SPECIAL FEATURE—The "Transistorized" Man

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FEBRUARY 1965

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Recharge Radio/Flashlight Batteries • Build Hi-Fi Multiplex Adapter • Compactron Regulated Power Supply • Build a $4.50 Tach Calibrator

Make "Pro" Meter Faces

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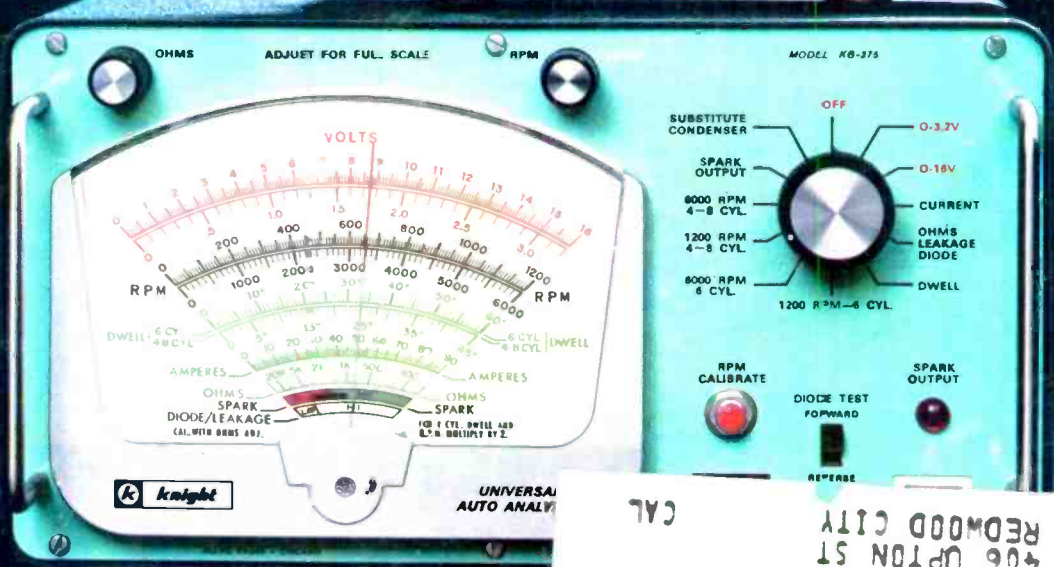

se Report (page 52)

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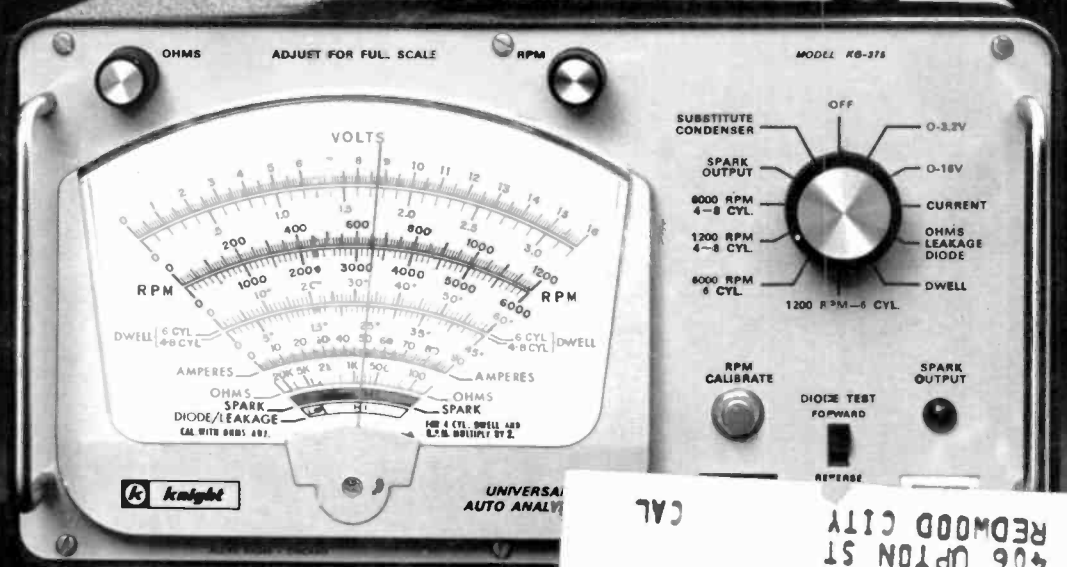

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) TRAINING KITS :XCITING, FAST

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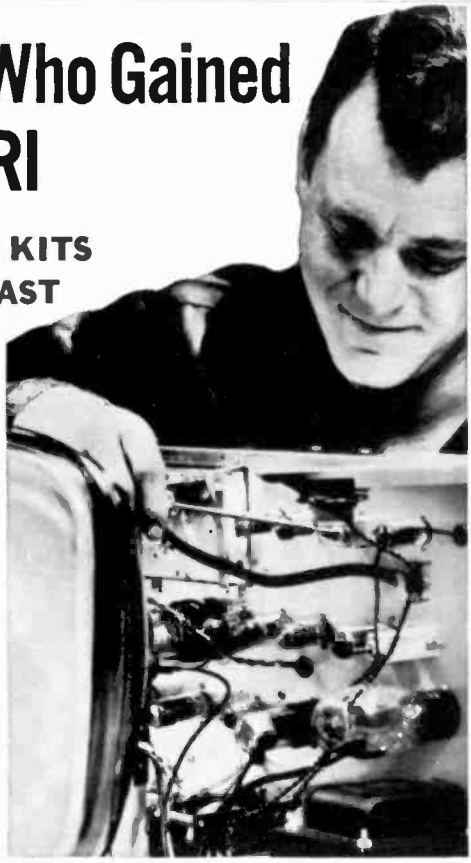

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"Many thanks to NRI for the Electronics training I received. I hold a first class FCC License and am employed as a studio and master control engineer/technician with KXJB-TV."

RONALD L. WOOD, Fargo, N.D.

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

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

NORMAN RALSTON, Cincinnati, Ohio

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POPULAR ELECTRONICS

ZIFF-DAVIS PUBLISHING COMPANY

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

This month's cover photo by Bruce Pendleton

VOLUME 22 FEBRUARY, 1965 NUMBER 2

Special Feature

Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

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Cadre C-75 1.5 watts, 2 crystal-controlled channels
15 times more power than ordinary "walkie-talkies" • clear communications 5 miles or more • solid-state design • 1 μv sensitivity • transmitter delivers 1 watt output to an antenna • AGC, adjustable squelch • rechargeable battery or penlite cell operation • jacks for earphone, external mike and antenna. Leatherette carrying case, set of channel 11 crystals, $99.95.

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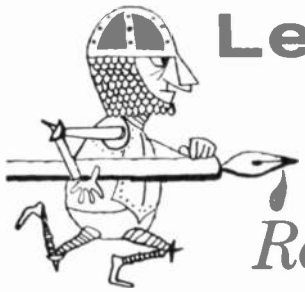
CIRCLE NO. 5 ON READER SERVICE PAGE



Letters *from our Readers*

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

"The Wonderful World of Lids"

■ I have just finished reading Carroll Moon's very funny story, "The Wonderful World of Lids" (December, 1964). Although it's a bit exaggerated, it does show what an outsider might run into on his first visit to a ham shack—my first meeting with amateur radio was about as confusing. I hope to see more stories like this one in the future.

TED JAPHET, WA5EQE
Holloman AFB, N.M.

■ I just finished reading "The Wonderful World of Lids." It was a riot, and I never laughed so hard in my life. Let's have more of this type of humor—maybe a story on SWL's?

JOHN MARX
Greensburg, Pa.

T-R Metal Locator

■ A construction project that I believe would be received with much interest is a transistorized transmitter-receiver type metal locator. The beat-frequency type locator such as "The Lodestar" (September, 1962) makes an interesting project, but is not nearly as popular with users as the transmitter-receiver style

of locator. My experience shows that this latter type of instrument is the best for finding bullets, buttons, weapons, etc., on Civil War battlefields, and for other, similar purposes. I have never seen a schematic for a transmitter-receiver unit, and am sure such a project would be welcomed by many.

EARL R. SLIDER, JR.
Atlanta, Ga.

We agree that a transmitter-receiver metal locator would be an excellent project, Earl. We're attempting to come up with such a project for future publication.

Transformers for "The Hi-Lighter"

■ We read with interest the article on the do-it-yourself high-intensity lamp ("The Hi-Lighter," September, 1964), and a subsequent reader's comment on the high cost of transformers. Rogers Electronic Corp. has the following low-cost transformers available: Model 1133 for a 6-volt #1133 bulb (with high-low tap), $2.65;

SCOTT'S TOP RATED LT-110 FM STEREO TUNER KIT NOW AT A NEW LOW PRICE ... $139.95

"... 1.88 uv sensitivity by a home alignment procedure without instruments ... an exceptional feat ..."

Electronics Illustrated

Here's terrific news for you kit builders! Now, the famous Scott LT-110 tuner kit ... top rated by every audio expert ... built by thousands of hi fi enthusiasts ... is available in handsome new styling at a truly modest price.

Look at the outstanding features of this superbly engineered tuner. It includes a heavily silver-plated front end ... prewired and tested in Scott's engineering laboratories. The critical multiplex section is also pre-wired and tested with the most advanced multiplex equipment available. Among the LT-110B's many extras: Stereo Separation in excess of 30 db, Sonic Monitor stereo indicator, 60 db Signal-to-Noise ratio, sensitive tuning meter.

Here's what the technical editor of Electronics Illustrated said about the LT-110: "If you have hesitated to go into stereo FM because of imagined complexities and highly technical skills and knowledge that might be required, fear no more. The LT-110 shows you how to enjoy stereo FM the easy way."

LK-72B 80-Watt Stereo Amplifier Kit. This popular amplifier kit delivers enough power to drive any speaker system, and at an outstanding price. Complete range of control features includes switched front panel headphone output, complete recording facilities, and provision for driving a third or center channel loudspeaker system without additional amplification. Only $149.95.

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Price slightly higher West of Rockies. Subject to change without notice.

CIRCLE NO. 36 ON READER SERVICE PAGE

Letters

(*Continued from page 6*)

Model 93 for a 12-volt #93 bulb, $1.85; Model 1073 for a 12-volt #1073 bulb, $2.45. The above prices are for individual orders and do not include a $1 handling and shipping charge.

ROGERS ELECTRONIC CORP.
43-49 Bleecker St.
New York 12, N.Y.

Canada's Tourist Radio Service

■ "On the Citizens Band" (December, 1964) states that those interested in obtaining a Tourist Radio Service license should apply to the Regional Superintendent of Radio Regulation, Department of Transport, 25 Sinclair Ave., Ontario, Canada. Omitted was the city: the *full* address is 25 Sinclair Ave., *Ottawa*, Ontario, Canada.

BRAD HOWARTH
Galt, Ont., Canada

Thanks for pointing out the omission, Brad.

Original CB Rules Upheld

■ When I read the statement in the "Letters from Our Readers" column (December, 1964) that "no one has a 'right' to any portion of the radio spectrum; it is a privilege granted to the worthy . . . ," my gorge began to rise. The statement is worthy of a snotty Prussian yelling "lebensraum!" I think that "desire" should be the only "need" necessary for the granting of a CB permit. As for rules, the operator should merely be required to be courteous and law-abiding, i.e., refrain from transmitting verbal filth, gambling information, or information to be used in aiding in the commission of crimes.

J. W. BADEAUX, JR.
Baton Rouge, La.

More Parts Data Requested

■ Why doesn't P.E. print all the purchasing information necessary for buying parts along with each project? All you have to do is put down the parts used in the author's prototype. This would be a great boon in helping experimenters get the best bargains—after all, electronics is our hobby, not scavenger hunting!

PHILIP R. OLENICK
Great Neck, N.Y.

Sorry, Phil, but you're oversimplifying a complex problem. Few experimenters make the projects we publish from 100-percent brand-new store-bought parts. Nor do the authors/designers of the projects. The general tendency is for experimenters to use readily available parts—which means they might be bargains purchased several years ago, surplus items no longer being made, or imported parts not available in every city. We try to provide as much information as possible on the true specs of a component and then leave procurement up to the reader. In the long run—over ten years' worth—we've found that this procedure works best.

Ultrasonic Blind-Guides

■ I very much enjoyed your cover story, "Experimenting with Sonar" (September, 1964). The author mentioned experimenting blindfolded and guiding

Letters

(*Continued from page 8*)

yourself around the house with the ultrasonic transmitter and "Sniffer" receiver. Although a compass-like device has been developed to detect obstacles and direction of travel, could a microelectronics ultrasonic system be more beneficial to the blind?

ROBERT MENKING, JR.
Silver Spring, Md.

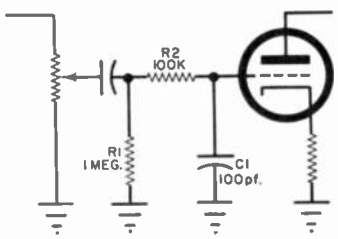
Some authorities seem to think so, Bob. For an article on just such a device, see "New Ultrasonic Radar for the Blind," January, 1964.

Eliminating Hi-Fi-I

■ When I set the selector switch on my receiver/amplifier to "phono," I can hear an FM station about two miles from my home that broadcasts on 93.7 mc. This happens regardless of the frequency the tuner is set to. What causes this unwanted "background music" and how can I get rid of it?

MICHAEL THALLER
St. Louis, Mo.

Your close proximity to the station is undoubtedly causing the problem, Mike. Enough of the r.f. signal is getting through to the grid of the first audio stage in your amplifier to be rectified (detected) and then amplified in the usual manner. A simple way to cure



this type of interference is to reduce the value of the grid resistor (R1) in the first audio stage to 1 megohm, and install R2 and C1.

Tesla Coils Again

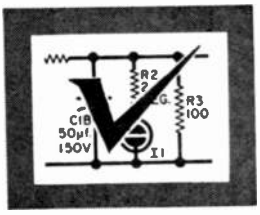
■ A few years ago, we made a huge Tesla coil standing nearly six feet tall, having a diameter of almost two feet, and resting on an insulated base three feet square. The power supply is separate and is comprised of a large transformer, 12 high-voltage capacitors, and a motor-driven rotary spark gap; it is connected to the coil with special cables. The coil will throw a spark nearly four feet, and draws 20 amps from the a.c. line. The unit is for sale, and would probably make an ideal addition to a high school or college laboratory.

HOWARD W. MEGEE
184 Meadow St.
Shelton, Conn. 06484

■ In reference to "Big TC" (July, 1964), the unit can be constructed very inexpensively. I got my transformer for free from a company that specializes in store fronts. The acrylic coil form suggested in the article need not be used—there are much cheaper ones available. Pieces of wooden dowel can be substituted for standoff insulators. Because I was unable to get a suitable feedthrough insulator for the top of the coil, I used an inverted clay flower pot. In the drainage

(*Continued on page 96*)

Operation Assist



THROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*— he'll appreciate it. If *you* need help, send a post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card;* we can handle them much faster than letters. Don't send a return envelope; your response will come from other readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those items that are not available from normal sources.

Schematic Diagrams

Granco Model 730 receiver, circa 1948(?). Tunes BC band. Has 7 tubes. (Noël Moss, 5355 Henry Hudson Pkwy., New York, N.Y. 10471)

Roberts "Reflex" home-built receiver, circa 1920. (G.M. Cooley, 1008 Temple Terrace Hwy., Tampa, Fla. 33612)

RCA receiver, circa 1948, model unknown. Tunes BC AM & FM and s.w. on 12 bands. Has 31 tubes. Also has tuning and loudness meter. (Thomas W. Moth, Box 178, Pecatonica, Ill. 61063)

Crosley receiver, circa 1939, model unknown. Uses one 80, two 47's, two 45's in push-pull output and three 24's. (John Harry, 4244 Washington, Columbia Heights, Minn. 55421)

Montgomery Ward Model GSL 1578 receiver, circa 1954. Tunes BC band. Has 4 tubes. (Russell Hawkins, Box 104, LaVergne, Tenn. 37086)

Hammarlund "Super Pro" receiver, ser. 16204. Tunes 540 kc.-20 mc. in 5 bands. Made for U.S. Navy; Navy identification 000153. (John Warkentin, c/o Monterey Bay Academy, P. O. Box 191, Watsonville, Calif.)

RCA Model 145 & 325 receiver, circa 1930. Tunes BC, 80 and 40 meters. Has 5 tubes. (Carl Shomate, R. R. #1, Oakland City, Ind.)

Philco Model 40-150 receiver, circa 1948(?), code 121. Tunes 3 bands. Has 7 tubes. (Ron Sortman, 34 E. Cottage Ave., West Carrollton, Ohio 45449)

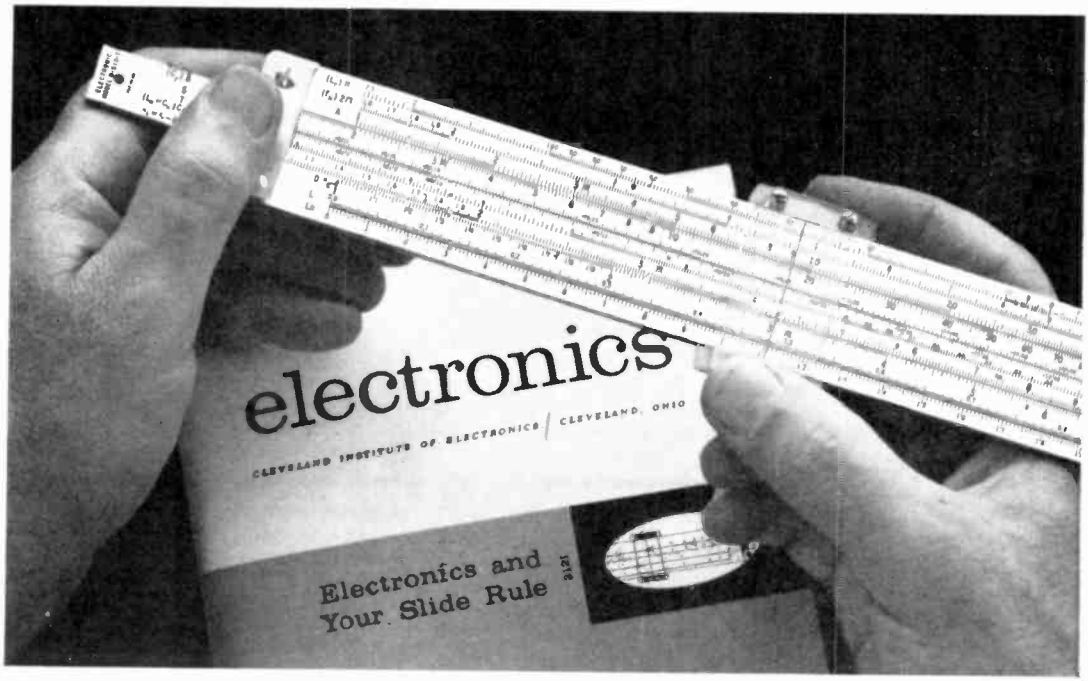
E. H. Scott receiver, circa 1932, model unknown. Has two tuning dials, not ganged, and plug-in-coils. Uses 2 27's, 2 24's 2 45's and 1 80. Detector is UX'27 or '56. (Henry G. Davis, 607 S. Third, Maywood, Ill. 60153)

Brunswick receiver, circa 1923, model unknown. Has 7 tubes. (Peter Chastain, P. O. Box 187, Empire, Calif. 95319)

Magnavox "Regency Symphony" Model 155B radio-phono combination, chassis 188B1, circa 1940. Tunes AM and s.w. bands. Has 13 tubes, and separate tuner. (Geoffrey Ashford, P. O. Box 213, San Carlos, Calif.)

(*Continued on page* 20)

A New Electronics Slide Rule with Self-Training Course



Why didn't someone think of this before?

Here's a great *new* way to solve electronic problems accurately . . . easily. The Cleveland Institute Electronics Slide Rule is the only rule designed specifically for the exacting requirements of electronics computation. It comes complete with an illustrated Self-Training Course consisting of four lessons . . . each with a short quiz you can send in for grading and consultation by CIE's expert instructors. With this personal guidance, you'll soon be solving complex electronics problems in seconds while others still struggle along with pad and pencil.

Here's what Mr. Joseph J. DeFrance, Head of the Electrical Technology Dept., New York City Community College, has to say about it:

"I was very intrigued by the 'quickie' electronics problem solutions. It is an ingenious technique. The special scales should be of decided value to any technician, engineer, or student. The CIE slide rule is a natural."

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This all-metal Slide Rule is a full 10" long and is made to our rigid specifications by a leading manufacturer of measuring instruments. Slide Rule, Self-Training Course *and* handsome top-grain leather carrying case . . . all yours for just $14.95. Cleveland Institute of Electronics, 1776 E. 17th St., Department PE-105, Cleveland, Ohio 44114.

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The Electronics Slide Rule with Self-Training Course is available only from Cleveland Institute of Electronics, and is covered by CIE's exclusive "Satisfaction Warranty." Order it now . . . use it for ten full days. Then, *if you're not completely satisfied*, you may return the Slide Rule with Self-Training Course and CIE will refund full payment.

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CIRCLE NO. 6 ON READER SERVICE PAGE

HOBSON'S CHOICE?

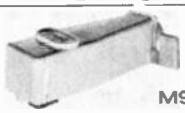
NEVER AGAIN!

If, in 1631, you went to rent a horse from Thomas Hobson at Cambridge, England, you took the horse that stood next to the door. And no other. Period. Hence, Hobson's Choice means No Choice.

And, as recently as 1961, if you went to buy a true high fidelity stereo phono cartridge, you bought the Shure M3D Stereo Dynetic. Just as the critics and musicians did. It was acknowledged as the ONLY choice for the critical listener.

Since then, Shure has developed several models of their Stereo Dynetic cartridges—each designed for optimum performance in specific kinds of systems, each designed for a specific kind of *porte-monnaie*.

We trust this brief recitation of the significant features covering the various members of the Shure cartridge family will help guide you to the best choice for you.

THE CARTRIDGE	ITS FUNCTION, ITS FEATURES...	IS YOUR BEST SELECTION
 V-15	The ultimate! 15° tracking and Bi-Radial Elliptical stylus reduces Tracing (pinch effect), IM and Harmonic Distortion to unprecedented lows. Scratch-proof. Extraordinary quality control throughout. Literally handmade and individually tested. In a class by itself for reproducing music from mono as well as stereo discs.	If your tone arm tracks at 1½ grams or less (either with manual or automatic turntable)—and if you want the very best, regardless of price, this is without question your cartridge. It is designed for the purist . . . the perfectionist whose entire system *must* be composed of the finest equipment in every category. Shure's finest cartridge.
 M55E	Designed to give professional performance! Elliptical diamond stylus and new 15° vertical tracking angle provide freedom from distortion. Low Mass. Scratch-proof. Similar to V-15, except that it is made under standard quality control conditions.	If you seek outstanding performance and your tonearm will track at forces of ¾ to 1½ grams, the M55E will satisfy—beautifully. Will actually improve the sound from your high fidelity system! (Unless you're using the V-15, Shure's finest cartridge.) A special value.
 M44	A premium quality cartridge at a modest price. 15° tracking angle conforms to the 15° RIAA and EIA proposed standard cutting angle recently adopted by most recording companies. IM and Harmonic distortion are remarkably low . . . cross-talk between channels is negated in critical low and mid-frequency ranges.	If you track between ¾ and 1½ grams, the M44-5 with .0005" stylus represents a best-buy investment. If you track between 1½ and 3 grams, the M44-7 is for you. If you track between 3-5 grams, choose the M44-C. All have "scratch-proof" retractile stylus.
 M7/N21D	A top-rated cartridge featuring the highly compliant N21D tubular stylus. Noted for its sweet, "singing" quality throughout the audible spectrum and especially its singular recreation of clean mid-range sounds (where most of the music really "happens".) Budget-priced, too.	For 2 to 2½ gram tracking. Especially fine if your present set-up sounds "muddy." It is truly an outstanding buy. (Also, if you own regular M7D, you can upgrade it for higher compliance and lighter tracking by installing an N21D stylus.)
 M99	A unique Stereo-Dynetic cartridge head shell assembly for Garrard and Miracord automatic turntable owners. The cartridge "floats" on counterbalancing springs . . . makes the stylus scratch-proof . . . ends tone arm "bounce."	If floor vibration is a problem. Saves your records. Models for Garrard Laboratory Type "A", AT-6, AT-60 and Model 50 automatic turntables and Miracord Model 10 or 10H turntables. Includes head shell, .0007" diamond stylus.
 M3D	A best-seller with extremely musical and transparent sound at rock-bottom price. Tracks at pressures as high as 6 grams, as low as 3 grams. The original famous Shure Dynetic Cartridge.	If cost is the dominant factor. Lowest price of any Shure Stereo Dynetic cartridge . . . with almost universal application. Can be used with any changer with 4-pole motor. Very rugged.

SHURE *Stereo Dynetic*®

HIGH FIDELITY PHONO CARTRIDGES . . . WORLD STANDARD WHEREVER SOUND QUALITY IS PARAMOUNT

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois

CIRCLE NO. 37 ON READER SERVICE PAGE

POPULAR ELECTRONICS
PRODUCT SERVICE PAGE

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

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

2 Add up your total number of requests and fill in the box in the upper right-hand corner of the coupon.

3 Mail the coupon to the address indicated below.

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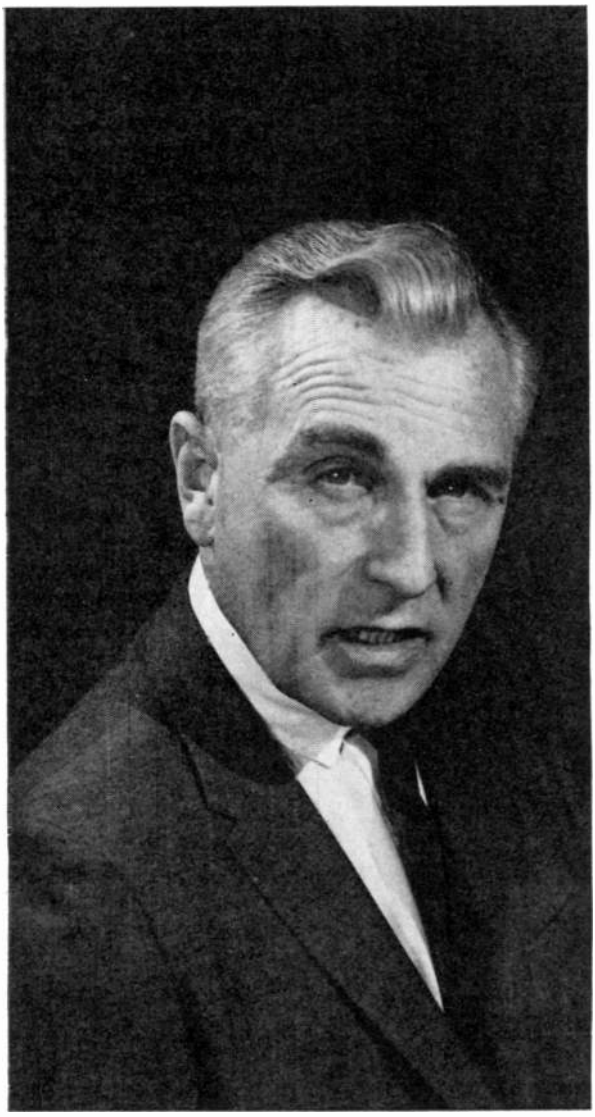
VOID AFTER MARCH 31, 1965 2

"There's no sure way to success in electronics-

but I'll put my money on the man who makes himself a specialist in one of these key areas"

Take the advice of men who have worked their way up to the top in the electronics industry. Make yourself a specialist in one of the key areas of electronics. Then stop worrying how cutbacks, layoffs and contract terminations will affect you and your family. If you have up-to-date, specialized knowledge, you can look forward to security and excellent earnings while men with ordinary qualifications are made obsolete—and unemployed—by advances in technology or by automation.

But, to become a specialist, you must supplement your experience in electronics with more technical education. Going back to school isn't easy for a man



CREI

who holds a full time job and has family obligations. And few residence schools offer educational programs directly related to current employment requirements in the electronics industry.

CREI Home Study Programs offer you a practical way to get the additional education you need without going back to school. You study at home, at your own pace, on your own schedule. And, because CREI Programs are developed and kept up-to-date with the help of engineers and scientists from every part of the electronics industry, you study with the assurance that what you learn can be applied to the job immediately.

Because CREI Programs cover all the areas of electronics that are important now and will be even more important in the future, you're sure to find a program that fits your particular ambitions and career objectives.

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. For your copy of this book, mail postpaid airmail card today or write: CREI, Department 1202-C, 3224 Sixteenth St., N.W., Washington, D.C. 20010.

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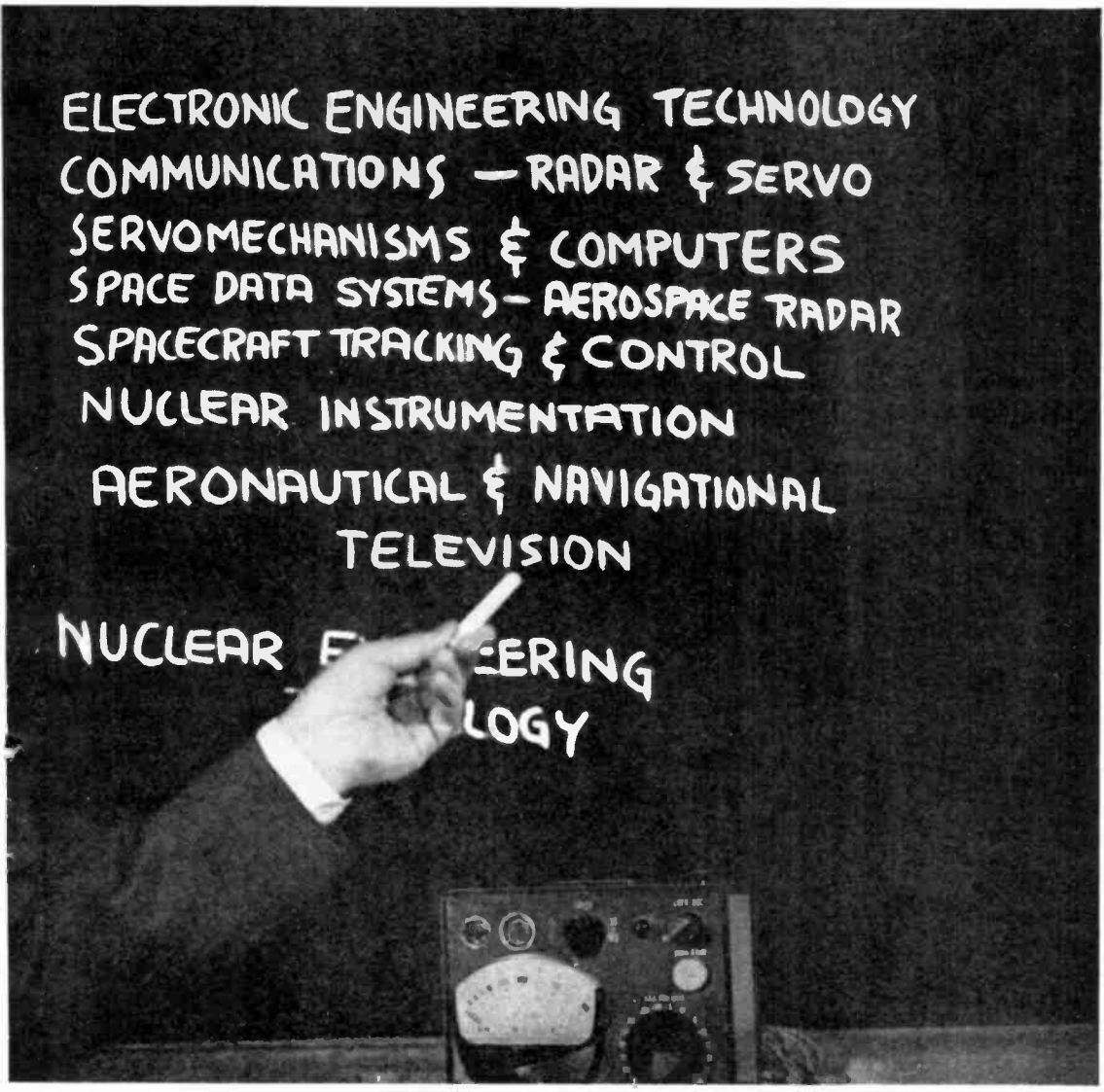


Operation Assist

(*Continued from page* 12)

Midwest amplifier, ser. 7162674A, model unknown. Has 6 tubes. (Eric Sabelman, 2100 Grace Drive, Santa Rosa, Calif. 95404)

RCA Model T-10-1 receiver. Tunes 540 kc. to 18 mc. Has 10 tubes. (Al Bloom, 97 Woodland Dr., Kings Park, N.Y.)

Magnavox Model 155B receiver and record player, style C101-43. Tunes AM, FM and s.w. bands. (Mark M. Byrum, 1904 McCauslen Manor, Stubenville, Ohio 43952)

Special Data or Parts

Hallicrafters Model 31A-430 receiver, chassis 70-E865. Instruction book and schematic needed. (Sherley Lawton Jr., U.S.S. Point Defiance LSD-31, "G" Div., c/o F.P.O. San Francisco, Calif. 96601)

Supreme Model 581 signal generator, ser. 150. Operating and alignment instructions needed. (Bernard M. Wills, Box 219, Oroville, Wash.)

Sentinel receiver, chassis 2038019 (first digit questionable); tunes BC band; has markings in meters and frequency. Type of battery and any other available information wanted. (Ronald Voigt, 4535 Cleveland, St. Louis 10, Mo.)

Westinghouse Model WR10 receiver. Parts list and schematic needed. (Robert A. Davis, 605 36 St., Sioux City, Iowa 51104)

Minshall Model K organ, circa 1952. Service manual, schematic, and source for parts needed. (Edward Zemojtel, 11224 Gerald Ave., Granada Hills, Calif.)

Atwater Kent Model 20 receiver, ser. 368482. **Grebe** synchrophase receiver, model unknown, uses 5 01A's. Schematics and source for parts needed. (Bruce Taylor, Delta, Iowa)

Electrical Research Products Model RA 330 sound level meter, made for Western Electric. Operating instructions and schematic needed. (A. Winkler, 284 Highland Ave., Newark, N.J. 07104)

Solar Model CF "Exameter." Schematic and operating instructions needed. (Leo E. Smith, R. D. #1, Box 375, Sandy, Utah)

Robin Radio Model 105 police receiver, ser. 160; tunes 154 mc. Parts list, alignment instructions, and schematic needed. (William Mishevich, 3873 Patterson Ave., Oakland 19, Calif.)

Eicor Model 1000 tape recorder, circa 1940, ser. 21042. Schematic and specifications on tape heads needed. (Max F. Sommers, Box 743, Polson, Mont. 59860)

Espey Model R.M.A. 174 AM-FM phonograph combination, ser. 105482; has 12 tubes. Schematic and source for tubes wanted, plus history of set. (Raymond Reese, 1706 Jacobson Blvd., Bremerton, Wash. 98312)

"Radio for Everybody," written in 20's by Austin Lescarbora. Old copy of book wanted. (Ethan W. Pahl, 123 S. Main St., Bellevue, Mich. 49021)

Silvertone Model 1561 receiver; tunes 540-1600 kc. and 5.5-18 mc.; has 6 tubes. Schematic and parts list needed. (Philip Kelly, Rt. 1, Box 638, Camas, Wash. 98602)

Millen Model 90711 VFO output impedance adapter. Unit wanted, or details for building one. (M.A. Stark, Route 2, Box 259-K, Brandywine, Md. 20613)

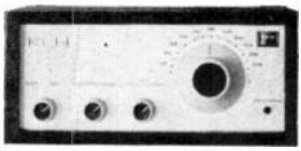
General Electric Model G-78 radio; tunes 3 bands from 550 kc. to 18 mc.; has 7 tubes. Schematic and alignment data needed. (Derrell Talley, Hutcheson Ferry Rd., Palmetto, Ga. 30268)

Atwater Kent Model 70 receiver, circa 1930, ser. 6346157, type L chassis. Schematic wanted and any additional information available. (Jack A. Freeman, 1009 Hillsdale St., Reidsville, N C.)

Stancor Model 10P amateur transmitter. Final tank coils and schematic needed. (Michael J. Murphy, 1734 S. 10th East, Salt Lake City 5, Utah)

Admiral receiver, circa 1940, ser. 183757, model unknown; tunes 3 bands, has 10 tubes. Alignment data and schematic needed. (C. L. Wells, 1612 Jackson St., S. Norfolk, Va. 23506)

Crosley "Invincible" Model 60 receiver; tunes 3 bands; has 11 tubes. Schematic needed and any available data on amplifier and tuning section. (Roy Callen, 2366 Padstow Cres., Clarkson, Ont., Canada) —30—



'Hey – who shrunk yer tuner ?'

To lots of people, there's trauma in a small stereo tuner. Traditionally, the multiplex tuner has been a big heavy monster. It's hard to accept that a unit that sits easily in the palm of your hand can outperform most of its bulky and cumbersome predecessors.

KLH's brand new Model Eighteen multiplex tuner is just about nine inches long. And no matter how you look at it, that's small for a high performance stereo tuner.

But the Eighteen isn't small just so that you can amaze your friends. It's small so that it will be the perfect mate for the KLH Model Eleven, Model Fifteen, Model Sixteen or any other good amplifier. It's small so that it won't waste precious space in today's homes and apartments. It's small so that it's less likely to be damaged or thrown out of alignment in normal handling and transportation.

And it's small because it works best that way.

Judged on an absolute basis, the performance of the Model Eighteen is comparable to that of tuners costing much more. When its price is taken into consideration, its performance can be described as truly incredible.

Like the most expensive tuners, you'll find the Eighteen a pleasure to tune. With Zero Center Tuning, there's no 'maybe area'. The meter tells you when you're tuned in and when you're not. The planetary tuning system we've used is mechanically the most accurate and trouble free. The tuning vernier has the silky yet positive feel that marks high quality engineering. The Stereo Indicator Light automatically identifies multiplexing stations as you tune.

But there is no vacuum tube tuner, at any price, with the ultimate reliability of the Model Eighteen. Beyond the fact that the Eighteen runs cool; beyond the fact that transistors don't age, the Model Eighteen has 4 IF stages employing transformers of extremely low mass. The slugs are less subject to jarring and misalignment when the Eighteen is shipped from the factory, or handled, than with heavier instruments. As a result, Model Eighteens in normal use will require substantially less maintenance and service than old fashioned tuners.

There's one more way the Eighteen differs from expensive tuners. It's not expensive. About $130. Hear it at your KLH dealer's and judge for yourself.

Just don't call it cute. It's very sensitive.

KLH RESEARCH AND DEVELOPMENT CORPORATION
30 CROSS STREET, CAMBRIDGE 39, MASSACHUSETTS

CIRCLE NO. 21 ON READER SERVICE PAGE

New Products

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

SWL RECEIVER KIT

Heath Company's new short-wave listener's receiver kit, the GR-64, covers the 550-kc. to 30-mc. range in four bands. The set features a lighted 7" slide-rule dial with a logging scale, a BFO for receiving code and SSB transmissions, a four-tube superhet circuit,

16-revolution tuning knob, electrical bandspread for maximum station separation, and a headphone jack. Also included are a 5" round speaker, a built-in rod antenna for BCB reception, plus unbalanced input for an external antenna connection, a transformer-operated solid-state power supply, parallel filaments for longer tube life, and a relative signal strength indicator. Price, $39.95.

Circle No. 75 on Reader Service Page 15

AUDIO EQUIPMENT CONSOLE KIT

The new KD10 equipment console kit available from *Electro-Voice, Inc.*, was designed to complement the E-V Marquis KD9A along-the-wall folded-horn 12" speaker enclosure and the Aristocrat KD6A corner folded-horn 12" speaker enclosure. It makes possible the assembly of an attractive, space-saving combination to house virtually any component high-fidelity system. Like the KD9A and KD6A, it has been prefinished in oiled walnut, engineered to provide ease of construction, and can be assembled in a single evening using only ordinary household tools. All necessary hardware is included.

Circle No. 76 on Reader Service Page 15

STABLE 23-CHANNEL CB TRANSCEIVER

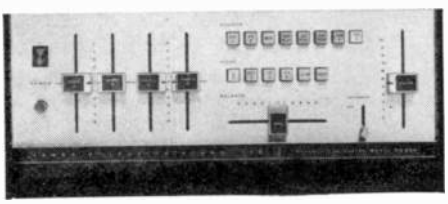
Exceptional frequency stability is claimed for *Pearce-Simpson*'s new 23-channel CB two-way radio—the "Guardian 23." The exclusive "HetroSync" circuitry in this frequency-synthesis transceiver mixes two frequencies instead of three, for maximum protection against spurious signals. Special close-tolerance crystals are used, resulting in a trans-

mitted frequency tolerance of ±0.003—well below the 0.005 required by the FCC. Other features include a low-noise nuvistor front end, a dustproof enclosed plug-in relay, and a pi-network with a two-stage TVI filter. The Guardian 23 utilizes a transistorized universal type power supply (12 volts d.c. or 117 volts a.c.), and the receiver is a dual-conversion superhet. Price, $299.50.

Circle No. 77 on Reader Service Page 15

STEREO PREAMPLIFIER

The Model SG520 "Graphic Controller" announced by *James B. Lansing Sound, Inc.*, is a "professional"-type stereo preamplifier for home use. Its straight-line attenuators allow precise adjustment of multiple functions separately or simultaneously and instant visual graph-like indications of control settings. Illuminated when depressed, the push-button



selectors provide instantaneous switching from any function to any other function. Additional features include concealed secondary controls and directly accessible signal jacks behind the front panel. Response of the JBL Model SG520 is within ¼ db from 20 to 20,000 cycles, distortion less than 0.15% within this range at full-rated 3-volt output. Referred to the low-level phono input, the hum and noise component is 1 μv. or less and is inaudible. Price, $450.00. Accessory case, $15.00.

Circle No. 78 on Reader Service Page 15

ROTORLESS CB BEAM ANTENNA

No mechanical rotator is needed for the new CB beam antenna available from *Antenna Specialists Co.*—the Model M-119 "Scanner" employs all-electronic techniques to focus and rotate the beam, while the antenna itself re-

Anyone (including your wife) can make just as fine a tuner as Fisher

...with the Fisher KM-60 StrataKit.

The Fisher KM-60 StrataKit makes it so easy to build an elaborate, high-performance FM-multiplex tuner that the technical experience or inexperience of the kit builder becomes totally irrelevant. Audio engineers and housewives can build the KM-60 with equal facility and completely equal results. And the results are spectacular.

The StrataKit method of kit construction is an exclusive Fisher development. Assembly takes place by simple, error-proof stages (Strata). Each stage corresponds to a *separate* fold-out page in the uniquely detailed instruction manual. Each stage is built from a *separate* packet of parts (StrataPack). The major components come already mounted on the extra-heavy-gauge steel chassis. Wires are *pre-cut* for every stage—which means every page. All work can be checked stage-by-stage and page-by-page, before proceeding to the next stage.

In the KM-60 StrataKit, the front-end and multiplex stages come fully assembled and prealigned. The other stages are also aligned and require only a simple "touch-up" adjustment by means of the tuner's laboratory-type d'Arsonval signal-strength meter.

When it comes to performance, the advanced wide-band Fisher circuitry of the KM-60 puts it in a spectacular class by itself. Its IHF sensitivity of 1.8 microvolts makes it the world's most sensitive FM tuner kit. Capture ratio is 2.5 db; signal-to-noise ratio 70 db. Enough said.

Price, $169.50. Walnut or mahogany cabinet, $24.95. Metal cabinet, $15.95.

FREE! $1.00 VALUE! The Kit Builder's Manual, an illustrated guide to high fidelity kit construction, complete with detailed specifications of all Fisher StrataKits.

Fisher Radio Corporation 102
21-40 44th Drive
Long Island City, N. Y. 11101

Please send me The Kit Builder's Manual without charge.

Name _____

Address _____

City _____ State _____

CIRCLE NO. 13 ON READER SERVICE PAGE

New Products

(*Continued from page 22*)

mains completely stationary. The Scanner is actually three antennas: one is used to radiate power while the remaining two form a screen to reflect and focus the beam. Rotation of the beam is accomplished instantly by switching the radiating job from one element to the next. The beam patterns are said to provide full-circle scan coverage with a directional gain of 7.75 db (equivalent to 30 watts output from a 5-watt source). The elements of the Scanner extend only three feet from the mounting boom, which indicates excellent wind resistance.

Circle No. 79 on Reader Service Page 15

80-WATT STEREO AMPLIFIER KIT

Features of the new *Scott* LK-72B 80-watt stereo amplifier kit include special equalization positions for phonograph and tape deck, separate bass and treble controls for each channel, derived center channel to provide signal for extension speakers or for center channel speaker, and a subsonic filter to pre-

vent waste of useful power. The power rating of the LK-72B is 40 watts (IHF) per channel; power band, 20 to 20,000 cycles ± 1 db; frequency response, 20-20,000 cycles ± 1 db; and harmonic distortion, 0.8%. Price, less than $150, including full-color instruction book and matching Part-Charts.

Circle No. 80 on Reader Service Page 15

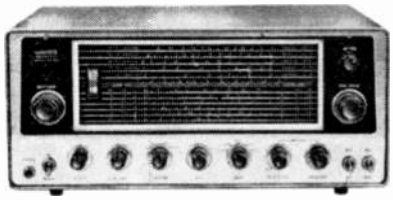
300-WATT POWER INVERTER

An all-transistorized 300-watt power inverter that changes 12-volt automobile battery power to 60-cycle, 117-volt a.c., is being sold by *Topaz, Inc.* Capable of running household appliances, small power tools, and test instruments, the "Powermaker" can provide emergency power in storm areas if commercial power fails. Campers and boating enthusiasts will also find it useful since it permits the operation of equipment in moving vehicles or in remote areas where power lines are nonexistent. Small in size (5¾" square), the "Powermaker" weighs just 12 pounds. Price, $44.95 (plus $2.50 shipping cost).

Circle No. 81 on Reader Service Page 15

AMATEUR COMMUNICATIONS RECEIVER

The HA-225 amateur communications receiver announced by *Lafayette Radio Electronics Corporation* features a 14-tube superheterodyne circuit and dual conversion on 6 meters. Frequency coverage is from 150 kc. to 54 mc. in five bands: 150-400 kc. (marine beacon) 1.6-4.8 mc., 4.8-14 mc., 10.5-30 mc., and 48-54 mc. A separate filament transformer provides constant heater voltage to the mixer and oscillator tubes for increased frequency stability. Other features: calibrated electrical



bandspread on 80 through 10 meters (6 meters is tuned with the main tuning control), and a 0-100 logging scale. Sensitivity is 0.5 μv. for a 10-db signal-to-noise ratio. Price, $139.50.

Circle No. 82 on Reader Service Page 15

FEEDBACK STEREO SYSTEM

A "Motional Feedback Stereo System," the Model AM-229M. announced by *Olson Electronics, Inc.*, consists of a 30-watt stereo amplifier and two 2-way speaker systems. Virtually all distortion developed in the speaker-amplifier circuit is said to be eliminated through the use of a second voice coil in the speaker: it generates a distortion-cancelling voltage which is fed back into the amplifier. Magnetic or crystal phono, tuner, tape, and auxiliary inputs are available. Frequency response is 30 to 25.000 cycles; hum and noise, −60 db; output impedance, 8 ohms. The speaker systems are mounted in oiled walnut cabinets. Price, $149.98.

Circle No. 83 on Reader Service Page 15

TRANSISTORIZED GUITAR AMPLIFIER

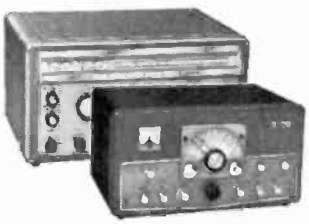
Specifically engineered for use with electric musical instruments, the new "Ampli-Vox" Model S-800 guitar amplifier being produced by *Perma-Power Company* is said to deliver professional sound at a budget price. Two high-quality speakers—a cabinet-coupled bass and mid-range speaker, and a 3" tweeter—are housed with the transistorized amplifier in a luggage-type case of durable Royalite. The Model S-800 can be employed with an electric guitar, bass fiddle, and accordian, either singly or in combination. A completely self-contained unit, it weighs only six pounds and is fully guaranteed for one year. There are separate controls for tone and volume, and a standby light to indicate whether the unit is on or off. Price, $68.00.

Circle No. 84 on Reader Service Page 15

CHECK JOHNSON FIRST!

For the Finest in: Citizens Band, Amateur and Industrial Radio Communications!

Nation's most popular, most complete Citizens Band line! Everything you ever wanted for CB — from compact, hand-held "Personal Messengers" to the tiny, new all transistor "Messenger III"! Information-packed, full-color 8-page brochure gives you all the details—see your distributor or use the coupon below.



Viking Amateur Equipment opens the door to world-wide adventure! Excellent value, solid performance, and an unmatched reputation for reliability—that's why novice and experienced amateurs check Johnson first! Complete, 20-page amateur catalog gives you all the dope on these world famous transmitters and station accessories.

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Please rush me the following literature:
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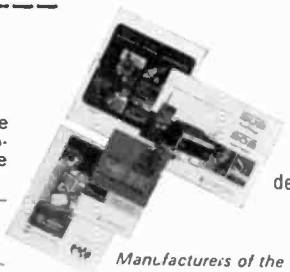

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CIRCLE NO. 20 ON READER SERVICE PAGE

POP'tronics Bookshelf

HOW TO BUILD RADIO-CONTROL MODELS

by William Winter

Here's a book that stands head and shoulders above anything else in its field. Obviously designed and written for the beginner, the handbook Bill Winter has assembled is a real solid information-packed work that your reviewer thumbed through several times—among other things, just to look at those extra large photos (the book is 8" wide and 11" high). The ten chapters contain almost everything a beginner, or seasoned modeler, might want to know—from how to build your first simple model control units, to the most complex projects an R/C builder can tackle. Highly recommended.

Published by Kalmbach Publishing Co., 1027 N. 7th St., Milwaukee, Wis. 53233. Soft cover. 96 pages. $3.00.

A PROGRAMMED COURSE IN BASIC ELECTRONICS and A PROGRAMMED COURSE IN BASIC TRANSISTORS

Your reviewer's first impression of these texts was mixed. If "programmed" tutoring of this type proves to be a successful method of teaching electronics, it would seem logical that it would put correspondence schools out of business. But is a so-called programmed course a reasonable substitute for a full-fledged correspondence course, or, for that matter, a good way of learning a lot about electronics in very little time? The answer to both questions can only be "maybe." While these books are perhaps the best of their kind, the authors assume that the reader has a fierce desire to learn, and enough stick-to-itiveness not to become overwhelmed by the welter of information and let his thoughts stray from the "program." Rather than consider these volumes substitutes for conventional teaching methods involving student-teacher or instructor relationships, we would recom-

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PROGRESSIVE RADIO "EDU-KIT"®

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YOU DON'T HAVE TO SPEND

HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program dsigned to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

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.

FREE EXTRAS

- **SET OF TOOLS**
- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

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."

PRINTED CIRCUITRY

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.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER FROM AD—RECEIVE FREE BONUS RADIO & TV PARTS JACKPOT WORTH $15

- ☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
- ☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
- ☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name.....

Address.....

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PROGRESSIVE "EDU-KITS" INC.

(ATT: S. GOODMAN, M.S. in ED., PRES.)

1186 Broadway, Dept. 634D, Hewlett, N. Y.

CIRCLE NO. 34 ON READER SERVICE PAGE

Bookshelf

(*Continued from page* 26)

mend them to a student as worthwhile adjuncts. The texts do carry the reader through the subjects in a selective and logical fashion, and the questions posed might well serve to stimulate a student to round out his training. Prepared by the New York Institute of Technology, "Basic Electronics" and "Basic Transistors" follow "Basic Electricity" (see "POP'tronics Bookshelf," February, 1964). Of the three, we feel that "Basic Transistors" has the greatest appeal strictly on its own merits and not as a teaching device.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Soft covers. "Basic Electronics" has 416 pages and is priced at $6.95. "Basic Transistors" has 474 pages and is priced at $7.95.

TRANSISTOR SELECT-A-SPEC

It's about time someone published a logically arranged transistor interchangeability guide. Every transistor experimenter knows that various books are available which give the type numbers of similar transistors—but what about direct substitution based on specifications alone? This book has solved that problem; transistor types are arranged according to maximum-collector-power rating, collector current, collector-to-emitter breakdown voltage, collector-to-base voltage rating, and emitter-to-base voltage. Don't pass up this reference book if you experiment with—or design—transistor circuits.

Published by Techpress Publications, Brownsburg, Ind. 46112. Soft cover. 136 pages. $3.95.

ALSO MENTIONS: *Lacy's Electronic Serviceman's Handbook*, published by William K. Lacy, 4311 Baldwin Drive SW, Huntsville, Ala. 35805. This pocket-size, 60-page, booklet provides an easy way to keep an inventory of various tubes on hand for radio-TV servicing. 60 cents . . . *How to Clean, Maintain and Protect Records* by Cecil E. Watts, published by Elpa Marketing Industries, Inc., New Hyde Park, N.Y. British record care authority Cecil Watts has summarized his years of research in this 16-page manual. Although it might be said to be a "puff" for his various record cleaner gadgets and solutions, the hi-fi enthusiast will find that it contains a number of valuable suggestions on record care. 25 cents. —30—

NOW...GET THE FINEST STEREO TEST RECORD ever produced for just...$4.98

Featuring Tests Never Before Available To The Hobbyist

UNIQUE FEATURES OF HiFi/STEREO REVIEW'S MODEL 211 STEREO TEST RECORD

- **Warble tones to minimize the distorting effects of room acoustics when making frequency response checks.**
- **White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.**
- **Four specially designed tests to check distortion in stereo cartridges.**
- **Open-air recording of moving snare drums to minimize reverberation when checking stereo spread.**

Why We Make the Model 211 Available Now

Although there are many stereo test records on the market today, most critical checks on existing test records have to be made with expensive test equipment.

Realizing this, HiFi/STEREO REVIEW decided to produce a record that allows you to check your stereo rig, accurately and completely, just by listening! A record that would be precise enough for technicians to use in the laboratory—and versatile enough for you to use in your home.

The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

Stereo Checks That Can Be Made With the Model 211

- ✓ **Frequency response — a direct check of eighteen sections of the frequency spectrum, from 20 to 20,000 cps.**
- ✓ **Pickup tracking — the most sensitive tests ever available to the amateur for checking cartridge, stylus, and tone arm.**
- ✓ **Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.**
- ✓ **Flutter—a test to check whether your turntable's flutter is low, moderate, or high.**
- ✓ **Channel balance — two white-noise signals that allow you to match your system's stereo channels for level and tonal characteristics.**
- ✓ **Separation—an ingenious means of checking the stereo separation at seven different parts of the musical spectrum—from mid-bass to high treble.**

ALSO: ✓ **Stereo Spread**
Speaker Phasing
Channel Identification

PLUS SUPER FIDELITY MUSIC!

The non-test side of this record consists of music recorded directly on the master disc, without going through the usual tape process. It's a superb demonstration of flawless recording technique. A demonstration that will amaze and entertain you and your friends.

All Tests Can Be Made By Ear

HiFi/STEREO REVIEW's Model 211 Stereo Test Record will give you immediate answers to all of the questions you have about your stereo system. It's the most complete test record of its kind—contains the widest range of check-points ever included on one test disc! And you need no expensive test equipment. All checks can be made by ear!

***Note to professionals:** The Model 211 can be used as a highly efficient design and measurement tool. Recorded levels, frequencies, etc. have been controlled to very close tolerances — affording accurate numerical evaluation when used with test instruments.*

DON'T MISS OUT—ORDER NOW

The Model 211 Stereo Test Record is a disc that has set the new standard for stereo test recording. There is an overwhelming demand for this record and orders will be filled by POPULAR ELECTRONICS on a first come, first serve basis. At the low price of $4.98, this is a value you won't want to miss. Make sure you fill in and mail the coupon together with your check ($4.98 per record) today.

FILL IN AND MAIL TODAY!

Stereo Test Record
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Please send me _____ test records at $4.98 each. My check (or money order) for $_____ is enclosed. I understand that you will pay the postage. (Orders from outside the U.S.A. add 50c to partially defray postage and handling costs.)

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Sorry—No charges or C.O.D. orders! PE-25

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- ✓ **Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.**
- ✓ **Flutter—a test to check whether your turntable's flutter is low, moderate, or high.**
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ALSO: ✓ **Stereo Spread**
Speaker Phasing
Channel Identification

PLUS SUPER FIDELITY MUSIC!

The non-test side of this record consists of music recorded directly on the master disc, without going through the usual tape process. It's a superb demonstration of flawless recording technique. A demonstration that will amaze and entertain you and your friends.

All Tests Can Be Made By Ear

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FILL IN AND MAIL TODAY!

Stereo Test Record
Popular Electronics—Dept. SD
One Park Ave., New York 16, N.Y.

Please send me _____ test records at $4.98 each. My check (or money order) for $_____ is enclosed. I understand that you will pay the postage. (Orders from outside the U.S.A. add 50c to partially defray postage and handling costs.)

Name_____
(Please Print)

Address_____

City_____ Zone_____ State_____

Sorry—No charges or C.O.D. orders! PE-25

From The Worlds Leading Manufacturer of Quality CB Communication . .

. . Antennas

Especially Designed With The CB'er In Mind!

By Mosley Electronics.

The all New DEVANT-1 is the result of continuous research and development to bring you Superior quality at a New Low-Low Price, $22.76. This field tested base station antenna is the newest advance in CB communications, performance guaranteed.

Many of the features of the DEVANT-1 are built into the base section. The vertical element terminates in a phenolic sleeve which has greater strength than the aluminum element. Radials terminate into a high strength "Cycolac" base, which again, has more strength than the aluminum element. The Coax female connector is part of the (weather-proof) radial support assembly. Antenna mounting is simplified, just mount the antenna on your mast, tighten two screws and lock nuts. Tapering the ends of the aluminum tubing (called swaging) is designed to reduce wind load, and any possibility of vibrations which would cause metal fatigue. Loading and impedance matching of the DEVANT-1 is accomplished with loops of one eighth inch aluminum rods.

From The Worlds Leading Manufacturer of Quality CB Communication . .

. . Antennas

Especially Designed With The CB'er In Mind!

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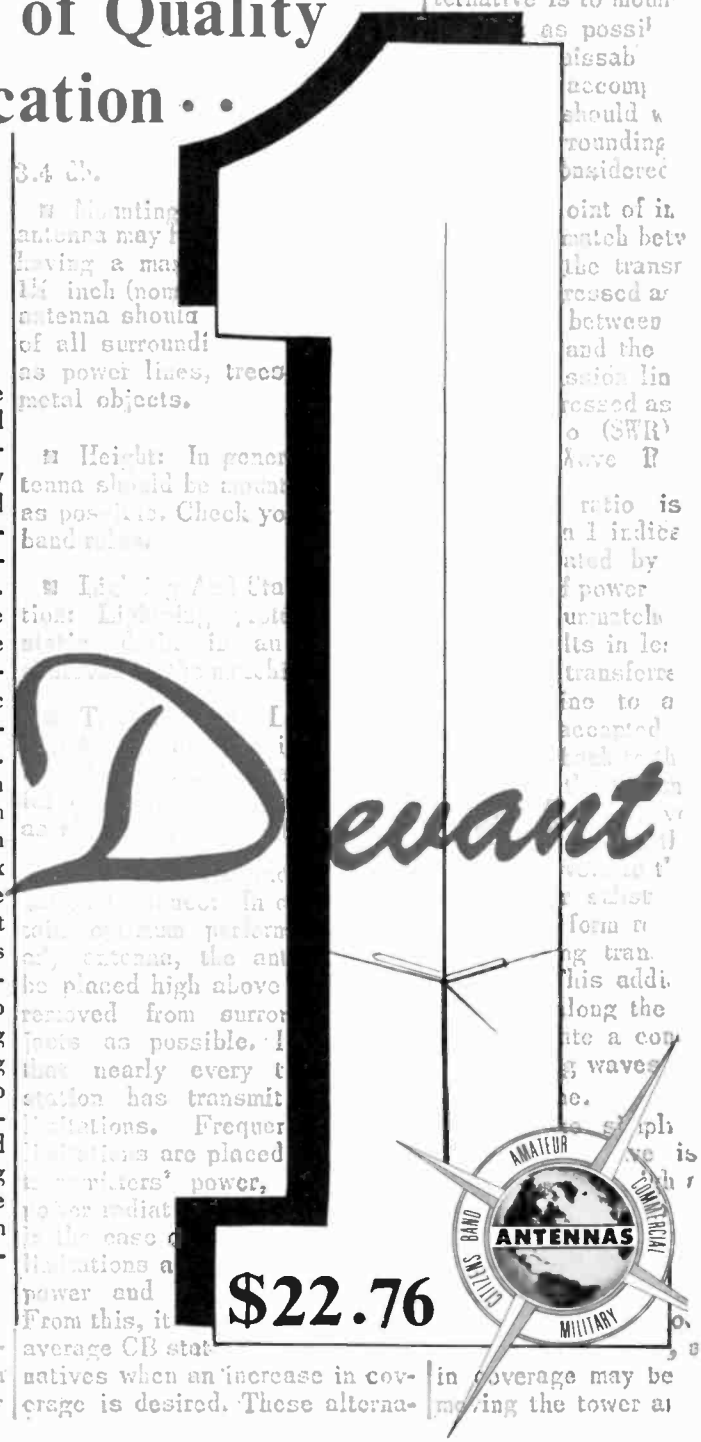
The Mosley DEVANT-1 antenna is an omnidirectional antenna with a gain of approximately



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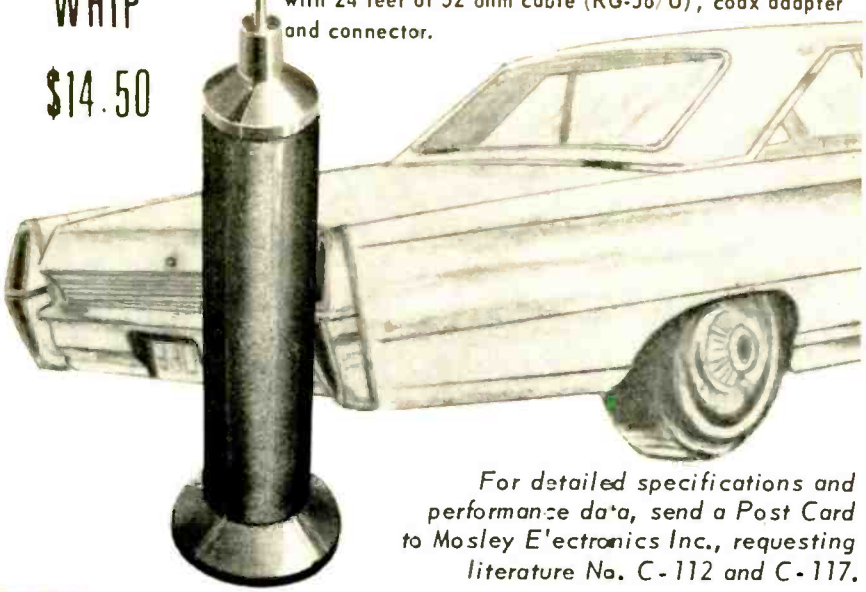
Devant "2"

A HIGH TEMPER TAPERED STAINLESS STEEL CB WHIP

$14.50

As the name "DEVANT (2)" suggests, the quality and performance of this live antenna is "Out-In-Front", "Ahead" of anything comparable on the CB market today. The success of this mobile wonder is no secret. The world famous Mosley quality in communication antennas, is a highly regarded and well known fact. Features include: Simplicity of installation, Adjustable resonance and length of coax cable used is. unrestricted. DEVANT (2) is a transformer matched antenna for use on channels 1 through 23. Antenna is mounted and secured directly to outer surface of mobile unit. Interior fabrics or hard to reach areas under rooftop, trunk and hood is absolutely no obstacle. Typical VSWR is 1.3 to 1 at resonant frequency. Resonant frequency may be changed by slightly adjusting the length of the whip section. All materials used on this antenna are corrosion resistant to insure maximum trouble-free performance. This antenna comes complete with High "Q" Transformer, incased in a nonconductive, weatherproof housing with 24 feet of 52 ohm cable (RG-58/U), coax adapter and connector.



For detailed specifications and performance data, send a Post Card to Mosley Electronics Inc., requesting literature No. C-112 and C-117.

Mosley Electronics, Inc.
4610 NORTH LINDBERGH BLVD.
BRIDGETON, MISSOURI, 63044

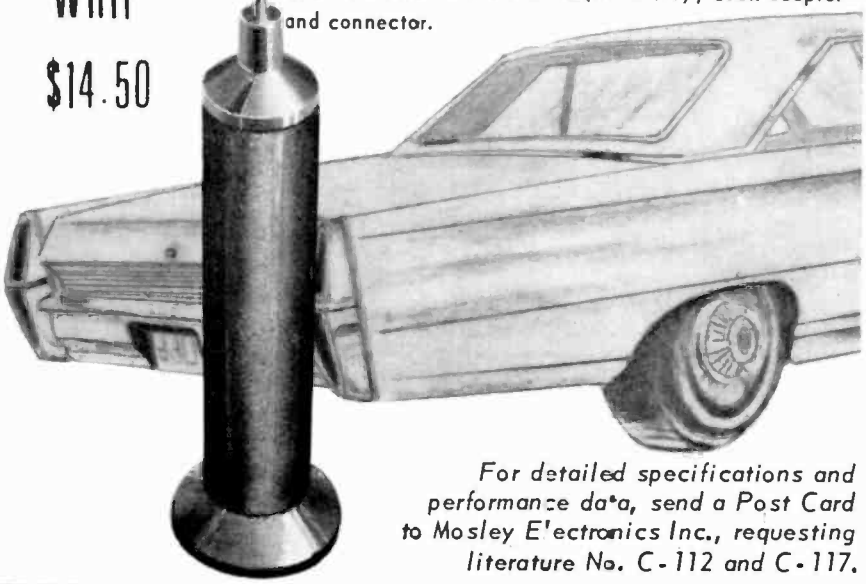
CIRCLE NO. 27 ON READER SERVICE PAGE

Devant "2"

A HIGH TEMPER TAPERED STAINLESS STEEL **CB** WHIP

$14.50

As the name "DEVANT (2)" suggests, the quality and performance of this live antenna is "Out-In-Front", "Ahead" of anything comparable an the CB market today. The success of this mobile wonder is no secret. The world famous Mosley quality in communication antennas, is a highly regarded and well known fact. Features include: Simplicity of installation, Adjustable resonance and length of coax cable used is. unrestricted. DEVANT (2) is a transformer matched antenna for use on channels 1 through 23. Antenna is mounted and secured directly to outer surface of mobile unit. Interior fabrics or hard to reach areas under rooftop, trunk and hood is absolutely no obstacle. Typical VSWR is 1.3 to 1 at resonant frequency. Resonant frequency may be changed by slightly adjusting the length of the whip section. All materials used an this antenna are carrosion resistant to insure maximum trouble-free performance. This antenna comes complete with High "Q" Transformer, incased in a nonconductive, weatherproof housing with 24 feet of 52 ohm cable (RG-58/U), coax adapter and connector.



For detailed specifications and performance data, send a Post Card to Mosley Electronics Inc., requesting literature No. C-112 and C-117.

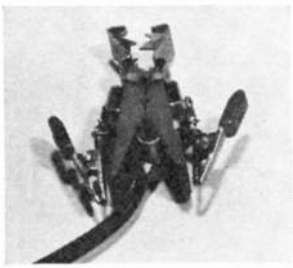
Mosley *Electronics Inc.* 4610 NORTH LINDBERGH BLVD. BRIDGETON, MISSOURI, 63044

CIRCLE NO. 27 ON READER SERVICE PAGE

Tips and Techniques

CLIPS ON CLIPS MAKE ALL ANTENNA CONNECTIONS

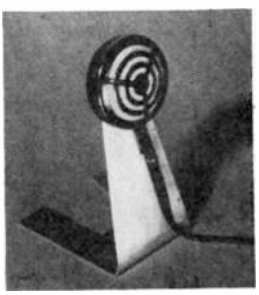
To increase the utility of the popular spring-clothespin-type TV antenna connector, simply solder or screw a small alligator clip to each side of the connector. In the absence of the conventional antenna terminal strip, individual conductors of the antenna transmission line can be connected to the small alligator clips. The extra set of clips can also be used as terminal points for stubs and other test leads even while the connector is clamped to a pair of terminals in the conventional manner.



—Carleton A. Phillips

LAPEL MIKE TAKES A STAND

A simple and inexpensive table stand for a lapel-type microphone can be made from a piece of 3" x 6½" scrap metal—1/32"-thick aluminum is suitable and easy to work. The dimensions are not critical. Approximately 4" from the top, bend the metal to form about a 70-80° angle, adjusting the bend for best stability. Remove rough edges, if any, and use polish or paint to improve appearance. A piece of felt cemented to the bottom will protect the furniture. You just clip the microphone to the top of the stand.



—Robert E. Kelland

(*Continued on page* 38)

NEW! from PEARCE-SIMPSON
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IBC 301
TWO-WAY BUSINESS BAND RADIO with remote head*
12 Volt Model **$329.90**

Specifically designed for business and industrial use, the IBC 301 is economical and easy to operate. 30 watts of AM power provides extended range and reliability. Channel frequencies are individually assigned by the FCC for business/industrial use.

***Can be dash mounted as a complete radio or the removable remote head can be installed independently with its own mounting cradle** • Remote head weighs less than 2½ pounds—small enough to fit in your hand • Solid state power supply and receiver for low power drain and greater efficiency • Illuminated operating indicators • Adjustable squelch, noise limiter • Universal mounting bracket—slide-rail • Optional AC power supply

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CB TWO-WAY RADIO • $299.50

23 CHANNELS — featuring Pearce-Simpson's exclusive HETROSYNC® circuitry. Two signals are combined instead of the usual three providing outstanding stability and maximum protection against spurious signals.

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CIRCLE NO. 33 ON READER SERVICE PAGE

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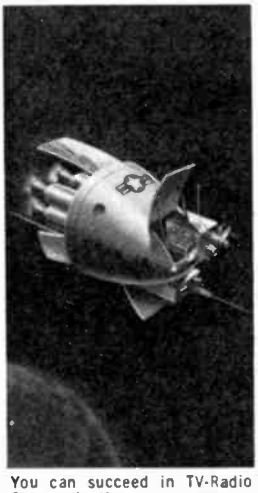

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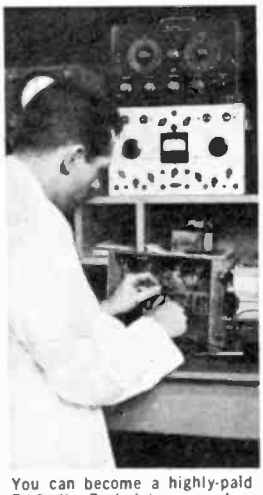

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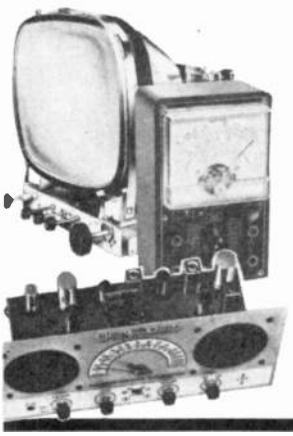

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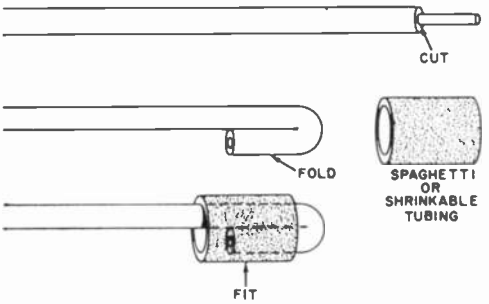
Tips

(*Continued from page 32*)

USE SPAGHETTI FOR OPEN ENDS —THEY COULD BE "HOT"

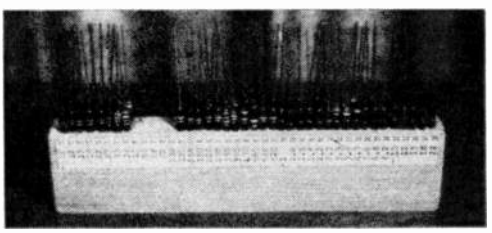
Not all open ends of wire or cable are "dead ends." You can insulate and protect them simply by covering them with a piece of spaghetti. Cut the exposed conductor close to the insulation and fold the end back onto



itself for a convenient but small distance. Although about ½" is usually enough, different thicknesses or stiffnesses of wire will require different size folds to make a neat finish. (Be careful to avoid accidental contact with metallic shielding when present.) Then slip a piece of spaghetti over the fold as shown in the drawing—it should fit snugly. —*Phillip Baskin, K2RLB*

RESISTOR STORAGE BLOCK

A handy way to keep resistors ready for instant use is to build a storage block for them. Three rows of holes drilled in the block will allow three resistors of each value to be stored; the hole spacing should be the same as the line spacing of the typewriter used for the identification slip which



is cemented to the side of the block. Six lines to the inch is just right for ½-watt resistors, and double or triple spacing can be used for 1-watt or 2-watt resistor blocks. Drill the holes 1⅝" deep using a 5/64" drill. You may want to apply a coat of clear laquer or varnish to the resistor value slip to keep it clean. —*Thomas H. Charters*

Turner's noise cancelling 333 TOPS FOR CB

Now you can get a deluxe professional communications microphone for use on CB — and at CB prices, too. The new Turner Model 333 CB Microphone is also ideal for amateur, marine and all other mobile communications.

A professional "noise cancelling" microphone, it features the shielded Koiled Kord that's so long lasting it's used on police cars, taxicabs, etc. High impact cycolac case. Voice response: 300-3000 cps. Just $21.50 list.

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909 17th Street N.E., Cedar Rapids, Iowa
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See your Turner Distributor, listed below. He has the 333 in stock.

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CIRCLE NO. 41 ON READER SERVICE PAGE

MYO-ELECTRICITY

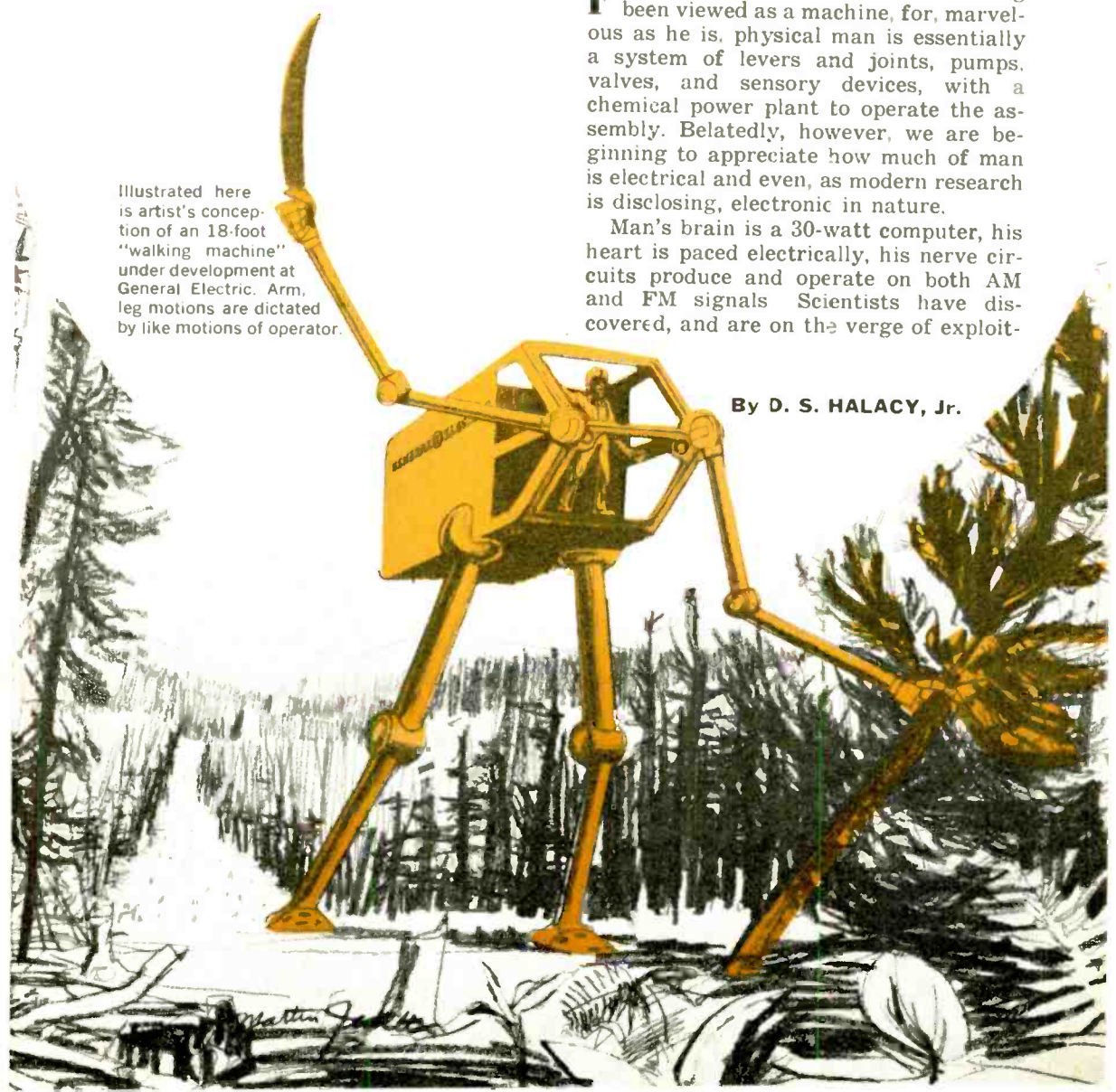
THE "TRANSISTORIZED" MAN

Basically, man is a walking, talking "wet cell" whose circuitry includes switches, semiconductors, resistors and capacitors . . .

FOR MANY PURPOSES, man has long been viewed as a machine, for, marvelous as he is, physical man is essentially a system of levers and joints, pumps, valves, and sensory devices, with a chemical power plant to operate the assembly. Belatedly, however, we are beginning to appreciate how much of man is electrical and even, as modern research is disclosing, electronic in nature.

Man's brain is a 30-watt computer, his heart is paced electrically, his nerve circuits produce and operate on both AM and FM signals Scientists have discovered, and are on the verge of exploit-

By D. S. HALACY, Jr.



Illustrated here is artist's conception of an 18-foot "walking machine" under development at General Electric. Arm, leg motions are dictated by like motions of operator.

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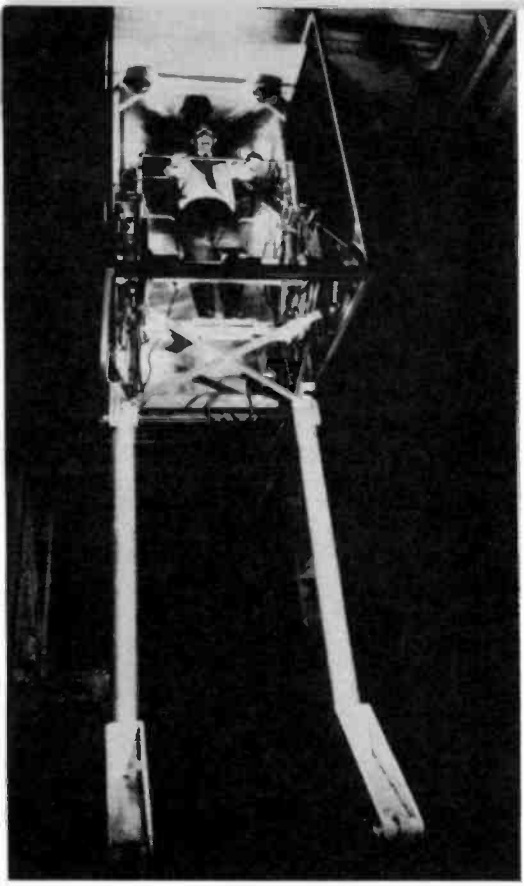


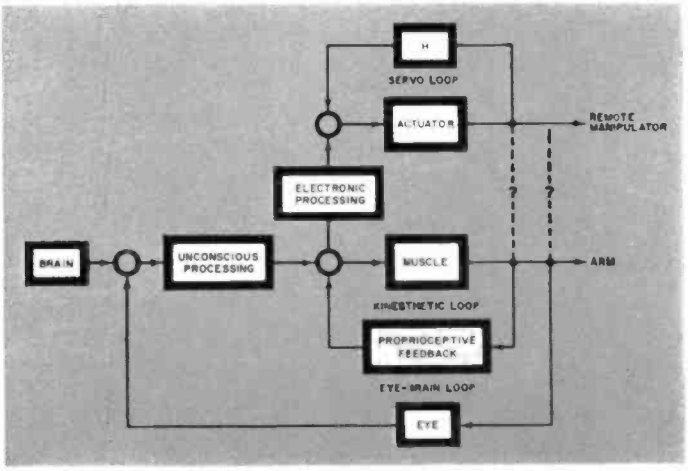
Preliminary version of "walking machine," developed for Army use across rugged terrain, undergoes tests at GE lab. Machine mimics and amplifies operator's movements.

ing, the fact that man not only produces electrical outputs in the r.f. range, but can also detect and translate such signals received from the outside world.

Recently a new kind of biologist has joined the ranks of the life scientists, the electrobiologist concerned with the different manifestations of electrical signals produced by the body and the corollary truth that similar signals produced *externally* can control man.

Electricity in Plants and Animals. Most living things have been found to produce electrical impulses. Studies of the lowly bean plant show that a current of about a hundredth of a microamp flows across a square millimeter of its root surface. Poking at the plant with a probe causes an electrical impulse of a very slow speed, a kind of a.c. with a cycle rate of only about three per minute. But the phenomenon is definitely electrical.

Fish produce electricity in far greater amounts than plants do; eels and catfish emit jolts of up to 500 volts at sufficient wattage to kill other fish. This electricity is generated in batteries of series-parallel circuits of *electroplaques,* each a miniature cell putting out 50 to 100 millivolts. In the case of the electric eel, spikes of up to 150 millivolts are produced. While the high-voltage fish use their output to attack or defend themselves against an



Use of electromyographic signals for control purposes was the purpose of a recent study undertaken by Philco's Bio Technology Laboratory. Block diagram shows how man and remote machine might be linked together.

enemy, other fish rely on a low-power, electrical-pulse navigation system. This fish version of radar transmits up to 1500 pulses per second, and, at the receiving end, some fish can detect a po-

tential gradient in the water about them of only .03 microvolt per centimeter. Thus, by listening to deviations in the returned electrical field, the fish can detect even tiny obstructions and avoid them.

What plants and lesser animals exhibit we might also expect to encounter in man, and we are not disappointed on this score. Drs. Robert O. Becker and Howard Friedman of the State University of New York, and Dr. Charles H. Bachman of Syracuse University, have done a great deal of research on the effects of electrical fields on human beings. It has long been suspected, and is now being proved, that ionization of air, magnetic fields, solar flares, and cosmic-ray activity have an effect on the mental and physical state of humans.

Electricity in Man. In the course of their work, the New York researchers have found a flow of d.c. in the body. This slow, steady current moves in one direction along sensory fibers and in the opposite direction along fibers of the motor nerves. The scientists believe it represents "the most primitive guidance system within man's body," a carry-over from early stages of our evolution. Further, they believe that the fundamental control of the human nervous system must be carried out by living analogs of semiconductor components. Thus, man is not only electronic, but transistorized as well!

The more the electrobiologists probe and measure, the more it is evident that our bodies use electricity in a wide variety of components once thought to be the exclusive property of the electrical and electronics engineer. We are one big walking, talking wet cell, and in the maze of circuitry strung throughout our bodies are biological switches, relays, semiconductors, lossless conductors, all sorts of transducers, resistors, and capacitors.

The brain specialist uses the bioelectric output in the form of an *electroencephalograph*. The heart specialist puts the *electrocardiogram* to use. More recently, the neurophysiologist has discovered *electromyography* and tapped the electricity produced by living muscle.

A major development in the field of bio-electricity is *myo-electric* control, the tapping of useful signals generated in our muscles. In 1952, not long after Norbert Wiener had startled the engineering world with his new science of cybernetics, or the methods of communication and control in humans and machines, novelist Bernard Wolfe wrote a chilling novel called *Limbo*. In it, he described artificial limbs controlled by the wearer's

Delicate switches on forehead control this powered arm-aid developed by Case Institute of Technology.

Computer (background) holds programs for arm-aid activities such as eating, shaving, and drinking.

own nerve signals, and powered by atomic energy for a performance that far surpassed human limbs. A military version of these artificial limbs offered "snap-on" replacements that functioned as tools, weapons, helicopters, and so on! Wild-eyed fiction? Before you make a snap decision, read on.

Muscle Electricity. When we flex a muscle, a number of phenomena occur which we normally do not think about and are not even aware of. The brain sends a signal along the proper nerves, and the nerve ending in the appropriate muscles triggers a complex electrochemical action that results in the contractile force providing the motion desired. Associated with this muscle action are tiny electrical impulses which can be detected with modern electronic equipment, amplified and otherwise processed for use in control systems.

With special electrodes taped or glued to the skin, EMG signals have been detected ranging from a few microvolts to several millivolts, and with frequencies from 3 to 1000 cycles per second. Maximum signal power is detected in the 10-to-200 cycles per second range and only muscle-contraction stimuli provide signals strong enough to be useful. Normal "noise" at the surface of the body effectively buries relaxation stimuli below about 30 microvolts. In processing signals for reliable pattern recognition, researchers do not rely on such measurements as peak-to-peak amplitude, but use smoothing transformations to provide suitable control signals.

Having established the fact that our muscles produce electrical signals, researchers quickly put the phenomenon to work. An obvious use of myo-electricity is the training of muscles in rehabilitation of handicapped persons such as amputees and polio sufferers. Since electrical signals can be displayed visually on an oscilloscope or audibly by loudspeaker, the subject can see or hear the generation of proper signals. (It is interesting to speculate on the possibility of using voluntary myo-electric signals to permit speechless persons to "talk"!) Workers at Queen's University in Kingston, Ontario, in Canada claim to have elicited responses not from just a bundle of nerve fibers, but from one individual "motor unit" amongst the thousands—a feat impossible without artificial feedback.

A greater refinement of the muscle training technique has recently been reported by Dr. John Lyman and his associates at UCLA. Feeling that the oscilloscope training method was not ideal, particularly with a naive subject, and that the loudspeaker method had similar shortcomings, the researchers devised a visual display board showing the schematic diagrams of the body. Lights placed at appropriate muscle sites lit up when the proper muscle action was made by the subject; a sort of myo-electric pinball game.

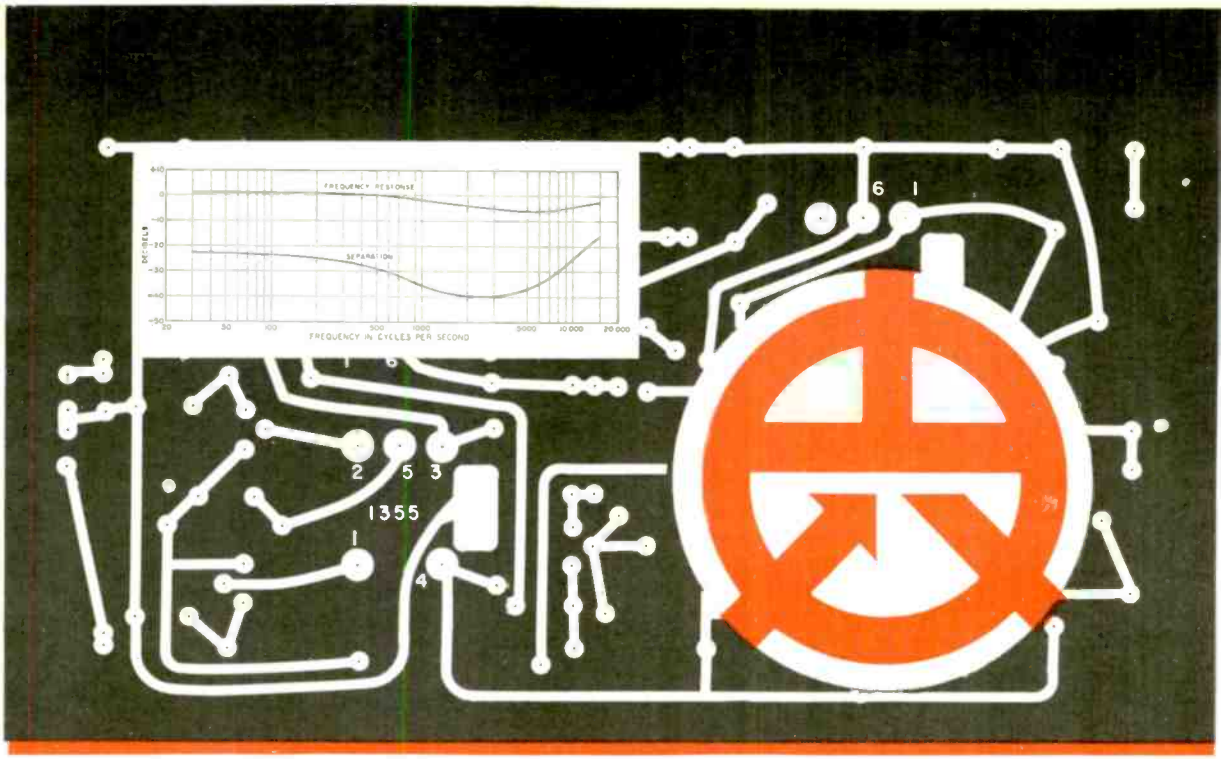
At the beginning of training, none of the desired responses could be made by one amputee subject. By the final training period, scores ranging from 97 to 100 percent were recorded for the various muscles involved.

Putting EMG to Work. Electromyography as a training method for muscular responses was only a prelude to a far more important use of these electrical signals. If a given myo-electric signal resulted in a desired movement of human limbs, could that same signal produce similar movement of artificial limbs? Prosthetics experts had long dreamed of such a technique, but the closest they had come was something called *cineplasty,* in which a muscle in the stump was attached to a cable that, in turn, actuated an artificial limb. If a nerve *signal* could be used, there would be much more intimate connection between the user's brain and the substitute limb.

As with the first Sputnik, Russia has stolen a march on the rest of the world in the field of myo-electric control of artificial limbs. American experts visiting Russia late in 1963 reported on this success. The Russians refer to their device as a cybernetic forearm prosthesis activated by muscle nerve impulses, and claim their system "is most convenient because the command is transmitted from the cerebral cortex to the hand by the beaten track which was severed by the trauma." Simply *thinking about it* operates the artificial hand!

Kobrinsky and Gurfinkel, the Russian scientists who began work on the myo-electric hand in 1958, found that the relationship of muscular effort and the

(*Continued on page* 90)



TRANSISTOR FM MULTIPLEXER

Double your pleasure from your hi-fi FM tuner or radio with an automatic switchless FM stereo adapter and stereo indicator

By O.D. CARLSON

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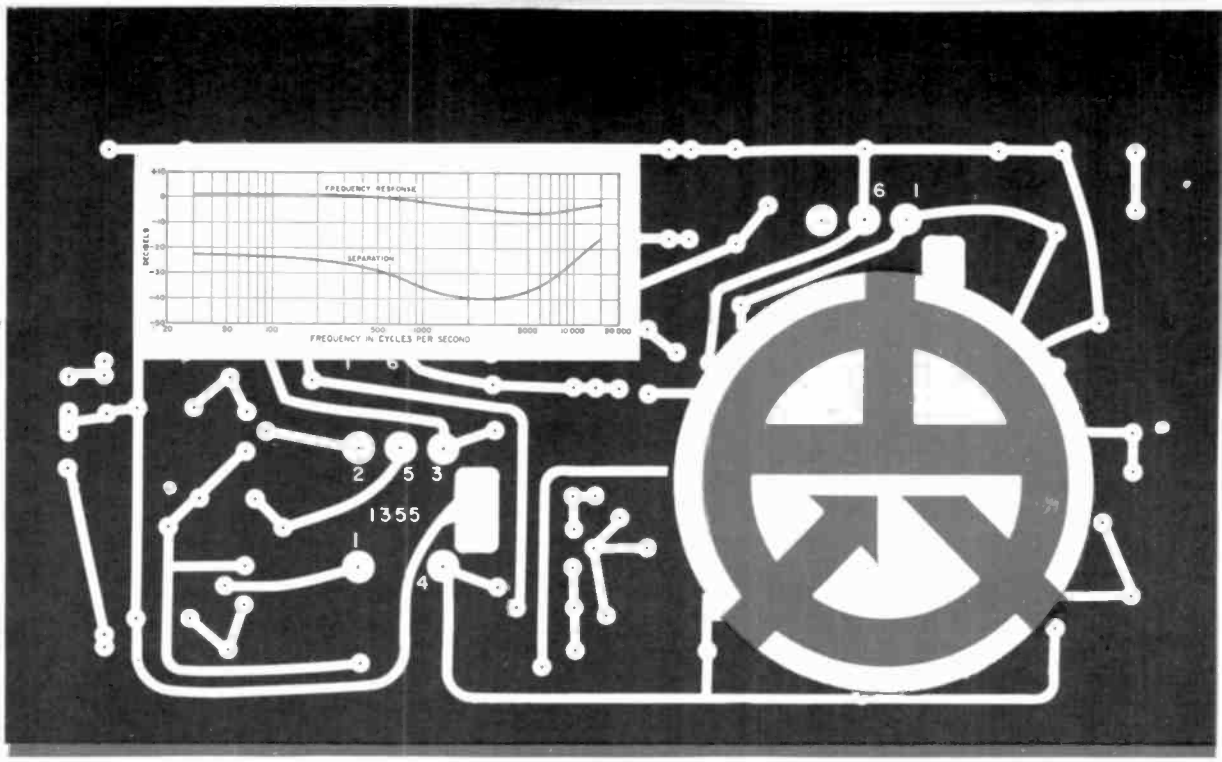
Audio passing through this time-sharing type of multiplexer is not subjected to the nonlinear phase distortion of bandpass filters, as is the case with some matrix-type adapters. Both mono and stereo programs are played through the adapter and electronically switched back and forth, from left to right, at a 38-kc. rate, without any discernible depreciation of quality. Stereo, when it is present, comes out like magic.

How It Works. Signals from an FM tuner are fed to the base of *Q1*. (See Fig. 1.) The 19-kc. pilot component in the stereo multiplexed signal is filtered out in the emitter tank circuit (*T1* and *C3*). All remaining signals are amplified and fed through the 67-kc. filter (*T3*) to an emitter follower (*Q2*). The audio signal is then fed to the collectors of switching transistors *Q5* and *Q6*.

As these transistors are switched on and off, the signal appears first at one emitter and then at the other at a



TRANSISTOR FM MULTIPLEXER

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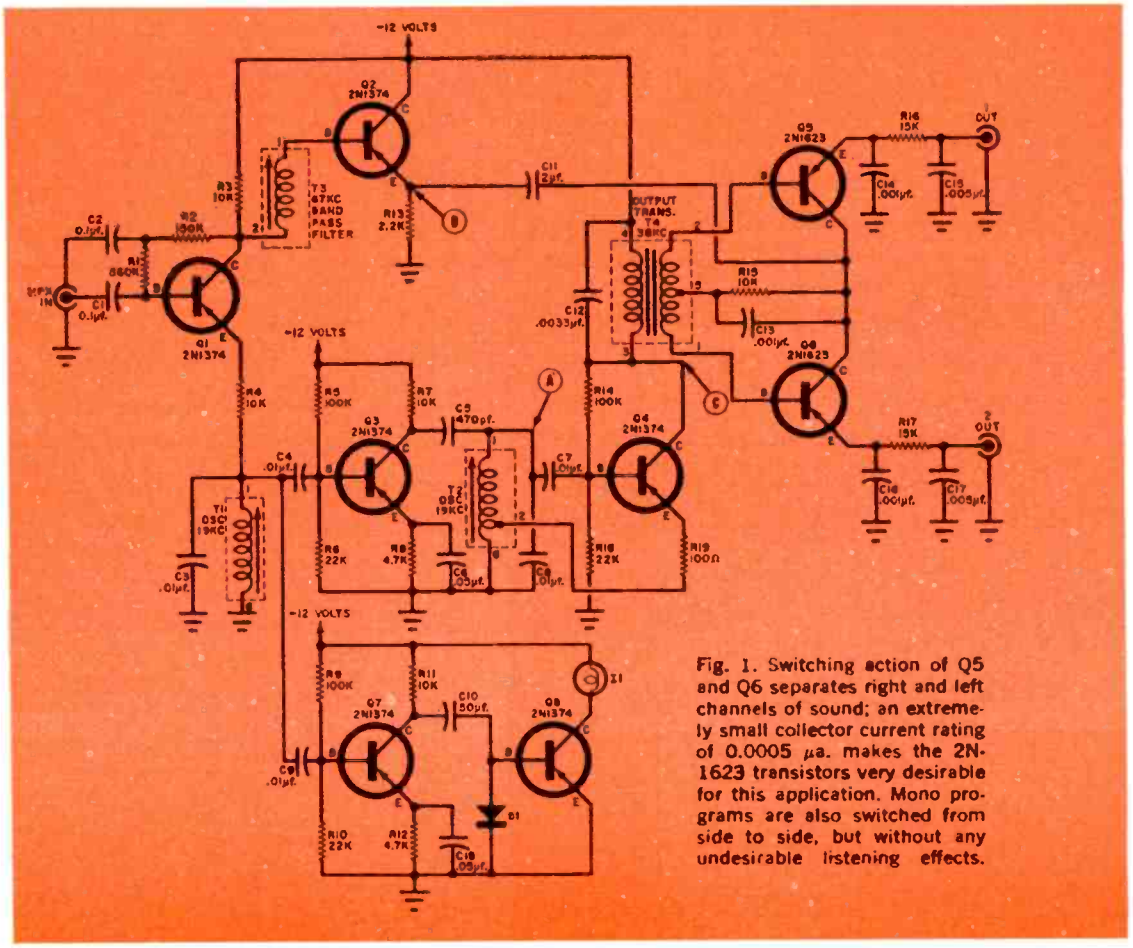


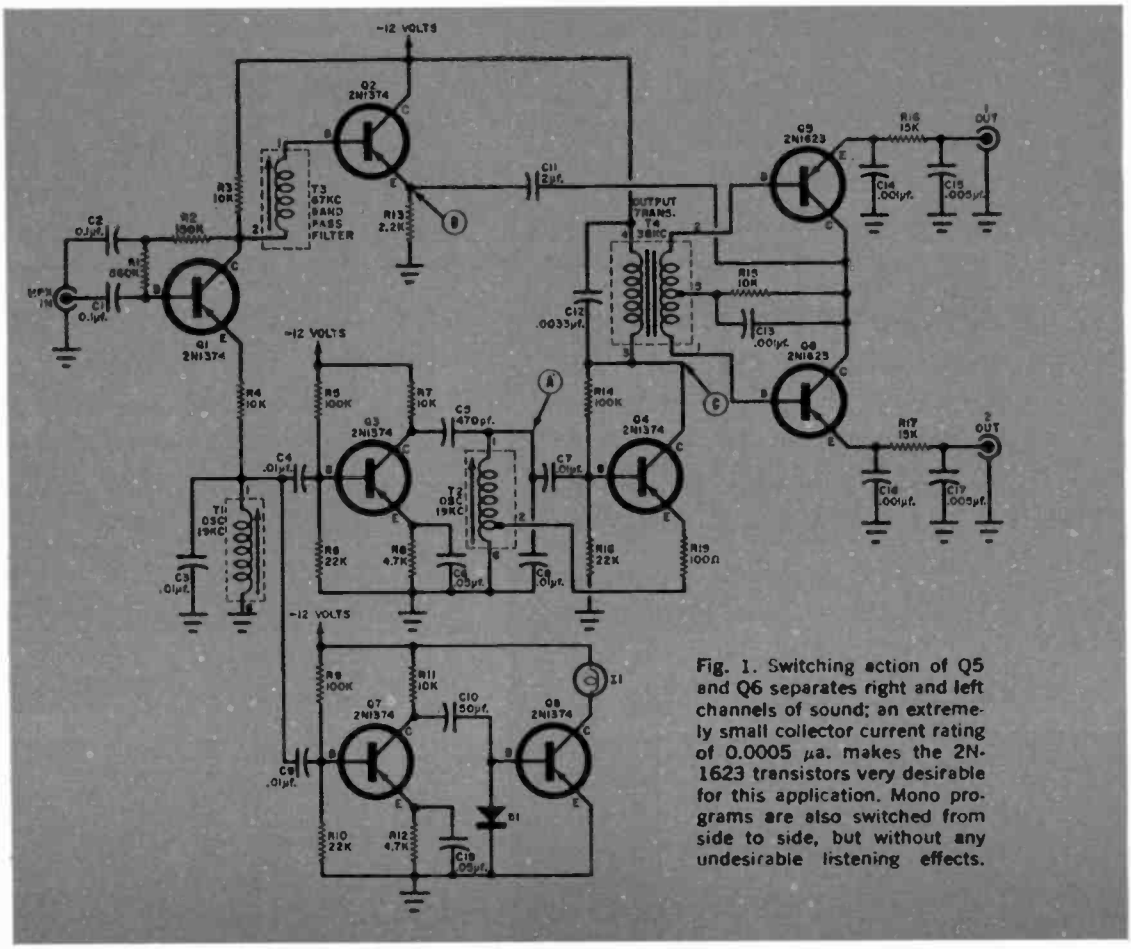
Fig. 1. Switching action of Q5 and Q6 separates right and left channels of sound; an extremely small collector current rating of 0.0005 μa. makes the 2N-1623 transistors very desirable for this application. Mono programs are also switched from side to side, but without any undesirable listening effects.

38-kc. rate. If this switching rate is precisely synchronized with the 19-kc. pilot signal of a stereo station, the left and right components of a stereo program are separated and recovered.

From the switching transistors, the signal passes through the appropriate de-emphasis networks (*C14*, *R16*, *C15* and *C16*, *R17*, *C17*). Standard 75-microsecond de-emphasis is employed, effectively filtering out any 38-kc. signal that may be introduced by the switching action. For that matter, all frequencies greater than 20 kc. are reduced or eliminated by the de-emphasis network. This is fine for the audio signals going to the loudspeakers, but no good for the signals from the tuner to the multiplexer. The multiplexer has to see the total stereo signal, which also has components greater than 20 kc. and so the signal take-off point in the tuner is *before* the de-emphasis network but *after* the detector.

Returning to the emitter tank circuit of *Q1* in the multiplexer, the 19-kc. pilot signal is fed to two identical amplifiers (*Q3* and *Q7*). Transistor *Q3* amplifies the signal to synchronize the 19-kc. oscillator (*Q4*). The collector tank circuit of this transistor is tuned to the second harmonic of the amplified 19-kc. pilot signal and passes a 38-kc. signal to the switching transistors via *T4*.

To see how the stereo indicator works, let us go back again to the emitter tank circuit of *Q1* and follow the signal path through *Q7*. The amplified 19-kc. pilot signal from *Q7* is rectified by *D1*, providing a negative-going signal to the base of *Q8*, and causing it to conduct and illuminate *I1*. Since the pilot signal is present only on multiplexed broadcasts, the lamp will go on when the receiver is tuned to an operating stereo



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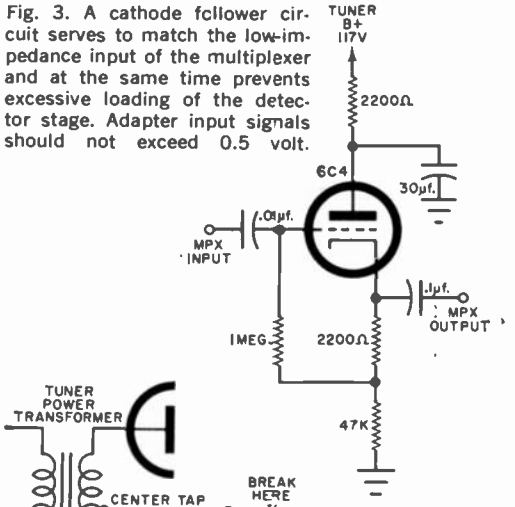
station. Pilot signal input levels of less than 0.2 volt are sufficient to operate the lamp driver circuit.

Construction. A printed wiring board can be made from the full-scale drawing. However, you can use any other conventional wiring technique and type of chassis. A 6" x 3" undrilled phenolic circuit board containing all internal wiring is available from the author. (See Parts List.)

First, mount the transformers; connect only one spade-type projection on each transformer can to ground, and cut off the other one. Resistors, capacitors, and interconnecting leads for power and indicator lamp follow in just this order. Bend the lead ends slightly to hold them in place and then solder. You can cut off excessive lead lengths either before or after soldering, depending upon which is easier for you. For best results, do a neat soldering and wiring job and avoid lifting the foil with excessive heat and pressure.

Leave the installation of the transistors and the diode for last. If a transistor socket is used for *Q4*, the oscillator can be easily disconnected during alignment of the adapter simply by removing the transistor. All other semiconductors are soldered directly to the circuit board. Allow approximately ⅜" of air space above the board for clamping a heat sink to each transistor lead as it is soldered.

Fig. 3. A cathode follower circuit serves to match the low-impedance input of the multiplexer and at the same time prevents excessive loading of the detector stage. Adapter input signals should not exceed 0.5 volt.



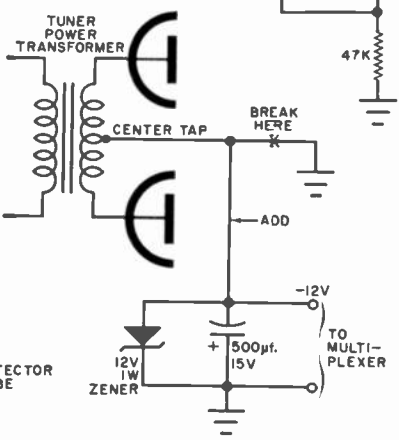


Fig. 4. Zener diode and filter capacitor added to the tuner's power supply eliminate need for an external power source for the multiplexer.

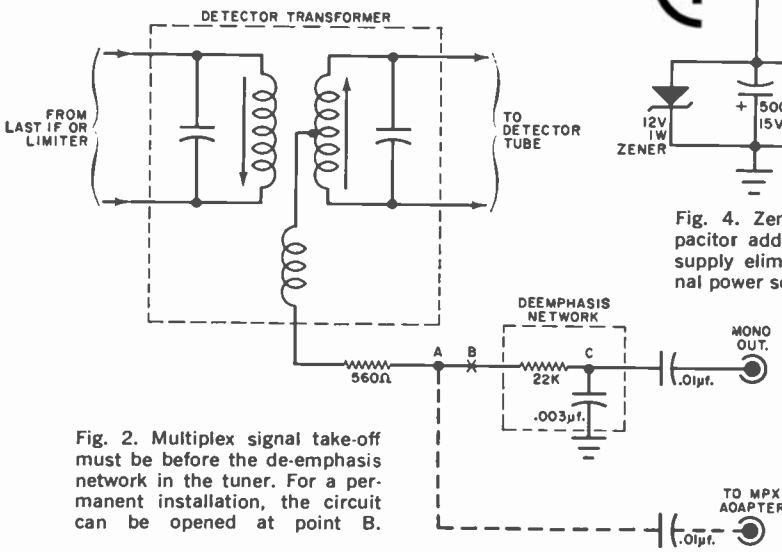
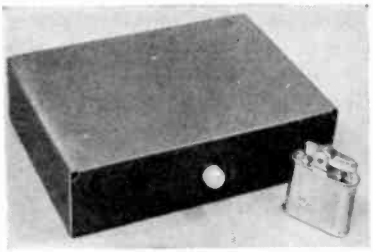


Fig. 2. Multiplex signal take-off must be before the de-emphasis network in the tuner. For a permanent installation, the circuit can be opened at point B.

Connection to FM Tuner. Reception of stereo FM programs places more stringent requirements on a tuner and its antenna than for mono broadcasts. Greater bandwidth and sensitivity is needed for stereo receivers. The extra bandwidth allows for the standard spread of mono signal frequencies plus the stereo signal frequencies. The need for increased sensitivity is evident from the fact that a portion of a given stereo radio station's overall signal strength contains stereo signals. The main channel, therefore has less than maximum power.

FM MULTIPLEXER



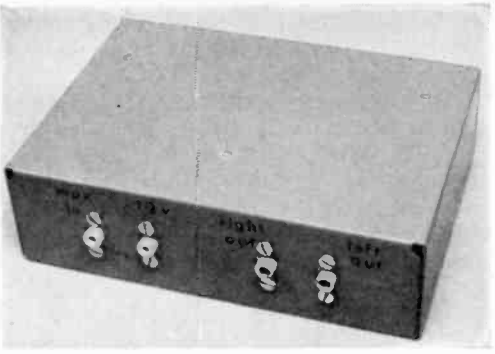


Fig. 5. Indicator lamp on front of cabinet goes on when stereo signals are tuned in. Electronic switching eliminates all external controls.

Tuners having a cathode follower output tube are easily modified to supply proper stereo signals, since this type of circuit already has a low output impedance. All you have to do is hook up the multiplexer in front of the de-emphasis network, as shown in Fig. 2. For a permanent installation, disconnect the de-emphasis network in the tuner (usually an 0.001- or 0.003-μf. capacitor on the output end of the 68,000- or 22,000-ohm resistor which is attached to the grid of the first stage after the detector), and turn the tuner's volume control to maximum (if it affects the signal take-off point).

Volume is not adjusted at this point in the system unless the signal to the multiplexer is in excess of 0.5 volts, because reduction here could diminish the 19-kc. pilot signal needed for the oscillator and other circuits in the adapter. On the other hand, excessive signal strength will cause distortion. About 0.3 volt makes the unit work just fine.

Since the multiplexer is used for both mono and stereo programs, de-emphasis of all signals is reinserted in the multiplexer.

Tuners not equipped with multiplex outputs are generally not satisfactory for stereo reception due to narrow bandwidth and sometimes lack of sensitivity, but with certain modifications and a good antenna can be made to work. In a

(*Continued on page* 102)

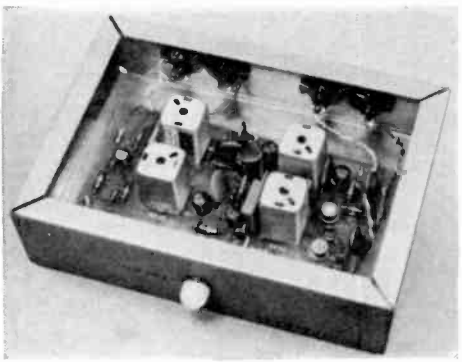


Fig. 6. Twisted leads are used as self-shielded conductors. The lead acting as a shield is connected only to the ground foil on the board. A bare wire connects the ground side of the jacks to a single ground point on the circuit board.

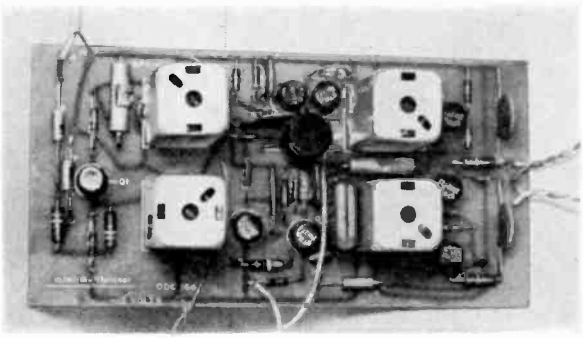


Fig. 7. A printed circuit board or any other standard wiring technique can be used. All components are mounted on one side. Keep transistors about ¼" above the board, or install in sockets.

PARTS LIST

C1, C2—0.1 μf.
C3, C8—0.01 μf.
C4, C7, C9—0.01 μf.
C5—470 pf.
C6, C18—0.05 μf.
C10—50 μf.
C11—2 μf.
C12—3300 pf.
C13, C14, C16—0.001 μf.
C15, C17—0.005 μf.
All capacitors ceramic disc or mica, 15 volts or better

D1—1N457 diode
I1—Indicator lamp (G.E. 344 or equivalent)
Q1, Q2, Q3, Q4, Q7—2N1374 transistor
Q5, Q6—2N1623 transistor
R1—150,000 ohms
R2—560,000 ohms
R3, R4, R7, R11, R15—10,000 ohms
R5, R9, R14—100,000 ohms
R6, R10, R18—22,000 ohms
R8, R12—4700 ohms
R13—2200 ohms
R16, R17—15,000 ohms
R19—100 ohms
All resistors ¼ or ½ watt, ± 10%

T1, T2—Oscillator coil (J.W. Miller 1354-PC)
T3—Bandpass filter (J.W. Miller 1352-PC)
T4—Output transformer (J.W. Miller 1355-PC)
1—Circuit board (ODC 1664)*
1—7" x 5" x 2" metal cabinet
Misc.—Lamp socket, phono jacks, wire, solder, small hardware, etc.

**An undrilled 6" x 3" phenolic circuit board is available for $2.50 from O. D. Carlson, 414 Edgewood Ave., Linwood, N. J.*

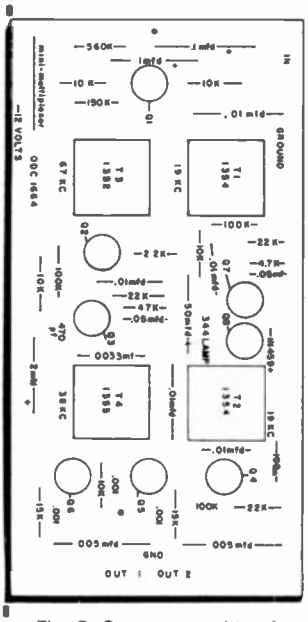


Fig. 8. Component side of board shows parts layout. In spite of its miniature size, there is ample space between the components.

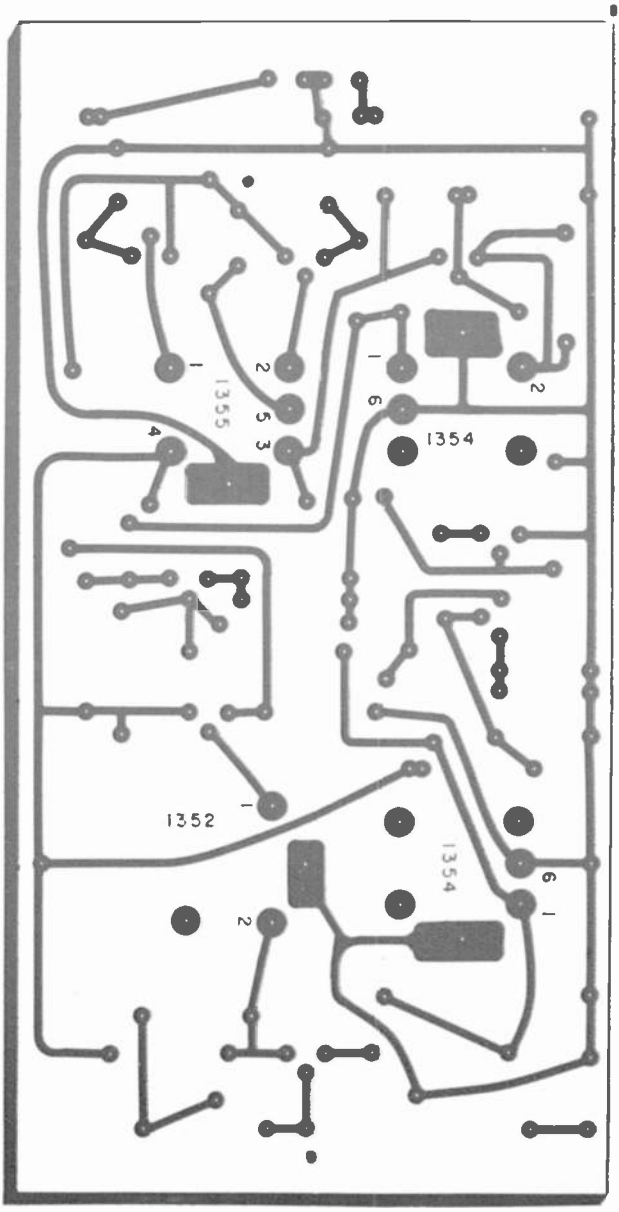
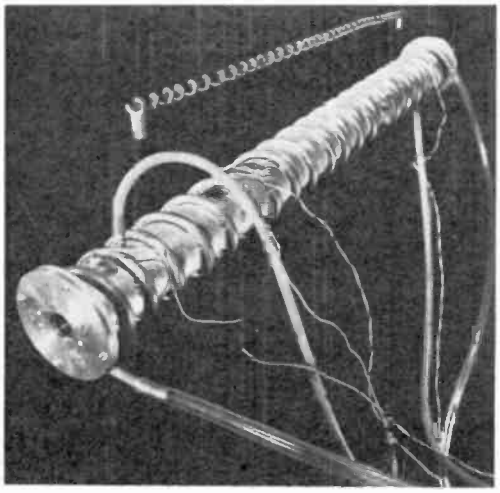


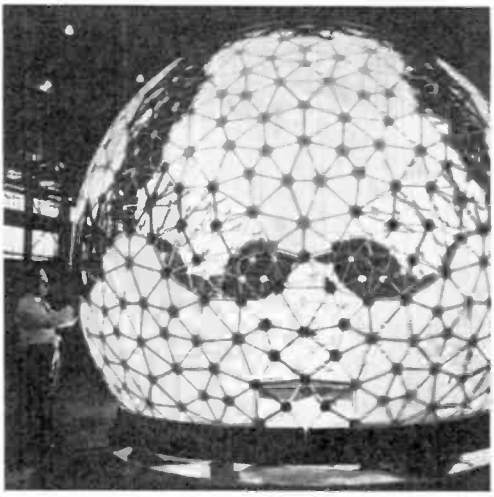
Fig. 9. Actual size of the printed circuit board. Materials are available from your local parts distributor to enable you to make your own board. Or undrilled boards having both sides printed in foil, as shown here and in Fig. 8, can be purchased directly from the author.

POPULAR ELECTRONICS news

ONE-HORSE THERMOSTAT—Scamper, a horse, looks with approval at a new Honeywell device to control heating-cooling systems with ratings up to one horsepower. It uses a heavy-duty snap-action switch.

LIGHT PIPE—Gas lenses can be used to guide a laser beam down the center of a curving pipe. A Bell Labs device—in prototype below—employs variations in the refractive indices of gases to guide light. Gas-filled pipes may make possible long-range laser communications.





BLAST DOME—Radomes designed to protect radar antennas from shock and blast as well as from the weather are being produced by Goodyear. The structures get their strength from unusual geometric configuration; skin is fiberglass.

SEA ARM—An electronically controlled "robot," designed to pick up 500-lb. objects from the ocean floor, was recently attached to the Navy bathyscaphe Trieste. Electronics were designed by ACF Industries.

AUTOMOTIVE ELECTRONICS

Transistor Ignition and CD Systems

By BRICE WARD

CAPACITIVE DISCHARGE (CD) ignition and silicon-controlled rectifier (SCR) ignition are two terms that may replace the magic phrase "transistor ignition" in 1965. The confusion that is gradually arising around these words reminds me of 1958 when stereo was introduced to the hi-fi world. It took years before the music listener became aware that stereo was also hi-fi.

Capacitive discharge ignition systems are now also transistor systems; at one time thyratrons were employed to discharge the capacitor, but now SCR's are used. It would have been better to use a broader term, such as "electronic ignition systems," in the first place. Let's see what the similarities and differences are between transistor ignition and CD systems.

Comparison of Systems. In the usual standard and transistor ignition systems, the necessary firing energy is stored in the magnetic field of an ignition coil. When this magnetic field collapses, it creates an inductive kick in the coil.

Keep in mind that the first voltage the coil "sees" is the 6- or 12-volt battery voltage. In spite of the coil having a turns ratio on the order of 100 to 1, it does increase this voltage to approximately 20,000 volts. According to the turns ratio, only about 1200 volts would normally be produced from a 12-volt input; so obviously something else is happening . . . during the time the points are closed, a relatively large magnetic field is built up around the many turns of wire in the ignition coil. When this field collapses, the low-voltage energy stored in the field is transformed into high-voltage energy, and is a function of time, number of lines of force, and number of turns of wire.

On the other hand, in the CD system the energy needed for firing the spark plugs is stored in one (or more) large capacitor. A highly efficient d.c.-to-d.c. converter steps up the battery voltage to about 350 volts and charges the capacitor. The coil now "sees" and starts to work from a 350-volt level instead of the usual 6 or 12 volts. The same coil now does not have to depend upon the built-up magnetic field, and, by the same token, no longer depends upon the dwell time of the breaker points to build up this magnetic field. Theory and practical experience have shown that using a capacitor to drive the ignition coil re-

EDITOR'S NOTE

In view of the ever-widening interest in automotive electronics, the editors of POPULAR ELECTRONICS are pleased to announce a new department devoted to this topic. Writing this department—which will appear on an irregular basis—is Brice Ward, who authored a comprehensive summary of transistor ignition systems for our June 1964 issue.

This department will cover the whole gamut of electronics applicable to car, truck, or boat. Ignition systems, regulators, tachometers, test equipment, etc., are but a few of the topics that will be discussed in depth in the following months.

In this first installment, Brice Ward reviews capacitive discharge ignition systems and tells why such systems are becoming so popular.

sults in a sharper, more accurately timed spark, and with much less energy loss (improved efficiency).

The silicon-controlled rectifier enters the picture as a replacement for the transistor switch used to control large amounts of current.

How CD System Works. When the breaker points open, a signal generated by a triggering circuit is applied to the gate electrode of the SCR, turning it *on*. With the capacitor acting as the reservoir, the entire voltage is applied immediately to the ignition coil primary. The voltage rises abruptly in the secondary and jumps the spark plug gap. This secondary rise time has been quoted as being extremely short, and should show up at around 15 microseconds to reach 25,000 volts—which would mean that a 5-microsecond figure to reach initial firing potential is not unrealistic.

This faster rise time accounts for the ability to fire fouled plugs and eliminate misfires, particularly at high engine speeds, resulting in more economy and power. Modern gasolines have a strong

Knight-Kit KG-375

The KG-375 analyzer is a handy self-contained piece of automotive test equipment. Four "D" cell batteries are held in a plastic cylinder with access from the left-hand side of the cabinet. The two handles on the panel provide ease in carrying and positioning the instrument when you're working around your car. All wiring (right) is wide open, permitting assembly of analyzer in under five hours.

SOME 30 years ago, all but a few automobile owners spent considerable time tinkering with their cars. However, in the last decade, as Detroit iron became increasingly complex and more and more accessories were jammed under the hood, the tinkering car owner almost became a thing of the past. Maybe it was the surge of interest in transistorized ignition that set the pendulum off again; in any event, it is swinging back in favor of more tinkering, and electronics enthusiasts (especially) are out every Saturday morning looking for that perfect tune-up, greater gas savings, and faster getaways.

As any electronics enthusiast knows, you must have test equipment to do a good job. Automotive test gear is not too common and only one manufacturer has previously offered a kit that could be used to solve tune-up problems. But the Knight-Kit division of Allied Radio Electronics Corp. (100 N. Western Ave., Chicago, Ill. 60680) has now released a combination test instrument that belongs in the workshop of every electronics technician, serviceman, or hobbyist.

Labeled the Model KG-375, this universal auto analyzer kit sells for $49.95 (complete with batteries and test leads). Wiring it is a cinch and should take the average builder no longer than 4½ hours. Because size is not a major problem, the wiring is wide open and most components are arranged between three oversized tie-point terminal strips. The meter is 7" wide and has clearly defined, color-coded scales (see cover photo).

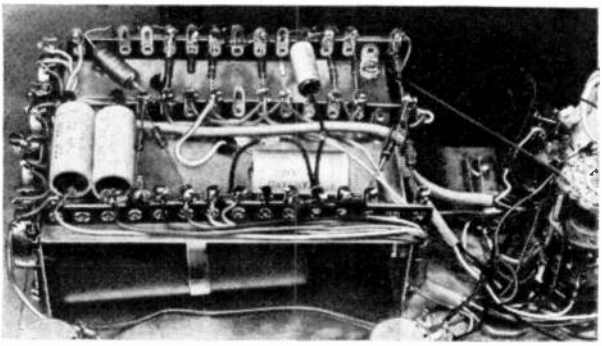
Probably the first section of this universal tester that you will use is the tachometer. The tach provides optimum means of setting carburetor needle values for a hot idle adjustment. The KG-375 can be attached to 4-, 6-, or 8-cylin-

tendency to "lead-foul" spark plugs even under the most perfect conditions. The spark from a conventional transistor system compared to that from a CD system can be likened to the gentle tap of a hammer compared to a sharp rap with the same hammer. (The CD-SCR system can work with the original coil supplied by the manufacturer.)

Power to charge the capacitor in the CD-SCR system is obtained from a transistorized inverter circuit. Because the efficiency of the CD-SCR is high, the inverter works on demand—high demand at high rpm's and very low demand at idle. In fact, with many CD-SCR systems, the maximum drain from the car's electrical system is only 3 amps at highway cruising speeds, and about 0.5 amp at a traffic light! This saving is of particular importance in cold weather starts. With the usual transistorized switching system, the cold start will demand up to 12 amps from an already straining battery—the CD-SCR loafs along at well under 1 ampere.

Coming: Review of new CD-SCR systems.

Universal Auto Analyzer



der cars and has two ranges—0-1200 rpm and 0-6000 rpm. Both ranges work from a transistorized Schmidt trigger pulse counter and can be attached to conventional and most transistorized ignition systems.

Dwell settings and angular measurement are probably the next most important functions of this unit. The analyzer can be used on 4-, 6-, or 8-cylinder cars for these readings as well as for tach measurements. The dwell-angle meter circuit consists of an ohmmeter with a diode in series with a calibrating resistor; a capacitor in the circuit protects against high voltage surges. Tests at POPULAR ELECTRONICS showed the calibration of both the tach (the builder calibrates using the 60-cycle a.c. line) and the dwell meter to be within plus or minus 2%—roughly equal to the accuracy of the meter.

Voltmeter tests possible with the KG-375 are many and varied. For example, the user can determine the state of the charge of his battery, as well as the battery capacity. Resistance in the starter ground return (it should not exceed 0.2-volt drop when starting the engine) can be checked out. Routine tests for broken or weak connections in and around the generator, ignition coil, distributor, etc., can all be made with the KG-375.

The spark output can be judged on a relative or comparative basis if the engine is held to a constant setting of about 850 rpm. The user slips a fine wire under the spark plug boot to contact the "hot" terminal and reads the meter. Moving from plug to plug and repeating this step should result in very similar readings—if not, a plug or plug lead may be defective, rotor or distributor cap worn, dirty or cracked, etc.

There are many other tests you can perform with the KG-375. Fortunately, Allied Radio has provided all of the necessary information in two separate books (wiring and assembly instructions are in one and operating instructions in the other). The instructions are extraordinarily well prepared—text on the left-hand pages and large illustrations on the right—and should enable any electronics enthusiast to get out there and service his automobile. -30-

TACHOMETER & ENGINE IDLE SPEED CALIBRATOR

Low cost, easy-to-make tester calibrates tachometers under actual conditions without any other equipment

By JAMES S. SHREVE

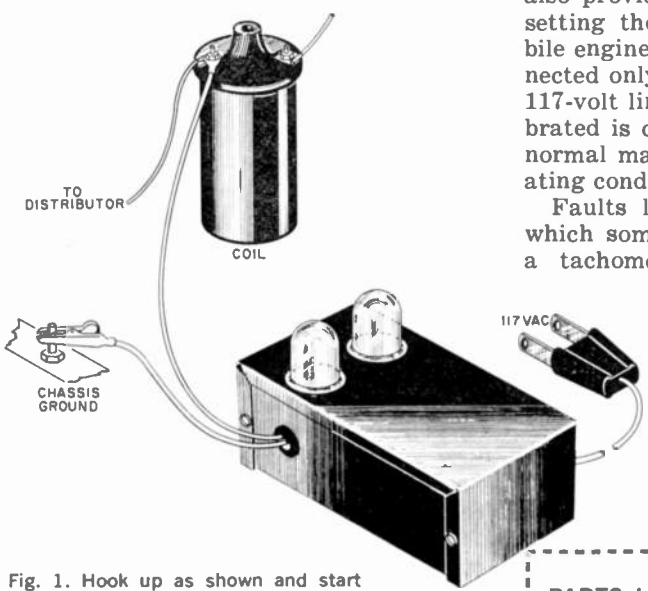


Fig. 1. Hook up as shown and start the engine; both lights will flash. At sync speeds, only one stays on.

THIS simple circuit enables you to calibrate automobile tachometers and check their accuracy. In many cases it also provides an independent means for setting the idle speed of your automobile engine. In use, the calibrator is connected only to the engine and a 60-cycle, 117-volt line. The tachometer to be calibrated is connected to the engine in the normal manner to establish actual operating conditions.

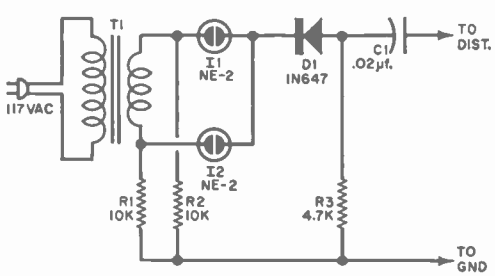
Faults leading to improper readings, which sometimes escape detection when a tachometer is bench-tested instead of tested in the car, have no place to hide. For this reason, the calibrator described here is especially good for testing accuracy of new tachometer designs.

How It Works. The calibrator has two neon lamps which alternately flash on and off when the unit is properly connected to the car and the a.c. power line. The rate of flash diminishes as the engine speed approaches either 450 rpm or 900 rpm for an 8-cylinder car, or 600 rpm or 1200 rpm for a 6-cylinder car. When each lamp flashes about once per second, engine speed is off by only 1.7%.

PARTS LIST

C1—0.02-μf, 600-volt capacitor
D1—1N647 diode rectifier
I1, I2—NE-2 neon lamp
R1, R2—10,000-ohm, ½-watt resistor
R3—4700-ohm, ½-watt resistor
T1—24-volt transformer (Burstein-Applebee stock No. 18B506 or equivalent)
1—5¼" x 3" x 2⅛" metal case
Misc.—A.c. line cord, 5- or 6-point terminal strip, two grommets, two alligator clips, and two neon lamp sockets

Fig. 2. Pulses from the ignition coil are keyed to the 60-cycle a.c. power line and cause the neon lamps to blink out a calibration signal.



As the engine reaches exactly one of the test speeds given above, one of the lamps will stay on and the other will stay off.

Figure 1 shows the hookup to the car and Fig. 2 is a schematic diagram of the calibrator. The principle of operation is rather simple: the whole idea is based on a coincidence of pulses from the distributor and the 60-cycle a.c. line voltage.

The ringing voltage produced in the primary circuit when the ignition points open passes through *C1* and appears across *R3*. Every positive swing of the ringing voltage passes through diode *D1* and attempts to ignite the neon lamps (in some cases the lamps do go on from ignition pulses only). At the same time, the voltage from the secondary winding of *T1* is also applied to the neon lamps. Therefore, at any given instant the potential across the neon lamps will be increased or decreased by *T1*.

While the potential across one lamp is increased, the potential across the other lamp is decreased by the same amount. The "favored" lamp fires at intervals or continues to fire and the other lamp is either extinguished at intervals or remains off. The speed of the alternate on-and-off action varies with the degree of out-of-sync conditions between the two comparison voltages.

When the distributor pulses are synchronized with the 60-cycle line, only one lamp is favored each time and appears to remain on all the time. Its partner never receives adequate voltage to fire; and thus it remains off all the time. A slight change in engine speed, either faster or slower, will again result in first one lamp, then the other, being in the favored position.

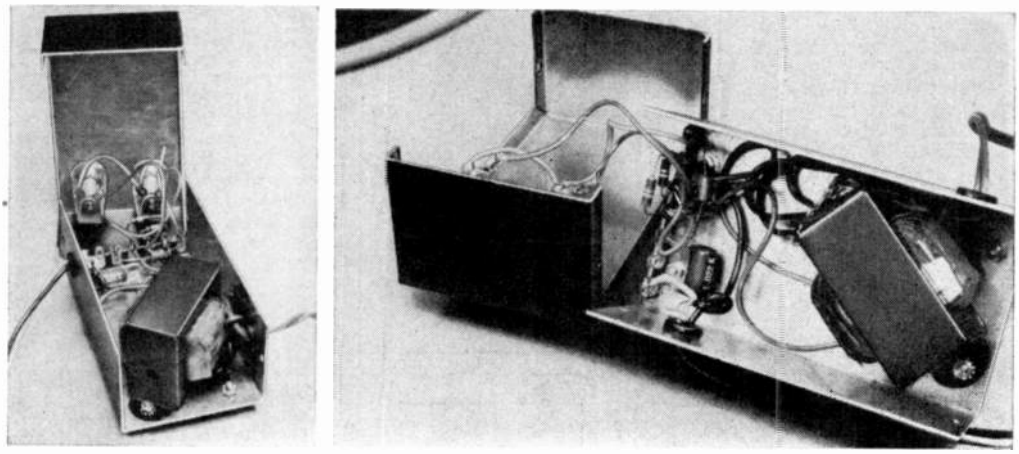
The lower of the two sync points for a given engine takes place when one ignition pulse occurs for every cycle of line current. The higher sync point shows up when two ignition pulses occur for every cycle. At still higher speeds, sync points do take place, but are difficult to pinpoint.

The calibrator will not work when primary circuit pulses are too low, too high, or of very short duration. Short duration pulses are found in transistor and capacitor ignition systems, but not in the conventional ignition system. High and low voltage pulses normally will not have to be reckoned with in an ignition system that is operating properly. If the pulse is too low, the neon lamps will not ignite; if the pulse is too high, the lamps will not shut off.

Construction. Layout of parts is not critical. A terminal strip supports all of the components except the transformer. It is desirable, if space permits, to install the calibrator in the tachometer's housing. Otherwise, a small metal or plastic cabinet can be used. The neon

(*Continued on page* 97)

Fig. 3. Allow enough room for neon lamp sockets to clear terminal strip when meshing both halves of the box. Lay out parts in any convenient manner. Neon lamps can be mounted in grommets or sockets.



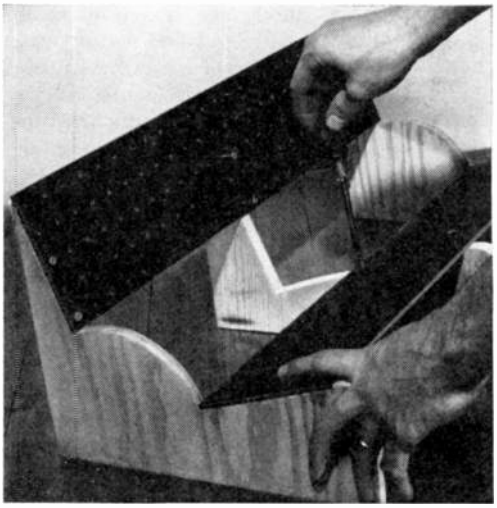
PEG 'N' DOWEL RECORD RACK

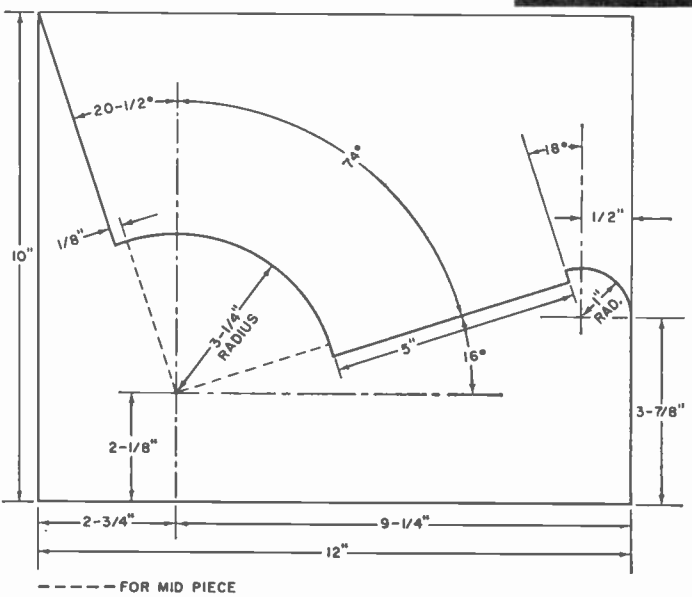
This adjustable rack will keep your records sorted and safe

By FRANKLYNN PETERSON

WITH a few dowels and a bit of peg board, you can make a modern-looking, inexpensive record file. And best of all, it's adjustable—the dowel dividers can be shifted. From a piece of 1" pine or hardwood, or a piece of ¾" plywood, cut three 10" x 12" supports as shown below. Make two pieces with the round bulge at the apex of the angle, and one without.

Two pieces of peg board are needed, each 5" x 24" (the last row of holes should be about ½" from the end if 1" lumber is used, and 3/16" from the end for ¾" plywood). The dividing dowels are made from 14" pieces of ¼"-diameter stock; the ends are filed or chiseled down to fit into the 3/16" peg board holes. To bend the dowels the required 90°, soak them in a tub of hot water for at least a few hours. 30

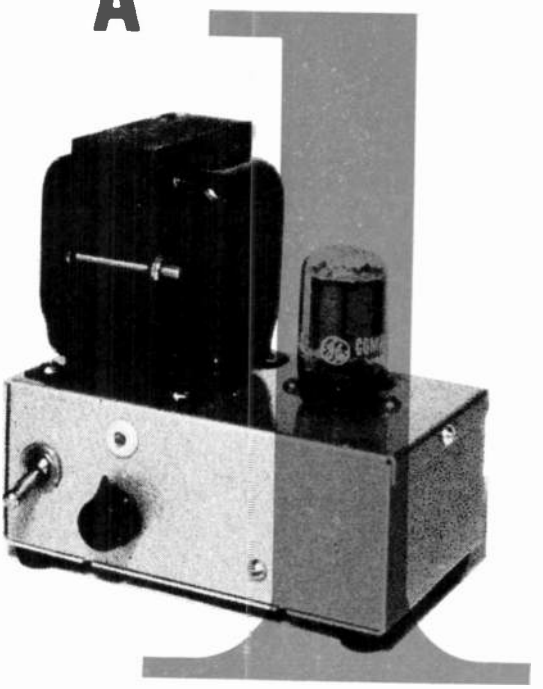




Sand the three base pieces completely, and assemble them with the pieces of peg board using flathead wood screws. Countersink the screws. First try bending the dowel dividers without soaking; if they are not flexible enough, soak them in a tub of hot water for several hours—longer if necessary. After the dowels have been softened enough to make the bend, put them into the peg holes to dry. Once they've dried at a 90° angle, it's easy to keep them in that shape without affecting their springiness.

Make three base pieces as shown at left, the center one without the bulge in it. You can paint or varnish the stand.

A COMPACTRON REGULATED POWER SUPPLY



By PHILIP E. HATFIELD, W9GFS*

Pick your voltages with this simple, economical electronically regulated supply—it's hard to beat

ADJUSTABLE, regulated power supplies for experimental projects, oscillators, and other devices are usually hard to come by. Batteries—one source of reasonably well regulated power—are expensive, and supplies using gas-filled regulator tubes allow for no adjustment of voltage. Electronically-regulated power supplies, the best answer to the problem, are usually multi-tube affairs of considerable complexity. With the circuit shown here, however, you can have an economical, electronically regulated power supply that uses just one tube envelope: a compactron.

While the supply does not have the capacity or refinements of some of the more elaborate units, its voltage range of 150-250 volts, its maximum output current of 60 ma., and its ability to compensate for normal line-voltage changes make it just the thing for small receivers, converters, and other gear requiring stable plate voltages.

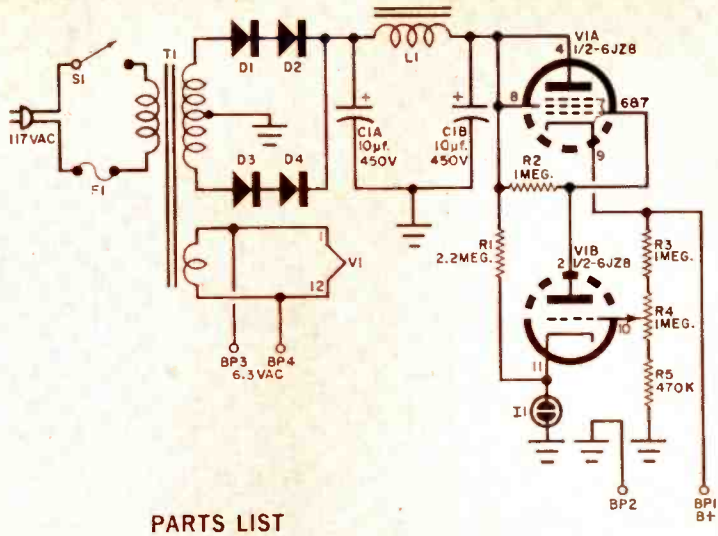
How It Works. Operation of the supply can best be understood by comparing it to a conventional power supply. As soon as we put a load on our unregulated supply, the output drops for several reasons. First, with no load, the filter capacitors charge to the peak voltage of the power transformer, and as we increase the load, we tend to discharge the capacitors faster than we charge them. Secondly, the transformer winding, the rectifier tube, and the filter choke all have resistance; and the more current we draw, the greater the sum of the voltage drops in these components. To compound the problems, the output voltage also goes up and down with the line voltage.

What is needed to compensate for all the above factors is a "potentiometer" in the B-plus line. We can use a vacuum tube as an automatic variable "potentiometer" by placing it in series with the output of the supply and varying its resistance by varying the bias on the grid. We then place a d.c. amplifier between the point where we sample the output voltage and the grid of the tube which is in series with the power supply output.

Finally, we place a gas tube in the cathode circuit of the d.c. amplifier to

*Tube Dept., GE, Owensboro, Ky. Story preprinted from revised edition of GE Hobby Manual.

The output of this full-wave supply is regulated by V1a-V1b. The V1a section acts as a variable resistor in series with the B-plus; its resistance depends on grid bias applied by triode section V1b. Lamp I1 is the voltage reference.



PARTS LIST

BP1 to BP4—"Six-way" binding post
C1—10/10 μf., 450-volt dual electrolytic capacitor
D1 to D4—500-PIV, 600-ma. silicon diode (1N1696 or equivalent)
F1—½-amp type 3AG fuse in fuse holder
I1—NE-2 neon lamp
L1—8-h., 75-ma. filter choke (Stancor C1355 or equivalent)
R1—2.2-megohm, 1-watt resistor
R2, R3—1-megohm, 1-watt resistor
R4—1-megohm potentiometer
R5—470,000-ohm, 1-watt resistor
S1—S.p.s.t. toggle switch
T1—Power transformer: primary, 117 volts a.c.; secondaries, 480 volts @ 70 ma., center-tapped, and 6.3 volts @ 3 amps (Stancor PC-8419 or equivalent)
V1—6JZ8 compactron tube
1—Compactron socket
1—2⅛" x 3" x 5¼" chassis box (LMB 136 or equivalent)
Misc.—Terminal strips, grommets, hookup wire, a.c. line cord, solder, etc.

give the amplifier a stable reference voltage for comparison with the power supply output voltage.

Practical Circuit. As shown in the schematic above, the pentode section of a 6JZ8 compactron (*V1a*) is placed in series with the supply output to act as the variable resistor; the triode section of the 6JZ8 (*V1b*) controls the grid bias applied to the pentode. A neon lamp (*I1*) connected in the cathode circuit of the triode, serves the dual purpose of voltage reference source and pilot lamp. The grid of *V1b* is connected to the output voltage of the supply through *R3*, *R4*, and *R5*.

To understand the operation of the regulator, assume that the load on the supply is increased. When this occurs, the output voltage tends to drop for the reasons previously given, and this drop decreases the positive voltage at the triode grid. Since the triode cathode is maintained positive by *I1*, and resistors *R3*, *R4*, and *R5* are proportioned to make the grid somewhat less positive than the cathode, a decrease in positive voltage at the grid increases the bias and causes the plate current of the triode to decrease.

The triode plate current flows through *R2*, and this decrease in current causes the positive voltage at the plate end of *R2* to rise, since there is less voltage drop across *R2* when less current flows through it. The control grid of the pentode is connected to the plate of the triode, and the rise in positive voltage on the pentode grid decreases its grid bias and thus lowers the effective resistance of the pentode. This, in turn, allows the output voltage to rise to the value it had before the load increased. If the load is decreased, the reverse of the foregoing reactions occurs. All of this takes place practically instantaneously.

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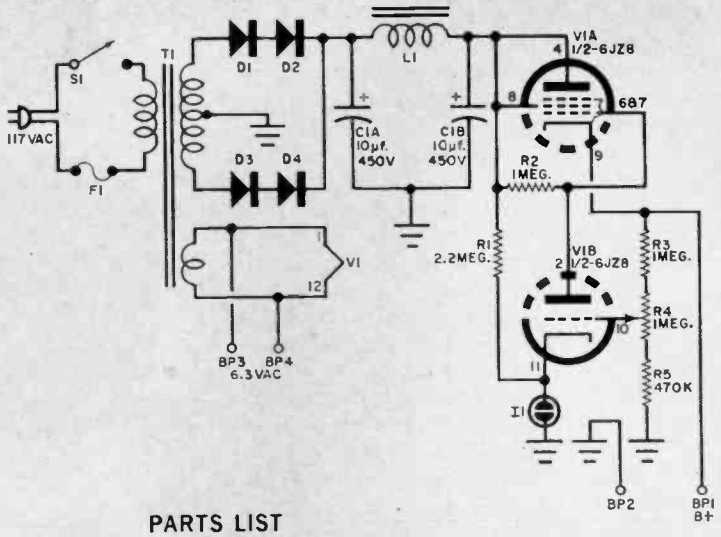

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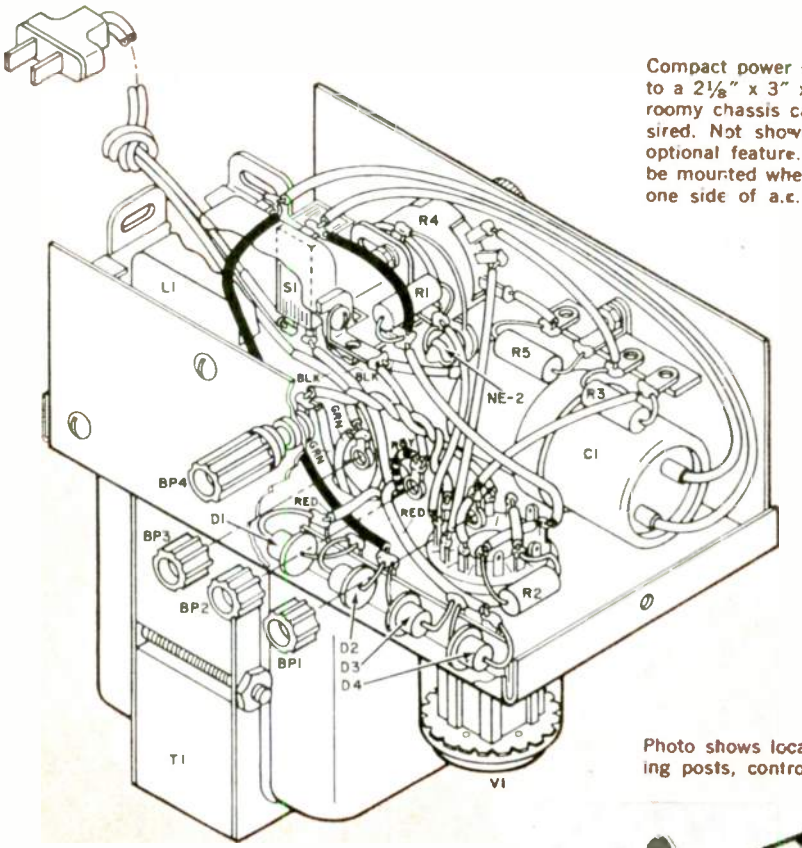
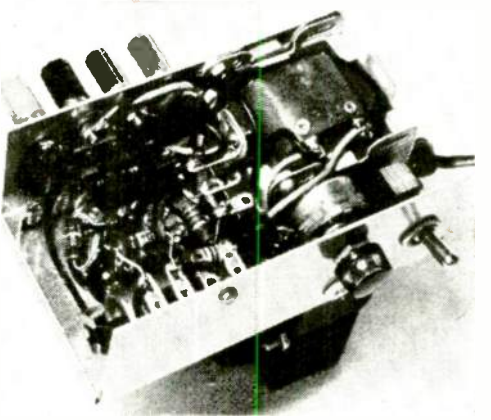


Compact power supply is built into a 2⅛" x 3" x 5¼" box; more roomy chassis can be used if desired. Not shown is fuse F1, an optional feature. Fuse holder can be mounted where space permits, one side of a.c. line wired to it.

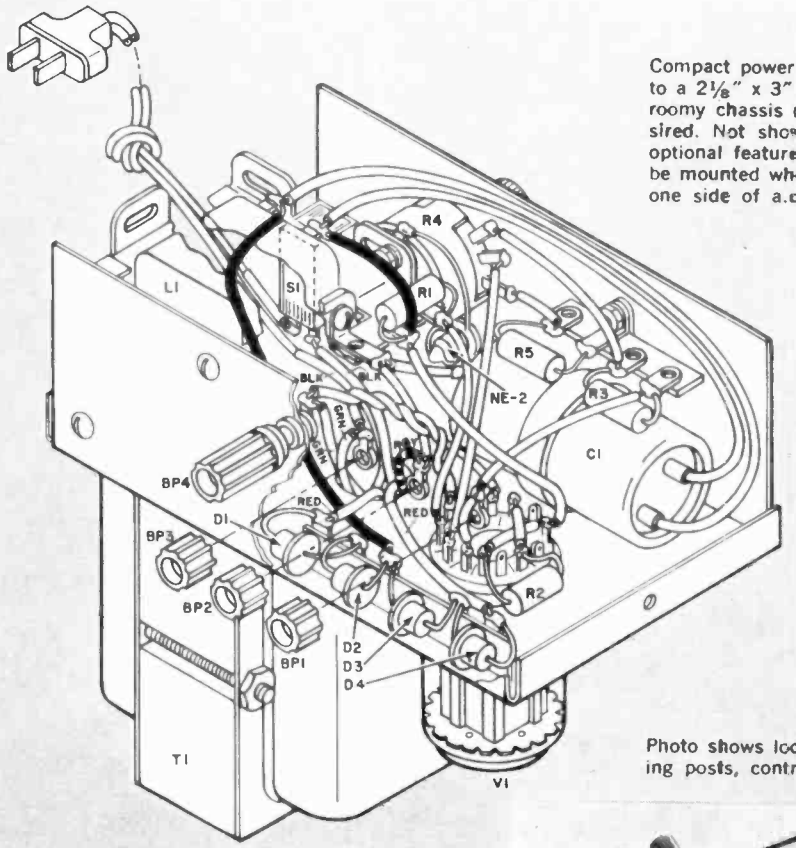
Photo shows location of the binding posts, control R4, switch S1.



er supply is not particularly difficult, although, as with any piece of gear, components should be installed in proper sequence, and care should be taken to avoid shorts between closely spaced parts. Although a larger chassis can be used, all parts fit neatly in a 2⅛" x 3" x 5¼" box. Mount the transformer on one end of the box, choke *L1* underneath, the binding posts on one side and switch *S1* and control *R4* on the other side. The 12-pin compactron socket is mounted in a hole cut out on the top of the box opposite the transformer. A five-lug terminal strip is used for mounting the four diodes, *D1* through *D4*. Two other terminal strips were used in the prototype unit, one of which is mounted on the side of choke *L1*.

Use a good grade of hookup wire for wiring the unit—preferably the cloth and rubber insulated type. The a.c. line cord is brought into the box through a grommet-lined hole in one end.

Adjustment. The output voltage of the supply may be set to any value between 150 and 250 volts with *R4*. To avoid exceeding the dissipation rating of the 6JZ8, the current drawn from the supply should be limited to 40 ma. at 150 volts, and 60 ma. at 250 volts. With the transformer specified, about 1½ amperes may be drawn from the 6.3-volt terminals to operate the filaments of the tubes in another unit. -30-



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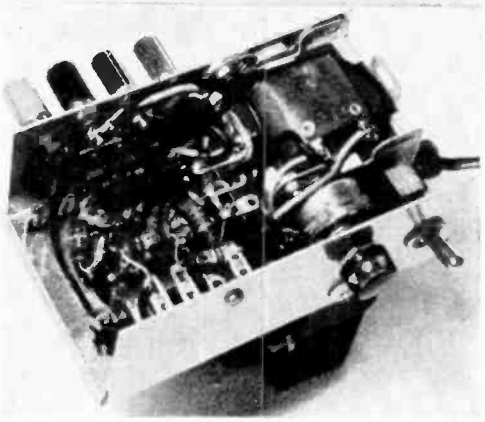

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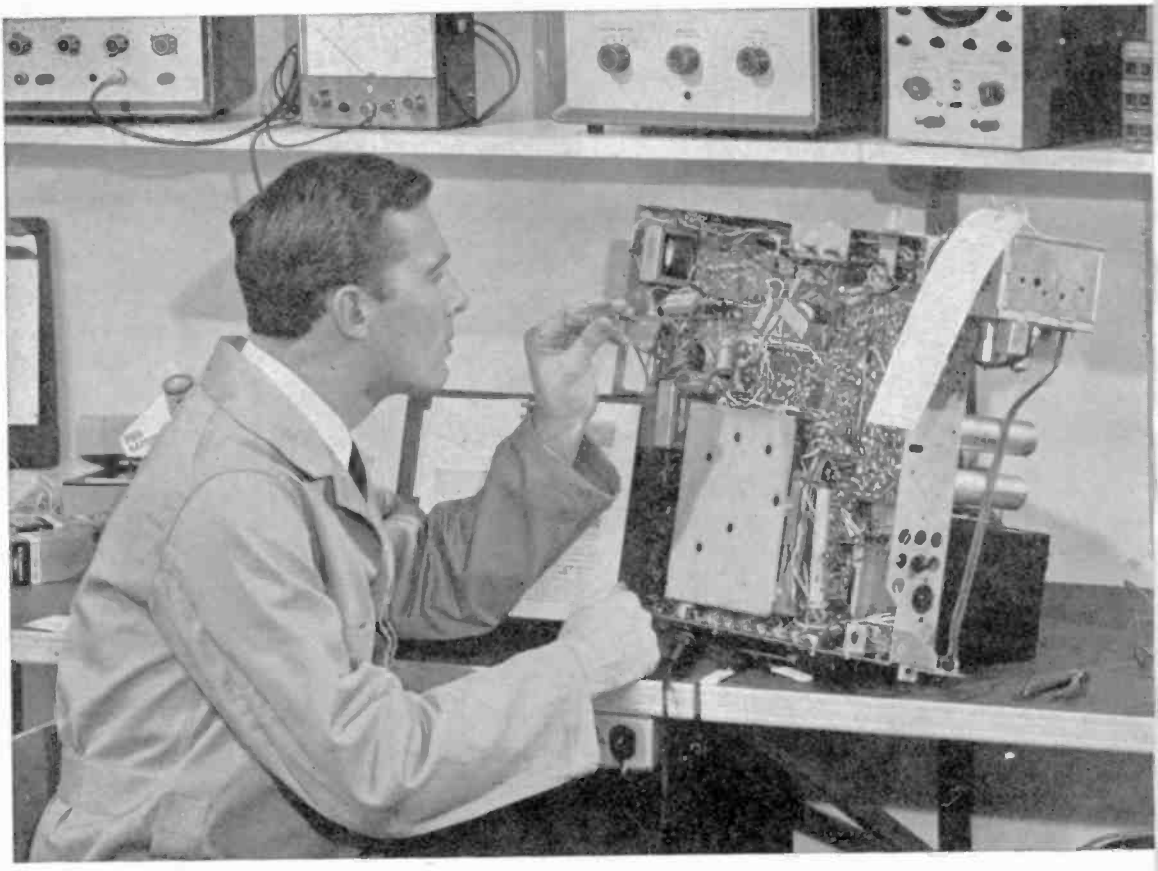

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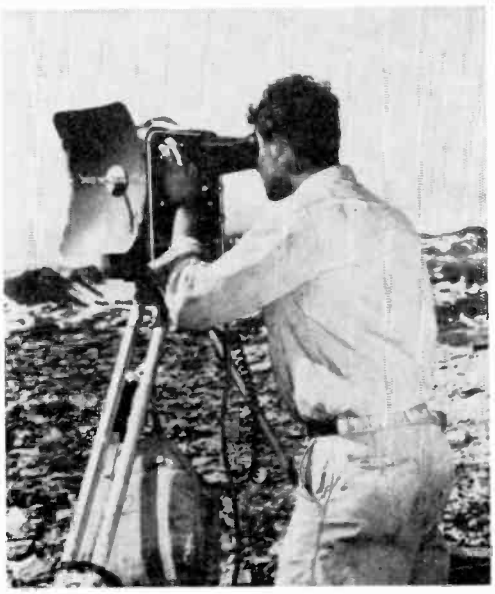
The Hydrodist, the black rectangular box at left, transmits microwaves to ground units. Distance is determined by the time it takes for the signals to make the round trip back.

Ground crew mans microwave transponder shown below. The return signals from the unit permit distances of up to 50 miles to be precisely measured.



ELECTRONIC SURVEYING:

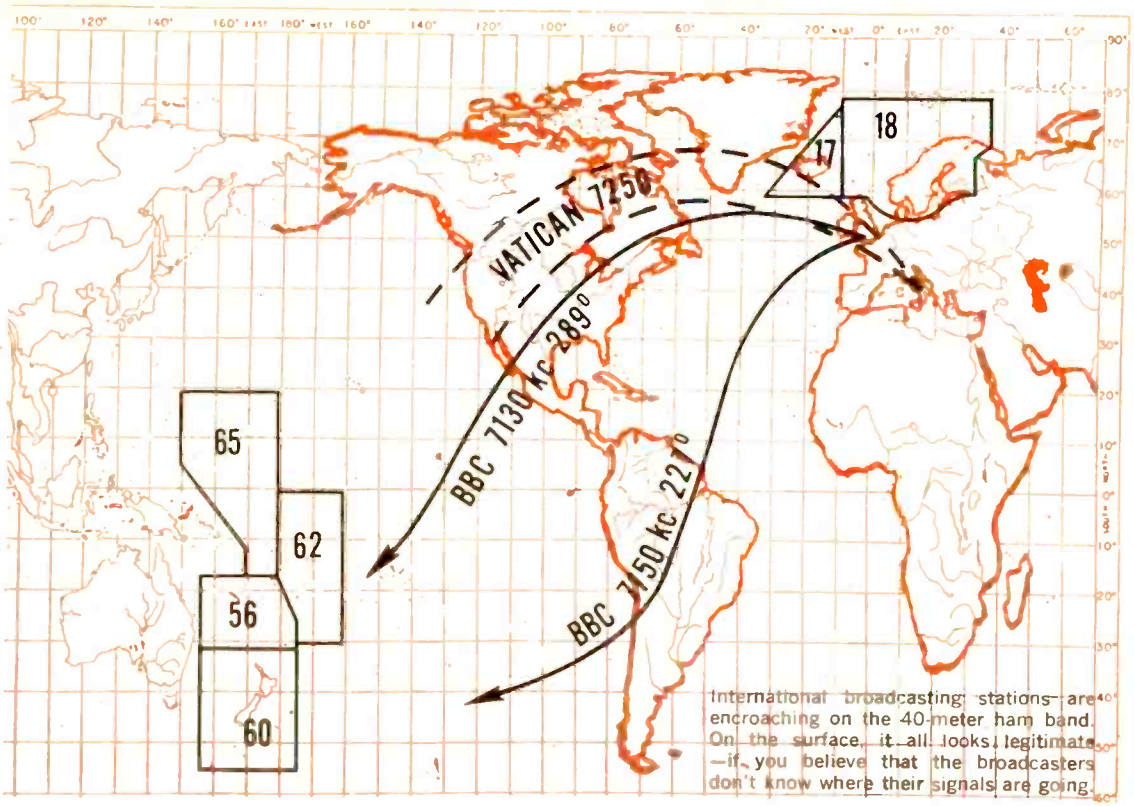
A PLATFORM IN THE SKY

Stabilized helicopter hovers over control point by using "Hoversight" (see text below). "Hydrodist" antenna and reflector are under craft's body, while a revolving beacon on which ground crews can focus their transits is mounted on nose. With reading made, ship quickly moves on to another location.

GIVE me a place to stand, and I'll move the earth," said Sir Isaac Newton. Roughly two and a half centuries later, Newton's platform in the sky is a reality—it doesn't move the earth, but it accurately surveys vast areas of its surface.

The platform is a Hiller helicopter incorporating a stability system that permits it to hover directly over a fixed point. Surveying instruments developed by Tellurometer, Inc. for the U.S. Geological Survey include: the "Hydrodist," which measures distances with microwaves; the "Hoversight," an optical unit which keeps the aircraft in place; and a height indicator.

The helicopter can hover accurately at a point up to 600 feet in the air—enabling the Hydrodist to make precise measurements to ground crews up to 50 miles away. —30—



International broadcasting stations are encroaching on the 40-meter ham band. On the surface, it all looks legitimate—if you believe that the broadcasters don't know where their signals are going.

Shoot a Radio Wave Into the Air

. . . it falls to earth—we know not where(!)

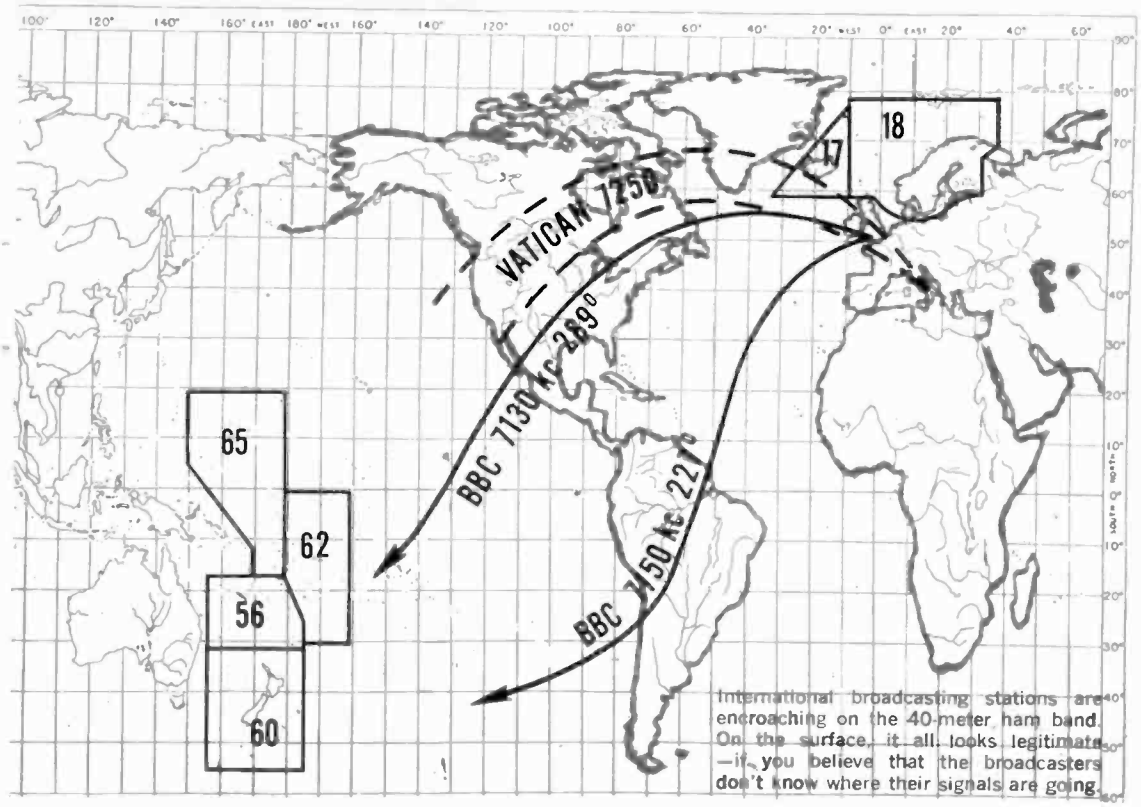
By **STANLEY LEINWOLL,** Radio Propagation Editor

Foreign broadcasters pump megawatt signals into the 40-meter ham band, ignoring radio treaties

TO prevent wholesale pandemonium in the radio frequency spectrum, certain frequencies have been set aside for international broadcasting. Bands have also been established for radio hams, marine traffic, airplanes, TV transmissions, etc. At regular intervals, emissaries of most of the countries throughout the world sit down and decide just who will use what frequencies for what purpose. The most recent such meeting was in Geneva, Switzerland, in 1959. The agreements reached at that meeting supposedly govern the radio spectrum and eliminate (or at least reduce) interference among the various radio services.*

Ask any radio ham what he thinks of the 40-meter band and he will probably

**The Geneva Radio Regulations state, "... countries shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations, or any other provision of the Regulations, except on the express condition that harmful interference shall not be caused ..."*



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pop a gasket denouncing the use of a ham band by international broadcasting stations. Short-wave listeners will gladly acknowledge that the hams' signals are weak compared to those of the superpower transmitters of *Radio Moscow*, the BBC, or even *Radio Vatican*! Tune any evening between 7100 and 7300 kc. and you'll find numerous international broadcasting stations ignoring treaty arrangements and burying all ham signals in the western hemisphere under a propaganda barrage.

Is it a coincidence that so many international broadcasting stations are heard loud and clear in the western hemisphere? Is it another coincidence that many of the programs are in the English language? Certainly not—it's a carefully planned campaign by the broadcasters involved.

Tentative Schedules. Under the Geneva Radio Regulations, international broadcasters are required to submit proposed program and frequency usage schedules to the International Telecommunications Union. The ITU—which is part of the United Nations—is the clearing house for information, and submitting schedules in advance permits broadcasters to eliminate conflicts that might result in mutually harmful interference. Such proposed schedules are issued several months in advance and correspond to the seasons: spring (March-April); summer (May-August); fall (September-October); and winter (November-February).

As this is being written, the tentative schedules for broadcasters using the 40-meter band during January and February have just been published. Looking at 7150 kc., we see that *Radio Moscow* intends to go on the air at 2200 GMT (5 p.m. EST) and broadcast continuously until 0600 GMT (1 a.m. EST the following day). The broadcasts will originate at Serpukhov (near Moscow) and will be from a 50-kw. transmitter into a barrage antenna with 16 db forward gain—or an effective broadcasting power of nearly 2,000,000 watts!

If the above sounds astonishing, the following will seem even more so. These *Radio Moscow* broadcasts are supposed to be for reception within Scandinavia (Zone 18)—Finland, Norway, Sweden and Spitzbergen, where the people apparently stay up all night and listen to the Russians. But if this is the case, why are most of the programs in English, including the popular "Listener's Mailbag"? If you look at the map on page 65, you'll see that the errant radio waves don't stop at the border of Zone 18, but continue over the Greenland ice cap and spread across the U.S.—during peak North American listening hours.

Everyone Uses 40 Meters. Most international broadcasters do not violate the Geneva Regulations as flagrantly as the Soviet Union does, but the regulations don't necessarily stop them from putting signals into North America where 40 meters is 100 percent amateur radio. *Radio Vatican* on 7250 kc. is scheduled to come on the air with 100 kw. at 1600 GMT, and sign off at 2130 GMT. Even though the hours of transmission are not optimum, the target areas are Zones 17 and 18, and the programming will be mostly in English.

The most fortunate scheduling "coincidence," however, can be credited to the BBC on 7130 kc. Its transmission between 2230 and 0330 GMT (5:30-10:30 EST) will be aimed at Zone 62—the Fiji Islands! Of course, in order to get there, the signals must travel through most of the U.S. and across Latin America.

A review of the tentative broadcasting schedules for January and February shows that none of the Europeans have indicated North America as the intended target area—the signals always seem to get there because radio waves know no borders or boundaries. The indicated target areas are anywhere from Central Europe to the southern Pacific Ocean, and from Scandinavia to Iceland —always unlikely places where there seem to be large "English-speaking" audiences. —30—

DX AWARDS

Have *you* won a DX States Award yet? If not, don't just sit there, Charlie. Get busy! If you're a WPE Short-Wave Monitor and have verified stations in at least 20 states (any frequency or service), you're eligible. To apply for your award, read the rules carefully, and fill out the coupon below. The current list of States Award winners appears on page 114.

1 Each applicant must be a registered WPE Short-Wave Monitor, and must enter his call letters on the application form.

2 Each applicant must submit a list of stations (any frequency or service) for which he has received verifications, one for each state heard. The list should contain 20, 30, 40, or 50 states, depending on which DX award is being applied for. The following information must be furnished in tabular form and in alphabetical order by state for each verification:

(a) State heard
(b) Call-sign of station verified and location
(c) Frequency
(d) Date station was heard
(e) Date of verification
(f) Indicate whether broadcast was a normal transmission for the class of station received, or a test.

All the above information should be copied from the station's verification. Do not list any verification you cannot supply for authentication on demand.

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

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

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

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

POPULAR ELECTRONICS' DX AWARD APPLICATION FORM

(please print)

WPE Call Letters _____ Name _____

Address _____ City _____ State _____ Zip Code _____

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

(check one) 20 ☐ 30 ☐ 40 ☐ 50 ☐

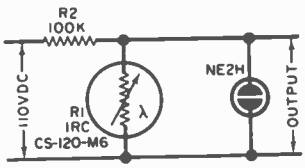
☐ I have enclosed a list of the required number of states, and I hereby certify that I hold a verification from at least one station (any frequency or service) in each of the states listed

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

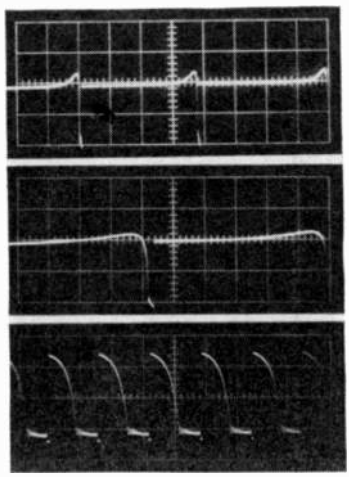
Signature _____ Date _____ 1965

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

A LIGHT-COUPLED OSCILLATOR



Simple oscillator can be powered by a bench supply delivering 110 volts d.c.; R2 is rated at ½ watt.



Waveforms (with R2 at 18,000 ohms) across lamp at .1, 1, and 30 cycles.

AN interesting and unusual relaxation oscillator employing light-coupling and only three components can be constructed by following the schematic at left. A cadmium sulphide photocell is optically coupled to a high-brightness NE-2H neon lamp. Oscillator frequency is variable from about 0.1 to about 100 cycles by changing the supply voltage or the value of *R2*.

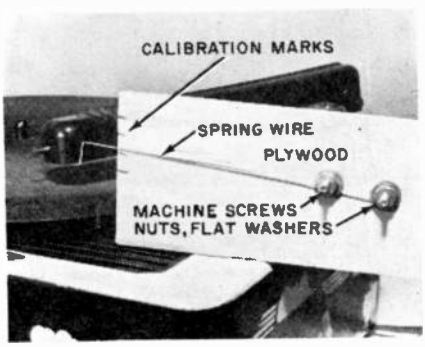
To provide maximum coupling and eliminate the effects of ambient light, the NE-2H is Scotch-taped to the face of an IRC CS-120-M6 photocell (available from Allied Electronics under Stock No. 7E878), and the whole unit wrapped in aluminum foil. In the dark, the resistance of the photocell is in the megohm range; when illuminated, it drops to about 1000 ohms. When sufficient voltage is applied to the circuit, the neon lamp fires and illuminates the photocell. The light causes the resistance of *R1* to drop and to effectively short out the lamp, causing it to turn off. With the lamp off, the resistance of *R1* rises and the cycle repeats itself.

The waveforms at left are of the a.c. component across the lamp for various supply voltages with an 18,000-ohm resistor at *R2*. The parasitic at the base of the waveform is eliminated by using a higher value for *R2*. Low-frequency oscillations are also produced when an a.c. voltage source is used, but they are unstable.

—Michael S. Robbins

QUICK AND EASY PHONO BALANCE

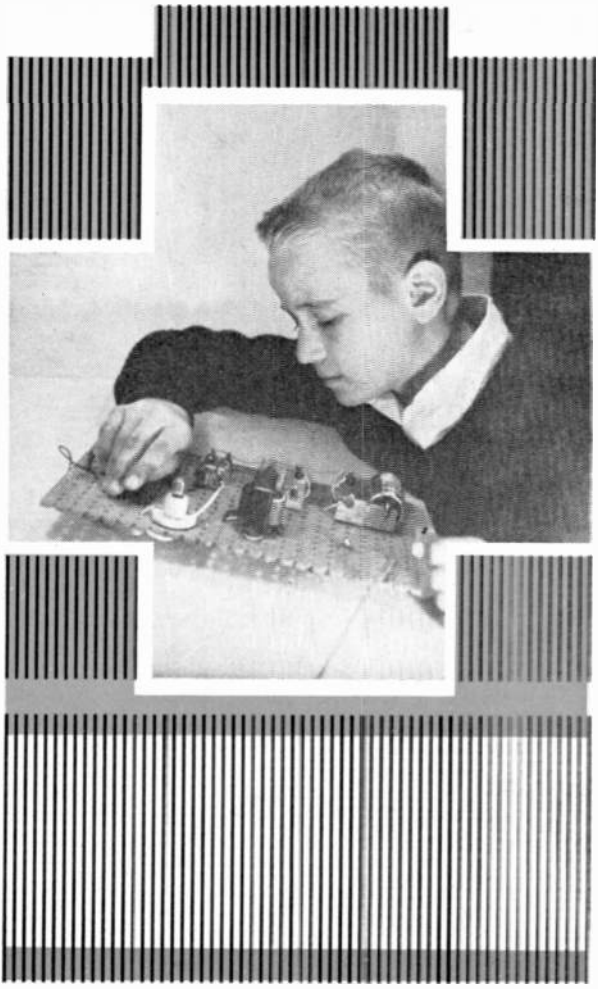
Simple, inexpensive phono balance is spring wire mounted on plywood.



IF YOU find yourself without a phono balance handy the next time you adjust the tracking weight of your tone arm, you can quickly fabricate one using a few simple materials. For a base, get a ¼" piece of plywood or fiberboard about 2½" x 5". The balance arm itself is made of a 5" to 7" length of ordinary spring wire. The one used in the author's model came from a commercial "spring-making" kit, and is about 20 gauge. Piano wire, a steel fishing leader, etc., will also do. One end of the wire is shaped into a small hook to slip on the tone arm while the other is clamped between metal washers held in place by *6-32* machine screws and nuts. The washers serve to keep the wire away from the base, eliminating rubbing. The last step is to calibrate the balance in grams. Reasonably new U.S. coins can be used: A dime weighs about 2.5 grams, a penny 3 grams, and a nickel 5 grams.

—Luis Vicens

NEW LIFE FOR OLD DRY CELLS



By WALTER TEMCOR

Tired of coughing up change for batteries? This charger will add hours of power to your radio, toys, and flashlight dry cells

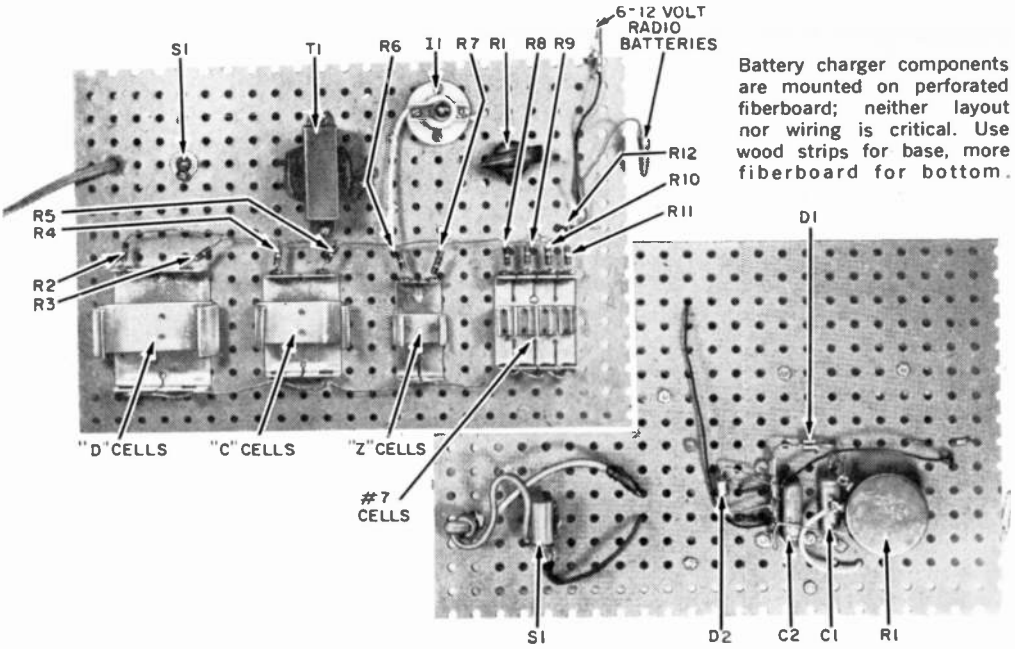
AN EVER-INCREASING variety of toys, instruments, radios, and other gadgets are dry-battery-operated, and battery prices are just about double what they used to be. Is there any way to cut battery costs? Some big industrial firms say "yes"—just recharge them. The battery charger shown here will recharge penlight and flashlight cells in relatively good condition. As an additional bonus, it will also handle your 9-volt transistor radio batteries!

The charger, breadboarded on a piece of perforated fiberboard, is simplicity itself. Four battery holders hold two "D" cells, two "C" cells, two penlight "Z" cells, and four penlight size "7" cells. A pair of clip leads connect to 6- to 12-volt batteries.

The Circuit. Charging voltage is furnished by a 6.3-volt filament transformer (*T1*) working into a voltage doubler rectifier circuit which uses two silicon diodes (*D1* and *D2*). One half of the doubler (the *D1* leg) has an output control and furnishes charging current for 1.5-volt batteries. The other half of the voltage doubler (the *D2* leg) connects in series with the *D1* leg for charging 6- and 9-volt transistor batteries.

Potentiometer *R1*, across filter capacitor *C1*, determines the charging current delivered to the batteries; lamp *I1* limits the charging current and serves as an indicator. Resistors *R2-R12* are limiting/isolating units that help to prevent interaction between different cells.

Construction. Wiring and layout of the battery charger is not at all critical. Enlarge holes in the fiberboard for mounting the a.c. line cord. *T1*, *S1*, and *R1*. Mount the battery holders, lamp socket, and other components. A three-lug terminal strip is used on the underside of the unit for making transformer, diode, and filter capacitor connections. Tape all exposed leads and switch terminals connected to the a.c. line.



Battery charger components are mounted on perforated fiberboard; neither layout nor wiring is critical. Use wood strips for base, more fiberboard for bottom.

To eliminate shock hazard and make the charger convenient to use, build a base with some wood strips and another piece of fiberboard as a bottom cover. The parts can be held together with screws.

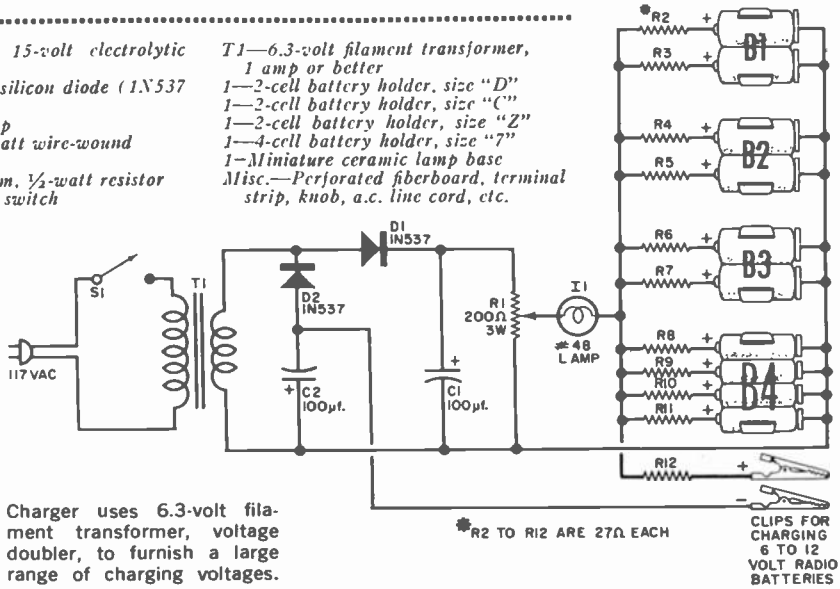
Charging Batteries. One important point to remember is that dry cell recharging is far more likely to be successful if you attempt it with batteries that still have some life left in them.

Insert batteries in the charger, set *R1* at midpoint, and flip the switch. Rotate *R1* until *I1* lights (don't go too far, however, or *I1* will burn out). For quick recharging (or for charging a large number of batteries), *I1* should glow brightly, indicating a charging current of about 50 ma. For slow charging, set *R1* for a dim glow from *I1* corresponding to a current of about 25 ma. Slow charging often works better with dry batteries.

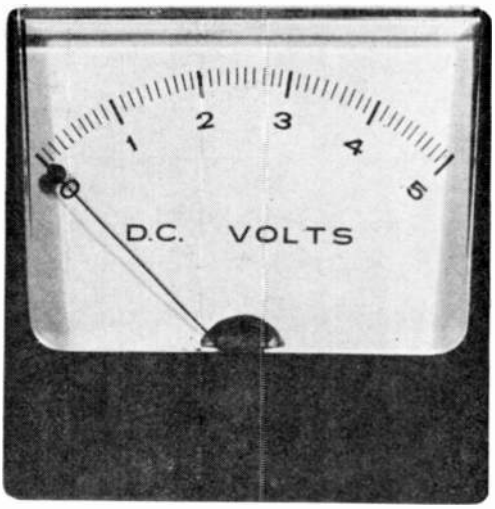
If you recharge your batteries frequently, you'll get longer life from them and save yourself some money. —30—

PARTS LIST

C1, C2—100-μf., 15-volt electrolytic capacitor
D1, D2—750-ma. silicon diode (1N537 or equivalent)
I1—#48 pilot lamp
R1—200-ohm, 3-watt wire-wound potentiometer
R2 to R12—27-ohm, ½-watt resistor
S1—S.p.s.t. toggle switch
T1—6.3-volt filament transformer, 1 amp or better
1—2-cell battery holder, size "D"
1—2-cell battery holder, size "C"
1—2-cell battery holder, size "Z"
1—4-cell battery holder, size "7"
1—Miniature ceramic lamp base
Misc.—Perforated fiberboard, terminal strip, knob, a.c. line cord, etc.



Charger uses 6.3-volt filament transformer, voltage doubler, to furnish a large range of charging voltages.



Before and After. Can you determine which of the meter faces above is homemade and which is the manufacturer's original? The only tip-off is the trademark under the title.

PUT YOUR BEST METER FACE FORWARD

You can make professional-looking scales with little effort and a small investment

By DON LANCASTER

WANT to change the scale of that panel meter sitting in your junk box? Or how about that surplus bargain, an 0-50 d.c. microammeter . . . calibrated as 0-75 MR/HR/FT^3 or something equally mysterious? Help stamp out sloppy meter faces! Get rid of wrong scales! You don't have to be an artist—all you need is $2.15 and some time. You'll wind up with a meter face as good as the factory original, and to your exact specifications. And each duplicate face will cost just 15 cents.

What's the catch? You simply work five times life size. In this king-size world, mistakes are few and far between, and easily corrected. Any misalignment that might creep in gets reduced 5:1 in the final reproduction. You use all prefab letters and numerals—no ink and no mess. A nearby photolithography firm then gives you the required reduction.

Measurements. The first step in making a new meter face is to carefully remove the *original*, and make all the measurements shown in Fig. 1. Multiply each one by five (except c, the scale angle), and record the results. Dimension *a* is the distance in inches between the pivot point or center and mounting screw; *b* the distance between the pivot point and title; *c* the scale angle in degrees; *d* the numeral radius in inches; *e* the lower division radius; *f* the middle division radius; and *g* the upper division radius.

Decide what the full-scale reading of the new meter scale will be, and choose a reasonable number of major divisions. Every major division, or every other one,

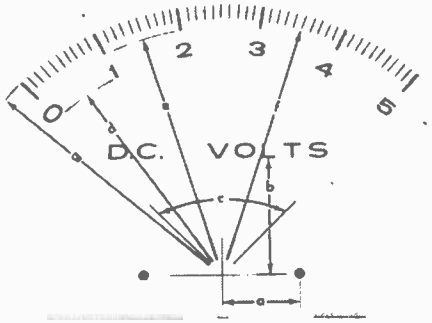


Fig. 1. Carefully measure dimensions "a" through "g" on original meter face and multiply by five. All measurements are in inches except the angle "c," which is measured in degrees with a protractor.

Fig. 2. Materials you need for making a new face include instant transfer letters, a beam compass, 3/8" printed circuit dots, 1/8"- and 1/16"-wide black printed circuit tape, and white illustration board.

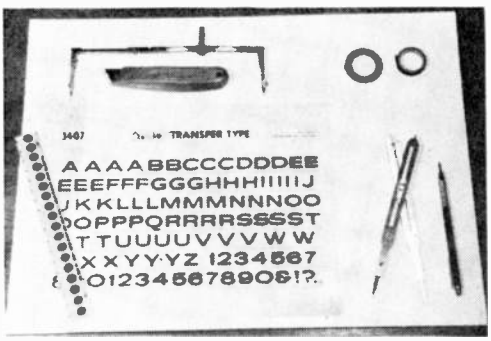
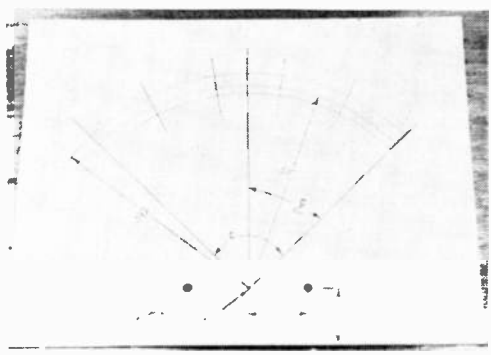


Fig. 3. The new meter face is drawn lightly in pencil on a piece of illustration board working five times up. First draw vertical center line, then add a horizontal base line 2" up from bottom of board.



should have a number below it. Limit the numbered divisions to between five and eight to make the meter easy to read. The number of minor divisions should be around 50. Each minor division should correspond to some reasonable increment, say one, two, or five of the full-scale units.

Materials and Layout. Go to the art store and buy a sheet of ½"-high instant transfer letters and numerals. You can also pick up a 15" x 20" sheet of white illustration board, although white cardboard or painted plywood will do. (For a meter face larger than 3½", get a 20" x 30" illustration board.)

Lay out the new face as in Fig. 3, keeping all pencil lines very light so they can be easily erased. Start with a vertical center line and add a horizontal line 2" up from the bottom; use a square to insure that these two lines are perpendicular. The point where the two lines cross is the pivot point of the meter, and the basis of all the measurements detailed in Fig. 1.

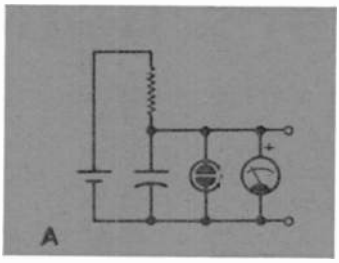
Carefully and accurately locate the meter mounting holes with two 3/8"-diameter dots (black printed circuit dots are ideal for this). Using a beam compass (or a pencil and some string), swing the arcs corresponding to the tops and bottoms of the major divisions, the scale numerals, and the minor divisions. Using a large protractor, locate the zero and full-scale points.

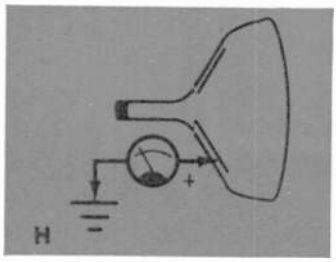
Next, with dividers (or just a ruler), lay out all the major division marks on the

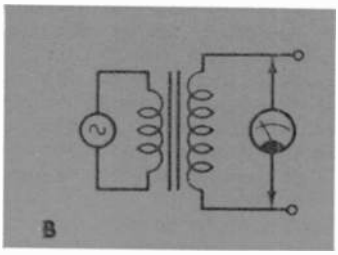
(*Continued on page* 108)

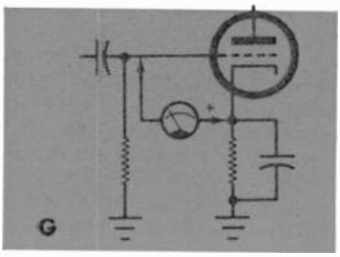
Fig. 4. High-contrast photolith negative (top) is a 5:1 reduction of art work. After negative is made, it is a simple matter to get photographic contact prints (below). Mount new face as described in text.

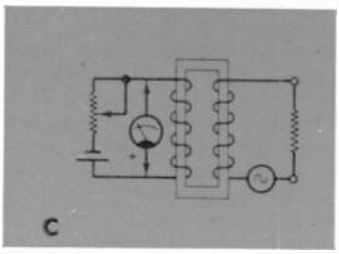
VOLTAGE FUNCTION QUIZ

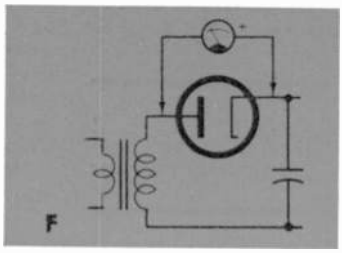




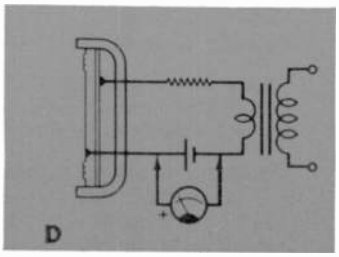


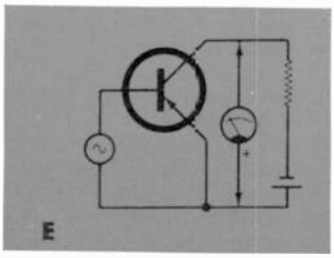






Voltage in an electronic circuit is like pressure in a water pipe: the more we have of it, the greater the flow of current. That's also Ohm's law and no one has broken it yet—perhaps. Not that we are intimating the law has been broken, but all kinds of tricks (functions) are performed with voltage. Sometimes current flows and sometimes it doesn't. Can you match the function of each type of voltage listed below (1 to 8) with the circuit (A to H) in which the voltage is likely to be found?





By ROBERT P. BALIN

1 Bias voltage ____
2 Collector-emitter voltage ____
3 Holding voltage ____
4 Inverse voltage ____
5 Polarizing voltage ____
6 Saturation control voltage ____
7 Second anode voltage ____
8 Secondary voltage ____

(*Answers on page* 103)

On the Citizens Band

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

ONE DAY SOON the FCC's Univac III electronic data processor will "cough up" the one-millionth Citizens Band license to be issued since the first one was hand-typed by a secretary in late 1958. It is doubtful that the Commission will celebrate with confetti, horns and funny hats, honoring Citizens Radio as the largest communications service in the world. There is, however, some significance that should be attached to the millionth communicator: He'll have a fair chance at becoming a member of a new breed of CB operators.

Yesterday's CB'ers (1958-60 style) were too prone to "jump the gun." Whatever was printed on CB'ing in those days was quickly consumed; whatever was manufactured was bought up faster than it could be produced; and whatever was proposed as a national effort to unite Citizens Banders across the country was quickly accepted by many who neglected to take a close look before signing up!

COMING: A NATIONAL CB ASSOCIATION

Most modern-day operators are not so gullible, partially because they've had a chance to profit by the mistakes and misinterpretations of some of the veteran clan, and partially because thousands of published words over the years have painted a more clearly defined picture of who's really interested in "bettering" the Citizens Band as opposed to "buttering" his own bread. Members of the "new breed" (and this includes thousands of "awakened" old-timers) have proven to those who are strictly profit-prone that Citizens Band licensees are not quite so dense as some might imagine.

They've about had it to the tops of their antennas with proposals from private-profit-seekers who are going to represent them on every plane; people who are "gonna show the FCC a thing or two;" and "organizers" who, when confronted with the question, "But what will this organization do for CB'ers on a national basis?" reply in generalities that, when deciphered, indicate the organization will probably buy new cars, have a lavishly furnished suite of offices, and lotsa spending money—*for the administrators*—not the CB'ers.

Several individual—and properly organized—Citizens Band clubs are forming their own *state-wide* CB Councils specifically aimed at eventually uniting and representing CB'ers on a national scale in an organization *of* CB'ers, created *by* CB'ers, and *for* CB'ers! When a representative number of state organizations have exchanged ideas and chosen their representatives, a session will be held to discuss the formation of a National Congress of Citizens Band Associations along the guidelines of a proposed set of bylaws.

The groups listed below have expressed the desire to assist other CB clubs in forming such state associations. If your club is interested in this project, write to these groups requesting information.

Southwest Georgia CB Club
604 10th Street
Albany, Georgia

Dixie Communication Club
3575 Cloudland Drive
Stone Mountain, Georgia

Washington State Citizens Band
Association, Inc.
7235 South Alder
Tacoma, Washington 98409

Michigan CB Council
3306 Kanter
Detroit, Michigan 48211

Word has just been received that there is also a state organization in California and another in Arkansas. We request that all state associations register with this column so that we can continue to inform other interested clubs of the progress being made. Additional clubs willing to assist other state groups will be listed here as soon as they make themselves known to your CB Editor. Please furnish proposals,

Ever try to install a standard-sized CB system in an Austin Healy "Sprite"? See text below for the way that Dave Hallow, KLK6733, handled the job.

bylaws, and other information pertinent to helping others develop "of, by, and for CB" —*nationally!*

Mini-Mobile. Sports cars of the past and present seem to have been supplied with a special set of problems to grey the hair of any CB "road-running" enthusiast. A two-way radio system has to be installed without detracting from the car's original appearance. (Those in the know are aware that the "lines" of a sports car are as important to the owner as what's under the hood, and—in many cases—what the driver wears on his head. Dave Hallow, KLK6733, feels that he has come up with the right combination of refinements to keep his vehicle in the sports car class, yet provide a CB-active mobile.

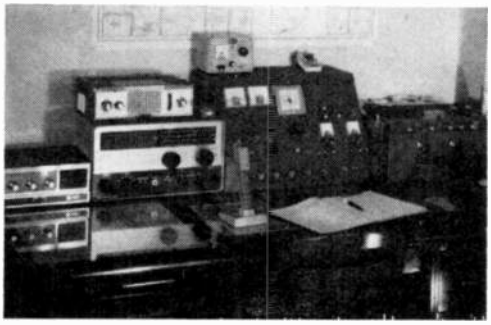
To eliminate the need for drilling a second hole in the body and having two antennas waving from one of the stubbiest sports cars manufactured (both unwritten crimes among certain fans), Dave replaced the existing AM broadcast antenna with an Antenna Specialists M-103 combination CB/AM antenna. With no room to spare under the dash, an E. F. Johnson M-III transistorized transceiver was compactly center-mounted, and a Johnson suppression kit wired into the power complex to eliminate any possibility of interference. To complete the system, Dave wired in a Telex DYB-10 boom-mike headset to permit hands-free communicating. The headset also enables the driver to clearly receive incoming signals at speeds above 40 miles per hour where wind noise becomes a problem.

Good job, Dave! It still looks like a sports car to us!

On the Right Track? An unnamed CB'er in Ottawa, Ill., has added a new twist to his background of installation experiences. However, sources indicate that he isn't liable to spend much time talking about it at future coffee breaks. But someone *has* stated that placing an antenna tower across railroad tracks, prior to installation, causes bells to ring, lights to flash, and safety bars to come down, stopping all oncoming traffic at the crossing! A further study indicates that towers are *quickly* removed in such cases. Is that how the story goes, Tom?

Club Chatter. Among the new clubs joining OTCB this month is Atlanta REACT, Atlanta, Ga. The club's charter with National REACT (Radio Emergency Associated Citizens Teams) was reinstated in August, 1964. More than 50 members cover Atlanta and its western suburbs with emergency radio monitoring. Besides many accident emergencies handled by the monitor station, one of the more important recent assists involved a request for type "O" negative blood donations needed for a man in critical condition; the State Patrol and the REACT monitor were notified one evening, and by morning ten donors had been located and were standing by. Atlanta

(*Continued on page* 109)



The neat and efficient-looking shack at right is the monitoring station of Atlanta REACT in Atlanta, Ga. It's capable of maintaining emergency communications over a 50-mile radius.

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

ALTHOUGH semiconductor manufacturers announce new devices on an almost day-to-day basis, these devices are, for the most part, simply upgraded or modified versions of familiar types—typically, planar or mesa transistors with somewhat higher gain or better high frequency response than previous types. Truly new devices—those resulting from major technological advances—are developed at less frequent intervals, perhaps at an average rate of about one every month or two. Finally, significantly new devices based on a scientific "breakthrough," such as the tunnel diode, are introduced at average intervals of from six months to a year.

Naturally, your Semiconductor Editor tries to report on significantly new breakthroughs as soon as they are announced, and upon other important developments at reasonable intervals. Here, then, is a quick roundup of new semiconductor devices introduced within recent weeks by major manufacturers.

• A *tetrode* field-effect transistor (FET) is now being offered by Siliconix, Inc. (1140 West Evelyn Ave., Sunnyvale 5, Calif.). Identified as Type 3N89, the new device has two gate electrode connections and is suitable for use in choppers, mixers and high-gain micro-power amplifiers. It features the high input impedance characteristic of all FET types and, with good high frequency characteristics, is of particular value in low-frequency r.f. amplifiers and i.f. amplifiers with a.g.c.

The schematic diagram of a typical a.g.c., i.f. amplifier stage featuring the 3N89 is shown in Fig. 1. Furnishing approximately 20 db gain, this stage has a typical a.g.c. range of about 40 db. In operation, the input signal is coupled through *C1* to tuned circuit *L1-C3* and applied to *Q1*'s control gate G1. The amplified output signal is developed across tuned load *L2-C4*, with a portion of this signal coupled back to G1 through trimmer *C2* for stage neutralization. The next stage is coupled to an impedance-matching tap on *L2* through d.c. blocking capacitor *C7*, while d.c. voltage is applied through another tap, bypassed by *C6*. Finally, the variable a.g.c. voltage is applied through isolating resistor *R1*, bypassed by *C5*, to the second gate electrode (G2).

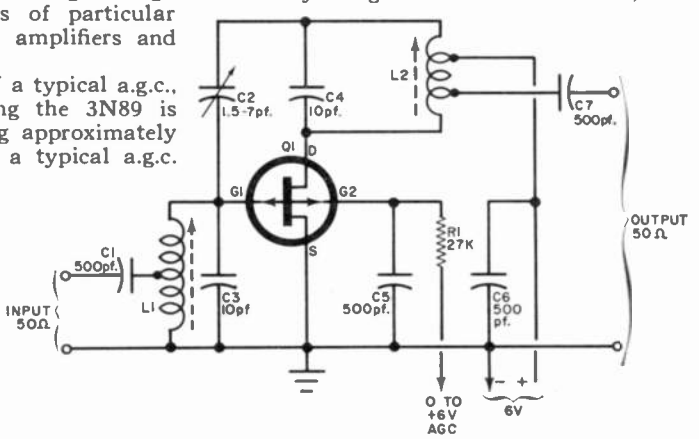


Fig. 1. Tetrode transistor is good for choppers, mixers, and high-gain amplifiers. Amplifier shown here exhibits about 20 db gain and has a typical a.g.c. range of about 40 db.

• A series of *UHF* field-effect transistors has been introduced by the KMC Corporation (Long Valley, N. J.). With less cross-modulation distortion than conventional UHF junction transistors, the new units are suitable for use as amplifiers at frequencies up to 300 mc. They are all packaged in the standard TO-18 case and are available in six families, with current ratings up to 100 ma.

• Production of the most powerful silicon transistors ever built has been announced by the Silicon Transistor Corporation (Carle Place, N. Y.). Single-diffused *npn* mesa types, they have a power dissipation rating of 300 watts at up to 100°C and can handle currents of up to 150 amperes. Type numbers are STC2500 and STC2501. Primarily designed for use in controls, am-

plifiers, power supplies and inverters, the new units can be employed in place of three or four lower power types.

• An experimental semiconductor device capable of converting d.c. directly into r.f. microwave energy is being produced in small quantities by the Thomas J. Watson Research Center of the IBM Corporation (Box 218, Yorktown Heights, N. Y. 10598). It consists of a small slab (approximately 0.008" x 0.008" x 0.005") of *n*-type gallium arsenide (GaAs) on a copper heat sink, as shown in Fig. 2, In operation, pulsed d.c. applied across the GaAs slab is converted into r.f. energy at approximately 800 mc. Although overall efficiency is only about 2%, peak output powers of about 1 watt have been achieved.

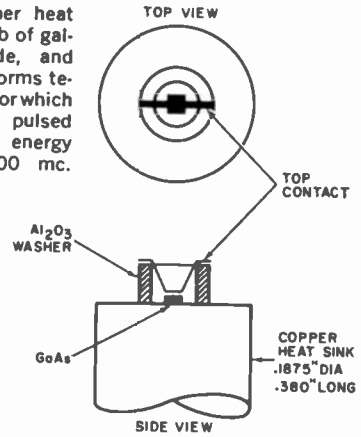


Fig. 2. Copper heat sink, tiny slab of gallium arsenide, and top contact forms tetrode transistor which can convert pulsed d.c. into r.f. energy at about 800 mc.

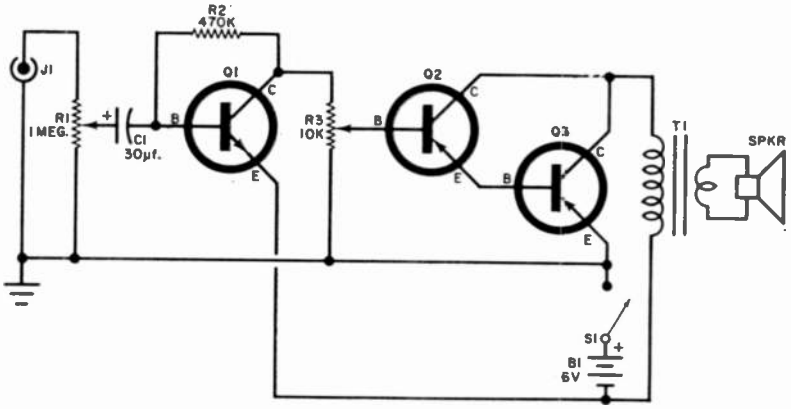


Fig. 3. General-purpose audio amplifier circuit submitted by reader Craig Ransom is good for intercom, signal tracer, etc.

This IBM device may well represent a significant scientific breakthrough. When perfected, it could be used as the basic source of r.f. energy for a variety of compact transmitters, and should be of particular value in space and line-of-sight communications as well as in instrument applications.

Readers' Circuits. Reader Craig Ransom (23 Clinton Place, Suffern, N. Y.) submitted the general-purpose *audio amplifier* circuit shown in Fig. 3. Craig tells us that his circuit "developed out of just fooling around." Although we have no statistics to prove it, Craig, we'd be willing to bet that an overwhelming number of experimental circuits originated in much the same way. In fact, many great inventions have resulted from people "just fooling around" with ideas.

Craig's circuit consists of an *npn* common-emitter preamplifier (*Q1*) complementary-coupled to a *pnp* Darlington stage (*Q2* and *Q3*) which, in turn, is direct-coupled to a loudspeaker. Transistor *Q1*'s base bias is derived from its collector circuit through resistor *R2*. Transistor *Q2*'s base bias is obtained from a voltage-divider made up of *Q1*'s emitter-collector circuit and potentiometer *R3*. Transistor *Q3*'s base bias is obtained from the voltage-divider action of *Q2* and *Q3*. Resistor *R1* serves as a simple input gain control and *C1* as a d.c.-blocking and coupling capacitor. Operating power is furnished by battery *B1*, controlled by s.p.s.t. switch *S1*.

Standard, readily available components are used. Transistor *Q1* is a general-purpose *npn* transistor, such as a 2N94 or 2N170. Transistors *Q2* and *Q3* are general-purpose *pnp* power transistors similar to the Lafayette No. 19 G 1507. Potentiometers *R1* and *R3* are small types, and resistor *R2* is only a half-watt big. Capacitor *C1* is a 30-μf., 6-volt electrolytic type. Jack *J1* may be any standard input terminal. Switch *S1* is a s.p.s.t. toggle, slide, or rotary type, while *B1* is a 6-volt lantern battery (typically, a Burgess F4BP). Finally, any 4- to 10-ohm loudspeaker can be used.

Neither layout nor wiring is critical, and the builder duplicating Craig's circuit can use a conventional metal chassis, perforated phenolic board, or etched circuit, as preferred. Polarities must be observed, and signal leads should be kept short and direct.

Naturally, care should be taken not to overheat semiconductor leads if these components are soldered in place.

Craig cautions that *R2*'s final value may have to be determined experimentally after the circuit is wired, for the value needed here will vary somewhat with *Q1*'s d.c. leakage characteristics. Potentiometer *R3*'s adjustment, too, must be determined experimentally. In general, both resistance values should be chosen for the best output volume and least distortion.

The completed amplifier can be used in receivers, record players, intercoms, signal tracers, etc.

The interesting *electronic "siren"* circuit in Fig. 4 was submitted by reader Christo-

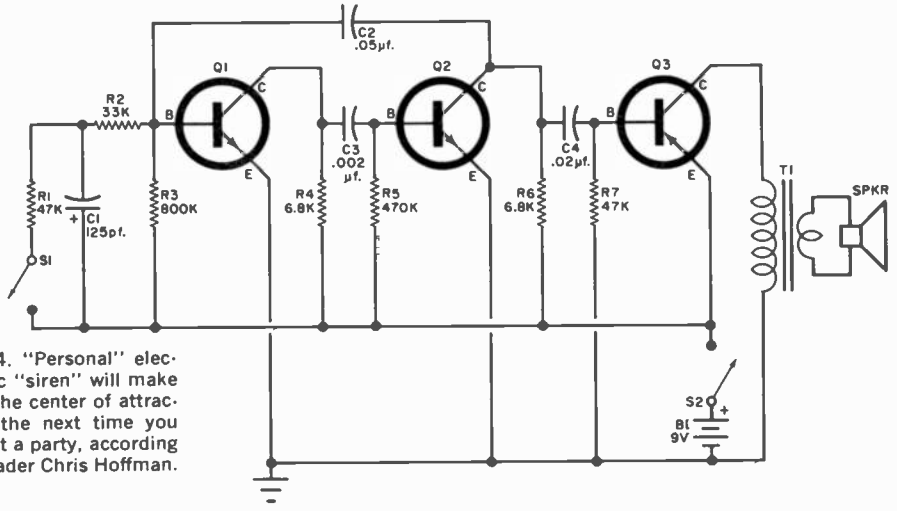


Fig. 4. "Personal" electronic "siren" will make you the center of attraction the next time you are at a party, according to reader Chris Hoffman.

pher C. Hoffman (510 Crescent Parkway, Sea Girt, N. J.). He writes that he assembled his original model in a pocket-sized box, using a miniature loudspeaker, and that it has been a source of "much amusement" at parties.

Chris used a conventional collector-coupled multivibrator (*Q1* and *Q2*) driving a single-ended power amplifier (*Q3*). "Siren" action is achieved by controlling the multivibrator with a push-button-operated *RC* network.

In operation, then, *Q1*'s base bias is furnished in part through resistor *R3* and in part by *RC* network *R1, C1* and *R2*. Thus, *Q1*'s instantaneous bias changes as *C1* is charged, or discharged. Transistor *Q2*'s base bias is determined by resistor *R5*. Resistors *R4* and *R6* serve as collector loads for *Q1* and *Q2*, respectively, while cross-coupling is provided by capacitors *C2* and *C3*. The output signal of *Q2* is coupled to the power amplifier stage (*Q3*), through capacitor *C4*. Transistor *Q3*'s base bias is developed across resistor *R7*. The amplified output signal is coupled to a loudspeaker through transformer *T1*, and operating power is furnished by battery *B1* controlled by switch *S2*.

Low-cost conventional parts are used in the device. Transistors *Q1* and *Q2* are 2N170 *npn* units, while *Q3* is a *pnp* power transistor—typically, a 2N301. Capacitor *C1* is a 125-μf., 15-volt electrolytic, while all other capacitors can be either ceramic or tubular paper types. All resistors are half-watt units. Switch *S1* is a s.p.s.t. push-button type, but *S2* can be a slide, toggle or rotary type.

According to Chris, output transformer *T1* should have a 5000-ohm primary, and a secondary to match loudspeaker impedance. Any standard speaker can be used. The power supply, *B1*, can be either a single 9-volt battery, such as a Burgess Type 2N6, or can be made up of six penlight or flashlight cells connected in series.

Chris indicates that it may be necessary to try different transistors for *Q1* and to vary the values in *Q1*'s bias resistor network (*R1, R2* and *R3*) to achieve the most realistic "siren"-like tone.

Although the completed instrument will not have adequate power output for use on emergency vehicles, it should prove useful as an "attention getter" at parties and club meetings or as a demonstration device for science fairs.

Transitips. Our reader mail indicates that *beta* is one of the least understood of all transistor specifications, even though one of the most important, for it is directly related to the gain which a transistor can deliver when used as an amplifier. It is not, however, a fixed value. Transistors of

(*Continued on page 98*)

Monthly Short-Wave Report

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

THE "LOCAL" SHORT-WAVE BROADCAST BAND STATIONS

ON A RECENT DX PROGRAM presented by *Radio Finland,* mention was made of a plan to abolish "local" broadcasting on the short-wave bands by 1970. The plan is believed to have originated with the International Telecommunications Union, in Berne, Switzerland, at the instigation of a number of international broadcasters who want additional frequencies for their own use.

So far as we can ascertain, this plan would eliminate all "local" short-wave stations around the world that have broadcast-band counterparts, such as some of the Canadian 49-meter stations (CFRX, CHNX, CJCX, CFCX, etc.). Theoretically, a complete elimination of the "local" stations would enable the larger overseas stations to extend their signals into areas that are now covered by the "local" stations.

It is assumed that the plan would cover all frequencies from the 49-meter band down (or from about 5900 kc. up) wherever there are local-type stations operating. It is further assumed that it would NOT affect the tropical bands (from 5200 kc. down) in view of the fact that very little operating is done on the latter frequencies by the overseas "giants."

A number of DX'ers have taken exception to this plan and are asking that other DX'ers seriously consider what such a plan might accomplish, if successful. The only advantage that can be seen by your Short-Wave Editor would be the possible elimination of some of the interference that now exists.

Although the plan would definitely hurt the DX'er, we cannot accept this as being, in itself, a valid reason for attempting to scrap it. We do believe, however, that it should be opposed for the following reasons:

(1) It is erroneous to call this type of broadcasting "local," as if it were merely a duplication of local standard broadcasting services. These stations provide a *regional* service which could only be provided by standard broadcasting stations through the use of high-powered transmitters or numerous smaller broadcast or relay stations. Such facilities are generally beyond the economic capabilities of many countries and presumably would still be so five years from now.

(2) Some countries, because of large areas of sparse population, can probably never be covered in an adequate manner by standard broadcasting stations. Good examples are Australia and Brazil.

(3) Listeners in foreign countries can also hear the "local" broadcasts. These people serve as an audience for a form of advertising on the part of the originating countries in much the same manner as those who listen to regular international broadcasts.

It is no accident that congestion in the bands used for the "local" broadcasts has been increasing. The fact is that the broadcasters do find them useful for increased coverage, even where they are operated in

One of Europe's top-flight monitors is Reg Wilson of Fawley, Hampshire, England. Reg has been DX'ing since 1946, and has over 300 QSL cards to show for it. His myriad receivers include an R1155A, a Hammarlund HRO, an RCA unit, several home-brewed jobs, and his pride and joy—an Eddystone 840C. Reg is an electrical engineer by vocation; he services electrical equipment on the "Queen Mary," the "Queen Elizabeth," and other large ocean liners.

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Argentina	Buenos Aires	11,780, 9690, 6090	2200, 0100 (Mon.-Fri.)
Australia	Melbourne	17,840, 15,220	2030, 2130, 2230
		9580	0745
Bulgaria	Sofia	9700	1900, 2000, 2300
		7290	1630
Canada	Montreal	15,190, 11,760, 9625	1800 (Caribbean)
		9625, 5970	0215, 0300 (W. Coast)
		5970	0800
Congo (East)	Leopoldville	11,755	1630
Congo (West)	Brazzaville	15,190	1430
Czechoslovakia	Prague	11,990, 9795, 7345, 7115, 5930	2000, 2230
Denmark	Copenhagen	15,165	0730
		9520	2100
West Germany	Cologne	11,965, 11,795, 9735	1010
		9735, 9575, 6145, 5960	1955
		11,795, 9735, 9575, 6145	0000
Hungary	Budapest	9833, 9540, 6234	1930, 2030
		9833, 7305,7215, 6234	2200, 2330
Italy	Rome	9575, 5960	1930, 2205
Japan	Tokyo	15,285, 15,135, 11,780	1900
Jordan	Amman	9555	2015
Lebanon	Beirut	9625	2130
Netherlands	Hilversum	9590, 6085	1630 (exc. Sun.)
		9730	2330 (exc. Sun.)
Netherlands Antilles	Bonaire	9715, 6085	2330 (exc. Sun.)
Portugal	Lisbon	6185, 6025	2105, 2245
Romania	Bucharest	9590, 9570, 5910, 7225, 6190, 5990 (9570 not used at 2030)	2330, 2200, 2030
Spain	Madrid	11,715, 9615, 6140	2200, 2100, 2000
Sweden	Stockholm	15,240	0900
		5990	2215, 2045
Switzerland	Berne	9535, 6105, 6080	2015
		15,305	2315
Turkey	Ankara	15,165	1700
United Kingdom	London	15,300, 11,860	1100
		9510, 6195	1700, 1800, 1900, 2100
U.S.S.R.	Moscow	9700, 9680, 9660, 9650, 9640, 9620, 9570, 7440, 7360, 7310, 7290, 7240, 7170, 7150 (may not all be in use at any one time)	1730, 1900, 2000, 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250, 5985	1950

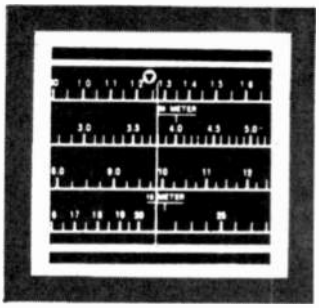
conjunction with standard broadcast stations. Were they not valuable, there would not be such a large number of local-type stations in operation.

One possible alternative to the above plan that might help relieve the band-crowding situation would be to discourage operation of the low-powered regional stations under consideration in the 49-meter band in favor of increased operation in the 60-, 75-, and 90-meter bands (3500 to 5100 kc.) where congestion would be less severe. This would benefit the international broadcasters, who would suffer less interference to their services in the 49-meter band, as well as the regionals who are themselves being interfered with by the international broadcasters.

When we have additional and more definite information on this plan, we will report to you again on the subject.

"Freedom Radio 904." We are indebted to the *Radio New York Worldwide* DX Program for the following information on *Freedom Radio 904*. Operating the latter station (frequency not given) is a complex job for the regime in the Soviet Zone of Germany. The station has for some time been announcing itself as being under-

(*Continued on page* 110)



Across the Ham Bands

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

CERTIFICATE CHASING

FOR some interesting reactions, start a discussion among a group of hams about the constantly increasing number of certificates offered by amateur organizations around the world.

True "certificate chasers" claim that collecting certificates adds zest to their QSO's, keeping them from being boring, rubber-stamp duplicates of each other. And it is a fascinating game to search out new stations and more QSL cards to qualify for additional awards as they are announced.

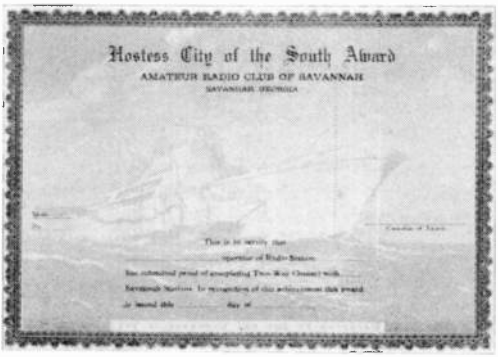
But other hams insist that it's the certificate chasers themselves who make too many contacts uninteresting with their "Hello, please QSL for the XYZ award, 73" routine repeated endlessly, contact after contact. They say that if these operators worked half as hard to carry on interesting QSO's as they do to collect certificates, they would not need certificates to prove they enjoy amateur radio.

Fortunately, amateur radio is big enough to accommodate the adherents of both viewpoints. We personally recommend certificate chasing as a lot of fun as long as you don't become too fanatical about it.

There are so many certificates to work for—close to 700 at the last count—that you might well wonder which ones to start with. While this is largely a matter of personal preference, undoubtedly the most popular award in the U.S. is the WAS (Worked All States) award offered by the American Radio Relay League, Inc., 225 Main St., Newington, Conn. 06111. Its popularity is due to the fact that working the 50 states and collecting the written confirmations to prove it is difficult enough to offer a real challenge to any ham; yet the goal is not beyond the capabilities of Novices, other low power station operators, or amateurs handicapped by a poor location or an inefficient antenna.

Other awards in the above category are *CQ Magazine*'s county award, Canada's WAVE award, and the many awards offered by responsible state and local ham organizations. But look with suspicion at ultra-simple awards; they sometimes turn out to be little more than advertising gimmicks, as proved by the material sometimes packed with the certificate when it arrives.

Whatever award you decide to strive for, the smartest first step is to mail a stamped, addressed envelope to the sponsoring organization for a copy of the latest official rules. Follow them exactly, especially the rules governing what the sponsor will accept as


Hostess City of the South Award
AMATEUR RADIO CLUB OF SAVANNAH

An avid certificate chaser in Detroit, Mich., is Steve Solo, W8IEC; the picture above shows only about 30 of the more than 100 certificates on the walls of his ham shack. At left is a photo of a certificate typical of those being offered by amateur radio clubs throughout the U.S. (background is actually a light blue); the person to contact for rules pertaining to this certificate is Carrie Lynch, WA4BVD, 1814 East 62 St., Savannah, Ga.

Amateur Station of the Month

Russell Moore, WA9MO, Gary, Ind., operates on all frequencies between 3.5 and 29.7 mc. from his efficient-looking station, which feeds an "all-band" trap dipole and a Mosley TA-33 tri-band beam antenna. He also operates mobile, and is active in the local Civil Defense Communications Net. Russ will receive a one-year subscription to POPULAR ELECTRONICS for submitting the winning February photo in our Amateur Station of the Month contest. To enter the contest, send a clear picture of your station—preferably showing you at the controls—together with some data on your ham career to: Photo Contest, c/o Herb S. Brier, W9EGQ, Box 678, Gary, Ind.

proof of claimed contacts. Most sponsors of major awards require the submission of QSL cards or other written proof to eliminate any possibility of cheating, but many awards are issued simply upon the submission of a witnessed list of claimed contacts.

Thirteenth Annual Novice Roundup. The ARRL's Novice Roundup is the one annual contest designed especially for Novice operators. This year's edition starts at 6 p.m., local time, Saturday, Feb. 6, and ends at 6 p.m., local time, Feb. 21. You work a maximum of 40 hours on any or all Novice bands and contact as many different stations in the different ARRL sections as possible. With each station worked, you exchange your QSO numbers and section names to earn a contest point.

Your final score is the sum of your contact points added to the highest code speed recorded on your ARRL code-proficiency certificate, multiplied by the number of different sections worked. The winning Novice in each section will be awarded a certificate. All other classes of licensees are invited to enter the contest (preferably operating just outside the Novice band limits), but only Novices are eligible to win certificates.

Besides being a lot of fun, the Novice Roundup offers a golden opportunity for anyone working for a Novice WAS certificate to pick up missing states. Send your score to the ARRL, 225 Main St., Newington, Conn. You can get free contest log sheets from the same address.

1965 ARRL DX Competition. If you don't like DX contests, we suggest you operate phone during the c.w. weekends of the ARRL International DX Competition and on c.w. during the phone weekends when DX is coming through. The phone contest is from 0001 GMT, Feb. 13, to 2400 GMT, Feb. 14; and between the same times on Mar. 13-14. The c.w. contest takes place on Feb. 27-28 and Mar. 27-28. Each contest period begins at 7:01 p.m., EST, on Friday, and ends one hour earlier on Sunday.

In this contest, U.S. and Canadian amateurs work the world, sending a signal report followed by the abbreviation for their state or province to each DX station worked. The DX stations, in turn, send a signal report followed by three numbers representing their transmitter power. Each complete exchange is worth three points. A DX station may be worked only once per band, but it may be worked again on other bands. On c.w., U.S. stations may work no more than six stations in each country per band. For Canadians, the quota is eight. There is no quota for DX stations or for the phone contest.

To compute your total score, add the QSO points earned on all bands and multiply them by the number of different countries worked. As the contest rules prescribe that scores must be submitted in a certain manner, we advise that you request a supply of free contest log sheets from the ARRL.

If this is your first DX contest and you are running low power, don't overlook 21 mc. (and 28 mc. if it is open). Competition there is likely to be less than on the lower frequency bands. Ditto on the second weekends as compared to the first.

Notes from Club Bulletins. In *Auto Call,* published by the Foundation for Amateur Radio, Inc., Washington, D.C., we found an interesting story—with a tragic ending.

Gene Yoakum, WA4OKK, a member of the Alexandria, Va., police force, noticed

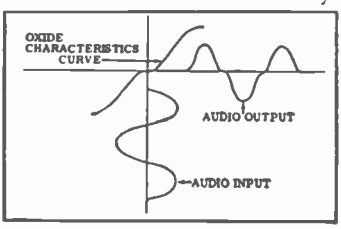
(*Continued on page* 100)

Some plain talk from Kodak about tape:

Bias transfer characteristics and dependent parameters

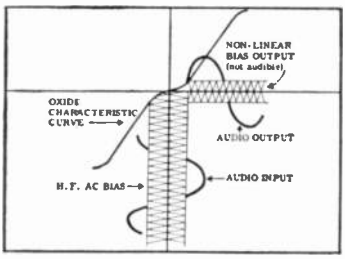
Ever heard the story about the pilot on his first solo flight? Unfortunately the engine failed. But fortunately he had a parachute. But unfortunately the chute failed to open. But fortunately he landed on a haystack. But unfortunately there was a pitchfork in the haystack. Except for the unhappy ending, this might be the story of how gamma ferric oxides respond to magnetic fields. Everything about it is fortunate with one exception. *Linearity*. The oxide needles used in the coatings have atrocious linearity characteristics. Feed in a clean, pure sine wave and out comes a non-sinusoidal complex waveform that looks something like a demented snake trying to bite its own head off. How does it sound? About as pleasant as Junior's first violin lesson.

How then is magnetic recording possible? Fret not—there's a way out. The entire problem is solved by one wonderful, mysterious phenomenon called bias. The transfer curves tell the story.

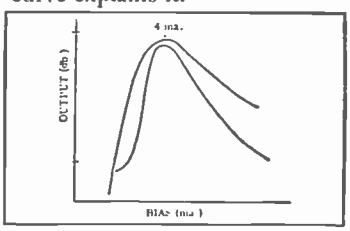


The slightly twisting curve at the upper left represents the oxide response. The lower curve is a pure, sine wave input. At the upper right we have the result of the response curve on the input . . . a mess.

The reason it looks the way it does is because the sine wave input is affected by the non-linear characteristics of the gamma ferric oxides. But look closely. Note that while the oxide performance is non-linear when taken over its entire length, we can find linearity over selected sections. In other words, we can get rid of our distortion if we can put the signal on the linear section of the oxide's characteristic curve. And that is exactly what bias does. It "lifts" the signal away from the convoluted central area on the graph and moves it out to linear areas.



The amount of bias (that is the current in milliamperes) applied to the head is highly critical if top performance is to be achieved. Bias affects output, high and low frequency sensitivity, signal-to-noise ratio and distortion. This curve explains it.



The steep curve represents low frequency sensitivity (measured in db.) at varying bias levels for many tapes. Note that you get good performance providing you have a bias setting of about 4 milliamperes. (Curves for the other magnetic parameters are similar in shape and all peak at about the same bias level.) Vary one milliampere and you "fall off the curve" and suffer severe losses in sensitivity. Now look at the broader curve. You can vary a milliampere with hardly any change in performance at all. Here's the point. *Kodak tape has that broad curve.* It gives you top performance even though your bias settings aren't perfect. And if your tape recorder is more than a year old, then chances are enough shift has taken place to push you off the cliff. That's why we designed a broad bias curve. And that's why you need it. It's just one more way that Kodak tape gives you an extra bit of assurance of top performance.

KODAK Sound Recording Tapes are available at all normal tape outlets: electronic supply stores, specialty shops, department stores, camera stores . . . everywhere.

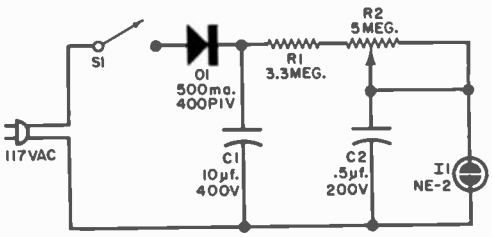
EASTMAN KODAK COMPANY, Rochester, N.Y.

Darkroom Metronome

AS the darkroom addict is well aware, the exposure of a good print usually involves giving certain areas of the picture more or less light by dodging and spotting. Developing times may vary under different conditions. Stopping to reset the timer for each step of the process soon becomes an impractical nuisance, and the timer is quickly discarded in favor of simply counting seconds. Unfortunately, many of us forget to count, or count inaccurately.

The "Darkroom Metronome" was devised to make counting seconds entirely practical. Simply a neon lamp relaxation oscillator operated from the a.c. line, it flashes once a second or more depending on the setting of *R2*. You still have to count flashes, of course, but the trying part, timing, is done for you.

The prototype unit was built into a 3¼" x 2⅛" x 1 5/16" Minibox. Neon lamp *I1* was housed in a red jewel on the top of the box, while *S1* was mounted on one side and potentiometer *R2* on the other. A word of caution is in order here: *All wiring must be carefully isolated from the metal box.*



Flash rate of neon relaxation oscillator is determined by time constant of R1, R2, and capacitor C2.

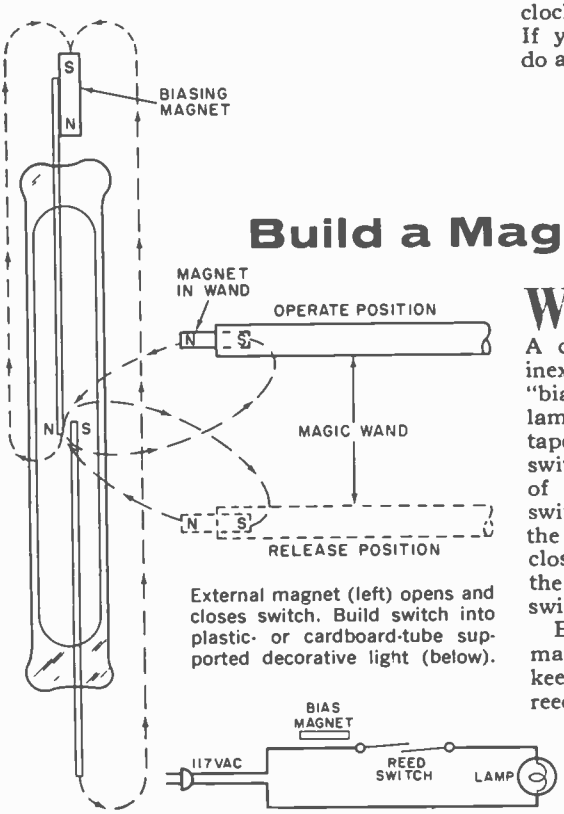
The Metronome is operated directly from the a.c. line, and its chassis can easily become hot with respect to ground if this precaution is not observed.

Construction of the unit is straightforward. Drill a hole in one end of the box for the line cord and line it with a grommet. Switch *S1* is a s.p.s.t. slide type, *C1* a small electrolytic capacitor, *R1* rated at ½ watt, *C2* a paper capacitor, and *R2* a 5-megohm potentiometer with any type of taper. Lamp *I1* is simply wired into the circuit by its leads, as are the remaining components.

To calibrate the Metronome, count flashes for 30 seconds using a watch or electric clock, adjust *R2*, and repeat until satisfied. If you're not fussy, any flashing rate will do as long as you stick to it.

—David M. Gusdorf

Build a Magic Lamp



External magnet (left) opens and closes switch. Build switch into plastic- or cardboard-tube supported decorative light (below).

WAVE the magic wand and the lamp goes on. Wave it again and it goes off. A capacity operated relay? No, a simple, inexpensive reed switch equipped with a "bias" magnet. The principle of the magic lamp is shown at left. A bias magnet is taped to one of the leads of a GE-X7 reed switch. In this position, it is not capable of closing the switch; however, once the switch has been closed with the aid of the magic wand, the bias magnet holds it closed. When the wand bucks the field of the bias magnet instead of adding to it, the switch opens.

Build the switch into an electric Christmas candle or other small electric lamp, keeping within the 15-watt rating of the reed switch. The bias magnet and that used in the wand (a piece of dowel with the magnet glued to one end) are part of GE's "Experimenter Line" as is the switch.—*L. F. Hudson*

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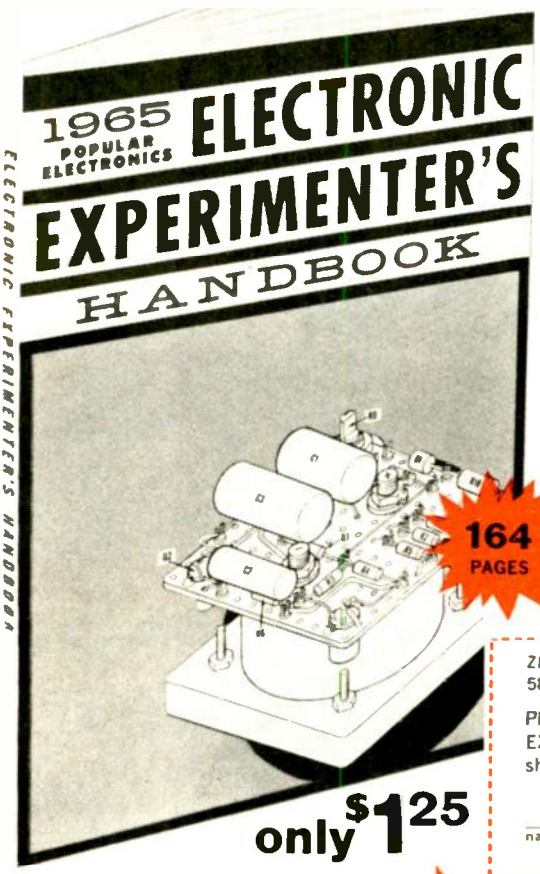

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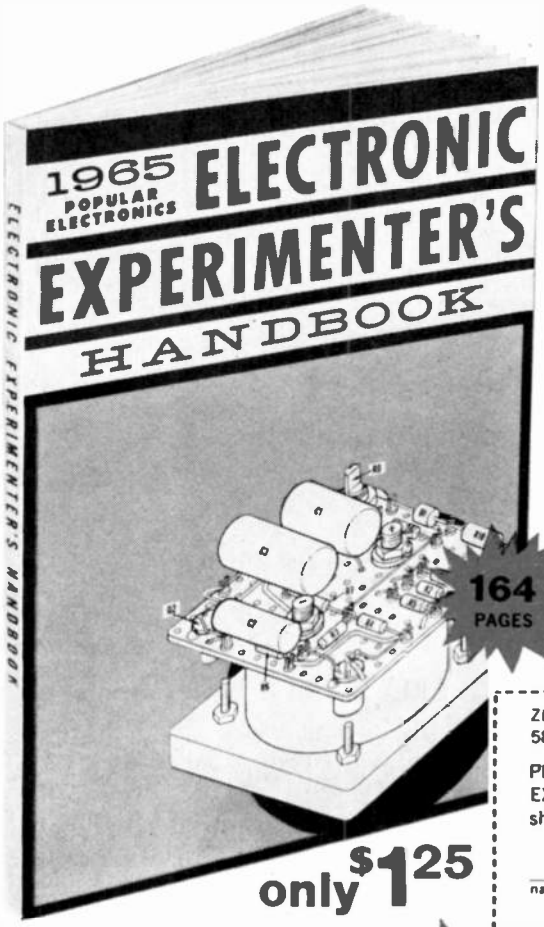

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PE 25

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

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

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Myo-Electricity

(*Continued from page* 44)

electric signal generated was linear; by electronically amplifying "bio-electric" signals from opposed muscles as much as 20,000 times, they were able to operate their artificial hand in a manner similar to the way Nature does. Given these basic EMG signals to work with, Kobrinsky and Gurfinkel used them as described in a Russian technical paper:

> The information obtained from the continually measured bioelectrical potentials of the muscle is processed into a set of standard impulses whose repetition frequency is proportional to the power of the biocurrents. The potential that is measured by the electrodes glued to the skin near the muscle is converted by a linear amplifier and is fed to the input of a full-wave rectifier. From its output the voltage is applied to an integrating block whose output voltage, with a corresponding choice of parameters for the integrating cell, is approximately proportional to the instantaneous value of biocurrent power.
>
> From the output of the integrating block the voltage is applied to the input of a thyratron relaxation generator that forms pulses the distance between which is inversely proportional to the voltage in the generator input. After power amplification the formed pulses are fed to the input of a mechanical device.
>
> To reproduce any movement, biocurrents are tapped from two antagonistic muscles, for instance, flexor and extensor, and accordingly two channels of converting the information are used . . .

The Russian device is reportedly a fabulous piece of bio-electronic equipment. Spring-loaded silver electrodes are mounted on the inside of the artificial forearm. One pair rides above the extensor, another the flexor muscles of the stump. A common "indifferent" electrode is also provided. Input resistance on dry skin is about 100 to 150 thousand ohms.

The amplifier for the artificial hand incorporates a 5:1 stepdown transformer for impedance matching. After three stages of amplification, the signal is rectified and smoothed with a time constant of 100 milliseconds. Next come two d.c.-coupled stages, with two channels of single-ended amplification driving relay coils.

A 13.5-volt nickel-cadmium battery powers a 2-watt electric motor. Signals from proper electrode pairs drive the motor in the appropriate direction called for by nerve signals in the arm. After three days of use, the battery must be plugged into a charger, but this can be conveniently done overnight.

The artificial hand-arm weighs about the same as a living limb, and provides the capability of lifting up to nine pounds and doing such delicate tasks as installing a light bulb in a socket without breaking it. Grasping force at the thumb is said to be about four and a half pounds.

American Advances in EMG. While the Russians were developing their myo-electric artificial limb, American researchers were also busy. At UCLA's Department of Engineering, Drs. Weltman, Groth, and Lyman in 1959 published a report entitled, *Analysis of Bio-electric Prosthesis Control.* Well aware of the benefits in using the patient's own nerve signals to control an artificial limb, researchers were simply not able to extract reliable enough signals from the welter of myo-electric activity present in the body.

Much of the difficulty reported by American scientists was in distinguishing the desired signal in the midst of all the noise or irrelevant electrical activity surrounding it. A sneeze, for example, raised havoc with a piece of equipment monitoring muscles for control functions! Instrumentation was another problem. Placing electrodes of metal foil above the pertinent nerve area was generally successful in picking up tiny electrical signals, but the slightest movement of the electrode relative to the surface of the skin introduced false signals. New, lighter, and better-attached electrodes were designed.

In September, 1964, researchers at Case Institute of Technology demonstrated an artificial hand-arm operated in part by myo-electric control. Taking signals from the trapezius muscle in the subject's shoulder, the device amplifies and applies them as a stimuli to weak

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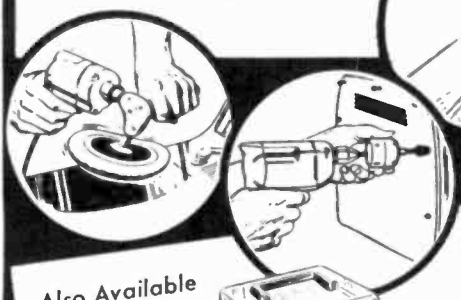

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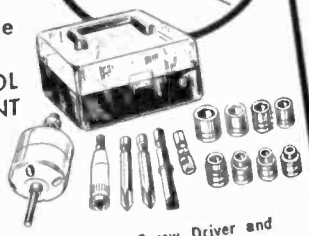

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muscles in the hand to provide finger movement. The Case arm is thus an artificial neural bypass. Other features include computer-control of routine movements, plus patient-control by means of eyelid movements, and aiming of infrared signals at the motor controls of the hand-arm.

The Amplified Man. Application of myoelectric control in another field came about as astronauts were being hurled into space. While the bugaboo of weightlessness seemed a small problem, there was much concern over man's ability to properly operate controls during the extreme acceleration environment of blast-off and re-entry. At times these forces reached as high as 8 *g*, with the result that a human body "weighed" more than half a ton, and an arm alone might weigh close to 100 pounds.

Working under contract to the Air Force, Spacelabs, Incorporated designed and constructed a myo-electric "muscle booster" for astronauts subject to extreme conditions of acceleration. Results of this work were described at the Air Force Bionics Symposium in 1963.

Electrodes were glued in place over the anterior, medial, and posterior deltoids, and also the pectoralis muscle. A training period of only one or two minutes was found sufficient for the subjects to effect control of the servo booster.

As with the Russian artificial arm, tiny muscle signals were detected and amplified, but by electronic equipment worn in a vest rather than in the arm itself. Next, amplified signals were sent to a "control logic" computer, consisting of four identical logic channels, with "truth tables" containing three or four muscle combinations.

From the computer came signals to drive the boost motor which actuated the booster "splint" attached to the arm of the operator. Activation of the anterior deltoid caused "up" movement of the splint. The posterior deltoid produced "down" movement. "In" movement, toward the subject's body, was produced by proper activation of both anterior deltoid and pectoralis muscles, and "out" movement by medial deltoid and pectoralis.

Subjects were trained to use the myoelectric boost system to operate a control switch on a simulated spaceship control

panel. With the arm artificially weighted to 80 pounds, they carried out their tasks successfully, producing in and out movements simultaneously with up and down movements. Speed of the booster was normally 6.8 degrees per second and no difficulty was experienced at this slow rate of movement. However, above 13.5 degrees per second, subjects were unable to hold the hand steady at the desired position, and the booster displayed the "oscillatory hunting" common in electromechanical control systems.

Other Projects. Quite naturally, the other military services were among those keenly interested in the control capability being demonstrated for myo-electricity. One result was a Navy contract granted to Philco Corporation for "A Study to Investigate the Feasibility of Utilizing Electrical Potentials on the Surface of the Skin for Control Functions."

To better analyze myo-electric signals, Philco developed the "Myocoder" which amplifies the EMG signals, rectifies and integrates them, converts from analog to digital and then from binary to decimal, and, finally, prints out the results. Since the r.m.s. value of the signals is almost directly proportional to muscle force, this measurement was chosen as the basis for electronic equipment to handle the signals.

An interesting possible application of EMG control suggested as a result of the Philco study was that of remote manipulation of a machine by a set of original signals generated by a "master" operator.

General Electric is working on an extension of the amplified man concept with its CAM's or "cybernetic anthropomorphous machines." These giant walking machines being developed for the Army will be controlled by a human operator's EMG signals, with feedback to intimately couple him with the mechanical monster he is a part of.

Reminiscent of the knight of old whose strength was "as the strength of ten," other researchers have extended the booster idea to amplifying not just an arm, but the whole man. Cornell Aeronautical Laboratory is among those engaged in such "amplified-man" projects and has produced complete "exo-skeletons" for increasing the power of arms and legs. Here is myo-electricty on a much larger scale than in the case of the artificial arm. Foreseen are average loads of not just a few watts, but 15 *horsepower,* with peak requirements up to 90 horsepower!

Where To From Here? Myo-electric applications are still in their infancy, yet the tremendous implications in the concept are already obvious. Most development work is being done by the military, and these projects will surely lead to intimately coupled power boosters for humans, "thought-wave" control systems, and perhaps even "telepathic" communication. Civilian applications, too, are bound to come—first in artificial limbs and later in bio-electronic sensory augmentors and substitutes. Among the intriguing possibilities, suggested not by science-fiction writers but scientists themselves, are thought-controlled automobiles and human hearing directly from r.f. signals. Big things are destined for myo-electricity—and myo-electronics as well! —30—

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CIRCLE NO. 16 ON READER SERVICE PAGE

Letters

(*Continued from page* 10)

hole I attached a ⅜" bolt, and onto this I screwed a copper ball with a threaded base which I obtained at a junk store—it makes a spectacular discharge electrode. To reduce the noise made by the spark gap, I constructed a noise suppressor out of a piece of acrylic tubing with holes for ventilation. My unit uses three capacitors, and when the output exceeds 200,000 volts, strange things happen. The discharge is no longer a bluish glow but a fantastic display of streaks of artificial lightning.

ELIHU SAVAD
Brooklyn, N.Y.

Those "Frightening" P.E. Projects

■ A friend and I built a ghost out of a bedsheet for Halloween. On this was "mounted" eight neon bulbs and, inside, the associated circuitry for the "Nonsense Box" (July, 1963). The ghost was mounted on a wire so it would slide down from a chimney to the front of

the house next door which was floodlighted with the "Spookin' Light" (September, 1964). A tape recorder provided sound effects. At the peak of its popularity, the performance attracted six cars and about 25 "trick-or-treaters."

ALAN M. USAS
LaGrange Park, Ill.

Another Club for BCB DX'ers

■ In "Broadcast Band DX—Getting Started" (November, 1964) there was one big error of omission in the listing of radio clubs. The author did not include the IRCA (International Radio Club of America, P.O. Box 5181, Terminal Annex, Denver, Colo. 80217). The IRCA publishes the *DX Monitor* 34 times yearly, a paper solely devoted to BCB DX. As a BCB DX'er, I can wholeheartedly agree that the BCB is a real challenge. My greatest claim to fame is logging and verifying a station from each of the six continents in a single season—using a Delco "All American Five," slightly modified, of course.

JACK L. KEENE, WPE5BMP
Houston, Texas

P.E.'s Compressor-Expander

■ I would like to incorporate the compressor-expander ("Build a Hi-Fi Volume Compressor Expander," October, 1964) in my hi-fi system. However, I also have an L-pad in the speaker circuit. On which side of the pad should the compressor-expander be connected, or doesn't it matter?

LARRY HUGHES
Ontario, Calif.

It depends on the impedance values of the amplifier, speaker and pad. The best thing to do, Larry, is to try both positions, and leave the compressor-expander in the position which sounds louder or better to you. Chances are that it won't make any difference which position you use. Do follow the instructions described in the text, however. —30—

Tachometer Calibrator

(*Continued from page* 55)

lamps can be mounted in grommet-lined holes on the front of the case, or in regular small sockets.

Substitutions of components can be made. However, two things should be kept in mind: (1) the peak inverse voltage rating of the diode must be at least 300 volts and (2) the transformer voltage should be well over any possible difference in firing voltage of the two neon lamps, but not so high as to fire the lamps unaided by the ignition pulses. Transformer voltage on the order of 24 volts works very well.

Operation. To calibrate the tachometer, connect the newly made calibrator as shown in Fig. 1, one wire going to any convenient chassis ground and the other going to the coil's terminal which is connected to the distributor points. Plug the power cord into any 117-volt, 60-cycle a.c. outlet.

Start the car, and adjust the motor speed until the lamps indicate synchronism. Note the tachometer reading, then adjust the motor speed until the lamps indicate synchronism for the second point, and again note the tachometer reading. You now have two accurate calibration points for the tachometer. The difference between each reading and the corresponding true figures (450 and 900 rpm for an 8-cylinder engine and 600 and 1200 rpm for a 6-cylinder job) is the tachometer error.

No trouble should be encountered in identifying the two points of synchronization. The lower speed is a slow idle, and the upper speed is much faster than idle. As either point is approached from either a higher or lower engine speed, the blinking rate of the lamps will slow down, indicating that you are approaching the calibration speed.

In the event your car specifications show that one of the calibration speeds is the proper idling speed, the calibrator can be used to set the idle adjustment without the aid of a tachometer. Many V-8's with automatic transmission idle at 450 rpm when the transmission is in *Drive* and the *parking brake is on.* —30—

Transistor Topics

(*Continued from page 78*)

a specific type number may have a wide range of *beta* values under identical operating conditions and still be within overall specifications. Hence, many firms will list the *beta* specification either as a range of values or as a minimum—typically, "*beta:* 20-60" or "*beta:* 10 minimum." In addition, an individual transistor may have any of several *beta* values, depending upon operating biases.

By definition, *beta* is *the ratio of the change in collector current to an incremental change in base current at a constant collector potential.* It is, then, the transistor's *amplification factor* when used in the common-emitter configuration.

Referring to the simple circuit in Fig. 5, we can plot the transistor's collector current (*Ic*) vs. base current (*Ib*) characteristics curve by changing *Ib* in small steps

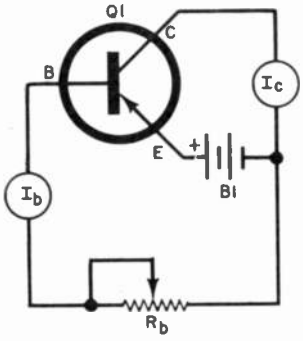


Fig. 5. Simple circuit used to determine beta at various portions of the response curve.

(adjusting *Rb*) and recording the corresponding values of *Ic*. A typical curve might look somewhat like the one illustrated in Fig. 6.

Beta, then, can be determined by dividing a small change in base current (ΔIb) into the corresponding change in collector current (ΔIc). This is, *beta* $= \Delta Ic/\Delta Ib$. It is proportional to the *slope* of the *Ic* vs. *Ib* characteristic curve. But the slope of the curve changes. Hence, *beta* is *different at different points on the characteristics curve.*

Inexpensive transistor checkers generally measure *beta* by applying a fixed set of parameters which may or may not correspond to actual operating conditions. The *beta* readings may be considerably higher or lower than the transistor's actual *beta* in a circuit having a different set of operating conditions.

You can obtain a fairly close approxima-

tion of *beta* by means of a simple test technique. Using a circuit similar to the one illustrated in Fig. 5, adjust the fixed base bias (*Ib*) for a value near the one you plan to use in your equipment circuit and measure the resulting collector current (*Ic*). Next, change the base bias by a *small* amount and check the *resulting change* in collector current. Then divide the collector

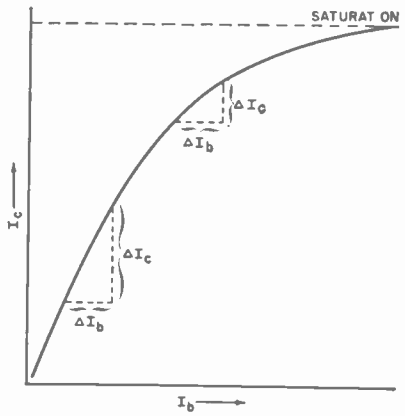


Fig. 6. Beta readings will vary as the slope angle of the response curve. Notice that for the same amount of change in base current, there is a smaller change in collector current as the curve flattens out and approaches saturation.

current *change* by the base bias change. The result is the transistor's *beta* at that operating point.

A practical example may prove helpful. If we plan on using a fixed base bias of, say, 0.5 ma., we may find that collector current is, typically, 10 ma. We increase *Ib* to, say, 0.6 ma. If *Ic* increases to 13 ma., we have a *change* in *Ic* of 3 ma. corresponding to a change of 0.1 ma. in *Ib*. *Beta* at an operating point of 0.5 ma., then, is:

$$beta = \frac{3.0\ (Ic\ \text{change})}{0.1\ (Ib\ \text{change})} = 30$$

Book News. The second edition of the *Transistor Specifications and Substitution Handbook* has been released by TechPress Publications (Brownsburg, Ind. 46112). Selling for only $1.95 a copy, this book lists thousands of transistor types, their basic specifications, and computer-selected substitutions. Obsolete as well as current types are included. Easy to use, this volume should be of value to hobbyists, service technicians, and practical engineers.

Motorola Semiconductor Products, Inc. (Box 955, Phoenix, Arizona 85001) has just published a new book which your columnist

considers a "must" for every experimenter's library—a down-to-earth, spiral-bound *Circuits Manual*. Selling for only $2 a copy, it describes a variety of practical circuits using power semiconductors, including motor controls, inverters, power supplies, regulators, switching controls, lamp controls, ignition systems, and r.f. transmitters. Complete schematic diagrams and parts lists are included in most cases.

That's it for now. I'll be back next month with more bits of information. . . .

—Lou

Across the Ham Bands

(*Continued from page* 82)

that his K-9 Corps dog, Mucho, seemed to have an unusual ability to understand commands he heard over the police radio. Gene was granted special permission to conduct a 6-month experimental training course with Mucho.

Gene fastened a VHF receiver to Mucho's harness; and, after many hours of work, he trained Mucho to respond to "his master's voice" by radio, even when they were blocks apart and out of sight of each other. Even more impressive, Mucho would ignore commands by anyone else, either by radio or in person.

Shortly thereafter, Gene responded to an emergency in which a dangerous armed man had barricaded himself in a house and was holding an 18-month-old baby as a hostage. Gene sent Mucho into action, controlling him by radio. Mucho got the criminal's gun, he was captured, and the baby was rescued unharmed. And Mucho was elected "Dog of the Year" by the Alexandria Kiwanis Club.

The tragic ending to this story: Gene stopped a person who was acting suspiciously to ask a routine question. The suspect snatched out a gun without warning and killed Officer Gene Yoakum instantly.

Mucho is now being retrained to work with another police officer.

News and Views

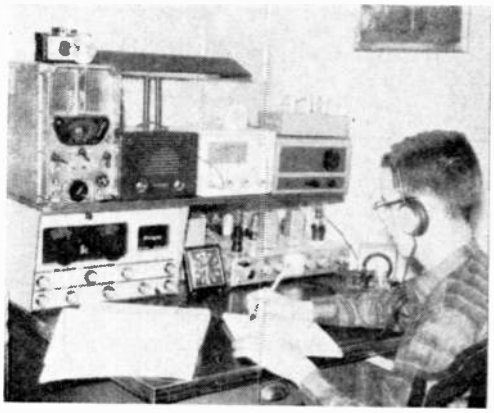
James Lockwood, WA4KOO, 130 Hampton St., Rockmart, Ga., has 47 states worked—38 confirmed—on 75-meter phone. Playing no favorites, Jim uses a Heathkit DX-100B transmitter and a Drake 2B receiver on AM and a Heathkit HW-12 on SSB. An inverted-V antenna does the outdoor work. Jim also operates portable on 10 meters with a converted CB "walkie-talkie" . . . **Edward M. Wadsworth, WN5KDQ,** 1515 Upperline St., New Orleans, La., "wasted" his first three months as a Novice trying to work 80 meters with a 40-meter

dipole antenna. But after switching his Knight-Kit T-60 transmitter and R-55A receiver to 40 meters, he immediately knocked off 20 contacts in five states . . . **Jerry Greathouse, WA5GFC,** 738 N. 16th St., Enid, Okla., on the other hand, finds that his 80-meter, inverted-V dipole works well on 80, 40, *and* 15 meters! Jerry uses a Knight-Kit T-60 transmitter and a 250-pound, Army-surplus AR-88 receiver for the lower frequencies, and a Lafayette HE-45A transceiver feeding a ground-plane antenna on 6 meters.

James Williams, WB2LWM, 197 Sparling, Rochester, N.Y., shares a Hammarlund HX-50 transmitter and a Hammarlund HQ-110AC receiver with his dad, Roger, W2NES. The HX-50 works on AM, SSB, and c.w., but sticks mostly to c.w. and AM. With a 40-meter dipole, Jim has worked 31 states, 3 Canadian provinces, and 5 other countries. Actually, he likes rag-chewing better than chasing DX, and has a Rag Chewers' Club certificate to prove it . . . **Max, WN5JLL/WA5JLL,** wonders why we recommended using the International Phonetic Word List instead of the ARRL Word List in last November's column. The reason is simple: the ARRL list, while still a good list, is out of step with the recommendations of Appendix 16 of the Geneva Radio Regulations of 1959 . . . **Kent A. Williams, WA2VOL,** 4265 Harris Hill Rd., Buffalo, N.Y., works 80 through 10 meters with a Heathkit DX-60 transmitter, HG-10 VFO, and a Hammarlund HQ-100A receiver. His antennas include an "all-band" dipole, and 40- and 20-meter dipoles. In addition, he is working on a beer-can beam for 15 meters. Kent likes to build and modify equipment, as indicated by his home-brew antenna coupler and the plate modulator he added to his transmitter. Forty-eight states (all confirmed), all Canadian call areas, and 18 DX countries are checked off as worked in his log-book.

John Lube, WN5KGW, 5750 Wigton Dr., Houston, Texas, ran the 6146 tube in his second-hand EICO 720 transmitter into exhaustion his first month on the air. But he worked 29 states and Canada in the process, so he considered it a fair trade—the new tube works fine. John's antenna is a bent, 40-meter dipole . . . **Bill Milligan, WN8MOY,** 14 Wayne Ave., Youngstown, Ohio, exchanges greetings with other 40-meter hams with the help of a Heathkit DX-20 transmitter, a Hallicrafters SX-110 receiver—plus a Heathkit Q-Multiplier—and a 40-meter dipole antenna. He has QSL's from 33 states and a Rag Chewers' Club Certificate on his shack wall as a result. If you would like an RCC certificate on your wall, Bill will be glad to help you qualify for it . . . **Morty Williams, WB6IQI,** 17532 Osborne St., Northridge, Calif., used a converted ARC-5 (military surplus) transmitter running 50 watts to work 31 states, Canada, and Mexico. A Drake 2B receiver and a 40'-high Hy-Gain 14-AVS vertical antenna helped.

Steve Edwards, WN4UYK, 806 Lieber St., Henderson, Ky., operates a Globe Chief 90A transmitter feeding a 40-meter dipole 20' high. With a Hallicrafters "Sky Champion" receiver sorting out the incoming signals, Steve has 13 states and Canada logged on 40 meters . . . "All the DX You Can Work in a Year" is the object of the First Annual DXCC Contest of the Long Island DX Association. The station in each U.S., Canadian, and Australian call area that works the greatest number of countries over 100 will be eligible for an award. For more information, write LIDXA, Box 599, Lynbrook, N.Y. . . . **Fred Armentrout, WN4UMX,** 1061 Woodrow Ave., Waynesboro, Va., likes to practice his limited Spanish by working Spanish-speaking amateurs. He has added QSL cards from Ecuador and Cuba to his collection in the process. In addition, he has worked 31 states and three Canadian provinces. A Knight-Kit T-60 feeding either a 40-meter dipole or a Lafayette HE-95 vertical antenna does the transmitting. An RME-69A plus an RME DB-20 preselector does the receiving.



Ron Hunter, WA9GYH, Murphysboro, Ill., is an officer of two radio clubs, edits two club papers, and is an active member of the local Civil Defense organization. But he still has plenty of time for "hamming"; Ron had 33 states—including Alaska and Hawaii—in his logbook when he sent in this picture.

Let's see *your* "News and Views" and station photo on these pages soon. Also, we will appreciate being put on the mailing list to receive *your* club bulletin. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Ind. 46401. 73,

Herb, W9EGQ

Transistor FM Multiplexer

(*Continued from page* 49)

strong signal area, tuner sensitivity is usually not a problem. Some tuners have high-impedance detector circuits which are not suitable for connecting directly to the relatively low impedance transistor circuit in the FM multiplexer. The circuit shown in Fig. 3 can be added to a tuner not equipped with a cathode follower.

Power requirements for the multiplexer are −12 to −17 volts at approximately 25 ma. for stereo, and 11 ma. for mono operation. Less current is needed for mono reception because, in this mode, the stereo indicator lamp is normally off. Various power supplies can be used, but one simple way to get power is to draw it from the tuner's supply as shown in Fig. 4.

The response and separation curves on page 45 were derived from a quality report by Hirsch-Houck Laboratories.

Alignment and Operation. Alignment is begun by removing *Q4* from its socket to kill the 19-kc. oscillator and make it easier to follow the 19-kc. input signal. (See Fig. 1.) Feed into the input jack a 19-kc., ¼-volt signal, and tune *T1* and *T2* for maximum indication on a scope or VTVM attached to point *A*. The indicator lamp should light. Be careful not to overload the circuits with too strong an input signal.

Next, with the generator still set on 19 kc., replace *Q4*, and tune *T4* while looking with a scope at point *C* for the largest 38-kc. signal. Then reset the generator to 67 kc. and tune *T3* for minimum signal at point *B*. If a signal generator is not used, leave *T3* at its factory setting—unless you are bothered by a whistle when tuned to a station broadcasting both stereo and SCA signals; in this case, tune *T3* to eliminate the whistle.

Now, connect the multiplexer into a hi-fi system and tune in a stereo station. The indicator lamp will go on when a stereo program is coming through. Because of the sensitivity of the indi-

cator lamp and bandpass characteristics of the lamp circuit, the lamp will light on interstation hiss and will flicker occasionally on high-frequency modulation in a mono program. If this should happen, ignore it, as it does not create any confusion once you know about it.

If possible, tune in a station known to broadcast portions of its program on one channel only, and during such a broadcast retune *T4* very carefully to reduce the audio output from the unused channel to an absolute minimum. Decrease the volume level of the in-use channel and raise the volume of the unused channel to get the best possible setting for this critical adjustment.

Now all you need is a pair of slippers, a pipe, an easy chair, and a stereo FM disc jockey who shares your taste. —30—

Voltage Function Quiz Answers

(*Quiz appears on page* 73)

1 - G BIAS voltage determines operating point of a vacuum tube.

2 - E COLLECTOR-EMITTER voltage of a transistor is applied in the reverse direction to increase dynamic resistance and power gain.

3 - A HOLDING voltage of a neon glow lamp is the voltage needed to maintain conduction.

4 - F INVERSE voltage across a rectifier is the instantaneous sum of the voltage across the capacitor and the negative voltage on the plate of the tube.

5 - D POLARIZING voltage is applied to the diaphragm and another nearby plate in a condenser microphone. Movements of the diaphragm change capacitance values and vary current flow.

6 - C SATURATION CONTROL voltage of a magnetic amplifier is a form of d.c. bias used to obtain a preset level of saturation.

7 - H SECOND ANODE voltage applied to the inside coating of a cathode-ray tube is used to accelerate the electron beam toward the screen.

8 - B SECONDARY voltage in a transformer is the product of the turns ratio and the applied voltage.

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Best Meter Face Forward

(*Continued from page 72*)

top arc. Then lay out each minor division by dividing each major division into a suitable number of parts. Guide lines are drawn through each of these division points, aimed radially toward the meter pivot point. Add the actual scale markings using $\frac{1}{8}$"-wide black printed circuit tape for the major divisions, and $\frac{1}{16}$"-wide tape for the minor ones. Carefully cut the tape squarely across each arc with a razor blade or a sharp knife.

Transfer the scale numerals into place, being very careful about centering. Note that the center of a *20* is exactly between the "2" and "0," while the center of a *10* is just inside the "0." The center of each numeral group should exactly correspond to the axis of that major division. The title baseline is drawn parallel to the original baseline, and the title pressed into place. To center the title, add up all the space required for each letter and space, and then start the lettering *half* this distance away from the centerline.

Nonlinear Scales. Nonlinear scales require more thought. If the scale is clearly defined mathematically, the scale divisions may be determined by suitable algebra or geometry. An ohmmeter scale is started with a 0 and ends with infinity at full scale. The exact center of the scale is equal to *R*, the internal resistance of the ohmmeter; *2R* is located one-third of the way up the scale; *3R* is one-fourth, *4R* is one-fifth of the way up the scale, etc. For a 1-10 log scale, lightly lay out a linear 0-10 scale. Divisions for each log point are then placed on the log of each desired number. This means the 1 goes at 0, the 2 at 3.01, the 3 at 4.77, etc. Decibel scales work in much the same manner.

Photolith Negatives. Most towns have at least one photolithographer who can make a 5:1 reduction of your art work in the form of a photographic negative. The cost of this service is about $1.00. Don't go to an ordinary photographer, as it will cost much more, and the film used will not have nearly the contrast ratio that lithography film has (the negative is either perfectly transparent or else jet black). Take the negative to a photo store and have semigloss contact prints made; the cost of each print should be about 15 cents.

To mount a new meter face, cut the print to size, align it carefully, and cement it with rubber cement to the *back* of the original meter face. If you ever need the original again, you'll have it handy. —30—

On the Citizens Band

(*Continued from page 75*)

REACT'S current monitoring frequency is channel 4; director of the unit is Robert E. Beverly.

James J. Porten reports that Chicago, Ill., also has a new REACT team dubbed "The Chicago Monitors." The group is headed by Charles Hickey, KLJ5888, president; Jesse Johnson, KBH2211, vice president; Diane Hickey, KLJ5888, and Corinne Marks, KHD7189, secretaries; Charles Walker, KLJ5202, treasurer; and George Dukak, KLK1129, sergeant at arms. The team monitors channels 1 and 9, 24 hours a day, 7 days a week.

Finger Lakes CB Club, Geneva, N.Y., joins the OTCB roster this month. Its officers include: Wm. G. Snyder, 20Q3190, president; Chas. Buck, 20W6285, vice president; F. Pearl Bennett, 20W5030, recording secretary; Wm. L. Bruzee, KIE0189, treasurer; and Jerry Bennett, 20W4677, sergeant at arms. A well-written, news-packed newsletter is published monthly.

The "Tri-County Transceivers" were organized in Landrum, S.C., less than a year ago. President William H. McClure, Rt. 2, Landrum, requests information on obtaining a club charter. Possibly an incorporated club in the area can contact him or mail him details.

Latest officers installed in the Northern Hills Citizens Radio Club, Cincinnati, Ohio, include Andy Flading, 19Q3197, president; Bill Goldstein, KHG0424, vice president; Jim Albrinck, 19Q9024, secretary; Bill Brayles, KHH1124, treasurer; and Joe Sefferino, KHG3557, and Stan Fogel, 19W8191, directors. The NHCRC has an active membership of 90; membership is open to all male CB'ers 18 years or older. The club meets every first Wednesday of the month. A 1956 Chevy carry-all is maintained for area emergencies and for use in local parade assistance. An auxiliary is being planned for the future.

Current officers of the Lakeland Citizens Radio Net, Madison, Wis., are Larry Haak, president; Ken Krueger, vice president; Richard Steimel, secretary-treasurer/editor; and Art Krueger, Marty Steiner, and Norm Farrington, directors. Haak, both Kruegers, and Steimel were re-elected. The club publishes a clean-cut, informative news bulletin, *Lakeland Newsletter,* monthly. Current projects include placement of highway "monitoring channel" signs and the possibility of a 15-minute club radio show.

Planning a jamboree this year? Get your

activity sheet and all information regarding the event in the mail to us as soon as possible to be sure it will be listed in time to give out-of-state CB'ers a chance to plan to attend. Mail all jamboree material, plus other items you think will be of interest to our readers, such as your club's latest activities, formation of emergency and rescue squads, planned projects, and emergency assists, to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Did you forget to send us that picture last year? Do it *now!*

I'll CB'ing you.

—Matt, KHC2060

Short-Wave Report

(*Continued from page* 80)

ground somewhere in the Federal Republic of Germany. In less romantic fact, it operates at a place called Burg, near Magdeburg, in the Soviet Zone.

Listeners seemed to like the Western dance music on *Freedom Radio 904,* but apparently were bored stiff by its Eastern propaganda. So a group of motivational-research experts decided that the people would be more interested if they believed they were hearing a forbidden message. Now, to bolster the impression that here is really an underground, hush-hush type of operation, the Soviet Zone sponsors have hit upon an idea blending psychology and electronics—they are jamming their own broadcasts!

Recording for SWL's. While it is not the policy of this column to publicize new products, we feel that one item might be well worth mentioning. There is now available a 33⅓-rpm recording of interval signals, station identification announcements, station music, and anthems of many overseas short-wave stations. During its total playing time of 40 minutes, you can hear stations in Mozambique, Sudan, Free China, Israel, Ethiopia, and a dozen others.

Complete details, including price, can be obtained from SWL Records, 4017 Jackson Ave., Culver City, Calif. 90231.

"Radio Amateur Notebook." In answer to many inquiries concerning the schedule for the *Voice of America*'s "Radio Amateur Notebook," the program is on the air on Sundays only, as follows: at 0230-0245 on 3980, 5995, 6040, 6075, 6080, 6185, 7130, 7195, 7200, 7270, 9520, 9545, 9615, 9635,

9740, 11,790, 11,925, and 17,735 kc.; at 0345-0400 on 6125, 7155, 9605, 9650, 11,930, 15,120, and 15,315 kc.; at 1745-1800 on 5995, 7205, and 9740 kc.; and at 2230-2245 on 6030, 9565, 9650, 11,770, 11,830, and 11,890 kc. This schedule will remain in effect until March 6.

Current Station Reports

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Reports should be sent to P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

Albania—*R. Tirana* has abandoned 9715 kc. and returned to 9390 kc. where it has been noted in Eng. at 1500, Arabic at 1600, and Eng. at 1630-1700. The second xmtr remains on 7090 kc.

Australia—The Australian Home Service operates on this schedule: (VLI, Sydney) VLI6 on 6090 kc. at 1500-0907 (Sundays from 1530); (VLH and VLR, Melbourne) VLH15 on 15,230 kc. at 1830-0315 (Saturdays from 1800), VLH11 on 11,880 kc. at 1500-1815 (Saturdays to 1745, Sundays from 1530), VLH9 on 9680 kc. at 0330-0907, VLR9 on 9680 kc. at 1745-0330 (Sundays from 1730), VLR6 on 6150 kc. at 1500-1730 (Sundays to 1715) and at 0330-0900; (VLT and VLK, Port Moresby) VLT9 on 9520 kc. at 1715-0145, VLT4 on 4890 kc. at 1500-1700 (Sundays from 1530) and at 0200-0900, VLK4 on 4890 kc. at 1715-0145, VLK3 on 3925 kc. at 1500-1700 (Sundays from 1530) and at 0200-0900; (VLQ and VLM, Brisbane) VLQ9 on 9660 kc. and VLM4 on 4920 kc. at 1500-0907 (Sundays from 1530); (VLW and VLX, Perth) VLX15 on 15,425 kc. and VLW9 on 9610 kc. at 1915-0515, VLX9 on 9610 kc. and VLW6 on 6140 kc. at 1700-1900 (Sundays from 1730) and at 0530-1107. VLX operates with 50 kw., VLI 2 kw., the others 10 kw. "Australian DX'ers Calling" can be heard Saturdays at 1430 on 11,840 and 9600 kc., and at 1700 on 15,240 and 11,820 kc.; Sundays at 0000 on 17,820 and 15,220 kc., at 0400 on 11,710 and 9670 kc., at 0800 on 9580 kc., at 1030 on 9570 and 7220 kc., and at 2115 on 17,840 and 15,220 kc.

Bolivia—*Radiodifusora Libertad*, possibly in Santa Fe, Departamento de Santa Cruz, was noted on 5750 kc. from 1800 to closing at 2150-2200; a new station, it seems to feature Bolivian music with anti-governmental and "anti-Yankee" talks. Station CP66, *R. Centenario*, Santa Cruz de la Sierra, 4873 kc., was in the 90-meter band in 1963 and has now reappeared in the 60-meter band with Spanish language and Bolivian music to 2200 closing.

Brazil—Station ZYT29, Sao Paulo, 9675 kc., is fair to good from 1804 to 1812 with newscast in Portuguese; listen for frequent mention of Brazilian towns. Rarely reported is ZYN37, Feira de San-

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QSL—Verification
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
kc.—Kilocycles	s/on—Sign-on
kw.—Kilowatts	xmsn—Trnsmission
N.A.—North America	xmtr—Transmitter

tana, 4765 kc.; this station is noted at 0540-0600 with non-stop instrumental music, mostly U.S. tunes of the 1930's. Station PRA7, Sao Paulo, is noted on 15,415 kc. around 1800-1825 with Eng. religious programs.

Canada—*R. Canada* is considering issuing a new QSL card with a seasonal picture. The Shortwave Club can be heard Saturdays in French at 1445 to Africa on 17,820, 15,320, and 11,720 kc., and to Europe at 1530 on 15,320, 11,720, and 9630 kc.

Canary Islands—*R. Nacional de Espana*, Tenerife, signs on with an ID at 1900 on 9600 kc. This is the new *Centro Emissor del Atlantico*, operating with 100 kw. on 620 kc., and with two 50-kw. xmtrs on the short waves.

Cape Verde Islands—A station tentatively ID'd as *R. Barlavento* is consistently noted on 3930 kc. at 1700-1900, but there is severe QRM from amateur operators. A newscast in Portuguese is given at 1732-1745 with long pauses between items; a gong is rung before and after the news.

Congo (West)—Short-wave relays of ORTF *(l'Office de Radiodiffusion et de Television Francaise)* from Brazzaville are scheduled as follows. Network I: at 0000-0215 on 4795, 9730, 11,725, and 15,445 kc.; at 0600-0730 on 7105, 11,710, 15,190, and 21,500 kc.; at 0730-0800 on 7105, 11,710, 15,445, 17,720, and 21,500 kc.; at 0800-0830 on 17,720 kc.; at 0830-0950 on 17,720 and 21,500 kc.; and from 1100 to 1600 on 5970, 7105, 9730, and 11,710 kc. (1200-1400), 11,970 kc. (1230-1430), 11,725 kc. (1430-1600), 15,190 kc. (1230-1400), and 15,290 kc. (1400-1600). Network II: at 0530-0720 on 11,970 and 15,445 kc.; and at 1400-1500 on 15,190 kc. France Inter is aired on Sundays only at 0900-1200 on 7105, 11,725, 17,720, and 21,500 kc. Regarding the Republic du Tchad postage stamps that have been appearing on recent veries, it seems that stamps of many countries of the former "Franco-African Community" have been valid in the Congo for some time. Stamps from Gabon and the Central African Republic have been used in Brazzaville for at least a year.

Czechoslovakia—*R. Prague's* xmsns to N.A. continue at 2000-2055 and 2230-2325 on 5930, 7115, 7345, 9795, and 11,990 kc. There is also a Sunday program at 1000-1055 on 15,285, 15,448, and 17,825 kc. Broadcasts to the Far East and Europe are scheduled at 0300-0355 on 6055, 9505, 15,230, 15,285, and 21,450 kc.

Denmark—Copenhagen's latest schedule reads: to N.A. at 2030-2130 on 9520 kc. and 0700-0800 on 15,165 kc.; to South Africa at 1330-1430 and to South Asia at 0930-1030 on 15,165 kc.; to North Africa and the Middle East at 1445-1545, to South America at 1645-1745, to the Far East, Australia, and New Zealand at 0400-0500, and to Greenland at 1230-1310—all on 9520 kc.

Dominican Republic—A program schedule just received from HIDA, *R. Hit Musical*, Santiago de los Caballeros (3385 kc., 1000 watts) shows that it is affiliated with *Radio Canada, Radio Vaticano*, the British Broadcasting Corp., and *La Voz De Las Americas*.

Ecuador—Station HCHA2, *R. Ondas Quevedenas*, Quevedo, 3610 kc., now announces that it is operating with 5000 watts. It is fair after 21,000, increasing to good at 0000 s/off, with mostly Ecuadorian music and anmts in Spanish. This station has not verified the reporter's last seven reports.

El Salvador—Station YSS, *R. Nacional*, El Salvador, listed as inactive on 6010 kc., has been tuned on that channel at 2145-2200 with news.

England—London transmits to N.A. daily at 1030-1045 on 15,300 kc., at 1045-1230 on 5300 and 11,860 kc., and at 1615-2145 on 9510 and 6195 kc. Newscasts in Eng. are given at 1100, 1700, 1800, 1900, and 2100.

Ethiopia—English broadcasts from the *Radio Voice of the Gospel*, ETLF, Addis Ababa, are scheduled at 0815-0830 to Ceylon on 15,410 (15,355) kc. and to India on 9705 (9765) kc., at 0830-0900 to India on 9765 (9705) kc., at 0930-1000 to India on 15,410 (15,355) kc., at 1200-1215 to E. Africa on 9565 (9705) kc., and at 1330-1415 to W. Africa on 11,755

(11,745) kc. Frequencies in parentheses above are alternate frequencies used in case of severe interference.

Germany (West)—*Deutsche Welle* has been noted on 11,965 kc. to N.A. with news at 1010. *R. Liberty*, 17,745 kc., is heard from 1234 to 1301 s/off with talks and music in native language.

Grand Turk Island—In response to our request in the November, 1964, column, information has been received indicating that VSI8 is owned and operated by Cable & Wireless, Ltd. and provides Monday-Saturday service to Grand Turk and other islands in the Turks Island group. The xmtsns are mostly personal messages. One humorous report (from a clergyman in the Philippines) indicated that a most urgent message was sent some time ago from a minister on one of the outer islands to Grand Turk requesting that the case of rum *not* be sent; someone had mixed up shipping orders. The station operates on 4560 kc. at 1330-1340.

Greenland—Canadians take note: the Armed Forces Radio Service, Thule, has been logged regularly in Alaska on 1425 kc. (medium waves) from 0204 to 0430 with pop and western music, network news, and frequent weathercasts. The power is 1000 watts.

Korea (South)—Seoul's latest schedule reads: on 6015 kc. (moved from 6035 kc.) at 0300-1100 (Eng. at 0330-0400); on 9640 kc. in Eng. to N.A. at 0000-0030 and 0530-0600, in Korean at 0500-0530; on 11,925 kc. in Korean at 2130, Eng. at 2200, Spanish at 2230-2300, and to Europe in Eng. at 0130 and French at 0200-0230 and 1100-1130, and Eng. again at 1030-1100.

Malaysia—*R. Malaysia Sarawak*, Kuching, 4950 kc., has a program of recorded music that runs to 1000 on Saturdays which is heard well on the West Coast. The station *(R. Malaysia)* is expanding its services and intends to purchase two new 50-kw. xmtrs. It now broadcasts to Indonesia at 0300-0530, 0730-1130, and 1830-1900 on 11,900, 9750, 7110, and 6175 kc.

Mexico—*R. 590 (R. Quinientos Noventa)*, Mexico City, 5965 kc., has Esso news at 1830-1840 and music to 1930 with frequent ads. This is dual to the usual 590-kc. outlet (XEPH).

Monaco—*Trans World Radio*, Monte Carlo, is noted on 965 kc. from 1300 with religious music, from 1312 in Armenian.

Netherlands—The revised schedule for the "Happy Station Program," Sundays only, reads: at 0100-0220 and 0230-0350 on 15,445 and 9715 kc., at 0530-0650 on 9715, 6020, and 5980 kc., at 0900-1020 on 15,425, 11,710, and 6020 kc., at 1030-1150 on 15,425 and 9590 kc., at 1400-1520 (to N.A.) on 11,955 and 9715 kc., and at 1940-2030 over PJB, Bonaire, 800 kc.: this program is not as yet listed for any

The Medium Waves

On the standard broadcast channels, the following stations were reported as being heard most frequently during the past month (they are listed by frequency in kilocycles):

540 XEWA, San Luis Potosi, Mexico
543 St. Georges, Grenada
566 Athlone, Ireland
640 Basse-Terre, Guadeloupe
695 Roseau, Dominica
705 St. Vincent
755 Lisbon, Portugal (Eng. at 1745-1830)
764 Baghdad, Iraq
845 Rome, Italy
880 TGJ, Guatemala City, Guatemala
885 Montserrat (Eng. news at 2000)
1133 Yugoslavia
1375 St. Pierre & Miquelon
1475 Austria

Bonaire short-wave outlet. Other xmsns to N.A.: at 1555-1650 on 9590 and 6085 kc., and at 2255-2350 (Bonaire) on 9715, 6085, and 800 kc.; these are Monday to Saturday xmsns only.

Netherland Antilles—We've received numerous conflicting schedules for Bonaire's short-wave outlets but that from *R. Nederland* is probably the most official: Dutch at 1700-1820 to southern South America on 11,730 and 9590 kc.; Spanish at 1730-1820 (except Sundays) to the same areas on 11,800 and 9715 kc.; Dutch to northern South America and the West Indies at 1830-2020 (Sundays to 1950) on 9590, 6085, and 6020 kc.; Spanish to the same areas at 1930-2020 (except Sundays) on 11,800 and 9715 kc.; Spanish to Mexico at 2030-2120 (except Sundays) on 9715 and 6085 kc.; Dutch to N.A. at 2130-2250 and Eng. to N.A. at 2300-2350, also on 9715 and 6085 kc.

Peru—OAX5U, *R. Huamanga*, Casilla 9, Ayacucho, 6123 kc., is a new station but it uses the same call as *R. Huancavelica;* the schedule is not yet known but the station has been heard from 2200 to 2350 close, all Spanish. *R. Onda Azul*, Casilla 112, Puno, 4801 kc., is seldom heard due to a teletype station being on the same channel; programs are light music and "Escuelas Radiofonicas" in Spanish, and the best listening time is around 2200.

Poland—Here is the latest schedule from Warsaw, currently in effect. English is broadcast to the British Isles at 1330-1400 and 1430-1500 on 6135 and 7125 kc , at 1530-1600 on 5950 and 7145 kc., at 1630-1655 on 6135 and 7125 kc., and at 1730-1800 on 5950 and 9540 kc. The overseas Eng. service is scheduled at 0230-0300 and 0330-0400 on 9675, 11,840, and 15,120 kc.; French at 0600-0615 on 7285, 9540, 9675, and 11,955 kc., at 1130-1200 on 7285 and 9675 kc., at 1230-1300 on 7285, 9540, and 9675 kc., at 1500-1530 and 1630-1700 on 5950 and 7145 kc., and at 1700-1730 on 5950 and 9540 kc. A Chopin concert is given daily at 0130-0200 on 7125 kc. and at 1100-1130 on 9540 kc. An international concert is aired at 0730-0900 on 7285 kc. and at 1400-1530 on 9540 kc.

Spain—*Radio Nacional de Espana,* Madrid, is heard on 9725 kc. (announced as 9360 and 6130 kc.) to N.A. at 2125-2140 and to close at 2345.

Spanish Guinea—Santa Isabel is heard on 6345 kc. around 1630-1705 with classical music.

Sweden—Several reliable DX'ers have placed *R. Sweden*'s N.A. xmsns on 9705 kc. although they are being heard only on 5990 kc., the only frequency announced by the station. The 9765-kc.

DX States Awards Presented

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

Twenty States Verified

Joseph Agrella (WPE4FNS), Ft. Lauderdale, Fla.
Victor J. Lipinski (WPE4HTV), Alexandria, Va.
Norman Kiel (WPE2LON), Bronx, N. Y.
David A. Kent (WPE2MIJ), Auburn, N. Y.
Jerry Bond (WPE2FXO), Watertown, N. Y.
Robert Osowicki (WPE2LVD), Amsterdam, N. Y.
Neil Hauser (WPE2LQQ), Great Neck, N. Y.
Thomas Krawczykowski (WPE9FYS), Bellwood, Ill.
Dave Brown (WPE6EMI), Woodland Hills, Calif.
Bruce Schulze (WPE5DXL), Durant, Okla.
Douglas Purcell (WPE4HSH), Trussville, Ala.
Richard Schafer (WPE4HUN), Miami, Fla.
Joseph Hutchens (WPE8EUM), Marquette, Mich.
Albert Gurka (WPE9GHV), Chicago, Ill.
Donny Perro (WPE4HDU), Mobile, Ala.
Melvin E. Black (WPE9GUO), Jacksonville, Ill.
Buddy C. Hamburg (WPEØEBA), Denver, Colo.
Max Baldwin (WPE3COU), Newark, Del.
Mark Katz (WPE2MLV), Brooklyn, N. Y.
Charles P. Mohr, Jr. (WPE2MKI), White Plains, N. Y.
Richard S. Brown (WPE3AAQ), Baltimore, Md.
Steve Curfman (WPE9GWK), East Alton, Ill.
David V. Heminger (WPE6EJM), Livermore, Calif.
Eugene Stoudenmire (WPE4CDM), Prattville, Ala.
David Duquette (WPE1FOS), Springfield, Mass.
Les Delmarter (WPE6FKU), Porterville, Calif.
Steven Leiffer (WPE1FPZ), Whitestone, N. Y.
David Heil (WPE8GEF), Oak Hill, W. Va.
Glen Gray (WPE8HCB), Mt. Morris, Mich.
Harold J. Wilkinson (WPE6FMU), Concord, Calif.
Dave Wieboldt (WPE4HFV), Sanford, Fla.
Richard M. Paradise (WPEØDKP), Rochester, Minn.
Francis Gifford (WPE8HVI), Lathrup Village, Mich.
Edward H. Rollfs (WPE1FNU), Topsfield, Mass.
Charles Brice III (WPE4HSP), Chester, S. C.
Odis Woodward, Jr. (WPE4DKF), Memphis, Tenn.
Pete Glenn (WPE2JMT), Morristown, N. J.
Robert A. Howell (WPE8GXG), East Lansing, Mich.
Robert Astmann (WPE2LWS), Kenmore, N. Y.
Brett M. Stephens (WPE9EOH), Glenview, Ill.
Douglas Lamerson (WPE2MNN), Richmond Hill, N.Y.
Thomas Gaffigan (WPE3FBF), Dundalk, Md.
Calvin Larsen (WPE7BWJ), Coeur d'Alene, Idaho
Douglas Ortman (WPE4HJR), Orlando, Fla.
Gary A. Laptosh (WPE2MHP), South River, N. J.
Bruce Dean (WPE1FRQ), Seekonk, Mass.
Bruce Gemmill (VE7PE1AD), Vancouver, B. C.
Bruce Kirkpatrick (WPEØDZY), Topeka, Kans.
David W. Johnson (VE2PE1BS), Montreal, Que., Canada
Walter Poppinga (WPE9CBC), Lafayette, Ind.
Bryan Dowd (WPE4HHA), Rome, Va.
Peter Neenos (WPE2LMI), Buffalo, N. Y.
Dick Holic (WPE2MGR), Endwell, N. Y.
Richard Bender (WPE2MAJ), Hoboken, N. J.
Michael Akerbergs (WPE2KSW), Brooklyn, N. Y.
Jim Marksbury (WPE6EWO), San Diego, Calif.
Joseph H. Buczyna (WPE9FXD), Chicago, Ill.
A. D. Carson (VE6PE5M), Fort Saskatchewan, Alberta, Canada
Arnold Galina (WPE1FQS), Worcester, Mass.
R. S. Kloenhamer (WPE8HUX), St. Clair Shores, Mich.
James T. Navary (WPE3FVN), W. Mifflin, Pa.
Jack Page, Jr. (WPE5DXH), Pontotoc, Miss.
Hugh Ducklow (WPE9GZN), Appleton, Wis.
David Glow (WPE1FKZ), Pepperell, Mass.
Mike Rosenzweig (WPE2MCE), Bronx, N. Y.
M. James Mansfield (WPE9HDF), Rock Island, Ill.
Philip R. Barvey (WPE2MQD), Poughkeepsie, N. Y.
John A. Czupowski (WPE9ETD), Cicero, Ill.
Steve Fetter (WPE8HSM), Newark, Ohio
Robert McArthur (WPEØEFA), Kansas City, Mo.
J. Paul Ochenkowski (WPE1FYY), Hamden, Conn.
Kenneth M. Deschere (WPE2LVK), Poughkeepsie, N. Y.
Mike Patton (WPE5IAA), Houston, Texas
Richard Mauer (WPE2JWI), West Orange, N. J.
Charles Hill (WPE3DXW), Annapolis, Md.
Graeme Case (WPE8FKX), Cincinnati, Ohio
Mike Martin (WPEØBTP), Moravia, Iowa
Bill Fulmer (WPE4HNE), Jackson, Tenn.
David Williams (WPE7IK), Coos Bay, Oregon
Reg Firth (WPE2GFO), Amsterdam, N. Y.
Richard Daniel (WPE3EXJ), Swarthmore, Pa.
Ovide Brudo (WPE1EEX), Ware, Mass.
Larry Belekevich (WPE9GLP), Green Bay, Wis.

DX COUNTRY AWARD RULES

Are you eligible to apply for a 25, 50, 75, 100, or 150 Countries Verified Award? Here is a brief resume of the rules and regulations.

(1) You must be a registered WPE Short-Wave Monitor and show your call on your application.

(2) You must submit a list of stations for which you have received verifications, one for each country heard. You must also supply the following information in tabular form: (a) country heard; (b) call-sign or name of station heard; (c) frequency; (d) date the station was heard; (e) date of verification. All of the above information should be copied from the station's verification. Do not list any verifications you cannot supply for authentication on demand. Do not send any verifications at this time. Should any verifications need to be sent in for checking, we will notify you and give you instructions on how to send them.

(3) A fee of 50 cents (U.S. coin) must accompany the application to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible. Applicants in countries other than the U.S. may send the equivalent of 60 cents (U.S.) in coins of their own country if they wish.

(4) Apply for the highest DX award for which you are eligible. If, at a later date, you are eligible for a higher award, then apply for that award.

(5) Send your application, verification list, and fee to Hank Bennett, Short-Wave Editor, P. O. Box 333, Cherry Hill, N. J. 08034. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Short-Wave Monitor Certificate in your possession). Reports, news items, or questions should be mailed in a separate envelope.

channel is used to South Asia with Eng. ending at 1015, then native language.

Switzerland—Berne's newest schedule reads: to Eastern N.A. at 2015-2115 on 6105, 6080, and 9535 kc.; to Western N.A. at 1000-1100 on 15,305 kc. and to the Near East and Middle East at the same time on 9535, 9665, and 11,865 kc.; to the United Kingdom and Ireland at 0700-0800 on 9665 and 7110 kc.; to Japan and China at 0215-0315 on 9670, 11,865, and 15,305 kc.; to Australia and New Zealand as well as most of S. E. Asia at 0400-0500 on 15,305, 17,820, and 21,520 kc.; to India, Pakistan, and Africa at 0815-0915 on 9535, 11,865, 17,795, and 17,845 kc.; and to Africa at 1345-1445 on 9595, 9655, and 11,715 kc.

Tahiti—*R. Tahiti*, Papeete, according to its QSL card, broadcasts at 1115-1215, 1630-1800, and 2230-0230 (Sundays at 1500-1800 and 2230-0300) on 11,825 and 6135 kc., with programs in French and Polynesian.

Turkey—WPE5JZ, currently in this country, reports a station that will probably never be picked up in N.A. It is the Armed Forces Radio Service station (location classified) operating on 1570 kc. with 60 watts 24 hours daily.

U.S.A.—*Radio New York Worldwide*, WRUL, New York, is operating at 0700-1100 on 15,440 kc. (to Europe and northwest South America), on 15,135 kc. (to British Isles), and on 17,760 and 11,940 kc.; at 1100-1115 on 15,440, 17,760, and 11,940 kc.; at 1115-1230 on 11,840, 11,940, 15,440, and 17,760 kc.; at 1230-1245 on 11,840, 15,440, and 17,760 kc.; at 1245-1500 on 9640, 11,840, 17,760, and 15,440 kc.; at 1500-1515 on 9640 and 15,440 kc.; at 1515-1640 on 9640, 11,855, 11,940, and 15,440 kc.; at 1640-1700 on

POPULAR ELECTRONICS

February 1965

ADVERTISERS INDEX

SHORT-WAVE CONTRIBUTORS

Bob Hill (*WPE1ARR*), Boston, Mass.
Bill Smith (*WPE1FZ*), Uxbridge, Mass.
Riley Sundstrom (*WPE2AIJ*), Stockton, N. J.
William Graham (*WPE2LMU*), Binghamton, N. Y.
Angel Garcia (*WPE2LXA*), New York, N. Y.
Frank Mather (*WPE2LWW*), Buffalo, N. Y.
Charles Coombe (*WPE2MOB*), Trenton, N. J.
Donald Huber (*WPE2MPJ*), Huntington, N. Y.
Arthur Epstein (*2WPEMPW*), Bronx, N. Y.
Jeffrey Greene (*WPE2MQM*), Bronx, N. Y.
William Dickerman (*WPE3BEB*), Williamsport, Pa.
Steven Russell (*WPE3EWZ*), Bethesda, Md.
Grady Ferguson (*WPE4BC*), Charlotte, N. C.
John Brunst (*WPE4BQ*), Neptune Beach, Fla.
Kenneth Alyta, Jr. (*WPE4FXB*), Charlotte, N. C.
Jeff Tallent (*WPE4HUZ*), Louisville, Ky.
Del Hirst (*WPE5CFU*), Snyder, Texas
James Helmke (*WPE5DCV*), San Antonio, Texas
Joseph Martine (*WPE5IZ*), Izmir, Turkey
Stewart Mac Kenzie, Jr. (*WPE6AA*), Huntington Beach, Calif.
Shaler Hanisch (*WPE6BPN*), Hartford, Conn.
Bill Lund (*WPE6CJ*), Manhattan Beach, Calif.
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Al Hart (*WPE6EWU*), South Gate, Calif.
Trev Clegg (*WPE6FIF*), Fresno, Calif.
Jim Pruitt (*WPE6FFK*), Merced, Calif.
Bruce Bumm (*WPE6FPB*), Seaside, Calif.
Ed Fellows (*WPE7BLN*), Seattle, Wash.
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Kenneth Rosen (*WPE8HSZ*), Detroit, Mich.
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Terry Lauher, Tarzana, Calif.
Raymond Nowak, S. Milwaukee, Wis.
Joe Piechuta, Meriden, Conn.
James Pirnat, Euclid, Ohio
Martha Trojanova, Prague, Czechoslovkia
Radio New York Worldwide, New York, N. Y.
Sweden Calling DXers Bulletin, Stockholm, Sweden
Station ETLF, Addis Ababa, Ethiopia
R. Nederland, Hilversum, Netherlands

11,940 kc.; and at 1700-1900 on 9550 and 11,940 kc.

U.S.S.R.—Moscow now transmits half-hour programs to N.A. at 1700, 1800, 1900, 2000, and 2300 as well as at 2100-2230 and 0000-0100 on many frequencies in the 31-, 41-, and 49-meter bands. Kiev has Eng. to N.A. at 1940-2000 on Mondays and Thursdays on 7120, 7180, 7310, 7330, and 9660 kc. The reportedly nonexistent *R. Yerevan* (see January column) sent a schedule by registered mail which lists European service at 0400-0500 Wednesdays and Sundays on 15,380, 11,970, 11,925, 7320, and 6010 kc., and American service at 1530-1630 Saturdays and Sundays on 7275, 7185, 6155, and 5965 kc.; no Eng. was specified but there is usually a 10-minute segment near the end of each xmsn.

Vatican City—*Vatican Radio* has dropped 11,740 kc. and added 5985 kc. for its 1950 xmsn to N.A., dual to 9645 and 7250 kc. The Australia and New Zealand beam is noted on 11,735 and 9630 kc. in Eng. at 1700.

Venezuela—Station YVPM, 2430 kc., is noted from 1917 to 1950 at good level most evenings. This may be a change from the listed 3365-kc. frequency although we have no definite information as yet.

Clandestine—A new clandestine station announcing as *Bayrak Radio, The Voice of the Turkish Cypriot Fighters*, is broadcasting on 6700, 6705, and 7275 kc., with Turkish at 0130 and 1230, Greek at 0200 and 1330, and Eng. at 0230 and 1400. —30—

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FOR SALE

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

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

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TRANSISTORIZED Products Importers catalog, $1.00, Intercontinental, CPO 1717, Tokyo, Japan.

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

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

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

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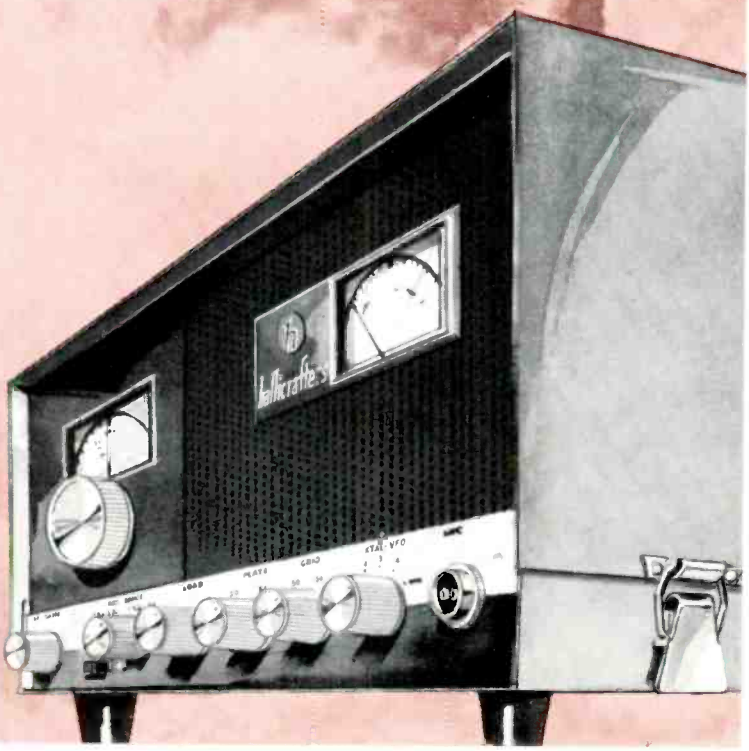

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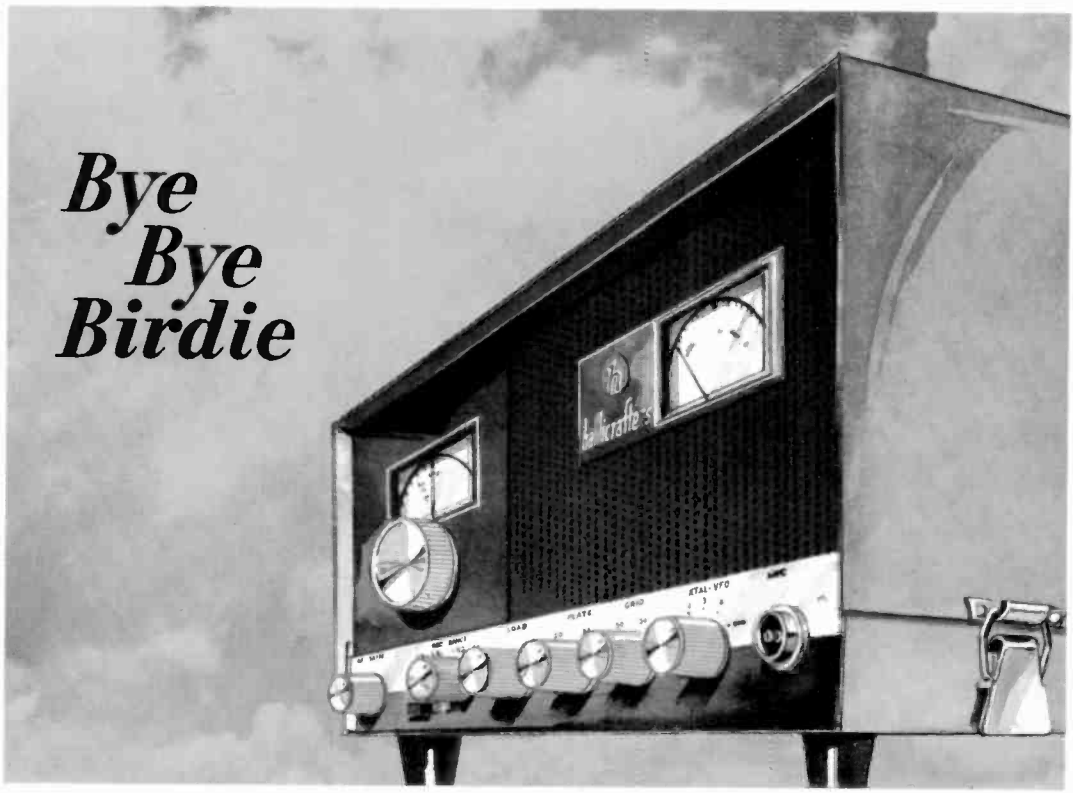
CIRCLE NO. 14 ON READER SERVICE PAGE



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Which end of this popular hand tool is the handle?

(Pass this test and you've qualified to build any of these handsome Electro-Voice Prefinished Kits!)

Do it yourself? Why not! We guarantee you'll be proud of what you see and hear when you assemble any E-V prefinished kit.

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SETTING NEW STANDARDS IN SOUND

CIRCLE NO. 12 ON READER SERVICE PAGE

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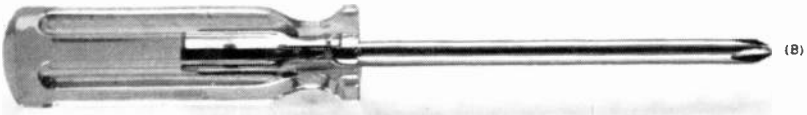

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