselves radio "ams." Then, somewhere along the line, the word "am" could have picked up the aspirate "h," resulting in the familiar term "ham."

DAVID G. LEEPER, K1YST
Longmeadow, Mass.

REMEMBER WHAT THE SPIDER DID

"Plan Now For Your License" (July, 1965) has encouraged me to try again. I have studied many times for my ham radio license, but have been easily discouraged. If I don't get it now, I never will.

RICHARD BALL
Bronx, N. Y.

Richard, it's worth another try.

GRANDMA'S BREADBOARD UPDATED—UPDATED

Having been instrumental in the development of the DeVry modular breadboarding components, I quite naturally read the September, 1965 issue with much interest. Judging from our recent mail, however, the article which accompanied the cover picture ("Grandma's Breadboard Updated," p. 67) caused some confusion in the minds of some of your readers. The confusion apparently stems from the fact that we have developed two breadboard systems.

The modular system illustrated on the September cover is the newer and more flexible system. The components pictured can be purchased either separately or as a kit. The most popular kit includes a good quantity of white Celcon connectors, red Cycolac panels and nylon stacking rods in a plastic case for $18.50 complete. Individual components can be purchased for as little as 30 cents each.

The original system developed by DeVry does list for $37.50 as indicated in the article, but is completely different in appearance. It is marketed by DeVry Industries Inc. (formerly Paromel Electronics), and features a large "see through" base of clear plastic. The original system is used

LETTERS

(*Continued from page 6*)

extensively by schools where wiring templates are positioned underneath the board to guide students in circuit construction.

MALCOLM HOUGHTON
Director of Education
DeVry Technical Institute
Chicago, Ill.

MORE ON "HAMS WITH OTHER HOBBIES"

I was glad to see that POPULAR ELECTRONICS has agreed to serve as a clearinghouse for hams with other hobbies. I'm now anxiously awaiting the results—with optimism. However, there are bound to be some problems in getting people together at any one given time, on a given band, and with a specific hobby interest. Perhaps experimental pathfinder type groups would help to overcome these problems. The experience of these experimental groups could then be written up for the guidance of others. I would like to set up one such group, within the limits of my rig and antenna system, and perhaps other hams who feel as I do, will set one up also.

ART TAYLOR, WØEYC
Lincoln, Nebr.

Go to it, Art; and we offer the same encouragement to any other ham who would like to set up a net. See page 92 for the first edition of the "Ham Hobby Clearinghouse."

COLOR ORGAN BREAKS SOUND BARRIER

I have just built the "Color Organ" (March, 1965) but I cannot get it to work without a lot of volume. I am driving a pair of University

"Senior II" speakers with a 70-watt Allied transistor amplifier. Can you recommend a bulb that would light up at normal volume levels?

JOHN F. GIBSON
Barstow, Calif.

I built a color organ. Could you please tell me how I can turn down the volume and still have the colored lights.

SERI KITT
Los Angeles, Calif.

John and Seri, just insert an L-pad between the speakers and the amplifier to quiet down the speakers to a comfortable listening level. Connect the color organ directly to the amplifier. The #47 bulbs have tested out quite well. Smaller bulbs are susceptible to quicker burnout and do not emit enough light to properly illuminate the photocell. Another solution is to add a separate amplifier between the color organ and your regular amplifier or preamp. The only justification

Use this check list before you install a home TV distribution system

	COAXIAL VHF	TWINLEAD* VHF	COAXIAL UHF/VHF	TWINLEAD* UHF/VHF AND UHF ONLY
Channels received	2-13	2-13	2-83	2-83 (14-83 for UHF only)
Color reception when properly installed	Excellent	Excellent	Excellent	Excellent
Cable loss: @ channel 13 for VHF only @ channel 83 for UHF/VHF	4 db (foam filled) 6 db (solid)	1.8 db/100 ft. @ Channel 13	9 db (foam filled) 13 db (solid)	5.6 db/100 ft. @ Channel 83
Loss increase when wet	Nil	Negligible	Nil	Negligible
Reception when run near or through small metal areas	Excellent	Excellent when properly installed	Excellent	Excellent when properly installed
Reception when run near or through considerable amounts of metal	Excellent	Not recommended	Excellent	Not recommended
Ease of installation	More difficult	Easy	More difficult	Easy
Extra parts required	Connectors, matching transformers	None	Connectors, matching transformers	None
Performance in strong-signal areas	Excellent	Excellent—fair**	Excellent	Excellent—fair**
Performance in weak-signal areas	Excellent	Excellent	Excellent	Excellent
Cable pickup of interference (ignition, appliances, etc.)	None***	None—slight**	None***	None—slight**

*A high quality, low-loss foam encapsulated cable type **Depends upon local conditions ***Poorly designed accessories will pickup interference.

Once you know the facts—there is one best choice for your home system—Blonder-Tongue. Whether you prefer 300 ohm or a 75 ohm coax system, Blonder-Tongue has the products you'll need. There is only one way you can protect your home TV system against obsolescence when new UHF stations come on the air—that's with a Blonder-Tongue all-channel UHF/VHF system.

Blonder-Tongue products designed for all-channel home systems include: All-channel signal amplifiers (V/U-All-2 indoor and U/Vamp-2 mast mounted); all-channel couplers (A-102-U/V two-set and A-104-UV four-set). Rounding out the all-channel concept are UHF/VHF matching transformers (Cablematch U/V set mounted; MT-283 mast-mounted) and the TF-331-U/V flush-mounted feed-thru.

Take your pick. Blonder-Tongue makes them all—and all are "Color Approved". Buy the line with 15 years of quality leadership. Write for free booklet "How to Plan a Color-Approved Home TV System".

BLONDER-TONGUE

9 Alling Street, Newark, New Jersey 07102

home TV accessories • closed circuit TV • community TV • UHF converters • master TV

CIRCLE NO. 7 ON READER SERVICE PAGE

LETTERS

(*Continued from page 8*)

for the low gain is the low price . . . normally a color organ sells for about five times more money.

"SIDEARMS" FOR CAMPER'S SPECIAL WANTED

Congratulations on the "Camper's Special" (August, 1965). I have been looking for a rig like this for some time. There's only one problem—I need an inexpensive battery-operated receiver to match.

BOB MOCZYDLOWSKI, WB2PWA
Linden, N. J.

I have completed two Camper's Specials and would like to modulate them with a suitable transistor modulator.

E. J. ANTOINE, VE5EA
Davidson, Sask., Canada

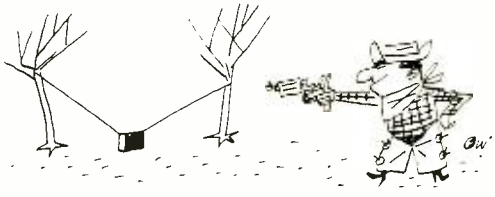
The Camper's Special calls for three B&W Miniductors and two 2N3053 transistors. I have not been able to get these parts.

DAYTON JONES, WN3DVH
Philadelphia, Pa.

The drawing of the antenna shows the lead-in connected to *TS1*. Shouldn't it be connected to *TS2*?

WAYNE J. SHOPE, K4ANL
Charlotte, N. C.

Looks like a busy day for the Camper's Special, but here goes. Wayne, don't shoot. We give up.

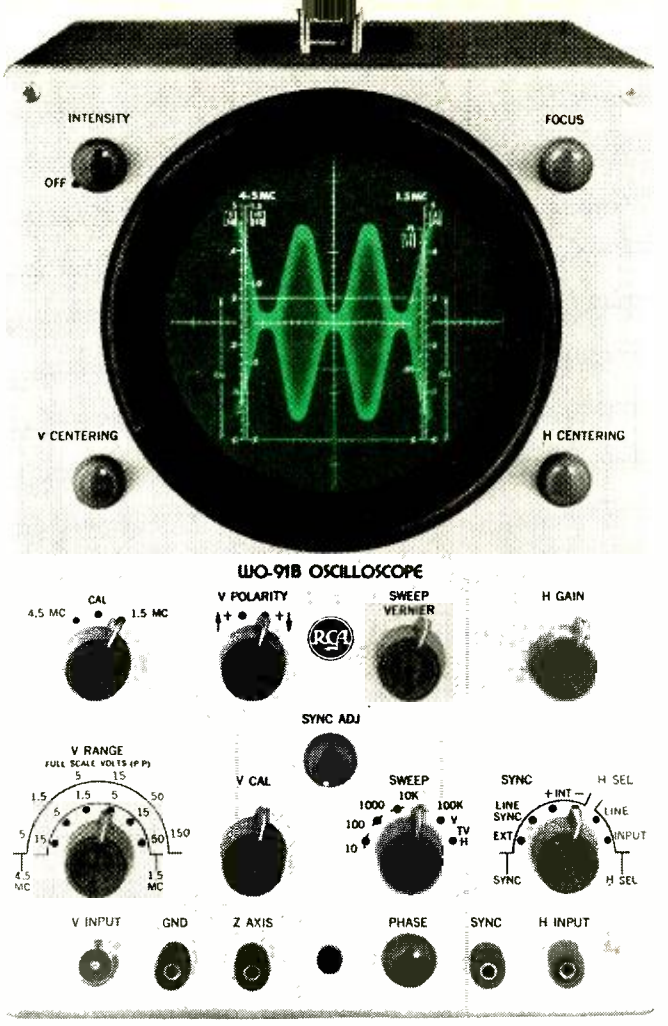


The antenna is supposed to be connected to TS2. The text is correct. D.J., if your local electronics parts distributors can't help you on these parts, try a mail-order house. Lafayette's 1966 catalog lists the transistors for 99 cents each and the coils for 62 and 68 cents each. E.J., you might consider the 6-watt transistor amplifier on page 73 of this issue. Bob, we saved you for last because we are still working on a Camper's Special transceiver.

POPULAR ELECTRONICS IS FOR HOBBYISTS

In one reader's opinion, you have successfully filled the gap between a technical trade publication and a layman's type of journal. The descriptions of how your circuits work have saved me more than once when it came time to troubleshoot a project.

The following information may be useful to you in statistical compilations. I am 26 years old, have a degree in Economics and hold a position as a Systems Analyst (Data Processing Busi-



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- Optional at slight extra cost: RCA WG-354A slip-on capacitance-type voltage-divider probe that extends the range of the scope to permit observation of signal pulse amplitudes up to 5000 volts. RCA WG-302A slip-on RF/IF/VF signal tracing probe for RF applications from 100 Kc to 250 Mc.

☐ WO-91B Scope:	**$249.50***
☐ WG-354A Probe:	**$ 7.50***
☐ WG-302A Probe:	**$ 8.20***

Ask to see it at your Authorized RCA Test Equipment Distributor.

*Optional distributor resale price. All prices subject to change without notice. Prices may be slightly higher in Alaska, Hawaii and the West.

RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

CIRCLE NO. 34 ON READER SERVICE PAGE

LETTERS (*Continued from page* 10)

ness Systems). I have been reading your magazine since 1958, and I have built about 15 kits (hi-fi, test equipment, tach, and sonar). My wife also builds kits—an FM tuner among others. My other hobbies are photography, guns, and model railroading.

DAVE MCBURNEY
Yorba Linda, Calif.

Our computer tells us that you were about 18 years of age when you started to read PE, and that it's good to have such loyal readers. Thank you for the statistics, Dave, but don't be surprised to hear that many others dwell in the same "statistical" house.

TEMPUS FUGIT, BUT—

In the "Current Stations Reports," (August, 1965), you said that *Radio Luxembourg I* on 233 kc. was heard in New England as early as 1820 with rock-and-roll music. Is this true? I always thought that wireless radio transmissions weren't possible until 1916 and the first radio wasn't on the air until 1921.

ROBERT WIVAGG
Elizabeth, Pa.

Even Dr. Mahlon Loomis, the real inventor of wireless, didn't create a spark until 1894 (October issue, 1965). We raised our eyebrows about 233 kc., Robert, not 1820. Our Short-Wave Editor did say the beacon that normally operates on this frequency was not on the air. So far as "1820" is concerned, it stands for 6:20 P.M., Eastern Standard time, as all SWL's know. We guess you're not a short-wave listener yet.

QSL BUREAU, LONDON

We have read with interest the letter from S. J. Stansfield, WA8GDR, entitled "QSL's From Iron Curtain Not Propaganda" (August, 1965) referring to QSL Bureau services maintained by the International Short Wave League. We would like to point out that our headquarters address is 12 Gladwell Rd., London, N.8—not 86 Barrenger Rd., as stated in Mr. Stansfield's letter. The use of the QSL Bureau is free to members, and the Bureau handles both amateur and broadcast QSL's and reports. Membership details are available upon request.

PETER BYSH, Hon. Secty./Treas.
International Short Wave League
London, England

"WATCH OUT" FOR THE LIGHT WATCHMAN

In your article on the "Li'l Dusker—the Light Watchman" (September, 1965) you have a Sigma 5HC2 photocell, Allied stock number 0 E 307, in the Parts List. We have not been supplying this photocell since last November because it was dropped by the manufacturer. However, we can

(*Continued on page* 20)

POPULAR ELECTRONICS
PRODUCT SERVICE PAGE

You can get
additional information promptly
concerning
products advertised or mentioned
editorially
in this issue

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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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Mail the coupon to the address indicated below.

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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
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

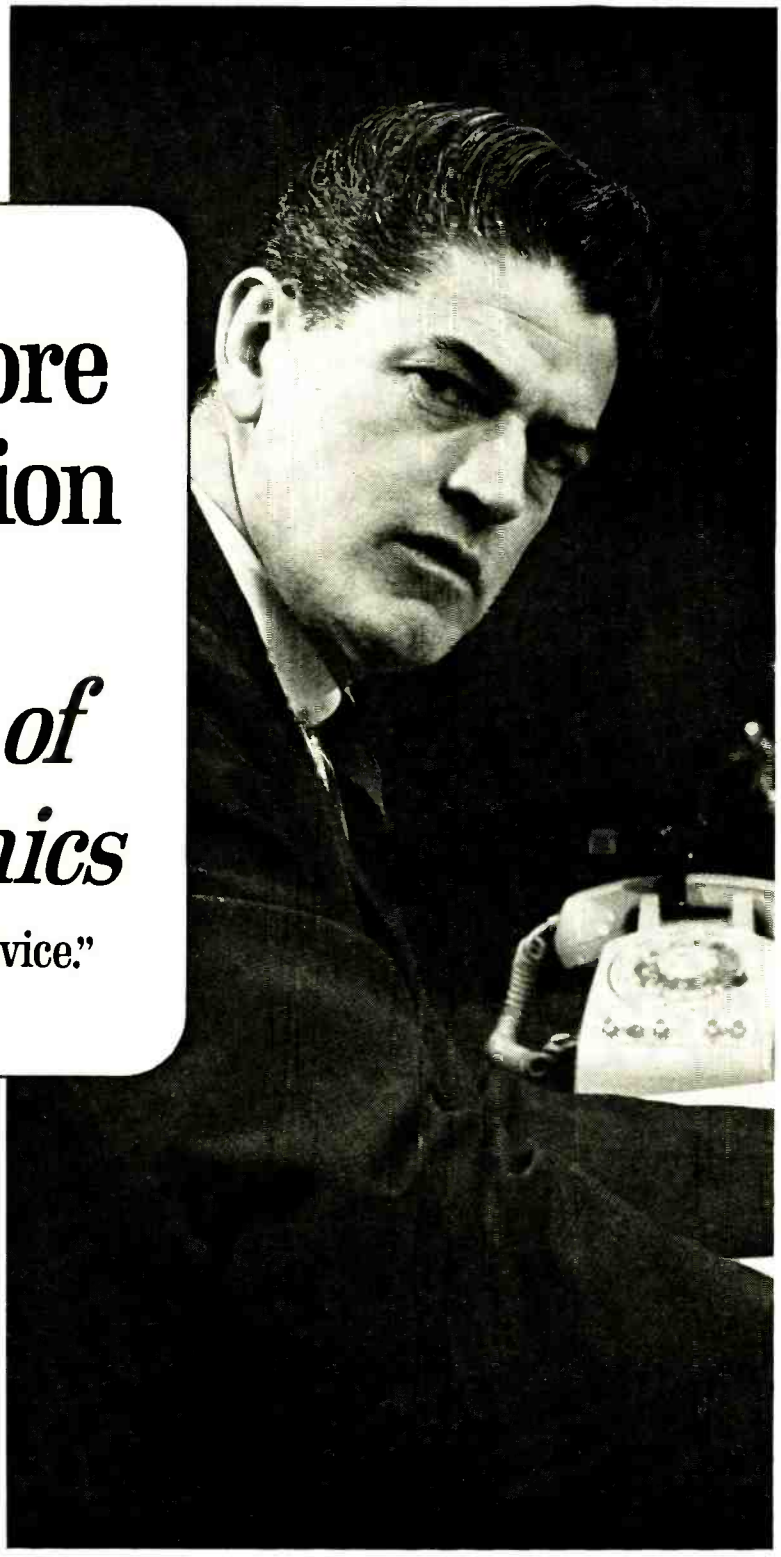
NAME *(Print clearly)*_____

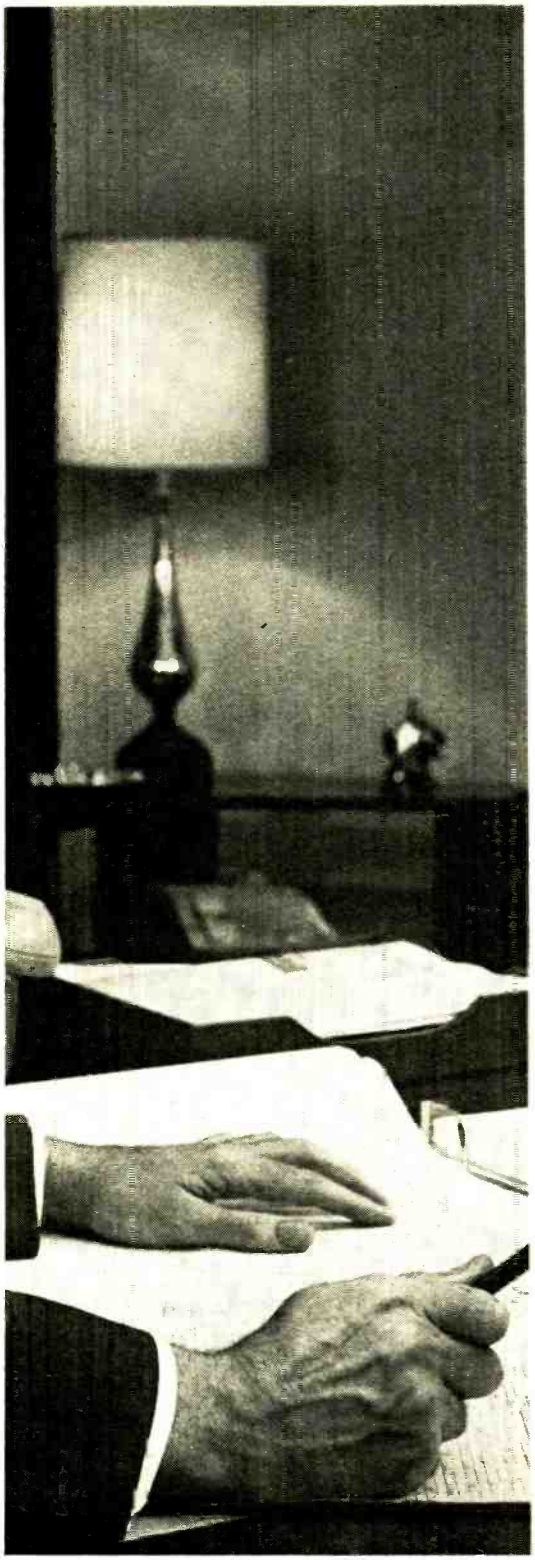
ADDRESS_____

CITY_____ **STATE**_____ **ZIP CODE**_____

VOID AFTER DECEMBER 31, 1965 11

"Get more education or *get out of electronics* ...that's my advice."





Ask any man who really knows the electronics industry. Opportunities are few for men without advanced technical education. If you stay on that level, you'll never make much money. And you'll be among the first to go in a layoff.

But, if you supplement your experience with more education in electronics, you can become a specialist. You'll enjoy good income and excellent security. You won't have to worry about automation or advances in technology putting you out of a job.

How can you get the additional education you must have to protect your future—and the future of those who depend on you? Going back to school isn't easy for a man with a job and family obligations.

CREI Home Study Programs offer you a practical way to get more education without going back to school. You study at home, at your own pace, on your own schedule. And you study with the assurance that what you learn can be applied on the job immediately to make you worth more money to your employer.

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. For your copy, airmail postpaid card or write: CREI, Dept. 1211C 3224 Sixteenth Street, N.W., Washington, D.C. 20010

Founded 1927

CREI

Accredited Member
of The National Home Study Council

LETTERS (*Continued from page 12*)

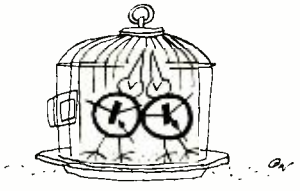
supply a somewhat superior photocell to work in this circuit: Special Clairex 5M5, for $2.00. The Clairex unit would have to be obtained on special order, but if there is a substantial demand for it we will stock it.

J. W. RUBIN
Allied Radio Corp.
Chicago, Ill.

While we are on the subject, here's some data on relay K1 in the "Li'l Dusker." It's made by Philips-Advance, part number 15-24-1C. The coil is rated at 24 volts, 1100 ohms. Contacts are 1 amp. Price, $1.50.

DARLINGTON PAIR NOT LOVEBIRDS

Not long ago I ran across a reference to a "Darlington pair" in connection with an article



on transistors, but there was no explanation. Can you tell me what they are?

E.A. HEATH
Palo Alto, Calif.

Sure thing, E.A. See the How It Works section of "Super Sens," on page 57 of this issue.

REAL POWER WANTED, NOT STEAM POWER

I enjoyed the "Steam-Powered Ham Rig" (July, 1965). Now, how about using real power, but still in the milliwatts?

MIKE MARTZ
Sidney, Ohio

The Stanley Steamer must have been before your time, Mike, or you would have more regard for the power of steam. If you wish, you can try a 3-volt battery hookup instead of the steam engine.

DOES IT PAY TO BUY CB EQUIPMENT?

I would like to know if it is wise to buy a CB set at this time, in view of all the new rules and regulations to knock out the CB'er.

CHARLES GROTTICELLI, JR.
Brooklyn, N. Y.

Charles, a great number of CB'ers share our view that the FCC regulations are designed to provide maximum practical use of the airways. We don't think the FCC wants to knock out the CB'er. Whether or not it pays for you to buy a CB set depends upon what you intend to do with it. —30—

American Basic Science Club's Master Lab . . . a
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You Get ALL the Following Equipment in 9 Monthly Kits

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All the equipment for basic electrical experiments with **Wheatstone Bridge** (measures resistance), **Magnetizer** and **Demagnetizer, Thermocouple, Potentiometer, Continuity Tester, Extinction Voltmeter, Solenoid Coin Tosser, Electromagnetic Relay, Neon Lamp, Galvanometer, Induction Coil, Resistors,** Chemicals and Electrodes for Plating and Electrolysis.

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A Neon Lamp that flashes at intervals you can synchronize with the speed of rotating or vibrating objects in order to "freeze" their motion to permit close study and checking frequencies and RPM. Flashes are timed by a high speed **Oscillator.** Operates on the Master Lab DC Power Supply. (When bought as a separate unit uses a 90 V Battery that is included in unit price.)

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Crystal Photocell, Electronic Amplifier, Relay, large Condensing Lens in Cabinet Mount. Features automatic "on-or-off" or holding circuit operation. Sensitivity Control. Plug-in Outlet for controlled circuit. Use for alarms, counters, etc. Operates on 115V AC. **A basic unit for many exciting experiments.**

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ANALOG COMPUTER

Electronic Computer multiplies, divides, calculates powers, roots, logarithms. Set up the problem on the scales of two linear potentiometers and find the answer by listening for the null point on the third potentiometer. More accurate, educational, and **practical** than similar computers that sell for several times the price. Easy to assemble. **Complete with Headphone.**

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Exciting optical projects for the study of light. Equipment includes: **Five Precision Lenses, Prism, Polarizing Filters, Diffraction Grating, Mirror, Telescoping Tubing, Lens Mounts, Tube Holders and Brackets.**

All the parts and instructions to build a Microscope Camera Obscura, Camera Lucida, Polariscope, Photometer and many other optical devices.

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A PRECISION 35MM ENLARGER . . . horizontal type with twin condensing lenses and 3" F/L projection lens. Produces quality enlargements up to 8" x 10". Contact Print Frame takes negatives up 3½" x 4½". **3 Plastic Developing Trays, Neon Safelight, Tray Thermometer, Film Clips, Developing Chemicals, Printing and Enlarging Paper and Darkroom Handbook.** Make quality enlargements for 6c. Make prints for only 2c.

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SHORTWAVE AND BROADCAST RADIOS. 3-tube regenerative circuit. Uses 115V AC house current. Complete with headset.

CARBON MICROPHONE and 2-stage **AUDIO AMPLIFIER**

RADIO TRANSMITTER for code or voice.

RIPPLE TANK WAVE GENERATOR with variable frequency. Produces waves, nodal lines, etc. Invaluable in understanding wave theory.

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CODE PRACTICE OSCILLATOR with manual "Steps to a Ham License." All you need to pass the FCC Ham License Exam.

An exciting learn-by-doing course and lab. You get more than 25 dollars worth of electronic parts by **GE, RCA, MALLORY, STACKPOLE, TRIM, CINCH, CENTRALAB,** and other reliable manufacturers.

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DC POWER SUPPLY

Changes regular 110-120V AC to the **direct current required for electronic projects and experimenting.** Consists of a **Power Transformer, Vacuum Tube Rectifier, 20/20mFD Capacitor Filter Circuit ,** and a **Potentiometer Voltage Selector.** Dial Control for 0 to 85V. A safe Isolated Power Supply that eliminates the need of expensive multi-volt batteries.

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PHOTOMICROGRAPHY LAB

"Projection-Type" Camera takes and prints pictures of subjects mounted on microscope slides. Enlarges up to 100 times. Takes the place of microscope, camera and printer. No other equipment needed. Includes: **Developing Trays, Chemicals, Paper, Microscope Slides and Safe Light.** Uses standard sizes of regular roll film.

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SLIDE PROJECTOR

Has interchangeable projection assemblies — one for standard 35MM slides, and the other, with greater magnification, for microscope slides. Comes with **140 watt GE Projection Lamp, Large Twin Condensing Lenses** for extra brightness, sturdy **Steel Housing** with inner chimney and baffle for cool operation.

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LIGHT TRANSMITTER-RECEIVER

The **TRANSMITTER** consists of a **Light Source,** a **Modulating Reflector Diaphragm** and an Optical Projection System. The **RECEIVER** is a **Two-Stage Audio-Amplifier,** controlled by a Photo-electronic Cell that catches the projected light beam and causes the original sound waves to be reproduced in the headphone.

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ATOMIC ENERGY LAB

ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. See the vapor trails of alpha and beta particles, and of cosmic rays.

SPINTHARISCOPE. Shows exploding atoms.

ELECTROSCOPE — metal housed with **Scale** and **Magnifying Viewer.** Measures background radiation and tests sample sources.

SAFE RADIOACTIVE MATERIALS. Alpha Source in handy container and Uranium Ore.

Full instructions and explanations open up the fascinating field of nuclear physics.

(Available as a Separate Unit for $6.95 Postpaid)

SPECTROSCOPE

Analyze spectra of glowing gases. **See and identify the Fraunhofer Lines. A quality instrument featuring an easy-to-read built-in scale and a powerful condensing system** for a bright spectrum. Equipment includes **Alcohol Burner and a 2 Watt Neon Spectral Lamp. Full instructions cover theory and use.**

(Available as a Separate Unit for $5.95 Postpaid)

ULTRAVIOLET LAMP

140 watt filter type UV LAMP. Heavy metal cabinet. 6 Foot Cord, Rotary Switch. Produces dazzling color effects with Invisible black light. Has many uses in the fields of Mineralogy, Crime Detection and Science. Accessories include **Invisible Ink, Tracer Powder, Fluorescent Crayons.**

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SURVEYOR'S TRANSIT

A practical Transit. 6X erect image telescope with Range Finder Reticle for measuring remote distances and heights. Vernier reading for both horizontal and vertical scales. Leveling Head with Thumb Screw Adjustment and Spirit Level. Clamps under head hold wooden legs of Tripod. (Legs not included.) **Instructions cover elementary surveying, range-finding.**

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TELESCOPE AND MOUNT

30X erect image. Extends to 30" length. Five ground and polished Lenses. **Ramsden Eyepiece. Sturdy Equatorial Mount** makes it easy to follow the movement of heavenly bodies. Mount has fittings for wooden legs that complete the tripod (legs not included).

(Available as a Separate Unit for $4.95 Postpaid)

WEATHER STATION

A REMOTE READING ANEMOMETER AND WIND-VANE . . . Flashing Neon Lights on indoor indicator board show wind speed and direction. Operates on less than 1 cent per month, **Safety Power Cord** makes all connections safe. 150 ft. of Lead-In Wire. Plus — **Air Tank Barometer** with 4 ft. indicator column. **Sling Psychometer** measures relative humidity. **Rain Gauge** measures rainfall to 1/100 inch. ALSO Cloud Chart, Weather Map and Forecasting Manual — a complete set-up for amateur meteorology.

(Available as a Separate Unit for $7.95 Postpaid)

9 KIT MASTER LAB Includes *ALL* the Equipment for *ALL* the Above...only $37.55

SEND ONLY **$2.00** WITH COUPON

PAY ONLY **$3.95** PLUS POSTAGE FOR EACH OF THE 9 KITS . . . ONE-A-MONTH

CANCEL ANY TIME YOU WISH — MONEY BACK IF NOT DELIGHTED

MULTI-USE DESIGN — A MASTER LAB FEATURE

All the above equipment, as separate units, adds up to over $140.00.

How can the 9 kit Master Lab have it all for only $37.55 ?

Multi-use design is the answer. For example: The Slide Projector quickly and easily converts into the Photo-Enlarger, Spectroscope, Cloud Chamber Illuminator. Similarly, the Transit Head doubles as a Telescope Mount. Such multi-purpose design makes possible an all-science lab at an unheard-of low price. Multi-purpose design is used only where it is advantageous, and not for such applications as the permanently-mounted weather instruments, where it would not be practical.

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Get Master Lab on either plan (see coupon). You may start with the Kit-a-Month plan, and at any time get the balance of the 9 kit series in one shipment by sending $3.95 for each of the unshipped kits.

SEPARATE UNITS ALL GOOD BUYS

You can order any of the individual units and be sure that it is a quality item and the best value in its field. The Master Lab, however, is the "buy of buys" and every science-minded person should try it.

NO EXPERIENCE NECESSARY — IT'S EASY! IT'S FUN!

You will enjoy the easy-to-use equipment and the exciting learn-by-doing course. The 9 instruction manuals and the 6 auxiliary text books are expertly written and clearly illustrated. Over 490 pages. Over 280 illustration. A real science course for a solid science background.

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Everyone interested in science should have your enjoyable kits. You are doing a wonderful job.

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501 East Crockett St., San Antonio, Texas 78202

A MASTER LAB CHRISTMAS — FOR A HAPPY NEW YEAR!

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.

"KWIK-START" IGNITION SYSTEM

When points or "condensers" fail, your car's engine will still run with a "Kwik-Start" emergency ignition system. You won't have to push your car or have it towed to the garage—you can drive there. Produced by *Kwik-Start Enterprises*, the system is easy to install—you just disconnect the primary wire between distributor and coil and attach the Kwik-Start unit. In addition, if the points or "condensers" are okay, Kwik-Start will tell you so and try to diagnose the trouble. It's available in both 6- and 12-volt models.

Circle No. 75 on Reader Service Page 15

SUPERHET CB WALKIE-TALKIE

The Model HA-130 introduced by *Lafayette Radio Electronics* is a low-cost superheterodyne walkie-talkie for the Citizens Band. Housed in a durable black-and-silver simulated leatherette plastic case, its five-transistor, two-diode circuit employs a crystal-controlled receiver and a 100-mw. transmitter section, each using plug-in, easy-to-change crystals. Simple to operate, the HA-130 has only a push-to-talk switch and an on/off volume control. The collapsible 34" antenna radiates power effectively for up to one mile. Channel 10 transmit and receive crystals, an earphone jack, and a 9-volt battery are supplied with the unit.

Circle No. 76 on Reader Service Page 15

MAGNET VARIETY KIT

Ever consider using a magnet as a tool or knife holder? As a dashboard retainer fitting for your car? As a holder for pipe or flashlight brackets? If you'd like to put magnets to practical use around your home, office, or recreation area, you'll be interested in the low-cost variety kit available from *Edmund Scientific Company*. It contains 16 magnets, in nine different shapes, and of several compositions—including a rubber strip and flexible material containing thousands of tiny individual magnets.

Circle No. 77 on Reader Service Page 15

POCKET WIRING TOOL

Cutting jumper wires and component leads to measured length, stripping insulation, and tailoring lead bends are the main functions of the new *James* "Snip-N-Strip" tool. Constructed of tough, lightweight, glass-filled Nylon plastic, it contains a retractable surgical-steel knife blade and comes with a convenient, removable pocket clip. A trigger-actuated set of quadrilateral shear blades cleanly cut conductors without distorting stranded types, and a sliding scale on the side of the tool provides an accurate, quickly adjustable length gauge.

Circle No. 78 on Reader Service Page 15

UNI-SUSPENSION TURNTABLE

New from *Thorens* is the TD-150 AB two-speed (33⅓ and 45 rpm) turntable. The tone arm board and turntable platter are on a single adjustable spring-loaded suspension. Balanced in horizontal and vertical planes, the tone arm incorporates a low-mass plug-in cartridge shell with an exclusive patented system for adjusting vertical tracking angle. The motor is a 375-rpm double-synchronous type. Rumble, wow, and flutter are said to be below NAB stereo standards.

Circle No. 79 on Reader Service Page 15

"PLATTER PUSSES"

"Platter Pusses," made by *Robins Industries Corp.*, are felt-flocked leatherette discs which are designed to keep fingerprints off your hi-fi records. You just fold one in your hand and pick up a record without touching it with your fingers. The inexpensive "Platter Pusses" are packaged in lots of 12.

Circle No. 80 on Reader Service Page 15

TEST LEAD HOLDER

A test lead rack designed to store patch cords and cable assemblies has been announced by *Pomona Electronics Co., Inc.* The rack simplifies the job of locating a particular test lead by making it readily accessible. Fabricated from cold rolled steel, with baked enam-

What most people don't know about hi-fi kits could fill a book.

This one. (And it's free!)

FREE! $1.50 VALUE! 32 PAGES! *The New Kit Builder's Manual* is a completely new version of the authoritative Fisher guide to high-fidelity kit construction. It is new in format, twice as long in content, and contains detailed specifications of all Fisher StrataKits. Here is an introduction to kit building presented in a manner so nontechnical and lucid, even your wife will understand it. Included are comprehensive, illustrated articles on every phase of assembly, wiring and soldering. *The New Kit Builder's Manual* is the handiest tool a do-it-yourself audiophile can have: the first thing you need before investing in stereo amplifier, tuner or loudspeaker kits.

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The Fisher

CIRCLE NO. 17 ON READER SERVICE PAGE

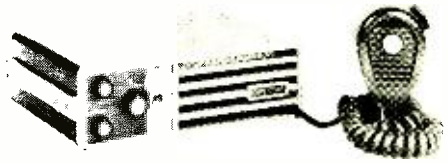
PRODUCTS (*Continued from page 22*)

el finish, the unit accepts cables up to 0.210 inch in diameter. Mounting holes are provided for easy installation on any vertical surface.

Circle No. 81 on Reader Service Page 15

SOLID-STATE CB TRANSCEIVER

Could your car use a 23-channel transceiver that takes less current than an ordinary dashboard clock and will function even when the car battery is so low that it won't turn over the engine? According to *Pearce-Simpson, Inc.*, its solid-state "DIRECTOR" will do

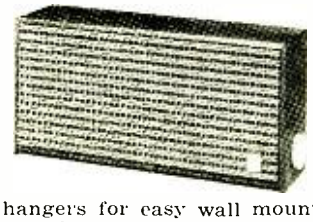


both of those things. The "DIRECTOR" requires no warm-up period, and features a dual-conversion superhet receiver and a special high-gain audio power amplifier. It comes complete with crystals and a universal, all-angle-mounting bracket on a slide rail.

Circle No. 82 on Reader Service Page 15

COMPACT SPEAKER SYSTEM

Only 6⅝" high x 13 11/16" wide x 4" deep, the *Jensen* X-11A two-way speaker system is intended for use as an extension speaker. High frequency response is 14,000 cycles, and full room volume is possible with low-power amplifiers. Features include a volume control and built-in hangers for easy wall mounting. Having an impedance of 8 ohms, the X-11A can be used with amplifiers having 4, 8, or 16 ohms output.



Circle No. 83 on Reader Service Page 15

INTERCHANGEABLE TV ANTENNA

The "Starfire" is claimed to be the only antenna on the market that can be used with either 75- or 300-ohm transmission line—*without* matching transformers. Announced by *Kay-Townes Antenna Company*, it's a high-gain, 11-element, gold-anodized unit for local and fringe reception, and especially designed for color reception.

Circle No. 84 on Reader Service Page 15

CALIBRATION STANDARD CARTRIDGES

Built right into the stylus of each *Stanton* 581 calibration standard cartridge is a completely integrated dust-removing device. The 581—otherwise known as the "LONGHAIR" cartridge—has a free-riding long-haired brush extending from the front of the plastic stylus V-guard. It engages the grooves in advance of the stylus and prevents any collection of lint or dust on the stylus tip—without affecting delicate tracking forces. The 581 is available in three models.

Circle No. 85 on Reader Service Page 15

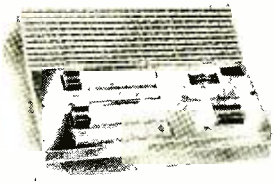
CB BEAM ANTENNA

Constructed of high-tensile strength aluminum, the A-411-S 4-element "Scotch-Master" beam is a sturdy, bi-directional base station antenna announced by *Mosley Electronics, Inc.* It boasts a VSWR of 1.5/1 or better and is gamma-matched. Gain is 8.7 db over ¼-wave dipole or 11.2 db compared to an isotropic antenna. And if you stack two A-411-S antennas together, you get an additional 3 db gain. A stacking kit is available.

Circle No. 86 on Reader Service Page 15

TRANSISTORIZED INTERCOM

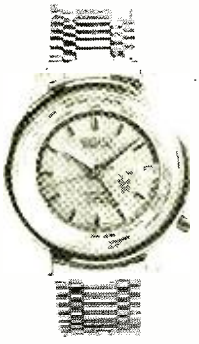
Up to ten master stations can be connected to the *Lafayette* Model USI-10 transistorized intercom, and up to five private conversations can take place simultaneously. A special indicator circuit provides a silent visual signal of a call by a particular station; if a "call" is received while the unit is in communication, the indicator lamp remains lit until the "call" is answered. Communication is possible up to 1000 feet.



Circle No. 87 on Reader Service Page 15

WORLD TIME WRISTWATCH

Hams everywhere can tell the time anywhere on the five continents just by glancing at *Seiko*'s new 17-jewel, self-winding world time wristwatch. There is just one large, easy-to-read dial which gives the local time in every global time zone. There are no adjustments to be made, and there is no need for mental arithmetic or reference to any charts. A synchronized permanent color code indicates whether the time in any overseas zone is day (blue) or night (black), and an automatic calendar shows the date large and clear. The wristwatch never needs winding if it is worn daily.



Circle No. 88 on Reader Service Page 15

THE TURNER TRANSISTORIZED

+2

WITH VARIABLE OUTPUT LEVEL

Now, from Turner comes the very finest base station microphone ever designed. The +2 features a two transistor pre-amp with volume control to give you up to 50 times the output level you now have. Yes, just dial your desired signal for maximum modulation all the time — every time. You can work close or far away from this microphone, or change the output for a big or little voice.

Eventually, all sets lose some of their initial power. Turner's +2 puts the zip back into your set and keeps it up to full strength at all times!

The +2 has tailored frequency response of 300-3500 c.p.s. This means the best and clearest voice transmissions with knocked down local noise interference.

Exclusive touch-to-talk or lock on-off switching — the +2 works with **all** tube or transistor sets regardless of switching requirements or type.

Ask your dealer about the new +2. **LIST PRICE $49.50**

THE TURNER MICROPHONE COMPANY
901 17th Street N.E.
Cedar Rapids, Iowa

Available in Canada
Export: Ad Auriema, Inc., 85 Broad Street, New York 4, N.Y.

CIRCLE NO. 43 ON READER SERVICE PAGE

"New set of wheels? I hit the jackpot!"

"Ever since I can remember I've been hung up on anything that rolls. From skates to scooters to my own home-made custom job. And I've always wanted more wheels.

"So I joined the Army. Jackpot! I found more wheels, more different kinds of wheels than I ever thought existed. Wheels. Treads. Science-fiction rigs running on rubber pillows. Even a mechanical mule.

"And I get a chance to work on all of them. That's part of being an Army mechanic.

"Next month I'm off to see the world. And some of the wildest jobs that ever rolled."

An Army enlistment has been the turning point for many men. And it can be for you. It can give you the chance to learn any one of over 300 skills, skills you can build your life on. You can travel to countries and places you might never see otherwise. And you'll be proud of what you're doing.

Look into what the Army has to offer. You'll find there's more for you in today's action

Army

PARTS METHODS IDEAS GADGETS DEVICES

TIPS & TECHNIQUES

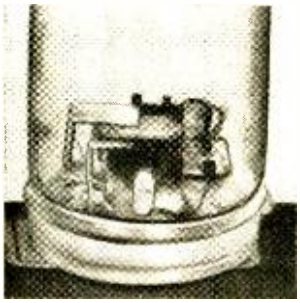
DRILL HOLES IN VTVM FOR EASY CALIBRATION

To calibrate the EICO 221 or similar type VTVM, you must first remove the unit from its carrying case, since the calibration controls are mounted inside the case. However, if you drill holes through the top of the case in line with the controls, you will be able to leave the unit in place when you calibrate. The holes should be large enough to pass a small screwdriver after grommets are inserted for a finished appearance. Calibration for d.c. can be readily accomplished by using a mercury battery as a reference; each cell puts out 1.35 volts, even after it has aged greatly. For a.c. adjustments, use an accurate a.c. meter for comparison. The line voltage, while nominally 117 volts, does vary from time to time.

—Walter Robson, Jr.

RELAY GATHERING DUST? BOTTLE IT UP FOR PROTECTION

Relays that must be used in dusty locations are subject to failures resulting from dirty contacts. To prevent such failures, enclose your relay in an airtight housing. Suitable housings can be made from a variety of containers such as screw cap jars, coffee cans with plastic snap-on covers, or for the really small relay, small vials. The lid, or cap, of the container with relay attached is mounted on the chassis, and the wiring for the relay is run through a hole in the cap which is then sealed. Finally, the container is screwed or snapped



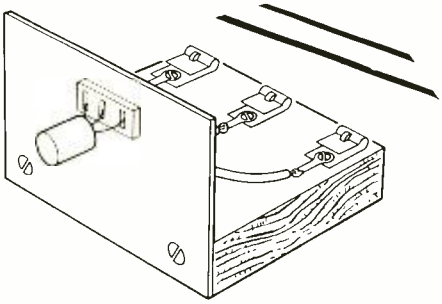
TIPS

(*Continued from page 27*)

onto the cap to effectively seal the relay against dust. —*Wm. B. Rasmussen*

TRANSISTOR ADAPTER SPEEDS TESTS AND ELIMINATES SOLDERING

To avoid soldering and unsoldering in an experimental circuit or when you are trying to find a transistor that will work in your circuit, you can build this inexpensive adapter. It will enable you to quickly plug in your transistors. Simply take a ¾"-thick block of

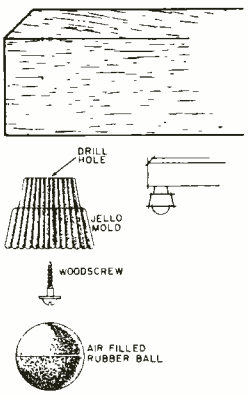


wood measuring approximately 3½" x 3" and attach it to a metal plate of the same size. Mount a transistor socket on the plate and connect the socket terminals to three Fahnestock clips on the block as shown. Material and dimensions are not critical.

—*James O. Fishbeck*

GELATIN MOLDS AND RUBBER BALLS SHOCK-MOUNT HI-FI EQUIPMENT

Make use of several homemade air suspension mounts to isolate your record player or other hi-fi equipment from annoying vibrations — particularly those which travel along the floor and hi-fi furniture. Each mount consists of a small gelatin mold, a woodscrew, a washer, and an air-filled rubber ball just large enough to fit into the wide end of the mold. Drill a hole in the bottom of the mold just large enough to accommodate the screw. Place the washer between the screw head and mold, and screw the mold into place on a side of the base. Then cement the rubber ball in place inside the mold. If the sides of the base are too thin to hold the screws, you can build up the cabinet with a block of wood. —*Harry Goldman*



Zip through Scott's new solid state FM stereo tuner kit in one afternoon

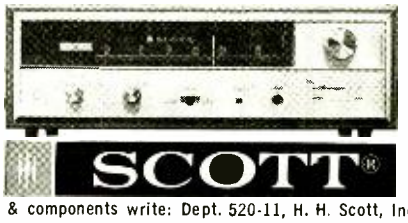
Four to six hours! That's all you need to zip through Scott's new LT-112 FM stereo tuner kit. Start after lunch—enjoy superb stereo at dinner.

Scott solid state circuitry is the key to the LT-112's superior performance. Costly silicon transistors give performance unapproached by any other kit on the market. The LT-112 is kit-brother to Scott's best-selling 312 solid state stereo tuner, of which *Audio* said, ". . . one of the finest tuners anywhere."

Your LT-112 arrives with all critical circuitry pre-wired, pre-tested, pre-aligned, and mounted on heavy-duty printed circuit boards. Scott's exclusive life-size, full-color construction book details every step . . . makes perfect wiring almost automatic.

You'd never believe a kit so easy to build could be so packed with features. Built into the LT-112 is a new Scott invention . . . the Trimodulation meter, used for a Signal Strength Indicator, Zero Center Indicator, and Alignment Meter.

See your Scott dealer today, and pick up an LT-112 tuner kit . . . $179.95 plus one enjoyable afternoon will net you a lifetime of listening pleasure.



For complete information on Scott's kits & components write: Dept. 520-11, H. H. Scott, Inc., 111 Powdermill Road, Maynard, Mass.
Export: Scott International, Maynard, Mass. Cable HIFI. Prices slightly higher west of Rockies.
Prices and specifications subject to change without notice.

CIRCLE NO. 39 ON READER SERVICE PAGE

ELECTRONICS LIBRARY

RECEIVING TUBE SPECIFICATIONS & SUBSTITUTIONS

Having made a "name" for itself by publishing several cross indexes of transistors, Techpress, Inc., has now invaded the vacuum-tube field. This book lists the specifications of more than 2000 American and foreign tubes. The style of the listing is similar to that successfully employed by Techpress in its previous books. Details on tubes are tabulated according to type number and according to general family characteristics (diode, triode, etc.). Special codes and symbols are used in the tables to simplify the presentation. This book is likely to be of great value to designers, or experimenters wanting to upgrade equipment.

Published by Techpress, Inc., Brownsburg, Ind. 46112. Soft cover. 140 pages. $1.95.

SOLAR CELL & PHOTOCELL EXPERIMENTERS GUIDE

by Stu Haberman

The basic objective of this latest book in the Howard W. Sams "Photofact" series is to demonstrate the theory and application of light-sensitive devices by actually constructing projects that rely on them for their operation. How and why these devices operate as they do is explained, and you are told what type to choose for particular applications, and whether to use sunlight, artificial light, or other light sources to activate the devices. Many variations of the projects covered here are possible; this guide furnishes the basics, and you provide the innovations.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 128 pages. $2.95.

BASIC ELECTRONICS (Second Edition)

by Bernard Grob

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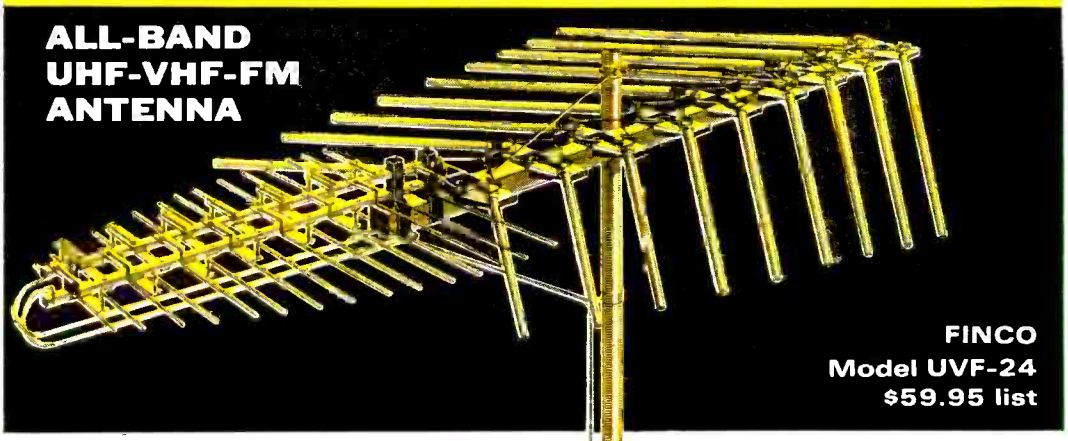

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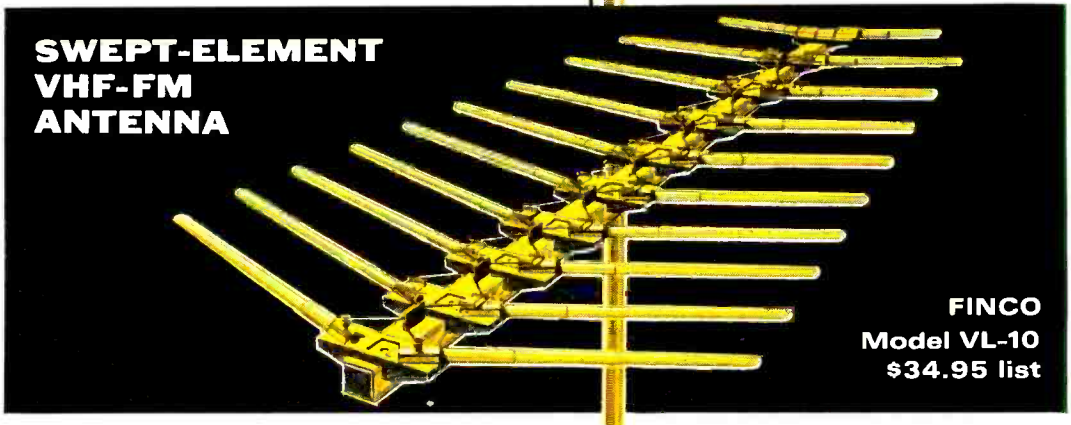

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LIBRARY

(*Continued from page 30*)

handling of illustrations, or because the idea is novel. Author Grob has arrived at just about the ideal combination of the above ingredients in the second edition of *Basic Electronics*. Obviously a classroom text, the organization of the material, illustrations, etc., is so complete that this book can be safely recommended to any beginner. Your reviewer was particularly impressed by the clever use of gray tones in circuit diagrams and formulas to identify essential components or answers to problems. Very highly recommended.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover, 588 pages. $7.50.

BASIC ELECTRONICS: "AUTOTEXT"—A PROGRAMMED COURSE IN CIRCUITS

by RCA Institutes, Inc., and edited by Jack W. Friedman, Harry G. Rise, and Gerald McGinty

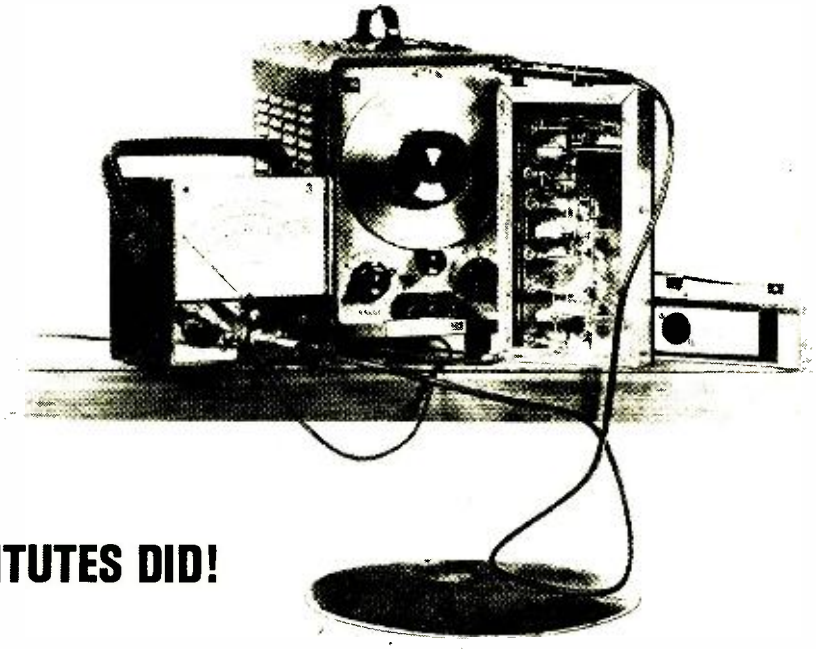
A programmed course in basic electronics for beginners with no previous knowledge or experience in electronics, this book covers d.c. and a.c. circuits, principles of resonance and filters, and prepares the student for the study of tube and transistor circuits. It is actually a work book—the text consists of a comprehensive series of questions to be answered right in the book. The student can then compare his response immediately with answers which appear on tear-out sheets in the back of the book. The home-study student should find both text and illustrations easy to understand, and with an average amount of application should be able to learn how to read schematics, and to have a working knowledge of capacitors, resistors, coils, transformers, etc. Very highly recommended.

Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. Hard cover, 534 pages. $13.00.

FREE LITERATURE

More of everything for everyone is claimed for Allied Radio's new 1966 catalog, including what's new in the world of Knight-Kits. It contains 508 value-packed pages. For your copy, write to Allied Radio, Dept. 3-J, 100 N. Western Ave., Chicago, Ill. 60680 . . . New-Tronics Corporation, 3455 Vega Ave., Cleveland, Ohio 44113, has just issued a new catalog on its expanded line of CB antennas and accessories. A number of new mobile antennas are illustrated and described as well as base station models —30—

SOMEONE SHOULD DEVELOP AN EASY WAY TO LEARN ELECTRONICS AT HOME



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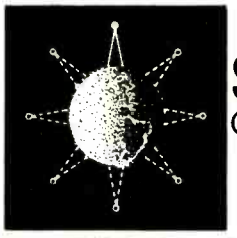


SATELLITES ON THE AIR

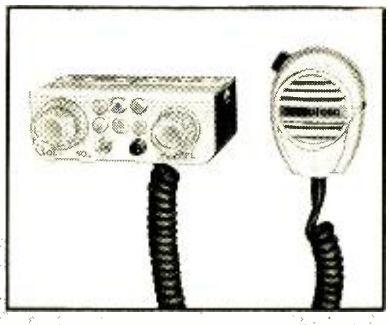
The following satellites were in orbit and transmitting as this issue closed.

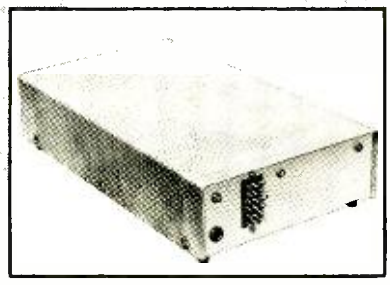
Echo 2	136.020 mc.
Alouette**	136.077 mc.
Explorer 23**	136.080 mc.
Explorer 28	136.125 mc.
Relay 1**	136.140 mc.
Relay 2	136.142 mc.
Explorer 21	136.145 mc.
Echo 2	136.170 mc.
Explorer 22**	136.171 mc.
OGO 1**	136.200 mc.
Tiros 8	136.231 mc.
Tiros 9**	136.231 mc.
Tiros 10	136.232 mc.
Tiros 7	136.233 mc.
Explorer 26	136.275 mc.
Explorer 25	136.292 mc.
Explorer 20**	136.350 mc.
Pegasus 1**	136.410 mc.
Pegasus 2	136.410 mc.
Pegasus 3	136.410 mc.
Syncom 2**	136.468 mc.
Syncom 3**	136.470 mc.
Ariel 2	136.558 mc.
Alouette**	136.593 mc.
Relay 2**	136.620 mc.
Relay 1	136.621 mc.
1964 83C	136.650 mc.
1963 38C (USA)	136.651 mc.
Explorer 20**	136.680 mc.
Explorer 24	136.710 mc.
OSO 2	136.712 mc.
Explorer 27	136.740 mc.
1965 58C (USA)	136.768 mc.
Gravity Gradient (USA)	136.800 mc.
EGRS III	136.840 mc.
Solar Radiation	136.886 mc.
Pegasus 1	136.890 mc.
Tiros 7	136.924 mc.
Tiros 8	136.923 mc.
Syncom 2**	136.980 mc.

**Transmits only upon ground command

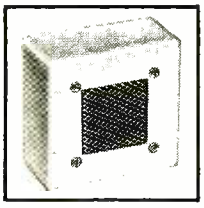
This listing does not include all of the satellites in orbit—many of which no longer are transmitting, or transmit erratic, very weak signals. Satellites of the Soviet Union generally use tracking and telemetry frequencies in the band between 19.990 and 20.010 mc. Exact frequencies of some Soviet satellites are broadcast by Radio Moscow immediately after launching. In orbit are Cosmos 41, 42, 43, 44, 49, 51, 53, 54, 55, 56, 58, 61, 62, 63, 70, 71, 72, 73, 74, 75, 78.

SMALL PACKAGE BIG PUNCH!





INTERNATIONAL Model MO TRANSCEIVER For CITIZENS RADIO SERVICE



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NEW! 3 RCA EXPERIMENTER'S KITS

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The 80-page, illustrated RCA Experimenter's Manual (KM-70) will familiarize you with the theory and operation of solid-state components in the kits. At the same time, it will give you complete detailed information on all 14 circuits including schematic diagrams, circuit descriptions, and construction details, as well as photographs of the circuits as easy-to-follow assembly guides.

Here is what you can make...

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- RCA Basic Experimenter's Kit (KD2105) One Silicon Controlled-Rectifier; Two Transistors; Five Rectifiers.
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If you want to build one circuit or all 14, check with your RCA Distributor where kits and RCA Experimenter's Manual are on display. He'll be glad to help you select the kit or kits for the solid-state circuit you have in mind. Do it today!

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CIRCLE NO. 35 ON READER SERVICE PAGE

1956 1965 HI-FI TEN YEARS LATER

By LAWRENCE LEKASHMAN
Vice President, Soles
Electro-Voice, Inc.

A QUICK SUMMARY
OF THE LAST DECADE
IN HI-FI AND
THE IMPACT OF STEREO

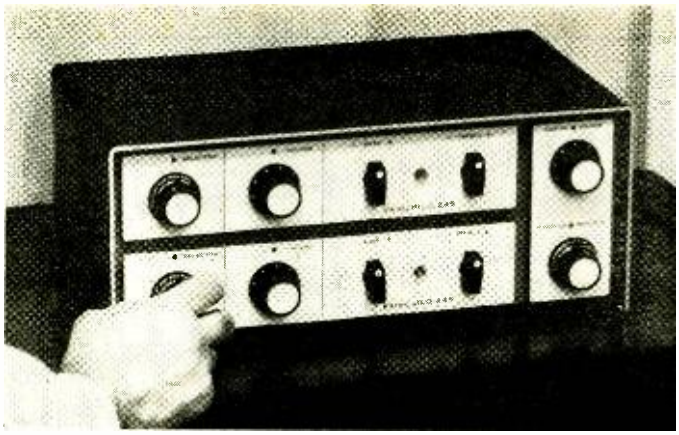
NOSTALGIC PHOTOS AND CAPTIONS FOR HI-FI GEAR BY THE EDITOR

BETWEEN 1956 and 1965 all the sciences and technologies exposed to the public view have advanced by Herculean leaps. While all pall in comparison to space exploration, too frequently the yardstick for progress is the dramatic or awesome achievement. Obviously, the entire field of electronics has progressed throughout the past decade. Electroacoustics—the conversion of sound into electricity or electricity into sound—traverses many applications including military communications, long-distance telephone, sonar, seismology, etc. Less sophisticated, but most important for the pleasure it brings to so many, is the reproduction of music with optimum fidelity.

Links in a Chain. If each link in the chain of hi-fi sound reproduction could be isolated one from the other, a ten-year review would be relatively simple. But each link in the hi-fi chain is related to the others and the development of one affects all.

The most obvious example is the emergence of the transistor as a medium-priced practical device holding out the greatest number of advantages to the hi-fi sound engineer. The transistor was not developed for hi-fi, yet it is in this very field that the transistor will achieve its most notable and significant application for the average consumer.

On the other end of the scale, subtle



In the scramble to advance from mono to stereo (in 1958), there were numerous attempts to combine the old and the new. This Fairchild 248 stereo preamplifier sold for a whopping $239.50. It obviously consisted of two separate preamplifiers housed in the same wraparound. Controls at right-hand side of unit were for Master Volume and selection of output functions.

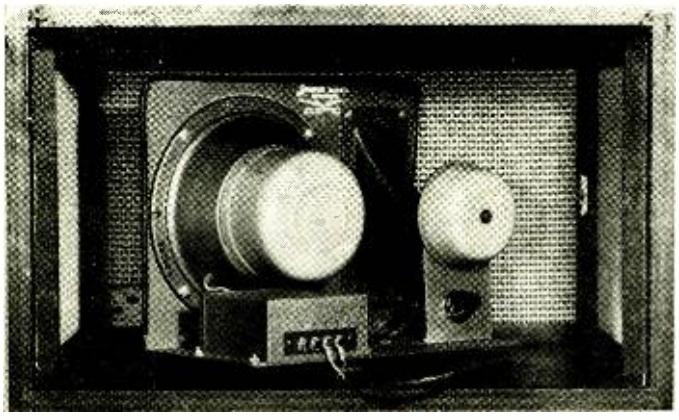
developments have taken place gradually over the past decade to which all but the most sophisticated technician might be oblivious. Look at, for example, the automatic record changers and transcription players. At the end of a decade of progress, these units still change records, they track the grooves, and they shut themselves off automatically. But mechanical engineers have met the demands of hi-fi sound reproduction and have developed better materials, more precise machine fit, ingenious designs, and quality control that easily permits a record changer to perform as well, or better than, the transcription player of 10 years ago.

The Speaker. Certainly the most critical element in any hi-fi system is the loudspeaker: critical, because it is impossible for any system to reproduce sound one iota better than the speaker to which it is attached; critical, because the speaker is a component selected by subjective evaluation; and critical, because of the misinformation circulated about the performance of loudspeakers.

In the past decade, no sound-wave reproducer has emerged to challenge the efficiency, power-handling ability, and wide audio range of the dynamic speaker. Whether we see it in its familiar cone design, or as a compression driver or dome radiator, this superlative reproducer is unlikely to be superseded in the next decade by gas-operated speakers, electrostatic speakers, or other devices.

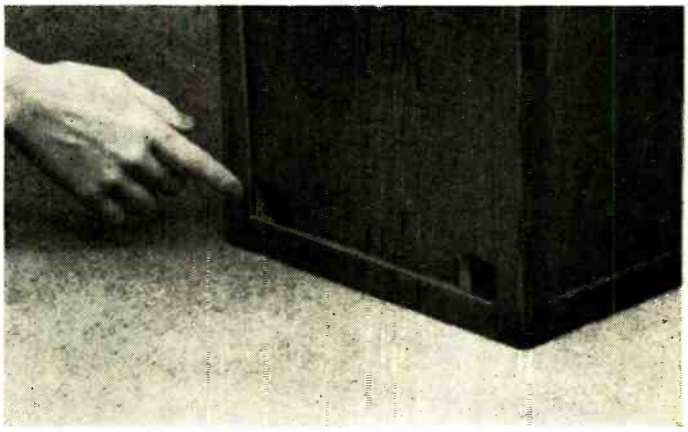
Dynamic speaker design has not stood still during the past decade. Even the most conventional speaker has been improved through the use of lighter weight, but more powerful magnets; improved cone suspension and voice coil design; and sturdier, non-resonant baskets. Improvements were dictated by the requirements of stereo and the demand for two channels of full-range, well-balanced sound.

This demand also resulted in the development and exploitation of the so-called bookshelf-type speaker system. Possibly two-thirds of the speaker systems sold today are of the shelf type. A

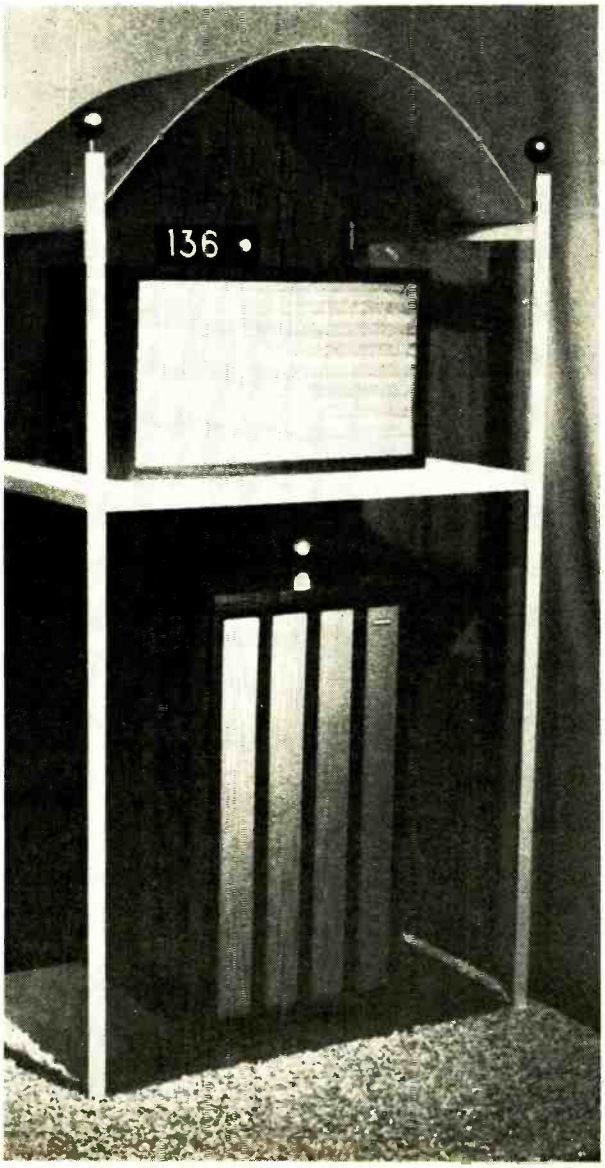


Almost every speaker has some directional characteristics, but Jensen's SS-100 was a bona-fide attempt to use "direction" to solve the stereo listening area problem. In the SS-100, the mid-range and treble speaker were mounted on a platform and could be aimed at the audience.

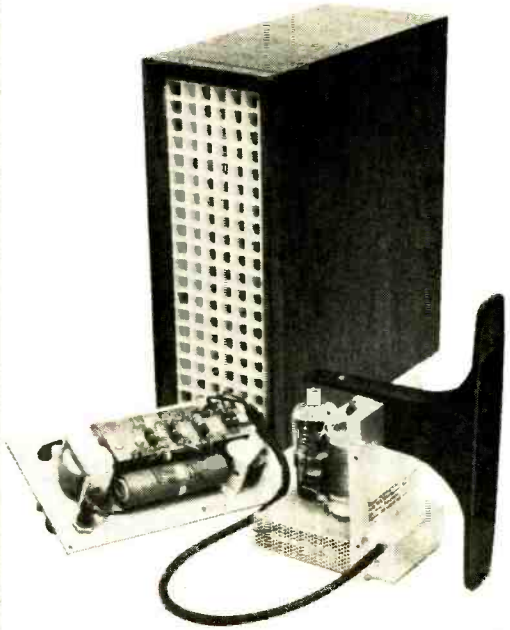
This is the speaker system that never was—the "Integrand." Designed around a servo response mechanism, it was supposed to adjust itself to room acoustics for better reproduction. It didn't.

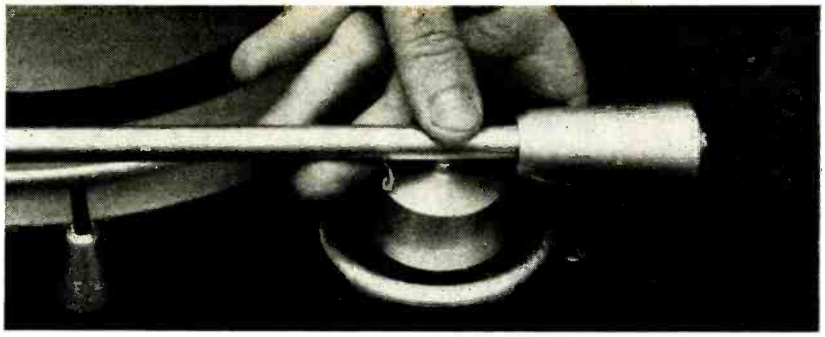


Miniature loading slots at the bottom of this system helped produce reasonably good sound bass. A product of one man, Stewart Hegeman, this EICO HFS-2 also featured a free-floating tweeter for near 360° treble dispersion. The HFS-2 was years ahead of its time (1957), but those that liked its sound were unrestrained in their praise.

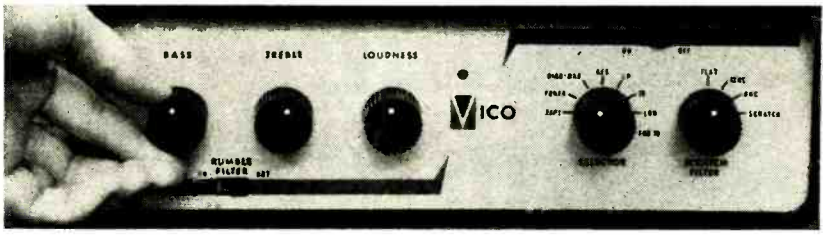


The "Ionovac" has had a colorful history, but little public acceptance. This version was offered to hi-fi enthusiasts about five years ago by the DuKane Corporation. Capable of crystal-clear treble note reproduction from 3500 to 20,000 cycles, the Ionovac is now being sold in England and France.





The Stromberg-Carlson PR-498 was the antecedent of many similar lightweight, statically balanced, single-pivot, and viscous-damped tone arms. Permanently attached to a PR-500 turntable, this combination was once considered one of the best integrated arm/turntable units.



Practically every hi-fi enthusiast has forgotten this all-transistorized Vico 77 mono amplifier. Introduced in 1957, the 77 left much to be desired, but was a harbinger of things to come.

decade ago, the acoustic-suspension, shelf-type speaker was just emerging, and small speaker systems were poor sound reproducers. Today's shelf-type speaker system is the result of a careful application of known principles—a fact established in a landmark patent suit in 1962.

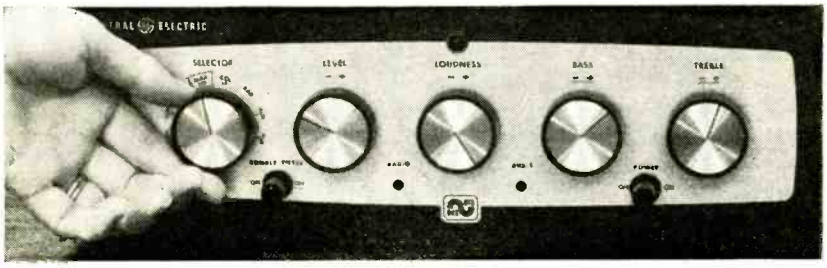
Gone, but not completely forgotten, are the many speaker systems designed to "save" conversion costs from mono to stereo. "Gimmick" speakers for stereo are now a thing of the past and not likely to reappear in the next decade.

The Phono Cartridge. No single piece of a hi-fi system has had to undergo a more revolutionary change with the advent of stereo than the phono cartridge. While speakers and amplifiers simply doubled up, the cartridge with its single stylus now had to track grooves vertically and horizontally—or any combination of motion in between.

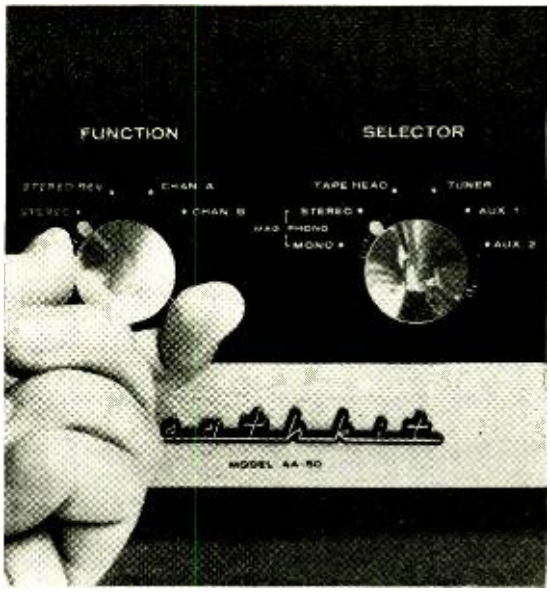
In this brief review, it is impossible to thoroughly cover the evolution from the "magnetic reluctance" cartridge of 1956 to today's superb transducer. Suffice it to say that the first stereo cartridges left much to be desired and that step-by-step improvement by many manufacturers now permits record reproduction comparable to the flatness and separation of channels of magnetic tape.

Frequency response, uniformity of manufacturing, excellent compliance, and stereo separation have been refined to the point where the phono cartridge—magnetic or ceramic—offers little opportunity for significant improvement. There will be a continuing search for transducing methods other than that used by the present cartridge, but all of these devices must employ a stylus—the single element that has seemingly reached the limit of the art. Possibly in the next decade we will see better sound-to-noise ratios and better impedance matching to transistorized circuits. The benefits of these improvements will be subtle and not earthshattering.

The Record Changer. During the past decade, the record changer has under-



G.E.'s PA-20 mono amplifier replaced the "Convertible" which really came apart in two pieces. The PA-20 was notorious for heat generation.



The Heath Company had been instrumental in getting hi-fi off the ground with the famous Williamson power amplifier. The AA-50 was one of the true integrated stereo amplifiers in the middle ground between tubes and all solid-state units.

gone pronounced improvements. By today's standards, a 10-year-old changer is a relic comparable to a "Model T." Among the lesser evils of the old changers were rumble—now intolerable in stereo reproduction—and high stylus tracking pressures. Rumble and flutter have both disappeared from the 1965 changer.

Stylus pressures are a fraction of those required 10 years ago and changer mechanisms no longer introduce lateral friction to wear down stereo record grooves. In fact, the greatest argument today for single-plate turntables is more one of convenience to the individual who plays single records, rather than the technical performance advantages. Oddly enough, Americans have yet to manufacture a changer equal in performance to those imported from Europe.

Tape Decks and Recorders. It would be improper to discuss changers without acknowledging the growing popularity of tape decks and tape recorders. In a manner similar to the changer, tape decks and recorders have been undergoing refinement in the past decade. The 15-ips tape speed is almost a thing of the past and 7½ ips is giving way to 3¾ ips.

Though tape does not have the wide public acceptance of the record changer, the cost of prerecorded tape is now competitive with stereo records. Lack of public acceptance is probably due to the continuing search for the ideal tape packaging method—cartridge versus reel-to-reel.

The greatest and most significant improvements in tape playback have been in the design and fabrication of heads. A good tape deck with high-performance heads is a perfected instrument, capable of reproducing clean source material equivalent in sound to the original performance.

Electronics Hardware. Least vulnerable to subjective analysis and most easily defined in the engineering laboratory is the electronics portion of the hi-fi system. The transition in the past decade from mono to stereo placed great burdens on the manufacturer to deliver far more electronics hardware to the consumer at reasonable and competitive prices.

Today the typical stereo arrangement requires two preamplifiers, two power amplifiers, or two integrated amplifiers, all in one cabinet. With the advent of FM multiplexing and the retention of AM broadcasting, the receiver sections of stereo tuners and receivers have become alarmingly complex. These technical problems and how they were resolved would make a separate story, even though the impact of multiplexing upon the consumer has been modest.

The "revolution" in hi-fi, now upon us, is in the application of solid-state devices (transistors, diodes, etc.). The insistence by component manufacturers on the use of tubes at a time when "package" set manufacturers were widely converting to transistors with their highly touted advantages of infinite life and minimum heat was most difficult to reconcile. The truth of the matter is that the use of transistors with characteristics of uniformity and performance suitable for incorporation in hi-fi equipment was simply prohibitively expensive until recent years. The story by Hans Fantel (page 47) explores the transition from tubes to transistors in 1964-66.

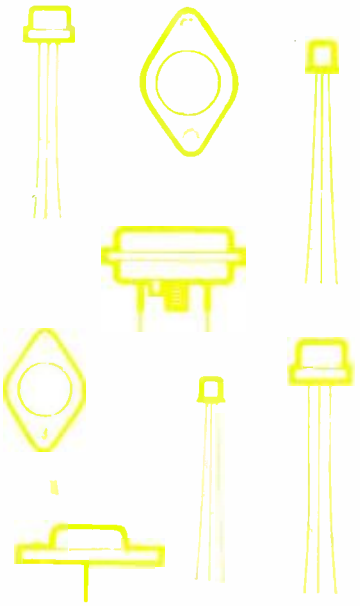
Hi-fi shows are held in most major cities. Those held in New York, Los Angeles, and San Francisco are sponsored by the Institute of High Fidelity. The shows provide an opportunity for the hi-fi enthusiast to meet and talk to the design engineers and company officials about their equipment. This photo illustrates the introduction of Harmon-Kardon's stereo amplifier kits.

The contribution that kits have made to the hi-fi field can never be accurately estimated. Scott changed the kit building picture through use of color-coded wiring and pictorial diagrams.

Continuing Evolution. It will be apparent to the discerning reader that the 10 years of progress in the hi-fi field have been those of progress by "evolution" rather than by "revolution"—with the sole exception of the transistor. These 10 years have underscored a number of extremely significant facts.

One of the great advantages professed by the manufacturers of hi-fi equipment is the enormous flexibility they can offer. It is interesting to note that it would have been possible to update any hi-fi system throughout this 10-year period without obsoleting all of the components. The gradual insertion of new and better products as the needs of the user dictated was practical at all times. The increase in popularity of hi-fi equipment has resulted in the manufacturing of finer components at less cost than in 1956.

While the prognosis for the future is hazardous, we can safely expect to see continuing evolution. There is little likelihood of radical developments in the method of sound reproduction or in the chain of equipment that should make you hesitate to purchase or build a hi-fi system of your choice. Only the degree of sound perfection need determine how much you want to spend. —30—



HI-FI STEREO FOR '66—IN SOLID

By HANS FANTEL

Transistors are the magic ingredients

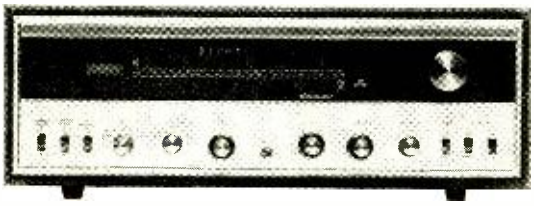
IT'S BEEN a long time coming, but stereo/hi-fi has finally turned the corner and entered a new design era. From 1966 on, "solid state" will be the key to solid sound. Nearly every new tuner, hi-fi amplifier, stereo receiver or tape recorder introduced at this year's High Fidelity Show in New York City—the annual new product parade of the industry—was fully transistorized.

"Tubes have had it," commented one engineer after passing row after row of solid-state stereo equipment. And that about sums it up.

"So what else is new?" you might ask, if you are the skeptical type. After all, transistors have been around for years. Ordinary pocket radios, cheap phonographs, and even TV sets became transistorized long ago. Why did hi-fi lag behind?

Granted, some transistorized hi-fi gear has been on the market for almost five years. But most of the pre-1964 amplifiers sounded shrieky and had the inconvenient habit of dying young. By con-

Knight is the brand-name for equipment sold by Allied Radio. The Knight KN-376 stereo receiver features AM coverage as well as the usual FM/FM multiplexing. Rated at 35 wpc of music power, this 32-transistor receiver goes for $270.00.



Scott's 388 solid-state AM/FM receiver is reported to be the first hi-fi component to use field-effect transistors in the FM tuner section. Use of such transistors eliminates cross modulation on weak signals. The 388 is rated at 40 wpc, and sells for less than $500.00.

trast, today's transistor designs equal or outperform any tube-type hi-fi. So the logical questions are: Why can they do it now when they couldn't before? Why did it take so long? And what's the advantage for the buyer?

Part of the overall answer is that hi-fi design engineers had to wait for the right type of transistors to become available at the right price. And then they had to learn how to design circuits around those transistors.

Design Problems. Up to now, few transistor types have been capable of satisfying the exacting demands of true high fidelity sound reproduction. Transistor manufacturers, with their eyes on the top dollar, concentrated their efforts at making transistors for spacecraft and computers, paying little attention to the needs of the hi-fi fan. Most medium-price transistors were inherently too noisy for critical audio applications and they tended to lose much of the treble above 5000 cycles. Besides, they couldn't handle the power required for realistic hi-fi sound.

"They'd blow faster than fuses," recalls Stewart Hegeman, who did pioneer work in transistorized audio. "The good-sounding transistors weren't rugged enough, and the rugged ones sounded awful."

This didn't matter much with pocket portables or tin-voiced low-fi phonographs, but for a long time it kept transistors out of genuine hi-fi applications. Most manufacturers stuck with tubes.

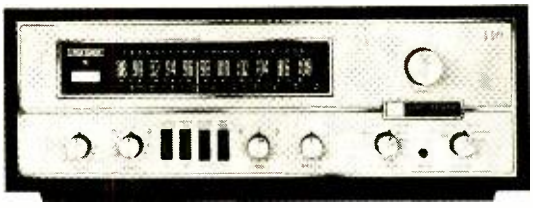
Several years ago a handful of hi-fi companies tried to scoop the audio market with marginal transistor products. But they discovered that fancy claims and sleek styling couldn't fool the ear. Most were soon out of business.

All this changed when the semiconductor manufacturers finally came up with new transistors capable of meeting the stringent specs of genuine high fidelity. Thanks to automated manufacturing techniques, the new transistors were more uniform in quality, more reliable in operation, and cheaper, too. Silicon transistors—offering much greater audio frequency bandwidth and power capability—had begun to replace the older germanium transistors.

But one more roadblock had to be overcome before the transistor's final takeover in audio. That obstacle existed in the minds of audio engineers. Too many still looked at the transistor merely as a *substitute* for a tube and tried to fit transistors into conventional circuits. In doing so, they threw away nearly all the advantages the transistor offers. It took time for engineers to learn to "think" in terms of solid-state circuitry.

De-Bugging Transistor Circuits. Offhand, the advantages of the transistor seem obvious. Compared with tubes, the transistor is smaller, draws less power, develops practically no heat, takes no time to warm up, doesn't change characteristics with age—in fact, it doesn't wear out. Unlike tubes, transistors don't produce noise when exposed to vibration

Rated at 25 wpc, the Fisher 440-T is the solid-state replacement for the well-known 500-C tube-type stereo receiver. Tagged at $329.50, the 440-T has an unusual mode switching arrangement to permit playback of each of the four tracks of a monophonic tape.



Builders report that they have constructed this EICO 3566 stereo receiver kit, which sells for $219.95, in 35 hours. The manufacturer is also offering a prewired and tested version for $325.00. The difference represents a substantial saving for the kit builder.

—they are not microphonic—and shrug off accidental knocks. Besides, transistors are virtually hum-free, so that the music sings out against a background of almost complete silence.

Best of all, transistor amplifiers need no output transformer. Being low-impedance devices, transistors can feed their output directly into loudspeakers. By getting rid of the output transformer, transistors bypass one of the main bottlenecks to fidelity. As a result, transistorized hi-fi equipment usually sounds crisper and clearer than the older tube designs.

But before these advantages could be realized, transistor circuits had to be thoroughly de-bugged. Transistors were sensitive and had to be protected from overloads. Otherwise, their potentially long life would be cut short by the first loud bang in the music. And since some low-signal transistors react badly to heat, special circuits had to be devised to compensate for temperature variations.

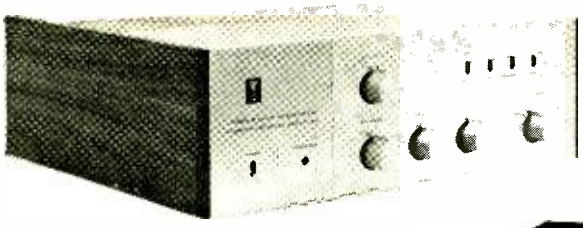
None of this know-how came easy. Engineers discovered, for example, that it sometimes takes about four transistors to do the job of one tube. They tried shortcuts to make the product cheaper, but attentive listeners could always tell the difference.

One trouble that plagued early transistor designs was exactly the opposite of what bothered tube circuits. While tubes would distort at musical climaxes, the transistor jobs did fine on *fortissimi*. But at soft volume levels, the sound tended to become harsh. This was especially noticeable during solo passages of sweet-voiced instruments, such as violin, cello, and clarinet.

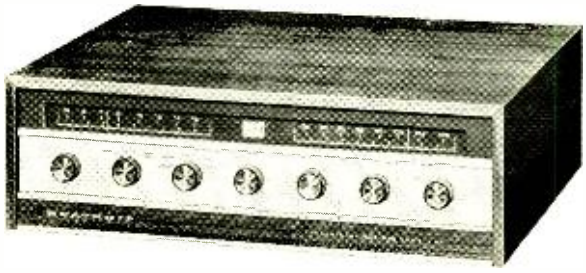
For a long time, engineers were flummoxed by this trouble. Finally, they tracked down its source. It was distortion produced by the "Class-B" operation of push-pull output transistors. In this circuit, two transistors work in tandem, each taking turns in developing power. Splitting up the work in this way prevents the transistors from overheating and burning out. But the trick is to time each transistor's duty cycle so precisely that the alternate cycles match properly. Inaccurate timing of the Class B circuits results in either a momentary gap or a momentary overlap between the cycles. That's what was causing the curious harshness of the early transistor designs. Engineers finally devised special feedback correction to cancel out this type of distortion.

All this does not mean that tube equipment has been swept from the market entirely. Even such top-rank firms as Dynaco and Marantz still stick with tubes. Their attitude is that their present models offer outstanding performance and they see no reason to change them. Many manufacturers, in fact, offer both tube and solid-state equipment, but there is little doubt that the significant engineering advances are now being made in the transistor field.

Compact Quality. Ed Miller, who supervises electronic design at Sherwood Elec-



The SA600 is rated at 65 watts to deliver full power at any frequency from 10 to 30,000 cycles. Manufactured by James B. Lansing Sound, Inc., it sells for $300.00.



Only $184 buys this 66-watt stereo receiver kit from Heath. As a bonus feature, the AR-13A has AM broadcast-band coverage. The tuner sections are shipped prealigned.

tronic Laboratories in Chicago, says: "Now we can pack more power into compact equipment. With cool-running transistors, we needn't worry about heat dissipation in high-power amplifiers, and lower operating temperatures make other components last longer." Miller also feels that the low hum levels attainable with transistors are an important design improvement.

Bob Furst, who designed Harman-Kardon's "Stratophonic" series of stereo receivers points to the outstanding stability of transistorized tuner circuits. "With solid-state r.f. circuits," he says, "we have virtually eliminated FM drift. I can turn the receiver off at night, and when I turn it back on in the morning, the station comes in right on the nose."

Speaking for KLH, a company that has always stressed compactness along with quality performance, John Milder says: "Solid-state design has enabled us to produce the first fully portable stereo system in a single suitcase—amplifier, speakers, turntable, FM stereo tuner—and all in a package you can lift with one hand."

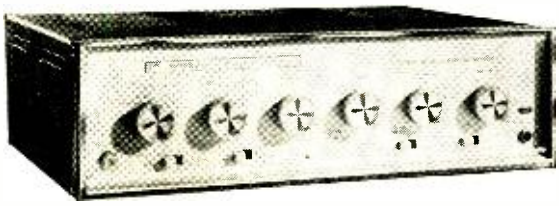
The real payoff, however, is in the sound. Across the board, from budget models to deluxe designs, solid-state equipment offers an astonishing clarity that only the most expensive tube equipment has ever matched in the past. The term "transistor sound" has been coined to describe the sparkle, the crispness, and the tightly controlled bass typical of well-designed solid-state components.

1966 EQUIPMENT SAMPLER

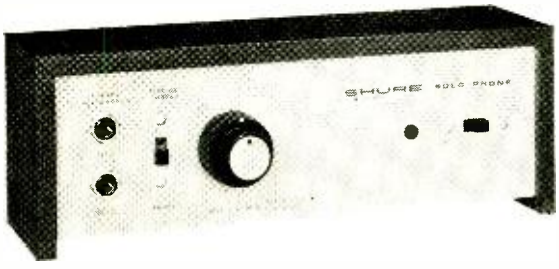
With nine out of every ten hi-fi manufacturers introducing new solid-state equipment, we can but sample the wide variety shown at the recent hi-fi shows. This sampling is to give you an idea of the types and prices of the new gear. For a detailed up-to-the-minute buyer's guide, look for the 1966 edition of "STEREO/HI-FI DIRECTORY" on your newsstand. This excellent guide itemizes all the performance specifications, models, and prices—for only $1.25.

Amplifiers. Solid-state amplifiers are being sold this very month in every price category from $59.95 (Knight-Kit KG-320 at 16 watts per channel of music power) to $300 (James B. Lansing SA600 at 40 wpc r.m.s.). Kits are particularly popular including the integrated Heath AA-21D tagged at $137 for 50 wpc (music power). If you're satisfied with less power, try the Heathkit AA-22 (33 wpc for $99.95). Acoustech offers a preamp and power amplifier at $199 and $149, respectively; the power amplifier is rated at 45 wpc. Scott offers the LK-60 with 60 wpc at $189.95.

Budget-priced amplifiers with factory



Music power output of the Sherwood S-9900 is rated at 45 wpc. Power bandwidth at 1% harmonic distortion is 12 to 35,000 cycles. This solid-state amplifier sells for about $230.00.



This small amplifier was designed by Shure Brothers for private headphone listening to records, tapes, or FM tuners. Called the "Solo-Phone" (Model SA-1), the amplifier may also be used as a tape monitor. It sells for only $45.00.

The Electro-Voice 1177 stereo FM receiver stands just 3 3/8" high. Rated at 25 wpc, it sells for $280.00. A big brother (Model 1178) has AM broadcast coverage in addition to FM/FM multiplexing for $315.00.

wiring include the Lafayette LA-340, putting out 20 wpc for $79.95, Knight's KN-966 with 33 wpc and fetching $119.95, and the high-style Electro-Voice 1144, 25 wpc, for $124.50. For a 35 watts or more per channel amplifier, take a look at Sherwood's S-9000 (75 wpc at $299.50), Fisher's TX-300 (50 wpc at $280) and the Altec Lansing 360A (35 wpc, tagged at $389).

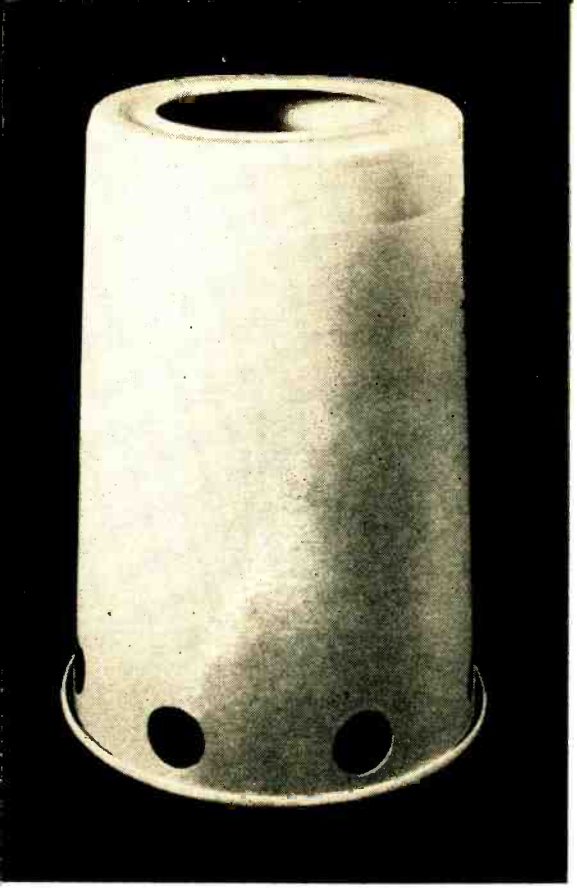
Tuners. Although "solid state" has not captured a major share of the tuner market, it is nevertheless making serious inroads on tubes. Actually the difference between tubes and transistors in FM tuners is not as apparent as in amplifiers. Some manufacturers combine the best of tubes and transistors, as exemplified by Grommes (Model 2000 tagged at $249.95) and Kenwood (Model TK-500 at $174.95).

Of course, the big problem in selecting a tuner is making a decision about the necessity for AM as well as FM and/or FM/FM multiplex. Tuners run the gamut of prices from the low-cost Eric (Model ST-100 at $99, list) for FM only, to the Scott 312B with FM/FM multiplex provisions at $249.95. Kits are also available, with the Heathkit AJ-43D selling for $109 being a noteworthy example. The AJ-43D has AM/FM/FM multiplex reception. Allied Radio offers a similar setup known as the KG-765, for $94.95 as a kit and $139.95 prewired.

Receivers. Several years ago these units were called "stereo receivers" because they generally consisted of two complete amplifiers, FM tuner, and multiplex adapter. The word "stereo" is being dropped, but the "receivers" still need only to be connected to a phono player and speakers to be a complete stereo hi-fi setup. Of course, transistors have been tremendously important to the receiver manufacturers. Back in the tube days, the stereo receiver threw off heat like a blast furnace and some of the more poorly designed receivers soon cooked themselves to death.

If you're cost-conscious, take a look at the EICO 3566 with 35-plus wpc sold in kit form for $219.95. Health has the AR-13A kit with 20 wpc (Heath rating) for $184; this Heathkit has a built-in

(*Continued on page* 113)



UNIQUE 99¢ SPEAKER ENCLOSURE

By JOHN N. AYRES

Simple plastic baffle uses inverted wastebasket

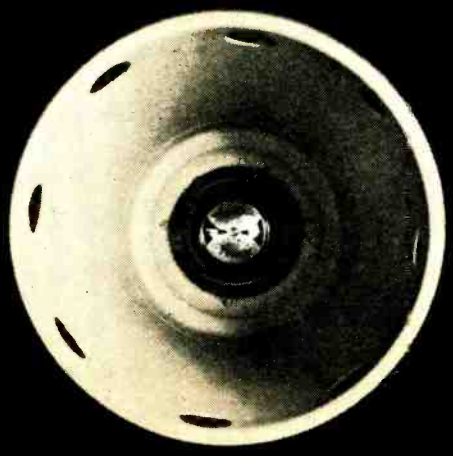
WANT a cheap, effective, and reasonably attractive enclosure for an 8″ speaker? Although the "99¢ Enclosure" grew out of the need for a temporary setup, the unit is quite appropriate for permanent home hi-fi systems, especially where positioning of conventional enclosures for best stereo listening is hampered by furniture placement or peculiarities of the room's general layout. The portability and durability of this unit makes it practical to store a couple of them out of the way, then move them into position each time they are used.

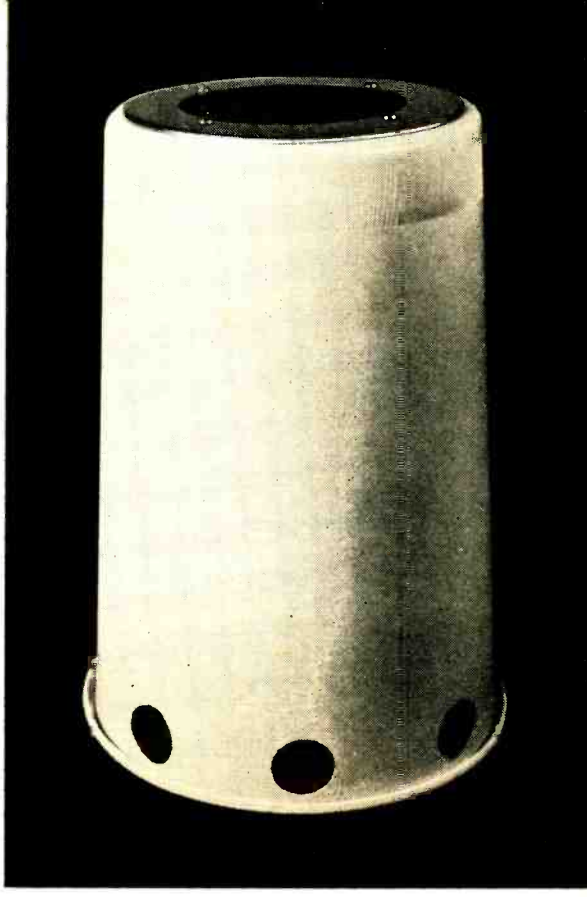
The speaker used by the author was a Lafayette SK-128, but any other full-range 8″ speaker would be equally appropriate for use in this unique enclosure. Construction can be completed in five or ten minutes with the aid of a drawing compass, measuring tape, and penknife.

Construction. The "enclosure" is available, practically ready for use, in almost any department or variety store, in the form of a "Steri-lite" 44-quart polyethylene wastebasket (U. S. Plastic Company Model #1040). Prices may vary but the pilot model was obtained at a cost of 99 cents. This container is approximately 20″ tall and tapers from a diameter of about 14″ at the top to a little over 11″ at the bottom. It comes in three colors: beige, turquoise, and yellow. The material is sufficiently soft so that undesirable resonances are avoided, yet firm enough to easily support the heaviest 8″ speaker.

The general idea is to place the wastebasket on the floor, upside down, and mount the speaker in the bottom. To prepare the basket, first determine the actual diameter of the speaker cone (it will be about 7″), then adjust your drawing compass to half that amount—the radius—and draw a circle on the bottom of the basket. Be sure the pivot of the compass is in the exact center. Now, using a penknife, cut the opening for the speaker following the line as closely as possible, but don't worry about minor irregularities since the edge will not show. Punch the mounting holes using

Turn the wastebasket upside down and cut out a hole to pass the frame, but not the rim of the 8-inch speaker. Holes in bottom of inverted basket are ports to release back pressure. Dress the enclosure up with a decorative grille (shown in right hand photo).





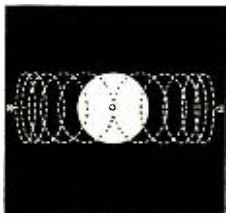
the speaker itself as a template; a paper punch or any sharp, pointed instrument will do the job.

Using the Enclosure. Connect the speaker leads to your amplifier, and sit back and listen to a familiar record. You will find the upward firing arrangement quite desirable, for the sound spreads out in all directions—obscuring the fact that you are listening to a small 8″ speaker. Use of a pair of them imparts an amazing stereo effect, totally eliminating any "hole-in-the-middle."

A decided improvement in bass response will be observed if the enclosure is supported about two inches above the floor. But instead of rigging up an elaborate support, the same effect can be had by cutting six or eight equally spaced 2″ holes around the circumference of what now serves as the bottom of the enclosure (originally the top of the basket). Keep the holes as close to the bottom as possible, using a tape measure and drawing compass for layout and a penknife for cutting as before. This time, however, take pains to make your cuts as clean as possible, since they will not benefit from concealment as does the big opening for the speaker. Very fine sandpaper can be used to smooth off the edges.

You can also install a suitable protective and decorative cover for the speaker if you are willing to exceed your 99¢ budget. Radio stores have grilles for wall or ceiling installations that will do nicely. However, be sure the one you select has an overall diameter not exceeding 10½″, so that it will fit the basket properly. (Electro-Products' #SG-8CO, among others, makes a good fit and is attractive as well). Four pan-head machine screws, washers, and nuts secure the works.

Bearing testimony to the value of the finished product as both a unique, attractive conversation piece and an acoustical device of commendable performance, the author's dentist extracted his two SK-128 speakers from their factory enclosures and put them into a pair of the 99¢ wastebaskets. —30—



ZERO-BEATING THE NEWS

WE KNOW YOU'RE THERE . . . BUT WHERE OH WHERE? A literal antiworld populated by stars and planets and made up of atoms of antimatter may well exist physically in addition to the known material universe, according to Dr. Leon Lederman, professor of physics at Columbia University. Dr. Lederman presented new basic evidence for the possible existence of such an "antiworld" in reporting with his associates on the discovery of a new elementary particle, the "antideuteron." The new particle is the antimatter counterpart to the nucleus of deuterium, or heavy hydrogen. In demonstrating its existence, the Columbia research team used the 33-billion electron-volt synchrotron at the Brookhaven National Laboratory.

"The antideuteron is the first compound of antiparticles ever observed, and consists of an antiproton and antineutron," Dr. Lederman explained. Knowing that the antideuteron exists means that all the properties of the nuclear force responsible for the stability of all nuclei "are closely mirrored in the antiworld." As a result, he further stated that "It is no longer possible to question the basic physics part of the cosmological conception of a literal antiworld made up of negative nuclei surrounded by positive electrons. It is not possible now to disprove the grand speculation that the antiworld could be populated by thinking creatures."

The evidence would seem to indicate that this antiworld does not only have antiparticles replacing particles, but also is a mirror image of our world, in which the flow of time is also reversed. Just where this antiworld is, though, is somewhat of a mystery. Investigators have looked, without success, for evidence that it interpenetrates the known physical universe. Dr. Lederman pointed out, however, that "in cosmological theory, if the whole thing started with an explosion, there is every reason to believe that the same number of particles and antiparticles were created."

LITTLE THINGS MEAN A LOT—Two large-scale computer memory systems able to store more than a trillion bits of digital information will be built for the Atomic Energy Commission by International Business Machines Corporation. Basic storage elements are film chips contained in plastic cells; the tiny cell held by Melva Ellis of IBM can store the equivalent of three encyclopedia volumes—about 4.5 million words. Data will be recorded by means of an electron beam which "writes" digital data on the film chips in the form of microscopic black and white coded spots. When information must be retrieved from, or stored in, the memory systems, the cells move automatically to photoelectric reading and writing stations. Retrieved data can be printed, recorded on magnetic tape, or viewed at remote data display devices. To be installed by IBM in 1967 at the Lawrence Radiation Laboratory in California, the mass memories will be used to store results of experiments processed by the laboratory's vast computer complexes.

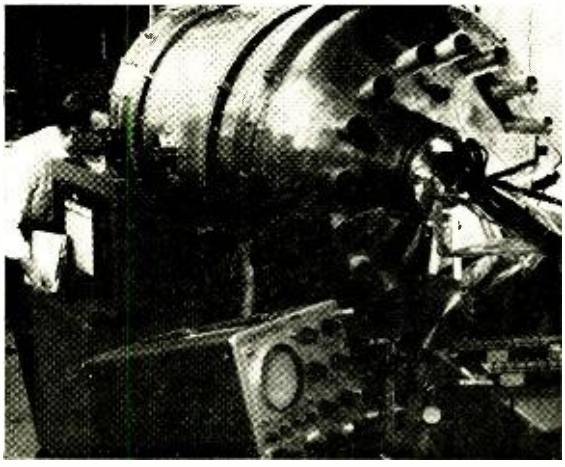
ELECTRONIC WHEELCHAIR DEVELOPED—A hat-mounted electronic control system which enables people whose limbs are paralyzed or amputated to operate wheelchairs and other equipment by head movements was recently described by its inventor, Donald Selwyn, a systems analyst at International Telephone & Telegraph Corporation. The equipment permits a quadriplegic with normal head mobility to drive himself about in a motorized wheelchair. According to Selwyn, the system also has military and commercial applications, as it will permit a normal individual to perform complex tasks otherwise requiring an extra pair of hands.

Before being provided with a servo-controlled wheelchair, Bruce Lowe, a quadriplegic at New York's Goldwater Hospital, depended for nearly 10 years on the assistance of hospital personnel for wheelchair transportation. Now, however, he propels himself around without any assistance and is studying pre-law at Long Island University. He has maintained an A average and has won a scholarship.

Bruce's wheelchair is equipped with a head-controlled tape recorder for taking and reviewing spoken notes at the college. By simply nodding his head he can perform all maneuvers required for parking and navigating around obstacles. Special nodding sequences can selectively operate the tape recorder or other devices.

"OLD-FASHIONED" METAL SCORES COMEBACK—A pea-size pellet, traveling at meteoroid speeds, wrecked these sheets of aluminum during tests made by Boeing Company engineers in Seattle. The purpose of the tests was to find the best metal to use in building manned spacecraft. Despite the damage shown here, test results favored use of the "saucepan" material over space-age metals.

GEMINI 7 TO USE LASER TRANSMITTER—NASA has scheduled a communications test between the two-man "Gemini 7" spacecraft and the earth using a laser device built by Radio Corporation of America. One of the astronauts in the spacecraft will aim the laser transmitter at another laser light beamed at the spacecraft from the White Sands Missile Range in New Mexico during the 14-day flight set for early 1966. When the light-beam receiver picks up the pulses of light from the spacecraft, the ground laser beacon will flash to indicate contact made. Weighing only six pounds, the device puts out 16 watts.

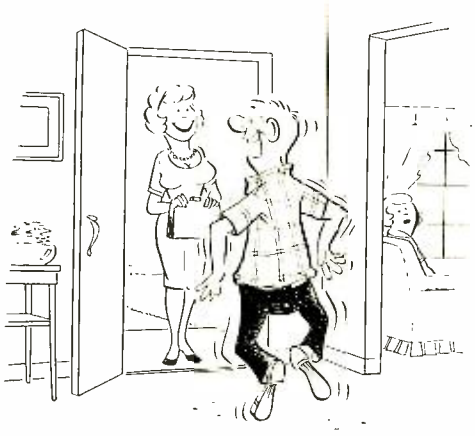


ORBITING OBSERVATORY UNDERGOES TESTS—Electronic equipment for an orbiting observatory that will help scientists determine the origin of stars is being tested by Sylvania Electric Products, Inc. Here, an engineer is seen checking equipment inside a thermal-vacuum chamber where temperatures range from 70°F below zero to 160°F. The equipment includes data processing and programming devices, a guidance system, and a power supply. The observatory, to be carried aboard the largest unmanned satellite under development by NASA, will permit scientists to measure the light absorption characteristics of interstellar gas and dust clouds, from which, it is believed, stars are formed. Until now, astronomers have been unable to study this light because it is absorbed by the earth's atmosphere. The space vehicle will be launched with a circular orbit 500 miles above the earth sometime in 1967.

THE HAM

AS
SEEN
BY
WALT MILLER

"WA6OXX mobile, this is WA6ZRG mobile. You've got an extremely strong signal. What's your QTH?"



"William Able 6 Oboe Zebra Zebra? I pictured you quite differently!"

???

"Will it bother you if I vacuum in here?"

"Oh, forget it. I can get a new suit any time."

SUPER-SENS

By LOUIS E. GARNER, JR.

Versatile electronic relay provides unlimited control functions

DO YOU need a burglar alarm, a fire alarm, an automatic fan control, an automatic light switch, a liquid level control, an automatic dehumidifier control, a photoelectric counter, a radio remote control, a lawn sprinkler control, an automatic door opener, a time delay relay, an electronic latching relay, or a sound-actuated relay?

Would you like to amaze your friends and neighbors, gain the respect of your teachers or co-workers, assemble a Science Fair project that is different, or build a basic control that can be used in hundreds of applications?

If you can answer yes to any of these questions, you'll enjoy building and using *Super-Sens*, an easy-to-wire, inexpensive electronic relay so sensitive that it can be tripped by a pencil line drawn on a piece of paper.

Electronic relays are not new. They have been designed and manufactured for years. You can purchase a variety of types at prices ranging from $20 to $50 or more, or you can build *Super-Sens* for less than $10.00.

One popular "supersensitive" electronic relay offered by a leading laboratory supply house requires a signal current of 50 microamperes at a little under 10 volts. *Super-Sens*, in contrast, will trip with a miniscule control current of about 0.2 μa. at approximately 1 volt. Using its built-in bias circuitry, the device can trip with as much as 50 megohms between its input terminals.

Super-Sens can be actuated by many input devices: photocells, humidity detectors, microswitches, thermostats, magnetic contacts, pressure switches, thermistors, and almost any high or low resistance type of sensor or probe, as well as the comparatively low level signals obtained from a carbon microphone or a simple radio receiver.

Super-Sens, in turn, can be used to actuate almost any type of electrically operated equipment: lamps, solenoid valves, buzzers, bells, power relays, fan motors, pumps, door openers, heating systems, etc.

HOW IT WORKS

Super-Sens is essentially a two-transistor, high-gain, direct-coupled d.c. amplifier driving a standard sensitive-type electromagnetic relay. See Fig. 1. Transistors *Q1* and *Q2* are connected in a modified Darlington circuit. (A Dar-

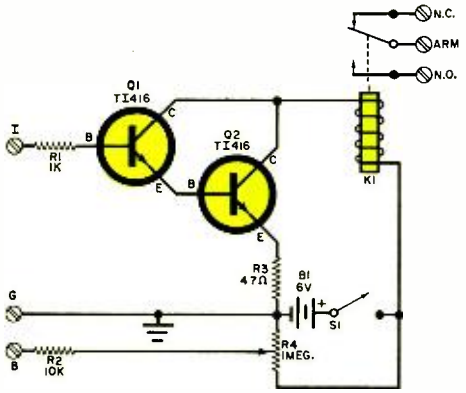


Fig. 1. As little as 0.2 μa. at 1 volt is enough to trigger relay; up to 50 megohms can be sensed.

lington circuit is a circuit having two or more transistors connected in such a manner as to have a single input, a common load and a current gain which is the product of the current gain of each transistor.)

Series resistor *R1* tends to limit base current to prevent accidental damage to the transistors by excessively strong input signals. Unbypassed emitter resistor *R3* stabilizes circuit operation, and provides a degree of temperature compensation. Sensitivity control *R4* and current limiting resistor *R2* are parts of a bias and control circuit to permit the use of external resistive-type and switch-type sensors. Circuit power is supplied by *B1* and is turned on and off with s.p.s.t. switch *S1*.

When a signal or bias voltage of proper polarity (base positive with respect to emitter) is applied to the base emitter circuits of *Q1* and *Q2*, the transistors conduct and energize *K1*. Bias voltage can be taken from the internal *R2*, *R4*, *B1* circuit (*B* terminal) or it can be derived from an external circuit.

There are essentially three basic types of input circuit control devices that *Super-Sens* will cater to: those that look like a voltage source, those that look like a resistor, and those that look like a switch. The voltage source devices are hooked up to *I* and *G*.

The resistor control types are given special consideration: high-resistance devices are connected across terminals *I* and *B* (in series with the internal

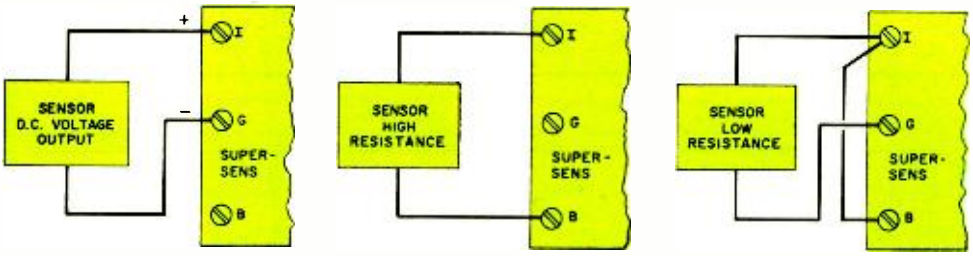


Fig. 2. Any one of three basic types of sensors can be used: those that look like a voltage, such as a photovoltaic cell, etc.; those that look like high or low resistors; and those that act like a switch.

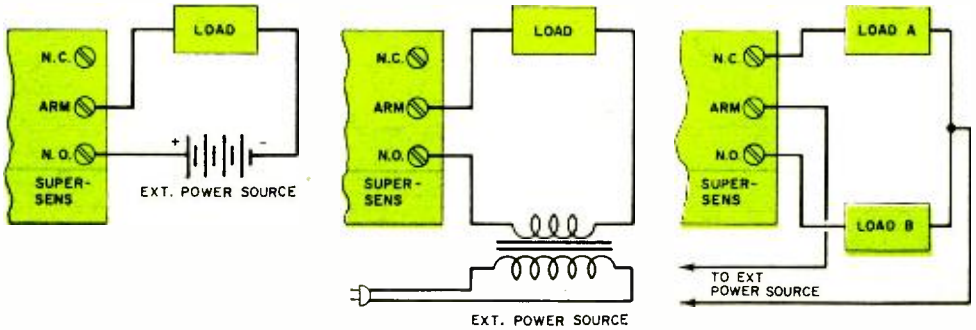


Fig. 3. Controlled external load circuit can utilize almost any source of power. If power requirements exceed the relay contact's rating, a power relay can be added. One or two loads can be switched.

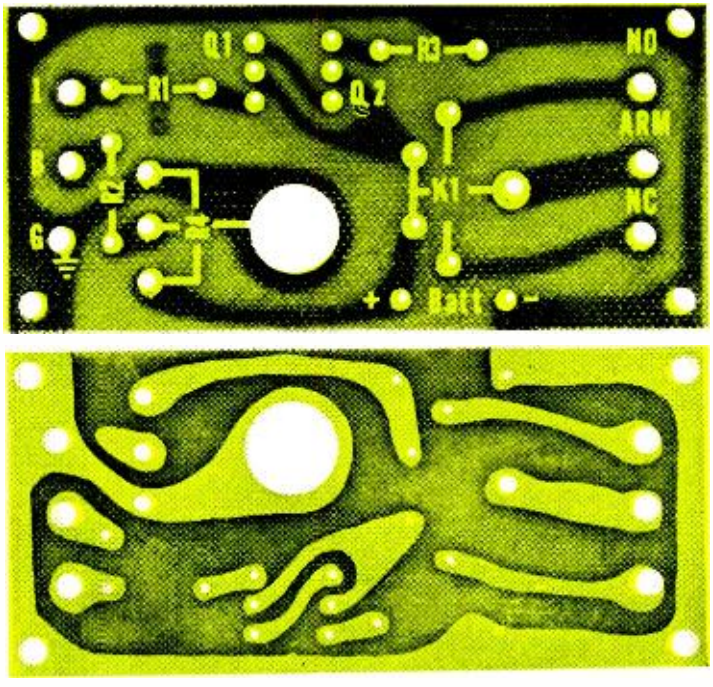


Fig. 4. Etched circuit board construction provides a mounting base for all the components, including the relay. Conventional chassis-type construction is also quite suitable. If you want to make your own printed circuit board, you can use these actual size photos as guides. All components are mounted on one side of the board (top). The foil side (bottom) must be clean to prevent leakage between conductors.

bias circuit) and low-resistance types are placed between terminals *I* and *G* with a jumper from terminals *I* and *B*, as shown in Fig. 2. Actually, the resistive devices are made to function like a voltage source, since terminal *B* has sufficient voltage of proper polarity to forward-bias the transistors.

Switch-type devices can be connected between points *I* and *B*, and *R4* adjusted to provide just enough voltage to pull in the circuit when the switch is closed. Conversely, these switches can also be made to drop out the circuit. A jumper between *I* and *B*, and *R4* adjusted to pull in the circuit, will keep the circuit on until a switch across *I* and *G* causes the circuit to drop out when it is closed.

The relay can be hooked up to provide either a normally open, or normally closed control circuit, or both, as shown in Fig. 3.

CONSTRUCTION

Since the basic unit is the same for all applications, let's put the thing together, and then we'll consider some of the many applications. All components are standard and readily available through most electronics supply houses.

PARTS LIST

B1—6-12 volt battery
K1—Relay (LMCO GS-100 or equivalent)
Q1, Q2—TI416 transistor
R1—1000-ohm, ½-watt resistor
R2—10,000-ohm, ½-watt resistor
R3—47-ohm, ½-watt resistor
R4—1-megohm potentiometer, linear-taper
S1—S.p.s.t. toggle or slide switch
1—Etched circuit board*
1—Cabinet (Minibox 2102)
Misc.—Small knob, screws, nuts, hardware, wire, solder, etc.

*A pre-etched circuit board on an epoxy-glass base is available from DEMCO, Box 16041, San Antonio, Texas 78216 for $2.00. This firm can also supply: a "basic" kit (board, relay, transistors) for $7.50; a complete kit for $9.50; and a pre-etched moisture sensor for $1.50.

If you etch your own board, follow the actual size layout shown in Fig. 4. Wiring is not critical, but special precautions should be taken. First, be sure there is ample separation between the *I*, *B*, and *G* terminals. Second, use an epoxy-glass rather than a paperbase phenolic copper-clad base board, (moisture absorption in the latter material may cause erratic operation). Third, be sure to remove all of the unused copper during the etching process, for an al-

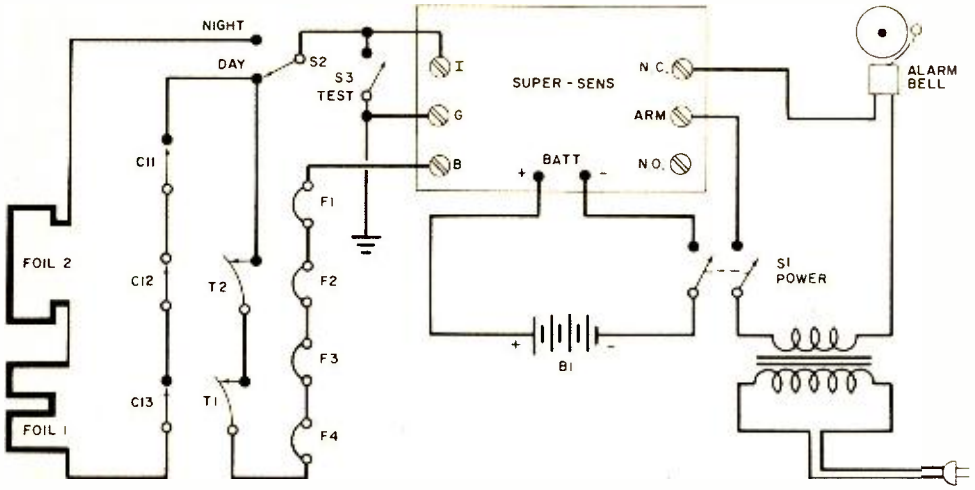


Fig. 5. Fire alarm circuit has fusible links F1 to F4, and thermostatic contacts T1, T2. Door and window contacts C1 to C3 and foil patterns make up burglar alarm. Place sensors in strategic locations.

most invisible, microscopically thin layer of copper can provide sufficient conduction to actuate the relay.

To avoid accidental mechanical damage, mount the relay last. Heat-sink the transistor leads with a pair of long-nose pliers to prevent heat damage when soldering. The *Sensitivity* control can be mounted on either side of the board.

The completed board can be mounted in a small Minibox as a self-contained instrument, or in another piece of equipment, depending on the device's ultimate use. Mount the board on spacers to provide air space between the board and the cabinet. Power supply *B1* can be built in or externally connected.

A number of component changes can be made to meet individual needs. General Electric GE-10 transistors will serve as direct replacements for the specified *T1* units. A Sigma 4F-1000/S-SIL relay can be used in place of the JAICO type, although a new layout and larger circuit board would be required. If maximum sensitivity is needed at all times, omit *R4* and connect *R2* directly to the *S1, K1* junction.

A variety of power supplies can be employed. The total current drain when the relay is closed is only a few milliamperes, permitting the use of small transistor-type batteries.

As might be expected, the instrument's ultimate sensitivity depends on supply voltage, component tolerance, and the gain of the transistors. With the components specified in the Parts List, the current sensitivity (for relay closure) will vary between 0.15 and 0.45 μa., using a 9-volt power supply.

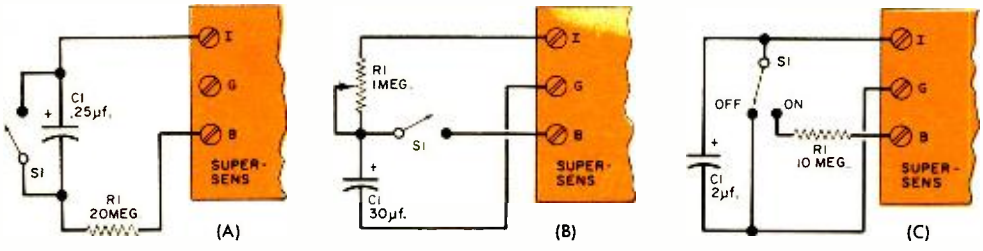


Fig. 6. An RC network can be added to make a time-delay relay. Circuits (A) and (B) stay on for a desired time after the switch is opened. "Turn on" is delayed in circuit (C) when the switch is closed.

If higher gain transistors are used, the overall sensitivity may be as great as 0.1 (or less) μa., while lower gain units may provide a sensitivity of 0.75 μa.

APPLICATIONS

Burglar and Fire Alarm. An easily installed alarm system, suitable for a home or place of business, is shown in Fig. 5. It offers fire alarm protection during the day, and both fire and burglar alarm protection at night.

A break in any part of the external series circuit will trigger the alarm. A "push-to-test" switch (*S3*), when depressed, will sound the alarm if the relay circuit is in working order.

Fire protection is afforded by fusible links *F1* to *F4* and by thermostatic contacts *T1* and *T2* placed on ceilings in strategic locations. Door and window contacts *C1* to *C3*, together with the foil patterns, provide burglar protection. Any combination of switches, contacts, or links can be used, so long as the circuit forms a closed loop and the total resistance of the loop isn't great enough to prevent an adequate amount of voltage from terminal *B* to be applied to terminal *I*. The sensitivity control can be adjusted to compensate for loop resistance and battery conditions.

Switch *S2* skips the door and window detectors during the day, and *S1*, which can be lock-protected, serves as a master on/off control. If switching *S2* from night to day or day to night causes a momentary but undesirable alarm, connect the *Night* side of the switch to the switch's center arm. In this mode of operation, *Super-Sens* is on all the time, the relay is energized, and the normally closed contacts are held open.

Occasionally, a latch or alarm-hold type of operation is desirable . . . that is, once the alarm is triggered, it sounds continuously even after a break in the loop is restored. In this type of operation, the alarm can be reset only at the main panel, which could be located inside a locked cabinet. To build in the latch feature, connect a 1-megohm, ½-watt resistor in series with terminal *I* and *S2*. Adjust the *Sensitivity* control until the relay just pulls in (silencing the alarm), then back off slightly. Use the test switch and control alternately, and adjust until the desired action is achieved.

Time Delay Relays. Controls which can switch a circuit "ON" or "OFF" for preset or adjustable periods of time are used extensively in experimental work, photography, laboratory tests, chemical processing and manufacturing. *Super-Sens* can be used in such applications by adding a relatively simple "time delay" accessory. Typical circuit arrangements are shown in Fig. 6.

A 20-megohm resistor connected in series with a 0.25-μf. capacitor in Fig. 6 (A) sets up a time delay on the order of 3 to 9 seconds, depending on the setting of the *Sensitivity* control. A momentary normally open contact switch connected across the capacitor allows the circuit to conduct when the switch is pressed and released. The relay closes and remains closed until *C1* is charged up and stops drawing current.

The circuit in Fig. 6 (B) permits a wider range of control. When *S1* is de-

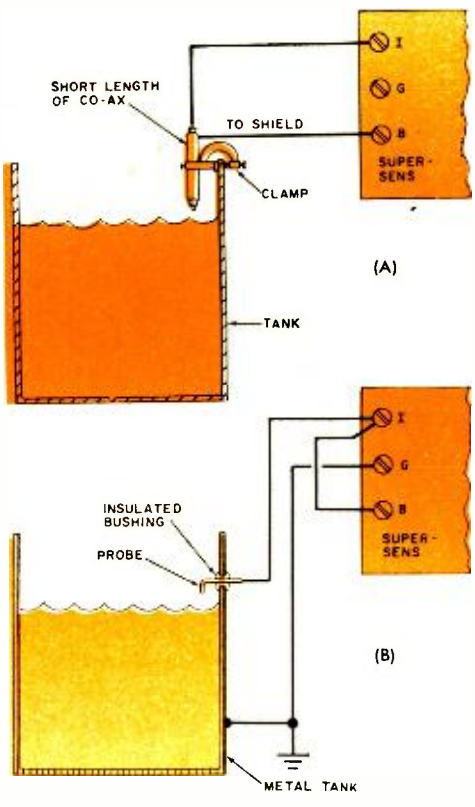


Fig. 7. Levels of low- and high-conductive liquids can be monitored by easily made probes.

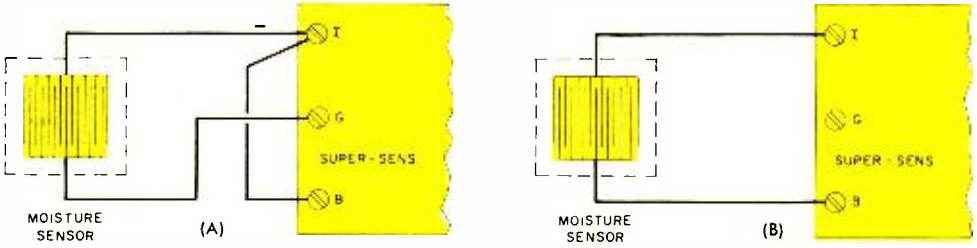


Fig. 8. These circuits can be used to control humidifiers and lawn sprinklers. Just a drop of rain on the sensor will release the relay in circuit (A). Circuit (B) can detect slightest trace of moisture.

pressed and released, *C1* is charged by the bias supply and then discharges slowly through the instrument's input circuit, holding the relay closed until *C1* loses most of its charge. The time delay varies with *R1*'s setting, and ranges from about 25 seconds with *R1* set at 0 resistance to as much as 1 minute and 45 seconds when *R1* is set at 1 megohm. The timing range can be changed if you use different values for *C1* and *R1*. The larger the time constant (*R1* x *C1*), the longer the time delay.

In Fig. 6 (C), a delay in "turn on" time takes place after the slide switch is thrown. When *S1* is switched to the "ON" position, the relay does not close until the current through *R1* and *C1* falls off enough to reduce the voltage drop across *R1*.

Liquid Level Control. Farmers, chemical engineers, food processors, electroplaters, beverage manufacturers, industrial plant operators and others need to check or maintain liquid levels in large tanks or vats from time to time. *Super-Sens* can do an excellent job in such applications when used with suitable sensor probes. Typical techniques are shown in Fig. 7.

A short length of rigid coaxial cable can be used as a simple liquid sensor probe if clamped to the side of a tank. If the cable's shield is connected to the instrument's *B* terminal and the center conductor to the *I* terminal, the relay will close when the liquid reaches the exposed lower end of the cable. Connections are as shown in Fig. 7 (A).

If a metal tank is used, the sensor probe may be a short length of conductor mounted in an insulated, liquid-tight bushing at an appropriate point on the side of the tank, as illustrated in Fig. 7 (B). If the liquid is highly conductive, connections can be made to the *I* and *G* terminals, with a jumper between the *I* and *B* terminals. With these connections, the *Sensitivity* control is adjusted until the relay just closes. The relay will open when the liquid level reaches the probe.

Other types of probes can be used, of course, including insulated metal strips cemented inside the tank or short parallel metal rods mounted on an insulating block and attached to the tank. Regardless of the probe used or the type of liquid handled, *Super-Sens* can control pumps or solenoid valves, or activate remote signaling devices.

Rain Alarm. A standard moisture sensor plate will make *Super-Sens* serve as a rain alarm. The sensor plate leads are connected as shown in Fig. 8 (A) and operate in the same way as the level control in Fig. 7 (B). Just a drop or two of rain on the sensor plate is enough to cause the relay to open.

Humidity Control. A modification of the "rain alarm" circuit is shown in Fig. 8 (B). Here, the moisture sensor plate is connected and operated in the same manner as the circuit shown in Fig. 7 (A). With this arrangement, *Super-Sens*' high sensitivity will respond to the slightest trace of moisture and close the relay. It can detect the small amount of moisture condensed from a person's breath and can be used, among other applications, for controlling a dehumidifier.

Lawn Sprinkler Control. If the moisture sensor plate used in the "rain alarm" and "humidity control" circuits is replaced by a pair of semi-insulated spike-type probes driven into the ground, *Super-Sens* will serve as an automatic lawn sprinkler control. Its output terminals

(*Continued on page* 110)

HOW TO STACK TV ANTENNAS TO INCREASE SIGNAL STRENGTH AND TO REDUCE GHOSTS

By LON CANTOR
Jerrold Electronics Corp.

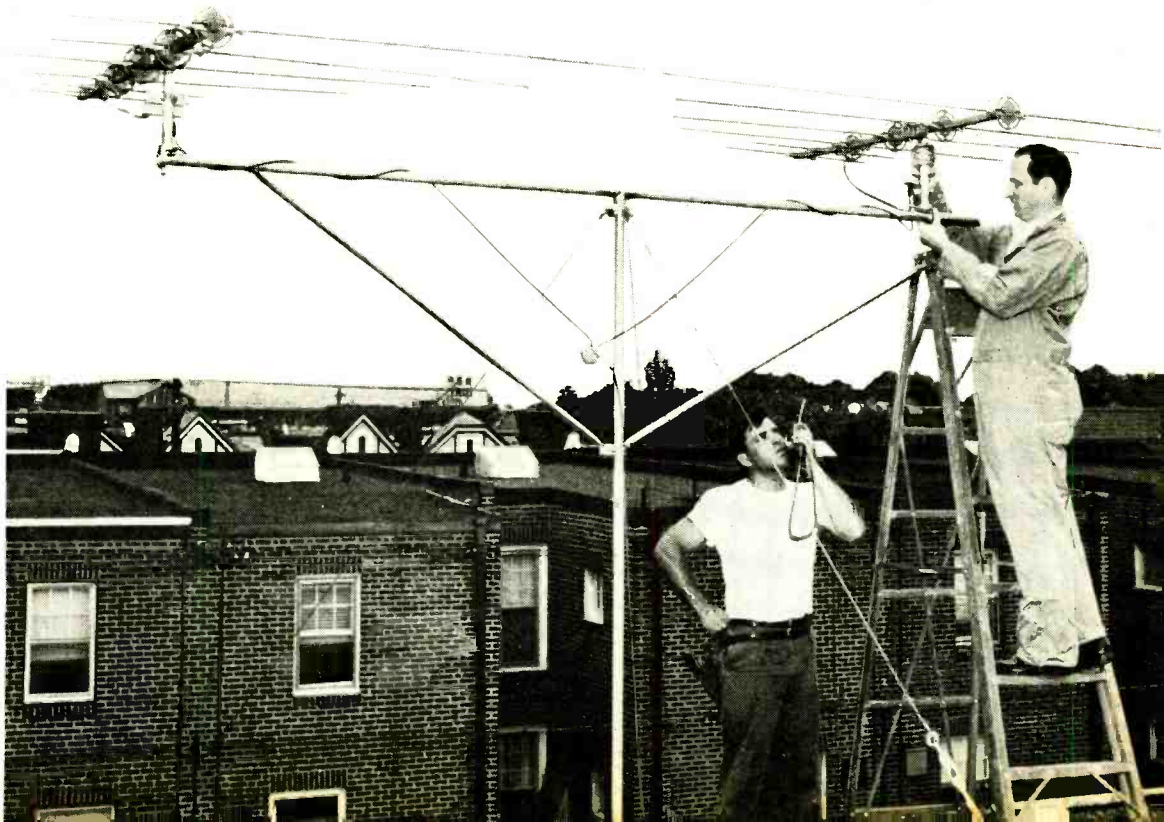
IF ONE ANTENNA is good, why aren't two better? They are. Two properly stacked antennas will bring in about one-and-a-half times more signal voltage than a single antenna; a stack of four can almost double the signal voltage. Of course you can't just keep doubling the antennas indefinitely. Beyond eight, there is no appreciable increase in signal pickup.

However, increasing signal strength isn't the only reason for stacking antennas. In fact, it isn't even the best reason. If you need more signal pickup, you may be better off buying a more expensive, higher gain antenna than stacking two antennas. And, if even the best antenna you can find doesn't do the job, you should probably add a good mast-mounted preamplifier.

When should you stack antennas? When you are faced with certain reception problems that can't be solved in any other way. There are two ways to stack antennas: vertically and horizontally.

Vertical Stacking. There are three reasons for stacking antennas vertically:

(1) To reduce signal fading from distant TV stations;



VERTICAL STACKING
reduces fading
reduces airplane flutter
increases signal pickup

HORIZONTAL STACKING
reduces ghosts
reduces man-made interference
reduces adjacent-channel interference
reduces co-channel interference
increases signal pickup

(2) To reduce airplane flutter;
(3) To increase signal pickup.

Because TV signals are so high in frequency, they are limited primarily to line-of-sight distances. However, by various means, they do manage to get to "blind" areas and regions a short distance over the horizon. While lower frequency radio waves do follow the curvature of the earth and TV signals don't bend very well, a small portion of the TV signal does bend around obstructions to get to the antenna. This can take the form of a knife-edge type of diffraction as from the roof-edge of a building, or a gentler slope as from the top of a hill.

Television signals also reach the fringe antenna by reflection—bouncing off of atmospheric interfaces, and refraction—bending caused by atmospheric layers with different densities.

Let's suppose you're putting up a fringe antenna. You won't get the most signal just by mounting the antenna as high as possible. Instead, you must carefully probe for the height that gives you the best possible TV pictures. Because of the methods of signal propagation, this height is quite critical. It is the height at which most of the diffracted, reflected, and refracted signals that are present arrive in phase. At heights at which these various signals arrive out of phase, they actually subtract from each other.

The trouble is that the signals that reach the antenna by atmospheric reflection and refraction are not stable. They change as the atmosphere shifts. This is the main reason for signal fading in fringe areas.

The solution to this problem is the vertical stack. You put the two antennas at different heights. Thus, when one antenna is receiving out-of-phase signals, the other is receiving in-phase signals. If you combine these two antennas properly, you wind up with an average signal that doesn't vary much. This is a form of diversity reception.

When the antennas are not delivering the same signal, the out-of-phase antenna acts as a load to the in-phase antenna. Instead of getting additional signal, you actually get less than the in-phase antenna alone can deliver, unless you effectively isolate one antenna from the other.

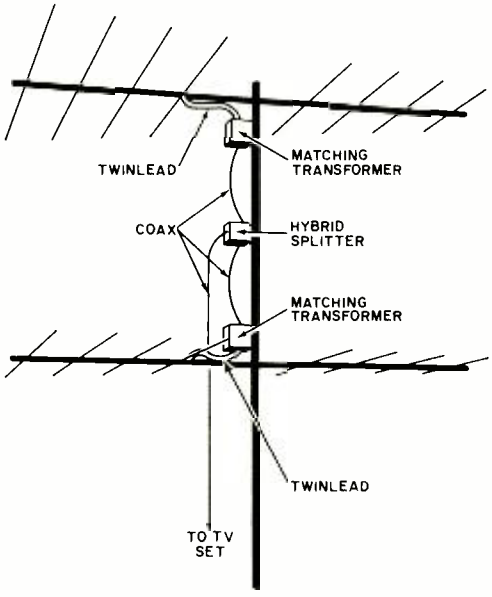


Fig. 1. Hybrid splitter allows signals from each antenna to add to each other, and minimizes loss when one antenna acts as a load on the other. Leads to transformers and splitter should be equal.

Commercially available stacking bars won't do the job. Stacking bars are fine when both antennas are delivering approximately the same signal. Obviously, this is seldom the case in a fringe installation.

Figure 1 shows how antennas should be vertically stacked to minimize signal fading.

There are five important things to do to make a good vertical stack.

(1) Use identical antennas.

(2) If you use coaxial cable, such as RG-59/U, you should also use a weatherproof 300-ohm to 75-ohm matching trans-

CHANNEL NUMBER	FREQUENCY RANGE (mc.)	WAVELENGTH (inches)
2	54–60	205
3	60–66	186
4	66–72	170
5	76–82	148
6	82–88	138
7	174–180	66.5
8	180–186	64.5
9	186–192	62.25
10	192–198	60.5
11	198–204	58.5
12	204–210	57
13	210–216	55.25

Fig. 2. Select wavelength of lowest channel to adjust space between stacked antennas to prevent mutual interference. Two-thirds wavelength is minimum.

former mounted as close as possible to each antenna.

(3) Use a hybrid type splitter. This type of unit is like a one-way valve. The output contains the sum of the two inputs, with virtually no loss. Yet the two inputs are isolated from each other. Even if the signal on one antenna goes down to zero, it cannot subtract more than about 10% of the signal from the other antenna.

(4) Space the antennas at least two-thirds of a wavelength away from each other on the mast. A full wavelength is preferred, but this is not always possible. In calculating this distance, use the wavelength of the lowest channel in your area. Figure 2 shows the wavelengths of all the VHF channels.

(5) Make the harness symmetrical. The lead run between each antenna and its matching transformer must be identical. Similarly, you must use equal lengths of cable between each matching transformer and the hybrid splitter.

Horizontal Stacking. It is foolish to use a horizontal stack simply to increase signal pickup. It is easier, cheaper, and just as effective to use a vertical stack for this purpose. Horizontal stacks, however, may be the only possible way to do the following things:

(1) To reject ghosts;

(2) To minimize co-channel interference;

(3) To minimize adjacent-channel interference;

(4) To reduce man-made interference.

Figure 3 shows the reception pattern of one log-periodic antenna, compared with that of two of them horizontally stacked. Notice that stacking not only increased gain, but changed the pattern considerably. The stacked pattern shows two side lobes, although there are others, with nulls in between. These nulls are important. You can use them to get rid of unwanted signals.

The pattern shown in Fig. 3 is for one particular horizontal stacking situation: when the antennas are stacked precisely one wavelength apart (center to center). Notice that under these conditions nulls

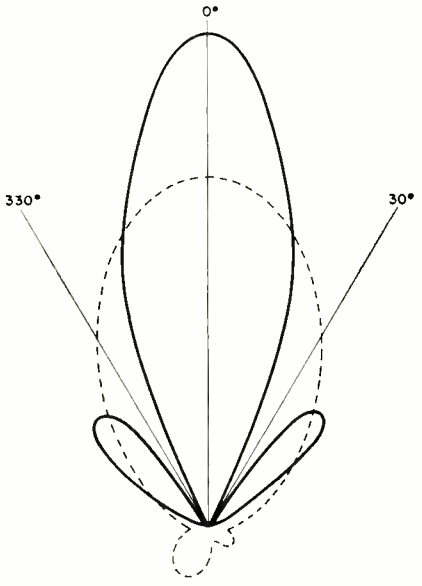
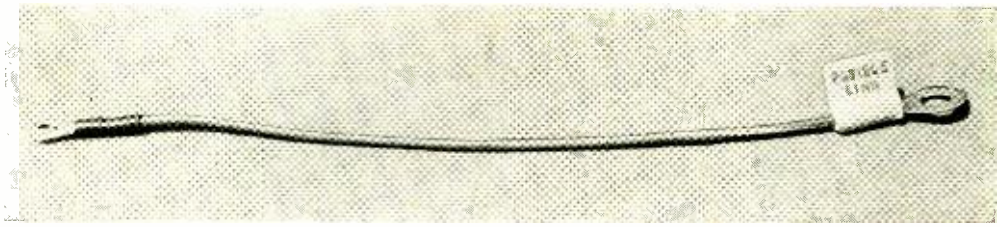


Fig. 3. Angle of null points can be changed by adjusting the spacing between horizontally stacked antennas (solid line) to drop out interference. Dotted line is response curve of single antenna.

are produced at 30° to the right and left of 0°.

Now, suppose you had a tall tower reflecting a ghost signal from an angle 30° away from the transmitted signal. You would simply aim the two antennas at the transmitter, the ghost would conveniently fall into the null, and you'd never see it on the TV screen. It is seldom, however, that you can count on unwanted signals coming in from precisely one of those angles. Therefore, you have to find a method of varying the angles of the nulls.

(*Continued on page* 113)



PROTECT YOUR CAR'S ELECTRICAL SYSTEM

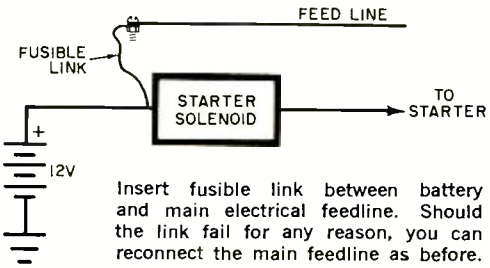
By CHARLES ERWIN COHN

Forty-five-cent link provides under-the-hood fire protection

MOST VEHICLE lighting and electrical accessory circuits are well-protected by fuses or circuit breakers. However, the main feedline which connects the battery to the generator and to all circuits, except the starter, and the circuit wiring up to the fuse block or circuit breaker very often go unprotected. Should a short occur at a point ahead of the protective devices, the high currents would cause extensive wire damage, battery damage, and possible fire.

At a cost of only 45 cents, it is now possible to minimize this hazard. A fusible link introduced by Chrysler Corporation on its 1965 autos can be adapted for use in any car equipped with a 12-volt battery system. The part number is 2580389, and it can be obtained from any Chrysler dealer.

The link is a short length of 16-gauge wire which behaves like a fuse. Because the regular wiring in the car is much heavier, the link will burn out before the regular wiring has a chance to do extensive damage in the event of a short. At 30 or so amperes, the link runs hot; and at about 40 amperes, it quickly melts. Normal total current requirements in a car rarely exceed 30 amperes. For the system to operate again, once the link fuses, it must be replaced. Special heat-resistant insulation is used to safely contain the hot link.



Insert fusible link between battery and main electrical feedline. Should the link fail for any reason, you can reconnect the main feedline as before.

As shown in the diagram, the link is connected as close to the battery in the electrical system as possible. It should not be inserted in the starter circuit. Usually, the link can be attached to the "hot" terminal of the starter relay. As a safety precaution, disconnect the battery before you install it, and reconnect the battery after the job is done.

Disconnect the feedline from the solenoid, and connect the end of the link with the larger terminal lug to the solenoid and the other end to the feedline. A small nut and bolt can be used to connect both wires. All connections should be firm. The junction of the link and the feedline should be taped, and positioned so that it will not accidentally cause a short circuit.

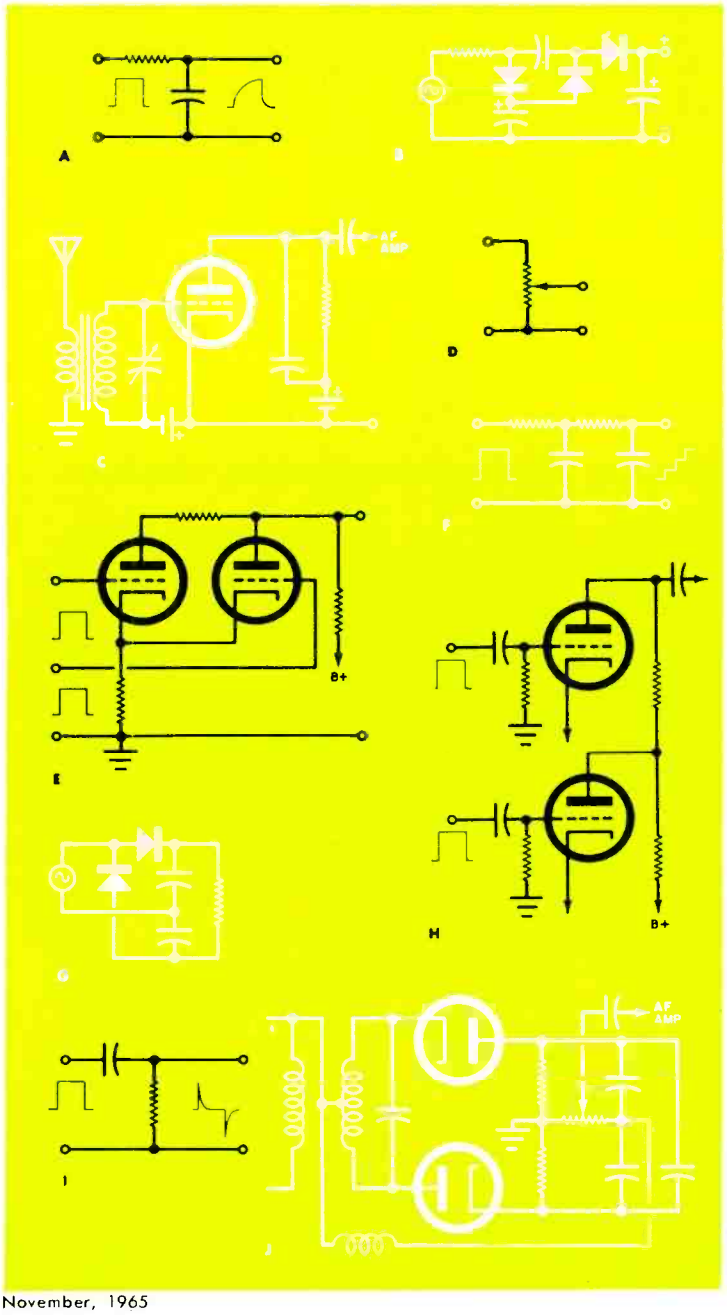
In the event the link gives way when you are miles away from a service station, reconnect the feedline as it was originally—after you have cleared the short circuit. —30—

ELECTRONIC MATH QUIZ

By ROBERT P. BALIN

Many basic electronic circuits can and do perform mathematical operations ranging from elementary arithmetic to integral calculus. See if you can identify the electronic circuits (A-J) below which perform the mathematical operations (1-10) at right.

(*Answers on page* 115)



1 Add _____

2 Count _____

3 Differentiate _____

4 Double _____

5 Divide _____

6 Integrate _____

7 Ratio _____

8 Square _____

9 Subtract _____

10 Triple _____

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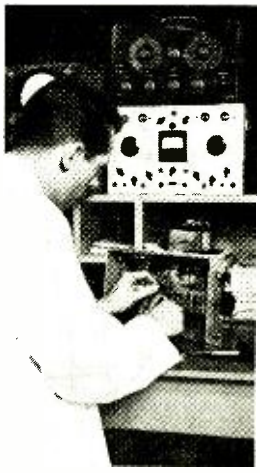

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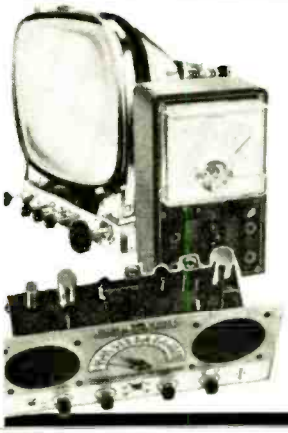

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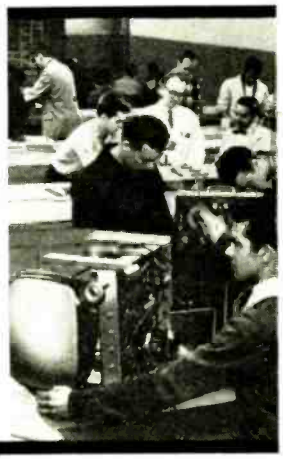

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PREDICTED RADIO RECEIVING CONDITIONS

EXCELLENT DX IS PREDICTED FROM NOVEMBER THROUGH FEBRUARY

By STANLEY LEINWOLL, Radio Propagation Editor

THE WINTER of 1965-66 is likely to be the last good DX'ing winter season for the AM broadcast band for some years. As the sunspot numbers increase, we can expect to see more medium-wave signal absorption in the ionosphere. Propagation of medium-wave broadcasting signals over great distances is dependent on many factors, including transmitter power, frequency, antenna characteristics, latitude of the transmitting station, sunspot activity, the time of day and, of course, the season of the year.

During the winter nighttime listening periods, when noise levels in the Northern Hemisphere will be at a minimum, DX conditions should be at their very best. The graph on this page shows the signal strength variation in DX reception versus local time at the mid-point of the path between transmitter and receiver. For European AM broadcasting stations between 500-1600 kc., the best DX period should be from approximately 2100 to 0000 EST.

The following is a summary of DX receiving conditions expected during the period from November, 1965, through February, 1966.

41 and 49 Meters. Continuing the trend of the past several years, these bands will be best for DX reception during the evening hours. Among the stronger stations heard in this hemisphere will be West Germany on 6075 kc., and the BBC on 6195 kc. Not easy to log, but worth looking for, will be Italy on 6060 kc., East Germany on 6115 kc., and RIAS on 6005 kc. The latter station operates 24 hours a day from West Berlin with transmissions aimed toward East Germany.

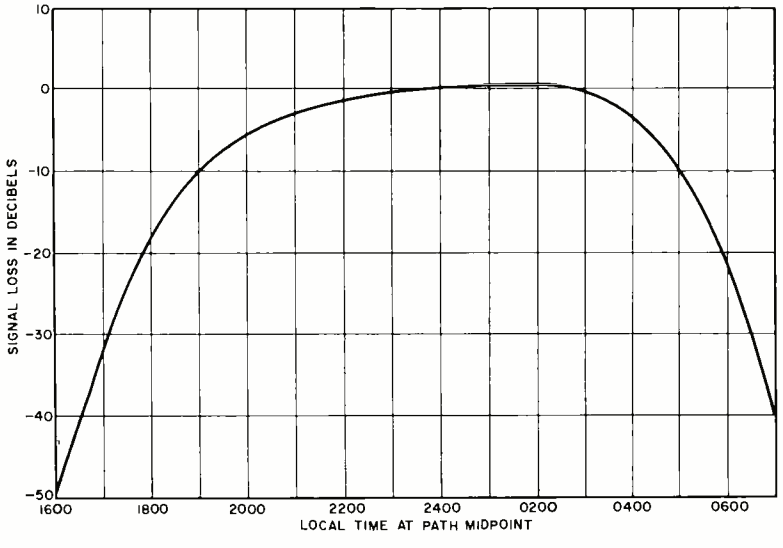
The BBC will be active on 7130 kc. with transmissions beamed to the South Pacific* but coincidentally passing over the East Coast of North America. The Russians will be found throughout the 40-meter ham band with transmissions beamed to North America, particularly their block-buster signal on 7150 kc.

31 Meters. DX receiving conditions in this band will improve during the early winter months. Expect to hear DX stations starting from late afternoon local time. Reception will consist primarily of Europeans and Africans, as well as some stations in South and Central America.

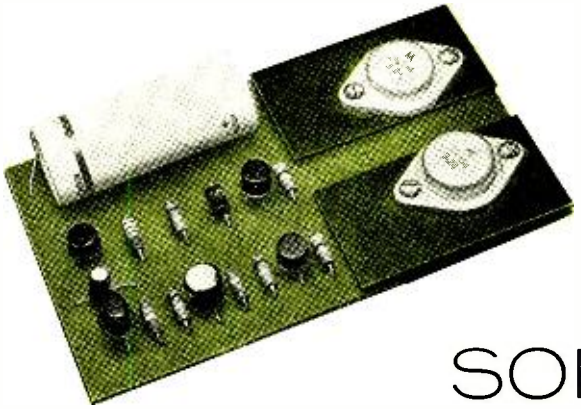
Guinea will be on 9650 kc. until 1900

(*Continued on page* 123)

*See *"Shoot a Radio Wave Into the Air," Leinwoll,* POPULAR ELECTRONICS, *February, 1965, p. 65.*



This graph, copied from CCIR Report 264, Geneva, 1964, shows the expected signal loss of AM broadcast-band signals vs. time at the mid-point of the signal path. Across the North Atlantic, AM signals should be strongest between 9 p.m. and midnight, Eastern Standard Time. Strength of the AM signal drops off rapidly after about 1 a.m. EST.



By CHARLES E. FENOGLIO

SOLID-STATE 6-WATT AMPLIFIER FOR 10 BUCKS

All-purpose push-pull audio amplifier operates on wide range of input voltage and output impedance without bias adjustments

IF YOU would like to have a quality, low-cost amplifier for a hi-fi or public address system—one you can use at home or in your car, and can convert into a speech amplifier, modulator, or high-power intercom—then try your hand at this transistorized "Six-Watter." You can build it in less than two hours, at a cost of about $10.00. All components can be mounted on a printed circuit board, and construction is easy.

Several novel circuit features make it possible to use few parts, eliminate transformers, and achieve high efficiency. A unique d.c. bias stabilizing network eliminates the bias adjustments normally found on this type of amplifier and permits operation with a wide range of supply voltages without modification.

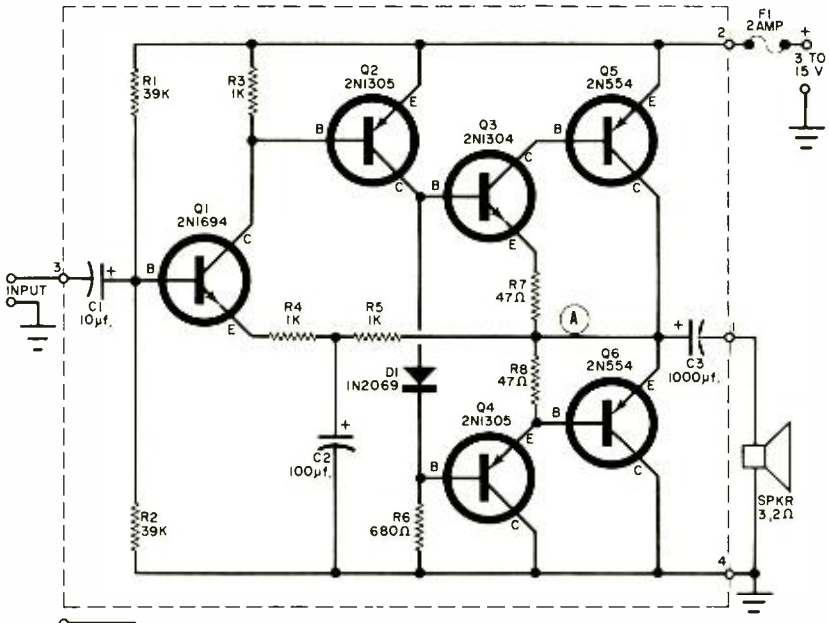
The excellent low-frequency response of the Six-Watter is due in part to the absence of transformers and the use of high-value coupling capacitors as well as direct coupling. High-efficiency Class B operation makes it ideal for use wherever battery life is an important consideration. Power consumption from a 12-volt battery under no-signal conditions is less than ½ watt.

While the amplifier can work on any supply voltage ranging from 3 to 15 volts, the higher the voltage source, the greater the audio power output you can get. An input signal of less than 0.2 volt is sufficient to drive the Six-Watter to full output. This is more than adequate gain for most tuners, and crystal or ceramic phono cartridges.

How It Works. Audio input is coupled to the base of transistor *Q1* through capacitor *C1*. The amplified signal at *Q1*'s collector is direct-coupled to the base of *Q2*. Here again, the signal is amplified and directly coupled to *Q3* and *Q4*. Transistors *Q3* and *Q4* work in opposite directions; while one is conducting more, the other is conducting less—their output signals are 180° out of phase with each other. This type of circuit makes it possible to drive a push-pull output stage without the aid of a transformer.

The signals from *Q3* and *Q4* are directly coupled to *Q5* and *Q6* respectively. Transistors *Q5* and *Q6* operate as Class B power amplifiers. Balanced operation requires that the product of the current gain of *Q3* and *Q5* be equal to that of *Q4* and *Q6*.

The filter network, *C2* and *R4*, prevents audio voltage variations at point



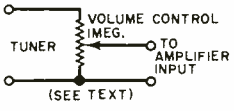


Fig. 1. The audio amplifier uses a novel six-transistor circuit requiring neither transformers nor bias adjustments. It operates with supply voltages of between 3 and 15 volts. An input signal of 0.2 volt is sufficient to drive it to full output. Volume control can be added if desired.

PARTS LIST

C1— 10-µf., 15-volt electrolytic capacitor
C2— 100-µf., 15-volt electrolytic capacitor
C3 1000-µf., 15-volt electrolytic capacitor
D1—1N2069 diode
F1 2-ampere fuse
Q1 2N1694 transistor
Q2, Q4 2N1305 transistor
Q3— 2N1304 transistor
Q5, Q6 2N554 or 2N2148 transistor
R1, R2 39,000-ohm, ½-watt resistor
R3, R4, R5 - 1000-ohm, ½-watt resistor
R6—680-ohm, ½-watt resistor
R7, R8—47-ohm, ½-watt resistor
1 Printed circuit board, available from Hazleton Scientific Co., Box 163, Hazel Park, Mich. 48030 for $2.85 postpaid with all holes drilled and for $1.95 postpaid undrilled
2 1¾" x 2½" x 1/16" heat sinks, copper or aluminum

A in Fig. 1 from reaching *Q1*'s emitter. This results in a high degree of d.c. stability without affecting the a.c. gain of the amplifier.

Any speaker impedance ranging from 1.6 to 16 ohms can be used. Because power output is a function of speaker impedance, and source voltage, stick to a 3.2-ohm speaker and a 12-volt source, if possible.

Construction. You can make your own circuit board, or purchase one for $2.85

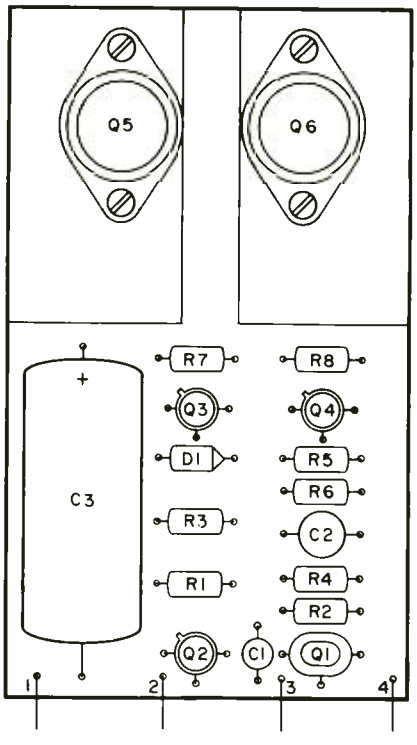


Fig. 2. Carefully locate and solder all of the components onto the printed circuit board as shown.

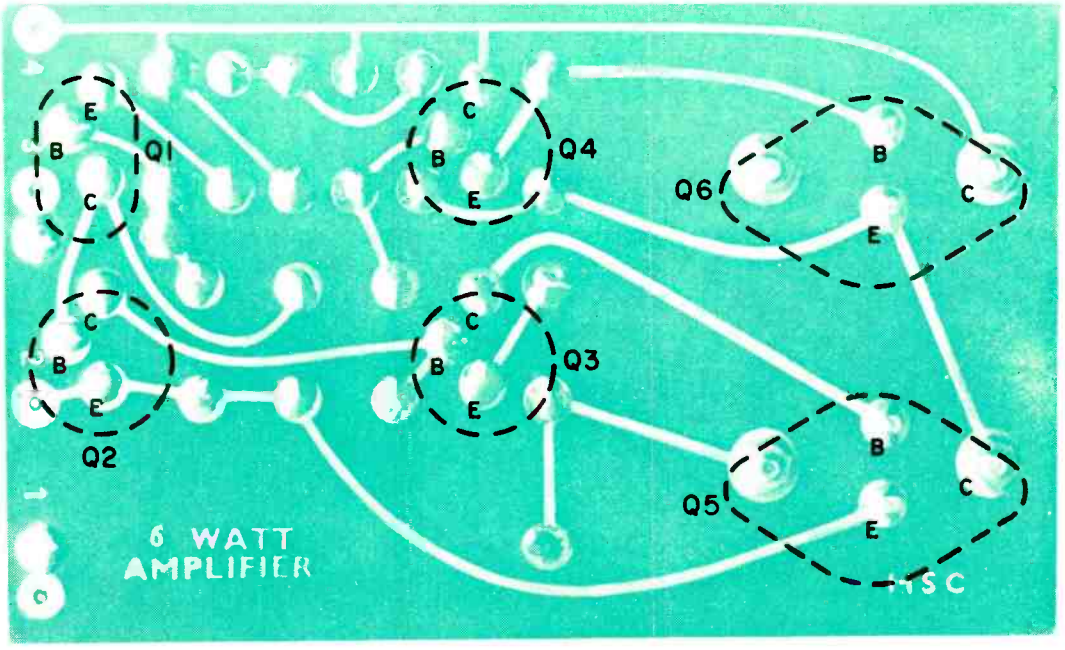


Fig. 3. Use this full-size guide in making your printed circuit board. Space the transistors about ½" above the board and hold transistor leads on top side of board with a pair of long-nose pliers when soldering.

(see Parts List), or you can mount and wire the components on a small (approximately 4" x 6") conventional type chassis. If you use the board, locate and solder the parts in place as shown in Fig. 2. Space the transistors about ½" above the board and hold the transistor lead on the top side of the board with a pair of long-nose pliers while soldering.

Heat sinks for *Q5* and *Q6* can be cut from a 1/16" copper or aluminum sheet, and should measure 1¾" x 2½". Drill holes as shown in Fig. 3. Two holes are used to mount each heat sink on the board, and two are used for the transistor pins. Paint the heat sinks black to increase thermal dissipation. If you plan to use the amplifier continuously at high power levels and high ambient temperatures, increase the size of the heat sinks.

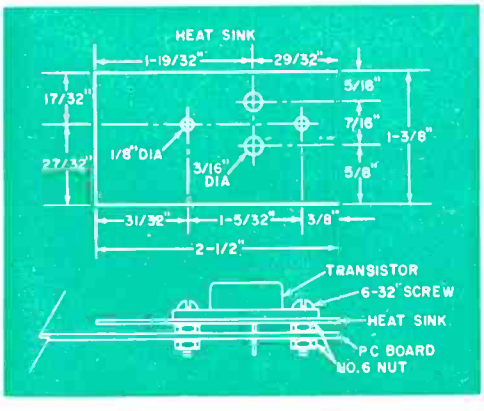


Fig. 4. Use thin copper or aluminum stock to make heat sinks and mount with the transistor as shown.

Final Check. After completing construction, feed a 6- to 12-volt d.c. source to terminals 2 and 4 (positive voltage to terminal 2) and measure the d.c. voltage between point *A* and terminal 4.

It should be one-half the supply voltage. If it is not, *R1* and *R2* may not be matched closely enough. In this case, temporarily replace *R1* with a 100,000-ohm potentiometer and adjust the pot until the voltage at point *A* measures one-half the supply voltage. Then measure the resistance of the potentiometer and replace it with a fixed resistor of that value.

Modifications. You can add a volume control to the amplifier by connecting a potentiometer to the circuit between the

(*Continued on page* 111)

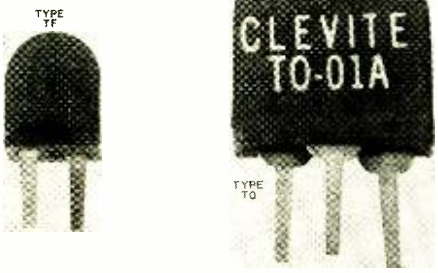
PARTS PROFILES

By DON LANCASTER

COMPONENTS OF THE MONTH

"PARTS PROFILES" IS INTENDED TO PROVIDE YOU WITH EXCITING INFORMATION ABOUT UNUSUAL OR LITTLE KNOWN ELECTRONIC COMPONENTS AND DEVICES THAT ARE INEXPENSIVE, INTERESTING, AND USEFUL. THESE PRODUCTS WILL USUALLY ENABLE YOU TO BUILD MORE INTERESTING PROJECTS AT LESS COST, IN LESS TIME, AND WITH IMPROVED PERFORMANCE. ALL ITEMS COVERED ARE AVAILABLE NATIONALLY OR FROM AT LEAST ONE RELIABLE SOURCE OF SUPPLY.
—THE EDITORS

CERAMIC FILTERS REPLACE I.F.'S



Is an i.f. transformer a *must* in *every* superhet receiver? Not any more. You can now use a new resonant mechanical filter by Clevite that tunes automatically to the 455-kc. i.f. in any transistor radio. It comes in two series (TO-01 and TO-02).

"Transfilters," as they are called, are tiny ceramic devices no bigger than your thumbnail, and they *never need alignment*. Features include: low cost ($1.70 each); small size (¾" x ⅝" x 3/16", maximum); low insertion loss (less than 3 db); wide bandwidths (4 to 10 kc.); and availability of all standard input and output impedances.

The same manufacturer has also put out a resonant trap (TF-01) that can be used in place of the conventional emitter bypass capacitor in transistor circuits to increase the i.f. selectivity. Figure 1 shows typical frequency response of a transfiltered i.f. stage in which both TO and TF transfilters are used. For a typical transistor i.f. circuit using the transfilters, refer to Fig. 2.

But transfilters are not limited to i.f. circuits; they have other applications. You can use one to make a test oscillator if you don't own a signal generator, or would like to have another signal source. Figure 3 shows a simple oscillator employing the TO-01 unit. This oscillator can be assembled and put into a pocket flashlight case, complete with penlight batteries, and can be used for signal injection or other test purposes.

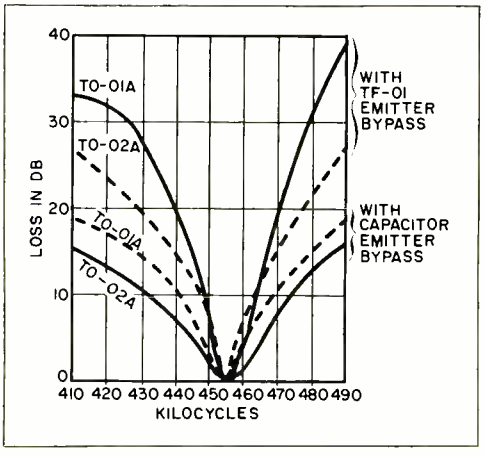


Fig. 1. Typical relative frequency response of transfilterized receiver i.f. stage. Note attenuation when Clevite TF-01 replaces emitter bypass capacitor.

You can get data sheets and application notes direct from the manufacturer, Clevite Electronic Components, 232 Forbes Rd., Bedford, Ohio. The retail outlet is Semiconductor Specialists, Inc., 5700 West North Avenue, Chicago, Ill. The TO types retail at $1.70 each, and the TF at $1.50.

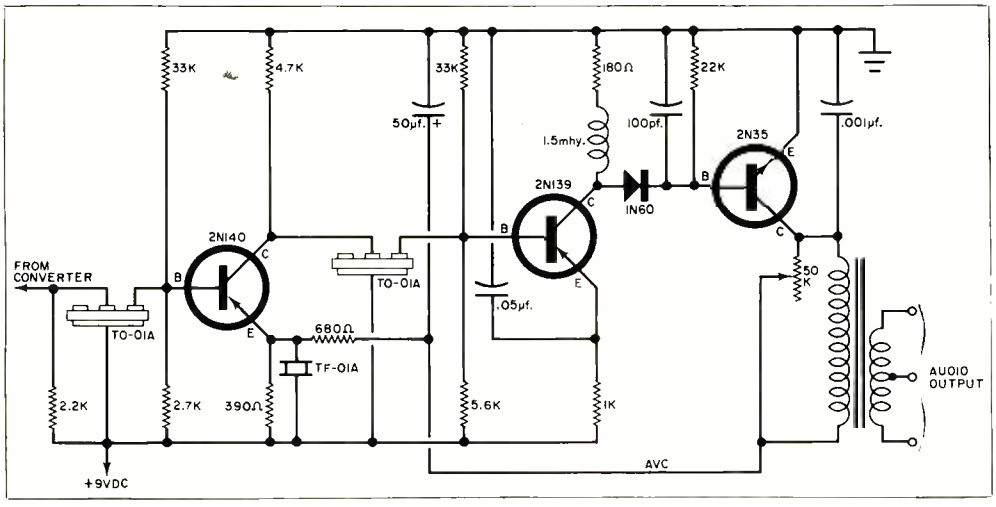


Fig. 2. This transistorized circuit uses transfilters in place of conventional i.f. transformers. Insertion loss is less than 3 db, and bandwidths of from 4 to 10 kc. provide a selective or high-quality i.f.

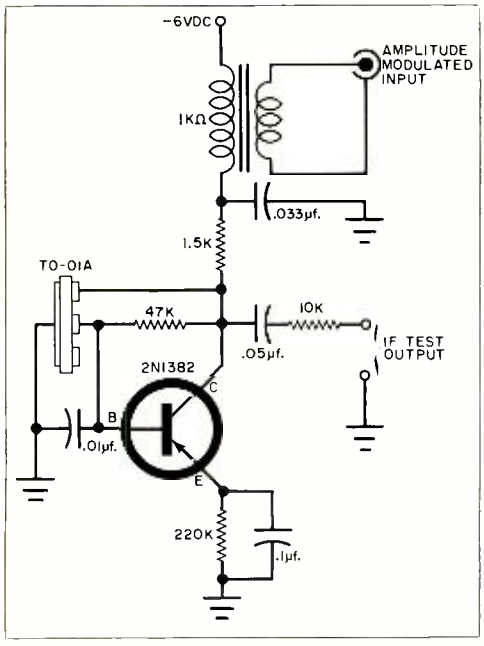
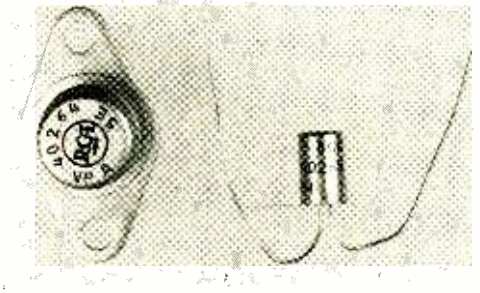


Fig. 3. Test oscillator using a TO-01 transfilter and a single transistor. The unit can be built and housed in a small pocket flashlight case, complete with penlight batteries and all, at a very low cost.



NEW SEMICONDUCTORS REPLACE TUBES

Here, at last, are the long-awaited equivalents of the popular 35W4 rectifier and the 50C5 power amplifier vacuum tubes: the new RCA 40265 silicon rectifier and 40264 silicon transistor. With this double-barreled bombshell, RCA has tolled the death knell for the vacuum tube in circuits commonly used by the experimenter or hobbyist.

With these semiconductors, you don't waste the 13 watts of heater power that vacuum tubes consume, and which does nothing more than heat up the inside of your radio, phonograph, or what have you, and cook the life out of your capacitors and other components. What's more, the silicon units cost less than the tubes.

We are not saying that these semiconductors are precisely interchangeable with their tube counterparts. What we are saying is that they will perform every circuit function that the tubes will, and at the same voltage levels. RCA plans to use these two semiconductors (plus three more you'll learn about when you write for data sheets) as the basis for a line-operated all-solid-state AM radio, as well as in other consumer items.

Let's take a look at the 40265 rectifier first. When working with this baby, remember that you are playing with an a.c.-d.c. circuit

(*Continued on page* 116)

SOLID STATE

By **LOU GARNER,** Semiconductor Editor

LAST MONTH we suggested that hobbyists and experimenters consider using some of the low-cost silicon transistors on the market. And we listed some of the types that are available. Now let's go into them in a little more detail.

Texas Instruments' TI-411 through TI-414 are medium-power, high-frequency amplifiers, while TI-415 through TI-419 are low-level, low-noise amplifiers. General Electric's 2N2921 through 2N2926 and the GE-10 are all audio amplifiers. Of these, the GE-10 is the most readily available; this unit can be used as a general-purpose replacement for nearly all other low-cost silicon transistors. Motorola's MPS706 and MPS834 are switching types, and are quite suitable for use in r.f. or audio circuits.

All these transistors are encapsulated in molded epoxy with one side flattened, as shown in Fig. 1, to facilitate lead identification. As shown, currently available units feature *in-line* lead connections. These differ from the usual *spaced lead* arrangements used in such popular types as the 2N107 and 2N170.

Remember that all currently available silicon transistors are *npn* types, so if they are being used as direct replacements for *pnp* germanium types, the circuit power supply and electrolytic capacitor polarities must be reversed. Figure 2 shows a typical biasing arrangement you can use for an *npn* amplifier stage.

In general, silicon transistors have lower internal leakage than corresponding germanium types. Moreover, many of the newer silicon jobs have very high *beta* (gain) ratings. For example, the TI-416 has a gain of over 600. If you put a silicon transistor in a circuit designed for operation with a germanium job, you may have to readjust the base bias to achieve optimum circuit performance. In the circuit shown in Fig. 2, the base bias can easily be readjusted by simply changing the *R1/R2* resistance ratio.

If you check the spec sheets for the various transistors mentioned here, you'll come up with a wide set of ratings but you'll also find that each of the types has a power dissipation of at least 200 milliwatts, and a collector-to-base rating of at least 25 volts. What this all means is that you can use silicon transistors in most standard circuits, and in so doing get a moderate amount of power from the output stages.

Although we have been talking about the low-cost jobs, all that has been said applies to the higher priced silicon transistors as well. Naturally, some transistor lead arrangements vary, but their applications remain the same. So if you want to start out experimenting with transistors salvaged from the inexpensive surplus computer boards that many distributors are offering, go right ahead. Later, as you gain experience with silicon types, we think you'll agree that you'd "rather switch than fight."

Reader's Circuit. Who said simple AM broadcast-band receivers have lost their charm? Certainly not reader Cary A. Jave-

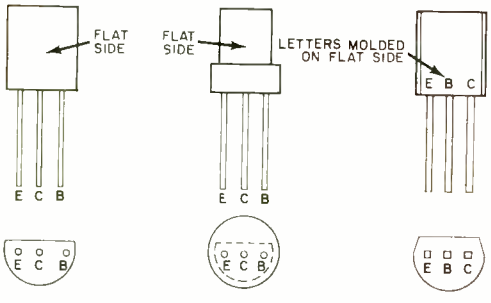


Fig. 1. Silicon transistors featuring in-line lead connections instead of usual spaced lead arrangement. Flattened side facilitates lead identification.

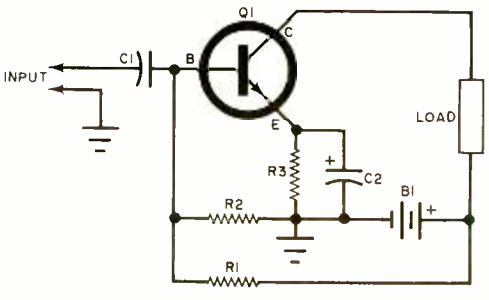


Fig. 2. Circuit configuration of typical amplifier stage using a silicon transistor. Base bias is determined by resistance ratio of R1/R2 combination.

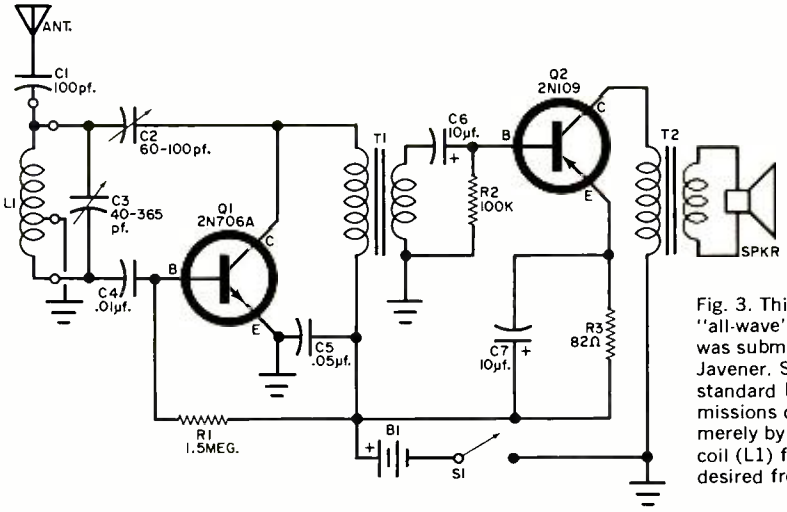


Fig. 3. This two-transistor "all-wave" radio circuit was submitted by reader Cary Javener. Short-wave and standard broadcast-band transmissions can be received merely by changing the plug-in coil (L1) for each desired frequency band.

ner (Rt. 1, Box 208-A, Cameron, Wis. 54822), who submitted the general-purpose receiver circuit shown in Fig. 3. Cary says his little two-transistor "all-wave" radio does a superb job receiving amateur and s.w. bands, in addition to the standard broadcast band. The only requirement is that a new coil be substituted for each band since there are no provisions for switching.

Cary observed that the receiver's upper frequency is determined primarily by the characteristics of *Q1* as well as the inductance of the coils used. Tuning will be critical on the high bands unless a smaller tuning capacitor is used for *C3*, about 140 pf. or less, when working the high bands.

Unfortunately, Cary did not furnish specific coil-winding data, although he did indicate that he used a set of plug-in coils capable of covering from 550 kc. to 15 mc. However, the coils are nothing special; just keep the tap as close as possible to the base-end of the coil.

Let's look at the circuit. Coil *L1* and capacitor *C3* comprise the r.f. tuning circuit, while *C1* and *C4* are just couplers. Capacitor *C2* is variable from about 60 to 100 pf., and controls the amount of regeneration desired. Transistor *Q1* is a 2N706A *npn* r.f. amplifier operated as a grounded emitter regenerative detector. It is base-biased by the drop across *R1*. Interstage transformer *T1* is an Argonne AR109, while output transformer *T2*, an Argonne AR164, was selected to match the impedance of the 8-ohm speaker used.

Transistor *Q2* is a 2N109 *pnp* unit that's being used as an audio driver; it is indirectly biased through *R2* and *R3*. Capacitor *C6* is an audio coupler, and *C7* is an emitter bypass capacitor which reduces negative feedback; they are both 10-volt electrolytics. Operating power is supplied by a single 9-volt battery, but you could use six penlight or flashlight cells in series instead. The on-off switch can be any s.p.s.t. type.

The receiver can be assembled on a regular metal chassis, on a perforated phenolic board, or even on an etched circuit board. It all depends on your own preferences,

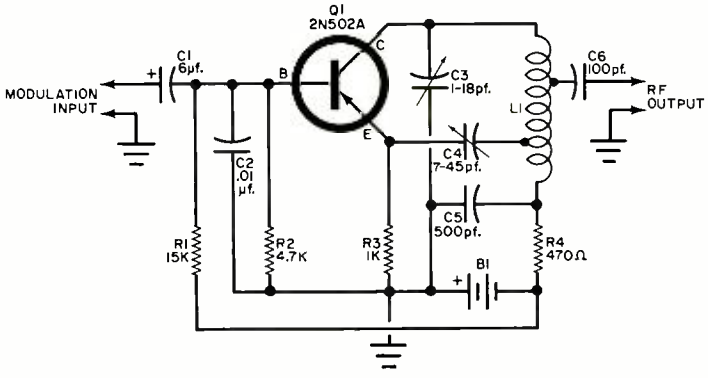


Fig. 4. Base-modulated oscillator by Philco can be used in a sweep generator, wireless mike, or transmitter circuit. Basically a modified Hartley oscillator, the circuit produces good frequency modulation linearity with modulating voltage applied to the base of transistor Q1.

since neither layout nor lead dress is critical. But regardless of what you do elsewhere, you must follow good wiring practices in the r.f. section; that is, keep leads as short and direct as possible and properly dressed. And watch your polarities.

Cary swears that he was able to pick up amateur stations in Wisconsin, Minnesota, and Michigan using a 75-meter coil wound on a ferrite core, and that almost any standard antenna can be used with his receiver. However, remember that the set's sensitivity, as well as its selectivity, will be governed largely by the coils used, as well as by the skill of the operator in adjusting both the tuning (*C3*) and regeneration (*C2*) controls. In general, *C2* should be adjusted to just below the point at which oscillation takes place.

Manufacturer's Circuit. Developed by Philco and described in Application Report #755, the base-modulated oscillator shown in Fig. 4 can be used in a sweep generator, wireless microphone, telemetry system, or transmitter circuit.

It is basically a modified Hartley oscillator, with *Q1*'s base bias supplied by voltage divider *R1*-*R2*. Here, the modulating voltage is applied to the transistor base, but equally good frequency modulation linearity would be obtained if the modulating signal were applied to the emitter. However, to get maximum utilization from even weak modulating signals, the base modulation technique is to be preferred. Furthermore, because some amplitude modulation is always present, regardless of what you do, limiters should be used to remove the AM peaks.

In Fig. 4, coil *L1* and capacitor *C3* form a parallel tuned circuit whose frequency is determined by *Q1*'s internal collector-to-emitter capacity, the inductance of the coil, and the setting of *C3*. The interelectrode capacitance, in turn, is a function of the base bias which varies with the applied modulating signal. It can be seen, therefore, that the frequency of the oscillator varies with the amplitude of the modulating signal.

The oscillator is designed to operate at a center frequency of 30 mc., with a maximum deviation of 400 kc., and can be built with readily available components. For instance, transistor *Q1* is a Philco 2N502A unit, *C1* is a 12-volt electrolytic, *C2*, *C5*, and *C6* are ceramic or mica capacitors, while *C3* and *C4* are small trimmers. Coil *L1* consists of 20 turns of B&W 3003 ½"-diameter coil with emitter tap at 3 turns, and the output tap at 9½ turns. Battery *B1* is rated at 12 volts; and all resistors are half-watters.

Transitips. In our October column, you may recall, we discussed some of the effects of harmonic distortion, and pointed out that

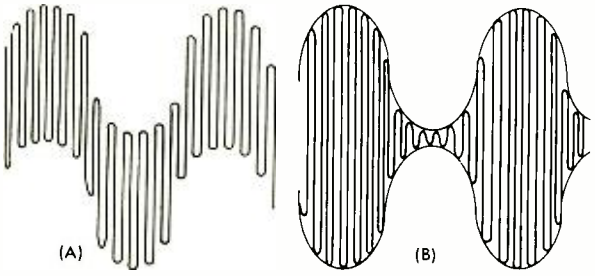


Fig. 5. These waveforms show what happens when two identical signals are handled by (A) linear (distortion-free) amplifier and (B) nonlinear amplifier.

a nonlinear amplifier can easily become a harmonic generator, producing frequencies that were not part of the applied signal. For example, if you put in a 1-kc. note, you can get out harmonics at 2 kc., 3 kc., 4 kc., etc. We refer to them as second harmonic, third harmonic, and so on.

Now let's look at another type of distortion which is also due to the nonlinear operation of an amplifier. This is intermodulation distortion, better known as plain I.M. In some respects, I.M. is more annoying than harmonic distortion, and can be a headache even when the harmonic distortion is within a tolerable level.

For example, suppose two signals, each of a different frequency, are applied simultaneously to a distortion-free amplifier. One will merely be superimposed on the other, and the resultant waveform will be as shown in Fig. 5(A). Observe that the amplifier output signal contains only the original signals.

On the other hand, if the same two signals are passed through a nonlinear circuit, one signal will *modulate* the other, developing an output waveform similar to that in Fig. 5(B). This composite signal contains not only the two original signals, but also frequencies equal to their sum and difference. For instance, if the two original signals were 50 cycles and 1 kc., the output would contain signals at 50 cycles (original), 950 cycles (difference), 1 kc. (original), and 1050 cycles (sum).

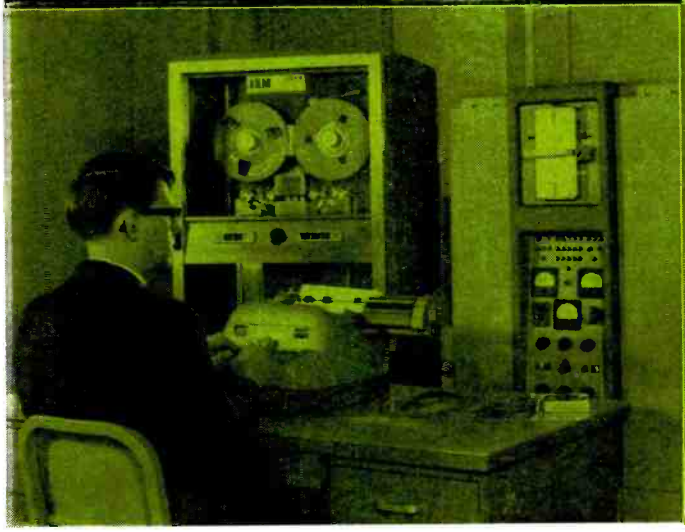
The situation becomes even more complex when both harmonic and intermodulation distortion are present. The output waveform would then contain not only the sum and difference frequencies of *all* signals handled, but harmonics of these, harmonics of the original signals, *and the sum and difference frequency signals of the various harmonics.*

In terms of practical transistor amplifiers, harmonic distortion generally is caused by incorrect bias, overdrive, a defective transistor, transformer saturation, or a leaky coupling capacitor. Push-pull circuits can be used to minimize the effects of harmonic

(*Continued on page* 114)

Computer becomes a teacher

ALPHA-COM



AS THE YOUNG MAN sits facing the computer, a punched paper tape is drawn through a photoelectric reader. Now the electric typewriter tied into the computer takes over. The young man shifts slightly forward to read the question that has been typed out. He ponders the question for a moment and then types back his answer. The computer, through the typewriter, responds:

"Your answer is incorrect. At your earliest convenience read pages 74-79 in your textbook. Try again."

The young man described above is using ALPHA-COM, a teaching program which permits a question-and-answer relationship between the student and the computer. The computer's arithmetic and logic circuits evaluate the answers, deciding whether they are right or wrong. If an answer is right, the computer types the next question. If wrong, it types back an appropriate reply and tells the student to try again. Some typical ALPHA-COM replies are:

"Read the question again, more carefully."

"You are guessing. Try again."

"Ask your instructor for additional reading assignments."

ALPHA-COM is neither expected nor intended to replace human instructors but is a powerful teaching aid that makes the learning process faster and

easier. Developed at Northwestern TV and Electronics Institute of Minneapolis, Minn., it enables the computer to test a student's knowledge, to call attention to his errors, to evaluate his performance by calculating a numerical grade, and to make recommendations for further study. Because Northwestern trains technicians for employment in the electronics industry, the original ALPHA-COM program contains questions relating to electronics theory. It can, however, be easily modified for other subject areas.

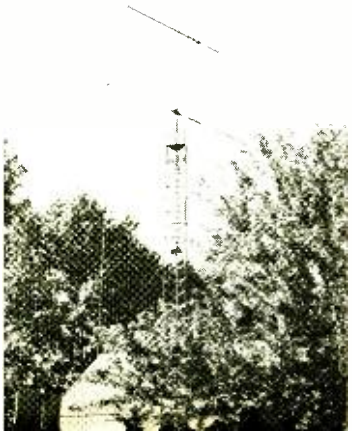
A compassionate but demanding teacher, ALPHA-COM (for *ALPHA*numeric *CO*nversational *M*ode programming) will always give the student a chance to "try again" after an incorrect answer, but it insists on a correct answer before going ahead to the next question. Not only can the computer recognize an incorrect answer, it can recognize an illegitimate answer—one that has nothing to do with the question it has asked. It will respond to such an answer by typing out a reprimand to the student, and it will tolerate two such attempts to be "cute." The third time, it will summon the human instructor by repeated ringing of a bell. Only manual intervention by the instructor (he types a special code number) will stop the bell and restore question-and-answer operation.

While the giants of the computer industry direct their major efforts toward business and industrial applications, educators are more concerned with the computer as a teaching machine. It is not difficult to imagine a future installation consisting of dozens of typewriter-equipped stations connected to a central computer which would have sufficient memory capacity and input/output circuitry to handle a whole class of students at once. The computer would communicate with each student individually, allowing each to progress at his own rate, and directing some back to earlier lesson material for review. It would also calculate students' grades and retain these in memory for later reporting to school officials. All this is not mere speculation—it can be done today by any school having computer-oriented personnel and sufficient funds for the necessary hardware. —*Ed Bukstein*

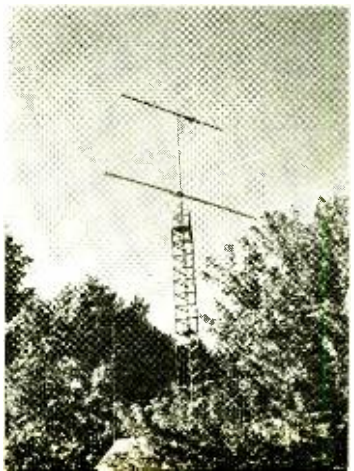
GET THAT BEAM ANTENNA SHOT

THERE ARE three very good reasons for taking a photo of your brand-new beam antenna. First, you might find a magazine willing to publish the shot (don't laugh—it happens every day); second, you might fit the photo into your next QSL card; but the third reason may be most important. When that antenna went up, so did your insurance liabilities. Not only is a beam a hazard (children always try to climb the tower), but have you considered the cost of replacement? Are the tower and beam insured? If they are, how can you approximate their value—without a photo that an expert could appraise?

Taking antenna photos is not an easy task. Most amateur photographers need reminding that black and white films don't "see" the same things against the bright sky as the human eye. Filtering is called for (see caption), and be sure to shoot when the sun is glancing light off the elements toward the camera. –30–



The photo on the left was taken with 35-mm. Plus-X and a setting of 1/100 sec. at f16—no filtering. On the right is the same scene shot several minutes later with a Kodak Wratten Type A filter at 1/100 and f5.6. Note darkened background and how the elements stand out against the sky.



DON'T JUNK YOUR OLD FM TUNER

UPDATE IT FOR LAND MOBILE RADIO SERVICES

By **CHARLES E. FRANCIS,** K8VRX

HAS YOUR FM tuner been made obsolete by the recent onslaught of vastly improved FM and FM stereo receiving equipment? Then spruce up that old tuner and snoop in on police calls, fire, civil defense, weather reports, and rescue squad operations for sheer pleasure or wild excitement. The simple modifications described here will enable you to change the tuning range of any variable-capacitor-tuned FM tuner or receiver to pick up high-band Land Mobile radio services (see "Hats Off to VHF," August, 1965). It should take less than 30 minutes.

This conversion to receive the 152- to 174-mc. band is designed to maintain the standard 10.7-mc. intermediate frequency. The i.f. section of the tuner need not be realigned. However, to avoid getting lost in tracking and other problems, you should be certain that your tuner or receiver is in good working order before you begin the conversion.

The procedure is basically the same for any variable-capacitor-tuned tuner, regardless of make or model, the only difference being in the number of turns for the r.f. or oscillator coil. While it is easier to pinpoint the effects of your modifications with a grid dip meter or other frequency-measuring device, in most instances you will be able to find your way simply by noticing the effects of each adjustment. The Heathkit Model FM-3 tuner, typical of a great many units now in use, responded very well to this treatment.

Converting the Tuner. The modifications are simple and consist of the following four steps:

(1) Remove the tuner case, and all components necessary to gain access to the tuning elements. Do not remove more than you have to. Figure 1 shows the front panel, dial cord, and dial-cord pulley removed to give you a better view of the parts to be modified.

(2) You will note that the tuning capacitor (Fig. 2) has two sections, the front being the r.f. section, and the rear the oscillator section. Using a pair of long-nose pliers, *carefully* remove *one* rotor end plate from each section. These

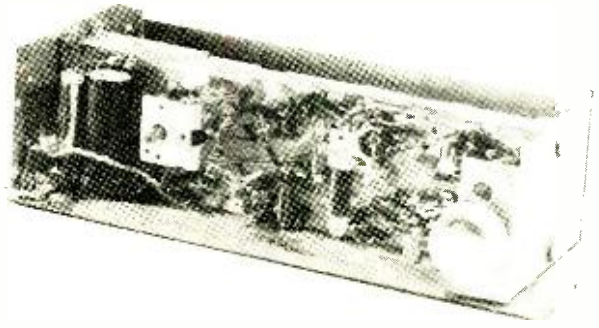


Fig. 1. The tuner front panel, dial cord, and dial-cord pulley can be removed to provide adequate working space. In most cases, it will only be necessary to remove the tuner chassis from the cabinet to gain access to tuning capacitor and coils.

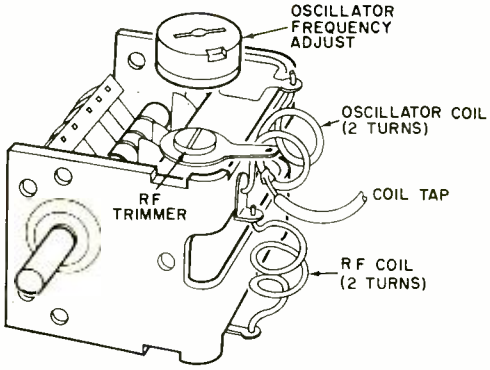


Fig. 2. These components determine the operating frequency of the tuner. The coils are adjusted by compressing or expanding the turns as necessary for good frequency coverage and tracking in the band.

plates are press-fitted into place and can be gently worked out of their positions. It should not be necessary to twist, bend or break the plates. *Caution: Do not bend, loosen, or otherwise damage the other plates. If possible, do not even touch the other plates.* After removing one plate from the rotor in each section, there will still be two rotor and two stator plates left in each section. (If your tuner has a different-size variable capacitor with a different number of plates, the procedure is still the same—do not remove more than one plate from the rotor in each section.)

(3) Remove the r.f. coil and replace it with a two-turn coil formed by wrapping a piece of #16 solid copper wire around an ordinary pencil. Stretch the coil turns to a length of $\frac{7}{16}$ inch, leaving a short pigtail for connection.

(4) Remove the oscillator coil and replace it with one formed by wrapping two turns of #16 wire around a pencil. Stretch the turns to $\frac{15}{32}$ inch across. Reconnect the oscillator coil tap at the center of the coil, and reassemble the components and hardware, but do not put the tuner back into the case.

Except for an air check and a few adjustments, your conversion is completed.

Antenna Considerations. For optimum performance, a highly directional antenna aimed at the station you are listening to is ideal; but with signals coming at you from different directions, you are better off with a ground plane or other omnidirectional antenna. The vertical antennas usually have a 52-ohm impedance and call for a 52-ohm coaxial transmission line. If you do go for the 52-ohm job, insert a 52-ohm to 300-ohm matching transformer between the line and the set, at the set's antenna terminals.

An ordinary indoor TV 300-ohm antenna can be used quite effectively, if you telescope the elements down to proper size. Simply adjust the length and direction for maximum volume.

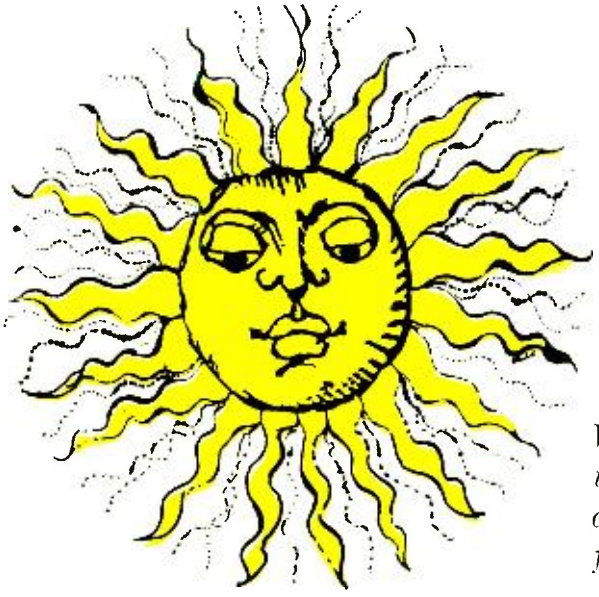
Touch Up and Tune In. If the tuner works perfectly when you connect the antenna, go no further—you're in! But most likely you'll have to do a little touching up of the coils and/or trimmers. Here's what you do:

(1) Tune in a station near 170 mc. and carefully adjust the oscillator trimmer to bring in the station near the high end of the band. If you can't bring in the station where you want it when adjusting the trimmer, try expanding or contracting the length of the oscillator coil to move the station down or up, respectively.

(2) Adjust the r.f. trimmer for maximum volume and clarity. If you have the feeling that you could get more out of the r.f. trimmer by tightening it a wee bit but you can't because it is already screwed all the way down, just back off about a turn and a half, compress the r.f. coil a little and try the trimmer again. (Of course, you can expand the coil if the trimmer is wide open and still doesn't seem to be open enough.)

(3) Now try tuning in a station at the low end of the band. If the station comes in, that's it. If it doesn't, you may have to shift the tuning range up a bit more. It's easy; the oscillator adjustments shift the band up or down the tuning scale and the r.f. stage peaks the signal.

Should you run into tracking problems, such as good volume and clarity at one end of the band and not at the other, select a station in the middle of the band and, with the variable capacitors set in mid position, adjust the oscillator and r.f. coils and trimmers for maximum volume and clarity. Any tracking errors still present will be reduced by about 50%. —30—



Why depend on batteries when you can get all the energy you need free of charge? How?

LET THE SUN POWER YOUR PORTABLE

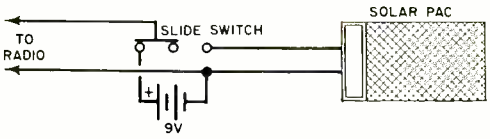
By HOMER L. DAVIDSON

YOU CAN USE the sun to power your small transistor radio—or, if it's raining, you can use a 100-watt light bulb. The only other element you really need is International Rectifier Corporation's "Solar Pac," which can be hooked up to charge the radio's battery, or to operate the radio, or to do both. The "Solar Pac" comes in two models: SP5C26C (4.5 volts at 26 ma.) and SP9C13C (9 volts at 13 ma.), and is available from electronic supply houses for $9.95.

There are many ways you can connect the solar pack to your radio. You may

want to add a switch (see schematic) to provide a choice of either solar or battery power. Or you can simply connect the pack's 6″ leads to the battery connections inside the radio. You can even use the solar pack as a plug-in supply by connecting an earphone jack and cord to the pack, removing the existing wires from the radio's earphone plug, and running a pair of wires from the plug to the battery connections.

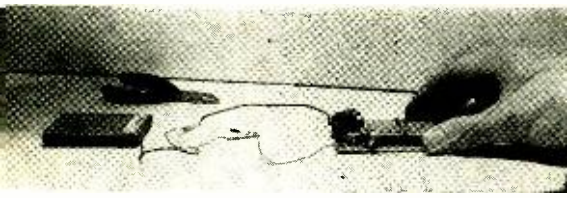
Mounting the pack is no problem as it is supplied with mounting pads which can be attached easily to any radio case or cover. But for a more permanent installation, place the pack against the plastic back of your radio, outline its shape with a scribe, carefully cut out the required area with a knife-tipped soldering iron or jeweler's saw, fit the pack into place, and seal around the edges with cement.



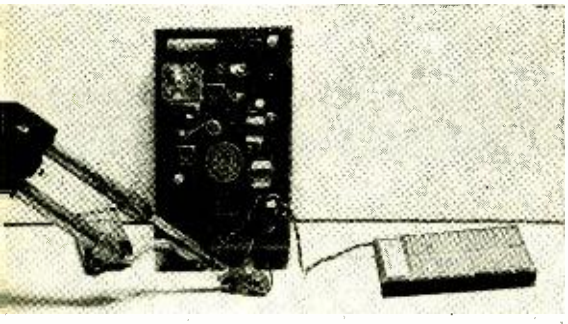
Your portable can be switched to either battery or sun operation by adding a slide s.p.d.t. switch.

If you plan to use the solar pack as a universal power supply for more than one radio or transistor project, add alligator clips to the pack's leads for easy handling. Should circumstances require lower voltages than that provided by the solar pack, insert an inexpensive 100-ohm potentiometer in series with the output to reduce the voltage.

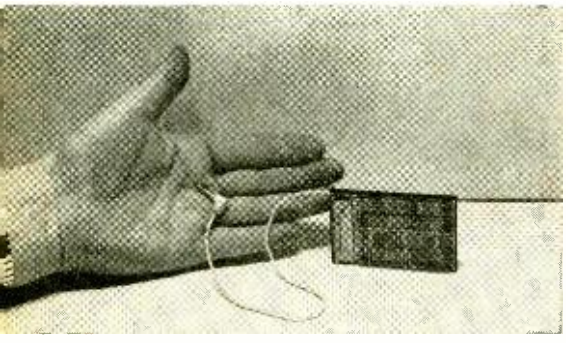
Once you know how much resistance you need in a given circuit (by measuring the pot's resistance in the circuit), you can substitute a fixed resistor. Add a resistor only when no battery is in the circuit, and only when the unit is to be used out-of-doors. A resistor is not required indoors as you can move closer to or further away from the light source to obtain a desired voltage. -30-



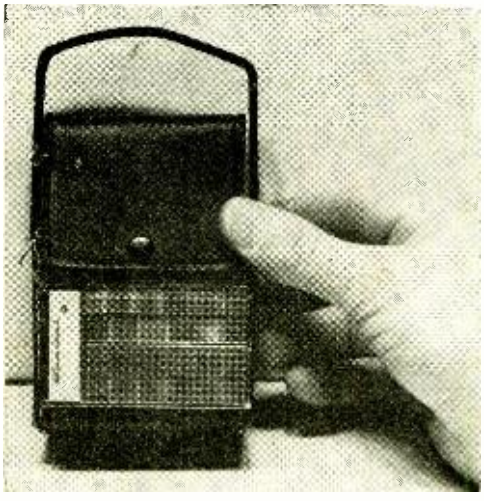
Hook up a couple of alligator clips to the leads of the solar pack to make easy-to-connect power supply.



By connecting the solar pack in parallel with the battery, you can charge the battery while operating the radio, or run the radio without the battery.



The earphone jack connections of your transistor radio can be modified to accommodate the solar pack.



The solar pack can be cemented to the radio case, and the leads can be slipped under the case flap.

SHORT-WAVE LISTENING

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

SAFETY RULES FOR SWL'S

EVEN short-wave listening can be a dangerous sport. There are many ways in which an SWL can be accidently injured in the pursuit of his favorite hobby—particularly while making repairs or installing an antenna.

One of the most common types of accidents, fortunately not usually too serious, involves those who insist on probing into their receivers while the power is on. It can be done if you know what you are doing. Unfortunately, it usually takes a few jolts to make some people have more respect for those innocent-looking capacitors.

The safest way to examine a faulty piece of equipment is with the power off. The best thing to do is pull the plug and ground the capacitors before you stick your fingers inside the receiver.

No expert electronics man has gone through life without being walloped by B-plus, or tickled silly by the a.c. power line, or burned by a hot tube. It's smart business to learn from the mistakes of others, because you may not live through one of your own.

The antenna, too, can become an accident machine. We recently received a letter from a mother whose son was electrocuted while erecting an antenna. So slow down and walk away from an installation that can come in contact with a power line. The operator who lost his life may have noticed the nearby power line, and he may have assumed that it couldn't happen to him. What he should have done was to get far enough away from the power line to prevent contact even if the antenna toppled over.

And there's always the risk of falling out of a tree, or off a ladder or roof when you're putting up an antenna. Be sure the ladder is firmly footed and the tree is firmly planted before you climb. It may be embarrassing to find yourself up a tree, or out on a limb, or hanging from your fingernails over the edge of a roof—even if you don't fall. It's a good idea to use the buddy system. Invite a friend over and let him at least hold the ladder for you. Should you become stranded and not be able to get down safely, he will be able to call the fire department to rescue you.

In most cases, just plain common sense goes a long way towards preventing accidents. So take time out to examine a situation before you get involved in one.

(*Continued on page* 125)

Above: David Berger, WPE3GJO, Wilmington, Del., DX'es with a Lafayette KT-340 backed up by a Knight-Kit "Star Roamer." His antenna: a 126' Windom. His record: 31 countries logged, 22 verified.

At right: The Hallicrafters SX-110 receiver shown belongs to Wayne White, WPE7CDS, of Safford, Arizona. Wayne's antenna is a 3-way long-wire. He has 30 countries logged, 29 of which are verified.

DX AWARDS

The third in our series of DX Awards is an all-Canada award and is based upon having at least one verification from each of Canada's provinces. The rules and regulations are basically the same as for the previous contests, but you should read them carefully to make sure you follow the correct procedure. If you do not yet have a Short-Wave Monitor identification, you'll find an application blank on page 127 in this issue.

1 Each applicant must be a registered WPE Short-Wave Monitor, and must enter his identification sign on the application form (or facsimile).

2 Each applicant must submit a list of stations (any frequency or service) for which he has received verifications, one for each heard and verified. The list should contain 6, 8, 10, or 12 provinces, depending on which DX award is being applied for. The following information must be furnished in tabular form and in alphabetical order by province for each verification:

(a) Province heard
(b) Call-sign of station verified and location
(c) Frequency
(d) Date station was heard
(e) Date of vertification (postmark dates acceptable)

All the above information should be copied from the station's verification. Do not list any verification you cannot supply for authentication on demand. The provinces of Canada deemed acceptable are: Alberta, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, and either Yukon or Northwest Territories.

3 All pertinent verifications, whether QSL cards or letters, should be carefully packaged and stored by the applicant until such time as instructions are received to send in some or all of them for checking purposes. Instructions on how and to whom to send the verifications will be given at that time. Failure to comply with these instructions will disqualify the application.

4 A fee of 50 cents (U. S. coin or stamps) must accompany the list of verifications to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible for an award. Applicants outside of the United States may send 60 cents (U.S.) in coins of their country if they so desire. Please do not send International Reply Coupons (IRC's).

5 Apply for the highest DX award for which you are eligible. If, at a later date, you become eligible for a higher award, then apply for that award, following these rules and regulations exactly as before.

6 Mail your verification list, fee, and the application form to: Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS DX AWARDS, P. O. Box 333, Cherry Hill, N.J., 08034. Include in the envelope only those items which are directly related to your entry for the award. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Monitor Certificate). If you want to supply news items, reports, etc., please use another envelope.

POPULAR ELECTRONICS' DX AWARD APPLICATION FORM

(please print)

WPE Identification _____ Name _____

Address _____ City _____ State _____ Zip Code _____

Please enter my application for the following POPULAR ELECTRONICS' DX AWARD:

(check one) 6 ☐ 8 ☐ 10 ☐ 12 ☐

☐ I have enclosed a list of the required number of provinces, and I hereby certify that I hold a verification from at least one station (any frequency or service) in each of the provinces listed

☐ I have enclosed 50 cents to help cover the costs of processing and mailing my DX Award

Signature _____ Date _____ 1965

Mail to Hank Bennett, POPULAR ELECTRONICS DX AWARDS, P. O. Box 333, Cherry Hill, N. J.

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

Prepared by ROBERT LEGGE

All of the stations below have announced English-language newscast programs at the times and on the frequencies given. Note a number of changes in the setup of the listing from our previous editions: use of EST in the colloquial a.m. and p.m.; use of mc. instead of kc.; and a division of transmissions beamed to the eastern and central parts of the U.S. from those beamed toward the west coast. Some additional broadcasts are beamed to North America, but are not included in this listing since they are not expected to be heard satisfactorily during the winter months. —*THE EDITORS*

TO EASTERN AND CENTRAL NORTH AMERICA

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MC.)
ALBANIA	Tirana	7 p.m.	0000	7.265
ARGENTINA	Buenos Aires	10 p.m. (Mon.-Fri.)	0300 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	7:45 a.m.	1245	9.58
BULGARIA	Sofia	7 p.m., 11 p.m.	0000, 0400	6.07
CANADA	Montreal	7:15 a.m.	1215	5.97, 11.72, 15.32
CHINA	Peking	8 p.m., 9 p.m.	0100, 0200	7.035, 9.48
CUBA	Havana	10 p.m.	0300	6.135
CZECHO-SLOVAKIA	Prague	10 a.m. (Sun.)	1500 (Sun.)	15.285, 15.448, 17.825
	"	8 p.m., 10:30 p.m.	0100, 0330	5.93, 7.12, 7.345
DENMARK	Copenhagen	7:30 a.m.	1230	15.165
FINLAND	Helsinki	7:15 a.m. (Tues., Sat.)	1215 (Tues.-Sat.)	15.185
GERMANY	Cologne	8:30 p.m.	0130	6.075, 9.64
HUNGARY	Budapest	7:30 p.m., 8:30 p.m.	0030, 0130	7.305, 9.833
	"	10 p.m., 11:30 p.m.	0300, 0430	7.305, 9.833
ITALY	Rome	8 p.m.	0100	5.96, 9.63
JAPAN	Tokyo	7 p.m.	0000	11.78, 15.135
NETHER-LANDS	Hilversum	4 p.m.	2100	6.085, 9.59
	"	8:30 p.m.	0130	9.59 (via Bonaire relay)
NORWAY	Oslo	11 a.m. (Sun.)	1600 (Sun.)	15.175, 17.825
PORTUGAL	Lisbon	9 p.m., 10:45 p.m.	0200, 0345	6.025, 6.185
SPAIN	Madrid	8 p.m., 9 p.m.	0100, 0200	6.13, 9.615
SWEDEN	Stockholm	9 a.m.	1400	15.195
	"	8 p.m.	0100	5.99
SWITZERLAND	Berne	8:15 p.m.	0115	6.08, 6.12, 9.535
UNITED KINGDOM	London	11 a.m.	1600	11.84, 15.30
	"	5 p.m., 6 p.m.	2200, 2300	6.195, 7.13, 9.51, 9.735
	"	7 p.m., 9 p.m.	0000, 0200	6.195, 7.13, 9.51, 9.735
U.S.S.R.	Kiev	7:30 p.m. (Mon., Thurs.)	0030 (Tues., Fri.)	7.31, 9.665
	Moscow	5 p.m.	2200	7.15, 7.31, 9.665
	"	6 p.m., 7 p.m., 8 p.m.	2300, 0000, 0100	7.15, 7.205, 7.31
	"	9 p.m., 10 p.m.	0200, 0300	6.07, 7.15, 7.31
	"	11 p.m., 12 Mid.	0400, 0500	7.15, 7.31, 9.665
VATICAN CITY	Vatican	7:50 p.m.	0050	5.985, 7.25, 9.645

TO WESTERN NORTH AMERICA

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MC.)
ARGENTINA	Buenos Aires	10 p.m. (Mon.-Fri.)	0600 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	6:30 p.m., 7:30 p.m.	0230, 0330	15.22, 17.84
CHINA	Peking	7 p.m., 8 p.m.	0300, 0400	7.08, 9.457
	Taipei	6:50 p.m.	0250	9.685, 11.825, 15.345
CUBA	Havana	9 p.m.	0500	6.135
GERMANY	Cologne	7:10 a.m.	1510	9.735, 11.795
	"	8:55 p.m.	0455	6.145, 6.16, 9.575
JAPAN	Tokyo	7:15 p.m.	0315	11.78, 15.135
KOREA	Seoul	7 p.m.	0300	11.925
SPAIN	Madrid	7 p.m.	0300	6.13, 9.615
SWEDEN	Stockholm	6:30 p.m.	0230	5.99
SWITZERLAND	Berne	7 a.m.	1500	15.305
THAILAND	Bangkok	8:15 p.m.	0415	11.91
U.S.S.R.	Moscow (via Khabarovsk)	7 p.m., 8 p.m.	0300, 0400	9.54, 9.735, 11.85
		9 p.m., 10 p.m.	0500, 0600	9.54, 9.735, 11.85

ON THE CITIZENS BAND

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

IN THE April edition of this column, we began an unofficial campaign to bring the facts about CB radio to the attention of the general public through AM broadcast station interviews. The project was primarily designed to explain the Citizens Radio Service, its purpose, and especially the manner in which it is being used in public service and emergency activities. Following two kick-off interviews in which we were allotted 30 minutes per segment to "spread the word," we encouraged every CB club in the country to approach their local AM stations with a similar proposal: to be interviewed, discuss and answer questions about CB radio as its users know it.

PROJECT INTERVIEW ON TV

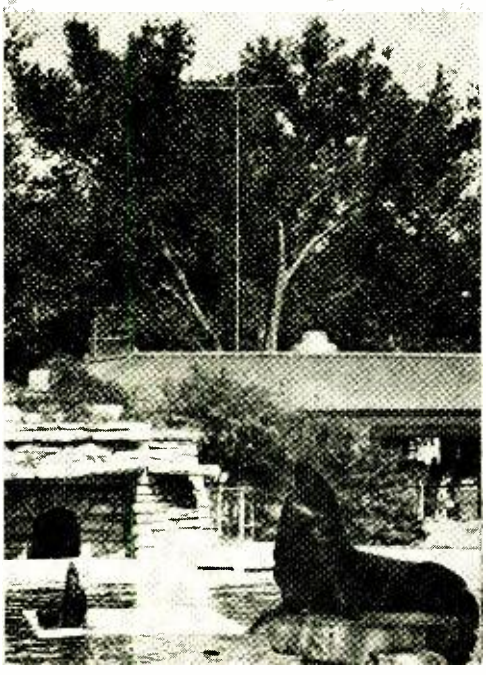
Just recently Jane Neubauer, the charming hostess of "Tete A Tete," a daily television information program, heard of our past discussions over AM radio stations WBEL and WOBT, and asked that we join her at WREX-TV in Rockford, Ill., to fill her audience in on "what this CB business is all about!" The pleasure was ours!

Prior to videotaping the show, we felt quite confident that we were in good hands upon learning that the audio and video engineers, Don and Jerry Meinders, and the director of the show, Guy Fiorenza, were all licensed Citizens Band operators. During the near quarter-hour telecast, we were able to cover the advent of CB, its primary purpose and uses, its growth and expanding applications in the realm of emergency assistance.

Jane and her audience were shocked—but interested—to learn that there are 850 REACT emergency teams across the country; 1000 H.E.L.P. volunteer units; 1000 CB clubs actively engaged in public service and emergency assists; and 3 million potential "assistants" ready to volunteer if and when needed. In fact, as a result of the interest stimulated by our first telecast, Jane has invited us back for another session to be devoted strictly to the emergency uses of CB radio.

We suggest that club officers review our April OTCB column; and we urge *all* clubs, teams, or groups to plot an interesting program for AM radio and/or television. Be sure the plotting is done *before* approaching the program director. And keep in mind that a good television interview demands good video—your handsome profile with a

"Tete-a-Tete" hostess Jane Neubauer and CB Editor Matt Spinello discuss the birth, growth, and multiple uses of CB radio on a quarter-hour telecast that was designed to promote "Project Interview."



The building in the background is the main control center for 13 base stations located throughout the St. Louis (Missouri) Zoo. The sea lion in the foreground appears to be imitating the antenna, a Mosley "Devant-1," perched on the roof of the building.

microphone sticking from your ear is not enough. Take along a set of clear pictures showing your group in action. If possible, bring an older-type handmade CB transceiver to compare with a modern-day piece of gear.

We would appreciate receiving copies of scripts used or a tape dub, if possible. At least, send us the details of your interview along with the results. A good, clear photograph would also be appreciated. Be sure to include names, addresses, and other pertinent information.

Our thanks to Miss Neubauer, WREX-TV, and the TV/CB crew that enabled us to add "video" to "Project Interview." If half of the active Citizens Band clubs across the country were to participate in the project on a local level through area AM/TV facilities, an uninformed public of millions might better understand our communications position before the year is out.

CB Safeguards Animals. We've never been associated with the minority of critics who theorize that "CB has gone to the dogs." We recently became aware, however, that Citizens Band radio has definitely come to the aid of a large variety of animals paralleling Noah's assortment on the ark. KDT0340 is the call-sign of the St. Louis (Missouri) Zoo. The grounds employ 13 base station transceivers, two mobile truck units, and several walkie-talkies.

The main control station is identifiable to the eye only by the Mosley "Devant-1" base station antenna perched on the roof of one of the refreshment stands on the grounds. The 12 other base stations spread throughout the zoo can be reached by this center or can contact one another through the same control station. In the old days (before CB), a refreshment stand that ran short of supplies was forced to wait for a supply boy who made regular rounds on a motor scooter. A considerable wait often meant loss of profit to the stand plus the loss of friendship on a warm day from the little tyke who wanted that bottle of soda pop "now." Today, a press of the CB mike button, a short transmission, and supplies are on the way in short order.

Workers at each refreshment stand collectively have a wide area view of the entire zoo, enabling them to relay malfunctions of the parking gates or any discrepancies at any of the animal pens within view. Plain-clothes policemen patrolling the grounds can also be contacted through any one of the 13 base stations.

The watchmen who guard the zoo at night contact one another by means of CB walkie-talkies. If one needs help, the other can be on the scene usually in seconds. Also, there are times when temperatures within the zoo need regulating due to the unusual demands of some of the residents. If a furnace needs adjustment, one guard can contact another for assistance, or ask the other to cover his post while he is temporarily occupied.

When animals arrive for the zoo at the St. Louis Lambert Airport, a CB-equipped zoo truck crew meets the airplane, examines the animals, then relays their condition and informs the zoo of any special preparations that must be made for the new residents while they are being transported ten miles to their new home.

The St. Louis Zoo has found Citizens Band radio invaluable for its purposes. The operation of CB behind the scenes helps bring efficiency to the world-famous institution.

Area Call Books. Our old friend, Mel Baer, of K9TVA Enterprises advises us of the availability of cross-referenced Class D CB license directories for several FCC areas.

(*Continued on page* 119)

HAM HOBBY CLEARINGHOUSE

NEW POPULAR ELECTRONICS FEATURE

A couple of months ago the Editors of POPULAR ELECTRONICS offered to set up a clearinghouse for hams with other hobbies if there was enough interest shown in such a service. Since then the postcards have been coming in, as evidenced by the listings below.

If YOU have a second or third hobby that you would like to talk about on the air, tell us about it, or them. We believe that, through this clearinghouse, other hams who have the same interests will try to contact you. By the same token, the information appearing here should enable you to initiate some calls of your own—to those radio amateurs who have the same hobbies that you do.

To be listed here, just send us a postcard with the following information typed or printed on it: your call letters, other hobbies, the frequencies on which you operate, mode of operation, when you're on the air, and your name and address. Send the card to: Ham Hobby Clearinghouse, c/o POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

WA2FAS—Flying, coin and stamp collecting, and water sports; 80 to 10 meters, 20 and 15 meters SSB; evenings and weekends, Friday evenings preferred. (Gary Goldberg, 221 Clark St., Hillside, N.J., 07205)

WB2KPO—Astronomy, photography, and hi-fi; 75, 40, and 20 meters, SSB; weekends and after school on weekdays. (Howard Lester, 245 Rumsey Rd., Yonkers, N.Y. 10701)

WB2LHH—Electronic equipment, especially older models; 14,290-14,320 kc., SSB; 11 a.m. to 2 p.m. Sundays. (R. I. Palluth, 398 Manor Rd., Staten Island, N.Y.)

WB2NIN—Medicine, medical electronics, science, and hi-fi; 80 and 40 meters, mostly CW, sometimes AM; 8-10 week nights, 1-5 Saturday afternoons. (Dr. Maurice J. Small, 158 S. Harrison St., East Orange, N.J. 07018)

WB2NRX—Photography and SWL'ing; 40 meters, CW; afternoons from 4:30 to 5:30. (Henry F. O'Meara, 21 Glendale Rd., Brockport, N.Y.)

WB2ODI—BCB DX'ing; 75-15 meters, phone and CW. (Chris Schmink, Williamsville, N.Y. 14221)

WB2OVI—Hi-fi/stereo, and project construction; 6 meters, phone; Friday afternoons and Sundays. (Alan R. Sandler, 861 E. 27 St., Brooklyn, N.Y.)

WB2RBA—Model rocketry and photography; 75 meters phone, and 80 meters CW; would like to start a net of teen-agers on 75 meters. (Joe Malloy, 474 Pacific St., Massapequa Park, N.Y. 11762)

WN2TDA—Archery and reading; 40 meters; 5-10 p.m. during the week and all day weekends. (Bill Dundas, 2 Stiles St., Painted Post, N.Y.)

K3ZLB/5—Radio and ham TV, scuba diving, archery, leathercraft, and hunting; fixed and mobile on any band from 80 to 2 meters, AM, CW, and SSB, and 424 mc. TV; weekdays after 2400 GMT, weekends after 2000 GMT. (Joseph M. Sweet, 9312 A. Wolff Ave., Ft. Bliss, Texas)

WA3AZI—Aviation and space topics, archery, home construction projects; 40 and 15 meters, CW; nights and weekends. (Michael Griffin, 715 Webb St., Aberdeen, Md.)

WN4YKA—Stamp and coin collecting, chemistry, and camping; 80, 40, and 15 meters; weekdays after 1900 EST, all day weekends and holidays. (Roy L. Moore, 307 Nunn St., Hazard, Ky.)

WB6CWR—Glider flying and sailing; 40, 20, and 15 meters, CW. (Larry Miller, 14918 Kingsley Dr., Gardenia, Calif.)

WB6IAD—Surfing and skateboarding; 40 meters, CW; 1 to 3 a.m. and 12 to 2 p.m. (Charles Smith, 427 Serra Dr., South San Francisco, Calif. 94081)

K7LPO/7—Science and math; low end of 80-meter band; evenings. (LeRoy Taraba, 155 W. Jackson St., Monmouth, Oreg.)

WA8RER—Astronomy, photography, and amateur rocketry; 6 and 2 meters, AM and CW; any nights from 7 to 10 p.m. (Kenneth J. Burgess, 15577 O'Conner, Allen Park, Mich.)

WN8PWF—Boating and beagles; 7.15 and 7.2 mc. from 0530 to 0700 GMT; monitors 7.153 mc. (Art Colby, 525 Maple St., Saugatuck, Mich.)

WA9NDU—Stamp collecting and science fiction; 80, 40, and 2 meters. (Bruce Mocking, 5248 Arcadia St., Skokie, Ill. 60077)

WA9NDV—Astronomy, reading, swimming, and skiing; 20 meters, CW and AM, and 15 meters, CW; after 4 p.m. daily. (Joe Larson, 410 Lawrence Ave., Rothschild, Wis.)

WØDQI—Telephone band communications; would like to start club; phone 515-232-0161; no collect QSO's accepted. (Edward C. Booth, Route 1, Ames, Iowa 50010)

VE2BJP—Stamp collecting and 8-mm. movies; 20 meters, AM. (Gerard R. Labelle, 1716 Avenue De Grosbois, St. Bruno, Comte Chambly, Canada)

AMATEUR RADIO

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

USEFUL TIPS ON CONTEST OPERATING

FOR THOSE HAMS who like competition, the most enjoyable part of amateur radio is contest operating. In the next month or so, two of the year's biggest contests are scheduled. They are *CQ*'s "World-Wide DX Contest" (CW and phone), and the ARRL's "Section Sweepstakes Contest" (CW and phone). If you intend to work any of these contests in a big way (the CW and phone contests are separate activities), write to the sponsors for official score sheets and rules, including a stamped, self-addressed, business-size return envelope with your request.

The WWDX phone contest starts at 0000 GMT, October 23, and ends at 2400 GMT, October 24; the CW contest runs from 0000 GMT, November 28, to 2400 GMT, November 29. You obtain the log sheets from and mail your scores to: WWDX, *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050. The SS phone contest starts at 2100 GMT, November 13, and ends at 0300 GMT, November 15; the CW contest runs from 2100 GMT, November 20, to 0300 GMT, November 22. You obtain the log sheets from and mail your scores to: SS, ARRL, 225 Main st., Newington, Conn. 06111. In each contest, you operate for any 24-hour period.

To make a winning score in any of these contests requires both good equipment and good operating, although it is possible to have fun with simple gear. In a DX contest, the competition from high-power stations is almost overwhelming on the 80-, 40-, and 20-meter bands, except in the pre-dawn morning hours. But the competition is less severe on 15 and 10 meters—especially the latter, when it is open. And you will give yourself a better chance if you concentrate on less "exotic" DX like Bermuda, England, and Germany, which the big wheels have already worked, rather than countries like Afghanistan, etc., which everybody needs. In the SS contest, competition for individual stations is less severe than in the DX contest; therefore, transmitter power is not so important, and most experienced SS'ers use less than 150 watts to obtain the lower power multiplier (phone scores are multiplied by 1.5 if transmitter power is less than 150 watts, CW scores by 1.25).

Ordinarily, in a contest, an operator doesn't tarry after a CQ. If he doesn't hear a reply immediately, he CQ's again or moves to another frequency. As a result, if you have to throw several switches to get on and off the air, you will usually be left at the post. For the same reason, long calls are unnecessary. In situations where many operators are calling the same station, too

AMATEUR STATION OF THE MONTH

Garry Shandling, WA7BKG, of Tucson, Arizona, was the winner of the Arizona Section Novice award in last year's "SS" contest. WA7BKG worked 42 states as a Novice; as a General, he has added 9 states and 15 countries to his total. He uses a Hallicrafters HT-44 SSB/CW transmitter and a SX-111 receiver plus a vertical antenna. Garry will receive a one-year subscription for this winning entry in the Amateur Station of the Month contest. If you would like to enter, send us a clear picture of your station—preferably showing you at the controls—and some information about your amateur career and your equipment. Mail your entry to: Amateur Photo Contest, c/o Herb S. Brier, W9EGQ, Amateur Radio Editor, P.O. Box 678, Gary, Ind. 46401.

Old-timer Walt Severin, W9SCV, Evanston, Ill., has all states and 45 countries worked. Featured among his gear are a Hallicrafters HT-37 SSB transmitter, a Collins 32V3 for AM, a Hammarlund HQ-170A receiver, and a Mosley TA-33 tri-band beam antenna. Walt is a member of the Professional Loafers club.

Angelo Miranda, Jr., WB2JHC, New York, N.Y., operates from the 8th floor of a 20-story apartment building with a 35' wire run outside the building. His log shows 31 states, Germany, and Guatemala worked. His transmitter is a Knight-Kit T-150.

many of them make excessively long calls in the hope of outlasting the competition. A better method is to make a series of short calls with pauses between them to see what the called station is doing until it answers you or someone else or has apparently left the frequency.

A common mistake is to keep calling the same station time after time. Usually, it is wise to write off a station you can't raise with a reasonable number of calls, and stalk another station. Chances are the next time you run across the first station, it will be easy to raise.

One of the neatest tricks of contest operating when done properly is "tail-ending." Just as station A signs off with station B, you give station B a snappy "one-by-one" call on A's frequency. Station B pauses momentarily to log your call letters before he sends his "final" to station A, after which he works you. Obviously, tail-ending takes real skill; if you call too soon, you will interfere with the contact already in progress, and the called operator will ignore you—if he is a good operator. And if you do it too often, he will place you on his never-work list. Conversely, if you call too late, the station you want will already be transmitting. Further complicating the problem, some operators refuse to answer tail-enders under any circumstances, while other rare stations are virtually impossible to work by any other method.

Hobby-Type License Denied. On July 7, 1965, the Federal Communications Commission denied the International Crystal Company's petition for the issuance of a no-examination, 10-watt "hobby" license for operation in the 29-mc. amateur band. The Commission pointed out that issuing an amateur license without requiring the applicant to demonstrate both his ability to send and receive the Morse code and his technical qualifications would contravene article 41 of the International Radio Regulations (Geneva, 1959).

To make its policy unmistakably clear, the Commission further declared: "Even if examinations were not required by international regulations, the Commision would, as a matter of policy, impose such a requirement as being consistent with, and necessary to, the purposes for which the Amateur Radio Service was established."

Once again, the Commission strongly urges Citizens Radio Service operators who wish to operate radio as an activity in and of itself to obtain a license in the Amateur Radio Service. The agency points out the ease with which a Novice license (which offers its holder the opportunity to obtain the experience necessary for advancement to higher class licenses) can be obtained.

Incidentally, in a hard-to-explain maneuver, the FCC reduced its estimate of the number of valid amateur licenses in existence by 15,000. At the same time, 75,000 were chopped off the CB totals! Possibly someone was counting renewals as new licenses.

From the Club Bulletins. In its special YL issue, *SIRAN (South India Radio Amateur Newsletter)* reports that there are four licensed women amateurs among India's 400 amateurs. It also reports 26 in Australia, and 200 in Germany. And in the USSR, 10% of the amateurs are YL's.

In the Denver Radio Club's *Round Table*, Elsie White, wife of KØCNV, takes a dim view of the amateur's use of the term "XYL" instead of the word "wife." The practice doesn't save time. On CW, "wife" contains 10 dots and dashes (only three of them dashes), while "XYL" contains 12

(*Continued on page* 117)

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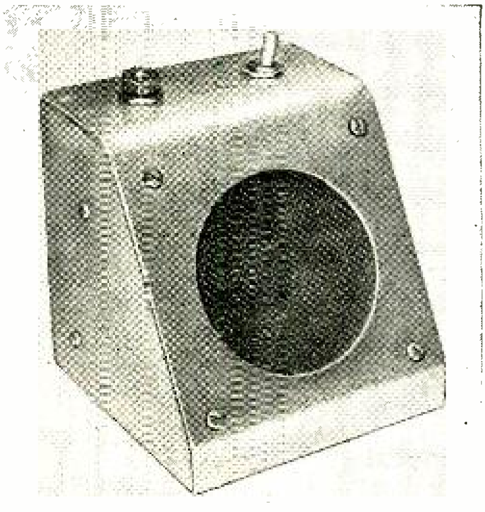
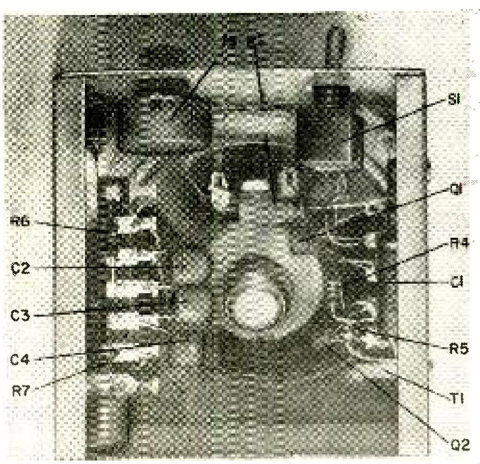


TONAL DARKROOM TIMER OR METRONOME

By FREDERICK W. CHESSON

Adjust tone and timing to your specific needs



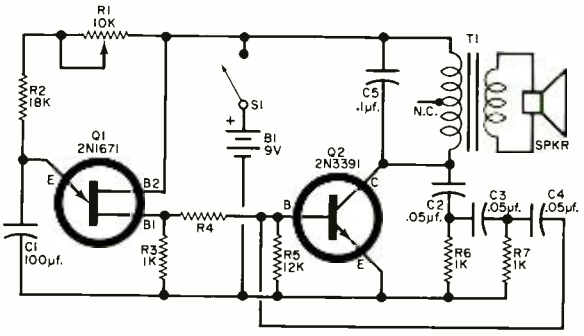
Housed in a meter case, components can be conveniently mounted on two 7-terminal solder-lug strips.

HERE'S A NEAT little timer that will provide pleasant-sounding musical tones in your darkroom at one-second intervals. Not only will it eliminate the tedium of making prints to a monotonous-sounding, mechanical-clacking type timer, but it will also give you better print control, as its staccato tones are right on the button. Transistor-operated and small enough to fit in any available space, the timer easily converts to a metronome.

How It Works. A unijunction transistor (*Q1*) in a relaxation oscillator circuit triggers a phase-shift audio oscillator (*Q2*), turning it on and off. As capacitor *C1* is charged through *R1* and *R2*, the emitter voltage of *Q1* rises toward the supply voltage. When the emitter volt-

burp burp burp burp burp burp

A unijunction transistor (Q1), connected as a relaxation oscillator, triggers phase shift oscillator Q2, which generates the audio tones. Changing the values of one or more components in the Q1 circuit alters the rate of tone burst, and changing the values of one or more components in the phase shift oscillator alters the tone.



age becomes sufficiently positive, the emitter becomes forward-biased, and discharges *C1* through the emitter and *B1* junction and *R3*. The voltage drop across *R3* forward-biases *Q2* and turns it "on." As *C1* becomes discharged, the current through *R3* drops, and *Q2* shuts "off."

The tone signal is generated by *Q2* and the phase shift components (*R6*, *R7*, *C2*, *C3*, and *C4*). The signal taken from the collector of *Q2* is coupled to a small speaker through *T1*. The value of 18,000 ohms for resistor *R4* represents a compromise between tone duration and intensity; you can substitute resistors with values between 10,000 and 25,000 ohms for different output signals.

Since the unijunction transistor is the oscillator trigger, changing the values of one or more components in the *Q1* circuit (*R1*, *R3*, *R3* and *C1*) will change the rate of the tone burst. The frequency of the tone can be changed by changing the value of one or more components in the phase shift network.

Construction. A universal meter case makes an ideal container for the timer, as it easily accommodates a small speaker in place of a meter as well as the other circuit components. Potentiometer *R1* and switch *S1* are mounted in the holes normally used for the meter feedthrough terminals. Copper screening is used to cover the speaker.

The small components can be mounted in any convenient manner, such as on a couple of solder-lug terminal strips, with one strip carrying the phase-shift components and the second one the transistors and other components. The miniature output transformer case is soldered to a ground lug on the latter terminal strip, and the battery is fastened to the inside of the case with a U-shaped aluminum strap.

Calibration and Use. The primary winding of *T1* can be tuned for a slight increase in output; capacitor values between 0.05 and 0.25 μf. can be tried for *C5*. Tone pulses should begin about 10 seconds after the unit is turned on. After a minute or so, adjust *R1* for one-second beats by comparing the timing of the beats with the sweep second hand on your wristwatch. —30—

PARTS LIST

B1—9-volt battery
C1—100-μf., 25-volt electrolytic capacitor
C2, C3, C4—0.05-μf., 100-volt miniature Mylar capacitor
C5—0.05 to 0.25 μf., 100-volt capacitor—see text
Q1—2N1671 unijunction transistor
Q2—2N3391 transistor
R1—10,000-ohm potentiometer
R2, R4—18,000-ohm, ½-watt resistor
R3, R6, R7—1000-ohm, ½-watt resistor
R5—12,000-ohm, ½-watt resistor
S1—S.p.s.t. switch
T1—Miniature output transformer, 500 ohms to 3 or 8 ohms (Lafayette TR116 or equivalent)
SPKR—Miniature speaker, 3 or 8 ohms
Misc.—Universal meter case, 7-terminal strips (2), screen mesh, wire, solder, etc.

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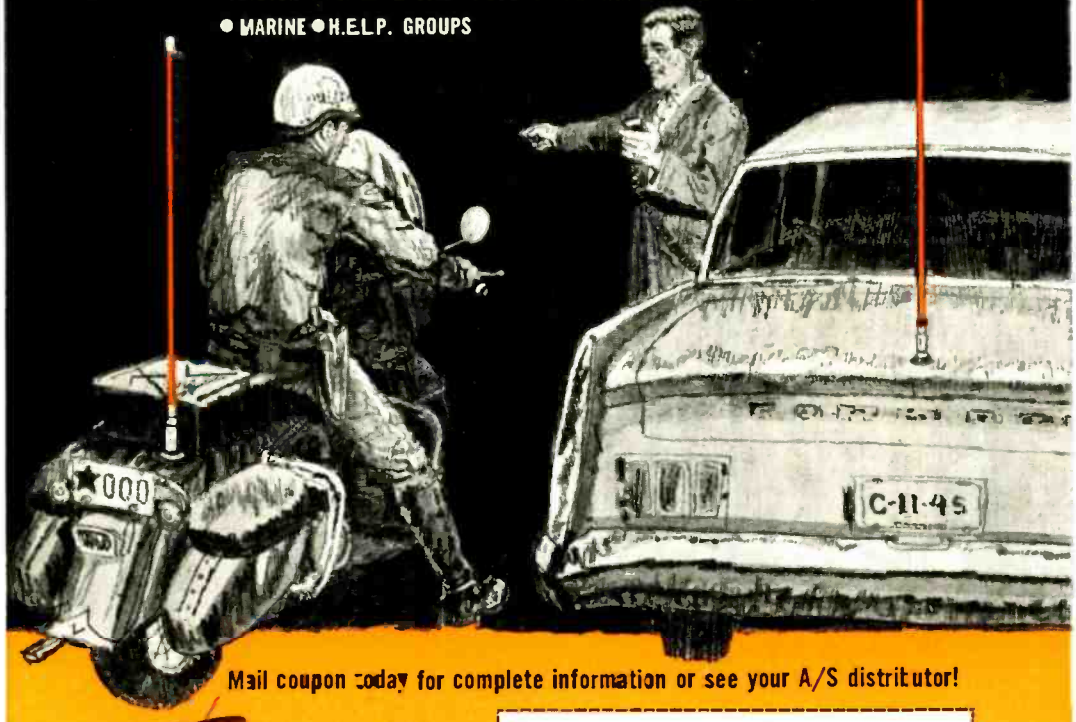

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CIRCLE NO. 5 ON READER SERVICE PAGE

New Ideas For Christmas Giving

A Gift Everyone Wants . . . New Heathkit 10-Band Transistor Portable!

Travel The Airwaves Of The World . . . with this new "go anywhere" 10-band portable. 7 bands tune 2-22.5 mc shortwave, marine and amateur stations. Longwave (150-400 kc) receives aircraft and marine broadcasts. 88-108 mc brings you the relaxed listening of FM. And the 550-1600 kc AM band keeps you posted on the latest news, weather and sports.

16 Transistors, 6 diodes, 44 Prebuilt & Aligned RF Circuits . . . your assurance of instant operation, superior performance and easy, 10-hour assembly. Two separate AM & FM tuners are preassembled & aligned, ready to drop into place. FM tuner and IF strip are same components used in deluxe Heathkit FM stereo gear for the finest FM ever heard in a portable!

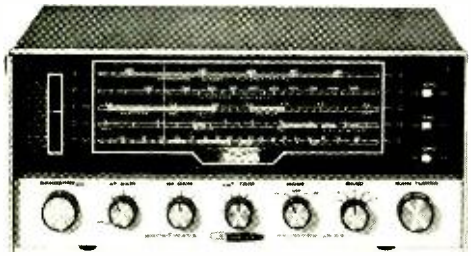
Two Built-In Antennas . . . a large ferrite rod in the carrying handle for AM and longwave, plus a 5′ telescoping whip for FM and longwave.

More Deluxe Operating Features . . . like the battery-saver switch that cuts battery drain up to 35% for indoor listening, or provides full power for strong, outdoor reception; rotating tuning dial; nighttime dial light; 4 simple controls for tuning, volume, tone, AFC and band switching; 4″ x 6″ PM speaker; earphone & built-in jack; time zone map and "listener's guide." Runs on 6 "D" and 1 "C" flashlight batteries (not included). Also operates on 117 v. AC as it "float" charges batteries with optional converter/charger, GRA-43-1 $6.95, 17 lbs.

Kit GR-43

$159.95

New Deluxe Shortwave Radio . . . For The Seasoned SWL!



Kit GR-54

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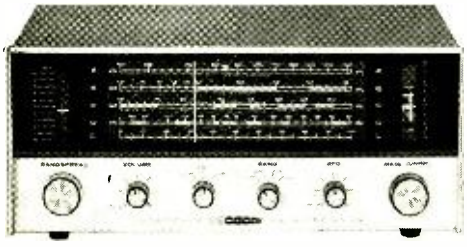
Compare It To Sets Costing $150 And More! 5 bands cover 200-400 kc, AM, and 2-30 mc. Tuned RF stage, crystal filter for greater selectivity, 2 detectors for AM and SSB, tuning meter, bandspread tuning, code practice monitor, automatic noise limiter, automatic volume control, antenna trimmer, built-in 4″ x 6″ speaker, headphone jack, gray metal cabinet, and free SWL antenna. Assemble in 15 hours. 25 lbs.

Explore The Exciting World Of Shortwave With This Low Cost Receiver!



Kit GR-64

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Hear Live Broadcasts From Hundreds Of Foreign Countries . . . pick up the Voice of America, Radio Moscow, government stations . . . tune in hams, ship-to-shore radio, weather and popular AM stations . . . all on this versatile new receiver. Covers 550 kc to 30 mc—includes AM plus 3 shortwave bands. 5″ speaker; lighted bandspread tuning dial; relative signal strength indicator; 7″ slide-rule dial; BFO; 4-tube circuit plus 2 rectifiers; AM antenna; metal cabinet. 15 lbs.

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CIRCLE NO. 19 ON READER SERVICE PAGE

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other *P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information,* write him directly—*he'll appreciate it. If* you *need help, send a postcard to Operation Assist,* POPULAR ELECTRONICS, *One Park Avenue, New York, N.Y 10016. Give maker's name, 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.*

SCHEMATIC DIAGRAMS

GE Model 260 receiver, circa 1940. Tunes BC and 5 s.w. bands. Has 6 tubes. (David Worby, R.R. #2, Box 4, Hartland, Wis.)

Motorola Model WR4 record player, circa 1945. (Charles A. Stuart, 5 Main St., Marstons Mills, Mass. 02648)

E.H. Scott receiver, ser. 2952. Tunes .55 mc.—16.5 mc. on 3 bands. Has 11 tubes. (Marion Faris, Peconic Trlr. Park, Box B3, Riverhead, N. Y. 11901)

Philco Model 46-350 receiver. Tunes BC. Has 6 tubes. (Chuck Schwark, 1852 W. Lake Ave., Glenview, Ill. 60025)

Triumph Model 830 oscillograph wobbulator. Has 7 tubes. (Stanton N. Drummond, 152 N. Crescent Drive, Rome, N. Y. 13440)

E.H. Scott "Phantom" FM receiver, ser. TT398, circa 1940. (A. Viljoen, 22 Strathbogie, 8 Caroline St., Hillbrow, Johannesburg, S. Africa)

Philco Model 38-4 receiver, code 121, circa 1947. Tunes BC and s.w. on 2 bands. Has 8 tubes. (John Pensock, 2620 Glenview Rd., Wilmette, Ill. 60091)

Boulogne-Billancourt receiver, ser. 587. Tunes 15—2000 meters. (John W. Vogel, P.O. Box 7, Hudgins Mathews Co., Va. 23076)

RMA "Phonochord" receiver. Tunes BC and s.w. Has 10 tubes, field coil speaker, and magic eye. (Steve Randolph, Box 330-A, Fairhill Rd., R.D. #4, Sewickley, Pa.)

Springfield walkie-talkie 2-meter radiophone, circa 1957. (John Schroeder, 4272 Atlas Ave., Oakland, Calif. 94619)

Westinghouse Model WR210 receiver, ser. 541970. **Coronado** receiver, ser. 344068. (David E. Halbakken, P.O. Box 615, Fertile, Minn. 56540)

Superior Model 1230 signal generator, circa 1945. Tunes 7 r.f. bands and 5 a.f. bands. Has 3 tubes. (Paul Rutter, 200 W. South St., Angola, Ind. 46703)

Sansei "Zephyr" hi-fi receiver. Tunes AM and FM. Has 6 tubes and 2 diodes. (Emil Albertini, Box 242, McDonald, Pa. 15057)

R-2A/ARR-3 surplus receiver, NXsa-66738, 1149:CFF, circa 1940. Has 13 tubes and magic eye. (K.A. Fulton, 754 N. Clementine, Anaheim, Calif. 92805)

Browning Model 35 receiver. Tunes 1.5—22 mc. Has 8 tubes and 6E5 tuning eye. (Joseph Patrick, Box 104, R.D. #4, Finleyville, Pa.)

(*Continued on page* 106)

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Now, with Hy-Gain's Duo-Beam 10, you can add miles of distance to your Citizens Band range...transmit and receive stronger and clearer signals in the area you've been working. And, because the Duo-Beam 10 is ROTATABLE, you can do it with PINPOINT ACCURACY in any of the 360 degrees surrounding your station! The Duo-Beam 10 is a twin-driven 10 element beam that re-forms the 5 watts output power from your transceiver and funnels it in a "ray-like" path close to the ground to deliver you power equivalent to what you'd get from a CB rig with output power as high as 120 watts. That's "Talk Power." The Duo-Beam 10 is rugged, too...all heavy gauge aluminum construction with iridite treated hardware... designed to survive 80 mph winds. Easy to install on rooftop towers, TV towers, or on a 1⅝" mast...It's guaranteed to outperform any legal antenna for CB. **Model 1110DB $99.95** Net

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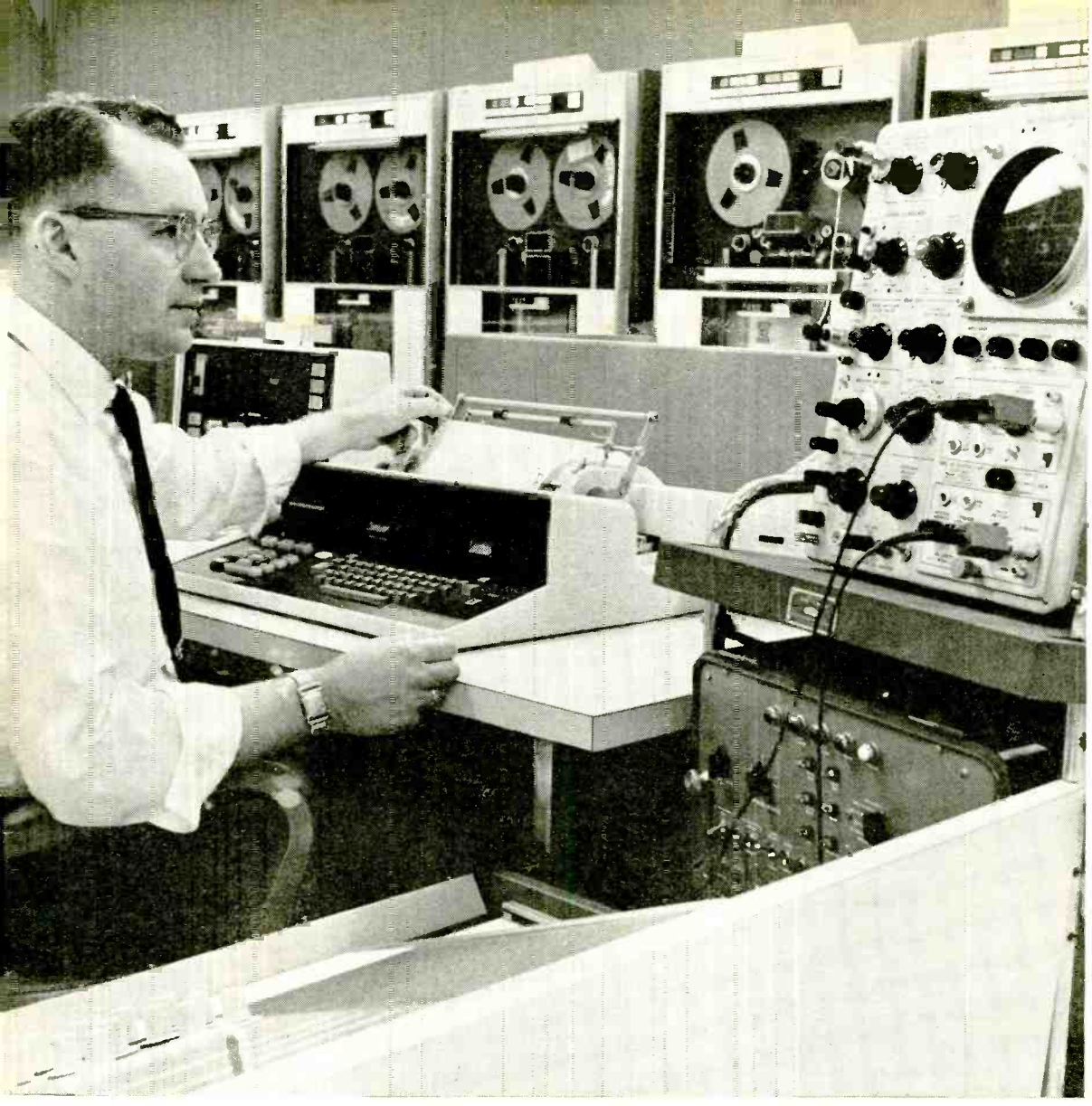
CIRCLE NO. 20 ON READER SERVICE PAGE



Why Fred got a better job . . .

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

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What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I *now*. I sent for my three *free* books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail *today*. Find out how you can move up in electronics too.

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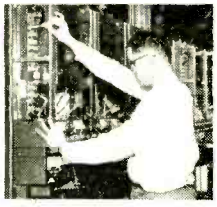

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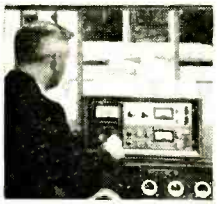

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ASSIST (*Continued from page* 100)

DuMont Model 274-A oscillograph, ser. 932. Has 5 tubes and CRT. (Dennis F. Konicky, 200 Yancey St., Fort Walton Beach, Fla. 32548)

Oxford Model CT400 capacitor analyzer. (B. J. White, 29-8 Garden Circle, Waltham, Mass.)

E. H. Scott receiver, ser. M-559. Tunes on 4 bands. Has 23 tubes. (Ralph Armstrong, 314 W. Santa Ana St., Ojai, Calif. 93023)

R4/ARR2 surplus receiver, circa 1953. Tunes 34-58 mc. Has 9001's and a 12A6. (Tom Brown, 458 Randolph, Pomona, Calif. 91766)

Fisher Model T-20, T-30 metal detector. **Detectron** Model 7-T metal detector. **Goldak** Model 520-B metal detector. (Roland Earl, 11311 Hunnewell, San Fernando, Calif.)

Hickok Model 560 mutual conductance tube tester. (Jim Hallock, Jr., Tilden, Ill. 62292)

GE (Canada) Model F-62 receiver, ser. 0767, circa 1936. Tunes 530-1720 kc., 2.1-22 mc., on 3 bands. Has 6 tubes. (Lynn Green, Rt. 6, Box 86, Birmingham, Ala. 35217)

Superior Model 450-A tube tester. (Charles R. Mueller, Box 8, Keyesport, Ill.)

Detrola Model 700 17" TV, circa 1951. Has 18 tubes. (John Baron, 5782 Renville St., Detroit, Mich. 18210)

SPECIAL DATA OR PARTS

Philco Model 42-350 receiver, code 121, circa 1942; tunes BC, s.w., FM; has 7 tubes. Schematic and parts source needed. (David Jones, 1811 Edison Dr., San Antonio, Tex.)

RCA Model 46X13 receiver. Schematic and ballast tube M-86289-9 needed. (R. A. Spinney, 50 Pond St., Billerica, Mass. 01821)

Wards "Airline" Model 6D4-1 receiver, ser. 6-D4-904188; tunes BC and s.w. Schematic, dial and pointer needed. (Steve Hallberg, Box 184, Center City, Minn.)

Perkin Elmer Model 012-0110 densitometer, ser. 151. Schematic, operating instructions, and input device with connecting cable needed. (Arnold Walter, 155 Bathurst Dr., Tonawanda, N.Y. 14151)

Patterson receiver, circa 1938; tunes 550 kc. 18 mc. on 3 bands; has 12 tubes. Schematic and tube layout needed. (Christopher Coles, 1033 Alta Pine Dr., Altadena, Calif. 91001)

Heath Model MP-11 marine converter-charger. Kit assembly manual needed. (R. J. Stephenson, P.O. Box 1123, Chattanooga, Tenn.)

Sanyo Electric Model 8SP14 receiver; has 8 transistors. Schematic and tuning meter needed. (E. Metz, 4620 N. Kenneth, Chicago, Ill. 60630)

Stromberg Carlson Model RBS receiver, circa 1940; tunes 2-20 mc. Schematic and alignment instructions needed. (Wayne K. Irwin, R.F.D. #1, Mt. Spring Rd., Rockville, Conn. 06066)

Philco Model 620 receiver; tunes 530-1700 kc., and 2.3-22 mc.; has 6 tubes. Schematic tuner coils, switch, and other parts needed. (Lance Muller, 8895 Halsted St., San Diego, Calif. 92123)

Grunow Model 1067 receiver, chassis #10D; tunes .54 to 18.4 mc on 3 bands; has 10 tubes. Schematic, service data, and source for parts needed. (Richard Neubert, 60 Balch Ave., Manchester, N.H. 03102)

Hallicrafters S-20R receiver, series H-144011; tunes .54-10 mc. Schematic and accessory socket data needed. (Michael Ramaccia, 1 Wind Pl., Whitesboro, N.Y. 13492)

Philco Model 37-670 receiver, circa 1936; tunes BC and s.w.; has 11 tubes. Tuning dial (Philco Part No. 27-5213) needed. (Steve Shapiro, 2512 Princeton Rd., Cleveland, Ohio 44118)

RCA Model 813K receiver, circa 1928; tunes BC and s.w.; has 13 tubes. First i.f. transformer needed. (Paul Songer, 2925 NE 45th Ave., Portland, Ore. 97213)

Hazeltine "Air Castle" receiver, chassis #821, ser. 313115; tunes AM and s.w. Schematic and power transformer needed. (Bill Cruse, Box 630, Mooresville, N.C. 28115)

Fada Model C 69 A receiver, ser. 1704; has 5 tubes. Battery voltages needed. (James Pyles, 16 Dobson Rd., East Brunswick, N.J.)

Midwest receiver, circa 1933; tunes 155 kc.-32 mc. on 5 bands; has 16 tubes. Schematic and other data needed. (Johnny Simmons, 2953 Crestline, Macon, Ga. 31204)

Philmore Model 100-1 receiver; tunes BC band; has 5 tubes. Schematic and alignment data needed. (Elbridge W. Smith, 8 N. Grandview Terr., Cobleskill, N.Y. 12043)

Belmont Radio Model BC-1161-A receiver, circa 1940; tunes 150-210 mc.; has 13 tubes. Schematic, alignment data, and operating manual needed. (J. Laine, 807 E. St., Dedham, Mass. 02026)

RCA "Radiola 46" Model AR-596 receiver. Tuner section framework and tuning capacitor needed. (Ray Lowe, Route 1, Box 44-B, Wilkesboro, N.C.)

Presto record head control disc cutter amplifier; has 11 tubes. Schematic and other data needed. (Malcolm Thaden, 6202 Ruatan St., Berwyn Heights, Md. 20741)

GE Model 16C103 TV set, circa 1951. Deflection yoke needed. (Gary J. Schlager, 54 Barbara Pl., Cheektowaga, N.Y. 14225)

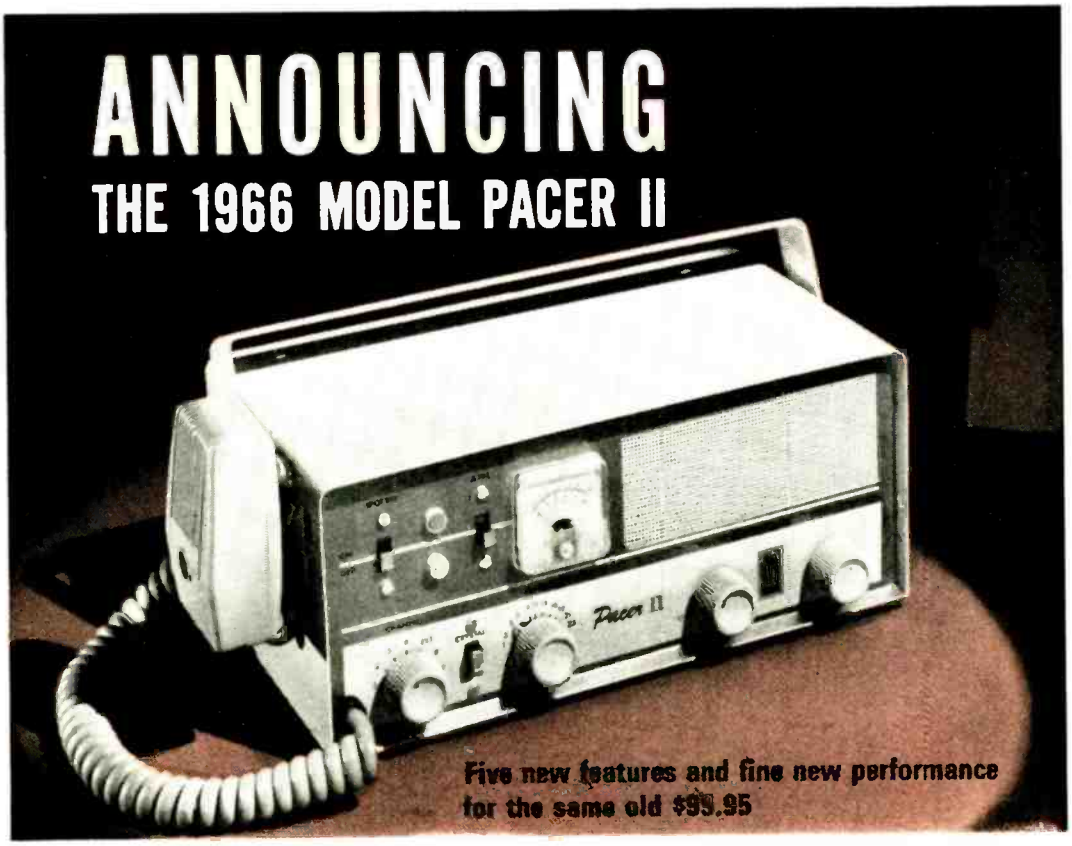
Admiral Model 4H18 phonograph, TV and AM-FM receiver. Service info. and other available data wanted. (Jay Hans, 22 Sparrow Circle, White Plains, N.Y. 10605)

Zenith "Trans-Oceanic" receiver; tunes 550 kc.—18 mc. on 6 bands; has 8 tubes. Schematic, operating instructions, and battery info. needed. (Stanley Jones, Box 488, Hollandale, Miss. 38748)

Federal "Orthosonic" receiver, type E, ser. 292795; tunes BC; has 6 01A tubes. Schematic and info. on hooking up batteries needed. (V.E. Lingbloom, Elsie, Nebr. 69134)

Supreme Model 504-A tester. Parts list, schematic, and operating manual needed. (Thomas P. Meehan, 1109 Laurel Ave., E. Palo Alto, Calif.) —30—

ANNOUNCING
THE 1966 MODEL PACER II



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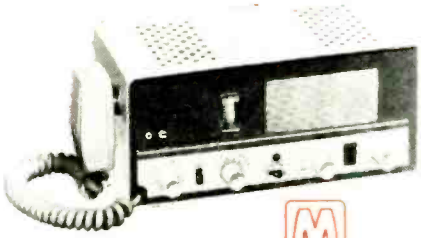

Get on the air for just $79.95 and get these new Mustang II features: eight crystal-controlled (not just six) channels, quick-change external crystal socket, "S" meter, spotting switch, 23-channel tunable receiver, plus PTT mike, positive squelch control.

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CIRCLE NO. 51 ON READER SERVICE PAGE

Super-Sens

(*Continued from page* 62)

(ARM and either N.O. or N.C. contacts) are connected to switch an appropriate solenoid valve in the automatic sprinkler system.

Either the low-resistance connections or high-resistance connections can be used, depending on soil conductivity, electrode (probe) spacing, and desired soil moisture content. In any case, the instrument's *Sensitivity* control can be finely adjusted to achieve the desired operating characteristics.

Acoustic Relays. Add an easily-built, low-cost accessory, and *Super-Sens* becomes a sound-operated relay. Three types of circuits are shown in Fig. 9.

In Fig. 9 (A), a low-impedance single-button carbon microphone (Shure R10), a 6-volt battery, an 8-ohm to 500-ohm output transformer (Argonne AR-164), a 1N34A general-purpose diode, and a 2-μf., 15-volt electrolytic capacitor apply a positive-going signal to energize the relay.

A single-transistor amplifier, in Fig. 9 (B), enables the use of a high-impedance (Philmore M-55), or a low-impedance carbon microphone. A 1-megohm resistor (*R1*) is used with high-impedance microphones and a 47,000-ohm resistor for low impedance types. The *Sensitivity* control is adjusted until the relay closes and is then backed off slightly. Thereafter, a sudden sharp sound will cause the relay to "latch" open.

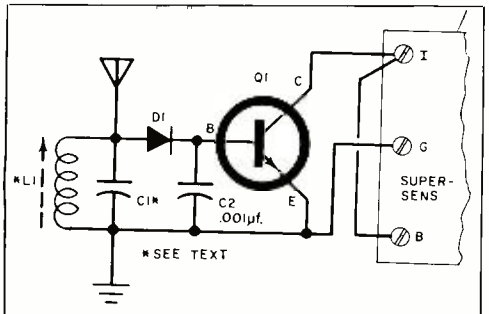


Fig. 10. Radio control can be achieved with simple detector. Tune C1, L1 to desired frequency.

A crystal microphone cartridge, or a magnetic headphone element can be used as a microphone with the circuit shown in Fig. 9 (C). The diode and transistor are the same as in the previous circuits. The *Sensitivity* control is set in the same manner as in the circuit in Fig. 9 (B).

The acoustic relay circuits shown here are moderately sensitive, requiring a fairly loud signal for operation. Where extreme sensitivity is needed, *Super-Sens* can be coupled to a 3- or 4-transistor audio amplifier. The hookup would be the same as in Fig. 9 (A).

Radio Control. *Super-Sens* can be operated by remote radio signals provided that a suitable control circuit is con-

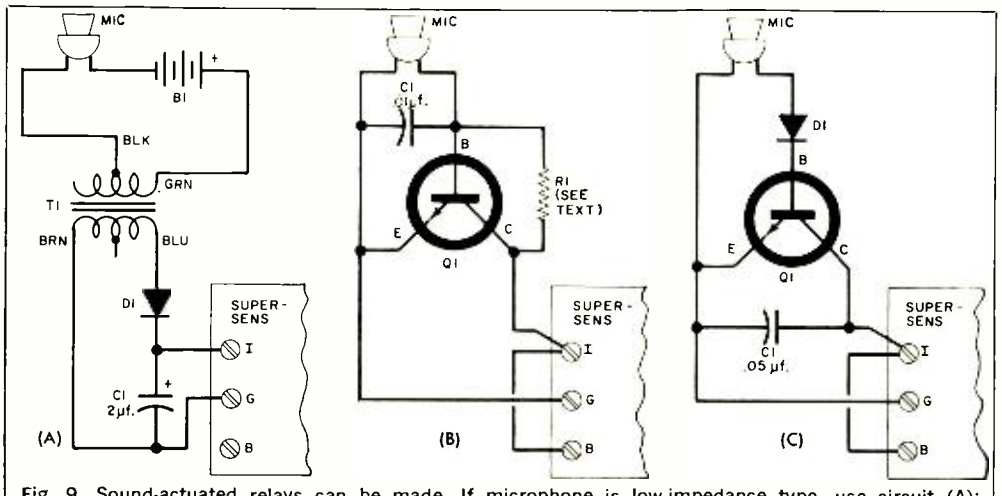


Fig. 9. Sound-actuated relays can be made. If microphone is low-impedance type, use circuit (A); high-impedance pickups work well in circuit (C); a low- or high-impedance unit can be used in circuit (B).

nected to its input terminals, as shown in Fig. 10.

The values of tuned circuit *L1* and *C1* are chosen to resonate at the desired control frequency. A general-purpose diode (1N34A) and an *npn* transistor (2N169) can be used. Adjust the *Sensitivity* control until the relay just closes in the absence of the radio signal. An incoming radio signal will open the relay.

Bench tests with the remote control circuit were made using a standard AM broadcast-band ferrite-core antenna coil (Superex "Vari-Loopstick") for *L1* and a 270-pf. ceramic capacitor for *C1*. With a relatively short antenna, positive relay operation was obtained when a strong local broadcast station was tuned in.

Photocells of all types can be used with *Super-Sens* to make it respond to variations in illumination and color. Invisible infrared rays can be used as intruder alarms. Smoke detectors and industrial counting devices can also be made. Regardless of the intended application, whether specific or general, the only limit to *Super-Sens* is your imagination and skill. —30—

6-WATT AMPLIFIER

(*Continued from page 75*)

signal source and amplifier input as shown in Fig. 1. Although a 1-megohm pot is shown, values of 100,000 or 500,000 ohms can be used.

If plans call for the amplifier to be employed with a low-impedance input device, say about 1000 ohms, reduce the value of *R4*—or even eliminate it. This will give you a substantial increase in gain. There's no point in reducing the value of *R4* for a high-impedance input, as no appreciable gain will be realized. A 150-ohm resistor placed in series with *C2* introduces negative feedback, and lowers the output impedance still more, and reduces distortion, but sacrifices gain. The higher the resistance, the greater the feedback and the lower the gain.

The amplifier's high-frequency response can be substantially improved by substituting 2N2148 transistors for the 2N554's in the output stage. They cost

BIAS NETWORK

A closer look at the biasing arrangement of the various transistors in the Six-Watter is needed for a better understanding of how the circuit operates and how balanced operation can be achieved even if the d.c. current gain of the transistors differs.

Resistors *R1* and *R2* maintain the bias voltage at the base of *Q1* at approximately one-half the supply voltage. If the voltage at point *A* in Fig. 1 drops, the potential difference across *Q1*'s base-emitter junction increases and causes *Q1* to conduct more heavily. The greater current flow through *R3* increases the voltage drop across *R3*, and increases the forward bias of *Q2*. This makes *Q2* conduct more heavily and increases the forward bias on *Q3* and *Q5*, at the same time decreasing the forward bias on *Q4* and *Q6*.

Transistors *Q5* and *Q6* act like a voltage divider across the power supply, and the biasing action just described reduces the dynamic resistance of *Q5*, and increases the dynamic resistance of *Q6*. This raises the voltage at point *A* and tends to restore it to its former value.

If, on the other hand, the voltage at point *A* rises above normal, the forward bias on *Q2* decreases, reducing the bias on *Q3* and *Q5*, increasing the bias on *Q4* and *Q6*, increasing the dynamic resistance of *Q5*, decreasing the dynamic resistance of *Q4*, and, finally, decreasing the voltage at point *A* to its normal value.

Diode *D1* also affects the bias of *Q3* and *Q4*. The voltage drop across *D1* places a small forward bias on *Q3* and *Q4*, which in turn places a small forward bias on *Q5* and *Q6*. This forward bias reduces crossover distortion and serves to thermally stabilize the amplifier. Changes in voltage drop across the diode due to changes in temperature tend to compensate for similar temperature changes in the base-to-emitter voltages of the transistors. The voltage drop across *D1* is essentially independent of supply voltage and therefore is able to maintain the same bias over a relatively wide range of supply voltage.

about $1 more each; the 2N554's were used because of their low cost. Should you decide to substitute "bargain" transistors for *Q5* and *Q6*, you may run into higher than normal leakage currents. To overcome this situation, you can connect a 100-ohm, ½-watt resistor between the base and emitter of *Q5* on the bottom side of the board.

If you plan to use the Six-Watter as a narrow-band speech amplifier, reduce the value of *C2* and place a small capacitor in parallel with *R5* to cut the amplifier's response at both the high and low ends.

The amplifier can also be used as a modulator for small transmitters. An ordinary output transformer connected backwards makes a reasonably good match as a modulation transformer. Use an output transformer which can match the impedance of the final stage of your transmitter to the amplifier's nominal 3.2-ohm load. —30—

HI-FI STEREO FOR '66

(*Continued from page 51*)

AM tuner, in addition to the usual FM/FM multiplex. Allied Radio has added the KG-964 to its Knight-Kit line with 34 wpc and with a price tag of $189.95.

In the wholely-wired up line and ready to go are such units as the Harman-Kardon "Stratophonic Series" ranging from 18 to 33 wpc and price tags of $279 to $469. Scott's latest entry in this field is the elegant 388 marketed at just under $500; the 388 appears to be the first receiver using field-effect transistors to virtually eliminate all FM cross-modulation effects. Fisher's latest word is the husky 600T rated at 55 wpc and 1.8 microvolts of FM receiver sensitivity; it's tagged at $459.50. The Bogen line offers the new RT8000 for $319.95 and 35 wpc. For sleekness, try the Electro-Voice 1177 with 25 wpc which sells for only $280.

Other Equipment. Transistors have invaded tape recorders in style, but a report on these units will appear in a separate article scheduled for the December issue of POPULAR ELECTRONICS. You can also find solid-state devices in other odd corners, such as the Shure SA-1 "Solo-Phone"; this small amplifier can be connected to either tape or phono and used to drive two sets of stereo headphones.

Regardless of where you find them—transistors are in hi-fi/stereo to stay. *Vale* tubes. —30—

HOW TO STACK TV ANTENNAS

(*Continued from page 65*)

Fortunately, this is quite simple. All you have to do is vary the horizontal spacing between the antennas. And you don't need any complicated formulas or measurements, either. The trial and error method works best.

Before you start shifting the antennas, you should construct a symmetrical harness—same type leads, lengths, and matching transformers—between the hybrid splitter and the antennas.

Point both antennas directly at the transmitter. Keeping them parallel, slowly move one antenna closer to, or away from, the other. While you are doing this, you need someone to watch the TV set for a sudden, sharp reduction in the unwanted signal. Secure the antenna in this position. The unwanted signal may still be noticeable in spite of the sharp reduction. But, you're not through yet.

Remember that the unwanted signal must appear as equal and opposite polarity voltages to cancel out. By finding the correct horizontal spacing, you've made sure that the unwanted signal arrives at the two antennas 180° out-of-phase. Now, you must make sure the signals are equal. To do this, simply move one antenna up and down on the mast while someone again watches the screen. Secure the antenna at the point where the unwanted signal is weakest.

Horizontal stacking is used to clean up master TV antenna systems, and it works just as well in home TV installations—especially color installations. —30—

SOLID STATE

(*Continued from page 80*)

distortion for, as we discussed last month, even-order harmonics are cancelled out in a push-pull stage.

Unfortunately, the push-pull circuit can also introduce an undesirable amount of intermodulation distortion due to the non-linearity of the composite transistor characteristics. The remedy, here, is to use matched transistor pairs in the push-pull stage, and then operate the stage Class A or Class AB to insure a smooth crossover point.

In summary, to minimize *all types* of distortion in your transistor audio amplifier:

(1) Adjust individual stage bias values for operation within the transistor's linear region, biasing single-ended stages Class A, and push-pull stages Class A or AB. Avoid the use of Class B stages.

(2) Make sure that no stage is overdriven.

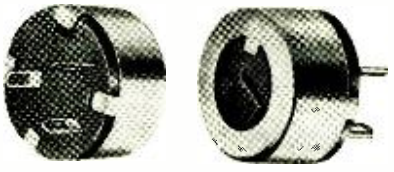
(3) In push-pull circuits, use only transistors with matched gain and leakage characteristics.

(4) Make sure that iron-core transformers are operated within their d.c. ratings to avoid saturation.

(5) Use good-quality coupling capacitors to avoid interstage leakage.

(6) Use inverse feedback where appropriate.

Product News. The Clarostat Manufacturing Company (Dover, N.H.) has just announced a new low-cost trimmer potentiometer. Ideal for miniature transistor circuits, the unit is only ½" in diameter by $\frac{5}{16}$" deep. It is designed for screwdriver adjustment, is



available in standard resistance values from 100 ohms to 1 megohm, and has a power rating of ¼ watt.

A new line of extremely high gain Darlington pair transistors, packaged in single cases, has been introduced by the Solid State Electronics Corp. (15321 Rayen St., Sepulveda, Calif.). The first device in the line, the SST610, offers a current gain of 10,000 with an output current of 120 ma. Future units will have a gain of up to 100,000 or more, according to the manufacturer.

The development by General Electric's Semiconductor Products Department of a

new continuous-strip manufacturing process should result in more low-cost SCR's for consumer products. The first units produced with the new process are 150-watt, 117-volt types; later units will have ratings of up to 2 kw. or more. Initially the new SCR's will be used in motor control circuits of such appliances as food mixers and sewing machines.

Well, the Holiday Season is approaching; now is a good time to start assembling transistorized gifts for your friends. Until next month . . . —*Lou*

MATH QUIZ ANSWERS

(*Quiz appears on page* 67)

1 — H Amplifiers which have their load resistors in series produce an output signal proportional to the sum of the in-phase input signals.

2 — F A step counter produces an escalated output which varies exponentially with the number of pulses it receives. It can be used to count the number of pulses it receives, and as a frequency divider by allowing it to trigger another circuit, say at every 2nd. 3rd . . . 7th step, as desired.

3 — I A differentiator circuit produces an output whose instantaneous values are proportional to the rate of change of the input voltage waveform.

4 — G A voltage doubler produces a d.c. output which is approximately equal to twice the r.m.s. value of the a.c. input voltage.

5 — D A voltage divider provides an output which is in the same proportion to the applied voltage as the divider resistance is to the total resistance.

6 — A An integrating circuit provides an output voltage which is approximately proportional to the time integral and potential of the input voltage.

7 — J In a ratio detector circuit, the variations of audio frequency output signals have the same ratio as the variations of the applied FM radio frequency signals.

8 — C A triode square law detector produces an output signal which is proportional to the square of the input signal.

9 — E A differential amplifier produces an output signal whose amplitude is proportional to the difference between two in-phase input signals.

10 — B A voltage tripler circuit produces a d.c. output which is approximately equal to three times the r.m.s. value of the a.c. input voltage.

PARTS PROFILES

(*Continued from page 77*)

connected directly across the power line, so don't take chances. You *must* use a polarized plug or a nonmetallic case. Input and output connections that could be touched accidentally must be transformer-coupled, unless you are using a power isolation transformer. A low-cost 25-watt unit will more than suffice since filament power is no longer needed.

Figure 4 shows a line-operated half-wave power supply that provides a no-load d.c. output of about 165 volts. Resistor *R1* is a limiting resistor that also takes care of current surges. You can use this supply as a direct replacement in any tube or selenium rectifier circuit that calls for approximately 150 volts at not more than 150 mils. The 40265 makes a dandy power supply for experiments with neon lamps.

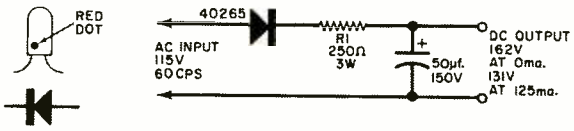


Fig. 4. Low-cost, line-operated, half-wave power supply using RCA 40265 400-volt, 125-ma. silicon rectifier, semiconductor equivalent of 35W4 tube.

Now let's give the 40264 the once-over. This job needs a heat sink because of its high power rating (4 watts, 300 volts). The heat sink must be insulated, or you will have to use a mica washer and silicone grease between it and the transistor. It's best to use nylon screws for insulation; if you use ordinary hardware, then use nylon bushings for mounting. The thing to remember is that the transistor case is at line potential and must be mounted where it cannot be touched accidentally.

Figure 5 shows the 40264 in a basic two-stage amplifier that can serve as a phonograph amplifier or be used in the audio output stage of an AM receiver. At ½-watt output, the distortion is only 2%. If you don't mind 10% distortion, then you can crank it up to a full one watt of power.

The frequency response, which can be quite good, is determined by the quality of the output transformer you use. The amplifier will put out 600 milliwatts with an input of around ½ volt into 50,000 ohms. This is usually adequate for most inputs except magnetic pickups and other extremely low-level sources.

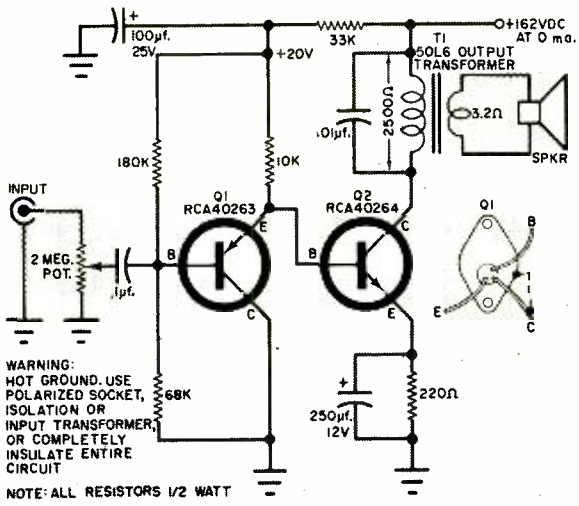


Fig. 5. Basic line-operated solid-state amplifier delivering up to one watt of audio power at 10% distortion; at one-half watt distortion is only 2%. Frequency response is a function of the quality of the output transformer used, but is usually good.

A data sheet, No. ICE-313, on RCA solid-state devices 40261 through 40265, is available on request from: Radio Corporation of America, Electronic Components and Devices, Harrison, N.J. The RCA 40264 power transistor and 40265 rectifier are priced, respectively, at $1.20 and 35 cents, and are available from RCA semiconductor distributors. —30—

AMATEUR RADIO

(*Continued from page* 94)

dots and dashes (half of them dashes). When spoken, "XYL" contains three syllables; "wife" contains one. Furthermore, Elsie complains, being called an "ex" young lady casts aspersions on her state of preservation, and is an insult to her intelligence and to the skill of her beauty operator. Elsie realizes, by the way, that she is fighting a lost cause.

As reported in the June 15 issue of the *DX-pedition of the Month Bulletin*, John H. Gayer, HB9AEQ, honorary president of the International Amateur Radio Club, Geneva, Switzerland, speaking at the Second SSB Banquet in London, England, related that one of the problems plaguing amateur radio was unauthorized commercial intruders moving into the ham bands at hours

when amateur activity is low. From personal observation, several South or Central American commercial CW stations move into the 20-meter amateur band almost every afternoon. But if a couple of powerful amateur stations happen to open up on the frequency usurped by the intruders, the latter soon move back where they belong—or on someone else's frequency.

News and Views

Allan J. Sarkin, WN6PTT, 9115 S. Strub Ave., Whittier, Calif., operates on 80 meters using a converted ARC-5 war-surplus transmitter feeding an end-fed antenna. He receives on a Knight-Kit R-55 or on a BC-454; both are helped along by a preamp and a surplus FL-30 audio filter. Allan likes to rag-chew to give himself plenty of code practice so he can get his General license as soon as possible, which he plans as the next step in his campaign to earn an Extra Class license . . . **Arne Henden, WN5HMR,** 1565 S. Esperanza, Las Cruces, N. M., reports that three out of four of the stations he works say he is their first New Mexico contact. Arne stays on 40 or 15 meters and has 40 states worked, including three contacts with Hawaii, plus Guatemala, Canada, and the Bahamas. An Elmac A-54 transmitter pushing 40 watts into a 40-meter dipole antenna, and a Hammarlund HQ-110 receiver handle the electronic work. Arne's neighbors are in for a "thrill" soon—he is building a 40-10 meter quad antenna and a 15-meter beam, both to go on a 40' pole . . . **Dan L. Marshall, WN8QEO,** 1728 Sheffield Drive, Akron, Ohio, is a resourceful ham. When his Novice license arrived, he already had a Hallicrafters SX-140 receiver; but the HT-40 transmitter, which was on order, hadn't arrived. So Dan built himself a 25-watt transmitter and knocked off five states in his first week on the air. Now, with the HT-40, he has 23 states worked. All of his operating is on 80 meters, with an 80-meter inverted-V antenna.

All Florida High School Amateur Radio Clubs, take note. Plans are under way to organize a Florida H.S. Net. Write to **C. Lynn "Tank" Miller, WA4UBQ,** president, Hillsborough H.S.A.R.C. (WA4VQW), 309 West Lambright, Tampa, Fla., 33604, for information . . . **Agustín O. Monasterio, XE1OOL,** P.O. Box 41-634, Mexico 10, D.F., Mexico, is one of the youngest of the 6000 Mexican amateurs (he is 16). In three months, running 50 watts on 20 meters, AM phone, he has worked 19 countries—all in the Americas. His transmitter is a Heathkit DX-60 feeding a 40-, 20-, 15-meter inverted-V antenna, and he receives on a National NC-140. Unfortunately, Augustin has not yet been able to get the antenna to "load" on 40 or 15 meters, but being limited to one band hasn't seemed to slow him down much . . . **Pete Doyle, WN2OUO,** 16 Woodcliff Lake Rd., Saddle River, N.J., closed out his Novice career by working Italy the day before his license expired. Being away at school most of the time cut down Pete's on-the-air time, but he did work 13 states and a few other DX stations besides Italy with a Heathkit DX-60 transmitter and a Lafayette HE-10 receiver. Of course, Pete is now *Giung Ho* after his General ticket . . . **Mike Di Corpo, WN1CRS,** 35 Sunny Brook Bend, Waterbury, Conn., also found that school cuts down on a fellow's QSO total. Still, he made 100 contacts in 10 states and Canada with his Heathkit DX-60 transmitter in spite of a poor receiver—he now has a much better Lafayette KT-320 receiver. And with separate dipole antennas already up for 80, 40, 20, 15, and 10 meters, Mike is ready for the arrival of his General ticket, too.

Everitt C. Bollin, WA3DVO, 2029 E. Lanvale St., Baltimore, Md., is a radioman in the Navy stationed in Washington, D.C., following a tour of duty on Midway Island, where he operated as KM6CJ. In two months on the air from Baltimore, Ev's Knight-Kit T-150 transmitter, Gotham V-80 vertical antenna, 20-meter dipole, and Hallicrafters SX-140 receiver have come within a state or two of a WAS (Worked All States) certificate . . . **John Wieder, WAØJYJ,** RFD 1, Northboro, Iowa, likes to rag-chew on 75-meter phone and to chase DX on 20-meter CW. He has one transmitter—a Heathkit DX-100; two antennas—a V-40 vertical and an 80-meter dipole; and three receivers—a Hammarlund HQ-150, Heathkit GR-91, and Hallicrafters S-85. John's brag list contains QSL cards from 13 of the 44 states worked, and all Canadian call areas, plus Puerto Rico . . . **Richard T. Schweizer, Jr., WB2PCF,** 240-27-145 Ave., Rosedale, L.I., N.Y., is a three-antenna man. They are: a Hy-Gain 14-AVS vertical; an 80-meter inverted V; and a Hy-Gain TH-2 2-element beam. Like WAØJYJ above, he has 41 states worked and 43 QSL'ed; in addition, he has all Canadian provinces and 16 countries worked. A Johnson "Ranger" transmitter and a Drake 2-B receiver serve as the go-betweens between Dick and his antennas . . . **Brian Kirchoff, WN6WWD,** 206 Alpine St., San Rafael, Calif., had no trouble deciding which was his most thrilling contact—American Samoa! In addition, he has 9 states worked. Brian's Heathkit DX-20 runs 50 watts to feed a 40-meter dipole about 30' high, and he receives on a Lafayette HE-40.

Good luck in the WWDX and SS contests. Until next month, keep your "News and Views" and pictures coming; and remember, we appreciate receiving copies of your club paper. The address to use is: Herbert 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 91*)

Appropriately dubbed "Call Letter Directory," the volumes list CB'ers in both alphabetical and numerical order by state, town, and licensee in each town. In addition, the directory contains Part 95 rules and amendments, the phonetic alphabet, the 10-Code and an alphabetical listing of call-letter prefixes for all areas, and a 1960-65 U.S. area map.

The books are put together well, are highly legible, and are a real help when you know the other party's call-sign but not his name, or vice versa. Directories are currently available for areas 6, 8, 9, 11, 12, 18W and 18E. The listings are up to date and total 13,000 to 40,000 per directory, depending upon the size of the area. Prices

range from $3.50 to $5.95. The directories will be republished annually, and other area listings will be available soon.

For all the details, drop a line to K9TVA, Dept. SS, 6429 N. Glenwood Ave., Chicago, Ill. 60626. And while you're at it, ask Mel for a copy of his illustrated brochure which lists a bundle of useful CB identification badges, decals, pins and accessories.

Club News. The Metropolitan Denver Citizens Radio Club of Denver, Colorado, has reported on their participation with authorities when a 12-foot wall of water

heading down the South Platte River threatened Denver and the metropolitan area. Approximately 200 CB'ers responded immediately to a call for assistance in evacuating persons living along the river. Before the threat was over, more than 500 CB'ers were on hand to help where needed. Several mobile units were placed at roadblocks while others were used for transportation. Most of the CB'ers involved averaged three to four hours sleep in 24 hours; some went without sleep for two days.

The Five Watt Wonders CB Radio Club of Greater New Orleans, La., made an all-out drive to up membership, set up a permanent 24-hour monitoring station, and ready their group for upcoming Mardi Gras festivities. The club's monitoring channel hit the air for the first time this year on Mardi Gras Day. The station handled emergency traffic for 12 hours through contact with CB mobiles stationed at six different Red Cross stations spread along the Mardi Gras parade route. New Orleans Red Cross and police officials were amazed at the swiftness with which the CB'ers handled 113 emergency requests for supplies and ambulance service during the activities.

In Fort Lauderdale, Fla., a Mr. Richard Gaddy was so appreciative of the "fast service" he received from CB'ers in the Eleven Meters Citizens Radio Club, he decided to join them. His car was stolen early one a.m., and his main concern was that the vehicle contained a number of valuable books and papers belonging to the insurance firm that employed him. Club members spread the word throughout Broward, Dade and Palm Beach counties. Two days later CB'er Jake Moore, KKP5456, spotted the car and relayed the information to Bill Walker, KKP4058. All stood by until sheriff department deputies took over, and Mr. Gaddy's car and its contents were returned intact.

1965 OTCB Club Roster. The following are clubs reporting to *On the Citizens Band* for the first time. New clubs or those which have not been listed in this column in the last year should forward all details to keep our "active" CB club list current. Be sure to include number of members, when organized, primary activities, emergency assists, and special teams or groups. A picture of your group could end up on these pages—if you include it.

Anchorage, Alaska: Southcentral Alaska Chapter of MCEU, Inc. This club was organized in December, 1964. The officers are: Tom Moore, KKN0808, president; Jerry Miller, KLN9149, vice president; Tony Armstrong, KKB3724, secretary; and Rick Croan, KLU0173, treasurer. The group was

CIRCLE NO. 25 ON READER SERVICE PAGE →

lauded by William Egan, Governor of Alaska, and Don Lowell, state Civil Defense director, for assistance during the Alaskan earthquake.

Vancouver, B.C., Canada: Tupper High Communications Club. Organized in September, 1964, the group meets at the Sir Charles Tupper High School weekly. They specialize in the repair of radios and appliances for a small service charge but no dues are collected from club members. Club president is Cal Dooseman, XM11-3033; vice president, Ging Quan; and secretary, Larry Hudson, VE7PE1AO.

National Park, New Jersey: Dvert CB Club of National Park. Forty-three active members work closely with police and civic authority groups. The club monitors channels 9 and 13. Officers are: Carl Wilson, president; Bob Vincent, vice president; Donna Black, secretary; and Lil Kenny, treasurer.

Other clubs reporting: In *Aurora, Colorado,* Aurora CB Radio Association; in *Chicago, Illinois,* Mid-America Rescue Squad of Illinois; in *Silvis, Illinois,* Iowa-Illinois CB Club; in *Knoxville, Tennessee,* Knox County 10-4 Club, Inc.

I'll CB'ing you,

—Matt, KHC2060

PREDICTED CONDITIONS

(*Continued from page 72*)

EST, and Israel on 9725 kc. from 2300 to 0030 EST; both should be audible on nights when DX conditions are good. The gigantic transmitters of the *VOA* from Greenville, North Carolina, should be heard over much of the country on both 9635 kc. and 9740 kc. with their English-language broadcasts.

25 Meters. East-west reception in this band is not expected to be good during the next few months. The maximum usable frequency will be too low for much DX during the daylight hours and too high for DX during the nighttime hours. Many Central and South American stations will be audible, however.

For DX'ers interested in transmissions from the Pacific, the *VOA* relay station at Colombo, Ceylon, on 11,835 kc. should occasionally be audible from 0700 to 1300 EST. Taipei, Formosa, on 11,825 kc. will also be on the air at approximately the same time. The Philippines on 11,900 kc. and 11,930 kc., as well as the BBC relay from Singapore on 11,955 kc., may be audible in the western half of the United States.

19 Meters. Almost unlimited DX possibilities exist in this band from before sunrise until after sunset local time. Overall, the 15-mc. band will be the best DX band at this time of year with every major foreign broadcaster, and many smaller ones, using these frequencies in daylight hours.

Of special interest will be the new British relay station on 15,310 kc. This transmitter has a power of 250,000 watts and will carry programs for West African consumption. The announced schedule says that the transmitter will be on the air at sunrise, and at 0900 is scheduled to move to 15,435 kc. and remain there until sign-off at 1730 EST.

Turkey will be a good catch from 1100 to 1600 EST on 15,195 kc. Listen also for Nigeria on 15,255 kc. with transmissions from mid-morning to mid-afternoon EST.

16 Meters. On good days in this band very strong signals should be received—even exceeding the strength of those in the 19-meter band. DX will peak in the morning and should taper off in the early afternoon. On the West Coast, DX will decrease sharply after 1000 PST.

Announced schedules show Egypt on 17,785 kc. and Switzerland on 17,795 kc. South Africa, on 17,805 kc. will be on the air during the morning hours, local time.

13 Meters. Increased sunspot numbers will result in more extensive use of this band by foreign broadcasters. Although it will be used primarily by the BBC and the *VOA*, the Congo has announced transmissions on 21,500 kc. and Ghana will be on 21,545 kc. from 0900 to 1030 EST. Switzerland has plans to beam transmissions to Southeast Asia from 0330 to 0530 EST.

Broadcast and Long-Wave Bands. Station directories indicate that there are more than 10,000 broadcasting stations operating in the band between 500 and 1600 kc. Of these, approximately 4000 are licensed in the United States. During the daylight hours, reception in this band will not be a problem, since medium-wave transmissions do not propagate to any appreciable distance. At night, however, it will be a serious problem, particularly in suburban areas with congestion and interference from DX stations 500 to 1500 miles distant.

DX'ers should look between the broadcasting channel allocations in North America for Europeans, especially Madrid on 584 kc., Lisbon on 755 kc., Rome on 845 kc., Paris on 863 kc., London on 1214 kc., Lille on 1376 kc., Monte Carlo on 1466 kc., and Vienna on 1475 kc. And the *VOA* maintains a station in Munich on 1196 kc. that can occasionally be heard on the eastern coast of North America. -30-

SHORT-WAVE LISTENING

(*Continued from page 87*)

Utility DX'ers Take Note. Jan Tuner, Editor of the Radio Communications DX Club in Sweden, tells us that a new point-to-point guide—a booklet containing 25 pages of addresses, report forms in four languages, frequency lists, advice on reporting, and a list of military stations—is now available. The listed price is $1.20 via surface mail, $1.40 via airmail. For further information, write directly to RCDXC, Kyrkvagen 6A, Kopparberg, Sweden.

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 Eastern Standard 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 Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to all contributors.

Afghanistan—*R. Kabul*, 15.225 kc., was noted at 1300-1330 in German with music. This station requires very sharp tuning. Do not confuse it with a nearby propaganda station, or with *R. Nederland* which is on 15,220 kc. at a comparable time.

Albania—*R. Tirana* can be heard closing in Spanish at 1815 on 11,717 kc. but badly squeezed by Moscow and Athens. Major portion of the program is news. This station is also heard in French at 0000 on 9390 kc. and in Eng. to N.A. on 7225 kc. at 1900-1930.

Algeria—Algiers, 6049 kc., has an ID in French at 1604 after a dramatic offering. The station was also noted signing off in Spanish at 1759.

Angola—Local area monitoring of all stations in Angola has resulted in the following complete and up-to-date list (frequencies in parenthesis are officially listed but not currently in use): *Emissora Oficial de Angola*—3375, 4820, 6025, 7235, 9535 kc. (3955, 4955, 6195, 7265, 9555, 9700, 9760, 17.705 kc.); *R. Clube de Angola*—4870, 7140, 9630 kc.; *R. Ecclesia*—4985 kc. (11.755 kc.); *R. Clube de Cuanza Sul*—1840, 7285 kc. (6000, 11.970 kc.); *R. Clube do Congo Portugues*—6135 kc. (4860 kc.); *R. Clube de Malange*—4935, 7115 kc.; *R. Clube do Moxico*—5137 kc.; *R. Clube de Cabinda*—5035 kc. (7260 kc.); *R. Clube do Lobito*—4910, 7175 kc.; *R. Diamang*—4770, 9615, 11.685 kc. (11,700 kc.); *R. Clube do Huambo*—3704, 5065, 7125 kc. (5060, 7160, 9665, 11.925 kc.); *R. Clube de Mocamedes*—(3740, 5005 5015, 7240, 9515 kc.); *R. Clube da Huila*—3970, 5925, 9675 kc. (11.940 kc.); *R. Clube do Bie*—4895, 7390 kc. (7205, 7215 kc.); *R. Comercial de Angola*—3990, 4795, 7155 kc. (3980, 3995, 4775, 4860, 7150 kc.); *R. Clube de Benguela*—5040, 6150 kc. (3395, 3975, 7160, 9505 kc.)

Belgium—Brussels is noted on a new frequency, 9615 kc., at 1730-1800 in French and Flemish with pop music.

Brazil—Stations observed recently in the 19-meter band are as follows: *R. Jornal do Comercio*, Recife, 15.145 kc.; a weak station in Fortaleza—probably *R. Clube do Ceara*, 15.165 kc.; *R. Marajoara*, Belem, 15.245 kc.; *R. Tupi*, Rio de Janeiro, 15.370 kc.; *R. Clube Ribeirao Preto* (identifying as

PRA7). 15,415 kc.; and *R. Nacional,* Brasilia, 15,445 kc. In addition, a weak, unidentified station believed to be a Brazilian is on 15,225 kc.

On about 3310 kc., a station announcing as *R. Gazetta* has been logged from 1911 to 1940 with Brazilian vocal and instrumental music and some announcements and ads in Portuguese.

Congo (West)—*Radiodiffusion Television Congolaise* was heard on 9718 kc. with African music at 1430-1530. This Brazzaville outlet is not dual to 9729 kc.

Cyprus—A new frequency for the BBC East Mediterranean Relay, Limassol, is 9580 kc. It was noted with BBC news at 1300 and 1400 and local programming in between. S/off appears to be 1615. Heavy QRM from Yerevan prevents solid copy.

Ecuador—Station HCJB, Quito, uses 15,120 kc. at 1430 in Eng., dual to 17,850 kc., and 15,105 kc. at 1605 in German.

Station HCAH3, *R. Trebol* (which does not announce as *El Trebol*), 4915 kc., is noted at 2310-2345 with typically bouncy Ecuadorian music. An ID is given every 10 to 15 minutes. The location reportedly is Zaruma but the announcer seems to say "desde Caliban"(?) and mentions Loja often.

Ethiopia—*Radio Voice of the Gospel,* Addis Ababa, has the following current Eng. schedule. Transmitter 1: 0815-0830 to Ceylon on 15,410 kc.; 1045-1100 to Ethiopia on 6010 kc.; 1400-1445 to West Africa on 11,785. Transmitter 2: 0830-0900 to India on 9730 kc.; 1130-1145 to Malawi on 9765 kc.; 1300-1315 to E. Africa on 9565 kc.; and 1415-1430 to S. Africa on 9705 kc. There is an Eng. and Zulu xmsn at 1315-1415 to S. Africa on 9705 kc. on Tuesdays, Thursdays, and Saturdays only. Reports also indicate a good signal along the East Coast at 1230-1300 on 11,845 kc.; this transmission is in Arabic. A late item lists 7268 kc. as now being used at 2245-2330 daily (except Saturdays) in Somali, and from 2330 in Amharic.

Gabon — *Radiodiffusion Television Gabonaise,* Libreville, is heard on 4777 kc. with uninterrupted music from 1740 to 1755/close with announcements in French. Normal closing time is 1800 Sundays, 1630 weekdays.

Germany (East)—*R. Berlin International* is scheduled to the N.A. East Coast at 2000 and 2130 on 9560 and 11,880 kc., and to the West Coast at 2245 and 2345 on 9770 and 11,920 kc. The 2130 xmsn on 11,880 kc. appears to be the best received.

Ghana—Accra has been testing to N.A. in Eng. at 1500-1600 on 9760 kc. (and on 11,800 kc. in

The listening post of Mike Larcombe, Folcroft, Pa., contains both a Hallicrafters S-120 receiver and a Heathkit AR-3. Mike, otherwise known as WPE3EAI, has 69 QSL cards; 60 countries logged, 33 verified.

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.

(Do not fill out)

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Name . . . . . .

Street, City and Zone . . . . . .

State and Zip . . . . . .

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

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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 . . . . . .

Arabic), at 2230-2330 on 6110 kc., at 0100 (possibly from 0030) on 3366, 4825 and 4915 kc., and from 1730 on 4825, 4915, and 4980 kc.

Greece—Forces B/C Station, Athens, was logged on 6045 kc. after *VOA* s/off at 2345 with music, anmts in Greek and wake-up exercises to 0000. It was also noted at 1603-1802 with a wide variety of music. This station has been very rarely logged since it was on 7420 kc. about ten years ago.

Italy—Rome broadcasts in Eng. as follows: to N.A. at 2000-2020 on 11,905 and 9630 kc.; to Egypt at 0735-0755 and to Malta during the same time period on 11,905, 9630, and 6010 kc.; to the United Kingdom at 1615-1635 on 11,905 and 9575 kc.; to the Near East at 0700-0730 on 9575 and 6010 kc.; and to Japan at 1705-1725 on 11,905 and 9710 kc.

Ivory Coast—The new International Service from Abidjan on 6015 kc. is heard nicely with arias from Gluck's "Iphegenie en Aulide" at 1650-1750. The ID is *Radiodiffusion Television Ivorienne.*

Kuwait—Kuwait is heard daily on 9520 kc. from 1330 to close-down around 1610. Arabic news is given at 1400 and 1600, at times read by a woman. Other programs are varied, consisting of western classical music, Arabic vocal and instrumental tunes, long talks in Arabic, and ID's at 5-10 minutes before the hour. On the hour, clock bells are rung in seemingly random fashion.

Lebanon—The most current schedule from Beirut reads: to Africa on 11,810 kc. at 1330-1400 in Eng., at 1400-1500 in Arabic, and at 1500-1530 in French; to South America on 11,790 kc. at 1800-1830 in Portuguese, at 1830-1930 in Arabic, and at 1930-2000 in Spanish; to U.S., Canada, Mexico, Antilles, and Europe on 9710 kc. at 2030-2100 in French, at 2100-2130 in Arabic (to U.S. East Coast), at 2130-2200 in Eng., at 2200-2230 in Arabic (to U.S. West Coast), and at 2230-2300 in Spanish. Omnidirectional xmsns are on 5980 kc. at 2330-0230 and 0915-1320, and on 9545 kc. at 0430-0900.

DX States Awards Presented

To be eligible for one of the DX States Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 20, 30, 40, or 50 different states in the U.S. The following DX'ers have qualified for and received awards in the categories indicated.

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Forty States Verified

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Gregg A. Calkin (VE1PE3L), Saint John, N.B., Canada
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Robert J. Wagner (WPE3GIO), Philadelphia, Pa.
Stephen Schmidt (WPE2IXG), Webster, N. Y.
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Bruce Nissen (WPEØEBX), Vinton, Iowa
E. Joseph Sabo (WPE7BTZ), Seattle, Wash.
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John McDonald (WPE9HLW), Chicago, Ill.
Tom Weiss (WPE8IGN), Cuyahoga Falls, Ohio
Pete Sils (WPEØEAX), Cedar Falls, Iowa
Larry Jones (WPE5EFQ), Laurel, Miss.
John Stevenson (WPE9GNU), Delaware, Wis.
James Drost (WPE2NEH), Hampstead, N. Y.
Bob Burckle (WPE4IHZ), Louisville, Ky.
Silvio A. Marini, Jr. (WPE4IIO), East Point, Ga.
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John A. Brebner (VE3PE2EL), Kingston, Ont., Canada

SHORT-WAVE ABBREVIATIONS

annmt Announcement	N.A.—North America
BBC British Broadcasting Corporation	QRM—Station interference
B C Broadcasting	R. Radio
Eng. English	s/off Sign-off
ID Identification	VOA—Voice of America
kc.—Kilocycles	xmsn Transmission
	xmtr— Transmitter

Maldive Islands—After long test xmsns, *Mali Sinico Radio* is now conducting regular broadcasts at 0200 on 9650 kc. in Hindi, Singhalese, Tamil, and Japanese. Has anyone logged this station as yet? We'd appreciate receiving the complete schedule as well as the address and technical information.

Mexico—Station XEMP, Mexico City, 11,740 kc., is now using the ID *La Charrita del Cuadrante*. It is being heard from 1815 to 2015 in Spanish.

New Guinea—*R. Wewak*, VL9CD, Papua, has been noted weakly on 3335 kc. with a world news bulletin in Eng. at 0300 followed by a varied music program.

Pakistan—Karachi uses 9614 kc. in parallel with 11,672 kc. for the Turkish xmsn at 1345-1430. The 9740-kc. frequency listed by some sources is not being used.

Peru—The mysterious *R. Union*, 6115 kc., is heard at 0100-0200 with dance music; the only ID's noted to date consist of *con una programa especial de bailables*—a call-sign is never given, nor a location. Some sources list *R. Luz*, Lima, as being on 6115 kc.; however, it is actually on 3355 kc. and fair from 2200 to 2330/s/off with classical music, annmts, and commercials in Spanish.

Poland—Warsaw's latest schedule reads: to South America in Polish at 1800-1830, 1830-1900, 1930-2000, and 2000-2030 and in Spanish at 1900-1930 and 2030-2055 on 9675, 11,840, and 15,120 kc.; to Australia and New Zealand in Eng. at 0230-0300 and 0330-0400 and in Polish at 0200-0230 and 0300-0330 on 9675, 11,840, and 15,120 kc.; to Africa in Eng. at 0700-0730 and 0800-0830 and in French at 0730-0800 and 0830-0900 on 7125, 11,840, and 15,120 kc., in Eng. at 1400-1430 and in French at 1330-1400 on 7285 and 9675 kc., in Eng. at 1700-1730 and in French at 1730-1800 on 7125, 7145, 7285, 9675, and 11,840 kc.

Portugal—Lisbon is operating at times on 7225 kc. at 1730-1830 with pop music and Portuguese language in a beam to Sao Tome, Angola, and Mozambique; from 1830 to Brazil. The *La Voz del Occidente* service was heard at 2120-2145 but not dual to 6025 or 6185 kc.

Samoa (Western)—A short-wave xmtr is reported to be in operation at Apia on 6040 or 6140 kc. Schedule and the correct frequency are requested.

Somali Republic—*R. Mogadiscio*, 4968 kc., has been noted opening in Arabic at 2200 with world news; an ID at 2212, then Eng. news; from 2220 with native-language news, probably Somali. This is in dual to 7160 kc.

South Africa—The South African B/C Corp. will spend $5.6 million to build the most powerful radio xmtr in Africa, according to one news source. It will be used to send a true image of the republic and its people to the outside world, the article said. Broadcasts will be made in nine languages. However, there was no mention of frequencies to be used nor a target date for the opening of the station.

Spanish Guinea—*Emisora de Radiodifusion Santa Isabel*, Fernando Po, 6250 kc., is excellent at times with uninterrupted Chopin etudes from 1658 to 1735; then light pop music to 1752/close. S/off annmts were in Spanish and a brief march preceded the actual close.

Tahiti—Both outlets of *R. Tahiti* are giving excellent results on the West Coast, but the 6140-kc. outlet is now better than the 11,825-kc. outlet. The former is best around 0000-0100 in French, the

POPULAR ELECTRONICS
November 1965
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Joe Piechuta, Plantsville, Conn.
Bert Pryor, Athens, Ga.
Christopher Schwink, Williamsville, N. Y.
Radio Voice of the Gospel, Addis Ababa, Ethiopia
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

latter around 2200 with Tahitian-language programming.

Thailand—*R. Thailand*, HSK9, Bangkok, operates to N.A. at 2315-0015 with news in Eng. at 2325, and in their General Overseas Service at 0525-0657 with news in Eng. at 0530, on 11,910, 7185, and 6160 kc.; for the Thai Forces in Korea, Republic of Vietnam and Cambodia at 0430-0520 and in a Home Service relay at 0800-0900, on 11,910 kc. There is no Eng. listed for the two latter xmsns. Reception reports are requested and will be verified by card and acknowledged by letter. Return postage is not required.

Tunisia—Tunis I, 6195 kc., in the Arabic Network, overrides the BBC with chanting at 2345, an annt in Arabic at 2348, then wake-up exercises. It is QRM'ed after 0000 by the BBC and another signal, probably that of *R. Burundi*.

Windward Islands—St. Georges has moved up from 5010 kc. to 5020 kc. where it is heard at 1730-2115. The 19-meter outlet has also moved, this time to 15,130 kc.; try for it around 1530. East Coast listeners and those in the southern states might also try for one of the medium-wave network stations: Castries on 1565 kc. (down from 1580 kc.); St. Georges on 540 kc.; Roseau on 695 kc.; and Kingston on 705 kc. All of the latter stations broadcast with 500 watts except the 250-watt Castries outlet.

Medium Waves

Your Short-Wave Editor frequently monitors 800 kc. evenings to check on the signal of PJB, *Trans World Radio*, Bonaire. It generally runs fair to good despite the presence of two 50,000-watt Canadian stations, CKLW in Windsor, and CJAD in Montreal, as well as the 150,000-watt voice from XELO in Ciudad Juarez, Mexico. But we were surprised recently to receive the following report from a listener just *thirty miles* from CKLW: "PJB comes in here fair to good at 2100 with religious talks." This is the first time anyone living within 200-300 miles of either CKLW or CJAD has reported the 800-kc. outlet. —30—

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COMMERCIAL RATE: For firms or individuals offering commercial products or services. 90¢ per word (including name and address). Minimum order $9.00. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.
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GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass.

MESHNA'S TRANSISTORIZED CONVERTER KIT $4.50. Two models converts car radio to receive 30-50 mc or 100-200 mc (one mc tuning). Meshna, Lynn, Mass. 01901.

ELECTRONIC Ignition Kits, Components. Free Diagrams. Anderson Engineering, Epsom, New Hampshire 03239.

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DIAGRAMS for repairing Radios $1.00. Television $2.50. Give make model. Diagram Service, Box 1151 **PE**, Manchester, Connecticut 06042.

CB WPE QSL Cards. Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

ROCKETS: Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 18, Colorado.

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CANADIANS—GIANT Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio. Rush $1.00 (Refunded). ETCO, Dept Z., Box 741, Montreal, **CANADA.**

TV CAMERAS, transmitters, converters, etc. Lowest factory prices. Catalog 10¢. Vanguard, 190-48 99th Ave., Hollis, N.Y. 11423.

WEBBER Labs. Transistorized converter kit $5.00. Two models using car radio 30-50 Mc or 100-200 Mc, one Mc spread. Easily constructed. Webber, 40 Morris, Lynn, Mass.

JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

CANADIANS, TRANSISTORS AND PARTS. Free catalogue contains reference data on 300 transistors. J. & J. Electronics, Dept. PE, Box 1437, Winnipeg, Manitoba.

TRANSISTORIZED CONVERTER 26-200 MC. Receive signal from 26 to 200 MC (1 MC spread), on broadcast band using car radio, crystal control or tuneable (1 MC spread). Kit $11.00 pp. Wired $20.00 pp. Webber Labs, 40 E Morris St., Lynn, Mass.

COMPONENTS? Kits? Hardware? For catalogue write Trans-Vu-Pacs, Box 267, Chelsea, Mass. 02150.

QSL's BROWNIE W3CJI 3111A Lehigh, Allentown, Pa. 18103. Samples 10¢ with catalogue 25¢.

TRANSISTORS—Miniature Electronic Parts. Send for free Catalog. Electronic Control Design Company, P. O. Box 1432K, Plainfield, N.J.

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DETECTIVES! Free brochures! Electronic intelligence devices for your needs and budget. **SILMAR ELECTRONICS,** 3476 N.W. 7th Street, Miami, Fla. 33125.

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CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco Industries, Box 10563, Houston 18, Texas.

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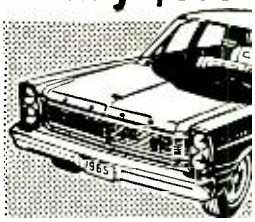

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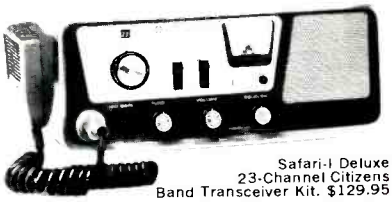

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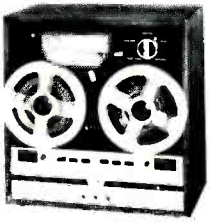

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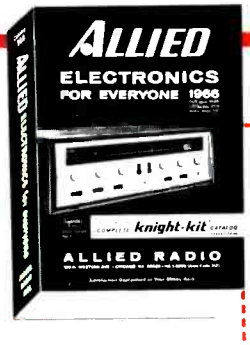

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