SPECIAL—CB Walkie-Talkie Fix-it Guide

DECEMBER-JANUARY 75¢

Science and Electronics

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If our transistor motor turns you on, our stroboscope will turn you off!

- No brushes or slip rings—just transistors to provide the push in this easy-to-build DC motor
- A transistor and tube join up in our goof-proof strobe circuit to visually freeze rotating motions

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Dazzle your friends with lightworks.

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The now dimension to music pleasure. EICO All Electronic Solid-State Audio-Color Organs transform sound waves into moving synchronized color images. Connect easily to speaker leads of hi-fi or radio. From $29.95

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The electronics you need to create audio-stimulated light displays to your own imagination. Activates Light Display Units, Strobe Lites, Lamp Controllers (Xmas trees, Patio lights, etc.). From $24.95 kit, $39.95 wired

Strobe Lites

High intensity bursts of white light from Xenon tube flash in cadence with each beat of audio. From $21.95 kit, $39.95 wired

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All amplifier power ratings according to IHF standards. Cortina designed and manufactured in U.S.A. and guaranteed by EICO

70-Watt AM-FM Stereo Receiver, including cabinet, Cortina 3770, $189.95 kit, $279.95 wired.

70-Watt FM Stereo Receiver, including cabinet, Cortina 3570, $169.95 kit, $259.95 wired.

150-Watt Stereo Solid-State Stereo Amplifier, including cabinet. For the audio perfectionist. Cortina 3150, $149.95 kit, $225 wired.

70-Watt Stereo Solid-State Stereo Amplifier, including cabinet, Cortina 3070, $99.95 kit, $159.95 wired.

FM Stereo Tuner, including cabinet, Cortina 3200, $99.95 kit, $159.95 wired

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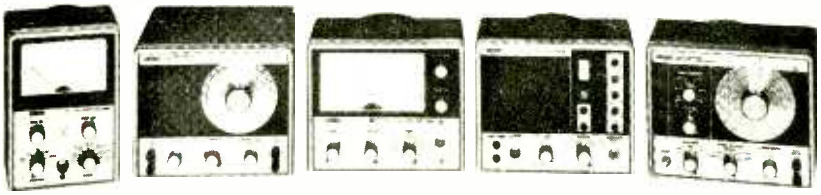

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your best investment for a rewarding career in electronics:

Transistor experiments on programmed breadboard—using oscilloscope.

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RCA stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER

Beginner or refresher—AUTOTEXT, RCA Institutes' own method of Home Training will help you learn electronics faster, easier, almost automatically.

3 THOUSANDS OF WELL PAID JOBS ARE OPEN NOW

RCA Institutes can help you qualify for a rewarding career if you have an interest in electronics. Every year, thousands of well paid electronics jobs go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Select from a wide choice of courses and career programs ranging from basic Electronics Fundamentals to advanced training including Computer Programming and Electronics Drafting. Each Career Program begins with the amazing AUTOTEXT method.

5 SPECIALIZED ADVANCED TRAINING

For those working in electronics or with previous training, RCA Institutes offers advanced courses. Start on a higher level. No wasted time on material you already know.

6 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

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At no extra cost, a variety of valuable specially engineered kits come with your program—yours to keep and use on the job.

8 TRANSISTORIZED TV KIT AND VALUABLE OSCILLOSCOPE

You will receive in most career programs a valuable oscilloscope. Those enrolled in the TV Program or courses receive the all-new Transistorized TV Receiver—exclusive with RCA. (Picture tube available at additional cost.)

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You can take advantage of RCA's convenient monthly payment plans. There is one to suit your budget.

10 RCA GRADUATES GET TOP RECOGNITION

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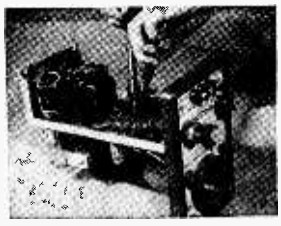
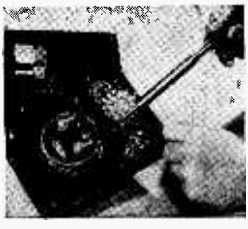
Construction of Oscilloscope.



Construction of Multimeter.



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December 1969/January 1970

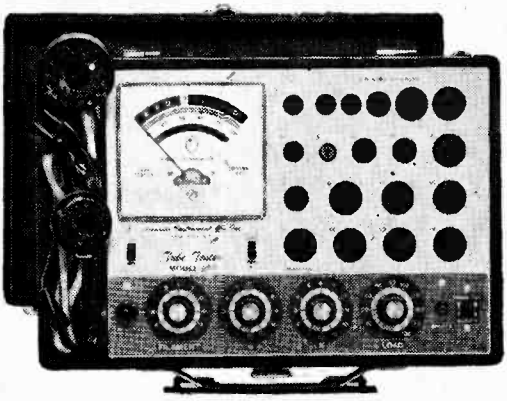
Science and Electronics

★ Cover Highlights

Cover illustration by Len Goldberg

The New 1970 Improved Model 257 **A REVOLUTIONARY NEW**

TUBE TESTING OUTFIT



- **Tests all modern tubes including Novars, Nuvistors, Compactrons and Decals.**
- **All Picture Tubes, Black and White and Color**

ANNOUNCING... for the first time

A complete TV Tube Testing Outfit designed specifically to test all TV tubes, color as well as standard. Don't confuse the Model 257 picture tube accessory components with mass produced "picture tube adapters" designed to work in conjunction with all competitive tube testers. The basic Model 257 circuit was modified to work **compatibly** with our picture tube accessories and those components are not sold by us to be used with other competitive tube testers or even tube testers previously produced by us. They were custom designed and produced to work specifically in conjunction with the Model 257.

COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

STANDARD TUBES:

- Tests the new Novars, Nuvistors, 10 Pins, Magnovals, Compactrons and Decals.
- More than 2,500 tube listings.
- Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
- Ultra sensitive circuit will indicate leakage up to 5 Megohms.
- Employs new improved 4½" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
- Complete set of tube straighteners mounted on front panel.

BLACK AND WHITE PICTURE TUBES:

- Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
- The Model 257 tests all Black and White Picture Tubes for emission, inter-element shorts and leakage.

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- The Red, Green and Blue Color guns are tested individually for cathode emission quality, and each gun is tested separately for shorts or leakage between control grid, cathode and heater. Employment of a newly perfected dual socket cable enables accomplishments of all tests in the shortest possible time.

The Model 257 is housed in a handsome, sturdy, portable case. Comes complete with all adapters and accessories, ready to plug in and use. No "extras" to buy. Only **$52.50**

NOTICE *We have been producing radio, TV and electronic test equipment since 1935, which means we were making Tube Testers at a time when there were relatively few tubes on the market, way before the advent of TV. The model 257 employs every design improvement and every technique we have learned over an uninterrupted production period of 34 years.* *Accurate Instrument Co., Inc.*

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Try it for 10 days before you buy. If completely satisfied remit $52.50 plus postage and handling charge. (If you prefer you may **PAY MONTHLY ON OUR EASY PAYMENT PLAN.)** If not completely satisfied, return to us, no explanation necessary.

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Science and Electronics

Volume 27 Number 3

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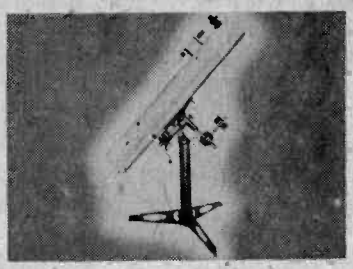

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Superb Astronomical Reflector—Up to 576X. Capable of revealing faint stars of nearly 13th magnitude, split double stars separated by less than 1 sec. of arc. Features aluminized & overcoated 6" f/8 ground and polished pyrex parabolic mirror accurate to ¼ wave, 48 F.L. 6X achromatic finder scope. 4 eyepieces—48X Kellner, ½" 96X & ¼" 192X Ramsdens, Barlow to double or triple power—rack & pinion focusing mount. 47¾" aluminum tube. Electric clock drive w/manual slow-motion control. Setting circles. Heavy-duty equatorial mount. Pedestal base. Compares to $295–$350 models.

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4¼" REFLECTOR TELESCOPE

Stock No. 85,105HP 3".....$94.50 F.O.B.

Stock No. 85,050HP.....$29.95 Ppd.

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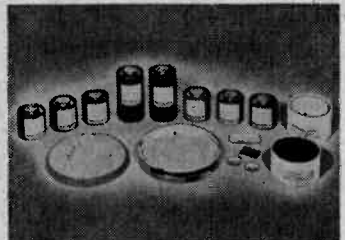
Big, new 100-page handbook packed with facts, loaded with illustrations. All latest developments, applications, equipment. Covers strobes, sources, black light, projectors, crystal and organic slides, color organs, mirrors, polarized color, screens, light boxes, MusicVision, etc. Rare find for business, home, hobby. Ideal for display houses, combos, experimenters, hobbyists. 8½" x 11" looseleaf paper punched to fit 3 ring binder . . . add new developments as they happen.

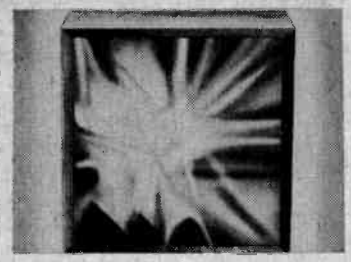
Stock No. 9100HP.....$3.00 Ppd.



ASTRONOMICAL TELESCOPE KITS

Grind your own mirror for powerful telescope. Kit contains fine annealed pyrex mirror blank, tool, abrasives, diagonal mirror and eyepiece lenses. You build instrument valued from $75.00 up.

Stock No.	Diam.	Thickness	Price
70,003HP	4¼"	¾"	$9.75 Ppd.
70,004HP	6"	1"	13.95 Ppd.
70,005HP	8"	1⅜"	21.00 Ppd.
70,006HP	10"	1¾"	34.25 F.O.B.
70,007HP	12½"	2⅛"	65.85 F.O.B.



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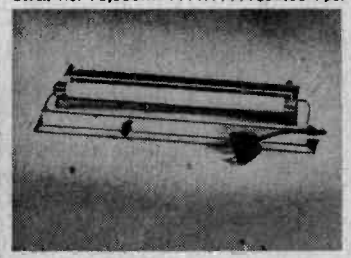
The almost hypnotic spell of ever changing firelight has been captured in a cool-light display box! With the liquid motions of a rising and cascading fountain blowing in the wind, psychedelic colors appear, intermingle and vanish to rise again in new patterns and drift away. This soothing light show housed in a handsome 11½" square by 7" deep, walnut finished lumia light box is an effective addition to any room—your living room, bedroom, rec-room, doctor's office. Especially effective among a wall picture group. Modern as tomorrow—available today!

LUMIA LIGHT BOX

Stock No. 71,180HP .....$29.95 Ppd.



LONG-WAVE BLACK LIGHT FIXTURE

Extremely versatile, compactly designed, long wave (3200-4000 angstroms) black light (ultraviolet) fixture. Has 6-watt, 110-V lamp with built-in filter—eliminates harmful shorter wave ultraviolet rays. Use to identify minerals, fungi, bacteria—check for surface flaws, oil and gas leakage—perfect for displays with fluorescent paper, paints, chalk, crayons, trace powder. Incl. adjustable aluminum reflector, push-pull switch, connecting plug. Mount vert., horr., or on corner. 10" L., 1½" W., 1¼" H.

Stock No. 70,364HP.....$12.50 Ppd.

REPLACEMENT BULB

No. 60,124HP .....$4.50 Ppd.

"FISH" WITH A MAGNET

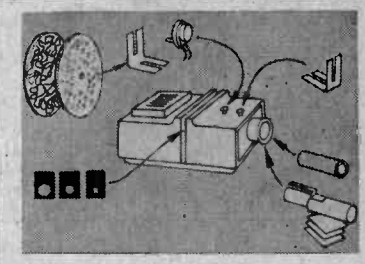
Go treasure hunting on the bottom. Fascinating fun & sometimes profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasure" haul can be outboard motors, anchors, other metal valuables. 5-lb. Magnet is war surplus—Alnico V Type—Gov't cost $50. Lifts over 150 lbs. on land—much greater weights underwater.

Stock No. 70,571HP.....$14.00 Ppd.

Stock No. 70,570HP—3½ lbs...$ 8.75 PPd.

Stock No. 70,572HP—7½ lbs...$18.75 Ppd.

Stock No. 85,152HP—15¾ lbs..$33.60 FOB



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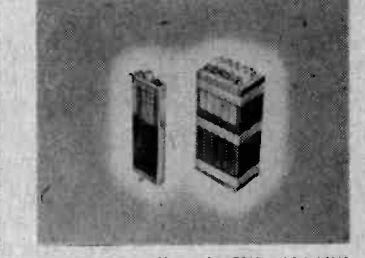
Dazzling, avante-garde visual effects. Fantastic variety. Incredibly beautiful. Special package offer contains all necessary apparatus. Create floating, exploding, fiery bursts of color like "Symphony of Spheres," "Chromatic Starbursts," "Crystal Starburst." Features 35 mm 500 W. fan cooled projector,—produces big image at short distance. Accepts two 9" diam. wheels (Dry Kaleidoscope & Hexidoscope), 2 cylindrical accessories (6" Colored Cloud & 5" Hexidoscope w/six internal mirrored walls). Perfect for entertaining, parties, photography. Complete instructions.

Stock No. 71,121HP .....$79.50 Ppd.



NICKEL-CADMIUM BATTERY BARGAIN!

Terrific values—slightly used gov't surplus. Lightweight 5 cell, 6 volt, 4 Amp-hour battery with almost unlimited life. Extremely high current output. Recharges in 1 hour with Edmund kit. Won't deteriorate when left discharged. Minimum maintenance—few drops of water per year. Rugged, shock-and-vibration resistant nylon case. Delivered partially charged, filled with electrolyte. 3⅛"x2"x6⅞". 2 lb.

Stock No. 70,942HP (battery)...$15.00 Ppd.

Stock No. 70,807HP (charger kit).$8.00 Ppd.

Stock No. 41,109HP (cell).....$3.95 Ppd.

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148 PAGES! MORE THAN 4,000 UNUSUAL BARGAINS!

Completely new 1970 edition. New items, categories, illustrations. Dozens of electrical and electromagnetic parts, accessories. Enormous selection of Astronomical Telescopes, Microscopes, Binoculars, Magnifiers, Magnets, Lenses, Prisms. Many war surplus items: for hobbyists, experimenters, workshop, factory. Mail coupon for catalog "HP." **EDMUND SCIENTIFIC CO., 300 EDSCORP BUILDING, BARRINGTON, N.J. 08007**

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POSITIVE FEEDBACK

Julian M. Sienkiewicz
EDITOR-IN-CHIEF

☐ Why is it many people believe magazine editors are expert poker players? True, we all have poker faces, but that is besides the point.

The reason I brought this subject up is very simple. After receiving a few letters from readers in downtown Burbank, Calif. requesting odds of information on different poker hands, I had some difficulty in obtaining same. In fact, when several knowledgeable people were asked to compute the odds, the results differed. Man, what a mess!

So here are the odds (see box below) as computed by your Editor with the help of several text books and a desk-top computer. If you disagree with my computations, please let me know. Supply the correct probability and your method used to compute same.

Combination	Probability in Five Random Cards
ONE PAIR (Two cards of one kind)	0.4237
TWO PAIR (Two cards of one kind; two of another kind)	0.04761
THREES (Three cards of a kind)	0.02128
STRAIGHT (All five cards in sequence but of different suits)	0.003925
FLUSH (All five cards of one suit but not in sequence)	0.001965
FULL HAND or FULL HOUSE (Three cards of one kind; two cards of another kind)	0.001441
FOURS (Four cards of one kind)	0.0002401
STRAIGHT FLUSH (Five cards of the same suit and sequence)	0.00001385
ROYAL FLUSH (An ace high straight flush)	0.000001539

And, if you happen to agree with me, let me know how you did it. Never can tell, I may have stumbled on the right answer with the wrong technique.

We Pass. In this issue we have omitted the Bookshelf column due to circumstances beyond our control. Please forgive us. The column will return with the next issue.

As We Go to Press. Shortwave listeners will spot an obvious goof in our Biafran story (see page 43), but it's not our fault. The provisional capital in our story is Orlu, but the provisional capital has since become Owerri. We hope Owerri will still be the capital when you read this. Either way, our Biafran story makes for exciting reading and all broadcasting frequencies and times remain unchanged to the best of our knowledge.

Hot News Item. In the past we have brought our readers some hot news items which are the original efforts of George Caisse of Levittown, Pa. Here's one more to tickle whatever or wherever you tickle best.

• Las Vegas (Special)—Rockhill Squelch, popular module and pin-up coil, brought down the house while performing a wire-stripping act here Saturday night. Miss Squelch, although considered to be well abreast of the times, is alleged to have had several brushes with the law. She appeared on stage in a new gown covered with sequence, and complained that the men in blue had bugged her dressing room and crimped her style with new regulations.

When interviewed backstage, she revealed that the City Contoller told her that he is opposed to any attempt to ground her chassis; this took a big load off her mind. ■

"Thirteen dollars! Why in 1924 a service call was only a dollar and the repairman threw in a new crystal!"

Special $5 Offer

Learn TV repair...10 day trial!

Don't take *our* word for it—prove it to yourself! If you don't agree with every word we say about ICS's new TV Servicing/Repair course—we lose the bet and *you lose nothing.*

Send Just $5

Simply send us $5 for the first text of the course. Read through it. See how simple and easy-to-understand the instruction is. And how thorough. Then decide for yourself. While this first text will not, by any means, give you a complete training—it *will* convince you how easy it is to learn—the ICS way.

And, if by chance you're not convinced—simply return the text within the 10 day trial period and receive a full refund.

Worth Much More

As a part of the complete course, this text is worth much more than $5. This special trial is simply our way of showing you how completely confident we are that the ICS TV Servicing/Repair course can stand up to *any* TV Repair training you can get *anywhere,* at *any price*—yet the full cost is only $99.

In just a few months you can be trouble-shooting on color sets. Just the first two texts combined will enable you to repair 70 percent of *all* TV troubles. Instruction is simple, very easy to grasp. Photos show you what a TV screen looks like when everything is normal, and what it looks like when trouble fouls it up. The texts tell you how to remedy the problem and why that remedy is best. What's more, quizzes are spotted throughout the course so you can check your progress.

Course is Short . . . Complete

All in all, the course consists of 6 texts . . . 936 pages of concise, easy-to-follow instruction . . . plus 329 detailed illustrations . . . a dictionary of TV terms geared directly to course material—which will be invaluable during the course and later.

At the end, you get the coveted ICS diploma, plus membership in the ICS TV Servicing Academy. And by that time you will be able to handle tough, multiple TV problems on color sets as well as black and white—100% of all TV malfunctions! This could mean a tremendous future for you. Full-time, part-time, your own business.

The National Electronic Associations found this ICS course so thorough, so helpful, easy to grasp that they approved it (first home study course ever to receive such an honor) for use in their own apprenticeship training program.

Act Now

You have nothing to lose. Send coupon today or write ICS, Scranton, Pa. 18515. Then examine the first text. See for yourself. If, during the 10 day trial period, you're not convinced—just return the text. And we'll refund quickly.

ICS International Correspondence Schools
Division of Intext

ICS, Scranton, Pa. 18515 **G8589K**

☐ Here's my $5.00. Send me the first text of the ICS TV Servicing/Repair Course. If I'm not convinced within 10 days that this is the most thorough and easy to understand way to learn TV repair, you'll refund my money and that's that.

Name_____
(please print)

Address_____

City_____ State_____ Zip#_____

☐ Send the full course. I've included $99—plus state tax. (And I'll still have the 10 day trial refund privilege.)

Return This Coupon Today For 10 Day Trial.

Pencil in that Design

A slim, 3-oz. instant heat pencil iron that will do the work of much heavier pistol-type guns has been brought out by Wall Mfg. as their Model IDL. Its slimness came about

Wall Soldering Pencil

by using a dual heat element controlled by a thermal time delay relay, nixing the need for a transformer. When a switch on the handle is depressed, a high-wattage element brings the tip temperature up to operating heat in seconds. The relay then cuts in a lower wattage element that maintains the proper soldering heat with no danger of overheating. It continues at the lower wattage until a higher heat is required, then the relay cuts in again for as long as needed. Initial input is 180 watts and it operates at 40 watts. Heating elements may be changed without tools. Iron-plated or ⅛-in. plug-in tips are inserted by loosening one set screw, and you can match the tip to your job. Price is $9.95 and more info can be had from Wall Manufacturing Co., Kinston, N. C. 28501.

Neat Lil Radio

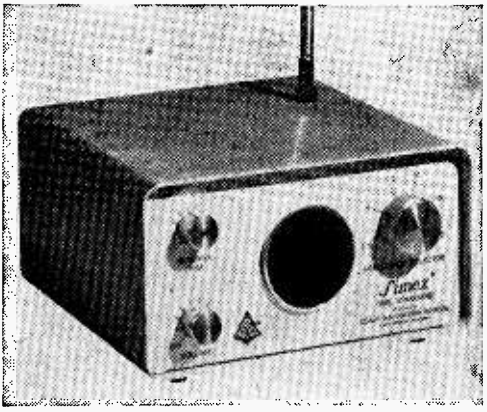
Heath Company has brought out a solid-state AM/FM table radio, the GR-48, a bargain at $39.95 in kit form. The GR-48

Heathkit GR-48 Table Radio

has switchable automatic frequency control (AFC) and 5 μV sensitivity. Automatic gain control on AM keeps the volume constant under varying signal strengths. There are built-in AM and FM antennas. The cabinet is avocado green with a color-coordinated grille. The dial is back lighted and all controls are front-panel mounted. There's a 3 x 5-in. oval speaker. The circuit goes together on a single circuit board, and the AM/FM tuner is supplied pre-assembled and factory-aligned. Write for more on the GR-48 to Heath Co., Benton Harbor, Mich. 49022.

Time, Gentlemen!

Here, developed by the Coast Navigation School of Santa Barbara, Calif., is the Simex Time Standard, which gives you an accurate GMT signal, anywhere you are. The receiver operates on fixed frequencies at 2.5, 5, 10, 15, and 20 MHz to receive signals from WWV in Fort Collins, Colo., and WWVH in Hawaii. An additional special frequency at 7.335 MHz will get you CHU in Ottawa, Canada. The receiver will also pick up standard time signal patterns from Tokyo, Moscow, Johannesburg, and others through-



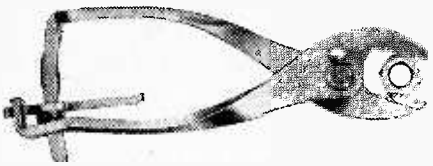
Coast Navigation School Simex Time Standard

out the world. The Simex Time Standard measures 4 x 8 x 8 in., weighs 3 lb., and operates on either batteries or 12-V power supply. Price is $159.50 and you can find out more about it by writing Coast Navigation School, 418 E. Canon Perdido, Santa Barbara, Calif. 93101.

Pliers with Pizazz

The Sta-Tite Corp. calls these automatic locking pliers Lock-Matic. The tool is 7½ in. long and does the work of an adjustable wrench, clamp, or gripping tool, in addition to performing as pliers. Its two-position slip joint jaws open from zero to ⅞ of an inch with locking action and to an inch and a

"It works okay when plugged in, but I get too many ghosts without a rooftop antenna!"

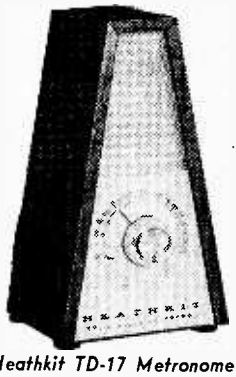


Sta-Tite Automatic Locking Pliers

quarter for use as pliers. Lock-Matic pliers are made of heat-treated steel with a chrome finish, and they will hold objects with pressures ranging from a fraction of an ounce to 1000 lb. Price is $3.98 and you can get more info from Sta-Tite Corp., 3900 Louisiana Circle, St. Louis Park, Minn. 55426.

Keeping Time with Solid State

Here's a solid-state metronome kit, the TD-17, from the Heath Company. It's adjustable from 40 to 210 beats per minute. You set the desired tempo on a large, easy-to-read dial and the volume is adjustable by a control on the back panel. There's a chart on the bottom that converts tempo in differ-

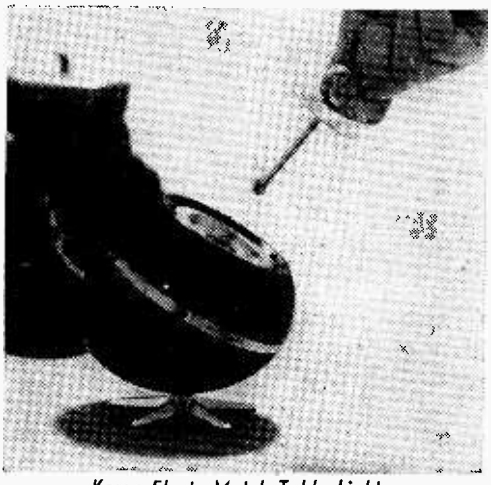


Heathkit TD-17 Metronome

ent time signatures to beats per minute. The TD-17 uses batteries and maintains its accuracy indefinitely. Unit assembles in about two hours on one small circuit board and is furnished with a cherry-finished cabinet. Price is a mere $12.95. Write for more information to the Heath Co., Benton Harbor, Mich. 49022.

A Regular Ball o' Fire

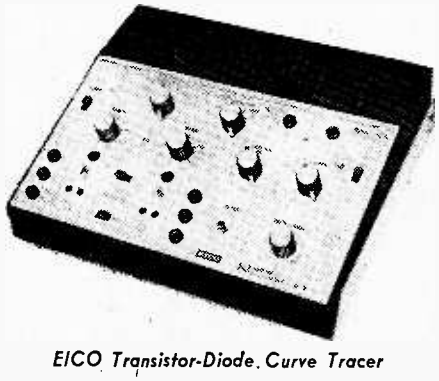
Want to make your boss happy for Christmas? Here's a new, different kind of table lighter, operated by battery. It's called ElectroMatch and it's available in black or white with gold trim. The "match" is a life-time nylon wick encased in metal with a sculptured handle. There is no flint to replace; a large fluid reservoir lasts for weeks, and batteries last for 6 months. Price is $19.95 with a one-year guarantee. Write to Korex Industries, 821 Malcolm Rd., Burlingame, Calif. 94010.



Korex ElectroMatch Table Lighter

Hardtop Convertible

With the new EICO Model 443 you can convert your scope to a curve tracer. This transistor-diode curve tracer makes it possible for you to obtain direct readout of semiconductor characteristics on an oscilloscope. Diode and rectifier curves then can be traced include forward voltage, forward current,



EICO Transistor-Diode Curve Tracer

reverse current, and peak inverse voltage. Transistor tests include h_{FE}, h_{OE}, i_{CEO}, v_{CE}, (sat), and bv_{CBO}. Beta can be read directly from the controls on the front panel. A special matching switch allows you to compare or match sets of transistors. The Model 443 features all silicon solid-state printed circuit board construction and dual

transformers for isolation and safety. Other features include a flashing light to indicate presence of high voltage on the diode test terminals, built-in oscilloscope voltage calibrators, and terminals for connecting external test sockets. The 443 transistor-diode curve tracer is available in kit form at $69.95 and factory-assembled at $99.95. For further information write EICO Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, N. Y. 11207.

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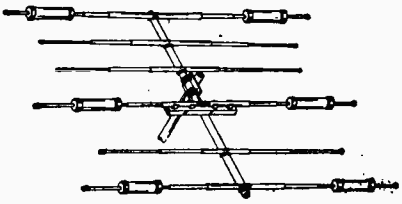

Mosley Classic 36 Amateur Radio Antenna

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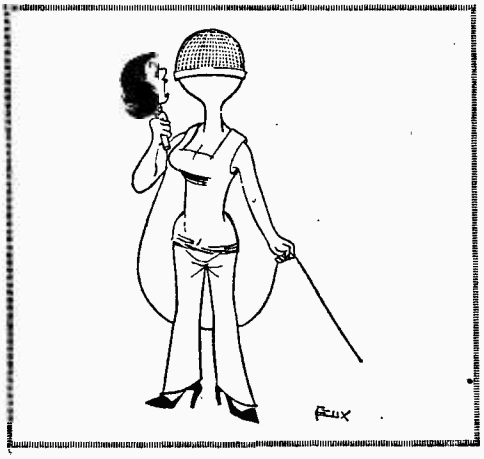

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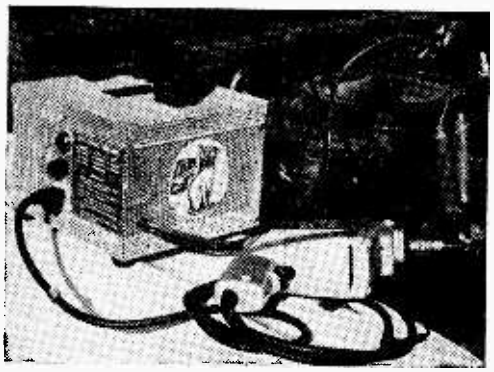

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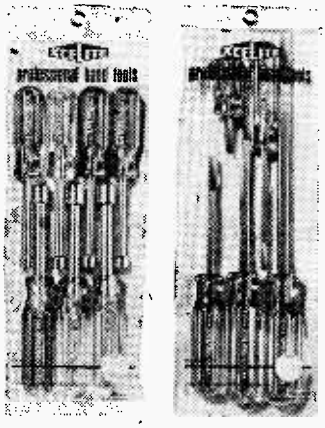

Xcelite Packaged Professional Hand Tools

Piezo Mike—No Wires

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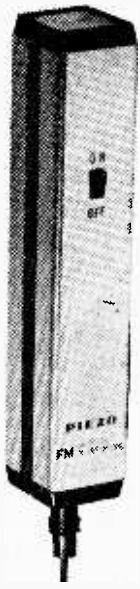

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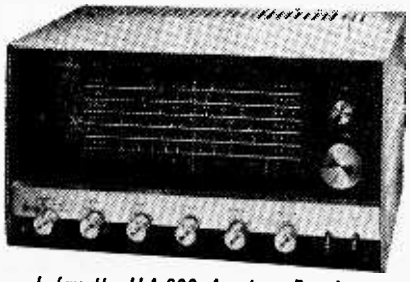


Lafayette HA-800 Amateur Receiver

brator (less crystal). Sensitivity is better than 1 μV on 20, 40, 80 meters, 0.5 μV on 15, 10 meters, and 2.5 μV on 6 meters. Size is 15 x 9¾ x 8¼ in. The price is $149.95 and you can get more specs from Lafayette Radio Electronics, 111 Jericho Tpke., Syosset, N. Y. 11791.

Chemtronics Tun-O-Foam Tuner Spray

Let Us Spray

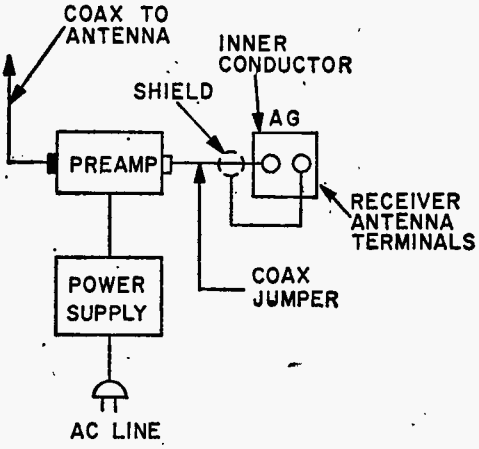
Chemtronics has a new tuner spray which does away with any carbon substance, using instead a synthetic element. They claim it to be longer-lasting, capable of withstanding extremes of temperature and maintaining lubricity over thousands of channel changes. Called Tun-O-Foam, it will keep your tuner lubricated from −40°F to +290°F. Along with lubrication, Tun-O-Foam provides a cleaning and polishing action. Non-abrasive, it will not wear away thin metal platings. Price is $2.39 for an 8-oz aerosol can and it's available from Chemtronics, Inc., 1260 Ralph Ave., Brooklyn, N.Y. 11236.

(Continued on page 100)

50 Miles—Wants More

I was wondering if you had plans for a directional antenna for my 150-175 MHz police band receiver. I have inquired to other magazines but have received no answer. Also, I would like to know where I can get a pre-amp for the above band. I would greatly appreciate any further information on improving reception in this band, so I can receive signals from a greater distance. At present I average about 50 miles using a ground plane type antenna.

—R. K., No. Arlington, N. J.



A detailed description of how to construct a directional VHF antenna would take up two or more pages. You can get a lot of dope on how to build one in "The Radio Amateur's Handbook" which you can buy at most radio parts stores and which describes 144-148 MHz band ham antennas. Just make the elements a bit shorter for the police band. However, don't expect a big range improvement—50 miles is sensational for that band. As for a pre-amp, you can use an Ameco PV-144 connected as shown in the diagram. But, with 50-miles range, do you need it?

Color Blind

I want to buy a color TV set but am confused. One company advertises that its sets are better because of hand-wiring. Most others use printed circuits. Which is better?

—F. A., Flushing, N. Y.

Hand-wiring costs more. But, printed circuits are considered so reliable that most military and aerospace equipment employs them. Our experience indicates that the hand-wired TV sets are excellent, not necessarily because of hand-wiring, but so are many that employ PC boards. Our formula for purchasing a color TV set is simple: find the model you want in a showroom, and if it is working with good color, buy that floor model and nothing else. Sure, your set will be slightly used, but if it works in the showroom, it'll work at home.

Goodbye, Dear World

Would you tell me how to take the back off of my GE Porta-Color TV set? I took all the knobs off and the screws, it says to, but I couldn't seem to make it.

—J. H. B., Maynard, Mass.

Have you tried a crowbar or beer bottle opener? Best bet is to call the GE service department in Boston and ask. Unless you know what you're doing, don't mess around with the innards of a color TV set. Frankly, if you can't get the back off, what the heck you plan to do once it's off—electrocute yourself?

RC on C with Class D 505—Yuck!

What form do I ask the FCC for in order to obtain a radio control license in the .72 MHz band?

—A. S., Evergreen Park, Ill.

FCC Form 505. Same as for Class D CB. Yours would be Class C.

DXing Out-of-Town

I would like to receive Channel 3 from Hartford, Conn. (WTIC). I just bought a rotator and a Channel 3 antenna but I can only get Channel 3 from Philadelphia, including Channels 2 and 4. I thought if I could filter out Channels 2 and 4 I might be able to get WTIC. Could you give a circuit that would do that? If it is possible to eliminate Channel 3 from Philadelphia as well I would appreciate a circuit for it, too!

—R. E., Brooklyn, N. Y.

You've got a sticky wicket. Filters, designed for CATV head ends (receiving locations) are available, but expensive. Try calling Vikoa on its New York City tie line, WH 3-5793. If no luck, write to Jerrold Corp., 401 Walnut St., Philadelphia. As for eliminating the Philly station, you need the most directive antenna you can get, and it should have a high front to back ratio.

transformers for isolation and safety. Other features include a flashing light to indicate presence of high voltage on the diode test terminals, built-in oscilloscope voltage calibrators, and terminals for connecting external test sockets. The 443 transistor-diode curve tracer is available in kit form at $69.95 and factory-assembled at $99.95. For further information write EICO Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, N. Y. 11207.

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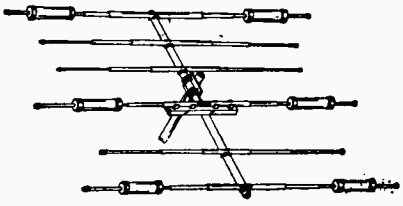

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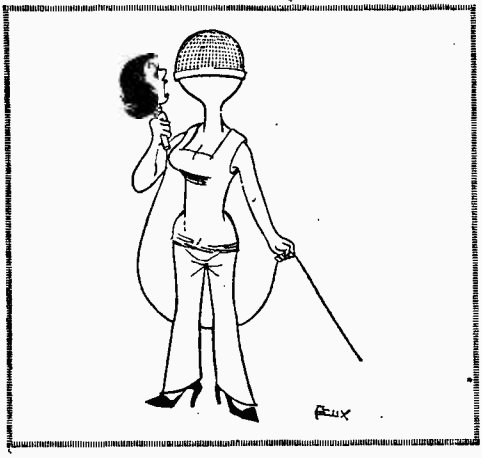

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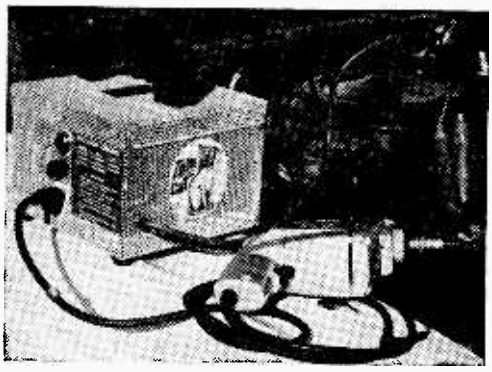

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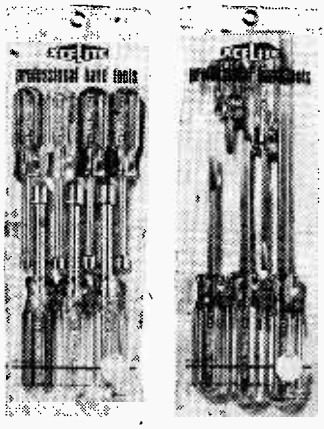

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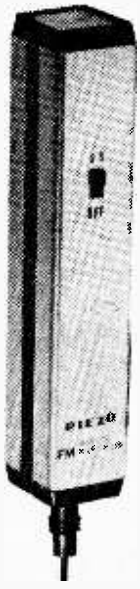

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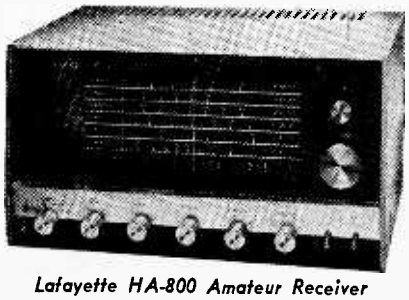

Lafayette HA-800 Amateur Receiver

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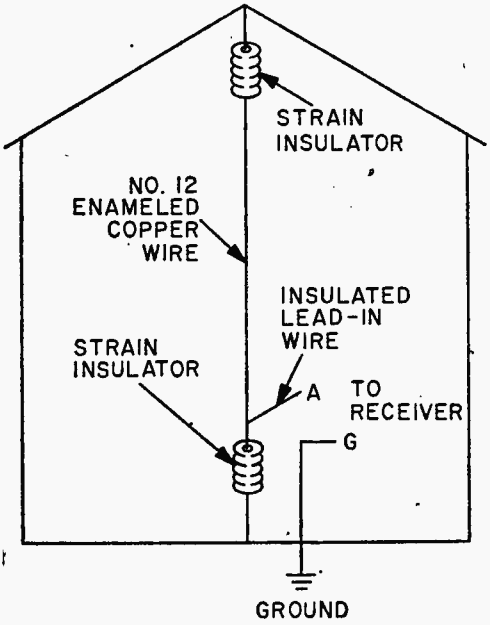
Try a Long Run

Could you please tell me what type of antenna I should use for short wave reception in the 2 to 8 MHz range? I am in an area where there are houses and power lines.

—T. D., Rochester, N. Y.



If you've got room, run a 50-foot long inverted L wire antenna. If very little room, run a vertical wire alongside the house as shown in the digram. Use a ground, too.

Buy a Timex

I am a shortwave listener and I know that

"Sure I have a license. Here's my FCC License—Foul, Cougar and Coyote!"

WWV and WWVH time signals are at 2.5, 5, 10 and 15 MHz so what is it doing around 7535 kHz?

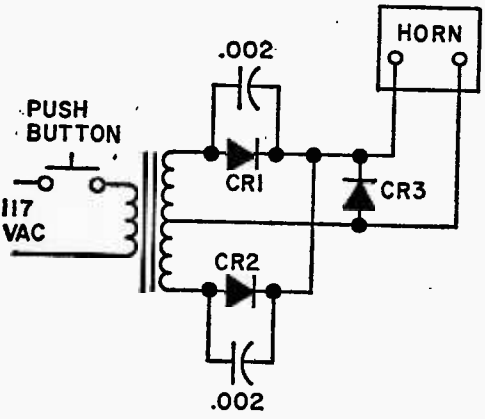
J. W. R., West Hartford, Conn.

That stray is a Canadian time standard station.

Up the Amps

I have a 6-volt automobile horn that I would like to operate on AC outside of the house. Is this possible? If so, how can I do it? I tried a 10.5-volt doorbell transformer but that wouldn't do it.

—G. K., Riverside, Calif.



The doorbell won't handle enough amps. When you connect it to the horn, the voltage drops because of the poor voltage regulation of your bell transformer. You can try making a power supply consisting of a heavy-duty, 12.6-volt, center-tapped filament transformer, heavy-current diode rectifiers and an inductive surge protector (CR3) which is also a heavy current diode.

Radio Power

My AM-FM-LW-MB-SW has been giving me problems. On shortwave (4.5-23 MHz) I receive unwanted television and AM/FM audio. Realignment does not help. How can I cure this?

—T.G.O., New York, N. Y.

Don't we all have the same problems? The air in Manhattan is not only filled with soot, but is also polluted with radio signals and noise. There is no easy cure for your problem unless you move to Brooklyn.

Soft Egg

Recently, I ordered a 550 kHz to 30 MHz receiver and in my opinion it has the best specs for any receiver I have ever seen at its price. But one thing has puzzled me. I have read Ask Me Another *for years, and in nearly every other issue there has been a letter about Q-multipliers and filters, mechanical and crystal. I have never used filters, and consequently don't know their purpose, or even what they are. I wish you would clarify me on this point, and then tell me whether the receiver I ordered will suffer, or gain, by having one. Specifications are enclosed. You will find the receiver has an excellent Q-multiplier.*

—G. R. C. Sitka, Alaska

The specs you sent indicate you do not need to add a selectivity filter. They're for receivers that are not selective. When your Q multiplier will allow you to adjust IF bandpass from 300 to 4500 Hz at 6 db down, up to 70 db peak and a 60 db notch, it's like asking for egg in your beer if you want more. Of course, you might like egg in your beer—or even in your coffee as some Alaskans do.

We're Still Right

In regard to an answer in Ask Me Another, *you told S.R.M. of Chicago he could not convert an FM BCB receiver to 108-160 MHz. Well he can! Any FM receiver can receive, if tuned properly, from 108-160 MHz. I suggest you apologize. If the receiver is not truly FM why can it receive 88-108 MHz signals. Tell me that, old man.*

—Moonbeam, Brooklyn, N. Y.

Moonbeam, of course an FM BCB receiver can be converted to tune through the aviation (118-134 MHz), land mobile (150-174 MHz) and marine (152-162 MHz) bands. But you won't be able to demodulate AM aviation signals unless the receiver is modified to pick up the AM signal at or ahead of the limiters since the limiters erase AM. While you will be able to demodulate FM signals in the land

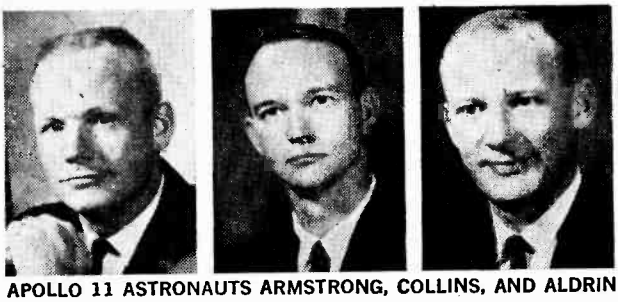
". . . and under the dash there's a hi-fi long playing gramophone!"

NOW...You can follow the footsteps of America's Astronauts on the moon...with the new, inflatable HAMMOND MOON GLOBE!

A Triumph Of Graphics, Cartography And Research...

NOW AVAILABLE IN BOTH STANDARD AND ILLUMINATED MODELS

This detailed new inflatable globe lets you pinpoint where Apollo 11 Astronauts Neil Armstrong and Buzz Aldrin first walked on the moon. Find the Sea of Tranquility...the Sea of Serenity...the Ocean of Sorrows...all the places whose names are soon to become bywords of the Space Age. Spot mountain ranges, waterless seas and craters. Find future Apollo mission landing sights. Use the latitudinal and longitudinal grid to locate every feature—every point that man explores.



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Maplewood, New Jersey

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Maplewood, N. J. 07040

YES! Please rush me #_____Hammond Moon Globe(s) today!
I enclose my check (or money order) for $_____ to cover:
#_____Illuminated Model(s) @ only $16.95 ea.
#_____Standard Model(s) @ only $12.50 ea.
PLUS 75¢ EACH FOR POSTAGE AND HANDLING

NAME_____

ADDRESS_____

CITY_____STATE_____ZIP_____

mobile and marine bands, it will be difficult to separate the stations and audio recovery (volume) will be low. This is because an FM BCB receiver is designed to separate stations whose carriers are 200 kHz apart and to pass FM signals with ±75 kHz FM deviation. Land mobile channels are spaced 20 to 30 kHz apart and narrow band FM (±5 KHz) is used. If you add an NBFM 10.7 MHz selectivity filter at the IF input, selectivity will be improved, and if you also replace the discriminator or ratio detector input transformer, greater audio recovery will result.

Wants AC Only

I have an AC/DC shortwave receiver. I would like to know if there is an inexpensive way to convert it to an AC type?

—B. E. M., Sterling, Ill.

The easiest way is to connect a 1:1 isolation transformer between the set's power plug and the power outlet. They come equipped with a line cord and receptacle into which you can plug in your set. The harder way is to rewire the tube heaters from series to parallel and to install a power transformer in the set. The first way is cheaper, easier and the results are the same.

Why Ask Us?

Could you please tell me what type or types of batteries I could use in a Silvertone Model 1919 receiver?

—T. A. R., Utica, Mich.

Write to Sears, Roebuck & Co., Arthington Ave., Chicago, Ill., where such information should be on file.

Neon, Gretchen!

Now a resident of Germany, I need a used 15,000-volt 30-ma, neon sign transformer. Could you tell me where I might obtain one for say $8.00 to $15.00?

—P. B., Mannheim, Germany

With so many taverns serving such fine beer in Germany, why don't you try asking some of the barmaids if there's a defunct neon beer sign in the basement?

Odd Ball

Where can I get type 832A tubes for a VHF transmitter?

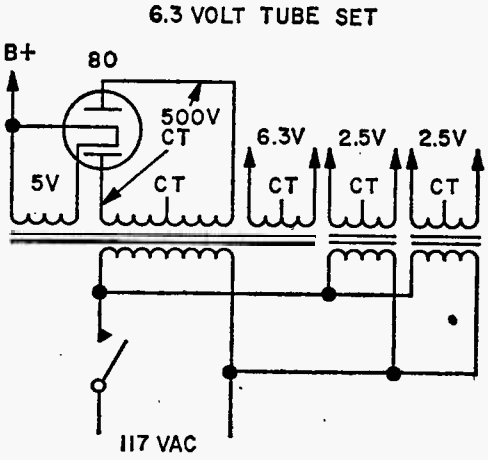
—C. E. C., Pittsburgh, Pa.

Metropolitan Supply Co., 468 Park Avenue South, New York, N. Y. 10016, carries them in stock. Write for their tube catalog. You might also be able to get them from Griffith M. Morgan Co., 1337 W. Fargo, Chicago, Ill. 60626.

Who Took It?

I have a Model 60 Atwater Kent radio. The transformer near the 80 tube is missing. Where can I find a replacement?

—K. D., Colfax, Wis.



While we recall most AK receivers, we don't remember if the 60 employs 2.5 volt or 6.3 volt tubes. If the latter, a Triad R-10 A (or equal) power transformer should do. However, if 2.5-volt tubes are used, you also need one or two 2.5 volt filament transformers (Triad F-6X, for example), depending upon whether the AF output tube filaments are isolated from the heaters of the other tubes. See diagram. The same techniques can be used with other early vintage receivers.

Those Were the Days . . .

I wonder if you have any information on a broadcast station whose call letters were WEAF? I have no idea when it went off the air, but I know such a station existed because I saw an RCA AM/SW radio, with one of its push button station selectors labeled WEAF.

—R. W., Washington, N. J.

It is now WNBC and is owned by NBC. It used to be owned by AT&T. By the way, there is a WEAF on the air today. See White's Radio Log.

We Aim to Satisfy

Would you please show me the simplest plans for an electronic organ (not the kind with keys but the kind with the knob you turn to get a high or low tone)?

—D. J. W., Union City, N. J.

In this issue, Bud!

Remote Control

Would you please give me a simple diagram so I can build a remote unit (not wireless) to control TV volume local and/or remote along with switch capability to use remote only, local only, or both speakers?

—R.B.V., Montgomery, Ala.

ASK ME ANOTHER ☆☆☆☆☆☆☆☆☆☆☆☆

Why bother? Allied Radio has a new Remote Speaker/Control Unit kit that's real cheap and includes a timer. It's cheaper than buying parts! get their address from their ad in this issue.

Salty TV

What kind of antenna can I use on my boat for a TV set? The built-in telescoping antenna is not adequate.

—O.H., San Francisco, Calif.

You can get a very compact marine TV antenna from JFD Electronics, 1462 62nd St., Brooklyn, N.Y. 11219, or almost any marina or TV store can order one for you. It has two removable, telescoping elements. You may have seen similar antennas on limousines. A long coaxial cable is included plus a control box which permits adjusting the antenna electrically for best reception on a specific channel. Sometimes a good omnidirectional FM antenna can do the job.

Go Tape Cartridge

My kids want to play recorded music whenever I take the boat out on a cruise. The needle (the hi-fi boys call it a stylus) won't stay in the record grove. Got any suggestions?

—E.T., Hamilton, Bermuda

Forget phonograph records. They're being obsolesced by tape cartridges and cassettes. You can get a cartridge or cassette playback system

(Continued on page 99)

Metric Unit Prefixes

Prefix	Symbol	Power of 10	Numerical Value	
tera	T	10^{12}	trillion	1,000,000,000,000
		10^{11}	hundred-billion	100,000,000,000
		10^{10}	ten-billion	10,000,000,000
giga	G	10^{9}	billion	1,000,000,000
		10^{8}	hundred-million	100,000,000
		10^{7}	ten-million	10,000,000
mega	M	10^{6}	million	1,000,000
		10^{5}	hundred-thousand	100,000
myria	my	10^{4}	ten-thousand	10,000
kilo	k	10^{3}	thousand	1,000
hecto	h	10^{2}	hundred	100
deka	da	10^{1}	ten	10
		10^{0}	one	1
deci	d	10^{-1}	tenth	.1
centi	c	10^{-2}	hundredth	.01
milli	m	10^{-3}	thousandth	.001
		10^{-4}	ten-thousandth	.000 1
		10^{-5}	hundred-thousandth	.000 01
micro	μ	10^{-6}	millionth	.000 001
		10^{-7}	ten-millionth	.000 000 1
		10^{-8}	hundred-millionth	.000 000 01
nano	n	10^{-9}	billionth	.000 000 001
		10^{-10}	ten-billionth	.000 000 000 1
		10^{-11}	hundred-billionth	.000 000 000 01
pico	p	10^{-12}	trillionth	.000 000 000 001
		10^{-13}	ten-trillionth	.000 000 000 000 1
		10^{-14}	hundred-trillionth	.000 000 000 000 01
femto	f	10^{-15}	quadrillionth	.000 000 000 000 001
		10^{-16}	ten-quadrillionth	.000 000 000 000 000 1
		10^{-17}	hundred-quadrillionth	.000 000 000 000 000 01
atto	a	10^{-18}	quintillionth	.000 000 000 000 000 001

WHERE TO FIND THE FCC AT DISTRICT OFFICES THROUGHOUT THE U.S.

Dist.

1 1600 Customhouse
Boston, Mass. 02109

2 748 Federal Building, 641 Washington St.
New York, New York 10014

3 1005 New U.S. Customhouse
Philadelphia, Pa. 19106

4 415 U.S. Customhouse, Gay and Water Sts.
Baltimore, Md. 21202

5 405 Federal Building
Norfolk, Va. 23510

6 2010 Atlanta Merchandise Mart, 240 Peachtree St., NE
Atlanta, Ga. 30303

7 Federal Building, Box 150
Miami, Fla. 33101

8 608 Federal Office Building, 600 South St.
New Orleans, La. 70130

9 5636 New Federal Office Building, 515 Rusk Ave.
Houston, Tex. 77002

10 708 Jackson St., Room 401
Dallas, Tex. 75202

11 Room 50 Mezzanine Floor, 849 South Broadway
Los Angeles, Calif. 90014

12 323A Customhouse, 555 Battery St.
San Francisco, Calif. 94126

13 441 New U.S. Courthouse, 620 S.W. Main St.
Portland, Ore. 97205

14 806 Federal Office Building, 1st Ave. and Marion St.
Seattle, Wash. 98104

15 521 New Customhouse, 19th bet. California and Stout St.
Denver, Colo. 80202

16 208 Federal Courts Building, 6th and Market Sts.
St. Paul, Minn. 55102

17 3100 Federal Office Building, 911 Walnut St.
Kansas City, Mo. 64106

18 826 U.S. Courthouse, 219 South Clark St.
Chicago, Ill. 60604

19 1029 Federal Building
Detroit, Mich. 48226

20 328 Post Office Building, Ellicot and Swan Sts.
Buffalo, N.Y. 14203

21 502 Federal Building, 335 South King St.
Honolulu, Hawaii 96808

22 322-323 Federal Building
San Juan, P.R. 00903

23 55 U.S. Post Office Building
Anchorage, Alaska 99501

24 521—12 Street, N.W., Room 204-A
Washington, D.C. 20555

LITERATURE

ELECTRONIC PARTS

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1969 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★5. *Edmund Scientific's* new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyers' guide for Science Fair fans.

★4. *Olson's* catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

1. *Allied's* catalog is so widely used as a reference book that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1969 *Allied Radio* catalog? The surprising thing is that it's free!

7. Before you build from scratch, check the *Fair Radio Sales* latest catalog for electronic gear that can be modified to your needs. *Fair* way to save cash.

8. Get it now! *John Meshna, Jr.'s* new 96-page catalog is jam packed with surplus buys—surplus radios, new parts, computer parts, etc.

★140. How cheap is cheap? Well, take a gander at *Cornell Electronics'* latest catalog. It's packed with bargains like 6W4, 12AX7, 5U4, etc., tubes for only 33¢. You've got to see this one to believe it!

★135. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable building, creating, experimenting and learning. Find out for yourself by circling 135 now!

106. With 70 million TV and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get *Universal Tube Co.'s* Troubleshooting Chart and facts on their $1.50 flat rate per tube.

10. *Burstein-Applebee* offers a new giant catalog containing 100s of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

★11. Now available from *EDI (Electronic Distributors, Inc.)*: a catalog containing hundreds of electronic items. *EDI* will be happy to place you on their mailing list.

★6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest 8-page flyer chock-full of *Poly-Paks'* new $1.00 electronic and scientific "blis-dor" paks and equipment.

23. No electronics bargain hunter should be caught without the 1969 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

CB—AMATEUR RADIO SHORTWAVE RADIO

102. No never mind what brand your CB set is. *Sentry* has the crystal you need. Same goes for ham rigs. Seeing is believing, so get *Sentry's* catalog today. Circle 102.

146. It may be the *first—Gilfer's* speciality catalog catering to the SWL. Books, rigs, what-nots—everything you need for your listening post. Go *Gilfer*, circle 146!

100. You can get increased CB range and clarity using the "Cobra-23" transceiver with speech compressor—receiver sensitivity is excellent. Catalog sheet will be mailed by *B&K Division of Dynascan Corporation.*

141. Newly-designed CB antenna catalog by *Antenna Specialists* has been sectionalized to facilitate the picking of an antenna or accessory from a handy index system. Man, *Antenna Specialists* makes the pickin' easy.

130. Bone up on the CB with the latest *Sams* books. Titles range from "ABC's of CB Radio" to "99 Ways to Improve your CB Radio." So Circle 130 and get the facts from *Sams.*

107. Want a deluxe CB base station? Then get the specs on *Tram's* all new Titan II—it's the SSB/AM rig you've been waiting for!

96. Get your copy of *E. F. Johnson's* new booklet, "Can *Johnson* 2-Way Radio Help Me?" Aimed for business use, the booklet is useful to everyone.

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1969 catalog. *Lafayette* has CB sets for all pocketbooks.

46. Pick up *Hallicrafters'* new four-page illustrated brochure describing Hallicrafters' line of monitor receivers —police, fire, ambulance, emergency, weather, business radio, all yours at the flip of a dial.

116. Pep-up your CB rig's performance with *Turner's* M+2 mobile microphone. Get complete spec sheets and data on other *Turner* mikes.

48. *Hy-Gain's* new CB antenna catalog is packed full of useful information and product data that every CBer should know. Get a copy.

111. Get the scoop on *Versa-Tronics'* Versa-Tenna with instant magnetic mounting. Antenna models available for CBers, hams and mobile units from 27 MHz to 1000 MHz.

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1969 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

101. If it's a CB product, chances are *International Crystal* has it listed in their colorful catalog. Whether kit or wired, accessory or test gear, this CB-oriented company can be relied on to fill the bill.

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "S5S." Also, CB accessories that add versatility to their 5-watters.

TOOLS

★78. Want to speed setting of locknut/screw controls? *Xcelite's* new HSC-1 interchangeable hollow-shaft nutdriver with drilled handle lets you adjust nut and screw simultaneously. *Xcelite* will send Bulletin N867 on request.

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

ELECTRONIC PRODUCTS

143. Bring new life to your hobby. Exciting plans for new projects—let Electronics Hobby Shop give you the dope. Circle 143, now.

★44. Kit builder? Like wired products? *EICO's* 1969 catalog takes care of both breeds of buyers. 32 pages full of hi-fi, test, CB, ham, SWL, automotive and hobby kits and products —do you have a copy?

★42. Heath's new 1970 full-color catalog is a shopper's dream. Its 116 pages are chuck full of gadgets and goodies everyone would want to own. Mostly kits are shown but many factory-wired products are available. Get your catalog today!

144. Hear today the organ with the "Sound-of-Tomorrow," the Melo-Sonic by *Whippany Electronics.* It's portable—take it anywhere. Send for pics and descriptive literature.

12. *C. B. Hanson* new Automatic Control records both sides of a telephone call automatically—turns off automatically, too! Get all the details —today!

126. Did you dig *Delta's* new literature package chucked full of pics and

LIBRARY...

★ Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

specs on such goodies as an FET-VOM, SCR ignition system, computerized auto tach, hi-voltage analyzer, etc.? Man, then let *Delta* know you're alive! Circle 126 now!

109. *Seco* offers a line of specialized and standard test equipment that's ideal for the home experimenter and pro. Get specs and prices today.

9. Troubleshooting without test gear? Get with it—let Accurate Instrument clue you in on some great buys. Why do without?

145. *Alco Electronic Products* has 28 circuit ideas using their remote control relay. Get 100-and-one odd jobs done at home without calling an electrician. Get all the facts today!

SCHOOLS AND EDUCATIONAL

★136. You can become an electrical engineer *only* if you take the first step. Circle 136 and *ICS* will send you their free illustrated catalog describing 17 special programs. *ICS* also has practical electrical courses that'll increase your income.

★74. Get two free books—"How to Get a Commercial FCC License" and "How to Succeed in Electronics"—from *Cleveland Institute of Electronics.* Begin your future today!

★3. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools and instructions come with course.

142. *Radio-Television Training of America* prepares you for a career—not a job. 16 big kits help you learn as you build. 120 lessons. Get all the facts today!

114. Prepare for tomorrow by studying at home with *Technical Training International.* Get the facts today on how you can step up in your present job.

★137. For success in communications, broadcasting and electronics get your First Class FCC license and *Grantham School of Electronics* will show you how. Interesting booklets are yours for the asking.

HI-FI/AUDIO

26. Get with today's hi-fi jet set. *H. H. Scott* sets the pace with their fantastic line of audio components, some in kit form, too! *Scott* will send you all the poop if you circle 26!

104. You can't hear FM stereo unless your FM antenna can pull 'em in. Learn more and discover what's available from *Finco's* 6-pages "Third Dimensional Sound."

119. *Kenwood* puts it right on the line. The all-new *Kenwood* FM-stereo receivers are described in a colorful booklet complete with easy-to-read-and-compare spec data. Get your copy today!

30. *Shure's* business is hi-fi — cartridges, tone arms, and headphone amps. Make it your business to know *Shure!*

17. Mikes, speakers, amps, receivers—you name it, *Electro-Voice* makes it and makes it good. Get the straight poop from *E-V* today.

99. Get the inside info on why *Koss/Acoustech's* solid-state amplifiers are the rage of the experts. Colorful brochure answers all your questions.

TAPE RECORDERS AND TAPE

14. You just gotta get *Craig's* new pocket-size, full-color folder illustrating what's new in home tape recorders—reel-to-reel, cartridge and cassette, you name it! It looks like a who's who for the tape industry.

123. Yours for the asking—*Elpa's* new "The Tape Recording Omnibook." 16 jam-packed pages on facts and tips you should know about before you buy a tape recorder.

31. All the facts about *Concord Electronics Corp.* tape recorders are yours for the asking in their free 1970 catalog. Portable, battery operated to four-track, fully transistorized stereos cover every recording need.

34. "All the Best from *Sony*" is an 8-page booklet describing *Sony-Superscope* products—tape recorders, microphones, tape and accessories. Get a copy today before you buy!

35. If you are a serious tape audiophile, you will be interested in the all new *Viking/Telex* line of quality tape recorders.

TELEVISION

★70. Need a new TV set? Then assemble a *Heath* TV kit. *Heath* has all sizes. B&W and color, portable and fixed. Why not build the next TV you watch?

127. *National Schools* will help you learn all about color TV as you assemble their 25-in. color TV kit. Just one of *National's* many exciting and rewarding courses.

SCIENCE AND ELECTRONICS
Dept. 170
229 Park Avenue South
New York, N.Y. 10003

Please arrange to have the literature whose numbers I have circled at right sent to me as soon as possible. I am enclosing 25¢ to cover handling. (No stamps, please.)

Sorry, only 20 circled items maximum.

☐ Indicate total number of booklets requested

1	2	3	4	5	6	7	8	9	10
11	12	14	17	23	26	30	31	34	35
42	44	45	46	48	70	74	78	96	99
100	101	102	103	104	106	107	109	111	114
116	118	119	123	126	127	129	130	135	136
137	140	141	142	143	144	145	146		

NAME_____

ADDRESS_____

CITY_____

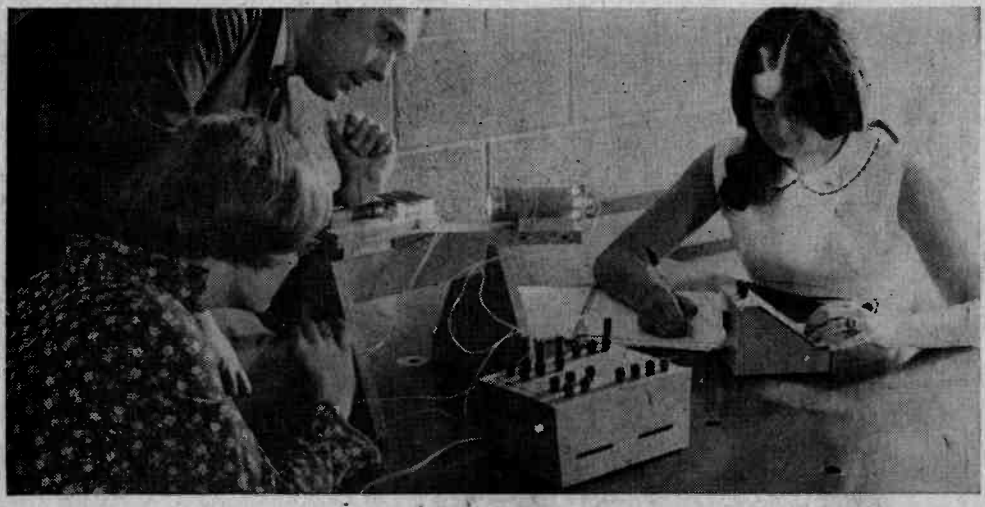
STATE_____ ZIP_____

Three students from all-girl physics class at Moline, Ill. high school examine wave patterns projected by ripple tank. That's instructor F. Darrell Goar in center.

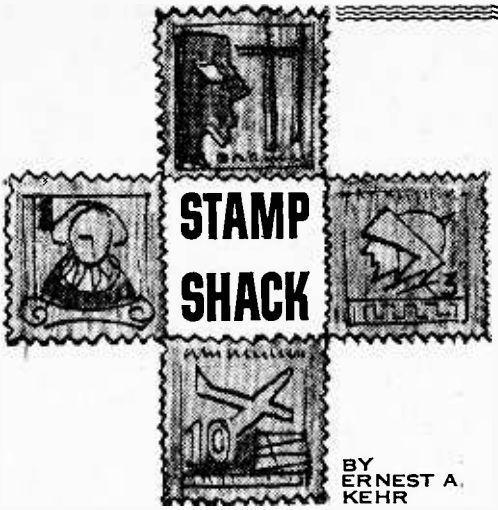
DISTAFF STAFF

If an all-girl physics class sounds a mite unlikely, take it from Moline, Ill.'s F. Darrell Goar that you're wrong. Pleased as punch with his success in attracting girls to his physics classes, Mr. Goar thinks his approach the likeliest thing since Newton's apple.

Asked why sex should split physics classes, Mr. Goar explains that girls invariably assume the role of a secretary when paired with boys as partners in lab experiments. Rather than be participants, they lapse into a spectator role, recording data while the boys manipulate the apparatus. Results to date support Mr. Goar's thesis *in toto*. ■

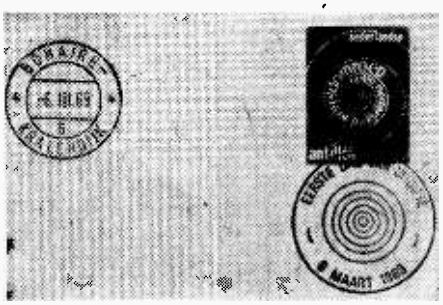


Moline's all-girl physics class makes use of curriculum published by Raytheon's D.C. Heath and Co. Class has received award from American Association of Physics Teachers.



BY ERNEST A. KEHR

● ● On March 6, 1969, the Netherlands Antilles issued an attractive blue, green and ultramarine 25-cent stamp whose unusual design commemorates the opening of the islands' latest telecommunications facilities. All mail dispatched on that date from Kralendijk, Bonaire, received in addition to the regular postmark, a distinctive "First Day of Issue" cachet. This repeats the concentric circle theme to suggest radio waves. The stamp, designed by Oscar Ravelo, a Curacao artist, features the new antenna superimposed on an outline map of Bonaire, one of the six islands that comprise the Netherlands Antilles.



Netherland's "First Day of Issue" Cachet

● As long ago as 1887, Curacao was linked with the first trans-Atlantic cable, which had been laid on the ocean floor only a year earlier. This was significant, for Curacao enjoyed a vital position as a world trade and commerce center in the Caribbean area.

● Until the islands attained independence in 1954, they had formed a colonial unit ruled by Holland since the days of Peter Stuyvesant—and under whose New Netherlands administration they had been governed. Although there really are six islands in the group (Aruba, Bonaire and Curacao off the South American coast, and St. Maartens, St. Eustacius and Saba 1,500 miles north east near Puerto Rico) the Dutch simply called all, "Curacao," or Dutch West Indies.

● Wireless communications were installed and opened on Oct. 16, 1908, under the Netherlands Antilles Radio and Telegraph Administration, putting Curacao right behind the United States and Canada in the adoption of that then-new communications medium. The coastal radio station, PJC, was the very first one built in the entire Caribbean territory.

● Daily radio contact was established between Curacao and The Hague in 1926, and later that same year, was extended to send regular messages all the way to Java, in the Dutch East Indies, 13,000 miles away.

● These developments and Curacao's eminent leadership in the telecommunications field served to promote the setting up of a radio broadcasting system throughout the islands, with the first station opened in 1934.

● Following World War II, private radio broadcasting transmitters were installed in other Antillean islands. A United States firm—Trans World Radio, Inc.—opened a powerful station on Bonaire in 1964. This led to the signing of a contract with the Dutch World Broadcasting System to provide air-time to relay programs from Holland to the Caribbean, North and South America and even West Africa.

● The programs are carried regularly in Dutch, English and Spanish tongues on both short and medium wave broadcast bands to reach the largest possible audience within their range. Until then, Radio Nederland had to rely solely on its homeland transmitters whose power was insufficient to reach all the desired destinations.

● These relay transmissions proved so successful and practical that Radio Nederland built its own facilities on Bonaire—the island especially noted for its tranquil resort beaches and flamingo flocks; unlike Aruba and Curacao, this isle has no large refinery or other industries whose electronic controls might interfere with the sending of clear signals.

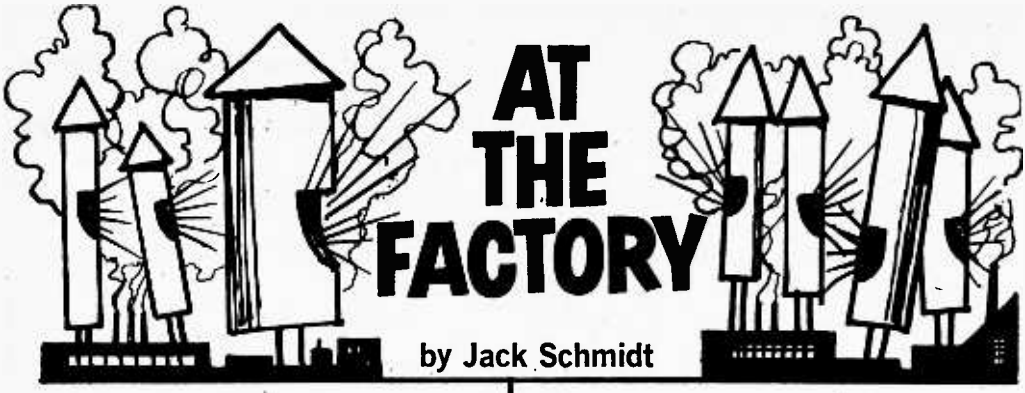
● With these new 300-kilowatt transmitters, it now is possible to reach listeners on the entire Western Hemisphere, Australasia, New Zealand, Western Africa and Southern Europe. All this makes the Netherlands Antilles one of the most active and important telecommunications centers of the world.

* * * * * *

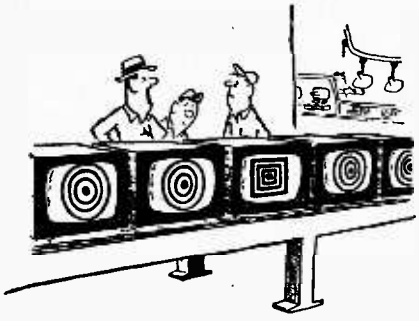
● ● What's New?

● Shortly after its announcement that the Bureau of Engraving and Printing—a branch of the Treasury Department that produces United States stamps for the Post Office Department—

(Continued on page 108)

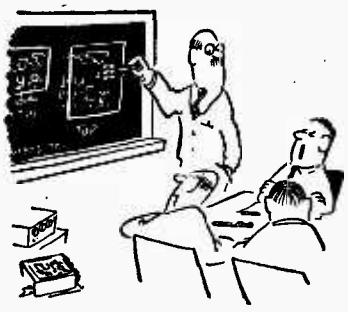


"Just one more, 'Testing, one, two, three', out of you and I'll..."



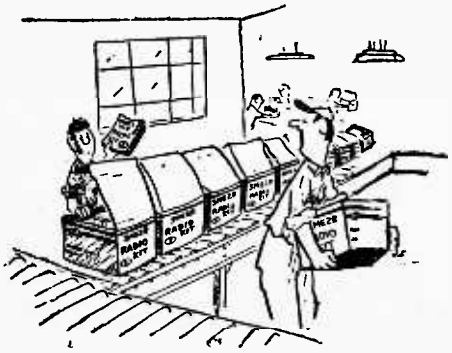
"Okay, Rodney, tell me! What seems to be upsetting the test department?"

"Production is running along as usual... and that seems to be our trouble!"



"If you put the fuses there, the customers will be able to get at them!"

"...thereby insuring high-speed delivery to the shipping department!"



"If you're out of 3ME2B books, then stick in the old 2K2A instruction books!"

Science and Electronics
DECEMBER-JANUARY 1970

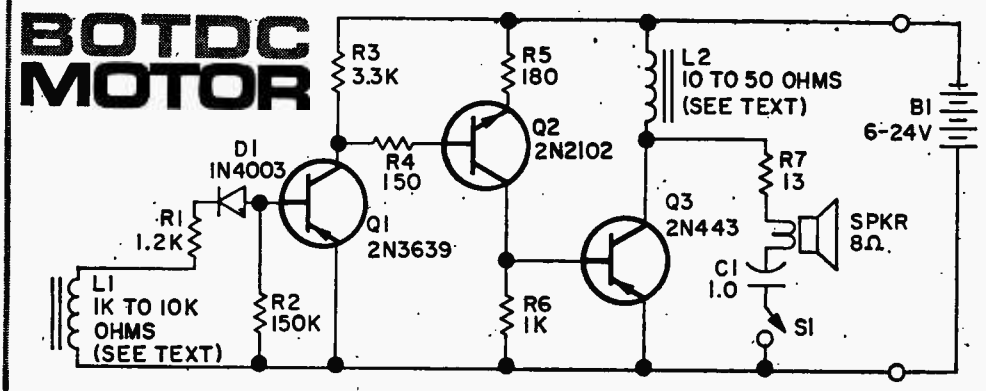
the BOTDC MOTOR

the Battery Operated Transistor Direct Current motor you can build today!

by Charles D. Rakes

NOW HERE IS an electronic project that will baffle your non-scientific friends. Sans commutator, brushes, and/or mechanical contacting points, this motor gets its modus operandi from an unique application of the switching capabilities of transistors. Our BOTDC *(Battery Operated Transistor Direct Current)* motor will be a traffic stopper at any science fair and should put you in the running as a winner.

WHAT MAKES TM RUN. In a static condition (rotor stationary), no current will flow through the circuit even though the battery is connected. Reason is that the transistors are biased to cut-off (non-conducting). Thing is, though we've said no current will flow, actually a small leakage current (inherent in nearly all transistors) does flow. *(Turn page)*



Schematic diagram for the electronics circuitry of the BOTDC Motor. Battery is disconnected by removing the leads from the binding posts on this board.

BILL OF MATERIALS FOR TRANSISTOR MOTOR

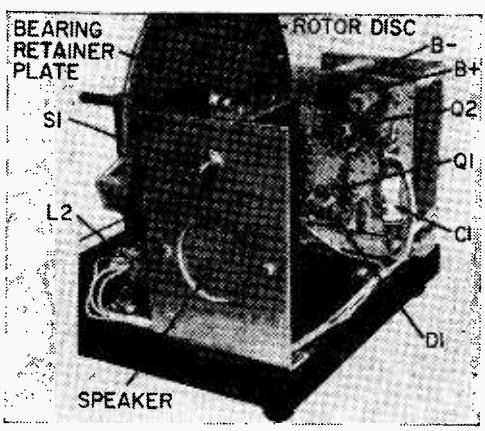
C1—1-uF, 200-V capacitor
D1—General purpose silicon diode (type 1N4003 or equiv.)
L1—1000 to 5000-ohm relay coil, similar to coil used in Potter & Brumfield KA11AY relay
L2—10 to 50 ohm DC relay coil, similar to coil used in Potter & Brumfield MR11D relay
Q1—2N3639 silicon epoxy pnp transistor (Raytheon)
Q2—2N2102 silicon npn power transistor (Motorola or Delco)
R1—1200-ohm, ½-watt resistor
R2—150,000-ohm, ½-watt resistor
R3—3300-ohm, ½-watt resistor
R4—150-ohm, ½-watt resistor
R5—180-ohm, ½-watt resistor
R6—1000-ohm, ½-watt resistor
R7—12-ohm, 1-watt resistor
S1—Spst miniature toggle switch (Lafayette 99T6162 or equiv.)
1—Speaker, 2-in., 8 ohm (Lafayette 99T6036 or equiv.)
4—Magnets, horseshoe 1 x 1⅛ x 5/16 in. (Lafayette 14T3303 or equiv.)
2—Binding posts (Lafayette 99T6233 or equiv.)

Misc.—¾-in. plywood, ⅛-in. plywood (or phenolic, epoxy glass, hardboard sheet), ⅛-in. aluminum sheet, aluminum or steel strapping for mounting brackets, ball bearing assemblies, ¼-in. steel rod, perf board, push-in pins, rubber feet, name plate, shaft coupler (Hammarlund FNC46S or equiv.), solder, hookup wire, hardware, etc.

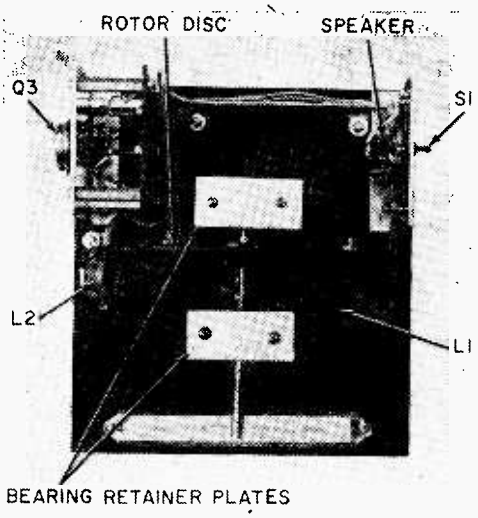
But this isn't sufficient to create a strong enough magnetic field in the driving coils to sustain rotation.

After the rotor has been given a push to start rotation with the transistors energized by battery B1, a voltage is induced in the coil as one of the magnets approaches pickup coil L1. This voltage, coupled through diode D1 produces a negative pulse on the base of Q1. This pulse turns *on* Q1, which delivers a positive current pulse to the base of Q2, turning it *on*. This, in turn, produces a negative pulse at the base of Q3, turning it *on*. As conduction of Q3 increases it's driven to saturation, thus placing full supply voltage across driving coil L2, creating a maximum magnetic field in it. This magnetic increase and decrease drives the rotor on its axis.

Since all of the magnets on the rotor have been oriented (see construction details) so that the magnetic field in L2 attracts them,



Rear view showing speaker, electronics board L2, and general positioning of the various parts of the motor. Switch S1 turns off speaker which monitors the pulses as they are generated. The clicks attract attention.



Top view of motor board showing position of rotor bearings that must be aligned to ensure minimum friction for rotor shaft. Retaining plates hold rotor bearings firmly in supports.

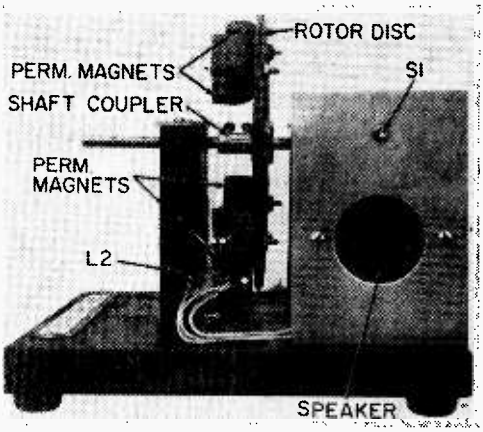
the motor magnet is magnetically pulled towards L2, thus sustaining the motion of the rotor.

Because of the positioning of the magnets, one approaches L2 while another is passing L1. This creates a new pulse, which again turns *on* the transistors. The pulsing *on* of the transistors develops magnetic saturation pulses in L2 that keep the motor in motion. Its speed is limited by the voltage of battery B1, which, in our motor, can be any DC voltage from 6 to 24 volts.

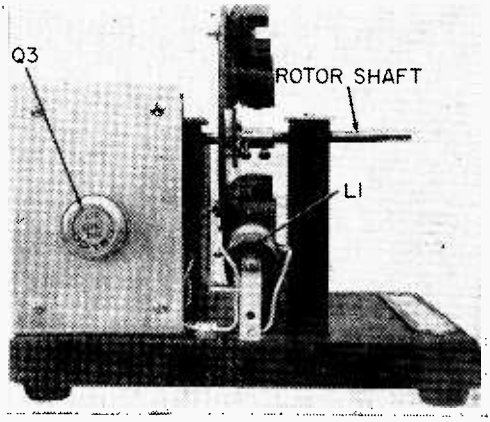
We've included a smal speaker together with switch it *on* or *off*, merely to attract attention if you are exhibiting your motor. Each time a pulse is developed a click can be heard in the speaker.

Current consumption is quite low (our model, using coils of 30 and 1000 ohms respectively for L1 and L2, draws 55 mA at 6 V). Therefore, you can expect relatively long battery life. If a small friction load is placed on the rotor shaft the total current drain will increase slightly. As this load is increased, slowing the rotor and eventually stopping it, current consumption will drop proportionately. When the rotor is stopped, current consumption will drop to the same level as the unit drew before rotation started (all transistors turned *off*).

This decrease in current drain with an increase in load is just the opposite condition of that for a conventional motor in which current drain increases as the load does. If a DC motor is stalled and the current isn't shut *off*, the excess heat generated by the current flowing through its windings will eventually destroy the motor completely.

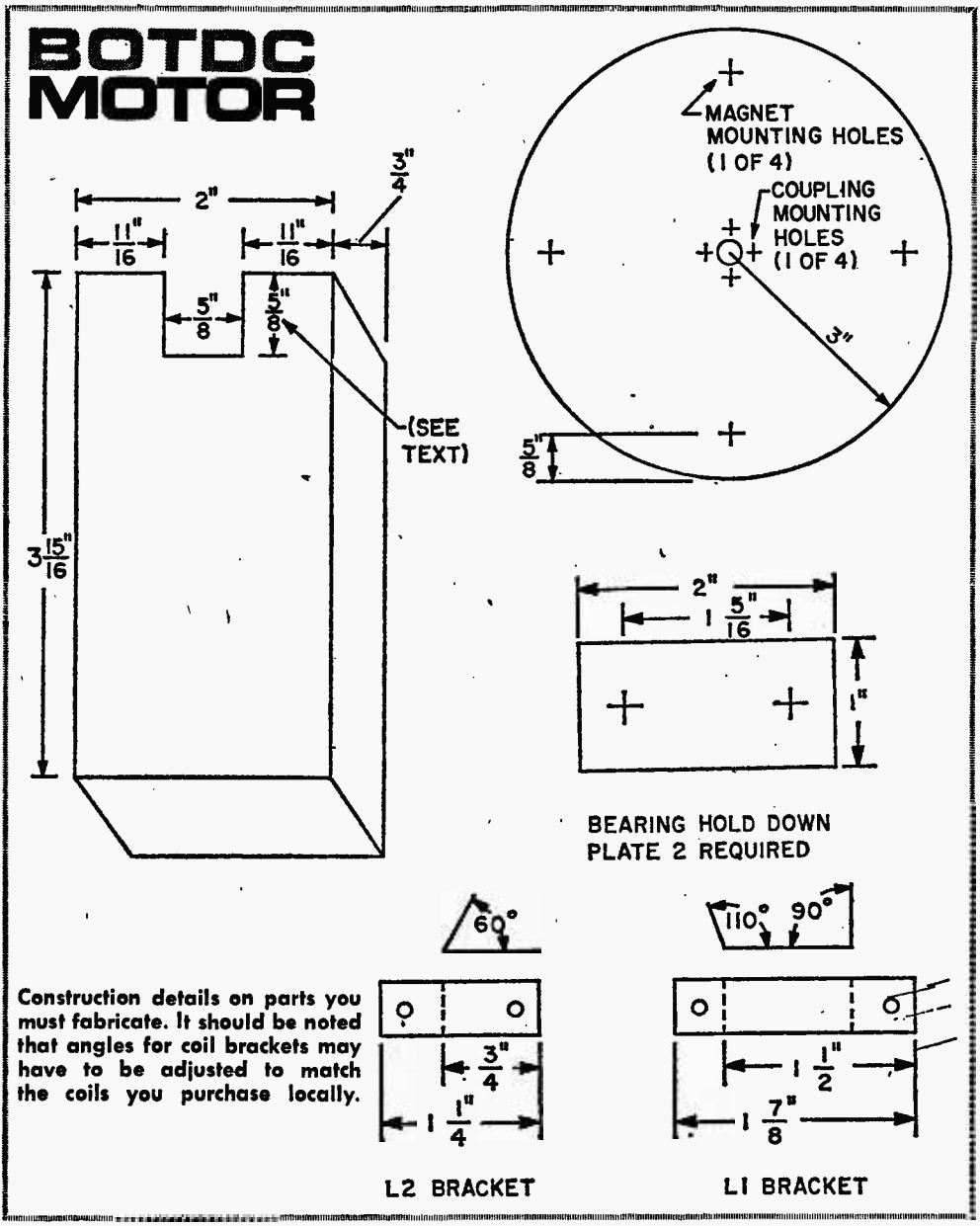


Right side of motor assembly detailing location of speaker and its mounting plate, coil L2, one bearing support block, and the rotor disc. Note shaft coupler referred to in text.



Just as there are two sides for every story our BOTDC Motor has another side, too. One viewed here shows positioning of Q3 on its heat sink as well as location of coil L1.

Let's Make It! We built our Transistor Motor on a 7¼ x 8 x ¾-in. plywood baseboard. We made two wooden blocks (3 15/16 x 2 x ¾ in.) to support the rotor. Any nonmetallic material such as plywood, hardboard, phenolic sheet, epoxy glass sheet, etc., can be used for the rotor disc (we used hardboard). The rotor shaft is made from a length of ¼-in. dia. steel rod, running in anti-friction bearings. We used small ball



Construction details on parts you must fabricate. It should be noted that angles for coil brackets may have to be adjusted to match the coils you purchase locally.

bearings which can be purchased from your hardware dealer, mill supply house, or surplus machinery dealer.

Coils L1 and L2 are standard relay coils. If you can't get the ones we list in the Parts List, perhaps you can find surplus relays using coils having specifications similar to those we used.

With the exception of transistor Q3, coils L1 and L2, and the speaker and its *on/off* switch, all electronics components are mounted on a 2⅞ x 4¼-in. piece of perf board using push-in pins to hold the various parts and also to serve as points for electrical connections.

Transistor Q3 and the speaker are each mounted on separate and identical 3 x 4½ x 1/16-in. aluminum brackets. The mounting bracket for Q3 also serves as its heat sink. The speaker grille can be a series of holes drilled in the bracket in a suitable pattern within a 1½-in. circle. Alternatively, you can cut a circular hole 1½-in. diam. and back it up with a piece of perf board, per-

forated metal, or screening to protect the speaker cone.

The perf board containing the circuit components is fastened to the rear of the Q3 heat sink with 1⅛-in. to 1¼-in. long spacers to hold it away from the heat sink and Q3's terminals in order to prevent short circuits in the wiring on the perf board.

The only other structural parts that have to be made are the mounting brackets for coils L1 and L2 and the bearing retainer plates. Details of dimensions and bending angles are shown in the drawings (those for the coil mountings are only approximate). You'll have to establish final size and angles, depending on the type of coils you actually buy. Coil L1 should be mounted on the baseboard and the bracket angled so that there is a ¼-in. clearance between its pole piece and the face of any magnet on the rotor as it passes the coil. Similarly, L2 should be mounted on the baseboard as shown so that there is ⅛-in. clearance between its pole piece and a magnet face.

When cutting the notch that holds the bearing in the wooden blocks, keep its depth slightly less than the diameter of the bearing you're using. This will help clamp the bearing in position when the hold-down plate is fastened to the block.

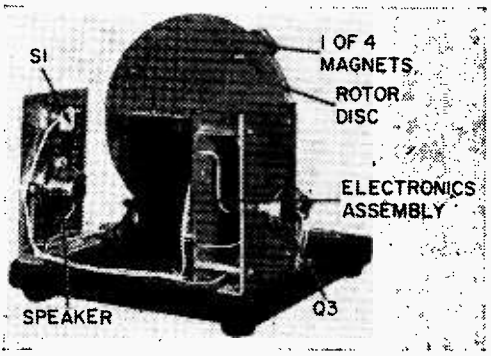
If you can't find a flange plate with a bushing to hold the shaft to the rotor disc, a simple way to make one is to start with a flexible coupling designed for mounting between a variable capacitor and dial of a radio. Carefully remove the bushings from the center supporting the washer bushings leaving the flexible arms attached to the bushings. Drill a hole in the center of the motor's rotor disc so that it will sit snugly around the shaft.

This done, slip the bushings removed from the coupler, one over each end of the shaft, and fasten the arms to the disc. What you have done, really, is to substitute the motor disc for the smaller diameter washer originally holding the two bushings together in the flexible coupling. Be sure the set screws in the bushings are tightened against the shaft to ensure proper alignment and rotation capability of the rotor assembly.

Assemble the electronics and wire the motor in accord with the schematic. Be sure to doublecheck your wiring to make certain there are no errors and that D1 is correctly polarized. Now that you've completed the hardest work of the project, you're ready to finish putting together your motor and having some fun.

Fitting the Pieces Together. First mount the bearing mounting blocks and coil brackets to the baseboard. Slip the bearing assemblies over the ends of the rotor shaft and mount this assembly in the bearing support blocks. Before tightening the bearing hold down plates, be sure the bearings are aligned so that the shaft will turn freely with a minimum of friction.

Now mount the magnets to the disc, arranged as shown in illustrations. After mounting and wiring the electronics assembly, the speaker, and coils L1 and L2, you're ready to orient the magnets. To do this, connect the battery to the motor and connect a temporary jumper from the collector to the emitter of Q3. Slowly rotate the



Rear view showing general placement of various parts of motor. Electronics board is held away from mounting plate with spacers.

rotor disc by hand so that each magnet is brought past L2. If the magnet is attracted towards L2, it's correctly positioned and should be tightened in this position. If, on the other hand, the magnet is repelled, loosen its mounting screw and turn the magnet 180 degrees on its axis; it then should be magnetically attracted by L2 and can be tightened in this corrected position.

Final Adjustment. Remove the temporary jumper from Q3, leaving the battery connected, and give the rotor a turn in either direction. If all is well the rotor will continue its rotation, slowly picking up speed to a maximum (dependent on battery voltage) and will continue running at full speed until the battery is disconnected.

If the rotor doesn't continue to turn and pick up speed after you've given it its initial

(Continued on page 102)

By ARTHUR S. COOKFAIR

FAMOUS PATENTS

No. 1,102,653

GODDARD'S FIRST "ROCKET APPARATUS"

A century ago the idea of sending rockets to explore outer space was a science fiction dream; today it is a fascinating reality. But for the dream to become a reality required the efforts of a special breed of men. Such a man was Robert H. Goddard—foremost of the rocket pioneers.

As a teen-ager at the turn of the century, Goddard dreamt of space exploration. By the time he finished college, in 1911, the dream had become an obsession. While most Americans were getting used to the sight of the new horseless carriages bouncing along on crude roads, the young scientist was busy designing rockets to study the outer reaches of the earth's atmosphere.

His first patent, titled "Rocket Apparatus" (shown in the accompanying illustration) was granted in 1914. Years ahead of his time, Goddard set forth advanced concepts that were to be used more than three decades later, when the United States space program began. The patent describes the use of multistage engines to reach greater altitudes and tapered nozzles to provide maximum thrust from the burning gases. The rocket was designed to carry a pay-load of photographic and recording instruments in a special gyro-stabilized compartment. At the end of the flight, the apparatus could be returned to earth by parachute, without damage to the instruments.

Although the patent was granted, the true significance of the invention was not recognized at the time. In a world preparing for war, it went almost unnoticed.

During WW I. When the United States entered World War I Goddard offered his services to the government. But the military authorities weren't interested in space exploration, and the young rocket expert went to work on a more "practical" project—a portable, rocket-powered cannon, capable of knocking out a tank but light enough for a foot soldier to handle. The rocket cannon wasn't completed in time for use in the first World War. But twenty-five years later a streamlined version of the weapon was used extensively in World War II and became known as the *bazooka*.

The Liquid Rocket. Throughout the 1920s, in his spare time from his duties as a physics professor at Clarke University, Goddard continued his experiments with rocket engines. When he reached the limit of his own finances, his work was kept going with the *(Continued on page 110)*

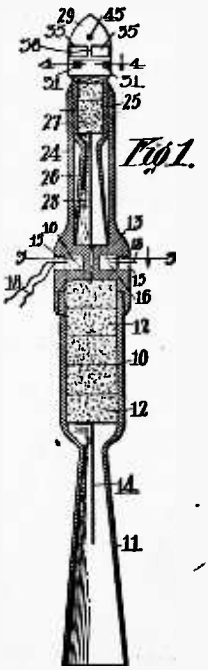


Fig 1.

A drawing that any high-school freshman can draw was Fig. 1 in Goddard's first patent.

COVER STORY

build the...

STOP LIGHT STROBOSCOPE

by Steve Daniels, WB2GIF

It didn't take you very long to discover that a little NE-2 neon lamp strobe may be OK for checking the speed of your turntable, if you don't mind working with it in a darkened area and then squinting. But it just isn't satisfactory for checking motors such as those used in appliances, or those running at odd speeds.

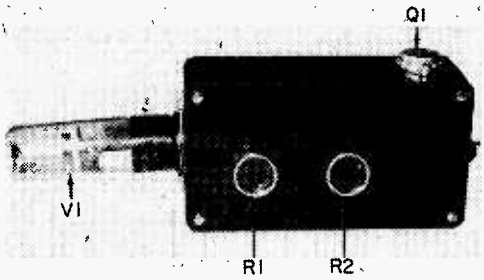
Our StopLight Stroboscope, which combines a single transistor and a Strobotron flashing tube, will meet most of your speed-determining needs. True, its output is not as

Here's a compact stroboscope that takes only one evening to build and many more to enjoy!

STOP LIGHT STROBOSCOPE

brilliant as the expensive units using Xenon lamps. However, its simplicity of design and moderate cost will more than offset this major difference and certainly make this a worthwhile project to build.

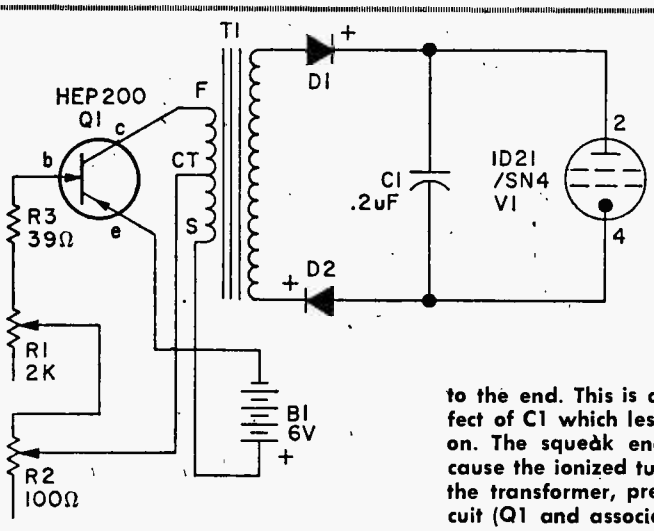
How It Works. Transistor Q1, acting as an audio oscillator, generates AC voltage in the primary of transformer T1. The secondary steps up the voltage which is rectified by diodes D1 and D2 to supply DC current to capacitor C1. When the voltage builds up high enough V1 fires, discharging C1 and the whole process is repeated. The frequency and output voltage of the oscillator is controlled by varying the base bias of transistor Q1 through R1, R2, and R3. This varies the DC pulsing, which, in turn, determines the charging of C1 and the rate of flashing of the Strobotron tube, V1.



All wired up and ready to go, the StopLight Stroboscope looks simple enough to wire in one evening. Motorola transistor can be mounted inside box—but looks exotic outside.

Note that transformer T1, designed to step down the 117 VAC (normally applied to its primary) to 6.3 V in its CT secondary, is connected in just the reverse manner. In our StopLight Stroboscope the 6.3V CT primary is the tank coil of the oscillator, and the normally 117V primary becomes the secondary, in our circuit, providing a step-up ratio of better than 18.5 to 1.

How to Make It. We used a 6¼ x 3¾ x 1⅞-in. molded black bakelite case with



Hearing is believing! You can verify the "How It Works" notes on this page by placing your ear next to the plastic box of the unit. You'll hear an audio tone that will stop with each flashing. With the stroboscope set for a slow flashing rate, you can detect a slight tone increase from the beginning of each squeak to the end. This is caused by the loading effect of C1 which lessens as a charge is taken on. The squeak ends when V1 flashes, because the ionized tube is a short circuit across the transformer, preventing the oscillator circuit (Q1 and associated parts) from working.

PARTS LIST FOR STOPLIGHT STROBOSCOPE

B1—6-V battery (Eveready #731 or equiv.)
C1—0.2-uF. 600-V capacitor
D1, D2—1.0 Amp, 1000 PIV silicon diode rectifier (International Rectifier 5A10 or equiv.)
Q1—HEP-200 Motorola transistor
R1—2000-ohm, linear taper potentiometer (Allied 46E3785 or equiv.)
R2—100-ohm, linear taper potentiometer (Allied 46E1102 or equiv.)
R3—39-ohm, ½-watt resistor
T1—6.3-V @ 1.5 amp CT filament transformer (Allied 54E1419 or equiv.)
V1—1D21/SN4 Sylvania Strobotron tube ($7.30 from Allied Radio)
1—6¼ x 3¾ x 1⅞-in. molded plastic box and panel (Allied 42E7885 or equiv.)
1—4-prong tube socket (Allied 47E0024 or equiv.)

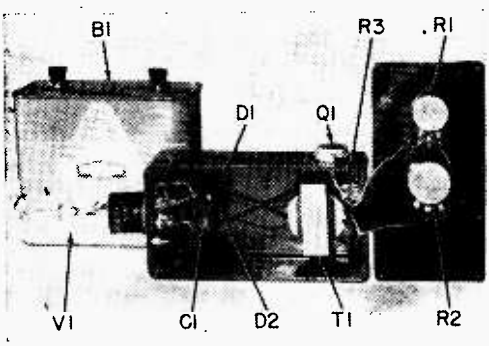
Misc.—Tie strips, knobs, hardware, hookup wire, solder, etc.

matching panel to house our StopLight. Drill a 1 3/16-in. hole in one 3¾ x 1⅞-in. end to mount the 4-prong socket for the Strobotron. Use a circle cutter in a slow-speed drill to cut this hole. Drill holes to mount the transistor in the right-hand 6¼ x 1⅞-in. side of the case near the end opposite the one in which the Strobotron socket is mounted.

Transformer T1 is mounted in the bottom of the box near the transistor terminals. A three-terminal tie strip is also mounted on the bottom but near the Strobotron socket. Resistor R3 is mounted to a tie strip fastened to the end of the box opposite the one in which the socket is mounted.

Potentiometers R1 and R2 are mounted centered on the panel of the box in the clear space between the 4-prong socket and transformer T1. Battery leads are brought out through a small hole in the end opposite the socket. The battery lead is fabricated by twisting together two pieces of different colored hook-up wire. Solder alligator clips to the leads on the ends outside the box.

Be sure to wire the potentiometers so that speed increases with clockwise rotation of R1 (course adjustment) and with counter-



With the front cover removed, the StopLight Stroboscope reveals all of its electronics. If you care to, mount the parts in a larger case and include battery holders for four D cells. Sure as shootin', the D cells will not last as long as the Eveready #731 job listed in the Parts List, but they will do the job just the same—and in one small portable box, too!

clockwise rotation of R2 (fine adjustment). If either control operates just the opposite, reverse the leads to it.

Testing StopLight. After mounting and wiring all of the parts in accord with the schematic, double-check the wiring, making sure of the polarity of diodes D1 and D2. Plug the Strobotron in its socket.

Before connecting the battery, set the controls at the midpoint of rotation. Prolonged operation at highest speed could damage the Strobotron. As soon as the battery is connected the Strobotron should start to flash off and on. Rotate R1 full counter-clockwise and the flashes should slow down.

It may be difficult to notice any change created by the fine adjustment control unless you are actually observing a rotating device; then it will appear to stop the motion if the coarse control has been adjusted to the point where the motion appears to slow down almost to stopping. The flashing lamp should be brought as close as possible to the rotating object in order to shine as much light from the lamp onto the rotating object. However, remember that the Strobotron tube, V1, is made of glass. Don't jam it into a moving fan blade or gear drive.

Another operation note: do not run the StopLight so that the Strobotron tube burns continuously.

Calibration. There are several ways that can be used to calibrate the controls. One method would be to connect a frequency meter across the Strobotron and read the frequency directly which would be the same as the speed of rotation. If a frequency meter is not available, you may use an oscilloscope that has a calibrated time base. Connect the oscilloscope the same as the frequency meter was connected and count the number of pulses displayed on the oscilloscope screen. This will give an indication of the frequency.

If these lab instruments are not available to you, it's possible to shine the flashing lamp on a turntable or other rotating device whose speed is known and then adjusting the controls until the device appears to stop. This will then be your major calibration point.

Another way to calibrate your StopLight Stroboscope is to use an audio oscillator, amplifier, and speaker. Set the oscillator to a low audio frequency and shine the flashing lamp on the cone of the speaker. When the speaker seems to stop its motion, the flashing rate will be the same as the frequency of the audio oscillator.

Of course you can always borrow a General Radio Strobotoc, if you are fortunate enough to know some one who owns one and will be agreeable to your borrowing it.

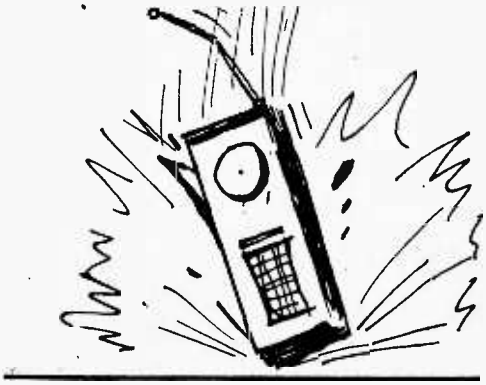
A word of caution: remember when you have apparently stopped the motion of a rotating device by shining your StopLight stroboscope on it, the device is still running full speed, so keep your fingers away. ■

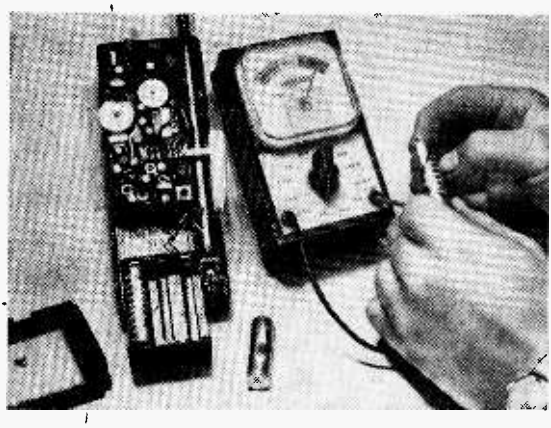
CB FIX-IT SPECIAL

11 STEPS TO WALKIE-TALKIE REPAIR

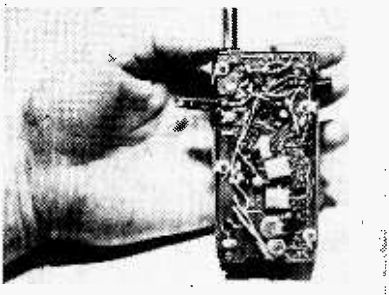
by Homer L. Davidson

Don't give up on that sick walkie-talkie! You can fix it yourself by following our 11 steps to CB walkie-talkie repair. You don't have to be a CB expert nor an expert technician to make minor repairs. Most troubles are simple and easy to locate. Only a few hand tools are needed, and five will get you ten they're in your workshop now! Have a little patience and proceed with our step-by-step guide. Remember, most CB troubles are easy to repair. It's finding the trouble that takes knowledge, and this we offer you in steps.

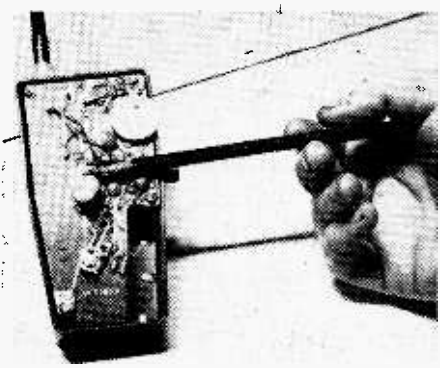




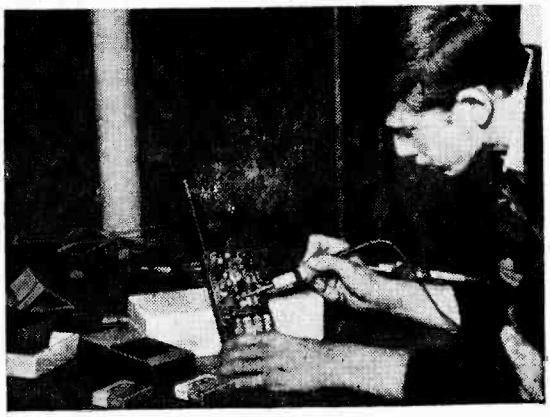
1 Check those small dry cells first! If you don't have a battery tester, check voltage with the "talk" button depressed. If one or more dry cells are low, replace all. Be sure dry cell contact surfaces are shiny bright or else you lose volts.



4 If you can't turn your walkie-talkie on and the batteries are good, then you got switch trouble. The on-off switches in most portables are flimsy and break easily. Use an alligator clip across the switch connections—if this works, a new switch is needed.

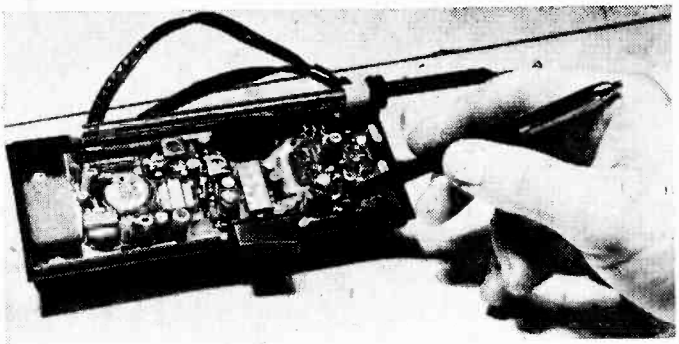


5 If your unit will not go on the air, then it's time to push, poke, and pull to detect loose components, snapped wires, etc. Poor or marginal connections are responsible for most transmitter problems. Better go back to Step 2 and do some careful inspecting and soldering.



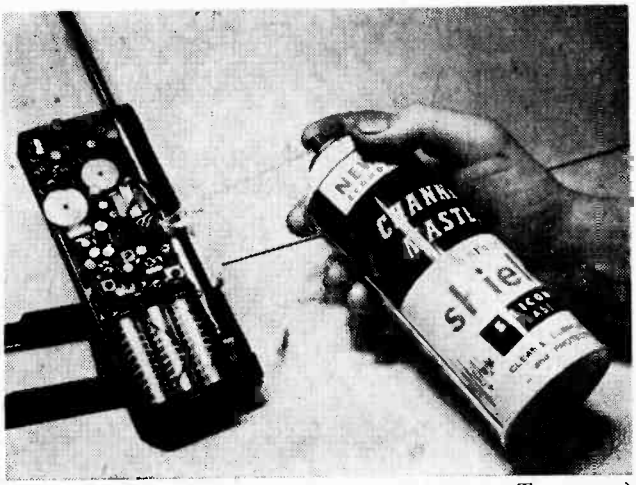
2 One big headache common to battery equipment is loose battery leads. Use a small-tip, low-wattage solder iron while making repairs. Apply enough heat to make a good solder joint and stop. Nose around for other loose connections or cold solder joints in the printed circuit board. Check switch connections, too!

3 Walkie-talkie antennas usually break with time because of the abuse they take. Don't toss out the unit because its sky hook snapped. Multi-section antennas are available at most parts suppliers and can be installed in your unit. Be sure to select an antenna that comes close in length to the original. A longer antenna does not mean better reception or more signal out—it may mean poorer operation because of detuning.



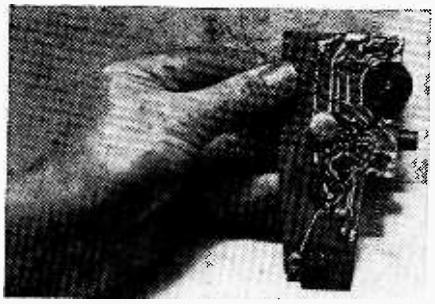
6 No reception? In superhet models this means trouble in unit's front end as a rule. Check antenna coil for broken leads or loose connections. Travel from antenna to audio section touching transistor leads as you go. As soon as buzz comes from speaker, you know trouble is in previous transistor stage. Check for physical defects and damage before yanking out any transistors.

7 One good way to get rid of bugs is to spray them dead with electronic Raid. Push-to-talk switches cause a lot of trouble because of dirty contacts. It's not the switch's fault. The unit's low cost prevents use of hermetically-sealed switches, so dirt and dust will louse up the contacts. Use one of the many contact cleaners currently on the market place. A short spray and a dozen switch pushes should clean up any trouble in your rig.

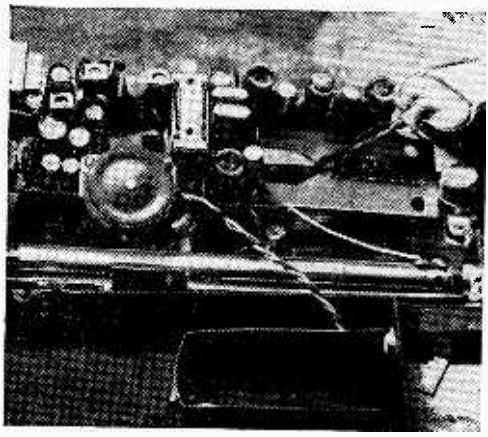


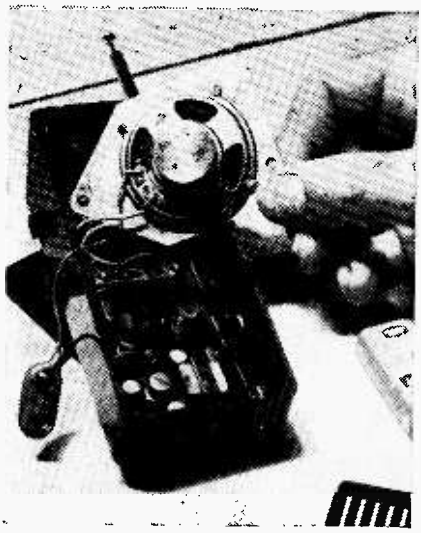
(*Turn page*)

WALKIE-TALKIE



8 Let's face it, you drop a walkie-talkie and you have to pay the price. In this case it means removing the printed circuit board and patching it up if necessary, not to mention the epoxy work needed on the case.

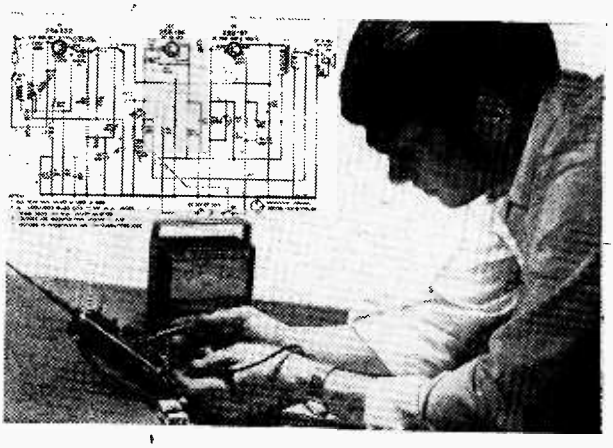




9 The sound from walkie-talkies is never hi-fi, but it can get worse with time because dirt, dust, humidity, and what-not tear, jam, warp, etc., the speaker cone. A quick test is to listen to the receiver at low volume—if it still sounds bad, it's time for a new speaker. Most jobs are 8-10 ohm units available from electronic supply houses. Pick a PM speaker replacement with the exact dimensions as the original.

10 If your receiver looks like it was salvaged from a vacuum cleaner bag, it's due for a thorough cleaning. Here's where old-fashioned GI spit and polish will pay off. Use Q-tips and water-color brushes to wipe and brush away the gook. You'll be surprised at the defects that can be uncovered this way.

11 If the first ten steps do not get your walkie-talkie on the air, you're in for some dog work. Most rigs come supplied with schematic diagrams—use them to pinpoint troubles. Make resistance measurements and continuity checks. Use the lowest scale setting when possible and likewise for voltage checks. If a transistor tester is available, check each transistor. It's a good idea to compare measurements against your other unit if you own a pair. It's up to you now, we ran out of space.



BIAFRA'S INCREDIBLE RADIO

by Don Jensen
Shortwave Editor

Day begins early in Biafra. In Orlu, since April the provisional capital, truck convoys, loaded with supplies flown in during the night, rumble in from the makeshift airstrip at Uli, 18 miles away. Not far from the town, radio engineers warm up a shortwave transmitter. A rhythmic tuning signal radiates across the African farmland.

In the tin-roofed town, Biafrans awaken to the sound of tramping feet and the abrasive shouts of drill sergeants counting cadence. Thousands of receivers are switched on.

"This is Radio Biafra, the home service of the Broadcasting Corporation of Biafra. The time is 25 minutes before six and we are broadcasting in the 41-Meter band. We invite you to join in our morning devotional service."

This morning, as on nearly 900 mornings before, Biafrans, two-thirds of them Christian Ibos, arise listening to hymns and prayers from Radio Biafra. Most will have no breakfast. Their faith must sustain through half a day.

By 6 a.m., a second transmitter is on the air. It's the Voice of Biafra, the overseas service, beaming a newscast to the outside world. Most Biafrans, though, still are tuned to the domestic channel for the "Early Bird" program, a wake-up show with fanfares, pep talks and rousing music.

"Say it loud!" exhorts an announcer. Throughout the country the still sleepy audience shouts back at their loudspeakers, "I'm Biafran and I'm proud!"

For the B.C.B.'s chief engineer, A. S. Alaribe, formerly senior sound technician for the Eastern Nigeria Broadcasting Service, it has been months of scrounging spare parts in a dwindling local market, keeping his transmitters together with spit, string and sealing wax. It has been equally tough for the university dons who write the programs, and for announcers, all veterans of broadcasting in Lagos and Enugu. Probably not since World War II has a station had to operate under such trying conditions.

Before WW II. Broadcasting in Nigeria isn't new. It began in Lagos back in 1936. After the war, 13 medium wave government relay stations, three of them in the Eastern region, were built. Shortwave came in 1952, when a 300-watt experimental station was

BIAFRA

set up in Enugu. A broadcasting house was constructed the next year and, later, more powerful transmitters were added.

Enugu's second station, the commercial Eastern Nigeria Broadcasting Service, began on October 1, 1960, Nigeria's independence day. It used the two 10-kilowatt transmitters made by Pye Telecommunications Ltd., in England. These, one a medium-wave station, the other shortwave, plus a 10,000-watt shortwave transmitter added to the Nigerian Broadcasting Corporation's Enugu relay in 1965, were taken over by Biafra.

When the paper revolution became a real war in July 1967, the B.C.B. was more than a month old. The Voice of Biafra was active on 4855 kHz, the ex-ENBS frequency. Radio Biafra programs were aired by the NBC government relay on 3980 kHz.

Nigeria's opening offensive stalled and the hastily trained Biafran army pushed forward to within 135 miles of Lagos, capturing Benin City, capital of adjoining Midwest State.

Republic of Benin. On August 9, a truckload of soldiers headed out Benin City's Agbor Road. Leaving the sprawl of low, yellow buildings behind, the vehicle wound its way up the wooded slope of Ikpoba Hill. Beside a converted two-story residence they piled out of the truck and a young officer walked inside. To a startled technician, he announced the takeover of the NBC midwest relay station. A similar scene took place at the nearby Broadcasting House studios on Ikoba Road.

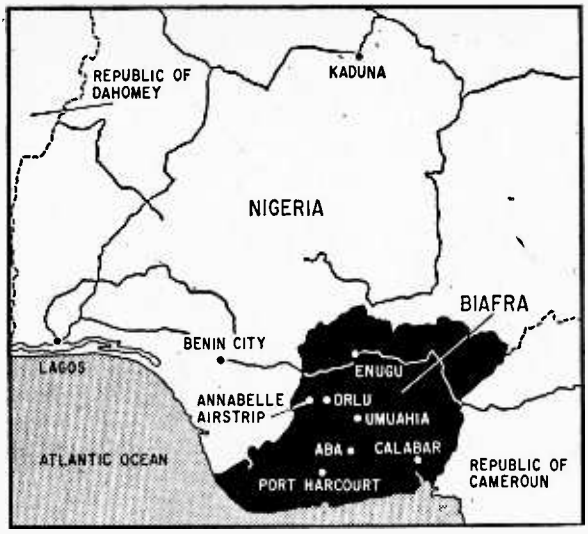
They stayed until September 18, when at 4 p.m., Midwest Radio left the air. It was thought—incorrectly it turned out—that the easterners were dismantling the radio equipment for shipment to Enugu. Two days later the newly proclaimed Republic of Benin, a separate entity, but allied with Biafra, fell. Benin City again was in federal hands.

Back to Biafra. The tide turned and the Nigerians pushed toward Enugu. With his capital in danger, the 33-year-old Ojukwu made plans to evacuate the government to safer ground. The word came down from Dr. Ifegwu Eke, commissioner of information, "Pack up and move out!"

The three transmitters, especially the seven-year-old medium waver, were big and bulky. But contingency plans had been in advance and there were plenty of willing hands. Main switches were pulled and the dismantling work began.

A week before Enugu fell on October 4, a truck convoy headed for Aba, 120 miles south. Headlights dimmed, the string of lorries

Biafrans don't care how the food comes as long as it comes. At left, UNICEF airlift brings bags of powdered milk —a commodity that's very scarce in Biafra. Below, an aircraft is unloaded in the dead of night, fearful of Nigerian air attack. Some 150 to 200 tons are delivered nightly.



followed blacktopped Highway 3 through Awgu and Okigwi. There the road bulged west, crossed the Imo River and straightened southward again to Umuahia. A final 37 mile stretch and they rolled into Aba.

In the new capital, Biafran radio was rebuilt. Its new antennas already up, the 4855 kHz. station was back on the air just 72 hours after it shut down. Two weeks later, the other shortwave station, its frequency changed to 6145 kHz., was reactivated as the Voice of Biafra. Strangely, this move and two subsequent ones were never announced. The B.C.B. still announces its location as Enugu.

Broadcasting continued despite problems. Hard to replace tubes failed. Tape recorders sputtered and stalled. Apologetic announcers often broke in to advise that "Until we can continue with the broadcast, here are some records."

One major interruption occurred on April 4, 1968 and lasted two days. On that date, Nigerian Ilyushin jets dropped eight bombs on Aba, destroying and damaging a number of buildings and killing 36 persons. Another type of harassment, radio jamming, began in July but with slight success.

On the Move Again. Aba was lost on September 4, but again one jump ahead, the stations were moved to Biafra's third capital, Umuahia. This shift was accomplished in just 36 hours.

For the young republic things hardly could have been worse. Its rickety air force had been shot out of the sky long before. Its soldiers were lucky to go into combat with a bullet or two each. Civilians were dying, thousands per week, from starvation.

Then two things happened to change the picture. International relief flights began arriving with food to stem the starvation, and France's Charles DeGaulle, for reasons never explained, decided to help Biafra. An

(Continued on page 104)

Biafran Background

Eighty-five years ago, the colonial powers, tired of wrangling over the spoils, met in Berlin to divvy up Africa. To Britain went the chunk that would become Nigeria, an uncohesive territory of feuding tribes. For years London provided the glue that held it together. But with independence in 1960, Nigeria came unstuck. Tribal jealousies triggered coups d'état, political assassinations, and in 1966, the mass murder of 30,000 Ibos.

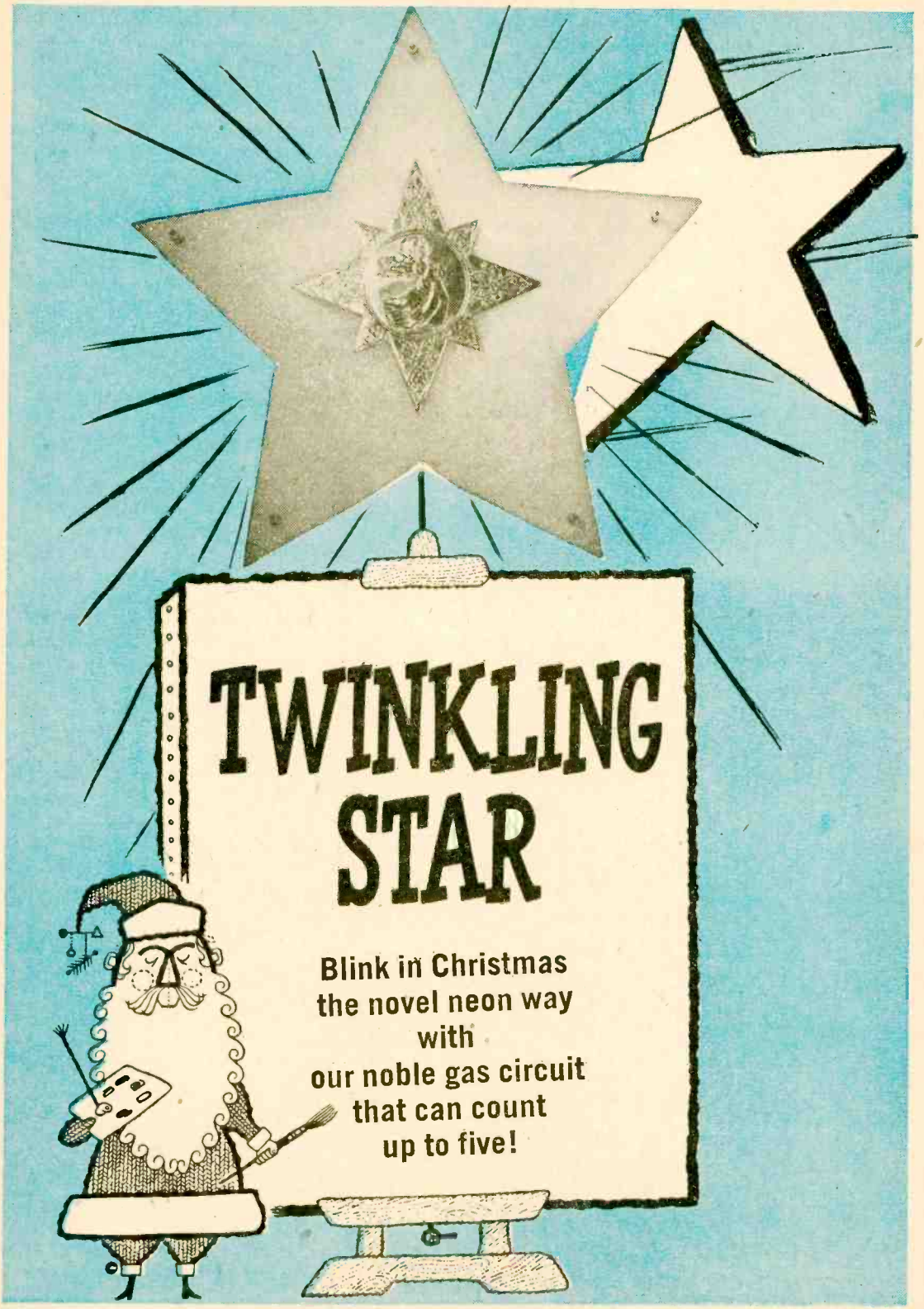
The Ibos are a remarkable people, ambitious, industrious and educated. They've produced doctors, scientists, engineers and successful merchants. Convinced they were marked for genocide, some eight million of them sought refuge in their traditional eastern homeland. There, in Enugu on May 30, 1967, their leader, Lt. Col. Chukwemeka Odumegwu Ojukwu proclaimed Biafra's independence.

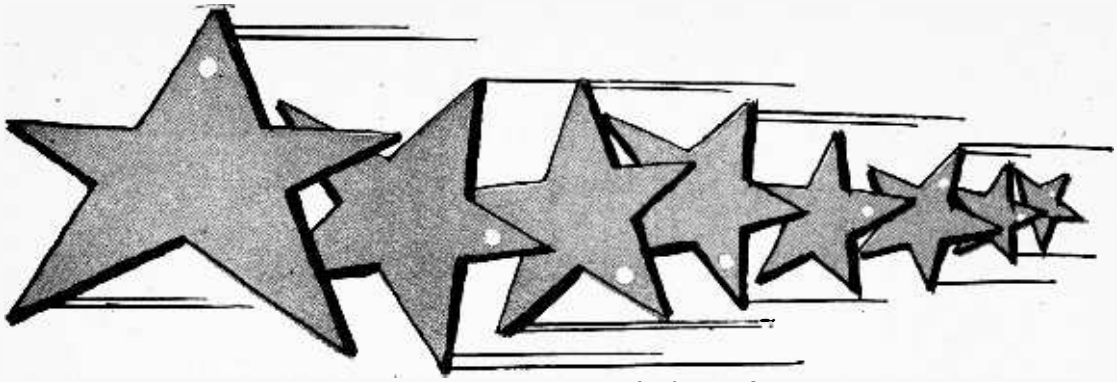
The Nigerian government of Maj. Gen. Yakubu Gowon in Lagos vowed to end the rebellion with "swift, surgical police action." Armed with modern British and Russian weapons, his forces launched their campaign. But for more than two years the usually outgunned, seldom outfought Biafran army held out, though driven into an enclave one-tenth its original size. The death toll has been staggering, thousands on both sides killed in combat, and at least a million and a half Biafrans victims of starvation.

Cut off from the outside world, except for an overtaxed airlift, the Ibos' talents for improvisation paid off. From their home-refined gasoline—only a bit more potent than Biafran Survival Gin—to their hand-rolled cornsilk cigarettes, they've proved necessity is the mother of invention.

With a basic need to communicate with its people, and tell its story to the world, Biafra has placed a high priority on radio broadcasting. Here, for the first time, is the story of how, despite great difficulty, Africa's newest nation has kept its radio voice alive!

* * * * *


TWINKLING STAR
Blink in Christmas
the novel neon way
with
our noble gas circuit
that can count
up to five!

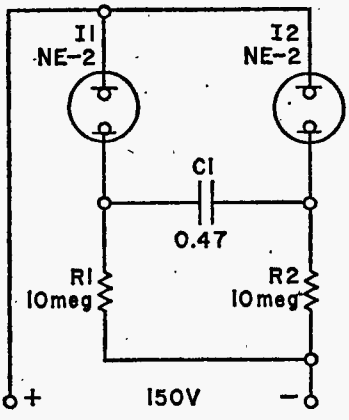


by William F. Splichal, Jr.

"Tis the time to be jolly, etc., etc., etc." Want to build Christmas or other seasonable decorations that are more attractive, relatively inexpensive and real attention getters? And, at the same time you can impress your friends and neighbors with your ability to apply your mastery of electronics to things other than being a ham or CBer.

We built an attractive, twinkling *Star of Bethlehem* by using a 5-stage ring counter employing five neon lamp oscillators that are fired and extinguished sequentially at a fixed rate. Neon lamp oscillator/ring counters can be built from a few inexpensive components and can be applied in many ingenious ways to animate displays and decorations. We have included information on how to connect any number of lamp oscillators in combinations of two or more, as needed, for other different applications.

Although our Twinkling Star is operated from a self-contained AC power supply, and we have included information for the supply, these ring counter/oscillators will work as well from batteries. The current drain is quite low and the batteries should last for several months of operation.



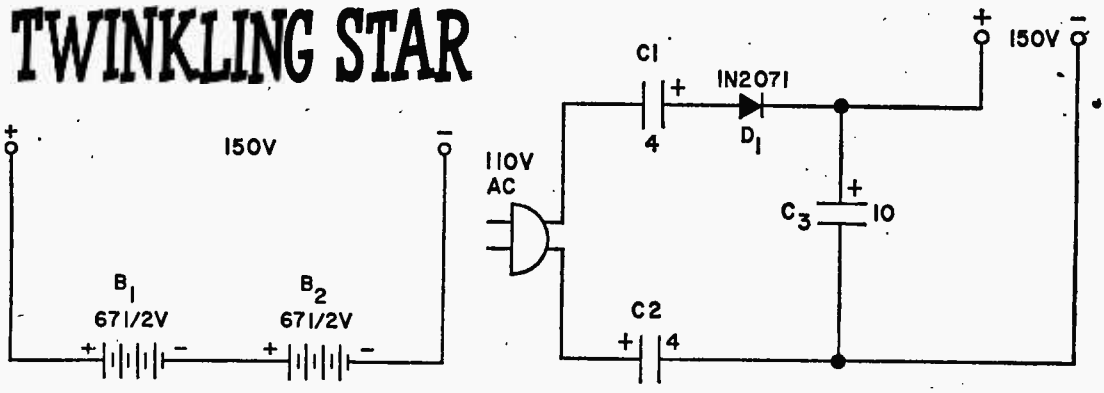
It may not look like a ring counter, but it is! This basic circuit can be extended to 3, 4, 5 or more sections—using one lamp per section.

Why It Twinkles. The simple two-element neon lamp, heart of the oscillator/ring counter of our project, provides for the stepping from one to another lamp oscillator. The neon lamp is also a relaxation oscillator, which in this application is a voltage generator.

Neon gas acts as an insulator when low voltage is applied to the two elements of the NE2 lamp, and prevents the flow of current. As this voltage increases, the force applied to the gas eventually becomes of sufficient magnitude to force electrons to flow towards the positive element. This flow of electrons from the gas atoms causes the atoms to become more positive and creates current flow to the negative element, which flow increases the total current flow. In this manner the neon gas in the lamp is transformed from an insulator to a conductor. This condition is called ionization, and can be used as a switch to step current flow from one lamp to the next lamp through the coupling capacitor.

Applying this operation to our circuit we see that when voltage from the power source is switched *on* to the first neon lamp, the voltage begins to charge the capacitor coupling the first lamp to the next lamp. This action is repeated from lamp to lamp in the string to the last lamp. It then starts all over again because the last lamp is capacitively coupled to the first one. The frequency of flashing of the lamps is determined by the time constant of the RC network formed by the coupling capacitor and the drain resistor. The frequency is increased (faster flashing) as the capacity of the coupling capacitor is reduced and, conversely, the frequency is decreased (slower flashing) as

TWINKLING STAR



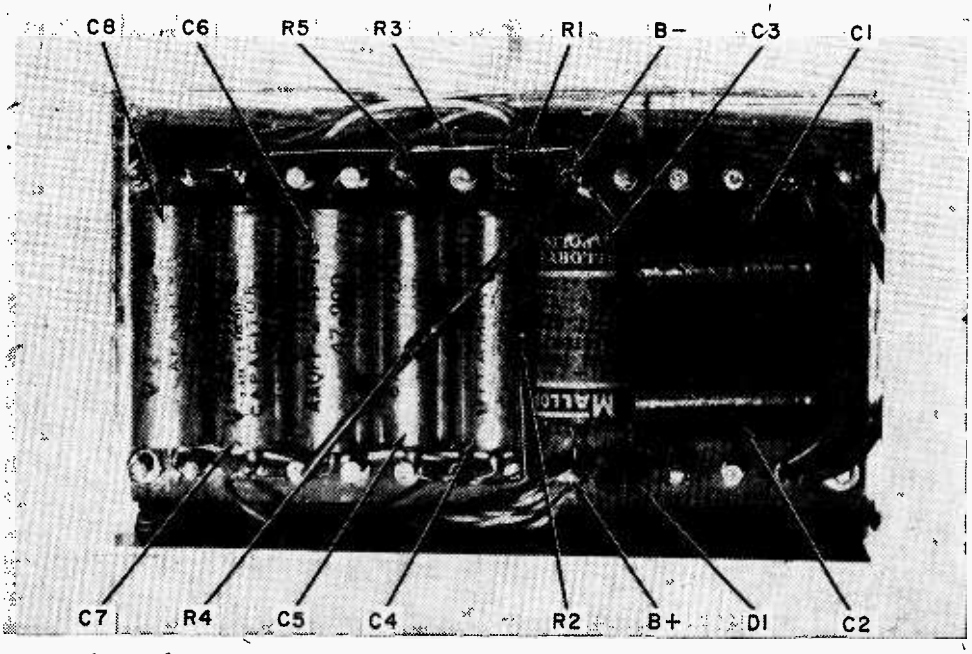
It takes power to drive the Twinkling Star—a lot of volts but very little milliamps. Circuit at left is battery powered and will last through Christmas season. Circuit at right lets the line do the work. Capacitors C1/C2 offer some line isolation.

the capacity of the coupling capacitor is increased.

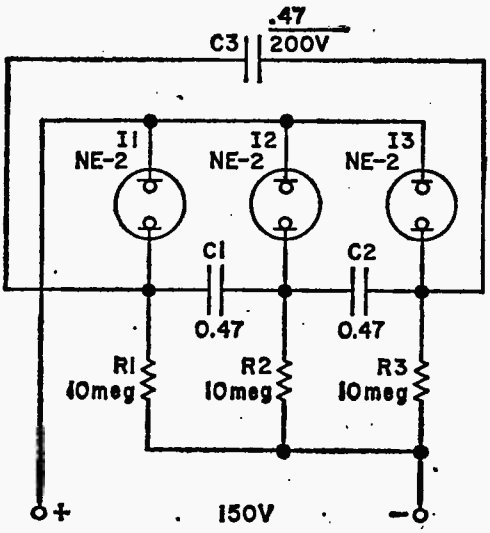
Be a Star Maker. We cut our star from a 1¼-in. thick sheet of Styrofoam twelve inches square. Drill a 7/32-in. diameter hole at each of the points of the star. Force an NE2 neon lamp through each hole from the rear so that its tip will protrude about ½ in. from the front of the star.

For easy identification later on, different colored hook-up wire leads should be soldered to the lamp leads before positioning the lamps. This will come in very handy later in the construction to help establish the sequence of flashing at the completion of construction during the testing of the unit. At that time the stepping sequence will be determined. Be sure the lamp leads are separately insulated and do not short out after the backing is cemented on.

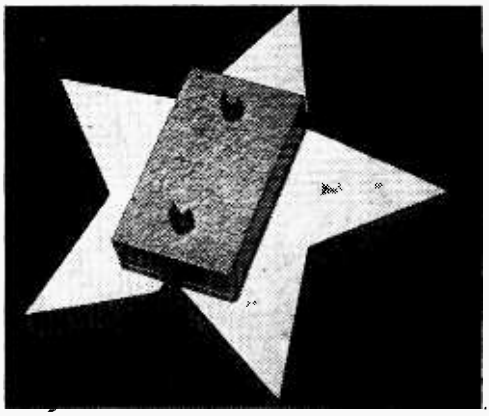
The ring counter/oscillator assembly and its power supply are housed in a 5¼ x 3 x 1¼-in. metal interlocking chassis box. The base of the box is screwed to the backing of the Styrofoam star before the backing is cemented to the Styrofoam. Drill a hole



Here's a guts eyeview of the electronics behind Twinkling Star. Parts placement and wiring location are not critical—just do a neat job and the lights will blink.



Here's our friend, the ring counter, again! Compare to schematic diagram below to discover how additional lamp sections are added.



The back of Twinkling Star shows how all the electronics is packed in an aluminum box.

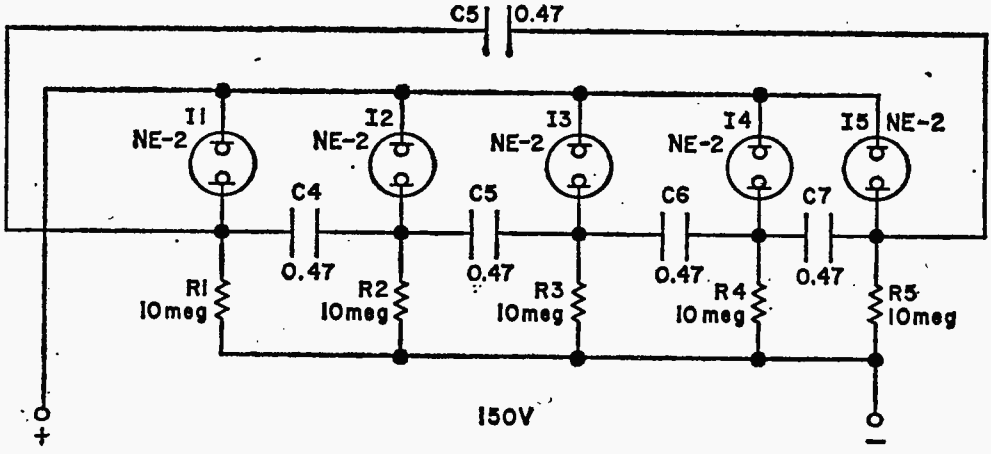
near the center of the base of the box large enough to feed the lamp leads into the box. It would be a good idea to protect the wires with a rubber grommet in the hole. Use silicon rubber or similar cement to cement the heavy cardboard or hard-board backing, which has been cut to match the shape of the star, to the Styrofoam. Cut channels running from each lamp to the center on the rear of the star in which the lamp leads lay. Feed the leads through the backing material and the base of the box before cementing the backing.

All of the components, except for the

(Continued on page 108)

PARTS LIST FOR TWINKLING STAR

C1, C2—4-uF, 450-V electrolytic capacitor (C-D Beaver type BR-4-450 or equiv.)
C3—10-uF, 150-V electrolytic capacitor (Mallory TC-42 or equiv.)
C4 through C8—0.47-uF, 200-V tubular capacitor
D1—1N2071 silicon diode
I1 through I5—NE2 neon lamp (use NE2H for brighter light)
R1 through R5—10-megohm, ½-watt resistor
1—5¼ x 3 x 1¼-in. interlocking chassis (LMB type 139, gray hammertone or equiv.)
Misc.—Styrofoam, heavy cardboard or hard-board, silicon rubber cement, line power cord and plug, ¼-in. spacers, 2½ x 5⅛-in. terminal board (Lafayette 47E2910 or equiv.), colored hookup wire, clips similar to fuse-mounting or capacitor-mounting clips, hardware, solder, etc.



The lights in the circuit will flash on, then off, in sequence from I1 to I5 and then back to I1, and so on, etc. Locate bulbs on Twinkling Star randomly.

HAM TRAFFIC DE W7DQS

by MARSHALL LINCOLN

Is Your Radio Club Dying?

A frequent comment I read in ham radio club papers and hear from individual hams goes something like this: "Boy, our club sure is in bad shape. I can't get the guys to do anything. Only a handful show up at meetings, and they just want to sit around. Nobody has any real interest in the club."

Does that sound familiar? Did you think *your* club was the only one with that kind of trouble? Well, it isn't, not by a long shot! Lots of ham clubs are suffering the doldrums, and lots of club presidents and editors are moaning and crying about the troubles they're having in keeping the "good old club" going. The wailing they do across the land sounds like 40-meter phone on a winter Saturday night!

What's gone wrong, and what can be done about it?

Well, it seems to me that nothing has gone "wrong" in the sense that a villain can be found to blame for the troubles so many clubs are having. However, there certainly has been a change in the nature of ham radio in recent years, and this change has apparently affected club activities more than any other ham activity that comes to mind.

Likes Attract. The main reason that so many clubs were so active and successful in years past, it seems to me, is simply that nearly everyone in ham radio had basically the same interests: building or buying or modifying equipment, putting it on the air, and talking to one another to see how good it was. There were only two modes of operation in general use: AM and CW—and just about everybody used both. The radio club was the common meeting ground in every city for guys with these interests to get together. From these meetings came field trips, contests, local nets, auctions, technical discussion nights and many other activities in which everyone was interested.

But, my, how things have changed, haven't they?

Opposites Repel. This is the age of specialization, in ham radio just as in business and industry. Go to a club meeting today where there may be a dozen guys assembled, and you'll find nearly every one of them is interested in a different phase of hamming. One may be a DX hound, another may be a traffic handler, a third may be on SSB, the next guy may be on FM, the next fellow is getting set up for RTTY, and the next fellow is a CW contest hound, and so on. Every one of them works hard at ham radio and enjoys it tremendously, yet his interests have virtually nothing in common with the others! Is it any wonder this club soon will dry up and die?

Of course not, yet there's nothing really "wrong" that has created this situation—it's just that, except in large cities with a large number of hams, there isn't much chance for a "general interest" ham radio club to be very large and active any more.

Talk to Yourself. So, what to do about it? Maybe it's time to back off and take a fresh look at just what purpose a club should serve. Some of the radio clubs which are staggering along with few active members and lagging interest should have a good heart-to-heart talk with themselves, and decide if they aren't just beating a dead horse. Why should club officers scold their members for lack of interest in the club—when maybe it's the club's fault for having lack of interest in its members! If everyone in a club is interested in a different phase of ham radio, maybe the club should stop trying to be a "general interest" club and pick up one

or two of these specialties as the main "theme" for the club. Sure, the members who aren't interested in these specialties will drop out. So what? The guys who are left will have a new interest in the club, and probably will begin dragging some of their buddies to meetings. The club may not wind up with as large a membership as it had originally, but it probably will be more lively and active—and that's what really counts.

The Age of Specialists. Many of the ham clubs which are still lively today are the ones which cater to the interests of a single group of hams, such as those in RTTY, or FM, or TV, or those who concentrate just on DX, or on contests or on traffic handling or mobile operating, or such like. Other hams in the same community who are not involved in the special interest of the club may be barely aware that the club exists, but that doesn't really matter. The important thing is that some sort of club activity, which can benefit a number of hams, has been preserved by tailoring the club to the interests of a group of potential members.

I'm still in favor of a good, active "general interest" ham club in every community, *if* it's possible to maintain one and hold the interest of a significant number of the community's hams. However, all too often, it has been shown in city after city across the nation that these clubs just don't hold the interest of many of the community's hams. So, turning to a specialized club seems to be a sensible alternative.

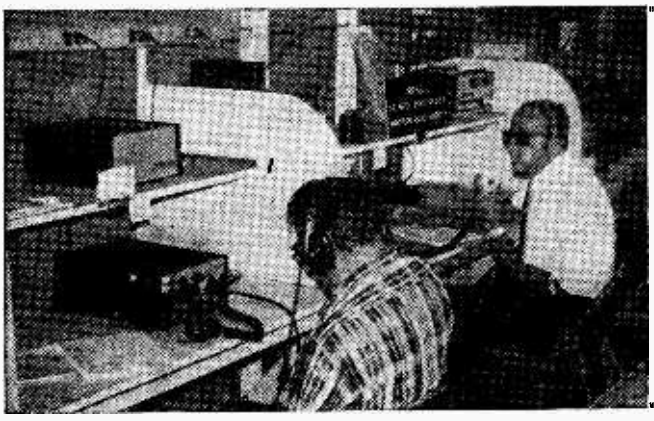
Once you hit the specialty trail, you still need some activities to keep members' interest up. There's a growing number of mobile clubs across the country, since mobile hamming is extremely common these days. Even in this field, though, there are specialties! Some guys work SSB and others work FM. A few still work AM, but this is dying out. Most mobillers stick to just one band—with 75, 40, 6 and 2 probably the most common. The guys on 75 and 40 generally work moderately long range, while the guys on 6 and 2 generally make local contacts. Right here, you have at least four specialties just among mobile operators! The guys on 75 don't understand what 2-meter operation is like, for instance, and generally couldn't care less.

So, where can you go from here? Well, some mobile clubs go in for hidden transmitter hunts, which can be pretty exciting and still safe if they're properly managed. Others volunteer to help out local charities during their fund drives, or work with the local police on Halloween night vandalism patrols. Just a couple of this type activities in a year can hold a club together, since the time between these mobile outings can be spent planning, organizing and working on equipment for the next activity. Helping out at parades, golf tournaments, fireworks displays and model airplane contests are just a few more opportunities for the mobile crowd to keep a club active.

Some clubs seem to have a lot of competitive spirit, and encourage contests among members, or sponsor contests in which members and non-members alike are welcome to participate. This allows a club to "blow its own horn" by awarding certificates to persons who may not belong to the club, but may become interested in joining.

Some clubs have taken on outside chores, such as helping present radio classes at a blind school, or conducting classes for prospective novices in the community. These activities can involve quite a number of members, if done well, since there is equipment to be built, antennas to be erected, class out-

(Continued on page 109)



Operating WB41CJ at the Kennedy Space Center are WA4LJG on 40 Meters (left), K4DJN on 15 Meters, and, with just a piece of him showing, is WA4WBG on 20 Meters. The Space Center Amateur Radio Society begins special operation on Apollo lift-offs, continues for several hours, and sends certificates to stations logged.

10 New Exciting Kits For Home & Hobby

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Kit GR-78
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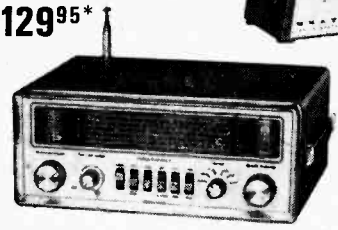

NEW Heathkit GR-78 Solid-State General Coverage Receiver... Tunes 190 kHz To 30 MHz In Six Bands

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NEW Heathkit GR-88 & GR-98 Solid-State Portable Monitor Receivers For VHF-FM And Aircraft Bands

GR-88 . . . Tunes narrow and wide band signals between 154-174 MHz . . . for police, fire, most any emergency service. Exceptional sensitivity and selectivity. Smart compact styling, portable or fixed station capability with accessory AC power supply, variable tuning plus single channel crystal control, collapsible whip antenna, adjustable squelch control, easy circuit board construction. 5 lbs. GR-98 . . . Tunes 108 through 136 MHz for monitoring commercial and private aircraft broadcasts, airport control towers. Same features as the GR-88 above. 5 lbs. **GRA-88-1**, Accessory AC Power Supply . . . $7.95*

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Kit GR-38
$32.95*

NEW Heathkit GR-38 Solid-State AM Clock Radio

Discover An Easier Way To Get Up In The Morning . . . with the new GR-38. Set the front panel switch to "Alarm" to hear both alarm and news & music of AM radio, or use "Auto" position for only the radio. The "Snooze" alarm lets you turn off the alarm for ten minutes but keeps the radio on to wake you up gradually, and cycles continuously until selector switch is reset. The accurate, dependable clock controls the accessory AC socket so you can have coffee perking or lights turned on in the morning. The all solid-state radio really pulls in those stations and runs cool, maintenance-free. AGC keeps stations at a constant volume and a full wave transformer power supply eliminates power line hum. Styled in coral with matching grille. There IS a better way to get up in the morning . . . with the Heathkit GR-38 . . . order yours now. 6 lbs.

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The next best thing to a personal doorman. The "wireless" factory assembled transmitter operates up to 150 feet away. Just push the button and your garage door opens and the light turns on . . . and stays on until you're safely inside your home. The giant 7 ft. screw mechanism coupled with the ¼ HP motor mean real power and reliability, and the adjustable spring-tension clutch automatically reverses the door when it meets even the smallest obstruction . . . extra safety for kids, pets, bikes, even car tops. Assembles completely without soldering in just one evening. Easy, fast installation on any 7' overhead track door and jamb & pivot doors with GDA-209-2 Adaptor at $7.95. Order yours now. 66 lbs.

From The Leader

HEATHKIT®

NEW Heathkit Ultra-Deluxe "681" Color TV With AFT . . . Power Channel Selection & Opt. RCA Hi-Lite Matrix Tube

The new Heathkit GR-681 is the world's most advanced Color TV with more built-in features than any other set on the market. Automatic Fine Tuning on all 83 channels . . . power push button VHF channel selection, built-in cable-type remote control . . . or you can add the optional GRA-681-6 Wireless Remote Control any time . . . plus the built-in self-servicing aids that are standard on all Heathkit color TV's. Other features include high & low AC taps to insure that the picture transmitted exactly fits the "681" screen, automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs, top quality American brand color tube with 2-year warranty. With optional new RCA Matrix picture tube that doubles the brightness, **Model GR-681MX only $535.00.**

GRA-295-4, Mediterranean Cabinet shown **$124.95***

Heathkit "295" Color TV

With Optional RCA Matrix Tube . . . with the same high performance features and built-in servicing facilities as GR-681 above . . . less AFT, VHF power tuning and built-in cable-type remote control. You can add the optional GRA-295-6 Wireless Remote Control at any time. New optional RCA Matrix tube doubles the brightness, **Model GR-295MX, $485.00.**

GRA-295-1, Contemporary Walnut Cabinet shown **$64.95***

Both the GR-681 and GR-295 fit into the same Heath factory assembled cabinets; not shown Early American style at $109.95*

NEW Deluxe Heathkit "581" Color TV With AFT

The new Heathkit GR-581 will add a new dimension to your TV viewing. Brings you color pictures so beautiful, so natural, so real . . . puts professional motion picture quality right into your living room. Has the same high performance features and exclusive self-servicing facilities as the GR-681, except with 227 sq. inch viewing area, and without power VHF tuning or built-in cable-type remote control. The optional GRA-227-6 Wireless Remote Control can be added any time you wish. And like all Heathkit Color TV's you have a choice of different installations . . . mount it in a wall, your own custom cabinet, your favorite B&W TV cabinet, or any one of the Heath factory assembled cabinets.

GRA-227-2, Mediterranean Oak Cabinet shown **$109.95***

Heathkit "227" Color TV

Same as the GR-581 above, but without Automatic Fine Tuning . . . same superlative performance, same remarkable color picture quality, same built-in servicing aids. Like all Heathkit Color TV's you can add optional Wireless Remote Control at any time (GRA-227-6). And the new Table Model TV Cabinet and roll around Cart is an economical way to house your "227" . . . just roll it anywhere, its rich appearance will enhance any room decor.

GRS-227-5, New Cart and Cabinet combo shown **$54.95***

Both the GR-581 and GR-227 fit into the same Heath factory assembled cabinets; not shown, Contemporary cabinet $64.95*

NEW Heathkit Deluxe "481" Color TV With AFT

The new Heathkit GR-481 has all the same high performance features and exclusive self-servicing aids as the new GR-581, but with a smaller tube size . . . 180 sq. inches. And like all Heathkit Color TV's it's easy to assemble . . . no experience needed. The famous Heathkit Color TV Manual guides you every step of the way with simple to understand instructions, giant fold-out pictorials . . . even lets you do your own servicing for savings of over $200 throughout the life of your set. If you want a deluxe color TV at a budget price the new Heathkit GR-481 is for you.

GRA-180-1, Contemporary Walnut Cabinet shown **$49.95***

Heathkit "180" Color TV

Feature for feature the Heathkit "180" is your best buy in color TV viewing . . . has all the superlative performance characteristics of the GR-481, but less Automatic Fine Tuning. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart. Get the value-packed GR-180 today.

GRS-180-5, Table Model Cabinet & Cart combo **$42.50***

Both the GR-481 and GR-180 fit the same Heath factory assembled cabinets; GRA-180-2, Early American Cabinet $94.95*.

Add the Comfort And Convenience Of Full Color Wireless Remote Control To Any Rectangular Tube Heathkit Color TV . . . New Or Old!

Kit GRA-681-6, for Heathkit GR-681 Color TV's **$64.95***

Kit GRA-295-6, for Heathkit GR-295 & GR-25 TV's **$69.95***

Kit GRA-227-6, for Heathkit GR-581; GR-481 & GR-180 Color TV's **$69.95***

Now There Are 6 Heathkit® Color TV's To Choose From

2 Models In 295 Sq. Inch Size

NEW
Kit GR-681
With AFT
$499.95* (less cabinet)

Kit GR-295
$449.95* (less cabinet)

2 Models In 227 Sq. Inch Size

NEW
Kit GR-581
with AFT
$419.95* (less cabinet)

Kit GR-227
NOW ONLY
$379.95* (less cabinet & cart)

2 Models In 180 Sq. Inch Size

NEW
Kit GR-481
with AFT
$359.95* (less cabinet)

Kit GR-180
NOW ONLY
$329.95* (less cabinet & cart)

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HEATHKIT

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Please send model (s)_____

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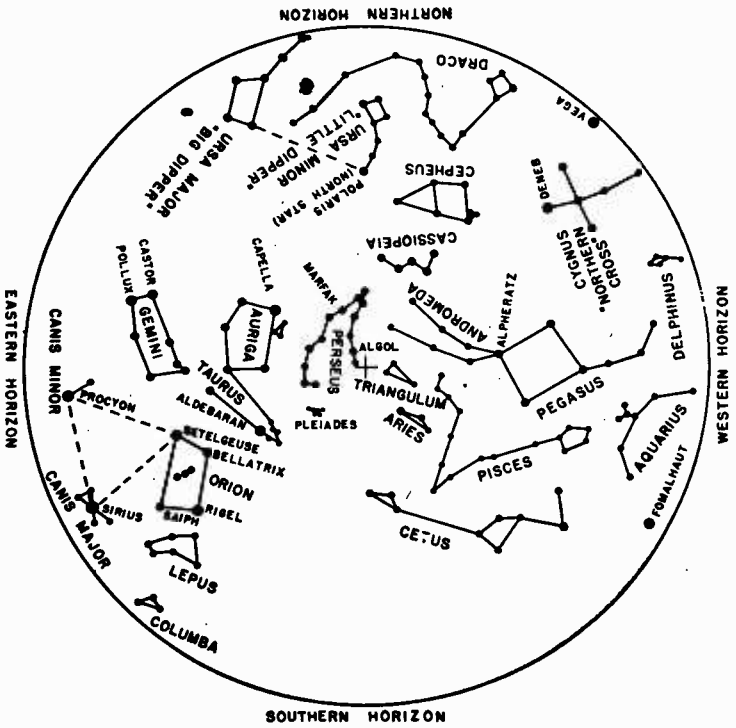
*Mail order prices; F.O.B. factory. Prices & specifications subject to change without notice. CL-364R

The ★ Skies Above Us



by Dr. Roy K. Marshall

THE NIGHT SKY IN DECEMBER

★★ The stage is now being set for the performance of the most brilliant cast of stars of the whole year. So often questioners have asked me why the sky is so much clearer in the winter, so the stars seem so much brighter. The fact is that the stars now beginning to dominate the eastern sky constitute the biggest batch of the brightest stars to be found anywhere in our sky of mid-northern latitudes.

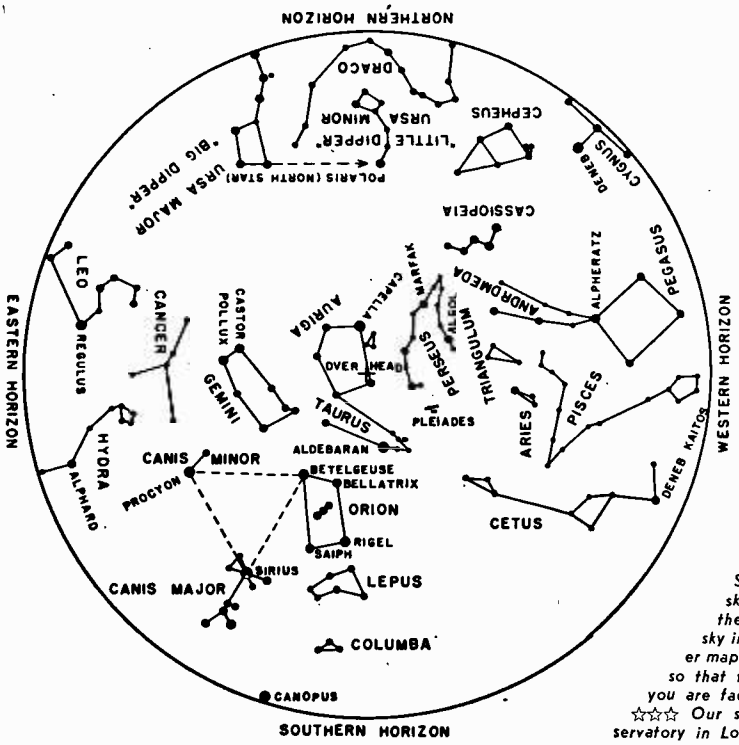
★ In early December, at 9 p.m., the brightest star in all the heavens—Sirius, the Dog Star—glitters and flashes colors like a brilliant gem, low in the eastern sky, a little toward the south. By early January, it will be in the same part of the sky at 7 p.m. and will be well up in the southeast at 9 p.m.; its violent glittering will be much subdued because it has cleared the disturbed air close to the horizon. Anyone who looks at the sky for more than a minute or two, and takes the pains to observe the behaviors of the stars as he raises his eyes slowly from the horizon to the zenith, will soon sense that it must be our air that produces the twinkling and dancing of the stars. At the horizon we are receiving starlight that has passed through the worst and longest layer of air, while at the zenith the path is shortest.

★ If you see a moderately bright reddish star between Capricornus and Aquarius, that is not shown on December's map, it will be the planet Mars. Only one other planet, Saturn, is in our evening sky now; fainter than Mars and yellow-white in color, it stands well up in the east at sunset, between Aries and Pisces.

★ A little north west, almost exactly opposite Sirius, the Northern Cross in the constellation Cygnus stands upright, flanked by Vega to the north and Altair to the south. They have done their act in summer and autumn and are bidding us good-bye until the summer comes again.

★ Back to the east once more, the mighty hunter-warrior Orion, on his side, leads Sirius and Procyon up the sky. There are two groupings of stars that a great many people see and ask about; one is the fine three-star lineup marking the belt of Orion, the other is the tight little cluster of six stars known as the Pleiades, in the constellation Taurus, the Bull. Sometimes the Pleiades are called the Seven Sisters, because they were the seven daughters of Pleione and Atlas. Except with a keen eye, only six stars will be readily seen; a very keen eye, under excellent conditions, might be able to see nine.

★ Even a very small telescope or a good pair of binoculars will show, south of Orion's



☆☆☆ *The maps show the principal stars which are above the horizon at latitude 34° North at about 9 p.m. standard time at the middle of the month. These maps are practical star location guides anywhere in the United States throughout the month showing the sky at 10 p.m. on the first and at 8 p.m. on the last of the month. To look at the night sky in December and January, select the proper map and hold it vertically. Then turn the map so that the point of the compass toward which you are facing shows at the bottom of the map.* ☆☆☆ *Our special thanks go to the Griffith Observatory in Los Angeles, California.* ☆☆☆

THE NIGHT SKY IN JANUARY

Belt, one of the most exciting objects in the heavens, "a piece of frozen chaos," I have often called it. In photographs taken with large instruments, it is a magnificent turbulent mass of hydrogen, oxygen, nitrogen and other gases in the nucleus of which is a little cluster of very hot stars whose ultraviolet radiation excites the gases to shine.

★ This great nebula may be the result of an enormous cataclysm in the distant past. Now the damage may be repairing itself because with radio telescopes, very recently, we have found here dull infrared objects that may be newly-forming stars, made of dust and gases of the ancient cataclysm drawn together by their mutual gravitational attraction, but not yet sufficiently compact to bring to shine with visible light. Several new faint visible stars has also appeared here in recent years, revealing their youthful instability by an erratic variability of light.

★ In the distant future, this great nebula may have become a star cluster with a few remaining wisps of gas, as are the Pleiades today. This charming cluster yields readily to a small telescope, revealing scores of stars fainter than the group of six naked-eye objects which mistakenly is often called the "Little Dipper," just because it is little. There is only one *the* Little Dipper, and it hangs by the end of its handle from Polaris, the North Star.

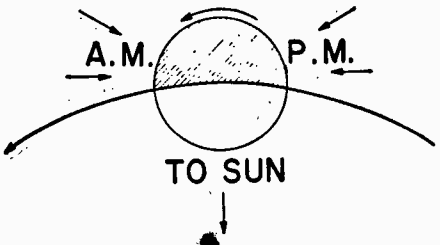
★ The heavenly twins, Castor and Pollux, are northeast of Orion and the fainter star, Castor, deserves our attention now because, near it, is the point in the sky from which a shower of meteors called the Geminids (from Gemini, the Twins) appears to radiate in mid-month. The significance of meteors and meteor showers will be made clearer in the article which follows. For now, however, let it suffice to know that, if it is clear on the nights of Dec. 12 and Dec. 13, you should be prepared to bundle up and watch for these briefly luminous bits of cosmic debris. There will be a crescent moon but it will not interfere, because it will have set before the best time to start to observe. Another shower occurs on Jan. 3, perhaps not so important as the one in December, but watch for it, too, especially if the earlier one is clouded out. These meteors are the Quadrantids, from Quadrans, the Quadrant, an obsolete constellation off the end of the handle of the Big Dipper.

Now, discover what you should know and do about these "shooting stars."

★★ One area of astronomy in which the interested star-gazer can make a contribution without any equipment except patience and

The Skies Above Us

willingness to watch the sky is in observations of meteors, commonly called "shooting" or "falling stars." It always amazes me that only a very small portion of our populace knows how frequent are these fleeting points of light. But this ignorance is, of



Top view of earth in orbit shows why we see more meteoroids after midnight. Higher velocity at impact causes brighter trails.

course, a reflection of how few people ever bother to look at the sky except, perhaps, to see whether it's clear or cloudy, and then only for a brief moment.

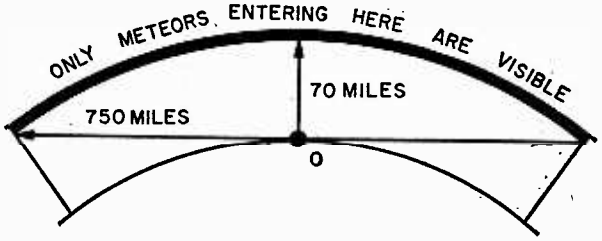
★ These phenomena occur as the earth, in its annual journey around the sun, collides with tiny bits of cosmic "junk," usually ranging is size from a small pinhead to a very small pea. They become visible because of friction with the air as they enter our atmosphere, yet soon disappear because, in our present concept, they are not strong, solid bodies, but are tiny icy dustballs. The mass of an average easy-to-see meteoroid (as we call them before they collide with us) may be such that about 150 of them would scarcely weigh one ounce!

★ How, then, can such a small object become so bright, especially when we may see it begin to glow at a height of 70 miles or more? The speed with which it enters the important part of our air can range between 7 and 43 miles per second, depending upon whether it catches up with us or meets us head-on; any speed in this range is sufficient to bring the particle to a very high temperature as it batters its way through trillions of molecules of air per cubic centimeter and the kinetic energy is converted into radiation. The filament in an incandescent lamp is very small, but it can emit a lot of light because it is very hot.

★ From careful observations by earnest groups of observers, the random rate of meteors is found to be seven per hour. This presupposes that the sky is very clear and there is no bright moon or artificial light to reduce the contrast. When we realize that this is the count for a single observer at one spot on the earth, and that he sees only about a thousandth of the total volume of the earth's atmosphere, we can begin to realize how much of this cosmic "junk" is out there.

★ Moreover, not all of that geometrical volume of the atmosphere is equally good for the observations. The horizon air is ten times as far away as the zenith air, so meteors are dimmed by a factor of 100 because of distance and the situation becomes even worse because of the long light-path through the denser, dirtier air near the horizon.

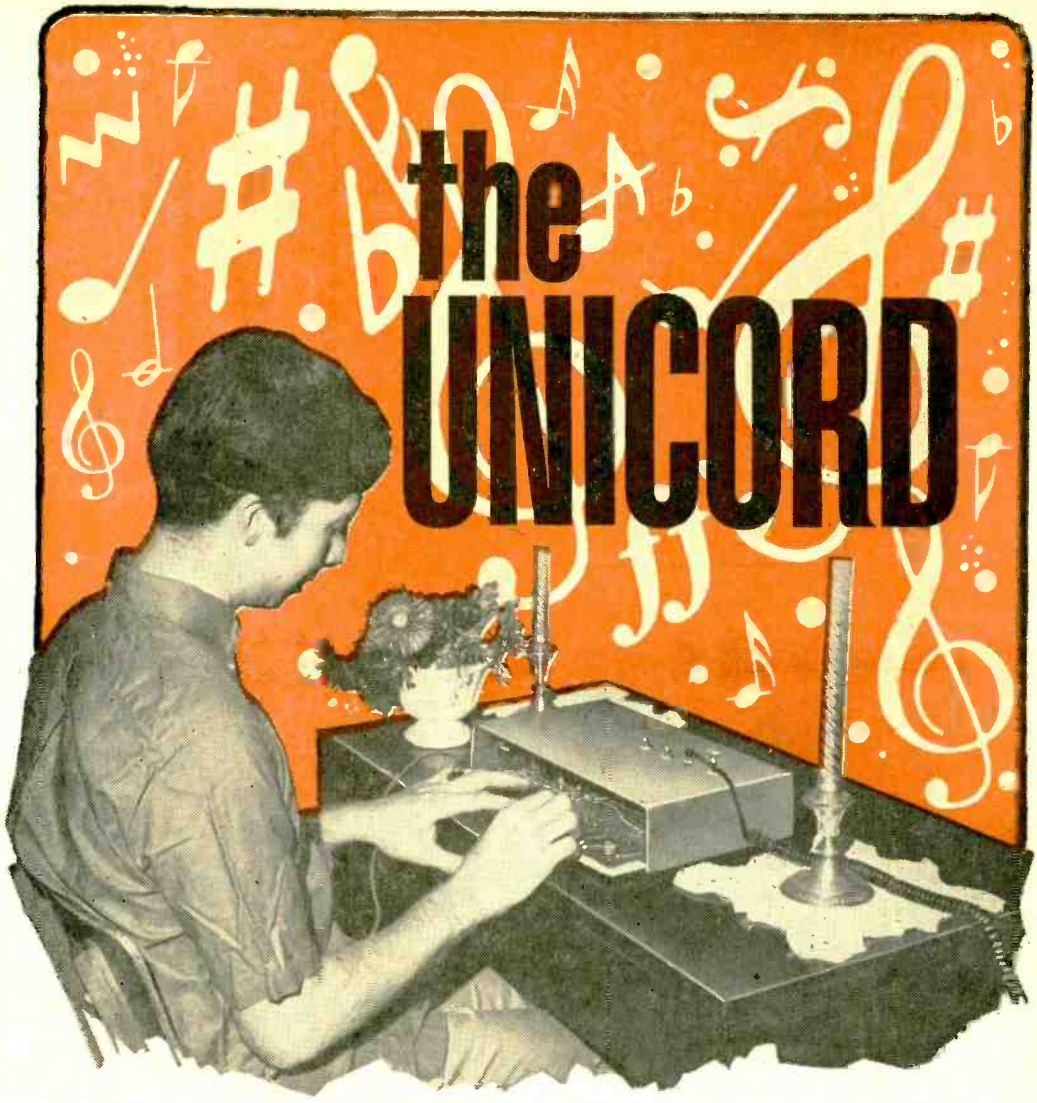
★ In the paragraphs above, an interested person should be able to set up a useful observing program for himself and friends.



Lower arc (not to scale) is earth. Upper arc represents atmosphere at 70 miles where meteoroids begin to glow. From any one spot on earth the observer can see only four one-thousandths of the total viewable meteoroids for any given period.

First of all, find an exposed place free from city lights or their glare in the sky. Avoid nights with a bright moon. Second, be comfortable and relaxed, as lying in a chaise lounge. If the night is chilly or cold, use the old astronomical rule: if you can keep your hands and feet warm, less bundling-up will be necessary. When lighting a cigarette, close the eyes. When talking with a companion, don't turn your head. Concentrate on one wide area of the sky instead of skipping here and there. Third, make records. Before starting serious observing, make up a sheet with quarter-hours marked off on the left

(Continued on page 106)



You can build this multiple chord organ with tremolo for less than $30

by Steve Daniels, WB2GIF

You're sick of those circuits for electronic organs that work great but let you play only one note at a time? You can't afford the bread for a "Mighty Wurlitzer," but you still want to be able to play chords? Well then, our Unicord is just what the doctor ordered. Employing unijunction transistors, it can be built for about 30 bucks. And, best of all, you can play complex chords up to a maximum of five notes over a range of better than an octave. In addition, it has tremolo that can be switched *on* when you want it and a switch to give you bass boost or brilliance at will. Output of Unicord can be fed to any phono input on a radio or TV, PA or hi-fi amplifier, tape player, etc.

How It Does It. Commercially built electronic console organs are designed with separate divider or generator stages for each note in

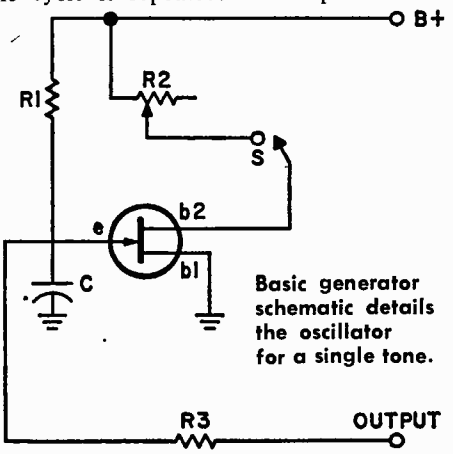
the UNICORD

order to provide flexibility and range. That is why you pay hundreds of dollars for these instruments. Our Unicord is built around a basic module containing five tone generators with circuitry that derives three notes from each generator. Frequencies of these notes are adjustable by means of three variable resistors. You can play no more than one of each of three derived tones from each generator at any one time. However, this has proven to be a minor problem when the notes are properly distributed between generators, since the organist can combine the output of more than one generator to make up chords.

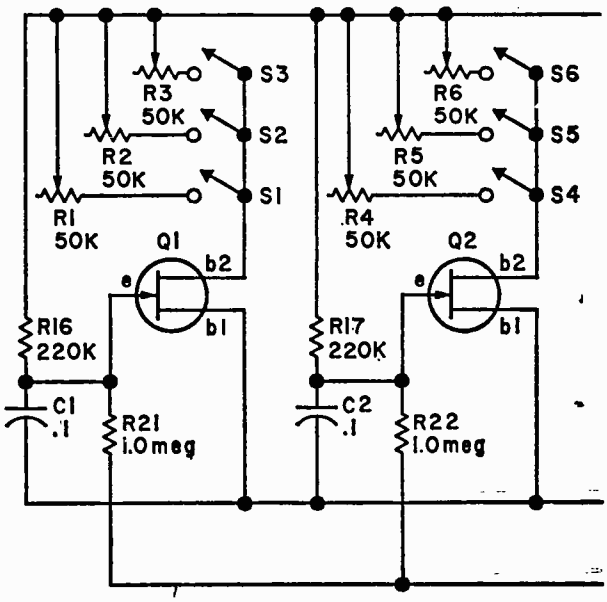
Since all of the tone generators are identical electronically, the technical description for one applies to all. Reference to the schematic diagram for the complete module, and also the separate basic generator schematic, will make it easier to understand the following functional description of Unicord's circuit.

Depressing a key applies B+ to its respective unijunction generator circuit. Referring to the basic generator schematic, this charges capacitor C through its associated resistor R1 until the peak point voltage of its UJT is reached. At this point the 2N2646 UJT now starts to conduct current through its base b1. The junction voltage at the emitter is clamped almost to ground. The current through the transistor then decreases and the transistor is driven to cut-off.

Capacitor C now begins to recharge and the cycle is repeated. The repetition rate, which actually establishes the frequency of the note, is determined by the RC time constant. End result is an audio voltage, developed at the emitter and coupled to the output buss through the high resistance iso-

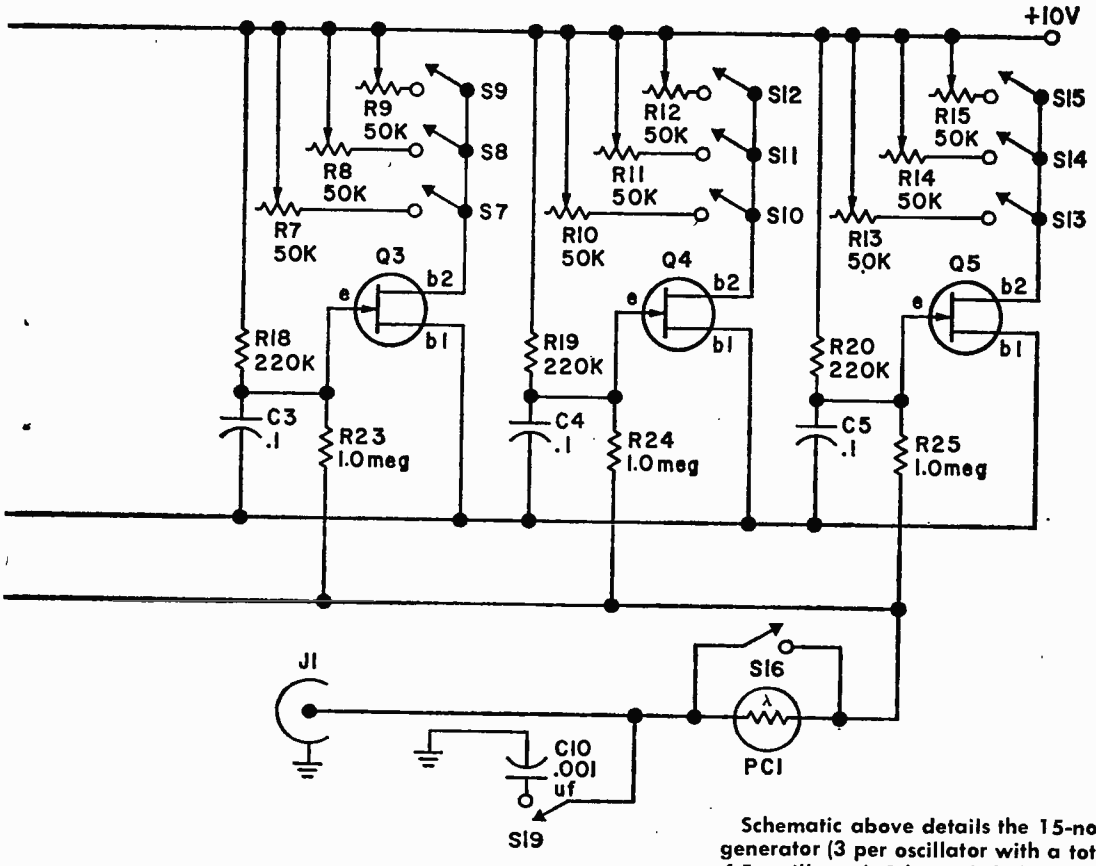


Basic generator schematic details the oscillator for a single tone.



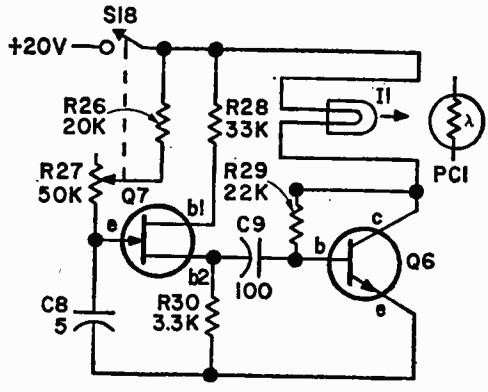
PARTS LIST FOR UNICORD

C1 through C5—0.1-uF, 600-V tubular capacitor (Allied 43E4232 or equiv.)
C6—1000-uF, 25-V electrolytic capacitor (Allied 43E5864 or equiv.)
C7—500-uF, 15-V electrolytic capacitor (Allied 43E6268 or equiv.)
C8—5-uF, 15-V electrolytic capacitor (Allied 43C6624 or equiv.)
C9—100-uF, 15-V electrolytic capacitor (Allied 43C6633 or equiv.)
C10—0.001-uF, 150-V tubular capacitor (Allied 43C1636 or equiv.)
D1, D2—1-amp silicon diode (Allied 24C9572 or equiv.)
I1—6-V, 50-mA miniature screw base incandescent bulb (H.H. Smith #2418-26)
J1—Open circuit phone jack (Allied 47E4955 or equiv.)
PC1—Clairex photocell type CL604L (Allied 60E7465 or equiv.)
Q1-Q5—2N2646 unijunction transistor
Q6—GE-10 general purpose transistor
Q7—2N2160 unijunction transistor
R1 through R15—50,000-ohm trimpot (Allied 46E3674C or equiv.)
R16 through R20—220,000-ohm, ½-watt resistor
R21 through R25—1.0-megohm, ½-watt resistor
R26—20,000-ohm, ½-watt resistor
R27—50,000-ohm, linear taper potentiometer with switch (Allied 46C5523)



Schematic above details the 15-note generator (3 per oscillator with a total of 5 oscillators). Schematic below is for tremolo unit. Lamp I1 of tremolo unit excites photocell PC1 of generator unit.

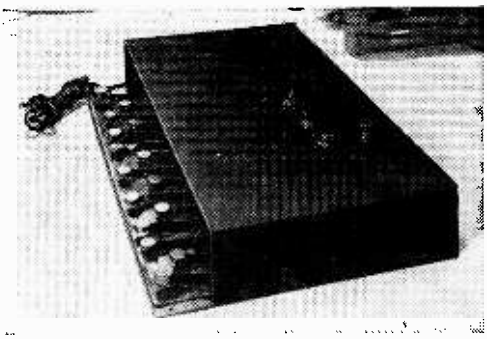
R28—33,000-ohm, ½-watt resistor
R29—22,000-ohm, ½-watt resistor
R30—3300-ohm, ½-watt resistor
S1 through S15—Keys (switches) for playing notes—see text
S16, S19—Spst toggle switch (Allied 47E4955 or equiv.)
S17—Spst toggle switch (Allied 56E5604 or equiv.)
S18—Spst switch mounted on R27 (Allied 46C5359 or equiv.)
T1—Power transformer, 117-V, 50-60 Hz pri; 12.6 VCT, 2-A sec (Allied 54E4200 or equiv.)
1—Lamp holder for miniature screw base G-3½ lamp (Allied 60E8077 or equiv.)
Misc.—10 x 13½ x ¾-in. plywood for base, sheet aluminum or tin cans for keys, plastic discs for key tops, perfboard, flea clips, wire, solder, 19¾ x 11-in. piece of sheet iron or aluminum, ½-in. spacers, etc.



lating resistor R3. So much for the generation of a tone.

Tremolo is produced by energizing a photocell with pulsed light. Lamp I1 is driven by a low-frequency oscillator similar to the tone generator oscillator. Negative pulses from base b1 of oscillator Q7 are coupled to a common-emitter, fixed-bias amplifier Q6, which has lamp I1 connected in its collector circuit. Transistor Q6 is cut-off whenever re-

the UNICORD



The completed Unicord shown with its cover in place. Cover adds class over solder joints.

verse bias pulses are applied to its base, thus raising and lowering current flow through I1, causing I1 to proportionally increase and decrease in illumination.

These variations, in turn, increase and decrease the output of the photocell. And since the photocell is in series with the output of the tone generator, the generator output is varied at the same rate. This variable output produces the tremolo effect. Tremolo is disabled by closing switch S16, which shorts out the photocell.

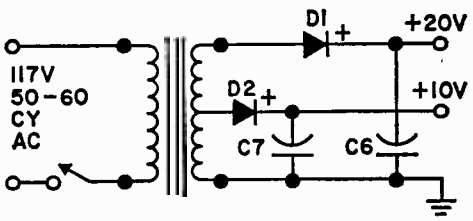
Bass boost/brilliance switch S19 inserts a 0.001 *u*F capacitor between the output buss and ground to produce the equivalent of a bass boost by filtering out higher harmonics. The output has more brilliance when S19 is open and has the bass boost effect when this switch is closed.

On Being an Organ Builder. The basic 5-tone, 15-note generator is mounted on 10 x 13½ x ¾-in. piece of plywood, along with the 15 keys and required power supply. All of the keys are made from 7/16-in. strips of aluminum or tin cut from a tin can. The natural keys are 2½-in. long and the sharp keys are 1½-in. long. Keys are formed so that the front half is elevated near the rear portion. When the keys are screwed to the wood base at their rear, the elevated front accounts for the spring return action; this occurs whenever the organist removes his finger from the key. Cement plastic discs (not over ½-in. in diameter) on top surface of the front of each key. An insulator prevents hum being introduced by body contact through organist's finger.

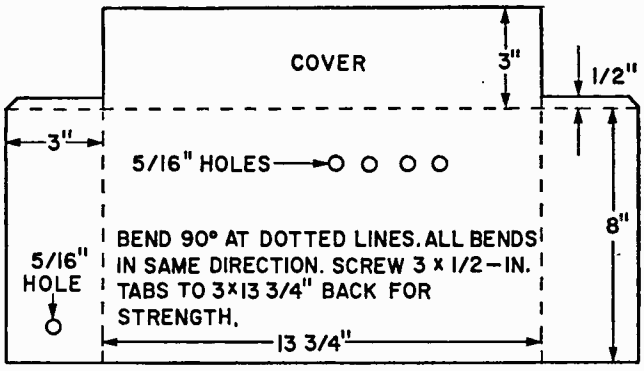
Place 9 wood screws in a straight line, spaced ⅞-in., center-to-center, ¾-in. from the front edge of the base board and 6 wood screws in between the 9, 1¾-in. from the front edge as shown in our photo. Before tightening these screws connect together, with bare wire, groups of three (starting from your left when facing the board) and extend these busses by connecting insulated wire leads approximately 5 to 9-in. long which will be connected to the generator later on during the construction. Mount each key to the board with wood screws. Screws should be placed in a straight line, 2¾-in. from the front edge of the board on ⅞-in.

THE UNICORD ORGAN TUNING CHART

Musical Note	Frequency (Hz)	Musical Note	Frequency (Hz)
(Middle) C	261.63	(Middle) G#	414.90
C#	277.20	A	440.00
D	293.66	A#	465.00
D#	310.55	B	493.88
E	329.63	C	523.25
F	349.23	C#	554.40
F#	370.41	D	587.32
G	392.00		



Instead of dropping resistor, dual voltage power supply provides 10 VDC for tone generators and 20 VDC for tremolo unit.



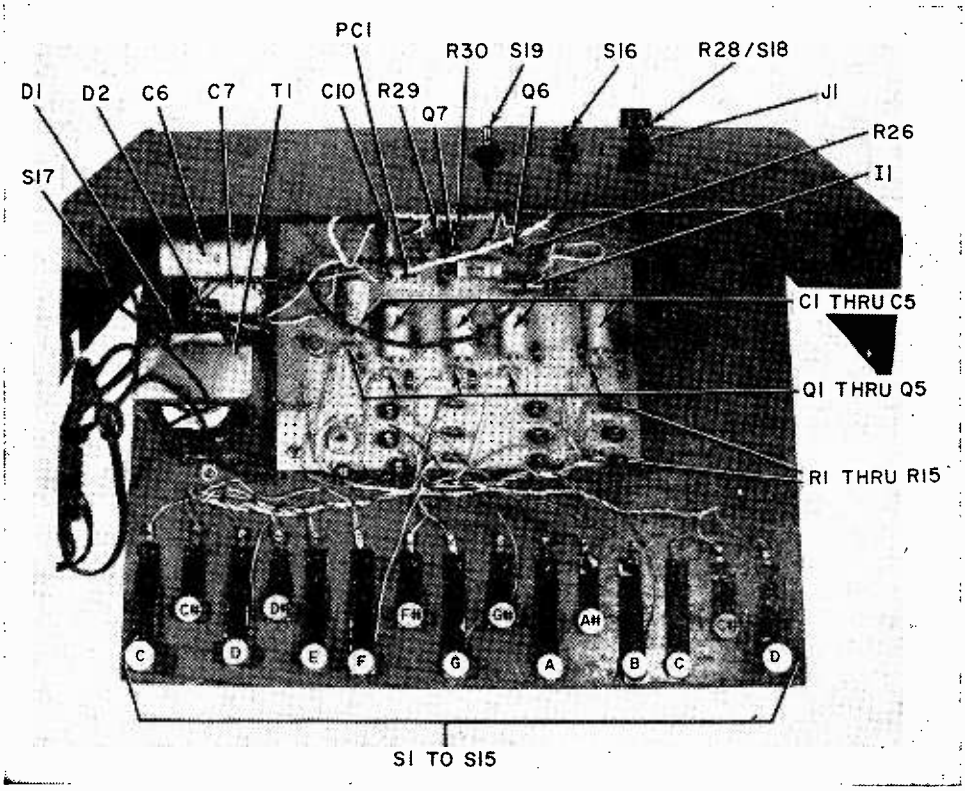
Cover bent from a single sheet of thin aluminum or steel. If metal brake not handy, place aluminum between two hard surfaces to make bends.

centers. Fasten a soldering lug under each screw for making connection between the key and the tone generator before tightening the key to the board.

The power transformer, diodes, and filter capacitors that make up the power supply are mounted the rear left-hand corner of the base board. The perf board, containing the electronic circuitry, is mounted in the remaining space on the base board.

All components for the generator, the tremolo circuit and bass boost, with the exception of switches and tremolo control, are mounted on a 7¼ x 5¼-in. piece of perf board. Follow the layout we use as detailed in our photo. In hooking up the keys use as many different colors of wire as are available. This will help identify the various notes when you are tuning the organ.

Use flea clips or push-in terminals for terminating circuit to external parts such as tremolo control, power, and bass/brilliance switch not mounted on the perf board. We used flea clips for each base b2 lead of the UJTs for connecting them to the keys. Take care when soldering the diodes and UJTs: if



Unicord opened to show location of components. All keys are mounted on 7/8-in. centers. Note that natural and sharp keys are alternated except between E and F, and B and C.

the UNICORD

possible use an alligator clip as a heat sink temporarily clipped to each lead during the soldering. Separate the photocell about 2 in. from the lamp in the output of the tremolo circuit.

When mounting the perf board to the base board use ½-in. spacers to raise it above the base board. Do not fasten it down until the unit is completely wired and tested. It will be easier to adjust the trim pots if the perf board is free to be moved around during this operation.

A suitable cover for the entire assembly can be made from a 19¾ x 11-in. sheet of metal, either aluminum or sheet iron. Notch out the two corners, leaving a ½ x 3-in. tab to be fastened to the back of the cover with sheet metal screws; these tabs will strengthen the cover. Bend the sheet as shown in the drawing to form a box-like cover.

On Being an Organ Tuner. The easiest way to tune the organ, especially for those who have a musical ear, is to compare the organ output signal with the desired note produced by a musical instrument known to be in tune. A piano, guitar, violin, banjo, ukelele, or accordion will be ideal as any one of these instruments has had each of its notes tuned to specific frequencies, which can be repeated as often as desired. If none of these instruments is available, an accurately calibrated audio oscillator will serve just as well. The accompanying chart tabulates the correct frequency for each note.

Once you have determined that the tone generator and tremolo are working properly, and you do get an output from the Unicord when each key is depressed, you are ready to tune it. The Unicord should be fed into the high impedance input of your amplifier. The photo of the Unicord with cover raised has the specific note assigned for each of the keys indicated for each key. When tuning, hold down a key so that the Unicord output will be heard while you strike the same note several times on your musical instrument.

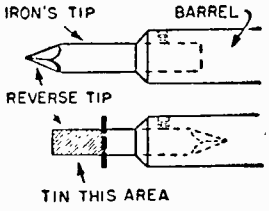
Here is where that good musical ear comes into play—compare the tone of the Unicord note with that of the musical instrument and adjust the trimpot associated with the key being tuned until the note from the Unicord is identical to the note of the instrument. Repeat this operation for all 15 keys and then you are ready to try your hand at being an organist.

If you should use an audio signal generator as your standard tone source instead of a musical instrument, you first set the audio generator to the frequency for the note you are tuning (determined from the chart), feed the output of the audio generator as well as the output from the Unicord, to an input of your amplifier and then proceed to make the same tuning adjustments described for tuning with a musical instrument. For those purists who are extremely sensitive to true tone, or those who may have a "tin ear," you can use a frequency counter on the output of the Unicord, if one is readily available.

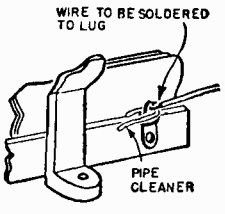
Now that it's properly tuned you can idle away the hours playing your favorite chords to your heart's content. Our guess is you'll be loath to find a project that's half as much fun as your Unicord. ■

● GRIN and TIN

• When a soldering iron having a removable solid copper tip held in place with a setscrew begins to lose its heating ability due to the filament aging, here's what you can do. Loosen the setscrew, remove the tip, and place it in the barrel backwards. File the newly-exposed surface of the tip lightly to clean off scale, then heat the iron and tin the tip with a thin layer of solder. When you place the tinned portion of the tip back into the barrel, more efficient heat conduction will result and the iron will operate at or near its original heat output.



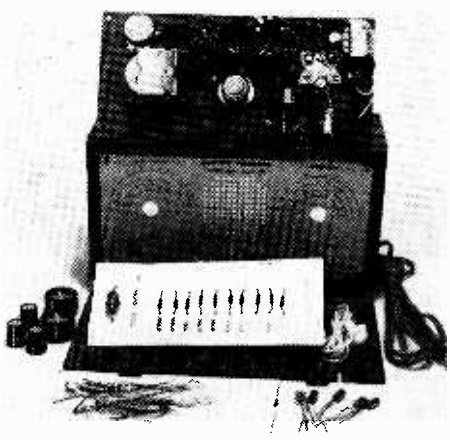
• For a neater job of soldering a wire or cable to a lug, build a dam around it with a pipe cleaner as shown. This idea is particularly good for automotive or radio jobs, where precision is necessary.—V. H. LAMOY.



RADIO SHACK GLOBE PATROL
4-Band, Solid-State
BCB/SW Receiver Kit

The modern kit is so good, so thoroughly designed and illustrated, that there is real if little *fun* obtained from construction; if you place the parts in the right place it's almost guaranteed to work. About all you can expect from a kit is a substantial savings of money, good performance, but very little in the way of electronic experimentation. In fact, if the kit works right off the bat and requires no troubleshooting the electronic experimentation is *zero*.

But now there's a kit that offers hours and hours of real experimentation—just to get it working. A kit with a parts layout that just itches for experimentation, almost inviting the builder to try component substitutions. What is it? It's the Radio Shack "Science Fair" GLOBE PATROL shortwave receiver, priced at about $20; and $20 is just a few dollars more than the cost of the components needed for the crummy crystal radio project foisted on virtually every Junior High science student from here to Lower Slobovia. In fact, the Globe Patrol kit contains well over $20 worth of *good* components of the type used by many experimenters.



Here's the Radio Shack Globe Patrol kit in its virgin state. Just a little know-how from you and it blooms beautifully.

The Globe Patrol is a three-transistor, line powered, *regenerative* shortwave receiver and amp that tunes from .55 to 30 MHz. It is supplied complete with plastic cabinet, rear cover and a screened front panel. The receiver has both a main tuning and bandspread dial, earphone jack and built in speaker. The entire circuit is assembled on a printed-circuit board on which all major components have been factory mounted—to some degree. The instruction manual has both schematic and pictorial diagrams, and is arranged in the step-by-step system common to all major kits.

We go into detail on the kit so you may fully understand the challenge and experimental possibilities.

Assembling the Kit. All major components are supplied premounted on the PC board (at least they are supposed to be premounted). You will find that transformers T1 and T2 are loose, from knocking around, and must be mounted. Other than the *underside pictorial* there is nothing that indicates the correct color-code wire connections for the transformers; so your first challenge will be to remount the transformers correctly (we said the kit will be fun). After you pass the transformers' mounting tabs to the board. solder the tabs to the foil so they won't fall off again. The foil appears to be covered with a plastic sheet. Don't try to remove the sheet as it protects the copper from oxidation which will make soldering difficult. Solder right through the sheet. (This is not mentioned in the instructions).

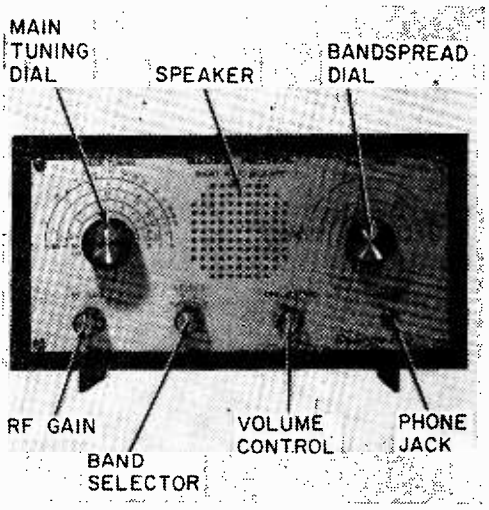
LAB CHECK

Next step is to plug in the remaining components and solder. Don't bend the leads over on the foil. Let the leads stick straight through the hole, solder each component as it is installed and clip each lead close to the board (⅛" from board).

You will find that somebody goofed and forgot the most important connections—those to the main tuning capacitor. So do it this way. Position the board with the control shafts facing down and the RF coils nearest you. The tuning capacitor terminals will now fall vertically, two near you and two near the back of the board. The top back terminal is not used. The bottom back terminal connects to hole 13 and to the bandspread capacitor stator terminal. The top front terminal connects to coil A terminal 3A. The bottom front terminal connects to bandswitch terminal SW3.

Complete the kit wiring except for the antenna connections to the terminals on the back cover. Place a strip of tape over the linecord PC board terminals and over the power terminals on the back of the volume control. All high voltage will now be covered and it will be safe to handle a "hot" chassis.

Checkout. Temporarily connect the hank of wire (the supplied antenna) to the radio's antenna input wire: carefully dress the leads from the RF coils so they or the attached components are neat and non-shorting and connect the line cord to an outlet. Apply power by rotating the volume control full clockwise (maximum volume), set the bandswitch to band A (broadcast band) and advance regeneration control till you hear noise or a station. Tune the main tuning capacitor for a loud station—it better be loud because the speaker volume is very low. The speaker is an extra feature and best listening is obtained with the supplied earphone.

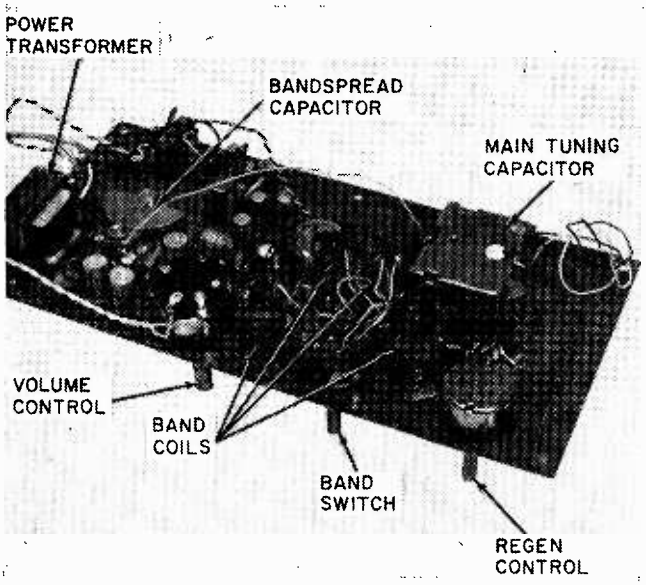


Completely assembled, the Editors found that assembly was no trouble at all. Pre-cut and stripped wires make work go fast!

Typical of regenerative RF front end and simple diode detectors there is virtually no selectivity; perhaps one, two or three very strong BC stations will fill the band from end to end. Next, try the remaining bands. Performance will most likely be good on bands B and C and virtually non-existent on band D (13 to 30 MHz). If you ever receive anything on band D consider it a bonus.

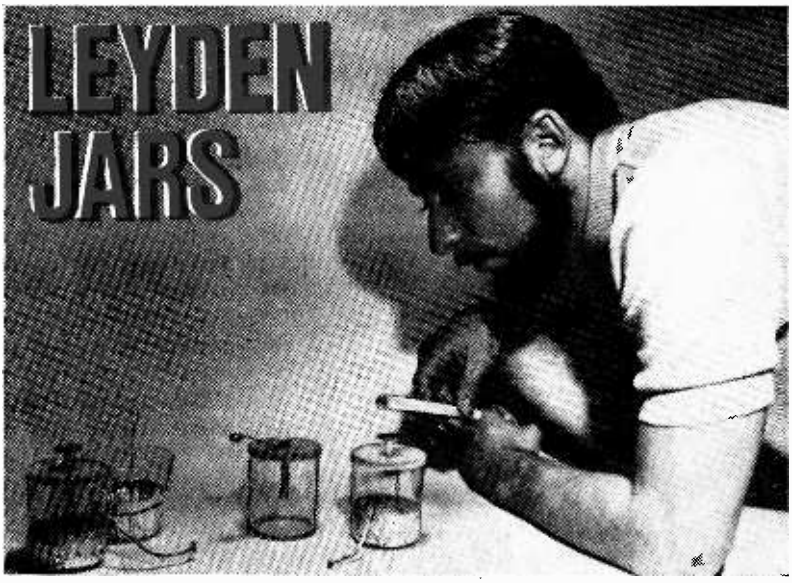
The Globe Patrol is supplied with an experimental kit of components that lets

(More on page 105)



Completed printed circuit board has a very wide-spaced component layout. This permits easy experimentation by component substitution. You may have to remove speaker mounted under board when making some of the changes.

EXPERIMENTING WITH... BEN FRANKLIN'S LEYDEN JARS



Discover how capacitors work by duplicating some original experiments performed in the 18th Century.

by
Charles Green
W6FFQ

Many people like to think of Benjamin Franklin as one of the founding fathers of our country. As one of the signers of the Declaration of Independence, he is regarded as a great statesman and humanitarian. In addition, "Old Ben" was considered one of the leading scientists of his era and was as well known for this in Europe as he was in America.

That is why, when the Continental Congress searched for a man of prestige to send to France to ask for assistance in the American War for Independence, they chose ol' Ben Franklin.

Franklin's original experiments with static electricity contributed to world-wide recognition of his scientific ability. His analysis of the principles of the Leyden Jar was the result of one of his great experiments.

The earliest known apparatus capable of storing an electrical charge was labeled a Leyden Jar, the forerunner of present-day capaci- *(Continued overleaf)*

BEN FRANKLIN'S LEYDEN JARS

tors. The first Leyden Jar was made by Pieter van Musschenbroek, in the town of Leyden in the Netherlands.

It consisted of a glass jar, filled with water with outer surface wrapped in metal foil. Electrical connections to the water was made by a wire touching the water. Other versions employed metal shot or metal foil inside the glass jar.

Benjamin Franklin's experiments proved that the electrical charge is actually stored in the glass, and not in either the inner or outer foils. You can confirm Franklin's discoveries by following our plans for building a Leyden Jar and an Electroscope and then use them in the experiments outlined, which closely follow Franklin's original ones.

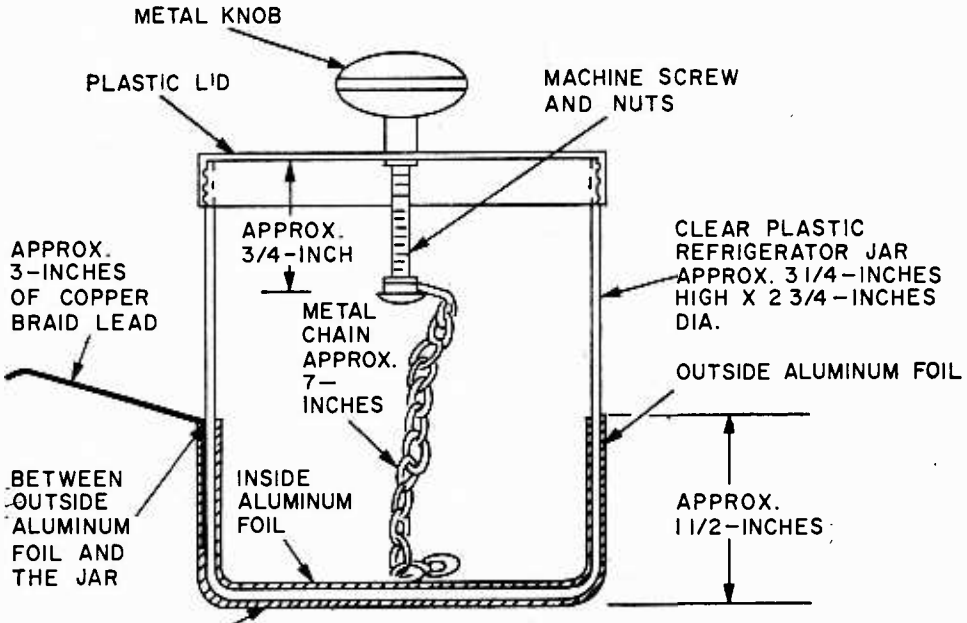
Constructing a Leyden Jar. We made our Leyden Jar by covering the inner and outer surfaces of a clear plastic refrigerator food storage container with ordinary aluminum foil. We used one 2½-in. high by 2¾-in. diameter, fitted with a snap-on lid although the size is not important. This is a convenient size for construction and for handling during the experiments. The foil was formed to the jar to a height of approximately 1½ in. from the bottom and held in place with Scotch tape.

A piece of copper braid, or braided shielding from shielded wire, about 3-in. long is held in contact with the outer foil by slipping it between the outer foil and the side of the jar before taping the foil. Check to be sure that the braid makes good electrical contact with the foil.

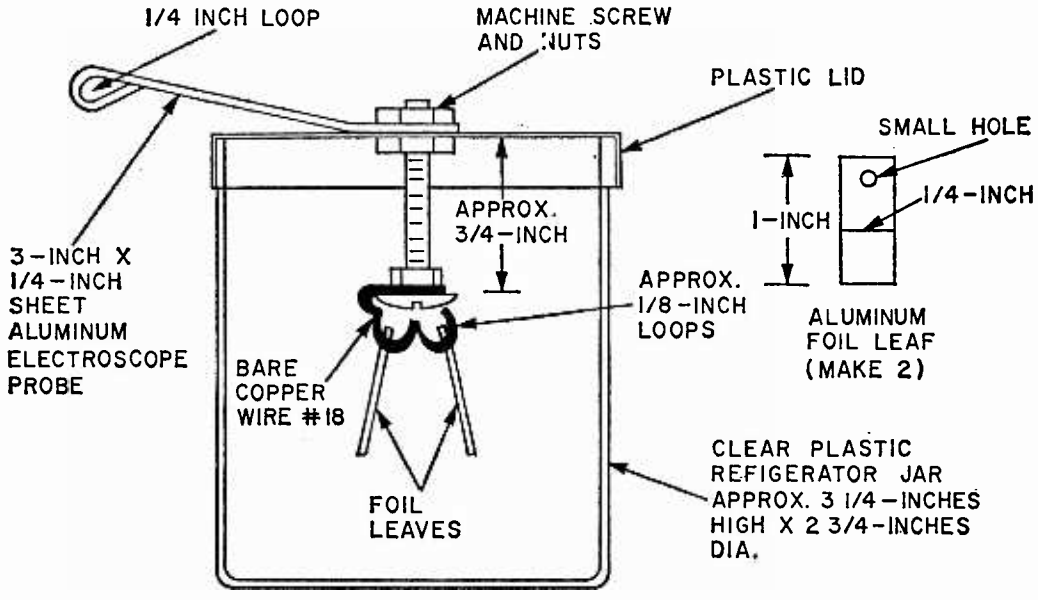
A metal drawer knob, mounted in the center of the lid, to which a length of metal chain is fastened, is used to connect to the inner foil.

Constructing an Electroscope. The electroscope is an elementary indicator of an electrical charge. We used the same type and size of clear plastic refrigerator container for the electroscope as was used for the Leyden Jar.

A short length of #18 bare copper wire was formed to contain two open loops about ⅛-in. in diameter and was then fastened to the head of a ¾-in. long machine screw by means of a nut and washer. The bolt was then mounted in the center of the jar lid. A 3-in. length of sheet aluminum, ¼-



A trip to the kitchen will reward you with almost all the raw materials needed to assemble a workable Leyden Jar. Dimensions are not critical, but try to duplicate author's prototype.



Details for building the Electroscope, a primitive indicator of electrical charge on a body. It, too, is made from kitchen materials and odd items from your workbench.

in. wide, is mounted to the outside surface of the lid under the locking nut for this bolt. Form a ¼-in. loop on its free end to use this strip as a probe. Cut two pieces of aluminum foil 1-in. long and ¼-in. wide. Punch a clearance hole near the top of each piece so that each can be hung separately on one of the loops previously formed in the copper wire that is fastened to the jar cover.

Assembly for Dielectric Experiments. A clear plastic drinking cup (2¾-in H x 3½-in. dia), with tapering sides, plus aluminum foil muffin baking cups are the principal materials needed for this experiment.

The cup for the inside conducting plate is cut to a height of ½ in. Make 1-in. loops in a piece of #18 gauge bare copper wire and bend one of the loops to form a right angle on one end so that the wire will be perpendicular to the bottom of the muffin foil cup when fastened there. Total length should then be approximately 4 in. Tape this looped end to the bottom inside the cup making certain that a good electrical contact between the wire loop and the cup is maintained.

The outer foil cup is cut to a height of about 1¼ in. Form the cups to the inner and outer surfaces of the plastic glass so they fit snugly but can still be easily ved. This is a necessary physical re- ent of the experiment. Make two exact pairs of cups for inside and out.

The accompanying drawings and photos detail the construction of these devices as well as showing how they are used in experiments.

Emulating "Old Ben." Now that the construction work is finished, let's conduct some experiments to prove Old Ben's theory and also to learn more about the action of a capacitor.

These experiments must be made in a very dry environment; they will not work under conditions of high humidity. If at all possible work in an air-conditioned area. Make certain that the rubbing cloth is completely dry and discard it for a fresh one frequently to avoid its becoming dampened by moisture from your hands. Drive off excess moistue by heating the cloth in an oven.

The experiment is begun by holding a plastic or glass rod firmly in one hand and vigorously rubbing its free end with a cloth. Immediately upon stopping the rubbing, touch the free end of the rod to the metal knob of the Leyden Jar. Repeat this action about a dozen times. Each time the rod contacts the knob electricity flows from the rod to the jar, building up the charge in the jar. Be careful not to touch the end of the rod you have rubbed with your finger as this will discharge it.

You test the jar for its charge by bringing

BEN FRANKLIN'S LEYDEN JARS

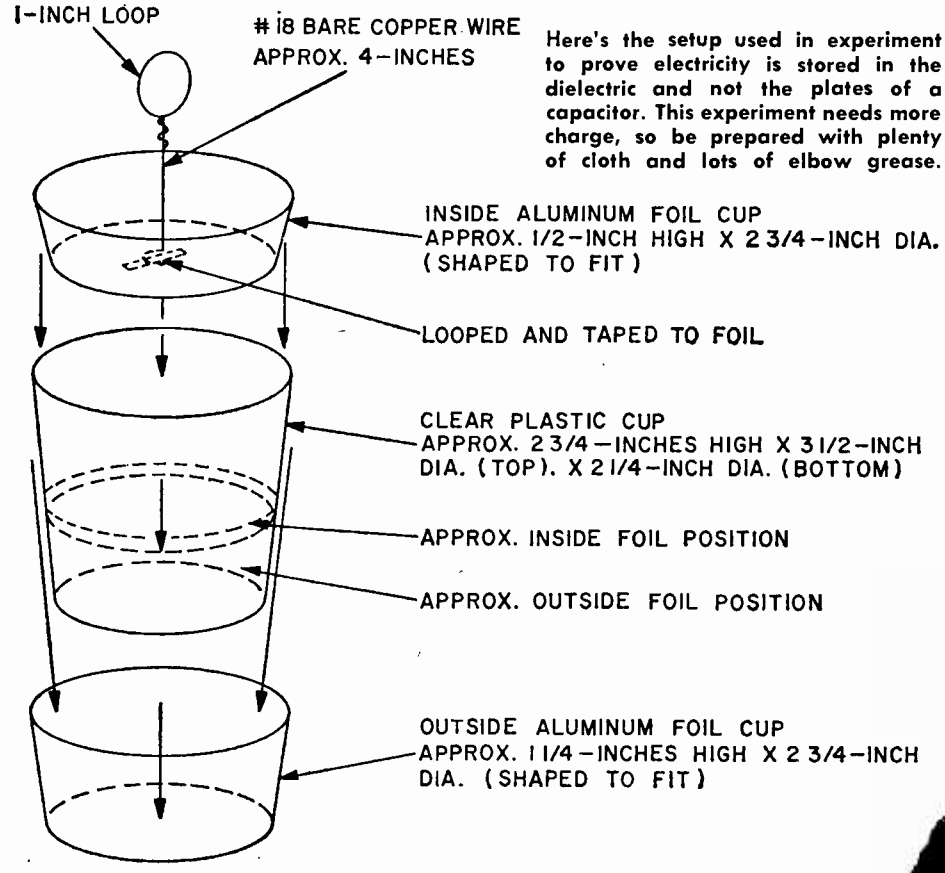
the copper braid connected to the outside foil near the metal knob in the center of the lid. A spark will be seen to jump between the braid and the knob as the braid is brought close to the knob. An NE2 neon lamp can be used for this indication by connecting one lead to the braid and touching the knob with the other lead. The lamp will light momentarily. It is possible to store enough electrical energy in the jar to create an electrical charge of sufficient magnitude to shock you, so be careful not to touch the jar with your fingers.

One Leyden Jar Experiment. Franklin charged his Leyden Jar with static electricity produced by vigorously rubbing a glass rod with a dry cloth. He repeatedly rubbed the rod to full charge and then touched it to the metal knob in the lid of the Leyden Jar.

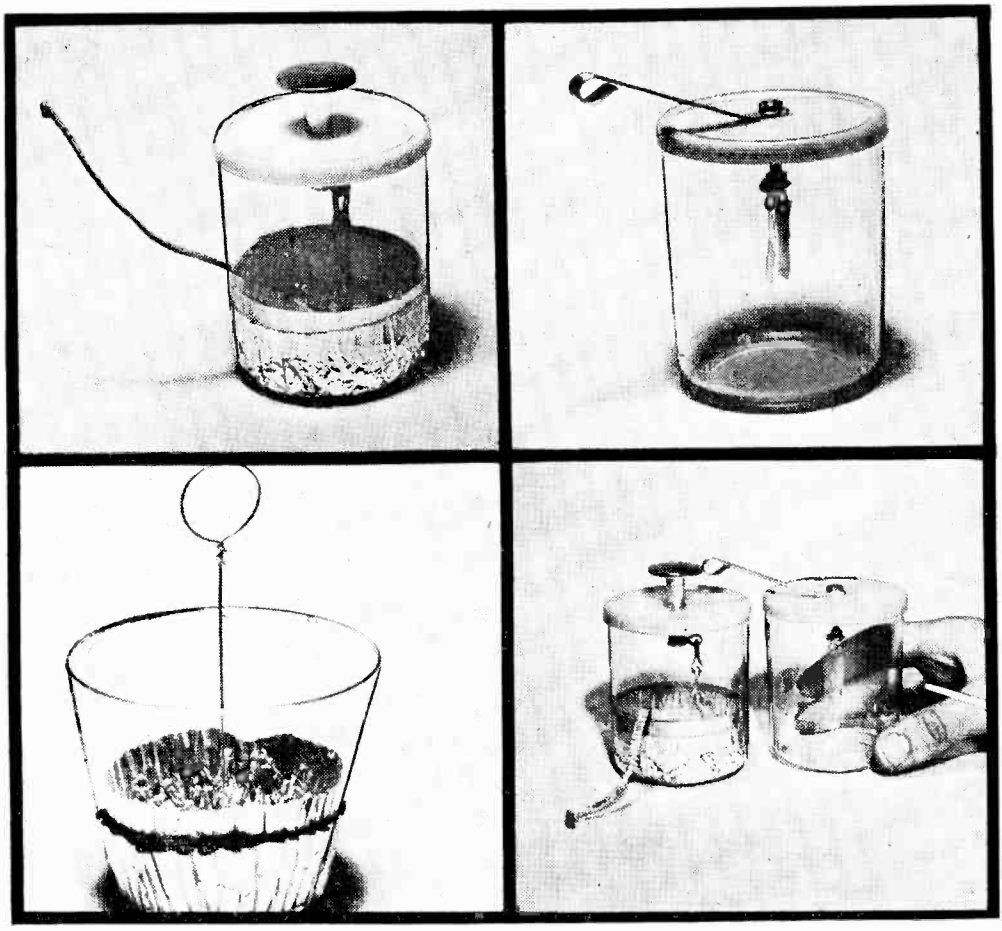
The vigorous rubbing of the rod with the cloth transfers some electrons from the rod to the cloth, thus making the rod more positive and the cloth more negative. Franklin is credited with using the words positive and negative to designate differences in polarity. A plastic rod can be used in place of a glass one. When using a plastic rod, however, electrons are transferred from the cloth to the rod and therefore the polarity is reversed.

You can use an old tooth brush handle, or an aligning tool, or a swizzle stick, or glass or plastic stirring rod.

The electroscope you built can be used to indicate the charge on the Leyden Jar. Bring the probe of the electroscope in contact with the knob of the jar. The foil leaves will move apart indicating that the jar is charged. The distance that the leaves move apart will be proportional to the amount of charge. You can prove this by varying the amount of the charge you place on the jar (change the number of times you touch the rubbed rod to the knob on the jar). Discharge the



Here's the setup used in experiment to prove electricity is stored in the dielectric and not the plates of a capacitor. This experiment needs more charge, so be prepared with plenty of cloth and lots of elbow grease.



Top left and right photos show constructed Leyden Jar and electroscope, respectively. Bottom photos show capacitor (left) used in the experiment and Leyden Jar (right) coming in contact with electroscope to detect electrical charge. These simple electrical charge instruments were the exotic test gear used by Ben Franklin back in the 18th Century.

electroscope just before contacting the jar with its probe, each time, by first grounding the probe.

A Dielectric Test Experiment. Experiments on Leyden Jars were conducted by many scientists. However Benjamin Franklin was the first to determine exactly how the Leyden Jar stored electricity. His findings became the basis for the development of the capacitors we use so profusely in electronic and electrical equipment today.

Franklin proved that the electrical charge is stored in the jar (the dielectric) rather than on the conductors (the plates) by carefully removing the inner and outer conduc-

a after charging his Leyden Jar.

that can reproduce this experiment by set-

remo the material we prepared earlier.

quirem in the previous paragraph on page 69 headed: Assembly for Dielectric Experiment.

Place the plastic drinking cup in the foil cup formed for the outside of the glass and place the foil cup, with the copper wire lead taped to it, inside the glass. Charge the assembly in the same manner as the Leyden Jar was charged. The success of this experiment is dependent on as large a charge as possible. Have extra cloths available to activate the rod that charges the assembly more times than when charging the Leyden Jar. Take care not to touch the lead wire from inner cup, or the plastic cup.

When you have charged the assembly, carefully lift out the center foil cup, using plastic photographic print tongs, and set this foil cup aside.

Now is when the second set of foil cups

BEN FRANKLIN'S LEYDEN JARS

you made previously is used. With the plastic tongs pick up the foil cup from this second set of cups and carefully place it in the plastic cup. Then, still using the plastic tongs, lift the plastic cup containing the second inner foil cup from its original outer foil and place it in the outer foil cup of the second set you made.

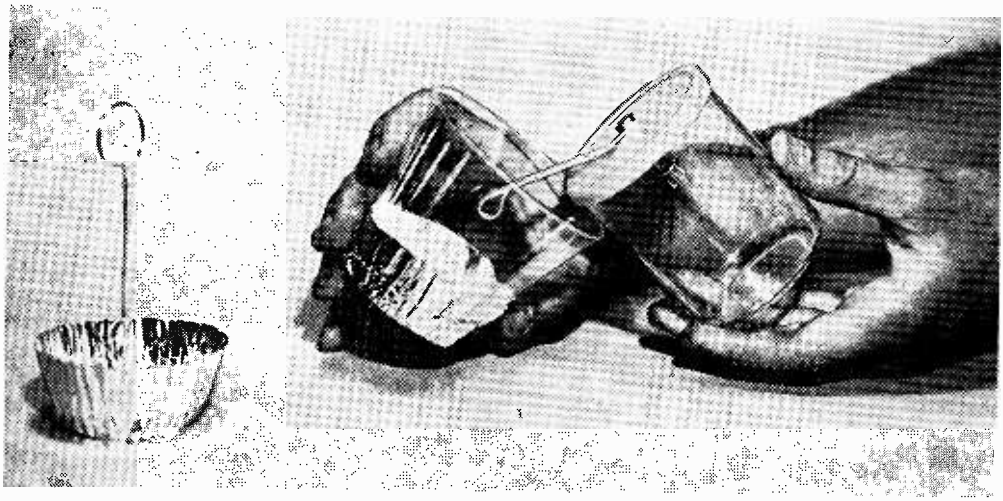
At this point bring the probe of the Electroscope in contact with the wire loop taped to the inner foil cup. You will note that the Electroscope's leaves separate, indicating that the assembly is still charged. Now discharge the Electroscope.

Recharge the assembly and then carefully remove the inner foil cup again. Holding the assembly by the outer foil cup only, tip the plastic cup so that the probe of the Electroscope comes in contact with the lower inside section of the plastic cup. Observe that the leaves of the Electroscope separate, indicating a charge on the plastic cup even though the inner metal foil conductor has been removed. You may have to move the probe of the Electroscope around to locate a spot where you get best foil separation. ■

BILL OF MATERIALS FOR THE LEYDEN JAR ELECTROSCOPE AND DIELECTRIC EXPERIMENT ASSEMBLY

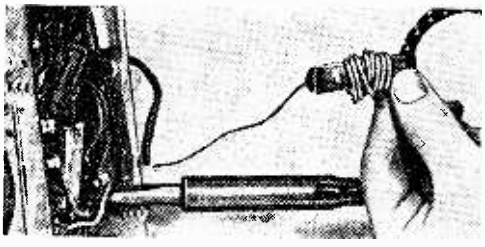
2—Clear plastic refrigerator jars approximately 3¼-inches high x 2¾-inches in diameter
1—Clear plastic drinking cup approximately 2¾-inches high x 3½-inches in diameter (top) and tapered to approximately 2¼-inches in diameter at the bottom
1—Plastic or glass rod
1—Plastic photographic print tongs
Misc.—Cloths (wool or cotton), household aluminum foil, aluminum foil baking cups (muffin size), metal knob (drawer knob—see text), machine screws and nuts, metal chain, copper braid, scotch tape, #18 solid copper wire, etc.

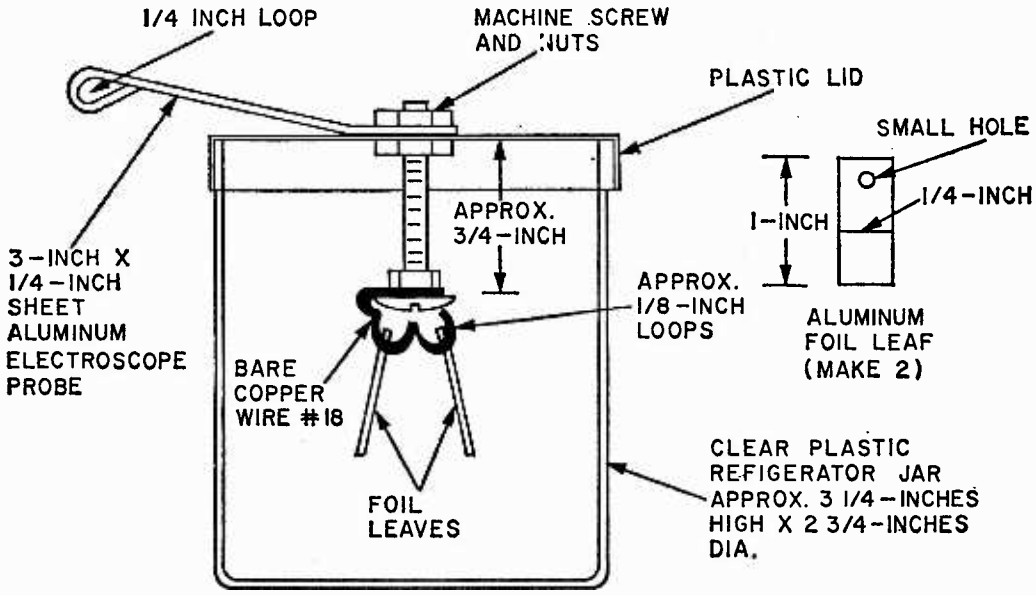
The center foil of the capacitor has been carefully removed to permit sampling the charge on the dielectric with the electroscope. Move probe about to locate the greatest charge.



SOLDER CLIP TIP

● You'll have no trouble keeping track of rosin core solder when working on kits. Just purchase a trouser clip at a bicycle store, slip it over the iron cord and wind some solder around clip so it can't come off. —*Joe Gronk*





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BEN FRANKLIN'S LEYDEN JARS

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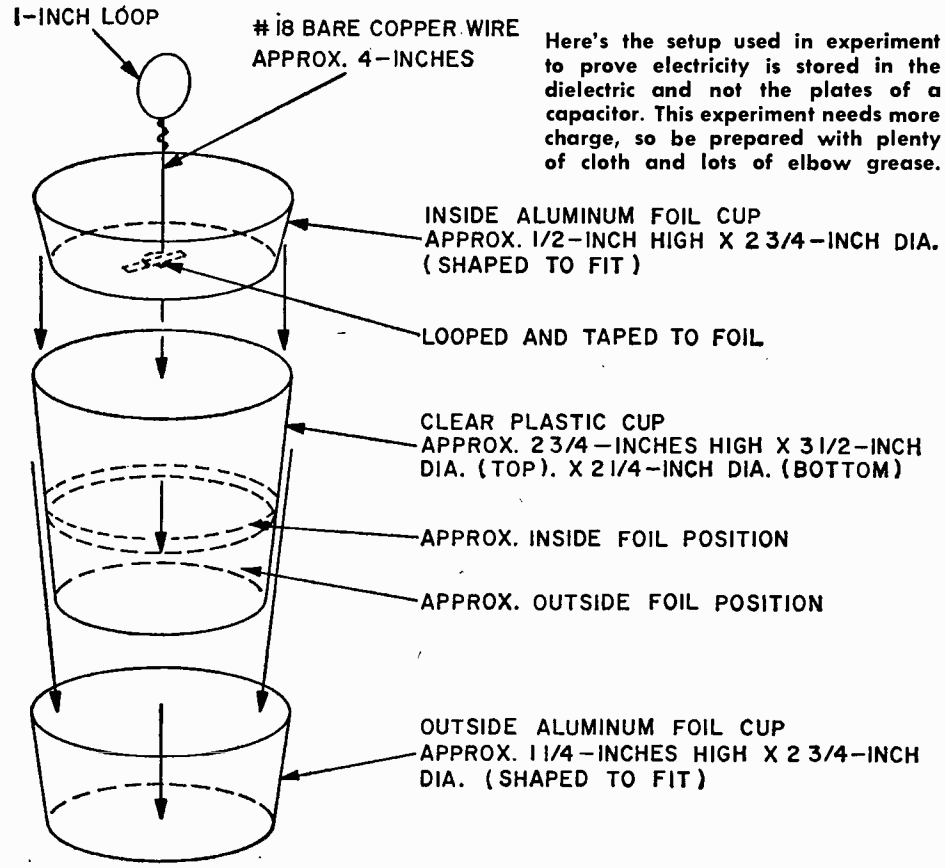
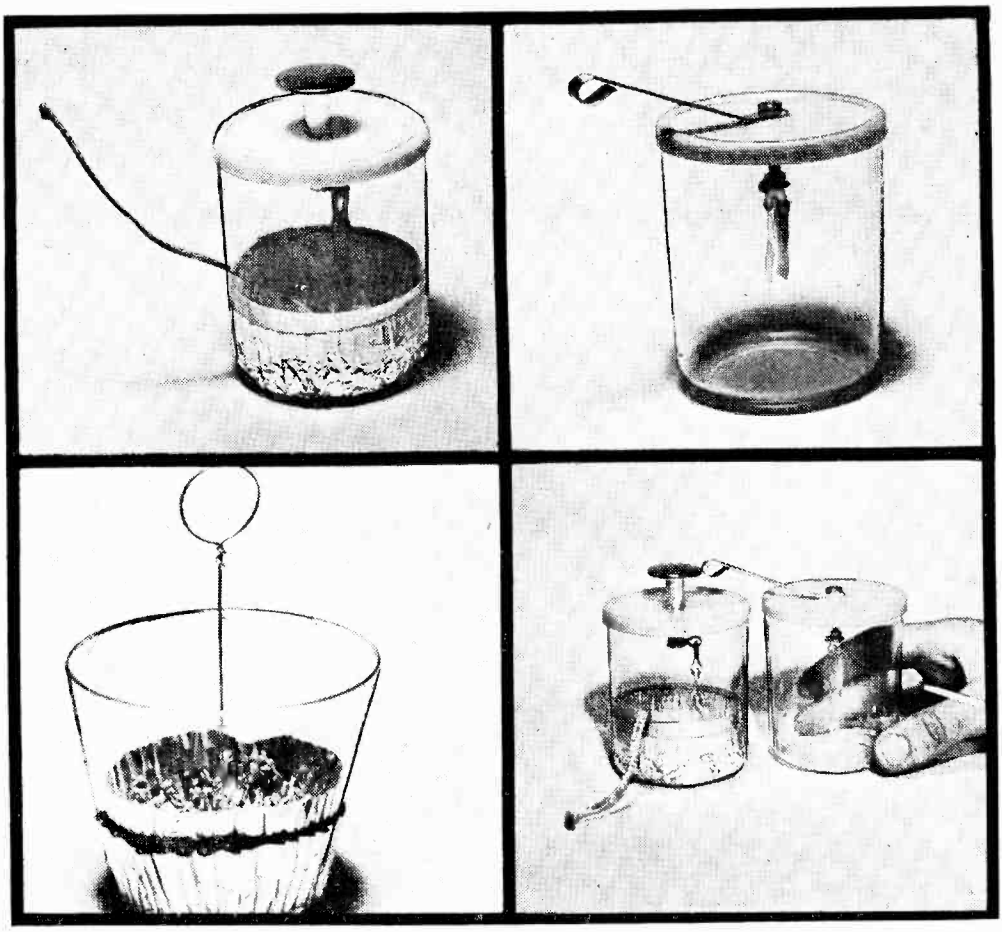


Here's the setup used in experiment to prove electricity is stored in the dielectric and not the plates of a capacitor. This experiment needs more charge, so be prepared with plenty of cloth and lots of elbow grease.



Top left and right photos show constructed Leyden Jar and electroscope, respectively. Bottom photos show capacitor (left) used in the experiment and Leyden Jar (right) coming in contact with electroscope to detect electrical charge. These simple electrical charge instruments were the exotic test gear used by Ben Franklin back in the 18th Century.

electroscope just before contacting the jar with its probe, each time, by first grounding the probe.

A Dielectric Test Experiment. Experiments on Leyden Jars were conducted by many scientists. However Benjamin Franklin was the first to determine exactly how the Leyden Jar stored electricity. His findings became the basis for the development of the capacitors we use so profusely in electronic and electrical equipment today.

Franklin proved that the electrical charge is stored in the jar (the dielectric) rather than on the conductors (the plates) by carefully removing the inner and outer conductors after charging his Leyden Jar.

We can reproduce this experiment by setting up the material we prepared earlier, described in the previous paragraph on page 69 headed: Assembly for Dielectric Experiment.

Place the plastic drinking cup in the foil cup formed for the outside of the glass and place the foil cup, with the copper wire lead taped to it, inside the glass. Charge the assembly in the same manner as the Leyden Jar was charged. The success of this experiment is dependent on as large a charge as possible. Have extra cloths available to activate the rod that charges the assembly more times than when charging the Leyden Jar. Take care not to touch the lead wire from inner cup, or the plastic cup.

When you have charged the assembly, carefully lift out the center foil cup, using plastic photographic print tongs, and set this foil cup aside.

Now is when the second set of foil cups

BEN FRANKLIN'S LEYDEN JARS

you made previously is used. With the plastic tongs pick up the foil cup from this second set of cups and carefully place it in the plastic cup. Then, still using the plastic tongs, lift the plastic cup containing the second inner foil cup from its original outer foil and place it in the outer foil cup of the second set you made.

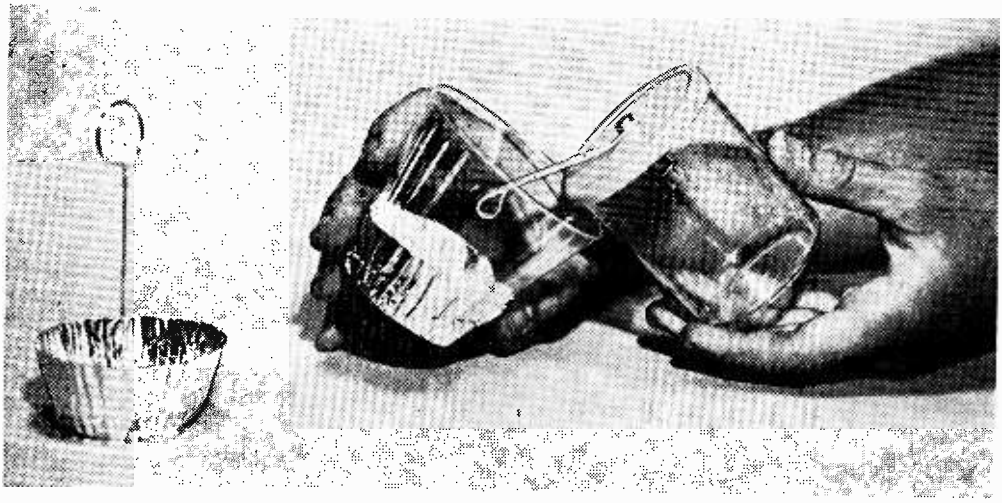
At this point bring the probe of the Electroscope in contact with the wire loop taped to the inner foil cup. You will note that the Electroscope's leaves separate, indicating that the assembly is still charged. Now discharge the Electroscope.

Recharge the assembly and then carefully remove the inner foil cup again. Holding the assembly by the outer foil cup only, tip the plastic cup so that the probe of the Electroscope comes in contact with the lower inside section of the plastic cup. Observe that the leaves of the Electroscope separate, indicating a charge on the plastic cup even though the inner metal foil conductor has been removed. You may have to move the probe of the Electroscope around to locate a spot where you get best foil separation. ■

BILL OF MATERIALS FOR THE LEYDEN JAR ELECTROSCOPE AND DIELECTRIC EXPERIMENT ASSEMBLY

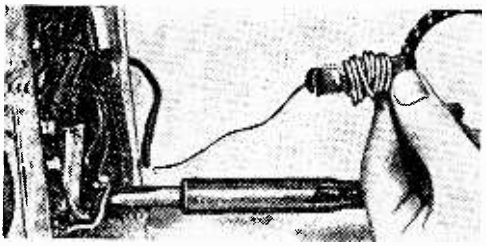
2—Clear plastic refrigerator jars approximately 3¼-inches high x 2¾-inches in diameter
1—Clear plastic drinking cup approximately 2¾-inches high x 3½-inches in diameter (top) and tapered to approximately 2¼-inches in diameter at the bottom
1—Plastic or glass rod
1—Plastic photographic print tongs
Misc.—Cloths (wool or cotton), household aluminum foil, aluminum foil baking cups (muffin size), metal knob (drawer knob—see text), machine screws and nuts, metal chain, copper braid, scotch tape, #18 solid copper wire, etc.

The center foil of the capacitor has been carefully removed to permit sampling the charge on the dielectric with the electroscope. Move probe about to locate the greatest charge.



SOLDER CLIP TIP

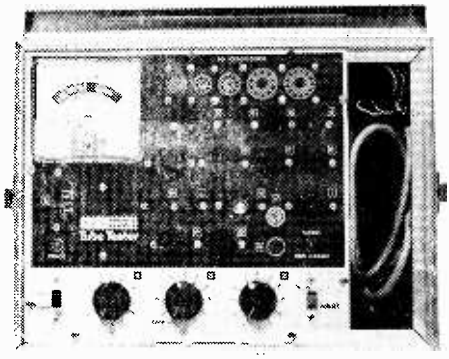
● You'll have no trouble keeping track of rosin core solder when working on kits. Just purchase a trouser clip at a bicycle store, slip it over the iron cord and wind some solder around clip so it can't come off. —*Joe Gronk*



EICO MODEL 635

Socket Conglomerate

Vacuum Tube Tester



The corner drugstore comes to your electronics shop. Well, maybe not the drug department or soda fountain, but most certainly that ever popular *drug store tube tester* . . . for the EICO 635 Tube Tester is an electronic tube tester for your work bench with the speed and simplicity of the drugstore models.

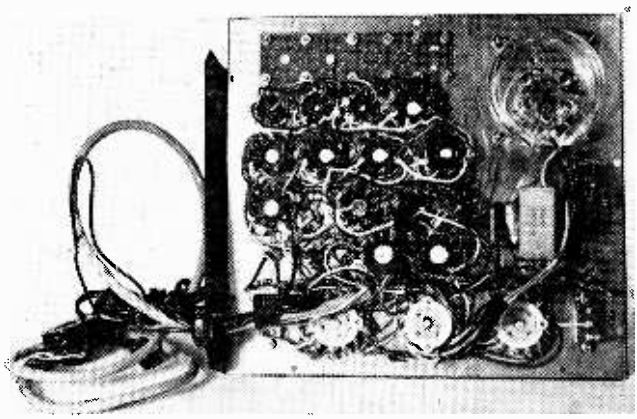
Way back when the vacuum tube was king, a tube tester looked like a tube tester should look, with lots of knobs and switches that set up, among other things, the tube connections for a single socket. If you had 8-pin tubes, you would first set up the filament connections, say pin 2 and 7, or 1 and 8. Then you'd set up the connections for every other tube element because there was just one single test socket per type to accommodate all tubes using that socket.

Just try to imagine one of those "flight control" panels in a drugstore; odds would be that more tubes would be ruined by improper element settings than in the TV sets from which they were removed. So smart manufacturers built drug store testers with several sockets per tube type (8 pin, 9 pin, etc.), each socket having a different wiring arrangement so that a few sockets of each type automatically accommodated hundreds of tube types. Not only did this speed up tube testing by eliminating up to 10 switches and controls, but the possibility of error was sharply reduced because the user had to set perhaps two or three controls, instead of 10 or more.

EICO's new Model 635 tube tester uses this same multi-socket technique, ensuring fast, efficient and low cost tube checking ($44.95 kit form; $69.95 wired).

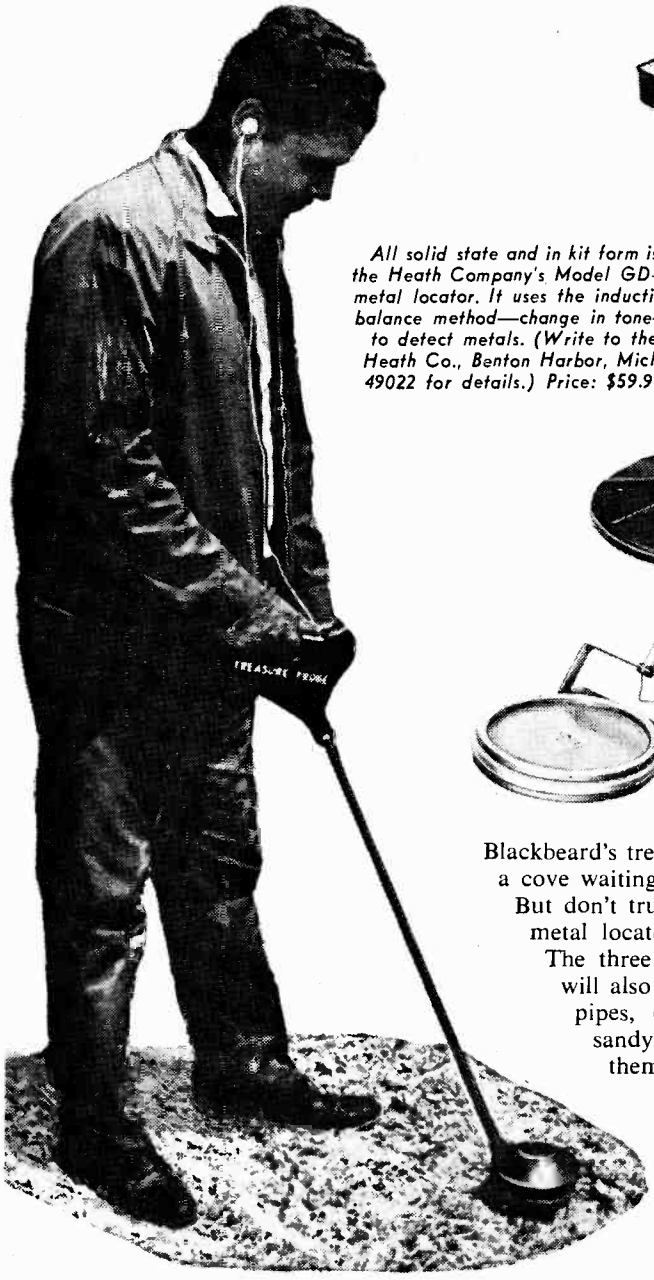
What's It Like? The 635 is housed in a supplied luggage-type portable case, with a storage compartment for the test leads. Sixteen sockets (of different types) provide for testing of any tube in general consumer equipment use; from Nuvistors, to loctals, to 8 and 12 pin 110° CRTs. A supplied tube data book indicates which tube socket to use for a given tube type, and the settings for the 4 operating controls, which set up the filament voltage, meter sensitivity and inter-element connections. The user then looks at the *short/leakage* panel lamp. If it's *on,*

(Continued on page 103)

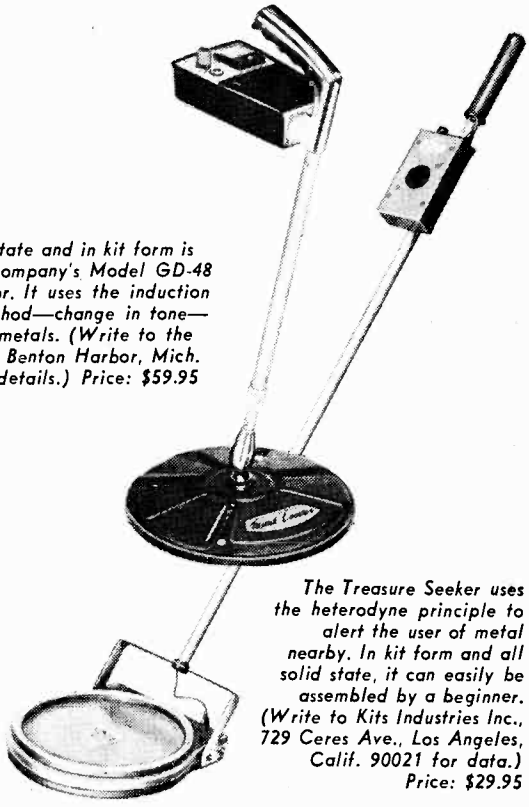


The EICO tube tester may look like a lot of hard work to wire, but it's not really. Just take your time and recheck each connection to avoid hard-to-find mistakes. Guts fit into nice luggage-type carrying case with cover.

thar's GOLD in them thar hills?



All solid state and in kit form is the Heath Company's Model GD-48 metal locator. It uses the induction balance method—change in tone—to detect metals. (Write to the Heath Co., Benton Harbor, Mich. 49022 for details.) Price: $59.95



The Treasure Seeker uses the heterodyne principle to alert the user of metal nearby. In kit form and all solid state, it can easily be assembled by a beginner. (Write to Kits Industries Inc., 729 Ceres Ave., Los Angeles, Calif. 90021 for data.) Price: $29.95

Blackbeard's treasures are still hidden in many a cove waiting for the lucky treasure seeker. But don't trust to luck! Put your trust in a metal locator and find that pot of gold! The three units illustrated on this page will also find small iron objects, hidden pipes, coins, jewelry, and more on sandy beaches, back yards, and even them thar hills!

Wired and ready to go is the Mark II Treasure Probe. A heterodyne device, the unit uses silicon transistors. (Write to Treasure House, 2139 Highway 9, Lakewood, New Jersey 08701 for facts.) Price: $22.95

HORN SPEAKERS

by Art Trauffer

Here's a quickie way to blend the old and the new. Build a transistor radio into the base of an old-fashioned horn loudspeaker and you've got the makings for some real good conversation.

Your friends will do a double-take when they hear *soul* from the 60s coming out of a 1920ish speaker. Just latch onto a horn salvaged from an attic, barn, auction, or second-hand store, and you've won half the battle.

Next trick is to build a transistor radio into the hardwood base. We've used a "Build-In" Radio Shack model 12-1150 which has six transistors, its own volume control and switch, and a 2¼-in. PM speaker. This go-go accessory should be just right for your installation. Of course, the size of the radio and the base might depend on the exact model horn you wind up with.

We used black walnut stock about 5/16-in. thick to make a base measuring 6¾ x 5¾ x 1½ in. The open-bottom box was put together with small nails and wood glue. It was then sanded smooth, given a coat of walnut stain, and rubbed to a shining finish with soft facial tissues.

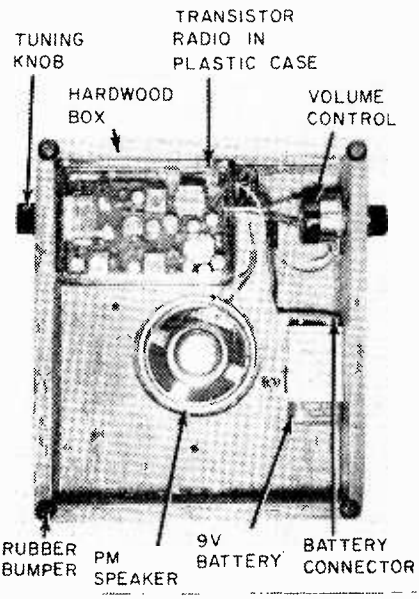
The Radio Shack chassis is enclosed in plastic and can be mounted on the side of the base with short flathead machine screws. (Angle brackets or epoxy cement might also be used.) Cement the speaker or mount it with brackets, right over the opening cut into the base. This is where sound will be fed out through the horn.

A metal angle bracket keeps the 9-V battery in place. After the components are wired according to the schematic, all you need do is attach rubber feet to each corner

(Continued on page 108)

BILL OF MATERIALS FOR HORN SPEAKER

1—"Build-In" transistor radio (Radio Shack 12-1150 or equiv.)
1—9-V battery (Burgess 2U6 or equiv.)
2—Short flathead 6-32 machine screws
Hardwood base:
1—6¾ x 5¾ x 5/16-in. piece
1—1-3/16 x 5/16-in. piece, about 25 in. long (for sides)
Misc.—Speaker horn, 4 small rubber feet, metal stock for angle brackets (optional), flange or fittings (see text), battery connector; volume control, PM speaker, knobs (if not supplied with radio), solder, hardware, etc.

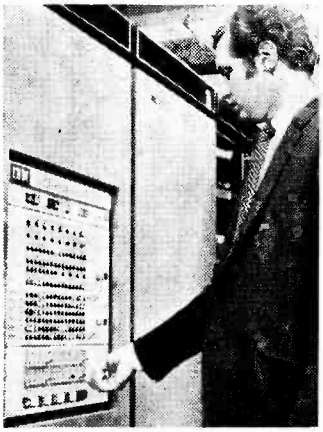


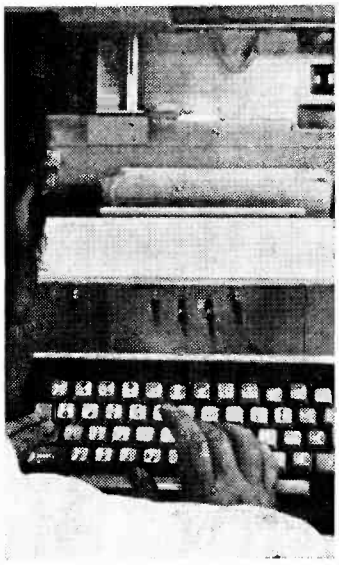
Man, it's easy to put together in one evening, and anyone can do it. Photo above is practically a wiring diagram.

the IMPOSSIBLE DREAM...

You take the high road; I'll take the low road . . . and you know as well as I do, baby, that it'll be bumper-to-bumper for both of us all the way there.

unsnarl the entangled traffic

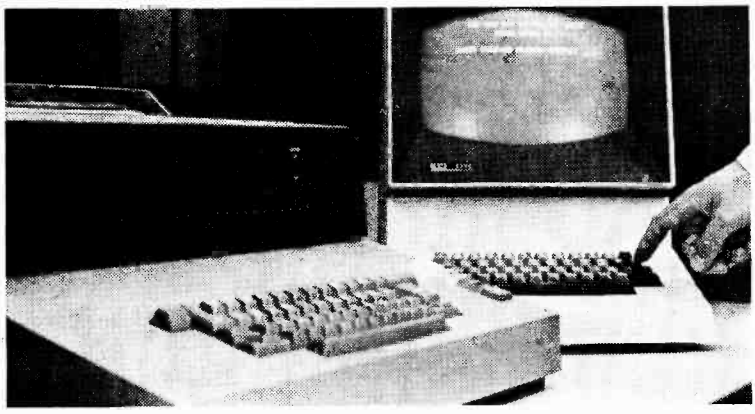




Above, monitor console permits engineer to override computer anytime. Right, system's keyboard.

Kit (below) modifies signal controller so it can be activated by computer. If no instructions are received from computer, controller functions normally.

Left, display station located on printer keyboard furnishes means for checking system visually. Below, pole-mounted sensors which feed data to IBM computer.



Largest electronic traffic brain in the world is the new computerized traffic control system that has been installed on one of the busiest and most congested boulevards in the U.S. Controlling vehicular flow on Queens Boulevard in New York City, the system controls 120 signalized intersections, with an estimated 850 three-level (red/amber/green) signals and over 390 walk/don't walk controls.

In essence here's what happens: 36 overhead sensors located at key points along the Boulevard aim sonic beams at lanes of traffic. Associated with these sensors is an IBM 1800, a computer that measures volume and direction of traffic, then adjust lights for a more effective movement of that traffic. ■

ELECTRONICS AND LOVE

☐ In this scientific age, many of us take our mechanical world for granted. We go about ignoring some of the inspirational things that the machine has accomplished, and we tend to think of the machine only as a means to furthering our own luxury. But at the Mill Neck Lutheran School for the Deaf on Long Island, N.Y., the machine and the men involved with them are not taken for granted. It is here that one sees the great and the good things that the machine can be used for in our electronic age.

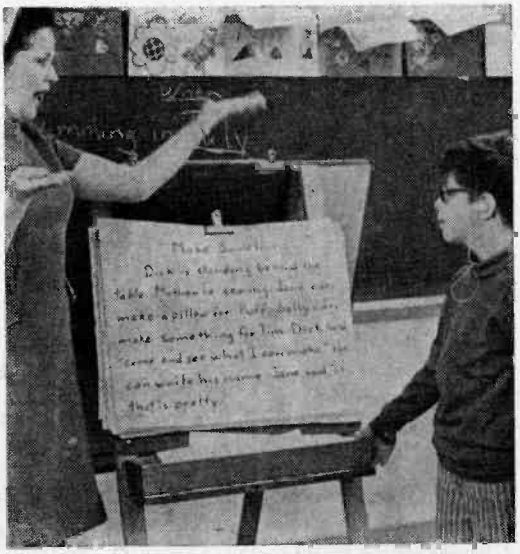
Housed in an old Tudor style mansion on beautiful grounds covering some 85 acres are the classrooms, library, and living quarters for faculty and students. In this school are the men and the machines that are used for rehabilitating these youngsters so that

Mirror and feather become invaluable teaching tools as they enable child to see how closely her lip movements resemble teacher's. Right, effect of earphones is apparent.

OVERCOME A SILENT WORLD

when they leave they are on an almost equal level of learning with other youngsters their age. At Mill Neck one can observe the teachers and technicians working together to build the body and the spirit of another human being to live a normal and happy life.

The importance of the machine and the associated electronics for teaching the deaf isn't realized until the visitor sees these machines at work. An ordinary visit becomes a revelation. One sees for the first time how a child reacts to her first sound with special electronic earphones capable of penetrating her deep and silent world. Like a stone thrown into a well, they break the surface of this deaf child's world. Her spirit comes rushing to the surface of our world, for communication has been made. *(Turn page)* ■

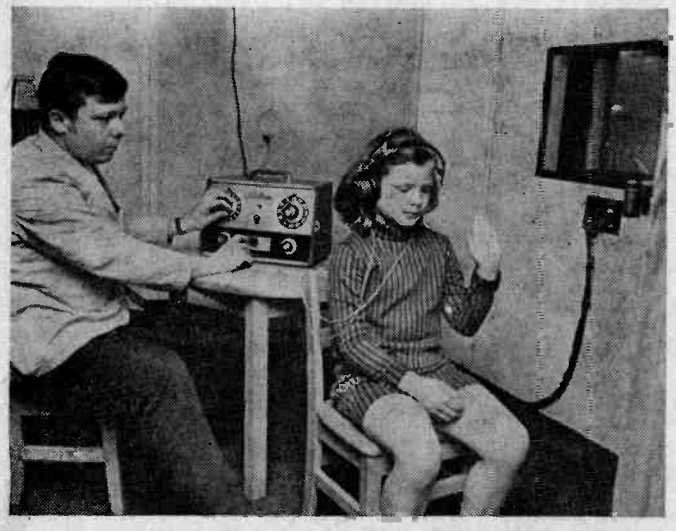


Each child wears portable auditory training equipment that can be adjusted to suit his needs. Teachers rely heavily on both gestures and written word to communicate with them.

...a silent world

Below, child learns to identify simple objects. Thanks to headphones, instructor can give child name of object at same time child is looking at picture, thus reinforcing learning process. Book shown here illustrates farmyard animals.

Above, students listen intently as instructor fills them in on details of studies. Below, teacher uses flashcards to help youngsters boost their knowledge of basic arithmetic.



Left, audiological test is administered to each child enrolled in Mill Neck. Purpose is to gauge precisely how handicapped child is before he begins studies.

VOLUME 51, PART 6

WHITE'S RADIO LOG

An up-to-date Directory of North American AM, FM, and TV Stations, including special sections on World-Wide Shortwave Stations and Emergency Stations for Selected Areas

WHITE'S RADIO LOG CONTENTS FOR 1969*

* If you saved six consecutive issues of Radio-TV Experimenter and Science and Electronics, you will have a complete White's Radio Log. If you have missed an issue, you may be able to get a copy by writing directly to the publisher stating which issue you wish and enclosing $1.00 for each issue.

WHITE'S

RADIO LOG

U. S. FM Stations by Call Letters

Call	Location	Freq.
KABC-FM	Los Angeles, Calif.	
KABI-FM	Abilene, Kan.	98.3
KABL-FM	San Francisco, Cal.	
KACA	Prosser, Wash.	
KACE-FM	Riverside, Calif.	
KACO	St. Louis, Mo.	107.7
KADI	St. Louis, Mo.	
KADO	Texarkana, Ark.	107.1
KADX	Denver, Colo.	
KAFE-FM	Santa Fe, N. M.	
KAFF-FM	Flagstaff, Ariz.	92.9
KAFI	Auburn, Calif.	
KAFM	Salina, Kans.	
KAGH-FM	Crossett, Ark.	
KAIM-FM	Honolulu, Hawaii	
KAJS	Newport Beach, Calif.	
KAKC	Tulsa, Okla.	
KAKI	San Antonio, Tex.	
KALA	Davenport, Ia.	
KALB-FM	Alexandria, La.	
KALH	Denver, Colo.	
KALL-FM	Salt Lake City, Utah	
KALW	San Francisco, Calif.	
KALX	Berkeley, Cal.	
KAMB	Merced, Cal.	
KAMS	Mammoth Spring, Ark.	
KAMU	Anchorage, Alaska	
KANG	Angwin, Cal.	
KANS-FM	Larned, Kan.	
KANT-FM	Lancaster, Calif.	
KANU	Lawrence, Kans.	
KANW	Albuquerque, N.Mex.	
KAOL-FM	Carrollton, Mo.	
KARD	Wichita, Kan.	
KARK	Little Rock, Ark.	
KARL-FM	Carlsbad, Cal.	
KARM-FM	Fresno, Calif.	
KASC	Conway, Ark.	
KASE	Austin, Tex.	100.7
KASI-FM	Ames, Iowa	107.1
KASU	Jonesboro, Ark.	
KATN-FM	Boise, Ida.	
KATY-FM	San Luis Obispo, Calif.	
KAUS-FM	Austin, Minn.	99.9
KAVI-FM	Rocky Ford, Colo.	
KAVR-FM	Apple Valley, Cal.	102.3
KAWB	McKinney, Tex.	95.3
KAWL-FM	York, Neb.	
KAWY	Casper, Wyo.	
KAYD	Beaumont, Tex.	
KBAY	San Jose, Cal.	
KBBB-FM	Borger, Tex.	
KBBI	Los Angeles, Calif.	
KBBK-FM	Boise, Ida.	
KBBL	Riverside, Cal.	
KBBW	San Diego, Cal.	
KBBX	Seattle, Wash.	
KBBY	Bakersfield, Cal.	107.9
KBCA	Los Angeles, Calif.	
KBCL-FM	Shreveport, La.	
KBEE-FM	Modesto, Calif.	
KBER-FM	San Antonio, Tex.	
KBEW-FM	Blue Earth, Minn.	
KBEY	Kansas City, Mo.	
KBFL	Buffalo, Mo.	
KBFM	Lubbock, Tex.	
KBGH-FM	Memphis, Tex.	
KBGL	Pocatello, Ida.	88.7
KBGN-FM	Caldwell, Ida.	94.1
KBHF	Bozeman, Mont.	
KBHS-FM	Hot Springs, Ark.	
KBIA-FM	Columbia, Mo.	
KBIG-FM	Los Angeles-Avalon, Cal.	
KBIM-FM	Roswell, N.Mex.	
KBIQ	Edmonds, Wash.	
KBKB	San Diego, Cal.	101.5
KBLE-FM	Seattle, Wash.	
KBMC	Eugene, Ore.	
KBMF-FM	Spearman, Tex.	
KBMJ-FM	St. Louis, Mo.	90.7
KBMO-FM	Benson, Minn.	93.5
KBMR-FM	Bismarck, N.D.	94.5
KBNM	Albuquerque, N.M.	
KBNO	Houston, Tex.	
KBOA-FM	Kennett, Mo.	
KBOB	West Covina, Cal.	
KBOC	Ogden, Utah	
KBOE-FM	Oskaloosa, Iowa	
KBOI-FM	Boise, Ida.	
KBOO	Portland, Ore.	
KBOS	Tulare, Cal.	94.9
KBOX-FM	Dallas, Tex.	
KBOY-FM	Medford, Oreg.	
KBPI	Denver, Colo.	
KBPO	Beaumont, Tex.	
KBRF-FM	Fergus Falls, Minn.	103.3
KBRG	San Francisco, Cal.	
KBRI-FM	Brinkley, Ark.	102.3
KBRK-FM	Brookings, S.D.	101.7
KBRO-FM	Bremerton, Wash.	
KBTC	Houston, Mo.	
KBTM-FM	Jonesboro, Ark.	
KBUC-FM	Terrell Hills, Tex.	106.3
KBUS-FM	Terrell Hills, Tex.	
KBUR-FM	Burlington, Ia.	
KBUY-FM	Ft. Worth, Tex.	
KBUZ-FM	Mesa, Ariz.	
KBVR	Corvallis, Ore.	
KBYE-FM	Oklahoma City, Okla.	98.9
KBYU-FM	Provo, Utah	
KCAB-FM	Dardanelle, Ark.	
KCAL-FM	Redlands, Calif.	
KCAW-FM	Port Arthur, Tex.	93.3
KCBH	Beverly Hills, Calif.	
KCBL-FM	Greeley, Colo.	
KCBS-FM	San Francisco, Calif.	
KCCE	Weatherford, Okla.	
KCCM-FM	Moorhead, Minn.	91.1
KCDR-FM	Cedar City, Utah	
KCEE-FM	Tucson, Ariz.	
KCES	Eufaula, Okla.	
KCFA-FM	Spokane, Wash.	
KCFM	St. Louis, Mo.	
KCHF-FM	Sioux Falls, S.D.	93.5
KCHO	Chico, Cal.	91.1
KCHV-FM	Conchella, Cal.	
KCIL	Houma, La.	
KCIM-FM	Carroll, Ia.	
KCIV	The Dalles, Ore.	104.5
KCJB-FM	Minot, N. D.	
KCJC	Kansas City, Kan.	
KCKN-FM	Kansas City, Kan.	
KCLC	St. Charles, Mo.	89.9
KCLO-FM	Leavenworth, Kans.	
KCLU-FM	Rolla, Mo.	
KCMA	San Francisco, Cal.	
KCMI	Los Angeles, Calif.	
KCMS-FM	Manitou Springs, Colo.	
KCNM	Carlsbad, N. M.	
KCOB-FM	Newton, Iowa	95.9
KCOE-FM	Cedar Rapids, Iowa	90.5
KCOM	Omaha, Nebr.	
KCOR-FM	San Antonio, Tex.	101.9
KCPR	San Luis Obispo, Cal.	91.3
KCPS	Tacoma, Wash.	
KCPX-FM	Salt Lake City, Utah	
KCRA-FM	Sacramento, Calif.	
KCRC-FM	Enid, Okla.	
KCRF-FM	Winnsboro, La.	95.9
KCRW	Santa Monica, Calif.	
KCSB-FM	Santa Barbara, Cal.	91.5
KCSC	Edmond, Okla.	
KCSM	San Mateo, Calif.	
KCSU-FM	Ft. Collins, Colo.	
KCTA-FM	Sinton, Tex.	
KCTC	Sacramento, Cal.	96.1
KCTS-FM	Minneapolis, Minn.	
KCUE-FM	Red Wing, Minn.	
KCUI	Pella, Ia.	
KCUR-FM	Kansas City, Mo.	
KCWM	Ft. Worth, Tex.	
KCWS-FM	Ellensburg, Wash.	
KCYS	Richland, Wash.	
KDAF-FM	Kansas, Mo.	
KDB-FM	Santa Barbara, Calif.	
KDBS-FM	Alexandria, La.	
KDCR	Sioux Center, Iowa	91.3
KDDD-FM	Dumas, Tex.	
KDEF-FM	Albuquerque, N.Mex.	
KDEN-FM	Denver, Colo.	
KDES-FM	Palm Spgs., Calif.	
KDFC	San Francisco, Calif.	
KDEF-FM	Albuquerque, N. M.	
KDFM	Walnut Creek, Cal.	
KDHI-FM	Twenty-Nine Palms, Cal.	
KDHL-FM	Faribault, Minn.	
KDHS	Modesto, Cal.	90.5
KDIC	Grinnell, Iowa	107.1
KDIG	San Diego, Cal.	
KDJW-FM	Amarillo, Tex.	
KDKA-FM	Pittsburgh, Pa.	
KDLA-FM	De Ridder, La.	
KDLK-FM	Del Rio, Tex.	
KDLO-FM	Watertown, S.D.	
KDLR-FM	Devils Lake, N.D.	
KDMC	Corpus Christi, Tex.	
KDMI	Des Moines, Iowa	
KDNC-FM	Spokane, Wash.	
KDNO	Delano, Cal.	98.5
KDNT-FM	Denton, Tex.	
KDOL-FM	Mojave, Cal.	
KDOT-FM	Scottsdale, Ariz.	
KDPS	Des Moines, Iowa	
KDSN-FM	Denison, Iowa	107.1
KDSU	Fargo, N.D.	
KDSX-FM	Denison-Sherman, Tex.	
KDUO	Riverside, Calif.	
KDUX-FM	Aberdeen, Wash.	
KDUZ-FM	Hutchinson, Minn.	107.1
KDVR	Sioux City, Iowa	
KDVS	Davis, Cal.	91.5
KEAR	San Francisco, Calif.	
KEAX	National City, Calif.	
KEBC	Oklahoma City, Okla.	
KEBJ	Phoenix, Ariz.	
KEBR	Sacramento, Calif.	
KEBS	San Diego, Cal.	89.5
KECR	El Cajon, Calif.	
KEDC-FM	Northridge, Cal.	
KEDP	Las Vegas, N. M.	
KEEL-FM	Shreveport, La.	93.7
KEEY	St. Paul, Minn.	102.1
KEEZ	San Antonio, Tex.	
KEFC	Waco, Tex.(s)	
KEFM	Nacagdoches, Tex.	103.3
KEFW	Honolulu, Hawaii	
KEHG-FM	Fosston, Minn.	107.1
KEIR	Dallas, Tex.	
KELA-FM	Centralia, Wash.	
KELD-FM	El Dorado, Ark.	
KELE	Lamesa, Tex.	100.3
KELO-FM	Sioux Falls, S. D.	
KELT	Harlingen, Tex.	
KEMO	St. Louis, Mo.	
KENA-FM	Mena, Ark.	101.7
KENW-FM	Portales, N. M.	88.9
KEQR	Chica, Cal.	
KERI	Bellingham, Wash.	
KERN-FM	Bakersfield, Calif.	
KERR	Salinas, Cal.	
KERS	Sacramento, Cal.	
KESD	Brookings, S.D.	
KESM-FM	El Dorado Springs, Mo.	
KETO-FM	Seattle, Wash.	
KEWB	Redding, Cal.	104.3
KEWC-FM	Cheney, Wash.	
KEWI-FM	Topeka, Kan.	
KEYC-FM	Mankato, Minn.	
KEYN-FM	Wichita, Kan.	
KEZE	Anaheim, Calif.	
KFAB-FM	Omaha, Nebr.	
KFAC-FM	Los Angeles, Calif.	
KFAD	Cleburne, Tex.	94.9
KFAM-FM	St. Cloud, Minn	
KFAV	Fayetteville, Ark.	
KFBC-FM	Cheyenne, Wyo.	97.9
KFBD-FM	Waynesville, Mo.	
KFBK-FM	Sacramento, Cal.	92.5
KFCA	Phoenix, Ariz.	91.5
KFGQ-FM	Boone, Ia.	99.3
KFH-FM	Wichita, Kans.	
KFIG	Fresno, Cal.	
KFJB-FM	Marshalltown, Ia.	
KFJC	Los Altos, Cal.	
KFJZ	Fort Worth, Tex.	
KFKF-FM	Bellevue, Wash.	
KFLA-FM	Scott City, Kan.	
KFLY-FM	Corvallis, Ore.	
KFMA	Jerome, Ida.	92.7
KFMB-FM	San Diego, Calif.	
KFMC	Provo, Utah	96.1
KFMD	Dubuque, Ia.	
KFMF	Ft. Collins, Colo.	
KFMG	Des Moines, Ia.	
KFMK	Houston, Tex.(s)	
KFML-FM	Denver, Colo.	
KFMM	Tucson, Ariz.	
KFMN	Abilene, Tex.	
KFMP	Port Arthur, Tex.	
KFMQ	Lincoln, Nebr.	
KFMR	Fremont, Cal.	
KFMS	San Francisco, Cal.	106.1
KFMU	Kansas City, Mo.	
KFMV	Magnolia, Ark.	
KFMW	San Bernardino, Calif.	
KFMX	San Diego, Calif.	
KFMY	Eugene, Oreg.	
KFNB	Oklahoma City, Okla.	
KFNE	Big Springs, Tex.	
KFNW-FM	Fargo, N.D.	
KFOA	Honolulu, Hawaii	
KFOG	San Francisco, Calif.	
KFOX-FM	Los Angeles, Cal.	
KFRD-FM	Rosenberg, Tex.	104.9
KFRE-FM	Fresno, Calif.	
KFRN-FM	Brownwood, Tex.	99.3
KFTM-FM	Ft. Morgan, Colo.	
KFUO-FM	Clayton, Mo.	
KFWT-FM	Ft. Worth, Tex.	
KFXM	Jackson, Miss.	
KFYR-FM	Bismarck, N.D.	
KGAF-FM	Gainesville, Tex.	
KGBC-FM	Galveston, Tex.	106.5
KGBI-FM	Omaha, Neb.	100.7
KGBN-FM	Caldwell, Idaho	
KGBS-FM	Los Angeles, Cal.	
KGCC	Denison, Tex.	89.7
KGEC	Palm Springs, Cal.	
KGFM	Pakersfield, Cal.	
KGHO-FM	Hoquiam, Wash.	
KGIW-FM	Alamosa, Colo.	93.5
KGLA	Los Angeles, Calif.	
KGLT	Bozeman, Mont.	
KGMB-FM	Honolulu, Hawaii	
KGMI-FM	Bellingham, Wash.	
KGMO-FM	Cape Girardeau, Mo.	100.7
KGMR-FM	Jacksonville, Ark.	
KGNC-FM	Amarillo, Tex.	
KGNO-FM	Dodge City, Kan.	
KGO-FM	San Francisco, Calif.	
KGPO	Grants Pass, Oreg.	
KGRC	Hannibal, Mo.	92.9
KGRD-FM	Las Cruces, N.M.	
KGRE	Greeley, Colo.	
KGRI-FM	Henderson, Tex.	
KGUD-FM	Santa Barbara, Calif.	
KGUS	Hot Springs, Ark.	97.5
KGVM-FM	Idaho Falls, Ida.	
KGVW-FM	Belgrade, Mont.	
KHAK-FM	Cedar Rapids, Iowa	
KHAR-FM	Anchorage, Alaska	
KHBL	Plainview, Tex.	
KHBM-FM	Monticello, Ark.	
KHBR-FM	Hillsboro, Tex.	
KHCB-FM	Houston, Tex.	105.7
KHEN-FM	Henryetta, Okla.	
KHEP-FM	Phoenix, Ariz.	
KHFI-FM	Austin, Tex.	
KHFM	Albuquerque, N. Mex.	
KHGM	Houston, Tex.	102.9
KHIQ	Sacramento, Calif.	
KHJ-FM	Los Angeles, Calif.	
KHKA	Hillsboro, Mo.	88.9
KHOB-FM	Hobbs, N. M.	
KHOF	Los Angeles, Calif.	
KHOM	Houma, La.	
KHOZ-FM	Harrison, Ark.	
KHPC	Brownwood, Tex.	
KHQ-FM	Spokane, Wash.	
KHRU	Clayton, Mo.	88.1
KHSC	Arcata, Cal.	90.5
KHSJ-FM	Hemet, Cal.	
KHVH-FM	Honolulu, Hawaii	
KHVR	Bijou, Calif.	
KHYI	Fremont, Calif.	
KIBS-FM	Bishop, Cal.	
KICD-FM	Spencer, Ia.	
KICS-FM	Hastings, Neb.	
KID-FM	Idaho Falls, Ida.	
KIEM	Eureka, Calif.	
KIFG-FM	Iowa Falls, Ia.	
KIFM	Bakersfield, Cal.	96.5
KIHI	Tulsa, Okla.	
KIKK-FM	Houston, Tex.	
KIKS-FM	Lake Charles, La.	
KILT-FM	Houston, Tex.	
KIMP-FM	Mt. Pleasant, Tex.	
KINB	Poteau, Okla.	107.3
KIND-FM	Independence, Kan.	
KING-FM	Seattle, Wash.	
KINI	Indio, Cal.	
KINK	Portland, Ore.	101.9
KINS-FM	Eureka, Cal.	96.3
KINT-FM	El Paso, Tex.	97.5
KIOI	San Francisco, Cal.	101.3
KIOO	Oklahoma, Okla.	
KIOS-FM	Omaha, Neb.	90.9
KIOU	Corpus Christi, Tex.	
KIRO-FM	Seattle, Wash.	
KISA	Kansas City, Mo.	
KISS	San Antonio, Tex.	
KISW	Seattle, Wash.	
KIT-FM	Yakima, Wash.	
KITE-FM	San Antonio, Tex.	
KITH	Phoenix, Ariz.	
KITT	San Diego, Calif.	
KITY	San Antonio, Tex.	
KIXI-FM	Seattle, Wash.	
KIXL-FM	Dallas, Tex.(s)	
KJAE	Lakewood, Colo.	107.5
KJAM-FM	Madison, S.D.	
KJAN-FM	Atlantic, Ia.	
KJAX	Stockton, Cal.	
KJAZ	Alameda, Calif.	
KJCK-FM	Junction City, Kan.	
KJEF-FM	Jennings, La.	
KJEM-FM	Okla. City, Okla.	
KJET-FM	Beaumont, Tex.	
KJIB	Portland, Ore.	99.5
KJLH	Long Beach, Cal.	
KJLM	San Diego, Calif.	
KJML	Sacramento, Calif.	
KKND	Jamestown, N.D.	
KJPO	Fresno, Calif.	
KJPW-FM	Waynesville, Mo.	
KJRG-FM	Newton, Kans.	
KJRL	Liberal, Kan.	
KJSB	Houston, Tex.	
KJSK-FM	Columbus, Neb.	
KKFM	Colorado Springs, Colo.	
KKHI-FM	San Francisco, Cal.	
KKIT-FM	Taos, N. M.	
KKLP	Pipestone, Minn.	98.7
KKMA	Pryor, Okla.	104.5
KKOP	Redondo Beach, Cal.	
KKWB	Breckenridge, Minn.	101.7
KKWS	Wadena, Minn.	
KLAW	Lawton, Okla.	
KLAY-FM	Tacoma, Wash.	
KLBK-FM	Lubbock, Tex.	
KLBS-FM	Los Banos, Cal.	
KLCC	Eugene, Ore.	
KLCN-FM	Blytheville, Ark.	
KLCO-FM	Poteau, Okla.	
KLEA-FM	Lovington, N. M.	
KLEB-FM	Golden Meadow, La.	
KLEF	Houston, Tex.	

Call	Location	Freq.
KLEM-FM	LeMars, Ia.	
KLEN-FM	Killeen, Tex.	93.3
KLFD-FM	Litchfield, Minn.	95.3
KLFM	Ames, Ia.	
KLGS	Los Gatos, Cal.	
KLFM	Beverly Hills, Calif.	
KLIL	Ukiah, Cal.	
KLIN-FM	Lincoln, Neb.	107.3
KLIQ-FM	Portland, Ore.	
KLIR-FM	Denver, Colo.	
KLIZ-FM	Brainerd, Minn.	
KLJT	Lake Jackson, Tex.	
KLMO-FM	Longmont, Colo.	
KLOA-FM	Ridgecrest, Calif.	
KLOM-FM	Lompoc, Cal.	92.7
KLON	Long Beach, Calif.	
KLOR-FM	Ponca City, Okla.	
KLOV-FM	Loveland, Colo.	
KLPW-FM	Union, Mo.	
KLRO	San Diego, Calif.	
KLSN	Seattle, Wash.	
KLSS	Mason City, Ia.	
KLTB	Bolivar, Mo.	
KLUE-FM	Longview, Tex.	
KLUR	Wichita Falls, Tex.	
KLVL	Pasadena, Tex.	
KLWN-FM	Lawrence, Kan.	
KLYD-FM	Bakersfield, Calif.	
KLYK	Longview, Wash.	105.5
KLYN-FM	Lynden, Wash.	
KLYQ-FM	Hamilton, Mont.	95.9
KLYX	Memphis, Tenn.	
KLZ-FM	Denver, Colo.	
KMAG-FM	Ft. Smith, Ark.	
KMAK-FM	Fresno, Calif.	
KMAQ-FM	Maquoketa, Ia.	
KMAX	Sierra Madre, Calif.	
KMBR-FM	Kansas City, Mo.	
KMCP	Portland, Oreg.	
KMEO-FM	Phoenix, Ariz.	
KMER	Fresno, Calif.	
KMET	Los Angeles, Cal.	
KMFA	Austin, Tex.	
KMFB-FM	Mendocino, Cal.	
KMFL-FM	Marshall, Mo.	102.9
KMFM	San Antonio, Tex. (s)	
KMFS	Memphis, Tex.	
KMHL-FM	Marshall, Minn.	
KMHT	Marshall, Tex.	
KMIH	Mercer Island, Wash.	90.1
KMJ-FM	Fresno, Calif.	
KMLB-FM	Monroe, La.	
KMMK	Little Rock, Ark.	
KMMM-FM	Muskogee, Okla.	
KMND-FM	Mesa, Ariz.	
KMOD	Tulsa, Okla.	
KMOX-FM	St. Louis, Mo.	
KMPL-FM	Sikeston, Mo.	97.7
KMPX	San Francisco, Calif.	
KMRC-FM	Morgan City, La.	
KMSC	Clear Lake City, Tex.	
KMSM	Rolla, Mo.	
KMSU	Mankato, Minn.	
KMTS	Moberly, Mo.	90.1
KMTY-FM	Clovis, N. M.	99.1
KMUL-FM	Muleshoe, Tex.	
KMUW	Wichita, Kans.	
KMYC-FM	Marysville, Calif.	
KMYO-FM	Little Rock, Ark.	
KMYR	Denver, Colo.	
KMUZ	Santa Barbara, Calif.	
KNBQ	Bethany, Okla.	
KNBR-FM	San Francisco, Calif.	
KNBT	New Braunfels, Tex.	92.1
KNBU	Baldwin, Kan.	
KNBY-FM	Newport, Ark.	
KNCV	Rochester, Minn.	101.7
KNDA	St. Louis, Mo.	
KNDR	Chickasha, Okla.	
KNDX	Yakima, Wash.	
KNEB-FM	Scottsbluff, Nebr.	
KNED-FM	McAlester, Okla.	
KNEI-FM	Waukon, Iowa	103.9
KNER	Dallas, Tex.	
KNEU	El Centro, Cal.	98.5
KNEV	Reno, Nev.	
KNEW-FM	Scottsbluff, Nebr.	
KNFB	Nowata, Okla.	
KNFM	Midland, Tex.	
KNHS	Torrance, Cal.	
KNIK-FM	Anchorage, Alaska	
KNIR-FM	New Iberia, La.	99.1
KNIX-FM	Phoenix, Ariz.	
KNJO	Thousand Oaks, Calif.	
KNOB	Long Beach, Cal.	97.9
KNOC-FM	Natchitoches, La.	
KNOE-FM	Monroe, La.	
KNOF	St. Paul, Minn.	
KNOK-FM	Ft. Worth, Tex.	
KNOS	Marshall, Mo.	91.7
KNRO-FM	Conroe, Tex.	
KNTO	Wichita Falls, Tex.	
KNTU	Denton, Tex.	88.5
KNUE	Tyler, Tex.	101.5
KNUJ-FM	New Ulm, Minn.	
KNUS	Dallas, Tex.	
KNWA	Fayetteville, Ark.	
KNWC-FM	Sioux Falls, S.D.	
KNWS-FM	Waterloo, Iowa	
KNX-FM	Los Angeles, Calif.	
KNXR	Rochester, Minn.	
KOA-FM	Denver, Colo.	
KOAP	Portland, Ore.	91.5
KOAT-FM	Albuquerque, N.M.	
KOB-FM	Albuquerque, N.M.	
KOBC	Joplin, Mo.	
KOBH-FM	Hot Springs, S.D.	
KOCM	Newport Beach, Cal.	
KOCN	Pacific Grove, Cal.	104.9
KOCV	Odessa, Tex.	
KOCY-FM	Oklahoma City, Okla.	
KODA-FM	Houston, Tex.	
KOFM	Oklahoma City, Okla.	
KOFO-FM	Ottawa, Kan.	
KOGM-FM	Tulsa, Okla	
KOGO	San Diego, Calif.	
KOIL-FM	Omaha, Neb.	
KOIN-FM	Portland, Oreg.	
KOIT	San Francisco, Cal.	
KOKE-FM	Austin, Tex.	
KOKH	Oklahoma City, Okla.	
KOL-FM	Seattle, Wash.	
KOLM-FM	Rochester, Minn.	
KONG-FM	Visalia, Calif.	
KONI-FM	Spanish Fork, Utah	
KOOI	Jacksonville, Tex.	106.5
KOOL-FM	Phoenix, Ariz.	
KOOM	Benton, Ark.	107.1
KOPR-FM	Great Falls, Mont.	
KORA-FM	Bryan, Tex.	
KORE-FM	Springfield-Eugene, Ore.	
KORK-FM	Las Vegas, Nev.	
KORU	Tulsa, Okla.	
KOSE-FM	Osceola, Ark.	
KOSI-FM	Denver, Colo.	
KOSO	Turlock, Cal.	
KOST	Los Angeles, Cal.	
KOSU-FM	Stillwater, Okla.	
KOSY-FM	Texarkana, Tex.	
KOTN-FM	Pine Bluff, Ark.	
KOTO	Alamagordo, N. M.	
KOVF-FM	Kearney, Neb.	91.3
KOWN-FM	Escondido, Cal.	
KOYL-FM	Odessa, Tex.	
KOYN-FM	Billings, Mont.	93.3
KOZE-FM	Lewiston, Idaho	
KOZN	Omaha, Neb.	94.1
KPAC-FM	Port Arthur, Tex.	
KPAK	El Paso, Tex.	
KPAN-FM	Hereford, Tex.	
KPAT-FM	Berkeley, Calif.	
KPCS	Pasadena, Cal.	89.3
KPDQ-FM	Portland, Ore.	93.7
KPEL-FM	Lafayette, La.	
KPEN	San Francisco, Calif.	
KPER-FM	Gilroy, Cal.	
KPFA	Berkeley, Cal.	94.1
KPFB	Berkeley, Calif.	
KPFK	Los Angeles, Calif.	
KPIK-FM	Colorado Springs, Colo.	
KPLC-FM	Lake Charles, La.	
KPLT-FM	Paris, Tex.	
KPLU	Tacoma, Wash.	
KPLX	San Jose, Cal.	
KPFM	Portland, Oreg.	
KPGM	Los Altos, Calif.	
KPLR-FM	St. Louis, Mo.	
KPMT	Oxnard, Cal.	
KPNW-FM	Eugene, Ore.	99.1
KPOC-FM	Pocahontas, Ark.	103.9
KPOI-FM	Honolulu, Hawaii	
KPOK	Portland, Ore.	98.5
KPOL-FM	Los Angeles, Calif.	
KPOP-FM	Roseville, Cal.	93.5
KPPC-FM	Pasadena, Calif.	
KPPS-FM	Parsons, Kans.	
KPQ-FM	Wenatchee, Wash.	
KPRI	San Diego, Calif.	
KPRM-FM	Park Rapids, Minn.	
KPRN	Seattle, Wash.	
KPSR	Los Altos, Cal.	91.5
KPRS-FM	Kansas City, Mo.	
KPSD	Dallas, Tex.	
KPSR	Los Altos, Cal.	
KPUL-FM	Pullman, Wash.	104.9
KPWD	Plentywood, Mont.	
KQED-FM	San Francisco, Cal.	88.5
KQFM	Portland, Oreg.	
KQIP	Odessa, Tex.	
KQMU	Salt Lake City, Utah	94.1
KQRS-FM	Golden Valley, Minn.	
KQTY	Wichita, Kan.	
KQUE	Houston, Tex.	
KQV-FM	Pittsburgh, Pa.	
KQWB-FM	Moorhead, Minn.	
KQXX	McAllen, Tex.	
KRAB	Seattle, Wash.	
KRAK-FM	Stockton, Calif.	
KRAM-FM	Las Vegas, Nev.	
KRAV	Tulsa, Okla.	
KRAZ	Farmington, N. M.	96.9
KRBE	Houston, Tex.	
KRBI-FM	St. Peter, Minn.	
KRBT	Woodland, Cal.	102.5
KRCB-FM	Council Bluffs, Ia.	
KRCC	Colorado Springs, Colo.	
KRCH	St. Louis, Mo.	
KRCS	San Bernardino, Cal.	
KRCW	Santa Barbara, Calif.	
KRDO-FM	Colorado Springs, Colo.	
KREB	Monroe, La.	
KREM-FM	Spokane, Wash.	
KREP	Santa Clara, Cal.	
KRES	Moberly, Mo.	
KREX-FM	Grand Junction, Colo.	
KRFM	Phoenix, Ariz.	
KRFO-FM	Owatonna, Minn.	
KRHM	Los Angeles, Calif.	
KRIL	El Dorado, Ark.	
KRIT	Clarion, Iowa	
KRKD-FM	Los Angeles, Calif.	
KRKH-FM	Lubbock, Tex.	
KRKY	Denver, Colo.	
KRLD-FM	Dallas, Tex.	
KRMD-FM	Shreveport, La.	
KRMG-FM	Tulsa, Okla.	
KRMS-FM	Osage Beach, Mo.	
KRNL-FM	Mt. Vernon, Ia.	
KRNT-FM	Des Moines, Ia.	
KRNW	Boulder, Colo.	
KRNY-FM	Kearney-Holdrege, Nebraska	
KROA	Aurora, Neb.	
KROB-FM	Robstown, Tex.	
KROC-FM	Rochester, Minn.	
KRON-FM	San Francisco, Calif.	
KROS-FM	Clinton, Iowa	
KROW	Santa Barbara, Calif.	
KROY-FM	Sacramento, Calif.	
KRPM	San Jose, Cal.	98.5
KRRC	San Jose, Calif.	
KRSA-FM	Salinas, Cal.	
KRSI	Minneapolis, Minn.	
KRSI-FM	St. Louis Park, Minn.	
KRSL-FM	Russell, Kan.	
KRSN-FM	Los Alamos, N.Mex.	
KRSP-FM	Salt Lake City, Utah	103.5
KRST	Albuquerque, N. M.	
KRUS-FM	Ruston, La.	
KRVM	Eugene, Oreg.	
KRVN-FM	Lexington, Nebr.	
KRWG	University Park, N. M.	
KRWL-FM	Carson City, Nev.	97.3
KRVS-FM	Lafayette, La.	
KRXL	Kirksville, Mo.	
KRYT-FM	Colorado Springs, Colo.	
KSAM-FM	Huntsville, Tex.	
KSAN	San Francisco, Cal.	94.9
KSBY-FM	San Luis Obispo, Cal.	
KSCO	Santa Cruz, Calif.	
KSBW-FM	Salinas, Calif.	
KSDB-FM	Manhattan, Kans.	
KSDO-FM	San Diego, Cal.	
KSDS	San Diego, Calif.	
KSEA	San Diego, Calif.	
KSEL-FM	Lubbock, Tex.	
KSEO-FM	Durant, Okla.	
KSFA-FM	Nacogdoches, Tex.	
KSFM	Dallas, Tex.	
KSFX	San Francisco, Calif.	
KSGM-FM	Ste. Genevieve, Mo.	
KSHE	Crestwood, Mo.	
KSHN	Sherman, Tex.	96.7
KSIB-FM	Creston, Ia.	
KSIS-FM	Sedalia, Mo.	
KSIX-FM	Corpus Christi, Tex.	
KSJM	Jamestown, N.D.	
KSJN-FM	New Brighton, Minn.	
KSJO-FM	San Jose, Calif.	
KSJR-FM	Collegeville, Minn.	
KSJS	San Jose, Cal.	90.7
KSKU	Hutchinson, Kan.	102.1
KSJT	San Angelo, Tex.	
KSL-FM	Salt Lake City, Utah	
KSLA	Seattle, Wash.(s)	
KSLH	St. Louis, Mo.	
KSLO-FM	Opelousas, La.	
KSMA-FM	Santa Maria, Calif.	
KSMB	Lafayette, La.	
KSNM	Santa Fe, N. M.	
KSOM-FM	Ontario, Cal.	
KSOO-FM	Sioux Falls, S.D.	
KSOP-FM	Salt Lake City, Utah	
KSOR	Ashland, Ore.	90.1
KSOZ	Point Lookout, Mo.	
KSPC	Claremont, Calif.	
KSPI-FM	Stillwater, Okla.	
KSPL-FM	Diboll, Tex.	95.5
KSPR-FM	Springdale, Ark.	104.9
KSRF	Santa Monica, Calif.	
KSRN	Reno, Nev.	
KSRT	Tracy, Cal.	
KSTE	Emporia, Kans.	
KSTN-FM	Stockton, Calif.	
KSTP-FM	St. Paul, Minn.	
KSUI	Iowa City, Iowa	
KSVP-FM	Artesia, N. M.	
KSWC	Winfield, Kan.	
KSWH	Arkedelphia, Ark.	88.1
KSWM-FM	Aurora, Mo.	
KSYM-FM	San Antonio, Tex.	90.3
KSYN	Joplin, Mo.	
KTAC-FM	Tacoma, Wash.	
KTAL	Texarkana, Tex.	
KTAP	Tucson, Ariz.	
KTAR-FM	Phoenix, Ariz.	
KTBC-FM	Austin, Tex.	
KTBT	Garden Grove, Cal.	
KTCF	Cedar Falls, Iowa	
KTCR-FM	Minneapolis, Minn.	
KTCS-FM	Ft. Smith, Ark.	
KTCU-FM	Ft. Worth, Tex.	
KTEA-FM	Midwest City, Okla.	
KTEC	Oretech, Oreg.	
KTEP	El Paso, Tex.	
KTFC	Sioux City, Ia.	
KTGR-FM	Columbia, Mo.	
KTHO-FM	Tahoe Valley, Cal.	
KTIB-FM	Thibodaux, La.	
KTIM	San Rafael, Calif.	
KTIS-FM	Minneapolis, Minn.	
KTJO-FM	Ottawa, Kans.	
KTLQ-FM	Tahlequah, Okla.	
KTMS-FM	Santa Barbara, Cal.	
KTNM-FM	Tucumcari, N.M.	92.7
KTNT-FM	Tacoma, Wash.	
KTOC-FM	Jonesboro, La.	
KTOD-FM	Sinton, Tex.	
KTOP	Topeka, Kan.	
KTOY	Tacoma, Wash.	
KTQM-FM	Clovis, N. M.	
KTRB-FM	Modesto, Calif.	
KTRH-FM	Houston, Tex.	
KTRM-FM	Beaumont, Tex.	
KTSM-FM	El Paso, Tex.	
KTSR	Kansas City, Mo.	
KTTS-FM	Springfield, Mo.	
KTUH	Honolulu, Hawaii	90.5
KTW-FM	Seattle, Wash.	
KTWD	Spokane, Wash.	
KTWN	Anoka, Minn.	107.9
KTXJ-FM	Jasper, Tex.	
KTXN-FM	Victoria, Tex.	98.7
KTWR	Tacoma, Wash.	
KTXR-FM	Springfield, Mo.	
KTXT-FM	Lubbock, Tex.	
KTYM-FM	Inglewood, Calif.	
KUAC	College, Alaska	104.7
KUAM-FM	Agana, Guam	
KUCR	Riverside, Cal.	
KUCV	Lincoln, Neb.	
KUER	Salt Lake City, Utah	
KUID	Moscow, Ida.	
KUDE-FM	Oceanside, Calif.	
KUDU-FM	Ventura-Oxnard, Calif.	
KUDY-FM	Spokane, Wash.	
KUER	Salt Lake City, Utah	
KUFM	Missoula, Mont.	
KUHF	Houston, Tex.	
KUKI-FM	Ukiah, Cal.	
KULA	Las Vegas, Nev.	
KULP-FM	El Campo, Tex.	96.9
KUMD-FM	Duluth, Minn.	
KUMN	Albuquerque, N. M.	
KUNF	La Canada, Cal.	88.9
KUOA-FM	Siloam Springs, Ark.	
KUOH	Honolulu, Hawaii	
KUOI-FM	Moscow, Ida.	89.3
KUOP	Stockton, Calif.	
KUOR-FM	Redlands, Cal.	
KUOW	Seattle, Wash.	
KUPD-FM	Tempe, Ariz.	
KUPK-FM	Garden City, Kan.	

Are your home-town FM stations listed correctly in *White's Radio Log?* If you believe there is a correction called for in *White's* listings, please check first with your local station. For each callsign obtain the correct city location and frequency. (Remember, even though your local paper may list a station as a "home-town" station, it may be officially licensed by the FCC for operation in the next city). Get all the facts on a piece of paper (be very brief), include your name and address, and mail to *White's Radio Log*, RADIO-TV EXPERIMENTER, 229 Park Avenue South, New York, N. Y. 10003. Your help in contributing to the accuracy and completeness of *White's Radio Log* will be sincerely appreciated. —*Editor*

WHITE'S RADIO LOG

Call	Location	Freq.
KURL-FM	Billings, Mont.	
KUSC	Los Angeles, Calif.	
KUSD-FM	Vermillion, S. Dak.	
KUSN-FM	St. Joseph, Mo.	
KUSU-FM	Logan, Utah	
KUT-FM	Austin, Tex.	
KUTE	Glendale, Calif.	
KUWR	Laramie, Wyo.	
KVBC	Grand Forks, N. D.	
KVCL-FM	Winnfield, La.	
KVCR	San Bernardino, Calif.	
KVEE-FM	Conway, Ark.	
KVEN-FM	Ventura, Calif.	
KVEZ	San Mateo, Cal.	
KVFM	San Fernando, Calif.	
KVFS	Vacaville, Cal.	95.3
KVHS	Concord, Cal.	91.1
KVIL-FM	Highland Park-Dallas, Tex.	
KVLV-FM	Fallon, Nev.	
KVMG-FM	Cochran, Ga.	
KVMN	Pueblo, Colo.	
KVOA-FM	Tucson, Ariz.	
KVOE-FM	Emporia, Kan.	
KVOP-FM	Plainview, Tex.	
KVOR-FM	Colorado Springs, Colo	
KVOX-FM	Moorhead, Minn.	
KVPC	Fairfield, Iowa	89.5
KVPI-FM	Ville Platte, La.	
KVRF	Vermillion, S.D.	
KVRO	Stillwater, Okla.	
KVSC	St. Cloud, Minn.	
KVSR	Rapid City, S. D.	97.9
KVTT	Dallas, Tex.	
KVWM	Show Low, Ariz.	
KWAR	Waverly, Iowa	
KWAT-FM	Watertown, S.D.	96.1
KWAV	Monterey, Cal.	
KWAX	Eugene, Oreg.	
KWBE-FM	Beatrice, Neb.	
KWBI	Morrison, Colo.	91.1
KWBU	Waco, Tex.	
KWCR-FM	Ogden, Utah	
KWDM	Des Moines, Ia. (s)	
KWEH	Camden, Ark.	
KWFC	Springfield, Mo.	
KWFR-FM	San Angelo, Tex.	
KWG-FM	Stockton, Calif.	
KWGN-FM	Abernathy, Tex.	
KWGO-FM	Abernathy, Tex.	
KWGS	Tulsa, Okla.	
KWHG	Lincoln, Neb.	
KWHI-FM	Brenham, Tex.	
KWHO-FM	Salt Lake City, Utah	
KWHP	Edmond, Okla.	
KWIC	Salt Lake City, Utah	
KWIL-FM	Albany, Ore.	107.9
KWIQ-FM	Moses Lake, Wash.	100.3
KWIX	St. Louis, Mo.	
KWIZ-FM	Santa Ana, Calif.	
KWJB-FM	Globe, Ariz.	
KWKC-FM	Abilene, Tex.	
KWKH-FM	Shreveport, La.	
KWKI	Kansas City, Mo.	
KWLM-FM	Willmar, Minn.	
KWLW	San Angelo, Tex.	
KWMF-FM	Walnut Creek, Cal.	
KWMT-FM	Ft. Dodge, Ia.	
KWMU	St. Louis, Mo.	90.7
KWNS-FM	Pratt, Kan.	
KWNT-FM	Davenport, Ia.	
KWOA-FM	Worthington, Minn.	
KWOC-FM	Poplar Bluff, Mo.	
KWPC-FM	Muscatine, Iowa	
KWPM-FM	West Plains, Mo.	
KWSB-FM	Gunnison, Colo.	
KWST	Los Angeles, Cal.	105.9
KWTO-FM	Springfield, Mo.	
KWTX-FM	Waco, Tex.	97.5
KWWC-FM	Columbia, Mo.	
KWWL-FM	Waterloo, Iowa	107.9
KWWM	Stephenville, Tex.	98.3
KWWR-FM	Mexico, Mo.	
KWXI	Ft. Worth, Tex.	97.1
KWXY-FM	Cathedral City, Cal.	103.1
KWYN-FM	Wynne, Ark.	92.7
KXEL-FM	Waterloo, Iowa	
KXFM	Santa Maria, Cal.	
KXIC-FM	Iowa City, Ia.	
KXIT-FM	Dalhart, Tex.	
KXJK-FM	Forrest City, Ark.	
KXKX	Lodi, Cal.	97.7
KXL-FM	Portland, Ore.	95.5
KXLU	Los Angeles, Cal.	88.9
KXLY-FM	Spokane, Wash.	
KXOA	Sacramento, Calif.	
KXQR	Fresno, Calif.(s)	
KXRA-FM	Alexandria, Minn.	
KXTR	Kansas City, Mo.	
KXXI	Alamogordo, N.M.	
KXXK	Dallas, Tex.	
KXYZ-FM	Houston, Tex.	
KYAK-FM	Anchorage, Alaska	101.3
KYEA	West Monroe, La.	98.3
KYEW	Phoenix, Ariz.	
KYFM	Bartlesville, Okla.	100.1
KYLE-FM	Temple, Tex.	
KYMS	Santa Ana, Cal.	
KYSM-FM	Mankato, Minn.	
KYSS-FM	Missoula, Mont.	100.1
KYTE	Livermore, Cal.	101.7
KYZM-FM	Cape Girardeau, Mo.	102.9
KZAK-FM	Tyler, Tex.	
KZAM	Seattle, Wash.	
KZAP	Sacramento, Cal.	98.5
KZEL-FM	Eugene, Ore.	
KZFM	Corpus Christi, Tex.	
KZOM	Oklahoma City, Okla.	
KZSU	Stanford, Cal.	
KZUN-FM	Opportunity, Wash.	
KZYM-FM	Cape Girardeau, Mo.	
WAAA-FM	Winston-Salem, N.C.	
WAAF	Worcester, Mass.	
WAAM-FM	Parkersburg, W.Va.	
WAAZ-FM	Crestview, Fla.	
WABC-FM	New York, N.Y.	
WABD-FM	Ft. Campbell, Ky.	107.9
WABE	Atlanta, Ga.	
WABF-FM	Fairhope, Ala.	
WABI-FM	Bangor, Maine	
WABX-FM	Detroit, Mich.	
WABZ-FM	Albemarle, N.C.	
WACO	Waco, Tex.	
WACT-FM	Tuscaloosa, Ala.	
WADB	Point Pleasant, N. J.	95.9
WADM-FM	Decatur, Ind.	
WADV	Buffalo, N. Y.	106.5
WAEB-FM	Cincinnati, Ohio	
WAEF	Cincinnati, O.	
WAER	Syracuse, N.Y.	
WAEW-FM	Crossville, Tenn.	
WAFB-FM	Baton Rouge, La.	98.1
WAFM	Angola, Ind.	100.1
WAGY-FM	Forest City, N. C.	
WAHR	Huntsville, Ala.	
WAIC	Springfield, Mass.	
WAIN-FM	Columbia, Ky.	
WAIV	Indianapolis, Ind.	
WAJC	Indianapolis, Ind.	
WAJM	Montgomery, Ala.	
WAJP	Joliet, Ill.	
WAJR-FM	Morgantown, W.Va.	
WAKE-FM	Valparaiso, Ind.	
WAKM	Bedford, Pa.	
WAKN-FM	Aiken, S.C.	
WAKO-FM	Lawrenceville, Ill.	
WAKR-FM	Akron, Ohio	
WAKW	Cincinnati, O.	
WALD-FM	Walterboro, S.C.	100.9
WALK-FM	Patchogue, N.Y.	
WALL-FM	Middletown, N. Y.	
WALM-FM	Marshall, Mich.	
WAMC	Albany, N.Y.	
WAMF	Amherst, Mass.	
WAMO-FM	Pittsburgh, Pa.	
WAMU-FM	Washington, D.C.	
WANG-FM	Coldwater, Mich.	
WANS-FM	Anderson, S. C.	
WANY-FM	Albany, Ky.	
WANM	Tallahassee, Fla.	
WANZ	Sebring, Fla.	
WAOV-FM	Vincennes, Ind.	
WAPC-FM	Riverhead, N. Y.	
WAPI-FM	Birmingham, Ala.	
WAPL-FM	Appleton, Wis.	
WAPS	Akron, Ohio	
WAQB-FM	Atlantic Beach, Fla.	
WARC	Meadville, Pa.	
WARD-FM	Johnstown, Pa.	
WARI-FM	Abbeville, Ala.	
WARK	Little Rock, Ark.	
WARN-FM	Fort Pierce, Fla.	
WARP	Due West, S. C.	91.7
WARU-FM	Peru, Ind.	
WASA-FM	Havre De Grace, Md.	
WASH	Washington, D. C.	
WASK-FM	Lafayette, Ind.	
WATH-FM	Athens, O.	
WATM-FM	Atmore, Ala.	
WATO-FM	Oak Ridge, Tenn.	
WATR-FM	Waterbury, Conn.	
WATZ-FM	Alpena, Mich.	93.5
WAUG-FM	Augusta, Ga.	
WAUK-FM	Waukesha, Wis.	
WAUP	Akron, Ohio	
WAUR	Aurora, Ill.	107.9
WAVA-FM	Arlington, Va.	
WAVO-FM	Decatur, Ga.	
WAVY-FM	Portsmouth, Va.	
WAWA-FM	Milwaukee, Wis.	
WAWK-FM	Kendallville, Ind.	
WAWR-FM	Bowling Green, O.	
WAWW	Murray, Ky.	
WAWZ-FM	Zarephath, N.J.	
WAXO	Kenosha, Wis.	
WAYL	Minneapolis-St. Paul, Minn.	
WAYZ-FM	Waynesboro, Pa.	
WAZL-FM	Hazelton, Pa.	
WAZY-FM	Lafayette, Ind.	
WBAA-FM	W. Lafayette, Ind.	
WBAB-FM	Babylon, N.Y.	
WBAG-FM	Burlington-Graham, N. C.	93.9
WBAI	New York, N.Y.	
WBAL-FM	Baltimore, Md.	
WBAP-FM	Ft. Worth, Tex.	
WBAW-FM	Barnwell, S.C.	
WBAY	Green Bay, Wis.(s)	
WBBA-FM	Pittsfield, Ill.	
WBBB-FM	Burlington-Graham, N. C.	101.1
WBBC	Jackson, Mich.	
WBBI-FM	Abingdon, Va.	
WBBM-FM	Chicago, Ill.	
WBBO-FM	Forest City, N.C.	
WBBQ-FM	Augusta, Ga.	
WBBR-FM	E. St. Louis, Ill.	
WBBW-FM	Youngstown, Ohio	
WBBY	Westerville, O.	103.9
WBCB-FM	Levittown-Fairless Hills, Pa.	
WBCH-FM	Hastings, Mich.	100.1
WBCI-FM	Williamsburg, Va.	
WBCL-FM	South Beloit, Ill.	
WBCM-FM	Bay City, Mich.	
WBCN	Boston, Mass.	
WBCO-FM	Bucyrus, O.	
WBCR-FM	Beloit, Wis.	
WBDG	Indianapolis, Ind.	
WBEA	Elyria, O.	
WBEN-FM	Buffalo, N.Y.	
WBET-FM	Brockton, Mass.	
WBEU-FM	Beaufort, S. C.	
WBEV-FM	Beaver Dam, Wis.	95.3
WBEX-FM	Chillicothe, Ohio	
WBEZ	Chicago, Ill.	
WBFB	Rochester, N. Y.	92.5
WBFG	Detroit, Mich.	
WBFM	Seneca, S. C.	
WBFO	Buffalo, N.Y.	
WBGM-FM	Tallahassee, Fla.	
WBGO	Newark, N.J.	
WBGU	Bowling Green, Ohio	
WBHT-FM	Brownsville, Tenn.	
WBIE-FM	Marietta, Ga.	
WBIL	Biloxi, Miss.	
WBIR	Knoxville, Tenn.	
WBIV	Wethersfield Township, N. Y.	107.7
WBIZ-FM	Eau Claire, Wis.	
WBJC	Baltimore, Md.	
WBJH	Trenton, N. J.	
WBKE-FM	North Manchester, Ind.	89.5
WBKV-FM	West Bend, Wis.	
WBKW	Beckley, W.Va.	
WBKY	Lexington, Ky.	
WBLK-FM	Buffalo, N.Y.	
WBLR-FM	Batesburg, S.C.	
WBLY-FM	Springfield, Ohio	
WBMD-FM	Catonsville, Md.	
WBMI	Meridan, Conn.	
WBMP	Elwood, Ind.	
WBMR	Telford, Pa.	
WBMT-FM	Oneida, Tenn.	
WBNB-FM	Charlotte Amalie, V.I.	
WBNC-FM	Conway, N. H.	
WBNL-FM	Boonville, Ind.	
WBNQ	Bloomington, Ill.	
WBNS-FM	Columbus, Ohio	
WBNY-FM	Buffalo, N.Y.	
WBOC-FM	Salisbury, Md.	104.7
WBOE	Cleveland, Ohio	
WBON	Milwaukee, Wis.	
WBOR	Brunswick, Maine	
WBOS	Brookline, Mass.	92.9
WBOW-FM	Terre Haute, Ind.	
WBPZ-FM	Lock Haven, Pa.	
WBRB-FM	Mt. Clemens, Mich.	
WBRC	Birmingham, Ala.	
WBRD-FM	Bradenton, Fla.	
WBRE-FM	Wilkes-Barre, Pa.	
WBRK-FM	Pittsfield, Mass.	
WBRN-FM	Big Rapids, Mich.	
WBRS	Waltham, Mass.	
WBRU	Providence, R.I.	
WBSM-FM	New Bedford, Mass.	
WBST	Muncie, Ind.	
WBT-FM	Charlotte, N. C.	
WBTC-FM	Houston, Mo.	
WBTM-FM	Danville, Va.	103.3
WBTR-FM	Carrollton, Ga.	92.1
WBUF	Buffalo, N.Y.	
WBUK	Columbus, O.	96.3
WBUR	Boston, Mass.	
WBUT-FM	Butler, Pa.	
WBUY-FM	Lexington, N.C.	
WBVA	Woodbridge, Va.	
WBVB	Union City, Pa.	
WBVP-FM	Beaver Falls, Pa.	
WBWC	Berea, Ohio,	
WBYM	Bayamon, P.R.	
WBYO	Boyertown, Pa.	
WBYS-FM	Canton, Ill.	98.5
WBZ-FM	Boston, Mass.	
WBZI	Xenia, O.	
WCAC	Anderson, S.C.	
WCAL-FM	Northfield, Minn.	
WCAO-FM	Baltimore, Md.	
WCAR-FM	Detroit, Mich.	
WCAS	Knoxville, Tenn.	
WCAU-FM	Philadelphia, Pa.	
WCBC	Memphis, Tenn.	91.1
WCBE	Columbus, Ohio	
WCBK-FM	Martinsville, Ind.	102.3
WCBL-FM	Benton, Ky.	
WCBS-FM	New York, N.Y.	
WCBW	Columbia, Ill.	
WCBY-FM	Cheboygan, Mich.	105.1
WCCA	McComb, Miss.	
WCCC-FM	Hartford, Conn.	
WCCM-FM	Lawrence, Mass.	
WCCN-FM	Neillsville, Wis.	
WCCO-FM	Minneapolis, Minn.	102.9
WCCV-FM	Charlottesville, Va.	
WCCW-FM	Traverse City, Mich.	
WCDR-FM	Cedarville, O.	
WCED-FM	Dubois, Pa.	
WCEF-FM	Parkersburg, W. Va.	
WCEH-FM	Hawkinsville, Ga.	103.9
WCEM-FM	Cambridge, Md.	
WCEN-FM	Mt. Pleasant, Mich.	
WCER-FM	Charlotte, Mich.	
WCFM	Williamstown, Mass.	
WCFW	Chippewa Falls, Wis.	105.5
WCHA-FM	Chambersburg, Pa.	
WCHD	Detroit, Mich.	
WCHK-FM	Canton, Ga.	
WCHN-FM	Norwich, N.Y.	
WCHO-FM	Washington Court House, O.	
WCHO	Camuy, P.R.	102.9
WCHR	Trenton, N. J.	94.5
WCHS-FM	Charlestown, W.Va.	
WCIL-FM	Carbondale, Ill.	101.5
WCIS-FM	Moss Point, Miss.	
WCJM	W. Point, Ga.	
WCJW	Cleveland, O.	
WCKS	Cocoa Beach, Fla.	
WCKW	La Place, La.	
WCLE-FM	Cleveland, Tenn.	
WCLI-FM	Corning, N.Y.	
WCLO-FM	Janesville, Wis.	
WCLT-FM	Newark, Ohio	
WCLV	Cleveland, O.	
WCLW-FM	Mansfield, Ohio	
WCMC-FM	Wildwood, N.J.	
WCME-FM	Brunswick, Maine	
WCMF-FM	Rochester, N. Y.	
WCMI-FM	Ashland, Ky.	
WCMJ	Chester, S. C.	99.3
WCMN-FM	Arecibo, P.R.	
WCMO	Marietta, Ohio	
WCMS-FM	Norfolk, Va.	
WCMT-FM	Martin, Tenn.	101.7
WCMU-FM	Mt. Pleasant, Mich.	
WCNA-FM	Scottsboro, Ala.	
WCNB-FM	Connersville, Ind.	
WCNH-FM	Quincy, Fla.	
WCNW-FM	Fairfield, O.	
WCOA-FM	Pensacola, Fla.	
WCOD-DM	Hyannis, Mass.	
WCOF-FM	Immokalee, Fla.	
WCOH-FM	Newnan, Ga.	
WCOL-FM	Columbus, Ohio	
WCOM-FM	Urbana, O.	
WCON-FM	Cornelia, Ga.	
WCOP-FM	Boston, Mass.	
WCOS-FM	Columbia, S.C.	
WCOU-FM	Lewiston, Maine	
WCOW-FM	Sparta, Wis.	
WCPA-FM	Clearfield, Pa.	
WCPC-FM	Houston, Miss.	93.3
WCPO-FM	Cincinnati, Ohio	
WCPS-FM	Tarbor, N.C.	
WCRA-FM	Effingham, Ill.	
WCRB-FM	Waltham, Mass.	
WCRD	Bluffton, Ind.	
WCRF	Cleveland, O.	
WCRM-FM	Clare, Mich.	
WCRS-FM	Greenwood, S. C.	
WCRT-FM	Birmingham, Ala.	
WCRX	Springfield, Mass.	
WCSC-FM	Charleston, S.C.	
WCSI-FM	Columbus, Ind.	
WCSM-FM	Celina, O.	
WCSQ	Central Square, N.Y.	
WCST-FM	Berkeley Springs, W. Va.	
WCSU-FM	Wilberforce, O.	
WCTC-FM	New Brunswick, N.J.	
WCTM	Eaton, Ohio	
WCTS-FM	Minneapolis, Minn.	
WCTT-FM	Corbin, Ky.	
WCTW-FM	New Castle, Ind.	
WCTX	Palmyra, Pa.	92.1
WCUE-FM	Akron, O.	
WCUF	Akron, Ohio	
WCUM-FM	Cumberland, Md.	
WCUY-FM	Cleveland Hts., Ohio	
WCWA-FM	Toledo, O.	
WCWC-FM	Ripon, Wis.	
WCWM	Williamsburg, Va.	
WCWP	Brookville, N. Y.	
WCWS	Wooster, O.	
WCYN-FM	Cythiana, Ky.	102.3
WDAC	Lancaster, Pa.	
WDAE-FM	Tampa, Fla.	100.7
WDAF-FM	Kansas City, Mo.	

Call	Location	Freq.
WDAN-FM	Danville, Ill.	
WDAO	Dayton, Ohio	
WDAR-FM	Darlington, S.C.	
WDAS-FM	Philadelphia, Pa.	
WDAY-FM	Fargo, N. D.	
WDBJ-FM	Roanoke, Va.	
WDBL-FM	Springfield, Tenn.	
WDBM	Medina, O.	
WDBO-FM	Orlando, Fla.	
WDBQ-FM	Dubuque, Iowa	
WDCX	Buffalo, N. Y.	
WDDE	Hamden, Conn.	
WDDS-FM	Syracuse, N.Y.	
WDEA-FM	Ellsworth, Me.	
WDEB-FM	Jamestown, Tenn.	
WDEC-FM	Americus, Ga.	
WDEF-FM	Chattanooga, Tenn.	
WDEH-FM	Sweetwater, Tenn.	
WDEN-FM	Macon, Ga.	105.3
WDEQ-FM	DeGraff, O.	
WDET-FM	Detroit, Mich.	
WDFM	State College, Pa.	
WDGC-FM	Downers Grove, Ill.	88.3
WDHA-FM	Dover, N.J.	
WDHF	Chicago, Ill.	
WDHS	Gaston, Ind.	91.1
WDIO-FM	Duluth, Minn.	
WDIX-FM	Orangeburg, S. C.	
WDJC	Birmingham, Ala.	93.7
WDJK	Atlanta, Ga.	
WDJR	Oil City, Pa.	
WDKC	Albany, N.Y.	
WDKD-FM	Kingstree, S.C.	
WDKN-FM	Dickson, Tenn.	
WDLB-FM	Marshfield, Wis.	
WDMB-FM	Statesville, N.C.	
WDMJ-FM	Marquette, Mich.	
WDMP-FM	Dodgeville, Wis.	107.1
WDMS	Greenville, Miss.	100.7
WDMW	Menomonie, Wis.	
WDNC-FM	Durham, N.C.	
WDOC-FM	Prestonsburg, Ky.	
WDOD-FM	Chattanooga, Tenn.	
WDOK	Cleveland, O.	
WDOL-FM	Athens, Ga.	
WDOM	Providence, R.I.	
WDOR-FM	Sturgeon Bay, Wis.	
WDOV-FM	Dover, Del.	
WDRC-FM	Hartford, Conn.	
WDRK-FM	Greenville, Ohio	
WDRM	Decatur, Ala.	
WDSC-FM	Dillon, S.C.	
WDSK-FM	Cleveland, Miss.	92.7
WDSU-FM	New Orleans, La.	
WDTM	Detroit, Mich.	
WDTR	Detroit, Mich.	
WDUB	Granville, Ohio	
WDUN-FM	Gainesville, Ga.	
WDUQ	Pittsburgh, Pa.	
WDUX-FM	Waupaca, Wis.	
WDUZ-FM	Green Bay, Wis.	
WDVL-FM	Vineland, N. J.	92.1
WDVR	Philadelphia, Pa.	
WDWD	Dawson, Ga.	92.1
WDWS-FM	Champaign, Ill.	
WDXE-FM	Lawrenceburg, Tenn.	
WDXL-FM	Lexington, Tenn.	
WDYL	Chester, Va.	92.1
WDYN	Chattanooga, Tenn.	89.7
WEAF	Leaksville, N. C.	94.5
WEAS-FM	Savannah, Ga.	
WEAT-FM	West Palm Beach, Fla.	
WEAU-FM	Eau Claire, Wis.	
WEAV-FM	Plattsburgh, N.Y.	
WEAW-FM	Evanston, Ill.	
WEBH	Chicago, Ill.	
WEBN-FM	Cincinnati, O.	
WEBQ-FM	Harrisburg, Ill.	
WEBR-FM	Buffalo, N.Y.	
WECI	Richmond, Ind.	
WECW	Elmira, N.Y.	
WEDA-FM	Grove City, Pa.	
WEDR-FM	Miami, Fla.	
WEEC	Springfield, Ohio	
WEED-FM	Rocky Mount, N.C.	
WEEF-FM	Highland Park, Ill.	
WEEI-FM	Boston, Mass.	
WEEP-FM	Pittsburgh, Pa.	
WEER-FM	Warrenton, Va.	
WEEX-FM	Easton, Pa.	99.9
WEFA	Waukegan, Ill.	
WEFG	Winchester, Va.	
WEFM	Chicago, Ill.	
WEGO-FM	Concord, N.C.	
WEHH-FM	Elmira, N. Y.	
WEIC-FM	Charleston, Ill.	
WEIV	Ithaca, N.Y.	
WEJL-FM	Scranton, Pa.	
WEKU-FM	Richmond, Ky.	88.9
WEKZ-FM	Monroe, Wis.	
WELD-FM	Tupelo, Miss.	
WELF	Glen Ellyn, Ill.	
WELL-FM	Freeport, Ill.	98.5
WELO-FM	Tupelo, Miss.	98.5
WELP-FM	Easley, S. C.	
WELR-FM	Roanoke, Ala.	95.3
WEMC	Harrisonburg, Va.	
WEMP-FM	Milwaukee, Wis.	
WEMU	Ypsilanti, Mich.	
WEND-FM	Ehensburg, Pa.	
WENN-FM	Birmingham, Ala.	107.7
WENY-FM	Elmira, N. Y.	
WEOK-FM	Poughkeepsie, N.Y.	
WEOL-FM	Elyria, Ohio	
WEPM-FM	Martinsburg, W.Va.	
WEPS	Elgin, Ill.	
WEQR	Goldsboro, N.C.	
WERE-FM	Cleveland, Ohio	
WERH-FM	Hamilton, Ala.	
WERI-FM	Westerly, R.I.	
WERM	Wapakoneta, Ohio	
WERS	Boston, Mass.	
WERT-FM	Van Wert, Ohio	
WESA-FM	Charleroi, Pa.	
WESC-FM	Greenville, S.C.	
WESO-FM	Southbridge, Mass.	100.1
WESP	Charlotte Amalie, V.I.	
WESR-FM	Tasley, Va.	103.3
WEST-FM	Easton, Pa.	
WESU	Middletown, Conn.	88.1
WETA-FM	Washington, D.C.	
WETL	South Bend, Ind.	
WETN	Wheaton, Ill.	
WEVC	Evansville, Ind	
WEVD-FM	New York, N.Y.	
WEXI	Arlington Heights, Ill.	
WEZK	Knoxville, Tenn.	
WEZR	Manassas, Va.	
WEZY-FM	Cocoa, Fla.	
WFAA-FM	Dallas, Tex.	
WFAH-FM	Alliance, Ohio	
WFAN-FM	Washington, D.C.	
WFAS-FM	White Plains, N.Y.	
WFAU-FM	Augusta, Maine	
WFAW	Fort Atkinson, Wis.	
WFBC-FM	Greenville, S.C.	
WFBE	Flint, Mich.	
WFBG-FM	Altoona, Pa.	
WFBM-FM	Indianapolis, Ind.	
WFBS-FM	Winston-Salem, N.C.	
WFCI	Franklin, Ind.	
WFCJ	Miamisburg, Ohio	
WFCR	Amherst, Mass.	
WFDD-FM	Winston-Salem, N.C.	
WFDR-FM	Manchester, Ga.	
WFDS-FM	Baltimore, Md.	
WFDT	Columbia City, Ind.	106.3
WFEM	Ellwood City, Pa.	92.1
WFFF-FM	Columbia, Miss.	
WFFM	Muskegon, Mich.	
WFHC-FM	Henderson, Tenn.	
WFID	Rio Piedras, P. R.	
WFIG	Sumter, S.C.	
WFIL-FM	Philadelphia, Pa.	
WFIM	Elkhart, Ind.	100.7
WFIN-FM	Findlay, Ohio	
WFIU	Bloomington, Ind.	
WFIW-FM	Fairfield, Ill.	
WFIZ	Conneaut, O.	
WFKO	Kokomo, Ind.	100.5
WFLA-FM	Tampa, Fla.	
WFLN-FM	Philadelphia, Pa.	
WFLO	Farmville, Va.	
WFLR-FM	Dundee, N.Y.	95.9
WFLS-FM	Fredericksburg, Va.	93.3
WFLT-FM	Franklin, Tenn.	
WFLW-FM	Monticello, Ky.	
WFLY	Troy, N.Y.	
WFMA	Rocky Mount, N.C.	
WFMB	Springfield, Ill.	
WFMD-FM	Frederick, Md.	
WFME	Newark, N.J.	
WFMF	Chicago, Ill.	
WFMG	Gallatin, Tenn.	
WFMH-FM	Cullman, Ala.	
WFMI	Montgomery, Ala.	
WFML	Washington, Ind.	
WFMM-FM	Baltimore, Md.	
WFMN	Newburgh, N. Y.	
WFMP	Fitchburg, Mass.	104.5
WFMQ	Lebanon, Tenn.	
WFMS	Indianapolis, Ind.	
WFMT	Chicago, Ill.	
WFMU	East Orange, N.J.	
WFMW-FM	Madisonville, Ky.	
WFMX	Statesville, N.C.	
WFMZ	Allentown, Pa.	
WFNY	Racine, Wis.	
WFOB-FM	Fostoria, Ohio	
WFOG	Wilmington, N. C.	102.7
WFOL	Hamilton, Ohio(s)	
WFON	Fond du Lac, Wis.	
WFOR-FM	Hattiesburg, Miss.	
WFOS	Chesapeake, Va.	
WFOY-FM	St. Augustine, Fla.	
WFPG	Atlantic City, N.J.	
WFPK	Louisville, Ky.	
WFPL	Louisville, Ky.	
WFRB-FM	Frostburg, Md.	
WFRE-FM	Fresno, Cal.	
WFRI	Auburn, Ala.	97.7
WFRL-FM	Freeport, Ill.	
WFRO-FM	Fremont, Ohio	
WFSC-FM	Franklin, N. C.	
WFST-FM	Caribou, Maine	
WFSU-FM	Tallahassee, Fla.	
WFTL-FM	Ft. Lauderdale, Fla.	
WFTM-FM	Maysville, Ky.	
WFTW-FM	Ft. Walton Beach, Fla.	
WFUL-FM	Fulton, Ky.	
WFUR-FM	Grand Rapids, Mich.	
WFUV	New York, N.Y.	
WFVA-FM	Fredericksburg, Va.	
WFYC-FM	Alma, Mich.	
WFYN-FM	Key West, Fla.	
WGAL-FM	Lancaster, Pa.	
WGAN-FM	Portland, Me.	
WGAR-FM	Cleveland, Ohio	
WGAT-FM	Gate City, Va.	104.9
WGAU-FM	Athens, Ga.	95.5
WGAY	Washington, D.C.	
WGBA-FM	Columbus, Ga.	
WGBE-FM	Columbus, Ga.	
WGBH-FM	Cambridge, Mass.	
WGBI-FM	Scranton, Pa.	
WGBM	Viroqua, Wis.	
WGCB-FM	Red Lion, Pa.	
WGCR-FM	Wellsboro, Pa.	97.7
WGCS	Goshen, Ind.	
WGEE-FM	Indianapolis, Ind.	
WGEM-FM	Quincy, Ill.(s)	
WGER-FM	Bay City, Mich.	102.5
WGET-FM	Gettysburg, Pa.	
WGEV	Beaver Falls, Pa.	
WGFM	Schenectady, N. Y.	
WGFS	Greensboro, N. C.	90.7
WGGC	Glasgow, Ky.	
WGGL-FM	Houghton, Mich.	
WGGM	Taylorville, Ill.	
WGGO	Buford, Ga.	102.3
WGH-FM	Newport News, Va.	
WGHN-FM	Grand Haven, Mich.	92.1
WGHQ-FM	Kingston, N.Y.	
WGHS	Glen Ellyn, Ill.	88.5
WGIG-FM	Brunswick, Ga.	
WGIL-FM	Galesburg, Ill.	
WGIM-FM	Medford, Wis.	99.3
WGIR-FM	Manchester, N. H.	
WGKA-FM	Atlanta, Ga.	
WGLB-FM	Port Washington, Wis.	
WGLC-FM	Mendota, Ill.	
WGLM	Richmond, Ind.	
WGLN	Sylvania, O.	105.5
WGLS-FM	Glassboro, N. J.	
WGLT	Normal, Ill.	
WGMR-FM	Tyrone, Pa.	
WGMS-FM	Washington, D.C.	
WGMZ	Flint, Mich.(s)	
WGNB	St. Petersburg, Fla.	
WGNC-FM	Gastonia, N.C.	
WGNU-FM	Granite City, Ill.	
WGOH-FM	Grayson, Ky.	
WGOS-FM	Miami, Fla.	
WGOV-FM	Valdosta, Ga.	
WGPA-FM	Bethlehem, Pa. (from Ga.)	
WGPC-FM	Albany, Ga.	
WGPL	Winston-Salem, N.C.	
WGPM	Detroit, Mich.	
WGPR	Detroit, Mich.	107.5
WGPS	Greensboro, N.C.	
WGR-FM	Buffalo, N.Y.	
WGRE	Greencastle, Ind.	
WGRN	Greenville, Ill.	
WGRP-FM	Greenville, Pa.	
WGSM	Smithtown, N.Y.	
WGSU	Genesco, N.Y.	
WGTB-FM	Washington, D.C.	
WGTS-FM	Takoma Park, Md.	
WGUC	Cincinnati, Ohio	
WGUL-FM	New Port Richey, Fla.	105.5
WGUS-FM	Augusta, Ga.	
WGVE	Gary, Ind.	
WGWR-FM	Asheboro, N.C.	
WHA-FM	Madison, Wis.	
WHAD	Delafield, Wis.	
WHAG-FM	Halfway, Md.	
WHAI-FM	Greenfield, Mass.	
WHAS-FM	Louisville, Ky.	
WHAV-FM	Haverhill, Mass.	
WHBB-FM	Selma, Ala.	
WHBC-FM	Canton, Ohio	
WHBF-FM	Rock Island, Ill.	
WHBI	Newark, N.J.	
WHBM-FM	Xenia, Ohio	
WHBQ-FM	Memphis, Tenn.	
WHCI	Hartford City, Ind.	
WHCL-FM	Clinton, N.Y.	
WHCN	Hartford, Conn.	
WHCU-FM	Ithaca, N.Y.	
WHDH-FM	Boston, Mass.	
WHDL-FM	Allegheny, N.Y.	
WHEN-FM	Syracuse, N.Y.	
WHFB-FM	Benton Harbor, Mich.	
WHFD	Archibald, O.	
WHFH	Flossmoor, Ill.	
WHFI	Birmingham, Mich.	
WHFM	Rochester, N.Y.	
WHFS	Bethesda, Md.	
WHGM	Bellwood, Pa.	
WHHI	Highland, Wis.	
WHHO-FM	Hornell, N. Y.	105.3
WHHS	Havertown, Pa.	
WHHY-FM	Montgomery, Ala.	
WHIL-FM	Medford, Mass.	
WHIM-FM	Providence, R.I.	
WHIO-FM	Dayton, Ohio	
WHIR-FM	Danville, Ky.	107.1
WHIZ-FM	Zanesville, Ohio	
WHKK	Erlanger, Ky.	100.9
WHKP-FM	Hendersonville, N.C.	
WHKW	Chilton, Wis.	
WHKY-FM	Hickory, N. C.	
WHLA	Holmen, Wis.	
WHLD-FM	Niagara Falls, N. Y.	
WHLF-FM	South Boston, Va.	
WHLI-FM	Hempstead, N.Y.	
WHLM-FM	Bloomsburg, Pa.	
WHLS-FM	Port Huron, Mich.	
WHLT-FM	Huntington, Ind.	
WHMA-FM	Anniston, Ala.	
WHMD	Marinette, Wis.	
WHME	South Bend, Ind.	
WHMP-FM	Northampton, Mass.	
WHMS	Hialeah, Fla.	
WHNC-FM	Henderson, N.C.	
WHNR	McMinnville, Tenn.	
WHO-FM	Des Moines, Iowa	
WHOD-FM	Jackson, Ala.	
WHOH	Hamilton, Ohio	
WHOK-FM	Lancaster, Ohio	
WHOM-FM	New York, N.Y.	
WHOO-FM	Orlando, Fla.	
WHOP-FM	Hopkinsville, Ky.	
WHOV	Hampton, Va.	
WHP-FM	Harrisburg, Pa.	
WHPE-FM	High Point, N.C.	
WHPH	Hanover, N.J.	
WHPK-FM	Chicago, Ill.	
WHPR	Highland Park, Mich.	
WHRB-FM	Cambridge, Mass.	
WHRF-FM	Riverhead, N.Y.	
WHRL	Albany, N.Y.	
WHRM	Wausau, Wis.	
WHRS	Boynton Beach, Fla.	91.7
WHRW	Binghamton, N.Y.	
WHSA	Highland Twp., Wis.	
WHSB	Alpena, Mich.	
WHSL-FM	Wilmington, N.C.	
WHSR-FM	Winchester, Mass.	91.9
WHSY-FM	Hattiesburg, Miss.	
WHTC-FM	Holland, Mich.	
WHTG-FM	Eatontown, N.J.	106.3
WHUB-FM	Cookeville, Tenn.	
WHUC-FM	Hudson, N.Y.	
WHUN-FM	Huntingdon, Pa.	
WHUS	Storrs, Conn.	
WHWB-FM	Rutland, Vt.	98.1
WHWC	Colfax, Wis.	
WHYL-FM	Carlisle, Pa.	
WHYN-FM	Springfield, Mass.	
WHYP-FM	North East, Pa.	100.9
WIAA	Interlochen, Mich.	88.3
WIAC-FM	San Juan, P. R.	
WIAI	Danville, Ill.	99.1
WIAL	Eau Claire, Wis.	
WIAM-FM	Williamston, N.C.	
WIAN	Indianapolis, Ind.	
WIBA-FM	Madison, Wis.	
WIBF-FM	Jenkintown, Pa.	
WIBG-FM	Philadelphia, Pa.	
WIBM-FM	Jackson, Mich.	
WIBQ-FM	Utica, N. Y.	
WIBW-FM	Topeka, Kan.	
WICB	Ithaca, N.Y.	
WICH-FM	Norwich, Conn.	
WICN	Worcester, Mass.	90.5
WICO-FM	Sallsbury, Md.	
WICR	Indianapolis, Ind.	
WIFE-FM	Indianapolis, Ind.	
WIFF-FM	Auburn, Ind.	
WIFI	Philadelphia, Pa.	
WIFN	Franklin, Ind.	
WIGS-FM	Gouverneur, N.Y.	
WIHS	Middletown, Conn.	
WIKI-FM	Chester, Va.	
WIKY-FM	Evansville, Ind.	
WIL-FM	St. Louis, Mo.	
WILE-FM	Cambridge, O.	
WILL-FM	Urbana, Ill.	
WILO-FM	Frankfort, Ind.	
WILS-FM	Lansing, Mich.	
WILY-FM	Centralia, Ill.	
WIMA-FM	Lima, Ohio	
WINA-FM	Charlottesville, Va.	
WINE-FM	Brookfield, Conn.	95.1
WINK-FM	Ft. Myers, Fla.	
WIOD-FM	Miami, Fla.	
WIPR-FM	San Juan, P.R.	
WIRB-FM	Enterprise, Ala.	96.9
WIRJ-FM	Humboldt, Tenn.	
WISA-FM	Isabela, P.R.	
WIRQ	Rochester, N.Y.	
WISM-FM	Madison, Wis.	
WISN-FM	Milwaukee, Wis.	
WISU	Terre Haute, Ind.	
WISZ-FM	Glen Burnie, Md.	
WITA-FM	San Juan, P.R.	
WITH-FM	Baltimore, Md.	
WITL-FM	Lansing, Mich.	
WITN-FM	Washington, N. C.	
WITT	Tuscola, Ill.	93.5
WITZ-FM	Jasper, Ind.	
WIUC	Winchester, Ind.	
WIUP-FM	Indiana, Pa.	91.3
WIUS	Christiansted, V.I.	
WIVA-FM	Aguadilla, Ore.	100.5
WIVC	Peoria, Ill.	
WIVE-FM	Ashland, Va.	
WIVI-FM	Cristiansted, St. Croix, V.I.	
WIVK-FM	Knoxville, Tenn.	
WIVY-FM	Jacksonville, Fla.	

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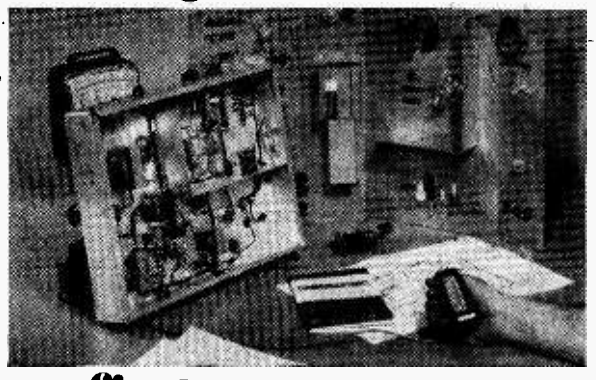

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WIXL-FM	Newton, N. J.	
WIXN-FM	Dixon, Ill.	
WIXX-FM	Ft. Lauderdale, Fla	
WIZR-FM	Johnstown, N.Y.	104.9
WIZZ-FM	Streator, Ill.	
WJAC-FM	Johnstown, Pa.	
WJAS-FM	Pittsburgh, Pa.	
WJAT-FM	Swainsboro, Ga.	
WJAX-FM	Jacksonville, Fla.	
WJAZ	Albany, Ga.	
WJBK-FM	Detroit, Mich.	
WJBL-FM	Holland, Mich.	
WJBM-FM	Jerseyville, Ill.	
WJBO-FM	Baton Rouge, La.	
WJBR	Wilmington, Del.	
WJCC	Angola, Ind.	100.1
WJCO-FM	Seymour, Ind.	
WJCR	University Heights, O.	88.9
WJCW-FM	Johnson City, Tenn.	
WJDX-FM	Jackson, Miss.	
WJEH-FM	Gallipolis, Ohio	
WJEJ-FM	Hagerstown, Md.	
WJER-FM	Dover, O.	101.7
WJFM	Grand Rapids, Mich.	
WJGA-FM	Jackson, Ga.	
WJGS	Houghton, Mich.	
WJHL-FM	Johnson City, Tenn.	
WJHR	Miami, Fla.	96.3
WJIB	Boston, Mass.	
WJIG-FM	Tullahoma, Tenn.	
WJIM-FM	Lansing, Mich.	
WJIV	Cherry Valley, N.Y.	
WJIZ	Albany, Ga.	
WJJD-FM	Chicago, Ill.	
WJJM-FM	Lewisberg, Tenn.	94.3
WJLK-FM	Asbury Park, N.J.	
WJLM	Salem, Va.	93.5
WJLN	Birmingham, Ala.	
WJMC-FM	Rice Lake, Wis.	
WJMD	Bethesda, Md.	
WJMI	Jackson, Miss.	
WJMK	Plainfield, Ind.	
WJML	Petoskey, Mich.	
WJMR-FM	New Orleans, La.	97.1
WJMX-FM	Florence, S.C.	
WJNS-FM	Yazoo City, Miss.	92.1
WJOF	Athens, Ala.	
WJOI-FM	Florence, Ala.	
WJOL-FM	Joliet, Ill.	
WJON FM	St. Cloud, Minn.	
WJOY-FM	Burlington, Vt.	
WJPA-FM	Washington, Pa.	
WJR-FM	Detroit, Mich.	
WJRH	Easton, Pa.	
WJRS-FM	Jamestown, Ky.	103.1
WJSK	Lumberton, N. C.	102.3
WJSM-FM	Martinsburg, Pa.	
WJTN-FM	Jamestown, N.Y.	
WJVM	Sterling, Ill.	
WJWS-FM	Ridgeway, Pa.	
WJZZ	Bridgeport, Conn.	
WKAI-FM	McComb, Ill.	
WKAJ-FM	Saratoga Springs, N.Y.	102.3
WKAK	Kankakee, Ill.	
WKAQ-FM	San Juan, P.R.	
WKAR-FM	E. Lansing, Mich.	
WKAT	Miami, Fla.	
WKAY-FM	Glasgow, Ky.	
WKAZ-FM	Charleston, W.Va.	
WKBC-FM	N. Wilkesboro, N.C.	
WKBI-FM	Ridgeway, Pa.	
WKBJ-FM	Milan, Tenn.	
WKBL-FM	Covington, Tenn.	
WKBN-FM	Youngstown, Ohio	
WKBR-FM	Manchester, N.H.	
WKBV-FM	Richmond, Ind.	
WKCI	Hamden, Conn.	101.3
WKCQ	Berlin, N.H.	
WKCR-FM	New York, N.Y.	
WKCS	Knoxville, Tenn.	
WKCU-FM	Corinth, Miss.	
WKDA-FM	Nashville, Tenn.	
WKDE-FM	Altavista, Va.	105.5
WKDN-FM	Camden, N.J.	
WKEE-FM	Huntington, W.Va.	
WKEI-FM	Kewanee, Ill.	
WKES	Chattanooga, Tenn.	88.9
WKET-FM	Kettering, Ohio	
WKEU-FM	Griffin, Ga.	
WKEY-FM	Covington, Va.	
WKFM	Chicago, Ill.	
WKFR-FM	Battle Creek, Mich.	
WKGO	Cumberland, Md.	106.1
WKHM-FM	Jackson, Mich.	
WKIC-FM	Hazard, Ky.	
WKIS-FM	Orlando, Fla.	
WKIX-FM	Raleigh, N.C.	
WKJB-FM	Mayaguez, P. R.	
WKJF	Pittsburgh, Pa.	
WKJG-FM	Ft. Wayne, Ind.	
WKKD-FM	Aurora, Ill.	
WKKY-FM	Erlanger, Ky.	
WKLC-FM	St. Albans, W.Va.	
WKLD	Oneonta, Ala.	97.7
WKLF-FM	Clanton, Ala.	
WKLN	Cullman, Ala.	
WKLR	Toledo, O.	99.9
WKLS	Atlanta, Ga.	
WKMH-FM	Dearborn, Mich.	
WKMO	Kokomo, Ind.	
WKMS-FM	Murray, Ky.	91.3
WKNA	Charleston, W. Va.	
WKNC-FM	Raleigh, N.C.	
WKNE-FM	Keene, N.H.	
WKNR-FM	Dearborn, Mich.	
WKNT-FM	Kent, O.	
WKOC	Kankakee, Ill.	
WKOF	Hopkinsville, Ky.	
WKOK-FM	Sunbury, Pa.	
WKOP-FM	Binghamton, N.Y.	
WKOX-FM	Framingham, Mass.	
WKOZ-FM	Kosciusko, Miss.	
WKPE-FM	Cocoa Beach, Fla.	104.1
WKPS	New Wilmington, Pa.	
WKPT-FM	Kingsport, Tenn.	
WKRC-FM	Cincinnati, Ohio	
WKRG-FM	Mobile, Ala.	
WKRT-FM	Cortland, N.Y.	
WKRX	Louisville, Ky.	
WKSL	Greenseastle, Pa.	
WKSN-FM	Jamestown, N. Y.	
WKSU-FM	Kent, Ohio	
WKTA	McKenzie, Tenn.	
WKTL	Struthers, O.	
WKTM	N. Charleston, S.C.	
WKTM-FM	Mayfield, Ky.	
WKTN-FM	Kenton, O.	
WKTZ-FM	Jacksonville, Fla.	
WKUB	Manitowoc, Wis.	
WKUZ	Wabash, Ind.	95.9
WKVI-FM	Knox, Ind.	99.3
WKVM-FM	San Juan, P.R.	
WKWK-FM	Wheeling, W.Va.	
WKYC-FM	Cleveland O.	
WKYF-FM	Greenville, Ky.	
WKYN-FM	San Juan, P. R.	99.9
WKYW	Frankfort, Ky.	
WKYX-FM	Paducah, Ky.	
WLAC-FM	Nashville, Tenn.	
WLAD-FM	Danbury, Conn.	
WLAE	Hartford, Conn.	
WLAG-FM	La Grange, Ga.	104.1
WLAN-FM	Lancaster, Pa.	
WLAP-FM	Lexington, Ky.	
WLAT-FM	Conway, S.C.	
WLAV-FM	Grand Rapids, Mich.	
WLAY-FM	Muscle Shoals, Ala.	
WLBE-FM	Leesburg, Fla.	106.7
WLBG-FM	Laurens-Clinton, S.C.	
WLBH-FM	Mattoon, Ill.	
WLBJ-FM	Bowling Green, Ky.	
WLBK-FM	DeKalb, Ill.	
WLBR-FM	Lebanon, Pa.	
WLCC	Lincoln, Ill.	88.7
WLCK-FM	Scottsville, Ky.	
WLCM-FM	Lancaster, S.C.	
WLDM	Oak Park, Mich.	
WLDR-FM	Traverse City, Mich.	
WLDS-FM	Jacksonville, Ill.	
WLEC-FM	Sandusky, Ohio	
WLEN	Adrian, Mich.	
WLED-FM	Ponce, P. R.	
WLET-FM	Toccoa, Ga.	
WLEW-FM	Bad Axe, Mich.	
WLEX-FM	Lexington, Ky.	
WLFM	Appleton, Wis.	
WLGN	Sag Harbor, N. Y.	92.1
WLIB-FM	New York, N.Y.	
WLIH-FM	New London, Wis.	
WLIL-FM	Lenoir City, Tenn.	
WLIN	Detroit, Mich.	
WLIP-FM	Kenosha, Wis.	
WLIR	Hicksville, N. Y.	
WLIV-FM	Livingston, Tenn.	
WLJC	Beattyville, Ky.	
WLJM	Gadsden, Ala.	
WLKR-FM	Norwalk, Ohio	
WLKW-FM	Providence, R.I.	
WLLH-FM	Lowell, Mass.	
WLMC	Okeechobee, Fla.	
WLNA-FM	Peekskill, N.Y.	
WLNG-FM	Sag Harbor, N.Y.	
WLNH-FM	Laconia, N.H.	
WLNO	London, Ohio	
WLNR-FM	Lansing, Ill.	
WLOA-FM	Braddock, Pa.(s)	
WLOB-FM	Portland, Maine	
WLOC-FM	Munfordville, Ky.	
WLOE-FM	Leaksville, N.C.	
WLOI-FM	La Porte, Ind.	
WLOL-FM	Minneapolis, Minn.	
WLOM	Chattanooga, Tenn.	
WLOP-FM	Jesup, Ga.	105.5
WLOQ	Winter Park, Fla.	
WLOS-FM	Asheville, N.C.	
WLOW-FM	Aiken, S.C.	
WLPO-FM	La Salle, Ill.	
WLPR	Mobile, Ala.	
WLRJ	Roanoke, Va.	
WLRS	Louisville, Ky.	
WLRW	Champaign, Ill.	
WLS-FM	Chicago, Ill.	
WLSM-FM	Louisville, Miss.	
WLSN	Elizabethton, Tenn.	99.3
WLTA-FM	Atlanta, Ga.	
WLTI	Lowell, Mass.	
WLTL	La Grange, Ill.	88.1
WLUR	Lexington, Va.	
WLUV-FM	Loves Park, Ill.	
WLVL	Louisville, Ky.	
WLVP	Franklin, N. J.	
WLYC-FM	Williamsport, Pa.	
WLYN-FM	Lynn, Mass.	101.7
WMAI-FM	Panama City, Fla.	
WMAJ-FM	State College, Pa.	
WMAL-FM	Washington, D.C.	
WMAQ-FM	Chicago, Ill.	
WMAR-FM	Baltimore, Md.	106.5
WMAS-FM	Springfield, Mass.	
WMAZ-FM	Macon, Ga.	
WMBC-FM	Columbus, Miss.	103.1
WMBD-FM	Peoria, Ill.	
WMBI-FM	Chicago, Ill.	
WMBN-FM	Petoskey, Mich.	
WMBO-FM	Auburn, N.Y.	
WMC-FM	Memphis, Tenn.	
WMCB-FM	Michigan City, Ind.	
WMCD	Statesboro, Ga.	
WMCF	Stuart, Fla.	
WMCO	New Concord, Ohio	
WMDD-FM	Fajardo, P. R.	
WMDE	Greensboro, N. C.	
WMDR	Moline, Ill.	96.9
WMEB-FM	Orono, Maine	
WMEH-FM	Bangor, Me.	90.9
WMER	Celina, Ohio	
WMEV-FM	Marion, Va.	
WMFC-FM	Monroeville, Ala.	
WMFD-FM	Wilmington, N. C.	100.9
WMFG-FM	Hibbing, Minn.	106.3
WMFJ-FM	Daytona Beach, Fla.	
WMFM	Madison, Wis.	
WMFP	Ft. Lauderdale, Fla.	
WMFR-FM	High Point, N.C.	
WMGM	Atlantic City, N.J.	
WMGR-FM	Bainbridge, Ga.	
WMGW-FM	Meadville, Pa.	
WMHC	South Hadley, Mass.	
WMHE	Toledo, Ohio	
WMHR	Syracuse, N. Y.	102.9
WMHS	Morrison, Ill.	
WMIC-FM	Sandusky, Mich.	
WMIL-FM	Milwaukee, Wis.	
WMIT	Black Mountain, N.C.	
WMIV	S. Bristol, N.Y.	
WMIX-FM	Mt. Vernon, Ill.	
WMJM-FM	Cordele, Ga.	98.3
WMJR	Ft. Lauderdale, Fla.	
WMKC	Oshkosh, Wis.	
WMKY-FM	Morehead, Ky.	
WMLP-FM	Milton, Pa.	
WMLS-FM	Sylacauga, Ala.	
WMLW	Milwaukee, Wis.	
WMMM	Westport, Conn.	
WMMR	Philadelphia, Pa.	
WMMS	Cleveland, O.	100.7
WMNA-FM	Gretna, Va.	
WMNB-FM	North Adams, Mass.	
WMNI-FM	Columbus, Ohio	
WMOA-FM	Marietta, O.	
WMOD	Washington, D. C.	98.7
WMOP-FM	Ocala, Fla.	
WMOR-FM	Morehead, Ky.	92.1
WMOT	Murfreesboro, Tenn.	89.5
WMOU-FM	Berlin, N.H.	
WMPH	Wilmington, Del.	91.7
WMPI	Scottsburg, Ind.	
WMPL-FM	Hancock, Mich.	
WMPS-FM	Memphis, Tenn.	
WMPT-FM	South Williamsport, Pa.	99.3
WMRA	Harrisonburg, Va.	91.1
WMRF-FM	Lewistown, Pa.	
WMRI-FM	Marion, Ind.	
WMRN-FM	Marion, Ohio	
WMRV	Endicott, N. Y.	105.5
WMRP-FM	Flint, Mich.	
WMRY	E. St. Louis, Ill.	
WMSG-FM	Oakland, Md.	
WMSH-FM	Elizabethtown, Pa.	
WMSK-FM	Morganfield, Ky.	
WMSP	Harrisburg, Pa.	
WMSR-FM	Manchester, Tenn.	
WMST-FM	Mt. Sterling, Ky.	105.5
WMT-FM	Cedar Rapids, Ia.	96.5
WMTH	Park Ridge, Ill.	
WMTI	Norfolk, Va.	
WMTL-FM	Leitchfield, Ky.	
WMTM-FM	Moultrie, Ga.	
WMTN-FM	Morristown, Tex.	
WMTS-FM	Murfreesboro, Tenn.	
WMTW-FM	Mt. Washington, N.H.	
WMUA	Amherst, Mass.	
WMUB	Oxford, Ohio	
WMUH	Allentown, Pa.	
WMUK	Kalamazoo, Mich.	
WMUL	Huntington, W.Va.	
WMUN	Muncie, Ind.	
WMUU-FM	Greenville, S. C.	
WMUZ	Detroit, Mich.	
WMVA-FM	Martinsville, Va.	
WMVB-FM	Millville, N.J.	
WMVG-FM	Milledgeville, Ga.	
WMVO-FM	Mt. Vernon, O.	93.7
WMVR-FM	Sidney, Ohio	
WMYB-FM	Myrtle Beach, Fla.	
WMYR-FM	Ft. Myers, Fla.	
WNAP	Indianapolis, Ind.	93.1
WNAS	New Albany, Ind.	
WNAT-FM	Natchez, Miss.	
WNAU-FM	New Albany, Miss.	
WNAV-FM	Annapolis, Md	
WNAZ-FM	Nashville, Tenn.	
WNBC-FM	New York, N.Y.	
WNBD-FM	Daytona Beach, Fla.	
WNBF-FM	Binghamton, N.Y.	
WNBH-FM	New Bedford, Mass.	
WNBI-FM	Park Falls, Wis.	
WNBX	Andalusia, Ala.	
WNCI	Columbus, O.	
WNCN	New York, N.Y.	
WNCO-FM	Ashland, Ohio	
WNCT-FM	Greenville, N.C.	
WNDA	Huntsville, Ala.	
WNDB-FM	Daytona Beach, Fla.	94.5
WNDN	Kingston, N. Y.	
WNDU-FM	South Bend, Ind.	
WNDY	Crawfordsville, Ind.	
WNES-FM	Central City, Ky.	
WNEW-FM	New York, N.Y.	
WNEX-FM	Macon, Ga.	
WNFM	Naples, Fla.	
WNGC	Athens, Ga.	95.5
WNGO-FM	Mayfield, Ky.	
WNHC-FM	New Haven, Conn.	
WNHS	Manchester, N. H.	101.1
WNHV-FM	White River Junction, Vt.	
WNIB	Chicago, Ill.	
WNIK-FM	Arecibo, P. R.	
WNIL-FM	Niles, Mich.	95.3
WNIU	DeKalb, Ill.	89.5
WNLA-FM	Indianola, Miss.	105.5
WNNT-FM	Warsaw, Va.	
WNOB	Cleveland, Ohio	
WNOE-FM	New Orleans, La.	101.1
WNOF	St. Paul, Minn.	
WNOK-FM	High Point, N.C.	
WNON	Lebanon, Ind.	
WNOR-FM	Norfolk, Va.	
WNOS-FM	High Point, N.C.	
WNOW-FM	York, Pa.	
WNPQ	New Philadelphia, O.	95.5
WNRE	Circleville, Ohio	
WNRG-FM	Grundy, Va.	
WNSL-FM	Laurel, Miss.	
WNTE	Mansfield, Pa.	89.5
WNTH	Winnetka, Ill.	
WNTI	Hackettstown, N.J.	
WNUB-FM	Northfield, Vt.	
WNUR	Evanston, Ill.	
WNUS-FM	Chicago, Ill.	
WNVA-FM	Norton, Va.	106.3
WNXT-FM	Portsmouth, O.	
WNYC-FM	New York, N.Y.	
WNYE	New York, N.Y.	
WNYN-FM	Canton, O.	
WNYR-FM	Rochester, N.Y.	
WOAB	Ozark, Ala.	
WOAK	Royal Oak, Mich.	
WOAP-FM	Owosso, Mich.	
WOAY-FM	Oak Hill, W.Va.	
WOBC	Oberlin, O.	
WOBM	Toms River, N. J.	
WOBN	Westerville, Ohio	
WOBT-FM	Rhinelander, Wis.	
WOC-FM	Davenport, Iowa	
WOCB-FM	W. Yarmouth, Mass.	
WOCH-FM	North Vernon, Ind.	
WOCN-FM	Miami Beach, Fla.	94.9
WOCO	Oconto, Wis.	107.1
WODL-FM	Carbondale, Pa.	
WOFM	Greeneville, Tenn.	
WOGM	Bellefontaine, O.	98.3
WOHS-FM	Shelby, N.C.	
WOI-FM	Ames, Iowa	
WOIA-FM	Ann Arbor, Mich.	102.9
WOIV	De Ruyter, N.Y.	
WOKI-FM	Meridian, Miss.	
WOKU-FM	Greensburg, Pa.	
WOKZ-FM	Alton, Ill.	
WOLA	San Juan, P.R.	
WOLD-FM	Marion, Va.	
WOLI	Ottawa, Ill.	
WOMA	Tallahassee, Fla.	
WOMC	Royal Park, Mich.	
WOMI-FM	Owensboro, Ky.	
WOMP-FM	Bellaire, Ohio	
WONC	Naperville, Ill.	89.1
WONE-FM	Dayton, O.	
WONF	Pensacola, Fla.	
WONO-FM	Syracuse, N. Y.	
WOOD-FM	Grand Rapids, Mich.	
WOOF-FM	Dothan, Ala.	
WOOO-FM	DeLand, Fla.	
WOOR	Oxford, Miss.	97.5

Call	Location	Freq.
WOPA-FM	Oak Park, Ill.	
WOPI-FM	Bristol, Tenn.	
WOR-FM	New York, N.Y.	
WORA-FM	Mayaguez, P.R.	
WORJ-FM	Mt. Dora, Fla.	107.7
WORM-FM	Savannah, Tenn.	
WORO	Corozal, P.R.	92.5
WORX-FM	Madison, Ind.	
WOSC-FM	Fulton, N.Y.	
WOSE	Oswego, N. Y.	
WOSH-FM	Oshkosh, Wis.	
WOSU-FM	Columbus, Ohio	
WOTT-FM	Watertown, N. Y.	97.5
WOTW-FM	Nashua, N.H.	
WOUB-FM	Athens, Ohio	
WOUR	Utica, N. Y.	
WOVE	Welch, W. Va.	
WOVV	Ft. Pierce, Fla.	
WOW-FM	Omaha, Nebr.	
WOXR	Oxford, Ohio	
WOYE-FM	Mayaquez, P. R.	
WPAA	Andover, Mass.	
WPAB-FM	Ponce, P. R.	
WPAC-FM	Patchogue, N. Y.	
WPAD-FM	Paducah, Ky.	
WPAG-FM	Ann Arbor, Mich.	107.1
WPAP-FM	Panama City, Fla.	92.5
WPAT-FM	Paterson, N. J.	
WPAY-FM	Portsmouth, Ohio	
WPBA-FM	Palm Beach, Fla.	
WPBC-FM	Richfield, Minn.	
WPBF	W. Palm Beach, Fla.	
WPBS	Philadelphia, Pa.	
WPDE-FM	Paris, Ky.	96.7
WPDM-FM	Potsdam, N.Y.	
WPDR-FM	Portage; Wis.	
WPEA	Exeter, N. H.	
WPEL-FM	Montrose, Pa.	
WPEN-FM	Philadelphia, Pa.	
WPEX-FM	Pensacola, Fla.	
WPFB-FM	Middletown, Ohio	
WPFK	Los Angeles, Cal.	
WPFM	Portsmouth, N. H.	
WPFR	Terre Haute, Ind.	102.7
WPGA-FM	Perry, Ga.	
WPGC	Bradbury Hts., Md.	
WPGF-FM	Burgaw, N.C.	
WPGI	Pittsburgh, Pa.	
WPGM-FM	Danville, Pa.	96.7
WPGU	Urbana, Ill.	
WPHS	Warren, Mich.	
WPIC-FM	Sharon, Pa.	
WPIT-FM	Pittsburgh, Pa.	
WPIX-FM	New York, N.Y.	
WPJB-FM	Providence, R.I.	
WPKE-FM	Pikeville, Ky.	
WPKM	Tampa, Fla.	
WPKN	Bridgeport, Conn.	89.5
WPKY-FM	Princeton, Ky.	104.9
WPLB	Greenville, Mich.	
WPLC	Plantation Key, Fla.	
WPLM-FM	Plymouth, Mass.	
WPLN	Nashville, Tenn.	
WPLO-FM	Atlanta, Ga.	
WPMP-FM	Pascagoula, Miss.	
WPOK-FM	Pontiac, Ill.	103.1
WPOR-FM	Portland, Me.	
WPOS-FM	Holland, O.	
WPPA-FM	Pottsville, Pa.	
WPQR-FM	Uniontown, Pa.	98.5
WPRB	Princeton, N.J.	
WPRE-FM	Prairie du Chien, Wis.	94.3
WPRK	Winter Park, Fla.	
WPRM-FM	Park Rapids, Minn.	
WPRO-FM	Providence, R.I.	
WPRP-FM	Ponce, P. R.	105.1
WPRS-FM	Paris, Ill.	
WPRT-FM	Prestonburg, Ky.	
WPSR	Evansville, Ind.	
WPTF-FM	Raleigh, N.C.	
WPTH	Fort Wayne, Ind.	
WPTN-FM	Cookeville, Tenn.	
WPTW-FM	Piqua, Ohio	
WPUV-FM	Pulaski, Va.	
WPWT	Philadelphia, Pa.	
WQAL	Philadelphia, Pa.	
WQDC-FM	Midland, Mich.	
WQFM	Milwaukee, Wis.	
WQIK-FM	Jacksonville, Fla.	
WQLT	Florence, Ala.	
WQMF	Babylon, N. Y.	
WQMG	Greensboro, N.C.	
WQMS	Hamilton, Ohio	
WQMU	Indiana, Pa.	103.1
WQMV	Vicksburg, Miss.	
WQNZ	Natchez, Miss.	95.1
WQRB	Pittsfield, Mass.	
WQRS-FM	Detroit, Mich.	
WQSB	Albertville, Ala.	
WQSM	Fayetteville, N. C.	98.1
WQST	Forest, Miss.	
WQSU	Selinsgrove, Pa.	
WQTC-FM	Two Rivers, Wis.	
WQWK	State College, Pa.	96.7
WQXE	Elizabethtown, Ky.	106.3
WQXI-FM	Smyrna, Ga.	
WQXM	Clearwater, Fla.	97.9
WQXR-FM	New York, N.Y.	
WQXY-FM	Baton Rouge, La.	
WRAD-FM	Radford, Va.	
WRAG-FM	Carrollton, Ala.	
WRAJ-FM	Anna, Ill.	
WRAK-FM	Williamsport, Pa.	
WRAL-FM	Raleigh, N.C.	
WRAR-FM	Tappahannock, Va.	
WRAY-FM	Princeton, Ind.	
WRBD-FM	Pompano Beach, Fla.	102.7
WRBJ-FM	St. Johns, Mich.	
WRBL-FM	Columbus, Ga.	
WRBN-FM	Warner Robins, Ga.	101.7
WRBR	South Bend, Ind.	
WRBS	Baltimore, Md.	
WRC-FM	Washington, D.C.	
WRCH-FM	New Britain, Conn.	100.5
WRCK-FM	Sheffield, Ala.	106.3
WRCM	Jacksonville, N.C.	
WRCO-FM	Richland Center, Wis.	
WRCP-FM	Philadelphia, Pa.	
WRCS-FM	Ahoskie, N. C.	99.3
WRDB-FM	Rudsburg, Wis.	
WRDL	Ashland, O.	
WRDR	Egg Harbor, N. J.	104.9
WREC-FM	Memphis, Tenn.	
WRED	Youngstown, Ohio	
WREK	Atlanta, Ga.	
WREO-FM	Ashtabula, Ohio	
WRFK	Richmond, Va.	
WRFL	Winchester, Va.	
WRFM	New York, N.Y.	
WRFS-FM	Alexander City, Ala.	
WRFW	River Falls, Wis.	88.7
WRFY-FM	Reading, Pa.	
WRGA-FM	Rome, Ga.	
WRHS	Park Forest, Ill.	
WRIG-FM	Wausau, Wis.	
WRIO-FM	Cape May, N. J.	
WRIP-FM	Rossville, Ga.	
WRIT-FM	Milwaukee, Wis.	
WRIU	Kingston, R. I.	
WRJN-FM	Racine, Wis.	
WRJR	Lewiston, Maine	
WRKB-FM	Kannapolis, N.C.	
WRKC	Wilkes-Barre, Pa.	88.5
WRKD-FM	Rockland, Me.	
WRKO-FM	Boston, Mass.	
WRLB	Long Branch, N. J.	
WRLD-FM	Lanett, Ala.	
WRLJ	Jacksonville, Fla.	
WRLM	Taunton, Mass.	93.3
WRLS-FM	Hayward, Wis.	
WRMC-FM	Middlebury, Vt.	
WRMF-FM	Titusville, Fla.	98.3
WRMI-FM	Morris, Ill.	
WRMN-FM	Elgin, Ill.	
WRNA	Charlotte, N.C.	
WRNJ	Atlantic City, N.J.	
WRNL-FM	Richmond, Va.	
WRNO	New Orleans, La.	
WRNS	Kinston, N.C.	95.1
WRNW	Mount Kisco, N.Y.	
WROA-FM	Gulfport, Miss.	
WROC-FM	Rochester, N.Y.	
WROI	Rochester, Ind.	
WROK-FM	Rockford, Ill.	
WROM-FM	Rome, Ga.	
WROR	Boston, Mass.	98.5
WROW-FM	Albany, N.Y.	
WROY-FM	Carmi, Ill.	
WRTC	San German, P.R.	95.1
WRPI	Troy, N.Y.	
WRPM-FM	Poplarville, Miss.	
WRPN-FM	Ripon, Wis.	
WRR-FM	Dallas, Tex.	
WRRH	Franklin Lakes, N.J.	
WRRN	Warren, Pa.	
WRRZ-FM	Clinton, N.C.	
WRSA	Decatur, Ala.	
WRSE-FM	Elmhurst, Ill.	
WRSJ-FM	Bayamon, P.R.	
WRSL-FM	Stanford, Ky.	
WRST-FM	Oshkosh, Wis.	
WRSV	Skokie, Ill.	
WRSW-FM	Warsaw, Ind.	
WRTC-FM	Hartford, Conn.	
WRTI-FM	Philadelphia, Pa.	
WRTM	Blountstown, Fla.	
WRTS	E. Liverpool, O.	
WRTV	Blountstown, Fla.	102.3
WRUF-FM	Gainesville, Fla.	
WRUN-FM	Utica, N.Y.	
WRUR-FM	Rochester, N.Y.	
WRUS-FM	Russellville, Ky.	101.1
WRUV	Burlington, Vt.	
WRUW-FM	Cleveland, O.	
WRVA-FM	Richmond, Va.	
WRVB-FM	Madison, Wis.	
WRVC	Norfolk, Va.	
WRVF	River Falls, Wis.	
WRVG	Georgetown, Ky.	
WRVI	Winnebago, Ill.	
WRVM	Suring, Wis.	
WRVO	Oswego, N. Y.	89.9
WRVP	New York, N.Y.	
WRWC	S. Beloit, Ill.	
WRWR	Port Clinton, Ohio	
WRXO-FM	Roxboro, N.C.	
WSAB	Mt. Carmel, Ill.	
WSAC-FM	Ft. Knox, Ky.	
WSAE	Spring Arbor, Mich.	
WSAF-FM	Sarasota, Fla.	
WSAI-FM	Cincinnati, O.	94.1
WSAJ-FM	Grove City, Pa.	
WSAL-FM	Logansport, Ind.	
WSAM-FM	Saginaw, Mich.	
WSAU-FM	Wausau, Wis.	
WSB-FM	Atlanta, Ga.	
WSBA-FM	York, Pa.	
WSBC-FM	Chicago, Ill.	
WSBF-FM	Clemson, S.C.	
WSBM	Saginaw, Mich.	106.3
WSBT-FM	South Bend, Ind.	
WSCB	Springfield, Mass.	
WSCC	Somerset, Ky.	
WSCI-FM	Platteville, Wis.	
WSCT-FM	Berkeley Springs, W.V.	
WSDM	Chicago, Ill.	
WSEA	Georgetown, Del.	93.5
WSEF-FM	Seneca Falls, N. Y.	99.3
WSEI	Olney, Ill.	
WSEK	Somerset, Ky.	
WSEL-FM	Pontotoc, Miss.	
WSEN-FM	Baldwinsville, N. Y.	
WSEO-FM	Kalamazoo, Mich.	
WSET	Nashville, Tenn.	
WSEV-FM	Sleverville, Tenn.	
WSFM	Harrisburg, Pa.	99.3
WSGM	Staunton, Va.	
WSHA	Raleigh, N. C.	88.9
WSHJ	Southfield, Mich.	
WSHR	Lake Ronkonkoma, N.Y.	
WSHS	Floral Park, N.Y.	
WSHU	Fairfield, Conn.	
WSHY	Shelbyville, Ill.	104.9
WSID-FM	Baltimore, Md.	
WSIE	Edwardsville, Ill.	88.7
WSIM-FM	Salem, Ind.	
WSIP-FM	Paintsville, Ky.	
WSIU	Carbondale, Ill.	
WSIV-FM	Pekin, Ill.	
WSIX-FM	Nashville, Tenn.	
WSJC-FM	Magee, Miss.	
WSJG	Hallandale, Fla.	
WSJM-FM	St. Joseph, Mich.	
WSJS-FM	Winston-Salem, N.C.	
WSLI-FM	Jackson, Miss.	
WSLM-FM	Salem, Ind.	
WSLN	Delaware, Ohio	
WSLS-FM	Roanoke, Va.	
WSLU	Canton, N.Y.	
WSM-FM	Nashville, Tenn.	95.5
WSMC	Collegedale, Tenn.	
WSMD-FM	Waldorf, Md.	
WSMI-FM	Litchfield, Ill.	
WSMJ	Greenfield, Ind.	
WSMT-FM	Sparta, Tenn.	
WSMU-FM	Starkville, Miss.	106.3
WSNJ-FM	Bridgeton, N.J.	
WSOC-FM	Charlotte, N.C.	
WSOM-FM	Salem, Ohio	
WSON-FM	Henderson, Ky.	
WSOU	S. Orange, N.J.	
WSOY-FM	Decatur, Ill.	
WSPA-FM	Spartanburg, S. C.	
WSPB-FM	Sarasota, Fla.	
WSPD-FM	Toledo, Ohio	
WSPE	Springville, N.Y.	
WSPK	Poughkeepsie, N.Y.	
WSPO	Columbus, O.	
WSPT-FM	Stevens Point, Wis.	
WSRC-FM	Durham, N. C.	
WSRF-FM	Ft. Lauderdale, Fla.	
WSRS	Worcester, Mass.	
WSRW-FM	Hillsboro, Ohio	
WSSU	Superior, Wis.	
WSSV-FM	Petersburg, Va.	
WSTC-FM	Stamford, Conn.	
WSTK	Woodstock, Ill.	
WSTM	St. Mathews, Ky.	
WSTN	Florence, S. C.	103.1
WSTO	Owensboro, Ky.	
WSTP-FM	Salisbury, N.C.	
WSTR-FM	Sturgis, Mich.	
WSTS	Laurinburg, N. C.	96.5
WSTU-FM	Stuart, Fla.	
WSTV-FM	Steubenville, Ohio	
WSTW	Wilmington, Del.	97.3
WSUB-FM	Groton, Conn.	105.5
WSUP	Platteville, Wis.	
WSUS	Stevens Point, Wis.	89.9
WSUW	Whitewater, Wis.	
WSVA-FM	Harrisonburg, Va.	
WSVB	Tamaqua, Pa.	
WSVL-FM	Shelbyville, Ind.	
WSVS-FM	Crewe, Va.	
WSWG	Greenwood, Miss.	
WSWM	East Lansing, Mich.	
WSWN-FM	Belle Glade, Fla.	
WSWW-FM	Platteville, Wis.	
WSYR-FM	Syracuse, N. Y.	
WTAB-FM	Tabor City, N. C.	
WTAD-FM	Quincy, Ill.	
WTAE-FM	Pittsburgh, Pa.	
WTAN-FM	Clearwater, Fla.	
WTAP-FM	Parkersburg, W. Va.	
WTAR	Norfolk, Va.	
WTAS	Crete, Ill.	
WTAW-FM	College Station, Tex.	
WTAX-FM	Springfield, Ill.	
WTAY-FM	Robinson, Ill.	
WTBO-FM	Cumberland, Md.	
WTBS	Cambridge, Mass.	
WTCA-FM	Plymouth, Ind.	
WTCH-FM	Shawano, Wis.	
WTCM-FM	Traverse City, Mich.	
WTCO-FM	Campellsville, Ky.	
WTCV	Memphis, Tenn.	104.5
WTCW-FM	Whitesburg, Ky.	
WTCX	St. Petersburg, Fla.	
WTDL-FM	Lake City, Fla.	94.3
WTES-FM	Buffalo, N.Y.	
WTFM	Lake Success, N. Y.	
WTGI	Hammond, La.	
WTGN	Lima, O.	
WTGR-FM	Myrtle Beach, S. C.	101.7
WTHI-FM	Terre Haute, Ind.	
WTHM-FM	Lapeer, Mich.	
WTHS	Miami, Fla.	
WTIC-FM	Hartford, Conn.	
WTID-FM	Norfolk, Va.	
WTIM-FM	Taylorsville, Ill.	92.7
WTIO	Charleston, W. Va.	
WTJS-FM	Jackson, Tenn.	
WTJU	Charlottesville, Va.	
WTLC	Indianapolis, Ind.	
WTLN-FM	Apopka, Fla.	95.3
WTMA-FM	Charleston, S.C.	
WTMB-FM	Tomah, Wis.	
WTMJ-FM	Milwaukee, Wis.	
WTNC-FM	Thomasville, N.C.	
WTNS-FM	Coshocton, O.	
WTNT-FM	Tallahassee, Fla.	
WTOA	Trenton, N.J.	
WTOC-FM	Savannah, Ga.	
WTOD-FM	Toledo, Ohio	
WTOF	Canton, Ohio	
WTOP-FM	Washington, D.C.	
WTOS	Wauwatosa, Wis.	
WTOT-FM	Marianna, Fla.	
WTOW-FM	Baltimore, Md.	
WTPA-FM	Harrisburg, Pa.	
WTPR-FM	Paris, Tenn.	
WTQX-FM	Selma, Ala.	
WTRE-FM	Greensburg, Ind.	
WTRF-FM	Wheeling, W.Va.	
WTRO-FM	Dyersburg, Tenn.	100.1
WTRS	Dunnellon, Fla.	102.3
WTSB-FM	Lumberton, N.C.	
WTSD	Waterford, Mich.	
WTSR	Trenton, N.J.	
WTSV-FM	Claremont, N.H.	
WTTC-FM	Towanda, Pa.	
WTTF-FM	Tiffin, Ohio	
WTTN-FM	Watertown, Wis.	
WTTR-FM	Westminster, Md.	
WTTV-FM	Bloomington, Ind.	
WTUN	Selma, Ala.	100.1
WTVL-FM	Waterville, Me.	
WTVR-FM	Richmond, Va.	
WTVY-FM	Dothan, Ala.	95.5
WTWC	Urbana, Ill.	
WTWX	Guntersville, Ala.	95.9
WTYD	New London, Conn.	
WTZE-FM	Tazewell, Va.	
WUAG	Greensboro, N. C.	
WUCB-FM	Chicago, Ill.	
WUFM	Utica, N. Y.	
WUHS	Urbana, O.	91.7
WUHY-FM	Philadelphia, Pa.	
WULX-FM	Richmond, Ind.	
WUNC	Chapel Hill, N.C.	
WUNH	Durham, N.H.	
WUOA	Tuscaloosa, Ala.	95.7
WUOM	Ann Arbor, Mich.	
WUOT	Knoxville, Tenn.	
WUPY	Lynn, Mass.	
WUSC-FM	Columbia, S.C.	
WUSF	Tampa, Fla.	
WUSO	Springfield, O.	
WUST-FM	Bethesda, Md.	
WUSV	Scranton, Pa.	
WUVT-FM	Blacksburg, Va.	90.7
WUWM	Milwaukee, Wis.	
WVAC	Adrian, Mich.	
WVAF-FM	Charleston, W.Va.	
WVAM-FM	Altoona, Pa.	
WVBC	Bethany, W.Va.	
WVBR-FM	Ithaca, N.Y.	
WVBU-FM	Lewisburg, Pa.	
WVCA-FM	Gloucester, Mass.	
WVCL-FM	Winnfield, La.	
WVCM	Carrollton, Ky.	
WVCR	Loudenville, N.Y.	
WYEC-FM	Hampton, Va.	
WVEM	Springfield, Ill.	
WVFM	Lakeland, Fla.	
WVFV	Dundee, Ill.	
WVGR	Grand Rapids, Mich.	104.1
WVHC	Hempstead, N.Y.	
WVHI	Evansville, Ind.	
WVIC-FM	E. Lansing, Mich.	
WVIK	Rock Island, Ill.	90.9
WVIP-FM	Mount Kisco, N.Y.	
WVIS	Terre Haute, Ind.	
WVJP-FM	Caguas, P. R.	
WVJS-FM	Owensboro, Ky.	
WVKC-FM	Galesburg, Ill.	
WVLE	Kaukauna, Wis.	104.9
WVLK-FM	Lexington, Ky.	
WVLR	Sauk City, Wis.	
WVMC-FM	Mt. Carmel, Ill.	
WVMG-FM	Cochran, Ga.	96.7

WHITE'S RADIO LOG

Call	Location	Freq.
WVMO	Monroe, Mich.	
WVMS	Chattanooga, Tenn.	88.9
WVNA-FM	Tuscumbia, Ala.	
WVNJ-FM	Newark, N.J.	
WVNO-FM	Mansfield, Ohio	
WVNY	Burlington, Vt.	92.9
WVOP-FM	Vidalia, Ga.	97.7
WVOR	Rochester, N.Y.	
WVOS-FM	Liberty, N.Y.	
WVOT-FM	Wilson, N.C.	
WVOW-FM	Logan, W. Va.	101.9
WVOX-FM	New Rochelle, N.Y.	
WVOZ-FM	Carolina, P. R.	
WVPC-FM	Monmouth, Ill.	
WVPO-FM	Stroudsburg, Pa.	
WVQM	Huntington, W.Va.	
WVSC-FM	Somerset, Pa.	
WVSH	Huntington, Ind.	
WVSR	Rapid City, S.D.	
WVSS	Menomonie, Wis.	
WVST	St. Petersburg, Fla.	
WVSU-FM	Birmingham, Ala.	
WVTC	Randolph Center, Vt.	90.7
WVTL	Monticello, Ind.	
WVTS	Terre Haute, Ind.	
WVUD-FM	Kettering, Ohio	
WVUM	Coral Gables, Fla.	
WVUR	Valparaiso, Ind.	
WVVV	Blacksburg, Va.	
WVWB-FM	Bridgeton, N.C.	
WVWC	Buckhannon, W.Va.	88.9
WVWO-FM	Cheyenne, Wyo.	
WWBA-FM	St. Petersburg, Fla.	107.3
WWBD-FM	Bamberg, S.C.	
WWCF	Greenfield, Wis.	
WWCO-FM	Waterbury, Conn.	
WWDB	Philadelphia, Pa.	96.5
WWDC-FM	Washington, D.C.	
WWDL-FM	Scranton, Pa.	
WWDL	Scranton, Pa.	
WWEB-FM	Wallingford, Conn.	90.1
WWGO-FM	Erie, Pa.	
WWGP-FM	Sanford, N.C.	
WWHC	Hartford City, Ind.	
WWHI	Muncie, Ind.	
WWHO	Jackson, Miss.	
WWJ-FM	Detroit, Mich.	
WWJC-FM	Superior, Wis.	
WWKS	Macomb, Ill.	
WWLA	La Crosse, Wis.	
WWMO	Reidsville, N.C.	
WWMS-FM	Bryan, O.	
WWMT	New Orleans, La.	
WWOD-FM	Lynchburg, Va.	
WWOG	Boca Raton, Fla.	
WWOL-FM	Buffalo, N.Y.	
WWOM-FM	New Orleans, La.	
WWON-FM	Woonsocket, R.I.	
WWOS	Palm Beach, Fla.	
WWPB	Miami, Fla.	
WWQS	Orlando, Fla.	
WWQT	Gainsville, Ga.	
WWRH	Columbus, Ga.	
WWRW	Wisconsin Rapids, Wis.	
WWSC-FM	Glens Falls, N. Y.	
WWSM	Bay Minette, Ala.	
WWST-FM	Wooster, Ohio	
WWSW-FM	Pittsburgh, Pa.	
WWTV-FM	Cadillac, Mich.	
WWTV	Corinth, Miss.	
WWTX	Corinth, Miss.	95.3
WWUH	Hartford, Conn.	91.3
WWVA-FM	Wheeling, W.Va.	
WWVR	W. Terre Haute, Ind.	
WWWS	Saginaw, Mich.	107.1
WWWW	Detroit, Mich.	
WWXL-FM	Manchester, Ky.	
WWYN-FM	Erie, Pa.	
WXAC	Reading, Pa.	
WXAX	Elkhart, Ind.	
WXBM-FM	Milton, Fla.	
WXEN	Cleveland, O.	106.5
WXFM	Elmwood Park, Ill.	
WXIS	Erwin, Tenn.	103.9
WXKL	Winter Haven, Fla.	
WXLI-FM	Dublin, Ga.	
WXLM	Savannah, Ga.	97.3
WXMT-FM	Merrill, Wis.	93.5
WXOS	Plantation Key, Fla.	100.3
WXPN	Philadelphia, Pa.	
WXQL	Glens Falls, N. Y.	
WXQR-FM	Jacksonville, N. C.	
WXRA	Woodbridge, Va.	
WXRC	Hickory, N. C.	
WXRF-FM	Guayama, P. R.	
WXRI	Norfolk, Va.	
WXTA	Greencastle, Ind.	
WXTC	Annapolis, Md.	
WXTO-FM	Grand Rapids, Mich.	
WXUR-FM	Media, Pa.	
WXUS	Lafayette, Ind.	92.7
WXYW	Suffolk, Va.	
WXYZ-FM	Detroit, Mich.	
WYBC-FM	New Haven, Conn.	
WYCR	York-Hanover, Pa.	
WYCS	Yorktown, Va.	
WYCA	Hammond, Ind.	
WYCE	Warwick, R.I.	
WYCS	Yorktown, Va.	
WYDD	Pittsburgh, Pa.	
WYFI	Norfolk, Va.	
WYFM	Charlotte, N.C.	
WYFY-FM	Columbia, Tenn.	
WYGO-FM	Corbin, Ky.	
WYNK-FM	Baton Rouge, La.	101.5
WYNR-FM	Brunswick, Ga.	
WYON	Grand Rapids, Mich.	
WYOR	Coral Gables, Fla.	
WYRL	Melbourne, Fla.	
WYSH-FM	Clinton, Tenn.	
WYSL-FM	Buffalo, N.Y.	103.3
WYSO	Yellow Springs, Ohio	
WYSU	Youngstown, O.	88.5
WYZZ	Wilkes-Barre, Pa.	
WZAK	Cleveland, O.	
WZEP-FM	DeFuniak Springs, Fla.	
WZFM	Charlestown, W.Va.	
WZIP-FM	Cincinnati, Ohio	
WZMF	Menomonee Falls, Wis.	
WZZM-FM	Grand Rapids, Mich.	
WZZW	Augusta, Ga.	

Canadian FM Stations By Call Letters

Call	Location	MHz
	Canadian Broadcasting Corporation Stations	
CBF-FM	Montreal, Que.	95.1
CBFL-FM	Maniwaki, Que.	98.9
CBH-FM	Richibucto, N.B.	98.5
CBL-FM	Toronto, Ont.	94.1
CBM-FM	Montreal, Que.	100.7
CBO-FM	Ottawa, Ont.	103.3
CBU-FM	Vancouver, B.C.	105.7
CBUF-FM	Vancouver, B.C.	97.7
CBW-FM	Winnipeg, Man.	98.3
	Privately Owned Stations	
CFBC-FM	Saint John, N.B.	98.9
CFCA-FM	Kitchener, Ont.	105.3
CFFM-FM	Kamloops, B.C.	98.3
CFFM-FM-1	Savona, B.C., Rebroadcasting the programs of Station CFFM-FM, Kamloops, B.C.	101.9
CFFM-FM-2	Clearwater, B.C., Rebroadcasting the programs of Station CFFM-FM, Kamloops, B.C.	92.7
CFFM-FM-3	Merritt, B.C., Rebroadcasting the programs of Station CFFM-FM, Kamloops, B.C.	103.9
CFFM-FM-4	Clinton, B.C., Rebroadcasting the programs of Station CFFM-FM, Kamloops, B.C.	106.5
CFFM-FM-5	Mount Timothy, B.C., Rebroadcasting the programs of Station CFFM-FM-4, Clinton, B.C.	99.7
CFGL-FM	Laval, Que.	105.7
CFMC-FM	Saskatoon, Sask.	103.9
CFMO-FM	Ottawa, Ont.	93.9
CFMQ-FM	Regina, Sask.	92.1
CFMS-FM	Victoria, B.C.	98.5
CFPL-FM	London, Ont.	95.9
CFQR-FM	Montreal 15, Que.	92.5
CFRC-FM	Kingston, Ont.	91.9
CFRN-FM	Edmonton, Alta.	100.3
CFRW-FM	Winnipeg 2, Man.	94.3
CHEC-FM	Lethbridge, Alta.	100.9
CHEX-FM	Peterborough, Ont.	101.5
CHFI-FM	Toronto, Ont.	98.1
CHFM-FM	Calgary, Alta.	95.9
CHGB-FM	La Pocatière, Que.	102.9
CHIC-FM	Brampton, Ont.	102.1
CHIN-FM	Toronto, Ont.	100.7
CHLT-FM	Sherbrooke, Que.	102.7
CHNS-FM	Halifax, N.S.	96.1
CHQM-FM	Vancouver, B.C.	103.5
CHRC-FM	Quebec, Que.	98.1
CHSC-FM	St. Catharines, Ont.	105.7
CHUM-FM	Toronto, Ont.	104.5
CHYM-FM	Kitchener, Ont.	96.7
CJAT-FM	Trail, B.C.	106.7
CJET-FM	Smiths Falls, Ont.	101.1
CJBQ-FM	Belleville, Ont.	97.1
CJBR-FM	Rimouski, Que.	101.5
CJCA-FM	Edmonton, Alta.	99.5
CJCB-FM	Sydney, N.S.	94.9
CJFM-FM	Montreal, Que.	95.9
CJIC-FM	Sault Ste. Marie, Ont.	100.5
CJMS-FM	Montreal, Que.	94.3
CJOB-FM	Winnipeg, Man.	97.5
CJOV-FM	Kelowna, B.C.	104.7
CJRT-FM	Toronto, Ont.	91.1
CJSS-FM	Cornwall, Ont.	104.5
CJUS-FM	Saskatoon, Sask.	89.7
CKAT-FM	North Bay, Ont.	93.7
CKCL-FM	Truro, N.S.	100.9
CKCY-FM	Sault Ste. Marie, Ont.	104.3
CKDS-FM	Hamilton, Ont.	95.3
CKFM-FM	Toronto, Ont.	99.9
CKGB-FM	Timmins, Ont.	94.5
CKGM-FM	Westmount, Que.	97.7
CKLC-FM	Kingston, Ont.	98.3
CKLG-FM	Vancouver, B.C.	99.3
CKLW-FM	Windsor, Ont.	93.9
CKOK-FM	Penticton, B.C.	97.1
CKOT-FM	Tillsonburg, Ont.	100.5
CKPC-FM	Brantford, Ont.	92.1
CKPR-FM	Port Arthur, Ont.	94.3
CKQS-FM	Oshawa, Ont.	94.9
CKRD-FM	Reed Deer, Alta.	98.9
CKSO-FM	Sudbury, Ont.	92.7
CKTB-FM	St. Catharines, Ont.	97.7
CKUA-FM	Edmonton, Alta.	98.1
CKVL-FM	Verdun, Que.	96.9
CKWM-FM	Kentville, N.S.	97.7
CKWS-FM	Kingston, Ont.	96.3
CKWW-FM	Windsor, Ont.	88.7
CKX-FM	Brandon, Man.	96.1
CKY-FM	Winnipeg, Man.	92.1

Canadian AM Stations By Call Letters

Call	Location	kHz
	Canadian Broadcasting Corporation Stations	
CBA	Moncton, N.B.	1070
CBAF	Moncton, N.B.	1300
CBD	Saint John, N.B.	1110
CBDR	Schefferville, Que.	1230
CBE	Windsor, Ont.	1550
CBF	Montreal, Que.	690
CBG	Gander, Nfld.	1450
CBH	Halifax, N.S.	860
CBI	Sydney, N.S.	1140
CBJ	Chicoutimi, P.Q.	1580
CBK	Regina, Sask.	540
CBL	Toronto, Ont.	740
CBM	Montreal, Que.	940
CBN	St. John's, Nfld.	640
CBO	Ottawa, Ont.	910
CBOF	Ottawa, Ont.	1250
CBR	Calgary, Alta.	1010
CBT	Grand Falls, Nfld.	540
CBU	Vancouver, B.C.	690
CBV	Québec, Que.	980
CBW	Winnipeg, Man.	990
CBX	Edmonton, Alta.	740
CBY	Corner Brook, Nfld.	990
CBZ	Fredericton, N.B.	970
CFGB	Happy Valley, Nfld.	1340
CFPR	Prince Rupert, B.C.	860
CFWH	Whitehorse, Y.T.	570
CFYK	Yellowknife, N.W.T.	1340
CHAK	Inuvik, N.W.T.	860
CHFC	Churchill, Man.	1230
CJBC	Toronto, Ont.	860
	Privately Owned Stations	
CFAB	Windsor, N.S.	1450
CFAC	Calgary, Alta.	960
CFAM	Altona, Man.	950
CFAR	Flin Flon, Man.	590
CFAX	Victoria, B.C.	1070
CFBC	Saint John, N.B.	930
CFBR	Sudbury, Ont.	550
CFBV	Smithers, B.C.	1230
CFCB	Corner Brook, Nfld.	570
CFCF	Montreal 15, Que.	600
CFCH	Calfander, Ont.	600
CFCL	Timmins, Ont.	620
CFCN	Calgary, Alta.	1060
CFCO	Chatham, Ont., with another Studio at Wallaceburg, Ont.	630
CFCP	Courtenay, B.C.	1440
CFCW	Camrose, Alta.	790
CFCY	Charlottetown, P.E.I.	630
CFDA	Victoriaville, Que.	1380
CFDR	Dartmouth, N.S.	790
CFGM	Richmond Hill, Ont.	1310
CFGP	Grande Prairie, Alta.	1050
CFGR	Gravelbourg, Sask.	1230
CFGT	Alma, Que.	1270
CFJC	Kamloops, B.C.	910
CFJR	Brockville, Ont.	1450
CFKC	Creston, B.C., with another Studio at Nelson, B.C.	1340
CFLD	Studio at Station CFBV, Smithers, B.C.	1400
CFLH	Studio at Station CFCL, Timmins, Ont.	1340
CFLK	Studio at Station CFCL, Timmins, Ont.	1230
CFLM	La Tuque, Que.	1240
CFLS	Levis, Que.	1240
CFLV	Valleyfield, Que.	1370
CFMB	Montreal, Que.	1410
CFML	Cornwall, Ont.	1110
CFMR	Fort Simpson, N.W.T.	1490
CFND	Fredericton, N.B.	550
CFNL	Fort Nelson, B.C. Studios at Station CKNL, Fort St. John, B.C.	590
CFNS	Saskatoon, Sask.	1170
CFOB	Fort Frances, Ont.	800
CFOM	Ville Vanier, Que.	1340
CFOR	Orillia, Ont.	1570
CFOS	Owen Sound, Ont.	560
CFOX	Pointe Claire, Que.	1470
CFPA	Port Arthur, Ont.	1230
CFPL	London, Ont.	980
CFQC	Saskatoon, Sask.	600
CFRA	Ottawa, Ont.	580
CFRB	Toronto 7, Ont.	1010
CFRC	Kingston, Ont.	1490
CFRG	Gravelbourg, Sask.	710
CFRN	Edmonton, Alta.	1260
CFRS	Simcoe, Ont.	1560
CFRW	Winnipeg, Man.	1470
CFRY	Portage la Prairie, Man.	920
CFSL	Weyburn, Sask.	1190
CFSX	Stephenville, Nfld.	910
CFTJ	Galt, Ont.	1110
CFTK	Terrace, B.C.	590
CFUN	Vancouver, B.C.	1410
CFVR	Abbotsford, B.C.	1240
CFWB	Campbell River, B.C.	1490
CHAB	Moose Jaw, Sask.	800
CHAD	Amos, Que.	1340
CHAM	Hamilton, Ont.	1280
CHAT	Medicine Hat, Alta.	1270
CHCM	Marystown, Nfld., with another studio at St. John's, Nfld.	560
CHEC	Lethbridge, Alta.	1090
CHED	Edmonton, Alta.	630
CHEF	Granby, Que.	1450
CHER	Sydney, N.S.	950
CHEX	Peterborough, Ont.	980
CHFA	Edmonton, Alta.	680
CHFI	Toronto, Ont.	680
CHGB	La Pocatière, Que.	1310
CHIC	Brampton, Ont.	790
CHIN	Toronto, Ont.	1540
CHIR	Leamington, Ont.	730
CHLC	Saguenay Co., Que.	580
CHLN	Trois-Rivières, Que.	550
CHLO	St. Thomas, Ont.	680
CHLT	Sherbrooke, Que.	630
CHML	Hamilton, Ont.	900
CHNC	New Carlisle, Que.	610

Call	Location	MHz	Call	Location	MHz	Call	Location	MHz	Call	Location	MHz
CHNO	Sudbury, Ont.	900	CJFX	Antigonish, N.S.	580	CKBI	Prince Albert, Sask.	900	CKNR	Elliott Lake, Ont.	1340
CHNS	Halifax, N.S.	960	CJGX	Yorkton, Sask.	940	CKBL	Matane, Que.	1250	CKNW	New Westminister, B.C.	980
CHOK	Sarnia, Ont.	1070	CJIB	Vernon, B.C.	940	CKBM	Montmagny, Que.	1490	CKNX	Wingham, Ont.	920
CHOO	Ajax, Ont.	1390	CJIC	Sault Ste. Marie, Ont.	1050	CKBS	St. Hyacinthe, Que.	1240	CKOC	Hamilton, Ont.	1150
CHOV	Pembroke, Ont.	1350	CJJC	Langley, B.C.	850	CKBW	Bridgewater, N.S.	1000	CKOK	Penticton, B.C.	800
CHOW	Welland, Ont.	1470	CJKL	Kirkland Lake, Ont.	560	CKCB	Barrie, Ont.	1400	CKOM	Saskatoon, Sask.	1250
CHQB	Powell River, B.C.	1280	CJLM	Joliette, Que.	1350	CKCH	Hull, Que.	970	CKOO	Osoyoos, B.C.	1240
CHQM	Vancouver, B.C.	1320	CJLR	Quebec, Que.	1060	CKCK	Regina, Sask.	620	CKOT	Tillsonburg, Ont.	1510
CHQR	Calgary, Alta.	810	CJLS	Yarmouth, N.S.	1340	CKCL	Truro, N.S.	600	CKOV	Kelowna, B.C.	630
CHQT	Edmonton, Alta.	1110	CJLX	Fort William, Ont.	800	CKCM	St. John's, Nfld.	620	CKOX	Woodstock, Ont.	1340
CHRC	Québec 4, Que.	800	CJME	Regina, Sask.	1300	CKCN	Sept-Iles, Que.	560	CKOY	Ottawa, Ont.	1310
CHRD	Drummondville, Que.	1480	CJMS	Montreal, Que.	1280	CKCQ	Quesnel, B.C.	570	CKPC	Brantford, Ont.	1380
CHRL	Roberval, Que.	910	CJMT	Chicoutimi, Que.	1420	CKCR	Salmon Arm, B.C.	1340	CKPG	Prince George, B.C.	550
CHRS	Jacques-Cartier, Que.	1090	CJNB	North Battleford, Sask.	1050	CKCV	Québec, Que.	1280	CKPM	Ottawa, Ont.	1440
CHRT	Riviere du Loup, Que.	1450	CJNR	Blind River, Ont.	730	CKCW	Moncton, N.B.	1220	CKPR	Port Arthur, Ont.	580
CHSC	St. Catharines, Ont.	1220	CJOB	Winnipeg 10, Man.	680	CKCY	Sault Ste. Marie, Ont.	920	CKPT	Peterborough, Ont.	1420
CHSJ	Saint John, N.B.	1150	CJOC	Lethbridge, Alta.	1220	CKDA	Victoria, B.C.	1220	CKRB	Beauce, Que.	1460
CHSM	Altona, Man.	1250	CJOE	London, Ont.	1290	CKDH	Amherst, N.S.	900	CKRC	Winnipeg, Man.	630
CHTK	Prince Rupert, B.C.	560	CJON	St. John's, Nfld.	930	CKDM	Dauphin, Man.	730	CKRD	Red Deer, Alta.	850
CHTM	Thompson, Man.	610	CJOR	Vancouver, B.C.	600	CKDR	Dryden, Ont.	900	CKRM	Regina, Sask.	980
CHUB	Nanaimo, B.C.	1570	CJOX	Grand Bank, Nfld.	710	CKEC	New Glasgow, N.S.	1320	CKRN	Rouyn, Que.	1400
CHUC	Cobourg, Ont.	1450	CJRC	Ottawa, Ont.	1150	CKEK	Cranbrook, B.C.	570	CKRS	Jonquière, Quo.	590
CHUM	Toronto 7, Ont.	1050	CJOY	Guelph, Ont.	1460	CKEN	Kentville, N.S.	1350	CKSA	Lloydminster, Alta.	1080
CHVD	Dolbeau, Que	1230	CJRL	Kenora, Ont.	1220	CKEY	Toronto, Ont.	590	CKSB	Saint-Boniface, Man.	1050
CHWK	Chilliwack, B.C.	1270	CJRN	Niagara Falls, Ont.	1600	CKFH	Toronto, Ont.	1430	CKSL	London, Ont.	1410
CHWO	Oakville, Ont.	1250	CJRS	Sherbrooke, Que.	1510	CKFL	Thetford Mines, Que.	1340	CKSM	Shawinigan, Que.	1220
CHYM	Kitchener, Ont.	1490	CJRW	Summerside, P.E.I.	1240	CKGB	Timmins, Ont.	680	CKSO	Sudbury, Ont.	730
CHYR	Leamington, Ont.	710	CJSA	Ste. Agathe des Monts, Que.	1230	CKGM	Westmount, Que.	980	CKSW	Swift Current, Sask.	1400
CJAD	Montreal, Que.	800	CJSL	Estevan, Sask.	1280	CKGN	Matane, Que.	1340	CKTB	St. Catharines, Ont.	610
CJAF	Cabano, Que.	1240	CJSN	Shaunavon, Sask.	1490	CKJD	Sarnia, Ont.	1250	CKTK	Kitimat, B.C.	1230
CJAT	Trail, B.C.	610	CJSO	Sorel, Que.	1320	CKJL	Saint-Jérôme, Que.	900	CKTS	Sherbrooke, Que.	900
CJAV	Port Alberni, B.C.	1240	CJSS	Cornwall, Ont.	1220	CKKC	Nelson, B.C.	1390	CKUA	Edmonton, Alta.	580
CJBM	Causapscal, Que., with Studio at Rimouski, Que.	1450	CJTR	Trois-Rivières, Que.	1150	CKKR	Rosetown, Sask.	1330	CKVD	Val-d'Or, Que.	900
CJBQ	Belleville, Ont.	800	CJTT	Kirkland Lake, Ont.	1230	CKKW	Kitchener, Ont.	1320	CKVL	Verdun, Que.	850
CJBR	Rimouski, Que.	900	CJVI	Victoria, B.C.	900	CKLB	Oshawa, Ont.	1350	CKVM	Ville-Marie, Que.	710
CJCA	Edmonton, Alta.	930	CJVR	Melfort, Sask.	1420	CKLC	Kingston, Ont.	1380	CKWL	Williams Lake, B.C.	1240
CJCB	Sydney, N.S.	1270	CJWA	Wawa, Ont.	1240	CKLD	Thetford Mines, Que.	1230	CKWS	Kingston, Ont.	960
CJCH	Halifax, N.S.	920	CJYR	Edson, Alta.	970	CKLG	Vancouver, B.C.	730	CKWW	Windsor, Ont.	580
CJCJ	Woodstock, N.B.	920	CKAC	Montreal, Que.	730	CKLM	Montreal, Que.	1570	CKWX	Vancouver, B.C.	1130
CJCN	Grand Falls, Nfld.	680	CKAD	Middleton, N.S.	1490	CKLS	La Sarre, Que.	1240	CKX	Brandon, Man.	1150
CJCS	Stratford, Ont.	1240	CKAP	Kapuskasing, Ont.	580	CKLW	Windsor, Ont.	800	CKXL	Calgary, Alta.	1140
CJDC	Dawson Creek, B.C.	1350	CKAR	Huntsville, Ont.	630	CKLY	Lindsay, Ont.	910	CKXR	Salmon Arm, B.C.	580
CJDV	Drumheller, Alta.	910	CKAR-1	Parry Sound, Ont.	1340	CKML	Mont Laurier, Que.	610	CKY	Winnipeg, Man.	580
CJEM	Edmundston, N.B.	570	CKAY	Duncan, B.C.	1500	CKMP	Midland, Ont.	1230	CKYL	Peace River, Alta.	610
CJET	Smiths Falls, Ont.	630	CKBB	Barrie, Ont.	950	CKMR	Newcastle, N.B.	790	VOAR	St. John's, Nfld.	1230
CJFP	Rivière-du-Loup, Que.	1400	CKBC	Bathurst, N.B.	1360	CKNB	Campbellton, N.B.	950	VOCM	St. John's, Nfld.	590
						CKNL	Fort St. John, B.C.	560	VOWR	St. John's, Nfld.	800

White's World-Wide Shortwave Stations

Propagation Forecast. Ever wonder where all that speaker noise comes from? Well, even if we eliminate all the local sources such as automobile ignition systems, fluorescent lights, your neighbors' TV sets, etc., most of the noise between 3 and 30 MHz is still *man-made*. We are of course referring to jamming, but not just the kind caused by the ultra left and the ultra right against each other's broadcasts. Most shortwave jamming, which usually takes the form of a buzz-saw-like noise, occurs on the utility bands and is carried out by the military to discourage unauthorized listening. The jamming is aired over non-directional antennas on the same frequencies being used for communications. But the latter use highly directional antenna arrays which enable them to override the interference at any chosen receiving site.

While in theory buzz-saw noise is restricted to utility frequencies, if the listener uses a relatively inexpensive receiver (as most SWLs do), such jammers can—and often do—produce images on shortwave broadcast bands. And despite the already overcrowded band conditions, we can safely forecast that this "propagation" problem will get worse as all the major military powers continue to develop more effective jammers. For example, American Electronics Laboratories recently unveiled a new high-powered airborne model which can operate at altitudes up to 50,000 feet.

There are other shortwave noise sources such as static generated by thunder storms during North American winter. This noise emanates almost entirely from the great tropical rain forests. There's also internal noise from your receiver, the stars, solar eruptions, and more. We'll talk about some of those next issue.

Hey, we've got a few letters in our mailbag which bring up some points worth mentioning since the topics asked about seem to be a familiar theme in our reader mail.

Reader Thad McConnell of Brighton, Mass., wants to know why some stations indicate their frequencies in "kiloHertz." Seems that his receiver is calibrated in "MegaHertz" and he feels that somebody ought to standardize or at least coordinate the broadcasters and the receiver manufacturers. Well, it may be a bit confusing but once you grasp the basic message here, Thad (and all others who have asked about this), it's a snap.

You see, these two terms are practically the same; kiloHertz means "thousand-cycles" and MegaHertz means "million-cycles."

WHITE'S SHORTWAVE SECTION

Dec. 1969/ Jan. 1970 LISTENER'S STANDARD TIME	ASIA (except Near East)	EUROPE, NEAR EAST & AFRICA (N. of the Sahara)	AFRICA (S. of the Sahara)	SOUTH PACIFIC	LATIN AMERICA
0000-0300	25, 31	41, 49	60, 41e	31e, 41w	(49), 60, 90
0300-0600	41, 49	31	19w	31, 41, 60w	49, 60, 90
0600-0900	25, 49w	13, 16, 19	19	25, 31	49
0900-1200	16, 19	13, 16, 19	19, 25	19 (poor)	25, 31
1200-1500	16, 19	13, 16, 19	19, 25	19 (poor)	25, 31
1500-1800	16, 19	31, 49	60e, 31w	19 (poor)	31
1800-2100	16, 19	25, 31	25, 31, (60w)	16, 19	(49), 60, 90
2100-2400	16, 19	31, 41, 49	60	16, 19	(49), 60, 90

To use the table put your finger on the region you want to hear and log, move your finger down until it is alongside the local standard time at which you will be listening and lift your finger. Underneath your pointing digit will be the shortwave band or bands that will give the best DX results. The time in the above propagation table is given in *standard time* at the listener's location, which effectively compensates for differences in propagation characteristics between the East and West Coasts of North America. Abbreviations: w—Western North America and e—Eastern North America. When w or e follow a band listing, it means the band is only good for that part of the continent. The shortwave bands in brackets are suggested as possible second choices. Refer to White's Radio Log for our world-wide Shortwave list.

Since a million cycles is a direct multiple of a thousand cycles, the term MegaHertz is merely a shorthand version of stating kiloHertz—just like you would find it easier to say $25-million rather than $25-thousand-thousand. To convert kiloHertz into MegaHertz, change the comma in the frequency to a decimal point (11,575 kHz becomes 11.575 MHz), and vice versa to change from MHz to kHz.

Next, Howard Freeman of Miami Beach, Fla., is hung up on a sky hook; that is to say that he's in a quandary. He wants good SW reception in all directions and similar quality reception on the broadcast band. He hasn't got room for an antenna farm so he asks for our opinion on what he should do. A broadcast band antenna might be too long for good shortwave reception and a shortwave antenna cut-to-frequency might be inadequate for broadcast; then there's the problem of which way to orient (aim) the antenna for the directional properties of whichever antenna he decides to use. Oh boy, sounds like you've really got a problem, Howie, our advice is to be totally unscientific and cop-out on engineering considerations, such as those you have questioned. Here's what you do. Go out and buy 100 feet or so of insulated antenna wire (we like #14 stranded) and some insulators—then start stringing. Don't worry about a thing, except to place an insulator wherever it is going to zig or zag as you string from tree-to-tree or building-to-tree. Don't worry about direction, don't be too concerned about the thing being too long for shortwave or the other way around. For receiving installations this long-wire nightmare should be dandy.

Arlo C. Carlton of Okmulgee, Okla., asks if we can give him the *complete* schedule of times and frequencies for National Bureau of Standards station WWV in Washington. Arlo, baby, they upped and moved WWV to Ft. Collins, Colo., a few years ago. The full 24-hour schedule is a bit too complicated and lengthy for printing here, but the station is on the air with clock ticks, various audio tones, voice announcements, radio propagation forecasts, and assorted other tidbits just

about all day and night (execpt for a few minutes of silence each hour). They are on 2500, 5000, 10000, 15000, 20000, 25000 kHz. They send a QSL card for reception reports and will mail you their full schedule upon request. Write to Station WWV, National Bureau of Standards, Ft. Collins, Colo. 80521.

Meanwhile, settle down and get some serious logging under your belt.

kHz	Call	Name	Location
2410	—	R. Puerto La Cruz	La Cruz, Venez.
2440	YVLG	R. Emis Rural	Santarem, Brazil
2480	YVPD	R. Giradot	Maracay, Venez.
2614	DAM	R. Tiempo (time signals)	Caracas, Venez. Elmshorn, W. Germany
		90-Meter Band—3200 to 3400 kHz	
2370	YVQP	R. Litoral	Naiguata, Venez.
3205	YVRV	R. Brazzaville	Brazzaville, Congo
3232	—	R. Abidjan	Abidjan, Ivory Coast
3242	—	R. Assuncao	Fortaleza, Brazil
3255	ZYH35	R. Nirgua	Nirgua, Venez.
3265	YVOC	R. Emis Rural	Santarem, Brazil
3285	—	R. Education Rural	Campo Grande, Brazil
3295	ZYX28	R. Gazeta	Maceio, Brazil
3315	ZYL21	R. Tingo	Maria, Peru
3325	OAX3P	R. La Convencion	Quillabamba, Peru
3335	OBX7K	R. Viente Siete	La Paz, Bolivia
3350	CPI03	Deciembre	Huanuco, Brazil
3360	OAX3D	R. Huanuco	Santo Domingo.
3375	HIAD	R. San Juan	Dom. Rep.
3380	TGCH	R. Escuela Radio	Guatemala City, Guat.
3390	CP89	R. Santa Ana	Santa Ana, Bolivia
4025	GIC24	(time signals)	Criggon, Gt. Britain
4652	HCAK2	R. Ecuador	Guayaquil, Ecuador
4725	HCEH3	R. El Progresso	Loja, Ecuador
		60-Meter Band—4750 to 5060 kHz	
4760	CP62	R. Bolivia	La Paz, Bolivia
4765	ZYN37	R. Feira de Santana	Santana, Brazil
4775	CP84	R. Los Andes	La Paz, Bolivia
4785	CP74	R. Indoamerica	Potosi, Bolivia
4792	HIAS	Onda Musical	Santo Domingo, Dom. Rep.
4800	OBX7C	R. Onda Azul	Puno, Peru
4810	OAX2U	S. San Ignacio	Jaen, Peru
4820	YVRC	V. de Apure	Apure, Venezuela
4830	CP70	R. Grigota	Santa Cruz, Bolivia
4840	OBX5E	R. Andahuaylas	Andahuaylas, Peru
4850	HCCV3	Ondas del Zamora	Loja, Ecuador
4860	—	R. Peking	Peking, China
4870	YVKP	R. Tropical	Caracas, Venez.
4880	YVKF	Ondas Populares	Caracas, Venez.
4892	—	R-TV Francaise	Cayenna, Fr. Guyana
4900	HROM	V. del Uluia	El Progresso, Honduras
4908	CE490	R. Transandina	Los Andes, Chile
4915	CP88	R. Amboro	Santa Cruz, Bolivia
4925	ZYA6	R. Icarema	Sobral, Brazil
4935	CPI10	R. Norte	Montero, Bolivia
4945	DZB6	National Teachers Coll.	Manila, Philippines Coro, Venezuela
4950	YVMM	R. Coro	New Delhi, India
4960	VUD	All India R.	Quito, Ecuador
4970	HCGH1	R. Tarqui	Santo Domingo,
4980	HIKZ	R. Dif Popular	Dom. Rep.
4985	ZYZ15	V. de Oeste	Cuiaba, Brazil
5000	MSF	(time signals)	Teddington, Gt. Britain
	WWVH	(time signals)	Maui, Hawaii
5010	—	Forces BC	Singapore, Malaysia
5020	HJFW	Trasmis. Caldas	Bogota, Colombia
5025	—	V. Amazona	Amazonia, Brazil
5035	HROE	V. de Fronteras	Tegucigalpa, Honduras
5045	ZK5	R. Raratonga	Raratonga, Cook Is.
5055	ZYX24	R. Cultural	Guiaba, Brazil
5075	HJGC	Accion Cultural	Bogota, Colombia
5192	CR6RV	R. Clube de Moxico	Moxico, Angola
5545	—	R. Peking	Peking, China
5870	—	R. Peking	Peking, China
		49-Meter Band—5950 to 6200 kHz	
5935	—	R. Peking	Peking, China
5955	—	R. Liberty	W. Germany
	CE595	R. Nuevo Mundo	Santiago, Chile
5960	HRHR	V. de Occidente	Tegucigalpa, Honduras
5970	—	R. Brazzaville	Brazzaville, Congo
5975	ZYT44	R. Guarajá	Florianapolis, Brazil
5980	ZFY	R. Demerara	Georgetown, Guyana
5985	LRS2	R. Splendid	Buenos Aires, Argentina
5995	—	V. America	Thessaloniki, Greece
6000	—	R. Afghanistan	Kabul, Afghanistan
6005	CP58	R. Progreso	La Paz, Bolivia
6010	HJFK	V. Amiga	Bogota, Colombia
6020	4VEB	R. Caraibes	Port au Prince, Haiti
6025	—	R. Peking	Peking, China
6030	CE603	R. Mineria	Talca, Chile
6040	BED9	V. Free China	Taipei, Formosa
6050	—	V. America	Wooferton, Gt. Britain
6055	CPI8	R. El Condor	Oruro, Bolivia
6062	OAX8L	R. Telesar	Pucallpa, Peru
6070	CFRX	CFRX	Toronto, Ont.
6080	—	R. Berlin Int'l	Berlin, E. Germany
	HCDG2	R. Bolivar	Guayaquil, Ecuador
6090	—	R. Luxembourg	Luxembourg
6095	OAX4H	R. Oficial del Congreso	Lima, Peru Taipei, Formosa
6105	BEC61	Air Force Station	Asuncion, Paraguay
6110	ZPA11	R. Charitas	Rio de Janiero, Brazil
6115	ZYC7	R. Tamoio	Tapachula, Mexico
6120	XETS	R. X-E-T-S	Montevideo, Uruguay
6125	CXA4	S-O-D-R-E	Bogota, Colombia
6130	HCFB2	R. Condor	London, Gt. Britain
6140	—	BBC	Popayan, Colombia
6145	HJEQ	V. del Cauca	Lisbon, Portugal
6155	CSB52	R. Renascenca	Lusaka, Zambia
6165	—	R. Zambia	Manila, Philippines
6170	DUH2	Philippines BC	Port au Prince, Haiti
6175	4VPJ	R. Capoise	Santo Domingo,
6185	HIAU	V. de Libertad	Dom. Rep.
6190	TGFT	R. Nacional	Tikal, Guatemala
6200	ZAA	R. Tirana	Tirana, Albania
6234	—	R. Budapest	Budapest, Hungary
6335	—	R. Peking	Peking, China
6520	—	R. Peking	Peking, China
		41-Meter Band—7100 to 7300 kHz	
7105	—	R. Nacional	Madrid, Spain
		Thai TV Co.	Bangkok, Thailand
7120	—	BBC	Cyprus
7125	VUD	All India R.	New Delhi, India
7140	—	BBC	Cyprus
7150	—	BBC	London, Gt. Britain
7155	—	R. Niger	Niamey
7165	—	R. Nederland	Hilversum, Netherlands
7170	—	All India R.	Kohima, India
7180	—	All India R.	Bhopal, India
7190	HLK30	V. Free Korea	Seoul, Korea
7200	—	R. Belgrade	Belgrade, Yugoslavia
7210	—	Swiss BC	Berne, Switz.
7220	—	R. Budapest	Budapest, Hungary
7230	—	R. Peking	Peking, China
7235	—	R. Pakistan	Karachi, Pakistan
7240	—	R. Garoua	Garoua, Cameroon
7255	—	R. Sofia	Sofia, Bulgaria
7260	VUM	All India R.	Madras, India
7270	BEC28	Military BC Corps	Hualein, Formosa
7280	—	R. Moscow	Moscow, USSR
7290	—	RAI	Rome, Italy
7295	—	R. Moscow	Moscow, USSR
7305	—	R. Peking	Peking, China
7350	—	R. Prague	Prague, Czech.
7443	HBX	United Nations	Geneva, Switz.
7660	—	R. Peking	Peking, China
9009	4XB31	Kol Yisrael	Tel Aviv, Israel
9340	—	R. Peking	Peking, China
		31-Meter Band—9500 to 9775 kHz	
9504	OAX8E	R. Loreto	Iquitos, Ecuador
9510	—	R. Bucharest	Bucharest, Rumania
9515	CXA71	R. Sarandi	Montevideo, Uruguay
9525	—	R. Warsaw	Warsaw, Poland
9530	—	V. America	Monrovia, Liberia
9535	—	R. Malaysia	Sarawak, Malaysia
9545	4VC	V. Reveloucion	Port au Prince, Haiti
9550	—	R. Tanzania	Dar Es Salaam, Tanzania
9555	YSS	R. Nacional	San Salvador, El Salvador
9565	DMQ9	Deutsche Welle	Cologne, W. Germany
9570	—	R. Australia	Melbourne, Australia
9575	BED91	V. Free China	Taipei, Formosa
9585	—	R. Niger	Niamey, Niger
9590	—	R. Peking	Peking, China
9595	ZYN29	R. Cultura	Bahia, Brazil
9600	OAX1R	R. Talara	Talara, Peru
9610	VLW9	Australian BC Comm.	Perth, Australia
9620	—	R-TV Francaise	Paris, France

WHITE'S EMERGENCY RADIO STATIONS

kHz	Call	Name	Location
9625	—	BBC	Cyprus
9630	CR6RL	R. Club de Angola	Luanda, Angola
9640	—	BBC	London, Gt. Britain
9645	ZYV40	R. Cultura	Pocos, Brazil
9655	—	Trans World Radio	Monte Carlo, Monaco
9660	—	R. Malaysia	Malaysia
9675	OAZ4L	R. del Pacifico	Lima, Peru
9685	BED73	V. Free China	Taipei, Formosa
9690	VUD	All India R.	Delhi, India
9700	—	BBC	London, Gt. Britain
9710	—	R. Peking	Peking, China
9720	CR6RZ	Emis Oficial	Luanda, Angola
9730	—	R. Berlin Int'l.	Berlin, E. Germany
9740	—	V. America	Woofferton, Gt. Britain
9745	BEC62	Air Force	Taipei, Formosa
9755	—	R. Nederland	Hilversum, Netherlands
9760	TGWA	V. de Guatemala	Guatemala City, Guatemala
9770	4VEH	R. St. 4VEH	Cap Haitien, Haiti
9810	—	R. Moscow	Moscow, USSR
9905	—	BBC	London, Gt. Britain
10175	—	R. Peking	Peking, China
10775	FTK77	(time signals)	Pontoise, France
11570	—	R. Moscow	Moscow, USSR
11685	—	R. Peking	Peking, China

25-Meter Band—11700 to 11975 kHz

11705	—	R. Sweden	Stockholm, Sweden
11710	VUD	All India R.	Delhi, India
11720	—	R. Canada	Montreal, Que.
11730	—	R. Nederland	Bonaire, Neth. Antilles
11740	—	Trans World R.	Monte Carlo, Monaco
11745	HVJ	Vatican Radio	Vatican City
11755	LRX	R. El Mundo	Buenos Aires, Argentina
11765	—	R. Sweden	Stockholm, Sweden
11775	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
11785	—	Deutsche Welle	Kigali, Rwanda
11795	—	Deutsche Welle	Kigali, Rwanda
11800	—	R. Warsaw	Warsaw, Poland
11805	CE1180	R. Society Nacional Agri.	Santiago, Chile
11815	VUD	All India R.	Delhi, India
11820	VUD	All India R.	Delhi, India
11835	4VEH	R. Station 4VEH	Cap Haitien, Haiti
11845	—	R. TV Francaise	Paris, France
11855	DZH8	Call of The Orient	Manila, Philippines
11860	BED45	V. Free China	Taipei, Formosa
11870	—	V. America	Thessaloniki, Greece
11875	ZYN32	R. Society	Bahia, Brazil
11885	ORU4	V. Friendship	Brussels, Belgium
11890	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
11905	DMQ11	Deutsche Welle	Cologne, W. Germany

kHz	Call	Name	Location
11910	HSK9	V. Thailand	Bangkok, Thailand
11920	—	R-TV Francaise	Paris, France
11925	—	Trans World R.	Monte Carlo, Monaco
11935	ZYS35	R. Club Paranaense	Curitiba, Brazil
11945	—	R. Nederland	Hilversum, Netherlands
11955	—	BBC	Cyprus
11965	—	V. America	Okinawa
11980	—	R. Peking	Peking, China
12010	—	R. Peking	Peking, China
15020	—	R. Hanoi	Hanoi, N. Vietnam

19-Meter Band—15100 to 15450 kHz

15100	—	Windward Is. BC	St. Georges, Grenada
15115	HCJB	V. de los Andes	Quito, Ecuador
15130	—	R. Liberty	Germany
15140	—	R. Australia	Melbourne, Australia
15150	OAX4T	R. Nacional	Lima, Peru
15160	TAU.	R. Ankara	Ankara, Turkey
15170	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
15180	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
15195	—	R. Japan	Tokyo, Japan
15215	—	R. Warsaw	Warsaw, Poland
15225	CXA64	V. de Melo	Montevideo, Uruguay
15240	—	R. Sweden	Stockholm, Sweden
15250	—	V. America	Manila, Philippines
15260	—	Far East Network	Tokyo, Japan
15275	—	R. Warsaw	Warsaw, Poland
15320	BED38	V. Free China	Taipei, Formosa
15360	—	R. RSA	Paradys, S. Africa
15385	DZF3	Call of Orient	Manila, Philippines
15435	DMQ15	Deutsche Welle	Cologne, W. Germany

16-Meter Band—17700 to 17900 kHz

17705	ZYR96	R. Novo de Julio	Rio de Janiero, Brazil
17745	—	BBC	London, Gt. Britain
17760	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
17780	VUD	All India R.	Delhi, India
17795	—	RAI	Rome, Italy
17815	—	V. America	Tangiers, Morocco
17835	—	R. Free Europe	Lisbon, Portugal
17850	—	R. Bucharest	Bucharest, Rumania

13-Meter Band—21450 to 21750 kHz

21450	—	R-TV Francaise	Paris, France
21485	HVJ	Vatican R.	Vatican City
21490	—	BBC	London, Gt. Britain
21500	—	R. Brazzaville	Brazzaville, Congo
21560	DMQ21	Deutsche Welle	Cologne, W. Germany
21640	—	R. Japan	Tokyo, Japan
21655	LKC	R. Norway	Oslo, Norway

White's Emergency Radio Station Listings for the Washington-Baltimore Areas

SCIENCE AND ELECTRONICS furnishes this exclusive listing of emergency radio stations as an aid to our many readers now engaged in the fascinating and rapidly growing hobby of monitoring emergency radio communications. We have and will be publishing similar lists devoted to different metropolitan areas in forthcoming issues so that you'll be able to accumulate a sizable array of this difficult-to-obtain data. Refer to the index on page 81 for our 1969 program. Our 1970 brand new schedule will be announced in the next issue.

If you desire to obtain similar lists from other areas in the United States that have not been published in this magazine in 1969, then we suggest you write to Communications Research Bureau, Box 56, Commack, N. Y. 11725. They may have a list of emergency radio services that covers your locality. Include a stamped, self-addressed envelope with your request.

WASHINGTON METROPOLITAN POLICE

KFZ835	155.415			
KGA829	39.02			
KGA885	155.25	155.31	159.03	453.55
KGB808	155.25			
KGB831	39.02			
KJR291	154.86			
KOP401	154.86			
KOP403	154.86			
KOP404-5	156.03			
KOP406	154.86			
KOP409-10	156.03			
KOP413-4	156.03			

DISTRICT OF COLUMBIA FIRE DEPT.

KCR293	154.19
KGA611	154.19

BALTIMORE POLICE DEPT.

KCX351	154.65	155.43	155.61

KCX352-3	154.65	155.61				
KCX355-62	154.65	155.61				
KCZ841	453.20					
KGA410	154.65	155.55	155.61	155.67	453.05	
	453.30	453.35	455.50			

BALTIMORE FIRE DEPT.

KGC220	154.31

MARYLAND MUNICIPAL AGENCIES

Station	Police		Fire	
Adamstown			KGE630	46.42
Adelphi			KCR899	33.74
			KCR899	33.86
			KGG372	same
Annapolis	KGA921	159.21	KGD308	46.50
			KGD322	46.50
			KGD324	46.50
Arbutus			KGC673	46.46
Arnold			KGU660	46.50
Arundel-by-Sea			KGE349	46.50
Avalon Shores			KGD306	46.50
			KGD306	153.83
Benedict			mobiles	46.42
Bladensburg	KJN738	453.90		
Boring			KGC700	46.46
Bowleys Quarter			KGC667	46.46
Braddock Hts.			KJI557	46.42
Brooklyn			KGC527	46.50
Bryans Rd.			mobiles	46.42
Cape St. Claire			KGF504	46.50
Carroll Manor			KGE630	46.42
Chesapeake Bch.			mobiles	39.10
			mobiles	39.30
Chillum			KCR899	33.74
			KCR899	33.86
			KGG372	same
Deale			KGD316	46.50
Dundalk			KGC699	46.46
Earleigh Estates			KGB466	46.50
Eastport			KGD728	46.50
			KJB937	47.46
Edgemere			KGC710	46.46
Edgewater			KGD724	46.50
English Consul			KGC711	46.46
Ferndale			KGC332	46.50
Frederick	KGA247	155.49	KGG530	46.42
Galesville			KGD312	46.50
			KGD312	153.83
Gambrills			KGE349	46.50
Glen Burnie			KGC908	46.50
Glyndon			KGC702	46.46
Green Haven			KGD281	46.50
Halethorpe			KGD224	46.46
Herald Harbor			KGD317	46.50
Hughesville			mobiles	46.42
Hyattsville	KFF284	155.13		
Hyde Park			KGC604	46.46
Indian Head			KEL445	46.42
Jessup			KGD307	46.50
Jonestown	KGG527	159.09		
Lake Shore			KGB740	46.50
Lansdowne			KGC608	46.46
La Plata			KGB686	46.42
Linkwood			KAP751r	46.06
Linthicum			KGC947	46.50
Lloyds			KAP747	46.06
Lombardee Bch.			KGC579	46.50
Lutherville			KGC707	46.46
Marley Park			KGC274	46.50
Middleborough			KGC633	46.46
Middle River			KGC669	46.46
Mt. Airy			KGC648	33.94
			KGC648	153.83
New Market			KJL553	46.42
N. Beach			KGE674	33.82
N. Point			KGC710	46.46
Odenton			KGC779	46.50
Orchard Bch.			KCB961	46.50
Pikesville			KGE207	46.46
Potomac Hts.			mobiles	46.42
Powhatan Bch.			KGC909	46.50
Prince Frederick			KCO372	33.82
			KCR278	33.82
Riva			KGD323	46.50
			KGD323	153.83
Rockaway Bch.			KGC605	46.46
Rosedale			KGC607	46.46
Secretary			KAP753	46.06
Sykesville	mobiles	39.26	KGC765	33.94
Towson			KGC701	46.46
Waldorf			KGC622	46.42
W. Annapolis			KGC845	46.50
White Marsh			KGC629	46.46
Woodland Bch.			KGD724	46.50
Woodlawn			KGC632	46.46

MARYLAND COUNTY AGENCIES

Anne Arundel Co.

Annapolis	KGB645	39.58	KGD479	154.28
			KGD479	154.34
Millersville	KBC879	39.98		
Severna Park	KGB353	154.77		
	KGB419	154.77		
	KGB419	156.21		
	KGR249	458.55		

Baltimore Co.

Baltimore	KGA340	39.42		
	KGA340	39.44		
	KGA340	39.62		
	KGA340	39.72		
Catonsville			KGE206	46.46
Cockeysville			KGC337	46.28
			KGK762	46.46
Dundalk			KGE248	46.46
Edgemere			KGE209	46.46
Essex			KGE205	46.46
Fullerton			KGE210	46.46
Halethorpe			KGD224	46.46
Middle River			KCL506	46.46
Parkville	KGC983	39.42	KGE211	46.46
	KGC983	39.62		
Pikesville			KGE207	46.46
Towson	KGA340	39.42	KBJ658	46.46
	KGA340	39.44	KEY850-2	46.46
	KGA340	39.62	KGL513	46.46
	KGA340	39.72	KBT795	46.46
	KBP322	39.44	KBT795	46.46
	KBW809	34.99	KGC337	46.46
	KGA203	34.99	KGD295	46.52
	KGA339	34.99	KGC337	154.28
	KGA888	34.99		
	KGA890-3	39.44		
	KGA895	39.44		
	KGD993	39.44		
Woodlawn			KGE208	46.46

Calvert County

	mobiles	39.10		
	mobiles	39.30		

Carroll Co.

Westminster			KGN512	154.28

Howard Co.

	mobiles	155.37	mobiles	154.28
Clarksville			KDZ328	154.25
Elkridge			KDZ331	154.25
Ellicott City			KDZ326	154.25
			KDZ332	154.25
Jonestown			KGG529	154.25
Lisbon			KDZ327	154.25
Savage			KDZ330	154.25
W. Friendship			KDZ329	154.25

Montgomery Co.

Beallsville			KDT347	153.95
			KDT347	154.16
Bethesda	KCP560	154.71	KCP601	153.95
	KCP560	155.52	KCP601	154.16
	KCP560	155.64	KCP601	154.28
Damascus	KCP561	154.71	KCP600	153.95
	KCP561	155.52	KCP600	154.16
	KCP561	155.64		
Gaithersburg	KGA241	155.64	KCP599	33.78
	KGA241	453.55	KCP599	154.16
Hillandale			KDT349	153.95
			KDT349	154.16
Kensington			KDT345	same
Laytonsville			KDT348	same

WHITE'S EMERGENCY RADIO STATIONS

Station		Police		Fire
Rockville	KGA241	154.71	KGC334	33.78
	KGA241	155.52	KGC334	153.95
	KGB972	same		
Silver Spring	KFT235	154.71	KFT234	153.95
	KFT235	155.52	KFT234	154.16

Prince Georges Co.

Cheverley	KGA240	158.73		
District Hts.			KGA361	33.74
			KGA361	33.86
			KGA361	46.12
Forestville				33.74
Hyattsville			KGA361	same
			KGA361	154.28
Seat Pleasant	KFC749	154.95		

MARYLAND STATE POLICE

Baltimore	KGG862	39.10	39.26	44.74	
	KGN485	39.10	39.34	44.74	
Church Hill	KAU730	44.74			
College Park	KGA911	39.10	39.26	44.74	453.55
Ellicott City	KJD351	39.10	39.26		
Forestville	KGH654	39.10			
Frederick	KGA918	39.10	44.74		
Hughesville	KAU729	44.74			
Jessup	KGA915	39.10	39.26	39.34	44.74
	KAU736	44.74			
Marlboro	KJD349	39.10			
Prince Frederick	KGD979	39.10	44.74		
Quantico	KAU731	44.74			
Randallstown	KBC660	39.10	39.34	44.74	
Rockville	KGE796	39.10	39.26	44.74	
Sykesville	KAU732	44.74			
Towson	KGC866	44.74			

MARYLAND TOLL ROAD POLICE

Annapolis	KDL813-4	39.10	39.30		
	KGF986	39.10	39.30	44.74	
Chestertown	KGG415	39.10	44.74		
Fairfield	KDL812	39.10	39.30		
Glen Burnie	KBT576	39.10	39.26	39.30	39.34
		44.74			
Hallowing Pt.	KBS713	39.10	39.30		
Leonardtown	KGD716	39.10	39.30	44.74	
Pikesville	KGB744	39.10	39.26	39.30	39.34
		44.74			
Waldorf	KGA916	39.10	39.30	44.74	
Westminster	KGA917	39.10	44.74		

MARYLAND GAME & INLAND FISH COMM.

Owings Mills	KGE486	31.34	31.46	151.205	159.24

MD. DEPT. OF FORESTRY CONSERVATION

31.34 31.46 151.145 151.205 151.325 151.355 159.24 159.39

MD. STATE TAX ENFORCEMENT UNIT

Stevensville	KGE774	39.10	39.22

VIRGINIA MUNICIPAL AGENCIES

Alexandria	KIC737	453.55	KFB899	154.43
	mobiles	158.91	KIE939-43	154.43
	mobiles	158.97	KIM627	154.43
			KIN753	154.43
			KIG374	46.18
Baileys Cross				
Falls Church	KIB289	156.15		
Herndon	KIH761	39.54		
Vienna	KIK622	155.70		

COUNTY AGENCIES

Arlington County

Station		Police		Fire
Arlington	KIB346	158.79		
	KIB346	453.55	KIC338	154.13

Fairfax County

Alexandria			KEL429-30	46.08
Annandale			KEL431	46.08
Burke			KEL506	46.08
Centreville			KEL424	46.08
Chantilly			KEL426	46.08
Clifton			KEL425	46.08
Dunn Loring			KEL427	46.08
Fairfax	KIB950	39.54	KEL434	46.08
	KIB950	463.55	KEL436	46.08
			KBH638	46.18
Falls Church			KEL423	46.08
			KEM583	46.08
Forestville			KEL428	46.08
Franconia			KEL432	46.08
Herndon			KEL421	46.08
			KEL433	46.08
Lorton			KEL420	46.08
			KEL422	46.08
Vienna			KEL435	46.08

Loudoun County

Lessburg	KIG504	39.50	KIU862	46.30

VIRGINIA STATE POLICE NETWORKS

Base stations:	42.86	42.88	155.01		
Mobile units:	39.06	42.68	42.70	42.86	42.88

VA. STATE FISHERIES & FORESTRY NETWORKS

31.66 151.265 170.475 171.425

MISCELLANEOUS EMERGENCY UNITS

DC continuous weather forecasts: KHB36 162.55
Md. State CD nets: 47.46 47.50
Baltimore CD: 161.25 161.79
Prince George's Co. (Md.) CD: KGG524 47.62
D.C. hospitals: 155.16
Baltimore hospitals: 155.28 155.34

LAND TRANSPORTATION UNITS

DC Transit System: KGB421 31.14
DC Auto Emergency: KGG615 159.05 150.965
Baltimore & Annapolis Busses: KES909 43.72
Auto Club of Md.: KCT862/150.92 KCJ261/150.93
KGE416/452.55

AERONAUTICAL UNITS

Civil Air Patrol: 143.90 148.15
Aero Emergency: 121.50
Aero weather briefings: 122.60
FAA Flight Service: 122.20 126.70 135.90
Private aircraft enroute: 122.10 122.20
UNICOM: 123.00
Dulles Int'l. Airport Tower: 119.20 119.70 122.55 126.10
Friendship Int'l. Airport Tower: 109.70 120.40 118.70
121.10 125.90
Wash. Nat'l. Airport Tower: 109.90 118.10 118.30 119.10
120.80 126.55 127.00 134.10

RAILROADS

REA Express: Balt.-KGE870 DC-KDE998 160.68
Wash. Terminal: KEX505 160.29 160.35 160.44 160.62
Canton RR: KGX531 160.98
Pennsylvania RR: 160.80 161.34
Southern RR: 160.245 160.83 160.95
Wash. & Old Dominion RR: 161.16
Western Md. RR: 161.40
B&O RR: 160.23 160.32 160.41 160.53 160.89 161.07

Patapsco RR: 160.59 160.845 161.13 161.355
Richmond & Fredericksburg RR: 160.305 160.335 160.395 160.425 160.455 160.48 160.515 160.545 160.575 160.77 160.86 160.92 161.04 161.10 161.22 161.28

Baker Whiteley Coal: KGD253 156.50
Md. Shipbuilding: KGA563 156.55
Md. Drydock Co.: mobiles 156.55
Wilson Line: KWB451-3 156.80 156.90
Balt. Maritime: KDD601 156.90

MARITIME UNITS

Marine Calling & Emergency: 156.80
Ship-to-Shore Telephone: KGD518/KAQ383 161.90
Intership: 156.30 156.40
Chesapeake Bay Pilots: KGE257 156.60
Glidden Co.: KGD822 156.35
Bethlehem Steel: KGC339 156.45
Triangle Towing: KGW337 156.45 156.90 156.95

MOBILE RADIOTELEPHONE CHANNELS

ZA-33.42	ZM-33.38	JK-152.78	YJ-152.63	QA-454.45
ZB-33.54	ZO-35.26	JP-152.51	YK-152.66	QB-454.55
ZF-33.30	ZR-35.50	JR-152.81	YL-152.64	QF-454.65
ZH-33.34	ZW-35.62	JS-152.69	YP-152.60	QJ-454.40
ZL-35.66	ZY-33.46		YR-152.75	QP-454.50
				QR-454.60

Ask Me Another

Continued from page 22

for under $50 which will operate from a 12-volt battery. The roll of the boat will have no effect on the tape—but watch what you eat!

Need Address

I need the address of Standard Radio Corporation in America. I have a miniature radio which needs service, and cannot find the address.

—R.T., Pen Argyl, Pa.

It is 60-09 39th Ave., Woodside, N.Y. 11377. And the next time you need an address of a manufacturer visit your local library. Most electronic manufacturers are listed in the *Electronics Buyers' Guide,* published yearly. If they're not in there, try the *Thomas Register.*

Emergency Battery

I am planning to use a 12-volt automobile storage battery as an emergency power supply for my radio equipment and I would like to have some tips on the care of the battery. I would also like to know how long I should charge the battery with my one-ampere charger.

—S.M., Bronx, N.Y.

Get a hydrometer and check the specific gravity of the cells at regular intervals. It should be between 1.260 and 1.300 when the battery is fully charged.

Radio Heaven Maybe

I'm an SWL and tune in mostly on 25 meters. There, I occasionally hear a sound that might be produced by trumpets and a French horn. It is about three bars duration and repeats itself indefinitely. What is it?

—M. G. Z., McKeesport, Pa.

We don't know, but why don't you write lyrics for it—it just might make the top-ten. Can our readers help us out?

FM Is Not AM

Please tell me how to modify my FM receiver front end to extend its range from 108 MHz to about 122 MHz.

—L. J. H., Chattanooga, Tenn.

While it could be done, you wouldn't benefit since there are no FM stations up there, only AM aviation stations—which your set would not demodulate.

Wasted Watts

I have an old TV set that was given to me which I use only as a phono amplifier. I would like to make it more compact by eliminating the picture tube. However, I learned that it is in series with the rest of the set and the amplifier section won't function without it. Can I replace the tube with something smaller and still use the set as a phono amplifier?

—R. T., Harrisburg, Pa.

You're burning up a lot of kilowatt-hours of power running a whole TV set and making use of only two or three of its tubes as a phono amplifier. If the set draws 160 watts and you get one watt of audio out, you've got a mighty inefficient lash up. Since you can buy a comparable amplifier in kit form for as little as $10.95, why don't you have the trashman take away that old TV set? ■

"It's worth an extra 45 cents if you louse up the educational channel!"

New Products

Continued from page 15

Hey Mable! Packaged Cable!

Now you can buy your coaxial cable in handy dandy packages, thanks to Amphenol. The line includes pretested RF cable assemblies most used by communications experimenters, CBers, and hams. Pictured, for example, is a 20-ft. length of RG-58/U type polyfoam cable with Astroplated PL-259 connector on one end, spade lugs on the other. So now you don't have to bother with the salesman measuring and cut-

Amphenol Packaged Coaxial Cable Assembly

ting short lengths of cable and searching bins for the proper coax connector. There's also a 3-ft. package, ideal for use as a patch cord or communications jumper cable, between radio transceivers and linear amplifiers, coaxial switches, test equipment, etc. Other lengths go from 12 to 100 ft. Prices and literature available from Amphenol Distributor Div., Bunker-Ramo Corp., 2875 S. 25th Ave., Broadview, Ill. 60153.

By Jupiter! Via Telescope

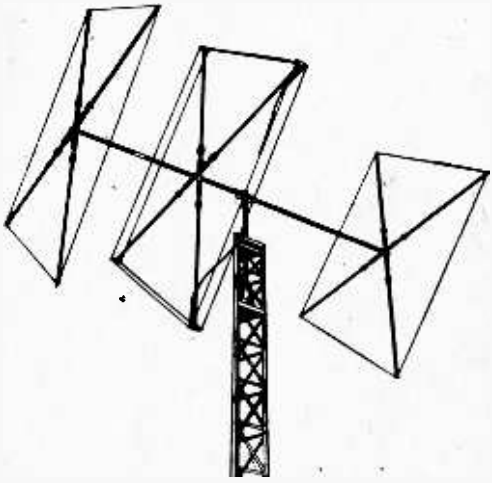
Now that all the world is an astronomer, wouldn't it be wonderful to have your own backyard telescope? Can't afford it? Edmund Scientific have put on the market a 6-in. mirror telescope optics kit (stock No. 71,191) for $75.00 which would cost about $250.00 already assembled. The mirror itself is already ground and polished, aluminized and overcoated, and there's a ⅜-in. thick elliptical diagonal with 1¾-in. major axis and 1¼-in. minor, a 28 mm

Edmund 6-In. Mirror Telescope Optics Kit

focal length Kellner eyepiece with 50° field of view and standard 1¼-in. barrel diameter and 2 achromats mounted in black anodized aluminum. The kit comes with a 36-page book, "Telescopes You Can Build," as well as specific instructions. The 6-in. reflector telescope will pick up four times as much light as a 3-in. scope, enabling you to view stars up to the 13th magnitude and resolve star clusters. To order by mail, or for more details write Edmund Scientific Co., Edscorp Bldg., Barrington, N.J. 08007.

Join the Mod Squad

Here's a new Mosley CB cubical quad with polarization which they're calling the Mod Quad (Model MCQ-27VH). The switching system includes a double radiator element, two gamma matches, and a polarization control box which permits polarization change at the flip of a switch from within the base station. The Mod Quad has three widely spaced elements on 14-ft. boom for top gain. High directivity elim-



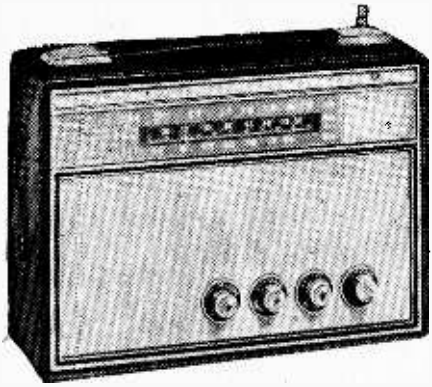
Mosley Mod Quad MCQ-27VH

inates unwanted side and back signals and low radiation angle keeps the signal close to the ground for maximum distance. Construction is of copper-coated steel wire, heavy-duty aluminum tubing, molded high-impact insulators, and stainless steel hardware. Feed point impedance is 52 ohms nominal, and the unit has forward gain of 9 dB compared to reference dipole, 11.1 over isotropic source. The Mod Quad withstands a wind load of 151 lbs. and weighs about 40 lbs. Price is $122.05 and you can get more specs from Mosley Electronics, Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042.

We the People Want Public Service

Included in Channel Master's new line of public service band communications receivers is Model 625A, which covers the 30-50 MHz

low band and the 147-174 MHz high band. It has three separate tuner and converter circuits with four IF stages for best sensitivity, selectivity, and signal-to-noise ratio. It operates on batteries or AC through a built-in power supply and battery rejuvenation circuit. The 6252A fea-

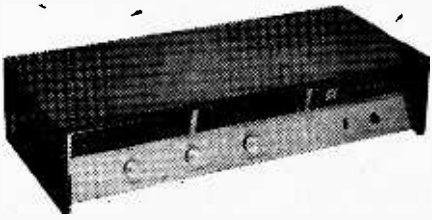


Channel Master 6252A Police-Public Service Band Receiver

tures variable squelch, and is supplied with an external antenna connecting cable for mobile use with standard car antennas. And there's a write-on log panel to record most-used frequencies. Dual Band Model 6252A price is $59.95 and you can write for further information to Channel Master, Ellenville, N.Y. 12428.

Reverrrrrb!

You can convert your sound system, stereo or monaural, to full-dimension reverberated sound with this new Gibbs Reverberator. Featuring a 10-watt amplifier specifically designed for reverberation, the unit uses solid-state components. Distortion is less than 3% at 1000 Hz, and both input and output impedance is 8 ohms. There are terminals on the rear panel for stereo or monaural amplifier leads and an auxiliary speaker. Controls on the front panel permit full tone control and the amount of reverberation desired. You can also run the music source without turning on the reverberation unit or

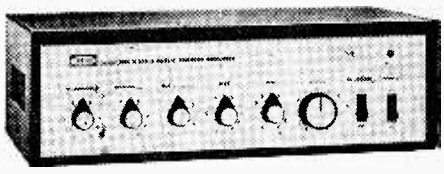


Gibbs Reverberator

disconnecting any amplifier or speaker leads. Price is $70.00 and further information may be obtained by writing to Gibbs Special Products Corp., 450 N. Main St., Janesville, Wis. 53545.

Now Hear This! PA Amp!

The new Allied 45-watt public address amplifier, model 3246T will power sound columns, outdoor weatherproof trumpets, indoor baffled speakers, or may be packed into a speaker case for portable use. It features a silicon-transistor circuit, inverse feedback, sound reproduction for paging, voice, or music distribution. The 3246T has microphone precedence—permitting paging over a program in progress. Rear of chassis has an AC outlet, and a low-frequency filter may be switched in to cut feedback and protect speakers from overload. Mike inputs are switch-controlled for low or high impedance. There are two auxiliary inputs to connect a phonograph, tuner or tape recorder. It can be used in either constant-voltage or standard im-

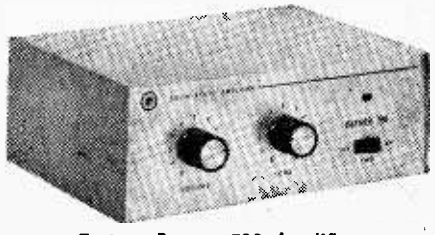


Allied 3246T Public Address Amplifier

pedance installations. Other features: separate calibrated bass and treble controls, gain controls for mike and auxiliary inputs and extra large master gain control. Frequency response is 40-10,000 Hz. The 3246T amplifier is priced at $79.95 and you can get an optional top-mounting 4-speed turntable for $24.95. Write Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680 for info.

Neat Li'l Amp

We have here model 790 from Trutone Electronics, an all-silicon solid-state audio amplifier with a sine wave output of 6 watts. Can be used at home, in offices, schools—anywhere you want microphone paging or music. The amplifier is supplied with one input for high-impedance microphone or music; speaker output is 8 ohms, 25-V line, 70-V line. Housed in a tan metal cabinet measuring 7 x 6⅛ x 3⅛ in., the unit is said to have foolproof operation. Should the output of the amplifier be shorted, mismatched, or have no load no harm will come to the transistors. Carrying a warranty of one year, the 790 is priced at $61.50. For further information write to Trutone Electron-

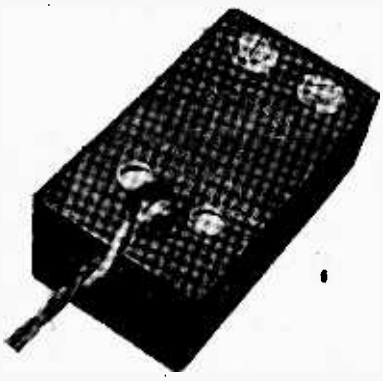


Trutone Raymer 790 Amplifier

ics, Inc., 14660 Raymer St., Van Nuys, Calif. 91405.

Swing from SWL to BCB

Mosley Electronics' TRS-57 transformer-balun for SWL antennas has been developed to adapt their SWL-7 and RD-5 shortwave listening antennas to receive standard broadcast bands below 4 MHz. The transformer-balun automatically transforms the doublet into the long wire antenna necessary for broadcast

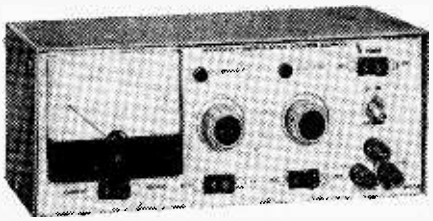


Mosely TRS-57 Transformer-Balun

band reception, eliminating the need for an additional antenna to receive local stations and distant cities. On regular shortwave bands, the TRS-57 acts as a balun to provide balanced receiver input. You can install it on the back of your SWL receiver with a screwdriver. Adaptable to any shortwave listening doublet, the TRS-57 is $7.43 and more information can be had from Mosley Electronics, Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042.

Are You a Solid-State Experimenter?

Heathkit's new IP-28 regulated power supply should appeal to experimenters who work with solid-state circuitry. Without using the



Heathkit IP-28 Regulated Power Supply

sensing terminals it delivers up to 30 VDC at 1 amp maximum load with less than 50-mV variation. There's a Remote Sensing feature that reduces the voltage variation at the load to less than 20 mV. A front panel rocker switch selects either 1-10 VDC or 1-30 VDC ranges, and the output is continuously variable. The IP-28 also has variable current limiting in two switch-selected ranges from 10-100 mA or 10 mA to 1 A. A 3½-in. meter can be switched to read either voltage or current, with two pilot lamps indicating which is being monitored. Styled in beige and brown like the rest of their instrument line, Heath says the IP-28 goes together in about 8 hours with circuit board-wiring harness assembly. Price is $47.50 and you can get more specs from Heath Co., Benton Harbor, Mich. 49022. ■

BOTDC Motor

Continued from page 35

start, disconnect the battery and transpose the connections to L1. This reverses the phasing of this coil. Reconnect the battery and your motor should run merrily along. If it doesn't, you must have made an error in wiring that was not revealed when you double-checked it. It's easy to make a mistake in connecting the transistors or diode, so check them once more.

When the motor is running properly and the speaker switch is turned *on*, you'll hear a clicking in the speaker every time a magnet passes L1 and generates a pulse. The repetition rate of the clicks will increase as the speed of the motor increases.

Whenever the motor isn't operating be sure to place the magnet keepers on the magnets and also be sure to remove them whenever you want to run the motor.

To make an attractive unit for a display, why not paint the baseboard and the rotor disc and magnets in contrasting or complementary colors? Perhaps the addition of an old commutator and brushes removed from a discarded conventional motor and some old worn-out ignition points that have been removed from your car can be worked into your display. These would show the difference between the older methods of switching current to make a motor run and the use of transistor switching to accomplish this function and how your Transistor Motor has done away with parts that wear out.

This project will provide you with mechanical, electrical, and electronic experience and could, at the same time, also win a prize for you at your next science fair. So go ahead and get started now and be ready in time for the competition. ■

EICO Tube Tester

Continued from page 73

the tube is *N.G.* and no further checks need be made. If the lamp is out, the user depresses the *quality* switch and gets a *good* or *bad* meter reading.

Supposedly, the EICO 635 can indicate a short between a tube's #1 and #2 grids, and the tube data book gives a test procedure. Unfortunately, the instructions say "move the designated switch", but nowhere does anything indicate which switch is the "designated switch". (Your unit may come with an addenda to the instructions.) Permanently attached cables for testing tubes with grid cap and CRTs are always at hand in the storage compartment.

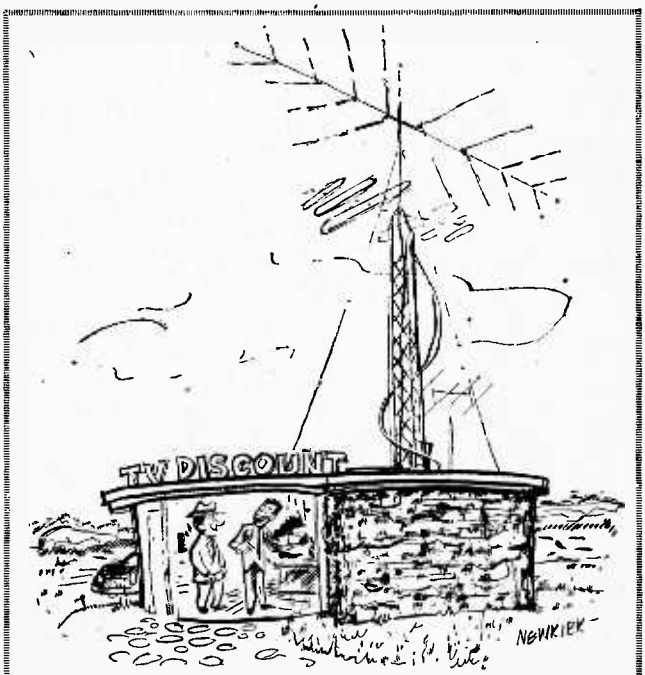
Getting Into Theory. The EICO 635 is an *emission* tester, meaning it expresses a tube's quality in terms of the cathode's electron emission. This testing technique is based on the generally correct assumption that a tube which puts out a normal emission is *good*, being *bad* when the emission is below the rated specification. (The 635 automatically selects the correct meter range for a good-bad indication.)

The emission check is made by converting the tube to a diode by shorting all the grids and plate together. In effect, all grids become a plate. Thus, the only active tube elements are a cathode and plate (a diode). Since the plate current of a diode for a given value of plate-to-cathode voltage (all other circuit constants being equal) is determined by the cathode emission, the number of electrons streaming from the cathode at a given voltage, the meter can be calibrated to indicate the degree of cathode emission in terms of *good* or *bad*. As a tube ages the cathode coating burns off, and the emission falls with the loss of coating. When the tube can no longer emit sufficient electrons the tube function fails.

Limited Filament Voltages. The EICO 635, as do many other modern tube testers does not provide every single filament voltage in current use; in fact, only 8 colleges are provided. The tester, however, is calibrated so that the meter readings are correct for any tube, based on the recommended filament voltage. For example, a tube with a filament in the 6.3 to 8.4 volt range is checked with 6.3 filament volts. Within a given tube type, the meter readings are a relative indication of quality (emission) between different tubes. As with other emission tube testers, you cannot relate the meter readings between different tube types, so don't try.

An interesting feature is a bank of plastic tube pin straighteners across the top of the panel that, while they do not straighten the pins in exact alignment as do metal pin straighteners, they at least ensure that the sockets will not be damaged by misaligned tube pins.

The EICO 635 kit is simple enough in the sense that there aren't many components, just innumerable interconnecting wires between the sockets. If you take your time connecting to the tube sockets, there's just about nothing that can go wrong. For additional information write to EICO, 283½ Malta St., Brooklyn, N.Y. 11207.



"Of course, there's too much interference around here, but it will play a lot better when you take it home!"

Biafran Radio

Continued from page 45

officially unofficial French airlift, via her former colonies of Gabon, Dahomey and the Ivory Coast, brought in just enough arms and ammuntion to shore up the tottering regime.

This Trip Was Special. One afternoon last October, an antiquated DC-4, one of eight planes on the Gabon-Biafra run, stood on the tarmac of a military airport at the edge of the sea, seven miles from Libreville. Under the watchful eye of French security men, sweating Gabonese loaded the aircraft. An hour later, the flight crew, three Frenchmen, drove up in a tiny Citroen. By 6 p.m. their plane was airborne, on its way to Uli, 450 miles away. Usually these flights carried long, rope-handled ammo boxes and army rations. That evening, though, the cargo was different.

A half hour out of Annabelle, code name for the Uli strip, cabin lights were switched off. Landing flaps lowered, the plane descended through the warm darkness. Parallel rows of runway lights flashed on below. The DC-4 settled bumpily on the widened stretch of highway that serves as Biafra's international airport. Immediately, the field's lights went out.

A Biafran ground crew skillfully and swiftly shifted the large crates from the aircraft to waiting trucks. Two hours and sixty miles later, the special cargo arrived at its destination, a hidden transmitter site just outside Umahia.

In the wooden crates were a brand new shortwave transmitter and a gas-fueled generator to power it. The compact, 10 kilowatt transmitter had been purchased secretly in Europe from the Swiss electronics company, Brown, Boveri and Co. Ltd. Possibly because the Swiss government had chewed out a munitions maker for selling arms to Biafra, the Baden, Switzerland electronics firm wasn't about to say much about the deal.

"We're not in a position to answer any of your queries," a company spokesman wrote tersely.

The Biafrans, though, were more talkative. The transmitter, it was explained, was converted to portable operation by B.C.B. technicians. In a short time it was broadcasting on 7304 kHz., replacing the old home service transmitter that had been wandering around the low end of 60 Meters.

Signals On—Shift! In November, the foreign service was moved to 6100 kHz., to avoid increasing interference. This frequency shift lasted until last February when the Voice of Biafra returned to 6145 kHz.

The two oldest transmitters, the then eight-year-old Pye equipment, were retired after hard service. The 49 Meter band station was installed in a supposedly permanent side, a converted home outside Umushia, and connected to a directional antenna, beamed west. The new transmitter, its programs aimed eastward, was parked nearby.

A mile away, studios and administrative offices were beehives of activity. Broadcasts were prepared by high-powered groups of civil servants and university lecturers. Research and writing involved the work of 40 separate committees. The Newstalk group scripted at least three different broadcasts each day. These were later reprinted in the official Biafra Newsletter publication. A trio of college profs and four assistants, the Outlook program committee, turned out six topics daily. Because there were more trained broadcasters than were needed, some of the staff joined the army. Others visited refugee camps to bring cheer to the destitute. Still others, unemployed musicians and performers, formed a Biafran version of a USO road company.

USO—Biafran Style! One rainy afternoon on the Owerri front, soldiers of the Mongor and Destroyer Battalions waited in the muddy marketplace of an obscure village. Eventually two tired buses plowed through the mire into the square. A cheer went up as a troup of men and women entertainers climbed from the vehicles.

For an hour, a first class band, several singers and a chorus line, described by a Radio Biafra staffer as "mouthwatering," entertained the Ibo GIs. Then it was back to the buses and a jolting ten mile ride to the next bivouac.

The long expected push on Umuahia came last April. Several weeks of fighting forced the Ojukwu government to again move its capital, this time to Orlu. On the 14th, the stations moved for the third time. But several days later they were back on the air again.

Tune In Biafra! Today, Radio Biafra, still operating from Orlu, is best heard around 0430 sign on a frequency that varies from 7301 to 7312 kHz. The Voice of

Biafra signs on at 0455 GMT, on 6145 kHz., but is often hard to hear because of interference.

The war cut off all regular postal service and for a long time SWLs were unable to get verifications from the Broadcasting Corporation of Biafra. But where there's a will, there's a way, and enterprising DXers finally figured out how to get their QSLs.

Reception reports may be sent to P. C. Chigbo, a special Biafran representative and former radio administrator, at Box 8861, Abidjan, Ivory Coast. Chigbo welcomes reports that "show the time of reception (GMT), name of announcers and any details of reception and the degree of clarity and strength of broadcast." He's not saying how, but he has ways of getting these reports to station officials inside the isolated country.

Or, you may write to C. A. Onyeáni, Suite 814, 342 Madison Avenue, New York, N.Y. 10017, and request that he forward your letter to the proper authorities for reply. In either case, at least *four* international reply coupons, available at your post office, should be enclosed. Replies often take a number of months.

What does the future hold for Biafra? No one can say. But Biafrans think they can make their independence stick. If they do, a large share of the credit must go to the dedicated men and women of incredible Biafran Radio! ■

Radio Shack Globe Patrol

Continued from page 66

try different amounts of feedback and bias for optimum performance on each band. (It may be necessary to remove the two screws that support the speaker to interchange some components.)

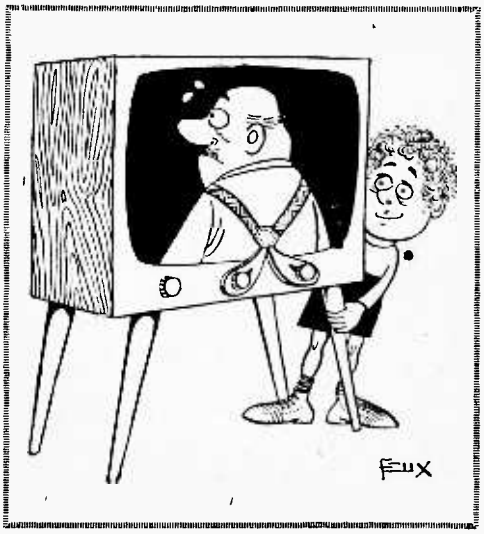
Experimenter projects. First thing is to soup-up each band to maximum; all except band A which has no adjustment. Note that the amount of positive feedback is determined by the capacitors connected between Q1's collector and the coils' feedback winding: C13, C14 and C15. If the capacitors are too small there is not enough sensitivity and you'll hear very little. If they are too large the receiver will break into a permanent squeal. Best results are obtained with a specific value of capacity, so try different values *between the two* supplied with the kit. Because the tolerance of Q1 is very broad you might even get better performance with capacitors values slightly *higher or lower* those supplied.

Next, try different transistors at Q1 to see the effect of *converter* and *amplifier* types. Any transistor manual will list similar transistors to the 2SA518 that is supplied. You might also try some general purpose or audio types to see the effect of transistor high frequency cut-off (you won't hear high frequency signals). Just remember to use pnp transistors, and to cross over Q1's base lead when installing the transistor or you'll wind up with interchanged collector and emitter leads. Different transistors may require different feedback capacitor values for optimum performance.

Next, try a few junk-box transistors at Q2 to increase the audio amplification. Don't use transistors with a Beta (gain) in excess of 200.

Just keep in mind throughout your experiments that the Globe Patrol is not going to deliver "great" performance. It's strictly a *fun* project that will receive medium to strong signals to about 13 MHz.

Go Get It, Tiger! The Globe Patrol Shortwave Receiver is on sale at all Radio Shack stores or by catalog direct from Radio Shack, 730 Commonwealth Ave., Boston, Mass. 02215. Here's your quick and easy way to discover the world of shortwave receiver experimenting. ■



The Skies Above Us

Continued from page 58

edge; leave a column for writing in the number of meteors observed in a 15-minute interval; leave some more room for any notes, such as "very bright," "faint," or a distinctive color or whether it left a persistent streak behind it or even burst. Whenever it is necessary to make notes, it is best to be equipped with a small flashlight whose glow is filtered through a taped-on piece of red cellophane; red light does not destroy the eye's dark adaptation. Fourth, here is where it is valuable to know the constellations, or at least to be able to find them on a star map, so the apparent path of the object can be indicated. Special skeleton maps on which paths can be marked will be supplied to serious observers by Dr. C. P. Oliver, American Meteor Society, Narberth, Pa., 19072. Write to him for conditions. Copies of your records should be sent to the same address.

★ As any hunter goes out for his game at a time and place most likely to yield some results, so the meteor hunter may choose the best time as well as a good place, as described earlier. Let's stay with the "random" meteor, for which the correct designation is "sporadic." We should see more of them after midnight than before, as the diagram indicates, because then we are on the "front" half of the earth in its orbital motion and, assuming that they come in equal numbers with equal average speeds from all directions, we meet them head-on, whereas before mignight, they must catch up with us. They too revolve around the sun, in an infinite number and variety of orbits.

★ It may be interesting to some of the readers of this magazine to know that radar has been very valuable to us in extending our knowledge of the number and the paths of meteors, even by day. In bludgeoning its way through the atmosphere, the tiny particles ionizes molecules of the air, and these tracks will be detected by radar, even if the particles themselves are far too small to reflect the waves.

★★ In Mark Twain's delightful *Eve's Diary,* he has her say, "By watching, I know that the stars are not going to last. I have seen some of the best ones melt and run down the sky."

★ If anyone has ever written a lovelier or more graphic description of the appearance of a meteor, I have never seen it. And then she goes on: "Since one can melt, they can all melt; since they can all melt, they can all melt the same night."

★ And so it must have seemed on the night of Nov. 12, 1833, two years before Mark Twain's birth, according to an account in the *Georgia Courier:*

> *". . . . At about 9 p.m. the shooting stars first arrested our attention, increasing in both number and brilliancy until 2:30 a.m., when one of the most splendid sights perhaps that mortal eyes have ever beheld was opened to our astonished gaze. From the last-mentioned hour until daylight the appearance of the heavens was awfully sublime. It would seem as if worlds upon worlds from the infinity of space were rushing like a whirlwind to our globe . . . and the stars descended like a snowfall to the earth. . . ."*

At Boston, that night, one actual count for the fifteen minutes before 6 a.m. led to a total of more than 30,000 meteors per hour! While it was this shower of meteors in 1833 that produced a burst of interest in these evanescent objects, there had been a shower of almost equal importance on November 11, 1799. On November 13, 1866, in Europe, and at the same time of year in 1867 in America, other showers were seen, but they were less spectacular than the one of 1833. These meteors all appeared to emanate from a small region in the constellation Leo, from which they gained the name Leonids. Because of the apparent periodicity of about 33 years, they were anticipated in 1899, 1900 and were disappointing. In 1901 the rate of the Leonids was only about 800 per hour, and since that time the shower had been disappointing until in 1966, when in the hour before dawn of Nov. 17 in Arizona, the rate was estimated at 150,000 per hour!

★ Showers of meteors coming from the direction of the constellation Pereus have been traced as far back as 902 A.D. and there is one possible occurrence recorded by the Chaldeans about 2700 B.C. These Perseids are usually quite reliable, although not very numerous. Around Aug. 12, each year, a single diligent observer might see as many as 50 meteors per hour, between 2 a.m. and dawn, and most of them will be Perseids.

★ In 1741, 1798 and eight times during

the nineteenth century, fine showers of meteors radiating from the constellation Andromeda were seen, in late November. In 1885, the rate was estimated as 75,000 per hour! But the last time this shower was seen, and then by no means as spectacular, was in 1899, although a few of the meteors may be seen each year. But in this shower we find the reason for such displays.

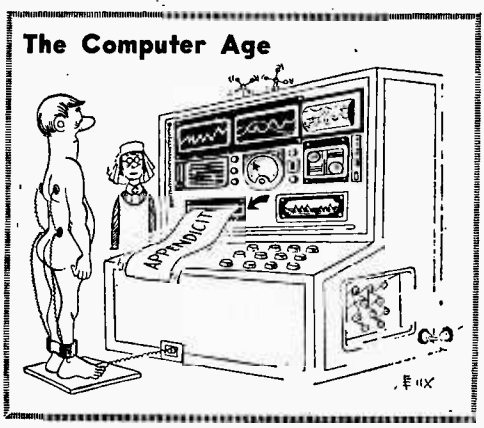
★ In 1772, an astronomer named Biela discovered a comet which revolved around the sun in a period of 6.2 years. It was seen again in 1805, 1825 and 1832. In 1845 it was seen to have split into two comets, perhaps because of a close approach to Jupiter, and it returned again in 1852 as double, with the two objects much further apart. Since that time, the comet as such has not been seen, but there was a good meteor shower from Andromeda on Nov. 27, 1872, a few weeks after the comet should have passed, and a faint hazy patch of light, rapidly fading, was seen in the opposite point of the heavens, which may have been the gases in the comet's head.

★ The meteors followed the path of the comet and so other showers have orbits that are those of known comets. In 1862, Lewis Swift discovered a comet whose path is the same as that of the Perseid meteors, with a period of about 120 years. The astronomer Tempel discovered a comet in 1866 whose orbit is the same as for the Leonids, with a period of 33 years. Our present view is that the head of a comet contains the kind of friable particles that are the meteoroids that produce ordinary sporadic and shower meteors. By collision, they knock each other about and some of them leak out of the comet. Sometimes they remain fairly close together, for the most part, and then we have meteor showers like the Leonids—a few each year as we cross the comet's orbit, but a big shower when we get in step and encounter the main mass. The Perseids seem to be strewn more uniformly along the comet's orbit, to produce more or less the same kind of shower every year. Perhaps this indicates that the particles have been leaking out of the comet for a long time.

★ Sometimes the comet has been known first and sometimes the shower has been known first and the comet discovered later. We have some showers well established with no associated comet known. The Geminids, with their maximum predicted this year for the nights of Dec 12 or 13, fall in this last category. Perhaps their parent comet has been so depleted that it, like Biela's, will not be seen again, or it has not yet returned to our neighborhood in recent centuries. The hourly rate of about 50 meteors, year after year, similar to that of the Perseids, may indicate an old, long-period comet.

★★ When an exceedingly large meteoroid is not entirely consumed by its passage through our atmosphere, we call the remaining portion of it that falls to the ground a meteorite, especially when we can pick it up and put it on display. It is generally agreed that a meteoroid must have a mass of at least ten pounds when it enters our air, about 70 miles up, before any appreciable part of it—say, about one ounce—can survive the beating the original object takes. Even so, a conservative estimate is that, on the total land area of the earth, more than 500 such bullets from space come to rest in an average year. When we consider how much of the land is desert or forested or uninhabited for other reasons, it is not remarkable that our museum cases are not stuffed to overflowing. It is a remarkable year when more than three or four previously unknown meteorites are announced, either "finds" from old landings or "falls" from objects actually observed as very brilliant meteors, perhaps accompanied by horrendous sound effects.

★ A meteor so bright that it attracts attention even if you aren't looking at the sky is called a fireball. One that is very brilliant and explodes, splattering the sky with fragments, is a bolide. These exciting bright objects are likely to be meteorite-droppers and the professionals depend upon amateurs and average citizens for help in observing them. But this field is so great that it must be saved for another time. ■

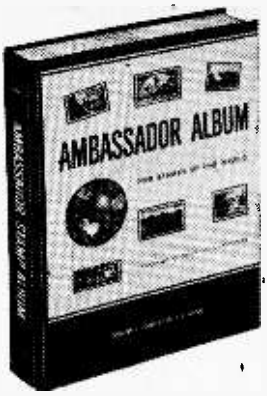


Stamp Shack

Continued from page 29

that a gigantic press capable of printing intaglio stamps in nine different colors in a single run, word was released that it was in the process of acquiring another one to produce stamps by the rotogravure process. Once in complete operation, it no longer will be necessary to contract with private printing firms for multi-color issues, such as was done with the last two "American Arts" stamps.

● A brand new, completely revised and updated edition of the Ambassador, a leading world-wide stamp album in its price range, has been published by H. E. Harris & Co., Boston. To be certain that the new edition would provide only for stamps which are currently easy to obtain at low prices, every page of the previous edition of the Ambassador was reviewed, and many revisions made. This principle enables the collector to fill the entire album without great expense. The new volume has historical and geographical descriptions of 150 nations, useful "How to Collect Stamps" guide, Stamp Finder, Collector's Dictionary, and a colorful World Map revised to show the very newest countries. The album's handsome vinyl-covered binder can be expanded to accommodate annual supplements and/or blank pages. The 1969 Ambassador Album is available at $4.50 from dealers or from the publisher. H. E. Harris & Co., Dept. O, Boston, Mass. 02117.



H. E. Harris Co. Ambassador Album

● Another helpful book is "Know Your U.S. Stamps," released by Scott Publications, 488 Madison Ave., New York, N. Y. 10022. The 94-page book, which also sells at $2.50, is a compendium of information which will assist the average collector in distinguishing between the many domestic issues whose designs many seem casually the same, but which have slight differences of engraving, paper, watermark or perforations and therefore are considered separate varieties. ■

Twinkling Star

Continued from page 49

lamps, are neatly mounted to a 2½ x 5⅛-in. terminal board having two rows of 12 terminals in each row staked at ½-in centers. The two rows are separated about 2 in. apart. After mounting resistors, capacitors, and the diode to the terminals as shown in the photo, fasten the terminal board to the base of the box. Use ¼-in. spacers to raise it from the metal base in order to prevent possible shorts. Be sure to observe correct polarity of the electrolytic capacitors and the diode rectifier.

Now, temporarily connect the lamp leads to the terminals and plug the power cord into an outlet. The lamps should blink on and off at random. Observe the stepping sequence and change the temporarily connected lamp leads around until you have oriented them to a stepping sequence you prefer (clockwise, counterclockwise or random), and then solder leads to the terminals.

We mounted two clips on the outer surface of the removable half of the box to facilitate clipping the star to the tree. We also cemented a gold Christmas seal centered on the front of the star to decorate it.

Forms other than a five-pointed star can be made from appropriate material and fitted with the flashing lamps. For example, you can make a candelabrum, an odd animal form, a facsimile of a building, etc. Use your imagination and build interesting animated decorations. ■

Horn Speakers

Continued from page 75

of the wood base. This'll help protect polished surfaces.

To mount the horn on the base you'll have to shop around for flanges, fittings, etc., that will allow you to join the neck of the horn to the box. If you want the horn to mount flush on the base (like the author's models), you'll have to disassemble the magnet assembly in the horn and then bolt the horn in place with fairly large wood screws. Be sure to mount a small speaker inside the horn if you choose the flush installation. ■

Ham Traffic

Continued from page 51

lines to be written, code practice to be conducted, all these in addition to the obvious duty of giving the class lectures and administering novice or technician exams. Hams who have engaged in such activities, especially to help handicapped persons learn to become hams, generally report they began to appreciate their hobby much more when they saw how hard others have to work to join the ham ranks.

Get Out Doors. Field Day can become a big thing for a club in the preparation for it is spread out over several months, so that it can be well organized instead of just a last-minute hurry-up mass of confusion. Advance preparation for Field Day is being frowned on by some operators as not in keeping with the "spirit" of this activity, but I disagree. One of our obligations as radio operators is to provide communications for emergencies if we're needed, and Field Day is supposed to be a test of our ability to operate under emergency conditions. You certainly can't argue against adequate *preparation* for emergencies, so I believe advance preparation for Field Day is right in keeping with the purpose of this contest. Just as our traffic nets operate every day of the year, handling routine messages, to keep in practice for the emergency that could come anytime, so I believe advance preparation, and maybe even some practice runs, are appropriate for Field Day. Maybe some of this activity could charge the batteries of YOUR club.

For your Hammy Calendar. With tongue in cheek, the editor of The Blurb, published by the Phil Mont Mobile Radio Club of the Philadelphia area, inserted this notice in the club paper: "The Tuesday Evening SSB Net will meet on Fridays during April instead of Mondays as originally scheduled. After April, the net will resume operation each Wednesday, since most of the members have been unable to get together on Sunday evenings anyway."

Now, is that clear, everybody?

Up, Up, and Away. With manned trips to the moon again making space exploration a front page item, members of the Space Center Amateur Radio Society at the Kennedy Space Center, Florida, have been giving quite a few hams a big thrill by making on-the-air contacts at the time of important launchings.

Operation at the club station, WB4ICJ, at the Space Center begins at the time of lift-off of the giant Saturn booster which send our astronauts to the moon, and continues as long as the energy of the operators holds out—generally 8 to 10 hours, I'm told.

To everyone contacted during this period who sends a QSL to the club along with a few stamps to cover expenses, the club sends a certificate prominently featuring the designation of the launch which occurred on the date of the contact.

A photo of some of the station operators in action during a launching is shown with this ham column.

Frequencies used by WB4ICJ during launches, according to information supplied by Ambrose Barry, W4GHV, the club's publicity chairman, are 3975, 7275, 14,340, and 21,340 SSB plus 15-meter novice CW. Although the club has been using only dipole antennas, they have made numerous DX contacts in addition to the hundreds of stateside contacts. Some stations have had to "wait in line" literally for hours to make contact following major space launches.

Members of the club include both government and industry employees at the Space Center. Meetings are in the Space Center Headquarters building at 4:30 p.m. on the second and fourth Tuesdays of each month, with visitors welcome.

Herb Gatchell, WB4HZB, is club president, and the club's mailing address is Box 21073, Kennedy Space Center, Florida 32815.

You're Welcome to Butt In. That, in effect, is what K3HNP said in an item in the Penn Wireless Association paper, the X-Mitter. He was explaining the use—and often the misuse or misunderstanding—of the signal QSK, which can be very handy on CW.

This signal, when used as a statement, says "I can read you between my signals." In other words, it tells the other operator "When my key is up, I can receive." This allows the receiving operator to butt in—there's no need to wait until the end of my transmission. This is a virtual necessity in efficient CW traffic handling, but it's mighty handy in CW rag chews as well.

It allows a station suddenly troubled with interference to tell the other guy about it—so the two of them can wait until the interference ceases, or move to a different frequency if they wish. It also often allows the

(Concluded on next page)

Ham Traffic

Continued from previous page

sending operator to realize when interference affecting his reception begins, or when a third operator wants to join the QSO.

How is this done? Simply with an electronic TR switch—either a tube or a solid state gadget which connects the receiver to the antenna. This TR (meaning transmit-receive) switch replaces the old fashioned antenna changeover relay. Whenever the transmitter is not actually transmitting, the receiver is immediately re-connected to the antenna so the sending operator can hear what's going on whenever he's not sending—even between the dits in a letter "I," if you please!

Such TR switches often are built right in some of the modern ham gear on the market. For older gear, there are several easy-to-build designs available in the popular ham handbooks, and there are several good commercial units on the market.

So the next time you hear a guy sending "QSK," you'll know what he means. And don't wait too long before you get equipped to say the same thing! Once you've tried it, you'll wonder how you ever got along without this convenience. ■

Famous Patents

Continued from page 36

aid of a series of small grants from the Smithsonian Institution. By 1923 he had designed a rocket engine that ran on liquid fuel—the forerunner of the great Saturn rockets that are powering the Apollo moon flights.

It was a test of a liquid fueled rocket that focused national attention on Goddards work. On a summer evening in 1929 he sent a 12-ft. instrument-laden rocket into the air from a launch site on the family farm in Massachusetts. The liquid fuel burned with a brilliance that could be seen for miles. Nearby residents reacted quickly. Thinking it was an airplane, in flames and crashing, they sent for fire engines and ambulances. When the furor died down, Goddard was left in the unenviable position of having to explain it to local officials as well as to reporters who had come searching for a sensational story. The resulting publicity led short-sighted Massachusetts officials to issue an injunction against further rocket launchings. Fortunately, however, the newspaper accounts attracted the attention of Charles A. Lindbergh who, in turn, brought Robert Goddard to the attention of the wealthy Guggenheim family.

With financial aid from the Guggenheims, the scientist was able to continue his experiments at a new test site in New Mexico. There, in a friendlier atmosphere, he carried on his work on liquid-fueled rockets. His experiments led, ultimately, to the granting of more than 200 patents. But there was little enthusiasm for rockets or space exploration in the United States during the 1930's. Even with the beginning of World War II, the Allied military authorities foresaw only limited applications, such as bazookas.

During WW II. In Germany, however, top-secret developments of rockets for military use had been underway for some time. The dramatic results of Hitler's rocket program came in 1942, when England was attacked by German V-2 rockets from a secret launch site on the continent. When the first of these rockets was captured intact and examined, it was discovered that it used many of the principles disclosed in Goddard's published patents. Although the U.S. military leaders had largely ignored Goddard's inventions and patents, the Germans were much wiser and did not—much to the regret of the people of England.

In his own country, full appreciation of Goddard's efforts came too late. The U.S. space race did not begin until after his death in 1945. When it did begin, his earlier discoveries played a vital role in the progress that has led so rapidly to the current exploration of the moon.

At one time it was said that the United States could not send up a rocket or put a satellite in orbit without infringing on one or more of Goddard's 200 patents. Official recognition of this fact came in 1960—fifteen years after his death—when the United States government awarded one million dollars to Goddard's widow and to the Guggenheim Foundation for infringement of the patents. ■

Copies of Goddard's Rocket Apparatus patent are available for fifty cents each from the U.S. Patent Office, Washington, D.C. 20231. In ordering, give the number of the patent—No. 1,102,653.

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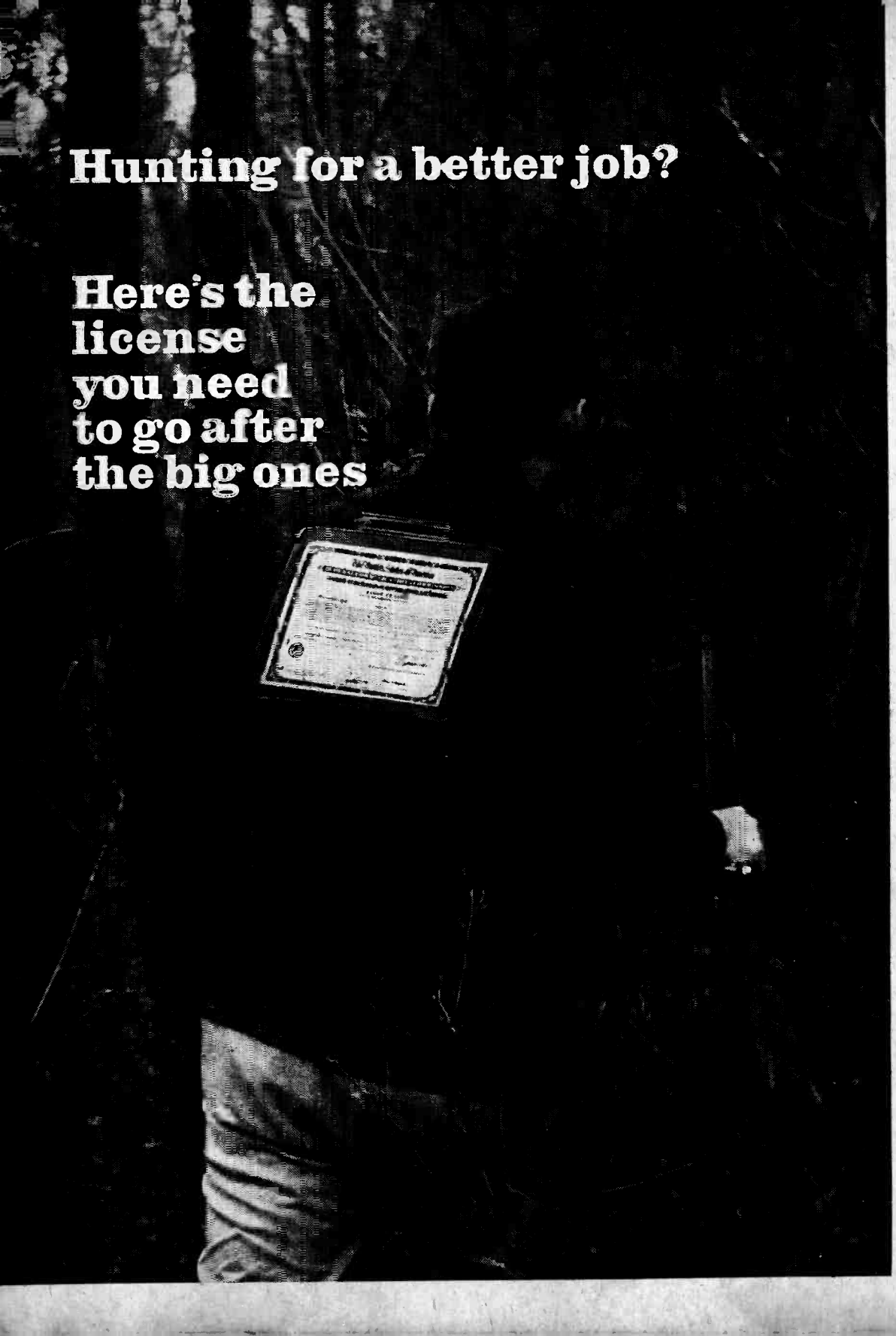
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So why doesn't everyone who wants a good job in Electronics get an FCC License and start cleaning up?

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

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

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

They got their licenses and went on to better jobs

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

Send for FREE book

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

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

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

FROM OUR MAIL BAG

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

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

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

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

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

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

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