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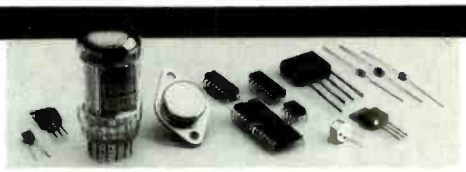

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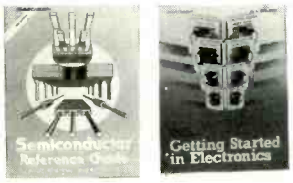

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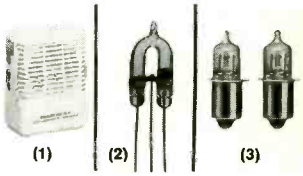

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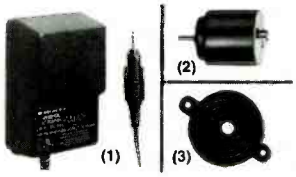

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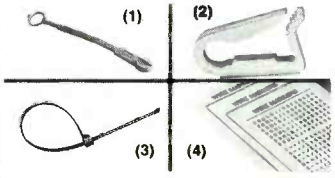

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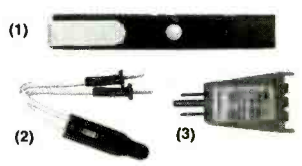

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EDITORIAL

LEARNING BY DOING

I'd like to start off this month by wishing all of you a heartfelt Seasons Greetings and Happy New Year from everyone here at Popular Electronics. The past year was one that was just chock full of fun and surprises for all of us. And if you've only had half as much fun reading our magazine and building our projects as we've had bringing it all to you, then we know you've had a ball, too!

But while having fun is what this magazine is all about, we have a serious side, too. Most likely, one of the reasons you are reading this magazine is to gain a greater knowledge of electronics, which in turn can give you a more enjoyable hobby.

But a knowledge of electronics can give you a lot more. It is a valuable skill that can serve you in many ways as you continue your education or your career.

With that in mind, we try to pack each issue with as much information as possible. Of course, you've got to take the initiative to make the most of it. Read the articles that focus on electronics principles and concepts. Work out the formulas for yourself, and make sure that you totally understand the concepts presented.

And why not try some of the projects? Each month, we present something that's just right for every level of builder, including those who's hands have never held a soldering iron.

But don't treat the construction details like a cookbook recipe. Take the time to also read the theory and circuit-description sections of the article so that you understand what the various parts of the project do, and how each affects everything else. That's the best way to get the most out of each project, and it can help you quickly pinpoint problems should things not work properly on the first try.

Once you start building, you're sure to be hooked for life. After all, it's fun, it's relaxing, and it's a great way to learn even more about electronics.

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LETTERS

CONSUMER-ELECTRONICS FOR THE BLIND

I am a totally-blind reader who has enjoyed **Popular Electronics** for many years. Using an Optacon, a device that provides a raised image of the text under a small camera moved by hand across the page, I am able to read the text and many of the schematics quite well. I particularly enjoy *Think Tank* and *Circuit Circus*, which feature small circuits that can be used alone or in other projects.

Your *Gizmo* section is very interesting, but it would be more helpful in many instances if the reviews indicated more clearly whether the products could be successfully operated without sight. Many products would be of great interest to visually-impaired individuals *if* they could operate them without sighted assistance. Clock radios must be set by holding a button until the desired time appears on an LED/LCD display, and so are totally unusable without sight. In moments of anger and frustration, I call that system "idiot data entry" as opposed to direct keyboard entry of data. We who are blind want just as much to have convenient and independent access to a clock radio as those who can see. Another example is cordless phones. Most cordless phones—which are audible devices—have only an LED for low-battery indication, but no audible indicator.

My wife (who is also blind) and I gain much enjoyment from shortwave scanners. The most important feature to give us satisfactory access to those units is direct keyboard entry. The next-most-important feature is a "feel-able" keyboard—with real buttons! Some membrane keyboards can be "brailled" but, all else being equal, real buttons provide more reliable operation. And some "keyboards" are merely smooth printed panels that provide no tactile assistance in locating keys; the devices usually don't provide any audible or tactile feedback when a "key" is pressed. (The "beep" associated with the keyboards on most microwaves has been an invaluable help to those of us without sight.)

I realize that many products, such as hand-held electronic dictionaries, fast-action arcade games, and light displays, are manifestly intended for visual-only use. But when devices that could potentially be useful to blind people are reviewed, I would like to know if we could really operate them, or whether they contain visual-only barriers that would prevent or seriously hamper our use of them. In an age when great strides are being made to give handicapped people access to the mainstream of society, I think it is time for the consumer-electronics manufacturing community to consider operation of its products by people with little or no sight. In addition to providing information to visually-impaired users, appropriate mention of device characteristics (keyboard, clock-set method, etc.) that facilitate product operation without sight would increase public awareness of the desire of most blind people to have as much access as possible to new and exciting consumer electronics.

D.P.
Independence, MO

SOUND-EFFECTS GENERATOR CORRECTION

After submitting my article "Build an IR-Triggered Sound-Effects Generator" (**Popular Electronics**, October 1990), I discovered a couple of errors had crept into the artwork. Transistor Q1 in Fig. 2 should be drawn as a PNP transistor. Its emitter connects to +5V, its base to R6, and its collector to R8. In Fig. 6, the pinout of the 2N2907 (Q1) should be the same as that for the 2N2222 (Q2).

Jan Axelson

LIGHTNING-GENERATOR ALERT

I just received the September issue of **Popular Electronics**, and found the article "Tesla's Lightning Generators" quite interesting. However, I would like to clarify some areas of possible hazard and poor performance.

There is a potentially *fatal* flaw in the schematic shown on page 30. In that representation, it appears that the low-potential (ground) side of the secondary is connected to one side of the primary-tank circuit. That can create a high RF potential in the high-voltage (60-Hz) transformer, which can break down the insulation—shorting out the transformer, possibly causing a fire, or even electrocution in some situations. A much safer way is to use the inherent neutral point in the transformer itself. The transformer core is designed to always operate at ground potential, with each high-voltage winding appearing at opposite potential (essentially, a center-tapped secondary, with the midpoint grounded). That ensures that the windings nearest the core will always be at the lowest possible potential. In any event, it is imperative that separate grounds be used for the primary and secondary sides of the circuit.

As to the author's claim that a 15KV DC capacitor will work with 10KV AC, that is not only wrong, but *dangerous*! Recall that the AC waveform has both a positive as well as a negative peak. Each peak will have an equivalent DC potential of 1.414 times the RMS AC rating. So, if both the positive as well as negative portions are used, that will impose an equivalent DC voltage of 2.828 times the RMS AC voltage! Capacitors have been known to *explode* when over-stressed in that fashion! I speak from experience; it happened to me some time ago. Luckily, I wasn't nearby at the time it decided to go.

The author also claims that ceramic "door knob" capacitors work best. While those types of capacitors will stand up to a great deal of abuse, they are extremely lossy at the RF frequencies created in the spark-gap oscillator section of the coil. A better type of capacitor to use is one that is suited to a pulse-discharge service. Polyethylene or polypropylene capacitors work best, but a Mylar unit with the proper DC rating will work almost as well, and can be obtained off the shelf from Plastic Capacitors in Chicago, IL.

B.C.T
Orange, CA

HAVES AND NEEDS

Can anyone help me find a schematic or the service literature for an Atari 2600 video-game machine? Thank you.

Ray Simmons
800 N. Columbia Ave.
Campbellsville, KY 42718

I would like to exchange information and ideas with others who are interested in preserving and/or improving the audio-amplifier circuit known as "Ultra-Linear." This milestone vacuum-tube circuit was patented by Hafler and Keroes around 1951. Many of you are probably more familiar with its popular descendant, the Dynaco Stereo 70. Thousands of them were sold, many as kits. It is my impression that many of them are still in use, and that there may be other hobbyists who are also interested in keeping the circuit alive.

Milton Maxwell
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A CALL FOR HELP

I was a Journeyman electrician for 20 years, until I lost all use of my left arm and hand in an accident. I'd still like to tinker around a bit as an electronics hobbyist, but I'm having a hard time figuring out a way to solder one-handed. I've tried some of the obvious solutions, including a swivel vise, but without much success. Can any of your readers come up with an idea for me?

Ronald M. Berkey
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If anyone can help Ronald out, please write directly to him.—Editor ■

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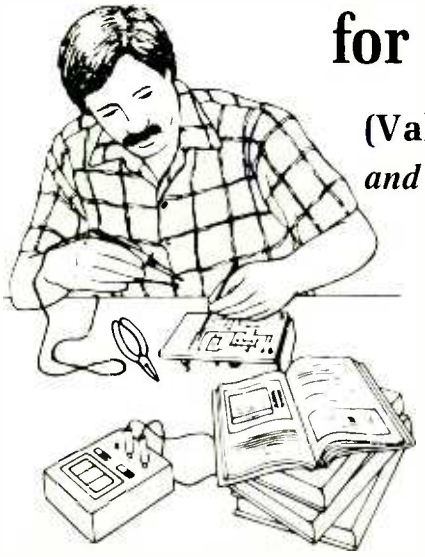

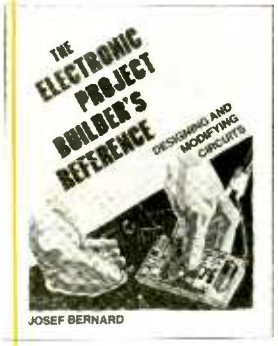

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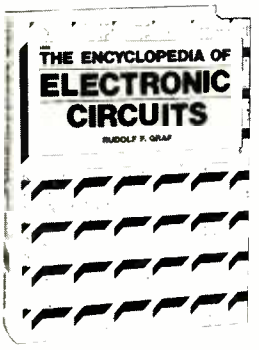

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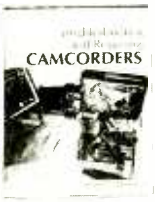

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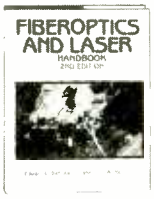

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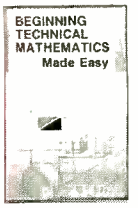

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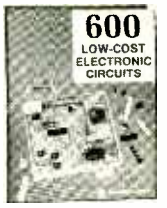

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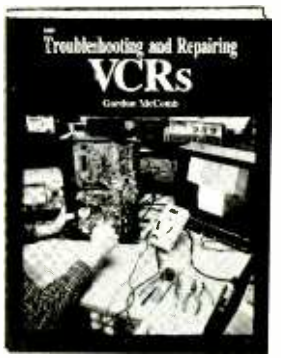

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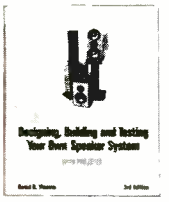

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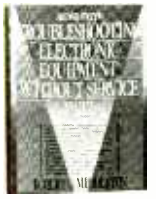

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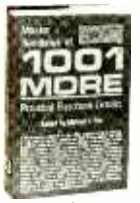

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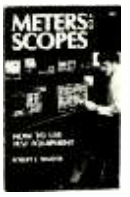

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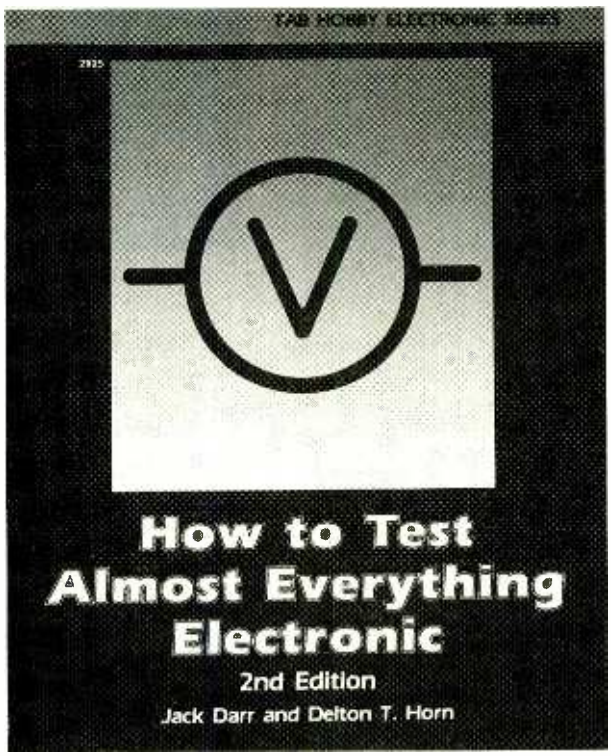
How To Test Almost Everything Electronic: 2nd Edition

by Jack Darr and Delton T. Horn

Originally written back in 1966—by two authors whose work is probably familiar to everyone who reads about electronic servicing— this popular book has been completely updated to reflect the drastic changes that have occurred since then. Tubes have become rarities, and IC's and digital circuitry are now the norm, yet when it comes to servicing electronic devices, some basic techniques remain the same. The new edition retains the original's practical, common-sense approach to troubleshooting and diagnostics, and applies



them to today's electronics. Some of today's test equipment has changed as much as the devices to be tested; this edition also covers the new types of test equipment available.

The book includes easy-to-follow instructions for using electronic test equipment, accompanied by examples of typical circuit types and basic principles of troubleshooting and interpreting test results. Most of the information is kept as general as possible, so it is applicable to various types of equipment. It covers power-supply, DC-voltage, VOM, VTVM, signal-tracing, alignment, oscilloscope, component, and TV tests. An overview of electronic test instruments discusses ammeters, voltmeters, oscilloscopes, logic probes, and analyzers. A new section on testing digital circuitry has been added.

How to Test Almost Everything Electronic: 2nd Edition is available for $9.95 from TAB Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

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INDUSTRIAL ELECTRONICS CET EXAM STUDY GUIDE

by Sam Wilson

Passing the Journeyman Certified Electronics Technician (CET) exam is an important career step, offering the possibility of more rapid advancement, increased earning potential, enhanced professional standing, and new job opportunities. For those who are planning to take the Journeyman CET test in the Industrial Electronics Option, or who are simply curious to find out what it requires, this book offers a comprehensive review of all the information needed to achieve certification.

Written as a companion to *Industrial Electronics for Technicians* (*Electronics Library*, **Popular Electronics**, November 1990), the study guide helps reader review related subjects before taking the CET test. Practice questions help readers to pinpoint their areas of strength and weakness so they can determine which areas to concentrate on. The book helps readers become familiar with test terminology and procedures as well as the subject areas covered by the exams. In addition to the questions presented in each chapter, a complete practice exam is included.

Industrial Electronics: CET Exam Study Guide is available for $16.95 from TAB Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

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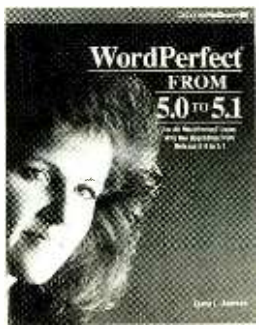
WORDPERFECT FROM 5.0 TO 5.1

by Karen L. Acerson

Having been involved in almost every aspect of WordPerfect, from development to documentation, including a stint as head of Customer Support at WordPerfect Corporation, Karen L. Acerson is certainly qualified to help WordPerfect users upgrade from 5.0 to the newest Release 5.1. In this book she discusses all the "hot" features of the latest version, detailing exactly what has changed and explaining how to take advantage of those changes. Included are discussions of WordPerfect 5.1's mouse support and pull-down menus, improved mail-merge functions, ability to create tables and complex equations, enhanced macro language, and the ability to import



spreadsheets from other software programs. The book contains descriptions of every WordPerfect 5.1 command, feature, and function, along with convenient tips for the best usage and applications. Also covered are the later enhancements to version 5.0.

WordPerfect: From 5.0 to 5.1 is available for $17.95 from Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710.

CIRCLE 93 ON FREE INFORMATION CARD

FISHER WORLD TREASURE NEWS

from Fisher Research Laboratory

Whether you're a dedicated treasure-hunter, or are simply curious about what's been going on in the world of metal detecting, you'll enjoy browsing through this 16-page newspaper-style periodical. Its articles cover the professional and hobby use of land and underwater metal detectors around the world—including recent valuable finds (a five-pound gold nugget); how-to

pieces on beach-combing and prospecting; and a story titled "The World's Longest Metal Detector" that was written by the commander of a California-based dive/rescue team. Special sections include "Treasure Hunters and the Law," "Metal Detectors and Archaeology," and "Underwater Treasure." This issue also features a "Guess the Coins" contest with a $660 land/sea metal detector as first prize.

Fisher World Treasure News is free upon request from Fisher Research Laboratory, Dept. NL-44, 200 West Willmott Road, Los Banos, CA 93635. Extra copies are available to diving clubs, treasure-hunting clubs, and search-and-rescue organizations.

CIRCLE 90 ON FREE INFORMATION CARD

WORDSTAR 5.5 MADE EASY

by Walter A. Ettlin

The latest update of WordStar, Release 5.5, has several new features—preformatted paragraph styles, simplified newspaper-style columns, and the ability to print directly from the keyboard. In addition, the "InSet" program allows users to work with graphics files. This book, an update of Walter Ettlin's original *WordStar Made Easy*, is designed to make it easy for experienced users to become familiar with those new features, and to help new users gain proficiency. It demonstrates all the skills required for most general word-processing tasks.

To make learning easier, the book is divided into lessons. Each lesson contains a set of instructions, sample exercises, and example text to be used in the lesson that matches the illustrations in the book. Readers are guided, step by step, through everything from basic document creation and editing to macros, calculations, and word searches. Two WordStar Command Cards, which summarize the most commonly used commands in the WordStar manual, are included. Appendices list the new and

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modified commands, and direct the reader to the lesson where each is discussed; list standard screen characters; show how to personalize WordStar; and present DOS commands.

WordStar 5.5 Made Easy is available for $19.95 from Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710.

CIRCLE 93 ON FREE INFORMATION CARD

THE SECRET LIFE OF QUANTA

by Dr. M.Y. Han

If there's one thing that's keeping pace with the rapid development of computers, telecommunications equipment, laser research, and superconductivity, it's the layman's growing feeling of bewilderment. Millions of people—including many who work in technological fields—are hard pressed to keep up with the latest advances in science, let alone to understand the impact those

advances will have on our lives.

This high-tech physics handbook for the layman explains how the laws of quantum physics govern the modern technical world. Concentrating on the nature of atomic particles, molecular structure, and electromagnetic radiation—the cornerstones of the physical universe—Dr. Han introduces general readers to a branch of physics that is relative to their daily lives. He examines principles that are used every day by scientists and engineers. Using simple language, lively analogies, and clear descriptions, Dr. Han explains the basic properties of atoms; light, electricity, magnetism, and electromagnetic radiation; molecular bonds; superconductors and semiconductors; lasers, masers, "xasers," and fiber optics; the Superconducting Super Collider; nucleons, quarks, and strong and weak forces; and nuclear technologies. He relates complex theories to non-scientific readers, without using mathematics, to bridge the information gap and make "science literacy" possible for the layman. An interpretation of what those developing technologies mean for the future is also included.

The Secret Life of Quanta is available in hardcover for $17.95 from TAB Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

CIRCLE 98 ON FREE INFORMATION CARD

THE AHSA ZONING INFORMATION PACKAGE

from The American Home Satellite Association

This comprehensive package on zoning regulations affecting dish ownership and use was developed by the American Home Satellite Association (AHSA) in response to widespread concern over regulations that fail to comply with the FCC's 1986 order preempting local zoning ordinances that discriminate against and restrict the installation of satellite antennas, or "dishes." It is not intended as a substitute for legal representation, but was designed as a resource to help dish owners, dealers, and their attorneys defend the right to install and use satellite-TV receiving systems.

The package includes a summary of the issues; a model zoning ordinance; and an 11-page "Legal Background Memorandum," which was prepared by Lauritz S. Helland, the AHSA's general counsel and an authority on satellite-communications law, and which can be sent to local government officials. It contains information essential to understanding the communications benefits and operating requirements of a home satellite-TV receiving system, and also highlights court decisions on zoning matters. Publication of the package, which will help meet the growing demand from dish owners for expert assistance on zoning matters, is the first step in an AHSA effort to create an atmosphere of informed awareness that could help do away with discriminatory restrictions against satellite-TV installations.

The AHSA Zoning Information Package is available at $24.95 for AHSA members and $39.95 for non-members, from the American Home Satellite Association, 16 Broadway, Valhalla, NY 10595; Tel: 800-321-AHSA.

CIRCLE 89 ON FREE INFORMATION CARD

PROTOTYPING CATALOG

from RF Prototype Systems

This 10-page booklet provides photographs, block diagrams, and other pertinent information regarding RF Prototype Systems' full product line. Highlighted in the completely updated brochure are the latest designs from San Diego Company, including the PLL Universal Serial Synthesizer Controller Board. Also featured are parts kits, connectors, and mounting hardware.

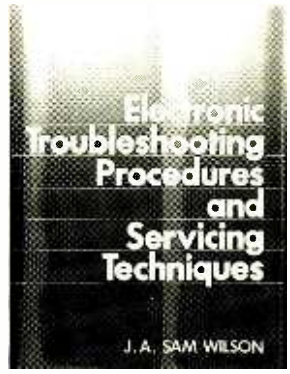
The Prototyping Catalog is free upon request from RF Prototype Systems, 9393 Activity Road, Suite C, San Diego, CA 92126; Tel: 800-874-8037 (in CA, 619-689-9715); Fax: 619-689-9733.

CIRCLE 88 ON FREE INFORMATION CARD

ELECTRONIC TROUBLESHOOTING PROCEDURES AND SERVICING TECHNIQUES

by J. A. Sam Wilson

Offering "tricks of the trade" along with the basics of troubleshooting and servicing, this book is a comprehensive collection of tests, measurements, procedures, and servicing techniques. In addition, it provides material on how to repair and replace various components. The book focuses on symptoms, showing readers how to interpret them to zero in on the faulty section. The book describes the specific measurements used for locating faulty components, circuits, and systems. To aid in understand-



ing, each chapter includes an overview of the subject, a list of specific objectives, a summary, and a self-test quiz. Examples of circuits and components are widely used throughout the text, along with almost 200 illustrations.

Electronic Troubleshooting Procedures and Servicing Techniques is available in hardcover for $36.80 from Prentice Hall, Englewood Cliffs, NJ 07632.

CIRCLE 99 ON FREE INFORMATION CARD

THE WONDERFUL WORLD OF HAM RADIO: AN INTRODUCTION FOR YOUNG PEOPLE

by Richard Skolnik, KB4LCS

Sometimes it takes more than just owning a ham radio to spark a young person's interest in the hobby. This fun-to-read book helps young people learn all the ins and outs of the hobby, and helps them appreciate what a valuable part of their lives it can be. It shows how hams can learn about other subjects, including electronics, geography, and computers, through their hobby. It explains how hams provide vital communications services during emergencies such as hurricanes and earthquakes, and even includes an actual emergency QSO. The book is written at a level that's easy for young readers to understand, and is jam-packed with photographs of radios, ham shacks, field-day setups, and students learning about and using ham radio. The book even explains how to get a ham license and set up a station to talk with other hams around the world.

The Wonderful World of Ham Radio: An Introduction for

(Continued on page 12)

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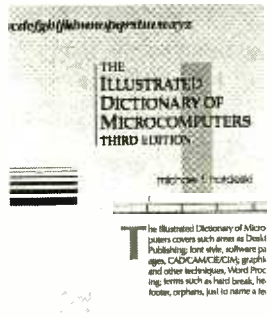
THE ILLUSTRATED DICTIONARY OF MICROCOMPUTERS: THIRD EDITION

by Michael F. Hordeski

Reflecting rapid changes in the world of microcomputers, the third edition of this comprehensive reference contains more than 1200 new entries. Covering such fields as microcomputer applications, hardware,software, desktop publishing, computer-aided design, word processing,



networking, and graphics, the dictionary provides up-to-the-minute definitions at a glance. Numerous illustrations help clarify and simplify the book's more than 9500 definitions, and meticulous cross-referencing directs readers to related terms.

The Illustrated Dictionary of Microcomputers: Third Edition is available for $19.95 from TPR, Division of TAB Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

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USING 1-2-3 RELEASE 2.2

by The LeBlond Group—Geoffrey T. LeBlond, William B. LeBlond and Suzanne Polen Berry

Designed to serve as both a tutorial and a reference work, this book should suit the full range of Lotus 1-2-3 users, from beginner to advanced. The early chapters show new users how to quickly get up and running, and contain a detailed treatment of all 1-2-3 features. Later chapters provide more in-depth information to help users with some degree of experience become more proficient. Intermediate level users will appreciate a quick review of 1-2-3 concepts, as well as the hands-on explanations of its major features including file-linking, macro recording, enhanced graphics, and printing options, and the "Allways" spreadsheet publishing options. For advanced users, the book covers the new macro-library manager. In addition, the book includes a bonus disk that contains an add-in word processor, "Spreadsheet Writer," along with documentation developed specifically to work in tandem with 1-2-3. Spreadsheet Writer can be used to write reports that include 1-2-3 spreadsheets with just a few keystrokes.

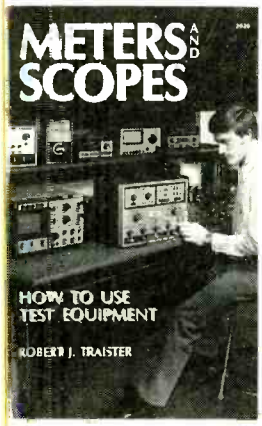
Using 1-2-3-Release 2.2 is available for $24.95 (including diskette) from Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710.

CIRCLE 93 ON FREE INFORMATION CARD

METERS AND SCOPES: HOW TO USE TEST EQUIPMENT

By Robert J. Traister

As a primer for the novice, or as a ready reference source for the more experienced technician, this book strives to help readers use today's complex test equipment to perform tests and make accurate measurements. It examines the function and use of various devices, including ammeters, voltmeters, ohmmeters, oscilloscopes, universal test instruments, tube testers, SWR meters, and more. Discussions on the measurement of light, heat, force, and pressure are included, and formulas, symbols, and electronics color coding are examined. The book explains how to troubleshoot circuits and diagnose problems. Pointers for buying test equipment are provided, as well as discussions on how to build your own test instruments.



Meters and Scopes: How to Use Test Equipment is available for $16.95 from TAB Books Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-233-1128.

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THE PC USER'S SURVIVAL GUIDE

by Jim Aspinal, Rory Burke, and Mike Todd

Aimed at anyone who uses a PC—from those who've just bought their first home computer to experienced programmers—this book provides specific "how-to" solutions for common computer problems. It explains exactly what steps to take when confronted with a locked keyboard, an unreadable disk, or lost files. It shows readers how to set up and manage their PC environment, choose the best utility software for their system, use preventative measures to maintain their systems, and troubleshoot board-level and hardware peripheral problems. Separate chapters are devoted to anti-virus packages, public-domain and user-supported software, and sources of technical support. Several convenient appendices provide software and literature references, error listings, disk-drive tables, keyboard codes, ASCII charts, and technical tips. In addition, the authors, who have 20 years combined computer experience, include their electronic-mail addresses for further advice and for downloading many of the application programs mentioned in the book.

The PC User's Survival Guide is available for $22.95 from M&T Publishing Inc., 501 Galveston Drive, Redwood City, CA 94063; Tel. 415-366-3600.

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QUE'S COMPUTER USER'S DICTIONARY

from Que Corporation

This easy-to-use resource for personal-computer users places an emphasis on practicality. It contains hundreds of definitions, explanations, examples, and illustrations intended to take the confusion out of personal computing on IBM's, compatibles, and Macintosh PC's. Also included are numerous tips and troubleshooting warnings to help users avoid many of the common computer mistakes.

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NEW PRODUCTS

CAR-SECURITY SYSTEM

A new concept in vehicle security, *Kraco's Electronic Nightstick* combines a carbonized-steel steering-wheel lock with an integrated alarm system. The system requires no installation, and includes a built-in flashlight with a high-intensity krypton bulb. Unlike other steering-wheel locks, the Electronic Nightstick locks on to the top of the steering wheel and extends horizontally, providing the added deterrence of high visibility. A

button inside the hardened-steel lock arms and disarms the alarm system. The Electronic Nightstick features a patented motion and shock sensor that detects illegal entry, an internal roller bar that makes it virtually impossible to cut, and a high-energy siren. Designed for use in cars and trucks, the lightweight unit is simple to mount and remove, and it fits easily under the seat.

The Electronic Nightstick has a suggested retail price of $109.95. For additional information, contact Kraco Electronics, 505 East Euclid Avenue, Compton, CA 90222; Tel: 213-639-0666.

CIRCLE 101 ON FREE INFORMATION CARD

DESOLDERING STATION

To address the problem of desoldering PCB's with high thermal demands, *OK Industries* has introduced the *SA-600* desoldering station. The SA-600 design incorporates a unique high-capacity nozzle, a high-power heating element, and a quick-rise vacuum pump, for optimal rework efficiency. The station has a safe 20-volt handpiece with a 65-watt heating

element. The high-mass desoldering nozzle provides superior heat capacity to allow efficient solder flow at lower temperatures. The SA-600 features vacuum and hot-air blow functions. Its has a variable temperature range of 660°F (350°C) to 840°F (450°C).

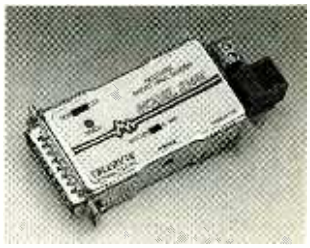
The SA-600 desoldering station has a list price of $557.50. For additional information, contact OK Industries, Inc., 4 Executive Plaza, Yonkers, NY 10701; Tel: 800-523-0067.

CIRCLE 102 ON FREE INFORMATION CARD

SHORT-HAUL MODEM

Incorporating ISDN technology, the model *214 Fastwire* short-haul modem from *Telebyte Technology* allows full-duplex transmission up to 38,400 bps on a single pair of wires over several miles. Performance is improved through the use of on-board adaptive echo cancellation. When two Fastwire modems are operating on a link, one is switched to master mode while the other is switched to slave mode, and a dedicated internal scrambler is used with different scrambling algorithms for the master and slave modes. The scrambled data is differentially encoded, making the data on the line polarity independent.

The time base for both modems is referenced to a highly stable crystal clock and is phase locked to the received-data stream. The signaling rate between two model 214's is 156K bps, and is maintained over distances of three miles on 22-gauge wire or 1.5 miles on 26-gauge wire at any full duplex data rate from 0 to 38,400 bps. The Fastwire can be used on DTE or DCE ports by positioning a slide switch to the appropriate position. It is available with a male, DB-25 connector and both an RJ-11 and screw terminals for the



composite link. Power is supplied by a small, wall-mounted transformer.

The model 214 Fastwire modem costs $138 each. For further information, contact Telebyte Technology Inc., 270 East Pulaski Road, Greenlawn, NY 11740; Tel. 800-835-3289 or 516-423-3232; Fax: 516-385-8184.

CIRCLE 103 ON FREE INFORMATION CARD

MULTI LASERDISC PLAYER

Three years after their introduction of the first multi laserdisc player on the market, *Philips* has a new entry: the *CDV600*. The player incorporates the Philips Bitstream one-bit D/A converter system with 256× oversampling and four-DAC digital differential mode. Other features include digital frame memory; a titling feature; and a 50-button jog/shuttle remote control that operates a variety of digital special effects including picture recall, freeze, and strobe. The laserdisc player can program up to 20 audio tracks or video chapters per disc, and

features "favorite track selection," which lets the user store favorite programs from up to 226 discs. Error-free copying from disc to audio cassette is ensured by the player measuring the running time of the disk against the recording time available on the cassette. The CDV600 will put as many full

selections as possible on the tape's first side, pause so that the user can turn the tape over, and then finish recording. The multi-laserdisc player also offers automatic music scan, random play, five-mode repeat, S-video output, and a programmable color background. A "laserdisc starter package" is included, and features the film *For All Mankind* as well as savings coupons for other popular films.

The CDV600 multi-laserdisc player has a suggested retail price of $1099. For more information, contact Philips Consumer Electronics Company, Consumer Affairs Department, One Philips Drive, P.O. Box 14810, Knoxville, TN 37914-1810; Tel: 615-475-0317.

CIRCLE 104 ON FREE INFORMATION CARD

WHOLE-HOME SURGE PROTECTION

To provide reliable protection from power surges and voltage spikes for appliances in each room of the house, *Intermatic* has introduced the *Whole Home Surge Protection Kit*. The kit's components are easy to install and are designed to protect a wide variety of sensitive electronic equipment, including microwave ovens, personal computers, VCR's, TV's, telephone-answering machines, workshop tools, and household appliances. The components act only when a power surge strikes, responding within one nanosecond by absorbing the destructive overload and allowing normal current to flow through the line.

The kit includes the *EG240RC* circuit-breaker panel protector, the *EG6EC* TV and VCR protector, the *EG3C* single-outlet surge suppressor, and the *EG111B* phone and fax protector. The EG240RC mounts on the home's electrical panel box with four wires. Two wires are connected to the load side of any two circuit breakers, another leads to the ground wire, and the fourth is connected to the neutral wire. That device offers protection against EMI/RFI as well as from both transverse- and common-mode noise. All the components are UL-listed, exceed IEEE specifications, and are backed by a three-year limited warranty.

The Whole Home Surge Protection Kit has a suggested retail price of $119.95. For more information, contact Intermatic, Inc., Intermatic Plaza, Spring Grove, IL 60081-9698.

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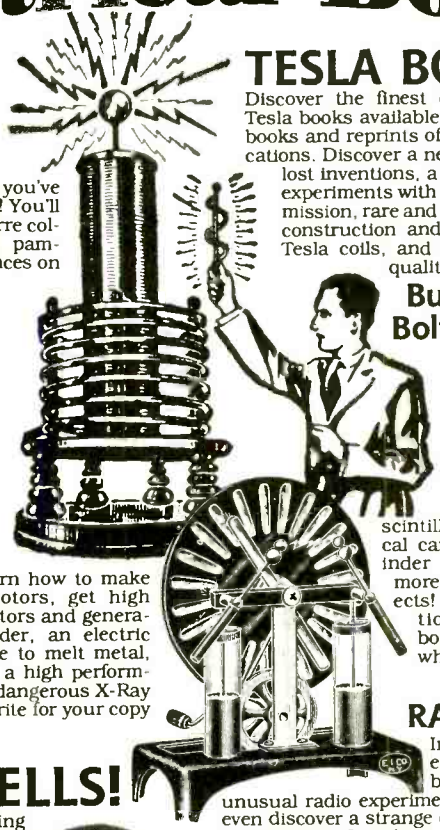

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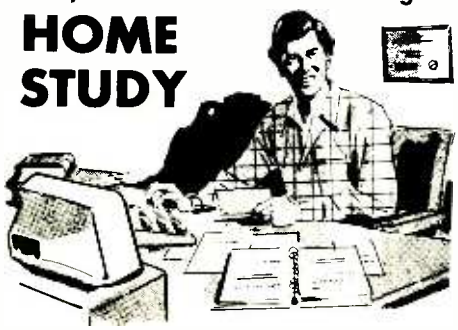

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channel CB and VHF weather monitor allows channels to be changed either remotely from the microphone or from the set's front panel. The 77-116 offers many advanced CB features, such as full ETR electronic frequency control, instant Emergency Channel-9 access, and a noise-limiter switch to reduce or eliminate background

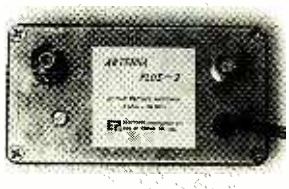
noises. The built-in weather monitor receives most NOAA VHF weather channels, providing 24-hour weather reports. The 77-116 has a green, high-intensity LED readout for easy viewing, an S/RF meter that displays incoming-signal strength and power output, and a double-layered RF-output heat sink for long transistor life. A quick-disconnect bracket and DC cord simplify installation.

The 77-116 CB/weather monitor has a suggested retail price of $149.00. For additional information, contact Midland International Corporation, Consumer Communications Division, 1690 North Topping, Kansas City, KS 64120.

CIRCLE 106 ON FREE INFORMATION CARD

DESKTOP WORLD-BAND ANTENNA

With its 15–22-dB internal amplifier and its 20-foot piece of wire, *Electron Processing's ANTENNA PLUS-2* desk-top antenna brings in shortwave signals like much larger antennas. Reception is "peaked" for shortwave frequencies and is further enhanced by a special filter that eliminates interference caused by local FM/TV/VHF/UHF transmitters. The ANTENNA PLUS-2 brings in 0.3–30 MHz (10–1000 meter bands) without creating an eyesore or



taking up much space, thanks to its compact size, rugged construction and unobtrusive styling. It is easy to install using adapting cables (not included) available for most receivers. The antenna comes with choices of BNC, Phono, SO239 (UHF), and F connectors. A version with a built-in antenna splitter and a second output jack is also available.

The ANTENNA PLUS-2 desktop antenna costs $89.95 for the standard model and $109.95 for the dual-output model. An introductory sale price of $79.95 is currently offered on the standard model. For more information, contact Electron Processing, Inc., P.O. Box 68, Cedar, MI 49621; Tel: 616-228-7020.

CIRCLE 107 ON FREE INFORMATION CARD

2-MHZ FUNCTION GENERATOR

Providing a full range of capabilities, including variable duty cycle, *B&K-Precision's* model *3011B* function generator fills the need for an accurate signal source for sine, triangle, and square waveforms, as well as TTL and CMOS pulse signals. A built-in frequency counter with 10-ppm time base allows precision frequency settings. The compact instrument

covers from 0.2 Hz to 2 MHz in seven ranges. Special features include a 4-digit LED readout, coarse- and fine- frequency controls, a separate TTL- and CMOS-pulse output, and external sweep/source capability. The duty cycle is continuously variable from 1:1 to 10:1 and, when inverted, from 10:1 to 1:1. For engineering applications, a switchable variable-DC offset introduces a DC signal on the generator output—a useful feature for matching the DC voltage at the signal input point

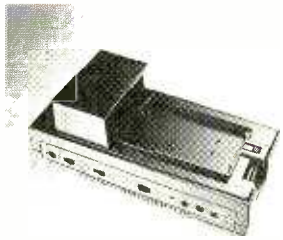
to prevent changes when the test signal is applied, and for evaluating the effects of DC bias on AC circuits.

The model 3011B function generator has a suggested list price of $249.00. For additional information, contact B&K-Precision, Division of Maxtec International Corporation, 6470 West Cortland Street, Chicago, IL 60635; Tel: 312-889-9087.

CIRCLE 108 ON FREE INFORMATION CARD

CAMCORDER-BATTERY CHARGER

Incorporating special circuitry to eliminate the "memory build-up" problem that plagues NiCd rechargeable batteries, the *Arkor Turbo Camcharger* can provide a full-capacity recharge every time it is used. Many camcorder owners have noticed that, after several recharging cycles, the batteries are no longer providing the full one- or two-hour charge indicated by the manufacturer. That's because, if a NiCd battery is recharged before it is



fully discharged, it chemically "remembers" the reduced level of its previous charge, resulting in increasingly shorter usage times. The Turbo Camcharger's electronic reconditioning circuitry controls the discharge/recharge process and eliminates battery "memory" while preventing cell reversal. Full-charge capacity is restored even to NiCd batteries that already have memory build-up. Other features include a "quick charge" mode, AC/DC capability, and a regulated-voltage output to provide direct power to camcorders and other types of portable equipment. Two versions are available. Model *TC-200-6* is for 6-volt Sony-type batteries and model *TC-200-12* is for 12-volt Panasonic-, RCA-, and Hitachi-type NiCd rechargeables.

The models TC-200-6 and TC-200-12 Turbo Camcharger, equipped for DC operation, have suggested retail prices of $99.95 each. With an AC power supply added, each costs $119.95. For further information, contact Arkon Resources, Inc., 11627 Clark Street, Suite 101, Arcadia, CA 91006; Tel: 818-358-1133; Fax: 818-383-6157.

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The Para-Link II interface extender has a suggested retail price of $124.95. For additional information, contact Data Spec, 9410 Owensmouth Avenue, Chatsworth, CA 91311; Tel. 818-772-9977.

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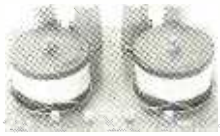

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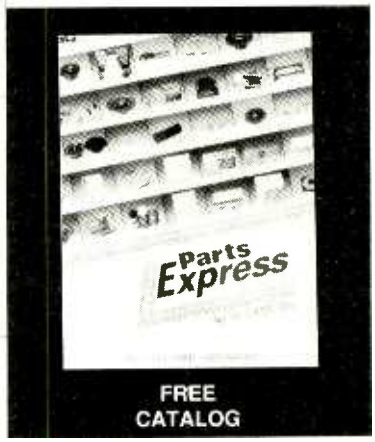

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ORA Electronics' IVR-3 is a mobile, glass-mount, cordless antenna that allows portable cellular phones to be effectively used inside the car by reducing drop-outs or no-service conditions. Employing a specially developed technology, radio waves picked up by the antenna

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The IVR-3 cellular repeater has a suggested retail price of $69.95. For further information, contact ORA Electronics, 9410 Owensmouth Avenue, Chatsworth, CA 91311; Tel. 818-772-2700.

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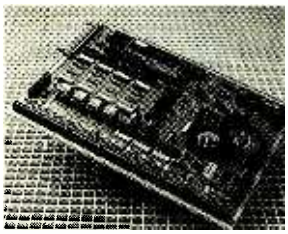
KNIGHT PATROL ALARM

Combining the benefits of professional-type alarm systems with speech synthesis, *Paladin's Knight Patrol* offers peace of mind at a reasonable price. The microprocessor-controlled alarm system is available either as a kit (pictured) or as a pre-assembled PC board. The firmware supplied with the kit EPROM offers a preprogrammed, 240-word vocabulary for alarm responses or status updates. With a 24-hour real-time clock, the trigger memory can *tell* you, in a pleasant female voice, where and when the security system was violated. Other features include 21 sensor zones for fire and security, two arming circuits, an auxiliary alarm, "Alert" and "Sleep" monitoring modes, two 5-watt audio amplifiers, and 10- and 3-Amp relay circuits for sirens or other alerting devices. In addition, the Knight Patrol features



self-diagnostics and is easily expandable. A complete line of peripherals is also available, including sensors, a custom steel enclosure, sounders, and batteries.

The Knight Patrol talking security system costs $250.00 in kit form and $295.00 pre-assembled. Shipping and handling charges are an additional $10.50. For further information, contact Paladin Electronics, 19425-B Soledad Canyon Road, Suite 333, Dept. P.E., Canyon Country, CA 91351.

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REPEATER CONTROLLER WITH AUTOPATCH

The *MFJ-2040* repeater controller with built-in phone patch offers programmable Morse-code ID, ring detection for reverse autopatch, input and output ports, and cross-band linking. An optional voice ID (*MFJ-50*) is also available. Installation is easy; the instruction manual provides step-by-step instructions, and standard "D"-style connectors for all control and audio lines are included. Hardware schematics are also provided. The software puts the

user in complete control, with choices of toll restriction, no toll restriction, or selected area-code dialing. The MFJ-2040 can be programmed to dial only in selected areas and lock out others. The input and output ports control a variety of remote devices—including link radios, pagers, and local speakers—via touch-tone commands. Transistor drivers are provided on all output ports to allow direct connections or driving relays. An optional five-second voice-message PROM (*MFJ-51*) is also available. Users can program their own private prefix code for controlling the repeater. Touch-tone commands and DIP switches are used to control the repeater options, such as the courtesy tone, transmitter hang time, time-out timer, toll restriction, autopatch, Morse code ID, repeater on/off, and line on/off.

The MFJ-2040 repeater controller costs $449.95. The MFJ-50 voice ID and MFJ-51 5-second voice-message PROM each cost $39.95. For more information, contact MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762; Tel: 601-323-5869 or 800-647-1800 for orders; Fax: 601-323-6551.

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SURROUND-SOUND SPEAKER SYSTEMS

To use as complete systems or to supplement their other speaker systems, *Now Hear This, Inc.* has introduced the model *1C* center-channel speaker and the *Zero 3-Pack*, which consists of three mini speakers. The 1C center-channel speaker has magnetically

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The 1C center-channel speaker and the Zero 3-Pack have suggested retail prices of $170.00 and $270.00, respectively. For further information, contact Now Hear This, Inc., 537 Stone Road, Suite E, Benica, CA 94510.

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Featuring an extra-large 10-digit LCD and sophisticated Euro-style design, *Texas Instruments' TI-3400 Europa* data bank/calculator stores up to 125 names and telephone numbers and provides calculator, clock/alarm, and appointment-schedule functions as well. Each two-line entry in the telephone directory can accommodate a name, an address, and several phone numbers, with 36 characters on each line. Long listings can be read by scrolling the display left and right. Confidential entries can be protected with a secret

password. The appointment-schedule function allows users to store information about appointments by date in chronological order. An alarm function is provided that can be set to give the user an audible reminder. A 12-hour digital clock conveniently displays the time, day, and date. As a calculator, the TI-3400 Europa adds, subtracts, multiplies, divides, calculates percentages, and has a three-key memory.

The TI-3400 Europa has a suggested retail price of $65.00. For additional information, contact Texas Instruments, Consumer Relations, P.O. Box 53, Lubbock, TX 79408; Tel. 806-747-1882. ■

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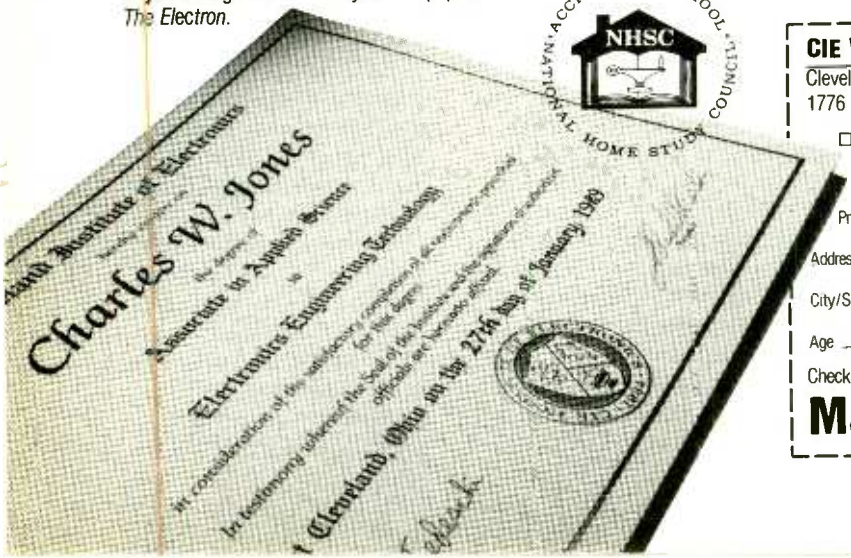

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THINK TANK

By Byron G. Wels, K2AVB

Holidaze

This is the time of year that we all celebrate the holidays and enjoy our families. Most of us tend to eat and drink a bit too much. As a result, we make new year's resolutions—promising to take off some weight, watch our diets, and in general, behave a bit better—but usually falter on that promise by no later than January 2nd, and go right on with our feeding frenzy! Oh well, to tell the truth, I don't drink anymore (or any less, either!).

I'm sure you've heard the expression "computer illiterate." I've got a friend who's a "technological illiterate." I first discovered that to be true when he asked me how long it takes to have videotape developed. Then on a trip by air, he tells me that he knows it's the wind blowing over the wing that makes an airplane fly, and that he understands that the propeller blows wind over the wing. But a jet plane has the engines in the rear. How does a jet fly? The capper came when he looked out the window of the plane and asked "How far away is the horizon?"

I recently lost my medical as a pilot. That doesn't mean that I'm not allowed to fly anymore, I just can't fly as "pilot-in-command." My friend Hawk (he owns a Cessna 172 Skyhawk) and I discovered a restaurant at the New Haven, Connecticut airport, where they serve two 1½- to 2-pound lobsters, fixed any way that you like them for thirteen dollars. Occasionally, we'll fly up there for dinner, and really pig out. And occasionally, when he thinks of it, he'll let me take the controls. It's a real hoot.

In most industries, you learn your craft or trade, become more proficient with practice, and (provided that luck is with you) you manage to make out through the course of your working life. Electronics doesn't work like that. No, our field is constantly changing and improving. If you don't keep abreast of it, you simply drop out. So very much has changed in so few years, that it becomes a constant, never-ending struggle just to stay on top of the latest developments.

I often wonder how today's electronic schools can keep the students constant with the changes. To add to the complexity of electronic life, the new developments demand a constant and continuous course of study, which has resulted in specialization. We become interested in one specific area of electronics, and hone our skills in that area to a fine edge, often ignoring other areas. That's a shame, too.

The guy who devotes and dedicates himself to amateur radio or communications, might miss the opportunity to apply some of the technology now available in, for example, laser technology, to his own sphere of interest! While nobody can know all things, it's a good idea to occasionally take a sideward glance into another field and just see what's doing on. For those ready to take that sideward glance, let's see what's in this month's mail.

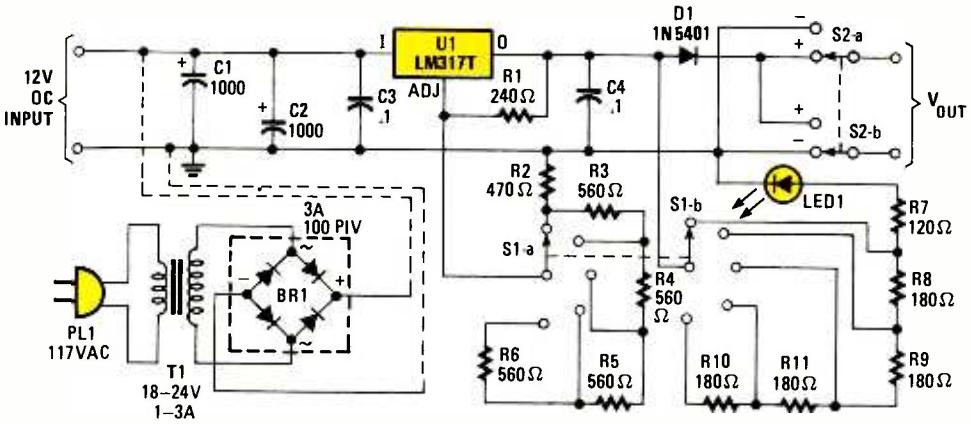

Fig. 1. The Step-Variable AC Adapter uses a common three-terminal regulator circuit with adjustability provided in an uncommon way.

STEP-VARIABLE AC ADAPTER

After getting "snookered" by all the under $10 adapters that use small, multi-tap transformers that vanish after any sort of load demand, I came up with the following variation of the LM317T adjustable voltage regulator to yield this step-variable DC power-supply (see Fig. 1), which can be fed from an AC outlet or from your car battery.

At the heart of the circuit is the LM317T adjustable regulator, which is set up pretty-much in the conventional way, except instead of a single 5k potentiometer tied to the regulator's ADJ terminal, a switch with a

number of fixed resistors are used. That variation gives regulated fixed output voltages of 3, 6, 9, and 12 volts DC depending on the level of voltage fed to the circuit.

Resistors R2–R6 control and set the voltage output of the regulator (U1). Resistors R6–R10 control the current to the power-on LED by adding series current limiting as the different voltage settings are used. Diode D1 offers reverse protection if a device is wired for reverse polarity, and if it is, just flip switch S2 to reverse the voltage polarity. Since some tape players and other equipment draw lots of current, the LM317T should be mounted with a heat sink.

That's about it, except for one afterthought: An optional DPDT switch and a 5k potentiometer between the regulator and S1 would offer you the best of both worlds—a step-variable, and continually variable power supply rolled into one simple circuit!

—Bob McVay, Troy, OH

Good going Bob. It just goes to show you that with a little imagination and a bit of know-how, anything can be accomplished!

PRINTER "ERROR" ALARM

What can be more frustrating than to have a printer quietly shut down while it's spitting out a file or report, especially when you're away from it and you return when it should be complete only to find that nothing has happened? Unfortunately, until now, my printer never had a beeper, buzzer, or anything else to alert me to such a condition. Whenever it had a paper feed or format error problem, it just quietly shut itself down and waited for me to correct the situation.

See Fig. 2. Somewhere, in the deep, dark recesses of digital circuitry, one can find an "output" logic level that is either high or low whenever the printer is in the normal operating state. The output can be from a control flip-flop or other logic device. The idea is to find such a place that changes logic level from either a high to low or a low to high state when the printer shuts off due to any error.

If you find an output that goes from low to high then wire it to INPUT A in the circuit. If the output goes from high to low, feed the signal to INPUT B. Diode D1, resistor R1 and capacitor C1 form a very good time-out circuit to let you manually use the paper feed button on the printer for the time you select before allowing the two oscillators of U1-c and U1-d

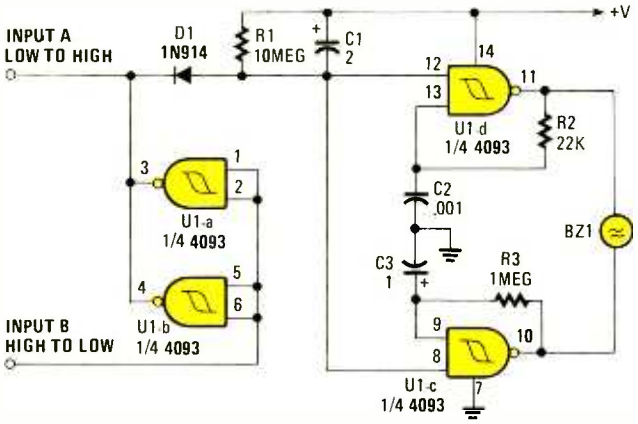

Fig. 2. Built around a single 4093 quad NAND Schmitt trigger, this circuit is designed to provide print-error indications.

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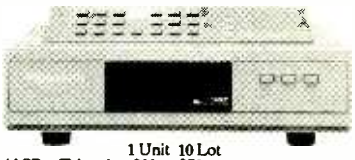

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to operate, which then sounds an "interupted" tone alarm after the time-out period has expired. Whenever the printer is placed back into a normal operating condition, the circuit becomes inactive.

The time-out part of the circuit can be established by using T = RC and the only IC that you can use is a 4093, preferably an HEF4093B because it's faster than a CD4093B. The values shown are what I used, but you can experiment if you like.

—John Mastromoro, Pennellville, NY

John, I've had the exact same problems with my own printer, but it won't bother me anymore. I'm busy wiring that circuit up for myself!

KEYLESS LOCK

I wanted to construct a keyless lock for my home, and toyed around with all kinds of ideas. I knew that I'd need a sequential switch using latches and finally arrived at this circuit.

See Fig. 3. The circuit uses a four-bit latch (U1). What makes the circuit sequential is that the set input of the first bit latch is tied to the reset of the second bit latch, and so forth. That insures that any bit latched will be reset by the previous bit latch. The ECG8314 also has a master reset (pin 9) that is tied to the first bit-latch reset (pin 3). That provides an added measure of security for the lock.

The outputs of U1 are fed to a four-input AND gate (U2), then to Q1 (used as switching transistor), which is used to drive relay K1. A lot of keypads have common line switches and that's what makes the circuit ideal. You might also be interested in knowing that the ECG8314 has an enable low (pin 1) that can be used as a timing circuit, should that be desired. I hope that this circuit is good enough for a book, Byron!

—Robert P. Johnson, Jr., Camden, ME

Good enough indeed, Bob. The book is on the way to you and I hope you enjoy it.

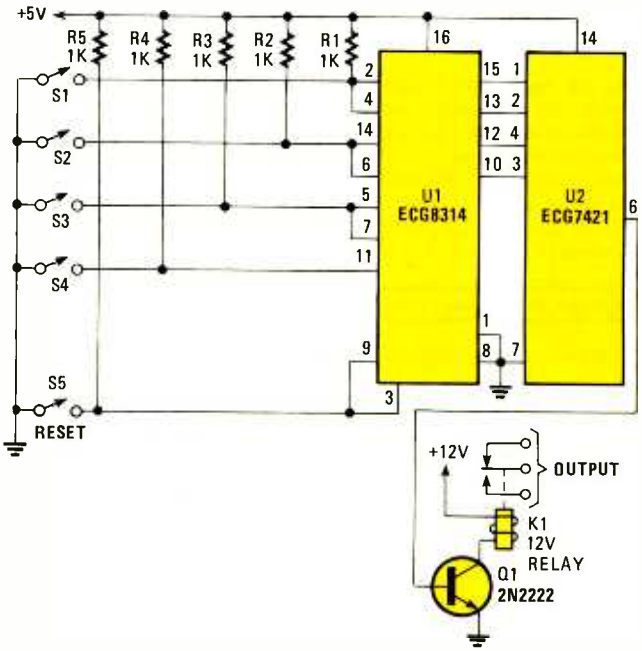

Fig. 3. The Keyless Lock is built around an ECG8314 four-bit latch (U1), a 7421 four-input NAND gate (U2), and a few additional support components.

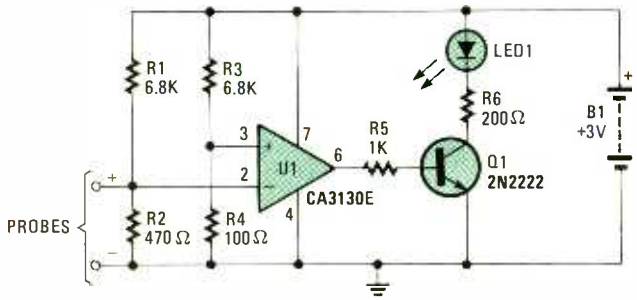

Fig. 4. When continuity is detected by the Low Voltage Continuity Tester, the output of U1 goes high, turning on the transistor, which in turn causes the LED to light.

LOW-VOLTAGE CONTINUITY TESTER

This tester is handy for troubleshooting digital-electronics circuits. Most commercial continuity testers apply approximately + 2.8-volts DC at the positive probe to the circuit-under-test. This inexpensive unit applies a mere + 0.3-volts DC at the positive probe. It assembles quickly and easily on a piece of perfboard and can be housed in a plastic tube. It uses an LED to signify the on state.

A schematic diagram of the circuit is shown in Fig. 4. Here's how it works: When continuity is detected by the probes, the output of the op-amp (U1) goes high, turning on the transistor, which in turn causes the LED to light indicating the on state. When no continuity is detected, biasing resistors R1 and R2 set the negative input of the op-amp so that the reference voltage is more negative than the positive input; under that condition, the output of U1 is low and the LED is off. The op-amp (U1) is a CA3130E CMOS-in/bi-polar-out device that requires only a single supply voltage and is therefore appropriate for this circuit. The voltage of + 0.3-volts DC at the positive probe is low enough so that a PN junction cannot be turned on when checking for shorts.

—*Francisco Serna, Escondido, CA*

Francisco, this circuit is one that all of our readers ought to have on their test benches! And I'm certain that many readers will be building this one.

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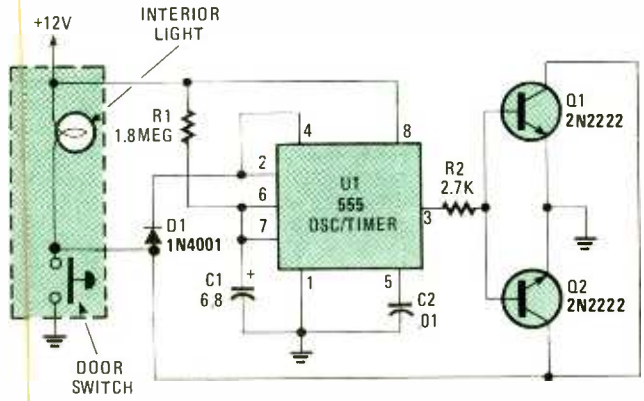

Fig. 5. This circuit can be added to your auto's dome-light circuit so that rather than the dome light turning off the moment that the door is closed, it remains on for a pre-determined period of time.

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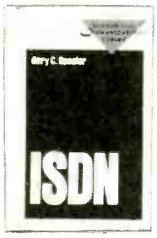

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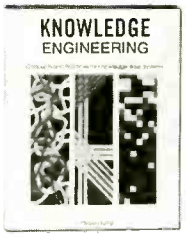

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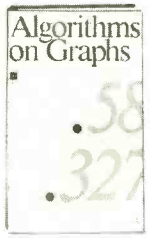

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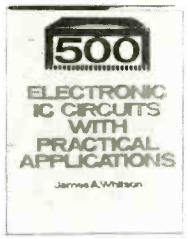

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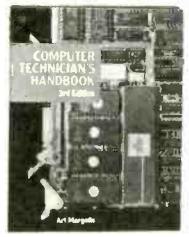

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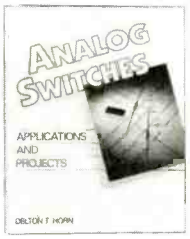

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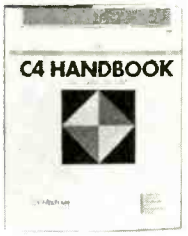

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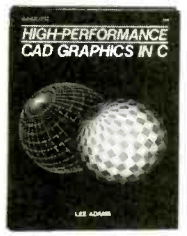

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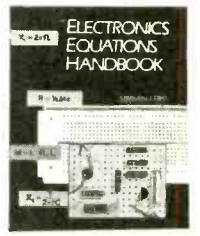

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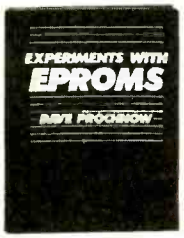

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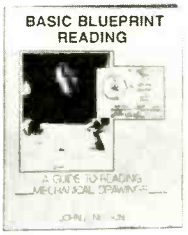

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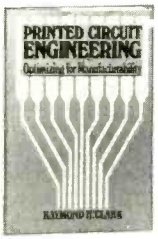

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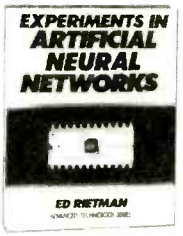

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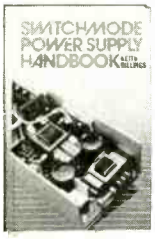

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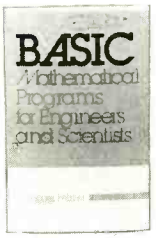

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the form of light while you're looking for the correct key, or fastening seat belts. The circuit doesn't require any cutting into the car's existing system; it attaches in parallel with the existing wiring.

See Fig. 5. The circuit is built around a 555 timer and uses very few support components. It's a conventional circuit, except for pin 4 (reset), which is tied to pin 2 (trigger) instead of pin 8 ($+V_{CC}$) as usual. That's so that when the car door is open (the door switch is closed and the interior light is on), pins 2 and 4 are in a standby mode just waiting for the door to be closed (and the door switch to open) to trigger the 555 and start the "on" cycle. By doing so, the time the interior light stays on is always the same, regardless of how long the car's door was open.

I used two 2N2222A's in parallel as the "electronic switch" for the interior light to handle the required power without the need for a heat sink. The 1N4001 diode (D1) is required to keep current from retriggering the 555 timer IC at pins 2 and 4. The time constant can be varied by changing the values of resistor R1 and capacitor C1.

I used a 6.8-µF Tantalum capacitor for two reasons: I already had one, and its small size. The circuit was assembled on a small piece of perfboard measuring ¾ × ¾ inch. I installed the circuit directly where the interior light was located inside the car's roof.

Make certain that the pin-8 connection to the 555 and the resistor go to the hot (+12V) side of the inside light bulb. The diode and the collector of the 2N2222A goes to the "open" side of the lamp. You can use any of the exposed metal of the car for a ground.

—Pedro R. Schaeffer, Mexico, D.F.

Good shot, Pedro! Your book is headed down Mexico way.

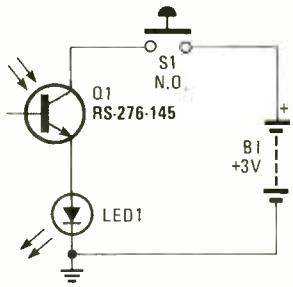

Fig. 6. The Infrared Tester was assembled from readily available parts and operates as a go-no-go test for infrared controls.

INFRARED TESTER

Anybody that works on VCR's knows that all of the new units use an infrared LED and two infrared phototransistors in the end-of-tape detection system. At times, it can be difficult to determine whether or not the infrared LED is operating. While there are infrared-detector cards available, it is often difficult to get them inside a VCR.

This circuit (see Fig. 6) is constructed of readily available parts and operates as a go-no-go test for infrared controls. When S1 is pressed, power is applied to the phototransistor and the transistor is biased on by the presence of infrared light. The transistor conducts, causing the LED to light.

—Delbert LaBo, Rittman, OH

Okay, Delbert! It's super-simple, and that's the way we like 'em.

That just about fills our space for this month. Until next time, send your pet ideas to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

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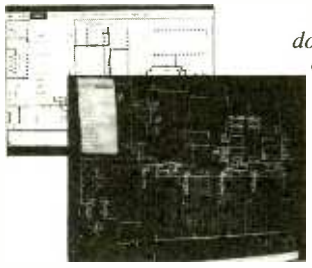

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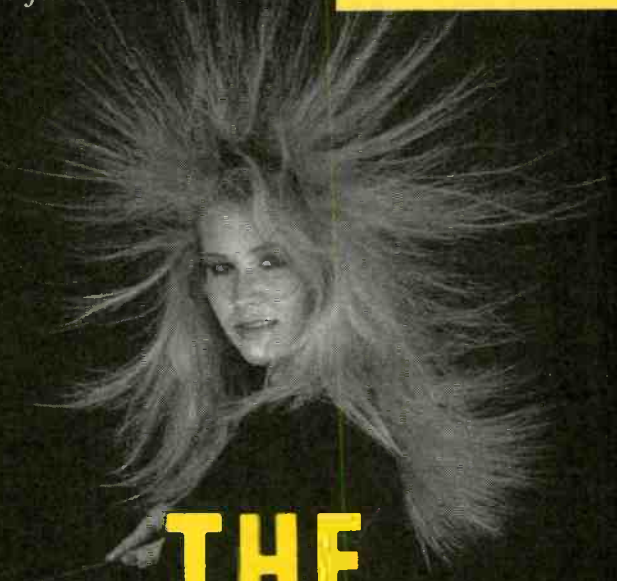
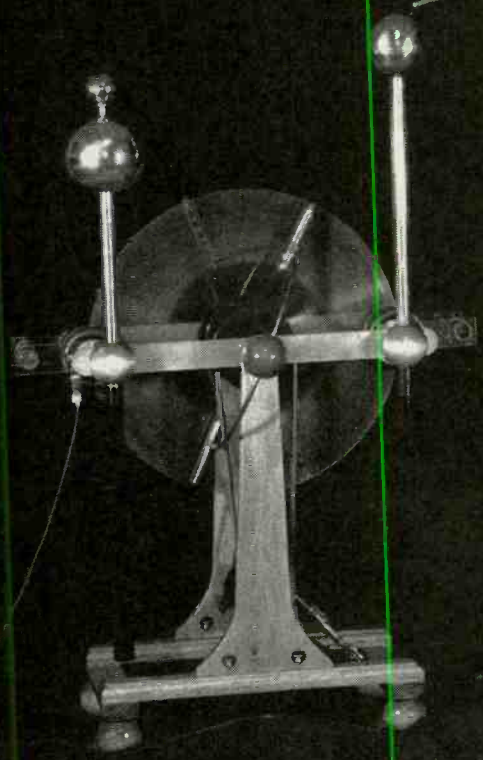


THE WIMSHURST MACHINE

BY GREGORY B. PUTZ

"Wimshurst machine? So that's what it's called!" my neighbor said, his eyes as wide as half dollars. I often heard that comment.

I took the Wimshurst machine off the shelf in my den and placed it on the desk before him. I turned the handcrank, the black plastic plates spun, and sparks jumped between the metal globes. "It will create 75,000 volts," I commented. He leaned away from the machine. As the plates spun, the machine hummed and sparks snapped between the globes. The smell of ozone soon filled the room.



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I'm sure that you, too, have seen a Wimshurst machine although you may not have known it's name. You probably know more about its cousin, the Van de Graaff generator. Both are electrostatic generators, but that is where the similarity ends. The Van de Graaff generator creates static charges by friction, while the Wimshurst device does it by induction. In the early days of electrostatics, the principle of induction was also known as "influence." In fact, the machine is more correctly called a "Wimshurst influence machine."

The Wimshurst machine played an important role in the early years of electrostatics. It provided high-voltages necessary for experiments in X-ray. But before I tell you how the Wimshurst machine works, let's take a quick look at the science of electrostatics.

Electrostatics. Electrostatics was first noticed sometime in 600 BC when the Greek philosopher Thales discovered that amber attracted light objects when rubbed. The phenomenon not only demonstrated a fundamental concept of electrostatics, but also gave us the word "*elektron*," meaning amber in Greek.

When Italian physicist Alessandro Volta invented the "voltaic pile" (or battery) in 1800, the science of electrostatics changed forever. Volta's new invention provided scientists with a stable, dependable source of moving charges (*i.e.*, DC). This invention was a turning point in electricity because now scientists could study *electrodynamics*, whereas before they were limited to studying *electrostatics*.

Triboelectric Effect. It's been a while since the days of Thales, but we all know a few modern ways to make electricity by rubbing. Shuffling our shoes across the carpet on a dry day causes a spark between our finger and a metal doorknob. Likewise, rubbing a glass rod with flannel and then pulling them apart causes the flannel to hang unnaturally towards the rod. The rubbing action causes the glass to develop an abundance of positive charges and the flannel an abundance of negative ones. Once pulled apart, the difference in charge of the two materials causes the attraction of the flannel to the glass.

The same happens when you rub paper against a plaster wall or wooden door. It sticks to the vertical surface because the rubbing creates opposite charges on the paper and the wall. Try it with a balloon and you'll see the same effect. In each of these cases, rubbing creates segregated electric charges and static electricity is the result.

In high school, you probably saw a Van de Graaff generator. It made sparks fly, fluorescent tubes glow, and your hair stand on end when you touched its dome. The Van de Graaff generator works in a way that is similar to rubbing glass with flannel, except that the rubbing is made continuous by using a moving belt inside the generator (see Fig. 1). As an electric motor turns the belt, metal combs in the generator's dome and base strip charges from the belt. As a result, the dome and base develop opposite charges. Small, classroom-sized Van de Graaff generators produce 200,000 volts. Larger ones, like those used for sub-atomic particle research, create several-million volts.

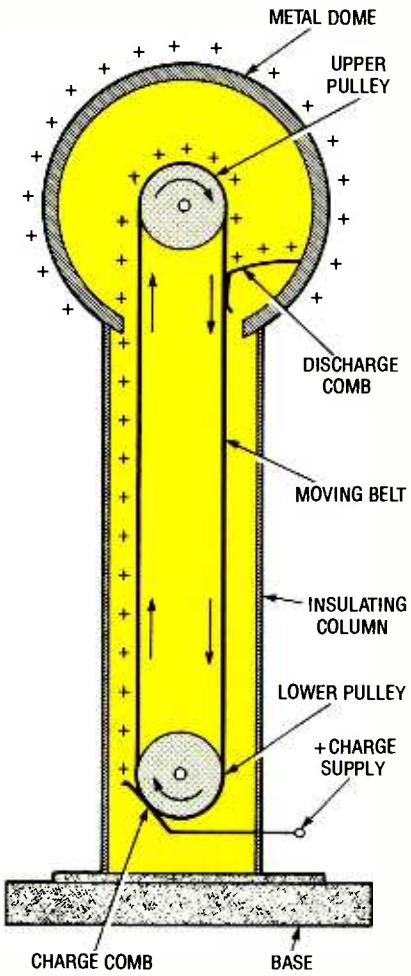

Fig. 1. A Van De Graaff generator places a high-voltage charge on its metal dome by friction, whereas a Wimshurst machine charges via induction.

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Glass rubbed with flannel, and paper, or balloons sticking to a wall, and the Van de Graaff generator are all examples of creating static electricity using friction. That is also known as *triboelectric* charging. As we mentioned, there is another way to create static electricity and that is by induction.

Induction. John Canton, in 1753, was the first to put forward the concept of induction of charge. He demonstrated that when a charged body is brought close to a neutral body, the neutral body develops a charge of equal magnitude but opposite polarity. One of the earliest devices to demonstrate induction was the "electrophorus." The electrophorus is the simplest electrostatic generator.

Later in 1787, Abraham Bennet, the inventor of the gold-leaf electroscope, developed the first simple machine to induce electrostatic charges. The device was called a "doubler" because of its ability to progressively accumulate static charges. His doubler did not use friction, but used Canton's induction concept to generate separate positive and negative charges.

New varieties of doublers, or "influence machines" as they were soon called, were developed by Nicholson in 1788, Belli in 1831, and Lord Kelvin in 1860. Also in 1860, Varley built the first successful high-voltage influence machine. Other induction devices were subsequently developed by August Toepler and Wilhelm Holtz. But it wasn't until 1878 that British engineer James Wimshurst invented the first dependable device to inductively generate static electricity. The Wimshurst influence machine was born.

The Machine Itself. Before we explain how a Wimshurst machine works, its a good idea to describe its structure. The Wimshurst machine has three major parts: rotating parallel plates, neutralizing rods, and collecting combs

(see photos). Today's bench-sized demonstration units typically have 12-inch diameter plates. During the heyday of electrostatics, larger Wimshurst machines (used for research or powering early X-ray machines) had multiple pairs of plates several feet in diameter.

Each Wimshurst machine develops a maximum electrostatic potential based on the number of plates used, their diameter, and the spacing between them. Interestingly enough, increasing the rotating speed of the plates does not increase the maximum discharge voltage. Only increasing the number of pairs of plates increases the discharge voltage.

The plates can be any sturdy, non-conducting material, such as glass or plastic (see Fig. 2). The plates are mounted in pairs, separated by a quarter-inch gap, on a horizontal shaft. The closer the plates are mounted to each other, the better the machine will operate. The plates are turned by belts and pulleys from a common crankshaft, but they rotate in opposite directions. A difference in pulley diameters causes the plates to spin several times faster than the handcrank.

Metal-foil strips called "sectors" are evenly spaced along the outer surface of each plate. Those help extract excess charges from the non-conductive plates.

The charges that accumulate on the sectors are removed by pairs of collecting combs made of tinsel threads. Each pair of combs is mounted on a U-shaped bracket, with one brush touching the front plate and the other brush touching the rear plate. The two U-shaped brackets are mounted opposite one another. They carry the accumulated charges to the machine's discharge balls.

There are two "neutralizing rods" that span the diameter of each plate and also have metal tinsel combs on each end. The front and rear rods are perpendicular to each other and are positioned at an angle of 45° to 60° from the machine's base.

In addition to the three basic parts of a Wimshurst machine, they typically have two built-in Leyden jars, which are very simple glass and foil capacitors. Each Leyden jar can be electively connected to a collecting comb by means of a hinged rod. If the Leyden jars are not connected to the collecting combs, then a continuous arc jumps between the discharge balls when the handcrank is turned. If the connecting rods are lifted to touch the collecting combs, then a sharp (and intense) snap of electricity jumps between the discharge balls every few seconds.

It is important to notice that all the metal parts of a Wimshurst machine are built with rounded edges. A fundamental rule of electrostatics is that charges find it much easier to "jump" from a pointed surface than from a rounded one. Any sharp points on the machine would allow the charges to dissipate quickly.

How it Works. Remember that the Wimshurst machine is an induction device. It doesn't depend on friction to make an electrostatic charge. As you'll see, quadrants of negative and positive charge are created across the plates by induction between the front and rear plates. As the plates rotate, these positive and negative charges are syphoned off through the metal sectors by the collecting combs.

As you may recall, the principle of induction requires that an object be initially charged before you can use it to induce a charge in something else. That holds true for the plates on the Wimshurst machine. Even before you crank the handle the plates have some static charges on their surface. The charge is created from the incidental rubbing and handling of the machine, and the machine actually amplifies this initial imbalance of charge.

Resources.

Wimshurst electrostatic generators are available from Edmund Scientific Company (Cat. No. B70,070), 101 E. Gloucester Pike, Barrington, NJ 08007-1380; Tel. 609-573-6250, and from The Chem Shop, 1151 South Redwood Road, Salt Lake City, UT 84104; Tel. 801-973-7966.

See the following books for more information:

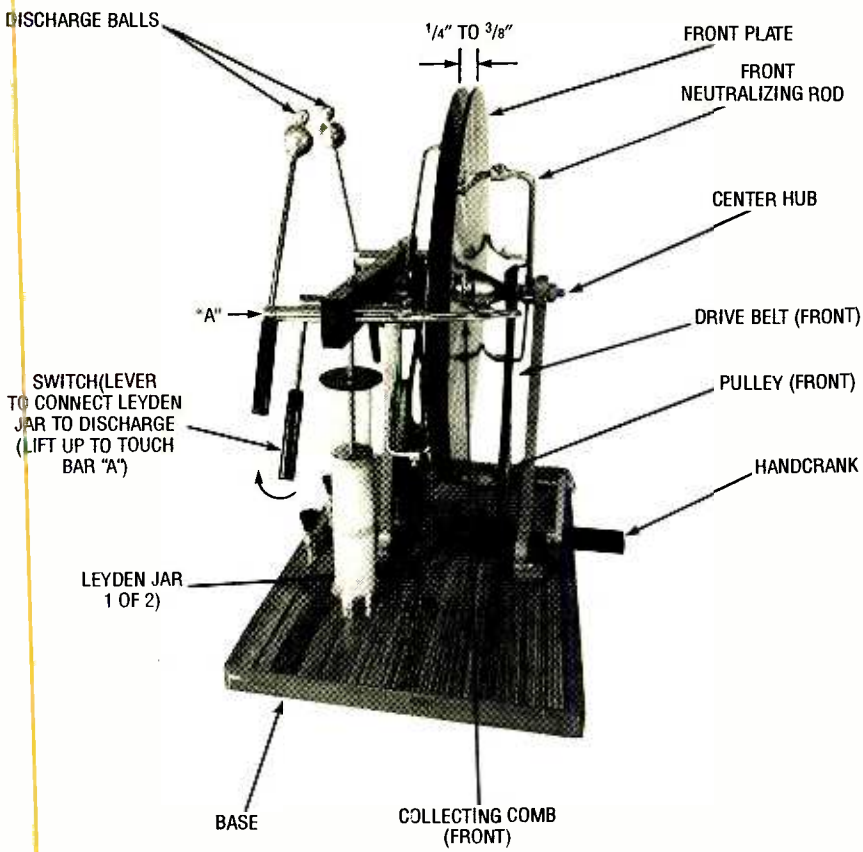
The Wimshurst Machine: How to Make and Use It, by Alfred W. Marshall; Lindsay Publications, Inc., P.O. Box 12, Bradley, IL 60915-0012.

Electrostatics: Exploring, Controlling and Using Static Electricity, by A.D. Moore; Anchor Books, 1968.

Handbook of Electrostatic Discharge Controls, By Bernard S. Matisoff; Van Nostrand Reinhold Company, 1986.

Electrostatics: Principles, Problems and Applications., By Jean Cross; Adam Hilger, 1987.

Homemade Lightning, By R.A. Ford, Book #3576, TAB Books, Blue Ridge Summit, PA 17294; Tel. 800-233-1128 or 717-794-2191.



The Wimshurst machine is composed of many parts. However, not all Wimshurst machines have Leyden jars although this one does.

Looking at Fig. 2 let's say that quadrant CD of the rear plate had a slight negative charge before the crank was turned. That would induce a small positive charge on the front plate in the same sector. As you turn the crank, electrons on the front plate sector at point C are repelled by the electrons built up on the rear plate. That pushes them up the neutralizing rod to A, which is a more desirable place to be because the rear plate has a positive charge there. That leaves electron-starved quardrant CD with a net positive charge, and electron-rich quardrant AB becomes more negatively charged.

Note that the rear plate—rotating in the opposite direction—works in a reciprocal fashion: Electrons move through the rear neutralizing rod from B to D. So on the rear plate, quadrant AB becomes more positive and quadrant CD becomes more negative. That permits the front neutralizing rod to scoop up more repelled electrons and so on.

In the region of the collecting combs, the front and rear plates have the same charge. The charges on the plates repel each other in those areas. That permits the collecting combs to scoop up the excess charges and send them to the discharge balls. The charges will continue to accumulate until surface leakage or a spark between the discharge balls dissipates them.

You can see the charge leakage by placing the device in the dark, setting the discharge balls a good distance apart, and looking at its corona discharge radiating from the edges of the plates. You'll also see tiny, purple arcs around all combs.

Setting the gap between the discharge balls an inch or two apart, causes a continuous shower of sparks to jump between the spheres. Connecting the Leyden jars to the discharge spheres allows you to separate the balls by a larger distance to produce big crackling sparks.

Demonstrations. Here are some demonstrations that you can try with a Wimshurst machine. For instance, with the Leyden jars disconnected, move the discharge balls far enough apart so that there is no spark when you turn the handcrank. Light a candle and hold it close to one ball and then the other. At the positive ball, the flame will be attracted toward it, and at the negative one, the flame will be repelled.

For another experiment, hold a piece of cardboard between the discharge balls (again with the Leyden jars disconnected). Allow the shower of sparks to jump through the cardboard. Inspect the cardboard and notice that the hole caused by the spark is bulged on both sides. That shows that sparks act like AC current, they oscillate between the discharge balls.

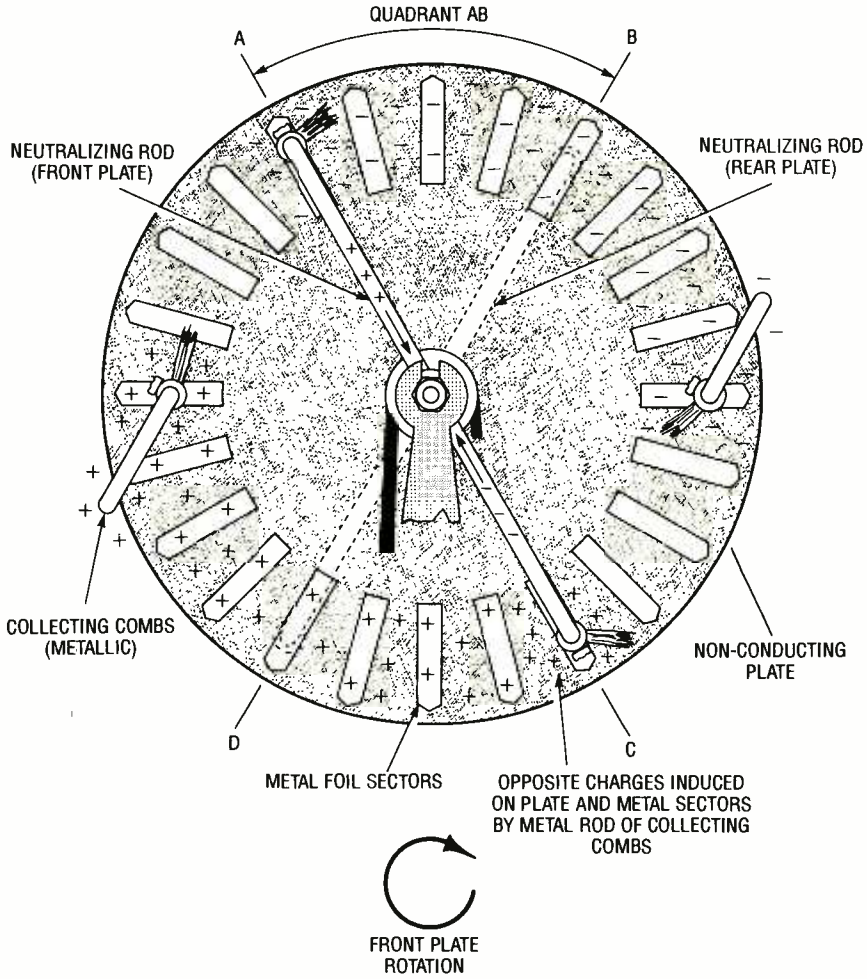
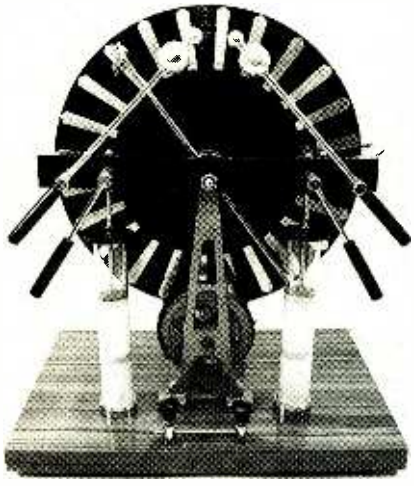


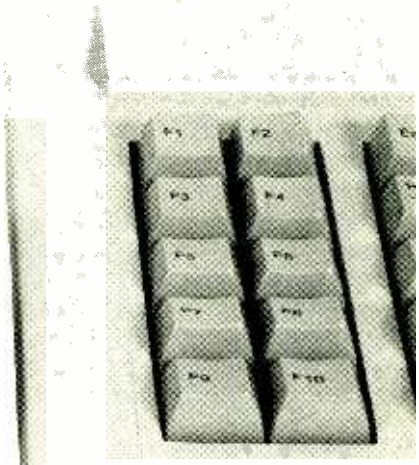
Fig. 2. This is the charge distribution on the front plate. Front and rear neutralizing rods scoop the charges up and move them to more desirable quadrants. The collecting combs can then wisk them away.



Here you can plainly see the Leyden jars and discharge spheres. The jars are connected to the spheres by lifting up the levers attached to them.

For a different effect, start by cutting some kind of shape out of a piece of aluminum foil. A good example is a letter, such as T or L. Paste the aluminum design to a piece of cardboard. Using a knife or razor blade, cut the design in several places to create discontinuities in the foil (don't let the cuts exceed 1/32 inch wide). Connect each end of the shape to one of the discharge balls. Run the machine and watch the arcs as the charges jump the cuts in the foil.

Safety. You must respect the potential of any electrostatic generator. Under normal use, they are safe, but you should not let that lull you into a false sense of security. **You must never attempt to condense, or store, the charge they produce without full knowledge of its dangers. Simply said, avoid connecting any capacitor to any electrostatic generator.**



Build The Bitgrabber

BY JOHN YACONO AND MARC SPIWAK

Here's an interesting little gadget that you probably have a use for—even though you may not be aware of it!

A computer is a black box in many respects to most people. Especially where something like the output of your parallel port is concerned. Let's face it: even using a logic analyzer, which is something that most computer hackers are not familiar with (not to mention that it's really expensive), it would still be an arduous task to try and figure out what character is present at the port. You would have to examine the logic levels on the eight-bit bus, convert them to a binary number, and look for a match on an ASCII table.

But why go through all that when you don't have to? Our *Bitgrabber* provides you with an RCA output jack that pulses low when any preselected ASCII code is detected. The low pulse can be seen easily with a logic probe, oscilloscope, or another, similar instrument. You could even attach an LED to the output, although the pulse may be too short to "see"—but more on overcoming that later.

Many of you are probably saying "why don't you just connect a printer to the port and see what it prints?" Well, that would be fine, except that graphics characters can't be printed on some printers, and there are some characters that can't be printed on any printer. Also, one reason that you may want to know what character is being output at the port is if your printer isn't working; in which case you obviously can't see the character. The Bitgrabber is an easy way to see if the problem is with your printer or the port itself.

There are other uses that may not be as obvious. The Bitgrabber can be used to buzz out parallel-printer and straight RS-232 cables. It can activate a device via a relay, optocoupler, or other similar device upon receiving the right signal. With a modified output stage, it can control a large number of devices using only twisted-pair wiring (very good for timed remote operation of household devices for people who already own a computer—and who doesn't?).

It can also be used as a test instrument for logic chips. You would set the detector's DIP switches to correspond to the proper input and output values for a given chip, connect the detector to the chip with a DIP clip, and see if a low pulse appears at the detector's output jack at the appropriate time.

Circuit Theory. The theory behind the circuit's operation is pretty simple. Let's say we wanted to detect the ASCII character represented by the binary number **11111111** (character 255) at your printer port. That character is used for special purposes and can't be printed like other characters, so simply using your printer to detect its presence won't work.

If we feed those bits into an eight-input AND gate, the gate's output would go high—but only if all eight inputs are high. Now, if we were to use an eight-input NAND gate instead, the only difference would be that the gate output would go *low* when all inputs are high. As a matter of fact, using a NAND gate is actually preferred, because IC's are very poor at supplying current to other devices, but they are pretty good at sinking it. And we assume that the output will be used to turn on something. Also, by grounding a device to turn it on, the detector's power supply can be isolated from the device you want to control. They will share only a common ground.

Now all that's great if you are only interested in detecting ASCII character 255. What about characters with zeros in them? The obvious answer is to invert each bit that should be zero before sending it to the NAND gate. However, using inverters is a bad idea because you'll have to rewire the circuit whenever you want detect a different character. Not only that, you could wind up with phase-delay problems.

A chip's phase delay is the time difference between a change at the input and the corresponding change at the output. It's like when you're playing

catch with someone; there is a time difference between when you catch the ball and when you throw it. That's not to be confused with rise time; the output of the chip takes time to reach the peak voltage after it has "made up its mind." Just like when you throw a ball up in the air; it takes a certain amount of time for the ball to reach its peak altitude after it has left your hand. If an inverter is used along one of the data lines, it will slow that line down so all the bits on the bus will not arrive at the NAND gate at the same time. If the phase delay is long enough in comparison to the transmission speed, the device will fail to function properly.

What we need, then, is a gate that can be used as an inverter or a buffer. That way, signals that need inverting will pass through the same number of gates as signals that are simply buffered. Further, if that gate can be programmed to be an inverter or a buffer with a simple switch, then there'll be no need to rewire the circuit to detect a different character. Simply set the switches to invert the lines you expect to be low, and buffer the rest.

The perfect gate for that purpose is the XOR gate. If you hold one of an XOR gate's inputs high, the compliment (inverse) of the other input appears at the output. If you hold one input low, the signal at the other input will be buffered through unchanged.

If you take a look at Fig. 1, you'll see that the quad XOR-gate chips, U1 and U2 do just that. Let's follow the path of the least-significant bit, D0, for clarity. It comes into the unit via pin 2 on the DB-25 connector, and goes straight to one of the XOR-gate inputs. The other input to that gate would be held low if the switch connected to it is closed, or it will float high through its pull-up resistor in R1 if that switch is open. So with a switch open, its gate is a buffer, with a switch closed, its gate is an inverter. If we invert all the inputs that we want to be zero, and buffer those we want to be one, then when the incoming character matches the one we're waiting for, all the inputs to the NAND gate will be high, thus its output will go low.

Parallel-Interface Handshaking. Computers transmit more than just character data through their parallel ports; they send control signals as well. They also expect to receive signals generated by the printer. Let's examine those "handshaking" signals and see how the Bitgrabber deals with them.

Start by taking a look at Fig. 2. There we show the four important signal types and their relationship in time. At the top are the eight data lines lumped together as a single band. Don't let that throw you, the value of the bits is not important. What is important is the time at which data is present at the port.

The data being output on lines D0–D7 starts to change at time t1 and is available for use by time t2. At t2, the computer sends a momentary low-going pulse, called the strobe signal, through pin 1 to the printer to indicate that the data is ready and waiting on the data lines. After t2, the printer can either output a busy signal (through pin 11), which keeps the computer from sending more data to the port, or it can wait until it's ready before sending an acknowledge signal (through pin 10), which also keeps the computer from proceeding. There are a few printers

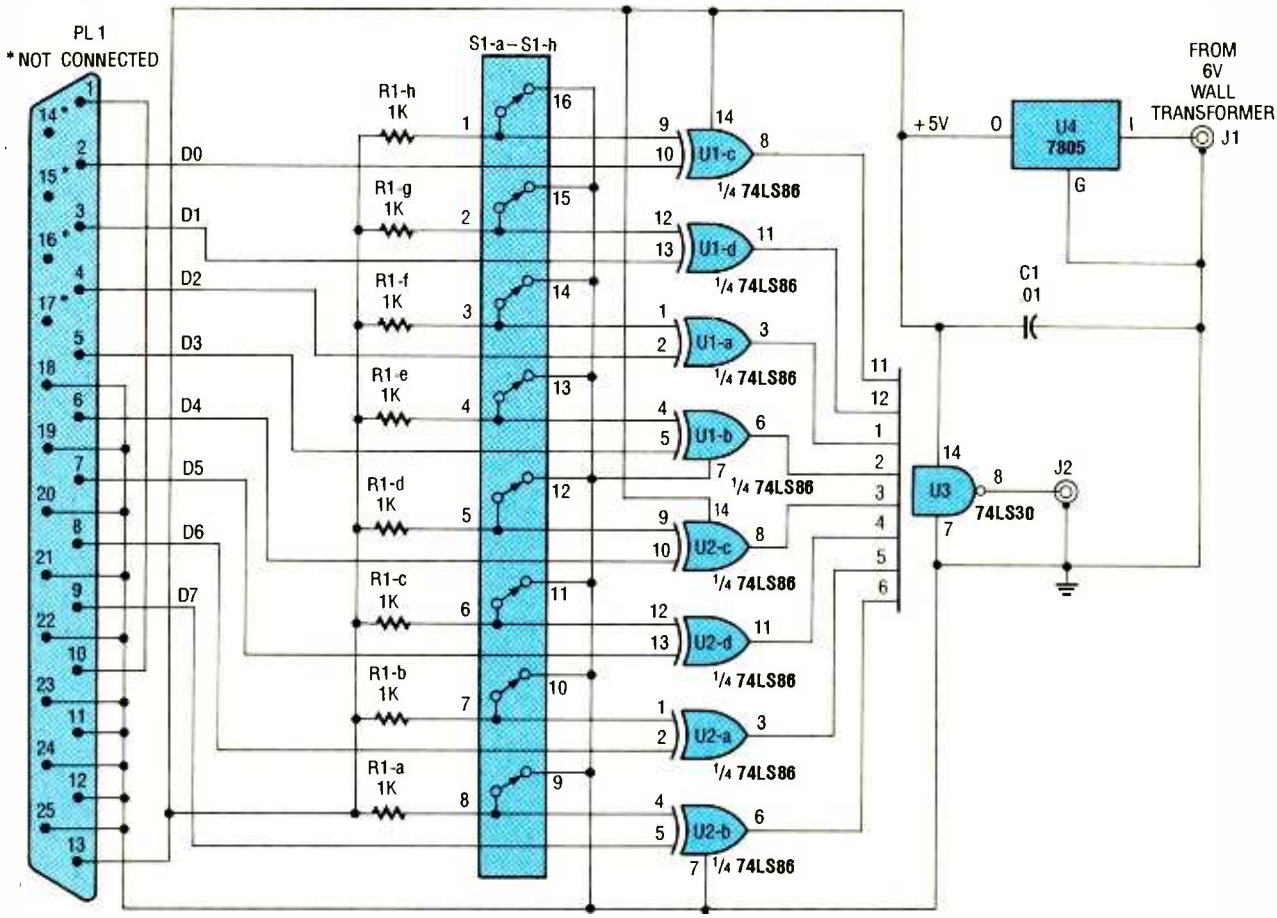


Fig. 1. Here is the schematic diagram of the Bitgrabber. The DIP switches allow you to set the unit to indicate the presence of any ASCII character.

that halt the computer in both ways, although to do so is redundant.

Now you might be wondering how the character detector does any handshaking without any pulse-generating components. Well, the detector lets the computer "shake" its own "hand." The busy line is tied low, which is okay because the computer doesn't care whether or not the busy line goes through any transitions. As long as the line isn't high the computer will just wait for the acknowledge signal. The *level* of the busy line is important, not its *transitions*, that's why the busy-line levels are drawn bold in the illustration.

The computer must therefore rely on the acknowledge line to detect the device's readiness. When the computer sends the strobe pulse, it considers the falling edge the start of transmission (that's indicated by the arrow on that edge). By the time the strobe line is low, the computer has already begun waiting for the acknowledge pulse. Interestingly enough, the computer only concerns itself with the rising edge of the acknowledge pulse; it pays no attention to the pulse's logic level or its falling edge.

Since the computer starts waiting for the rising edge of the acknowledge pulse right after the falling edge of the strobe pulse, we can use the rising edge of the strobe pulse in place of the rising edge of the acknowledge pulse. To accomplish that, the detector has an internal connection between pins 1 and 10 and the computer sends itself what it thinks is the rising edge of the acknowledge pulse.

Construction. The Bitgrabber is built using very few components, so its size can be kept to a minimum. All things considered, wire wrap is the best way to go for this project. So be sure to use IC sockets with wire-wrap pins on them for all of the components except the capacitors and the voltage regulator. The wiring job will be easier if you lay out the parts as they are arranged in the schematic.

All of the connections on the underside of the board are wire-wrapped, except in instances where there are many pins right next to each other that must be connected together. For example, one entire side of the DIP-switch package must be wired together, so a piece of bus wire was soldered directly to the row of pins. Using bus wire that way will save you from a lot of wire wrapping.

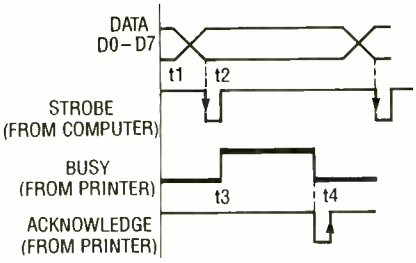


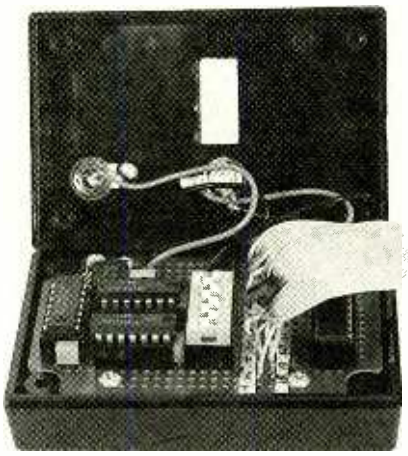
Fig. 2. Here are the important timing signals on your parallel port.

The unit connects to your computer with a DB-25 connector (PL1) crimped onto the end of a length of ribbon cable. If you look at the schematic, you'll see that pins 14–17 are unused, so don't connect them to the perfboard. Also, pins 1 and 10 just have to be connected to each other, so that's two more wires that don't have to be connected to the board.

Altogether, only 19 of the 25 wires in the ribbon cable have to be connected to the board. For added strength though, the unneeded wires are cut off *after* entering the case (more on selecting the case in a moment), and pins 1 and 10 are connected inside the cabinet. The other 19 wires are soldered to individual wire-wrap pins on the top of the board, to make wire wrapping on the underside neater.

Other components, such as the RCA-type output jack for J2, and the coaxial DC power jack (J1) are optional. You can use any kind of output jack that best suits your needs, and an on/off switch can be substituted for J1. You could omit the on/off switch as well, and simply plug in the unit when you need it.

The connections to the jacks were made using stranded wire soldered directly to the wire-wrap pins on the IC sockets. Wire-wrap wire can be used, but it breaks quite easily when wiggled back and forth.



A small piece of perforated construction board is all you need to build the circuit.

PARTS LIST FOR THE BITGRABBER

SEMICONDUCTORS

U1, U2—74LS86 quad 2-input XOR-gate, integrated circuit
U3—74LS30 8-input NAND gate, integrated circuit
U4—7805, 5-volt regulator, integrated circuit

ADDITIONAL PARTS AND MATERIALS

R1—1000-ohm, 16-pin, DIP resistor network (Digi-Key 761-1-R1000, or similar)
C1–C4—0.01-µF monolithic capacitor
S1—8-position DIP switch
PL1—DB-25 male connector
J1—DC power socket
J2—RCA phono jack

Cabinet, circuit board, 6-volt DC power supply, 25-conductor ribbon cable, 16-pin wire-wrap sockets, 14-pin wire-wrap sockets, solder posts, wire-wrap wire, bus wire, solder, etc.

The prototype was built with the intention of it being the only thing connected to the parallel port. However, if you wish to connect it in-line with a printer, for example, simply crimp an additional connector of the appropriate gender and type onto the ribbon cable, and disconnect the wires from pins 1, 10, and 11 inside the project box.

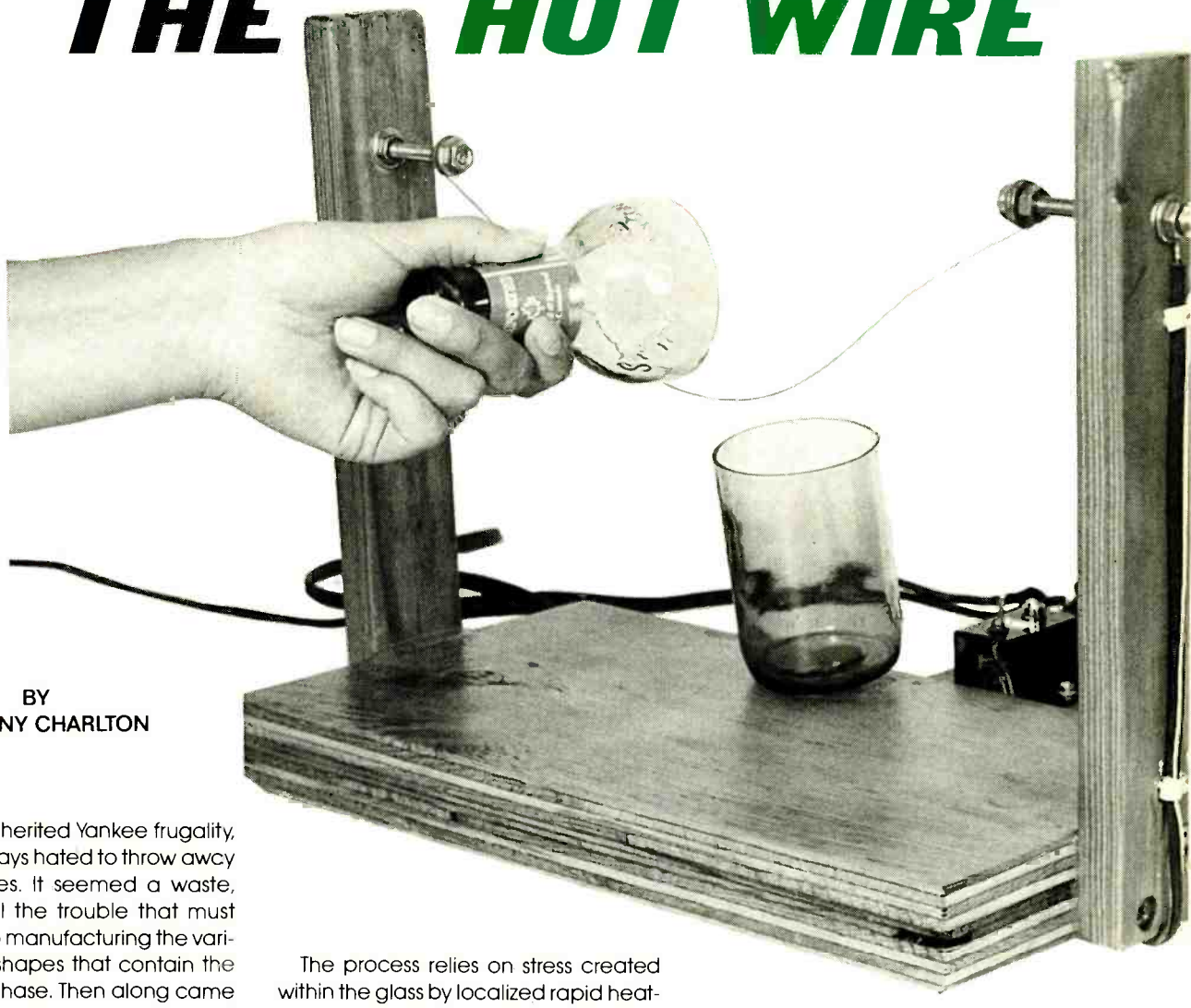
Testing the Unit. Let's test the circuit now, before installing it in a case, but be sure to put the board on a non-conductive surface during this step. With your computer off, plug the Bitgrabber's DB-25 connector into the parallel port. Plug the wall-transformer power supply into a surge-protected AC socket and connect its output plug to the Bitgrabber. Connect a logic probe, a pulse-detecting multimeter, or an oscilloscope to the detector's output. Now set the switch bank.

The desired character is selected by setting the bank of switches to the character's ASCII code as mentioned earlier. Table 1 contains the binary code for all 256 IBM-compatible characters. Note that on = 1, off = 0, S1-h sets the most-significant bit, and S1-a sets the least-significant bit. Now you're ready to power up your computer and send data to the port.

You needn't write a program just to

(Continued on page 96)

THE "HOT WIRE"



BY
ANTHONY CHARLTON

guess it's inherited Yankee frugality, but I've always hated to throw away glass bottles. It seemed a waste, considering all the trouble that must have gone into manufacturing the various sizes and shapes that contain the liquids we purchase. Then along came an idea on how to salvage some of those bottles and turn them into useful items. Cut off the neck, and then you can then make drinking glasses, planters, vases, lab ware, decorations, artistic creations, terrariums, and even fish bowls! But how?

Regular glass cutters of the wheel or scoring-point type proved frustrating and unreliable since the bottle would almost always break in the wrong place. The result was a ruined job, or one that required extensive grinding to get it only halfway decent.

Then, in an inspiration, the *Hot-Wire Glass-Bottle Cutter* was created. The Hot-Wire Glass-Bottle Cutter combines two techniques. The bottle is first scored lightly and evenly with an ordinary wheel-type cutter. Then a red-hot wire heating element is guided over the score line until a crack forms and neatly moves along the score line until the two pieces separate.

The process relies on stress created within the glass by localized rapid heating that causes the glass to crack. The score line then guides the advancing crack accurately to its ultimate end. With practice, that one-two approach produces a perfect job nearly every time. After separation, the cut glass is smoothed with emery cloth or a similar product to remove the sharp edges.

The Secret. The core of the project is its nichrome—a semi-flexible, but very tough alloy of nickel (61%), chromium (15%), and iron (24%)—wire heating element. Nichrome has an electrical resistance of about 65 times that of pure copper. Because of its high resistance, it heats up rapidly as current is forced through it.

There are several alloys of nichrome made. The prototype was made with the most often used type and is known by the names (other than nichrome): Alloy C, MWS-675, Tophet C, Chromel C, and Nikrothal-6. Nichrome is widely used for resistance-heater type devices, such as toasters, electric blankets, and giant high-temperature heaters used to remove welding stresses in oil and nuclear power-plant piping.

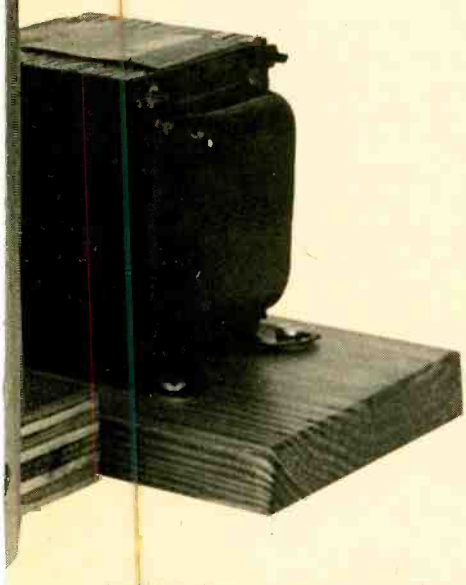
Perhaps it's most useful property is its very high maximum working temperature of around 1800°F. Indeed, heat of that magnitude can easily melt glass. However, in this project, the nichrome wire is heated to cherry red; roughly 1200°F, which is still below the 1285°F melting point of common bottle glass.

Wire temperature is very important. If the wire heating element is allowed to get too hot, the glass will begin to melt, leaving a sticky build-up on the wire, thereby making accurate cutting extremely difficult at best. On the other hand, if the wire does not reach a high enough temperature, the glass won't develop sufficient stress at the score line to cause separation.

There are two factors that control wire

BOTTLE CUTTER

Create colorful decorative ornaments and useful implements with an easy-to-build cutting assembly



temperature; resistance and current. The resistance of the wire depends on its gauge and length. Current depends on the resistance of the wire (including all of the wire in the current path) and the applied voltage across it.

Once the proper length of wire is "calibrated" to the supply voltage, you can replace the old heating element with another of the same gauge and length over and over again without altering the operating temperature of the element. Although calibration is easier using a digital thermometer with a small probe, it is not essential for building the project.

The Power Supply. The power supply (see Fig. 1) consists of nothing more than a heavy-duty, 12-volt, step-down transformer capable of supplying at least 5 amps continuously to heat the 24-gauge nichrome wire. Heavier gauges of nichrome wire require more energy. A big filament transformer salvaged from an old tube-type color TV was used in the prototype. Surplus dealers often have high-current transformers on sale for virtually peanuts.

At this point, it is important to note that AC transformers exhibit peculiarities under differing load conditions. Under light loads, the voltage output of an AC transformer may vary substantially from that specified by its manufacturer. For instance, the transformer used in our prototype put out 13.1-volts AC under light load, and 11.8 volts under a moderate-to-heavy load. That's a fluctuation of 11%—even though the unit is a massive and well-built transformer. So to avoid voltage fluctuations a heavy-duty transformer rated for 12 volts AC (and no less) is recommended.

A fuse is installed on the primary winding of T1, along with S1, which is included for safety and convenience. A high-brightness LED (LED1) is used to show that power is being delivered to the heating element for safety. That's because, although the wire may have a red glow (hot enough to sear flesh), under bright-light conditions the human eye cannot easily detect that glow. For that reason, it is recommended that the project not be left on unattended by a responsible person. There is also a second indicator (neon lamp NE1) on the primary side of the transformer, which is used to show AC power integrity.

The nichrome-wire heating element is strung between posts of a wooden frame and is held clear of the frame with bolts and nuts. It is important that the frame be very sturdy so that the wire does not flex while cutting, or separating the bottle will be difficult.

Frame Fabrication. Construction details for the frame are shown in Fig. 2. The base of the frame is made from a 2-inch thick piece of plywood (or other sturdy, non-conductive material) cut to 8 × 14 inches. Two uprights are attached to opposite ends of the 14-inch long base. The uprights are fashioned from ¾- × 2-inch plywood or hard pine (yellow pine, for instance) cut to 12 inches. Once the uprights have been cut to specification, align the two uprights with each other and drill holes through the uprights large enough in diameter to allow the bolts to slide through. Countersink the holes if needed.

Place the two uprights at opposite ends of the 14-inch length of the base and align them with each other and square them with the base. If you happen to have a wood dowel, tubing, or rod of some type lying around, thread it through the holes in the two uprights and center the uprights on the base to aid the alignment process. Once the uprights are aligned and squared with the base, drill a pilot hole through the uprights and into the base. That prevents splitting of the wood when the screws are tightened down.

Dry-assemble the frame, not quite tightening the screws all the way. Disassemble the frame and coat the mating surfaces with a fast-drying epoxy. Reassemble the frame, tightening the screws to achieve the tightest joint possible. Once the epoxy has set, the frame will be very strong.

Install the hardware at the top of the uprights as shown in Fig. 2 and begin wiring the circuit, guided by the schematic diagram in Fig. 1. The connections to the heating element and to the power supply must be clean and tight. Since nichrome will not hold a solder joint (it gets much too hot in operation) and the alloy doesn't braze easily, the connection is best made by wrapping a few turns of the nichrome wire around the bolts at the tops of the uprights, and squeezing the wire tightly between two washers by tightening the nuts.

The bolt must be long enough to prevent the heat from the heating element from charring the wood frame. A 3-inch bolt was used in the prototype, and had the added advantage of providing length adjustability for the wire. Eventually, the heating element will become tarnished and the connection to the bolt will increase in resistance. When that happens, the wire can be removed, cleaned with sandpaper, and then re-attached.

The transformer (which is the bulk of the power supply) may be bolted on the frame or (as in the prototype unit) located separately; use the configuration that you find most convenient. Heavy conductors must be used between the power supply and nichrome

heating element to minimize energy loss. The author used heavy-duty, 16-gauge, two-conductor lamp cord. Heavier gauge wire (14 gauge, for instance) may also be used, and if the lead between the transformer and the heating element is to exceed 3 feet, a larger gauge wire should be used to minimize power losses. The ends of the lead connected to the frame should be stripped back 1.5 inches, tinned, wrapped around the bolts, and the retaining nuts securely tightened.

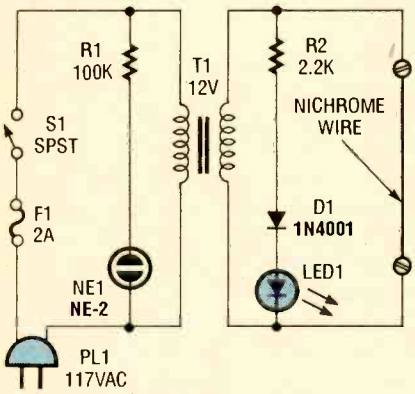


Fig. 1. The power supply for the Hot Wire Glass Bottle Cutter consists of nothing more than a heavy-duty 12-volt step-down transformer capable of supplying 2–5 amps continuously to heat the 24-gauge nichrome wire.

Getting Nichrome Wire. Nichrome wire can obtained from several sources. The supplier listed in the Parts List sells small quantities of the wire. Mail-order surplus dealers often carry inexpensive coils of nichrome wire. And some well-stocked hardware and electrical supply stores carry it for use in heating appliances. Heating elements may also be removed from some discarded older-model toaster ovens, hot plates (the coiled-wire type), waffle and clothes irons, etc.

For the salvage operation, a micrometer is a handy instrument to have around. It will enable you to determine the gauge of salvaged heating elements. Micrometers are available from suppliers of machinists tools and automobile repair parts. An inexpensive unit is accurate enough; and if possible, you can borrow or rent one from your local auto repair shop.

Remember, the support and power-supply dimensions given are matched to a 24-gauge wire heating element. Once you get the nichrome wire, carefully stretch out a section about 2 feet long. Remove the coiling by clamping one end in a vise and tugging at the other end until the wire is fairly smooth. Don't worry if it's a bit wavy; the heating and pressure that it will be subjected to will straighten it out as you cut your first bottle.

Assuming that you use 24-gauge nichrome wire and a 12-volt power supply, the active length of the element will be 10–12 inches. Since each transformer is a little different, you may need to experiment with the wire length to achieve the proper temperature range.

When the heating element is subjected to current, the glow is clearly visible in a darkened room; a blood-red glow is too cold, cherry-red is okay, or-

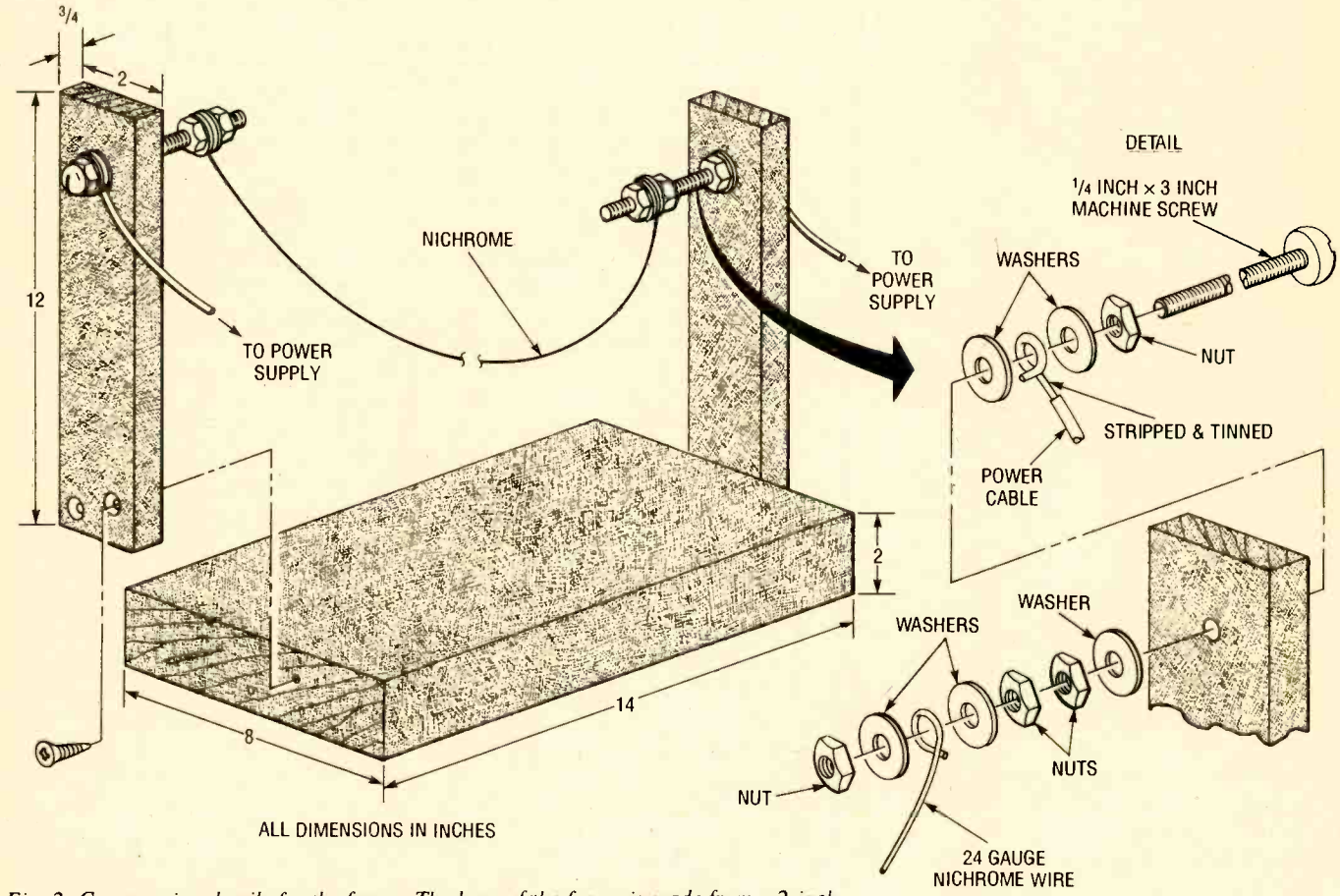


Fig. 2. Construction details for the frame. The base of the frame is made from a 2-inch thick piece of plywood (or other sturdy non-conductive material) cut to 8 × 14 inches. The uprights are fashioned from 3/4- by 2-inch plywood or hard pine cut to about 2 × 12 inches. Uprights are then cut to specification, aligned on opposite ends of the length of the base. The heating element is then suspended between the uprights supported by 3-inch bolts.

PARTS LIST FOR THE HOT-WIRE GLASS-BOTTLE CUTTER

D1—1N4001 1-amp, 50-PIV rectifier diode
LED1—Bright red light-emitting diode
R1—100,000-ohm, ¼-watt, 5% resistor
R2—2200-ohm, ¼-watt, 5% resistor
T1—12-volt, 2–5 amp, heavy-duty transformer
NE1—NE-2 neon lamp
S1—SPST switch
F1—2-amp fuse
PL1—Line cord with molded plug
24-gauge nichrome wire, ¼-inch diameter 3-inch bolts, ¼-inch hex nuts, ¼-inch flat washers, coarse-thread machine screws, C clamp, 90-degree angle bracket, wood, 16-gauge or (larger) line cord, 5-minute epoxy, emery cloth, wheel-type glass cutter, wood screws, fuse holder, insulated staples, etc.

Note: A 3-foot length of 24-gauge nichrome wire is available for $3 postpaid from Allegro Electronic Systems, 3 Mine Mountain Road, Cornwall Bridge, CT 06754. Order stock number 3-MWS-675. Free Technical Assistance for this project is available by calling 203-672-0123 weekday mornings from 9 until noon Eastern time.

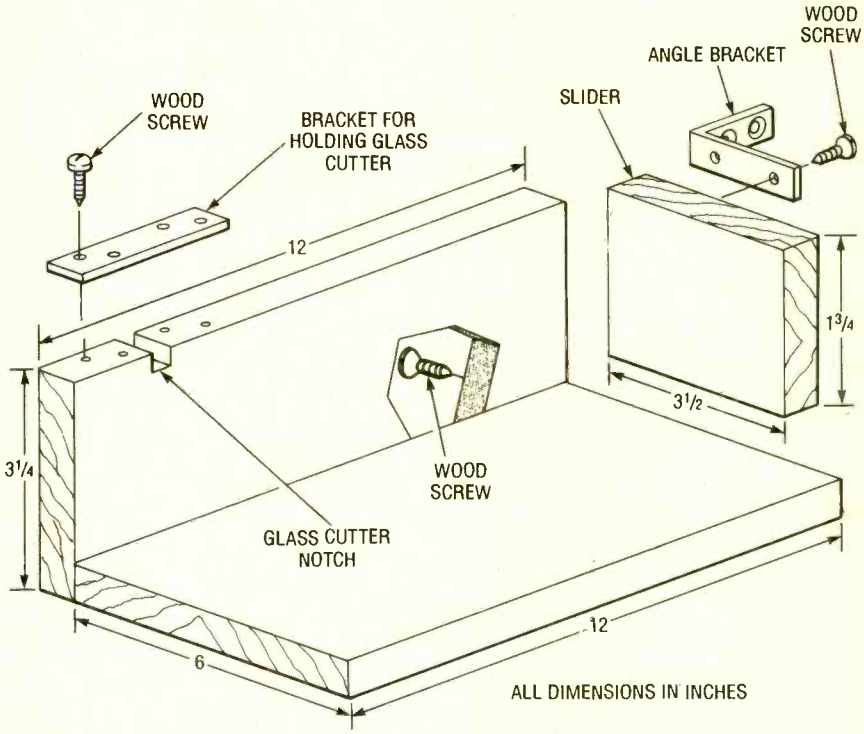
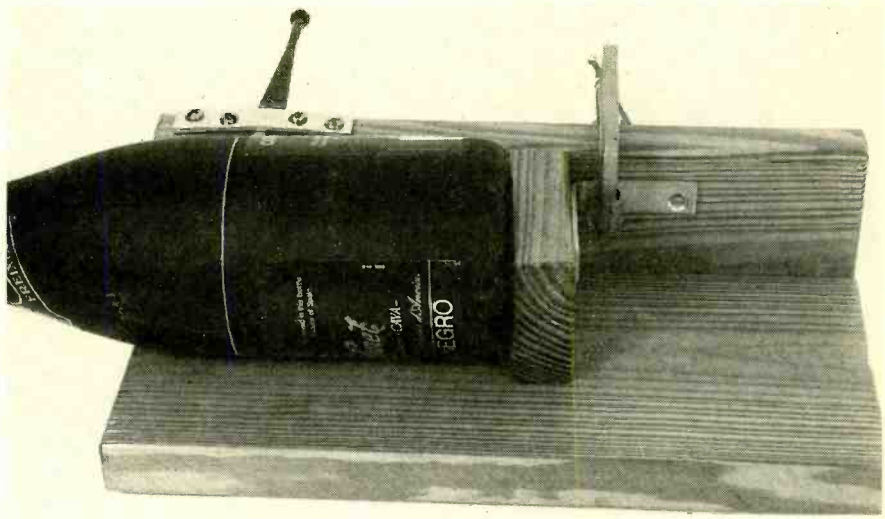


Fig. 3. Details of the scoring jig's construction. The scoring jig is nothing more than two pieces of hard wood attached at a right angle, and a slider made from a block of wood and an angle bracket. The jig also has a slot cut into one edge for a glass cutting tool.



The adjustable slider makes for easy positioning of the score line along the bottle's length, allowing you to sever the bottle at almost any point along its length.

ange-red is the best. Caution: The wire should not get orange (that's too hot) or yellow (way too hot). Too short a length, or too much power will result in excess temperatures, which will produce an orange or yellow glow. The wire should be hot enough to immediately char any piece of wood that contacts it. It should not be hot enough to stick to glass.

Start with 16 inches of nichrome wire. Stretch the wire between the two uprights, and fasten one end, and temporarily attach the other end to the opposite support. Check for the proper temperature range by turning on the power supply. After about 6 to 8 seconds the heating element should glow cherry-red to orange-red.

The wire's hot resistance is quite a bit more than its cold resistance. Because of that, the power supply has to work hardest when the wire is cold. Shorten the wire as needed to obtain the correct cherry- to orange-red glow. Once the proper temperature is obtained, fasten the ends of the heating element permanently to the supports.

Cut off the excess wire by making a nick with a file and flex it until it breaks. (Ordinary wire cutters will not work on nichrome as it is such a hard alloy.) Once the proper temperature is achieved, measure the length of the heating element and put a sticker with the measurement somewhere on your project for reference when the element is replaced.

Building the Scoring Jig. The second part of the project consists of a scoring jig; see Fig. 3 for details of its construction. The dimensions given assume that you'll be using the jig for fifth- (25.4 milliliter) or liter-sized bottles. An ordinary wheel-type glass cutter is positioned in the scoring jig to etch a score line around the circumference of the bottle. Here the most critical dimension is determined by relationship of the cutting wheel angle to the bottle side. The cutting wheel of the glass cutter should contact the bottle at about the center to slightly above it. An easy way to determine the proper position to draw a line down the center of both sides, level the bottle, and see where the wheel touches the bottle.

Smaller diameter bottles may be scored on the same jig by putting a

board of the proper thickness underneath to bring the wheel's touch point into compliance. Interestingly, larger diameter bottles are more forgiving of wheel angle.

Once you determined the proper position for the glass cutter, the glass cutter is mounted in the scoring jig as a permanent fixture. For real flexibility, you should make the score line position adjustable along the length of the bottle, enabling you to move the score line up and down the length of the bottle. The prototype was designed with a movable slider (back stop) for positioning the score line along the length of the bottle.

The scoring jig was made from hard pine or plywood for mechanical strength. A steel angle bracket was then screwed to the wooden block to form the slider. A "C" clamp is then used to clamp the angle bracket, and thus the slider, securely to the jig at the desired position. You may want to varnish the jig on the inside to allow the bottle to turn more freely as it is rotated against the cutting wheel. Another trick is to put a small amount of talcum powder or a Teflon-based drawer lubricant on the jig base to allow the bottle to turn more freely.

The glass cutter is held securely in place by a tight-fitting notch sawed into the side of the jig (see Fig. 3), and prevented from jumping out by a metal brace screwed to the wood. When the cutter needs replacement, the brace can easily be removed, and a new one installed.

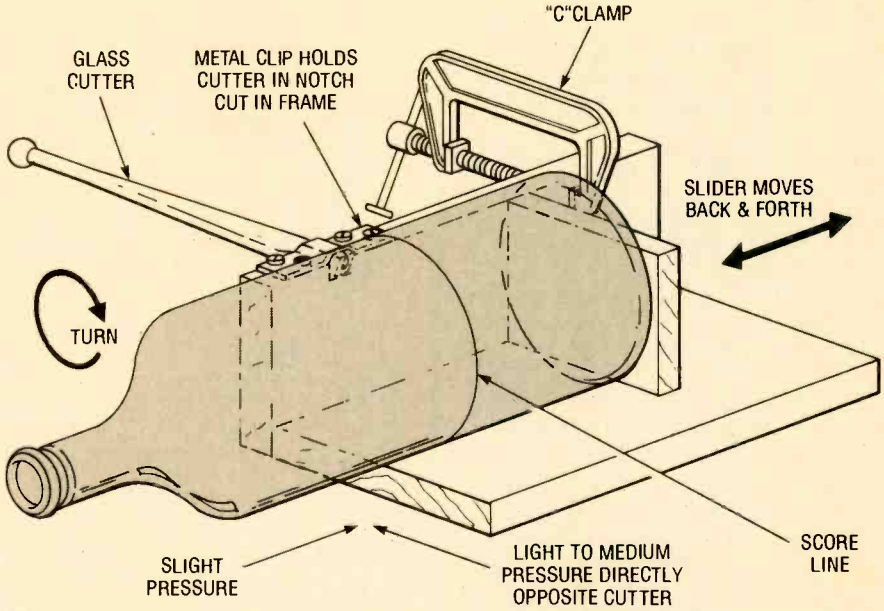


Fig. 4. Starting with a clean and totally dry bottle, score the bottle lightly and evenly, with the end of the score line meeting its beginning.

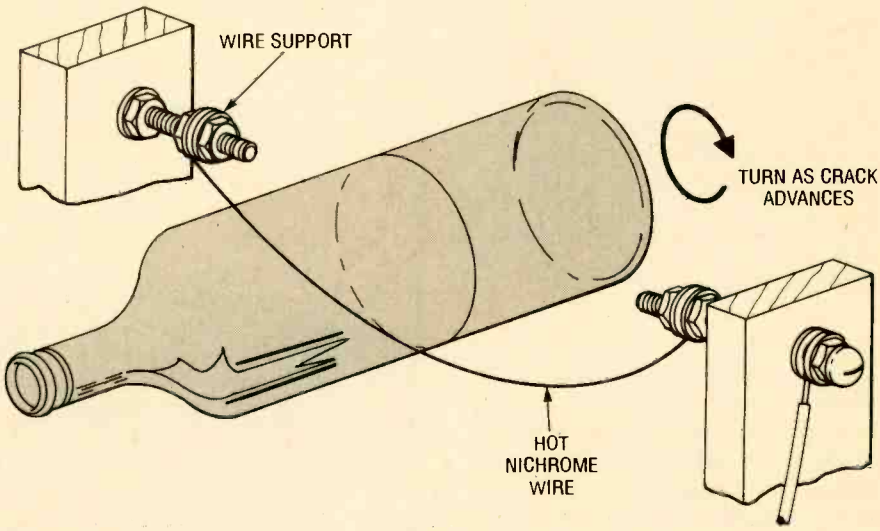


Fig. 5. Rest the bottle at the score line on the heating element, and gently rock the bottle back and forth against the hot wire. After a short time (determined by the thickness of the bottle being severed), a crack will form and crawl along the score line, eventually severing the bottle.

Cutting Technique. Cutting bottles does involve a little skill. First make sure the bottle is clean and totally dry. Score the bottle lightly and evenly (see Fig. 4). A deep score line actually is self-defeating as more paths are created for the crack to follow. Scores must meet at the ends. Once the bottle has been scored, turn on the power to the heating element, and allow 6 to 8 seconds for the element to reach operating temperature.

Rest the score line on the heating element, as shown in Fig. 5, and gently rock the bottle back and forth against the hot wire. Pressing the glass forcibly against the heating element will not do the job any faster and may even break the hot wire. Watch the crack crawl around the bottle, and precede it slightly with the wire. Viewing the bottle from an angle will help. The crack will look dark and the score line white. Several passes are needed in most cases to cut the bottle through.

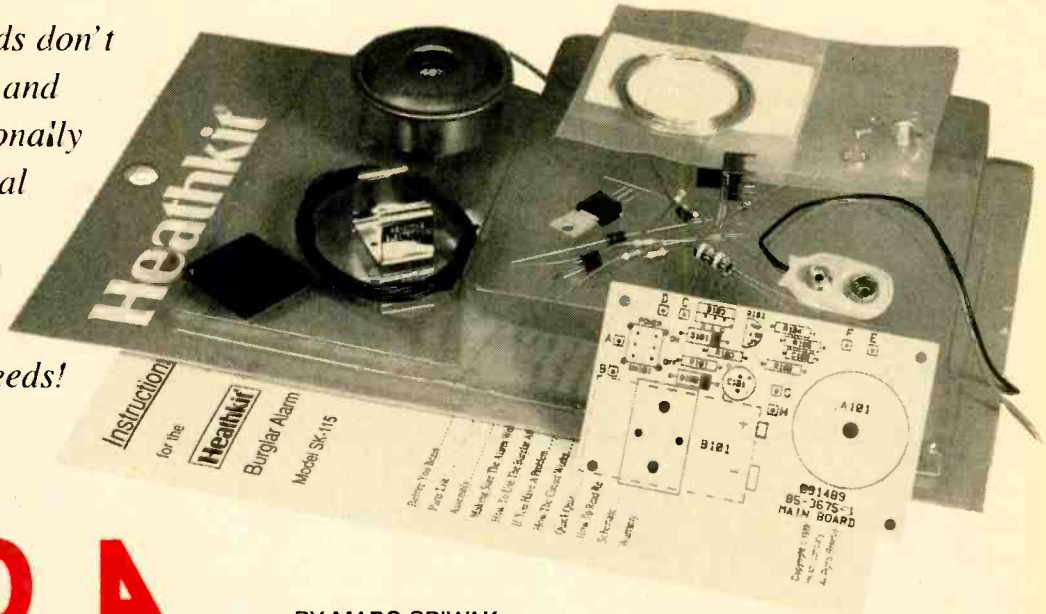
Let the wire determine the cutting pace. Thick glass will take longer to separate. Thin glass can cut quite fast. A wine bottle will take one to two minutes to cut; a large mayonnaise jar perhaps only half a minute due to the thin glass wall. If the wire is not cutting at all, it may be necessary to raise the heating element's operating temperature. If a cut refuses to be finished, set the bottle aside until it cools, then try again; the crack will advance more easily if the wire touches cold glass than hot.

One technique that might help with stubborn cuts (thicker glass in particular) is to cool the glass surface in the area of the score with an ice cube and then quickly and thoroughly dry the surface with a hand towel. Before the glass has a chance to return to room temperature, place the scored area back on the hot heating element. The rapid temperature change should cause the two halves to separate. Never force a stubborn cut apart; use a gentle pulling apart pressure, holding the bottle away from your body.

Be prepared for the bottle halves to fall apart in your hands! It's a good idea to wear gloves when cutting larger bottles. Very heavy bottles such as 5-gallon jars require that bath towels be laid to either side of the bottle.

(Continued on page 96)

If your security needs don't require the expense and bother of a professionally installed, commercial burglar alarm, then perhaps this project is just what your budget needs!



BUILD A Burglar ALARM

BY MARC SPIWAK

Let's face it, security equipment is not just for overly paranoid people anymore. It just makes good sense these days to have some kind of security system guarding your property and person. And it doesn't matter if your equipment warns you of intruders or keeps them out, as long as it provides some protection or, at the very least, gives you some peace of mind.

One major problem with security systems is that they are often quite expensive, especially when you consider the installation cost of such equipment. Even if you are an exceptional do-it-yourselfer, the job of installing an entire home-security system is enormous, and could take an individual several days to do. And then there's the monthly cost that's associated with some types of alarm systems. It's no wonder that spending several thousand dollars or several days of labor on an alarm system is not appealing to many people.

So what do you do? An alternative is to build the simple and inexpensive burglar alarm kit described in this article. Designed by Heathkit, and sold by them as their SK-115 Burglar Alarm kit (see ordering information in the Parts List), it's a simple circuit that drives a loud buzzer when either of its two zones are triggered—but more on that later.

Some of you are probably thinking that such a simple circuit can't possibly be very effective. But, on the contrary, the circuit itself is as reliable as any other, as long as it is properly triggered. Just because the circuit is very simple does not mean that the unit can't provide adequate protection for at least one room, such as your bedroom. The sound emitted from the buzzer is certainly enough to wake even the deepest sleeper should an intruder enter either the door or window.

Zones. Looking at the schematic diagram in Fig. 1, you can see that the unit has two *zones*. What that means, is that two separate entry points can be monitored, either both at the same time, or individually. That would be useful if, for example, you wanted to monitor the front door of your home for intruders, but were having a cookout in the backyard and wanted to leave the back door free for people to go in and out. Of course, if you were going to be out, you would want to have both doors monitored.

The way that the circuit is set up, Zone 1 should be connected to a normally closed switch and Zone 2 to a normally open one. Zone 1 is well-suited for notifying you if a window with foil tape is being broken into, but can be operated with any kind of normally closed switch that you can find, and it does not have to be used on a window. Zone 2 is suited for use with a mercury switch, which will lend itself to many unusual applications. But, of course, any kind of normally open switch will do for Zone 2. Keep in mind, though, that there are all kinds of specialized switches for security applications, and they come in a wide variety of normally open and closed configurations. So you can use either zone for just about any kind of application you can think of. You could even monitor a window for either being broken or lifted open.

Circuitry. As for the circuit itself, you can see from Fig. 1 that it is very simple. Switch S1 is the main power switch, and S2 and S3 are for Zones 1 and 2, respectively. Switches S2 and S3 operate as follows: S2 normally pulls the anode of D1 to ground, preventing it from conducting. If S2 is opened, D1 is allowed to conduct, which puts a positive voltage on the base of Q1, causing that transistor to turn on.

Switch S3 is normally open, but if it is closed, it directly supplies a positive voltage to the base of Q1 and, again, it turns on. Whenever Q1 conducts, SCR1 turns on, which in turn drives the buzzer, BZ1. Because an SCR is used, the buzzer will remain on even if S2 or S3 is retuned to its original position. Only if the power is removed from the circuit via S1, will the buzzer shut off. Even then, if the

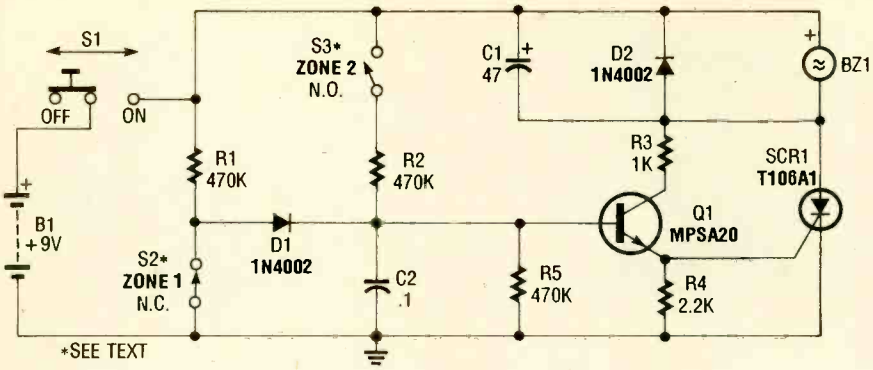


Fig. 1. The alarm is a simple circuit that drives a loud buzzer when either of its two zones are triggered.

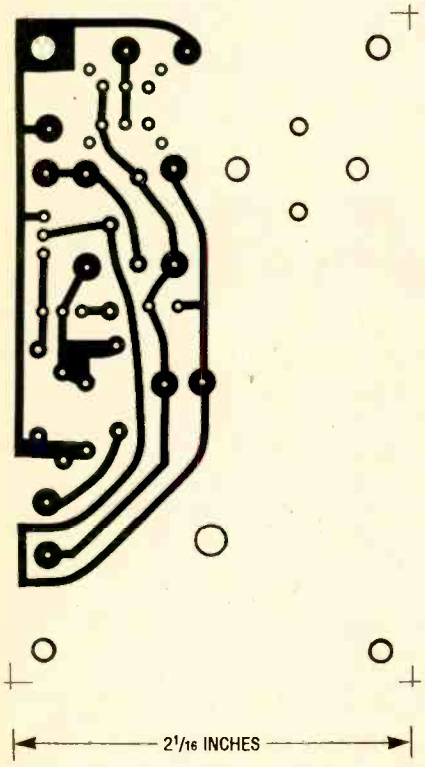


Fig. 2. If you want to build the project from scratch, here is a foil pattern for the printed-circuit board.

power is not left disconnected for approximately 15 seconds, the alarm will turn on again.

The circuit is powered from an ordinary 9-volt battery, for which a battery clip is provided. However, you can power the circuit from a 9-volt AC adapter or other similar supply. With a little bit of experimenting, you could probably use a much more powerful siren, provided that you power it from an appropriate source. But those kinds of circuit modifications are left entirely up to you.

Construction. Building the circuit requires no special skills other than basic soldering techniques. For those of you who want to build the project from scratch, a foil pattern for the PC board is provided in Fig. 2, and Fig. 3 is a parts-placement diagram. Simply install each part on the printed-circuit board in the order that they appear in the Parts List.

The only thing that requires some additional explanation is the buzzer. It's an ordinary 9- to 12-volt DC buzzer with the positive lead pre-installed. The buzzer has a tab attached to the back to which a ground lead is soldered. Actually, if you were mounting the buzzer on a conductive surface, such as inside a metal cabinet, where the cabinet itself is ground, the ground lead would be unnecessary. But for our purposes, the ground lead is required. So you must solder a length of wire to the tab, and then connect it to the printed-circuit board, as shown in Fig. 3.

Also note that the kit (more on that in a moment) comes with a battery holder that mounts to the printed-circuit board. That's a nice feature, but you don't have to use one. Four small squares of foam rubber are used as feet to prevent the unit from shorting on

(Continued on page 96)

PARTS LIST FOR THE SIMPLE BURGLAR ALARM

SEMICONDUCTORS

D1, D2—1N4002 1-amp, 100-PIV rectifier diode
Q1—MPSA20 NPN silicon transistor
SCR1—T106A1 4-amp, 30-PIV, silicon-controlled rectifier

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R2, R5—470,000-ohm
R3—1000-ohm
R4—2200-ohm

ADDITIONAL PARTS AND MATERIALS

C1—47-µF, 16-WVDC, electrolytic capacitor
C2—0.1-µF, ceramic-disc capacitor
S1—SPST toggle switch
S2, S3—See text
BZ1—9- to 12-volt DC buzzer
B1—9-volt transistor-radio battery
Printed-circuit materials, enclosure, battery holder and connector, foam rubber feet, wire, solder, hardware, etc.

Note: The SK-115 Burglar Alarm kit is available from Heathkit (Heath Company, P.O. Box 8589, Benton Harbor, MI 49022; Tel. 800-253-0570) for $14.95. Contact Heathkit for shipping and handling information, or visit your local dealer

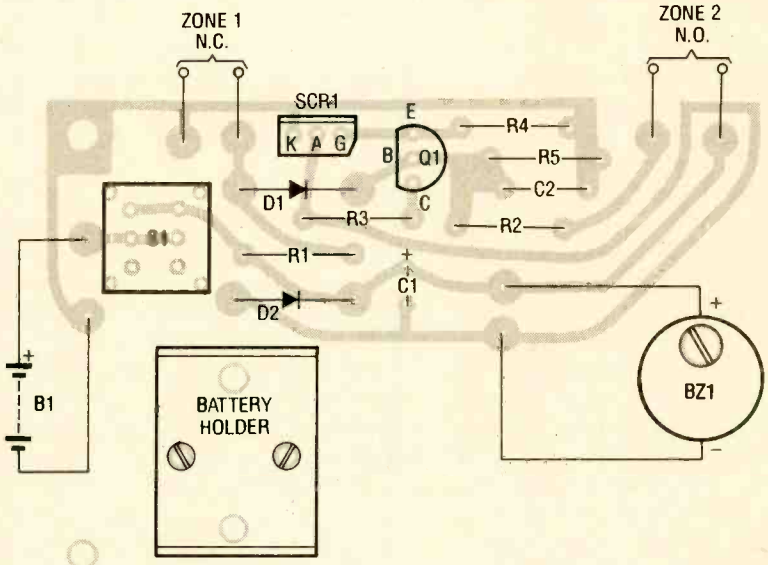


Fig. 3. When installing the board-mounted parts, be sure that each component is placed in the correct position, with the proper orientation.

ELECTRONIC NOVELTY LIGHT

BY STANLEY A. CZARNIK

Have you ever wondered how light dimmers work? ...or what components are used to accomplish the task? Well here's your chance to peer into the circuitry behind such devices

If you've been looking for an inexpensive and simple, yet unusual construction project with a number of attractive applications, here's just the thing. It's a small lamp-dimmer circuit, the variable output of which is wired to nine tiny parallel-connected lamps that are lined up inside a long rectangular plastic tube. The bulbs look like neon bulbs, the kind we're all familiar with. But look again. Neon bulbs are clear. These bulbs are white. Neon bulbs produce an orange light. The light from this collection of bulbs is a bright fluorescent green.

Essence of Fluorescence. The physics of fluorescent light is quite interesting. Certain substances, called phosphors, are able to absorb one or more types of electromagnetic radiation (ultraviolet, for example) and convert at least part of the absorbed radiation into light. Note that in this case the wavelength of the energy going in (UV) is shorter than the wavelength of the energy coming out (visible light). The relationship involved is known as Stoke's Law. Energy absorbed by the phosphor but not emitted as light is dissipated as heat.

Early in the commercial development of fluorescent lighting devices, it was decided that the source of energy would be the ultraviolet radiation of a low-pressure mercury arc. That automatically placed a limitation on how the lamps could be designed. The resonance line of mercury is 2537 angstroms. Phosphors that did not respond, or responded poorly, to the 2537-angstrom wavelength could not be used.

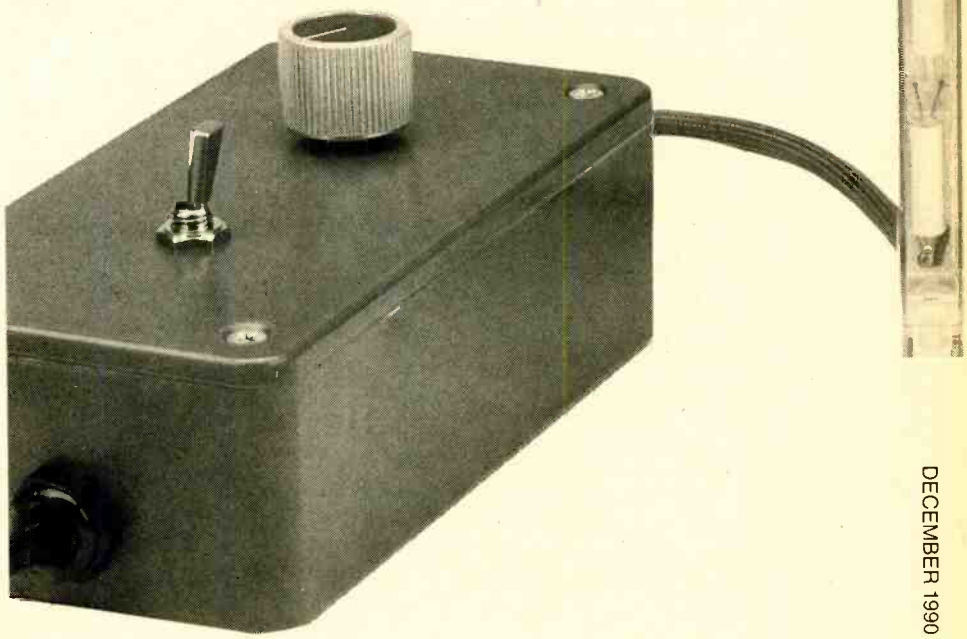
The nineteenth-century physicist William Crookes is famous for his original work on gaseous discharge, cathode rays, and fluorescence. One of the luminous substances used by Crookes was the mineral willemite—a naturally-occurring form of zinc silicate. The maximum sensitivity of zinc silicate is very close to the critical 2537-angstrom wavelength. That means that mercury vapor tubes lined with the compound are highly efficient sources of illumination. Zinc silicate containing a trace of manganese gives off a bright-green light and is considered an excellent fluorescent material.

The Dimmer Circuit. The lamp dimmer is a very simple circuit built around a T106D1 silicon-controlled rectifier (SCR). A 100k potentiometer (R1) is used to vary the current presented to the gate of the SCR. That, in turn, determines the level of current moving through the SCR, which is the electricity available to light the lamps.

The remaining electronic components are as follows: a 2k resistor which is used to limit the current applied to the gate of the SCR, and a .033 µF, 250-volt capacitor, which upon reaching a sufficient charge level causes NE1 to turn on. The in-rush of current through NE1 is then applied to the gate of SCR1, causing it to conduct. With SCR1 conducting, a pulsating DC voltage is supplied to the string of fluorescent lamps, exciting the gasses within the glass envelopes. The neon lamp is used as a gate-trigger device in this application.

Construction. First of all, you must obtain the miniature fluorescent strip light. These lights are available from JerryCo, a science surplus mail-order company in Evanston, Illinois. The strips are about 11 inches long and require no assembly or special preparation. See the Parts List for more information.

Putting the strip-light controller together is not difficult. But remember that the circuit runs on 117 volts AC. That



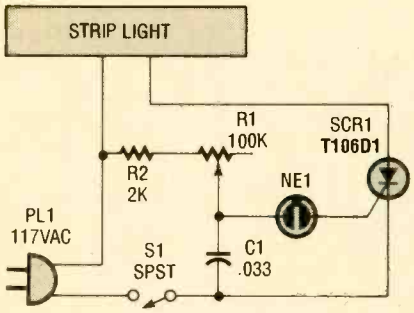
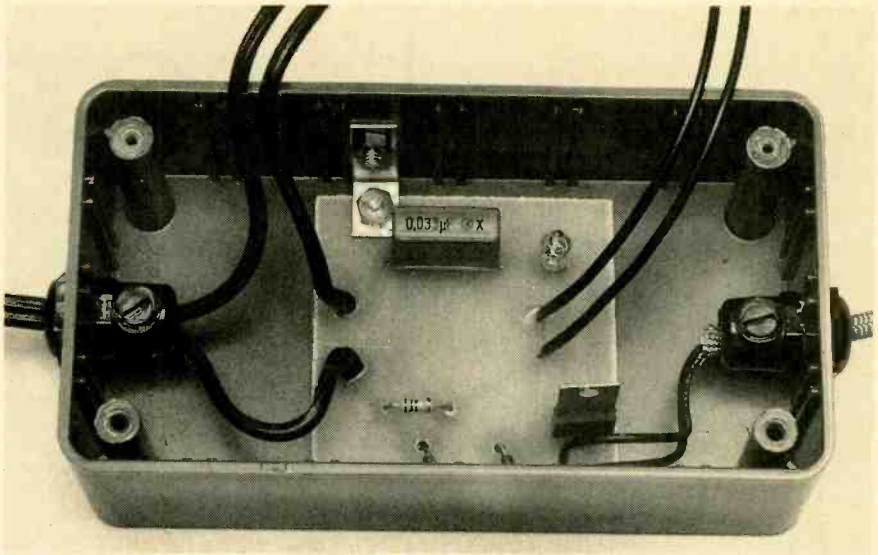


Fig. 1. The light strip controller is a simple circuit built around a T106D1 SCR. A 100k potentiometer (R1) is used to vary the current presented to the gate of the SCR. That, in turn, determines the level of energy moving through the SCR, which is the energy available to light the lamp.



The fluorescent light controller's printed-circuit board is fastened to the inside of a small plastic project box. The two wires at the upper left are connected to a SPST toggle switch. The wires at the upper right are connected to the 100k potentiometer. The 117-volt AC input passes through the strain relief at the far left. The variable output passes through another strain relief at the far right.

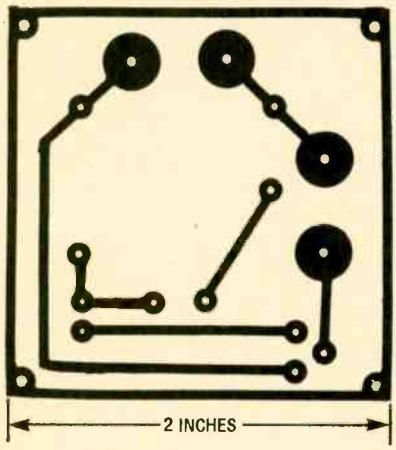


Fig. 2. While the Electronic Novelty Light is simple enough to be assembled on a small section of perfboard, this foil pattern is provided for those who prefer printed-circuit board construction.

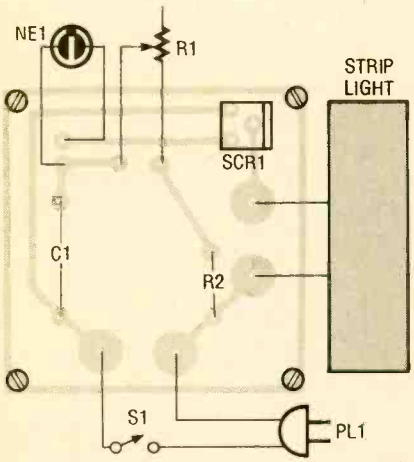


Fig. 3. There are only four components mounted to the printed-circuit board—hardly enough parts to screw up. In fact, the only error that might occur during construction has to do with the orientation of the SCR.

means that a plastic project box, or some other kind of non-conductive enclosure is necessary to protect the user. The box should be at least 4 inches long and 1½ inches wide.

To make things even more simple, a foil pattern for the author's printed-circuit board is shown in Fig. 2. After etching your board, install the board-mounted components guided by Fig. 3.

Once you've selected the enclosure that will house the circuit board, drill a hole at both ends of the enclosure; one for the power cord and another through which to connect the string of lamps to the board. It will also be necessary to drill two holes in the lid (or front panel) of the enclosure for potentiometer R1 and switch S1. The exact location of the controls is not critical, but make sure your switch is designed for 117-volt AC operation. Run a 117-volt AC line cord through a strain relief on one end of the project box, and the wires leading to the strip light through another strain relief on the opposite end.

After connecting all the components, as well as the input and output wires, place the PC board somewhere near the center of the box and attach it to the inside of the enclosure with a small metal bracket and a couple of screws.

Applications. There are lots of things you can do with your new novelty light. The first thing I thought of is to suspend the strip light over a small fish tank or attach it to the inside of a display case or a bookshelf. A fluorescent art project is yet another possibility.

One final note. The dimmer circuit seems to work best after the unit has been switched on for a few minutes. Then turn the potentiometer knob back and forth slowly for the desired level of illumination. Set the control carefully to a high resistance and the fluorescent glow will begin to flicker. It's an interesting effect.

PARTS LIST FOR THE ELECTRONIC NOVELTY LIGHT

SCR1—T106D1 silicon-controlled rectifier
R1—100,000-ohm potentiometer
R2—2000-ohm ¼-watt, 5% resistor
C1—0.033-µF, 250-WVDC, ceramic-disc capacitor
NE1—NE2 neon lamp
S1—SPST toggle switch
PL1—117-volt AC plug with line cord
Printed-circuit board materials, miniature fluorescent strip light, enclosure, strain reliefs, small metal bracket, wire, solder, hardware, etc.

Note: Miniature fluorescent strip lights are available from JerryCo Inc., 601 Linden Place, Evanston, Illinois 60202. Telephone: (312) 475-8440. One strip light (catalog number 20204) sells for $2.25. The company requires a $12.50 minimum order and a flat $4.00 fee for shipping and handling. The JerryCo catalog is 50 cents.

GIZMO®

DECEMBER 1990

VOLUME 7, NUMBER 12

A CHRONICLE OF CONSUMER ELECTRONICS

One Computer, with the Works!

PS/1 COMPUTER. Manufactured by IBM Corporation, US Marketing & Services, 1133 Westchester Avenue, White Plains, NY 10604. Price: $999 to $1999.

There are innumerable people out there who would like to use a computer, but who are terrified of them—or, more accurately, fearful of looking and feeling dumb when they try to buy or use one. To some extent, that anxiety is realistic: to the uninitiated, the world of computing is a complex, almost unnavigable maze. Some opt to hire a guide—usually someone who doubles as a computer salesman—but after the guide walks them through once or twice, the new users are on their own when they lose their way or hit a dead end. Many have opted, instead, to stick with their typewriters, calculators, and ledger sheets, and leave the computers to the experts—and the kids.

IBM, recognizing an untapped wealth of potential customers, polled thousands of people with little or no computing experience and, taking their responses to heart, came up with a PC designed, in its simplicity, to allay their fears and to meet their needs. The PS/1 is intended to be a breeze to hook up even for complete beginners, and—with DOS, an integrated software package, and a modem built in—ready to go for the most popular home applications.

This isn't IBM's first attempt to reach that market. In the early 1980's, their PCjr was introduced with great fanfare, but never lived up to the hoopla. Its embarrassingly low sales figures were blamed on a combination of factors: high price, limited computing power, lack of expandability, and a poorly designed keyboard. There were lessons to be learned from the PCjr debacle, and it seems that IBM has learned its lessons well.

The PS/1 is no PCjr. It's powerful, competitively priced, and expandible. Basically, the PS/1 is an AT-class machine, running an 80286 microprocessor at 10 MHz. Four configurations are available, ranging in price from $999 to $1999.

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The least expensive (and least useful) configuration has a single high-density 3½-inch diskette drive, a black-and-white VGA display, and 512K of memory. The next step up swaps the monitor with a color VGA display, and costs $1449. Neither of those configurations make too much sense these days. We'd recommend one of the more expensive variations, which feature a 30-megabyte hard disk, 1 megabyte of RAM, and either a black-and-white ($1649) or color VGA ($1999) display.

All models come with DOS 4.0 in ROM, and all offer a number of standard features, including a two-button mouse, a parallel port, and a built-in 2400-baud modem. A number of add-ons are also available, including: a 512K memory expansion card ($199), a 5¼-inch diskette drive ($299 for either the 360K or 1.2MB versions), an audio card and joystick ($249), and more.

While the PS/1 isn't directly compatible with standard PC plug-in cards, an add-on adapter card unit, which will allow you to add up to three standard cards, is available for $169. The PS/1 isn't directly compatible with standard monitors, either. That's because the VGA monitor (which IBM insists on calling a "Photo Graphic" display) also contains the power supply for the computer.

We'd prefer to see a fully standard and compatible PS1. But then again, we're not the type of people IBM is trying to reach with this product. So how does it rate on its main selling point, ease-of-use?

We tried to choose a reviewer who fit IBM's target market as closely as possible. Although she is not a total stranger to computing—she uses a word-processing program at work, and has tried a couple of popular database and spreadsheet applications—her attitude fits the profile. She has expressed the opinion that computers not only have personalities, but that they are secretive, malevolent, and vindictive

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Cut! Print It!

DI-TRON SYSTEMS VP1410 VIDEO PRINTER. Manufactured by Di-Tron Systems, 1760 Industrial Way #1, Napa, CA 94558. Price: $499.95.

Gee, we *really* wanted that Slice-O-Matic. But the commercial came on just as we were drifting off to sleep. Now how are we going to find out where to send our $9.95? What was that phone number? By the time we woke ourselves up enough to grab a pencil, the information had vanished from the screen. There's got to be a better way! Wait! You mean if we had *Di-Tron's VP1450 video printer* we'd be able to simply press a button a get a hard-copy printout of the screen?

That's right. Once you've hooked the Di-Tron printer up to your TV, it's just as easy to get a photo-sized printout as it is to turn off your alarm clock. A 4½-by-3½-inch printout on thermal paper might be just fine for gadget freaks like us. But after we were done playing around a bit, we asked ourselves why anyone would want a still picture of a video screen—except for our hypothetical situation mentioned above. Since you've probably asked yourself the same question by now, here's what we've come up with.

Nintendo players who record that elusive high score when nobody is looking can get an instant print of the screen to prove it to everyone. Would-be do-it-yourselfers can make a print of each step of a project as detailed on one of PBS's handyman shows. You can print your favorite scene from a home video movie to send to friends and family. And if a comercial highlights an upcoming show that you don't want to miss, just print out the picture and tack it up as a reminder.

We've received word of one user who has the printer hooked up to his security-system camera. Whenever his doorbell is rung, the "ringee" is captured in a video print.

If none of those applications does anything for you, then maybe you'll like our favorite: sending a video image to your computer for use in desktop publishing. Or perhaps you'd prefer using a transfer ribbon to make iron-on images. Unfortunately, we'll have to call those *potential* applications. During our tests, we couldn't get the software to do its job properly. To be fair, we were using a pre-publication version of the software that we had pressured Di-Tron to send us. It had no user interface, and our instruction sheet was written in pencil by the people at Di-Tron. We were able to view and print the

A sample printout shows President Bush answering reporters' questions about Iraq's invasion of Kuwait.

images sent to us by the software, but were unable to save our own images. We were, however, able to download data using a standard communications program. We even were able to display the data in the form of an image, but the image was barely discernible. That's because Di-Tron's software also takes care of some housekeeping functions that we were unable to duplicate. A working model of the software wasn't due to arrive until the day after our press deadline, but by the time you read this, Di-Tron should have its official release ready at a price of $35, or $70 for the advanced version.

The printer operates quietly because of the thermal paper and printhead that it uses. The quality of the image depends on the paper used. Standard fax-type paper

(Continued on page 7)

So You Wanna Be a Rock'N'Roll Star

JAMINATOR HI-TECH GUITAR. Manufactured by Worlds of Wonder, Inc., 4209 Technology Drive, Fremont, CA 94538. Price: Under $120.

Jamming certainly isn't new to us: We were practically raised on rock and roll. When we were six or seven years old, we received our first album: "Meet the Beatles." Immediately, a couple of old childhood standby's—our sets of wooden building blocks and Tinker Toys—were pressed into roles we're sure their manufacturers' hadn't foreseen. The longest wooden blocks became "guitars," and the Tinker Toy cross pieces were transformed into drum sticks, as we took on the *personas* of John, Paul, George, and Ringo. We turned up the volume on our little portable phonograph and spent hours dancing around the "rec" room, jamming to "I Wanna Hold Your Hand."

As teenagers, too sophisticated for building-block guitars and not talented enough for the real thing, we jammed on "air guitars." We turned up the volume on the stereo and strutted around with imaginary guitars, becoming as cool as Keith Richards, as dazzling as Eric Clapton, and sometimes wildly smashing our "instruments" in a frenzied Who finale.

At age thirty-something, we realize how silly that must have looked and have more or less shelved our "I-wanna-be-a-rock-and-roll-star" fantasies. While we might still get up and dance at an occasional concert, our jamming days are over.

Or are they?

We suspect not, now that we've tried the *Jaminator* from *Worlds of Wonder*, the company that brought us Lazer Tag and Teddy Ruxpin, the animated talking bear. Combining a guitar, keyboards, and percussion with full rock accompaniment, the Jaminator creates the sounds of an entire band. The press release promises that on first try "you can truly wail like a psycho speed metal beast." We weren't striving for quite that effect. However, the same pair of hands that once spent six months futilely trying to coax "Hang on Sloopy" from an acoustic six-string, simply strapped on the Jaminator, hit the power switch, plugged in a music Pak, and began playing "Foxy Lady" *almost* like Jimi Hendrix.

We say "almost" first, because you don't play the Jaminator so much as it plays itself and, second, because by pressing the wrong button at the wrong time—an easy thing to do until you get the hang of it—you can create some pretty awful sounds (or perhaps we merely stumbled upon the "psycho speed metal beast" effect). Finally, the player's level of musical training and aptitude goes a long way toward determining the quality of music created on the Jaminator.

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After it's powered up, you can play different guitar riffs by pressing one of the thirteen "frets" and then pressing one of the three "strings." Four keys, normally used to provide accents, can also be used to generate stored keyboard routines. Three percussion pads add drum effects. The music you can create is interesting, but not necessarily exciting—until you push the Start button.

The Start button is what gets your backup band in gear. The Jaminator comes with five generic rock-and-roll tunes built in, and six different Jaminator Paks are currently available to increase your repertoire. We tried the "Lead Rock Guitarists" Jaminator Pak, which included Chuck Berry's "Johnny B. Goode," "Hey Bo Diddley," and Hendrix's "Foxy Lady." The fascinating thing is that while the "backup band" was going through the chord changes, the guitar riffs that we were playing actually sounded like something those artists might play. And unless you have absolutely no sense of timing, you can sound pretty good. You never have to worry about hitting the wrong note—a built-in "harmonics compensator" adjusts the pitch of the riffs so that you're always in key.

The other five Jam-Paks include "Classic Rock I & II," featuring selections originally recorded by the likes of the Rolling Stones and Led Zeppelin; "Modern Rock," with songs from the Police, U2, and Dire Straits; and "Hard Rock I & II," on which we didn't recognize the title of single song, but we suspect represents the

(Continued on page 7)

CIRCLE 53 ON FREE INFORMATION CARD

Home, Phone E-T

HEATH SD-6230 HOUSE SITTER SECURITY MONITOR/DIALER. Manufactured by: Heath Company, Benton Harbor, MI 49022. Price: $129.95.

What does your house do when you're away? Nothing it's not supposed to, we hope. Unfortunately, unless you're "blessed" with nosy neighbors, you have no way of knowing for sure. And even if your house doesn't normally get itself into trouble, there are plenty of opportunities for problems—burglars, fires, and heating-system failure, to name a few.

If you're like us, you don't feel comfortable leaving your house or vacation home to fend for itself. But wouldn't you feel better if your house would call you at the first sign of trouble? That idea isn't as far-fetched as you might think. *Heath's House Sitter* can keep tabs on such things as temperature, strange (loud) noises, power failures, and more. If the House Sitter senses a problem, it will call up to four different telephone numbers and give a spoken report.

The problem with most telephone add-ons is that they rarely operate in harmony with answering machines. The House Sitter has an interesting way around any conflict. If it's set to answer on a higher ring than your answering machine, then for most calls the answering machine will pick up. However, if you call back within three minutes, the House Sitter will answer on the second ring and give its status report. So after you call in to check for any messages on your answering machine, you can call back and see if your house has anything to add about the temperature, loud noises, or power outages. You can also listen to the sounds in the room where the House Sitter is located. Of course, that does defeat the "toll saver" feature of your answering machine but, we suppose, it's a small price to pay for peace of mind.

The House Sitter is powered by a wall transformer. Six "AA" batteries (not included) provide an emergency backup power supply. The backup supply is very important. Without it, even a brief power failure would cause the House Sitter's memory to be erased—including the numbers to be called, the high- and low-temperature limits, and which ring to pick up on. We found that out the hard way: A brief power failure reset the House Sitter's default conditions, including its default to pick up on the fourth ring—the same as our answering machine. For that day, our messages consisted of nothing but the House Sitter's status reports.

When the batteries grow weak, you will be reminded—verbally—to replace them. But we'd prefer to use the built-in battery charger with nickel-cadmium batteries. (A switch in the battery compartment lets you select the type of batteries you install.) The batteries will power the unit for three (alkaline) or four (Ni-Cd) hours.

Installing the House Sitter is as easy as installing an answering machine—you simply plug in to the power and telephone lines. However, Heath inexplicably thinks it unnecessary to include a duplex jack that would allow a phone and the House Sitter to share the same phone jack. Granted, such jacks are readily available. But we think that not having one in the box will certainly frustrate a lot of buyers who will find that they can't initially use what they bought for the lack of a $2 jack.

However, when you do get it all hooked up, a friendly "Hello!" will greet you. The digitally recorded voice is very clear and easy to understand—unless you make a key-entry error. Then, you'll be able to understand what the error message *says*, but you might not be able to make sense of it without referring to the manual. Other than that, the voice messages are *very* helpful. An interesting feature is that when you enter, for example, the low temperature limit at 40°, you're prompted with the words "four" and "zero" as you press those keys. If you later hit the "What is" and "Low Temp" keys, the House Sitter will respond, "Forty degrees."

Programming the House Sitter is reasonably easy. Its front panel features an 18-key membrane keypad that's clearly marked. Most of the functions can be programmed intuitively. We barely had to refer to the manual to get things up and running. That process includes setting the home-telephone number and up to four numbers to be called in the event of an emergency; setting the low and high temperatures that will cause an alert condition; determining the duration of a power failure (from 0 to 199 seconds) that will cause an alert condition; and programming the length of time you can listen to sounds when you call in.

Under normal conditions, after the preset number of rings the House Sitter answers your phone with a status report. After that, you can listen to the ambient sounds for the length of time you selected. Then the status report is repeated, and the House Sitter signs off.

When the House Sitter detects a problem, it calls each of the numbers programmed, and reports on its condition. However, the unit doesn't detect when a call has been answered. It repeats its ID telephone number (your number) and then runs through its status report. At the end of its report, it asks for a return call within 30 seconds as an acknowledgement of receipt of a message. If it doesn't receive a call within 30 seconds, it will go on to the next number. It will run through its status report whether or not it receives an answer.

When you call in after an alert condition has prompted the House Sitter to place those calls, its out-going message will include an announcement of the phone number (or numbers) that it called. That allows you to call those numbers to see if the problem has been corrected.

If you have a security system installed, you can use it in conjunction with the House Sitter. You can wire a sensor (or the output of some alarms, including Heath's SS-5900 series) directly to the House Sitter, or you can position the unit where it will hear the alarm. A single loud noise—such as the breaking of a window—will not set off a sound-level alert. A steady, loud sound, such as that from a burglar or fire alarm, will.

The best feature of the House Sitter is its simplicity. It's easy to install and to use—even for the "low-tech" members of your household, and those who might receive the call. From our point of view, that simplicity is also its worst feature. We'd like to see a way to program the unit from a remote telephone location and for it to recognize busy signals and when a call has been answered. But we're not complaining. After years of trying, our house is finally talking to us!

Upstairs, Downstairs

HTS MASTERMIND UNIVERSAL REMOTE CONTROL. Manufactured by: HTS Corporation, 90 Inverness Circle East, Englewood, CO 80155. Price: $199.

It's funny how quickly we become spoiled. Do you remember the first remote-controlled TV's? Everybody laughed, "How lazy can you get!" Those early remotes used ultrasonic signals and could perform limited functions. Usually they could control a couple of motors in the TV; one motor controlled the volume, while the other controlled the channel selector—usually in one direction only. Back in those days BC (Before Cable), people didn't mind waiting for the channel selector to move lazily around its thirteen positions. Quite the contrary. They were "wowed" by the technology.

Despite how quickly the electronics industry changes, it took quite some time for remote-control capability to become commonplace. And it took some time for manufacturers to realize that they couldn't all use the same signals to control different functions on various types of equipment. For instance, pressing the volume button on your TV's remote control might also turn off the power on your VCR. *Those* were fun times!) Now that those problems have been ironed out, we'd be surprised to find anyone reading **GIZMO** who would even consider buying any electronics equipment that didn't offer remote capability.

It didn't take anywhere near as long for consumers, having attained the power to control devices from across the room, to become jaded. We here at **GIZMO** are no exception. Sometimes we complain when we have to sit up so that the remote has a good line of sight over the coffee table. And we've been known to mutter some unkind words under our breath when we pick up the wrong remote and turn the VCR on instead of the TV off. Sometimes, it seems like too much work to have to go into the media room just to change stations on the radio.

Manufacturers have, of course, come up with solutions. Almost five years ago, G-E introduced the Control Central, the first "universal" programmable remote. The idea has been copied by a number of other firms, and some new equipment comes with a remote that can operate other components as well. Those take care of some of our complaints. But they still work from a limited distance, and only in line of sight.

A new remote, the *MasterMind* from *HTS* addresses just about all of our complaints. It not only "learns" the commands of up to four remote controls, it also will convert those commands to UHF signals and transmit them even through walls to its base unit in another room, which decodes the UHF signals back to infrared. Those capabilities earned the MasterMind a coveted spot in the "Innovations '90 Design and Engineering Exhibition" at last summer's Consumer Electronics Show. Products were judged, by a panel of consumer-electronics journalists, on the basis of engineering innovation, excellence of physical and functional design, and distinctiveness.

The MasterMind consists of two units: a handheld UHF transmitter, and a base unit transponder. The transmitter will work through walls, around corners, etc., up to 200 feet away from the transponder, which must be placed so that it can "see" your infrared-controlled appliances.

The MasterMind isn't for everyone. We were asked by more than one acquaintance, "Why would I want to change the TV channel if I were in a different room and couldn't see it anyway?" Our answer, in exasperation, was "to drive whoever *was* watching it crazy!"

There are, of course, plenty of sensible reasons to like the MasterMind, beyond our petty complaints detailed earlier. Indeed, as audio and video systems extend their reach through the house, such a remote becomes almost a necessity. For example, almost all stereo amplifiers sold these days can handle at least two pairs of speakers. Yet that capability is one of the most under-used features. What good is a pair of stereo speakers in the bedroom if you have to walk downstairs to the living room to change stations? The MasterMind also is convenient for those who prefer to keep the clutter of a home-entertainment system behind closed doors—in an armoire, for instance. The transponder can be mounted inside the doors to control the stereo without opening the cabinet. (Of course, you'll still have to open the doors to watch TV!)

The situation that offers the best argument for a radio-frequency remote like the MasterMind is a satellite-TV receiver. Unless you're running a hotel or a Cable TV head end, you're not likely to have more than one dish and receiver. So where do you install the receiver, in the living room or in the bedroom? With the MasterMind, it doesn't really matter. As long as you can run your audio/video or RF cables from one location to the other, you can use the remote to control the receiver from any location.

The MasterMind offers four different modes: TV, VCR, CATV, and AUX. You "teach" it the proper commands by aiming it, and the remote whose commands you want it to learn, at the transponder. You then press the matching keys on each. LED's on the transponder let you know when the command has been learned.

Since there are only 32 function keys on the MasterMind, you're sure to run out of

CIRCLE 54 ON FREE INFORMATION CARD

keys before you've finished programming all of the various functions on your remote. For example, our VCR's remote features 38 keys. And the MasterMind doesn't have any keys labeled "Program" or "Start Time."

Fortunately, you don't have to pay any attention to the labels—you can, for example, program the MasterMind's "Mute" key to control your VCR's tape speed. You can also program the MasterMind's TV mode to control both your TV and the basic functions of your VCR. However, you'll have to find some way to remember what you program. The MasterMind offers no way to re-label its keys, and no convenient way to keep a translation chart or other notes.

Since each of the MasterMind's 32 keys can be programmed for a function in each of the four modes, the remote offers a theoretical limit of 128 different functions. However, some commands require more memory than others, so it's unlikely that you'll be able to program all 128 possible functions.

Another caveat: The MasterMind isn't compatible with all remotes. For example, it's not compatible with Bang and Olufsen equipment, and wasn't compatible with the video printer reviewed elsewhere in this issue of **GIZMO**. Fortunately, the manufacturer offers a full refund if it's not compatible with your equipment.

We found that, even if it wasn't compatible with all of our equipment, the MasterMind *was* completely compatible with our lifestyle. ■

PS/1 COMPUTER

(Continued from page 1)

characters. A self-described electro-mechanical *klutz*, she ordinarily would not even consider hooking up something as complex as a computer (or a telephone) without professional help.

IBM has removed the rigors of computer shopping by narrowing the consumer's choices to the four models described above. Our reviewer was spared from making even that one decision; IBM kindly sent their top-of-the-line PS/1 directly to our offices.

We were a bit leery about leaving her alone with the entire system still in its box (*yes, it all comes in one carton*), but she gamely agreed to try to hook it up. To everyone's surprise, in less than 15 minutes, it was up and running. The instructions in the "Getting Started" manual were clear and well-illustrated, but the main factor behind her success was that the process was truly simple. There are only four main pieces, all but one of the cables (the telephone cord) are already connected at one end, and no tools are required. That small triumph of man (oops, "woman") over machine also provided our reviewer with a tremendous boost of confidence.

As she began using the PS/1, there was little to dash her new-found confidence. The opening menu displays four attractively illustrated "quadrants" representing category choices of "Information," "Microsoft Works," "Your Software," and "IBM DOS." The same short-form manual that explained the system hookup (the PS/1 also comes with more detailed books on the PS/1, Microsoft Works, and Prodigy) demonstrates how to select a category using either the mouse or the keyboard, and leads the new user through a simple practice session in each quadrant. That manual ends by introducing the user to the two on-screen tutorials—"Works" and "System"—that can be accessed through the "Information" quadrant. Those tutorials, which pick up where the manual leaves off, are what makes the PS/1 stand out from the crowd.

The Works tutorial menu offers six options: an overview; instructions for the word-processing, database, spreadsheet, and communications programs; and a look at using the tools together. A lot of information is presented; by no means can you simply turn on the computer and be an expert. However, by going through each lesson in order the user can painlessly attain a thorough working knowledge of the integrated software system.

Each of the six options brings up a menu that is a complete, step-by-step course in that area, consisting of individual lessons that use eye-catching graphics and non-threatening, non-technical language. Once again, the emphasis is on building confidence. The lessons are set up in easy-to-digest increments—the approximate (usually exaggerated) time needed to complete a lesson is displayed at the start—and each combines textual and visual instructions and hands-on practice sessions with a large dollop of praise for each successfully completed task. Most practice sessions have the user do a task once by following detailed directions, a second time with only a few prompts, and completely solo on the third go-round.

By finishing the lessons in each subject area, our reviewer quickly put each part of Works through its paces. She had no trouble creating letters, databases, and spreadsheets—and this is a person who once spent the better part of a week trying unsuccessfully to teach herself Lotus 1-2-3. She enjoyed using the PS/1's modem to "call" another computer and "chat" with its operator.

Unfortunately, our reviewer didn't fare quite as well with the "System" tutorial. While it provided a simple overview of the hardware, software, system care, and an index of operations, it lacked the practical you-can-do-it feel of the "Works" lessons. While she came away with "a vague idea" of how the system was put together, what each part did, and what she could use it for, she still had almost no idea how to actually *do* anything with it.

Beginning with a strictly rudimentary knowledge of DOS, she found the PS/1's file system—in which graphic file folders represent directories and the folders' contents represent files—confusing, and ended up using trial-and-error to figure out how to copy her own software onto the PS/1. (Granted, she could have tried reading the in-depth references but, for basic functions, we felt she shouldn't have had to resort to those.) We experienced computer operators here at **GIZMO** agreed that IBM could have come up with a more convenient and more intuitive file-management system—perhaps something that took the best features of XTPRO and made it easier to use. Of course, experienced DOS users can always load their own programs—in fact, one of the things we liked most about the PS/1 is that it can bypass the DOS shell and be configured to boot up to just a C: prompt. But this computer's supposed to be for beginners, who don't have that option (or don't *know* they have that option, or suspect they *might* have that option but have no idea how to implement it!). Unfortunately, the "Your Software" quadrant really doesn't explain how to get your own software onto the system, either.

For those who do experience difficulty with hardware or software—and who are more technologically curious than our reviewer—IBM provides strong customer support by toll-free telephone and by modem, through the PS/1 Users' Club. Accessible through the Prodigy on-line information service (three month's Prodigy membership comes free with the purchase of a PS/1), the Users' Club provides extensive support 18 hours a day, seven days a week. Questions can be asked in three ways: by accessing "Answer Bank," a database filled with answers to the most commonly asked computer questions; by using the "Info Exchange" bulletin board; or by using "Write to Us" to directly query IBM experts, who respond within 24 hours. Judging from the questions and responses we perused, the advice given is prompt and on-target. "Prodigy" was also popular with our reviewer, who managed to unearth a problem with her American Airlines Frequent Flyer mileage, and to get several restaurant recommendations for the cities she's planning to visit on an upcoming vacation.

We did wonder, however, why a "family" computer with so many built-in attractions would include no games. That gap will be filled, in part, by Promenade, an educational and entertainment on-line service exclusive to PS/1 users. The service was not provided with our test unit, but should be available in the 48 continental states by the time you read this. It will provide live, on-line classes on using the PS/1; a complete on-line encyclopedia; libraries containing more than 7,000 software titles; and multiplayer card and board games that users can play against one another, instead of against the computer.

So, how *does* the PS/1 rate on ease-of-

use? There's no question that getting started on Works was a fast, painless process for our reviewer. Prodigy offered an easy, intriguing introduction to a different aspect of computing: on-line informational services. Although the "System" tutorial provided only enough information to get around (or to be dangerous?), there were ample sources of additional information provided. The *Users' Reference for PS/1 Computer* offers more details, and technical advice, yet is clearly written with the beginner in mind. The *Microsoft Works Reference* lets the user move well beyond the beginner level, teaching the nuances of the program. The Users' Club proved to be an easy-to-access source of a wealth of helpful tips. And—like icing on a cake—IBM's 48-Hour Service promises to pick up your dysfunctional PS/1, repair it, and return it in working order within two days.

The verdict? Our reviewer was *much* happier to be able to actually *do* things using Works and Prodigy than she was upset by not knowing how the computer worked or how to manage files outside of Works. And, clearly, those who want to learn more have the information they need in easy reach—literally, at their fingertips. Most important, after their initial, positive experiences with the PS/1, not-quite-novice users will have gained confidence in their *ability* to learn more. ■

CUT! PRINT IT!

(Continued from page 2)

will produce a fax-like image. Di-Tron's "professional" paper will produce a higher quality image. We'd recommend spending the extra money for the professional paper (about $30 for five 40-foot rolls as compared to about $25 for ten rolls of the economy "fax" paper). Each 40-foot roll can provide up to 100 prints. The official specifications on the print are: 480 lines, 336 pixels per line, with each pixel one of 16 possible shades of gray.

Using the printer could hardly be easier. Hooking it up is simply a matter of runing a video cable (not supplied) between an RCA jack on the back of the printer and the video output of your VCR or TV. Three rear-panel controls are provided for brightness and contrast adjustment, and to switch the input impedance between 75 and 300 ohms. The serial interface port uses a miniature stereo phone jack. The front panel also has three controls: power, reset, and print buttons. A one-button remote control is also provided so that you can start printing without leaving your chair.

With the exception of our software problems, the printer worked exactly as the manufacturer claimed. Now we just have to figure out what to *do* with the thing! ■

ROCK 'N ROLL STAR

(Continued from page 3)

"heavy metal" genre. If you prefer not to have the full band backing you up, a Select key will let you quiet one backup instrument at a time. And when you get tired of playing, the Finale button will let you wrap things up gracefully.

The built-in speaker hardly offers the volume you'd expect from an electric guitar, although it's certainly superior to our "air guitars" and sufficient for fooling around. An output jack will let you plug the Jaminator into your stereo so you can really make some noise (or use headphones so you can blow out your ears).

Since it is called the Jaminator, you'd expect that there would be some way for a couple of players to get together and jam—and you'd be right. Although we didn't get to try it, an optional cable will allow two players to link up and play everything in synchronization.

We really had fun with the Jaminator. Perhaps we would have gotten tired of it if we were able to keep the unit for more than the week we were allotted. Even so, we'd guess that the Jaminator would have better staying power than most $100 toys. In the end, however, that's what we decided that the Jaminator was: a toy that makes music, not a musical instrument.

For more information on any product in this section, circle the appropriate number on the Free Information Card.

ELECTRONICS WISH LIST

Remote Pause Control

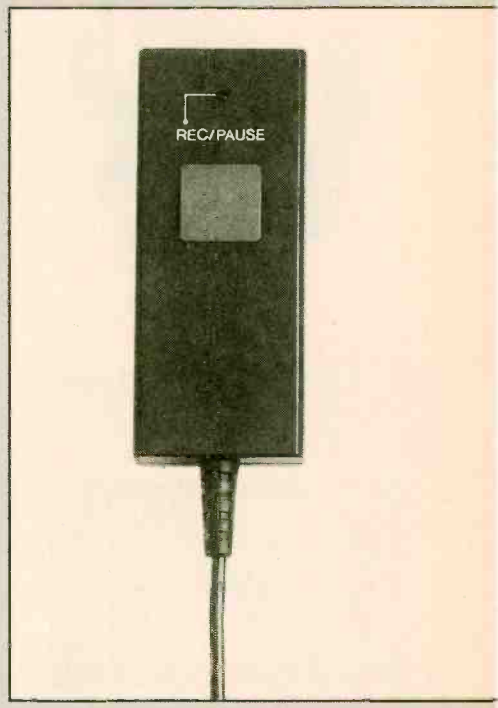
For using a camcorder from a remote position, without disturbing either the camcorder or the subject, or, perhaps, to get yourself in at least *some* of your vacation video scenes, *Philips Consumer Electronics Company* (One Philips Drive, P.O. Box 14810, Knoxville, TN 37914-1810) has introduced the *V8007BK01* remote pause control. Its 16-foot cable allows the user to start and stop the camcorder from across the room. The hand-held unit has a single button that controls the record/pause function and a light that indicates when the camcorder is in the record mode. The remote pause control is compatible with several models of camcorders from many popular manufacturers. Price: $9.25.

CIRCLE 55 ON FREE INFORMATION CARD

Remote Video System

Fox Marketing's (1747 Cattlemen Road, Sarasota, FL 34232) *Remote Video System* allows VCR and cable programming to be transmitted from one part of a house or apartment to another without the use of cables. The Remote Video System transmitter is connected to the audio/video source by cable and can then transmit a signal over the air to its companion receiver (to which is connected a TV set) anywhere within a range of about 250 feet. To ensure a constant signal, the transmitter and receiver have fine-tuning adjustments and include automatic frequency-change circuitry. Price: Not announced.

CIRCLE 56 ON FREE INFORMATION CARD



Remote Pause Control

ELECTRONICS WISH LIST

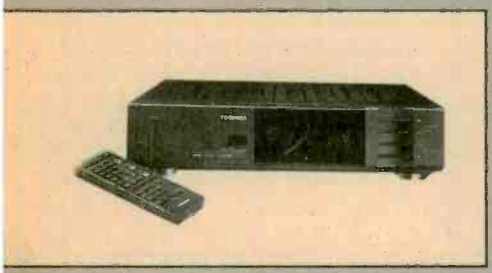
For more information on any product in this section, circle the appropriate number on the Free Information Card.

"Laptop" Organizer

"Laptop" Organizer

Bridging the gap between portable electronic organizers and laptop computers, the *B100P* from *Bondwell Industrial Corp.* (47485 Seabridge Drive, Fremont, CA 95438) has a full-size QWERTY keyboard and a large LCD readout—yet it weighs only slightly more than five pounds, is less than 1¾ inches thick, and runs off standard alkaline or NiCd "C" batteries. Based on a 9.83-MHz V30 CPU, the B100P is faster and has more memory than the usual personal organizer—2MB RAM (640K user RAM and 1.4M RAM disk) is standard. The RAM disk, or "Silicon Hard Disk," lets users store applications software and data files being downloaded from PC's and, at the same time, serves as a disk drive. Built-in software includes DR. DOS; PC Tools; Desktop management software; FastLynx for file transfers; and Bondwell's Travelnet, which provides travelers with convenient information such as phone numbers for major hotels, airlines, and credit-card companies. The B100P also has a 2400-bps Hayes-compatible modem, a standard RS-232 port, a parallel port, a real-time calendar/clock, and an AC power adaptor. A briefcase-style carrying case and RS232C and printer cables are optional. Price: $999.

CIRCLE 57 ON FREE INFORMATION CARD



Videophile Satellite Receiver

Videophile Satellite Receiver

Toshiba(Video Communications Group, 1010 Johnson Drive, Buffalo Grove, IL 60089) has introduced the *TRX-2000*, the first integrated receiver/descrambler (IRD) with a Super-Video (S-Video) output for "videophile" picture quality. The S-Video output provides separate luminance and chrominance signals that can be fed to Super-VHS VCR's or monitors equipped with S-Video inputs. In addition to improved picture quality, the TRX-2000 boasts category-driven program selection. More than 100 channels are factory-programmed into memory in 12 different categories, such as movies or sports; easy-to-use subject menus further simplify program selection. A built-in UHF remote allows users to control all major functions from any location in the home. This top-of-the-line IRD also features dual A/V outputs, dual source switching, a built-in VideoCipher II Plus descrambler module, C- and Ku-band capability, multi-color on-screen display, and an eight-event, one-year timer. Price: $1,949.

CIRCLE 58 ON FREE INFORMATION CARD

Cordless Headphones

Cordless Headphones

With the abundance of audio/video components and the huge selection of programming available today, it's not unusual for family members to disagree on what they want to hear, play, or watch. Headsets can help keep the peace. For use with both television and audio systems, the *IR-500 Infrasound* headset system from *Arkon Resources* (11627 Clark Street, Suite 101, Arcadia, CA 91006) includes an improved microphone adapter for use with older television sets that don't have an audio-output/headphone jack. The IR-500 consists of a comfortable, 6-ounce, Euro-style headset/receiver and an infrared transmitter that doubles as a headset stand. Designed for convenience, the system does not require the user to adjust the transmitter's volume output for optimal reception. The headset features an on/off volume control, and runs on two "AAA" batteries. Price: $99.95.

CIRCLE 59 ON FREE INFORMATION CARD

Japanese/English Translator

Japanese/English Translator

Executives, students, and travelers will appreciate *Seiko Instruments* (2990 West Lomita Boulevard, Torrance, CA 90505) model *TR-1700* Japanese/English translator. Users simply punch in a word on the keypad and press the "translation" key. Using direct-access search capability, the unit locates the correct translation and displays it on an easy-to-read, 16-character dot-matrix screen. If the original word is misspelled, the TR-1700 takes a guess and adds a question mark next to the translation. Multiple meanings or synonyms are indicated by a comma. The word search function can be used to locate a word or to learn new words by scrolling through the memory. A calculator and a currency exchanger are built in, and two batteries and a carrying wallet are included. Price: $89.99.

CIRCLE 60 ON FREE INFORMATION CARD

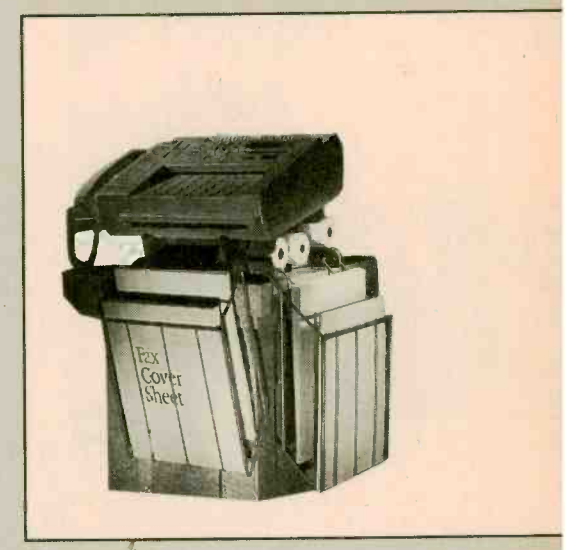
For more information on any product in this section, circle the appropriate number on the Free Information Card.

ELECTRONICS WISH LIST

Fax Organizer

If you've found the convenience of your fax machine to be somewhat offset by the mess of papers and supplies surrounding the unit, *FaxRax* is for you. The modular system, from *Lightwave Technologies Incorporated* (306 North Fiore Parkway, Vernon Hills, IL 60061), makes it easy to keep organized incoming and outgoing faxes, cover sheets, logs, directories, and paper rolls. The desktop fax set consists of two pieces—a fax stand and a paper basket—and is available in two finishes. The "Platinum" (*FRX003*) FaxRax includes a taupe, injection-molded, plastic ABS stand, and a basket made of vinyl-coated steel wire. FaxRax "Gold" (*FRW006*) is constructed entirely of wood stained in a light-oak tone. Additional paper baskets are available as options for each style, to accommodate as much of a mess as you can generate. Price: $34.99 (Platinum); $59.99 (Gold).

CIRCLE 61 ON FREE INFORMATION CARD

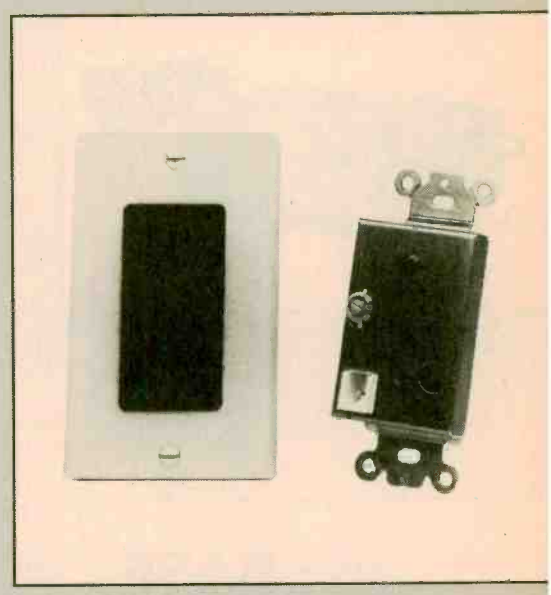


Fax Organizer

Around the Bend

Remote control is becoming even more so, thanks to devices like *Sonance's* (961 Calle Negocio, San Clemente, CA 92672) infrared repeater system, which permits remote control of multi-room audio systems even where a direct line of sight for infrared remote control is impractical. Dubbed *ROAR*, for remote optical amplified repeater, the system consists of four modules—an infrared sensor, an infrared splitter, an infrared emitter, and a remote power supply. The sensor and emitter are designed for wall mounting in standard light-switch junction boxes. The emitter module transmits a signal three times stronger ("brighter") than that of standard IR remote controls. The splitter and power supply can be mounted in unobtrusive locations. The splitter can handle up to four connections, and as many as ten units can be "ganged" together and operated from one power supply and sensor. Price: Not available.

CIRCLE 62 ON FREE INFORMATION CARD



Infrared Repeater

Pure Preamp

Perraux (26864 Mandelieu Drive, Murrieta, CA 92362) has long been a respected name in luxury handcrafted audio equipment, and its *EP Stereo Preamplifier* continues the tradition. The unit keeps circuit paths to a minimum by virtually eliminating all off-board wiring; there is just a main circuit board, with a sub-board to which are attached directly the volume and balance controls. To avoid interactions, all signal traces on the circuit board are isolated from each other by ground traces. Front-panel input-selection and tape-select switching are accomplished by switching voltages conveyed to the appropriate board; that, says Perraux, is the sonically more acceptable method. The EP has no tone controls or other switches that might induce extra noise and distortion. Price: $799.

CIRCLE 63 ON FREE INFORMATION CARD

Ultra-Compact Camcorder

The latest in the "less-is-more" category might be *Sony's* (Corporate Communications Department, Sony Drive, Park Ridge, NJ 07656) *CCD-TR4*. Billed as the world's smallest camcorder, it measures only 4⅜ × 4⅛ × 6⅝ inches and weighs well under two pounds (without tape and battery). The tiny 8mm unit doesn't skimp on recording or editing features however. Its 6× variable-speed power-zoom lens (f/7, 42mm) with macrofocusing makes it easy to take wide-angle or close-up shots. With a 5-lux minimum illumination rating, the CCD-TR5 performs well in low-light situations, and a high-sensitivity CCD image sensor ensures sharp, clear images. Automatic functions include autofocus, auto iris, and auto white balance. The one-page digital superimposer lets users add titles or graphic elements, and the flying erase head allows clean transitions between scenes. Other features include a linear time counter, a quick-start recording mechanism, and edit-search and record-review functions to allow playback while the unit is in camera mode. Using its switchable audio/video input/output terminals, the CCD-TR4 can easily be connected to a TV for playback or a VCR for editing and dubbing. Price: $1,100.

CIRCLE 64 ON FREE INFORMATION CARD

Ultra-Compact Camcorder

ELECTRONICS WISH LIST

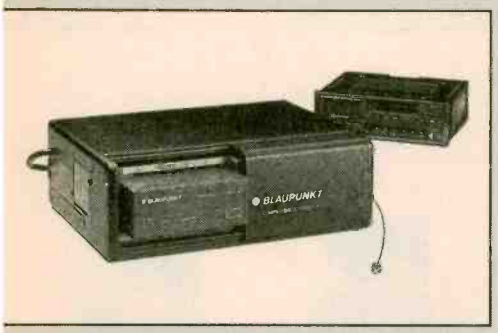
For more information on any product in this section, circle the appropriate number on the Free Information Card.

Anti-Car-Theft Card

Anti-Car-Theft Card

Magnetic-striped cards have been seen around banks for years—and now they're showing up in automobiles. The *Batron* integrated anti-theft/alarm system, from *Batron, Inc.* (10999 Reed Hartman Highway, Suite 336, Cincinnati, OH 45242) consists of a microprocessor that is installed directly into the vehicle's electric system, a piercing alarm, a uniquely coded magnetic-striped card, and a small card reader that can be placed on the dashboard or console. Before starting the engine, the driver must run the card through the reader to disarm the system. If the properly coded card is not recognized, the microprocessor sounds the alarm and shuts down the vehicle's four major operating components: the starter, the electronic ignition/coil, the fuel system, and the main ignition switch. The alarm is also triggered by attempted entry, abnormal movement, or broken glass. The system activates automatically when the ignition key is removed. A time delay gives the driver sufficient time to enter or exit the car—and since the card attaches directly to a key chain, no time will be wasted searching through a purse or wallet for it. A series of LED indicator lights lets the driver monitor the status of each of the anti-theft and alarm modes. Now, if we can just figure a way to make it give cash. Price: $445.00.

CIRCLE 65 ON FREE INFORMATION CARD



Fiber-Optic Car Stereo Link

Fiber-Optic Car Stereo Link

The *Blaupunkt* (Mobile Communications Division, 2800 South 25th Avenue, Broadview, IL 60153) *CDC M1* compact-disc changer uses a fiber-optic cable to send digital audio and program data from the CD changer, which is usually mounted in the car's trunk, to an under-dash interface module that converts the data to analog audio. The operating controls and a display are provided by the Blaupunkt *Washington SQR 49* AM/FM cassette player/receiver. The complete system lets users enjoy the radio, audio tapes, and CD's with a single in-dash component—and provides the benefits of fiber optics, including immunity from electrical noise, total electrical isolation to eliminate ground loops, and lighter and thinner cables. The 10-disc, single-magazine CD changer has a three-beam laser pickup with sophisticated error-correction and digital-processing circuits. The digital outputs of those circuits are converted into light pulses that travel through a 15-foot optical cable to the interface module, where the light is converted into electrical digital data and the audio is separated from the program data. A 16-bit D/A converter changes the audio data to stereo audio signals, which pass through a short, heavily shielded cable to the cassette/receiver's CD input. The program data is linked, via an I^2S (Inter-IC Signal) bus to the cassette/receiver, and back to the CD changer, with a conventional wire cable. The top-of-the-line Washington SQR 49 displays a readout of the current disc and track number and the CD scan function, along with the usual radio and tape information. It has a full array of performance, convenience, and anti-theft features, and can be installed permanently or as a removable unit. Price: $899.95 (CDC M1); $649.95 (Washington SQR 49).

CIRCLE 66 ON FREE INFORMATION CARD

6½-Hour Videocassette

6½-Hour Videocassette

Following the philosophy that a product that offers something extra will be successful, *BASF* (35 Crosby Drive, Bedford, MA 01730) has introduced a 6½-hour videocassette tape. At slow speed (EP or SLP) the *T 130* provides 30 minutes more recording time than standard tapes, and at the fastest speed (SP), an extra ten minutes. The extra recording time provided by the tape could mean the difference between catching and missing the end of a movie or sports event that runs longer than two hours (or is delayed). Price: Not available.

CIRCLE 67 ON FREE INFORMATION CARD

For more information on any product in this section, circle the appropriate number on the Free Information Card.

ELECTRONICS WISH LIST

Surround-Sound "Concert" System

The "Designer Series" of audio rack systems from *Yamaha Electronics Corporation, USA* (6722 Orangethorpe Avenue, Buena Park, CA 90620) allows fashion-conscious buyers a choice of three different finishes on cabinets that house identical components. The *CS-740* golden-oak veneer, *CS-742* bleached-oak veneer, and the *CS-745* high-gloss black cabinets (pictured here) each hold Yamaha's Concert System—the *AV-75* surround-sound amplifier with Dolby Pro Logic, the *K-65* dual-cassette deck, the *T-60* AM/FM stereo tuner, the *CDC-60* 5-disc CD changer, the *EQ-70* 10-band graphic equalizer, and the *P-31* fully automatic belt-drive turntable with cartridge. In addition, each system includes four speakers finished to match the cabinet: a pair of 3-way speakers with a 12-inch polypropylene woofer, 5-inch midrange, and 1-inch high-definition dome tweeter; and compact surround-sound speakers. Rounding out the Concert System is a pre-programmed, learning-capable remote control. Price: $2,299 in your choice of finish.

CIRCLE 68 ON FREE INFORMATION CARD

Surround-Sound "Concert" System

Talking Thesaurus

Franklin Electronic Publishers (122 Burrs Road, Mt. Holly, NJ 08060) uses state-of-the art voice technology to create the Speaking Wordmaster (WM-1500). The Speaking Wordmaster is a hand-held electronic thesaurus, phonetic spelling corrector, and word-game player that has the ability to pronounce, out loud, more than 80,000 words from its Merriam-Webster dictionary and thesaurus. Hard-to-pronounce or unfamiliar words are clearly pronounced at the touch of a key. The unit can even distinguish and properly pronounce homographs—words that are spelled the same but have more than one pronunciation and meaning (for example, "attribute"). More than 487,000 synonyms and 76,000 thesaurus definitions are provided. A unique feature, called "Sound-Alikes," will display two more than one word that sounds the same, and will include all definitions. For instance, typing in "rain" will call up two "sound-alikes": "rein:harness" and "reign: rule." A personal word list stores up to 50 of the user's own words; it's a handy place to store important words that aren't listed in a standard dictionary, like the correct spelling of your boss' wife's name. The games include flashcards, Hangman, anagrams, and jumbles. The Speaking Wordmaster comes with a built-in speaker, adjustable volume control, a headphone jack, a 16-character dot-matrix display with adjustable contrast, a QWERTY-style keypad, and automatic power shutoff. Price: $149.95.

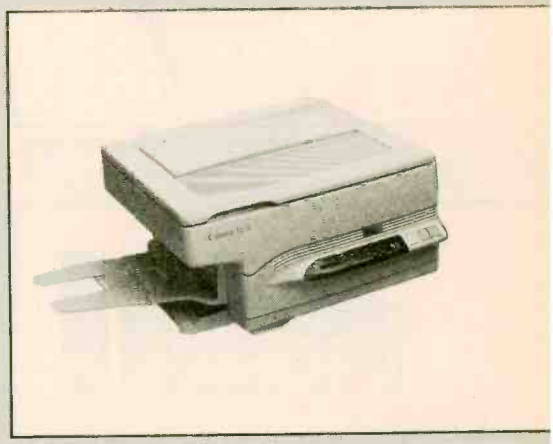
CIRCLE 69 ON FREE INFORMATION CARD

Talking Thesaurus

Personal Copier

Every part of the *PC-11* personal copier that possibly could wear out or run out is contained in its user-replaceable PC mini-cartridge, making it virtually maintenance free. *Canon U.S.A.'s* (Home Office Products Division, One Canon Plaza, Lake Success, NY 11042) PC-11 includes a convenient paper holder on its space-saving stationary platen, a fast (10-copies-per-minute) copying speed, and both selectable and preset zoom ratios. Ratios between 70% and 122% can be chosen in 1% increments, or users can opt for preset ratios of 70%, 78%, 86%, or 122%. The machine makes copies from business-card size to legal size. Manual feed allows users to make copies on materials other than plain paper, and automatic exposure with manual override provides clean copies from materials such as newspapers and half-tone originals. The automatic paper-feed system can feed up to 100 sheets. For colorful printing, the replaceable PC mini-cartridges are available in black, brown, blue, red, and green. Price: $1,795 (PC-11); $149.95 (black PC mini-cartridge); $99.95 (color mini-cartridge).

CIRCLE 70 ON FREE INFORMATION CARD



Personal Copier

ELECTRONICS WISH LIST

For more information on any product in this section, circle the appropriate number on the Free Information Card.

Portable Answering/Dictation System

Portable Answering/Dictation System

Cobra (Dynascan Corporation, 6500 West Cortland Street, Chicago, IL 60635) calls its model *An-8450 Traveler* "a totally new concept in business communications." For use while traveling and in hotel rooms, as well as at home and in the office, the Traveler combines a portable answering machine with a dictation recorder, and throws in a dual-time-zone alarm to boot. The device, which is about the size of a portable cassette player, includes a fully featured beeperless answering system with one-touch operation and auto reset. A digital voice chip contains the outgoing announcement, and a multifunction LCD readout indicates the number of messages and the time each was recorded. The dictation system uses standard microcassettes. Price: $229.95.

CIRCLE 71 ON FREE INFORMATION CARD

Cordless Phone

Cordless Telephone

Boasting "corded quality," *Uniden America Corporation's* (4700 Amon Carter Boulevard, Ft. Worth, TX 76155) model *CT 785* cordless phone also has a speakerphone, two-way page, and automatic intercom. The dual-keypad phone also features two-channel select, 10-number memory, "DialCode" digital security, and last-number redial. The batteries can be easily replaced by the consumer, and the phone can be wall or desk mounted. Price: $219.95.

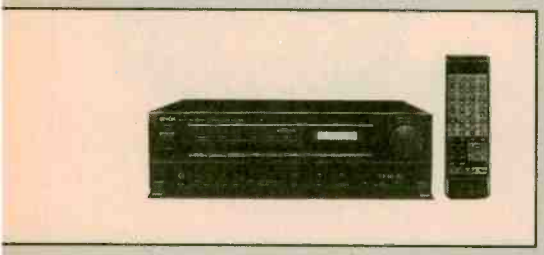
CIRCLE 72 ON FREE INFORMATION CARD

Portable Vacuum/Flashlight

Portable Vacuum/Flashlight

A handy item to keep in your car or boat—or around the house—the *PC5L Vaclite* from *Sanyo Fisher (USA) Corp.* (21350 Lassen Street, Chatsworth, CA 91311-2329) combines a hand-held vacuum cleaner with a searchlight. The cordless device can quickly handle a wide variety of smaller cleaning jobs, and doubles in an emergency as a flashlight. The wide-mouth intake speeds up normal vacuuming, and the crevice attachment gets into hard-to-reach spots. The Vaclite includes a charging bracket to recharge Sanyo *Cadnica* batteries during storage. A power indicator lights up when the unit is in use or being recharged, and goes off to signal the need for recharging. Price: $34.95.

CIRCLE 73 ON FREE INFORMATION CARD



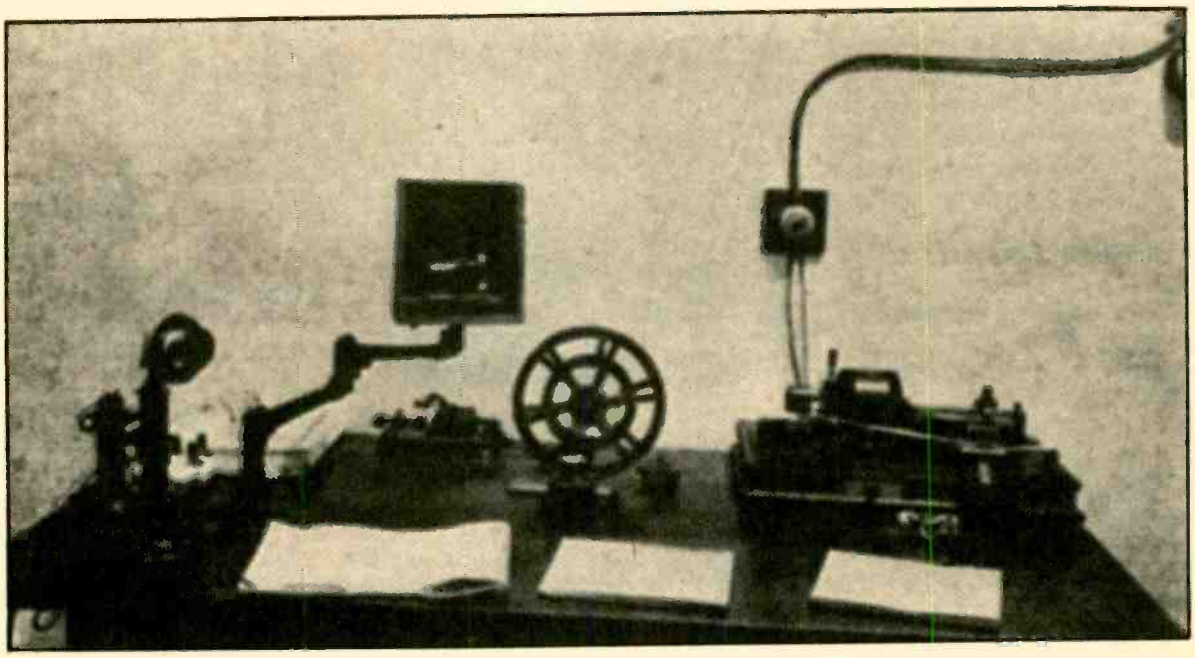
High-Performance A/V Amplifier

High-Performance A/V Amplifier

With "6-channel bridgeable amplifier topology," *Denon's* (222 New Road, Parsippany, NJ 07054) *AVC-1000* makes it easy to use an advanced Dolby Pro Logic A/V surround-sound system. The amplifier delivers 210 watts of total power: two 55-watt front channels are complemented by two 25-watt rear channels and two 25-watt center channels. The use of two center-channel amplifiers allows users to create a convincing stage for on-screen dialog, sound effects, and music. With the rear-panel bridging switch, the six amplifiers can be bridged to four channels to connect an existing high-power amplifier for the front channels. Then, the 55-watt front channels can be used to drive the rear speakers, and the rear amps can be bridged to make two 55-watt center channel amps. The AVC-1000's four Pro Logic and three surround modes adapt it to just about any size room and speaker configuration. A "Cinema" switch compensates for the sound mixes of programs intended to be shown mainly in theaters, and helps to keep the dialog sounding natural. In addition, the "Audio Visual Sound Effect Circuit" adds energy to the lowest registers to enhance video music and effects. The amplifier also offers five video and five audio inputs, including four S-video inputs, and a separate mono output for driving a powered subwoofer. The 62-key programmable remote control, which has built-in commands for controlling other Denon components, can be programmed to activate sequences of commands at the push of a button. Price: $700.

CIRCLE 74 ON FREE INFORMATION CARD

The Long Island



Spy Station

Read a true tale of espionage that would have made Ian Fleming proud, and how a ham-radio operator provided the clue that exposed the spies.

BY ROBERT ANGUS

Trained in Sayville, Long Island, New York on the night of Monday, July 5, 1915 and Howard Ballard was not pleased. Ballard, a bachelor in his 20's, listened to it ping on his pup tent, staked out in an open field beside the Long Island Railroad tracks. On the other side of the tracks, he could see the three giant transmission towers of the Atlantic Communication Company, and under them, men frantically loading cartons onto the back of a truck.

Ballard secretly wished that he could be anywhere else—at Kennedy's Cafe in downtown Sayville, for example—but he was on duty. His paper, the *Brooklyn Eagle*, had assigned him the task of breaching the security of the station, the only commercial communications link with Europe following the severing of the Transatlantic Cable at the outbreak of World War I. Earlier in the day, Ballard had been repelled by five gun-toting guards, and had retreated to the relative safety of the field across the tracks. He knew that on the following day, the U.S. Navy, suspecting espionage, would seize the radio station.

So, apparently, did the Atlantic Communication staff, who were busy whisking away anything that might prove incriminating as well as any high-tech equipment that otherwise would fall into U.S. Government hands.

A Twisted Tale. The Sayville story starts just over a year earlier, when workmen arrived one morning to start work on a little white building. Within days, it sported a large sign reading Telefunken. Before the month was out, there was a 500-foot tower. Since Congress had passed a Communications Act in 1913 limiting ownership of broadcast facilities to American citizens, the *New York Times* wanted to know how a foreign company could build a radio station on U.S. soil. A spokesman at Telefunken's office on lower Broadway told the Times, "We have no interest in the station. It has been purchased by U.S. interests."

The new owner was the Atlantic Communication Company of 90 West Street, which claimed that its business was transmitting and receiving commercial messages with a similar station in Nauen, Germany. Its president was Herman Metz, then just finishing his first term in Congress after a business career as importer and manufacturer of dyestuffs and drugs. Most of his business contacts were in Germany, and he represented such German companies in the U.S. as I.G. Farben, BASF, and Agfa. The company's general manager, A.E. Debec, told the *Times* reporter that Metz was unavailable, but assured him that Atlantic was owned by American

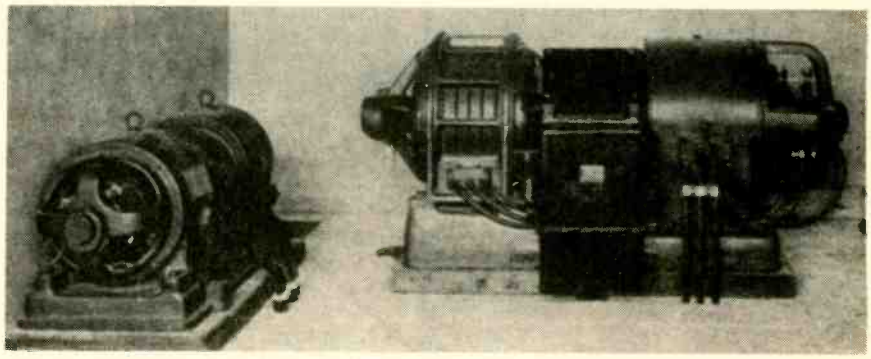
stockholders who had purchased the Sayville site "with some German capital."

That proved to be not entirely true; subsequent events showed that much of the equipment had been provided by the Imperial German Navy, and the transmitter was under the command of Captain Karl Zenneck. In fact, Metz was the only American to own stock in Atlantic. Dr. Karl George Frank, a German national, was the nominal secretary-treasurer and actual head of the firm.

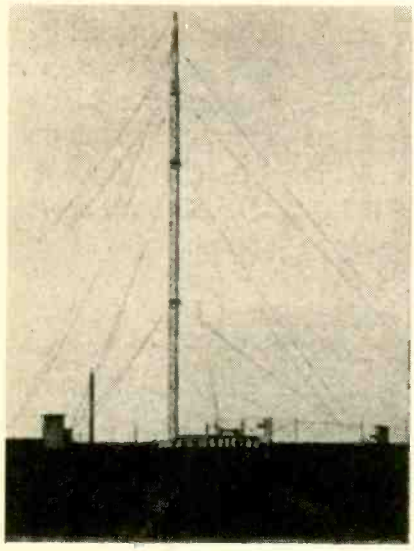
The Lusitania. What triggered all the attention was the sinking of the Cunard liner Lusitania on May 7. It had left New York several days earlier with a number of prominent Americans aboard. And, if German propaganda was to be believed, a cargo of war supplies destined for Britain. Carl Schurz Jr., the son of a New York congressman, and the New York representative for a number of German interests, told the *New York World* that the German submarine fleet had been alerted by wireless to the presence of munitions on the liner. Since Sayville was the only telecommunications link with Europe, and since radio amateurs had reported strange transmissions coming from it, suspicion naturally fell on the Atlantic Communication transmitter.

After establishing contact with Nauen, the Sayville operator would begin sending so fast that the message became unintelligible. But not all transmissions fell into this category. Between 11 PM and 5 AM, Sayville sent a full schedule of noncommercial messages at normal speed. The *Providence Journal* (whose editor later proved to be a British Intelligence agent) stationed a crack telegrapher at its experimental radio station at Point Judity, RI, with instructions to transcribe every word sent out by Sayville.

This large concrete and brick anchorage was one of six that supported the structure via thick cables. Note the large glass insulators.



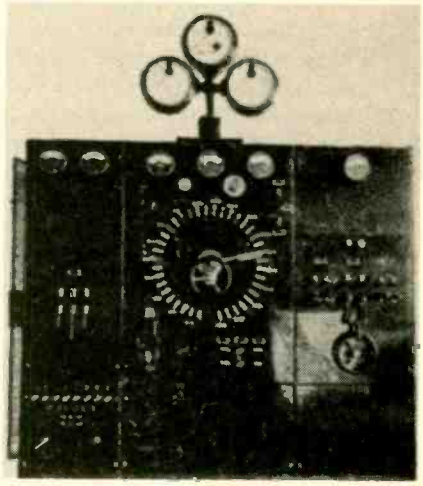
The main motor-generator set was made by General Electric. The unit at right consists of an induction motor driving a 220-volt DC generator, which in turn charged a 600-amp storage battery, which in turn powered the station.



The main Sayville tower was the first in North America to substitute a ball-and-socket joint base for the more common "Eiffel Tower" design in which the structure supports itself. Most AM radio towers today use the Sayville design. The building at the base of the tower is the operations and transmitter building.

Suspicion Grows. By the end of June, Navy Secretary Josephus Daniels ordered three lieutenants into Sayville as censors with instructions to hold up every message they couldn't understand. The censors did stop a number of what appeared to be commercial messages using code words or referring to British or German ships, but reported nothing else wrong. Acting on a tip that the censors were frequently not on duty, but more likely to be found at Kennedy's bar, the *Brooklyn Eagle* had dispatched young Ballard to the scene. When he arrived that fateful Monday, he reported, the armed guards shooed him away, telling him that none of the censors were in. When he asked for one of them by name, the guard replied that he was not in the operations building, "but must be somewhere around the grounds." The guard made no move to relay Ballard's request to see him.

A Ham Helps Out. Unbeknownst to Ballard, to the *Providence Journal's* telegrapher, or even to the otherwise well-informed staff at Sayville, a ham-radio operator in Westfield, NJ, had been recording the transmissions on an Edison dictating machine he'd specially modified for the purpose. Charles E. Apgar, a car salesman by day became a secret agent at night. At first, the transmissions made no sense to him, either. But one evening, the Edison



This odd device actually is a portion of the central switchboard panel.