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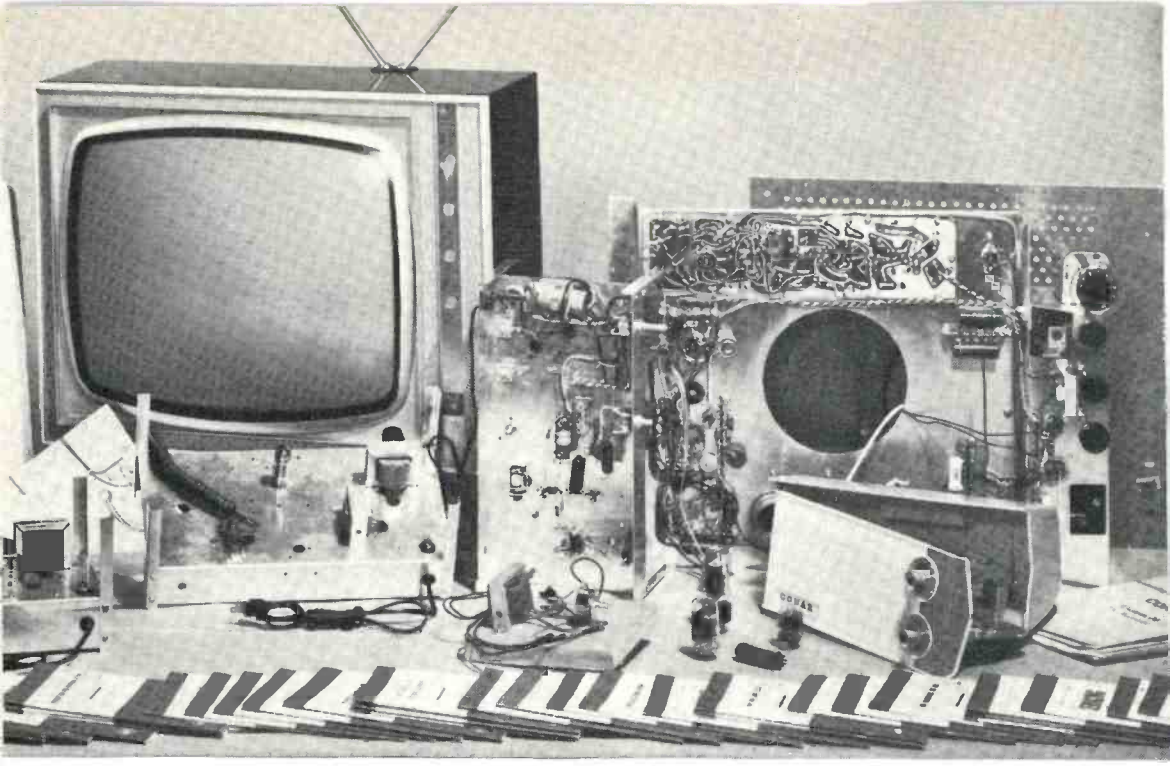

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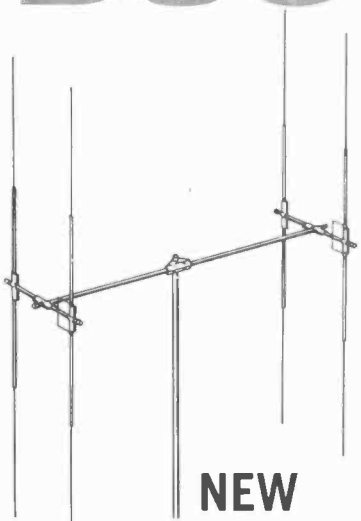

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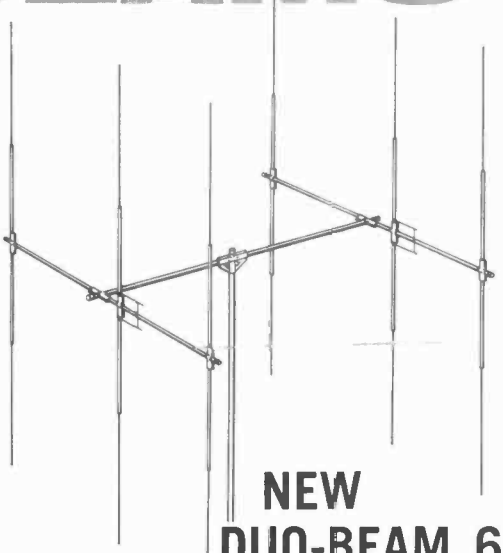

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This month's cover photo by Bruce Pendleton

VOLUME 22 JUNE, 1965 NUMBER 6

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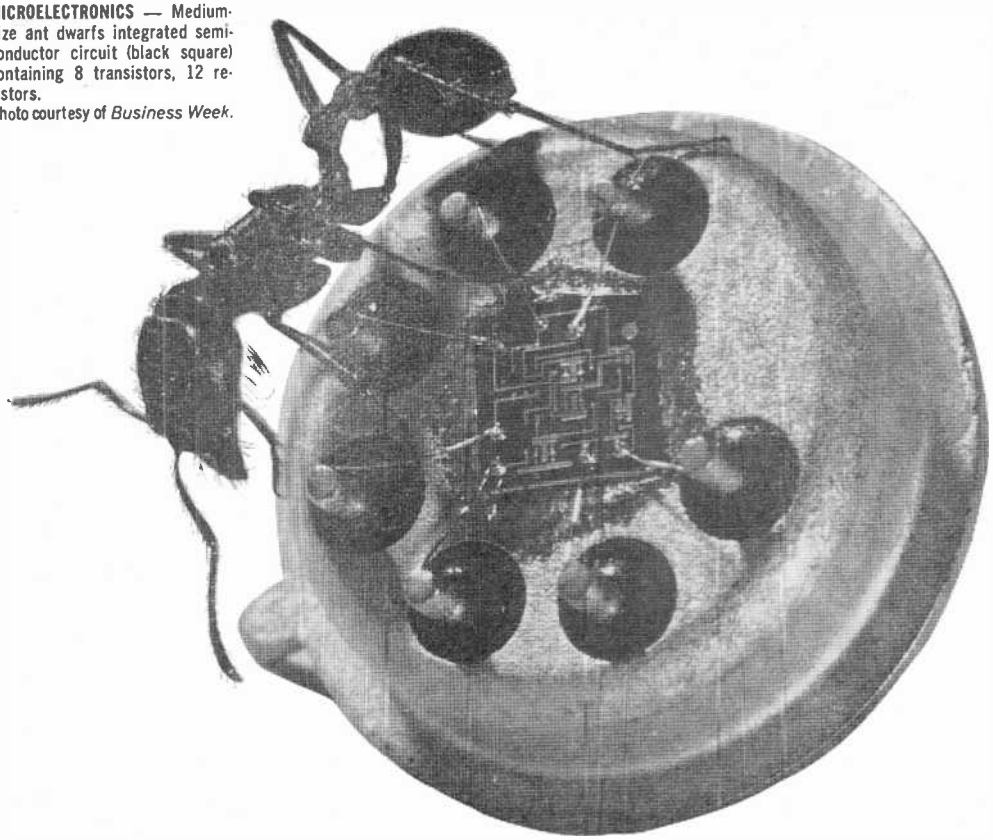
MICROELECTRONICS — Medium-size ant dwarfs integrated semiconductor circuit (black square) containing 8 transistors, 12 resistors.
Photo courtesy of *Business Week*.



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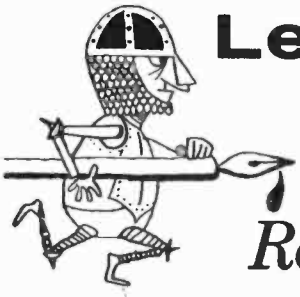


Letters from our Readers

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

Yes, There Really Is an NAA

■ In the "fiction" story entitled "One QSL Too Many" (April, 1965), the author mentions a station with the call letters NAA operating on a frequency of 17.8 kc. I actually hear a c.w. station with the call of NAA at about 7590 kc.; it comes in loud and clear every day. Can you tell me what kind of station this is?

EDWARD RESNICK
Philadelphia, Pa.

Sure, Ed. NAA is a well-known Navy station located at Cutler, Maine. Although NAA's very-low-frequency transmitting facilities—used for communicating with submarines—are the most spectacular aspect of the station, it also operates on the high frequency bands. For more information on NAA, see "How We're Using 'Rock-Bottom' Radio" in the December, 1963, issue.

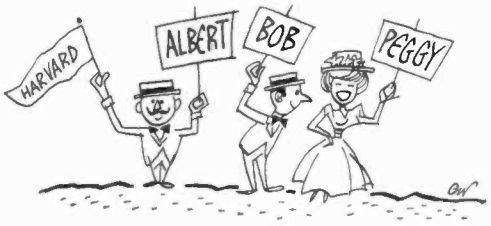
"Dymwatt" Prices Go Down

■ There are a couple of significant price breaks on the parts required for the "Dymwatt" (May, 1965, p. 71). The Triac ZJ-257 is now called the SC-40-B and sells for $4.65 instead of $6.98. So far as the trigger diodes are concerned, the TI-43 manufactured by Texas Instruments is priced at $1.02, compared with $1.75 for a Transitron trigger, and $2.25 for the G.E. trigger. By the way, the G.E. trigger diode is now called ST-2 instead of ZJ-238. All of these components are available from the larger mail order houses.

DON LANCASTER
Phoenix, Ariz.

Why Hams Are "Hams"

■ Although there have been many theories as to why amateur radio operators are called "hams," the following is the truth; fact not fiction. In 1909, one of the first amateur stations had the call HAM. This call was



made up from the first letter of each op's last name, Albert Hyman, Bob Almy, and Peggy Murray, who operated the Harvard amateur station. Then, when federal legislation threatened to destroy all amateur

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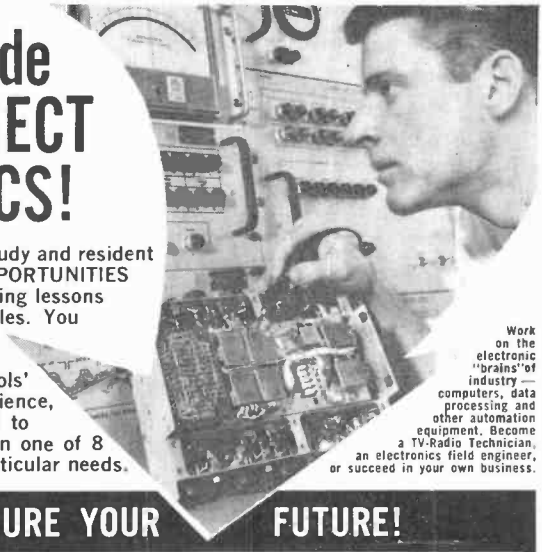

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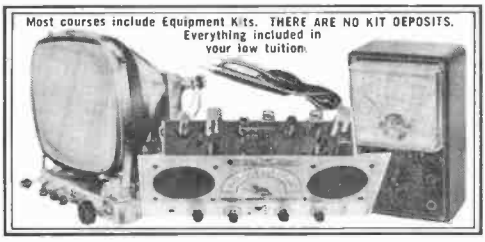

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Letters

(*Continued from page* 6)

radio, Mr. Hyman went to Washington to defend amateur radio and station HAM. The results were that the word "ham" came to mean all radio amateurs.

JIM LONIAK, KKD8541
Astoria, N.Y.

Interesting story, Jim; we hadn't heard it before. Perhaps other readers would care to comment.

Tool Article Lauded

■ I was very pleased with "Tools For the Electronic Hobbyist" (March, 1965) which I thought was very good. Now that you've given us information on the best tools to do the job, how about some plans for a well-designed shop with bench, tool racks, etc.

GREG NAU
San Diego, Calif.

Thanks for the letter, Greg. We'll keep your idea for a shop article in mind.

Improving Sound-Actuated Photo Trip

■ I built the sound-actuated switch for high-speed photography described in "Freeze Motion With Sound" (January, 1965), and am very satisfied with its performance. I saved some money by making a jack for the flash connection out of a ball-point pen refill. Also, I found that the transformer specified was heavier than needed—secondaries of 15 ma. and 600 ma. at 125 and 6.3 volts respectively work quite well. Incidentally, if you hook a selenium photocell in place of the microphone, the unit will work quite well as a slave unit. In addition, with a high output silicon cell and a concentrated beam of light, photos can be taken of objects as they pass through the beam. I cut a slot on one side to fasten the flash unit to the box, and mounted a

¼-20 nut on the inside to fasten the box to a tripod. (The item on top of the flash in the photo is an *f*-stop calculator from a b-c flash gun.)

DAVID P. TALICH
Corvallis, Ore.

Thank you for the letter and photo, Dave. Your ideas on constructing and extending the usefulness of the sound-actuated trip unit are very good, and should be of interest to other readers.

The Canadian Tariff Barrier

■ Concerning the letters on the high cost of electronic parts in Canada ("Letters from Our Readers,"

Letters

(*Continued from page 8*)

March and May, 1965), many of us have felt that the imposition of duty on imported items where there was essentially no local industry requiring protection could not be justified. Only last year I, as Canadian legal counsel to the American Radio Relay League, submitted a brief to this effect to the Canadian Tariff Board. At this date no action has been taken, and our Canadian Division of the A.R.R.L. is presently preparing another brief . . . A considerable amount of work is presently being done toward obtaining abatement of the very high import duties presently being assessed, and we hope that in the foreseeable future this inequitable situation may be remedied or alleviated.

A. K. MEEN, VE3RX
Toronto, Ontario, Canada

"Big TC" Takes First Place

■ Thanks to "Big TC," I've just won my school and district science fairs with the title of "First Place." I made a few improvisations, such as using a 10,000-volt transformer instead of a 15,000-volter, a cardboard tube instead of a plastic one, two capacitors, a

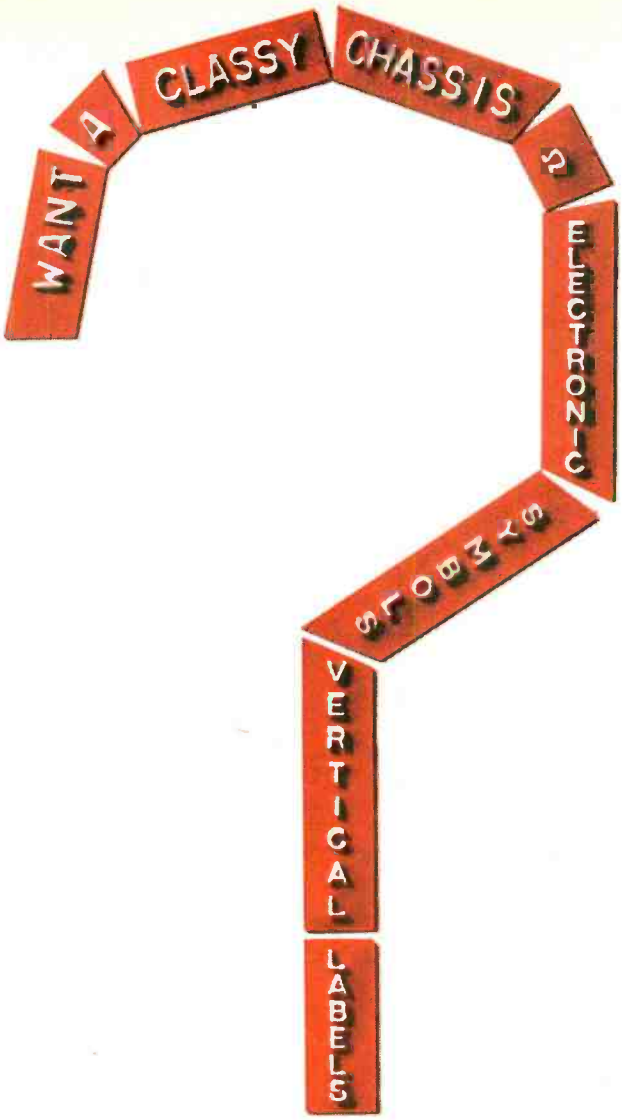
12-inch primary with 15 turns, and aluminum foil instead of tin. The cost of the project was only $3 because I had most of the parts. I am 12 years old and in the seventh grade. I intend to be an electrical engineer.

ALBERT J. SANOWSKIS
Chicago, Ill.

Congratulations on the awards, Albert. You may have made some improvisations, but, from the picture, your version of "Big TC" looks very fine indeed.

Air Traffic Eavesdropping

■ As a pilot, I feel there's one statement in "Tune In On Air Traffic" (September, 1964) which should be corrected. The article says that "When a pilot asks for an altimeter reading, he means that he wants the barometric pressure at the airport so he can set his altimeter for that pressure." This is not true! When a pilot asks for an altimeter reading, he wants just that. The altimeter reading is the barometric pressure at the airport—*adjusted to sea level.* For example: If the barometric pressure is 24.95 and the elevation of the airport is 5000 feet, then 5 inches would be added (1 inch per 1000 feet) to arrive at the altimeter reading—which would be 29.95. This reading is given to the pilot. Prior to take-off from that airport, a pilot on the ground would set the altitude reading on his



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Letters

(*Continued from page* 10)

altimeter to read 5000 feet, or the field elevation. He can then check his altimeter for error by comparing the altimeter reading on his instrument with the one given him by the control tower. If the author flies using *his* system, I suggest he stay near the coast; otherwise, he's likely to wind up against a mountain.

DON E. WILLIAMSON
Pasadena, Texas

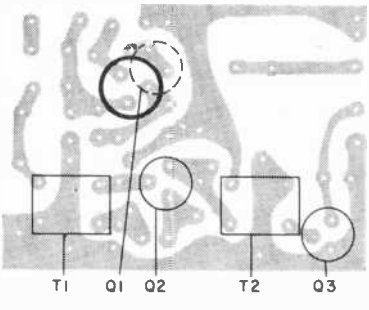
SSB "Flat-Topping"

■ Herb Brier's column on sideband operation and the need for a scope to do a good job ("Across the Ham Bands," March, 1965) was much appreciated. I have found that there is an easily-administered cure for one particular type of "flat-topping" which is due to operator error. There are many cases in which the SSB rig is tuned up according to the book—with the carrier inserted, of course. Then, the carrier is nulled out. When tuning up with the carrier inserted, the relative power meter shows a maximum output of, say, 8. Yet, SSB peaks on the same meter only hit about 4, so . . . up goes the audio until the needle hits 8, 9, or 10. Of course, the resulting signal looks like AM to those of us who have a scope, and has passed the intelligible point way back there. The meter reads low because it has internal damping and can't hope to keep up with the SSB bursts of energy. If anyone is in doubt about this, let him try his meter against the scope. Funny thing, but the best point for the audio setting is usually just about where the transmitter manufacturer said it should be.

WILLIAM B. MADDOCK, WAØAIZ
St. Louis, Mo.

Out of Tune

Miniature R/Ceiver (*April,* 1965, *page* 41). Transistor *Q1* should fit into the three openings within the heavy circle shown below, and not the dashed circle.



Paragon 144 (*April,* 1965, *page* 56). To center the transformer, change the third dimension at the top of Fig. 1 to 1¼" instead of 2¼". Current readings in the chart on page 91 are correct when measured with an EMICO 0-5 d.c. milliammeter. Other meters with a different internal resistance will read differently.

IF THE RCA MARK VIII C-B TRANSCEIVER IS SO GREAT AT $114.95*...

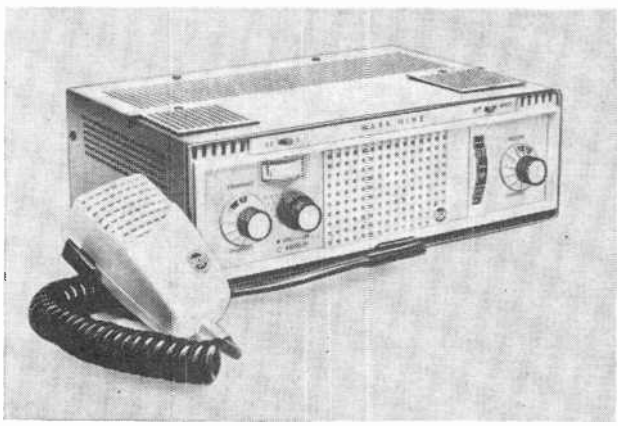
- 9 crystal-controlled transmit and receive channels
- Tunable receiver for reception of 23 C-B channels; dial marked in both channel numbers and frequency
- Exceptionally good voice reproduction
- Highly selective superheterodyne receiver with one rf and two if amplifier stages
- Electronic switching—no relay noise or chatter
- Illuminated "working channel" feature
- Light and compact—only 3½ inches high, weighs only 8 pounds with mike; fits easily under the dashboard of even a compact car
- Improved Automatic Noise Limiter to reduce effects of ignition and similar interference

...HOW COME THE NEW MARK NINE IS WORTH $20.00* MORE?

It has all the Mark VIII features— PLUS these additional features...

- Combination "S" Meter and Relative RF Output Meter. "S" Meter indicates the relative strength of incoming signal in "S" units. RF Output Meter (EO) indicates relative strength of the signal being transmitted.
- Spotting Switch. Permits precise manual tuning of receiver without use of receiver crystals. Receiver can be tuned (or "spotted") quickly to any incoming channel for which you have a transmit crystal. This means, when you buy crystals for extra channels, you can (if you wish) omit the RECEIVE crystals and buy only TRANSMIT crystals. This feature alone pays the price difference if you use a number of channels.
- External Speaker Jack. Lets you connect an external speaker to the set, so incoming calls can be heard in remote locations.

*Optional distributor resale price.



GET THE FACTS. Write for free descriptive folder on either the Mark VIII or Mark Nine to: Commercial Engineering, Department F133R, RCA Electronic Components and Devices, Harrison, N.J.

Available Through Your Authorized RCA C-B Radio Distributor

The Most Trusted Name in Electronics

CIRCLE NO. 26 ON READER SERVICE PAGE

Use it... mobile... base... or portable!

MESSENGER III

Cape Horn to Fairbanks, Alaska

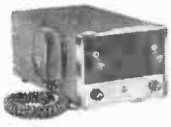
"Messenger III" goes all the way on Mercury Comet 16,200 mile durability run! Comet drivers report: Over 40 continuous days and nights, through rain, fog, sleet and snow . . . on washboard roads, some scarcely more than a trail . . . in tropic heat and frigid Arctic weather—the "Messenger III" never let them down!

For unmatched quality and dependability – GO JOHNSON!

The most popular CB transceiver in the world—the "Messenger III" offers everything you ever wanted in a CB transceiver . . . compact size, a husky signal, extreme sensitivity, razor-sharp selectivity—and complete flexibility for base station, mobile, public address, or battery powered portable use! Double conversion receiver—set-and-forget "Volume" and "Squelch" controls—11 channel coverage—"Tone Alert" Selective Calling System available as accessory.

E. F. JOHNSON COMPANY
2426 10th Ave. S.W. • Waseca, Minnesota 56093

WRITE TODAY for full color brochure, or see your Dealer/Distributor and ask for a demonstration!



MESSENGER TWO
Ten channels and tuneable receiver. Excellent receiver sensitivity and selectivity. Plenty of features. Delivers a penetrating signal with solid punch!

PERSONAL MESSENGERS
100 Milliwatt and 1½ Watt hand-held units. Twice the sensitivity and 40% more range than similar units with conventional circuitry!

MESSENGER
To date—one of the biggest sellers in the Citizens Band field! 5 channels—long on performance, short on cost.

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VOID AFTER JULY 31, 1965 6

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The United States of America

NUMBER P1-20-6490

FEDERAL COMMUNICATIONS COMMISSION

RADIO TELEPHONE OPERATOR LICENSE

FIRST CLASS

(General Radiotelephone Certificate)

This certifies that TOMMY WILLIS DUFFY

IS A LICENSED RADIO OPERATOR, AUTHORIZED, SUBJECT TO ANY SPECIAL ENDORSEMENT PLACED HEREON, TO OPERATE THE CLASSES OF LICENSED RADIO STATIONS FOR WHICH THIS CLASS OF LICENSE IS VALID UNDER THE ORDERS, RULES AND REGULATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION, ANY STATUTE OF THE UNITED STATES AND ANY TREATY TO WHICH THE UNITED STATES IS A PARTY.

THIS LICENSE IS GRANTED UNDER THE AUTHORITY OF THE COMMUNICATIONS ACT OF 1934 AS AMENDED AND THE TERMS AND CONDITIONS THEREOF AND OF ALL LEGISLATIVE ACTS, EXECUTIVE ORDERS, AND TREATIES TO WHICH THE UNITED STATES IS SIGNATORY, AND ALL ORDERS, RULES AND REGULATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION, WHICH ARE BINDING UPON RADIO OPERATORS, ARE MADE A PART HEREOF AS THOUGH SPECIFICALLY SET OUT IN FULL HEREIN.

NEITHER THIS LICENSE NOR THE RIGHTS CERTIFIED TO HEREIN SHALL BE ASSIGNED OR OTHERWISE TRANSFERRED TO ANY OTHER PERSON.

PLACE AND DATE OF ISSUANCE BUFFALO, NEW YORK SEPTEMBER 11, 1963

DATE AND TIME OF EXPIRATION SEPTEMBER 11, 1968 AT THREE O'CLOCK A. M., EASTERN STANDARD TIME.

SPECIAL ENDORSEMENTS

SHIP RADAR ENDORSEMENT - SEPTEMBER 11, 1963 - BUFFALO, NEW YORK

ISSUING OFFICER

Federal Communications Commission.

Tommy Willis Duffy (Licensee)

(Witnessing Officer)

Ben F. Waple (Secretary)

NOT VALID UNTIL SIGNED

SPECIMEN

Employers are paying good money for men holding FCC tickets. Read how to get yours:

When you hold a Commercial License issued by the FCC (Federal Communications Commission) you have written proof that you know and understand basic electronic theory and fundamentals. It's worth plenty . . . particularly to companies on the lookout for qualified electronics technicians. Here's how one of the country's leading office machine manufacturers rates men with FCC Licenses:

> "An FCC License is an asset to any man looking to enhance his career in the field of electronics. At our Company, a licensed man is well-rewarded because an FCC License attests to his knowledge of electronics theory . . ."

Thousands of employers will tell you the same thing. Licensed men get the good jobs. They make more money . . . move ahead faster . . . enjoy exciting, challenging work. What's more, they're needed badly in every field of electronics. Industrial electronics. Radio-TV Broadcasting. Aerospace. Electronics Servicing . . . including mobile and marine radio *plus* CB.

Yes . . . your opportunities are unlimited once you're carrying that FCC Commercial Ticket. AND CLEVELAND INSTITUTE OF ELECTRONICS CAN GET ONE FOR *YOU!* On the facing page, read how four ambitious men just like you have cashed in on CIE's sure-fire FCC Licensing Program. Read about CIE's exclusive money-back offer. And then send in the postage paid reply card. CIE will quickly send you complete FREE information. You will soon be on *your* way to a Commercial FCC License and the many rewards that go with it!

These CIE men have good jobs
(they have Commercial FCC Licenses)

Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE. "I give Cleveland Institute credit for my First Class Commercial FCC License. Even though I had only 6 weeks of high school algebra, CIE's AUTO-PROGRAMMING teaching method makes electronics theory and fundamentals easy. After completing the CIE course, I took and passed the 1st Class Exam. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises!"

Ted Barger, Electronic Technician, Smith Electronics Co. "I've been interested in electronics ever since I started operating my own Ham rig (K8ANF). But now I've turned a hobby into a real interesting career. Cleveland Institute of Electronics prepared me for my Commercial FCC License exam . . . and I passed it on the first try. I'm now designing, building and testing all kinds of electronic equipment . . . do a lot of traveling, too. It's a great job . . . and thanks to CIE and my FCC License, I'm on my way up."

Chuck Hawkins, Chief Radio Technician, Division 12, Ohio Dept. of Highways. "Cleveland Institute Training enabled me to pass *both* the 2nd and 1st Class License Exams on my *first* attempt . . . even though I'd had no other electronics training. (Many of the others who took the exam with me were trying to pass for the eighth or ninth time!) I'm now in charge of Division Communications and we service 119 mobile units and six base stations. It's an interesting, challenging and extremely rewarding job. And incidentally, I got it through CIE's Job Placement Service . . . a free lifetime service for CIE graduates."

Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company (subsidiary of Mid-Continent Telephone Company). "There's no doubt about it. I owe my 2nd Class FCC License to Cleveland Institute. Their FCC License Program really teaches you theory and fundamentals and is particularly strong on transistors, mobile radio, troubleshooting and math. Do I use this knowledge? You bet. We're installing more sophisticated electronic gear all the time and what I learned from CIE sure helps. Our Company has 10 other men enrolled with CIE and take my word for it, it's going to help every one of them just like it helped me."

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A CIE FCC License Course will quickly prepare you for a Commercial FCC License. If you don't pass the FCC exam . . . on the first try . . . after completing your course, CIE will refund all your tuition. You get an FCC License . . . or your money back!

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And that's why CIE can back their courses with the warranty you see at the left. CIE-trained men know their stuff . . . because CIE AUTO-PROGRAMMED Home Study *works!*

Get started now. Send postage-paid reply card for free information about a plan that gets you an FCC License *or costs you nothing!*

CIE **Cleveland Institute of Electronics**

1776 East 17th Street, Dept PE-28, Cleveland, Ohio 44114

Satellites On The Air

The following satellites were in orbit and transmitting as this issue closed. The satellites are listed by frequency and by code name. Some satellites are mentioned several times since different frequencies are sometimes used for tracking and telemetry.

Echo 2	136.020 mc.
Telstar 2	136.050 mc.
Alouette**	136.077 mc.
Explorer 23**	136.080 mc.
Explorer 24	136.080 mc.
Explorer 18	136.111 mc.
Relay 1**	136.140 mc.
Relay 2	136.142 mc.
Explorer 21	136.145 mc.
Echo 2	136.170 mc.
Explorer 22**	136.171 mc.
OGO 1**	136.200 mc.
Tiros 8	136.231 mc.
Tiros 9**	136.231 mc.
Tiros 7	136.233 mc.
Explorer 26	136.275 mc.
Explorer 25	136.292 mc.
GGSE	136.319 mc.
Explorer 20**	136.350 mc.
Pegasus 1**	136.410 mc.
Syncom 2**	136.468 mc.
Syncom 3**	136.470 mc.
Nimbus 1	136.499 mc.
Ariel 2	136.558 mc.
1964 83C	136.561 mc.
Alouette**	136.593 mc.
Relay 2**	136.620 mc.
Relay 1	136.623 mc.
1963 38C (USA)	136.651 mc.
Explorer 20**	136.680 mc.
Explorer 24	136.710 mc.
OSO 2	136.712 mc.
San Marco	136.738 mc.
1964 40C (USA)	136.771 mc.
EGRS	136.803 mc.
Solar Radiation	136.886 mc.
Pegasus 1	136.890 mc.
Tiros 7	136.922 mc.
Tiros 8	136.923 mc.
Syncom 2**	136.980 mc.

**Transmits only upon ground command

This listing does not include all of the satellites in orbit—many of which no longer are transmitting, or transmit erratic, very weak signals. Satellites of the Soviet Union generally use tracking and telemetry frequencies in the band between 19.990 and 20.010 mc. Exact frequencies of some Soviet satellites are broadcast by Radio Moscow immediately after launching. In orbit, but apparently not transmitting are Cosmos 41, 42, 43, 44, 49, 51, 53, 54, 55, 56, 58, 59, 60, 61, 62, 63.

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 promptly upon receipt. 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
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 _____
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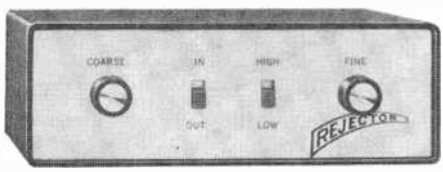
Sorry—No charges or C.O.D. orders! PE-65

New Products

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

TUNABLE NOTCH FILTER

Want to improve the reception on your receiver or transceiver? Who doesn't? According to *Galaxy Electronics,* you can do it by installing their "Rejector"—a tunable notch filter—between the receiver audio output and speaker. There are no r.f. connections, and the "Rejector" can be used with any intermediate frequency. Incorporating seven transistors, the unit is tunable from 300 to 5000 cycles; it will suppress heterodynes, QRM, ignition noise, and other irritating interferences by over 40 db.



Circle No. 75 on Reader Service Page 15

PHOTOELECTRIC KIT

Instructions for the construction of 19 separate light-actuated circuits come with the photoelectric kit now available from *Edmund Scientific Co.* The kit includes three T-4 CdS photoconductors, measuring ½" in diameter by ½" long; a mounting bracket; a Sigma a.c.-d.c. relay (rated at 2 amperes resistive load); and a 22,000-ohm, 1-watt resistor. Featured in the accompanying 52-page booklet are plans for building annunciators, volume controls, light meters, tachometers, counters, and other devices.

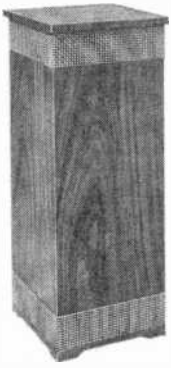
Circle No. 76 on Reader Service Page 15

PORTABLE STEREO PHONOGRAPH

A stereo phonograph that can be played anywhere! *Sony Corporation* is now marketing a "cordless" portable phonograph in the United States that will operate on six "D" flashlight cells, regular a.c. power, rechargeable batteries, or 12-volt car/boat batteries. Measuring 15½" x 7¾" x 15½", the HP-17 is a solid-state stereo unit with a built-in transistor amplifier and automatic record changer, plus two side-resonant speakers that fit inside the cover. The four-speed intermix record changer is accompanied by a specially designed tone arm which allows easy selection of the desired record band.

Circle No. 77 on Reader Service Page 15

MULTIDIMENSIONAL SPEAKER SYSTEM



Neither room placement nor seating is a critical factor so far as the "Criterion XL-360" speaker system is concerned —it offers 360° sound dispersion over its entire range. Introduced by *Lafayette Radio Electronics,* the "Criterion XL-360" boasts five speakers. Four dual-cone 6" x 3" speakers in the top section reproduce from 3000 to 20,000 cycles. The high-compliance 8" woofer, placed face down in the lower section, handles 32-3000 cycles. Sound is dispersed by a sound diffuser beneath the woofer through ports in all four sides of the cabinet. The unit's power-handling capacity is 20 watts; impedance is 8 ohms.

Circle No. 78 on Reader Service Page 15

FM MULTIPLEX SIGNAL GENERATOR

EICO Electronic Instrument Co., Inc., has introduced the Model 342 signal generator for servicing, testing, and demonstrating FM multiplex stereo tuners and receivers. The 342 provides a controlled-amplitude composite audio signal for direct injection beyond the detector into the multiplex section of a tuner or receiver, plus a 100% modulated (± 75 kc.) FM radio carrier—modulated by the built-in composite audio signal—which can be fed to the antenna terminals of the tuner or receiver. The frequency of the r.f. carrier is adjustable and is ordinarily set at about 100 mc.

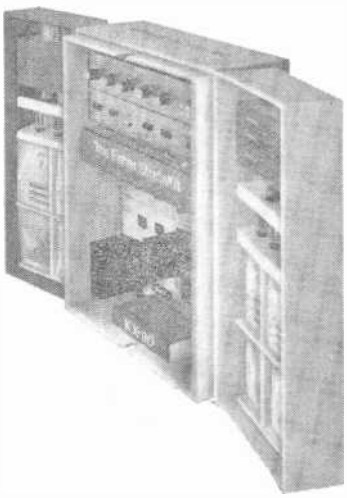
Circle No. 79 on Reader Service Page 15

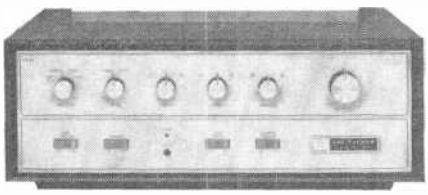
EFFECTIVE AIR PURIFIER

Do you work in a smoke-filled room? The "Executive" air purifier just made available by the *Puritron Corporation* will clear it up for you. Two tiny gold ion tubes release a steady, silent stream of negative ions which

Who makes the only great amplifier for $99.50?

You do... with the new Fisher KX-90 StrataKit.





Now, for the first time in high fidelity history, you can own a truly distinguished stereo control-amplifier for less than $100—if you are willing to build it yourself.

Fisher refuses to compromise quality. Therefore, even at $99.50*, the Fisher KX-90 StrataKit incorporates the same basic standard of fidelity as the most expensive Fisher components. Take away its price tag and it would still excite the admiration of the fastidious audiophile.

With 40 watts of clean power, the KX-90 can drive even inefficient speakers to their maximum performance level. Superior output transformers make certain this power will not fall off steeply at the frequency extremes. Advanced preamplifier features, including rocker switches and complete phono/tape facilities, provide unlimited flexibility.

It's all yours if you follow directions. And that's no problem with the exclusive Fisher StrataKit method. No experience is necessary. Assembly takes place by simple, *errorproof* 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). Major parts 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.

The end result is a Fisher stereo control-amplifier that is fully equal in performance as well as reliability to its factory-wired prototype. Fisher guarantees this. And who should know better than Fisher?

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

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

Name_____

Address_____

City_____

State_____

106

*WALNUT CABINET, $24.95

OVERSEAS RESIDENTS PLEASE WRITE TO FISHER RADIO INTERNATIONAL, INC . LONG ISLAND CITY, N. Y. 11101. CANADIAN RESIDENTS WRITE TO TRI-TEL ASSOCIATES, LTD., WILLOWDALE, ONT.

The Fisher

CIRCLE NO. 11 ON READER SERVICE PAGE

New Products

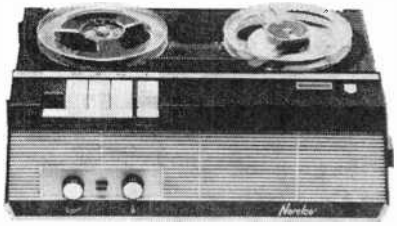
(*Continued from page 22*)

attack dust particles, smoke, and musty air —and purify the air quickly and effectively. Measuring 9½" x 6¼" x 3", the "Executive" has walnut-grained paneling with silver trim. It operates in three positions: standing up, lying flat on a desk, or hanging on a wall.

Circle No. 80 on Reader Service Page 15

MODERATE-PRICED TAPE RECORDER

Precision engineering, simplicity of operation, ruggedness, and *moderate price* are claimed for *Norelco's* new "Continental 95" tape recorder. The 12-pound unit has a frequency response of 80 to 12,000 cycles, and is equipped with an automatic record control that electronically adjusts the recording level to insure perfect tapes. Operating at 3¾ ips, the "Continental 95" provides up to three hours of playing time.



Circle No. 81 on Reader Service Page 15

D.C.-TO-A.C. INVERTER

Applications galore. The principle application of *ATR Electronics'* "Golden Line" Model 12T-RME-1 inverter is to operate most popular-brand 11" to 13" portable TV sets in automobiles, boats, mobile homes, buses, trucks, trains, planes, and what have you. But it is also said to be ideal for powering drink mixers, blenders, small power tools, soldering irons, small tape recorders, and many other small electronic and electrical devices. The Model 12T-RME-1 operates from 12 volts d.c., and delivers 110 volts a.c., 60 cycles, at 140 watts maximum. Output is "frequency-stable" and automatically controlled.

Circle No. 82 on Reader Service Page 15

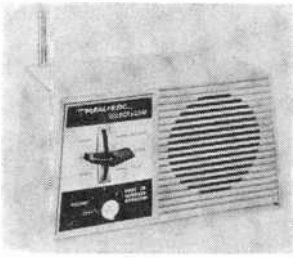
REMOTE-CONTROL LAWN MOWER

Are you the one who mows the lawn at your house? With the *Bunton* electronic "Lawn Lark," you can relax in your favorite lawn chair and send radio signals to start, stop, and turn the mower. You push a control key forward, and the mower goes forward. You turn the mower right or left with another control key. Releasing the control keys disengages the wheels and applies the brakes, bringing the unit to an instant stop. The "Lawn Lark" can also be operated the standard way, with an instantly attachable riding sulky. A leaf mulcher attachment comes with the unit as standard equipment, and a snow plow is available as an optional extra—come next winter.

Circle No. 83 on Reader Service Page 15

INTERCOM/TRANSCEIVER

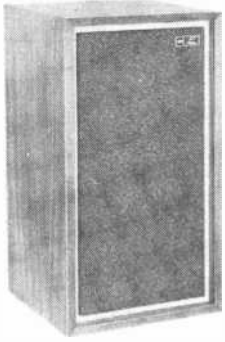
Called the world's first Citizens Band intercom, the "SELECTaCOM" is a desk-top device that serves both as a wireless intercom and a CB transceiver. Users of the 100-mw. "SELECTaCOM," which is being marketed by *Radio Shack Corporation* under its "Realistic" brand name, do not have to be on the same a.c. electrical circuit to communicate—the unit transmits and receives with crystal-controlled stability on CB channel 5. It can be incorporated into an intercom "net" with any number of similar units, and will receive channel 5 signals from mobile or walkie-talkie CB sets. No user's license is required. However, licensed increased-range operation is possible simply by switching to 3 watts and using an external ground plane antenna.



Circle No. 84 on Reader Service Page 15

"CROSSOVER-LESS" SPEAKER SYSTEM

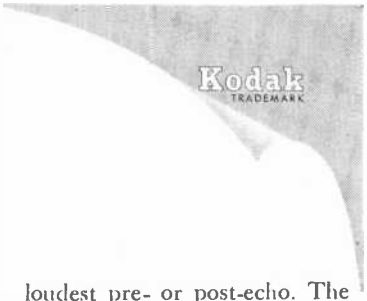
Conventional crossover networks have been eliminated in *Audio Dynamics'* Model 303A "Brentwood." This bookshelf speaker system is said to offer full-range performance without the resonance, phase shift, and distortion produced by electronic crossover networks in multiple-speaker systems. In the 303A, a single 8" driver functions as two separate speakers through a principle called "frequency discriminating decoupling"; different portions of the cone are made to handle different frequencies separately, providing woofer and mid-range performance from 35 to 6000 cycles. A Mylar-domed tweeter reproduces frequencies from 6000 cycles to the upper limits of audibility and beyond.



Circle No. 85 on Reader Service Page 15

Some plain talk from Kodak about tape:

Print-through and sound brilliance

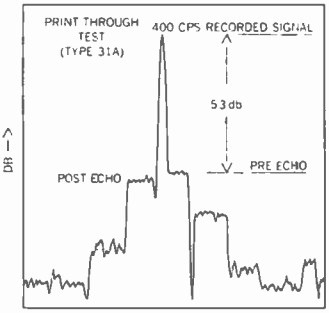


Put a magnet near a piece of iron and the iron will in turn become magnetized. That's print-through. With sound recording tape, it's simply the transfer of magnetism radiating from the recorded signal to adjacent layers on the wound roll. Print-through shows up on playback as a series of pre- and post-echoes.

All agreed. Print-through is a problem. There are some steps you can take to minimize it. You can control the environment in which you keep your tapes, for example. Store them at moderate temperatures and at no more than 50% relative humidity. Also store them "tails out" and periodically take them out for "exercising" by winding and rewinding them. You can even interleave the layers with a non-magnetic material. Any volunteers? A better way is to start with a tape that doesn't print much . . . which leads to low output problems *if* you don't make the oxide coating substantially more efficient.

And this is Kodak's solution. It's not simple, but it works. It starts with the selection of the iron oxide. In order to achieve low print-through, the oxide needles must have the proper crystalline structure. Kodak's oxide needles have that structure . . . offering the highest potential of any oxide currently available.

Milling the oxide ingredients also is very critical. If you mill for too long a time, the needles will be broken up and print-through will be drastically increased. Too short, and the dispersion will be lumpy. But other factors in the milling process are equally important. Like the speed at which the ball mill turns. It can't be rotated too fast, otherwise the needles will be broken up, and broken needles, you know, exhibit horrible print-through behavior. If you rotate the mill too slowly, the oxide and other ingredients will not be blended



uniformly. Other factors such as temperature and the composition and viscosity of the ingredients must also be critically controlled. One more thing. You've got to make sure all the needles end up the same size (.1 x .8 microns).

A very important contributor to low print-through is the binder that holds the oxide particles in suspension. The *chemical composition* of a binder contributes nothing magnetically to a tape's print-through ratio. What a binder *should* do is completely coat each individual oxide needle, thus preventing the particles from making electrical contact. And that is just what our "R-type" binder does. The final step is to take this superb brew and coat it just the right way on the base.

Print-through tests are a million laughs. We record a series of tone bursts . . . saturation, of course. We then cook the tape for 4 hours at 65°C. and then measure the amplitude of the loudest pre- or post-echo. The spread between the basic signal and the print-through is called the signal-to-print-through ratio. The higher the number, the better the results. Most of the general-purpose tapes you'll find have a ratio of 46-50 db. Low-print tapes average about 52 db. You can see from the graph that our general-purpose tape tests out at 53 db., so it functions as both a general-purpose tape and a low-print tape—and at no extra cost. High-output tapes with their thicker coatings have pretty awful print-through ratios—generally below 46 db. Kodak's high-output tape (Type 34A) has something special here, too. A ratio of 49 db—equal to most general-purpose tapes.

KODAK Sound Recording Tapes are available at electronic, camera, and department stores.

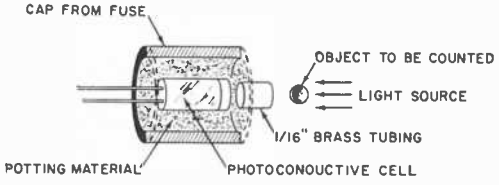
FREE! New comprehensive booklet covers the entire field of tape performance. Entitled "Some Plain Talk from Kodak about Sound Recording Tape," it's free when you write Department 8, Eastman Kodak Company, Rochester, N.Y. 14650.

EASTMAN KODAK COMPANY, Rochester, N. Y.

Tips and Techniques

MASK FOR PHOTOCELL PERMITS COUNTING OF SMALL OBJECTS

A photocell can be adapted to count very small objects simply by masking it. Drill a small hole in the metal end of a 3AG



fuse and solder a short section of 1/16" brass tubing to it, as shown in the illustration. Place the photocell inside the newly-made mask and fill the mask with silicone rubber or epoxy cement. A fuse end can be obtained by breaking the glass of an old fuse and scraping out the cement from the metal cap; you can remove any fuse material attached to the cap with a soldering iron. —*Wm. B. Rasmussen*

PIPE BOWL SHIELD MAKES A COOL COVER

You can get rid of unsightly holes in a chassis with pipe bowl covers. They snap on quickly, dress up as well as hide openings, and even allow for ventilation. These covers cost but a few pennies, and are available at any tobacco shop.

—*Henry R. Rosenblatt*

XYL'S HAIR SPRAY IS HANDY COIL-WINDING AID

Next time you plan to make a homemade coil, borrow a can of hair spray from the XYL, and put a coat on the coil form be-

short, short story
about a great new mobile cb antenna:

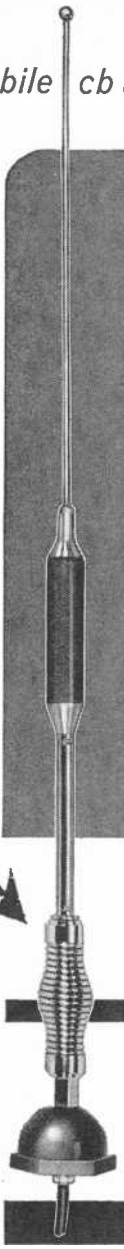
Capacity-matched to car body for excellent, low VSWR.

Fine-tuning adjustment

brand new loading techniques for more effective center loading

rugged, professional-type 2½" stainless steel shock spring

the beauty of this baby is its 18" length!



At last—a high-performance mobile CB antenna you can mount on your roof where it belongs, without making your car look like a space satellite!

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"Mighty Mite"
⅜" snap-in mount—
no soldering

M-131
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Gutter clip mount—
hang it anywhere

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"stripes of quality" ®

CIRCLE NO. 1 ON READER SERVICE PAGE

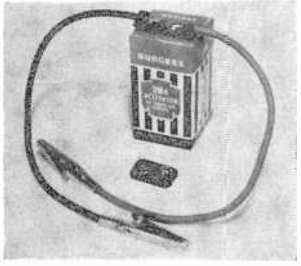
Tips

(*Continued from page* 26)

fore you start winding. When you've finished the winding process, spray the coil itself. You'll find that the hair spray will make a good coating. If the XYL wants to borrow your shellac for her hair . . . turn about is fair play. —*Howard Robinson*

SNAP LEADS FOR WORKBENCH POWER SUPPLY

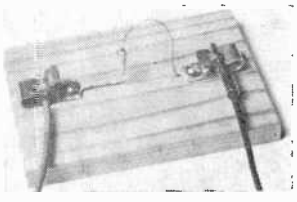
A standard transistor battery can be used as a power supply for experimental projects as well as for equipment tests on the workbench by attaching a pair of snap leads to the battery and the equipment. To make your own connector leads, salvage the terminals from a discarded type 2N6 battery or equivalent, or get a pair from your dealer. If the terminals are mounted on a terminal strip, cut the strip in half to enable them to fit on any size battery using this type of terminal. Connect the terminals to two wires, preferably one red and one black to indicate polarity. The wires should be flexible and durable. Finally, connect an insulated alligator clip to the other end of each wire.



—*Luis Vicens*

CATWHISKER DETECTOR ECHOES YESTERYEAR

For a nostalgic return to the pioneering days of radio, try your hand at making a catwhisker crystal detector. Carefully break the glass of either a new or discarded 1N34A germanium diode and keep the cathode end containing the little wafer of germanium. Solder the lead to a Fahnestock clip and screw the clip to a small wood base. When soldering the crystal, grip the lead with a pair of pliers (which acts as a heat sink). Also solder a 2" length of thin, stiff wire to another Fahnestock clip and fasten



(*Continued on page* 86)

Who Pays $30 Or More For Portable Radios These Days?

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Ⓑ

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Why? Pride! And a desire for better quality! Not just the pride of owning something new, but a special kind that comes from building it yourself. From watching it grow and take shape. From creating a sophisticated piece of electronics with your own hands.

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• Powerful 10-transistor, 2-diode circuit for instant operation, long trouble-free performance • Large 4" x 6" oval PM speaker for clear, bold sound • Automatic frequency control for drift-free reception • Treble-cut tone control for finer tone • Vernier tuning for accurate station selection • 34" telescopic antenna—headphone jack for private listening • Attractive simulated tan leather case with beige grille • Fast circuit board construction • Operates on 9 v. battery (model GRA-131-1 . . . $1.10) Kit GR-61, 6 lbs.

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CIRCLE NO. 40 ON READER SERVICE PAGE

POP'tronics Bookshelf

RADIO REGISTRY—Public Safety Radio Systems

If you are interested in the calls, locations, frequencies, etc., of all police and fire stations, this is your last opportunity to get a "Master Listing." Rather than update the police and fire listings, the Radio Registries will henceforth publish summaries of FCC actions every three months. These summaries will contain information on all new licenses issued in the preceding quarter year. They will cost $18 per year. However, for the summaries to be of value, you must have a Master Listing which catalogs all licenses issued prior to January, 1965.

Published by Communications Engineering, P. O. Box 629, Mineola, L.I., N.Y. Soft cover. 282 pages. $8.00.

TECHNICAL REPORT WRITING

by Rufus P. Turner

Here's a book that most magazine editors feel should be force-fed to any and all who aspire to be free-lance authors. Belatedly, good report writing is just being recognized by hundreds of high school and college administrators. Many people think that technical writing means writing to Government "specs." Actually, it doesn't; it means organizing material in a report, article, book, etc., so that it can be understood and appreciated by the readers. Mr. Turner has produced a very worthwhile book that we earnestly hope students and would-be authors will take the time to read.

Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017. Soft cover. 224 pages. $3.50.

(*Continued on page* 32)

Heathkit®/NELI Solid-State Ignitions

Plenty of get up and go! That's what you want from your auto. And that's what you get with either of these Heathkit/NELI transistor ignition systems. As for "get-up", both systems provide faster, easier starts in all weather.

And no, they won't add more horses to your engine, or get your buggy up to 60 mph. in 8 seconds. But they *will* help you get the maximum from the horses you have. And they will keep you going longer . . . on less gas. They reduce wear and tear, too. Add longer life to spark plugs, engine, and ignition system parts . . . fewer tune-ups!

The model on the left even cleans your points each time you start your car. This same model is *not* a kit. In fact, it takes just 5 minutes to install. And both models are zener protected to prevent damage to the coil from voltage variations.

Compare the two. Then choose the one that best fits your needs and budget.

A New Torque Fire®. . . Only All Silicon Electronic Ignition System! . . . $62.50

• Not a kit . . . takes only 5 minutes to install • Cannot be damaged by improper installation • Easy to transfer from car to car . . . present system is left intact • Operates on 6, 12 or 24 v. DC neg. gnd . . . any car, truck or marine engine with battery ignition system • Fires plugs under all conditions • No temperature limitations, mount on firewall if desired • Built-in test light assures reliability • Guaranteed 50,000 miles or 3 years

Model GDP-95, 3 lbs.

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• 4-transistor, zener diode protected circuit • Operates on 6 or 12 V. DC systems—installs easily on all cars, foreign or domestic • Built-in conversion plug for switching to conventional ignition system, if necessary • Completely sealed against moisture, corrosion, etc. Quick and simple to build & install . . . includes everything, nothing else to buy!

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CIRCLE NO. 40 ON READER SERVICE PAGE

Bookshelf

(*Continued from page* 30)

UNDERSTANDING LASERS AND MASERS

by Stanley Leinwoll

The one subject in electronics that attracts the most attention is no longer the transistor—now it's the laser. POPULAR ELECTRONICS' Contributing Editor Stan Leinwoll has assembled a fast-paced book that tells just what a laser—and a maser—is and how they are related. Theory of operation is discussed in very understandable terms, and the book closes with details on present applications. Glimpses into the future of laser technology are also sprinkled throughout the text.

Published by John F. Rider Publisher, Inc., 116 West 14th St., New York, N.Y. 10011. Soft cover. 96 pages. $1.95.

THE RADIO AMATEUR'S HANDBOOK, 42nd Edition, 1965

by The Headquarters Staff of the ARRL

It's that time of the year when hams and experimenters see the latest edition of the *Handbook* on store counters. Once again the ARRL staff has culled out the weaker projects and substituted up-to-the-minute receivers and transmitters. Many potential buyers have the mistaken impression that every year the *Handbook* is the same. It is, but only so far as concept and certain basic material is concerned. If you have a '63 or '64 edition, take a good look at the '65 issue —you'll be surprised at some of the new goodies the League has produced (e.g., a 5-band receiver, 450-watt c.w. transmitter ending in a 4E27A, etc.).

Published by the American Radio Relay League, Newington, Conn. Soft cover. 700 pages. $4.00 (USA), $4.50 (Canada), $5.50 (elsewhere). Also available in cloth for $6.50 (USA and Canada).

Capsule Reviews

PARAMETRIC AMPLIFIERS, a treatise on the exotic field of amplifiers designed for 1000 mc. and above, has recently been published by 73 Magazine, Inc., Peterborough, N.H. The 72-page paperback edition was authored by Jim Fisk, WA6BSO, and sells for $2.00 . . . An interesting little book with a big title, **"STROBOSCOPES" AND WHAT EVERYONE SHOULD KNOW ABOUT THEM,** has been released by Educational Book Publishing Company, Vincennes, Ind. This 41-page paperback, by Leonard R. Crow, is devoted to the fascinating experiments that can be performed with a stroboscope. Price, $2.85.

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HI-FI AND CB EQUIPMENT Headquarters

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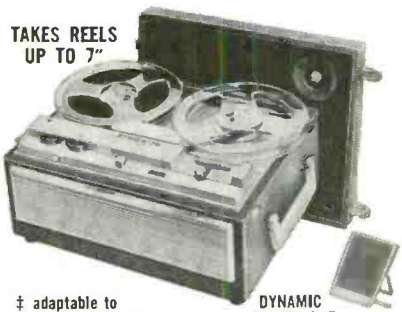
• 12 Crystal Transmit and Receive Positions • 23 Channel Tunable Receiver With Spotting Switch • 3-Stage Transmitter Rated For Full Legal Power • Dual Conversion Receiver with 5/10 μV Sensitivity • Multi-Stage Automatic Noise Limiting Circuit • Rugged Silicon Mesa Transistors • Compact—3"Hx11¾₁₆"Wx6¹⁵⁄₁₆"D • 12V DC Mobile Operation (Negative or Positive ground) • 117V AC operation when used with Matching Solid-State AC Power Supply (Optional at $16.95)



‡ adaptable to stereo playback

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– TRACK MONAURAL RECORD PLAYBACK

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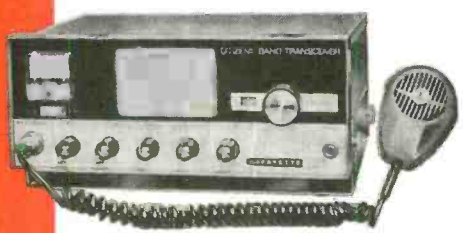

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With Advanced "Range-Boost" Circuit

- 17-Tube Performance with 13 Tubes
- Low Noise Nuvistor "Front End"
- 5 Double-Tuned IF Transformers
- Meets All FCC Requirements

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CIRCLE NO. 19 ON READER SERVICE PAGE

"Since I installed a transistorized ignition system, my VW gas mileage has increased an honest 3 miles per gallon."
Healdsburg, Calif.

"Our truck competes at the local drag strip. We have been able to decrease our elapsed time by 0.3 to 0.4 second—this amounts to a difference of several car lengths."
Port Washington, N.Y.

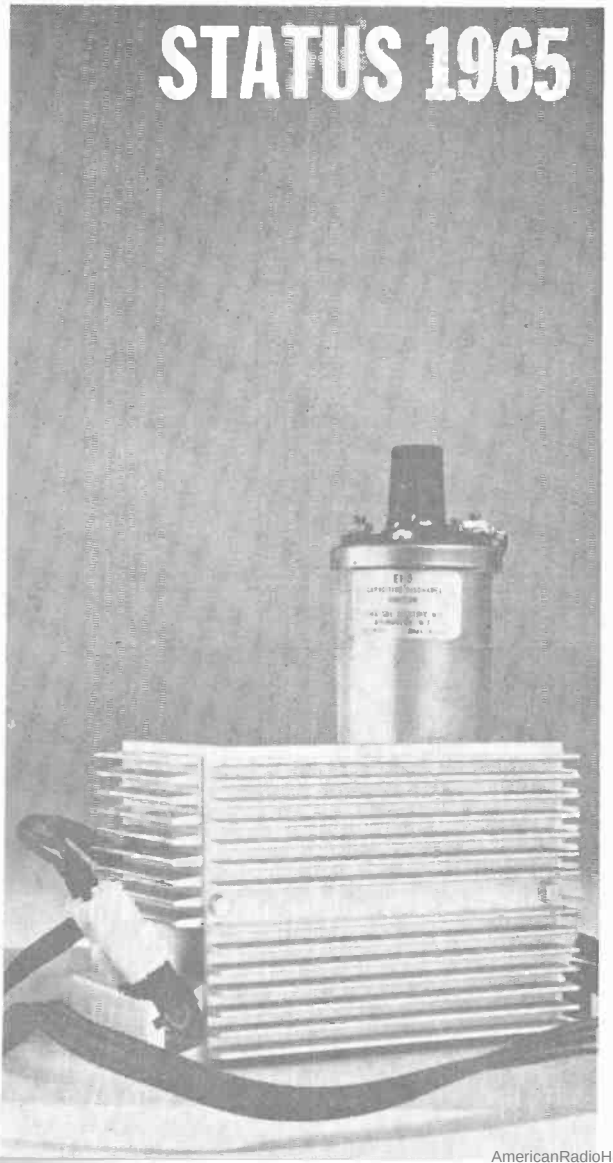
"New points installed on installation of Brand X *system. Points severely pitted when checked at 10,000 miles. No noticeable improvement in performance, fuel mileage or starting."*
Glendale, Calif.

"Possibly better performance above 90 m.p.h. No noticeable improvement in fuel mileage."
Lancaster, Calif.

TRANSISTORIZED IGNITION

STATUS 1965

By LEN BUCKWALTER



TEARING AROUND the track in a souped-up Dodge, Lee Yarbrough broke the record for one lap at Daytona. His speed: a blistering 181.8 m.p.h. His ignition system: transistor. This combination—speed and solid-state electronics—is now some four years old. And like many hot developments in the automotive field, the benefits are filtering down to the family car. The hopeful aim of the industry is to rid some 80 million cars of old-style ignition and tool them up for the transistor.

But as with most big breakthroughs, the initial excitement is being followed by sobering afterthoughts. Many car owners have discovered that transistor ignition cannot revive a sick engine . . . or make an old Hudson rear up, then jack-rabbit down the strip. Nor can the transistor give "life-time tune-up" and forever "eliminate spark plug and points replacement"—as claimed by one starry-eyed producer.

But as transistor ignition emerges from adolescence, it's showing sure signs of maturity. The field is shaking out some attic artists who have offered inferior merchandise, tempering claims and coming up with downright solid improvements. The winner, of course, is the car owner. But as four years have shown, he must shoulder part of the responsibility to net the benefits of transistor ignition.

An Antique. Before looking at those benefits, consider, briefly, conventional ignition. Its simple coil and breaker-point arrangement fills a single purpose:

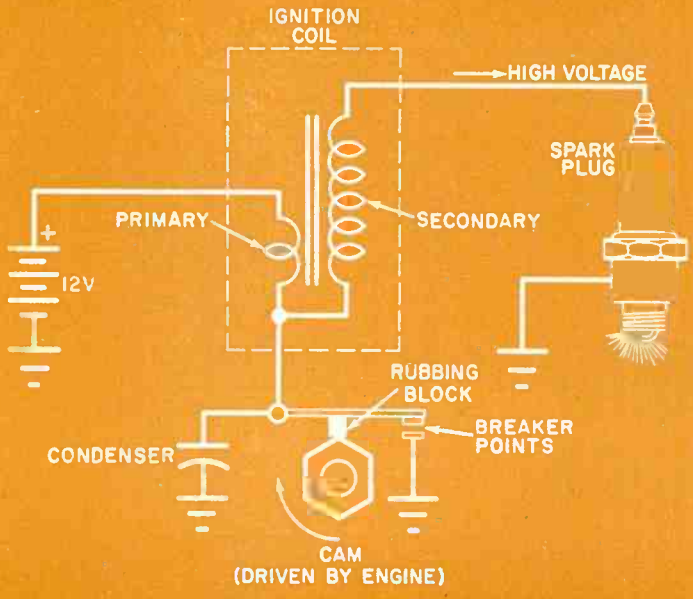


Fig. 1. This is the ignition system used in 98% of the cars on the road. Designed about 50 years ago, it has one advantage —it works! But it also has numerous disadvantages—including loss of peak performance at high speeds, wear of the breaker points, possible failure of the bypass capacitor, etc. Transistorized systems eliminate all of these failings and are gaining more and more acceptance as times goes on.

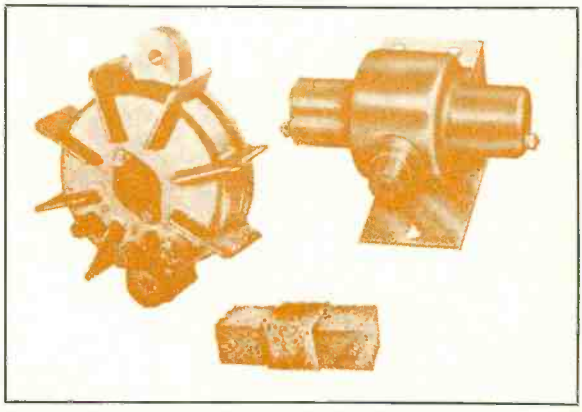
converting battery current into sparks which fire across the plugs and ignite the gas. You can trace the action in Fig. 1. The battery supplies current to the primary winding of the coil. As breaker points open and close, a magnetic field in the primary cuts across the secondary where high voltage appears. With this transformer action, about 10,000 volts rip across the spark-plug terminals.

This system is a half-century-old classic. It's tired. Not so for the rest of the car. Today's engine has a predilection for higher spark voltage, r.p.m., and compression ratios. And the really late models insist on going more thousands of miles between service stops. Taxed beyond design limits, the standard ignition commences to destroy itself soon after installation. The reasons aren't hard to find.

First is the demand for higher voltages —which means higher current through the points. Vintage cars switched about two amperes, but that figure is now double, or more. So the points burn out faster. And a voltage kickback from the coil socks the points with several hundred volts on each opening, despite some protection by the "condenser." The result is pitted, oxidized contacts which need replacement every 5000 to 10,000 miles.

That's only part of the story. As the engine revs up much beyond 2000 r.p.m. (when you travel more than about 35 m.p.h.), the coil can't gulp current fast enough. High voltage sags . . . the engine misfires. The classic ignition system of the gaslight era had to become less mechanical, more electronic.

Adding Solid-State Electronics. Wedding the transistor to the regular ignition system hasn't killed the old idea. It infuses new life. By keeping damaging currents out of the points, the contacts might last 10 times longer. The transistor easily handles high currents. Properly pro-



The sturdily-constructed Leece Neville Model 11EA has been on the market for years. The circuit is similar to the conventional arrangement at right.

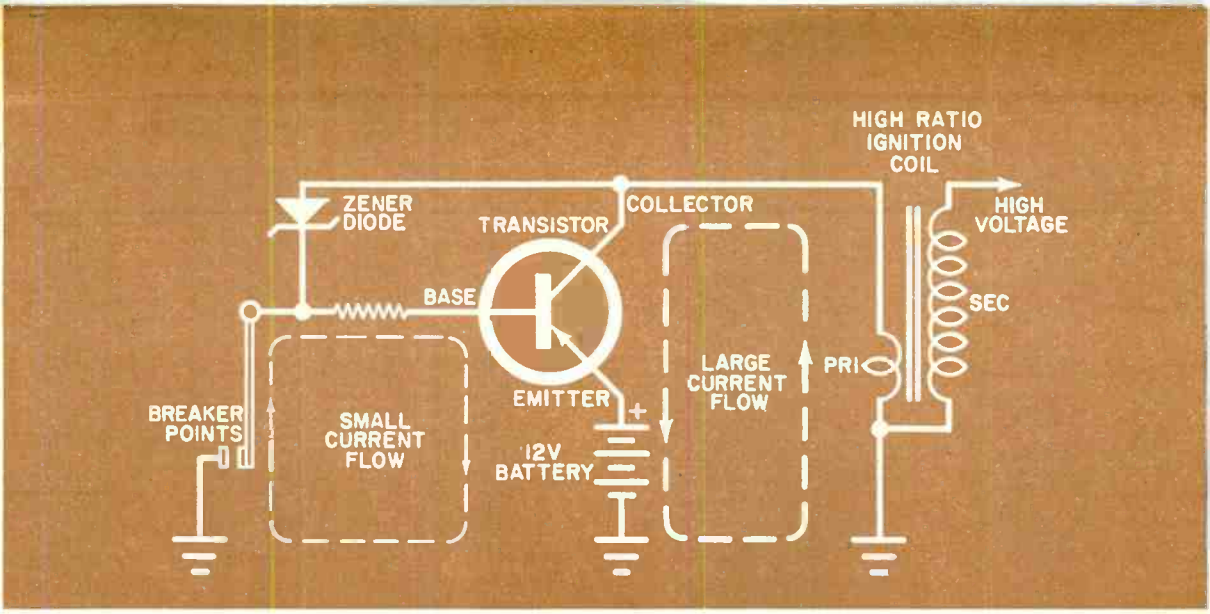


Fig. 2. Breaker points in the usual ignition system must make and break thousands of times per minute. Since the current flow through these points is on the order of five amperes, the points soon wear out. The transistorized system allows the points to carry a very small current, adding thousands of hours to their useful life. A transistor is used as a switch to make or break the current to the ignition coil.

tected, its semiconductor material withstands many amperes and shows no sign of long-term wear. Since the transistor is also a switching amplifier, tiny control signals can trigger those currents.

That control function is the new job of the breaker points, as shown in Fig. 2. Two key current flows are shown in dashed lines. Consider the points circuit. As points close, a small current flows from ground (or negative battery terminal) into the transistor. This "energizes" the transistor base. Collector and emitter respond by pulling heavy current from ground, through the primary winding of the coil, then collector and emitter, back to the positive terminal. A magnetic field is now built up around the primary winding. As points open, current flows cease and the field collapses to generate high voltage.

The significant operation is that the points now chop mere milliamperes. Husky coil current flows only through the transistor. Missing, too, is the searing voltage kickback from coil to points. Kickback does threaten to damage the transistor. This is squelched by the zener diode which short-circuits excessive voltage to ground.

Another feature of the circuit is a special coil with higher-than-normal turns ratio. It performs two functions. For one, it has fewer primary turns, so it soaks up current at faster rates and is able to produce higher voltage at high engine r.p.m. Also, the kickback effect is reduced (due to an additional step-down effect as voltage goes from secondary back to primary).

Benefits. In transistorizing the ignition system, designers have come up with a heady, impressive list of advantages. Some are obvious—like points that remain smooth and clean beyond 25,000

The Howard "Hopco" system is an example of an all-in-one transistor system built around a conventional circuit. It features instant switch changeover.

Transistorized Ignition

MANUFACTURER	MODEL	TYPE[1]	PRICE[2]	REMARKS
Alma Engineering 8135 Engineer Rd. San Diego 11, Calif.	Mark VII	Conventional	20.00	Manufacturer claims 58,00-volt output.
Anderson Engineering Epsom, N. H. 03239	Trans-ition	Conventional (all)	$34.75	Sold with 260:1 coil. A 400:1 coil is optional at $1 extra.
Automotive Electronics Co. 387 Park Ave. So. New York, N.Y. 10016	AEC-77A	Conventional (all)	39.95	Improved version of old favorite. Claimed 50,000-volt output. Company stresses use of tested components.
Autotronics, Inc. 43 Woodland Drive Woodcliff Lake, N.J.	'R' or 'S/S' Series	Conventional (all)	39.95	Fits VW, Porsches, Karmann Ghias especially well. Can be adapted to marine and American car use.
Carlin Manufacturing P. O. Box 309 Warsaw, Ind. 46580	Ti-Tron	Conventional	69.95	Heavy-duty construction for truck fleet use. Six-volt kit is available.
Clinton-Augis Co. 21613 Parthenia St. Canoga Park, Calif.	Omega-tron	Conventional	49.95	Heavy-duty and 6-volt models available at slightly extra cost.
Delco-Remy United Motors Service General Motors Bldg. Detroit, Mich. 48202	U2100	Conventional	62.95	Sold only by GM jobbers and dealers or as original equipment in new cars.
Delta Products P. O. Box 974 Grand Junction, Colo. 81502	Mark 10	Capacitive	49.50	Kit available at $34.95. A 6-volt version is available at $49.50.
Echlin Manufacturing Co. Echlin Rd. Branford, Conn.	Trans-Trigger	Conventional	61.95	Sold with bypass relay and wiring harness to convert back to original system in case of failure.
Electrotone Laboratories, Inc. 128 S. Paulina St. Chicago 12, Ill.	Trigniter	Conventional	49.95	Lower cost systems also available. Three-year service contract $3 extra. Negative ground, 6-12 volts, only.
Excel Elect. Prod. Box 442 Hicksville, N.Y.	X-L Trigger	Conventional	39.75	Uses Bendix Ignistor in place of usual transistor/zener diode.
Holley Carburetor Co. 11955 E. Nine Mile Rd. Warren, Mich.				New unit to be announced.
Howard Precision, Inc. 137 South Ave. Fanwood, N.J.	Hopco	Conventional	49.95	Negative ground, 6-12 volts. Positive-ground system available at extra cost. Switch-return to original system in case of failure.
Hyland Electronics, Ltd. 821 Boyd Ave. Ottawa, Ont., Canada		Capacitive	44.95	Positive-ground system $5 extra.
Judson Research and Mfg. Co. Conshohocken, Pa.	Electronic Magneto	Conventional	49.50	Positive-ground system at same price. For use on either 6 or 12 volts. Draws over 1 ampere through points.
International Rectifier Corp. El Segundo, Calif.	Powertron	Conventional	24.95	
Leece-Neville Co. 1374 E. 51st St. Cleveland, Ohio 44103	11EA	Conventional	59.00	12- or 6-volt negative ground. Coil turns ratio, 250:1.

1. Transistorized systems are identified as one of three basic types. "Conventional" indicates a transistor switching circuit utilizing the existing breaker points in the car. "Pulse" is a special system utilizing a magnetic pickup or light beam interrupter in place of the points. "Capacitive" is a system utilizing a low-turns-ratio ignition coil, but using it as part of a capacitive

Buyer's Guide

MANUFACTURER	MODEL	TYPE[1]	PRICE[2]	REMARKS
Mallory Electric Corp. 12416 Cloverdale Ave. Detroit, Mich. 48204	Photocell-Breakless	Pulse	n.a.[3]	Uses photocell with shutter attached to distributor rotor shaft. Eliminates breaker points.
Melspark 248 Ulysses Simi, Calif. 93065	Super Sport	Conventional	$2.50	Various other lower price models also available. Uses 400:1 coil ratio.
Micro-Kits Box 494 Paramount, Calif. 90724	Fury XII	Capacitive	69.95	Available as a kit for $39.95. Uses original-equipment coil.
Motorola, Inc. 9401 W. Grand Ave. Franklin Park, Ill.	TRI2N	Conventional	49.50	Proven-in-practice original circuit of the "Conventional" breed of transistorized ignition systems.
NELI 1370 Ygnacio Valley Rd. Walnut Creek, Calif.		Capacitive		No other information received at press time.
Network Research & Mfg. Corp. 442 Cedar St. West Hempstead, N.Y. 11552	Spark Injector	n.a.[3]	49.95	Uses original-equipment ignition coil. Manufacturer claims vastly improved car performance at mid-range driving speeds.
W.F. Palmer Electronics Carlisle, Mass.	Transpark	Conventional (all)	27.00	Manufacturer offers a wide variety of systems with different coil ratios at increased prices, also markets a low-cost ($14.95) system.
Prestolite Company P. O. Box 931 Toledo, Ohio 43601	Transigniter 250	Conventional	61.50	Along with higher priced companion unit (Model 201), these systems frequently appear in racing cars. Also installed as optional extras in '65 Studebakers.
Radatron, Inc. 232 Zimmerman St. North Tonawanda, N.Y.		Conventional (all)	59.95	Positive-ground systems are $10 extra. Chrome-plated heat sink. Similar to "Continental" or "Mark IV" offered by same manufacturer.
RPM Distributors, Inc. Boston, Mass.	Jet-Fire	Conventional (all)	29.95	Uses original-equipment ignition coil. Has switch to convert back to original wiring in case of failure. Recommended mounting under dash panel.
Slep Electronics Co. P. O. Box 178, Highway 301 Ellenton, Fla.	Banshee TS-30	Conventional (all)	39.95	Various coil ratios available from manufacturer at slightly increased prices.
Transmite Industries 25039 O'Neil Ave. Hayward, Calif.	Solid State	Capacitive	49.95	Made particularly for motorcycles. Manufacturer offers other systems at comparable price using "Conventional" circuitry.
Tung-Sol Electric Inc. 630 W. Mt. Pleasant Ave. Livingston, N.J.	EI 5	Capacitive	n.a.[3]	Solid-state replacement for their initial vacuum tube capacitive system. Uses special coil containing part of circuitry. Quick-disconnect plugs permit conversion back to original system in case of failure.
Webster Manufacturing 317 Roebling Rd. South San Francisco, Calif.	5600	Conventional	n.a.[3]	Thoroughly shielded for marine or mobile 12-volt negative-ground use only. Contains bypass relay.
WICO West Springfield, Mass. 01089		Conventional	58.45	Heavy-duty construction. Adapters available for 6-volt or positive-ground installations.
Workman Electronics Products, Inc. P.O. Box 5397 Sarasota, Fla.	Trans-IT BX15	Conventional	25.75	Simple transistor switch permits use of original-equipment ignition coil. Switch-return in case of failure.

discharging network. "All" means that the manufacturer has 12- and 6-volt, positive- or negative-ground systems for sale.

2. Prices given here are either those reported in use by the manufacturers, or are the commonly advertised prices for the systems. Prices are subject to change without notice.

3. Not available.

miles. Better gas mileage accrues from improved combustion at high speed. Higher voltage, too, overcomes some degree of fouling in the spark plugs, which makes plugs usable for three or more times their normal life. Also, there's faster starting at frigid temperatures, and better acceleration.

For these reasons, the bellwether of transistor ignition has been the sports-car buff. Manufacturers' files contain letters of praise, like the one from a Porsche owner in New Jersey: ". . . we shaved almost one second off our best lap time." This, of course, can mean the difference between winning and losing. Yet it is in the daily grind of commuting, or bussing the kids, that the system must also turn in a creditable performance.

To the casual car-owner, improvements are neither sudden nor dramatic. They accumulate. Consider these comments from a California VW-owner: "I am well satisfied . . . although power increase is barely noticeable. However, it must be there, for gas mileage has increased an honest three miles per gallon after a very careful check on a 3500-mile trip." He reports that points look brand-new after 5000 miles, then congratulates the company.

Careful evaluation has impressed another important booster of transistor ignition; the commercial operator with an eye on cutting costs. "When you use 250 gallons of gasoline per 1000 miles, the savings can add up fast," says Industrial Transport, an outfit that hauls new cars to dealers throughout the country. After installing transistor ignition, truck mileage increased from 4 to 4.7 miles per gallon. Savings on longer point and plug life, the company estimates, yield $300 on 30,000 miles. This looks good on any ledger.

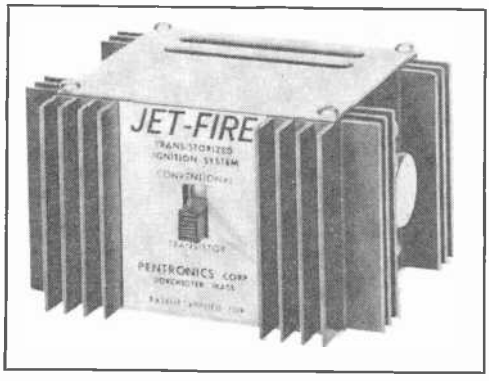
Another fleet owner installed systems in trucks without telling his drivers. The reason was to check results under normal driving conditions. Result: a saving of 10 gallons a day per truck.

Such gains have been charted by one manufacturer in terms of the typical passenger car. Let's say you drive 10,000 miles a year and use premium gasoline costing 35 cents per gallon. The car averages about 15 m.p.g. After adding transistor ignition, there's a possible saving of more than $35 a year. The assumption here is that points and plugs are changed every 10,000 miles. Taking a more optimistic example, where points and plugs are changed at 20,000 miles and you switch from premium to regular fuel, savings might rise to about $68 per year. These figures develop the convincing argument: transistor ignition can pay for itself in six months to a year, depending on the driver's habits.

Which pinpoints the most potent reason for transistor ignition in the family car. It's not so much a matter of flashy performance—that's more for the dragster—but rather for dollar savings that build slowly. Many users do find improvements like faster starting and peppy acceleration, but they're not exactly sensational.

Some Debits. It's no secret that the transistor ignition field is punctuated by occasional grumblings. That some systems fail to deliver promised performance could be attributed to a trio of reasons. First is what to expect. As mentioned above, the significant benefit is greater plug and point life, plus some possible improvement in gas mileage. Woolly claims, like "permanent tune-up," haven't helped. Other distributor parts—cam and rubbing block, for example—continue to wear and need attention.

The second problem is shoddy components and design. Transistor ignition is electronically simple in concept, but subtle factors make or break it. Heat sinks must be ample to dissipate heat. Transistors have to withstand some kick-back voltage. Car vibration and water

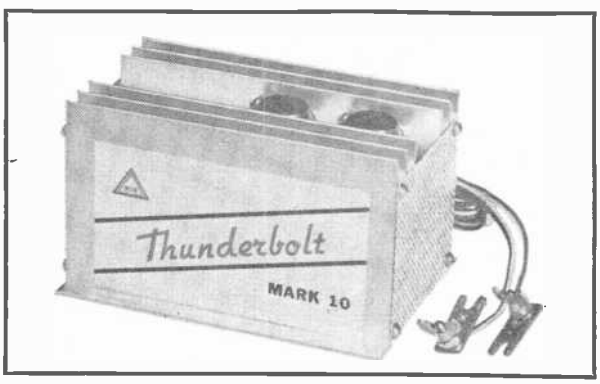


"Jet-Fire" system is mounted under dash so switch will be accessible. "Jet-Fire" units are installed in the Olins Rent-A-Car (Boston) trucks and cars.

spray can shorten the life of marginal products. Cost-cutting in small details may lead to early failure.

Finally, there's the user himself. As one manufacturer explains it, a big problem with transistor ignition is getting it installed properly. This shows up as failure to follow instructions—or inadequate instructions provided by the manufacturer. Search through numerous instruction manuals and you'll find a surprising amount of difference. In one case, there's a clearly illustrated booklet giving step-by-step details. Other manufacturers provide a confusing mimeographed sheet. Before attempting installation, the novice who comprehends little of his car's wiring should try to check the manual in advance. Where a good one is supplied, the risk of error is considerably lessened. It usually takes just one wrong connection to "pop" the system.

Reducing Risk. You carry a spare tire, reasons one manufacturer, so why not carry a spare ignition system? The "spare" he's talking about are the standard components removed from the car when the transistor ignition system is installed (namely, the regular coil and capacitor). Despite elaborate safeguards, the transistor system *is* more complex than regular ignition and could conceivably fail on the road. (This has happened, especially in the case of inferior design or improper installation.) To rescue the distressed motorist, many manufacturers provide some rapid method of converting back to the old system. In one approach, cables are fitted with plugs to quickly restore original connections. Another relies on changing a few wires. Some have a convenient change-over switch.



Delta's "Mark 10" has been continuously upgraded since its introduction. This manufacturer was first to mass-produce an SCR capacitor discharge system.

Most of the manufacturers sincerely believe that, when properly installed and maintained, a transistorized system will outperform and outlast the life of the car. However, by the same token, manufacturers recognize that under-the-hood temperatures play havoc with transistors and that the motorist should do as much as possible to put the transistorized part of the system in the coolest spot. Inside the passenger compartment is a good bet—if it can be accomplished. You might also start looking for warrantees and guarantees when purchasing a transistorized system. At least one manufacturer offers a "service contract" good for three years, or 50,000 miles, for only $3 extra.

Other sources of embarrassment have proved to be hard starting and the ignition switch. Transistor ignition moves heavy current through the points, but the *overall* drain of the system is usually higher. Additional current flows through the ignition switch, possibly causing it to burn out. A relay provided by some manufacturers will bypass the switch and eliminate the problem.

A relay, too, is sometimes supplied to stave off the possibility of hard starting. Like conventional ignition, the transistor type utilizes a ballast resistor which limits coil current to the correct value. During starting, however, the ballast should be bypassed since battery voltage may temporarily drop from 12 to 8 volts. Some manufacturers provide a relay, others offer it as an option. In any case, if difficulty is experienced, the manufacturer should be consulted about this provision. A relay can be added, if needed.

That ballast resistor has created problems for some people during installation. In nearly all systems, the car's old ballast must be identified, then replaced with a new one designed for the transistor circuits. The trouble is that the ballast can be either a separate resistor or hidden in the wiring that runs from ignition key to coil. Here's where a good auto owner's manual pays off. The better ones provide plenty of background information on how to locate the ballast in your car. Others describe a valuable voltmeter test to prove whether you've

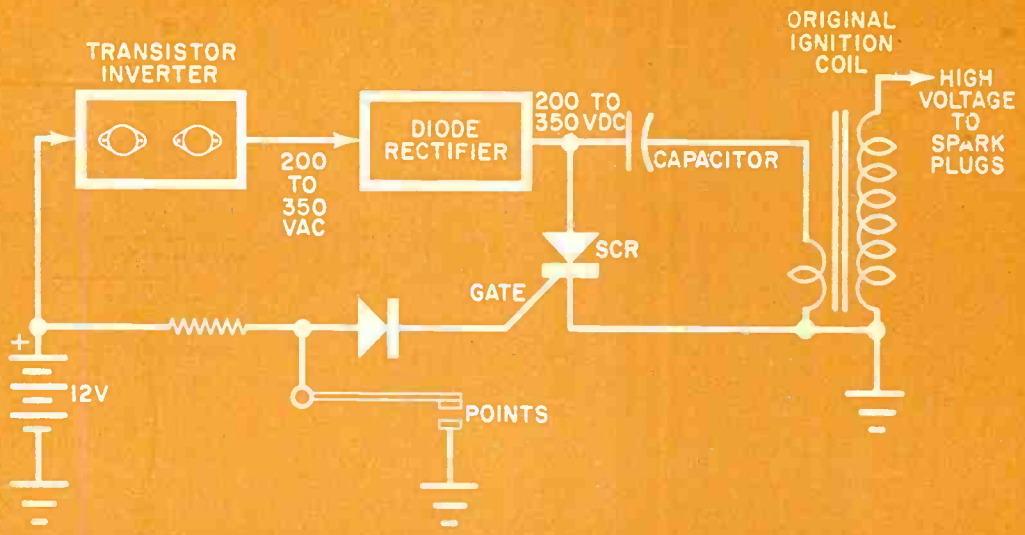
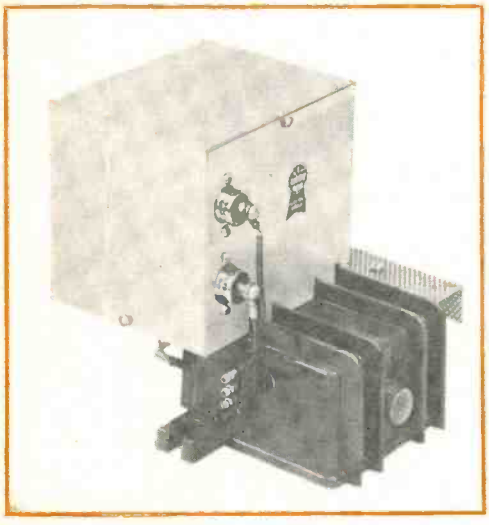


Fig. 3. Simplified diagram shows the operation of an SCR capacitor discharge ignition system. Car battery voltage is built up to 200-350 volts d.c. through an inverter and rectifier. This voltage is used to charge a 1.0 or 2.0 μf capacitor, which is discharged by SCR action controlled by the breaker points. One of the many advantages of this system is the low drain from the car battery while starting the engine.

done the job correctly. If you're getting 12 volts, for example, between one of the coil terminals and ground, that aspect of installation is correct.

What's Ahead? Most systems on the market fit the outlines described above; the transistor is a high-current switch; the points are the controller. A second-generation system is now gaining increased recognition. It's the capacitive discharge system. Some technicians estimate that it ultimately will win and become the standard original equipment for new cars.



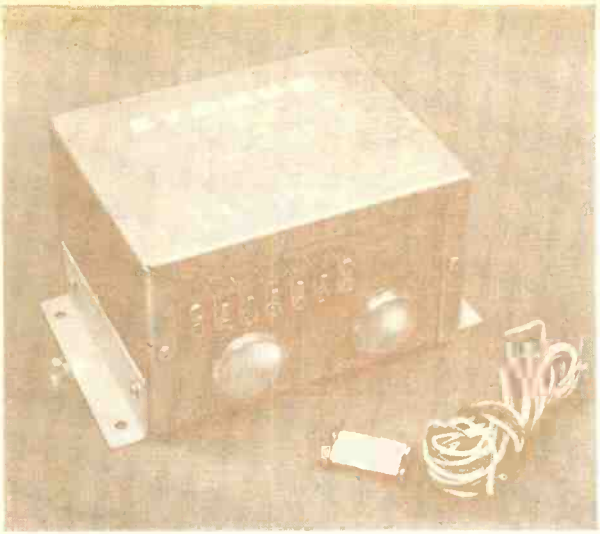
Webster's Model 5600 system has been shielded and filtered for noise-free radio reception. The circuit uses a single diffused-alloy type transistor.

The handful of manufacturers now producing such units for existing cars cite certain advantages for capacitive discharge. Installation is simpler, the original coil is re-used, and there's no significant change in car wiring. The capacitor may be left in place. Ignition-key and starting problems are eliminated since the system draws only the required amount of current (which depends on engine speed). Voltage is high enough to help fire fouled spark plugs.

The operating principle of the capacitive discharge system is shown in Fig. 3. The transistors do not provide high-current switching action as before. Their function now is raising battery voltage to several hundred volts. The transistors form an oscillator circuit whose circulating currents can be stepped up by a transformer. This makes up the inverter section. Following is a diode rectifier for changing oscillator output to d.c. at about 200 to 350 volts. Next in the chain is the capacitor which names the system; it is charged by the higher d.c. source.

The charge held by the capacitor is

(*Continued on page* 93)



TRANSISTORIZED CAPACITOR DISCHARGE IGNITION SYSTEM

By MURRAY GELLMAN

Put more spark into your gasoline engine to enhance performance

INCREASED gas mileage, quicker starting even in cold weather, longer life for breaker points and spark plugs, more power at high speed, and less ignition interference on ham and CB rigs are claimed for the transistorized Capacitor Discharge Ignition System. A one-two punch has been delivered to conventional ignition systems, and it's beginning to look as though they will be replaced by electronic systems in the very near future.

The first blow was struck with the introduction of the transistor system. The transistor system relieves the breaker points from having to carry all the current in the ignition coil's primary circuit, but still depends upon a large magnetic field around the ignition coil. The size of the field, among other things, depends upon the amount of time available between sparks. This time is shorter at higher engine speeds and it is quite normal for the high voltage to fall off at the higher speeds.

Until the transistor was put to work, a practical limit on the amount of current that could flow through the primary circuit to build up the magnetic field was determined by the size of breaker points. In order for the points to handle more current, larger points are needed, but there is a practical limit to point size. The silicon-controlled rectifier (SCR) eliminates the points as a stumbling block so far as current is concerned, although breaker points still have to be in good condition and properly timed.

More than enough current is now available to the coil. But the regular coil wasn't designed to take much more current, so a new coil became desirable, one with a shorter time constant, that is, one that would take all the current from the SCR in the amount of time between sparks even at the highest engine speeds. The drawback now is that the same high current is drawn at slow speeds and while starting. The battery has all it can do to satisfy the starter motor and chances are that when you need it the most, like on a cold winter morning, you'll be looking for a battery booster.

Several things have been done to overcome this effect: the use of coils with higher turns ratio, ballast resistor jumpers when starting, relays to connect the battery more directly to the coil, etc. Even before the designers had a chance to fully eliminate the bugs in this system, however, the second blow was struck. Another system has been transistorized and brought out for public consideration and use.

The capacitor discharge system, by no means a newcomer, was originally a thyratron operated device; it now takes on a completely new look and promises to become the new standard in a very

short time. This transistorized capacitor discharge ignition system has a transistor power supply and a capacitor to fire the ignition coil. As there is never any d.c. on the ignition coil, the coil works more effectively, and remains much cooler in the system. A negative-ground, 12-volt system is described here.

Construction. Assembly of the entire ignition system can be accomplished in less than half an hour. A printed circuit board, made of G 10 (fiberglass impregnated) material and heavy copper foil, simplifies the construction considerably.

The most important parts required are the SCR (*Q3*) and the transistor transformer (*T1*). This transformer is a special type, and can be purchased directly from SYDMUR (P. O. Box 25A, Midwood Station, Brooklyn, N. Y., 11230) for $14.95. The SCR can be purchased locally. SYDMUR claims their SCR's are pretested and exceed manufacturer's specifications. A special selection of SCR's was made to insure optimum performance; they are priced at $7.45 each.

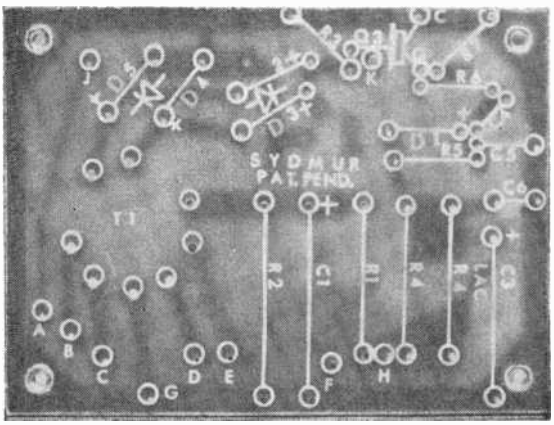
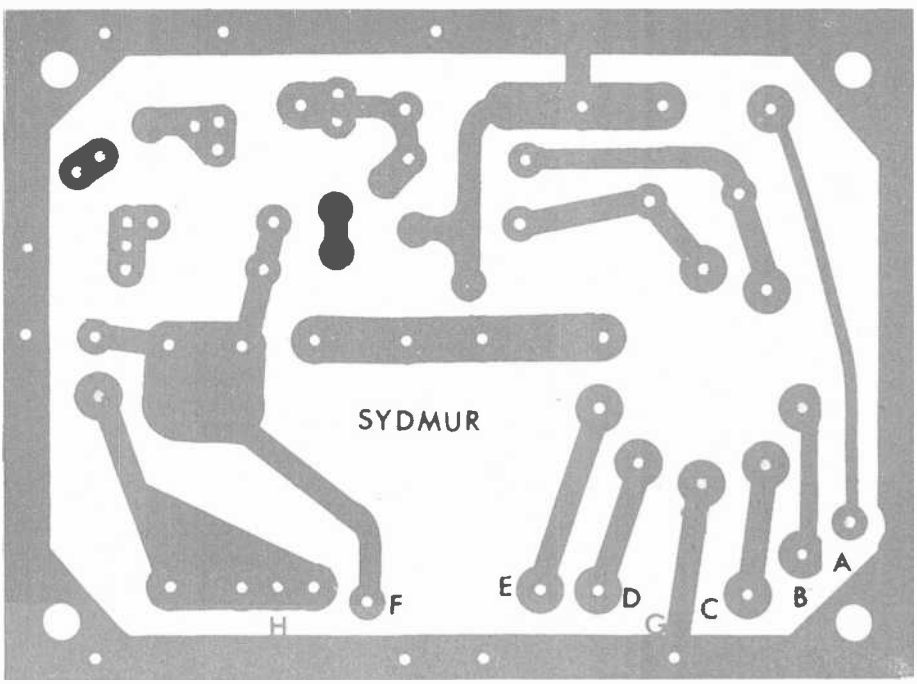


Fig. 1. Component side of circuit board (left) shows parts location and orientation. SYDMUR kit has all components color-coded, and the appropriate colors marked on the board to speed assembly. Actual size photo of board (below) will help you make your own. Do not change alignment of conductor paths.



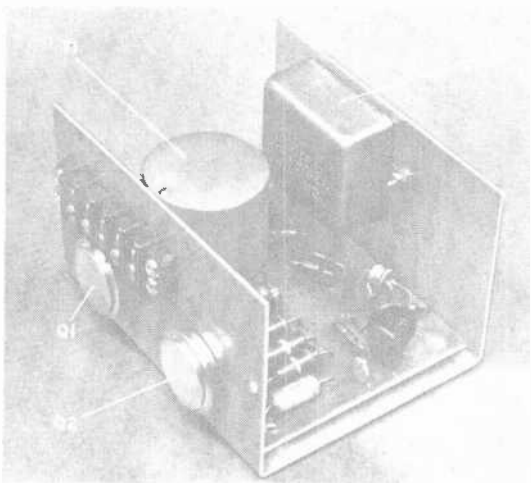
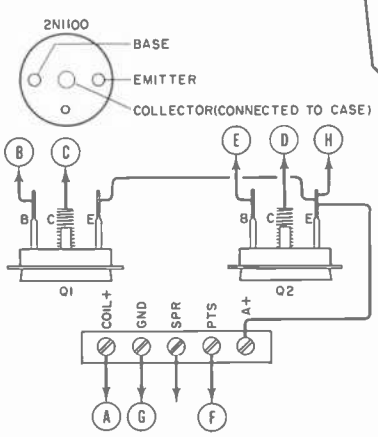
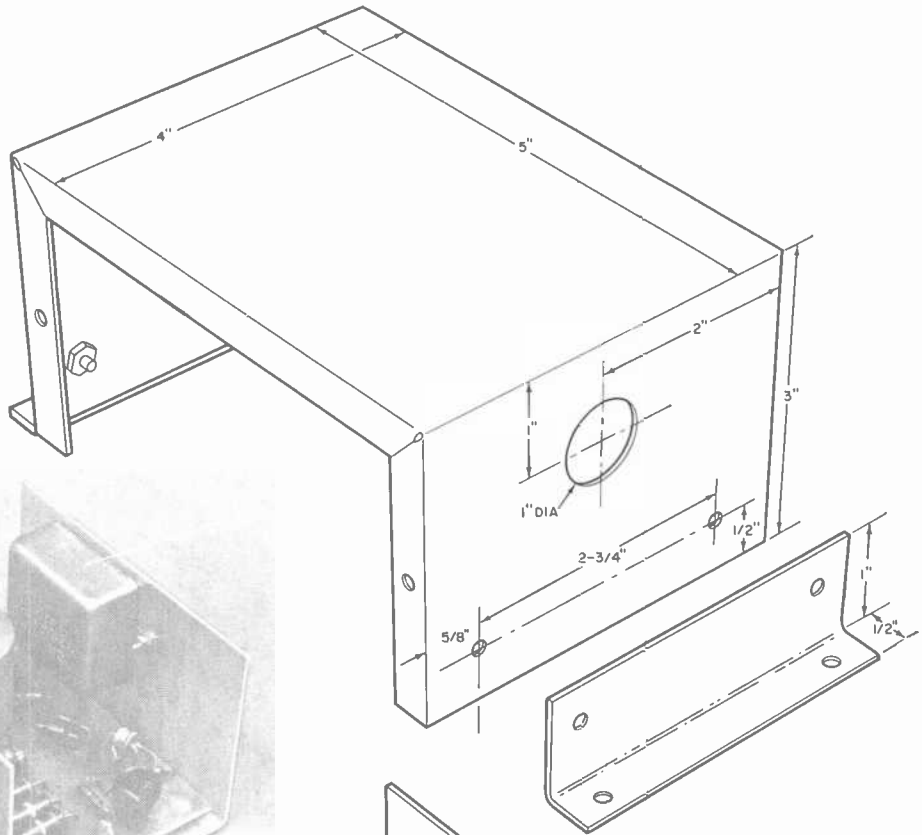
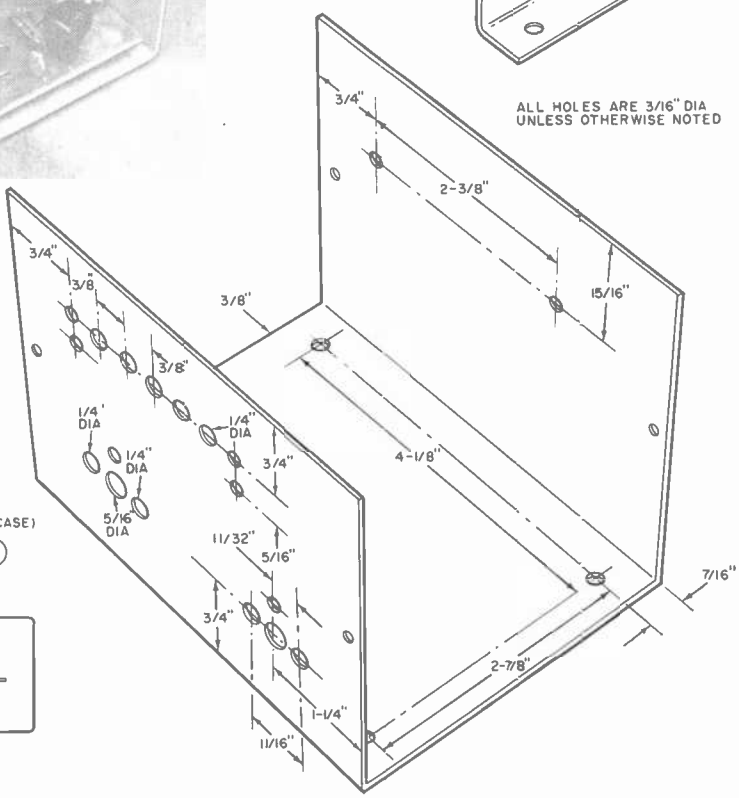


Fig. 2. Locate and drill all holes accurately. Large 1" hole is for screened air vent. Size and spacing of holes for terminal strip can vary. Mounting sequence is: Q1, Q2, terminal strip, completed board, and bathtub capacitor. Transistors must not touch the cabinet.







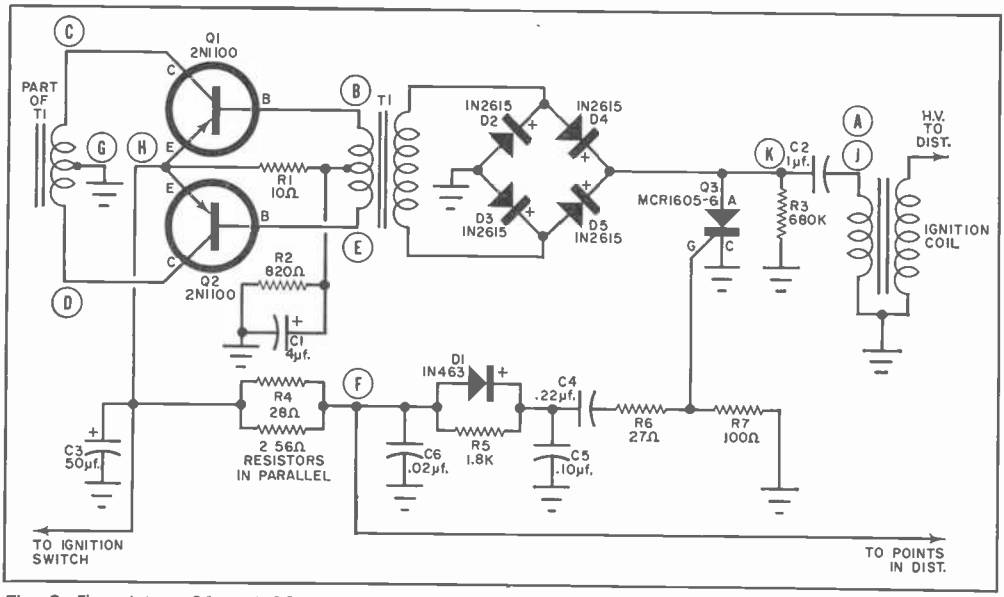


Fig. 3. Transistors Q1 and Q2 "chop" the battery input to enable T1 to step up the voltage, which is then rectified and used to charge C2. The potential stored in C2 is then "dumped" into the ignition coil.

None of the other parts are critical and they can be obtained from your local parts dealer.

Should you decide to make your own printed circuit board, follow the actual size and layout as shown in Fig. 1. Do not change any lines, or false triggering of the SCR can result.

First install all the components on the printed circuit board or other suitable chassis, and put it aside. Use rosin core solder and observe polarity of all diodes. Next, prepare the cabinet as shown in Fig. 2 and mount the transistors and terminal strip. Do not mount the bathtub capacitor until the circuit board has been put in place.

When installing the transistors, coat both sides of a mica insulator with silicon grease to act as a heat conductor and electrical insulator between the transistors and the cabinet. Line up the holes of the mica insulator with the holes in the cabinet. Next, insert the transistors (they can fit only one way). Then place a fiber washer over each transistor bolt, and follow with a metal washer and solder lug. Bolt the entire assembly into place.

Be certain that the transistor pins do not touch the metal cabinet. Use an ohmmeter to check this out. Connect one lead to the cabinet and the other to

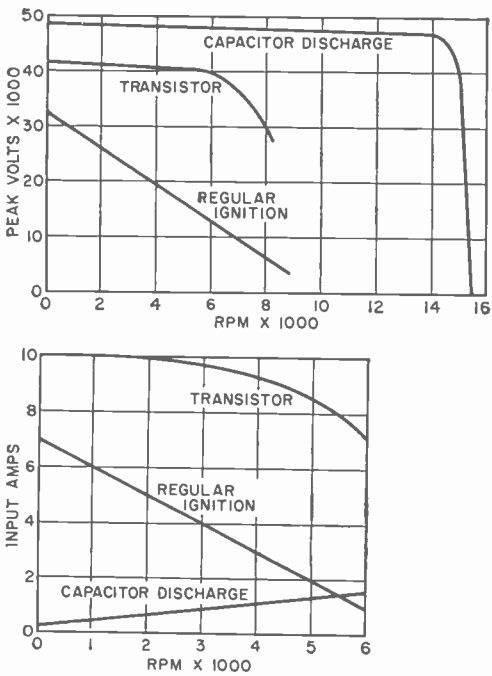


Fig. 4. Capacitor discharge system has highest voltage output and lowest current drain at road speeds.

the transistor case and then to the pins. If there is a reading on the ohmmeter, recenter the transistor.

Mount the board into place with machine screws and be sure that there is

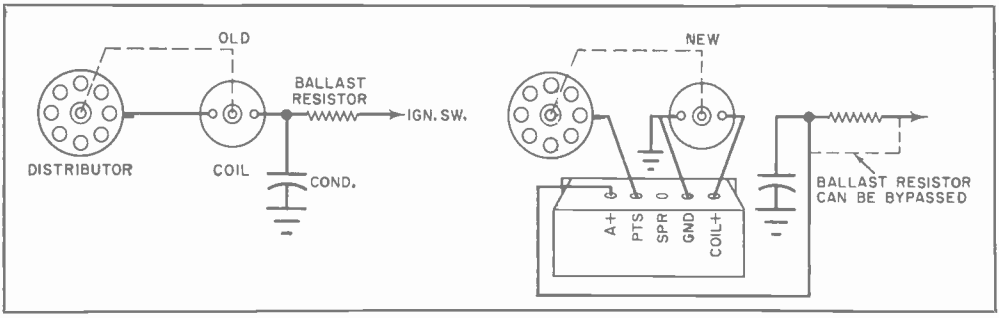


Fig. 5. Simple wiring change needed to install capacitor discharge system. To get the most out of the new installation, points, plugs, coil, wire, and distributor cap should be clean and in good condition.

PARTS LIST

C1—4-μf., 50-volt electrolytic capacitor
C2—1-μf., 600-volt bathtub capacitor
C3—50-μf., 25-volt electrolytic capacitor
C4—0.22-μf., 25-volt ceramic capacitor
C5—0.1-μf., 100-volt ceramic capacitor
C6—0.02-μf., 150-volt ceramic capacitor
D1—1N463 silicon diode
D2, D3, D4, D5—1N2615 silicon diode
Q1, Q2—2N1100 power transistor
Q3—MCR1605-6 silicon-controlled rectifier
R1—10-ohm, 2-watt resistor
R2—820-ohm, 1-watt resistor
R3—680,000-ohm, ½-watt resistor
R4—28-ohm resistor (two 56-ohm, 2-watt resistors in parallel)
R5—1800-ohm, ½-watt resistor
R6—27-ohm, ½-watt resistor
R7—100-ohm, ½-watt resistor
*T1—SPC-4 special transformer (SYDMUR)**
1—3" x 4" x 5" cabinet
Misc.—1" wire-screen snap-in plug, 5-terminal barrier-type terminal strip, circuit board, 4 3/16" spacers, machine screws, terminals, etc.

*The following parts are available from SYDMUR, P.O. Box 25A, Midwood Station, Brooklyn, N.Y.: transformer T1, $14.95; SCR Q3, $7.45; complete kit including a specially made cabinet, $44.50; and a completely wired unit, $60.00. A positive ground system is also available completely wired (not in kit form).

enough clearance on all sides and top and bottom to prevent short circuits. Connect a wire from point *C* (next to *T1*) to the collector and a wire from point *B* to the base of *Q1*. Connect a wire from point *D* to the collector; a wire from point *E* to the base; and a wire from point *H* to the emitter of *Q2*. The emitters of both transistors should be connected together and to the A+ terminal on the terminal strip. Finally, connect a wire from point *A* on the board to the *Coil+* terminal on the strip; a wire from point *G* to the *GND* terminal; and a wire from point *F* to the *PTS* terminal.

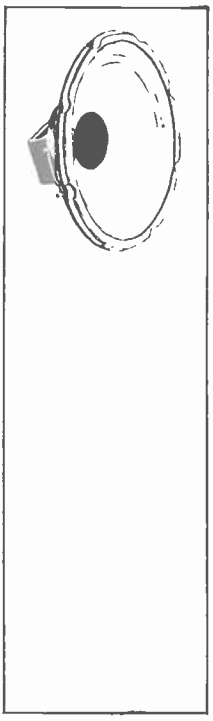
How It Works. When the ignition switch is turned on, the battery voltage is applied to the emitters of *Q1* and *Q2*. (See Fig. 3.) Transistors *Q1* and *Q2* are forward-biased through the resistive divider (*R1* and *R2*). Usually, whichever transistor has the most gain will conduct first. First one transistor conducts, and then the other, in a flip-flop manner. This form of oscillation repeats itself regularly and continuously; transformer action steps up the voltage to about 375 volts, which is then rectified by the full-wave bridge (*D2, D3, D4* and *D5*).

The d.c. voltage output from the bridge rectifier then charges capacitor *C2*. Capacitor *C2* stores this d.c. energy until the *SCR* (*Q3*) conducts. Resistor *R3* improves regulation and acts as a bleeder to discharge *C2* when the ignition switch is turned off.

When the points in the distributor are closed, the SCR (*Q3*) is an open circuit across the power supply. Also, when the points are closed, *R4* allows about 500 ma. of current to flow across the points to help keep them clean. When the points open, current flow through *R4*, *D1*, *C4*, *R6* and *R7* causes a positive pulse to be applied to the gate of *Q3*, which then flips into conductivity very rapidly (approximately 1 microsecond), discharging *C2* through the primary of the ignition coil.

Notice that the voltage impressed across the primary is on the order of 375 volts and not the usual 6 or 12 volts. The ignition coil can now produce a much hotter and "faster" spark. Actually, "faster" spark simply means a steeper slope (rise time) of the spark's waveform as it would appear on an oscilloscope. It is this very short rise time, inherent in a capacitor discharge

(*Continued on page* 87)



BUILD A STEREO BAL

Balance stereo speakers and find multiplex broadcasts with $4 indicator

By DAVE GORDON

THE Stereo Bal is designed to solve two common hi-fi/stereo problems. The first concerns system balance. Unless your stereo speakers are fed a balanced diet of power—the same amount to each speaker—you'll get off-center sound, and musical instruments will be reproduced either with incorrect perspective or incorrect volume.

The second problem that the Stereo Bal will solve involves FM-stereo broadcasts. Very few of the early FM-stereo tuners or receivers had built-in indicators to tell you whether or not the station being received was broadcasting in stereo. And even fewer of the multiplex adapters that converted standard FM tuners to stereo were equipped with stereo indicators.

What was needed was a simple, inexpensive (under $4), and practically foolproof gadget that could do both those jobs—and that is how the P.E. Stereo Bal came to be.

How It Works. To achieve stereo reproduction, there obviously must be a difference between the signals fed to the two speakers. Let's call the signal fed to the right speaker "A" and the signal fed to the left speaker "B." Any difference between the two signals represents the stereo information and is usually referred to as the "difference" signal or the A—B signal.

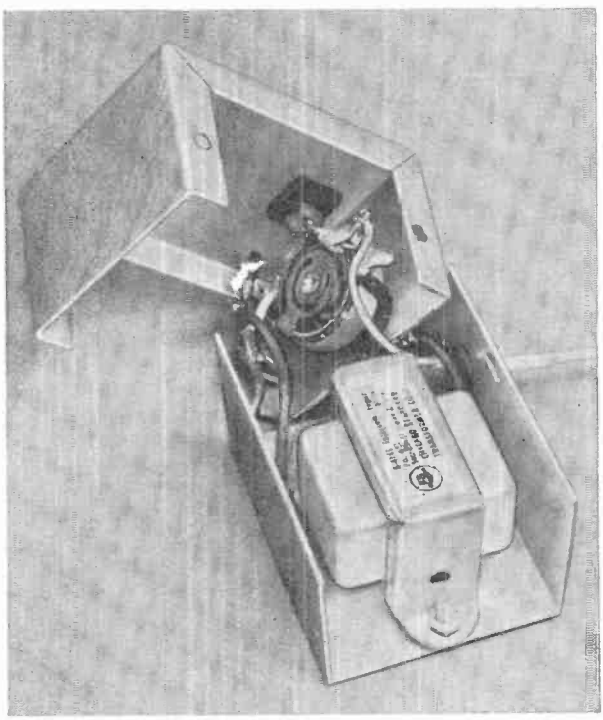
If an a.c. voltmeter were connected to the speaker terminals of a stereo amplifier (from the 16-ohm tap of one to the 16-ohm tap of the other), the meter would read no voltage as long as the same signal *at the same strength* appeared across the two 16-ohm terminals. However, as soon as there was any difference between the signals coming out of the amplifiers, the meter would respond.

That explains where the difference signal comes from, but how do we use it in the Stereo Bal? Instead of an expensive, easily damaged meter, we use a step-up transformer (*T1*) to soup up the very small difference voltage sufficiently to light a neon lamp.

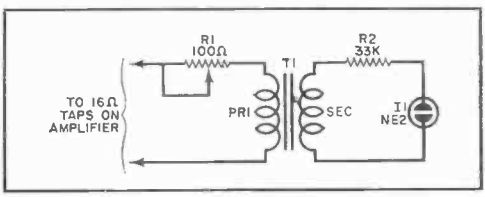
Construction. An inexpensive type of transformer that proved ideal for the soup-up job is one that normally serves as an input transformer for tube intercoms. Transformer *T1* is connected with its high-impedance side to the neon lamp. Control *R1* adjusts the sensitivity of the Stereo Bal in accordance with the loudness of the program being played.

Depending upon the type of neon-lamp pilot assembly used for *I1*, you may find that resistor *R2* is already built into the assembly and hence need not be added. As an inexpensive alternative to using a pilot-lamp assembly, you can make a socketless mounting by press-fitting an NE-2 lamp into a rubber grommet. In that case, simply solder *R2* to one lead of the lamp. Do not use an NE-51 as this lamp tends to be very fragile.

Parts layout is not critical. In fact, the Stereo Bal's few components can be mounted on a panel rather than in the



It's a tight fit, but all of the Stereo Bal components can be squeezed into a miniature aluminum box. Although the author used a small wire-wound potentiometer for R1, a carbon unit could be employed.



The Stereo Bal is fed from the 16-ohm output taps of each amplifier. There's no common ground return.

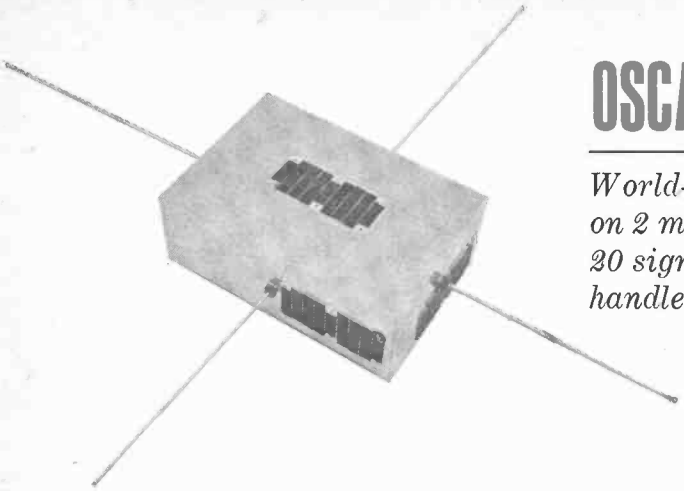
PARTS LIST

I1—NE-2 neon lamp or neon-lamp pilot assembly —see text
R1—75- or 100-ohm potentiometer (taper and value not critical)
R2—33,000- or 47,000-ohm, ½-watt resistor—see text
T1—Intercom input transformer, voice coil to grid (Stancor A-4744 or Thordarson 20A04)
1—Cabinet (Premier PMC-1000)
Misc.—Two-conductor speaker wire to reach from Stereo Bal to amplifier, hardware, etc.

small metal box shown in the model. The sole precaution that might be necessary is to avoid mounting *T1* too close to a power transformer or phono motor.

The leads from the Stereo Bal should

(*Continued on page* 91)



OSCAR III: A OK

World-wide communications on 2 meters and up to 20 signals at one time handled by ham satellite

RADIO AMATEURS have been smashing communications records and contacting each other across oceans and continents on a "line-of-sight" frequency band (2 meters) by means of a home-made repeater satellite whirling 500 miles above the earth in a 103-minute orbit. Conceived and built by a group of California hams (see article in the March issue of POPULAR ELECTRONICS), OSCAR III was the first multiple-access, linear translator satellite to be placed in orbit.

OSCAR III could accept any number of radio amateur signals within the input passband centered on 144.1 mc. and instantly retransmit these signals back to earth on a passband near 145.9 mc. and 50 kc. wide. As many as 20 signals have been reported passing through OSCAR III at one time.

Carried as a passenger into space aboard a research and development vehicle of the U.S. Air Force on March 9th, the 35-pound satellite broke radio amateur communications records on practically every orbit around the earth. Two-way conversations took place between amateurs in Massachusetts and Germany, New York and California, California and Hawaii, Argentina, and Alaska. In addition, numerous hams in Switzerland, Germany, England, Sweden, France, Czechoslovakia and even Australia communicated with each other.

The translator equipment aboard the satellite worked normally, but a secondary beacon transmitter did not operate. However, the main telemetry transmitter on 145.85 mc. returned excellent data to the various monitoring stations. Normally VHF signals exhibit a very limited line-of-sight communication range, but OSCAR III received the signals, amplified them, and instantaneously retransmitted them back to earth. It could "hear" signals up to several thousand miles away and retransmit them an equal distance, which made it possible to communicate on a worldwide basis.

A radio amateur satellite tracking station and a communication center were established on the campus of Foothill College, Los Altos Hills, Calif., to track OSCAR III. Orbital predictions generated at the center, using the college computer, were broadcast to hams throughout the world by means of the OSCAR short-wave amateur station W6EE. This station was heard on the 80-, 40- and 20-meter bands.

Swinging about the earth in its 500-mile high orbit, at an inclination of 70 degrees, OSCAR III is expected to remain aloft for months, until gravitation gradually pulls it down to a fiery end in the earth's atmosphere. The battery has now expired.

In Pasadena, Calif., Herbert Hoover Jr., W6ZH, president of the ARRL, lauded the project and the hams who made it an outstanding success. The group includes: William I. Orr, W6SAI, president of the Project Oscar Association; Lance Ginner, K6GSJ, coordinating manager; Harley Gabrielson, W6HEK, head of prediction group; and Don Norgaard, W6VMH, chief design engineer.

Here's looking forward to the launching of OSCAR IV. —30—

THE TASK of singling out one short-wave station on some of the international broadcast bands seems utterly impossible to someone attempting it for the first time. Stations upon stations pile up on the same channel, and stations separated by 5 or 10 kc. splatter over one another in a never-ending battle to be heard. The result is that only the most powerful, the best equipped, or those broadcasters with the most transmitters have a chance. Chaotic conditions reign in the 49-, 41-, 31-, and to some extent the 25-meter international BC bands.

CHAOS in Short-Wave Broadcasting

By STANLEY LEINWOLL
Radio Propagation Editor

Nature and man have combined to pack the 49-, 41-, and 31-meter bands. If there is no more room—what happens?

JUST how crowded the broadcast bands are in Western Europe is shown by the tables on pages 52 and 53. Similar crowding exists in these bands for the SWL in North America—possibly conditions are even worse because of the number of Central and South American broadcasters not heard in Europe.

During the peak evening listening hours three stations may operate on the same frequency simultaneously. Obviously, this can only result in the creation of useless garble. Even where there are only two occupants on the same channel, the frequency is generally unusable, except in cases where one of the broadcasters is employing much higher power or more antenna gain than the other.

The seriousness of the situation can be seen from the fact that there are very few channels in the 6- and 7-mc. bands that have one user per frequency—and there are no openings to make room for new broadcasters. Any new broadcaster must schedule his transmissions on a frequency which is already occupied. The 9-, 11-, and 15-mc. bands are equally crowded.

Why? There are three basic reasons for the overloaded condition in the high-frequency broadcasting bands:

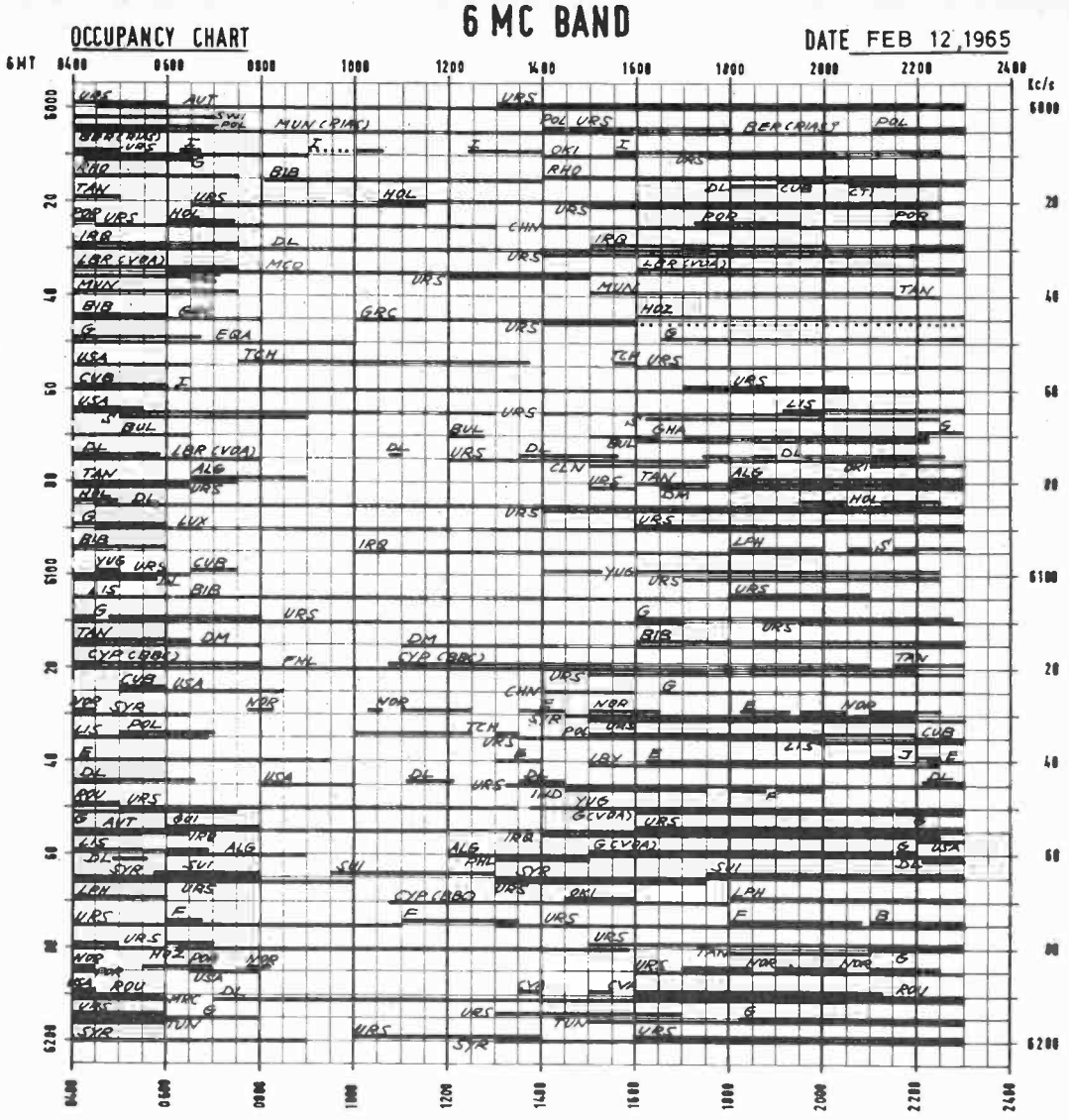
(1) Low sunspot activity—the higher frequencies are unusable.

(2) More use of the bands by emerging new nations.

(3) New transmitters being put into service by established broadcasters, including many very high power units.

The effect of sunspots on usable frequencies was discussed in the May issue of POPULAR ELECTRONICS (p. 77). In general, as sunspots go down, so does the number of usable international broadcasting bands. At present, sunspot activity is just past minimum and the number of channels available for high-frequency broadcasting remains at what is almost an all-time low.

During the past several years a number of new nations have begun high-fre-

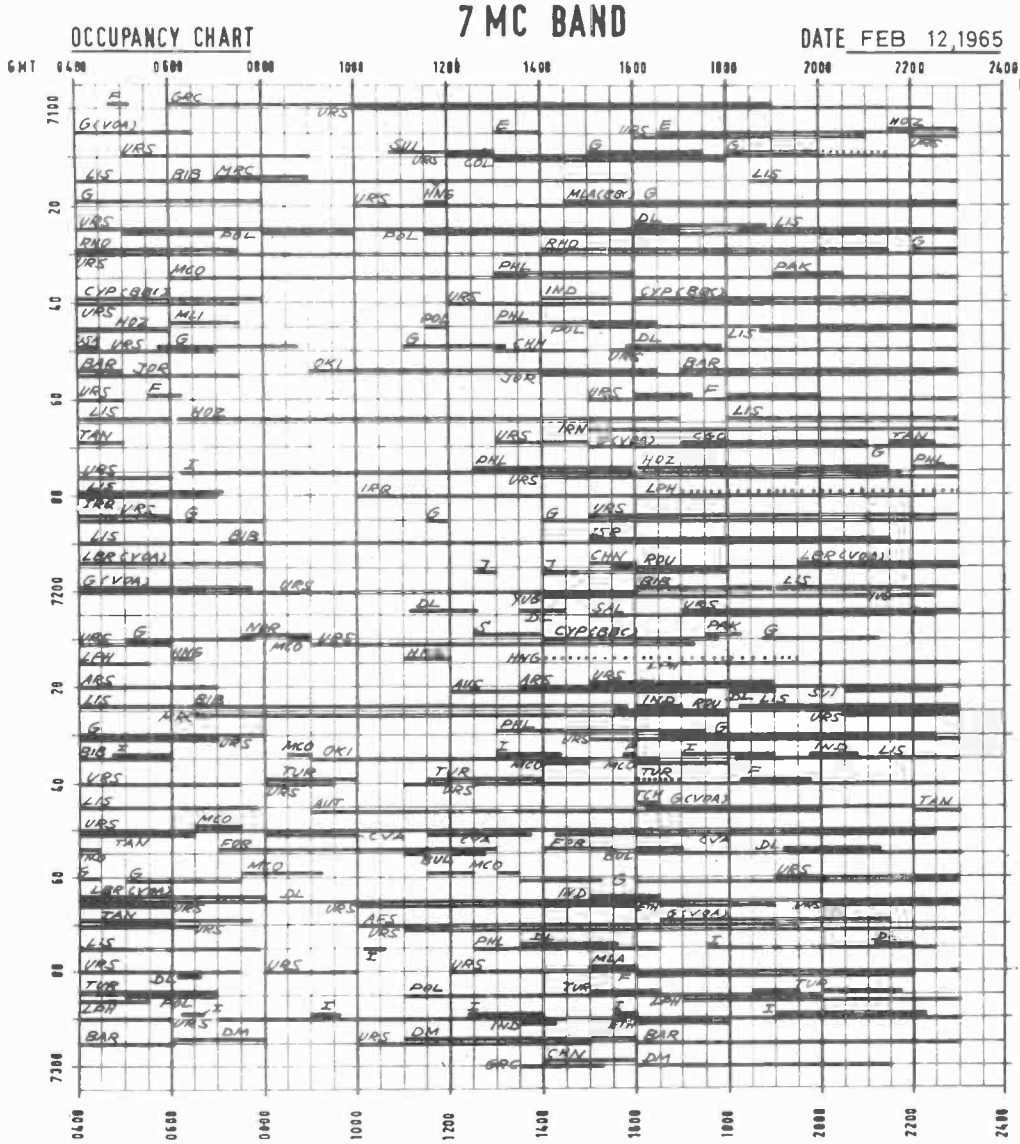


The charts on these two pages were prepared by the Radio Free Europe Engineering Department, in Munich, Germany. They are based on actual SWL observations which were made at various monitoring locations throughout Western Europe. Time in GMT is shown across the top and bottom of each chart and frequency (the 49-meter band on this page and the 41-meter band on the next page) along the sides. Each heavy hori-

quency broadcasting. Others can be expected to do so shortly. The 1965 edition of the *World Radio TV Handbook* shows a 10 percent increase in the number of African and Asian nations engaged in short-wave broadcasting since 1962. These new broadcasters have added more than 25 transmitters to those already in service.

The above figures do not include Afro-Asian countries that have added transmitters to already existing services, or are planning to add transmitters. Ghana, for example, has added a number of 100,000- and 250,000-watt transmitters to its international service, while countries such as Malagasy and Rwanda are planning more short-wave facilities.

Many of the world's established broadcasters have either added transmitters



zontal line represents use of the indicated frequency by a short-wave broadcaster. Abbreviations adjacent to the heavy lines tell what countries are broadcasting. The abbreviations are reasonably obvious: URS for Soviet Union, G for Great Britain, USA for Voice of America, I for Italy, NOR for Norway, etc. Note that there are many times when two or three stations broadcast simultaneously on the same frequency.

or increased the power of some of their transmitters, or done both, during the past several years. The use of high power sometimes splatters enough signal into adjacent channels to disrupt reception on either side of the high power station. This often causes the weaker station on the adjacent channel to move to another part of the band, in effect increasing the crowding there.

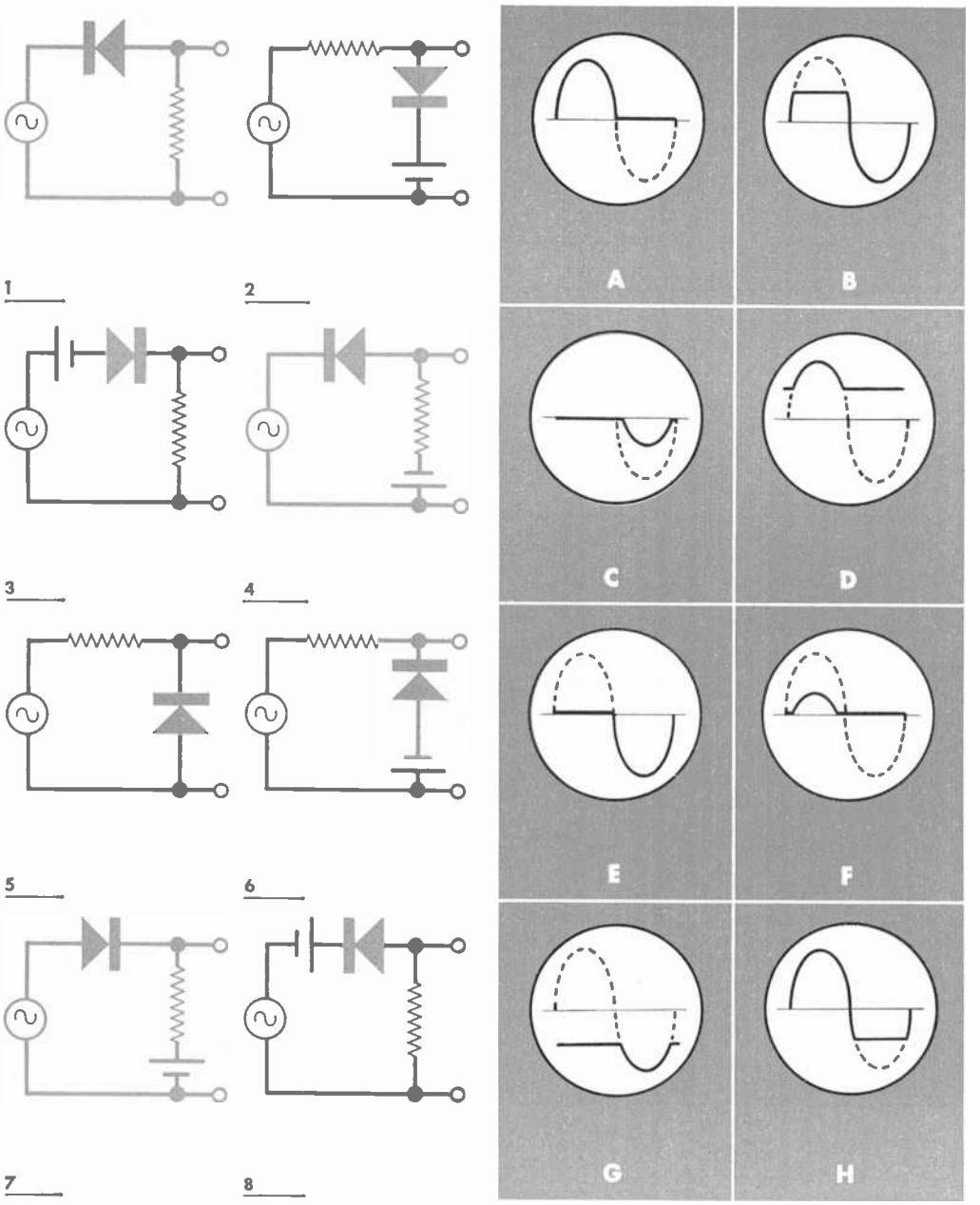
High-power short-wave transmitters have been put into service by the *Voice of America*, *Radio Free Europe*, *Radio Liberty*, Great Britain, and *Radio Moscow*, among others. Leader in the addition of high-power transmitters has been the *VOA*. Besides six 250,000-watt transmitters put into service at the new Monrovia (Liberia) site, and six 250,-

(*Continued on page* 92)

CLIPPER-LIMITER QUIZ

By ROBERT P. BALIN

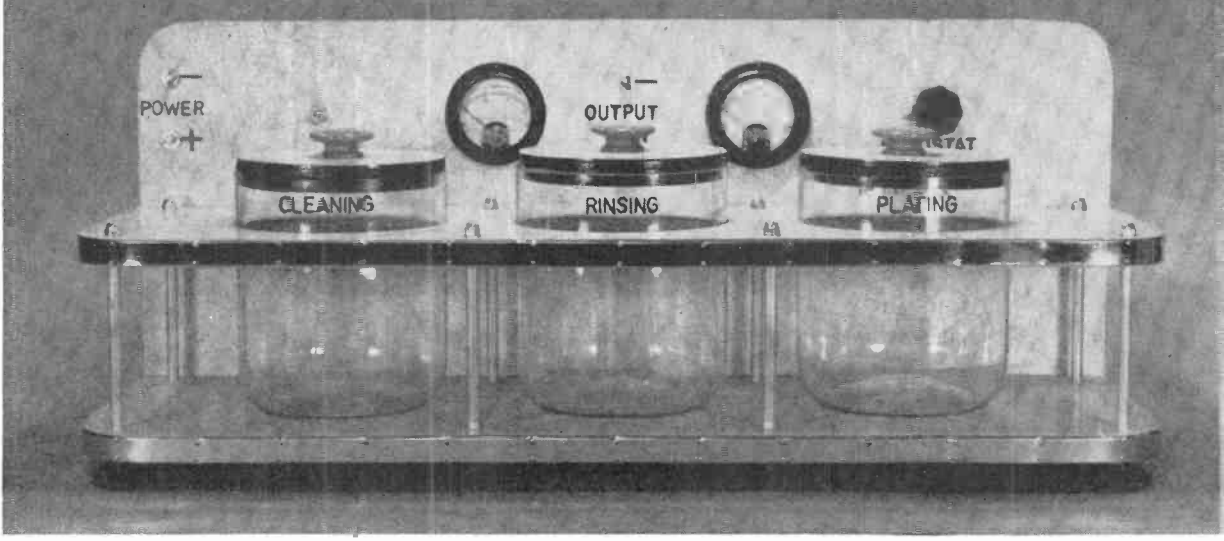
Clipping and limiting circuits are used in electronic devices to alter the wave-shape of signals. See if you can match the output waveforms (A-H) at right, below, with the circuits (1-8) at left. In each case a sine wave is fed in and then modified by the circuit; battery voltage equals one-half the peak voltage of the input signal. The dotted lines represent the undistorted output waveform.



(*Answers on page 99*)

ELECTROPLATE OR ANODIZE YOUR ELECTRONIC PROJECTS

By WALTER B. FORD



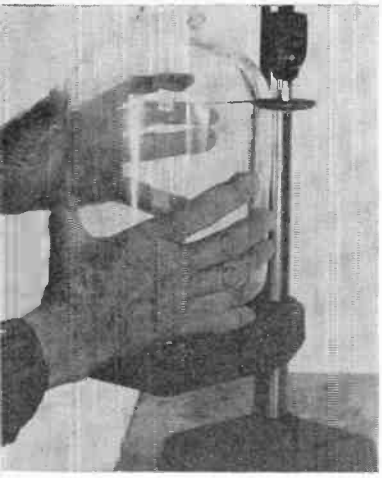
Dress up those panels, knobs, and chassis with attractive anodized colors or a nickel or copper plating

WANT to give your electronic projects and tools a polished, distinctive appearance? It can be done with an easily built electroplater-anodizer. You are probably familiar with electroplating—depositing a thin coating of metal on a piece of dissimilar metal—but you may have wondered how the brilliantly colored finishes you see on the panels of electronic gear and other appliances are produced. This process is known as anodizing. The assembly described here is capable of turning out either type of work with professional-looking results.

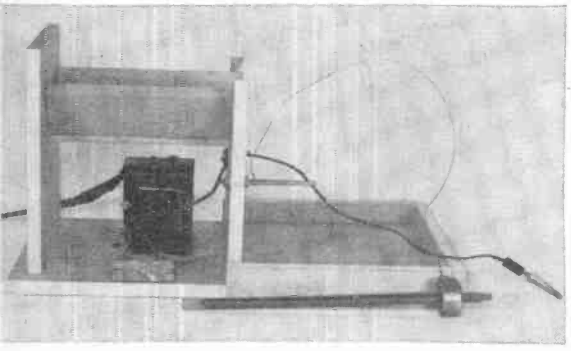
With a minimum investment, you can finish your chassis, panels, knobs, and other hardware in attractive rainbow shades. Or, if you prefer, you can add a brilliant coating of polished nickel or copper. Last but not least, the electroplater-anodizer makes an excellent science fair project in its own right.

Plating Jars. Although large crocks or jars can be secured commercially, the following procedure is given for those who would like to make their own. Secure a supply of about ten one-gallon bottles of the type used for cola, root beer, syrup, or cider. Six of these can be used to make plating jars, and the others to store solutions.

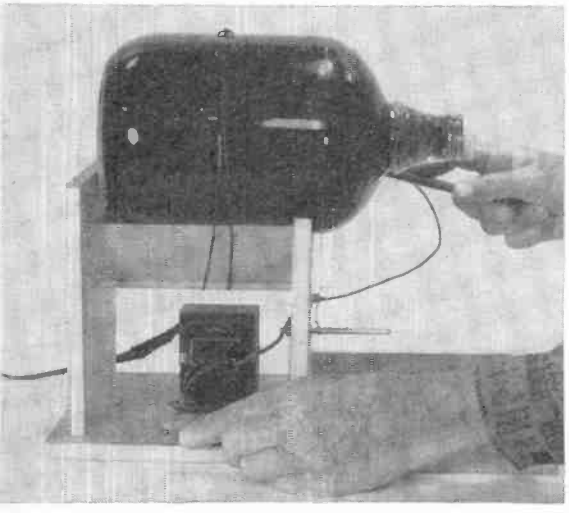
To make a jar, place a bottle on a drill press table and rotate it against a small grinding wheel that is turning in an opposite direction in the drill press chuck. Score the bottle around its circumference at a point just below where it begins to curve toward the neck, just deep enough to make a slight groove. You can obtain a suitable grinding wheel from your local hardware or auto supply dealer. Wear goggles during the scoring operation as a precaution against glass dust getting into your eyes.



The first step in making a plating jar from a gallon bottle is to score a ring around the top with a small grinding wheel.



This V-shaped rack was assembled for making plating jars. Chime transformer provides current for heating element resistance wire; heat snaps top from jar.



Heating element wire is inserted in groove around neck of jar, switch pressed. A rap with a block of wood will finish job if the top doesn't fall off.

As the next step in making plating jars, the author constructed a rack as shown in the photographs at left. It was designed to hold the jars while the tops were snapped off by heating the scored ring around the top of the bottle with a length of heating element resistance wire. If you want to duplicate the author's setup, secure about 20 inches of heating element resistance wire (electrical repair shops are good sources of new or used wire), and a door chime transformer with a 16-volt tap.

Connect the heating element wire, the transformer secondary, and a momentary contact switch in series. Place a bottle in the V-shaped part of the rack and secure it with a rubber band and a metal hook or a piece of twine. Then encircle a section of the scored ring around the bottle with the heating element wire, exert pressure on one end with a screw-driver blade to keep it in the groove, and press the switch. The wire should heat to a deep red, and after a few seconds you will hear a sharp snap. An inspection at this point will show that the glass has broken cleanly for part of its circumference.

Rotate the bottle and continue as above, making certain that the wire overlaps part of the previous cut. The top will usually fall off after the crack has encircled the bottle; if it doesn't, a rap with a block of wood will finish the job. After the tops have been removed, work the edges of the jars over carefully with fine emery cloth and an oil stone to remove any danger of cutting your hands. The jars will have a capacity of slightly over three quarts of solution—enough to handle a chassis or panel up to 5½" x 6", yet keep the complete assembly down to portable size.

The Plating Stand. The author made a plating stand of ¾" plywood covered with formica to dress up the project and make it stain resistant. (Incidentally, the formica-covered cutout for a kitchen sink may be large enough for a stand; check the yellow pages of your telephone directory for firms doing drainboard work.) As shown in the photograph at the beginning of this article, holes are cut for the jars, meters, terminal screws, and the rods that support the stand's deck. Cut out the circles for the jars

carefully, then top them off with a wood furniture knob—they will make excellent covers for the jars.

The Power Supply. Maximum current requirements for plating and anodizing are about 8 amperes at 12 volts. A 12-volt storage battery will do the job, but if you have to buy a battery and, in addition, a charger to keep it in operation, it would be more economical to build a power supply from which the plater can work directly. Suitable power supply kits are available, such as the EICO Model 1050K 6-12 volt battery eliminator and charger which sells for $29.95, or you can build a supply following the schematic below.

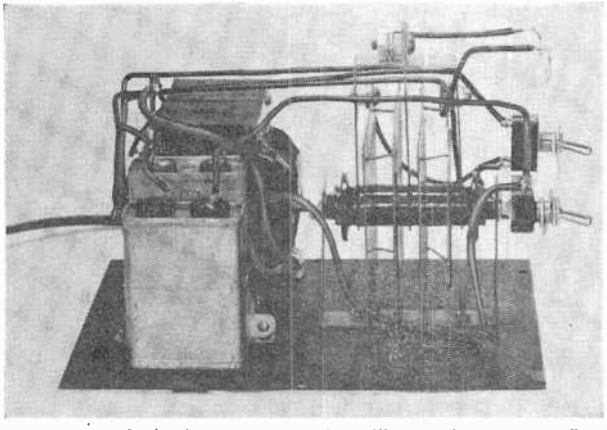
The transformer should be a heavy-duty rectifier type such as a Chicago-Stancor RT-204. Although a selenium rectifier was used in the prototype, two silicon units will also serve. Suitable silicon diodes are Lafayette 19 G 5003's, at 12 amperes, 50 PIV. These, of course, would have to be mounted on an aluminum heat sink. Although the 12-volt output from the power supply is sufficient for practically all the plating and anodizing jobs you will want to do, there may be occasions when an extra volt or two will be desirable. Extra voltage can be obtained by inserting capacitors in series with the transformer primary as shown. In the prototype, *C1* is a 4-μf., 600-volt bathtub type, and *C2* an 8-μf., 600-volt bathtub capacitor. Since we are dealing with a.c., non-polarized capacitors *must* be used.

Other power supply parts include *S2*, a s.p.s.t. toggle switch, and *S3*, a d.p.s.t. unit. The d.p.s.t. switch should be wired in the secondary circuit and marked "On Last/Off First." Switch *S2* in the primary should read "On First/Off Last." This will protect the rectifiers against voltage surges which may occur when the primary is switched on and off. The remaining component is *R1*, a 22-ohm, 50-watt rheostat (Ohmite Type J).

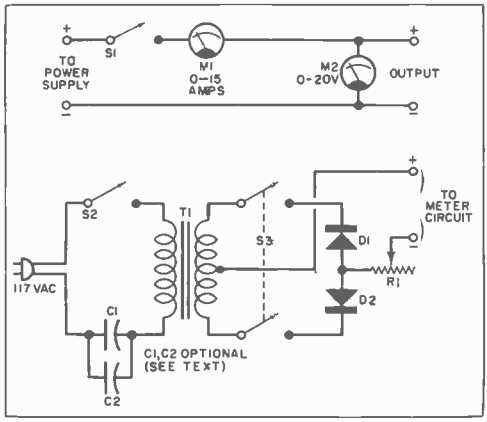
Metering. The ammeter in the photo at the beginning of this article is a surplus 0-1.5 milliammeter converted to a range of 0-15 amperes; the 0-20 volts meter is a similar unit. Actually, new meters of the inexpensive variety will serve as well, and no conversion is required. Examples are the EMICO NF-2C types available from Allied Radio.

Electroplating Techniques. There are many kinds of electroplating, some of which require chemicals that are extremely hazardous to use. For this reason, only nickel and copper plating are recommended for the beginner. Both processes are easy to handle, and together with anodizing they will provide enough finishes to fill practically every need in an experimenter's workshop.

Successful plating depends on cleanliness. All containers for solutions should be cleaned before using, and projects to be plated must not be touched directly with the hands from the time they enter the cleaning solution to the completion of the plating process. And avoid contaminating one solution with splashings



Author's power supply utilizes selenium rectifier; silicon diodes mounted on heat sink can be used instead. Capacitors must be non-polarized bathtubs.



Metering and power supply circuits are shown above. Switching arrangement protects diodes from surges (see text). Control R1 permits voltage adjustment.

from another. Move slowly and deliberately until you become experienced.

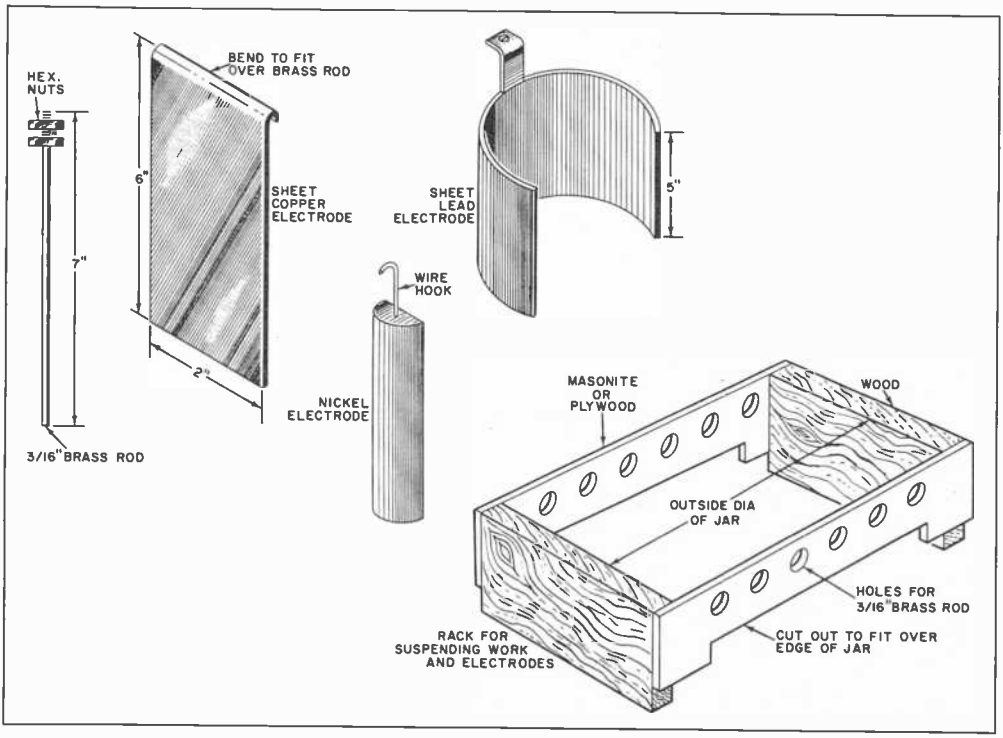
When preparing a metal object for plating, remove all scratches with fine emery cloth and polish it to the desired gloss with a buffer. Remove any oil or grease from the object with a solvent, then suspend it from a piece of bare copper wire and immerse it in a jar containing liquid household detergent and water. Swirl the object around in the detergent for several minutes, then rinse thoroughly in clean water.

In the process of electroplating, the object to be plated (referred to as the cathode) is suspended in a copper or nickel sulphate solution and connected to the negative terminal of the direct current supply. As current passes through the solution, particles of metal are dissolved from the anode and attracted to the work piece where they form a thin coating.

Nickel Plating. For nickel plating you will need 12 ounces of nickel sulphate, 1½ ounces of ammonium chloride, 1½ ounces of boric acid powder, and a piece of pure nickel. (Pieces of nickel too short for commercial use can often be obtained from your local plater.) Heat three quarts of water, preferably distilled, to about 150 degrees and dissolve the chemicals in it in the order given above. When the solution cools, it is ready for use.

Since nickel plating on brass is one of the easier operations, give your setup a preliminary try-out by plating a strip of that metal. Polish and clean the metal as previously directed, then suspend it in the nickel sulphate from a rack over the jar. Adjust the rheostat for current flow at the rate of about 10 to 20 amperes per square foot of surface to be plated. When the objects to be plated are too small to give a readable indication on the ammeter, a reading of the voltmeter will provide a satisfactory check. In that event, regulate the voltage to between one and two volts.

The time required for nickel plating will range from 12 to 20 minutes, with

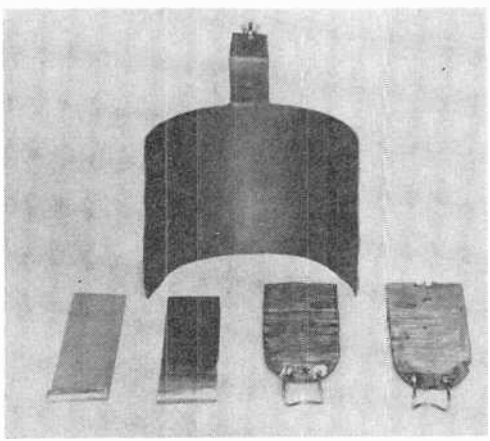


Anode for copper plating is shown above (left), for nickel plating (center), and for anodizing (sheet lead electrode, top, right). Recommended for suspending electrodes is rack at bottom, right. For copper and nickel plating, positive terminal is connected to anode, negative terminal to the object to be plated.

preference for the longer period at a reduced rate of current. Once the plating process has started, the current flow should not be interrupted until the plating is completed. If it is necessary to inspect the work during plating, do not remove it completely from the solution and make certain that it remains in contact with the power lead. When the plating is finished, rinse the work and dry it with a soft cloth or paper towel.

Copper Plating. For copper plating, secure 21 ounces of copper sulphate, 3 ounces of sulfuric acid, and a 1½″ x 6″ piece of sheet copper. Some safety precautions must be observed when working with copper plating solutions. Rubber gloves and goggles should always be worn and splashing should be avoided when pouring solutions. Pour the acid slowly into the water—NEVER POUR WATER INTO ACID! Pour three quarts of distilled water into one of the jars, add the copper sulphate, and stir with a glass or plastic rod until it is dissolved. Then *slowly* add the sulfuric acid to the solution and stir. Follow the polishing and cleaning operations outlined for nickel plating.

When plating iron or steel in an acid solution, a special preliminary procedure must be followed to make the copper adhere. Pour three quarts of water into a jar and add 10 ounces of sulfuric acid. Immerse the piece of sheet copper and the work piece in the solution and connect them to the terminals so the copper will be negative and the work piece positive. Note that the polarities are opposite from those required for the plating procedure.



Anodizing electrode is at rear, electroplating anodes in foreground. Two nickel pieces at right were cut from "short-end" secured from commercial plater.

Regulate the rheostat until gas bubbles arise from the work piece, and leave it in the solution for about five minutes. This prepares the steel for the plating of nickel to follow. Now remove the work piece from the solution, rinse it thoroughly, and transfer it to the nickel bath for about three minutes to receive a light coating of nickel, then to the copper plating solution for its final coat of copper. When a final coating of nickel on steel is required, the customary practice is to make it over a coating of copper as outlined above.

The current requirements for copper plating range from 10 to 40 amperes per square foot with a voltage range of one to four volts. The luster of copper or nickel plating can be further improved by buffing the finished work with a light polishing compound, but care must be used with copper so that you do not cut through its softer surface.

Anodizing. In the process of anodizing, a coating of aluminum oxide is formed on the surface of the aluminum. This coating is porous, and will absorb dyes made especially for the purpose to produce many beautiful effects. After dyeing, the surface may be sealed to provide lasting colors.

For anodizing you will need 7½ ounces of sodium hydroxide or household lye. (Handle it very carefully. Avoid getting any on your skin or clothing, and wear gloves and goggles.) Other necessary materials are 20 ounces of sulfuric acid, and an 8″ x 10″ piece of sheet lead. Cut the sheet lead to 5″ x 10″ size with a 1″ x 3″ tab extending from its center. Then shape the lead into a semicircle and place it inside the anodizing jar. Secure a terminal screw to the end of the tab and bend the tab over the jar edge.

Like plating, successful anodizing requires that the work piece be thoroughly cleaned. The same procedure should be followed as for plating, except that the work should be rubbed with fine steel wool prior to cleaning. Pour 10 ounces of sulfuric acid into three quarts of water for the anodizing solution. Al-

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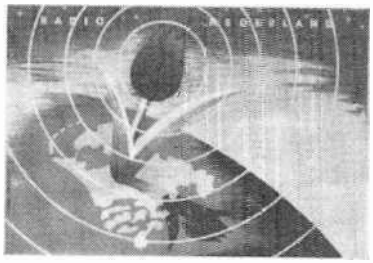

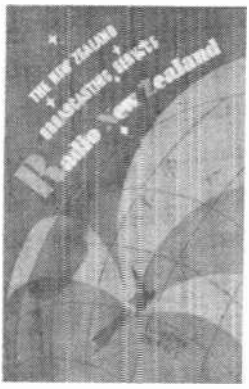

HOW TO GET THOSE HARD-TO-GET QSL's

By GERRY L. DEXTER

You CAN get
that station verification
you're after
if you work at it

MANY THINGS can happen between the time you drop your report into a mailbox and, hopefully, the mailman arrives bearing that all-important verification. Your report can get lost in the mail, for instance—the address may be wrong, out of date, or incomplete. If it does reach the station, it may be mislaid there, or fall into the hands of a secretary who doesn't know what it is. Or it may not include enough details of interest or value to the station operators to be worth a verification. In some instances, of course, a station may have a no-verification policy, plain and simple.

Let's take for granted the idea that getting a QSL card is going to be like pulling the proverbial "hen's teeth," and then see what can be done to improve your score. Some of the following suggestions may seem obvious to you, but others may indicate a better way of doing things.

First, your name and address should appear on every page of the report as well as on the envelope. It should be typed or carefully printed.

Station addresses, names, and/or slo-

gans can usually be found in the *World Radio TV Handbook*. Recent changes in address can often be found in club bulletins. If absolutely necessary, you can make up an address using the station name or slogan, call, city, province or state, country and continent. Including the station call in the address provides further insurance that your card will reach its destination, and often, when the station uses more than one frequency, including the call will help indicate more clearly which frequency you heard.

Detailed Reporting. List the station's frequency in kilocycles or megacycles. Most foreign stations use the term "meters," and this designation should also be included. The frequency in meters can be found by dividing the frequency in kilocycles into 300,000. If the frequency you give is approximate, *be sure* to say so in your report.

In listing time, use Greenwich Mean Time. In addition it is often wise, particularly with less widely heard stations, to convert GMT into the station's local time.

There are a number of commonly used signal strength and interference reporting codes, and it is perfectly O.K. to use them. However, you should also include a verbal description of the signal strength and interference in your report; when mentioning interference, note the type, intensity, and effect on the signal. If the station is transmitting on more than one frequency, try to check each and give the station a comparison report. Comparison reports on different transmissions made during the same day will also be appreciated by the station.

If at all possible, your program log should cover at least 30 minutes. Make it as complete as possible, listing the titles of musical selections you hear, if you know them, or at least the type of music (female vocal, piano solo, etc.). If the broadcast is in English, try to get the station identification word for word. If the station is using some other language, try to determine what language it is and to pick up enough of the words so that you'll know what they're talking about. Any unusual items such as a news bulletin or technical difficulties should, of course, be mentioned. Try to have your timings accurate to the nearest minute.

Items of Interest. Give not only the make and model of your receiver in your report, but also the number of tubes, i.f. and r.f. stages, and other special equipment that you use, such as a crystal filter, Q-multiplier, preselector, etc. Describe your antenna, and include type, height, length, and direction of prime effectiveness.

It will add interest to your report if you give the approximate distance you are from the station, the sunspot count (this may be obtained from broadcasts of the Swiss Broadcasting Corp., or from the propagation columns in some amateur radio magazines), and band conditions.

Although band conditions are relative, a comment or two helps indicate whether reception was normal, above normal, or below normal. A comparison of the signal of the station to which you are reporting and signals from stations in the same area and in the same band at the same time is a great help to a station. You can get forecasts of radio conditions in POPULAR ELECTRONICS and, on a daily basis, from National Bureau of Standards Station WWV. A letter to WWV will bring you details of this service.

Another item of interest to the station is your exact location in terms of latitude, longitude, and height above sea level.

Request a Verification. When it comes to verifications, the byword is *request*—never *demand*. A verification is a *courtesy* on the part of the station and not an obligation. Ask that your report be checked and, if found correct, that a card or letter of verification be sent.

Unless you *know* that a station does not require return postage, it should definitely be included with your report. The most often used form is the International Reply Coupon which your post office can supply for 15 cents. This is redeemable in most countries for enough postage to send a return by surface mail. Mint airmail stamps, however, will get you a faster reply Also, they are good in countries which do not redeem IRC's. One source of foreign mint stamps is A. N. Ringler, W2SAW, 466 Weaver Rd., Webster, N.Y.; W2SAW will be happy to send you a list of available stamps. As an extra precaution, you can

(*Continued on page* 89)

THE NIGHT BEN FRANKLIN CALLED IT A DAY

By FRED E. EBEL

You just don't see many Leyden jars these days

IT ALL STARTED the day I bought that transmitter from Jake. I can still hear him bragging: "It's so super you can load it with a piece of wet string!" I was never one to take to expressions, but for some reason Jake's statement sent a charge of d.c. to an imaginary bulb above my head. The bulb lit—I had an idea!

Why not load the transmitter with a piece of wet string—attached to a kite? What a skyhook! Zowie! I considered my idea a real stroke of genius. I even thought of soaking the string with salt water to increase conductivity. Maybe it would come to be known as the *Electrolytic Antenna* . . . maybe even bear my name!

I chose 2 meters because of its quasi-optical characteristics. Armed with a water bucket, salt, and a ball of twine bigger than a grapefruit, I ran the kite into the air. It rose higher and higher. I imagined the DX would be terrific!

But when I tried to load the string, nothing happened! The wind had dried it out! I felt like Edison trying to use a hair for a filament in that first bulb. Of course I could have flown the kite in a rainstorm, but I found no immediate desire to be at the receiving end of a 500-foot lightning rod!

Discouraged, I wandered back to my workshop to dabble with a power supply I had been building. Finally, a hunger pang won out and I retired for the night after a light snack consisting of two peanut butter sandwiches, a huge pickle, and a bowl of ice cream!

That night I dreamed!

I REMEMBER IT as though it actually happened; it was all so clear. I was bending over a hot soldering iron, connecting a lead from an 8-μf. filter capacitor to the B+ terminal, when suddenly I became aware of a white ruffle at my elbow. I knew it wasn't my wife since the ruffle led upward to a shoulder that revealed one huge braid—my wife wears a pixie! Facing the would-be intruder full-front, I was amazed to find Benjamin Franklin standing in my ham shack, resplendent in his frock coat with large buttons and pointed-toed shoes!

"Er, shouldn't you be signing the Declaration of Independence, or something?" I decided to say.

"Thou hast aroused my curiosity, lad." He waved a ruffled hand toward the power supply. "Thy strange apparatus, I . . ."

"That," I interrupted, with pride, "is a power supply I'm building for my ham transmitter. It'll deliver a full 400 volts d.c. at full load! In fact . . ."

"There," he said with a patronizing grin as he pointed skyward, "is where thy power lies. If you will construct a kite from a silk handkerchief with two cross-sticks, one with a pointed wire attached . . ."

"Please, Mr. Franklin," I begged, "I have no desire to lead a couple of million volts into my ham shack." I mentally recalled the front end of a receiver I once reduced to smoking ruin because of failure to ground the antenna.

"Ham shack?"

"Oh, *that,*" I proudly boasted. "That's a term given to licensed amateur radio operators who have . . ."

"Amateur?"

"Ah, you were saying something about a silk handkerchief, cross-sticks and string, I think, Mr. Franklin!"

"Oh, yes. Ahem! Young man, the electrical fire from a charged cloud will pass down the string to a key which thou wilst have attached to the end. From this thee may draw sparks!"

"You can say that again," I chuckled. "Look, Ben, I don't need sparks. See this cord with this plug attached? I push the plug into the wall outlet and I can get all the power I need."

Biting his lip, Franklin stood shaking his head. "It is ill manners to silence a fool and cruelty to let him go on."

"Hey, wild! I was wondering when you'd get around to quoting bright sayings from your *Poor Richard's Almanac!"*

"But dost thou not see, lad? Thee may not draw electricity by thrusting wire into a wall. *There* is where the electric fire is!" Again that ruffled hand was majestically pointing skyward.

Taken by this statuesque pose, I moved a step backward directly into the tip of my heated soldering iron. "Yeeeeeeeoooooow . . ." my posterior remarked to my brain cells. "Yeeeeeeeooooow . . ." my lips repeated, getting the message. "Why don't thee and thou and all the rest of you go fly a kite yourself?"

"Remember, he makes a foe who makes a jest," Franklin frowned. "As for thy reference to flying kites, I did so several hundred years ago. Indeed, I proved that lightning is electricity and I invented the lightning rod."

My smile turned to smirk! "Seems like I recall something about you not grounding the lightning rod."

"True," he blushed, "but I soon corrected the error."

"Lucky no one was broiled in the meantime!"

"Tell me of my faults and mend thine own," he Poor Richarded again, and he moved toward the workbench. "Tell me, my son, what is that odd-looking cylindrical object?"

"That's an 8-microfarad electrolytic capacitor; a condenser, I believe you may have called it. It stores electricity."

"Ah," his round face was aglitter, "the Leyden bottle!" He opened what appeared to be a carpet bag and, lo and behold, extracted a Leyden jar. "Here, thou must have it. It will store thy electrical fire!"

"Look, old man . . ."

"Tut, tut! Thou must respect thy elders!"

"No offense, sir. We hams call everyone 'old man,' regardless of age."

"A strange lot." But he was turning on the charm again, despite his puzzled look. "Here, attach the Leyden jar and remove that foolish *electrolysis contabulator."*

I decided to humor the great statesman. After all, how often does one dream with Benjamin Franklin? I connected the Leyden jar into the circuit. One thing for sure, *my* power supply would be *different!*

Mr. F. was pulling more goodies from the bag. "To fill the bottle with electric fire," he said, "we must rub this tube with the silk handkerchief and then apply the tube to the bottle. The vitreous fluid will . . ."

"Vitreous fluid! Ben, we've come a long way since your vitreous positive and resinous negative fluid. Today we rely on the electron theory."

Franklin shook the braided head. "Being ignorant is not so much a shame as being unwilling to learn."

That Poor Richard aphorism hit where it hurt. It was my turn. "Ben, I didn't

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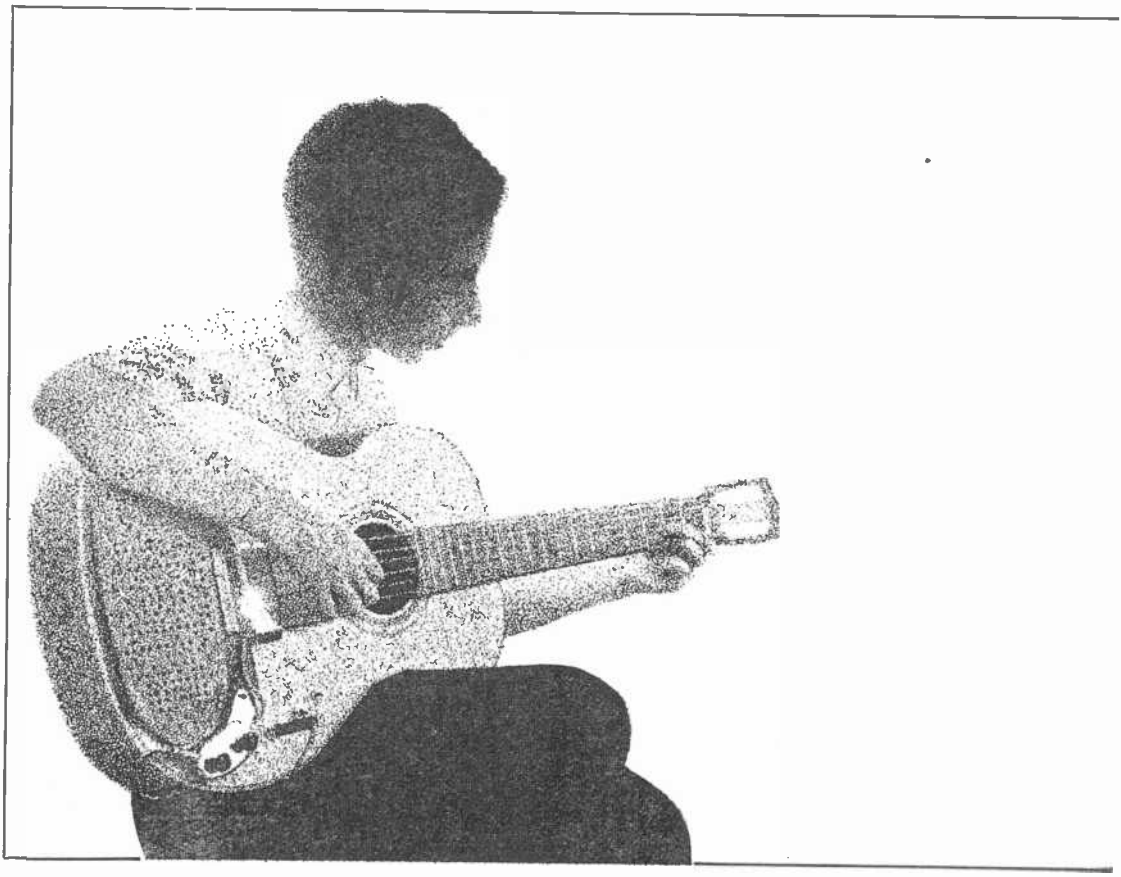


Lightweight and portable, it's just the thing for outdoor parties

IDEALLY SUITED for the hootenanny or beach party, this one-unit amplifying guitar needs no a.c. source or long extension cord. The complete power package is located out of sight, inside the unit. In addition to this convenience, guitar players will find the tone greatly enriched because of the added resonance of amplified sound. The instrument can also be played through an extension loudspeaker.

Construction costs of the amplifying guitar will vary with the type of instrument used. If you already have a guitar, it will cost about $18 to electrify it. If you don't, select an inexpensive folk-style, classic flat-top guitar with nylon strings, available in many stores for $16 and up. A steel-string guitar can be used if there is enough room for the speaker-amplifier assembly beneath the bridge. A hollow-body guitar gives the complete unit a desirable timbre and is most adaptable to this all-in-one packaging.

Construction. The speaker-amplifier assembly is shown in Fig. 1. Start construction by mounting the parts on the speaker frame with epoxy cement. The use of cement, rather than drilling and tapping for assembly, prevents the possibility of ruining the speaker. Be sure all parts are clean before cementing.

Wire the speaker-amplifier assembly as shown in Fig. 2. The leads between the speaker assembly, jacks and switch should be long enough to provide easy removal of the assembly when it becomes necessary to make battery changes.

Installation. Loosen the strings of the guitar to remove tension from the frame, then carefully lay out the opening for the speaker assembly. The opening should be centered between the base and bridge of the guitar, and should be made no

AMPLIFIER MODULE ELECTRIFIES GUITAR

By M. E. McGREW and NORM FRIED

larger than necessary. Be sure to leave enough wood ($\frac{3}{16}$" minimum) around the cutout for the screws that hold the assembly to the guitar.

After drilling a starting hole, cut through the guitar body with a fine-blade keyhole saw. Do this slowly and carefully to avoid splitting the wood. Then run a thin film of cement around the edge of the cutout for added strength and to moistureproof the wood.

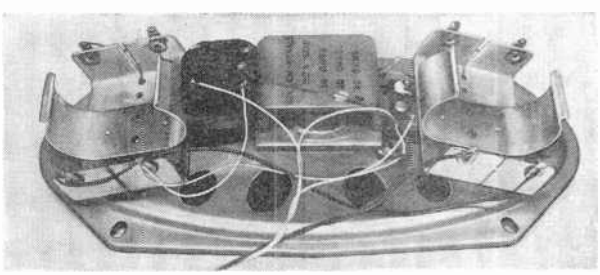


Fig. 1. Amplifier-speaker assembly, complete except for batteries. Components are mounted with glue.

Use the speaker holes as a drill guide to locate the holes for the four *6-32* screws. Cement *6-32* nuts and washers on the inside of the guitar in line with these holes. Spread the cement around to give the wood additional strength and to obtain a firm anchor for the nuts. Then drill three holes in the guitar body for the switch and jacks and secure them in place as shown in Fig. 3. Decal letters protected with a coating of lacquer will add a professional touch.

Mount the speaker assembly and covering grille in place and secure them with the four screws. The grille can be made from a $\frac{1}{16}$"-thick phenolic plastic board, available from most hobby shops. Predrilled boards or thin sheet aluminum can also be used.

Next, mount the contact microphone. If your guitar has no *F* holes in the body, remove the *F* hole clamp from the contact microphone and cement the pickup to the guitar adjacent to the bridge, as shown in Fig. 3. If your guitar has *F* holes, simply clamp the microphone into one of them. A word of caution at this point: do a little experimenting before cementing the microphone in place to determine the best location for maximum volume. Then mount the volume and tone control unit and run a film of cement around the metal base of the unit to hold it firmly in place.

Operation. Plug in your pickup jack, turn the switch on, and you are ready

PARTS LIST

1—Amplifier module (Cordover GA-9 or equivalent)
2—Battery holders (Keystone 176 or equivalent)
1—Guitar, classic flat-top styling with nylon strings
1—Microphone, guitar contact with adjustable volume and tone controls (Olson Model M-161 or equivalent)
1—Phone jack, closed-circuit (Switchcraft C12-A or equivalent)
1—Phone jack, open-circuit (Switchcraft 11 or equivalent)
1—Plug (Switchcraft 40 or equivalent)
1—Speaker, 4"x10" oval, 8 to 45 ohms
1—Switch (Cutler-Hammer 7580K4 or equivalent)
Misc.—Four D batteries, No. 22 hookup wire, epoxy cement, four 6-32x1" machine screws and nuts, washers, etc.

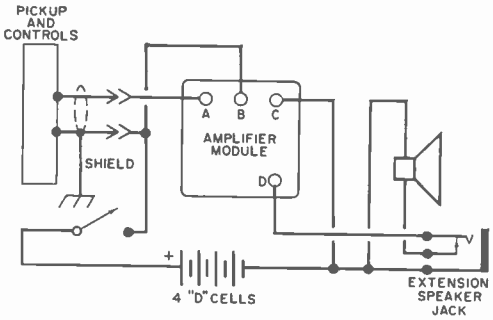


Fig. 2. Connections are made to the amplifier module as shown. For extra volume, add two more D cells.

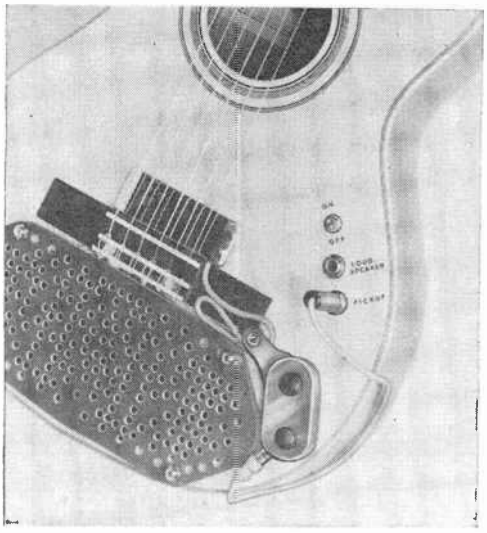


Fig. 3. Note placement of the contact microphone and controls. If your guitar has no "F" holes, cement the pickup in a "hot" spot next to the bridge.

to play. The volume and tone controls can be set to desired levels. For greater volume, two more *D* cells can be added in series. For additional reinforced sound projection, plug a 12" loudspeaker into the amplifier.

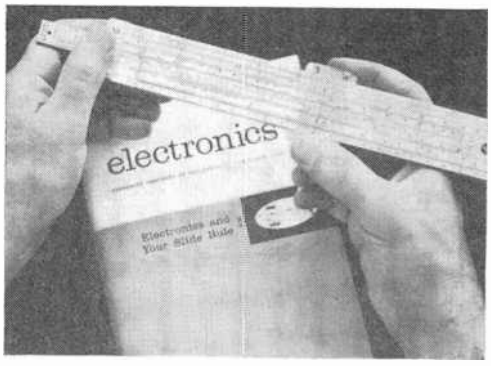
Didn't know the old guitar could sound that good, did you? —30—

"MUST" SLIDE RULE FOR ELECTRONICS

UNLESS you're a 100% Edison-type thinker, there will come a day when you've got to sit down and figure resonance or reactance. If you belong to the old school, you'll do it the hard way, but if you're 1965-oriented, you'll want to use the Cleveland Institute of Electronics slide rule.

My first impression of this slide rule remains unchanged—why didn't someone think of making one before? Cleveland Institute sells the slide rule through its bookstore (1776 East 17th St., Cleveland, Ohio 44114) for $14.95. Along with this novel instrument, you receive a 124-page book carefully detailing just how it is to be used.

The basic idea behind the development of the Cleveland slide rule was to change the scales on the reverse side so that



they read out in electronics values (reactance, resonant frequencies, etc.), Also on this side are the most useful formulas—just in case you've forgotten some. —*O. P. Ferrell*

R/C TRANSMITTER

By DANIEL MEYER

Transmitter sends tone-modulated signals up to 1 mile to energize miniature R/Ceiver

THIS TRANSMITTER is designed to operate with the miniature R/Ceiver described in the April issue. It can also activate any other receiver using tone-modulated signals in the Citizens Band, and can be operated without a license under Part 15.205 of the FCC Regulations. Transmitter output is approximately 90 milliwatts, more than enough to control a model up to one mile, line of sight, with the proper receiver.

The unit is powered by a 9-volt battery, and up to 20 hours of operation can be had with a No. 276 Eveready battery or equivalent. Weight of the complete transmitter including battery is a trifle over 1½ pounds. Cost of parts should not be more than $10 to $12.

Construction. Thanks to the availability of a special printed circuit board and pre-wound coils, construction is easy. The parts are mounted in the positions indicated by the part numbers printed on the top side of the printed circuit board. (See Figs. 1 and 2.)

The primary side of coil *L1*, indicated by a red dot, should be installed next to capacitor *C2*. Coil *L2*'s connections are between point *B* and *RFC1*. When installing the coils, be careful not to apply too much pressure on the lugs. Work

the lugs into the holes slowly, by rocking the form as it is pushed down. Rough handling can break the lugs loose from the coil form base.

After all parts are installed, bend the leads flush to the foil side of the board and cut them off so that they do not bridge any gaps between conductors. Solder the leads to the etched foil with a 25- to 50-watt iron. Use only rosin-core solder. Heat the lead being soldered and the foil at the same time and let the solder flow onto the connection. Avoid excess heat: it can cause the foil to separate from the board.

Drill out all the openings in the metal cabinet as shown in Fig. 4. Use a file to square off the opening for the switch. And use a wooden block behind the metal to prevent distorting the case when drilling or filing. The prototype transmitter is covered with a white self-adhesive vinyl plastic sheet.

Mount the rubber feet, switches, threaded spacers and antenna post as shown in Fig. 4. The antenna post is an *8-32* x ½″ panhead machine screw. It should be installed with a fiber shoulder washer on one side and a flat fiber washer on the other side of the metal to insulate the antenna from the case. Don't forget the solder lug between the head of the antenna screw and the fiber washer. Then wire in the battery clip and other leads.

Mount the circuit board on the two threaded spacers with *6-32* x ¼″ machine screws as shown in Fig. 5. Connect the wires from the antenna, switches, and battery to points *A*, *B*, *C* and *D* as indicated on the board.

How It Works. Transistor *Q1* acts as a crystal-controlled oscillator operating on the channel determined by the crystal. Coil *L1* and capacitor *C2* form a resonant circuit at the crystal frequency. The crystal provides a feedback path from the collector to the base of *Q1*. Resistors *R1* and *R2* establish the bias at the base of *Q1*. Capacitors *C1* and *C3* bypass r.f., as shown in Fig. 6.

The output stage (*Q2*) operates as a Class C amplifier. The base is link-coupled by *L1*, and resistor *R4* limits the current through *Q2* to a safe value. Collector voltage is obtained by way of *T1* and the r.f. choke. The tuned output stage consists of *L2* and stray antenna capacitance connected in series; this has a bearing on antenna resonance.

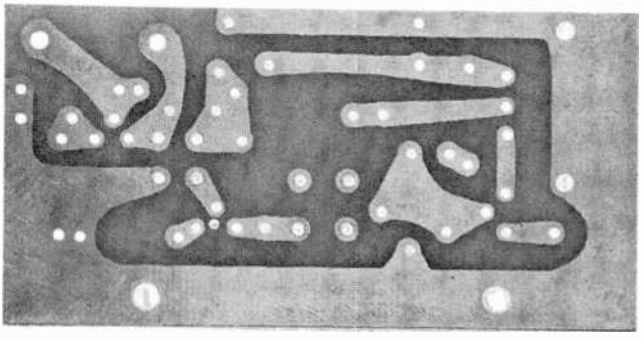


Fig. 1. Actual size photograph of printed circuit board will guide you in making your own.

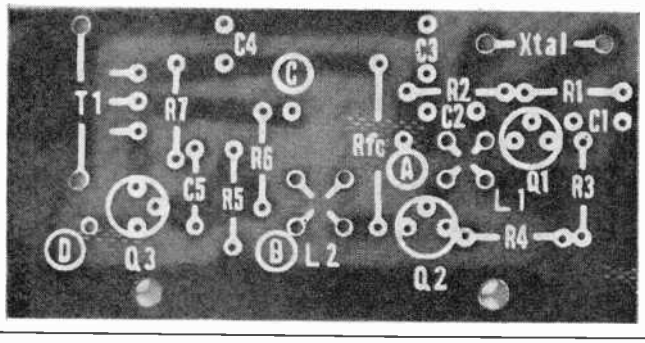


Fig. 2. Component side of board showing parts location and points at which to attach leads.

The tone generator stage (*Q3*) is an audio power oscillator. The auto-transformer (*T1*) provides feedback to the transistor base by way of *R7* and *C5*. Capacitor *C4* acts as an r.f. bypass. The emitter of *Q3* is connected to the *Tone* switch. Closing this switch completes the emitter circuit and operates the tone oscillator.

Tuning the Transmitter. The transmitter can be tuned with a field strength meter, or if one is not available, with a tuning meter you can easily make. The circuit is shown in Fig. 7.

The field strength meter can be loosely coupled to the transmitter circuit, while the less sensitive tuning meter would have to be connected to the antenna. You may or may not get a reading on the meter when the transmitter is turned on for the first time. If no reading is noted, turn the core in coil *L1* until you do get a maximum reading. Use a non-metallic tuning tool to make adjustments.

If everything is working normally, the output should reach a maximum and then suddenly drop to zero as you rotate the core. When this happens, return the core to a point a bit less than maximum. If you attempt to peak the oscillator, it will probably refuse to start after the power is turned off and then turned on. Then tune coil *L2* for maximum output.

All adjustments should be made while you are holding the case. Your body is part of the antenna circuit on this type of transmitter and adjustments must be made under in-use conditions.

After adjusting the coils, press switch *S2*. If the meter reading drops slightly

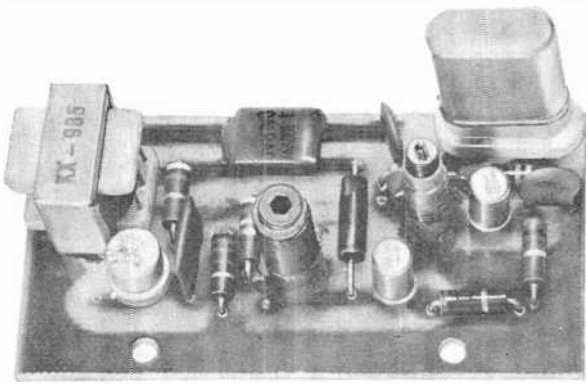


Fig. 3. Parts mounted on board, including crystal holder. Leave 1/16" air space under transistors. Connect leads to board before installing in cabinet.

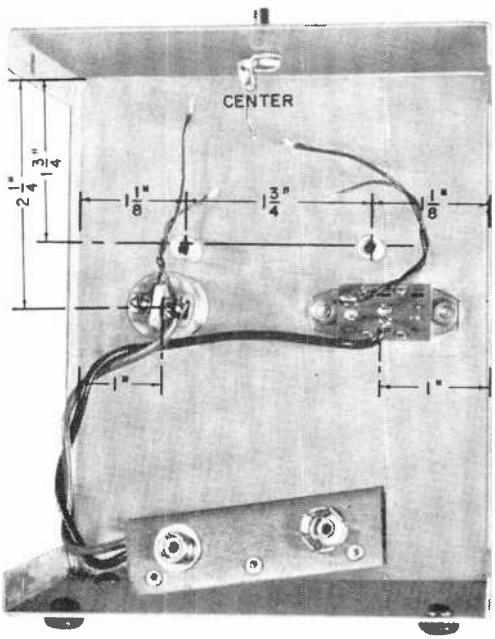


Fig. 4. Prepare cabinet and mount parts as shown before installing completed board. Note terminal located between screw and washer on antenna post.

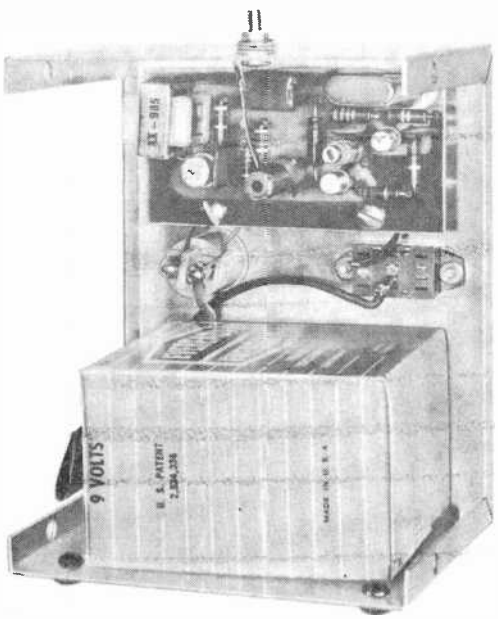


Fig. 5. After installing the board and battery, cement a piece of ½"-thick foam rubber to the inside of the cover to hold the battery in place.

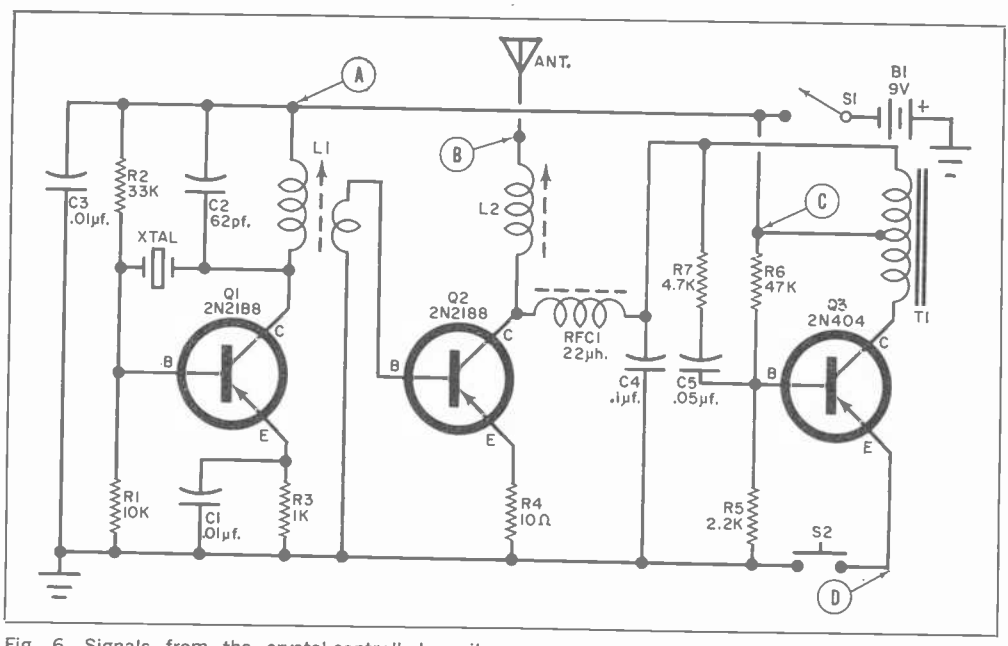


Fig. 6. Signals from the crystal-controlled oscillator (Q1) are modulated by tone generator (Q3) and boosted by the amplifier (Q2) for transmission.

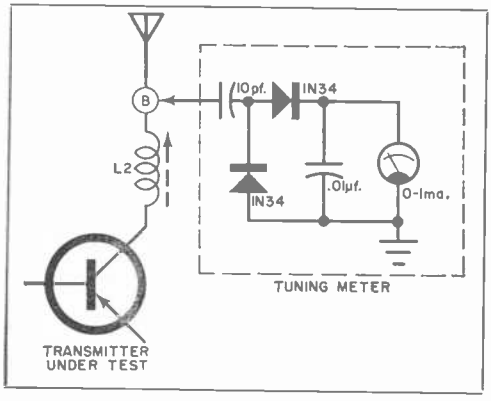


Fig. 7. Tuning meter can be easily made to align and check transmitter. Loosely couple or attach the meter to the antenna to get a usable reading.

the audio oscillator is probably working. This can be confirmed with a CB receiver if one is available.

Operation. Extend the antenna all the way, turn on the switch, and press the *Tone* button. Reduced antenna length will reduce the output. Check the battery periodically. If the battery voltage drops below 8 volts with the transmitter and the tone oscillator on, replace the battery. -30-

PARTS LIST

B1—9-volt battery (Eveready 276 or equivalent)
C1, C3—0.01-μf., 50-volt ceramic capacitor
C2—62-pf., NPO ceramic capacitor
C4—0.1-μf., 50-volt ceramic capacitor
C5—0.05-μf., 50-volt ceramic capacitor
*L1—Oscillator coil: primary, 12 turns of #26 magnet wire on 3/16" coil form with tuning core (Lafayette 34 G 8772 or equivalent); secondary, 3 turns of #26 magnet wire, bifilar wound, starting with third primary winding from the bottom end of the coil form and working down**
*L2—Tuned output coil: 25 turns of #26 magnet wire on ¼" coil form with tuning core (Lafayette 34 G 8952 or equivalent)**
Q1, Q2—2N2188 transistor
Q3—2N404 transistor
R1—10,000 ohms
R2—33,000 ohms
R3—1000 ohms
R4—10 ohms
R5—2200 ohms
R6—47,000 ohms
R7—4700 ohms
All resistors ½ watt, ± 10%
*RFC1—22-μh. r.f. choke**
S1—S.p.s.t. slide switch
S2—Normally open push-button switch
*T1—1600-ohm, center-tapped autotransformer***
Xtal—Third-overtone Citizens Band type crystal, 0.005% tolerance (any frequency within specified band)
1—52" telescoping whip antenna (Lafayette 99 G 3008 or equivalent)
1—3" x 4" x 5" aluminum box (Bud 2105 or equivalent)
*1—Printed circuit board**

*A set of parts consisting of the printed circuit board, T1, RFC1, and wound coils L1 and L2 is available from Daniel Meyer, Box 16041, San Antonio, Texas 78216 for $5.00.
**Available separately from Daniel Meyer for $1.00.

SIMPLE 60-CYCLE STROBOSCOPE

By LYMAN E. GREENLEE

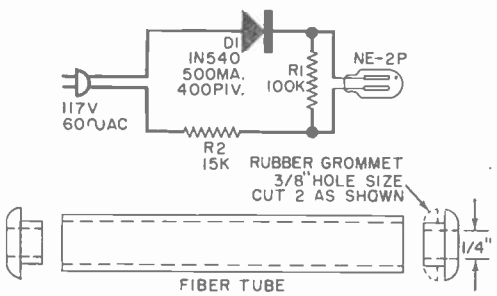
Use house current to synchronize rotating and vibrating devices

ANYTHING THAT VIBRATES or rotates at the rate of 60 times a second or a multiple thereof will appear to stand still when illuminated by this pocket-sized stroboscope. Measuring a scant three inches, this handy unit has many applications, including inspection of clock movements and a speed check of electric motors such as those found in tape recorders and record players. Do not confuse this unit with a simple neon lamp tester whose light flickers at a 120-cycle rate.

While almost any neon lamp can be used as the light source in this project, the new General Electric NE-2P is desirable because of its high intensity and low cost. The circuit is simple and straightforward; the entire assembly slides into a 3/8" inside diameter by 3"-long fiber or other suitably insulated tube. The neon lamp is held in place with a 3/8" rubber grommet that has been trimmed on one side as shown in the diagram. A similar grommet fitted to the opposite end of the tube holds the line cord in place. A few drops of cement will keep the grommets from working loose.

Diode *D1* allows only a half cycle of the 60-cycle a.c. line voltage to pass through the circuit. This is one of the few instances where the polarity of diodes is not important; you can, therefore, install the diode either way. Resistor *R1* is the load resistor and the voltage drop across it when current is flowing fires the neon lamp. Resistor *R2* is a current limiting device.

It is true that the 60-cycle strobscope will perform many circuit tests like an ordinary neon tester, but an ordinary neon tester cannot work like a 60-cycle strobe. -30-



Diode rectifier halves 120-cycle flashing rate to stop 60-cycle motion, or a multiple thereof. The entire circuit can be fitted into a 3" fiber tube.

PARTS LIST

D1—500-ma., 400-PIV silicon rectifier (1N540 or equivalent)
I1—Neon lamp (General Electric NE-2P or equivalent)
R1—100,000-ohm, ½-watt resistor
R2—15,000-ohm, ½-watt resistor
Misc.—Two grommets (¼" inside diameter x 3/8" shoulder diameter), line cord, 3" fiber tube (3/8" inside diameter), etc.

To construct the 60-cycle stroboscope, position and solder the components as shown, insulate the bare wires to prevent shorting, slide the works into the tube, and cement grommets in place.

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

TROUBLESHOOTING transistor equipment, whether home-built or factory-assembled, can be a tricky proposition. The improper use of test instruments can—and frequently does—cause additional damage. If you want to diagnose, rather than cause, trouble when servicing your equipment, you'll find it worthwhile to observe the following "Do's" and "Don'ts."

DO be familiar with your test equipment. Quite often, the open circuit voltage of a meter is enough to damage a semiconductor under test.

DO bond your a.c.-operated test equipment together with ground straps and to the equipment being tested, for the a.c. hum component on an instrument's ground lead may exceed the voltage rating of a semiconductor.

DO measure voltage to circuit ground and not across a component when working with a VTVM.

DO use a low-capacity probe with your oscilloscope when checking high-impedance circuits.

DO use heat sinks when removing or replacing semiconductor devices that are soldered in place.

DO observe all d.c. polarities, especially when replacing diodes, electrolytic capacitors, and batteries.

DON'T use old standard capacitor checkers to test low-voltage capacitors in transistor circuits without knowing the test voltage. The voltage output of many capacitor checkers may well exceed the ratings of the new electrolytic capacitors.

DON'T "dead-short" capacitors to discharge them when checking high-voltage circuits. The resulting current surges can cause damage to capacitors, transistors and diodes.

DON'T check capacitors by shunting another capacitor across them while the equipment is turned on. If you *must* use this test procedure, first turn the equipment off, then connect the shunt unit.

DON'T use high-voltage or shunt-type ohmmeters to check semiconductor devices or components.

DON'T use resistance measurements as an absolute guide, particularly when making in-circuit tests. Remember that ohmmeter current can bias transistors to various states of conduction.

DON'T switch the equipment on and off rapidly. The resulting transients can damage transistors and diodes.

DON'T make tests haphazardly. If in doubt about what a specific test should show, or its effect on circuit operation, DON'T make it. Use a substitute technique.

Readers' Circuits. Inexpensive, easily built, and virtually foolproof, the simple *p.a. amplifier circuit* shown in Fig. 1 was submitted by Edward Welch (11 Caspar Street, Boston, Mass. 02132). It can also be used as a power megaphone.

Edward used a single *pnp* transistor in a common-emitter hookup as a power amplifier. Base bias is supplied through resistor *R1*. The input signal is obtained from a carbon microphone which is coupled to *Q1* through impedance matching transformer *T1*, and d.c. blocking capacitor *C1*. The transistor is direct-coupled to the speaker. Operating power is supplied by a 3-volt battery, switched on or off by *S1*.

Readily available components are used in the circuit. Transistor *Q1* can be almost any common power type, such as a 2N176, 2N301A, or 2N554. The microphone is a single-button carbon unit. Capacitor *C1* is a 25-μf., 10-volt electrolytic, and *R1* is a 2200-ohm half-watt resistor. Any size speaker with a 4-ohm voice coil can be used. The power supply is made up of two flash-

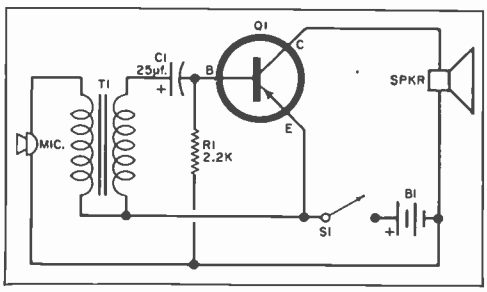


Fig. 1. Simple audio amplifier circuit submitted by Edward Welch can be used as power megaphone.

light batteries connected in series. A toggle. slide, or rotary switch will do for *S1*.

Any of several construction techniques can be used. Edward suggests assembling the circuit in a small loudspeaker baffle, with a jack provided for the microphone. If preferred, however, the amplifier proper could be assembled in a small Minibox and jacks provided for both the microphone and the speaker.

In developing the *power supply circuit* shown in Fig. 2, reader Alan Brookstone

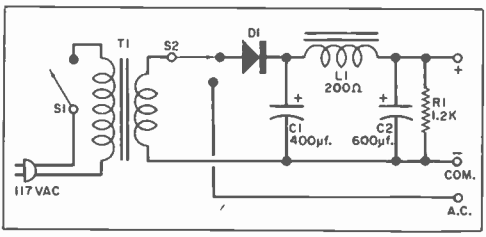


Fig. 2. Alan Brookstone's power supply extracts 9 to 12 volts from a 6.3-volt transformer to power transistor equipment, eliminating need for battery.

(17401 N.W. 19 Ave., Miami, Fla.) has taken advantage of the fact that a filament transformer will deliver voltage considerably higher than its nominal rating when lightly loaded. Using a standard 6.3-volt filament transformer, he is able to obtain as much as 9 to 12 volts d.c. and up to 15 ma. of current.

The circuit design itself is conventional. Voltage obtained from *T1* is applied to a half-wave rectifier (*D1*) and filtered by a pi-type network consisting of *C1*, *L1*, and *C2*. Bleeder resistor *R1* improves regulation and reduces the output voltage to 9 volts, as required by many transistor circuits. If a higher output voltage (12 volts) is required, *R1* may be removed. Switch *S2* permits a 6.3-volt a.c. output to be obtained.

Alan has used standard parts in his design. Transformer *T1* is a 6-volt, 1- to 3-ampere filament type. Diode *D1* can be any medium-current general-purpose unit (International Rectifier 5A4-D or equivalent). Capacitors *C1* and *C2* are 15-volt electrolytics, and may be tubular units or a multi-section can. Inductor *L1* is a conventional filter choke with approximately 200 ohms d.c. resistance, and *R1* is a half-watt resistor. The switches can be either toggle or slide types; *S1* is a s.p.s.t. and *S2* a s.p.d.t unit. Banana jacks, insulated binding posts, or a screw-type terminal strip can serve as output connectors.

The power supply can be assembled in a small cabinet for bench use, or wired on a circuit board for permanent use in other equipment. Neither parts arrangement nor wiring is critical.

Manufacturer's Circuit. The medium-power audio amplifier circuit shown in Fig. 3 was developed by RCA (Harrison, N.J.) and described in their Application Note No. SMA-35. Low-cost *npn* silicon transistors, able to operate from a 12-volt battery, are employed.

Performance-wise, the circuit can deliver up to 3 watts at a total harmonic distortion of approximately 2 percent at 1 kc. Overall gain is about 87 db, and input impedance is 500 ohms. The amplifier draws slightly over 500 ma. at a nominal 13.7 volts, and can be used at relatively high ambient temperatures.

A common-emitter type circuit is used in the first (*Q1*) and third (*Q3*) stages. The second stage (*Q2*) is operated as a modified emitter-follower. There is direct coupling between all stages, and transformer coupling to the output load.

The input signal is applied through d.c. blocking capacitor *C1* to *Q1*'s base and to circuit ground. Transistor *Q1*'s base bias is developed across a voltage divider network

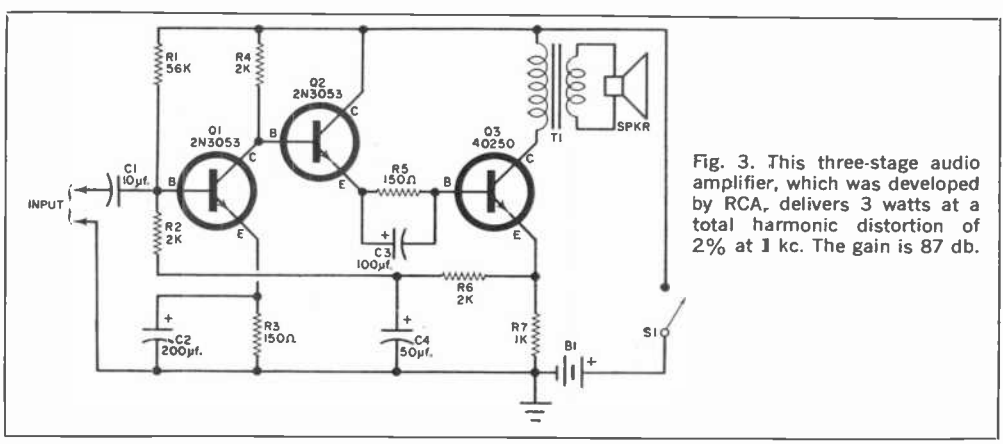


Fig. 3. This three-stage audio amplifier, which was developed by RCA, delivers 3 watts at a total harmonic distortion of 2% at 1 kc. The gain is 87 db.

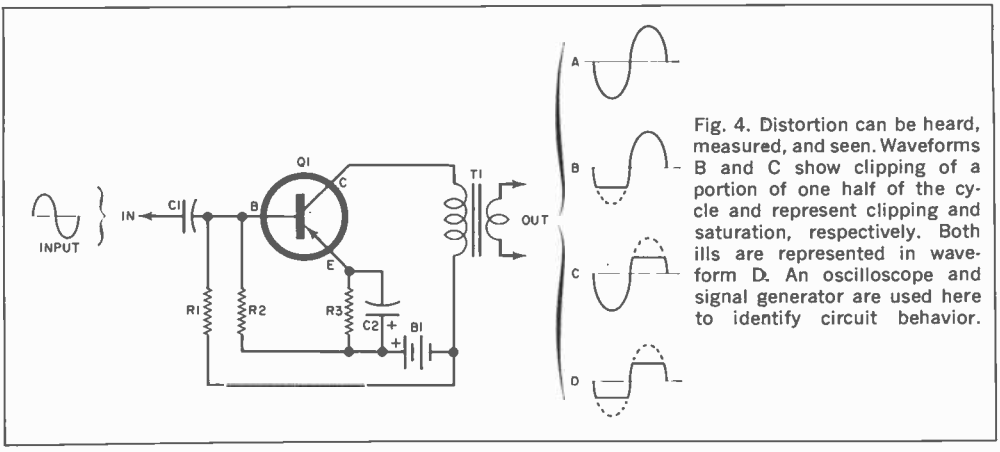


Fig. 4. Distortion can be heard, measured, and seen. Waveforms B and C show clipping of a portion of one half of the cycle and represent clipping and saturation, respectively. Both ills are represented in waveform D. An oscilloscope and signal generator are used here to identify circuit behavior.

of *R1*, *R2*, *R6* and *R7*. Stabilization is obtained from *Q3*'s emitter resistor (*R7*) and *Q1*'s emitter resistor (*R3*). Transistor *Q2*'s base bias is obtained from the voltage divider network consisting of *R4*, *Q1*'s collector-to-emitter dynamic resistance, and *R3*. Resistor *R5*, bypassed by *C3*, serves as a base current limiting resistor, and supplies both bias and drive to the power amplifier stage (*Q3*). Operating power is supplied by *B1*, and controlled by s.p.s.t. switch *S1*.

Conventional components are employed. Transistors *Q1* and *Q2* are 2N3053's, and *Q3* is a 40250. Except for *R7*, preferably a 2-watt unit, all resistors are half-watt types. The capacitors are 15-volt electrolytics. Output transformer *T1* has a 24-ohm primary, able to handle 500 ma. of d.c.; the secondary winding should match the speaker.

Intended for negative ground installations, the amplifier can be assembled and wired using standard construction techniques. Good wiring practice should be followed. All signal leads should be kept short and direct, d.c. polarities must be observed, and a small heat sink should be provided for power transistor *Q3*. The completed unit can be used with standard preamplifiers having a 500-ohm output.

Transitips. It has been some time since we've discussed distortion in transistor amplifiers, and mail received on the subject indicates that this is quite often a problem in home assembled projects. Here, then, is a review of some of the factors causing distortion.

Let us consider a typical amplifier stage using a *pnp* transistor (*Q1*) as common-emitter, as shown in Fig. 4. The input signal is applied through coupling capacitor *C1*. Base bias is developed across voltage divider *R1* and *R2*. Emitter resistor *R3* acts as a stabilizer, and *C2* prevents degeneration. The output signal is transformer-coupled to the next stage.

The output signal should be identical to the input signal in waveform, but of greater amplitude and possibly inverted, as shown in *A*, Fig. 4. As you know, in a *pnp* transistor, a negative voltage on the base with respect to the emitter causes the transistor to be forward-biased and collector current to flow. The positive-going portion of an input signal, such as a sine wave, reduces collector current because it reduces the forward bias, while the negative-going half increases collector current because it adds to the forward bias. In an *npn* transistor, the reverse would be true.

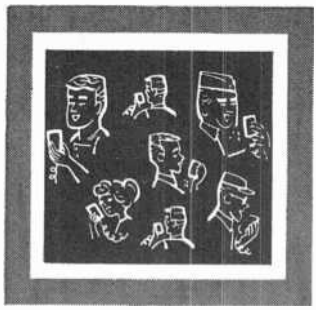
If *Q1*'s base bias is too low, as could be caused by an increase in *R1*'s value or a decrease in *R2*'s value, the transistor can be driven to collector current cutoff during the positive-going half-cycle of the sine wave, resulting in an output signal whose negative half-cycle is clipped, as in waveform *B*.

An excessive base bias, on the other hand, can permit *Q1* to be driven to saturation on negative-going input signals, resulting in an output signal whose positive-going half-cycle is clipped, as in waveform *C*. Such a condition could be caused by an open *R2* or a partial short across *R1*.

An excessively strong input signal can drive the transistor to cutoff on positive-going cycles, and to saturation on negative-going cycles, resulting in both halves of the output signal being clipped, as in waveform *D*.

There are, of course, a number of circuit conditions which can result in distortion even if the bias resistors are in good condition. If *C1* is coupled to the collector of a preceding stage, for example, leakage in this capacitor could cause an upset in base bias. Similarly, a leaky transistor can be close to collector current saturation even

(*Continued on page* 108)



On the Citizens Band

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

THE Automobile Manufacturers Association, Inc., has petitioned the Federal Communications Commission for the establishment of a new radio service for the motoring public. They have suggested that it be designated as the Highway Emergency Locating Plan Radio Service (H.E.L.P.) and that it constitute a new subpart "L" in the Land Transportation Radio Service Rules of the Commission. (See our March, 1965, issue, page 64.)

A.M.A. PETITIONS FOR H.E.L.P.

The Highway Emergency Locating Plan Committee was organized by the AMA in March, 1964. Charter members of this Committee include American Motors Corp., Chrysler Corp., Ford Motor Company, General Motors Corp., International Harvester Company, and the Kaiser Jeep Corporation. By means of the FCC petition, they hope to obtain permission for what they consider an urgently needed two-way radio communications system for motorists in distress or in emergency situations.

Investigations into the feasibility of providing the motoring public with a medium of instant communications during emergencies on the nation's highways produced an estimation that, since the FCC adopted the Citizens Radio Service in 1958, approximately 60% of the licensees have been seeking some method of extending the use of CB radio. Considering the six years of CB operation, and after examining many safety devices, the committee recognizes the fact that radio can offer a safe, economical aid to the stranded motorist.

The AMA petition asks for no changes in the existing Class D CRS, but requests that all citizens authorized to legally operate a motor vehicle in the U.S. be eligible for a license to operate in the HELP Radio Service. Further, the petition asks for simplified licensing; and since the channels requested are adjacent to Class D CB channels, the AMA recommends that cross service operation be permitted to enable licensed CB operators to take advantage of the HELP program by extending their existing systems.

Channel 9 is presently the accepted emergency channel adopted by the HELP program. In the petition, it is recommended that the 27.235- and 27.245-mc. frequencies be assigned exclusively to the HELP Radio Service. These frequencies are currently allocated to Automobile Emergency, Power, Petroleum, Forest Products, Taxicab, Motion Picture, Telephone Maintenance, Railroad, Relay Press, Motor Carrier, Special Industrial, Manufacturers, and Business communication services. However, according to the AMA, an investigation of the

Monitoring stations in hospital emergency rooms are a big factor in the H.E.L.P. assistance plan. Nearly 1000 H.E.L.P. stations are now in operation.

The police department in Franklin, Mich., is among the many across the country that monitor channel 9 so they can immediately aid motorists in trouble.

1965 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet or picnic? Send all the details to: 1965 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. For more information on the jamborees listed below, contact the clubs or club representatives at the addresses given.

Fresno, Calif. June 5-6
Event: Third Annual Jamboree. Location: Wildwood Beach Country Club. Contact: CB Radio Club of Fresno, 614 N. Sierra Vista, Fresno.

Akron, Ohio June 6
Location: Chippewa Lake Park. Contact: Tri-County C.R. League, Box 1301, Akron, Ohio.

Berrien Springs, Mich. June 6
Event: Michigan Water Wonderland Jamboree. Location: Berrien County Youth Fairgrounds. Contact: Jamboree, 2120 Irving Dr., Benton Harbor, Mich.

Dallas, Texas June 12-13
Event: Texas CB Fair. Location: Texas State Fairgrounds. Contact: Irvin Hemmle, 2200 W. Rosedale South, Ft. Worth, Texas

Aurora, Ill. June 13
Location: Phillips Park. Contact: Aurora 5-Watters, Box 653, Aurora, Ill.

Ambridge, Pa. June 13
Event: CB Picnic. Location: Economy Park. Sponsor: Beaver Valley Citizens Radio Assn. Contact: Harold C. Myers, 500 Linmar Terrace, Aliquippa, Pa. 15001.

Valparaiso, Ind. June 19-20
Event: NICRA Jamboree. Location: Porter County Fairgrounds. Contact: 1965 National NICRA Jamboree, Box 426, Valparaiso, Ind.

Tupelo, Miss. June 19-20
Event: Tupelo Signal Tracers Jamboree. Location: Community Center at Mississippi-Alabama Fairgrounds. Contact: Signal Tracers, Box 1084, Tupelo, Miss. 38801.

Rock Island, Ill. June 19-20
Event: Iowa-Illinois CB Club Jamboree. Location: Rock Island Fairgrounds. Contact: Jam-Com-Inc., 618 21st St., Moline, Ill.

Zanesville, Ohio June 19-20
Location: Muskingum Fairgrounds. Contact: Y City CB Assn., Zanesville, Ohio.

Fitchburg, Mass. June 20
Location: Notre Dame Athletic Field. Contact: Jamboree Chairman, 76 Chester St., Fitchburg.

Peoria, Ill. June 26-27
Location: Keenland Park. Contact: Illinois Valley CB'ers, Box 141, Peoria, Ill.

Straffordville, Ont., Canada July 2-4
Event: Canadian GRS & CB Campout. Location: Straffordville. Contact: P. W. Harding, 26 Grosvenor St., London, Ont., Canada.

Lorain, Ohio July 17-18
Event: National CB Jamboree & Campout. Location: Grotto Park. Contact: Lake Erie CB'ers, Inc., Box 5, Lorain, Ohio.

LaMesa, Calif. July 17-18
Location: American Legion Hall, LaMesa, Calif. Contact: So. California CB Assn., Box 17296, San Diego, Calif. 92117.

Bridgeport, W. Va. July 18
Location: Mannington Fairgrounds, Houge Park, Mannington, W. Va. Sponsor: Tri-County Citizens "D" Banders, Inc. Contact: Ann Digman, Box 173, Bridgeport, W. Va.

Milwaukee, Wis. July 24-25
Event: Beer City Jamboree. Location: Wisconsin State Fair Park. Contact: Milwaukee CB Club, Box 1277, Milwaukee, Wis.

Painesville, Ohio July 30-August 1
Location: Lake County Fairgrounds. Sponsor: 5 Watters of Lake County. Contact: George Parish, 225 Marion Ave., Painesville, Ohio.

Commission's records indicates that minimum use is made of these two frequencies, and that licensees are obtaining facilities to meet their requirements in the high band of the VHF section of the spectrum. Accordingly, they state, frequencies currently assigned on a limited basis would have greater utilization if assigned exclusively for the protection of life and property of the motoring public.

It is further proposed that all communications in the HELP service, regardless of their nature, be restricted to the minimum practical transmission time—the time required to adequately designate the location of the emergency. Stations in this service would not communicate with stations of any other class, nor would there be communication between mobile or base stations except in an emergency. Maximum power input would be limited to 30 watts for a land station, 5 watts for mobile.

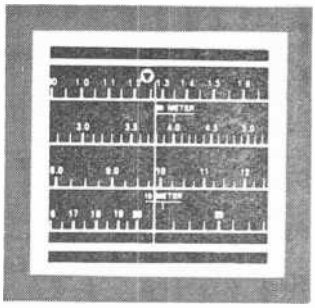
Individuals and organizations who have expressed full endorsement of the HELP program since its announcement on January 24, 1965, include: George Romney, Governor of Michigan; Joseph A. Childs, Police Commissioner of Michigan; the American Automobile Association, Washington, D.C.; REACT, Chicago, Ill.; Grand Valley Eleven Meter Radio Club, Wyoming, Mich.; and the Auto-Industries Highway Safety Committee, Inc., Washington, D.C.

At the start of the program, the HELP monitoring organization consisted of more than 20,000 owners of Citizens Band radio equipment (primarily REACT teams) who were organized to operate more than 600 24-hour-per-day monitoring stations (a REACT requirement) throughout the country. In addition, the more than 1,000,000 vehicles equipped with CB radios constituted an enormous potential of mobile monitoring stations.

The AMA states that public acceptance of the HELP plan has been excellent, and that the number of equipment installations and monitoring stations is rapidly increasing. It is anticipated that a minimum of 1000 monitoring stations will be in operation on the current HELP channel by the middle of 1965. These will include police agencies, road service organizations, hospital emergency services, garages with towing facilities, etc.

More investigations are currently under way which are expected to result in the availability to the motorist of vehicle radios which, in addition to providing reception of the standard broadcast stations, will also contain an integrated transmitter and receiver for the proposed HELP Radio Service channels.

(*Continued on page 98*)



Across the Ham Bands

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

BOOST YOUR PERCENTAGE OF CONFIRMED CONTACTS

AN OLD SAYING in amateur radio, wholeheartedly supported by all printers of QSL's, is that "exchanging QSL cards is the final courtesy of a QSO." To hear some hams tell it, however, *they* QSL 100 percent, but the percentage of replies is woefully low. As a result, many of these hams join the "You-QSL-First Club."

The sad part of the situation is that both hams in a QSO often mail QSL cards immediately after a contact, but the cards fail to reach their destinations, more often than not because they are improperly addressed. Prime examples are cards adddressed to "Operator Bob, WB2ABC, Anywhere, Some State." Except in very small towns, such cards usually land in the post office dead letter box, although a few of them may be salvaged by a cooperative postal employee and passed on to a local ham for delivery. Your Amateur Radio Editor receives a lot of misdirected cards in this manner; but even with the latest *Callbook* and a wide knowledge of local hams, many of them are still undeliverable.

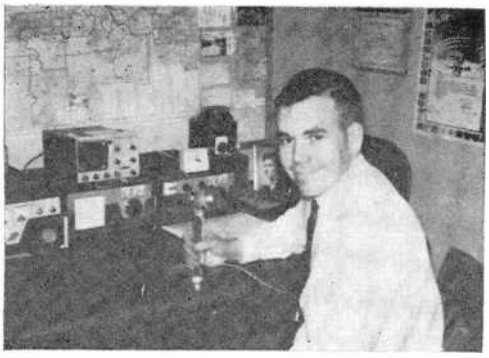
Of course, if you don't have a *Callbook* (available from any amateur supply house) and did not get a complete address during the contact, or if the address is not in the *Callbook*, it is a temptation to send a QSL card with an incomplete address. Unfortunately, it usually isn't a good gamble.

Another common cause of undeliverable QSL cards is careless copying of call letters. And U.S. hams are not the only ones who do this. Ray, W9MSG, the ARRL ninth call-area QSL Manager, recently showed us a handful of the DX cards with obviously incorrect call letters which come into the QSL bureau every month. With the 15-meter band opening up for DX much more than it has for the past few years (and, incidentally, giving many Novices and newer "Generals" their first chance to work foreign DX), the percentage of such cards reaching the bureau is increasing. Obviously, it is important to send your call letters distinctly at all times, whether you operate phone or c.w.

Contrary to what you have probably heard, the average DX operator QSL's at least as well as the average U.S. ham, only to have many of his cards sit unclaimed

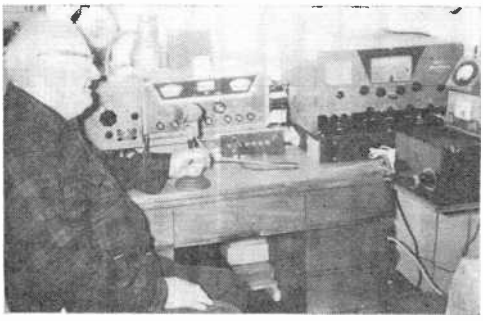
Amateur Station of the Month

Old-timer Don Halsey, W6PCX, of Arcadia, Calif., enjoys amateur radio as much today as he did 43 years ago when he was first licensed. Although his B&W 5100B transmitter and Gonset GSB-101B linear amplifier make a big noise on both AM and SSB phone, Don prefers c.w. 99.9% of the time. He receives on a Drake 2-B and a Hammarlund HQ-120. For submitting this winning photo in our Amateur Station of the Month contest, W6PCX will receive a one-year subscription. To enter the contest, just send us a clear picture of your station—preferably with you at the controls—and some data about your ham career. Entries go to Herb S. Brier, Box 678, Gary, Ind. 46401.



Eddy Shell, W5ZBC, Bossier City, La., works phone and c.w. on all ham bands between 3.5 and 29.7 mc. with his Drake TR-3 transceiver and associated gear.

The president of the "Professional Loafers Club of Licensed Amateur Radio Operators" is Elmer J. Malone, W9LXL (below). Composed of disabled, pensioned and retired amateurs, this club has 440 full members and over 600 honorary ones. If you're interested, write to W9LXL at 2319 N. 75th Ave., Elmwood Park, Ill. 60635 for details and an application card (be sure to enclose a return envelope).



month after month in the QSL bureaus. Most DX cards for U.S. and Canadian hams come via the ARRL QSL Bureau. To get yours, you must keep a supply of 8⅝" x 3⅝" business-size return envelopes on file with your call-area bureau, whose address is listed on page 126 of the 1965 COMMUNICATIONS HANDBOOK.

Place *your* address in the normal place on each of these return envelopes and clearly print your call letters in large letters in the upper left-hand corner. Affix a five-cent stamp if you expect no more than 6 DX cards a month, ten cents for 7 to 12 cards, etc. Each month, the bureau will mail you your cards as long as your S.A.S.E. is on hand. No envelopes, no cards.

If a DX station's address is not in the DX *Callbook,* you can mail a QSL card via the station's national QSL bureau, the address of which heads each country's listing.

Some DX stations have stateside QSL managers. If you are told to QSL via them, include a self-addressed envelope and return postage with your QSL, and you will normally get a card in return *promptly*. Omit the envelope and the postage, and the return card will probably eventually arrive via the QSL bureau.

The three most important requirements for a valid QSL card are the call letters of the station worked, the correct date and time of the contact, and the signal report. It is surprising how often new amateurs insert their own call letters in the space designed for the worked station's call letters.

FCC and Other News. As of March 29, the FCC's reciprocal operating rules for foreign amateurs went into effect. A foreign amateur must apply for an operating permit 60 days in advance on the new Form 610-A available from FCC offices and some overseas U.S. offices. The application must be accompanied by copies of the applicant's station and operator license and a U.S. address to which to send the permit. If the foreign amateur intends to operate mobile, he must also include an approximate itinerary with his application. Each permit will be issued for a maximum period of one year.

In the January, 1965, RSGB *Bulletin* (England), John Clarricoats, G6CL, reports that the U.S. Department of State has taken the initiative in setting up formal reciprocal amateur operating privileges with 30 to 40 administrations, and will move quickly when a favorable response is received from another country. After having the U.S. blamed for years for the lack of reciprocal operating privileges between U.S. and foreign amateurs, it will be interesting to see how fast the rest of the world moves now that conditions have been reversed.

In the Washington Area Young Ladies Amateur Radio Club column in *Auto-Call* (Washington, D.C.), Martha, W6QYL, is quoted as reporting that there are now 10,000 YL hams. If true, this means that, percentage-wise, the number of licensed YL's is increasing at a much faster rate than hams in general.

Bob, K8WSH, asks a thought-provoking question in the February, 1965, copy of the Marion, Ohio, *High Banders Log*. Would your ham station and log pass an unexpected inspection by the FCC? As Bob points out, FCC regulations grant Commission representatives that right whenever you are on the air and at other times by appointment.

Amateur Activities. Starting at 2 p.m., local time, June 12, and continuing until

(*Continued on page 96*)

Monthly Short-Wave Report

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

SHORT-WAVE "MAILBAG"

YOUR Short-Wave Editor has been asked by numerous participants in the DX Awards Program if there are going to be additional awards to fill spaces 3, 4, and 5 on the Monitor Certificate. Yes, there are; and several ideas are under consideration. However, we would be happy to receive your suggestions and comments. What would you like us to offer as the third award?

While on the subject of awards, individual copies of the "Countries List for DX Awards" are now available for those who are participating in that part of the program. Recently published in the 1965 Edition of the COMMUNICATIONS HANDBOOK, this is a complete list of countries that you may claim to help you qualify for the various Countries Awards. If you'd like a copy, send a self-addressed, stamped envelope with your request.

Edited Tapes. A P.E. reporter from Pennsylvania writes that Sterling Yates, a local disc jockey on KDKA, Pittsburgh, has begun to play edited tapes of broadcasts from short-wave stations on his Sunday morning programs. The tapes are run for only a few minutes—about the time it takes to play a popular recording. Heard on one recent program were excerpts of news and other items from "Echoes From Switzerland," which was taped during the 2015 transmission from Berne the previous evening. Unfortunately, our correspondent did not mention the exact time of the program, but listeners within a 300-mile radius of Pittsburgh will probably be able to tune it in.

"Kiss Me Honey" Again. Another of our veteran reporters has sent in an interesting item on the often-heard "Kiss Me Honey" station which operates on 11,695 kc. early afternoons to 1340-1400/close. He stated that the station was heard with a Middle East language talk and music at 1240 and from 1340 with the recording of "Kiss Me Honey." This is, to the best of our knowledge, the first time that anyone has actually heard the station broadcasting anything other than the "Kiss Me Honey" recording. We wonder if it has not, perhaps, been confused with the clandestine *Radio Peyk-e Iran* which does have Middle East language talks and music scheduled around that time. Although this particular reporter is an expert, further checks would definitely seem to be in order.

The *Sweden Calling DX'ers* bulletin recently reported that the correct name of the clandestine station is *Inja danishir Peyk-e Iran* and that its schedule calls for Persian

At left: In Chicago, Ill., Bob Tatan, WPE9GWX, has compiled a record of 42 states and 50 countries logged. His Hallicrafters S-38E receiver is backed up by a Knight-Kit "Span Master."

At right: P.E. reporter G. A. "Beni" Benadom, JA6PE1E/BV1PE1C, is currently stationed in Japan with the U.S. Navy. Beni's equipment includes two 30-tube triple-conversion receivers, Model R-390A/URR. Shown near the top of the photo is an LM-21 frequency meter which covers 15 to 30,000 kc.

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	6070	1950, 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	15,370, 11,930	1430
Czechoslovakia	Prague	11,990, 9795, 7345, 7115, 5930	2000, 2230
Denmark	Copenhagen	15,165	0730
		9520	2100
West Germany	Cologne	11,885, 11,795, 9735	1010
		9640, 6175	2040
		9735, 9575, 6145, 5960	0000
Hungary	Budapest	9833, 9540, 7305, 6234	1930, 2030
		9833, 7305, 7215, 6234	2200, 2330
Italy	Rome	9575, 5960	1930, 2205
Japan	Tokyo	15,135, 11,780	1900
Jordan	Amman	9555	2000
Lebanon	Beirut	9750	2130
Netherlands	Hilversum	15,425, 11,955	1235 (Tues., Fri.)
		15,425, 11,730	1535 (Tues., Fri.)
Netherlands Antilles	Bonaire	9685	2300
Portugal	Lisbon	6185, 6025	2100, 2245
Romania	Bucharest	9590, 9570, 9510, 7225, 6190, 5990 (9570 not used at 2030)	2330, 2200, 2030
Spain	Madrid	11,715, 9615, 6140	2200, 2100, 2000
Sweden	Stockholm	15,300	0900
		5990	2045
		9705	2215
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	15,180, 15,140, 9730, 9660, 9640, 9630, 9570, 9540, 7360, 7330, 7320, 7310, 7290, 7250, 7240, 7230, 7200, 7150, 7130, 6070 (all channels not in use at any one time)	1730, 1900, 2000, 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250, 5985	1950

at 1120-1240; Turkish to 1310; Arabic to 1335/close. Three frequencies are said to be in operation: 11,695 kc., heard in Europe and N.A.; 11,410 kc., heard in Europe but not as yet reported in the U.S. (so far as we know); and a third—unspecified—frequency.

Radio Portugal QSL's. Your Short-Wave Editor recently corresponded with *Emissora Nacional de Radiodifusao*, Lisbon, Portugal, after receiving several complaints from listeners who felt that they were getting poor treatment in response to their reception reports. The following comments are in accordance with a letter written by Miss Maria da Paz Barros Santos, head of the International Service.

The rules of *Radio Portugal* are clear-cut and firm. If you want to be a member of their short-wave club, you must follow those rules. If you are not a member of the club—and do not wish to become one—but still would like to obtain *Radio Portugal*'s

(*Continued on page* 100)

The price tag went on last

KLH Model Seventeen

The quality went in first. The kind of quality you can hear. Quality in the Seventeen's smooth, flawless response. Quality that gives the Seventeen the lowest harmonic distortion in the bass of any speaker in its price range. KLH quality in a handsome new oiled walnut enclosure. In the ingenious grillecloth that can be changed in a snap.

And while the quality was going in, the waste was coming out. All the waste that inflates the cost of speakers. The waste of rejects and varying quality in stock components from outside suppliers. (KLH builds, tests, and rigidly controls the quality of every component that affects the musical performance of a speaker.) The waste of obsolete design and engineering. Of inefficient and outdated manufacturing techniques. Of gingerbread 'features' that add nothing to musical performance.

When we finally had a speaker that was all quality and no waste, we put the price tag on. And you won't find a trace of puff in the price.

This is the Model Seventeen. A speaker that brings a whole new level of sound quality — a new distinction to speakers costing under $100.

But no description can tell you how the Seventeen sounds. You've got to hear it. Only then will you be able to understand what an unusual achievement the Seventeen is in high performance at low cost. See the Seventeen at your KLH dealer now. Listen to it. *Then* look at the price tag. We think you'll agree that nothing touches the Seventeen for honest sound at an honest price.

**Suggested retail for eastern U.S. Slightly higher in the West.*

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

CIRCLE NO. 17 ON READER SERVICE PAGE

SOMEONE SHOULD DEVELOP AN EASY WAY TO LEARN ELECTRONICS AT HOME

RCA INSTITUTES DID!

Here is a whole new approach to learning electronics at home! RCA Institutes, one of the nations' largest schools devoted to electronics, has developed a faster, easier way for you to gain the skills and the knowledge you need for the career of your choice. Here for the first time, is a student-proved, scientifically designed way to learn. If you have had any doubts in the past about home training in electronics —if you have hesitated because you thought you might not be able to keep up—or that electronics was too complicated to learn—here is your answer! Read how RCA Institutes has revolutionized its entire home training ideas!

NEW CAREER PROGRAMS
BEGIN WITH "AUTOTEXT" INSTRUCTION METHOD!

Start to learn the field of your choice immediately!

No previous training or experience in electronics needed!

With this new revolutionized method of home training you pick the career of your choice—*and RCA Institutes trains you for it.* RCA's Career Programs assure you that everything you learn will help you go directly to the field that you have chosen! No wasted time learning things you'll never use on the job! The Career you choose is especially designed to get you into that career in the fastest possible way!

Your Career Program starts with the amazing "AUTOTEXT" Programmed Instruction Method—the new, faster way to learn that's almost automatic! "AUTOTEXT" helps even those who have had trouble with conventional home training methods in the past. This is the "Space Age" way to learn everything you need to know with the least amount of time and effort.

CHOOSE A CAREER PROGRAM NOW

Your next stop may be the job of your choice. Each one of these RCA Institutes Career Programs is a complete unit. It contains the know-how you need to step into a profitable career. Here are the names of the programs and the kinds of jobs they train you for. Which one is for you?

Television Servicing. Prepares you for a career as a TV Technician/Serviceman; Master Antenna Systems Technician; TV Laboratory Technician; Educational TV Technician.

FCC License Preparation. For those who want to become TV Station Engineers, Communications Laboratory Technicians, or Field Engineers.

Automation Electronics. Gets you ready to be an Automation Electronics Technician; Manufacturer's Representative; Industrial Electronics Technician.

Automatic Controls. Prepares you to be an Automatic Controls Electronics Technician; Industrial Laboratory Technician; Maintenance Technician; Field Engineer.

Digital Techniques. For a career as a Digital Techniques Electronics Technician; Industrial Electronics Technician; Industrial Laboratory Technician.

Telecommunications. For a job as TV Station Engineer, Mobile Communications Technician, Marine Radio Technician.

Industrial Electronics. For jobs as Industrial Electronics Technicians; Field Engineers; Maintenance Technicians; Industrial Laboratory Technicians.

Nuclear Instrumentation. For those who want careers as Nuclear Instrumentation Electronics Technicians; Industrial Laboratory Technicians; Industrial Electronics Technicians.

Solid State Electronics. Become a specialist in the Semiconductor Field.

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SEPARATE COURSES

In addition, in order to meet specific needs, RCA Institutes offers a wide variety of separate courses which may be taken independently of the Career Programs, on all subjects from Electronics Fundamentals to Computer Programming. Complete information will be sent with your other materials.

LIBERAL TUITION PLAN

RCA offers you a unique Liberal Tuition Plan—your most economical way to learn. You pay for lessons only as you order them. No long term contracts. If you wish to stop your training for any reason, you may do so and not owe one cent until you resume the course.

VALUABLE EQUIPMENT

You receive valuable equipment to keep and use on the job—and you never have to take apart one piece to build another. New—Programmed Electronics Breadboard. You now will receive a scientifically programmed electronic breadboard with your study material. This breadboard provides limitless experimentation with basic electrical and electronic circuits involving vacuum tubes and transistors and includes the construction of a working signal generator and superheterodyne AM Receiver.

Bonus From RCA—Multimeter and Oscilloscope Kits. At no additional cost, you will receive with every RCA Institutes Career Program the instruments and kit material you need to build a multimeter and oscilloscope. The inclusion of both these kits is an RCA extra.

CLASSROOM TRAINING ALSO AVAILABLE

RCA Institutes maintains one of the largest schools of its kind in New York City where classroom and laboratory training is available in day or evening sessions. You may be admitted without any previous technical training; preparatory courses are available if you haven't completed high school. Coeducational classes start four times a year.

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In recent years, 9 out of 10 Resident School students who used the Free Placement Service had their jobs waiting for them when they graduated. And many of these jobs were with top companies in the field—such as IBM, Bell Telephone Labs, General Electric, RCA, and radio and TV stations and other communications systems throughout the world.

SEND ATTACHED POSTAGE PAID CARD FOR COMPLETE INFORMATION, NO OBLIGATION. NO SALESMAN WILL CALL. FREE BOOK INCLUDED. CHECK HOME STUDY OR CLASSROOM TRAINING.

RCA INSTITUTES, Inc., Dept. PE-65
A Service of Radio Corporation of America
350 West 4th St., New York, N.Y. 10014

The Most Trusted Name in Electronics

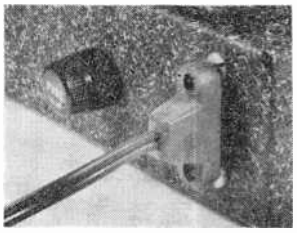
Tips and Techniques

(*Continued from page* 28)

this clip to the base as shown. File the free end of the wire to a point and bend it to contact the crystal. You can use this catwhisker detector in your favorite circuit and have fun finding the most sensitive spots. —*Art Trauffer*

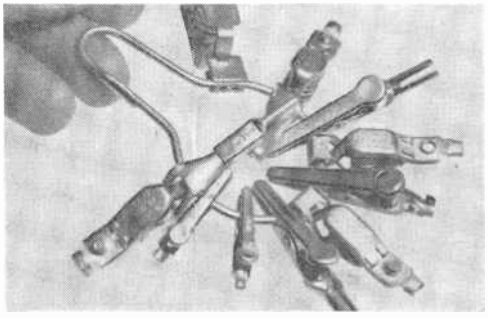
CHEATER CORD CONNECTS PROJECTS CONVENIENTLY, SAFELY

Do the line cords on your experimental circuits keep getting shorter? Each time you "borrow" a cord from one project to use on a newer circuit, the number of cordless old projects grows larger, and you wind up with a shoebox full of three-inch line cords. One simple solution to the problem is to install a cheater cord connector on everything you build. In addition, a certain margin of safety can be derived from the use of a cheater cord. If something happens that requires a quick disconnect, a tug on the line cord will cut off the power. —*Don Lancaster*



CUT CLIP CLUTTER WITH SHOWER CURTAIN RINGS

You can rack up assorted test clips on one or more shower curtain rings and keep them handy on the tool-board behind your workbench. A ring can be hung on any convenient nail or hook. If kept in the tool box, the racked-up clips are not likely to go astray or get mixed up with other hardware, tools, and parts. —*John A. Comstock*



Capacitor Discharge Ignition

(*Continued from page 47*)

system, that makes it possible to fire fouled and defective spark plugs. Another important gain is the fact that the coil does not have to draw current while the breaker points are closed to build up a large magnetic field as in conventional ignition systems.

At high engine speeds in conventional systems, not enough time is available to build up the magnetic field to maximum, and so there is a very definite drop in voltage, as shown in Fig. 4. Note that in this capacitor discharge system there is essentially no drop in voltage up to 15,000 rpm. Since engine speeds rarely exceed 5000 rpm, there is no drop in voltage over the entire range of usable engine speeds.

At the instant *Q3* conducts, it also shorts out the power supply, forcing the power transistors (*Q1* and *Q2*) into a quiescent state. The transformer (*T1*) is specially designed to prevent high transients and self-oscillation of the power transistors when *Q3* conducts. After *C2* discharges through the coil and *Q3*, the ignition coil—because of a flywheel type of action and its sinusoidal type of response—sets up a reverse current which develops a negative voltage on the anode of *Q3* and positively halts conduction. The SCR would normally shut off as the anode voltage approached zero. Polarity of the bridge rectifier happens to be just right to remove any residual negative voltage and to keep it within safe limits.

As soon as *Q3* stops conducting, the power supply turns on. By this time the same sinusoidal action of the ignition coil is now heading in the other direction and tends to aid the power supply in charging up *C2*, further reducing the charging time. All this is accomplished in less than 300 microseconds.

To prevent the SCR from conducting on point bounce or high impulse noise, the voltage on *C4* and *C5* back-biases *D1* and bleeds off through *R5* at a slower rate than the charge time (about 0.5 millisecond). Capacitor *C6* helps to pre-

vent any high-frequency noise that may create r.f. interference from getting out of the ignition system.

Note that the original coil is used and that the unit will perform on a battery voltage range from 9 to 16 volts.

Checking It Out. Before installing the system, you may want to satisfy yourself that all is in working order. The system can be tested if there is an ignition coil and a 12-volt battery available. Follow the installation instructions.

Care must be exercised when connecting the coil. A wire from the high voltage output should be gapped a maximum of 1" from the minus side of the ignition coil. There is a possibility of breaking down the internal insulation of the ignition coil if you omit this load.

Instead of using the breaker points, a wire can be connected from the *GND* terminal and brushed along the *PTS* terminal on the strip. Do not touch the ignition coil or high voltage lead while you are making this test, or you might get a nasty jolt.

Installation. Mount the unit close to the ignition coil, but as far as possible from the manifold. Remove all wires from the ignition coil. Also remove any capacitors if they are attached to the coil. Reconnect the wire or wires and the capacitor (if any) that were on the coil's plus terminal, to the *A+* terminal on the unit. Connect a wire from the *COIL +* on the unit to the + on the ignition coil. See Fig. 5.

Now connect a wire from the engine ground (the coil's clamp can serve as a ground) to the other side of the ignition coil—and to the *GND* terminal on the unit. Connect the wire from the terminal on the distributor to the *PTS* terminal on the unit. Be sure all connections are tight and well insulated, and do not let wires or metal touch the transistors.

It is advisable to install a new set of breaker points, and to clean the distributor head and the rest of the ignition system. Follow the car manufacturer's recommendations as to timing and gapping of points. If the spark plugs are shot, they'll work, but it is better to begin with your best foot forward.

When you turn the ignition switch on, a slight hum will be heard from the unit. Start the engine. -30-

Those Hard-To-Get QSL's

(*Continued from page* 61)

register your letter to make sure it gets delivered.

Most DX'ers prefer a station's QSL rather than a verification form which they have prepared for the station to fill in. However, you can send along a prepared verification as a last resort.

Other Tips on Reporting. Most stations place high value on comments and suggestions for improving their service, and a letter to the program department will usually be very much appreciated.

If you know the name of the person who signs verifications for a particular station—this information is often available through a DX club—you should send your report directly to him. If you don't know who the verie signer is, address your report to the chief engineer or technical director. Latin American signers often have the title of "Director General."

If you don't receive a reply to your first report after about six months, you can try a follow-up. Again, be polite; don't act as though the station is deliberately ignoring you. If at all possible, send a completely new report based on a more recent logging.

An ordinary SWL card should not be used for a report in the manner that hams use QSL's simply because you cannot include enough information on a card. A card with your WPE registration and information about your equipment does make an interesting addition, however. And you might further personalize your report by including a picture post card of your area, or a picture of yourself at your listening post!

Three P's and a Q. The same advice that is given for successful listening applies to reporting: *p*atience, *p*ersistence, *p*erseverance, plus *q*uality. It may take years to get a QSL out of some stations but top quality reporting will eventually do the job. Remember that even those stations which have a no-verification policy sometimes change their attitude.

Good luck and best wishes for a full mailbox. —30—

Ben Franklin Called It a Day

(*Continued from page* 63)

want to say this. In fact, I was going to let you go back to that Big Laboratory in the Sky without telling you about the mistake you made."

His heavy eyebrows raised, his eyes widening with doubt.

"You see, sir," I went on, "you made electricity flow the wrong way!"

"Be ye positive? Without pun intended to thee, of course."

"Yessir! You claimed that electricity flows from positive to negative potential, but, Mr. F., it flows from negative to positive."

Franklin pursed his lips. "Ye simply will not listen, will thee? Remember, people who are wrapped up in themselves make small packages!"

That did it! I had had enough. As I pointed to the open window shouting "out with thee," it happened. As if ordered by old Ben himself, a magnificent thunderstorm threw down lightning bolts the like of which I had never seen.

Benjamin Franklin was beside himself! Before I knew what was happening he had launched a kite through the window, a large key attached to the end of the string.

"No, no," I pleaded. "The power's right here, Mr. Franklin, in the wall socket. We don't need the kite!" But I was too late. Sparks and bolts were everywhere, and in a blinding flash, Benjamin Franklin was several hundred feet in the air, clinging to the kite string and rising higher by the second. He was trying to tell me something about "One may sometimes be much in the wrong in owning one's being in the right!"

I AWOKE with a start. The dream had seemed so realistic I had to investigate. I went into the ham shack and sniffed. No ozone! The window was closed; the stars were shining bright. I sighed! All seemed right with the world, after all.

But then, as I reached for the light switch, the glint caught my eye! It just couldn't be! A Leyden jar! It was connected to my power supply circuit. –30–

Build a Stereo Bal

(*Continued from page 49*)

be connected to the highest impedance speaker taps on your amplifier irrespective of which taps the speakers are connected to. If you are using two separate amplifiers, it may be necessary to run a lead between the two amplifier chassis. However, don't run the lead unless it appears that the Stereo Bal won't work without it.

How to Use the Stereo Bal: *As an FM Stereo Indicator and Output Balance.* With the tuner switched to mono, tune in a known mono station. Set the amplifier balance control to center or normal balance. Tune in a station and adjust the tuner's two output controls (if your tuner has output controls) for minimum flickering of the Stereo Bal's lamp. (When there is a separate output control for each channel of your stereo tuner, the best technique is to turn one control about 9/10 full up and then adjust the other control for balance.) Now switch the tuner to stereo and the bulb should flicker only on stereo program material; the brightness and duration of the flicker will depend upon the amount of stereo separation in the program material. It may also be possible to use the lamp's flickering to adjust the stereo separation of those tuners that have a control for that purpose.

For Phono and Overall System Balance. If you have a stereo preamplifier and stereo power amplifiers with input level controls, set the preamplifier for mono and center the preamp's balance control. Play a record and adjust the power amplifier's two input level controls using the same technique as given above to balance the tuner's outputs. If the power amplifier doesn't have input level controls, simply adjust the preamp's balance control for minimum lamp flicker. Incidentally, whenever there are both power amplifier input level controls and tuner output or other program source level controls to be balanced, the power amplifier should always be adjusted first. -30-

Chaos in Broadcasting

(*Continued from page* 53)

000-watt transmitters at the Woofferton (England) relay, the *VOA* has added six 500,000-watt and six 250,000-watt transmitters at its massive Greenville (North Carolina) plant.

The total number of transmitters put into service by Free World broadcasters has increased 10-15 percent since 1962. During this same period, the amount of useful spectrum space *decreased* by about the same amount.

The Soviets Go to Town. All of the Free World expansion, however, is dwarfed by the number of *Radio Moscow* stations added in recent years. Look at the band occupancy tables on pages 52 and 53. Note that during the morning and evening listening periods, the Soviet symbol (URS) appears on a great many frequencies. In the 6- and 7-mc. bands, the Russians are on 53 percent of the total available channels during the peak evening listening hours.

Within the past two years, during a period when sunspot activity was still decreasing, the Soviets nearly doubled their use of the 41- and 49-meter bands.

There is no indication that the rate of increase in the number of short-wave broadcasters will slacken. Developing nations continue to expand their broadcast operations; established broadcasters continue to plan for the addition of more and higher powered transmitters. The British, for example, are constructing a relay site in the Ascension Islands which will use four new 250,000-watt transmitters.

It is too soon to tell how much relief can be expected from increased sunspot activity. Several studies of the sunspot cycle just started indicate that there will be a low maximum, far under the peak of 1958. The result may be only a modest increase in the number of available channels in the short-wave bands.

We can conclude from the above that both man and nature have been working to bring about the increasing congestion in the high-frequency broadcast bands. Any attempt to limit international broadcasting would almost certainly end

in failure. Many nations have been asked to cut back on their short-wave broadcasting services, and presumably this has now been done. Another possibility, that of compulsory limitation of broadcasts by International Law almost surely would be doomed, since such limitation would be interpreted as interference in the nations' internal affairs. A plan to allocate specific frequencies to specific broadcasters was solidly beaten down at the last International Radio Conference.

Where To Now? Because most nations feel that international broadcasting must be expanded, one logical alternative might be to increase the size of the 49-, 41-, 31-, and 25-meter bands. Another proposition is to set up one or more new broadcasting bands. But where, and at whose expense?

Although the band congestion is not solely a problem faced by the broadcaster—hams and others are just as squeezed—the feeling is that broadcasting must be expanded and more channels must be found. —30—

Transistorized Ignition

(*Continued from page 42*)

controlled by the SCR, a silicon-controlled rectifier. Note how the breaker points are connected to the *Gate*, or control element, of the SCR. As points open, the SCR is turned on. The capacitor discharges a blast of current into the primary of the coil and high voltage appears at the coil secondary. Between sparks there is ample time for the capacitor to store current for the next discharge, even at high engine r.p.m.

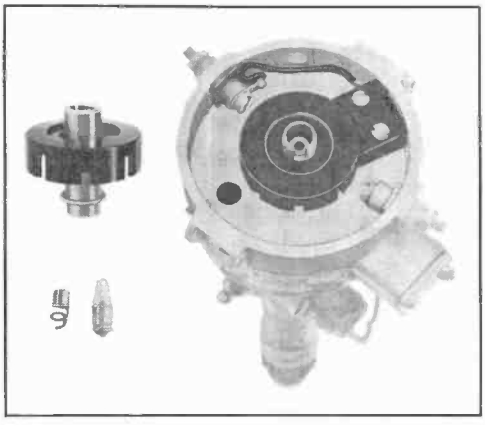
Look, Ma, No Points! Several manufacturers are looking to the future when the mechanical problems inherent in breaker points can be eliminated. In one such system, the distributor must be adapted to hold a 6-or 8-toothed magnetic wheel. As the distributor shaft rotates, the teeth induce a small current in a pickup coil rigidly affixed to the distributor wall. This pulse is then amplified and used to turn either transistors or an SCR "on and off" similar to breaker

point operation. Since no rubbing block is required, the overall ignition system should theoretically last the useful life of the car.

A refinement of the magnetic pulse is the photocell method. In this system, the light beam is interrupted by a shutter attached to the distributor shaft. Proponents of both the magnetic pulse and the photocell method claim that engine timing can be set to a "gnat's eyebrow." Detractors of these methods claim that one evil has been substituted for another and that necessity of more "electronics" in the pulse systems offers more chance of an eventual breakdown. Oddly enough, only the oldest and most reputable manufacturers of ignition systems offer either system for sale.

Your Responsibilities. Whatever unit you select, consider these factors. No system should be installed to offset some fundamental deficiency in the auto—like poor compression due to worn piston rings. In fact, transistor ignition is apt to *exaggerate* some basic troubles. One case occurred where the new system seemed to introduce roughness in engine performance. The culprit was traced to a dirty carburetor—it couldn't match the improved performance of the ignition. A dirty air filter, too, can limit performance.

Another crucial factor is the condition of old ignition components which must operate with the transistor system; the



Mallory Electric has introduced a system to eliminate breaker points. Attached to the distributor rotor shaft is a revolving shutter that interrupts a light beam aimed at a photocell. The on/off pulse is amplified and used to simulate the make and break characteristics of ordinary breaker points.

Transistorized Ignition Systems

available from electronics mail order houses

COMPANY	STOCK NUMBER	TYPE	PRICE*	MANUFACTURER**
Allied Radio Corp. 100 N. Western Ave. Chicago, Ill. 60606	54N019 54N047 54N112	Conventional Conventional Conventional	$29.95 22.95 39.88	Leece-Neville Electrotone Judson
Burstein-Applebee Co. 1012 McGee St. Kansas City, Mo. 64106	35B62	Capacitive	49.95	NELI
Heath Company Benton Harbor, Mich.	GDP-95 GDP-134	Capacitive Conventional	62.50 34.95	NELI NELI
Lafayette Radio Electronics 111 Jericho Turnpike Syosset, N.Y. 11791	11G0102 11G4101 11N103 11N7504	Conventional Conventional Conventional Conventional	14.95 29.95 24.95 37.50	Palmer(?) NELI Palmer Motorola
Olson Electronics, Inc. 260 S. Forge St. Akron, Ohio 44308	AM-244 AM-275	Conventional Conventional	24.98 9.95	House-made; 400:1 coil House-made; uses 200:1 ratio coil and has plug/jack arrangement to switch back to original system in case of failure.
Radio Shack Corp. 730 Commonwealth Ave. Boston 17, Mass.	12G1244	Conventional	19.88	Palmer(?)

**Prices do NOT include packaging and shipping costs where applicable.*
***Compare with Buyer's Guide for more details.*

distributor and high-tension leads, for example. Now that higher voltages are generated, these parts must be in first-class condition. Otherwise there is apt to be some cross-firing as the hot spark jumps between cables or finds a new path inside the distributor cap.

One protective step is installing a high-quality cable harness between distributor and plugs. Those small rubber boots capping plugs and distributor cables should also be in good condition to prevent arcing. Every ten thousand miles, the rubbing block and cam inside the distributor should be lubricated (sparingly) with grease made available for the purpose. And new points should be installed at the same time as the new system—with no attempt being made to file or clean up the old ones.

Meet these responsibilities and your transistor ignition system is ready to do its intended job—to rid the car of a heap of headaches under the hood. —30—

Across the Ham Bands

(*Continued from page 78*)

10 p.m., local time, June 13, the annual ARRL spring VHF QSO Party will be held. Participants work as many different stations in different ARRL sections as they can. You earn one point per contact on the 50- and 144-mc. bands, two points per contact on 220 and 420 mc., three points per contact on the higher frequency bands. Total score is the sum of the individual band points multiplied by the sum of the number of sections worked on each band. The same station can be worked once per band. Send your score to the Amateur Radio Relay League, 225 Main St., Newington, Conn.

Designed primarily to test amateur radio's emergency preparedness, the ARRL's annual Field Day is the year's most important operating activity. The 1965 affair will start at 2100 GMT, June 26, and continue until 2400 GMT, June 27. You can operate for any consecutive 24-hour period. Portable and mobile participants may work all other amateurs. Home-station participants may work only mobile or portable participants. Each contact earns one point, multiplied by three if emergency power is used, and again by 1.5 if battery power is used. There is an additional multiplier of three for power under 30 watts, and of two for power between 30 and 150 watts. Separate transmitters may be operated simultaneously on all the different amateur phone and c.w. bands. Write to the ARRL for official rules and log sheets.

Also in June, the Annual CHC/FHC/HTH QSO Party will be held between 2300 GMT, June 4, and 0600 GMT, June 7. If you're interested, mail a stamped, self-addressed business-size envelope to K6BX, Box 385, Bonita, Calif. 92002, for the rules.

News and Views

Ralph Filocco, K2IIL, 66 Robinson Ave., Newburgh, N.Y., is really a versatile ham. He operates 10, 15, and 20 meters, c.w., SSB, and RTTY with a Hallicrafters HT-32B transmitter feeding a Hy-Gain 4-element, tri-band beam 60' high. His teleprinter equipment includes a Model 15, URA-8, CV-57, and an SLR-13. He receives on a National NC-303, which also does a good job of hearing the OSCAR satellites in conjunction with a special high-sensitivity converter . . . **Don Russell, WN8ODK,** 109 Coshocton Ave., Mt. Vernon, Ohio, has two inverted V antennas and a "long wire" to connect him to the ionosphere. A Heathkit DX-35 transmitter with an antenna coupler pumps electrons into them, and a Knight-Kit "Span Master" receiver handles the reverse path. The scene of the action is 80 and 40 meters, and the results are 20 states and Canada worked . . . **Jim Cannon, WN6NXK,** 1106 Mary Ave., Sunnyvale, Calif., tried unsuccessfully for six days to work someone with a 50' receiving antenna. But as soon as he got his vertical up, the

picture changed. His Heathkit DX-20 transmitter and Navy-surplus TCS-13 receiver has carried the message to 12 states, Canada, and Mexico. Jim also has a 2-meter rig, but he never turns it on, he says, because working phone isn't going to get his code speed up to the General Class level. Inasmuch as Jim received an ARRL 10-wpm code certificate the day his Novice ticket arrived, we don't think he has anything to worry about.

Dan Shames, WB6JYL, 13515 Addison St., Sherman Oaks, Calif., feeds his Johnson "Ranger" transmitter into a Gotham vertical antenna, and he receives on a National NC-88. As a Novice, his record was 44 states and 13 countries on four continents. He believes that his contact with WM6DH was the first two-way Novice contact between the U.S. and Midway Island. Dan has added one state and one Canadian province as a General. He would like a schedule with South Dakota and will help you get your Rag Chewer's Certificate . . . **Leonard Hook, WA8KYH,** 450 Merritt Lane, Birmingham, Mich., has a Hy-Gain 14-AVS vertical on the roof of the house. If 43 states, 6 Canadian provinces, and 7 countries worked with 60 watts means anything, it performs well. A Knight-Kit T-60 transmitter and a Hallicrafters SX-11 receiver do their part. Dan will soon be on SSB, as well as c.w., with his new Heathkit "Marauder" transmitter . . . **Lawrence Cotaries, WN9MZS,** 6029 N. Damen, Chicago, Ill., lives on the third floor of a three-story apartment building and is forbidden to put up an outside antenna. After trying a mobile whip, which worked only locals, Larry strung up a 15-meter dipole in the apartment. He now has 18 states, 3 Canadian provinces, and 5 countries worked on 40 and 15 meters, spread over 200 contacts. He transmits on an EICO 720 and receives on a Hallicrafters SX-110.

Ted, WN6LSM, 4440 Walnut, Eureka, Calif., also uses an EICO 720 transmitter and a Hallicrafters SX-110 receiver. But he has both 80- and 40-meter dipole antennas. His record is 40 states and 9 countries on four continents with many east-coast contacts on 80 meters . . . **Bob, K2YFE,** is otherwise known as Lt. R. R. Migliorino, HHC- 1 Bn., 47th Inf., APO, Seattle, stationed at Ft. Wainwright, Alaska, where he now operates MARS station KL7WAH. He is as active as possible on all bands on c.w. and SSB. He looks particularly for Novices on 15 meters. No skeds are possible, because of his irregular operating hours, but he answers all cards received . . . The Elkhart High School Amateur Radio Club, W9IXS, 215 West High St., Elkhart, Ind., is compiling a list of high school amateur radio clubs and their call letters. The Elkhart club will send a copy of the list—already 40-strong—to any high school club that registers and includes a five-cent stamp.

On January 26, 1965, **Fred Gleeson, WA4LMD,** Louisville, Ky., worked M/Sgt. James E. Goode, U.S.A.F. Mission to Chile, over CE3QB in Santiago, Chile, and learned that a 15-year-old Chilean boy was dying of a wasting disease and that the drug for treating it was not available in South America. Four other Chilean children also had the disease, but were less seriously ill. WA4LMD managed to locate a supply of the drug at the Hoffman La Roche Co. in New Jersey, and arranged to have 20 vials (which the company donated) flown to Chile. Although the disease had advanced too far to save the first child, all of Chile applauded the "gringos" who worked so hard for their children. Makes you proud to be a ham, doesn't it?

Next month we hope to be quoting *your* "News and Views" and club bulletins. The first step is for you to mail them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, *Herb, W9EGQ*

On the Citizens Band

(*Continued from page* 76)

Finally, the AMA believes that the HELP program will afford an opportunity for designers to develop specialized radio equipment to solve other highway safety problems if the requested frequencies are allocated to this service. Even with millions of HELP installations in operation on the requested channels, there would still be unused "message capacity" because the equipment would only be employed by individual motorists for relatively short periods during emergencies and because the range of the equipment itself is limited.

The unused "message capacity" could be used for communications *from* medical, police or highway authorities *to* motorists in ways compatible with the HELP operations. The AMA feels that there is a tremendous potential for specialized radio equipment to provide traffic information, local roadway reports, and instructions to motorists. Such usage could contribute directly to increased vehicle safety and to more efficient utilization of the highways.

Tri-County Jamboree. News is steadily being received of many successful get-togethers already held this year. Among them, as reported by Roy Schultz, president of the Tri-County Five Watters, Inc., was a dinner/dance held in late February in Marengo, Ill. Over 240 members and guests from as far as 70 miles away wined, dined,

and danced till the wee hours. Roy claims that the main attractions included 29 door prizes (one of them a transceiver); an after-dinner speech by Wayne Johnson, KHA6189; a fine meal; and music by the Chris Boxleitner band. The Tri-County Five Watters come from the counties of Boone and McHenry in Illinois and the county of Walworth in Wisconsin.

1965 OTCB Club Roster. The following clubs have reported to *On the Citizens Band* for the first time. If your organization has not yet been listed in these pages, forward all details to OTCB Club Roster, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

● Texas REACT Team, Dallas, Texas. This group has just begun organizational procedures, but has already aided the city of Dallas by handling 30 emergency calls in a three-hour period during a recent flood. They have also operated a monitoring station at the Texas State Fair to guide out-of-towners to the fairgrounds.

● Wareham Mobileers, West Wareham, Mass. The Mobileers operate 32 mobile CB units for emergency and/or civic needs. Their headquarters are in the town hall, and they have direct contact with selectmen, police and fire departments. This group was commended by city officials for participation in the control of a forest fire involving the Plymouth/Carver/Wareham area. Current officers: Frank Durgin, KBA9825, president; Franklin Rice, KBA-4838, vice president; Lonnie Snell, KBA-9302, secretary; Cy Westgate, KBA0661, treasurer; and John Andrade, 1Q1480, communications officer.

● Prairie Queen Citizens Radio League, Centralia, Mo. Organized and incorporated in December, 1964, these CB'ers are presently establishing an emergency net, working with CD authorities, and planning an association with REACT. Officers: Gene C. Berck, KGJ0355, president; John Wagner, KLH1117, vice president; Dave Campbell, KLH0462, secretary; Allen Zaring, KLH4058, coordinator.

● Northwestern Indiana Citizens Radio Association (NICRA). With 90 members, this club is in the process of forming an emergency net for aiding police and sheriff departments in the area. Officers: H. Lee Gray, president; Donald Mitchell, vice president; Ernest Reeder, secretary; Wayne Huhn, treasurer; and Ernest Stanley, sergeant-at-arms.

● Flushing Citizens Band Radio Club, Flushing, N.Y. Now being organized in the county of Queens, this unit requests that anyone interested in joining contact acting president Steven Erkes, 35-11 164th St., Flushing, N.Y. Acting vice president/secretary is Richard Brugnoni, KKD7454.

● Crystals CB Club, Wantagh, N.Y. 11793. Recently elected officers are: Jay Dubner, KKD2495, president; Gary Epstein, KKD-6257, vice president/treasurer; and Richard Rios, KBI2123, secretary. The group monitors "9."

● Communications Corps of Harris County, Inc., Houston, Texas. This club is chartered by the state. With 58 members, the group is trained for emergency communications and assistance, and is authorized to enter disaster areas by issued credentials carried by each member.

Be sure to fill us in on your successful jamboree and other activities. And if you run across an unusual CB application, why not pass it along to us and include a picture? We'll show it to the rest of the troup via these pages.

I'll CB'ing you!

—Matt, KHC2060

Clipper-Limiter Quiz Answers

(*Quiz appears on page* 54)

1 — E	5 — A
2 — B	6 — H
3 — F	7 — D
4 — G	8 — C

Short-Wave Report

(*Continued from page 80*)

QSL card, make your report cover not less than 20 minutes listening time, and include as many items as possible about the program you heard (musical selections, announcements, etc.). Tell them that you are not a club member and that you only want to obtain their QSL card, provided your report meets with their approval. It *must* be a good report; if it isn't, you are out of luck.

A Timely Tip. Now that the warm weather is here, you might find it worthwhile to check out your listening post. It's a good time to solder up all of those loose connections in your antenna system, or install new insulators if necessary. Make sure that the system is properly protected by a lightning arrester and that the feed line (lead-in) has no breaks in it. And check out your ground line to be certain that it is still firm and tight.

It's also a good time to take your receiver outside and blow the dust out of it—but be careful not to damage any of those vital components! You might also remove the tubes and have them checked by a competent serviceman; replace those that are weak or show a tendency to have short circuits in them. Your listening post is only as good as you make it—the better it is, the more you will benefit from it.

Current Station Reports

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

Angola—*R. Comercial de Angola,* Sa da Bandeira, 4859 kc., is noted from 0057 with IS and music to 0130, then news in Portuguese. Beware of the Guatemalan c.w. station, TGY; it causes heavy QRM.

Argentina—*R. Belgrano,* Buenos Aires, has been heard on the new 11,780-kc. frequency (dual to 6090 and 9690 kc.) with news in Eng. at 2100-2110, Spanish to 2200, Eng. to N.A. at 2200-2300. It was also noted as late as 2328 with Eng. ID's and anmts.

Basutoland—The schedule of ZNF4V is reportedly quite variable but Sesotho is generally aired on Saturdays at 0130-0255 and 1300-1415. The Government Service broadcasts at 2350-0020, also in Sesotho, and at 2345-2350 and 1245-1300 in Eng., all on 3824 kc.

Bechuanaland—Station ZND, Lobatsi, has been moved and has been operating since mid-February as *R. Gaberones* on 3356 kc. with 700 watts; it will continue to do so until the recently ordered xmtrs

are placed in operation. Gaberones is the new capital of this country.

Belgium—Brussels has been found on 6175 kc. with French and Flemish daily to N.A. at 1815-2000.

Brazil—Station ZYB7, *R. Tupi,* Sao Paulo, is now on 6175 kc., replacing *R. Cultural,* from 0200 with music and ads. Station ZYA, *R. Roraima,* P. O. Box 171, Roraima, Boa Vista, 4837 kc., is seldom heard; when on the air, this Northern Brazilian outlet has local music and Portuguese vocals—a world news bulletin is given at 2000, and s/off time is 2030. Station ZYE7, *R. Educadora da Parnaiba,* Parnaiba, Piaui, 4823 kc., is another one that is rarely heard; the best listening time is around 1900; they have considerable carnival music. Station ZYE2, *R. Difusora Macapa,* Territorio do Amapa, 4911 kc., is fair with all-Portuguese programming until 2100/close. Station ZYR248 (?), *Lins Radio Clube,* Lins SP, 4935 kc., was inactive, but is now being heard around 1500 with ads and Brazilian pop tunes. Station ZYI24, on the same frequency, offers QRM after 1800. Still another rare station is *R. Educadora Rural,* Petrolina, Pernambuco, 5025 kc., noted to 2030 s/off with programs of local interest in Portuguese. (Editor's note: All of the above Brazilians, except ZYB7, were logged in Brazil. They would make fine catches for N.A. DX'ers!)

Brunei—*R. Brunei* was heard with Malay programs at 0700-0800 and Eng. to 0900 on 4865 kc. They verified in three weeks.

Burma—Rangoon has been found on 4795 kc. around 0604-0632 with Oriental music and some native-language announcements.

Chile—*R. Corporacion,* Santiago, is running an outlet on 9495 kc. that is strong at 1940 with usual native-language programs. It's unknown at press time whether 9495 kc. is a new or misplaced frequency for this station.

Congo (West)—Brazzaville is currently using 11,930 kc. around 1500 with French and pop tunes. Another outlet on 15,370 kc. has news in French at 1400-1415, then English.

Costa Rica—Rarely noted in N.A. is *Transmite R. Popular, Emisoras de R. Excelsior,* TISRHB2, San Jose, on 6076.5 kc. Try for it around 1700-1800 with news, ads, numerous anmts, and a variety of marimba music; all-Spanish. Two new stations are: *R. Atenas,* 6205 kc., noted at 0640 s/on and 0200 s/off; and *R. Acanal,* heard to 2100 s/off on 6210 kc. (but announced as 6150). At press time, late reports indicate that *R. Acanal* has left the air. Further information is requested.

Ecuador—Station HCOT1, *R. Saracay,* Santo Domingo de los Colorados, 3400 kc. (up from 3390 kc.), is heard well at 0100 with dedications. *R. Progreso,* Loja, 4706 kc., is sometimes good all night with requests and dedications in Spanish.

Egypt—*R. Cairo* has announced that a station to be known as the *Voice of the Palestine Liberation Fighters* will be on the air shortly. The station will operate in conjunction with the Arabic Military Government and will broadcast regularly for the Palestine Liberation Army. No frequency was given.

France—Paris has apparently made many additions to the Eng. schedule and is requesting comments on the additions. English is heard at 1435 on 11,920 kc. Newscasts in Eng. are given at 0115-0130 on 11,725 kc., and from 1330 to 1345 s/off on 11,775 and 11,845 kc. The latter xmsn follows a French newscast at 1315-1330.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QRM—Station interference
c.w.—Morse code	QSL—Verification
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
IS—Interval signal	s/on—Sign-on
kc.—Kilocycles	xmsn—Transmission
N.A.—North America	xmtr—Transmitter

Germany (East)—Unidentified time signal station on 4525 kc. is probably DIZ, Potsdam. This station is on continuously except from 0315 to 0445, and verification is by letter. Reports go to DIZ, Geodatisches Institut, Potsdam, DDR.

Germany (West)—The latest Eng.-language schedule from Cologne reads as follows: to Eastern N.A. at 2035-2115 on 9640 and 6175 kc. (replacing 6160 kc.), with French at 2115-2155; to Western N.A. at 1010-1050 on 11,795, 11,885, and 9735 kc. (replacing 9545 and 9640 kc.), and at 2355-0035 on 9735, 9575, 6145, and 5960 kc. (replacing 6160 kc.); to East Asia, Australia, and New Zealand at 0345-0440 on 15,275, 11,925 and 9640 kc. (replacing 17,845 kc.) and at 1610-1700 on 5980 and 7175 kc. (replacing 7275 kc.); to S. Asia at 0230-0340 on 11,785, 15,275 and 17,845 kc. and at 1050-1120 on 9545 and 11,775 kc. (replacing 7150 and 9735 kc.). There are Eng.-language broadcasts to Africa at 0105-0135 on 11,785, 15,275, and 17,845 kc. (replacing 9605 kc.) and the Kigali Relay on 7225 kc.; at 1115-1210 on 11,890, 15,275 and 17,845 kc. (replacing 15,155 and 9610 kc.) and also relayed on 7260 kc.; at 1520-1550 on 9575 and 11,785 kc. (replacing 7255 kc.) and also relayed on 7260 kc.

Ghana—Accra has news in Eng. beginning at 0200 on 7295 kc.

Guatemala—One of the strongest Latin American stations ever heard in the northeastern U.S. on the medium waves is TGJ, *R. Nuevo Mundo,* on 880 kc. "Hora Emphasis" was noted at 0008-0032, music to past 0050. This particular broadcast was heard during a period when WCBS, New York, was off the air; TGJ is often noted under WCBS.

Honduras—*R. Luz,* Olanchito, Yoro, has been strong for the past year on 4890 kc. from 0700 to 0800 with Spanish programs—including "Partido Liberal," a political orientation program.

Korea (North)—The latest schedule from *R. Pyongyang* reads: 1900-2000 and 2200-2300 in Eng. on 9750 and 14,520 kc.; 0100-0200 in French on 14,520 and 18,200 kc.: 0300-0500 in Russian on 5044 and 6540 kc.; 0500-0700 in Eng. and 0700-0800 in Chinese on 7580 and 9750 kc.; 1100-1300 in Russian on 6540 and 7580 kc.: and 1300-1500 in Eng. and 1500-1600 in French on 6540, 7379, 7580 and 10,380 kc. In addition, they have also been heard at 0915-0945 on 5044 kc., at 0945-1000 and at 1715 on 6540 kc., and on the same frequency in Japanese at 2300-0000. These are probably all Home Service transmissions. A late report from the West Coast indicates that 14,563 kc. is also in service, with Eng. to Latin America at 1900-2000 and 2200-2300; this is one of the strongest signals ever noted—possibly indicating a very powerful xmtr.

Lebanon—Beirut is definitely on 9755 kc. with Eng. to N.A.; broadcasts have been noted at 2130 and at other times. The African service is good on 11,775 kc. from 1330 to 1400, with s/off in Eng., French and Arabic.

Malaysia—*Voice of Malaysia,* Kuala Lumpur, has been noted on 7110 kc. with Eng. at 1900-1930 (news to 1910) and Mandarin to 2000, dual to 11.900, 9750, and 6105 kc. They request letters and reception reports.

Mozambique—*R. Clube de Mozambique,* Lourenco Marques, 4835 kc., has pop music and anmts from 2310 to 2350 with a good signal. Another outlet on

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

John E. Stevenson (WPE9GNU), Delavan, Wis.
Lee Rawson, Jr. (WPE9FWP), Lockport, Ill.
Patrick McGuire (WPE8FZJ), Canal Fulton, Ohio
Richard Heiser (WPE5DRF), Springer, N. M.
Gray Haeertig (WPE7CAO), Seattle, Wash.
Paul F. Arutt (WPE2LMX), Hewlett, N. Y.
John Sgrulletta (WPE2MXF), Bedford Hills, N. Y.
Angel Garcia (WPE2LXA), New York, N. Y.
Peter Moores (WPE1FIF), Lunenburg, Mass.
Gary Brown (WPE8IFA), Kingsford, Mich.
Melvin Granick (WPE2GAT), Laurelton, N. Y.
Arthur C. Tress (WPE2EKM), Union City, N. J.
Dick Doutt (WPEØEDU), Independence, Mo.
Barry Premeaux (WPE8HIP), Lansing, Mich.
James Tanenbaum (WPE6AAW), Los Angeles, Calif.
Allan C. Shepler (WPE3FXG), Orwigsburg, Pa.
Edward Braytenbah (WPE3FLC), Kensington, Md.
Nick Salerno (WPE2JMD), New York, N. Y.
Harry T. Stout (WPE4CXE), Elizabethton, Tenn.
Jeffrey Ribnik (WPE2NFP), West Orange, N. J.
Steven M. Thickstun (WPE3FRD), Library, Pa.
Edward Miles (WPE2MHZ), Mineola, N. Y.
Eric Maccalla, Jr. (WPE1FVY), Bridgeport, Conn.
Gary M. Chittum (WPE4GNR), Goodview, Va.
Kenneth O. Lunde (WPE6AKW), Goleta, Calif.
D. Rodman (WPE2JKN), Brooklyn, N. Y.
Donald Lovett (WPE4GBA), Keller, Va.
Bill Gerlog Jr. (WPE3GGY), Nazareth, Pa.
Jerry Van Vactor (WPEØDWI), Spearfish, S. D.
Merritt Markussen (WPEØDXE), Rolla, Mo.
David A. Robinson (WPE8GCE), Georgetown, Ky,
Roy Moore (WPE4FWH), Hazard, Ky.
Jim Wolfe (WPE9HPB), Collinsville, Ill.
Randall Lyon (WPE2LHO), Altamont, N. Y.
Geoff Stevenson (WPE9HQN), Lake Forest, Ill.
Edward Jaworski (WPE2NEP), Richmond Hill, N. Y.
James Drost (WPE2NEH), Hempstead, N. Y.
James H. Burton III (WPE4HTE), Staunton, Va.
Ralph H. Brown (WPE9HQO), Lake Forest, Ill.
Gary Welch (WPE1GFJ), Atkinson, N. H.
Bruce Patterson (WPE4GBW), Arlington, Va.
Barry Tarleton (WPE9ATG), Bellwood, Ill.
Lyle Lunsford (WPE3GGK), Baltimore, Md.
Christopher A. Maslen (WPE2NAO), Buffalo, N. Y.
Mike Altman (WPE9HPZ), Chicago, Ill.
Jim Cannon (WPE6FZQ), Sunnyvale, Calif.
Jan A. Lichtig (WPE6EEO), Livermore, Calif.
James Castino (WPE7CAH), Spokane, Wash.
Kenneth F. Burns (WPE6FMW), Palo Alto, Calif.
Ian Mac Farquhar (VE3PE1SJ), Scarboro, Ont., Canada
John Davis (WPE9HPG), Roberts, Ill.
Allison W. Capson (VE1PE9N), Saint John, N.B., Canada
Bruce Dunlavy (WPE8HXA), Cambridge, Ohio
David R. Oester (WPE7CEZ), Deer Island, Oreg.
Michael E. Moore (WPE4FYC), Chattanooga, Tenn.
Arthur S. Mullins (WPE9FUW), Oak Park, Ill.
Steven Wainshilbaum (WPE1FBH), Reading, Mass.
John M. Coleman (WPE3FTM), Pittsburgh, Pa.
Dave Truppo (WPE2MSD), New York, N. Y.
William E. Cutcher (WPE2GEJ), Auburn, N. Y.
Tim C. Hartmann (WPEØBJS), St. Louis, Mo.
Vincent Scotto (WPE2MRQ), Brooklyn, N. Y.
Brian Rose (WPE3GBR), Bethesda, Md.
Ernest Lendler (WPE1CQ), Branford, Conn.
Roger Camire (WPE1GEK), Manchester, N. H.
Kelly Andrews WPE4IGA), Goldsboro, N. C.
Bernie Maron (WPE2MUK), Oradell, N. J.
James M. Stroud (WPE8HCX), Canton, Ohio
Carlton R. Werner (WPE2NGV), Attica, N. Y.
Emmett Murphy (WPE7BEF), Butte, Mont.

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. You'll find an application form on page 77 of the April issue.

(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 and 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. 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. Please do not send International Reply Coupons (IRC's) or personal checks when applying for a DX award.

(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 Certicate in your possession). Reports, news items, or questions should be mailed in a separate envelope.

11,780 kc., heavily QRM'ed at times by *R. Belgrano,* Argentina, is heard at 2320-0000 with the "One For Me, One For You" program.

Niger—*R. Niamey,* 6060 kc., is noted with native-language chanting at 0130-0230; news in French is given some days at 0230. The dual 3260-kc. channel signal is very weak.

Saudi Arabia—Jeddah-Riyadh, 11,855 kc., is strong from 1435 with Arabic news and some pop records. The 7085-kc. outlet has a domestic newscast in Arabic at 1530-1545 but the signal is weak.

Solomon Islands—Station VQO4, Honaira, is listed on their QSL card as being on 3205 kc. but the card does not indicate whether this channel is active. Station VQO3 on 3955 kc. is heard from 0228 s/on with chimes and music; local news in Eng. is given at 0245. There is a news relay from London at 0415-0428.

South Africa—Eastern listeners are hearing the Africa Service with classical music at 1120-1130; Eng. news at 1130-1140; and music to past 1145. This transmission is on 17,805 kc. (replacing 17,885 kc.), 15,220 kc. (replacing 15,220 kc.), 9525, and 7275 kc. Western DX'ers report hearing the 9720-kc. outlet with a good signal from 1030 to 1130 s/off with commercials, news, sports, and recorded music.

Switzerland—Test xmsns will be made by the Red Cross on 7210 kc. at 0100-0200, 0630-0730, 1000-1100 and 1600-1700 on May 10, 12, and 14; July 5, 7, and 9; September 21, 23, and 25; and November 22, 24, and 26.

Tahiti—A QSL card from *R. Tahiti* lists operations at 1115-1215, 1630-1800, and 2230-0230 on 11,825 and 6135 kc., although late reports indicate a change from 6135 to 6140 kc. to avoid QRM.

Tchad—*La Radiodiffusion Nationale Tchadienne* is on the air weekdays at 0000-0100 and 0700-1630, on Saturdays to 1800 and on Sundays at 0000-1630 on 6165 kc., and on 4904.5 kc. "for morning and evening transmissions." The latter outlet was heard with news in French from 1615 to 1632 s/off.

U.S.S.R.—*R. Kiev* operates to N.A. in Eng. on Mondays and Thursdays at 1930-2000 on 9660, 7330, 7310, 7180, and 7120 kc., and at 2330-0000 with 7170 kc. replacing 7120 kc.. An Eastern listener reports hearing *R. Ulan Bator,* Mongolia, on 10,885 kc. at 2100-2130 with native-language talks and vocal music; it took five months to log it! Another one, either Komsomolsk or Petropavlovsk, on 11,755 kc., has been noted in native language around 1800; this should not be confused with Peking.

Vietnam (South)—Saigon is heard on 9620 kc. at 0735-0800 with Oriental music and talks, and on 4877 kc. with domestic programs at 0500-0800. Both channels are difficult to receive most of the time.

Yemen—*R. New York Worldwide* reports that Sanaa is on 5804 kc. Subsequent checks located a xmsn from 2250 to 0015 fade-out; news is given at 2330-2350 and native music with Arabic anmts at other times. Evidently this is an all-Arabic xmsn.

Zambia—One of the best catches reported this month is Zambia Broadcasting Corp. in Lusaka on 4965 kc. This one has to override the usually strong signal from *R. Santa Fe,* Bogota, Colombia, on the same frequency. Look for it around 0000-0140. They have an Eng. newscast scheduled at 0100; other programs are generally in native language but familiar products are mentioned in the commercials.

-30-

SHORT-WAVE CONTRIBUTORS

Francis Welch *(WPE1CRV)*, Rochdale, Mass.
David Siddall *(WPE1EBN)*, Hyannis, Mass.
Robert Cate *(WPE1FXM)*, Dover, N. H.
David Smith *(WPE1GBC)*, Everett, Mass.
Foster Cooperstein *(WPE1GCF)*, New Bedford, Mass.
William Graham *(WPE2LMU)*, Binghamton, N. Y.
Bill Kasperkoski *(WPE2MRL)*, Ontario, N. Y.
Jim Parisho *(WPE2MTO)*, Blackwood, N. J.
James Neff *(WPE2RS)*, Springville, N. Y.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Kenneth Alyta, Jr. *(WPE4FXY)*, Charlotte, N. C.
Jim Maynard *(WPE4FY)*, Lexington, Ky.
David Chaffin *(WPE4HJZ)*, Chattanooga, Tenn.
Bobby Conder *(WPE4HQT)*, Winston-Salem, N. C.
Jeff Tallent *(WPE4HUZ)*, Louisville, Ky.
John Seay *(WPE4IGT)*, Fairhope, Ala.
Joseph Ayala *(WPE4IIJ)*, Key West, Fla.
Margaret Williams *(WPE4IIP)*, Chesapeake, Va.
Del Hirst *(WPE5CFU)*, Snyder, Texas
Hubert Beavers *(WPE5DWC)*, Albuquerque, N. M.
Shaler Hanisch *(WPE6BPN)*, Hartford, Conn.
Trev Clegg *(WPE6FAF)*, Fresno, Calif.
Robert Gilbert *(WPE6FRT)*, San Diego, Calif.
Gary Fredericks *(WPE7CGG)*, Eugene, Oreg.
Robert Sabin *(WPE8DB)*, Wilmington, Ohio
Robert Eddy *(WPE8EQW)*, Newport, Ohio
Marlin Field *(WPE8FRE)*, Benton Harbor, Mich.
George Bednarik, Jr. *(WPE8IGS)*, Petoskey, Mich.
Paul Meyers *(WPE8IHV)*, Bethel, Ohio
James Pogue *(WPE9HLJ)*, Farmland, Ind.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Leo Alster, Rahway, N. J.
Joe Esser, New Kensington, Pa.
Robert Harris, Syosset, N. Y.
Patrick Hickey, Dallas, Texas
Michael Lee, Goose Bay, Labrador
Joe Piechuta, Meriden, Conn.
Ray Schlegel, Rochester, N. Y.
Jim Wedewer, Dyersville, Iowa
Radio New York Worldwide, New York, N. Y.
Sweden Calling Dx'ers Bulletin

Electroplate or Anodize

(*Continued from page* 59)

though this solution is the same as that used in one of the plating steps, employ a new solution here.

Suspend the aluminum work piece in the solution and connect it to the positive power output terminal. The connection to the work piece must be made with an aluminum strip, wire, or clamp. Any other metal will contaminate the solution. Connect the lead plate to the negative power terminal and adjust the rheostat for 12 or maximum voltage. The average anodizing time will be from 20 to 30 minutes, after which the work should be thoroughly rinsed and transferred to the dyeing bath.

The dyes for anodizing are generally sold in lots of a pound or more, and since a pound would last for years, your best source for smaller quantities is a local anodizing plant. An interesting experiment is to try dyes that are made for dyeing cloth. Some of the colors produce very good results while others do not work out at all, but in either event they are quite inexpensive. Dyes of this type that worked very satisfactorily for the author are Rit Gold 23 and Rit Fuschia. For best results, the commercial dyes for anodizing should be heated to between 125 and 150 degrees. The dyeing process will require about 20 minutes. Seal the anodizing by boiling the dyed piece in water for 30 minutes, or by spraying it with clear lacquer.

Special Problems. Lack of success in plating operations can usually be traced to failure to clean work properly, overly long plating time, or an incorrect amount of current. It is a good idea to plate several samples of metal, each of which is subjected to one of the above conditions, so that you can recognize the effects. Agitation of the work piece while it is in the solution is recommended to dislodge any bubbles which might collect on it. Anodizing troubles can generally be traced to unclean parts or too little current.

On projects where uniform plating is desired on both sides, anodes can be placed on either side of the work piece and connected to a common positive terminal. Although projects can be suspended from a bar placed across the jar, you will get more uniform spacing and eliminate the possibility of a short circuit if you make a rack for suspending the electrodes as shown on page 58.

A good source of supply for plating chemicals is the Hollywood Bronze Supply, 3445 Union Pacific Ave., Los Angeles 23, Calif. Anodizing dyes can be obtained from Sandoz, Inc., 61 Van Dam St., New York 13, N.Y. Many other suppliers will be found in the *Metal Finishing Guidebook* published by Metal Finishing, 381 Broadway, Westwood, N.J. This book is available in many libraries, but if you want to explore further the fascinating field of electrochemical metal finishing, it will be well worth your while to get your own copy.

As sulfuric acid is also used in batteries, many gas stations keep a supply on hand for sale. And other chemicals can often be found in drug stores. -30-

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Transistor Topics

(*Continued from page 74*)

without the application of external bias.

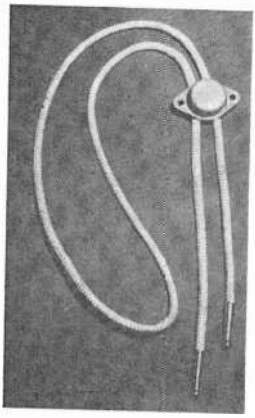
Also, a high resistance in the collector load can cause clipping long before the maximum rated collector current is reached. The higher the resistance, the higher the voltage drop; and if the voltage drop is high enough, the collector is starved and acts like a limiter, or clipper.

Of course, an oscilloscope is needed to see the waveforms. In the absence of a scope, however, you can combine a listening test with voltage and resistance measurements to predict what is happening.

Distortion in an audio amplifier can sound fuzzy, mushy, or muffled, depending on the degree and type of distortion. In addition, if the distortion is caused by excessive forward bias or leakage, the transistor can overheat and break down. Distortion in r.f. amplifiers can result in cross-modulation, poor selectivity, and other complaints.

"Reward" for Readers' Circuits. There is a good deal of personal satisfaction to be derived from developing new circuits and new applications. Certainly, too, contributors are probably pleased to see their pet projects receive recognition in our "Readers' Circuits" Section. To add a more tangible element of reward, however, a token of appreciation will be sent to each reader whose circuit is selected for publication in future issues. The token may vary from time to time. As a start, an attractive "Transistor Bolo Tie" similar to the one shown in the photo will be given (this is a product of USBEMS, P.O. Box 1564, Wheaton, Md. 20902).

That's it for now . . . —*Lou*



This attractive "Transistor Bolo Tie" will be given to readers whose circuits are published in future "Readers' Circuits" Sections in Transistor Topics.

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 75¢ per word (including name and address). Minimum order $7.50. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.
READER RATE: For individuals with a personal item to buy or sell. 45¢ per word (including name and address). No Minimum! Payment must accompany copy.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, components, valuable parts, equipment. Poly Paks, P.O. Box 942, Lynnfield, Mass.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Radios, Parts, Picture Catalog 20¢. Meshna, Nahant, Mass.

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.

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

"SPECIAL! WPE-SWL-CB-QSL cards, 3 colors, $2.50 per 100—Free Samples, Garth, Jutland, New Jersey."

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

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

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

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

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

CB-WPE-QSL CARDS. New **"FROSTALEEN"** Paper. **16 SAMPLES,** 25¢. Dick, W8VXK, 1996P N, M-18 Gladwin, Michigan 48624.

ELECTRONIC "GOODIES"—Bonanza surprise package, $1.00 ppd. Guaranteed satisfaction. **DART ELECTRONICS,** Box 214, Jericho, N.Y.

DIAGRAMS—Television $2.50. **RADIO 1919** to 1955 $1.00 each. Give Model. Diagrams, Box 55, Williamsport, Pa. 17704.

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

NEW Supersensitive transistor locators detect buried gold, silver, coins. Kits, assembled models. $19.95 up. Underwater models available. Free catalog. Relco-A33, Box 10563, Houston 18, Texas.

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco Industries, Box 10563, Houston 18, Texas.

TRANSISTOR Ignition. "Operation Pickup" described June 1963 POPULAR ELECTRONICS. Complete kit guaranteed components. Now $13.95 Postpaid. **NEW MODEL T-1A** including **DELCO** transistor, **MALLORY** coil. Kit $16.95. Wired, $18.95. Specify automobile. **ELECTROMART,** Box 2680, Milwaukee, Wisconsin. 53214.

INVESTIGATORS—Electronic surveillance devices. Price breakthrough on ultra miniature professional devices. Free details. Trol Electronics-PES, 342 Madison Avenue, New York, N.Y.

INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONIC SURVEILLANCE EQUIPMENT. ACE ELECTRONICS, 11500-L NW 7TH AVE., MIAMI 50, FLA.

CITIZEN BANDERS! Get base station Performance with your mobile units. No modifications or soldering necessary. Proven performance. Send for free details or send ($15.00) to: T. Francis, 15 Park Row, N.Y. 38, N.Y.

ACHTUNG! Das machine is nicht fur Gerfingerpoken und mittengraben. Is easy schnappen der Springenwerk, blowenfusen und poppencorken mit spitzensparken. 1st nicht fur gewerken by das Dummkopfen. Das rubbernecken sightseeren keepen hands in das pockets. Relaxen und watch das Blinkenlights. This attractive, brass metal plaque only $2.00 each. ppd. Southwest Agents, Dept. P, 8331 Hwy. 80 West, Fort Worth, Texas 76116.

WALKIE-TALKIE. Construct 2"x1"x½" transistorized, long range, 100 milliwatt marvel for $10. Plans, FREE GIFT, $2.00. Baker Electronics, R.R. 1, Greencastle, Ind.

LASER: Hobbyists, experimenters, amateur scientists. Build your own coherent-light optical laser. Complete instructions, schematic diagrams and parts list. $6.00. Same as above, diode laser. $3.00. Technical Writers Group, Box 5501, State College Station, Raleigh, N.C.

REVERBERATOR (Echo) **UNIT**—Build your own. Complete plans, schematic parts list—$3.00. Use with automobile radio, home radio, or record player. Technical Writers Group, Box 5501, State College Station, Raleigh, N.C.

CB CARDS-Economy line. Some low as $1.50 hundred. Send 10¢ for samples. Signal, Adams County, Manchester, Ohio.

AMAZING NEW electronic miracle transforms your TV room into a Stereophonic Theatre! Free details and Free Gift! Consolidated Acoustics, 1302C Washington, Hoboken, N.J.

BUY Appliances, Cameras, Watches, etc. at factory prices plus 10%! Free Details! Cam Company, 436-11 Bloomfield Ave., Verona, N.J. 07044.

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

NAMEPLATES, Decals and Signs of All Kinds. Seton, New Haven 15, Conn.

BUILD TV Camera Cheaper Than Ever! Send 10¢ for Details. ATV Research, Box 396, South Sioux City, Nebr. 68776.

HEAR AIRCRAFT, TOWER, WEATHER. 9 Transistor AM-FM portable receiver converts to VHF aircraft band. $26.50. **BUILD TINY, ULTRA SENSITIVE FM WIRELESS MIKE.** Wired board, parts, and instructions. $12.50. Free details. Transco, Box 13482 North County Branch, St. Louis, Mo. 63138.

DIGITAL CIRCUITS: Set-reset **FLIP-FLOPS** for operation up to 1,000,000 pulses per second, **PULSE GENERATORS, FULL ADDERS,** and **LOGIC GATES.** All circuits fully transistorized and mounted on plug-in printed circuit boards. A connector is provided with each unit. Rugged wide temperature range industrial units available. Type FF-1A flip-flop and connector for 10,000 pps operation: $3.87. Postage paid. Send for free literature giving detailed specifications of all circuits. **KOMTRON,** Box 275, Little Falls, N.J. 07424.

NEED RESISTORS? Factory fresh, **NAME BRAND,** ½ watt, 10% standard carbon resistors. Any regular value from 10 ohms to 2.2 megohms, $.05 each! Postpaid. Any quantity assorted. Minimum order $1.00 **TEPCO,** Box 508, Tullahoma, Tenn.

SAFEGUARD PRIVACY! New instrument detects electronic 'bugs', wire-tapping and snooping devices. Free information. Dee Equipment, Box 7263-E7, Houston 8, Texas.

TRANSISTORS—Miniature Electronic Parts. Send for free Catalog. Electronic Control Design Company, P. O. Box 1432K, Plainfield, N.J.

TRANSISTOR Ignition Coils 400:1 Special $3.95. Two Delco Transistor Cascade Amplifier (15 Amp) in Anodized Aluminum Heatsink, Below Parts cost at $5.95. 4/10-6/10 80 watt Ballast Resistors, 69 Cents. 6/10 Volt 20 Amp Load Relay with fuse, 99 cents. Complete Kit for 6-12 Volt Negative Ground, $9.95 postpaid. Orders under $5.00 Add 50 cents postage. Closeout, All New Merchandise, Supply Limited. Electronic Liquidators, BOX 1946, Grand Junction, Colorado.

AUTO REVERBERATION UNITS wholesale. Signal Systems, 31160 Eight Mile, Farmington, Mich. 48024.

15 DISTANCE One-tube plans—25¢. "One Tube Handbook"—50¢. Includes Transistor experiments, catalog. Laboratories, 1131-L Valota, Redwood City, Calif.

RAILROAD PAINTINGS FOR SALE. Charles Henry, 2820 Bailey Ave., Bronx, New York 10463.

CRYSTAL—Sub-miniature Types Only $1.05. Lists, Send 10¢ or stamps. Quaker, Hunlock Creek, Pa.

DIGITAL COMPUTER KIT: Learn how a computer operates! Build such things as counters, arithmetic unit, puzzles, and other logic circuits. This kit contains 12 logic modules of the type used in large computers, accessories, and a complete instruction manual. Kit price, complete, $26.95. NOR gate modules, $2.00, Flip Flop Modules, $3.50. Write for free catalog and descriptive literature. RLC Electronics, Box 8028, St. Louis, Mo. 63156.

CBer's, NEW Solid State Mobile Antenna Booster. Increase range, power, receiver sensitivity. Decrease SWR, noise. R.F., modulation indicator. Lightning protection. $9.95. Dynacomm, 4860 NW 2nd Avenue, Miami, Fla. 33127.

COLLECTORS "Gemini" Tie tac $3.50 Ppd. Space Hunter Sales, Box IIII, Canoga Park, Calif. 91304.

110VAC 60cy from car generator. Powers lights, refrigerator, transmitter, receiver, etc. Simple, easy to convert. Plans $2.00. Tedco, P.O. Box 12098, Houston, Texas 77017.

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

"GREAT BUYS" Catalog 10¢, 12VDC 4PDT Sealed Relays, 20,000 OHMS per Volt multimeter new with test leads, battery, leather case $10.95, wire ½¢ Ft. Fertik's, 9th Tioga, Phila., Pa. 19140.

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

CONTROL TV AUDIO REMOTELY UNIT. Attach to speaker. $5.50. Hall Electronics, 3950 E. Washington, Phoenix, Arizona.

FLASHLIGHT AND RECHARGING UNIT. Plugs into flashlight and into 12 volt car cigarette lighter. Uses standard batteries. $5.50. Hall Electronics, 3950 E. Washington, Phoenix, Arizona.

TV CAMERA Under $40.00—Completely Transistorized space age flying spot scanner—Schematics, Photographs, Plans—$3.00. Free Catalog—Beck, 777 Ruth Drive, Newbury Park, Calif. 91320.

QSL-CB-SWL (Letters)—Cards Printed; Samples 10¢. **MARTIN,** 828-D Schuylkill Avenue, Reading, Pa.

WE SELL CONSTRUCTION PLANS: $50 TV Camera, $40 Telephone Answering Machine, $50 Ultrasonic Dishwasher, $15 Bell System type Speakerphone, Phonevision, Private Eye Tail Transmitter, $75 Electron Microscope, $10 Legal Telephone Connector, $15 Automatic Telephone Dialer, Dial Telephone Exchange, Electronic Tranquilizer, Transistorized Teletype, Morse Code Copier, Police Radar Detector plus Legal Jammer, Telephone Extension in your car, TV Recorder, 3D TV Converter. **FREE** Super Hobby Catalog. **COLOR TV** Converter, completely electronic; No mechanical gadgets, costs about $35. All plans $4.75 each. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood, Calif. 90046.

DETECTIVES! Free brochures! Electronic intelligence devices for your needs and budget. **SILMAR ELECTRONICS,** 3476 N.W. 7th Street, Miami, Fla. 33125.

QSL'S $1.75/100 up. Catalogue-samples 10¢. Longbrook. Box 393-Y, Quakertown, N.J. 08868.

TELEPHONE Voice Switch: (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. $23.75. Postpaid USA, WJS Electronics, 1525 No. Hudson, Hollywood, Calif.

RESISTORS, NEWEST TYPE METAL-FILM, COPPER CIRCUIT BOARD, CAPACITORS, TERMINAL BLOCKS, FREE CATALOG, FARNSWORTH ELECTRONIC COMPONENTS, 88 Berkeley, Rochester, New York 14607.

INVESTIGATORS, keep in step with advancements in the art of electronics for the professional. Send $1.00 for equipment brochure. WJS Electronics, 1525 North Hudson, Hollywood, California 90028.

CB QSL-SWL cards. Attractive designs, glossy white. Plastic card holders. Letters, Warning & Police decals. Many items for CB'ers. Catalog No. 108 **FREE.** Woody, 2611 Shenandoah, St. Louis, Mo. 63104.

DIAGRAMS Radio, Television. 1919-1965 $1.00. Servicaide, Box 3412-A, Harrisburg, Pa. 17105.

FREE Catalog: Wholesale Electronics. Hundreds of items. **ROYAL,** Box 2591, El Cajon, Calif.

SENSATIONAL LISTENING; SENSITIVE POCKET VHF POLICE AIRCRAFT RECEIVER. Easily assembled. Plans $2.00. Ottawa Sales, Box 627, Holland, Mich. 49424.

COMPLETE ONE wired laser shown in Nov. 64 Popular Science, less ruby rod $75.00. Kenneth Rogers, 56 Robinwood Ave., Jamaica Plains, Mass. 02130.

ELECTRONIC SHOCK Book innocent looking, irresistible tantalizing title compels victim to open and Wow! Harmless $3.50. Mark II Enterprises, 19 Rigaud Rd., Spring Valley, New York.

"NEW CRYSTALS" in sets of 40 from 14.23-18.213mc 2-6 meter range, FT243 holder $14.95 per set postpaid. Jim Stover, 711 SE 60th 5A, Portland 15, Oregon.

YOU supply schematic; we supply parts. **CUSTOM KIT,** Box 63, Roslyn, Pa.

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1AB5	.75	3CY5	1.18	6A4	2.20	6BW4	1.10	6F7	3.95	6S8GT	1.50	10C8	1.49	12FQ8	1.19	18FW6	.75
1AD4	1.75	3D6	1.48	6A6	1.75	6BW8	1.35	6F8	3.25	6SA7GT	1.39	10DE7	1.29	12FR8	1.48	18FX6	.79
1AE4	1.30	3DG4	1.35	6A7	3.15	6BX7	1.62	6FG5	1.99	6SA7M	1.49	10DX8	1.37	12FX5	.96	18FY6	.69
1AF4	1.45	3DK6	.87	6A8GT	1.95	6BY5	1.65	6FG6	1.25	6SB7Y	2.35	10EG7	1.49	12FX8	1.27	18GD6	.81
1AG4	2.20	3DT6	.79	6A8M	2.50	6BY6	.98	6FG7	1.10	6SC7	1.65	10EM7	1.75	12GA6	.91	19	1.00
1AH4	1.75	3DZ4	1.59	6AB4	.79	6BY8	1.01	6FG8	1.75	6SD7	1.49	10EW7	1.45	12GC6	1.15	19AU4	1.40
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1AY2	.98	3FH5	.95	6AC7	1.75	6C4	.54	6FM7	1.31	6SG7	1.65	10JA8	1.35	12J5	1.21	19EA8	1.19
1B3	.88	3FS5	1.18	6AD7	3.25	6C5M	1.60	6FQ7	.89	6SG7GT	1.59	10JY8	1.49	12J8	1.70	19GQ7	1.99
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1G3	.88	4AV6	.70	6AJ8	1.73	6CG8	.85	6GE5	1.49	6SS7GT	1.89	12AF3	.95	12SH7	1.55	25B8	1.93
1G4	1.75	4BA6	.85	6AK5	1.50	6CH8	2.00	6GE7	1.19	6SU7	2.00	12AF6	.98	12SJ7GT		25C5	.66
1G6	1.50	4BC5	.90	6AK6	.94	6CK4	1.00	6GF5	1.42	6SZ7	1.25	12AG6	1.49		1.35	25CA5	1.50
1H4	1.25	4BC8	1.02	6AL3	1.00	6CL6	1.12	6GF7	1.69	6T4	.15	12AJ6	.94	12SK7GT		25CD6	2.10
1H5	2.59	4BD6	1.00	6AL5	.45	6CL8	.94	6GG8	1.15	6T8	1.23	12AL5	.71		1.45	25CU6	1.70
1H6	.98	4BN6	1.48	6AL7	1.95	6CM6	1.29	6GJ5	1.69	6U5/6G5		12AL11	1.69	12SL7GT		25DK4	.63
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1J5	.98	4BS8	1.35	6AM8	1.25	6CM8	1.45	6GK5	1.55	6U8	1.29	12AT6	.55	12SN7	.89	25EH5	.82
1J6	.98	4BU8	1.25	6AN4	2.35	6CN7	.92	6GK6	.99	6U8GT	1.10	12AT7	1.05	12SQ7GT		25F5	1.29
1K3	.88	4BZ6	.85	6AN5	1.95	6CQ4	1.25	6GM5	1.99	6V3	1.79	12AU6	.69		1.35	25L6	.75
1L4	.66	4BZ7	1.49	6AN6	2.45	6CQ7	1.80	6GM6	1.21	6V4	.59	12AU7	.99	12SR7	1.50	25W4	.95
1L6	2.60	4CB6	.87	6AN8	1.50	6CQ8	1.15	6GM6	.91	6V6GT	.79	12AV5	1.50	12U7	.95	25Z5	1.70
1LA4	1.30	4CS6	.59	6AQ5	.79	6CR6	.91	6GN8	1.35	6V6GTY	.79	12AV6	.59	12V6	.95	25Z6	1.10
1LA6	1.49	4CY5	1.10	6AQ6	.99	6CS6	.85	6GQ5	1.89	6V6M	2.39	12AW6	1.10	12W6	.89	27GB5	1.49
1LB4	1.80	4DE6	1.01	6AQ7	1.55	6CS7	.99	6GR7	1.42	6W4	.89	12AX3	1.03	12X4	.59	32ET5	.89
1LC5	1.05	4DK6	.58	6AQ8	1.20	6CU5	.84	6GT5	1.49	6W6GT	1.03	12AX4	.75	13DE7	1.12	32L7	.85
1LC6	1.80	4DT6	.87	6AR5	.99	6CU6	1.45	6GV5	1.65	6X4	.60	12AX7	.92	13DR7	1.29	33W7	1.95
1LD5	1.95	4EH7	1.47	6AR8	1.55	6CU8	.59	6GV6	1.85	6X5GT	.75	12AY3	1.05	13EM7	1.83	34DG5	.95
1LE3	1.25	4EJ7	1.47	6AR8	2.00	6CW4	1.69	6GW6	1.55	6X8A	1.30	12AY7	1.55	13FD7	1.89	34GD5	.83
1LG5	1.98	4EM6	1.19	6AR11	1.55	6CW5	1.39	6GW8	1.21	6Y6	1.65	12AY7	1.00	13FM8	1.15	35A5	2.30
1LH4	2.69	4E58	1.79	6AS5	.79	6CX8	1.49	6GX6	.88	6Y10	.98	12AZ7	1.00	13GF7	.79	35B5	1.20
1LN5	2.25	4EW6	1.01	6AS6	1.35	6CY5	.99	6GX8	1.31	7A4	1.75	12B4	1.00	14A4	1.45	35C5	.73
1N5	1.85	4GM6	1.59	6AS7	2.85	6CY7	1.29	6GY6	1.89	7A5	1.75	12BA6	.60	14A5	1.35	35EH5	.83
1P5	2.00	4GM6	1.25	6AS8	1.45	6CZ5	1.59	6GY6	.87	7A6	1.85	12BA7	1.90	14A7	1.39	35L6	.87
1Q5	1.95	4GS8	1.25	6AS11	1.95	6CZ7	1.95	6GZ5	1.16	7A7	2.25	12BD6	.72	14AF7	1.45	35W4	.40
1R4	.80	4GZ5	.91	6AT6	.49	6D4	1.75	6HA5	1.45	7A8	2.75	12BE3	.99	14B6	1.69	35Y4	1.00
1R5	.99	4GZ6	1.13	6AT8	1.40	6D6	2.50	6HB5	1.69	7AD7	2.25	12BE6	.61	14B8	1.95	35Z3	1.49
1S2A	1.90	4HA5	1.85	6AU4	.95	6D10	1.59	6HF5	1.79	7AF7	1.65	12BF6	.68	14C5	1.75	35Z5	.65
1S4	1.49	4HC7	1.39	6AU5	1.60	6DA4	.99	6HF8	1.45	7AG7	2.85	12BH7	.91	14C7	2.35	45Z3	.55
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1T4	.99	4HS8	1.18	6AU7	.54	6DB5	1.99	6HJ8	1.25	7AU7	.69	12BL6	.89	14E7	1.39	50B5	.89
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1U4	.99	4JC6	1.35	6AV5	1.45	6DC6	1.29	6HL8	1.19	7B5	2.75	12BQ6/		14F8	2.40	50DC4	.64
1U5	.97	4JD6	1.35	6AV6	.44	6DC8	1.25	6HS8	1.21	7B6	1.25	12CU6	1.55	14GT8	.95	50EH5	.87
1V	1.85	5AM8	1.34	6AV11	1.52	6DE4	1.03	6HT6	1.19	7B7	2.25	12BR7	1.15	14H7	1.95	50FY5	2.50
1V2	.79	5AN8	1.45	6AW8	1.35	6DE6	.93	6HZ6	.99	7B8	2.25	12BV7	1.32	14J7	1.95	50HC6	.86
1X2B	1.05	5AQ5	.52	6AX3	1.05	6DE7	1.29	6H6M	.79	7C4	1.15	12BW4	1.07	14N7	1.95	50HK6	.86
1Z2	3.25	5AR4	1.72	6AX4	.94	6DG6	.95	6J4	2.95	7C5	1.25	12BY7	1.15	14Q7	2.10	50L6	.95
2A3	3.25	5AS8	1.75	6AX5	1.15	6DJ8	1.65	6JB6	1.76	7C6	2.75	12BZ6	.76	14R7	2.40	50X6	2.35
2A5	1.95	5AT8	1.35	6AX7	1.25	6DK6	.89	6JC8	1.15	7C7	1.25	12BZ7	.95	14S7	1.95	50Y6	1.70
2A6	3.75	5AU4	1.40	6AX8	1.34	6DN6	2.74	6JE6	2.99	7E5	1.25	12C5/		14W7	1.85	50Y7	1.65
2A7	1.50	5AV8	1.52	6AY3	1.05	6DN7	1.35	6JE8	1.49	7E6	1.25	12CU5	.85	14X7	1.75	60FX5	.95
2AF4A	1.39	5AW4	1.00	6AZ8	2.18	6DQ5	2.75	6J5G	.95	7E7	1.33	12CA5	1.00	14Y7	1.75	70L7	.89
2AH2	1.34	5AZ4	1.98	6B4	5.95	6DQ6	1.50	6J5M	1.30	7E7G	1.10	12CR6	1.00	15AF11	1.95	117L7	3.50
2AS2	1.30	5B8	2.09	6B5	4.00	6DR7	1.29	6J5GT	1.20	7F7	2.10	12CS6	.95	15CW5	1.02	117N7	4.50
2B3	2.70	5BC3	.87	6B6	2.75	6DS4	1.29	6J6	.72	7F8	3.10	12CX6	1.05	15FY7	1.29	117P7	4.25
2B7	.95	5BE8	1.27	6B8	2.50	6DS5	1.21	6J7	1.95	7G7	1.65	12DA6	1.05	15HB6	1.25	117Z3	1.60
2BN4	.98	5BK7	1.25	6B10	1.35	6DT5	.95	6J7G	1.25	7H7	1.65	12DB5	1.05	15HY8	1.39	117Z6	2.75
2CY5	1.15	5BQ7	1.45	6BA3	1.05	6DT6	.75	6J7GT	1.75	7H8	1.25	12DC6	1.05	16AQ3	.98	22	.15
2D21	.85	5BR8	1.31	6BA6	.49	6DT8	1.35	6J8	2.50	7J7	2.50	12DE8	1.19	16GK5	1.25	24A	1.35
2DZ4	1.95	5BT8	1.25	6BA7	2.15	6DV4	2.35	6J11	1.79	7K7	3.00	12DK7	1.05	16GK6	1.15	26	1.40
2EA5	1.45	5BW8	1.31	6BA8	1.48	6DW4	1.39	6JH6	.99	7L7	1.99	12DL8	2.20	16GY5	1.90	27	1.60
2EN5	.83	5CG8	1.25	6BA11	1.45	6DW5	1.55	6JH8	1.69	7N7	2.75	12DQ6	1.55	17AX4	.89	30	1.25
2ER5	1.60	5CL8	1.30	6BC4	2.10	6DX8	1.19	6JH8	1.30	7Q7	1.85	12DQ7	1.29	17AY3	.98	31	1.50
2FH5	1.40	5CM8	1.47	6BC5	.62	6DZ4	1.53	6JK8	2.95	7R7	2.25	12DS7	1.40	17BE3	1.15	32	1.15
2FQ5	1.95	5CQ8	1.52	6BC7	1.47	6E5	1.89	6JT8	1.69	7S7	1.79	12DT5	1.15	17BG6	1.49	33	1.15
2F55	2.55	5CZ5	1.70	6BC8	1.55	6EA5	1.55	6JV8	1.49	7V7	1.81	12DT7	1.10	17BS3	1.15	34	1.15
2FY5	1.49	5DE8	1.15	6BD4	7.00	6EA7	1.47	6JZ8	1.44	7W7	2.45	12DT8	1.40	17C5	2.35	35-51	1.50
2GK5	1.57	5DJ4	1.00	6BD5	1.20	6EA8	1.19	6K6GT	.95	7X6	1.35	12DW7	1.19	17C9	1.95	36	1.50
2GU5	1.69	5EA8	1.21	6BD6	.94	6EB5	1.75	6K7	1.70	7X7	2.75	12DW8	1.25	17D4	1.03	655OMP	7.00
2GW5	2.40	5E58	2.21	6BE3	1.15	6EB8	1.60	6K7G/GT		7Y4	2.25	12DY8	3.20	17DE4	1.25	KT88	4.95
2HK5	.98	5EU8	1.29	6BE6	.84	6EH5	1.10		1.49	7Y7	1.75	12DZ6	.98	17DM4	1.19	KT88MP	
2X2	.60	5EW6	1.01	6BF5	1.39	6EH7	.79	6K8GT	1.25	7Z4	1.95	12EA6	.99	17DQ6	1.15		11.00
2X2A	1.30	5FG7	1.07	6BF6	.72	6EH8	1.21	6K8M	2.75	8AU8	1.50	12EC8	1.35				
3A2	1.45	5FV8	1.21	6BF8	1.65	6EJ7	1.39	6K11	1.49	8AW8	1.35	12ED5	.98				
3A3	1.29	5GH8	1.50	6BG6	2.35	6EM5	1.29	6KD8	1.39	8BH8	1.36	12EG6	1.03				
3A4	.74	5GJ7	1.62	6BH6	1.00	6EM7	1.93	6KT8	1.23	8BQ5	.99	12EH6	.98				
3A5	1.10	5GM6	1.00	6BH8	.94	6EQ7	1.10	6KU8	1.15	8BZ7	.95	12EL6	.71				
3AF4	1.49	5GX6	.89	6BJ5	.69	6ER5	1.35	6LB8	1.49	8CM7	1.07	12EL8	.95				
3AL5	.87	5HC7	1.49	6BJ7	1.19	6ES5	1.15	6L5G	1.50	8CN7	1.05	12EM6	1.14				
3AT2	1.23	5HG8	1.69	6BJ8	1.35	6ES8	2.19	6L6G	.98	8CS7	.98	12EZ6	.83				
3AU6	.55	5J6	1.02	6BK4	2.55	6ET7	1.60	6L6GA	1.50	8CX8	1.60	12F5	1.60				

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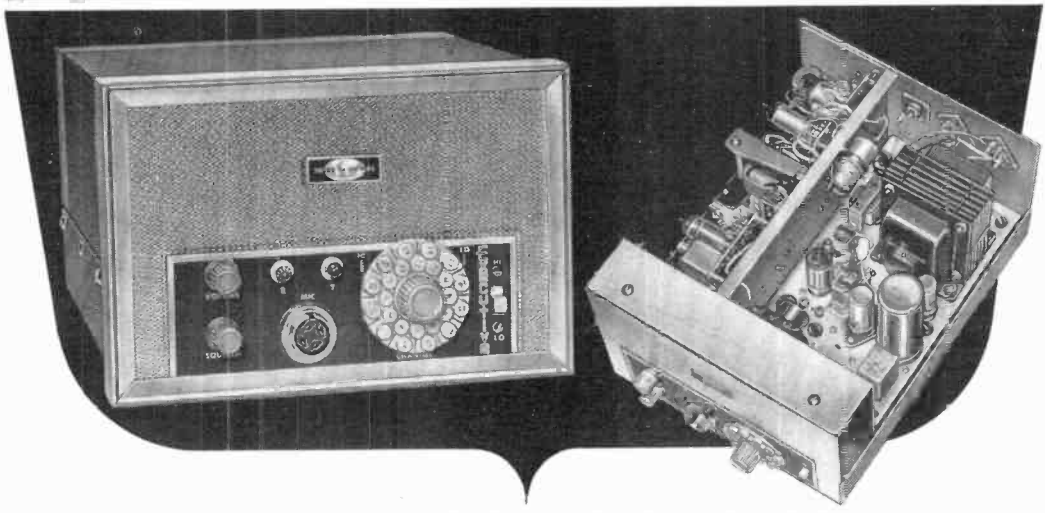

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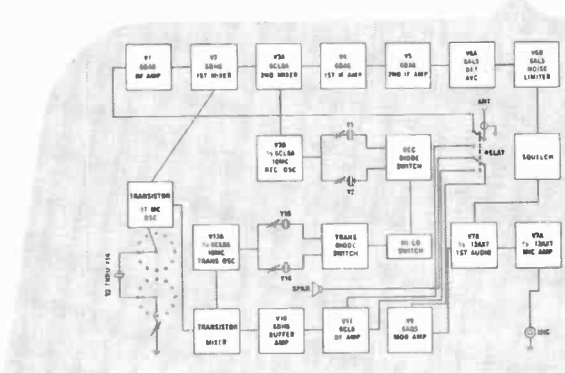

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