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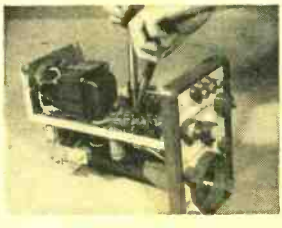
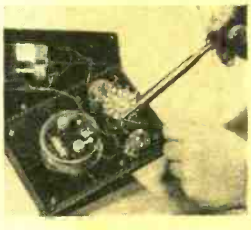


Construction of Multimeter.



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• January/February 1971 • Vol. 10 No. 6

e/e elementary Electronics

Dedicated to America's Electronics Hobbyists

☆ Cover

AUTHORS IN THIS ISSUE

nholt, Len Buckwalter—K1ODH, John Col-—KDQ1212, Webb Garrison, Rudolf F. ames S. Gupton, Jr., Don Jensen, Martin, Jack Schmidt, James len, and the ELEMENTARY aff

elementary Electronics

INCLUDING SCIENCE AND ELECTRONICS

Jan./Feb. 1971 Vol. 10/No. 6

Dedicated to America's Electronics Hobbyists

ELEMENTARY ELECTRONICS is published bimonthly by Science & Mechanics Publishing Co., a subsidiary of Davis Publications, Inc. Editorial, Business and Subscription offices: 229 Park Avenue South, New York, N.Y. 10003. One-year subscription (six issues)—$4.00; two-year subscription (12 issues)—$7.00; and three-year subscription (18 issues)—$10.00. Add $1.00 per year for postage outside the U.S.A. and Canada. Advertising offices: New York, 229 Park Avenue South, 212-OR 3-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles: J. E. Publishers' Rep. Co., 8560 Sunset Blvd., 213-659-3810; Long Island: Len Osten, 9 Garden Street, Great Neck, N.Y., 516-487-3305; Southwestern advertising representative: Jim Wright, 818 Olive St., St. Louis, 314-CH-1-1965 Second-class postage paid at New York, N.Y. and at additional mailing office.

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random noise

The Editor talks up!

Hello, is this the first time you are reading a copy of ELEMENTARY ELECTRONICS? For many readers it is! You see, a large group of people who formally subscribed to SCIENCE AND ELECTRONICS have joined us for the first time. For everyone this means increased coverage for your hobby and reading pleasure. We have retained almost all of the departments from both magazines and we will not eliminate any until we find out from you what you like and dislike. We started our survey in the last issue of e/e and continue with this issue and others to come. Please fill out the small questionnaire on the next page after you read the issue and mail it to us as soon as possible. The sooner, the better. You see, we need your help.

● *It's in the cards—four-channel sound.* Sure, we all know about the coming explosion in the doubling up of stereo to provide two additional channels of discreet audio programming. But, did you know that FM broadcast stations can broadcast four-channel sound today without the usual licensing rigamarole with the FCC. Why? Simple enough! Electro-Voice has come up with a black box that is inserted just before the input terminal of a FM transmitter and makes it all possible.

This black box at the transmitter works in strange ways. If you have a mating black box at your home stereo receiver, you can receive full four-channel sound. The black box for the home will set you back about $50 or less. Electro-Voice plans to market the device in areas where broadcasting stations will be using their black boxes at the transmitter. Eventually, manufacturers will incorporate the black box circuitry into their receivers so that the music buffs need only buy one component—the receiver. So you see, four-channel sound is really on its way.

But you may ask, what about the guys and gals who own stereo units at home and mono units in their cars. What will they hear on their FM receivers? The Electro-Voice system is compatible with stereo and mono when broadcasting four-channel sound. Hence, if all you own is a stereo receiver—you'll hear quality

ELEMENTARY ELECTRONICS READER SURVEY PART TWO

(Please do not give us your name)

If you answered Part One of this survey, please continue to help us and fill out the form below. If you missed Part One, don't let it trouble you, just fill out the questionnaire. Our thanks to one and all!

The story I like best in this issue is:

_____

The story I liked least is _____

_____

I like to read ELEMENTARY ELECTRONICS and other electronic magazines and books because:

- ☐ I do it for fun only.
- ☐ to help me with my hobby.
- ☐ to learn more about electronics.
- ☐ to get ahead in my job.
- ☐ to help me with my part-time business.
- ☐ to help me with my full-time business.
- ☐ _____(You tell us.)

You probably read other electronics magazines. Of all the others, which one do you like best.

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☐ Better ☐ Equal ☐ Not as good

How much time did you spend reading this issue?

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Do you repair TVs, radios, phonographs, or Hi-Fi's for your neighbors and friends?

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Now for some way out questions!

Do you own a camera that's valued at more than $100? ☐ Yes ☐ No

Do you develop your own film? ☐ Yes ☐ No

Do you own an enlarger? ☐ Yes ☐ No

Do you own an electronic flash? ☐ Yes ☐ No

Okay, that's enough information for one coupon. Thanks for your help.

Please return to:

The Editor
ELEMENTARY ELECTRONICS
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New York, N.Y. 10003

programming on two channels as you did before. And mono listeners will still hear only one channel as before—and it will be the blend of all four channels. Frankly, the listener can't tell the difference by listening.

What's it all about? What's inside? How does it work? This Editor does not know yet! Electro-Voice is keeping the wraps on tight until they get a patent on the product. We can't blame them nor can they blame us if we uncover the secret in the future and reveal it to you—our readers. ■

ask me another

Discover by asking!

Send your questions to—
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Another TV-to-Oscilloscope Question

How, if at all possible, can I convert an old television set into an oscilloscope with no major modifications? I believe at one time there was a company that sold such instructions.

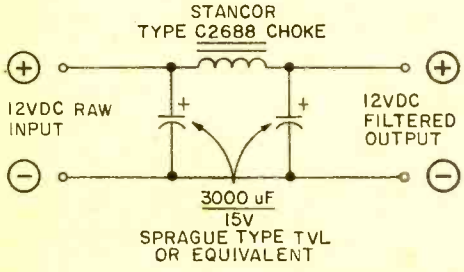
—B.H., Elmira, N.Y.

The modifications would be *major*. It would be cheaper and more realistic to buy and assemble a scope kit. However, if you have an old 630 TV Chassis, maybe your public library has some old electronics magazines in the basement telling how it can be done. This was a popular fad in the 50s, but you have to be out of your skull to do it in the 70s. There are lots of good experimenter's scopes available today beginning at $100.00 that are many times better than anything you can convert. Also, the price of conversion may cost over $100.00.

Smoothing out the Ripple

In "Ask Me Another" you had a schematic diagram of a 6- and 12-volt, 12 amp battery charger. Could you tell me what size and kind of diodes that I should use. Also, what filter setup for this power supply is suitable?

—T.W.G., Sidell, Ill.

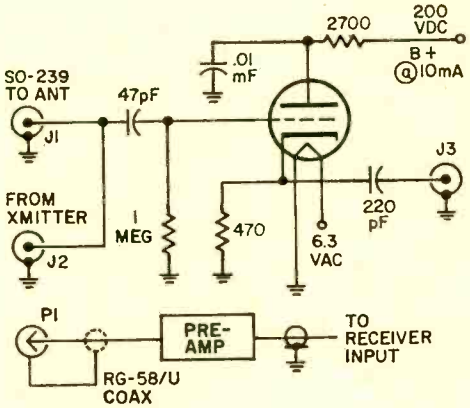


You have a wide choice of high-power silicon rectifiers. Pick diodes rated at 35 amps or more. For a filter you can use a Chicago-Stancor C2688 choke and a pair of 3000 μF electrolytics connected as shown in the diagram.

T/R for Two on 2

I own a Heathkit HW-17A two-meter transceiver. I would like to add an RF preamplifier to this unit. To do this, I would need some method of activating a relay with the RF output of the transceiver to disconnect the pre-amp so it wouldn't be zapped. I believe this is called an "RF actuated relay circuit," but I cannot find a circuit for one in any of my reference sources. I would appreciate your printing such a circuit in your column, as I am sure many others would be.

—R.E.T., Bloomington, Il.



Separate the receiver and transmitter antenna connections, build the electronic switch and connect it and the pre-amp as shown in the diagram. When you transmit, the electronic switch tube cuts off and isolates the pre-amp from the transmitter. J1, J2 and J3 are SO-239 coax connectors and P1 is a PL-259 plug. The tube may be almost any triode. You can probably steal the filament and plate voltage from the transceiver.

Don't you Believe It

I have seen an advertisement on a color converter in kit form ($52.95) or wired and assembled at prices for $71.00. It is supposed to convert a black-and-white set to color. Is this a piece of equipment that will really work and show true color?

—W. B. T., Sussex, N. B., Canada

We doubt it because a color picture tube costs more than the prices you mentioned. If you buy such a converter and it works, write an article for us about it. You could thus earn back more than what the converter cost. There is an outside chance the so called color converter adds a color wheel to your black-and-white TV set. If so, attach a fan blade to it and cool your living room at the same time!

Can't Beat the Local

I have been trying to receive an FM station

in Newark, N. J. (WHBI, 105.9 MHz), but there is also a station in Hartford, Conn. (WHCN) transmitting on the same frequency, resulting in the complete blockage of WHBI. Is there any way I can block reception of the Hartford station in order to receive the one from Newark?

—F.A., New Haven, Conn.

The objective of the FM station channel assignments is to provide local coverage and to allow use of the same channel by stations, each covering its own area. You could try a very directional antenna aimed at Newark. If it causes the Newark signals to be stronger than the Hartford signals, and if the capture ratio of your receiver is good enough, you could receive Newark with Hartford blocked out. By the way, what does WHBI offer—acid rock?

Front End Problems

When a six-meter converter is connected to the antenna of my short wave radio, and the medium wave band is tuned in at certain points on the dial, the AVC voltage rises and the noise lessens. This seems to indicate to me a carrier but no modulation is even heard. What are these signals and at about what frequency are they? Are they being received or are they generated into the set?

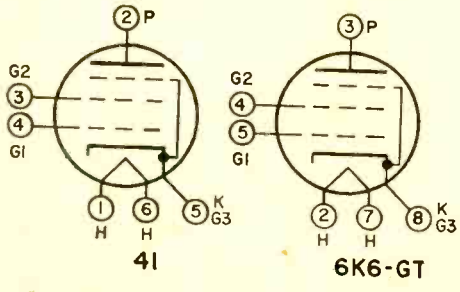
—W.S., Hackensack, N.J.

They could be caused by harmonics of your receiver's local oscillator combining with the converter's local oscillator, if they are present only when the converter is used.

Tube Talk For His Master's Voice

I just purchased an RCA Model 85 T radio circa 1939 that is in perfect condition. I found out that, after checking the RCA tube manual, that the type 41 tube isn't made any more. Do you know where I can get one or two replacements at a reasonable price?

—J.G., Raynham, Mass.



The 6K6GT is an exact electrical equivalent and is available from mail order houses if not at your neighborhood radio-TV shop. Replace the five-prong socket with an octal socket connected as shown in the diagram.

ASK ME ANOTHER

BC Band Hopping

I was listening on the 9.4-17.8 MHz band and picked up WWSW 940 KHz) at around 9.7 MHz and also at a place farther up the band. Afterwards, on another band, it came in at around 1.7 MHz. I also got WMBS (590 KHz) and KDKA (1020 KHz) at this same frequency. I can't understand this. Could you tell me what's going on.

—B.G., Uniontown, Pa.

Strange things happen when radio signals pass through and are mixed in the mixer of a superhet receiver. It would take several pages to explain why if all bases are covered. While most interference and spurious response conditions are the fault of the receiver, transmitters can be the cause, too. The signal from one transmitter may intermodulate with that of another transmitter and produce a spurious signal. Also, a BCB station could be radiating harmonics—multiples of the carrier frequency transmitter may intermodulate with that of another transmitter and produce a spurious signal. Also, a BCB station could be radiating harmonics—multiples of the carrier frequency —but this is unlikely because of FCC regulations. As long as you can tune in the stations you want, don't fight it and hang on to your receiver. Even the $1750 jobs suffer from the same kinds of annoyances, but to a lesser extent.

From Class to Career

I am attending an electronics trade school and will be graduating soon. I would like to know where I could get a listing, if there is such a listing, of positions openings in electronics in the U.S., and whom to contact. I am particularly interested in southeastern U.S.

—D.R.T., Daytona Beach, Fla.

More power to you. There are plenty of opportunities in Florida. Very few lists are complete since new companies crop up often. Best bet is to run a "Position Wanted" job in a Miami newspaper or in Electronic News, 7 East 12th St., New York, N.Y. 10003.

Top of the World BCB

I am located in the northern part of Kodiak Island and surrounded by mountains. I am using an indoor antenna and my SW and BCB reception is poor. An outside antenna would not do much good unless located on high ground. This would require a lead-in a half-mile long, which is not practical to install. Couldn't I install an antenna on the hill-top, and use an electronic device to pick up and rerediate signals to my receiver?

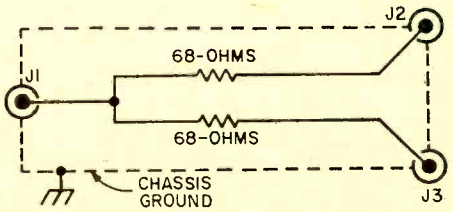
—S.K., Port Bailey, Alaska

It would be unlawful to set up a repeater station on the hill-top to relay signals at the frequencies you are interested in. Even if you are surrounded by mountains, an outdoor antenna will give you much better signal pick-up. Put up a long wire inverted L antenna—as long as possible—and use a ground too. The sky wave DX signals will find their way to your antenna.

Auto Antenna Sharing

I have a scanner-type 30-50 MHz band monitor receiver and an AM-FM radio in my car. I would like both receivers to share the same auto antenna. How can I do it?

—W.C., Franklin, Ky.



Your problem is a bit complex because your auto radio undoubtedly doesn't have separate antenna inputs for AM (540-1600 kHz) and FM (88-108 MHz). While we could dream up a Rube Goldberg gadget for you, the simplest way is to get an aluminum mini-box and mount a Motorola-type auto radio antenna jack (J1) on it. Your auto radio antenna's plug is inserted into this jack. You'll also need two RCA-type phono jacks (J2 and J3), connected together through two 69-ohm carbon resistors, as shown in the diagram. Connect the auto radio to J2 through a shielded cable, and the monitor receiver to J3 through RG-59/U coaxial cable. You won't get a perfect match since the auto radio input impedance and the monitor receiver input impedance are not the same. But, you will get a degree of isolation. The suggested device will cause some insertion loss, but not of significance.

"Just received my electric bill, Charlie, print me up some twenties!"

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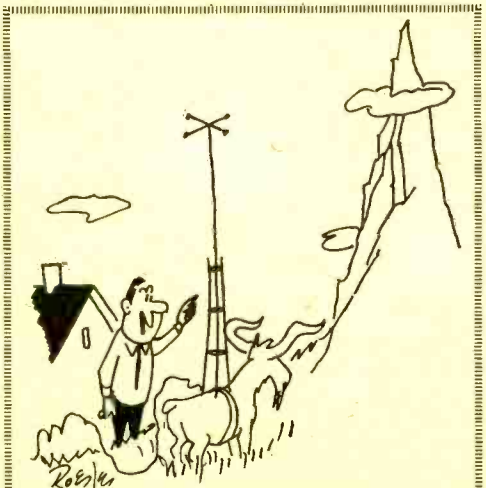
BY DON JENSEN

THERE are holes in the Bamboo Curtain! Despite the fact that we have no diplomatic relations with Red China, and no intelligence sources to speak of inside the country, we still have a surprising amount of knowledge about the goings-on in Mao-land today.

Much of this information is gathered by a little-publicized branch of the U.S. Central Intelligence Agency called the Foreign Broadcasting Information Service. FBIS isn't the typical cloak-and-dagger outfit; theirs isn't the James Bond-type spy bundled in his trench coat behind the wheel of an Aston Martin. Fact is, its operatives wear headphones anybody could buy, and operate run-of-the-mill tape recorders. FBIS gathers intelligence by listening to the shortwave broadcasts sent from foreign nations —just like you and I.

Scraps of data from these programs, fitted together by expert analysts, often give a surprisingly complete picture of what's going on behind these foreign frontiers. In the case of Communist China, FBIS cocks its electronic ear from listening posts in Japan, South Korea and Okinawa.

Most of the information from Mainland China comes from regional and provincial broadcasts directed to domestic Chinese audiences. Recently, for example, FBIS monitoring revealed that stations in Shanghai and in Hupeh and Honan Provinces were broadcasting opposing views on the role of the huge People's Liberation Army. Experts believe these programs point to a growing tension in Red China.



"Okay, now get!"

FBIS "Big Ear" antennas on Okinawa are located at a well-guarded installation on Zampa-Misaki Peninsula, a strip of land jutting into the East China Sea. Though a branch of the civilian CIA, the FBIS agency links with the military are close. It is serviced by nearby Kadena Air Force Base, and shares the same APO ZIP number. A few years ago, the bureau chief was a military man, a Col. Joseph R. Couch.

Transcripts of monitored Chinese programs are funneled to a collection point in Hong Kong, and from there they're sent to Washington for final analysis.

The FBIS China watchers are professional shortwave listeners, but some of the Red Chinese stations they tune can also be heard by Stateside DXers. Of course, the language barrier is a problem, but even if you can't understand the programs, there's a certain thrill in knowing that you're eavesdropping through cracks in the Great Wall of China.

By official decree, the 2,000-plus regional and local newspapers in China must use the press stories of Hsin-hua She, the New China News Agency. Provincial editors copy down these news stories as transmitted—at dictation speed—by Hsin-hua transmitters at Peking. These transmissions are readily identifiable by the very slowly spoken programs. A few of the many frequencies to try are 14,415, 14,465, 16,270, 16,340 and 16,435 kHz.

Of the numerous home service broadcasters, one of the most frequently logged is Fuchien Jen Min Kwang Po Tien Tai, a regional station at Foochow, on 2,340 kHz. Also at Foochow, in Fukien Province, are the stations of the Chinese People's Liberation Army. Some frequencies to check are 2,430, 3,200, 3,400 and 5,900 kHz. The early morning hours, say 1100 to 1400 GMT, are best for the lower frequency outlets. Hsin-hua transmissions can be heard during the early evening hours too.

Tiptopper. In the heart of Polynesia, some four thousand miles southwest of San Francisco, lies Tahiti. Since Gauguin caught on canvas the island's lush scenes, not the least of which are its lovely belles, Tahiti has enjoyed the reputation as a true Pacific paradise.

DXing the exotic South Seas isn't the easiest task in the world. Most of the Pacific isle stations are relatively weak and are clustered on the lower frequencies. But Radio Tahiti, in the tin-roofed capital of Papeete, is the exception. Though its transmitters are only four kilowatts strong, its 11,825 kHz. outlet gets out well and qualifies the station as this month's Tiptopper!

Radio Tahiti is part of the farflung ORTF (Office de Radiodiffusion-Television Francaise) system, headquartered in Paris. Programming is in both the native Tahitian and French. Regular programs of island music, with pulse-pounding drumming, is a listening highlight.

Across much of the U.S., Radio Tahiti's broadcasts are audible from as early as 0300 GMT sign on. At 0500, the language switches from Tahitian to French, until close down at 0800 GMT.

Reception reports go to Radio Tahiti, rue Dumont d'Urville 410, Papeete, Tahiti. Its QSL card perhaps is the only one in the world that might rate a censor's "X" rating. It features a drawing of an attractive topless mermaid!

Bandsweep. All times in GMT and frequencies in kHz. **998**—The ex-pirate station, Radio Syd, recently shifted from Swedish waters to West Africa, is now legal and land-based in Gambia. This one has a chance of reaching east coast listeners this winter after 0500. . . . **4,777**—RTV Gabonaise, "La Voix de Renovation," in Libreville, Gabon, has been renovated. Its new, high-power transmitter is heard until 2300 sign off. . . . **6,155**—Rarely heard Radio Citadelle, Cap Haitien, Haiti, has been logged recently around 1100 on this frequency. . . . **6,193**—Though listed for 6,185 Radio Republik Indonesia's outlet at Manokwari, West Irian, can be heard on this spot during the early morning hours around 1130 to 1230. . . . **9,755**—With seasons reversed south of the equator, the down-under weather report may startle you at first. You can hear it via Radio New Zealand at 1200. . . . **11,810**—A good European bet for beginners is Rome's RAI, with an English language program at 0100. . . . **15,235**—The Beatles popularized the sitar, an off-beat Indian instrument. You can hear sitar music in the original style on All India Radio's English session around 0300 to 0115.

(*Credits:* Gordon Nelson, MA; Jerry Berg, CO; A. R. Niblack, IN; Alvin Sizer, CT; Edward Shaw, VA; Tom Jones, MN; Dennis Driscoll, NC; National Radio Club, Box 99, Cambridge, MA, North American SW Association, Box 989, Altoona, PA)

Backtalk. "It's supernatural," writes Michigander Bob Smith. "Every time you write about a station, I hear it! Like when DX Central gave a run down on the Mid-East stations, I magically discovered Syria and Turkey. How about something on how to log Antarctica in ten easy steps?"

Would you settle for one giant step, Bob? Try tuning 8,997 Khz., for the singlesideband

(Continued on page 103)

stamp shack

Philatronics Today!

BY ERNEST A. KEHR

● ● With all the incredible tasks to which the computer has been successfully put, it was only a matter of time before someone would think of harnessing its electronic abilities to the design of postage stamps. And that was done early in 1970.

● As early as 1968, Jasia Reichardt said in a London publication, that in addition to accomplishing complicated business chores, plotting outer Space flights and aiding medicine fields, the computer "can perform various non-scientific chores and actually be used to express Cybernetic serendipity.'"

● Soon afterwards the Netherlands Bank commissioned R. D. E. Oxenaar to design a new banknote for Holland.

● Working in close cooperation with printers, laboratory and banking specialists, he decided to experiment with mechanical brains in rendering a suitable design that would be completely proof against counterfeiting and yet be pleasing to the eye.

● One of the concrete results of this investigation with regards to the graphic face of security paper in general was that linear structures—in the concept of thin, regular lines arranged according to patterns at continually different angles, an attractive micro-cosmos could be refined.

● He hitched electronically controlled, numerically governed computers to a lathe-work, engine-turning machine such as had been used by security printers for more than a century to produce the complicated background of banknotes, stocks, bonds and early postage stamps. (The world's first postage stamp consisted largely of such lathe-work background.)

● Results were so satisfactory that when Dutch "summer" semi-postals were authorized to help raise funds for child-caring institutions last Spring, the Netherlands Postal authorities decided to use this computerized designing system for the five stamps of this series that was released on April 7.

● While each of them is interesting—and unusual—they have specific computer titles: 12+8 cent shows an "isometric projection of circles towards a square;" the 15+10c represents "parallel planes in a cube, based on a program of the center for cubic construction at Heerlen;" the 25+10c shows "transition phases of concentric circles with increasing diametrics." Only the 20+10 and 45+20c values seem simple: "two scales" and "four spirals," respectively.

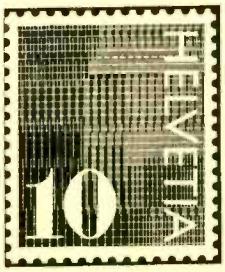
● The stamps have been received with mixed reactions on the part of the public and stamp collectors alike. Some were intrigued by the idea of seeing unprecedented types of design electronically made, others decried them as "horrid and soulless examples of art."

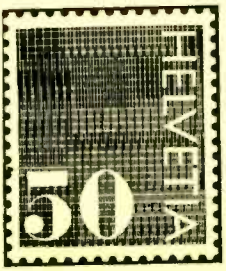
● ● Then, later in the year, Switzerland decided to issue the first of an entirely new set of stamps for use in automatic vending machines.

● They recalled that the original purpose of a postage stamp was to indicate only the country of origin and its face or franking value expressed in simple but dominating figures. Bern authorities commissioned Armin Hofmann, a Basel artist, to forget all about using pictures such as have distinguished previous Swiss stamps and concentrate only on these two subjects for his design.

● Whether he was aware of the Dutch experiment of a few months earlier or not has not been learned, but he, too, used the computer idea to create a pattern for his striking designs. Each of the three denominations released on Sept. 19 has a different background of shaded vertical and horizonal lines of various shapes. This forms an exceptional setting for the numerals (10, 20 and 50) and "Helvetia," neatly placed at the side. Because Switzerland has four official languages, the confederation ever since 1862, has used its original Latin name, Helvetia, instead of Schweiz, Suisse, Svizzera or Svizza to identify itself on stamps and currency.

● Now that the innovation has been made, it may soon be adapted by other stamps of the world. But while the pictures will be made by a mechanical, electronic device, it still will be the talent of an imaginative human designer who must properly program his instrument.





Switzerland three denominations for use in automatic vending machines.

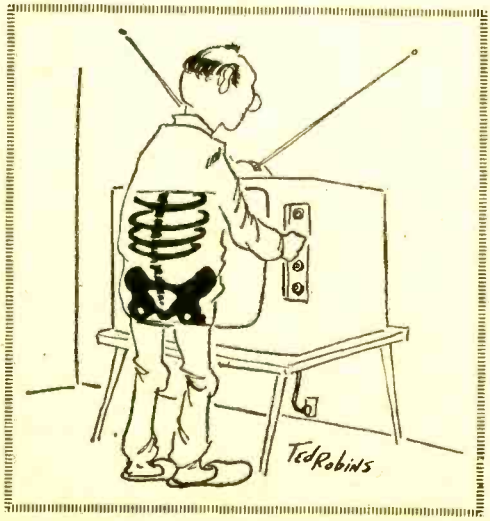
● ● What's New?

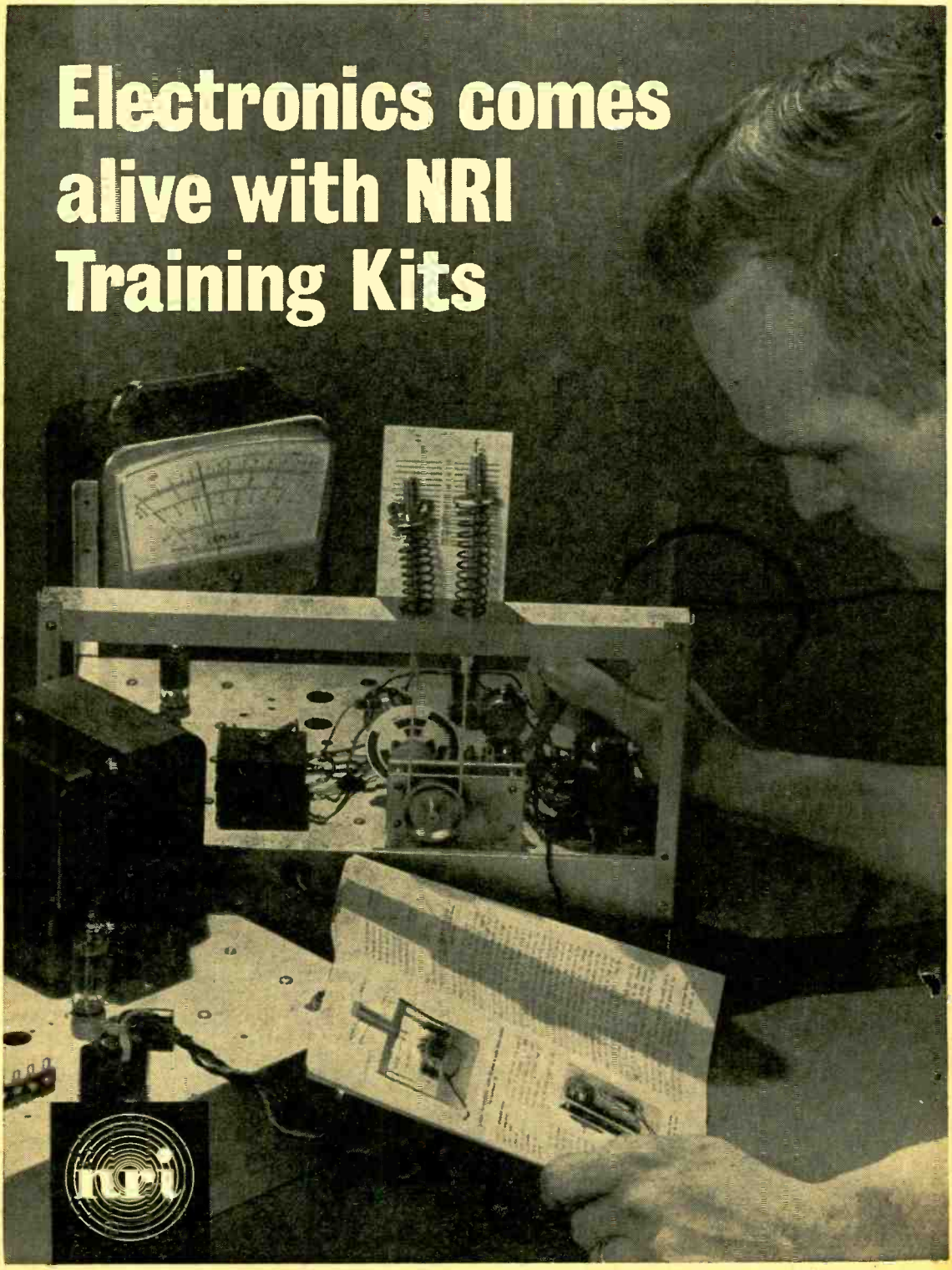
● Scott Publications, Inc., which has been producing the annual standard postage stamp catalogue and a wide variety of stamp albums for more than a century, recently was sold to Duane Hillmer, an Omaha industrialist, for $2¼ million. While the actual publishing will be done in Nebraska, the editorial and distribution offices will remain in New York, in the Harmer, Rooke & Co., building at 604 5th Ave.

● The Bureau of Engraving and Printing, in Washington, has acquired a $460,000 Italian rotogravure press which will be added to the battery of existing intaglio machines intended to produce much more colorful domestic stamps. Completely electronically controlled, this Andreotti Press will be used for commemorative stamps in full natural color. A prototype of the press already in operation at a Connecticut plant was used to make the 1970 "Christmas" and four anti-pollution stamps of the United States to give Bureau technicians experience in handling the Washington one when it is ready for printing by 1971.

● The H. E. Harris Co., Boston, Mass. 02117, has released its 1970-71 catalogue for sale at $1. It lists, illustrates and prices in unused and used condition, all stamps of the U.S., its possessions, the UN and British North America.

● What with the intense interest in Space exploration, and the collection of stamps connected with it, a group of enthusiasts recently formed the Manned Spaceflight Cover Society. Aims are the unification of collectors in this field, to issue a catalogue listing all Space stamps, labels and covers, and to issue covers for all future launchings, flights and returns. Membership applications and other details are available from Jack McMahon, 1915 Commonwealth, Houston, Texas 77006. ■

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new products

New in the Marketplace!

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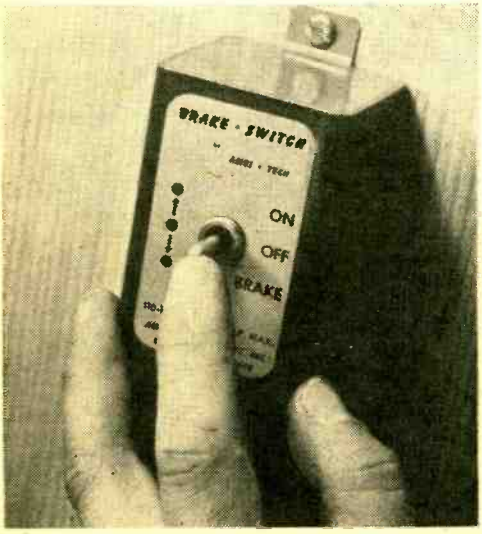
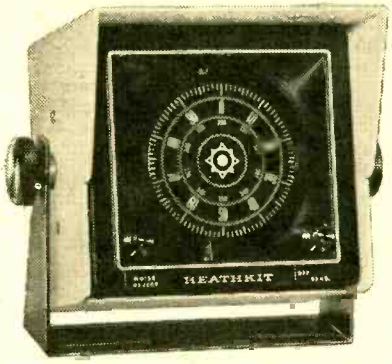
Home craftsmen and industrial users can now improve shop safety as well as production efficiency by stopping motor-driven equipment with remarkable speed. Brake-Switch, a novel solid-state device, features ON, OFF, and Brake switch positions, with an automatic return to OFF when Brake position is released. Installation is simple requiring no rewiring or mechanical attachments. The unit comes complete with an integral grounded receptacle and 9-ft. heavy-duty power cord. The switch can be mounted anywhere, permitting remote control if desired. Brake-Switch is ideal for controlling AC motor operated tools such as radial arm and table saws, lathes, grinders, etc. Slowdown time is eliminated, resulting in quicker setups and increased production speed. Long life is assured by solid-state construction and all units are guaranteed for 1 year. Standard unit, rated at ¾ HP or 10 A., sells for $14.95, plus postage. Write Ambitech Industries Inc., 861 Washington Ave., Westwood, NJ 07675 for further information.



Ambi-Tech Brake-Switch

Mariners Read The Depths

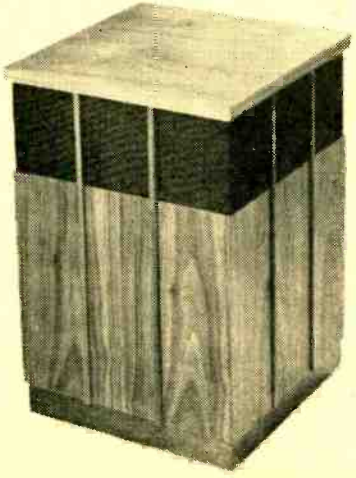
A new solid state Depth Sounder, model MI-19 has just been announced by Heath Company, Benton Harbor, Mich. Capable of measuring the depth of water down to 200-ft. with an accuracy of 5%, it can also be used to chart bottoms, spot schools of fish, determine underwater vegatation, etc. The new Heathkit MI-19 employs an exclusive adjustable noise rejection circuit that permits installation near an engine without ignition interference. Adjustable sensitivity control eliminates echos when navigating in shallow water. Unit designed for minimum damage due to damp or salt air. It is powered by boat's 12V battery. Available in kit form at $69.95. For additional information write Heath Company, Benton Harbor, Mich. 49022.



Heathkit Model MI-19 Depth Sounder

No More Seating Problems

Lafayette annouces a modestly priced 2-way 360°, multi-directional, acoustic suspension-speaker system. The Omni II will provide high



Lafayette Omni II Speaker System

quality stereo sound without regard to its location in a room. Design permits output of both direct and reflected sound patterns. Features a 10-in. woofer with 1¼-in. voice coil and 40.6-oz. magnetic structure, plus a direct radiator type 3½-in. super tweeter. Hand rubbed oiled walnut finish with charcoal brown grill cloth. . can be used as an attractive end table. Power handling capacity 40W, frequency response 50 Hz to 20 kHZ; 6 db crossover network at 2.6 kHz; impedance 8 ohms; size: 13 x 13 x 19¼-in. Imported by Lafayette Radio Electronics, stock no. 99-02438W is priced at $59.95. For further information write Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, L. I. NY 11791.

Pegboard Hangers

Every practical handyman and fix-it shop knows that the right way to efficient operations is to have a clean, uncluttered work area with facilities to keep all disassembled parts where they won't roll away, get lost or mislaid or gather dust and dirt, with tools at your fingertips. All Handy-Hanger pieces are made of high-impact plastic, structurally sturdy to take abuse, snap into ⅛-in. pegboard, provide a convenient place for tools, parts, and supplies. Two different 9-in. long tool holders accommodate screw drivers, pliers, wrenches and other hand tools. A 9-in. shelf will hold all kinds of loose, boxed, bottled, or canned items. Three sizes of parts bins, 7, 5, and 3 in. are just the thing to hold parts and supplies. Individual units are priced from 20¢ to $1.00, depending on item. A trial kit consisting of one of all 6 items is available for $3.50. For further information on Handy-Hangers write Wickliffe Industries, Inc., Wickliffe, Ohio 44902.

"I thought 'home entertainment center' meant radio, FM, stereo . . .!"

ELEMENTARY ELECTRONICS ETYMOLOGY

By Webb Garrison

Plasma

▲ To the man on the street, *plasma* is a label that points directly to blood. While its connection with the vital fluid of vertebrates is highly important, it represents only an intermediate stage in the story of an old and uncommonly slippery word.

From Greek *plassein* (fashion, form) Romans used *plasma* to name an artifact formed in a mould. Dormant for centuries, the ancient term was revived in the 18th century and used to designate a green variety of quartz—one of the most beautifully "moulded" of common crystals.

Almost as soon as this usage became established, anatomists found that the colorless liquid part of blood will coagulate under proper conditions. Since it could be moulded, what more natural name to use for it than "plasma"?

Though the label stuck, its original connotation was soon overshadowed by the fact that this fraction of blood is usually fluid, formless, and so translucent that surfaces are hard to see clearly.

Late in the last century physicists found that at extremely high temperatures many gases become completely ionized—composed of positively charged nuclei and negative electrons rather than molecules. Such gas was as shifty and variable as the liquid in which corpuscles float. So "plasma" jumped boundaries again and passed from physiology into physics.

Today it's generally thought that the plasma of physicists (which doesn't naturally occur on earth in stable form) constitutes almost all of the matter in the universe. Unlike the moulded objects of Greeks and Romans, such plasma is believed to be virtually formless and in constant process of shifting about.

De Broglie Wave

▲ Many terms in electronics and related fields come from names of trail-blazing scientists. Practically all words formed in this fashion commemorate men who rose from obscurity to fame as a result of their discoveries.

Not so the *de Broglie wave*.

It perpetuates the name of a French prince who was descended from a long line of wealthy aristocrats.

Louis Victor de Broglie, born in 1892, turned aside from the usual pursuits of the nobility and immersed himself in physics. Early in the 1920's he suggested (but couldn't prove) that electrons are the most schizophrenic of basic particles—for they can behave either as particles or as waves.

In 1929 he received the Nobel prize for his discovery of the wave character of electrons. At the time, the matter seemed of great theoretical significance but had no practical applications. Now operators of the 76-billion-electron-volt synchrotron at Serpukhov in the Soviet Union are putting the de Broglie wave to work. Only by use of formulas based on it can atomic scientists measure the probability of a particle's being somewhere within a given volume at a specific time.

Alloy

▲ Alchemists of medieval Europe devoted a great deal of time to investigation of properties of metals. They like to work with them in pure form, for their ultimate goal was "transmutation" or transformation of some base metal into gold.

Artisans, on the other hand, found that in many applications a mixture of metals performs better than the pure stuff. From a Latin term meaning "to bind," French craftsmen coined the phrase *de bon aloi* to name a good mixture.

Abbreviated a bit and modified to fit the speech of Englishmen, the name for a well-bound mixture became *alloy*.

Many an alloy proved its usefulness to early investigators of electrical phenomena. It remained for modern scientists, however, to discover and apply "freak" (or totally unexpected) properties of some alloys. When only 0.8 per cent cadmium is alloyed with copper, conductivity of the metal drops about 10%—but tensile strength is greatly increased. That's why many long-distance power lines depend upon this alloy.

Now research workers throughout the world are looking for a new "good mixture" that will have both high electrical conductivity and great tensile strength.

So much work is being done that chances of finding a new alloy for power transmission are good. When it comes, though, it's likely to be the fruit of trial-and-error experimentation rather than through a major breakthrough in theoretical knowledge. Metallurgy is still in its infancy. No one knows answers to questions about why a given alloy shows its special electrical and mechanical properties, or how these properties are acquired. ■

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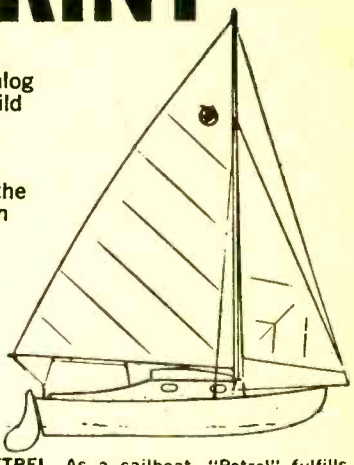

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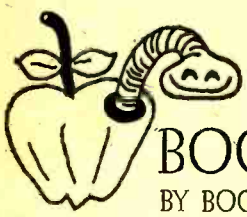
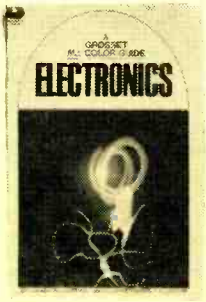


BOOKMARK

BY BOOKWORM

Color You Bright! The workings of electronics are described for both the uninformed reader and those with some technical knowledge in *"Electronics,"* by Roland Worcester, one of a newly published encyclopedic series of "Grosset All-Color Guides." Electronics today rules the technological scene much as mechanics did a few decades ago. Yet for many, the age of electronics is filled with mystifying events. Surrounded by television, radio, and hundreds of other electronic tools, we stand in awe over the supposedly hard-to-understand working of these devices.

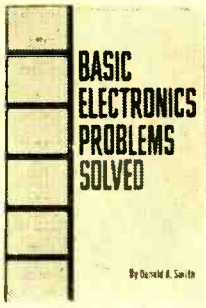
Dr. Worcester, a technical journalist and circuit and equipment engineer, develops his theme by describing actual circuits, with careful



Hard cover
159 pages
$3.95

explanations of what each component does. With the help of 300 specially created, full-color diagrams and illustrations, basic facts about electricity and its applications to the communications and other media are made crystal clear. The text is a very interesting and colorful way of getting started in self-taught electronics. Published by The Rowland Company, Inc., 415 Madison Ave., New York, N. Y. 10017.

What's the Answer. One of our best magazine authors has come up with a new book that everyone should peek into! It's *Basic Electronics Problems Solved* by Donald A. Smith. Here are quick, easy answers to basic electronics problems, wrapped up in a convenient one-stop reference dealing with both solid-state and tube-type circuits! The method used to present the information contained in this book has been needed by countless thousands for a long time. Unlike many tests which move too fast in the area of basics, this handbook starts from "scratch" and explains each step thoroughly, omitting nothing essential to a complete understanding of the fundamentals. The author presents not only a detailed explanation of each point but actual examples on how to work out



Hard cover
192 pages
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problems. Then, to firmly fix the information in the reader's mind, he has included problems for him to solve, with the answers in one appendix, and the entire solution in another. Thus, one has the opportunity to develop his own skills in problem solving, not merely seeing how someone else worked it out. Published by Tab Books, Blue Ridge Summit, Pa. 17214.

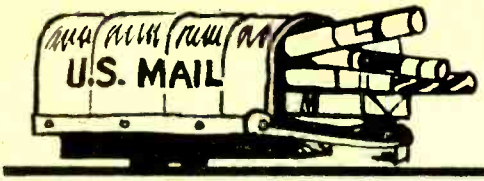
New PC Handbook. GC Electronics has released a new and colorful "Printed Circuit Handbook." The publication, useful to both design engineers and hobbyists, is illustrated with step-by-step instructions for printed-circuit fabrication—detailing four different techniques: direct masking; photo mask/cut-and-peel; master artwork, film negative, photographic; and "B" negative drafting system.

Techniques shown can be used for a single-piece prototype or for construction project applications as well as for full-scale manufacturing. Materials needed are carefully listed for each method. The Handbook presents many ideas and tips on printed circuit board layout, design and fabrication. The booklet, priced at 50 cents, is available at most GC and Calectro distributors.

● QUICKY REVIEWS

● *Fundamentals of Digital Computers* by Donald D. Spencer—a basic introduction to the field of electronic digital computing. Offers a good, fundamental approach to all aspects of digital computers. Published by Howard W. Sams, Indianapolis, Indiana: soft cover, 256 pages, $5.50.

● *Most-Often-Needed 1970 Color Television Servicing Information* presents needed repair material on many popular COLOR sets of all popular makes. Includes double page and triple page schematics, printed board views, alignment facts, and other factory supplied material to aid in carrying out needed repairs quickly. Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. 60035; soft cover, 192 pages, $4.00. ■



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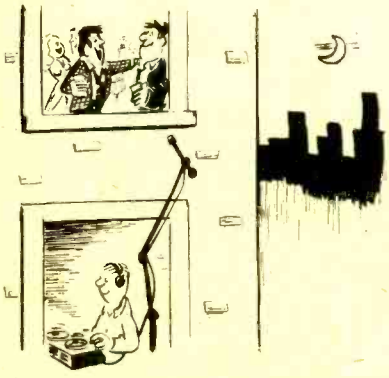
PARTY LINES

by Jack Schmidt

"The Johnson's are getting a new car, the Wilson's are moving and Joan is pregnant!"

"If I send over one of the kids, can I borrow a pound of sugar?"



"I dunno wha'sa matter... my dumb landlord is usually raising hell by now!"

"Would you mind slipping on this lapel mike and describe your sensations for us!"

"Before you come up, Harry, pick up a quart of milk, bread,..."

"I'm sure Miss Wilson doesn't care a bit about megahertz and things..."

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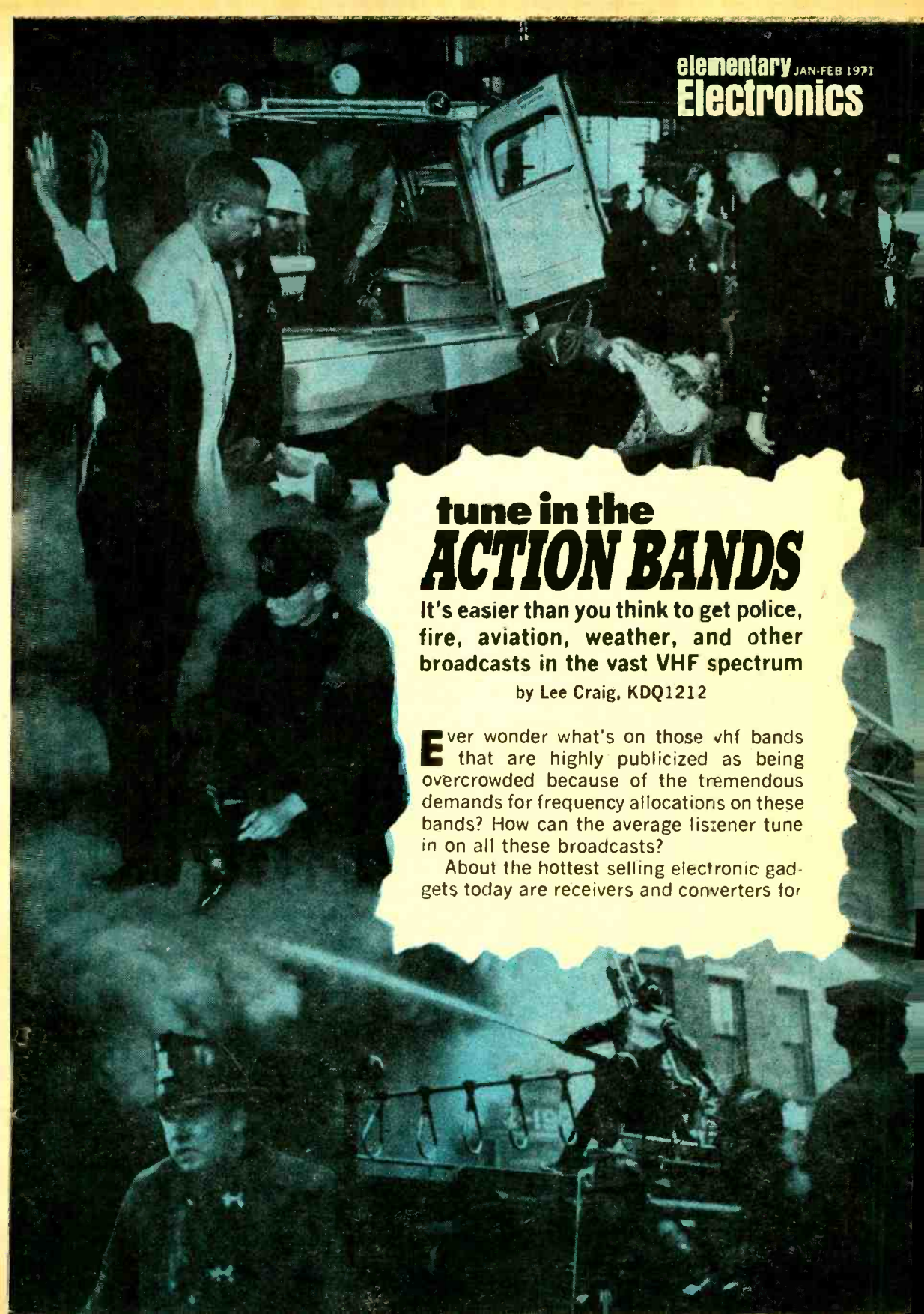


tune in the ACTION BANDS

It's easier than you think to get police, fire, aviation, weather, and other broadcasts in the vast VHF spectrum

by Lee Craig, KDQ1212

Ever wonder what's on those vhf bands that are highly publicized as being overcrowded because of the tremendous demands for frequency allocations on these bands? How can the average listener tune in on all these broadcasts?

About the hottest selling electronic gadgets today are receivers and converters for

e/e ACTION BANDS

the 30-50 MHz, 108-134 MHz, and 150-174 MHz communications bands. There are dozens of receivers and converters on the market. Some users are ecstatic and some are deeply disappointed. And many listeners who have purchased them don't know how to use them.

What Can Be Heard. Police and fire calls can be heard on both the 30-50 MHz *low band* and the 150-174 MHz *high band*. Police and fire calls can also be heard on the 450-470 MHz *uhf band*, but there are no low-priced receivers for this band, although there are converters. Despite the fact that there are three bands in which police and fire calls can be transmitted in any one area, all of the police and fire transmitters within your receiving range may all be in the same band.

However, there's lots more to hear on these bands—stations operated by industry, business establishments, highway maintenance departments, bus lines, truckers, etc. On the 150-174 MHz band you can hear train crews, ship-to-shore communications, taxicab dispatchers, and weather news broadcasts.

There is also the 108-136 MHz aviation band on which airport tower operators can be heard talking to pilots. If you live near a major airport you'll hear lots of activity when the weather is bad or during peak arrival/departure times.

Is It Legal? The FCC does not prohibit anyone from listening to any kind of radio transmissions. However, some state and municipal governments prohibit the installation and/or use of a radio receiver in a car, without a special permit, when the receiver is capable of intercepting radio transmissions of police, fire, and other government agencies.

Almost anywhere in this country you may lawfully listen to anything on the air in your own home, and in your car in most parts of the country. But federal law (Communications Act) prohibits (a) the use of any information transmitted over the air except by the addressee, (b) revealing the contents of any radio transmission, and (c) even acknowledging the existence of a radio transmission, except in emergencies where there is imminent danger to life or loss of property—such as an *SOS* from a ship. These prohibitions apply to all radio transmissions, including *CB*, except those of commercial broadcasting stations and amateur radio stations. This means you should not send QSL cards or reception reports to other than hams and broadcasting stations unless specifically requested.

How to Receive VHF/UHF. Land mobile, marine and aviation vhf radio stations can be intercepted with a fixed-tuned or tunable receiver, or, a converter in conjunction with an AM BCB receiver or a shortwave receiver. While strong nearby stations can be heard when using an indoor antenna, the use of a factory-made outdoor antenna is recommended.

Both fixed-tuned and tunable receivers are available. When using a fixed-tuned receiver, tuning in of signals is no problem. Just set the receiver to the desired channel by installing the correct crystal and wait for the station to come on the air. But when using a tunable receiver, you might tune and tune and hear very little. That's because most communications stations make very short transmissions. For example, station KAA7862 might go on the air for only a few seconds to transmit "KAA7862 base to mobile one, no changes in routing," and then stay off the air for hours. On the other hand, the local police radio station might, under certain circumstances, transmit 100 times every hour.

Tunable converters similar to this are available for use with AM BCB receivers for uhf FM reception.

Semi-portable, with self contained 117V AC and 12V DC supply, is tunable over low or hi bands plus 2 fixed freqs.

Range of Transmissions. Vhf monitoring is not for DXers. It's for very high frequency listeners. You can hear base stations (stations at fixed locations) over much greater distances than mobile units (stations in vehicles) because base station antennas are higher and the transmitters usually have greater power.

Range also depends upon your receiving antenna, your location, and the sensitivity of your receiver. Typically, with a good receiving setup, you should be able to hear base stations from 30 to 80 miles away, but you might be able to hear some mobile units only 4 or 5 miles away. Because of their very high antenna elevation while in flight, you might be able to hear aircraft up to 100 miles away.

Range is somewhat greater than line of sight. This doesn't mean that your receiving antenna must *see* the transmitting antenna, since vhf signals, especially above 100 MHz, are readily reflected by and around solid objects in the signal path.

In general, don't expect to hear communications stations located in other towns. For example, if you live in Seattle, don't expect to hear stations in Tacoma and Everett. However, in the 30-50 MHz band, you might occasionally hear stations hundreds of miles away because of unwanted *skip transmission*.

Tunable Monitor Receivers. A tunable vhf/FM monitor receiver consists of a tunable mixer and tunable local oscillator (it may also contain an RF stage ahead of the mixer), followed by an IF amplifier (usually 10.7 MHz), an FM detector, and an AF amplifier. Some also include one or more IF limiter stages ahead of the detector plus a squelch circuit.

The receiver could be tunable through either the 30-50 MHz band or the 150-174 band or both. When a receiver covers two bands, separate front ends—not switched coils—are usually provided. Some high-band receivers are tunable down to 144 MHz to enable reception of 2-meter ham bands.

A 108-136 MHz aviation band monitor receiver is similar except that it's designed to receive AM signals because aircraft currently use AM instead of FM.

Fixed-Tuned Receivers. A fixed-tuned monitor receiver usually employs a single-conversion superheterodyne circuit with a crystal-controlled local oscillator. Some are designed to receive on one channel only. To receive on another channel, the crystal must be replaced. However, there are numerous multi-channel fixed-tuned receivers. A crystal is required for each channel to be received. In addition, there are tunable receivers that have an option for crystal-controlled (fixed-tuned) operation on one or more specific channels.

More sophisticated fixed-tuned receivers employ a dual-conversion superheterodyne circuit plus a selectivity filter. Channels are selected either by exchanging or switching the first local oscillator crystals. The second local oscillator crystal remains the same for all channels and isn't exchanged as is the first local oscillator crystal.

Scanner-Type Receivers. A most exciting type of monitor receiver utilizes electronic scanning of a number of channels in sequence. A crystal must be provided for each channel. Such a receiver, for example, could be equipped with crystals for receiving on police, fire, mobile telephone, civil defense, and marine channels. The receiver will automatically and rapidly tune through each channel. But nothing will be heard until the receiver finds an active channel. When it does, the receiver locks onto this active channel until the received station

Single band, tunable police and fire solid state FM receiver. One unit for lo and another for hi band reception.

This tunable plus one fixed freq. band receiver operates off 117V AC or 12V DC. Companion hi-band available.

goes off the air. Then it continues to scan the channels until it finds another carrier.

Front panel pushbuttons enable locking out any or all of the channels for picking a particular channel for continuous listening and disabling the scanning circuit.

Most scanner-type receivers cover only one band. At least one is now available which scans channels in both the 30-50 and 150-174 MHz bands.

Multiband Receivers. In addition to dual-band FM monitor receivers, there are numerous multiband general-purpose portable receivers that cover the AM and FM broadcast bands plus one or more communications bands. One of these sets, for example, covers the two vhf land mobile bands, the vhf aviation band, three shortwave bands, and both the AM and FM broadcast bands. This kind of receiver is versatile, but isn't as satisfactory for communications band reception as one that is designed for that specific purpose.

Here's why. On the two land mobile bands, the receiver must demodulate *narrow band FM (±5 kHz)* signals and should be selective enough to separate signals spaced 20 kHz apart for the low band, or 30 kHz apart for the high band. On the FM broadcast band, the receiver must demodulate *wide-band FM (±75 kHz)* signals whose carrier frequencies are spaced 200 kHz apart. Unless the receiver contains two separate IF amplifiers, one for narrow and one for wide-band FM, or a selectivity filter for narrow-band FM, plus a narrow-band discriminator or ratio detector, it will not compare favorably on the land mobile bands with receivers designed specifically for narrow-band FM.

Superregenerative Receivers. You can build a simple superregenerative receiver for any of the three bands that will be able to demodulate both AM and FM signals, but you might be very disappointed with the results. Not because of inadequate sensitivity, but because of very poor selectivity. Also, if you use an outdoor antenna and your receiver doesn't have an RF stage, it could radiate harmful interference and might even create a hazard to aircraft by jamming its electronic navigation equipment.

Receiver Specifications. You can buy a vhf monitor receiver for less than $20.00 or pay more than $500.00 for a very sophisticated one. Naturally you can expect a lot more performance from a $150.00 set than from one that sells for $17.95. The way to ascertain the difference in performance is by reading and interpreting the spec sheets. The specs of some of the cheaper ones are oftentimes just not there.

What the Specs Define. When a receiver is said to cover the 30-50 MHz, 108-136 MHz, or 150-175 MHz bands, it should be operable at any frequency within the specified band. As stated previously, some high-band receivers are tunable through the 144-172 MHz or 147-174 MHz band, instead of being limited to just the 150-174 range. There's not much to hear above 162.55MHz except the weather channel at the present time.

Channel Capacity. Obviously, a tunable receiver should be capable of receiving any channel within its frequency tuning capacity. However, in the case of a multi-channel fixed-tuned receiver, all channels might have to be within a certain segment of the band (i.e. within 0.5 MHz of each other), in order to avoid reduced sensitivity on some channels.

Sensitivity. A professional FM communi-

12-channel, crystal controlled (6 hi & 6 lo), 117V AC/12V DC receiver for police, fire, business, weather bands.

8-channel, crystal controlled scanning monitor receiver for base station use on police, fire, weather, business bands.

Automatic scan of up to 8 crystal controlled hi-band channels over an 8 MHz range, locks in on 1st active channel.

Left, hand held AM/Vhf monitor receiver separate lo & hi band 3-crystal models Right, 2 models for hi or lo band tunable hand held VHF monitor receivers.

cations receiver is usually rated at 0.3 to 0.5 microvolt for 20 dB of quieting or 12 db SINAD. This is much higher sensitivity than can be expected of a low-priced monitor receiver. If it's a tunable receiver and the spec sheet says *1-microvolt sensitivity*, it probably is true but not necessarily at all frequencies within the tuning capacity. The lower the microvolt rating, the higher the sensitivity (e.g. 0.5 microvolt is ten times more sensitive than 5.0 microvolts).

Selectivity. Land mobile channels are spaced 20 kHz apart in the 30-50 MHz band, 30 kHz in the 150-174 MHz band, and 25 kHz in the 450-470 band. To separate them requires a receiver having good selectivity. A professional FM communications receiver usually has a rated adjacent channel selectivity figure of 60 dB or better, even as high as 100 dB. A typical, tunable low-cost vhf/FM monitor receiver is much less selective. Some even use 10.7 MHz IF transformers, of the type used in FM BCB receivers which can pass several communications channels at the same time. However, this doesn't mean the receiver is worthless for fun monitoring. Because of the FM *capture effect*, only the strongest signal will be heard if it's 6 dB stronger than the others, and if the receiver employs limiters.

Squelch. Unless the receiver has a squelch circuit, noise will be heard when no signal is being received, and/or when tuning through the band. If the receiver is to be left on to monitor a specific channel, it should have a squelch circuit.

Circuitry. Only a receiver employing a superheterodyne circuit should be considered. The number of IF stages is important—normally, the more stages the better. Many vhf/FM monitor receivers do not employ IF limiter stages. They'll work without limiters, but the full benefits of FM cannot be realized without limiters. However, a receiver employing a gated beam tube detector combines limiting action with FM detection. Limiters are not used in aviation band monitor receivers, which are for AM reception.

Detector. For best FM reception, the receiver should employ a discriminator, ratio detector, or gated beam detector. If it employs a slope detector, you will actually have an AM detector that will demodulate FM signals but will not discrimnate against noise.

Solid State. Both tube and solid-state monitor receivers are available and both can be excellent, depending on their overall design. Solid-state types are preferred for installation in vehicles because of their low battery drain.

Input Impedance. A professional vhf receiver is usually designed to be fed by a 50-ohm antenna system through 50-ohm coaxial cable. Lower-cost receivers may have a phono jack, an SO-239 coaxial connector, or a pair of screw terminals to which the antenna leadin (coaxial cable) is connected. Most will work well with a 30-100 ohm antenna system. Since nearly all vhf communications antennas are rated at 50 ohms, why use anything else in lieu of such an antenna in conjunction with 50-ohm coax?

Converters. Most vhf converters are designed for use with an AM BCB receiver. There are both tunable and fixed-tuned (crystal-controlled) converters. Some are designed to plug into an auto radio by inserting the converter between the antenna

and the car radio. Some are designed to be placed next to a home radio containing a loop antenna, so that output of the converter is inductively coupled to the receiver.

A fixed-tuned converter consists of a mixer and local oscillator, as shown in block diagram for fixed frequency vhf converter. Some have an RF amplifier ahead of the mixer. To receive weather broadcasts on 162.55 MHz, for example, the converter oscillator operates at 164.15 MHz (or 160.95 MHz) and down-converts 162.55 MHz signals to 1.6 MHz (1600 kHz). To receive 162.55 MHz signals when using a converter, simply tune the AM BCB receiver to 1600 kHz. (Some converters are designed to work with a receiver tuned to some other BCB-frequency.)

Although the received signal is FM, the AM receiver will demodulate the FM signals by a process known as *slope detection.*

A tunable converter consists of a tunable local oscillator and a fixed-tuned broadband mixer (or tunable mixer) as shown in the diagram for tunable vhf converter. An RF amplifier ahead of the mixer could also be provided. If designed to cover the 150-174 MHz band and to work with a BCB receiver tuned to 1600 kHz, the oscillator would be tunable through the 151.6-175.6 (or 148.4-172.4) MHz range. As the converter dial is tuned, the receiver accepts signals which produce a 1.6-MHz IF signal within the converter.

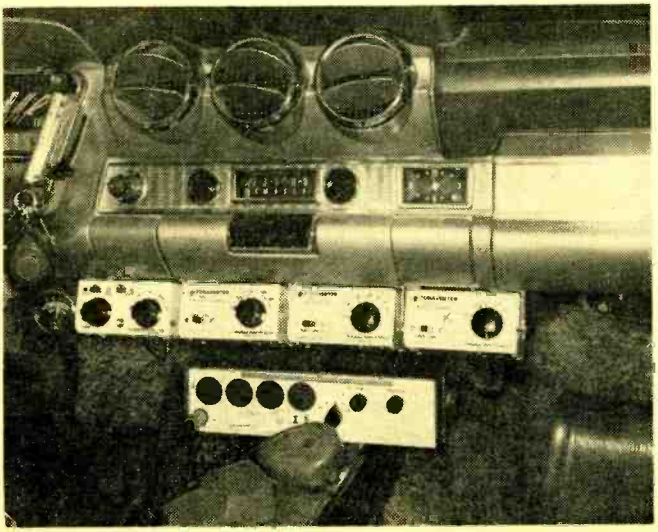
Where to Get VHF Monitor Receivers and Converters

Allied Radio Shack—2725 West 7th St., Ft. Worth, Texas 76107
Burstein-Applebee—3199 Mercer St., Kansas City, Mo. 64111
Courier Communications—100 Hoffman Pl., Hillside, N.J. 07205
Electra Corporation—Cumberland, Ind. 46229
Fannon Electronics—100 Hoffman Pl., Hillside, N.J. 07205
Heath Co.—Benton Harbor, Mich. 49022
Kaar Electronics Corp.—232 Wescott Dr., Rahway, N.J. 07065
Lafayette Radio Electronics—111 Jericho Turnpike, Syosset, N.Y. 11791
Midland International Corp.—P.O. Box 1903, Kansas City, Mo. 64141
Nova-Tech Inc.—24049 S. Frampton St., Harbor City, Cal. 90710
Olsen Electronics—260 S. Forge St., Akron, Ohio 44308
Regency Electronics Inc.—7900 Pendelton Turnpike, Indianapolis, Ind. 46266
Herbert Salch & Co.—Woodsboro, Texas 78393
Sharp Electronics Corp.—178 Commerce Rd., Carlstadt, N.J. 07022
Sonar Radio Corporation—73 Wortman St., Brooklyn, N.Y. 11213
Tompkins Radio Products—Bonnie View, Woodsboro, Texas 78393
World Radio—3415 West Broadway, Council Bluffs, Ia. 51501

When a converter is used with a single-conversion superheterodyne receiver, a dual-conversion superheterodyne receiving system is formed.

Fixed Antennas. If you are near the stations you want to receive, you might be able to get by with an indoor antenna. For the 30-50 MHz band you can use a 6-ft

(Continued on page 105)



A really complete communications monitoring installation. Four separate tunable converters cover a) 1.8 to 4.0 MHz ham band, b) 37 to 50 MHz public safety band, c) 118 to 128 MHz aircraft control band, d) 150 to 165 MHz hi-band police, fire, business band. All converter outputs are 1500 kHz to feed standard BCB auto radio installed in car. Unit below converters is manufacturers prototype for new CB transciever soon to be announced.

A simple gadget that adds on-off cycling to the windshield wipers of your automobile

WIPER-TROL

by John E. Bjornholt

Ever gone for a ride with your buddy in his new Varoom 8 when a light drizzle, or possibly a patch of misty air, clouds his windshield? And, because he can't see out, he then turns *ON* his windshield wiper to the *low* position. It swishes across the glass a few times, clearing it for the moment and stops automatically. Then, after a few seconds rest, just when it seems that the glass starts clouding up again, the wiper repeats this action and continues to cycle from *ON* to *OFF*, with a fixed rest between cycles, in this manner until the wiper switch is turned *OFF* manually. In all probability you've commented: *Hey, that's great!—Wish I had that feature on my jalopy.*

Shortly after seeing this action, and while musing on simple projects that you might engage in to occupy your spare time, you remembered the wiper action and wondered if you could dream up a gadget to duplicate it for your car. Our Wiper-Trol is just the thing you're looking for, and surprisingly, it outperforms the accessory you saw in operation on the Varoom 8. It's a very simple device to construct and requires only a few readily available electronic components that shouldn't cost more

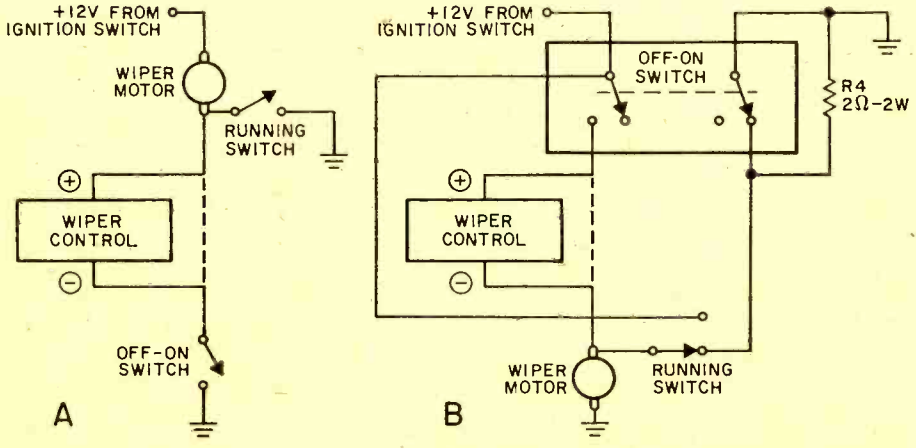
Photo courtesy SAAB Motors, Inc.

than $5. Chief advantage of WIPER-TROL over the commercial unit is that you will have the capability to adjust cycling from continuous running (needed when you're in a heavy downpour) to an infinite number of delay periods, up to about 10 seconds, between *stop* and *start* cycles.

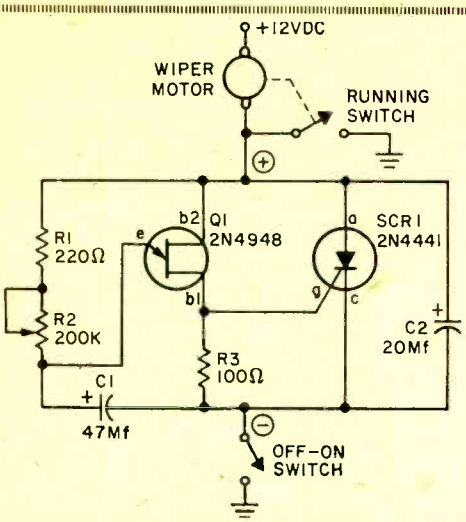
And it's so easy to build and install. The complete accessory consists of 2 or 3 fixed resistors, depending on make of car (if a Ford product, R4 is required to damp wiper motor when it reaches rest position to prevent overshooting, which could reclose the running switch—see drawing.); 2 capacitors; a potentiometer or rheostat; a silicon unijunction transistor; and a silicon controlled rectifier (SCR). These components are all mounted directly on the terminals of the potentiometer without using a space consuming circuit board or chassis. You can fasten the complete assembly to your car via a single hole drilled into the dashboard. Or, make a simple clamp type bracket to fasten it to the bottom of the dash without having to mutilate the dash. Just two wires connect WIPER-TROL to the wiper motor circuit. Of course we assume you have an electric wiper motor. (American Motors cars are the only ones currently being manufactured in the U.S. that do not use electric wiper motors.)

Wiper Circuit. First, let's consider the basic wiper motor circuit. When the driver turns *ON* the wiper he manually closes a switch to start the motor. When the switch is turned *OFF* the motor will continue to run until the wiper blades reach their normal rest position, at which time the motor shuts *OFF* so as not to leave the blades in a spot that may block the driver's vision. This is accomplished by a *running switch* built into the motor that is closed by a cam on the motor drive shaft after the motor has started to rotate. The *running switch* remains closed until the drive shaft reaches the equivalent of the rest position for the wiper blades. This switch parallels the manual *ON-OFF* switch so that, although the manual switch is shifted to the *OFF* position, the motor continues to receive current until the *running switch* cam opens this switch's contacts.

How WIPER-TROL Works. WIPER-TROL is connected in series with the manual switch lead to the wiper motor. When the manual switch is turned *ON*, capacitor C1 begins to charge through resistors R1 and R2. This charging current flows simultaneously through the wiper motor. But, this current is too small to cause the motor to run. When the capacitor voltage reaches the *stand-off* voltage of the unijunction transistor (Q1) the transistor fires, producing a pulse across resistor R3, discharging capacitor C1. At the same time this pulse is applied to the gate of the SCR, turning it *ON*. Once SCR1



Wiring diagram A details motor control circuit for most recent cars (past 6 to 10 years), other than Ford products, that employ electric windshield wiper motors. Ford products employ a slightly different control, circuit B. Resistor R4 damps motor when it reaches rest position, thus preventing overshoot to cause recycling.



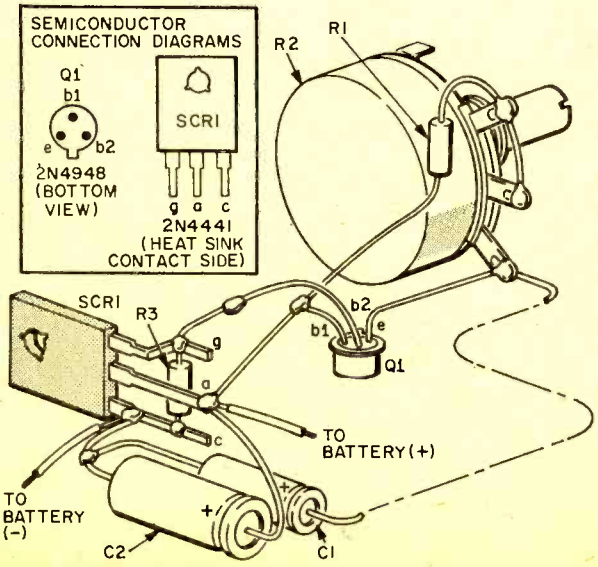
PARTS LIST FOR WIPER-TROL

C1—47 μF, 20 VDC tantalum capacitor (Sprague CS13B-E476M or equiv.)
C2—20 μF, 25 VDC aluminum electrolytic capacitor (Sprague TE-1305 or equiv.)
Q1—Silicon unijunction transistor (Motorola type 2N4948)
R1—220 ohm, ½-watt resistor
R2—250,000 ohm, 2-watt linear taper potentiometer (CTS Type 550R or equiv.)
R3—100 ohm, ½-watt, resistor
R4—2 ohm, 2-watt resistor (see text and drawing for Ford cars)
SCR1—3 amp, 75 PIV silicon controlled rectifier (Motorola type 2N4441)

It's easier to understand Wiper-Trol's circuit with motor control shown in series with Wiper-Trol.

is turned *ON* it will continue to conduct until the current flowing from its anode to its cathode is interrupted, which turns it *OFF*. The SCR is capable of handling current flows of several amperes and will easily handle the current of approximately 3 amps necessary to start the wiper motor of every automobile.

Once the motor is started, its *running switch* takes over and by-passes the WIPER-TROL by shorting out WIPER-TROL's time delay circuit. With no current flowing through the SCR it shuts *OFF* allowing it to recover, and also keeps C1 discharged. When the wiper motor reaches the rest point, at which time the *running switch* is opened automatically, the time delay circuit will again be energized and C1 will start to charge, and, after a period of time, the entire cycle is repeated over and over until the manual *ON-OFF* wiper switch is turned *OFF*. And this operating schedule is where WIPER-TROL has an advantage over the commercial wiper cycling accessory. You can adjust the cycling time between *ON* and *OFF* by changing the time delay between *OFF* and *ON* that is built into WIPER-TROL. Potentiometer R2 allows continuously variable time delay by controlling the amount of charging current C1 receives, the less the current (higher resistance of R2) the greater the delay, because it

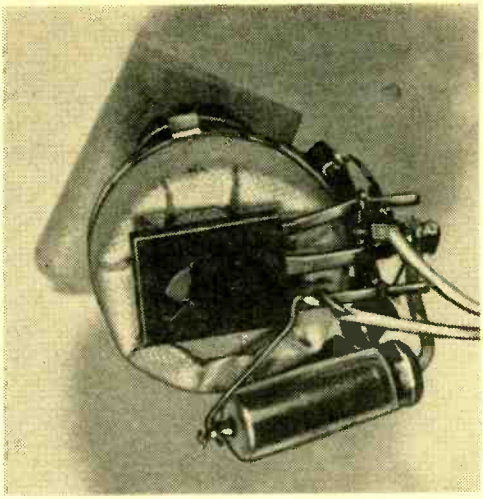


Because there's no chassis parts mounted directly to R2, and photo doesn't show construction details clearly, we've had our artist make this exploded view to help you build Wiper-Trol. We've not shown details on a mounting bracket because there are so many different configurations of dashboards. A simple bracket formed to wrap around bottom edge of dash that can be held with a set screw and that has a 2-in. tab perpendicular to bottom of dash will do the job.

takes longer for C1's charge to reach the stand-off voltage of Q1.

Making It. Layout of parts for WIPER-TROL isn't critical. However, we felt the unit should be compact and easy to mount. Therefore all components were mounted directly to the potentiometer's terminals. If you agree with this concept you'll want to follow our assembly, as shown in our layout diagram. You can, however, package the components to suit your own whims without appreciably affecting its operation. One word of caution. Make certain the electrolytic capacitors are correctly connected with respect to polarity. Also, before soldering leads of Q1 and SCR1 double check their connections. Too much heat can impair or destroy semiconductors.

Connecting It To Your Car. As previously stated, WIPER-TROL is inserted in series with the ungrounded lead (for most cars the positive lead) of the wiper motor. Normally the negative lead is returned directly to ground (the car frame) via the manual *ON-OFF* switch. (See our wiring diagrams for major auto manufacturers). When mounting WIPER-TROL on, or in the dash, be sure there is room for the assembly and that no other wires and/or supports, of which there is an amazing amount behind the dash of today's cars, will not touch any of WIPER-TROL's components. ■



Tape on rear of R2 prevents shorts with components so closely placed on back of control.

IC Portraits Zapped Out With Lazer Beam

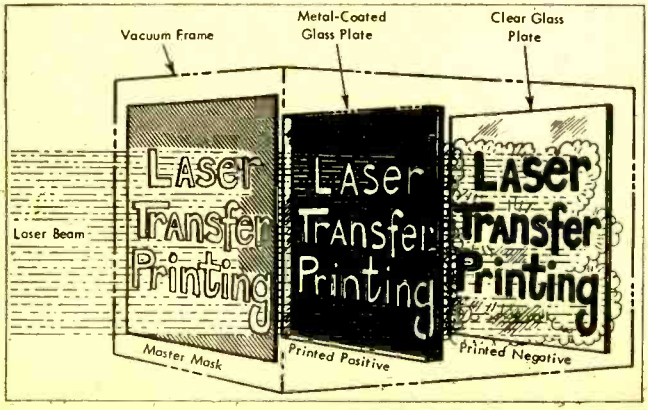
The laser's heat, rather than its light, has been harnessed to produce photomasks used to form semiconductor patterns on IC devices. In just a few billionths of a second a powerful pulse of thermal energy evaporates a mental image from one surface and, precisely deposits it on another.

This new technique of mass transfer (developed by IBM) permits the direct and simultaneous production of both positive and negative photomasks, a time-consuming process normally requiring several image-reversing steps.

A glass plate, coated on one side with chromium, one ten-millionths of an inch thick, is sandwiched in a vacuum frame between a master mask and a clear glass plate.

When the laser beam passes through the master mask, it sublimes (immediately turns metal to gas) metal from the first glass plate and deposits it on the second glass plate, thus making the first one a positive photomask and the second one a negative photomask.

—Joe Gronk



SQUELCH CB's NOISE ELIMINATOR

By Len Buckwalter

You won't find a knob marked "Squelch" on your AM radio or TV set. But, just about every CB receiver now manufactured sports one of these handy controls. The reason is that squelch can silence static that's heard in a speaker when no signal is being received, making it the greatest boon to noise-pollution elimination since the invention of ear muffs. Only an incoming message trips the squelch noise mask so you're spared the static crashes, atmospherics and other electronic egg-scrambling during standby periods. Why is no squelch needed for regular radio or TV? Unlike mobile communications, the incoming signal is constant, so steady broadcast signals keep the receiver free of background noise.

And that's the starting point for understanding how a squelch circuit functions. The receiver can sense the presence of a signal, then automatically control the audio stages. As we'll see, squelch can also work the other way—sense the noise or static—and similarly regulate the audio. Finally, there's "tone" squelch, sometimes termed "selective call." In this specialized circuit not only is noise silenced, but also the stations on the channel you don't wish to hear.

Stealing AVC. Simple squelch circuits are little more than electronic switches tripped by the receiver's AVC (automatic volume control) voltage. The overall idea is shown in the block diagram of Fig. 1 which represents a typical CB receiver. An incoming signal from the antenna passes through various stages until it reaches the detector where it's converted to audio. In the detector, too, a portion of the carrier signal (which is AC) is converted to DC by a diode rectifier. Since the DC signal will vary in strength with the carrier, it's used to protect the receiver against overload or excessive volume changes. This is the AVC voltage and, as shown by the dotted line in Fig. 1, is fed back to earlier stages in the re-

ceiver. If an incoming signal rises in strength, AVC is returned in a direction which reduces the RF (and sometimes the IF) amplifier gain.

If there is *no* signal in the receiver, there is no AVC voltage. Why not use AVC to directly control—or squelch—the audio along with earlier RF receiver stages? Squelch is, in fact, a brand of automatic volume control. The pitfall in using AVC directly to develop squelch action is that AVC changes too gradually, and over too-limited a range. For squelch to do its assigned job, it should create an all-or-nothing effect on audio. Thus, AVC may *start* squelch action, but additional stages are needed to impart the snap.

As seen in the block diagram of Fig. 1, this will occur in a "squelch" stage connected to AVC voltage, and also to the audio amplifier to be controlled. Let's trace how a typical squelch circuit might appear in both tube and transistor CB receivers.

Bottled squelch. A tube variety is shown in Fig. 2 and its operation boils down to this: AVC voltage is greatly boosted by an amplifier, then the magnified voltage controls the grid bias of a regular audio stage. Since AVC amplified voltage now swings over a much larger range, the audio tube switches briskly on and off. Let's trace it in some detail in Fig. 2. First, there's the conventional audio amplifier shown connected to the detector. Since all audio signals must pass through it, the amplifier handily serves as a controlled stage. The other stage (near the bottom of the diagram) is the squelch control, nothing more than a *DC amplifier*.

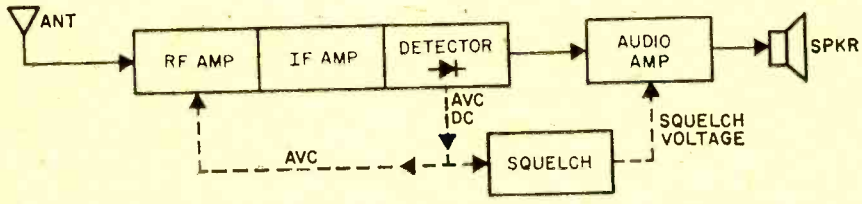
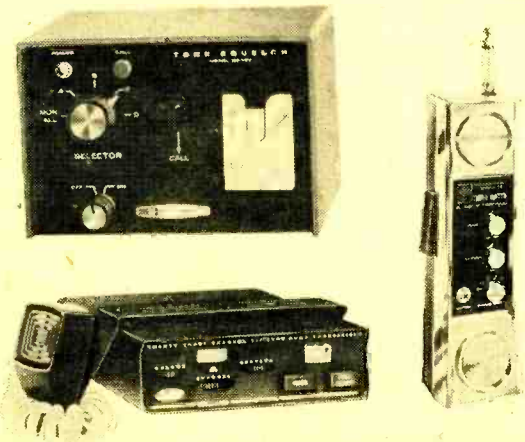


Fig. 1—Dotted lines on typical CB block diagram trace path of AVC voltage fed back to RF amp to control sensitivity and to squelch amp to open audio amp.

Note that the tube grid of the squelch control is operated by AVC voltage—and that the *plate* of this stage also connects upward to the grid of the audio amplifier.

Circuit action mainly occurs at the variable resistor which serves as the squelch adjust (a front-panel knob). As you can see, a voltage of 80 is at one side of the resistor, while 100 appears at the opposite end. The reason for the drop is current flowing



Upper left photo, Heathkit's Tone Squelch Kit model GD-162 for adding squelch to any CB rig. Photo lower left, Allied-Radio Shack model A2569, 23-channel CB mobile set; knob centered between channel indicator and 3-scale meter is squelch control. Handy-Talkie in photo at right has squelch knob centered between volume control and channel selector on Fanon IC-3000 unit. Squelch is usually found on more expensive equipments.

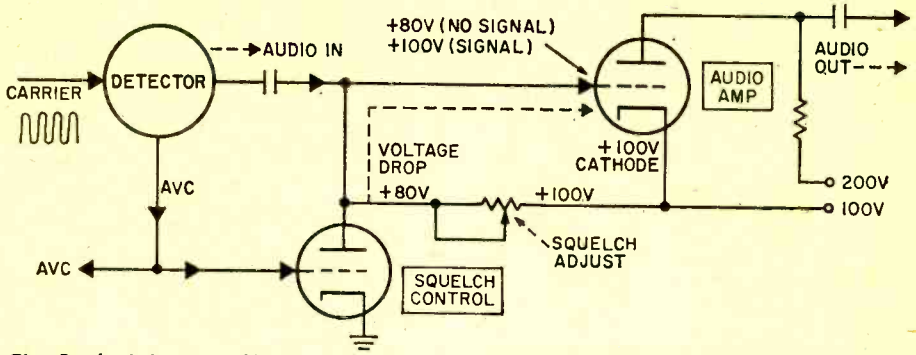


Fig. 2—In tube type CB rig change in AVC voltage when carrier is received lowers voltage drop across squelch control thus opening audio clamped by higher voltage.

through the squelch control tube. Assume there's no negative AVC voltage on the control tube grid; the resulting tube current flow produces the 20-volt drop shown across the variable resistor. The voltages are next applied to the audio amplifier. Note that 100 volts go to the tube cathode and 80 to the tube grid.

This set of voltages *cut off* the audio amplifier completely—no audio signals can pass. The reason is, the tube is now experiencing a relatively high *negative* grid bias. How does a negative charge develop from +80 and +100? It appears because grid voltage is always measured with relation to the cathode. Thus, if the cathode operates at +100 volts, and the grid at +80, the grid will appear to be relatively 20 volts *negative*. This is a substantial amount of grid bias and it cuts off any audio amplification through the stage. So the speaker is effectively silenced.

Now to see what happens when a signal arrives and trips open the squelch. Since an incoming carrier produces negative AVC voltage, it also cuts off current flow through the squelch tube. This kills the voltage drop across the squelch variable resistor and that 80 volts shown jumps up to 100 (the supply voltage). Since the controlled audio stage also receives 100 volts on its grid, that high negative bias developed earlier disappears. This places both grid and cathode at 100, so the grid bias now drops to a relative value of zero volts. The audio stage can now amplify and the receiver is unsquelched.

For the system to operate properly, you must set a squelch with care. The usual problem results when the knob is set too high and weaker stations cannot activate the squelch. As you can see in Fig. 2, a high setting could place the audio grid too far into the negative region and prevent the receiver from unsquelching except for strong signals. The technique for adjusting a squelch is to wait until no signal is being received, then rotate the knob until the background noise *just* disappears.

Transistorized, too! The solid-state version of a squelch circuit is shown in Fig. 3, The idea in this circuit is based on the forward and reverse characteristics of a silicon diode we call the squelch diode. When the diode is biased in the reverse direction, it presents an extremely high internal resistance and blocks the flow of audio between the detector and following audio stages. Consider, first, how the receiver is squelched during a no-signal period. Note that the squelch diode in Fig. 3 is receiving two voltages (besides the audio from the detector).

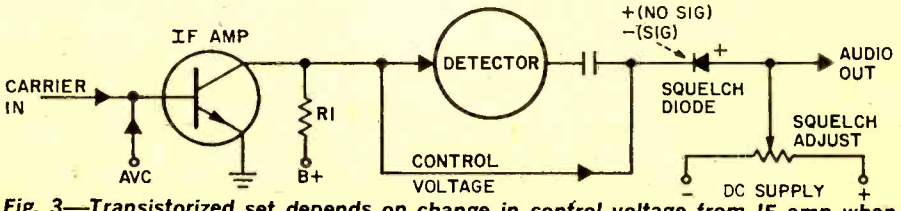


Fig. 3—Transistorized set depends on change in control voltage from IF amp when carrier is present to forward bias squelch diode reversing it's clamp on audio to open it.

SQUELCH

The one from the left is control voltage tapped from the collector of an IF amplifier stage. This transistor not only operates as an IF amplifier, but also serves to drive the squelch circuit (much like the squelch control tube did earlier). When no signal is received, collector current is high in that stage, and a corresponding voltage drop occurs across resistor R1. A sample of this drop is fed back to one side of the squelch diode for biasing. Notice that a second bias voltage also reaches the diode from the squelch adjust potentiometer. The net effect of these connections is a reverse-bias condition on the diode; the control voltage makes the cathode relatively positive with respect to the anode. Now the speaker is silent since nothing can get through the audio section. But when a signal enters the receiver, the IF amplifier conducts less current (because AVC voltage is being developed) and the collector voltage drop across R1 is greatly reduced. This makes the squelch diode relatively negative on its cathode—causing a forward bias condition. The diode's resistance plummets and the receiver is opened up for audio.

These squelch circuits are common in CB equipment and they do the job. But as the clerk in the discount store says, as you examine a sale-priced item, "Let me show you something better!" In the more expensive communications gear, the squelch will act snappier and have a more sensitive threshold for awakening on weak signals.

Noise is Nice? One of the deluxe squelches is the "noise-operated" type. Circuits described earlier are *carrier*-derived, but a *noise*-derived system is more sophisticated. As shown in Fig. 4, the action begins by tapping a sampling of signal from one of the IF stages in the receiver. Assume at this time that no station is being received so the signal is only atmospheric noise or other background static. This is fed down to a filter which sharpens the response to the steady "white" noise component rather than the clicks, clonks or other transients that might trip the squelch at the wrong time. The noise amplifier, as the name implies, boosts the noise level to a working value. Notice that the manually-adjusted squelch potentiometer is also at the input to the stage. It allows the operator to choose the operating threshold of the circuit.

Next, the amplified noise signal is rectified by a diode and smoothed to pure DC so it can exercise circuit control (as AVC did in the simpler squelches). But first, the DC is applied to a switching transistor to obtain the necessary snap-action. The switching transistor stage is little more than a conventional amplifier, but with almost no bias on its base terminal. This causes the transistor to operate wide open and saturate rapidly on an input signal. The result of the DC signal, therefore, is a rather high positive voltage at the output of the switching transistor (at the emitter). This is sent up to the audio section as the control voltage and the stage is clamped shut . . . nothing can be heard in the speaker. When an IF signal arrives due to a transmission from a CB rig, however, white noise disappears, no DC occurs and the audio stages are released for amplification.

As you can see, the noise-operated

(Continued on page 105)

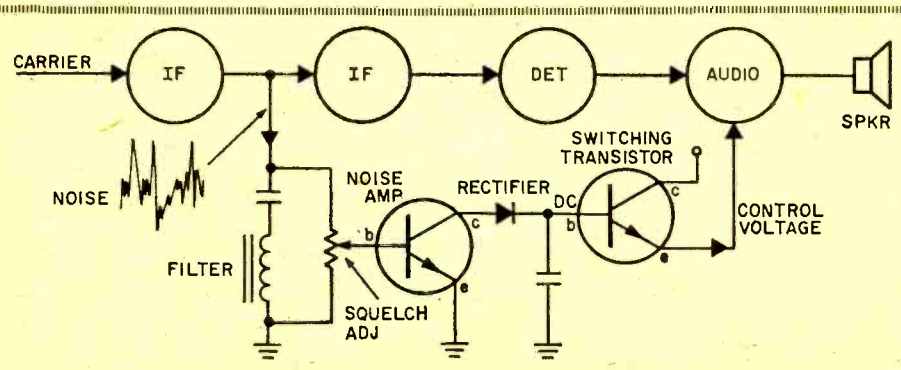


Fig. 4—Most sophisticated squelch noise operated rather than carrier derived, Filter separates white noise from other noise to develope squelch volts.

THE LOVE GAME

A fun device that's easy to build

by James Squires

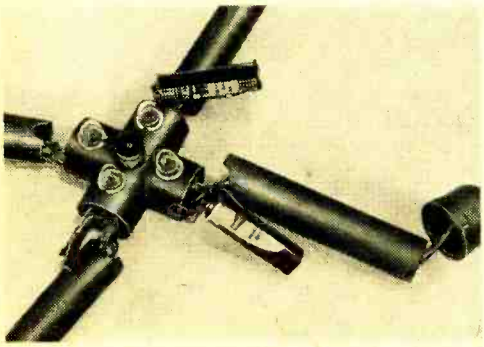
Your darkened living room is the scene for the *Love Game* and the *actors are you* and *any cute chick* you pick to sit beside you. You certainly know the rules already. In the few minutes that follow, you'll do your level best to put out the lights in the room, since we *all* do our best work in the dark. Being a real sport, though, you give her a fighting chance. With the *Love Game* placed between you and the chick it is the center of illumination and counter illumination. Frantically you turn this switch; now it's her turn, she turns that switch; you reach for another switch and brush her hand; your heart races, well,—that's the risk of the game. Now you turn another switch—all the lights dim but in frustrating defiance of the bigger game, they are still lit. And—oh well, the rest must wait until you have built your very own *Love Game*.

Game Rules: As in any game of love, it is best to become thoroughly familiar with all of the tricks, so you should get acquainted with the schematic diagram and the wiring diagram of our *Love Game*. This is necessary if you want to keep the upperhand and be a consistent winner. The rules, however, state that you take turns with your partner, operating one switch per turn. The game starts with all lights *ON*. Don't worry about memorizing

the various switch combinations, unless, of course, you must take every advantage, for with each move their effect changes. In fairness to chicks of the world, perhaps you, the builder of this fiendish game, knowing its innermost secrets, shouldn't play.

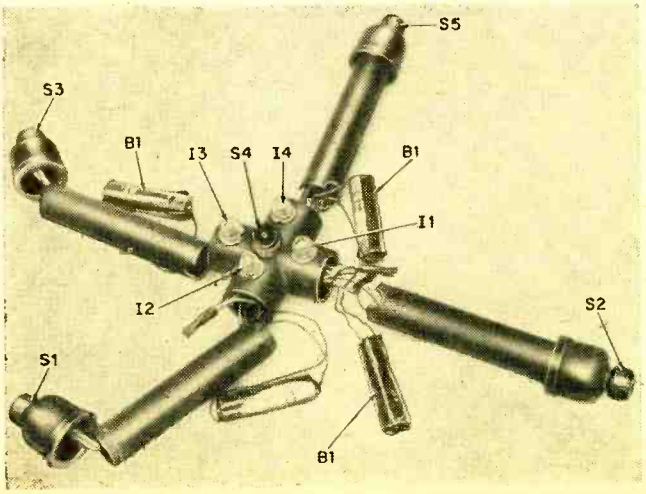
How It Works: Considering that *Love Game* involves switches, lights, batteries and, oh, yes, girls, it becomes extremely complicated and therefore warrants explanation, the game, that is, not the girls. As you play you will notice that each of the lights has two levels of illumination, bright and dim. The dim level occurs when L1 and L2 are switched on in parallel with L3 and L4 thus dividing the available battery current between the two sets of lamps, (see schematic diagram).

Each lamp draws 300 MA, therefore, the four of them draw 1.2 amps from the four paralleled AA cells making up B1. Taking into consideration the life of the batteries, lamps and switches plus a modicum of success on your part (that is, the lamps *OFF* more than they are *ON*.) the single set of batteries should let you play the *Love Game* with all of the girls in the neighborhood before having to replace batteries. The lamps are PR 6's and are rated at 2.47 volts and 300 mA drain per lamp.



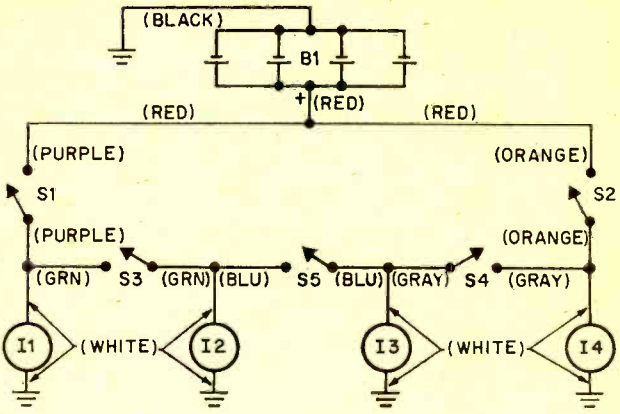
Building the Game: The chassis for the *Love Game* is somewhat unconventional, utilizing a new medium, one half inch plastic pipe of the kind used in underground sprinkler systems. Four plastic end caps, four pieces of plastic pipe 4-in. long for four arms, and a center cross piece, all fabricated from standard plastic pipe and associated parts, make up the chassis. Normally, plastic tubing is joined to fittings with a solvent that softens the plastic surfaces and, when it dries (fairly fast), results in the two surfaces joining together, but this proved unnecessary for the *Love Game*. The normal snug fit of the pipe into the end caps and cross piece is made snugger by the spray painting that is also used to provide an even colored surface to the pipe and pipe fittings. The added thickness of the paint provides the sufficiently tight fit needed for joining all parts in the assembly of the *Love Game*.

Drill a ⅜-in hole centered on its flattened surface in each plastic end cap to accept the Leviton Rotary SPST Switch (see drilling diagram). Before mounting the switches in the end caps, cut switch wires to a 3½-in. length and splice a pair of 8-in long, color coded No. 22 solid, insulated wires to each pair of switch leads. If at all possible use a different color for each pair of leads to help identify each switch, as we did in the model.



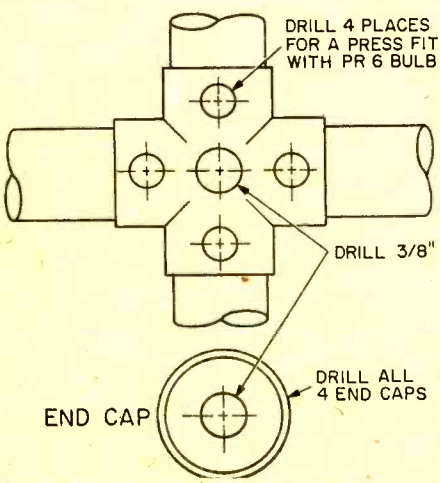
Above, Love Game in disarray shows you how we tucked batteries, splices, inter-connecting wires and lamps into the arms of the game. Below, this full, exploded view is presented to show exactly how the switches are oriented within the arms and center piece of the chassis (plastic pipe and fittings). Circuit diagram on opposite page can easily associated with this view.

You don't have to use identical color scheme we did so long as you match up lamps and switches according to our plan in schematic and identifying locations shown in photo on opposite page. How else can you learn how to enter the game with an advantage to assure you success? Unless, of course you're a "Jack Armstrong-All American Boy who wouldn't think of taking advantage of a girl, especially in a Love Game.



Mount the switch and insert the spliced wires into the plastic tubular arms and attach the end caps to the arms. The splices will be hidden within the tubes that are inserted each into an end cap and eventually one of the sections of the cross piece.

A 1½ volt AA cell battery is also housed in each of the four arms. As shown in the schematic, these four cells are connected in parallel to provide sufficient capacity for a minimum of 50 hours intermittent duty, if you can possibly call *playing the game* duty. Each of the four AA cells are individually wired by soldering a separate black wire to the can (negative terminal) of a battery and a separate red wire to each center post (positive) of a battery. Be careful to use as little heat as possible on the battery terminals and wires and do the soldering job quickly in order not to overheat the battery, as excessive heat will shorten its life. Wrap black vinyl plastic electrical insulating tape lengthwise around the battery to hold in position the negative lead which is brought up towards the positive end of the battery, and also to insulate its terminals. Next, insert each battery into its respective arm of the *Love Game*, negative end first. You now have two sets of leads extending from each arm-end cap combination. They are the two switch wires and the two battery wires. Refer to schematic diagram if necessary.



Core for a solid construction of Love Game chassis is standard cross piece used for branches in underground sprinklers. Lamp mounting holes are drilled for snug fit of PR6 Lamps. Switch holes are ⅜-in. diam.

Mount the fifth Leviton switch, S4, in the center hole drilled in the cross piece. Solder a separate No. 22 gauge insulated wire to the base button of each of the four PR6 lamps, again being careful not to use too much heat. Strip ¼-in. of insulation from four separate pieces of solid wire and insert one stripped end through each of the four holes where the lamps are to be mounted. The pressure of the slip fit (see drilling diagram) between the metal base of a lamp, the bared wire and the plastic of the cross piece will form the ground contact and complete the circuit for each lamp. Be careful not to press on the fragile glass bulb or to use the bulb as a handle when inserting the lamps into the plastic cross piece.

Connect all the black (negative) wires from the batteries to the ground contacts of the bulbs, just wired, by feeding them all together through one of the openings in the plastic cross piece. Twist, solder and tape the ground bundle. Do the same with the red (positive) wires, bundling, soldering and taping. Continue following schematic, being careful that no wires are left exposed which might short out the batteries during construction.

LOVE GAME

Starting the Game Love: Unless you insist on stacking the game against a *Stacked Partner*, and who could blame you, the only switch you might remember is S4 in the center of the plastic cross. S5 is isolated from the battery in either direction by two switches (S1, S3 and S2, S4) and it is therefore more difficult to guess whether it is open (*OFF*) or closed (*ON*).

However, the *Table of Darkness* will assist you in determining which switches will most quickly get the lights *OFF* and turn your *action ON*.

Prior to starting the game, the switches are set so that with a flick of one switch, either S1 or S2, all lights will come *ON*. The *Love Game* is ready to begin. Now—darken the room, set the *Love Game* between you and some willing lovely chick—and *Good Luck*.

Caution: It is not considered good form to use to undue advantage any special knowledge you might have gained during the construction of this game during your encounter. However, if by some stroke of faith she finds *your* special switch and turns *you ON* ahead of time, well—from there on you are on your own and—in the *Love Game* you play it by heart.

Just a suggestion, you may want to memorize the identity of the switches and lamps so you, the constructor can cheat, if you want to be sure of winning every round rather than to trust to luck that you'll remember all the positions of the switches and lights. (See photo for identity) One other bit of information. The Leviton (or equiv.) switches are obtainable from most hardware or electrical supply departments as are the PR6 lamps and AA cell batteries. The plastic pipe and associated fittings are easily obtained from garden supply shops or from dealers who sell underground sprinkler systems. You probably have the wire, solder and tape; the only other materials required in your workshop. ■

TABLE OF DARKNESS

SWITCH	ACTION
S1, S2	(a) Will light lamps I1 and I2 respectively when either S1 or S2 is closed (**ON**), regardless of the position of the other switches. (b) Either one can light all four lamps if S3, S4, and S5 are closed (**ON**).
S3	(a) Will light I2 if S1 is closed (**ON**) and S3 and S5 are open (**OFF**). Of course, I1 will also be lit when S1 is closed (**ON**). (b) Will light lamps I2, I3, and I4 if either S1 or S2 is closed (**ON**) when S4 and S5 are closed (**ON**).
S4	(a) Will light I3 if S2 is closed (**ON**) and S3 and S5 are open (**OFF**). (b) Will also light I2 if S5 is closed (**ON**). (c) Will also light I1 if S3 is closed (**ON**).
S5	(a) Will light I2 if S1 and S3 are closed (**ON**). (b) Will light I2 if S2 and S4 are closed (**ON**). (c) Will light I1 and I2 if S2, S3, and S4 are closed (**ON**). When S2 is closed I4 will be lit and when S4 is closed I3 will be lit.

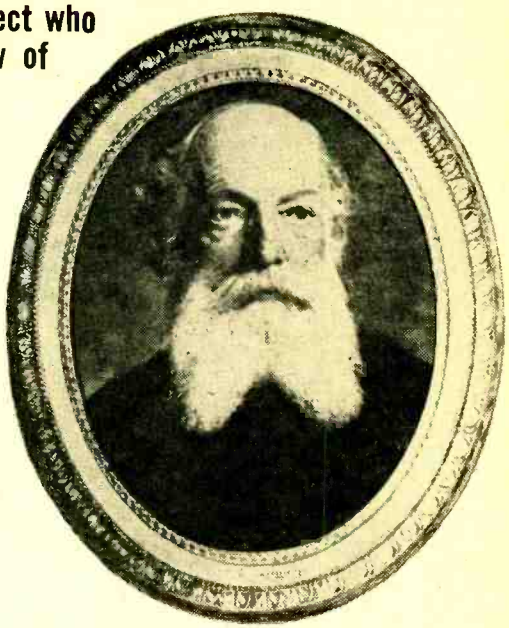
• Watch Out You're Not Cooked!

With the coming of the microwave oven, consumers must become aware of the possible inherent dangers of such devices. Manufacturers working closely with the government agencies are eliminating design troubles. However, you, the consumer, must be informed of simple safety tips. Here are ten you should know:

1. Read the instruction manual for the manufacturer's recommendations for safe operation of the oven.
2. Examine the oven for evidence of shipping damage.
3. Stay at least a full arm's length away from the front of an operating oven. Microwave field strength decreases with distance!
4. Switch the oven off before opening the door.
5. Do not allow children near the viewing port to watch the cooking of food.
6. Never insert objects (for example, a fork prong, aluminum foil, wire) through the door grill or around the door seal.
7. Never tamper with or inactivate the oven safety interlocks—devices to turn off the oven automatically when the door is opened.
8. Never operate an empty oven.
9. Do not use metal cookware.
10. Frequently clean oven cavity, door, and seals with water and mild detergent. Do not use scouring pads, steel wool, or other abrasives. ■

Dmitri Mendeleyev—the college reject who formulated chemistry's periodic law of elements.

GREAT MEN OF SCIENCE



Dmitri got off to a bad start. Ambitious for the last of her seventeen children, his mother took him all the way to Moscow so that he could study at Russia's greatest university.

His Siberian accent, however, was too much for the director of admissions. That's why Mendeleyev (or Mendeléeff or Mendeléev as his name is frequently rendered in English) had to settle for the Pedagogical Institute in St. Petersburg.

He made the best of a less-than-satisfactory situation, majored in three fields: physics, chemistry, and mathematics. No self-respecting university would permit a student to undertake such a program today; even in the 1850s a three-pronged attack upon nature's secrets was not the usual approach.

After graduating at the head of his class, the youth whose name sounds as though it might have come from a comic song, tried his hand at teaching.

He wanted the equivalent of graduate study in his fields of interest. Reluctantly, Dmitri went abroad because Russia had no first-rate physical scientists. First in France, and then in Germany, he was exposed to then-new ideas about the nature of elements.

Still, his doctoral dissertation was tame enough. It dealt with "The Union of Alcohol with Water."

For years, inquisitive scientists had been trying to make some kind of order out of the hodgepodge of elements. No one came even close to reaching that goal.

Mendeleyev decided to tackle the problem.

A full professor at the University of St. Petersburg at thirty-one, he had great confidence in himself. As a start toward finding some pattern running through the tangled maze of chemistry, he made sixty-three cards.

Each of Mendeleyev's cards represented one of the elements already isolated and named by scientists. Experimenting first with one pattern, then another . . . and another, and another . . . the Russian thought he saw a glimmer of light.

It came as a result of using lithium (atomic weight 7—an exceptionally lucky number!) as a starting point. The elements beryllium (9), boron (11), carbon (12), nitrogen (14), oxygen (16), and flourine (19) followed.

Then there was a great break in the chain. The next known element, sodium, has an atomic weight of 23.

Probing, questing, arranging and rearranging his cards until some of his friends privately agreed that he had gone mad, Dmitri stumbled on one of nature's secrets. Though more than three times as heavy as lithium, sodium has some properties remarkably like those of the silver-white metal. He thought about this for some time.

(Continued on page 101)

FCC NO CODE TEST

Will a brand new CB-type band get the FCC's green light?

No code test—no technical exam—to get a ham license. A dream? Perhaps. But, this dream might come true. The FCC is giving consideration to a proposal to establish a Hobby Class Amateur Radio Operator license. If the FCC adopts the proposals contained in a petition filed by Wayne Green, editor of 73 Magazine, here's what you will be able to do lawfully.

- Operate a ham station, using FM phone, on any frequency between 220.5 MHz and 224.5 MHz—that's a band 4000 kHz wide.
- Use transmitter power up to 100 watts.
- Gab to your heart's content about almost anything as long as you don't use profane or obscene language.
- Communicate with any other ham station of the same class as far away as your rig will reach.
- Talk as long as you want without silent periods.
- Install your antenna as high as you want.

On CB, thousands of CBers who would like to be hams, but are too lazy to practice code and study theory, are violating the law by doing the following which are prohibited:

- Exchanging communications with other CB stations for longer than five minutes at a time.
- Communicating with stations more than 150 miles away.
- Using the intrastation channels for interstation communications.
- Operating transmitters with input powers of more than 5 watts.
- Installing antennas more than 20 feet above an existing man-made structure or natural formation.
- Talking (over the air) about technical operations of their equipment, and using CB radio for hobby-type operations.

If you're one of the thousands of electronics experimenters who would like to be able to lawfully use two-way radio for the fun of it without having to pass a theory exam—and learn to send and receive International Morse Code—your dream has a good chance of coming true.

For 36 years—since the FCC was established in 1934—the FCC has steadfastly refused to waive the requirement for a code test for ham license applicants. But, now that England licenses beginner hams to operate at frequencies above 144 MHz without requiring applicants to pass a code test—and because uncontrollable chaos exists on the Citizens Band because of hobby-type operations—the FCC shows signs of bending.

Wayne Green, in his petition, proposes that hobby class license applicants need only to pass an exam on FCC rules and regulations. Instead of having to go to an FCC field office, the exam could be administered by any holder of a General Class (or higher) Amateur Radio Operator license.

The probability of this dream coming true is very high. Once the door has been opened a crack, the ramrod of public pressure will undoubtedly push the door wide open. The FCC can expect a deluge of letters demanding issuance of a notice of proposed rules changes, followed by demands for their adoption.

Some of you who do not know the significance of 220.5 to 224.5 MHz might be wondering if the band is worth having. Rest assured—it is.

Most hams operate in the HF bands on which DX communication is the big thing. Relatively few operate in the VHF and UHF bands above 54 MHz because of range limitations. But, the trend is upward in frequency because of higher quality communication in spite of reduced DX capability.

During and before World War II, UHF started at 30 MHz. Now, the VHF band extends between 300 MHz and 3000 MHz.

Almost all land mobile radio communi-

(Continued on page 104)

WATER WATER EVERYWHERE

and not one drop fit to drink!!!

by James S. Gupton, Jr.

Lack of pure drinking water is not a foreboding of the future. Unfortunately, it's a sad reality right now. The truth is we are running out of *fresh water*. Our ever-increasing population creates demands for water that far exceed the supply from our natural water sheds. To meet this increasing demand for water, our municipal water distribution systems must be augmented with water taken from streams and rivers that have been polluted by mankind and industry.

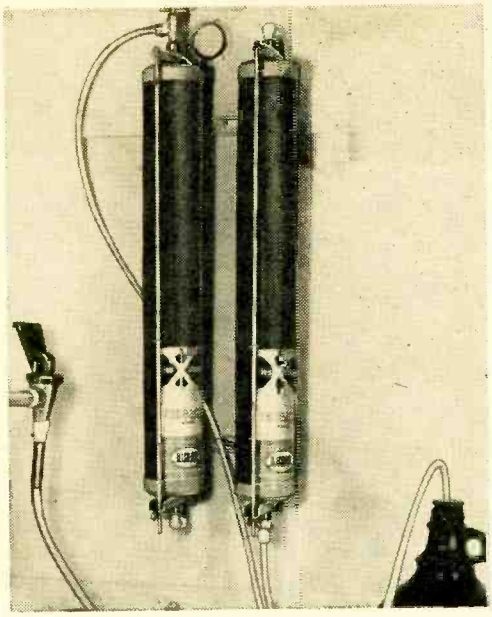
How does all this affect you as an individual? After all, you receive your water from the local municipal water system that both local and/or federal Departments of Health have certified to be pure. But is it really? The typical municipal water system depends upon a sand filtration method to remove impurities from the supply. Though sand filtration removes foreign particles

e/e WATER WATER EVERYWHERE

50 microns or larger, chemicals must be added to make the water safe for drinking. Thus, even though your water may look perfectly clear and is chemically safe to drink, lurking beyond the ability of the human eye to detect, chemical and mineral impurities may even create foul odors that make the water unsatisfactory. These invisible particles can wreak havoc on the unsuspecting public.

Typical Pollutants. Let's delve into the realm of particles so small they can only be detected by the magic lens of the microscope. Here we can get a first-hand view of just how pure (?) our drinking water is. In order to have a better understanding of microscope measurements, let's consider the micron, the standard of measurement for microscopic objects. (No, it's not something found in water, that would be a microbe!) A micron is a unit of measurement based on 1/1000th of a millimeter. To put that in inches, a micron would be 0.00003937 inch. Definitely too small to be measured with a yardstick, wouldn't you say?

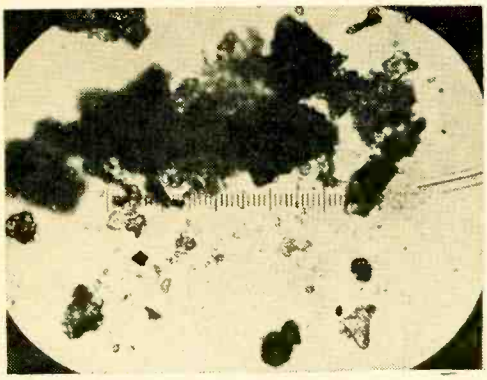
Now for the microscope. In one of our photos you will see the typical contamination contained in the water that comes out of your faucet if the water pipes in your house are made of iron. Contamination shown in this particular picture containing iron rust, algae, and mineral crystals is capable of cumulative effects on mankind. The older the neighborhood you live in, the more the water supply will be contaminated from the very pipes that bring you the water.



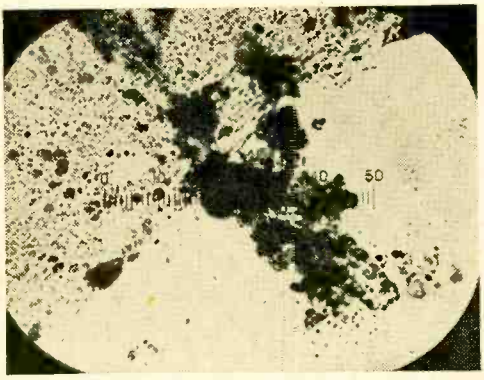
Inexpensive dual water filter is typical of supplemental units equipped with auto backflush feature delivering pure water.

This probably is one reason travelers are warned not to drink the local water. Natives who have consumed this contaminated water all their lives and probably have developed an immunity to it, but visitors are often made violently ill from *just a glass of water.*

Helpful Improvements. If you live in a newer neighborhood that has developed during the era of copper plumbing, you'll have a better water supply than if you live in the older housing areas. Another of our photos reveals the contamination found in water taken from copper water pipes. Though the



Water delivered by iron plumbing often looks like this. Particles of rust, iron oxides, add to pollutants already present.



Water flowing through copper tubing looks slightly better than example to left; soldered fittings partly cause problem here.

iron rust is missing, it is possible to have contamination from copper, solder, solder flux (which is an acid), in addition to the normal impurities inherent in sand-filtered water supplies. The relative size of the particles is measured by the scale on the picture, wherein each division represents 2 microns or 0.00007874 inch.

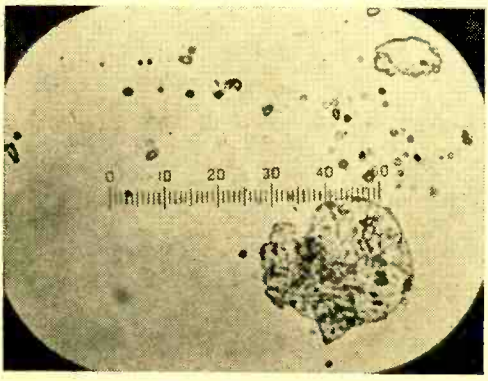
The most recent development in home construction is the use of plastic or PVC water lines. It is obvious from our photo that a large amount of contamination contributed by metal water pipes has disappeared, yet many foreign bodies still remain. What, then, can the average home owner do to ensure having satisfactory water to drink? How can we rid our water supplies from pollution?

Learn All You Can. There are many things that we can do to ensure a pure water supply. Hardly a day passes when the problem of pollution of our nation's water supply isn't mentioned in newspapers, magazines, television, and radio programs. How could you miss them? Well, the articles about pollution are seldom found on the sports or bargain sale pages and it's possible you may have gone for a snack or a drink of water just at the time the public service announcements on water pollution have appeared on TV. They've been there. You just happened to have missed them. Make it a point to learn all you can about the pollution of water in your area and appeal to your civic leaders to do something about it.

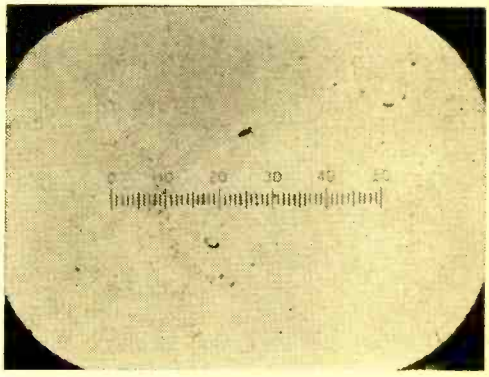
Interim Measures. That's the first step, but it will take years to accomplish noticeable improvements. To bridge the gap between pollution and pure water, intermediate stop-gap measures can be initiated through the use of supplemental water filters in your home. The dual water filter shown in our photos is typical of an inexpensive, supplemental water filter capable of producing water free of pollutants.

We refer to 15-megohm water as a measure of purity that implies less than 5 parts per billion in impurities. This is a total measure including particles of contamination, minerals, algae, and gas. The water in this category is roughly about half as pure as the theoretical purity of H_2O (water), which chemically consists of 2 atoms of hydrogen and one atom oxygen. While cost of the dual filter is relatively low (under $30.00), the volume of filtered water is limited to a little less than 5 gallons per hour. This is enough for a good drinking-water supply, but it's far below the full daily household requirements.

Our photo below shows the effectiveness of a full-volume household filter unit installed between the home and the supply mains. Though not as capable of the ultra high purity of the resin cartridge filter shown in the photo, this higher volume unit will remove all particles of 10 microns or larger at a pressure of 40 to 60 pounds per square inch, providing better than 10 gallons of good water per minute. To prove the results the photo shows the residual contamination left in water after passing through a full-volume filter. One doesn't require a scientific education to see the difference between the pictures shown here. You alone can take action that will bring about a purer water for homes, and eventually to our nation. Think about it, then take action. ■



Plastic plumbing contributes little contamination of its own to water supply. Algae seen are often present in supplies.

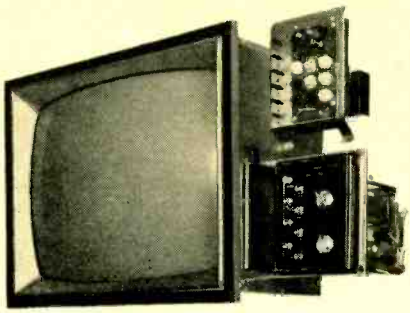


Full-volume household filter removes all particles, 10 microns or larger at pressure of 40 to 60 psi—a water drinker's dream!

New Heathkit® Solid-State

Design and performance features add up to one-of-a-kind superiority.

Over five years were spent in research and development to achieve the notably superior performance, improved convenience features, and ease of service now embodied in the new GR-270 and GR-370. They are premium quality receivers in the truest sense, and, we believe, the finest color TV's on today's market. Here's why...



Compare these features:

- Modular plug-in circuit board construction.
- MOSFET VHF tuner and 3-stage IF.
- Adjustable video peaking.
- Sound instantly, picture in seconds.
- Built-in Automatic Fine Tuning.
- Pushbutton channel advance.
- Tilt-out convergence and secondary controls.
- Hi-fi sound outputs — for amplifier.
- Virtually total self-service capability with built-in volt-ohm meter, dot generator, and comprehensive manual.
- Premium quality bonded-face etched glass picture tubes.
- Choice of 295" or 227" picture tube sizes.

Exclusive solid-state circuitry design... total of 45 transistors, 55 diodes, 2 silicon controlled rectifiers; 4 advanced Integrated Circuits containing another 46 transistors and 21 diodes; plus 2 tubes (picture and high voltage rectifier) combine to deliver performance and reliability unmatched by conventional tube sets.

Exclusive design solid-state VHF tuner uses an MOS Field Effect Transistor for greater sensitivity, lower noise, and lower cross-modulation ...gives you sharply superior color reception, especially under marginal conditions. Gold/Niborium contacts give better electrical connections and longer wear. Memory fine tuning, standard. Solid-state UHF tuner uses hot-carrier diode design for increased sensitivity.

3-stage solid-state IF has higher gain for better overall picture quality. Emitter-follower output prevents spurious signal radiation, and the entire factory-aligned assembly is completely shielded to prevent external interference.

Automatic Fine Tuning — standard on both sets. Just push a button and the assembled and aligned AFT module tunes in perfect picture and sound automatically... eliminates manual fine-tuning. Automatic between-channel defeat switch prevents tuner from locking in on stray signals between channels. AFT can be disabled for manual tuning.

VHF power tuning...scan through all VHF and one preselected UHF channel at the push of a button.

Built-in automatic degaussing keeps colors pure. Manual degaussing coil can be left plugged into the chassis and turned on from the front panel... especially useful for degaussing after the set is moved some distance.

Automatic chroma control eliminates color variations under different signal conditions.

Adjustable noise limiting and gated AGC keeps pulse-type interference to a minimum, maintains signal strength at constant level.

High resolution circuitry improves picture clarity and new adjustable video peaking lets you select the degree of sharpness and apparent resolution you desire.

"Instant-On". A push of the power switch on the front panel brings your new solid-state set to life in seconds. Picture tube filaments are kept heated for instant operation, and extended tube life. "Instant-On" circuit can be defeated for normal on-off operation.

Premium quality color picture tubes. Both the 227 sq. in. GR-270 and 295 sq. in. GR-370 use the new brighter bonded-face, etched glass picture tubes for crisper, sharper, more natural color. And the new RCA HiLite Matrix tube is a low cost option for the GR-370. See below.

Adjustable tone control lets you choose the sound you prefer ...from deep, rich bass to clean, pronounced highs.

Hi-fi output permits playing the audio from the set through your stereo or hi-fi for truly lifelike reproduction. Another Heath exclusive.

Designed to be owner serviced. The new Heath solid-state color TV's are the only sets on the market that can be serviced by the owner. You actually can diagnose, trouble-shoot and maintain your own set.

Built-in dot generator and tilt-out convergence panel let you do the periodic dynamic convergence adjustments required of all color TV's for peak performance. Virtually eliminate technician service calls.

Snap-out glass epoxy circuit boards with transistor sockets add strength and durability and permit fast, easy troubleshooting and transistor replacement. Makes each circuit a module.

Built-in Volt-Ohm Meter and comprehensive manual let you check circuits for proper operation and make necessary adjustments. The manual guides you every step in using this built-in capability. Absolutely no knowledge of electronics is required.

Easy, enjoyable assembly ... the Heathkit way. The seven-section manual breaks every assembly down into simple step-by-step instructions. With Heath's famous fold-out pictorials and simple, straightforward design of the sets themselves, anyone can successfully complete the assembly.

Heathkit Solid-State Modular Color TV represents a significant step into the future... with color receiver design and performance features unmatched by any commercially available set at any price! Compare the specifications. Then order yours today.

Kit GR-270, all parts including chassis, 227" picture tube, face mask, UHF & VHF tuners, AFT & 6x9" speaker, 114 lbs. **$489.95***

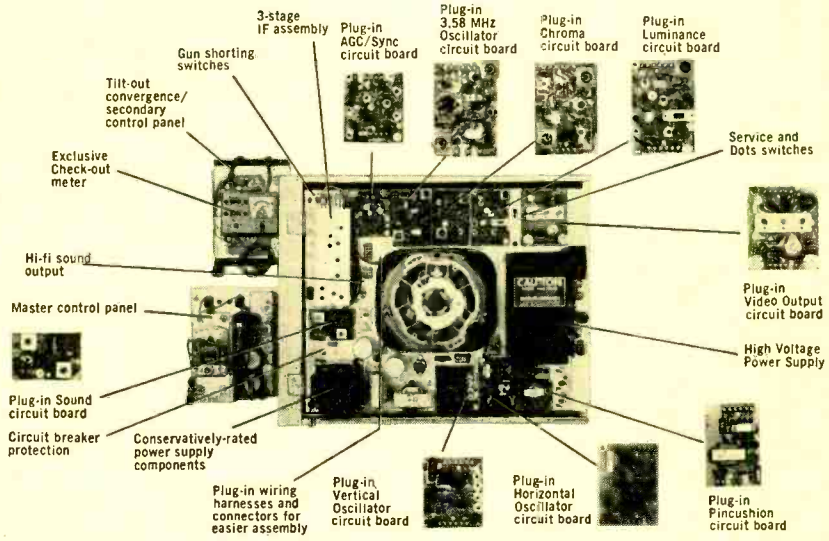
Kit GR-370, all parts including chassis, 295" picture tube, face mask, UHF & VHF tuners, AFT & 6x9" speaker. 127 lbs. **$559.95***

Kit GR-370MX, complete GR-370 with RCA matrix picture tube, 127 lbs. **$569.95***

GR-270 AND GR-370 SPECIFICATIONS — PICTURE TUBE SIZE: GR-370 Approximate Viewing Area: 295 Sq. In. GR-270 Approximate Viewing Area: 227 Sq. In. **DEFLECTION:** Magnetic, 90 degrees. **FOCUS:** Electrostatic. **CONVERGENCE:** Magnetic. **ANTENNA INPUT IMPEDANCE:** VHF 300 ohm balanced or 75 ohm unbalanced. UHF: 300 ohm balanced. **TUNING RANGE:** VHF TV channels 2 through 13. UHF TV channels 14 through 83. **PICTURE IF CARRIER:** 45.75 MHz. **SOUND IF CARRIER:** 41.25 MHz. **COLOR IF SUBCARRIER:** 42.17 MHz. **SOUND IF FREQUENCY:** 4.5 MHz. **VIDEO IF BANDWIDTH:** 3.58 MHz. **HI-FI OUTPUT:** Output impedance — 1 k ohm. Frequency response — ±1 dB 30 Hz to 10 kHz. Harmonic distortion — less than 1% at 1 kHz. Output voltage — 0.3 V rms nominal. **AUDIO OUTPUT:** Output impedance — 4 ohm or 8 ohm. Output power — 2 watts. **POWER REQUIREMENTS:** 110 to 130 volts AC, 60 Hz, 240 watts. **NET WEIGHT:** GR-370, 114 lbs.; GR-270, 101 lbs.

Modular Color Television!

Exclusive Modular Design . . . Circuit Boards snap in and out in seconds for easy assembly, simple servicing



New Expedited 48-Hour No-Charge Warranty Service Plan for Solid-State TV Modules! Special service facilities have been established at the factory and all Heathkit Electronic Centers to expedite service and return of Solid-State TV circuit modules within two working days. During the 90-day warranty period, TV modules will be serviced or replaced with no charge for labor or parts. After the initial 90-day warranty period expires, TV modules will be serviced or replaced at a fixed charge of $5.00 per module for labor and parts for a period of two years from date of original kit purchase.

Add extra convenience and versatility to your new GR-270 or GR-370 Solid-State Color TV with this new ultrasonic remote control kit. Lets you turn the set on and off, adjust volume, change VHF channels and adjust color and tint from the comfort of your chair. Assembles and installs complete in just a few hours and the built-in meter on the receiver makes final adjustment a matter of minutes. Kit GRA-70-6, 6 lbs. $64.95*

Choose One Of These Handsome, Factory Assembled Cabinets

3 models in 295 sq. in.

Luxurious Mediterranean Cabinet . . . factory assembled of fine furniture grade hardwoods and finished in a flawless Mediterranean pecan. Statuary bronze trim handle. 30-1/32" H x 47" W x 17¾" D. Assembled GRA-304-23, 85 lbs. $129.95*

Deluxe Early American Cabinet . . . factory assembled of a special combination of hardwoods & veneers and finished in classic Salem Maple. 29-21/32" H x 37¼" W x 19¾" D. Assembled GRA-303-23, 67 lbs. $114.95*

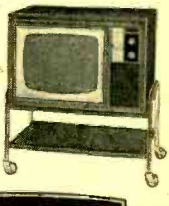
Contemporary Walnut Cabinet . . . factory assembled of fine veneers & solids with an oil-rubbed walnut finish. 29-17/32" H x 35-13/16" W x 19⅞" D. Assembled GRA-301-23, 56 lbs. $74.95*

3 models in 227 sq. in.

Exciting Mediterranean Cabinet . . . assembled using fine furniture techniques and finished in stylish Mediterranean pecan. Accented with statuary bronze handle. 27-31/32" H x 41⅞" W x 19-9/16" D. Assembled GRA-202-20, 70 lbs. $114.95*

Contemporary Walnut Cabinet and Base Combination. Handsome walnut finished cabinet sits on a matching walnut base. Cabinet dimensions 20-31/32" H x 31-7/16" W x 18⅝" D. Base dimensions 7¾" H x 27¾" W x 18⅝" D. **Assembled GRA-203-20 Cabinet,** 45 lbs. **$49.95* GRS-203-6** above cab. w/ matching base, 58 lbs. $59.95*

Handy Roll-Around Cart and Cabinet Combination. Features the GRA-203-20 walnut cabinet plus a walnut-trimmed wheeled cart with storage shelf. **Assembled GRA-203-20 Cabinet,** 45 lbs. . . . . $49.95* **GRA-204-20 Roll-Around Cart,** 18 lbs. . . . $19.95* **GRS-203-5, Cart & Cabinet Combo,** 58 lbs. **$59.95***



NEW
FREE 1971 CATALOG!
Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, guitar amplifiers, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

HEATHKIT
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Benton Harbor, Michigan 49022

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☐ Please send FREE Heathkit Catalog. ☐ Please send Credit Application.
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Address _____
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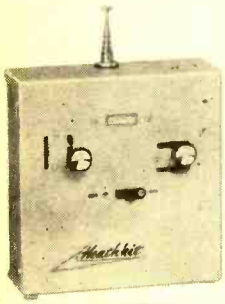
*Mail order prices; F.O.B. factory. Prices & specifications subject to change without notice. CL-392R

8 New Action-Packed Kits From Heath —

Heathkit GD-101
$49.95*



Heathkit GD-57
$129.95*

Transmitter

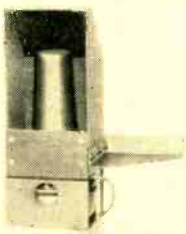
Receiver

Battery Pack

Servos

Heathkit Siren & Speaker
$99.95*

Amplifier & Controls



Exterior Horn

Concealed Horn

Heathkit MI-29
$84.95*

NEW Heathkit "Spectre" ⅛ Scale R/C Car
Join The Most Exciting New Hobby In America . . .

building and racing radio-controlled Grand Prix cars up to scale speeds of 200 mph. The Heathkit "Spectre" R/C car reaches that speed and has already proven itself a winner. And no wonder; its design is unique. It has a chrome plated steel chassis, adjustable caster and toe-in, specially formulated rubber tires that lock onto the cast nylon wheels, independent front suspension for excellent cornering and a 5.5:1 gear ratio for maximum torque at all speeds. The snap on, ⅛ scale car body (length: 19¾") is of high impact plastic — almost indestructable. Suspension is by real coil springs. The radio equipment compartment is dirt and oil proof. The Heathkit "Spectre" is the only complete car kit available. You get the body, chassis, wheels & tires, 4 oz. fuel tank & tubing, equipment case & protective foam, centrifugal clutch & gears, axles, servo linkages & mounting tape, all hardware, decals, numbers and a comprehensive manual. The "Spectre" accepts any .15 to .23 cubic inch R/C engine and any proportional R/C electronics system. It requires only two servos to operate the steering, brake and throttle. Get in on all the thrills of R/C car racing at the lowest possible price . . . order a Heathkit "Spectre".

Kit GD-101, R/C car only, 8 lbs.....$49.95*
Assembled GDA-101-1, Veco .19 R/C engine, 1 lb.....$19.95*

NEW Heathkit 3-Channel Digital Proportional R/C System
For Planes, Gliders, Cars And Boats

Ideal for use with the new Heathkit "Spectre" R/C car to give you total control . . . ease of handling. Here's what the Heathkit GD-57 R/C system includes: Transmitter with assembled, factory aligned RF circuitry; new 2 oz. miniature receiver that needs no IF alignment, in a tough nylon case; you also get two servos; all plugs; connectors; cables; charging cord; new flat-pack rechargeable nickel-cadmium transmitter and receiver batteries . . . and a special soldering iron. You can have your choice of five operating frequencies in each of three bands . . . 27, 53 or 72 MHz. This is the most value ever offered in a 3-channel rig.

Kit GD-57, transmitter, receiver, 2 servos, batteries, charging cord, switches and soldering iron, (specify freq. desired), 11 lbs.....$129.95*
Kit GDA-57-1, transmitter, battery, charging cord, (specify freq. desired), 5 lbs.....$54.95*
Kit GDA-57-2, receiver only, (specify freq.), 1 lb.....$34.95*

NEW Heathkit Siren/PA
For Licensed Emergency Vehicle Only

Hey Chief! Save up to 60% on a new electronic siren/PA system by ordering the low cost Heathkit GD-18. The siren gives both "wail" and "yelp" warnings at 55 watts output power, and you can adjust the pitch. As a public address it will amplify your voice with a full 20 watts of power, and it's practically immune to acoustical feedback. (Either PA or siren can be interrupted to use the other.) Incoming radio calls can be channeled through the GD-18 so you can hear them when away from your vehicle. Use it on any 12-volt auto electrical system with either positive or negative frame ground. It will operate from -20° to 150° F conditions. Control panel is lighted. Comes with gimbal bracket mounting. Take your choice of speakers . . . concealed or exposed.

Kit GD-18, Siren/PA Amplifier, 7 lbs.....$54.95*
Assembled GDA-18-1, Exterior Horn, 9 lbs.....$49.95*
Assembled GDA-18-2, Concealed Horn, 4½ x 4½ x 13", 9 lbs.....$49.95*
System GD-18A, (includes GD-18 plus exterior horn), 16 lbs.....$99.95*
System GD-18B, (includes GD-18 plus concealed horn), 16 lbs.....$99.95*

NEW Heathkit Solid-State Portable Fish Spotter

Costs half as much as comparable performers. Probes to 200 ft. Doubles as depth sounder. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Noise-Rejection Control stops ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Manual explains typical dial readings. Get set for next season; order your Heathkit MI-29 today.

Kit MI-29, 9 lbs.....$84.95*

The Value Leader

HEATHKIT®

NEW Heathkit 5-Band SSB Amateur Transceiver

The new Heathkit SB-102 . . . proud successor to the famous "100" & "101". You can expect top performance and value from this rig . . . and you get it. An all solid-state Linear Master Oscillator delivers faster warmup, greater stability and better tracking . . . new receiver circuitry gives better than 0.35 uV sensitivity for real performance under bad band conditions. Plus all the features that made the SB-101 the world's most famous, most popular transceiver . . . 180 watts PEP SSB input . . . 170 watts CW input . . . 80 through 10 meter coverage . . . USB, LSB or CW modes . . . built-in VOX or PTT operation . . . built-in CW sidetone . . . built-in 100 kHz crystal calibrator . . . Triple Action Level Control for reduced clipping & distortion . . . fast, easy bandswitching and tune-up . . . rugged, inexpensive 6146 finals . . . separate headphone level control & front panel jack . . . simple assembly with circuit board-wiring harness construction . . . sharp Heathkit SB-Series styling plus many more features. Order yours now.

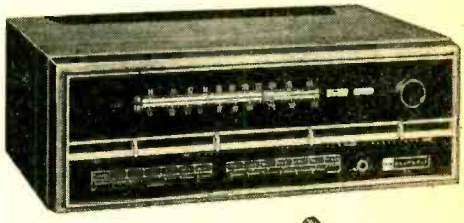
Kit SB-102, 23 lbs. $380.00*
Kit SBA-100-1, mobile mt., 6 lbs. $14.95*

Heathkit SB-102
$380.00*

NEW Heathkit 60-Watt AM-FM-FM Stereo Receiver

Superb stereo performance at budget price, that's the new Heathkit AR-19. A giant, electronically regulated power supply provides 60 watts IHF music power (ideal for all modular and high efficiency speaker systems) . . . frequency response is -1 dB from 6 Hz to 35,000 Hz . . . and Harmonic & IM distortion are less than 0.25% at *any* output. This advanced performance assures you of crisp, clean highs without ringing or breakup . . . solid, clean-cut lows without distortion — just pure, uncolored sound reproduction at all frequencies and power levels. The FM Stereo circuitry is unequalled by any receiver in this price class . . . a factory assembled & aligned FET FM tuners . . . superior overload characteristics & 2.0 uV sensitivity . . . a factory assembled & aligned FM IF circuit board with 4 IC's for superior AM rejection, hard limiting, greater stability and 35 dB selectivity . . . a precision ball-bearing inertia flywheel for smooth, precise tuning . . . two front panel tuning meters for exact station selection. Other features include modular snap-out circuit boards, built-in self-servicing capability, hi-fi AM reception and much more. Make the AR-19 the heart of your stereo system now.

Kit AR-19, 29 lbs. $225.00*
Assembled AE-19, oiled pecan cabinet, 10 lbs. $19.95*

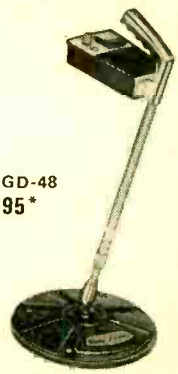


Heathkit AR-19
$225.00*

Heathkit Solid-State Metal Locator

Here's versatile, professional performance in a metal locator at lowest cost. The all solid-state GD-48 uses a unique induction balance detection system that doesn't produce a tone until metal enters the search field . . . eliminates having to listen for a change in tone. The built-in Sensitivity control allows adjustment to detect varying size objects down to 6 feet. A built-in speaker audibly signals presence of metal . . . for higher sensitivity use the accurate front-panel meter. And the front-panel headphone jack lets you use headphones to screen out annoying background noise. Look no further for an excellent metal locator . . . order the GD-48 now.

Kit GD-48, 4 lbs. $69.95*
GDA-48-1, 9 V battery, 1 lb. $1.30*



Heathkit GD-48
$69.95*

Heathkit Screw-Drive Radio-Controlled Garage Door Opener Now Costs Less

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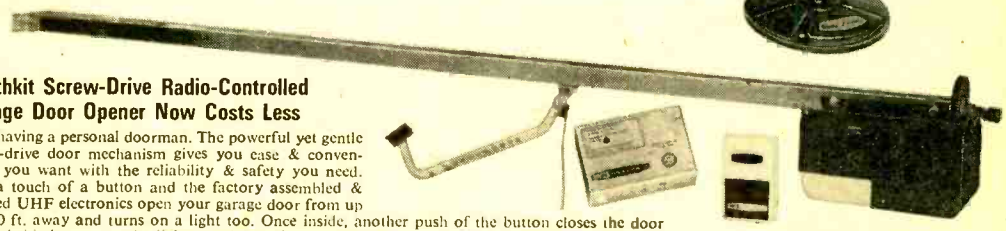
GD-209A, mechanism, receiver & transmitter, 66 lbs. $139.95*
GD-209B, mechanism, receiver & 2 transmitters, 66 lbs. $149.95*



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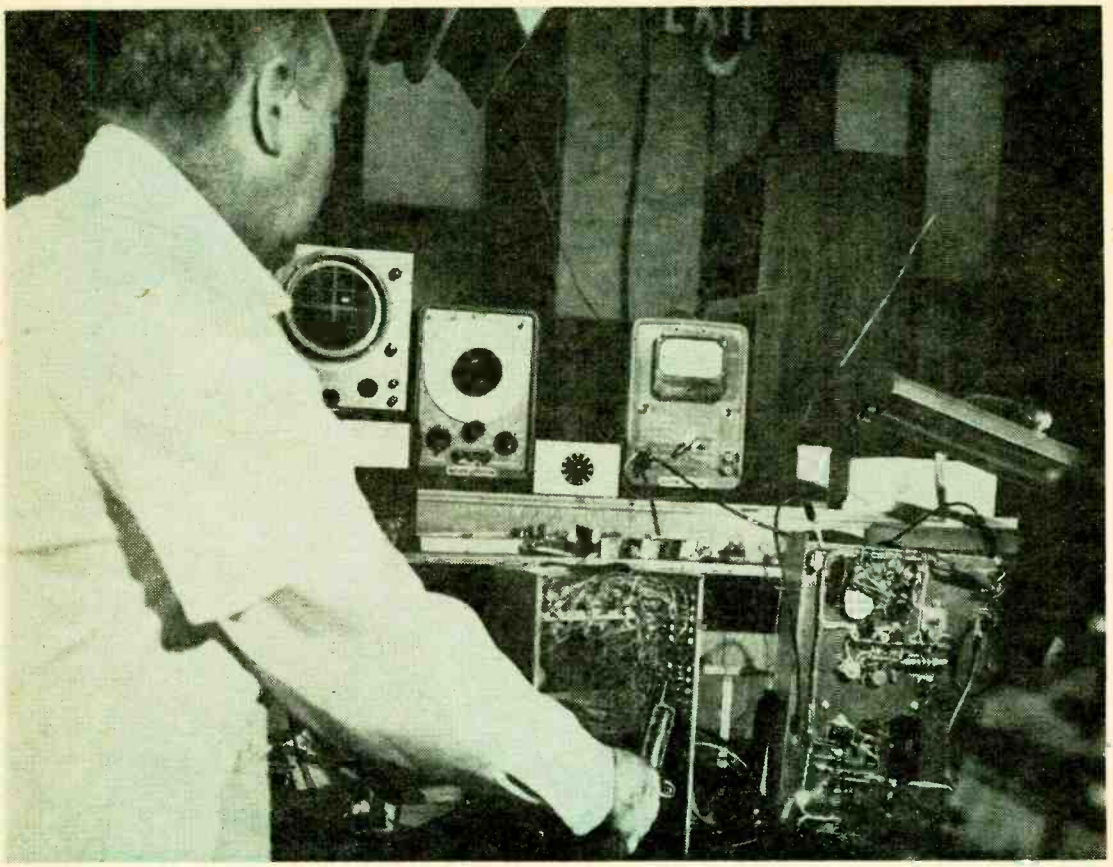
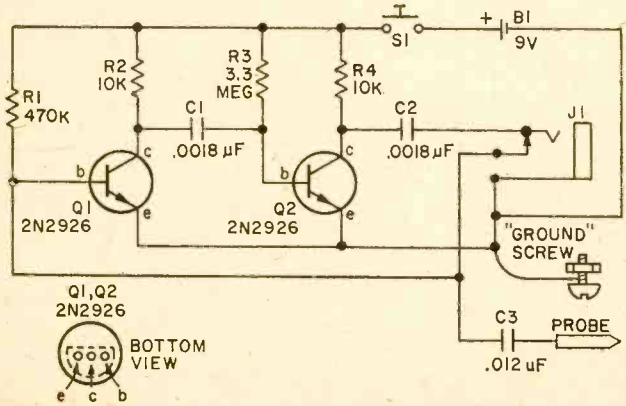


EVER run up against a set with a printed-circuit board that you couldn't get to work for love or money? Ever wish you could x-ray the circuit to find the trouble quickly? We're not pushing x-ray gear, but we have come up with a little gizmo that's almost as good. And while we can't guarantee it'll work every time we've had nearly 100% results using on *Sig-Prob*.

What It Is. Sig-Prob turns out to be about the handiest service tool any serviceman or electronic gadgeteer can have. It can be used to inject its rich-in-harmonics signal into a set, or you can turn it around and trace through the set a signal from another source to locate the stage that's not working. Either technique will quickly pinpoint the trouble.



It's easy to trace the two stage RC amplifier circuit as part of Sig-Probe's overall schematic. Also note that when phones are plugged into J1, C3, feedback capacitor for signal generation is disconnected (see text).

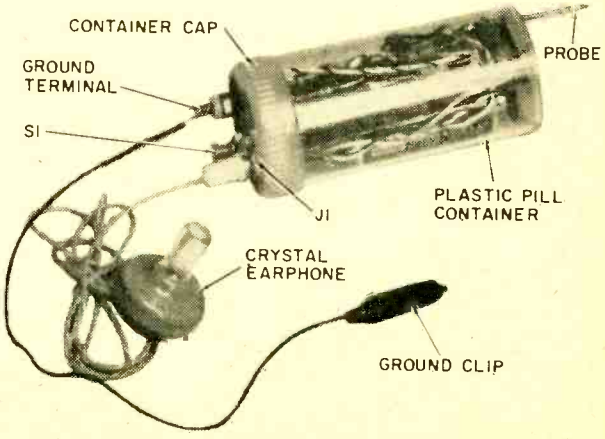
SIG-PROB

Eliminate those service headaches without taking a pill out of our pill-box test instrument

by Rudolf Graf
and
George Whalen

Sig-Prob is a small, hand device that contains a transistorized RC amplifier. It becomes a signal generator with the addition of a small capacitor in a feedback circuit. Whenever the headphone, used when signal tracing to check the presence of signal, is jacked into the probe, this capacitor is disconnected and the two stage RC amplifier is then used to raise the level of signal being checked through a specific point in a circuit so that it can be heard in the headphone.

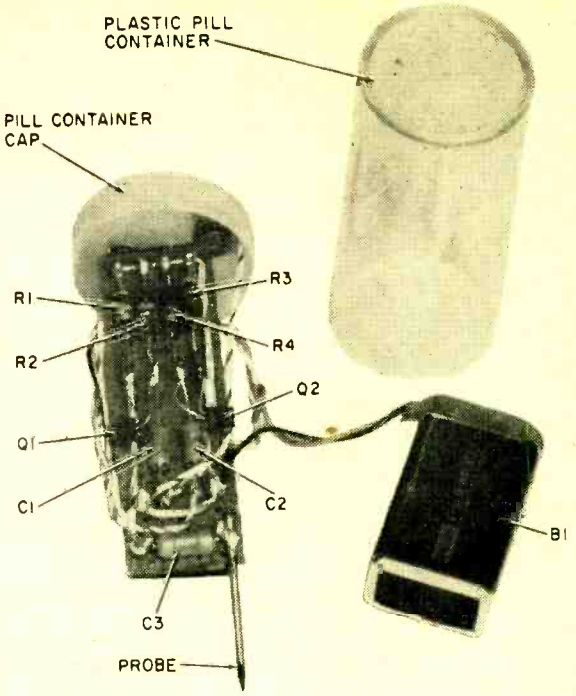
The two transistors and other small components are mounted to a small piece of perfboard. This assembly is slid into a plastic pill container (obtainable from your favorite drugstore), fitted with a probe and energized by a standard 9 V transistor radio



Here's the complete package, which includes pill-box housing circuit board, battery, probe, headphone jack, power switch and ground terminal. Crystal earphone needed when listening for circuit continuity is fitted with a plug for insertion into jack on housing.

battery that also is slid into the pill container along with the circuit board. The probe tip is fixed to the circuit board and passes through a hole drilled into the bottom of the pill container. By this sardine-packing-technique all of the components as well as the battery are held snugly in place when the cap is put on the container so that you wind up with a rugged, self contained service instrument that is most useful.

How It Works. By referring to the schematic you will be able to follow the circuit of *Sig-Prob* easily. When used as a signal tracer the crystal headphone is plugged into Jack J1. This connects the phone across the output stage of the 2-stage RC transistorized amplifier, and, at the same time, dis-



You can see there are no pills in our pill box, just resistors, capacitors, transistors and a 9V battery for energy.

PARTS LIST FOR SIG-PROB

B1—9 V. Transistor radio battery (Eveready 216 or equiv.)
C1, C2—0.0018 μF, 600 V dipped mylar-paper capacitor (Lafayette 34F82346 or equiv.)
C3—0.012 μF, 600 V dipped mylar-paper capacitor (Lafayette 34F82528 or equiv.)
J1—Subminiature closed cricuit phone jack (Lafayette 34F60383 or equiv.)
Q1, Q2—Silicon Planar npn transistor (GE Type 2N2926)
R1—470,000 ohm, ½ watt resistor
R2, R4—10,000 ohm, ½ watt resistor
R3—3,300,000 ohm, ½ watt resistor
S1—Spst NO Subminiature momentary push button switch (Lafayette 34F60011 or equiv.)
1—Battery connector (Lafayette 99F62879 or equiv.)
1—Crystal earphone and phone plug (Lafayette 99F25157 or equiv.)
1—Plastic pill container with plastic cap, 1⅜" dia. x 3" long (your favorite drug store is best source)
1—⅞ x 2¾-in. piece of perfboard (Lafayette 19F83113 or equiv.)
Misc: Wire, solder, 4 penny nail, bolt and nut and alligator clip for ground connection etc.

connects the feedback circuit that converts the amplifier to a multivibrator. The probe feeds signal from the circuit under test to the input of the amplifier, where it is amplified and coupled to Q2 for further amplification to drive the headphone with sufficient power for easy listening.

When used as a signal injector the headphone is not needed, and therefore, is removed by taking the phone plug out of J1. This automatically connects C2 through

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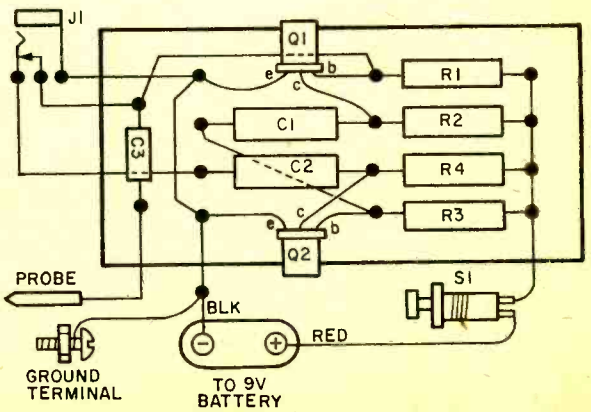


While circuitry isn't critical space is quite limited so we've drawn our layout which uses space available advantageously.

KATHI'S CB CAROUSEL

by Kathi Martin, KAIØ614

"If the boot fits, wear it" repeated my ever-patient ski instructor. That morning, I was supposed to receive my first lesson on the slopes at a sumptuous ski lodge located high in the Berkshire Mountains. So, again, I attempted to jam my feet into those gigantic ski boots. Well, fellow CBers, here I sit back in the office. A pair of rented crutches lean against my typewriter stand. And all over that lumpy, white, cast are the call letters of other CB enthusiasts I met while in the lodge's infirmary—all of us victims of broken bones or sprained sacroiliacs.

This was the first time I've seen CB transceivers carried by either ski instructors or members of a lodge's Slope Patrol. But activity on the Citizens Band doesn't end on this ski resort's slopes. It starts back at the inn, with Allied Radio Shack's Realistic Navaho TRC-23 B transceiver gracing this resort's base station. CB buzzes about the back slopes, too, thanks to a snowmobile-mounted Lafayette HB-625 mobile transceiver.

When I finally hobbled back to the lab a few weeks later, I ran samples of both rigs through their paces. I was very impressed with the way both transceivers operated. But that cute Slope Patrolman who snowmobiled me back to the infirmary also knew how to smooth the ruffles out of this girl's ego.

ALLIED RADIO SHACK TRC-23B

SOMEBODY once said that you could never tell a CB transceiver by its front panel. And they were right, for lurking behind the trim, mod front panel of *Allied Radio Shack's Navaho* rig lies some of the best performance I've seen in CB's low-priced field. While the *Navaho TRC-23B* transceiver didn't exactly remind me of a super-14-karat wedding band, it seemed to me that this transceiver is the perfect match for someone just starting out on CB's long and twisty road. For instance, let's look at the *Navaho's* front panel controls and switch setup.

Consisting of *channel selector, volume/power on-off* and *squelch*, the *Navaho* gives the CB enthusiast all the knobs he really needs to twiddle with. In my opinion,

(Continued on page 64)

Allied Radio Shack's Navaho TRC-23B

LAFAYETTE HB-625

IF all the guys I've known were built like *Lafayette's HB-625* I'd have a heck of a hard time trying to pick a favorite among them. Geepers, talk about big muscle in a mobile rig! *Lafayette's HB-625* certainly came through back on the slopes with tiger-sized performance.

My first impression of this rig was formed as that mod, mechanical St. Bernard called a snow mobile drove up to meet me. Nestled underneath the snow cat's windshield was this teensy CB rig.

And when I looked closer, not only did I see that this was the might-mite *Lafayette HB-625*, my eyes nearly fell out when I noticed that it was being powered off its own

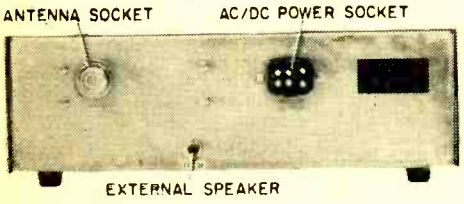
(Continued on page 65)

Lafayette HB-625

no rig worth its salt really needs more than these three control functions. And as every rig you're likely to run across has a *S/RF output meter,* Radio Shack also dandies up the front panel with one of these doojiggies.

Last, and absolutely not least, the *Navaho TRC-23B* sports a couple of bar-shaped lights. These tell you not only when you're transmitting, but show how well your voice signal's socking it to the transmitter!

Walking Or Hopping. Swinging around to



Zap Navaho with juice, twist on antenna, hit mike switch—you're in CB country!

this rig's back panel, you'll really begin to appreciate how simplicity can work for you. All that's visible to the eye is an *External Speaker Jack,* and *AC/DC power socket.* What could be easier for the CB enthusiast-to-be as he learns how to frug around CB's freqs? All the guy or gal has to do is plug in the microphone, twirl the antenna connector to his "stick," and start talkin'!

Speaking of talking, the *Navaho TRC-23B* comes with its own microphone. At the business end of the retractible mike cable is a connector unlike any I've seen on CB gear. I asked one of the fellows at the office why Radio Shack used this connector on the *Navaho.* He said that it helped Radio Shack's *Navaho* keep noise and buzzing sounds out of the mike cable. Sounds like a good idea to me.

Muscle Flexing. Naturally, in this day of miniskirt and micro-circuit, the entire *Navaho TRC-23B* transceiver is all solid state. The receiver part of this rig is double conversion, but the goodies don't stop here. Buried in a shiny little can on the printed-circuit board is a mechanical filter; this is the gizmo that gives the *Navaho* its excellent overall intermediate frequency selectivity.

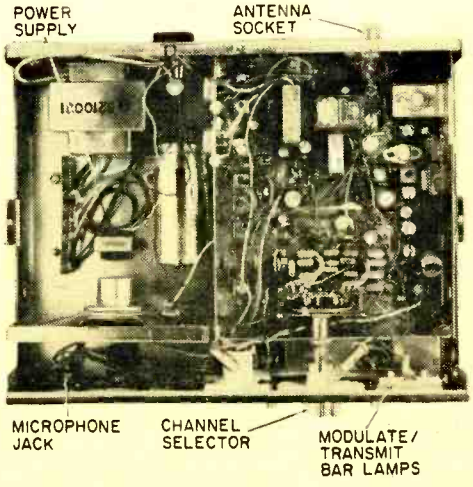
Also built into this rig is a 117 VAC power supply. You'd be surprised how many inexpensive rigs leave out this important feature. And further making my life simple is a power cord outlet that automatically selects either the internal AC power supply, or an external, negative-ground 12 VDC battery source.

A five-stage transmitter rounds out the *Navaho* rig. Here too, simplicity's king of the roost. The Radio Shack folk don't want you—or a screwdriver-equipped girl friend—to fool around with the transmitter's adjustments. So they tucked all these hands-off parts inside the rig's cabinet. Thing is, the *Navaho's* supplied factory-adjusted for any CB-type, 50-ohm antenna, so you've got no reason to poke around the *Navaho's* innards.

Three Ring Performer. Big Question Number One asks whether this 3 17/32-in. H X 11 13/32-in. W X 8⅞-in. D rig can really snag those micro signals bounding down the receiver antenna terminals. My answer is yes! Although receiver sensitivity measured 1.6 uV—a respectable figure for this CB warrior—the *Navaho's* background noise is so low that this rig can often receive weak signals sometimes not even heard on more sensitive (and more costly!) rigs.

I measured adjacent channel rejection, too, and found that to be a respectable 42 dB. The *Navaho's* ability to reject images is a very hefty 60 dB, and AGC action for a test signal level range between one and 10,000V was an ear-pleasing 6 dB.

(Continued on page 101)



Bottom view of Allied Radio Shack Navaho TRC-23B reveals easily serviced chassis, but it's unlikely rig'll ever need radio doctor giving it electronic medication.

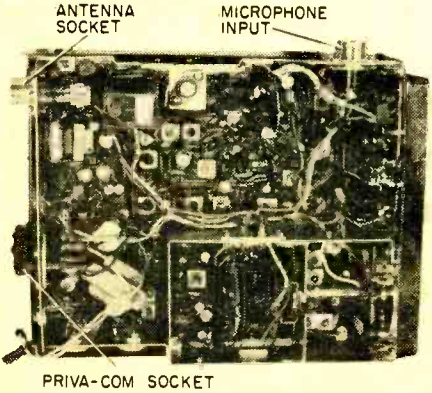
battery pack. It must have been packing one heck of a transmitting wallop, for the base rig back at the infirmary was miles away, and the Berkshires were in the received signal's way to boot!

Lasting First Impressions. When I removed the HB-625's top cover, I was amazed at the densely packed, but well-thought-out parts placement on the printed-circuit board. And the way all of the major adjustments were accessible from the rear panel.

But *Lafayette's HB-625* circuit is the really big kicker. Though this rig's basic design is some three years old (I'm told), it has been updated with the help of three integrated circuits. One of these IC's works as an *RF noise silencer.*

The great thing about an RF noise silencer is that it kills ignition noise *before* the noise wipes out the rest of the received signal in the rig. And if you think that's not a half-bad idea, try coupling it with an *IF noise silencer*—the sound of *Lafayette's HB-625* silence is really deafening! I wanted to know a bit more about this IF noise silencer, so I poked around the schematic.

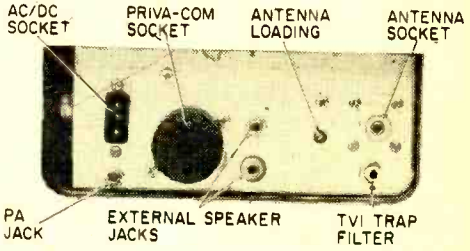
What I found out was that the IF noise silencer is really a mini-receiver turned to an "unused" frequency just outside the CB band. Since the noise on this unused channel is the same as on a received CB channel, the IF noise silencer's output kills the receiver's output by punching a hole in the received signal that corresponds to the noise pulses. You can't see the hole in a doughnut, and you certainly can't hear the minute holes created by the noise silencer in the receiver's noise output level.



It's no small wonder that Lafayette's HB-625 puts out in absolutely first-class fashion—let your baby blues run over jam packed printed-circuit chassis.

And this isn't where *Lafayette's HB-625* quits in quality-ville, either. The *HB-625* also has *Lafayette's* tried n' true *"Range Boost"* working for it. This gizmo is really a speech compressor that completely prevents overmodulation.

Not only that, it dished up an extra 10 dB of talk-power to the rig's modulator stage. That's a plus for Lafayette in my book; I have a habit of lowering my voice almost to whisper level when I'm on the air. But with this feature working for me, I could almost turn my head away from the mike, and lower my voice to a seductive whisper, before the S/RF meter needle quit its up-scale dance.



Derriere of Lafayette rig swivels with Priva-Com socket, other rear-end goodies!

Front Panel Doings. If looks are deceiving, then *Lafayette's HB-625* must be a wolf in sheep's clothing. Like that front panel, with it's kicky, round, *Channel Selector* sweeping you through all 23 channels—and the PA function, too—faster than Cinderella's carriage. And how about the *Volume* and *Squelch* control knobs gleaming above the walnut-finished front panel. Then, there's the *Delta Tune* control knob, a three-position affair, and the *IF silencer* selector switch sticking its head above that classy looking front panel.

Rear Panel Jazz. The *Lafayette HB-625* rear panel sports almost every conceivable external jack and control widget that the serious CBer needs to make himself heard. For instance, there are two *External Speaker* jacks, beside the *PA Speaker* jack. You've also got the antenna connector hiding on this panel. *Antenna loading* is also externally available to the CBer. And there's one more control to stick a screwdriver into. It's labelled *TVI,* and its sole job is to keep the peace between you and your television-staring neighbor. Of course, you've got your *AC/DC power* socket located on the back

(Continued on next page)

panel, and the *Priva-Com* socket.

If you've never heard of Priva-Com, it's Lafayette's ultimate noise-pollution reducer. You buy the Priva-Com accessory as an option, and plug it into the socket provided on the *HB-625*.

Now the receiver's output is completely cut off—until someone with a Priva-Com on their rig calls you through this accessory. The big operating feature here means that with Priva-Com you don't have to rely upon either noise cancelling circuit in the *HB-625* to kill band chatter. Priva-Com does it all for you; it really allows you to adjust the squelch control for its optimum setting, especially when you're receiving a message. That's when you need it most.

Heart of the Matter. Packed inside the *Lafayette HB-625's* cabinet is its double-conversion receiver, and conventional, four-stage transmitter. Measuring receiver sensitivity was a joy to behold, as 0.6 uV winging down the receiver's antenna terminals produced an excellent 53 dB adjacent-channel rejection figure.

Image rejection was an interference-free 88 dB, while the AGC action for a one to 10,000 uV test signal range was 11 dB. The 11 dB figure is a little high when compared to lesser quality rigs, but I doubt that you'll be able to hear the difference in signal level.

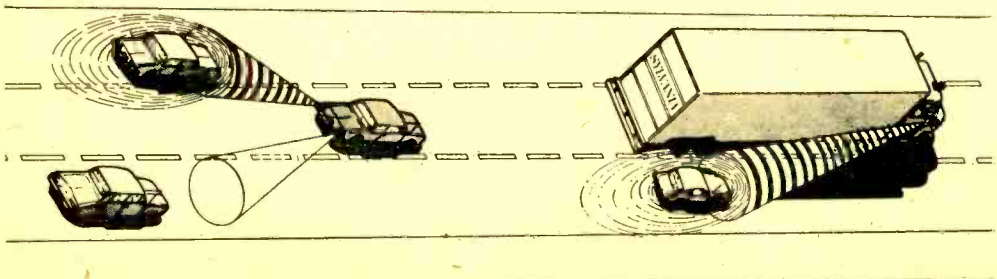
The transmitter portion of the *HB-625* is as easy to work as my extension 'phone. Push the transmit button on the mike, and talk! And a nifty jewelled red light located on the front panel shines when you punch the transmit button. Needless to say, the transmitter's supplied pre-tuned for the standard 50-ohm antenna load.

Parting Words. Even though we're well beyond Christmas, for $189.95 you can easily afford to play Santa again. The price includes all crystals, microphone, DC power cable, and a mobile mounting. If you want to convert the *Lafayette HB-625* to base station operation, then you'll also need their model HB-502B AC power supply. This accessory sells for $19.95. And if you really want to mobilize your *HB-625*, get their HB-506 portable DC power pack. Selling for $19.95, it attaches to the *HB-625*, permitting portable DC operation with its battery pack, telescopic antenna, and shoulder strap. Learn more about Lafayette's *HB-625* transceiver by writing to: Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, N.Y. 11791.

Officer, I didn't hit him—he backed up!

If you are the kind of driver who is plagued by other drivers sneaking up behind you—rejoice. There's a new gadget in the works that automatically warns a driver when another vehicle is approaching from his left or right rear blind zone. Engineered by Sylvania and now in the prototype stage, RAWS (*Rear Automatic Warning System—that's our name for it—Editor*) responds to noise generated by engines and tires of vehicles travelling above 35 miles-per-hour. RAWS has an advantage over radar and other detection systems because it can discriminate between moving vehicles and stationary objects such as trees, poles, bridges, road dividers and hitchhikers.

In operation, RAWS supplements existing mirrors by warning the driver that another vehicle is approaching from his rear. Red lights come on warning the driver not to change lanes. RAWS is particularly helpful in fog or rain when the driver has to exercise extreme visual surveillance to change lanes safely.—*Joe Gronk*



E/E examines the newest idea in compacts

LANDMARK 100

Electro-Voice's newest baby coos in surround-sound stereo!

If you can't go to a concert hall or a rock festival, the next best choice is to install a fine hi-fi stereo set in your home. But, you protest, my place is too small to accomodate the size speakers and amplifiers needed to duplicate concert hall sound, with its solid bass, clean highs and midrange—a *real* shimmering wall of sound. You're in for a real surprise, for we've discovered a new integrated compact stereo system that brought forth these comments when we first turned it on.

The Electro-Voice *Landmark 100 System* combines the latest electronic advances along with what appears to be a radically new acoustic development in the special speakers supplied as part of the complete system. All of which contribute to improved stereo sound in this new compact system. The built-in AM/FM-stereo tuner and automatic record changer, as well as input connections for external tape players and/or recorder, provide a versatility of input sources to the system's amplifier and speakers for reproducing any program source the listener desires.

About the Speakers. The most outstanding feature of the Landmark 100 is its speaker system. Termed by Electro-Voice, *Acoust-a-ray*, these babies are completely integrated with the tuner/amplifier. 'Tis said there's nothing new under the sun, and this certainly applies to the speakers that are part of this system. In searching for new, modern technology many good, tried and true ideas have been forgotten by manufacturers. Not so in the design of *Acoust-a-ray*; Electro-Voice has applied

e/e LANDMARK 100

some basic ideas found only in the most expensive speaker systems.

It's How You Slice It. Each speaker enclosure is a cube that's not a cube. The front is a conventional square baffle, but the side and rear surfaces are not uniform. One rear corner is neatly sliced off at about 45° in one plane and then sliced again at approximately 45° midway from the bottom to the top across the rear of the cube. This odd, truncated shape produces baffle planes, containing speakers, that face the back wall and ceiling of the room in which the enclosure is placed. To keep the size nominal (10 x 10 x 10-in.) and still enjoy the power handling capacity necessary to reproduce sound that has sufficient dynamic range to approach the original sound, four speakers are employed.

Three of the drivers are high-compliance, full range, miniature speakers 4½-in. in diameter and the fourth is a 2¼-in. tweeter. One full range speaker faces forward in the conventional position, the others are placed at asymetrical angles at the rear of the enclosure. One is mounted on the corner surface facing to the rear and the third is on the upward canted corner surface, along with the tweeter.

This arrangement utilizes three well known principles:

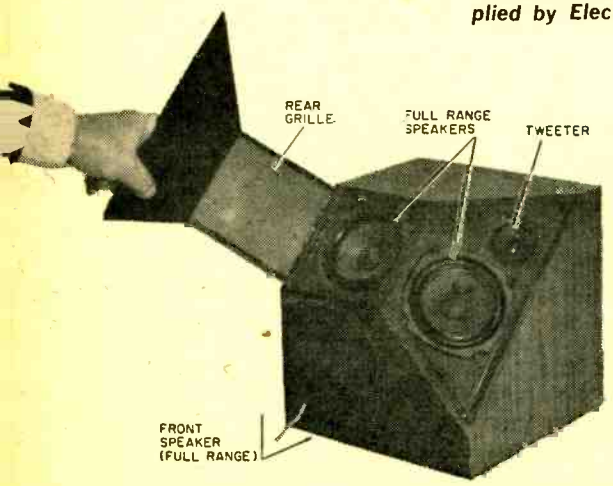
1—Since a single small speaker just can't handle the high power required, by distributing the power between several small speakers, each handling a portion of the total power applied, overload distortion is avoided while overall bass response is improved.

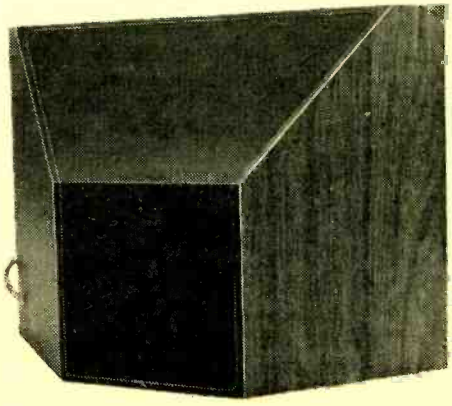
2—By employing multi-directional sound, reflected off the rear wall and corners of a room, the sound will be uniformly spread throughout the room and will eliminate the pin-point radiation effect of conventional small speaker enclosures. The stereo effect can be broad for large rooms or narrow to fill the center hole by changing the placement of each speaker assembly to a different side of the enclosure.

3—By directing the tweeter output towards the juncture of the rear wall and ceiling, the natural *beam effect* of the tweeter is eliminated and the highs are diffused so that all parts of the room rather than one location receives a reasonably equal distribution of high frequencies.

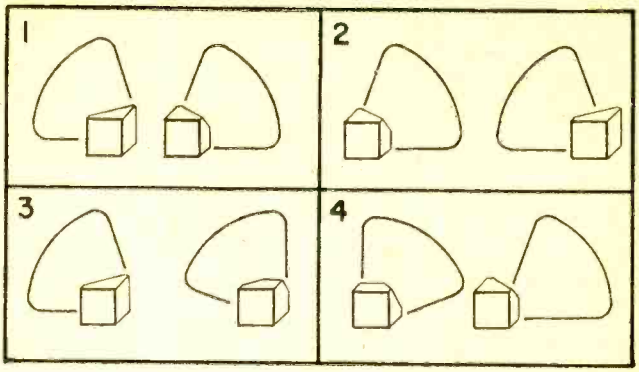
Brings Back the Bass. To all of this Electro-Voice has added what they term *Servo-Linear* motional feedback. This instantly corrects for distortion which may be generated by the speakers at high sound levels. Theoretically, this is how motional feedback works. A feedback network is inserted between the amplifier output and the speaker, which balances out the driving

You can readily see from two views shown here that old adage about the cut is everything for style and fit has been applied by Electro-Voice in designing Acoust-A-Ray speakers. Open cover reveals rear speaker arrangement.





These four basic coverage patterns indicate how, with proper positioning of speaker cabinets, to adapt sound output tailored to listener's preference regardless of room size. Broad, narrow, left or right side—any coverage can be set up.

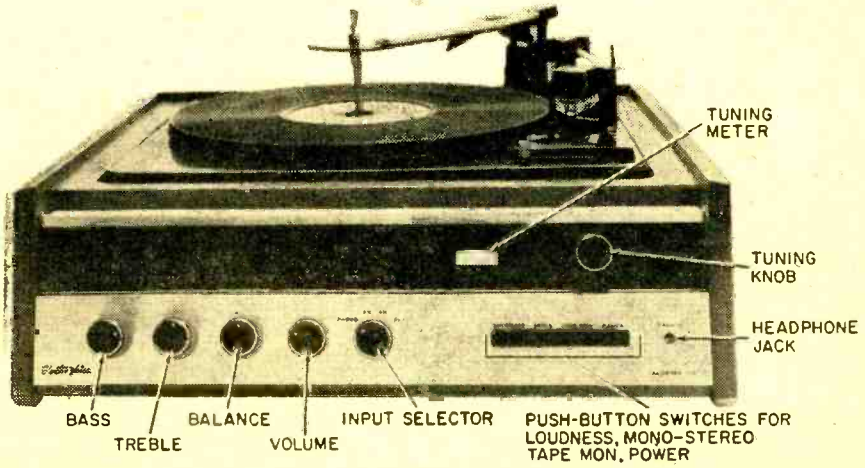


voltage, leaving the back EMF generated by the speaker. The output of this network is fed back to the amplifier input, thus producing a feedback voltage proportional to the cone motion. This is electrically similar to conventional feedback circuits except that it includes the transducer in its path. Because low frequency acoustic output of a speaker in a sealed enclosure is proportional to cone acceleration, and since the feedback circuit corrects response based on speaker velocity, the extra network is required. Bass equalization of 6 db/octave to produce flat response is effected by this circuit. Though we've not been impressed by speaker feedback where applied to large, multi-speaker arrays, we must admit that something in the *Acoust-a-ray* speaker system, supplied with, and forming part of the *Landmark 100* system, is delivering excellent bass from a relatively small speaker enclosure. So, until proven otherwise, we'll buy Electro-Voice's explanation of its motional feedback principle used in *Landmark 100.*

Because of the unusual truncation at the rear, the speaker enclosures can be arranged at different angles to direct the sound and spread it in various patterns simply by orienting each enclosure into different positions with respect to the wall and/or ceiling surfaces. Should it not be possible to place speakers equidistant from the listening position, the stereo effect will not be degraded because, as can be seen from the drawing of speaker coverage patterns, the speakers can be oriented to provide either a narrow or diffused sound source, or, they can be positioned to favor a particular direction.

Though we've waxed poetic about the speakers, let's not underestimate the rest of the units that make up the *Landmark 100 System.*

The Amplifier. The wide-band, low distortion amplifier employs direct coupled silicon circuitry to complement the operation of



You can adjust range and balance, set volume level, select program source, set loudness, select mono-stereo operation and tune receiver, all from front panel controls.

e/e LANDMARK 100

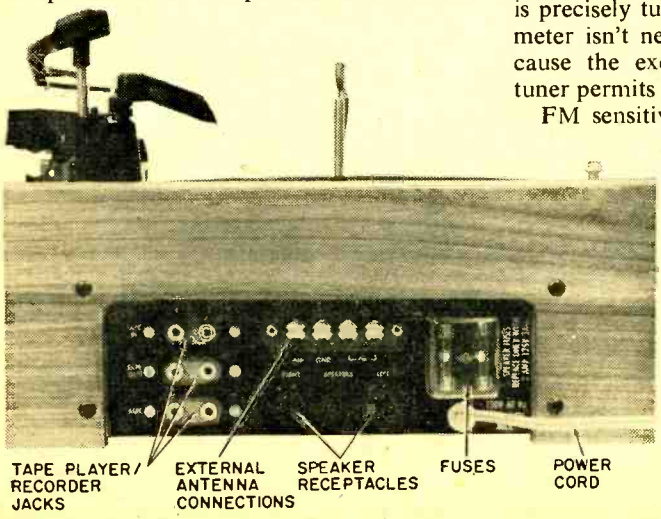
the *Servo-Linear* motional feedback. Because of the integration of amplifier and speakers through the *Servo-Linear* concept, conventional measuring techniques are not appropriate. However, the following specifications highlight the excellent performance of the amplifier. Power output is rated at 100 watts music power ± 1 db, 80 watts IHF; 40 watts continuous sine wave with both channels driven; 20 watts per channel. Total harmonic distortion (THD) is 0.15% at full rated output, measured at 1 kHz. Power bandwidth is 20 Hz to 25 kHz; frequency response is the same within ± 1.5 db. Total acoustic output of the entire system is flat over the range from 50 Hz to 18 kHz. Hum and noise on *AUX* and *TAPE* inputs is -70 db(ref. 100 mV) and on *PHONO* -55 db (ref. 3 mV). Five front panel controls are: 1) Continuously variable cut and boost (± 10 db) for *BASS;* 2) Same for *TREBLE;* 3) *VOLUME;* 4) *BALANCE* and 5) A four position *INPUT* selector. In addition, there are four push button switches mounted on the front control panel for 1) *Power;* 2) *Tape Monitor;* 3) *Mono-Stereo;* 4) *Loudness*, which simultaneously provides bass boost at low volume. As the position of the continuously variable volume control is moved to increase the volume the amount of loudness frequency compensation is proportionally reduced. A jack for plugging-in a pair of stereo headphones, with automatic level compensation for the phones and cut-off of the speakers when the phones are plugged-in, is also mounted on the front panel. Separate jacks for right and left channel for *TAPE-IN, TAPE-OUT* as well as *AUX. IN* connections are mounted on the rear chassis apron, as are receptacles for the speakers, protective fuses and AM/FM antenna connections.

The system is supplied with 16-ft. long, 4-conductor cables terminating in plugs, for connecting the speakers. The owner's manual cautions that these cables must be used as supplied and not shortened. Reason for this, we found on questioning Electro-Voice, is, that total resistance of the cables is incorporated as part of the feedback network and any change in their length will upset the feedback circuitry. Electro-Voice can supply extension cords if speakers must be located further than 16 ft. from the amplifier. They are made with special low resistance cable and have been designed not to affect the feedback circuit.

AM/FM-Stereo Receiver. An FET is incorporated in the front end of the tuner for high sensitivity and resistance to overload on strong signals. Integrated circuits (ICs), complemented by ceramic filters, are used in the IF amplifier and Multiplexer stages. When the system is off, the dial is completely black, with nothing showing until power is applied, at which time, AM/FM dial calibrations appear. A stereo beacon light as well as a center-channel tuning meter is provided for FM reception. Both AM and FM stations are tuned-in by the single tuning knob on the front panel. The zero center tuning meter shows proper tuning of FM stations, indicating when receiver is precisely tuned on the station. The tuning meter isn't necessary for AM reception because the excellent sensitivity of the AM tuner permits precision tuning by ear.

FM sensitivity is 1.9 uV IHF, with hum

(Continued on page 103)

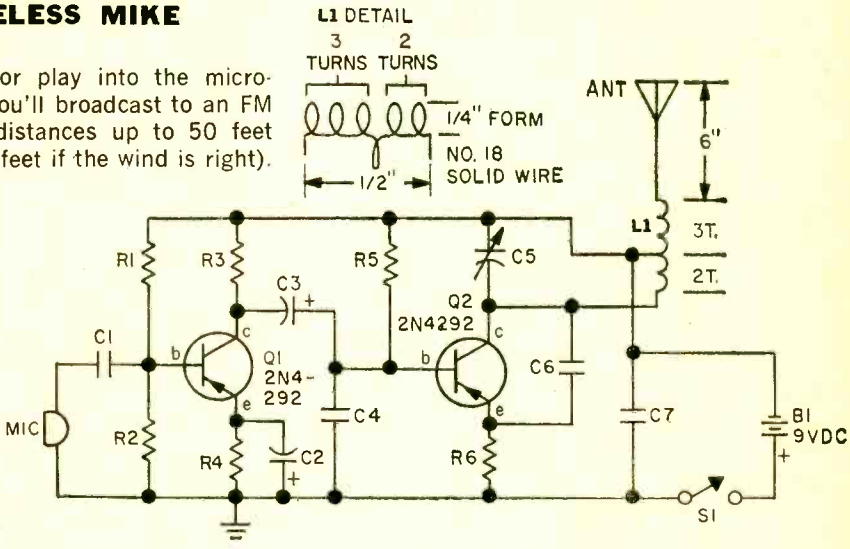


From this rear view one can ascertain how easy it is to make input and output connections and change fuses (if necessary). Screw terminals for external antennae and input/output jacks for tape equipment and speaker receptacles are very accessible here. Though not mentioned in front view you can see location of record changer above receiver/amplifier.

Clip Book Circuits

FM WIRELESS MIKE

Just speak or play into the microphone and you'll broadcast to an FM receiver at distances up to 50 feet (maybe 100 feet if the wind is right).



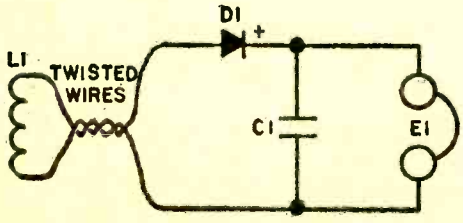
Use standard RF wiring precautions and make coil L1 exactly as shown. Best speech clarity is obtained by using a crystal or ceramic mike. For music reproduction, substitute a dynamic mike element.

The Unit can be assembled on a perfboard using push-in terminals for tie points. The case must be metal to prevent hand capacitance from continuously changing the output frequency. Pass the 6-in. solid wire antenna through the metal case using a ¼-in. hole and a rubber grommet insulator.

PARTS LIST

B1—9-V battery, Type 2U6
C1—0.05-uF, 3-VDC capacitor
C2—20-uF, 3-VDC electrolytic capacitor
C3—5-uF, 12-VDC electrolytic capacitor
C4—47-pF, 25-VDC capacitor
C5—5-30 pF trimmer capacitor
C6—6.8-pF ceramic capacitor
C7—0.01-uF, 10-VDC capacitor
L1—See pictorial detail
MIC—Crystal or ceramic microphone element
Q1, Q2—2N4292 pnp transistor
R1—47,000-ohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
R3—1500-ohm, ½-watt resistor
R4—3300-ohm, ½-watt resistor
R5—100,000-ohm, ½-watt resistor
R6—470-ohm, ½-watt resistor
S1—Spst switch

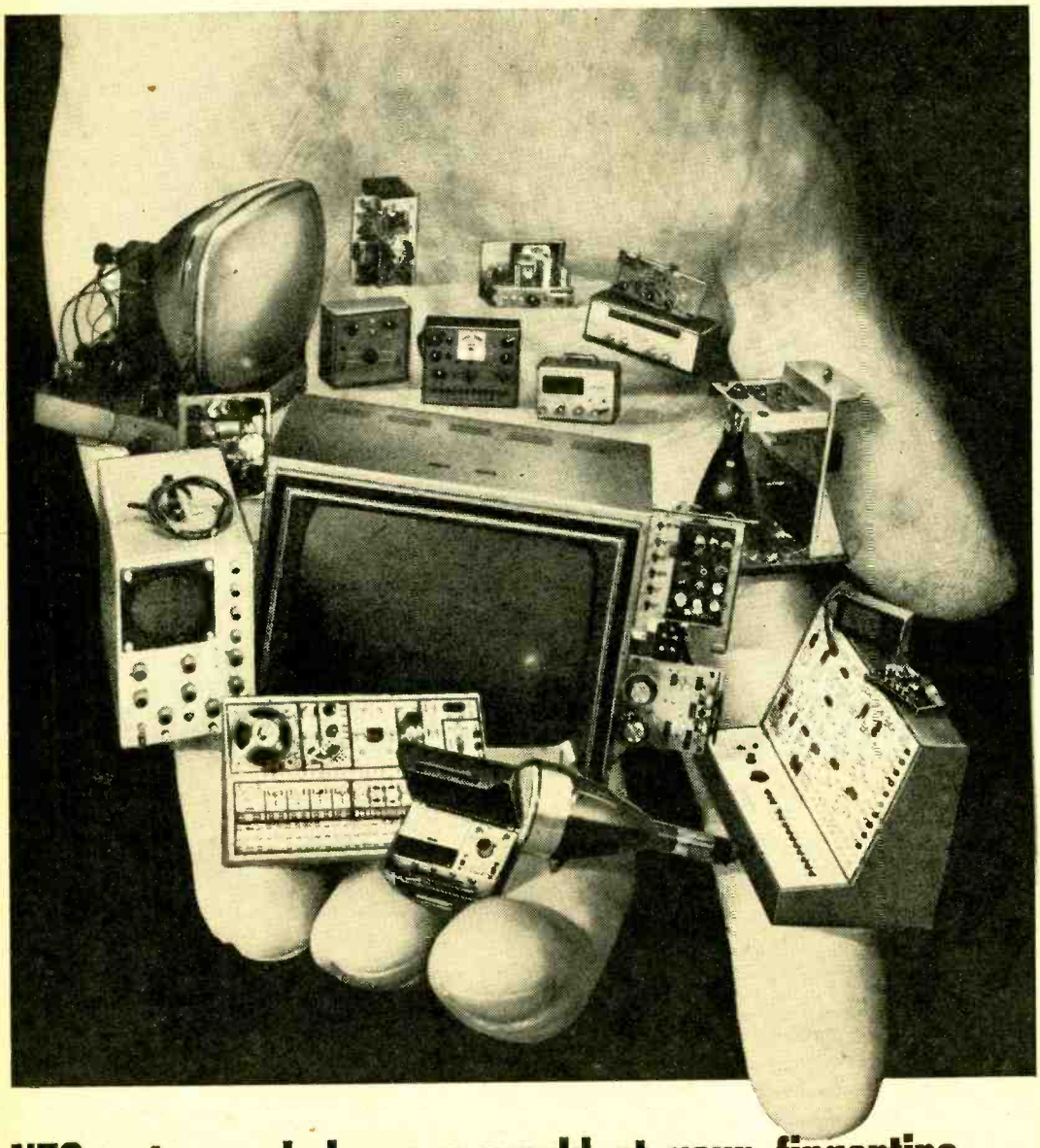
AM MODULATION METER



This simple modulation monitor for AM ham transmitters requires no connection to the transmitter. Just position the loop near the final tank or antenna matching coil until the signal is heard in the headphones.

PARTS LIST

C1—100pF disc capacitor
D1—1N60 diode
E1—Magnetic headphone, 2000 ohms or better
L1—Coil, 3 turns on 1½-in. dia. form, use any thin gauge wire



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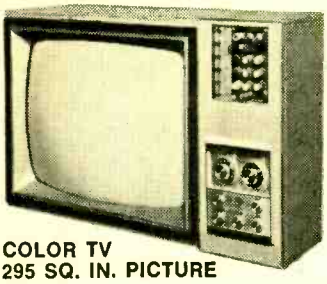

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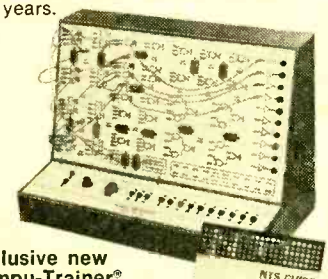

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5 Watt AM Transmitter/ Receiver

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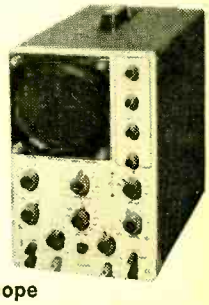

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Let the Stars

Advancing Moon through its phases, changing stellar patterns in Universe, is full-time job of control panel operator as he sits at desk of $170,000 computerized projector.

Closeup of highly-modified tape recorders shows special servo-type faders, toggle switches, too.

Audio control panel's equipped with tape recorders, other professional sound gear. It all makes for out-of-this-world multi-media show biz, eh?

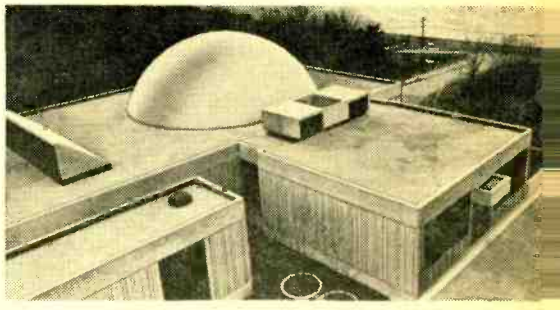
Get in Your Eyes

TRANSCEND the confines of Earth, Time, Space, the Universe. Experience for yourself the sensations of travelling through the four-dimensional universe without ever leaving the ground. It's all happening at a place where young minds can live and grow; where tripping out of this world is both legal and highly encouraged—The Hudson River Museum.

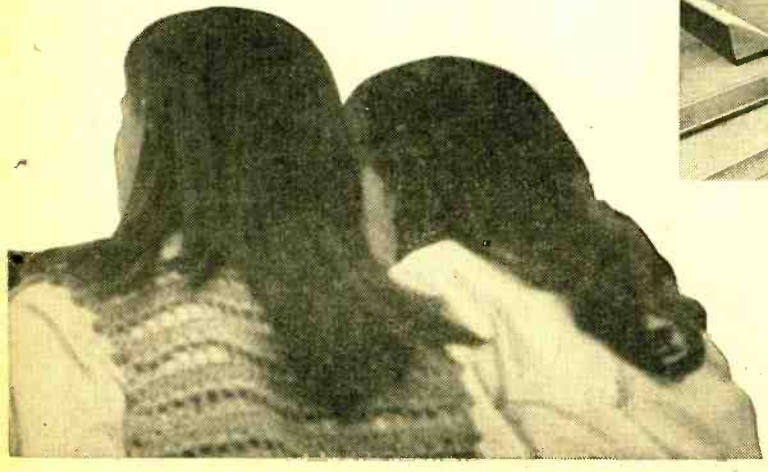
Located on the historic banks of the majestic river from which it draws its name, the Andrus Space Transit Planetarium, a part of the Hudson River Museum, awaits the chance to take you well beyond the Outer Limits' fringes. Andrus' electronic space transit system depends upon both man and machine to convey the would-be astronomer to the darkest reaches of space. Here, computerized equipment that includes multiple space projectors transports the neophyte star gazer through time and space so that he may experience the sensation of actually wandering through the voids of the universe.

A member of the planetarium's audience may operate his individual six-button remote control unit simulating the body sensations in the life of an astronaut. Slowly, he guides his simulated command module onto a rock-strewn target, somewhere deep within the bowels of a never-discovered planet. Or, with the aid of his remote-control unit, our amateur astronomer may discover how the stars look from yet another moon or planet in the solar system. And, further adding to a young space explorer's excitement, the actual pitch and roll of a space ship can be created, allowing him to feel these unearthly sensations—from the safety of his seat on old terra firma.

The would-be explorer comfortably seated in the museum's planetarium can journey back to the dawn of time, too. This modern launching pad for the imagination can pull you back through the ages to various places that existed centuries ago. One may glimpse Dutch sailing ships as they tack up the Hudson River to newly-built settlements. Cities vanish as the space transit equipment—with its exact computer coordinates—projects the pre-historic sky of the Stonehenge twilight. Pictured before you, as if you could reach out and almost touch these monoliths, stand symbols of the ancient culture created by Celtic man. And, as the scene changes on the planetarium's spherical ceiling, the Stonehenge priests give way to Apollo astronauts preparing to conquer the confines of outer space. It's all part of the daily routine at the Andrus Space Transit Planetarium—a place where the future lives today. ■



Hudson River Museum is snuggled among pine, poplar trees not far from bank of Hudson River proper. Atop wood, concrete museum is planetarium's 40 foot dome upon which is projected 3-D-like panoramic scenes of our Universe.



NEWSCAN

Here Comes Tomorrow

The 21st century will see a transportation revolution and it will be happening on the ground. But the roots of this revolution are growing today! Case in point is a 250-mph Linear Induction Motor test vehicle now being low-speed tested on a ¼-mile track by the Garrett Corporation under a contract from the U.S. Dept. of Transportation.

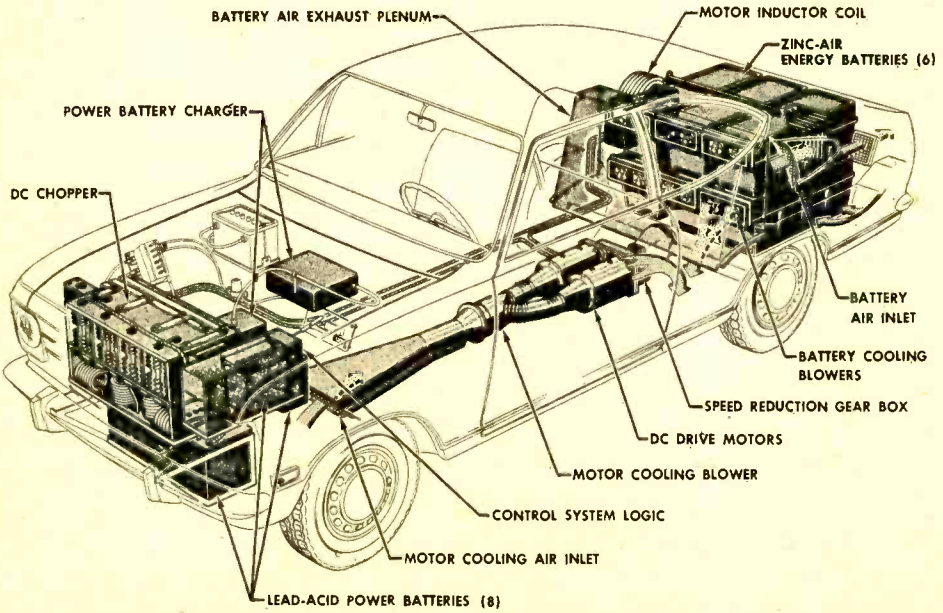
The goal of current testing of the sleek experimental vehicle is to develop practicality studies of a new concept in propulsion; the Linear Induction Motor, which the Dept. of Transportation says shows promise of ". . . replacing the wheel as the driving and braking mechanism for high-speed ground vehicles." The concept holds that conventional vehicles propelled by traction motors are speed-limited by rail-wheel adhesion and will not fit the futuristic requirements of the Seventies. A vehicle propelled by a Linear Induction Motor (LIM) on the other hand, is theoretically capable of high speeds because thrust isn't limited by such rail-wheel contact.

The LIM is a simple rearrangement of the classic rotary induction motor, the most widely used type of electric motor. The LIM is defined as being a rotary-type motor which is simply cut along a radius, unrolled and laid out flat. This presents an air gap between the primary and secondary windings, allowing linear motion between the two. One of the members is lengthened along the path of travel so that motion can be continuous.

Then, alternating current flowing in the windings of the primary members set up electromagnetic fields moving with respect to the primary members. The emf, in passing through the secondary, creates AC flow by simple induction, and the interaction of these induced secondary currents with the moving emf field produces a force between primary and secondary which pulls the primary along the length of the secondary. Hence, in the test vehicle at Garrett, the secondary, made of aluminum, is stretched along the ground and the primary members, attached to the vehicle, pull the vehicle along with them.

The advantages of the LIM concept are silence, lack of pollutant byproducts and a comfortable freedom from vibration. Since thrust is provided without need of physical contact, the LIM works equally well with air suspension vehicles. Also, there are no wearing parts such as gears or bearings, and speed is unlimited within the bounds of safety considerations.

This year the vehicle will be moved to a new large scale test track near Pueblo, Colorado, for



Phantom view highlights key components of the dual-battery XEP experimental electric car built by the General Motors Research Laboratories. Six zinc-air batteries are fitted in the trunk of the Opel Kadett. Eight special lead-acid batteries are mounted in the front.

General Motors engineer Harold A. Schulte inserts zinc anodes into one of the six zinc-air batteries which give the experimental XEP car its long range. Developed at the GM Research Laboratories, the electric car can travel about 150 miles at 30 miles per hour.

high-speed testing by the Dept. of Transportation. The Dept. of Transportation says it expects vehicles of this type to be in operation in this decade, depending on the results of the upcoming high-speed tests. Look out tomorrow, you may be here today.

Oh, Oh—Look Out, Mr. Editor

The long electronic arm of automation is reaching out and knocking on the doors of magazine and newspaper editors. A new electronic system for editing and proofreading stories on a video display terminal before they are set in type will even replace the blue pencil popular with editors. The system will shorten deadlines and reduce costs for newspapers, wire services, magazines, books and other publications.

Called the Harris 1100 Editing and Proofing Display, it is the first self-contained editing unit on the market. It has built-in digital logic and memory units that eliminate the need for a supporting computer, although it can be connected with existing computers if desired.

The system was designed to help editorial departments keep pace with computerized typesetting, photocomposition and high-speed data transmission. It incorporates technology developed by the company for satellite communications and advanced information handling systems.

The editing terminal displays 50 lines of copy at a time on a video screen. As the editor makes corrections, deletions or additions, lines automatically adjust themselves to the right length and revised copy appears instantly on the screen.

When he is satisfied with the final text, the editor pushes a button that dispatches the story to automatic typesetting machines—either conventional hot-metal linecasters or phototypesetters. The death knell of the copy boy.

Occupying the space of a standard desk, the system is technically described as a "self-contained, interactive video text editing and proofing terminal for graphic arts applications." It uses integrated circuits in all electronic assemblies.

An 8½ x 11" cathode ray tube displays the text to be edited in crisp capital and lower case letters, easily viewed in a normally lighted room. The operator makes changes via a keyboard in front of the terminal. He identifies the point at which changes are to be made by manipulating control keys for a "cursor"—a point of light that moves over the face of the cathode ray tube to the desired place in the text.

The copy to be edited is fed into the terminal by punched paper tape, either from a wire service or keyboarded locally. After the text is edited, a new tape is punched out at high speed to control the automatic typesetting machines. Terminals can also be connected directly to a computer, eliminating the punched tape procedure. The system permits proofreading for accuracy and length of copy before a single character is set in type. *(turn page)*

Electronic editing and proofreading display terminal manufactured by Harris-Intertype Corporation, now in use in the city room of "Today," the Gannett Company's daily newspaper serving the Cape Kennedy area.

e/e NEWSCAN

Base price of the editing terminal is $14,500. The makers of the system, Harris-Intertype Corporation, believes that practically all daily newspapers and wire services—and many magazine and book publishers—will be using some form of electronic editing by 1975. The company estimates the annual market for text editing systems will reach $15 to $20 million by that time.

Test Circuit

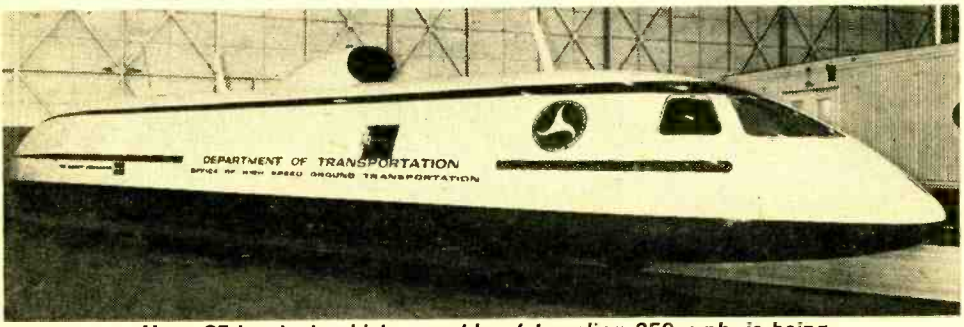
The world may be in store for some new and revolutionary vehicles. One of which is a new experimental electric car powered by two different kinds of batteries. Code named the XEP, the 3000-pound car features six zinc-air batteries for extended range and eight specially designed Delco-Remy lead-acid batteries for faster acceleration. The unique powerplant, developed here at the GM Research Laboratories, is mounted in an Opel Kadett test bed.

The car's zinc-air batteries give the XEP up to six times the range of a lead-acid battery powerplant of the same weight. The car's range is about 90 miles at 55 mph and about 150 miles at 30 mph. Its top speed is about 60 mph. The lead-acid batteries help accelerate the car to 30 mph from a standing start in less than 20 seconds.

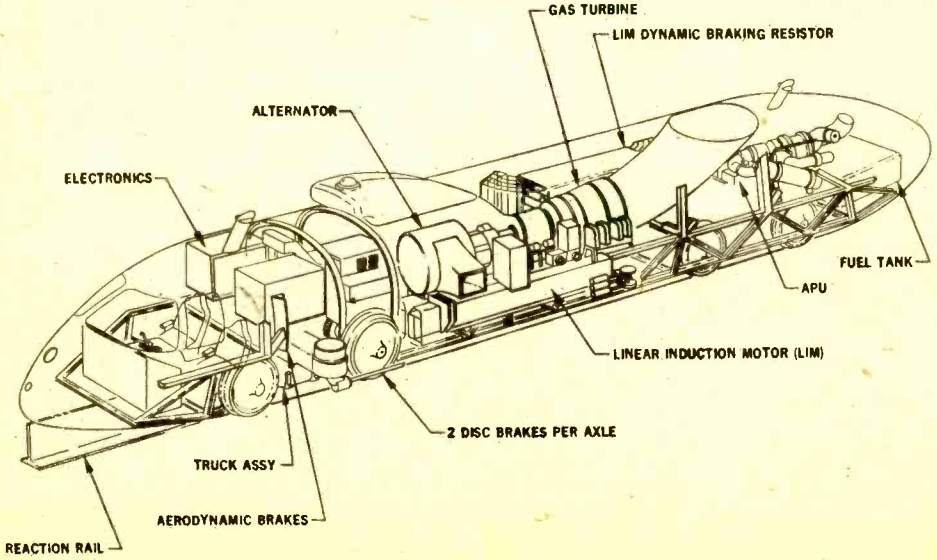
Unlike the electrically rechargeable lead-acid batteries (similar to a conventional car battery), the zinc-air batteries are mechanically rechargeable.

When the batteries are discharged, nearly 300 zinc plates must be removed and replaced. In addition, the potassium hydroxide electrolyte also must be changed. Other disadvantages of the current power train are its weight (almost 1600 pounds) and its size—the zinc-air batteries completely fill the trunk. These are the main reasons General Motors does not consider the system practicable for automotive applications. Nonetheless, the zinc-air battery offers interesting potential for future urban vehicle applications. For this reason, General Mo-

(Continued on page 97)



Huge 25-ton test vehicle, capable of traveling 250 mph, is being tested by Garrett Corp., Torrance, Calif. on a low-speed test track.

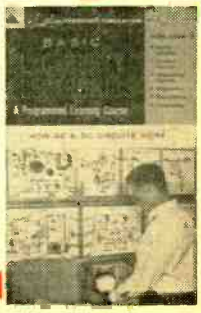


e/e's all NEW BASIC COURSE in ELECTRICITY & ELECTRONICS *

PART 7
UNDERSTANDING CAPACITANCE

What You Will Learn. Practically every circuit in electronics contains the property of capacitance. This property is one of the most important concepts you will learn in your study of electricity and electronics. Several electronic devices, such as time delay relays, photoflash units and even complicated computer circuits depend upon the property of capacitance for their operation.

In this part you will learn how capacitance can be used to block direct current (DC) and bypass alternating current (AC) signals. You will also see how capacitance causes applied AC voltage to lag behind the current in a given circuit, and how the capacitance phenomenon distorts the voltage waveform of pulses. When you have finished this part, you will be familiar with the units in which the property of capacitance is measured, and the factors influencing the value of a capacitor. *(turn page)*



* This series is based on Basic Electricity/Electronics, Vol. 2, published by Howard W. Sams & Co., Inc.

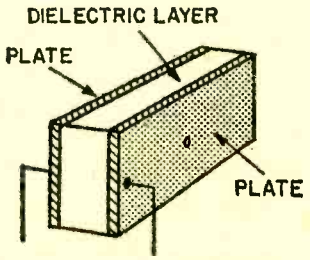
WHAT IS CAPACITANCE?

Capacitance is the property of an electrical circuit that **opposes a change in voltage**. Capacitance has the same reaction to voltage that inductance has to current. This means that if the voltage applied across a circuit is increased, capacitance will resist that change. If the voltage applied to a circuit is decreased, capacitance will oppose the decrease and try to maintain the original voltage.

In a DC circuit, capacitance has an effect only when voltage is first applied, and then again when it is removed. **Note that direct current cannot flow through a capacitance.** However, alternating current **appears** to flow through a capacitance—you will learn how later. Since voltage is constantly changing in AC circuits, capacitance acts at all times to retard these changes in voltage.

A basic capacitor is shown in the first diagram. It consists of two conducting

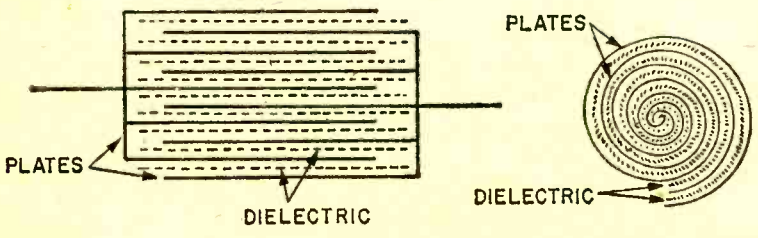
THE BASIC CAPACITOR IS MADE LIKE A METALLIC SANDWICH



metal plates separated by a layer of air or other insulating material, such as paper, glass, mica, oil, etc. The insulating layer is called the **dielectric layer.**

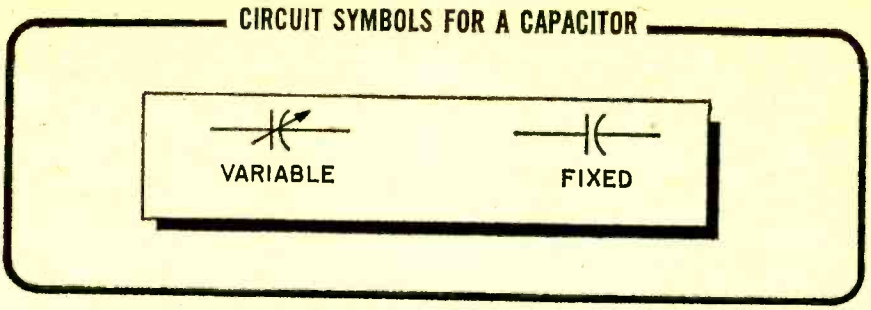
All capacitors have these two plates and a separating layer. In practice, the

CAPACITOR PLATES ARE OFTEN STACKED OR ROLLED TO SAVE SPACE



plates and dielectric are often stacked or even rolled into a compact form. Sometimes the dielectric is a paste or a liquid instead of a solid.

The circuit symbols for a capacitor appear on page 83.



When a capacitor is first connected to a battery, electrons from the negative terminal of the battery flow to the nearest capacitor plate and remain there. They can go no further, since the opposite plate is separated from the first by an insulating layer. Electrons are attracted from the opposite capacitor plate and flow into the positive terminal of the battery. After this initial movement of electrons, the negative-most plate of the capacitor is filled with all the electrons that the battery voltage can force into it, and the other capacitor plate loses the same number of electrons to the battery's positive terminal. This means that one plate has a negative charge and the other plate has a positive charge—the charge being equal to the battery's potential. No further current flows; the capacitor is "charged."

Positive and negative charges attract each other, so there will be a force between the plates of the capacitor. There is also a voltage between them that is equal to and opposes the voltage of the battery.

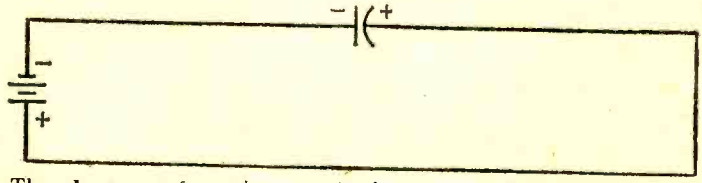
Because it takes a certain specific number of electrons to fill the negative plate, we say that the capacitor has a certain capacity, or **capacitance.**

Q1. Name two differences between capacitance and inductance.
Q2. Draw a circuit diagram of a capacitor connected across the terminals of a battery.
Q3. Explain what happens when you disconnect the battery terminals from a charged capacitor and place a wire across the leads of the capacitor.

Your Answers Should Be:

A1. **Capacitance opposes a change in voltage** while inductance opposes in current. **Capacitance blocks DC** while inductance does not.

A2. Your circuit diagram should look like this.



A3. The **electrons** from the capacitor's negative plate **flow through the wire to the positive plate** until both plates have the same number of electrons. The **voltage across the plates is then zero.**

CAPACITANCE MEASUREMENTS

The usual written symbol for capacitance is **C.** Capacitance is measured in **farads.** The amount of capacitance in a capacitor is the quantity of electrical charges (measured in coulombs) which must be moved from one plate to the other in order to create a potential difference of 1 volt between the plates. The number of coulombs transferred is called the **charge.**

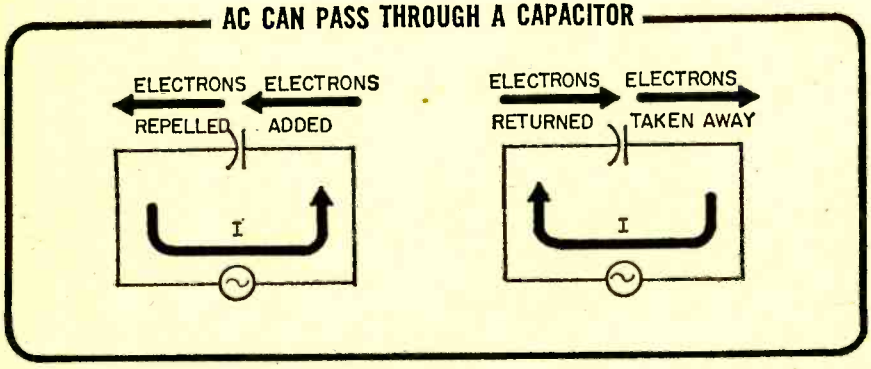
One farad is the capacitance in which a charge of 1 coulomb produces a difference of 1 volt between the plates. The larger the area of a capacitor's plates, and the closer these plates are to each other, the more charge the capacitor will hold with the same voltage applied across the plates.

Capacitance values are usually specified in microfarads (millionths of a farad, abbreviated **mfd** or μ**f**) or in micromicrofarads. Micromicrofarads are also called **picofarads** (millionths of a microfarad, abbreviated **mmf, μf,** or **pf**).

HOW DOES CAPACITANCE AFFECT AC?

Although current cannot flow through a capacitor, an AC current appears to do just that. The reason lies in the nature of capacitance. If the voltage across the plates is continuously varied, the number of electrons on the plates varies.

Increasing the number of electrons on one plate of a capacitor repels electrons from the other plate. Decreasing the number of electrons on the first plate allows electrons to be attracted back to the other plate.



An AC current can, **in effect,** get across the dielectric. Since the voltage is alternating, it causes a corresponding varying current to flow between one side of the capacitor to the other side. In other words, **voltage changes** appear to be transmitted across the dielectric gap.

If a capacitor has the same voltage as the applied voltage, no current will flow to or from it. If the applied voltage changes, the capacitor voltage will no longer equal the applied voltage. Current will flow trying to equalize the two potential sources.

In a circuit this means that if an AC sine-wave voltage is applied across a capacitor, an AC sine-wave current will appear on the opposite side, even though no electrons flow through the dielectric layer.

Q4. The capacitance of a capacitor is measured in - - - - - -.

Q5. A millionth of a farad is called a- - - - - - - - -and is abbreviated as - - - or - -.

Q6. A - - - - - - - - - - - is a millionth of a microfarad and is abbreviated - - - - - - or - -.

Q7. Current will flow from one plate of a capacitor to the other plate only when - - - - - - - is changing.

Your Answer Should Be:

A4. The capacitance of a capacitor is measured in **farads.**

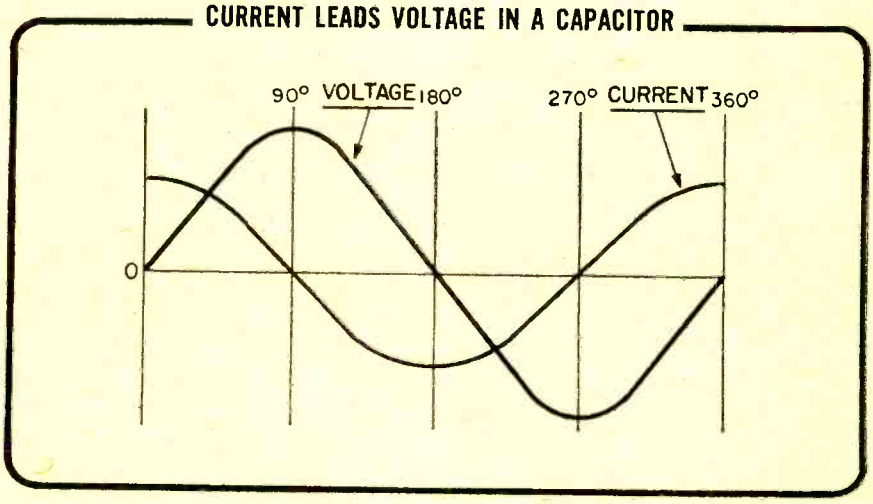
A5. A millionth of farad is called a **microfarad** and is abbreviated as **mfd** or μ**f.**

A6. A **micromicrofarad** is a millionth of a microfarad and is abbreviated **mmf,** μ**f,** or **pf.**

A7. Current will flow through a capacitor only when **voltage** is changing.

PHASE

Just as we learned in our study of inductance, alternating current and voltage are not in phase in a capacitive circuit. The **voltage lags the current** by 90° in a theoretically perfect capacitor.



At any instant, the current flowing into or out of a capacitor is proportional to the rate of change—or frequency—of the applied voltage. This can be seen in our illustration on page 86. The applied voltage is changing most rapidly at time A, the beginning of the sine-wave cycle. Therefore current flow is maximum.

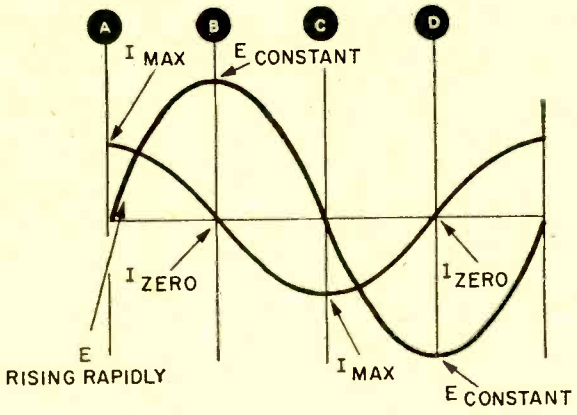
At time B the voltage across the capacitor has reached its peak and, for the moment, is not changing. Therefore current at this instant is zero.

At time C, voltage across the capacitor again is changing quite rapidly (but in the negative direction), and so the current is at its negative peak.

At time D, when the voltage reaches its negative peak and is momentarily not changing, the current waveform passes through zero once more.

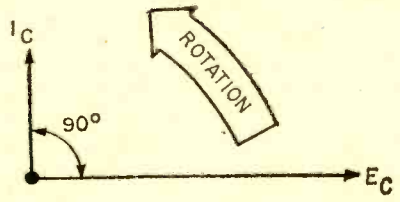
If we trace the current from point to point on the same graph showing the voltage waveform of our theoretically perfect capacitor, the result is a sine wave. Note that **current leads the voltage by exactly 90°.** This shows that if the voltage across the capacitor is a continuous sine wave with a constant amplitude, the current through the capacitor circuit is a sine wave that is 90° ahead of the voltage.

CURRENT IS DETERMINED BY THE VOLTAGE CHANGE



Current and voltage vectors in a capacitive circuit are 90° out of phase. In this case the current vector is **ahead** of the voltage by 90°.

CURRENT VECTOR LEADS THE VOLTAGE VECTOR



Q8. When an AC voltage across a capacitor is maximum, AC current through the circuit is - - - -.

Q9. When an AC current through a capacitor circuit is maximum, AC voltage across the capacitor is - - - -.

Q10. Contrast the phase relationship of AC voltage and AC current between an inductor and a capacitor.

Your Answers Should Be:

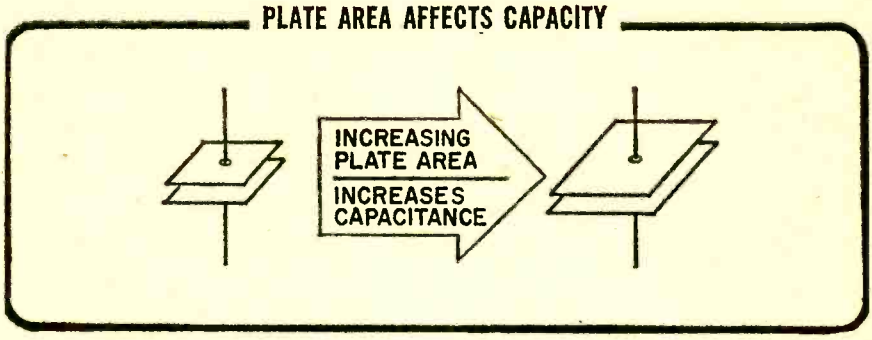
A8. When an AC voltage across a capacitor is maximum, AC current through the circuit is **zero.**

A9. When an AC current through a capacitor circuit is maximum, AC voltage across the capacitor is **zero.**

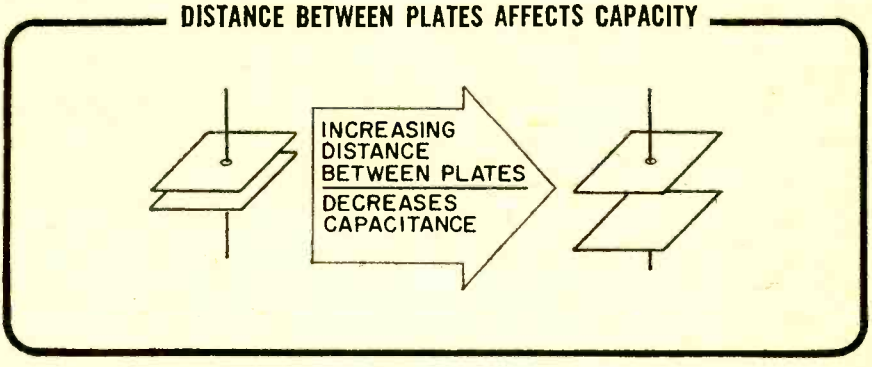
A10. In an inductor, voltage **leads** current by 90°; in a capacitor, voltage **lags** current by 90°.

FACTORS AFFECTING CAPACITANCE VALUE

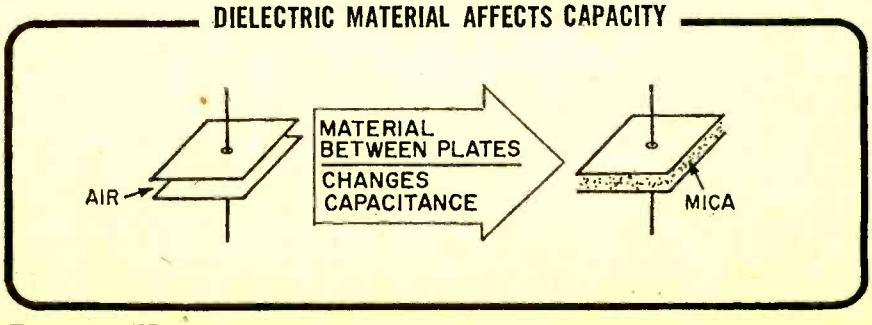
The amount of electrical charge that can be stored in a capacitor (the number of electrons that can be placed on the plate) varies with the **area** of the plates. Consequently, capacitance varies directly with area—if the area is doubled, the capacitance is doubled. When the area is doubled, or twice as many plates are connected in parallel, there is twice as much area to store electrons. Therefore the capacitance is twice as great.



Capacitance can also be increased by placing the plates closer together. When the plates are closer the attraction between the negative charges on one side and the positive charges on the other side is greater. It is, of course, necessary to keep the plates sufficiently separated so that the charge does not cross through the dielectric, possibly damaging the capacitor.



Higher values of capacitance can be obtained by using an insulating material (dielectric) other than air. This means that the plates can be placed closer together without the danger of a charge crossing the gap.



Dielectrics such as mica, glass, oil, and **Mylar** are a few of the materials that can withstand a high electric potential without breaking down. This property is called **dielectric constant.** The higher the dielectric constant, the better its ability to retain its insulating characteristics under unusual operating conditions. Air has a dielectric constant of 1, glass about 5, and mica 2.5 to 6.6.

Besides allowing the plates to be placed closer toether, a dielectric has another effect on capacitance. Dielectric material contains a large number of electrons and other carriers of electrical charge. Although electrons cannot flow as in a conductor, they are held rather loosely in the structure and can move slightly. The distortion of the structure of the dielectric, which is caused by charging the capacitor, has a large effect on the forces of attraction and repulsion that aid or oppose the flow of the electrons. This factor has a substantial effect on capacitance.

When materials such as mica or glass are used as the dielectric, the capacitors have a much higher value than the same size units with an air dielectric.

Q11. How does a mica capacitor differ from an air capacitor of the same physical size?

Q12. What are three factors that affect the capacitance of a capacitor?

Q13. A screw-type variable capacitor is made with an adjusting screw that is used to vary the distance between the capacitor plates. How would you increase its capacitance?

Your Answers Should Be:

A11. A mica capacitor has a **higher capacitance** that an air capacitor of the same physical size.

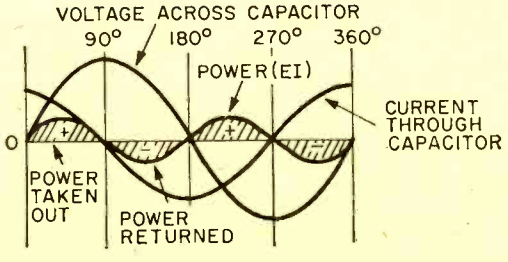
A12. The capacitance of a capacitor depends on these three factors: the **area** of the plates, the **spacing** between the plates, and the nature of the **dielectric material.**

A13. Tightening the screw moves the plates closer together and **increases capacitance.** Loosening the screw **decreases the capacitance.**

POWER

A perfect capacitor consumes no power. During the sine-wave cycle, the capacitor takes energy out of the circuit and stores it in the form of an electric field dur-

A CAPACITOR CONSUMES NO POWER



ing a quarter cycle. The capacitor returns it to the circuit in the next quarter cycle. **Energy is borrowed, but it is always returned.**

If the product of E times I is taken at every instant of the cycle, the power waveform will show that energy is taken out and returned in alternate quarter cycles.

To find the amount of energy (in **coulombs**) stored in a capacitor, multiply the capacity in farads by the applied voltage. In a circuit containing only pure capacitance, it makes no difference how long the voltage is applied—the same amount of energy will always be stored at a given voltage.

CAPACITIVE REACTANCE

Like inductance, capacitance has a reactance—an opposition to the flow of AC. But capacitive reactance **decreases** as frequency increases.

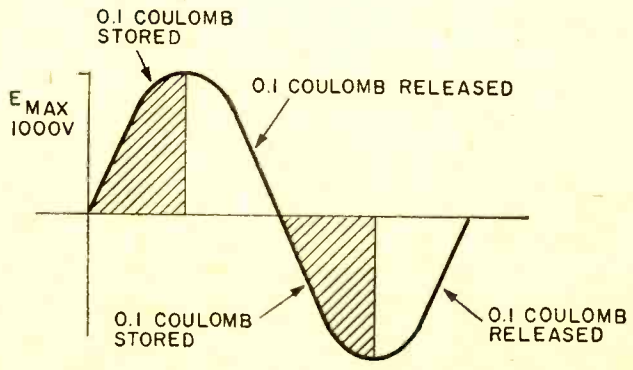
Suppose a capacitor is connected in series with an alternating voltage source. There is no resistance in the circuit.

A BASIC CAPACITIVE CIRCUIT

Because the circuit above contains no resistance, the voltage across the capacitor will be the same value as the source voltage at every instant.

When a capacitor is charged up to voltage E, it stores an amount of energy equal to the capacitance times the voltage. If the peak voltage of the AC source is E, the capacitor will have stored a particular amount of energy every time the voltage sine wave reaches its peak, and again stores that amount whenever the voltage reaches its negative peak. The energy depends only on capacitance and peak voltage.

EQUAL AMOUNTS OF ENERGY MUST FLOW IN EACH CYCLE

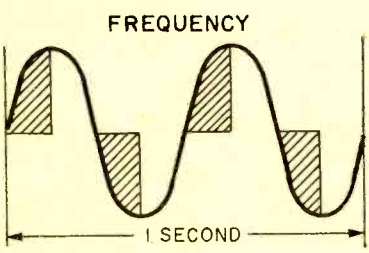


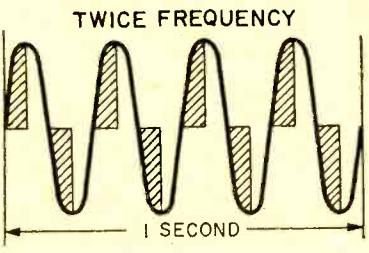
Q14. How much energy will be stored in a 100-mfd capacitor in the first quarter cycle of an applied AC voltage of 1,000 volts maximum?

Your Answer Should Be:
A14. 1,000 volts × .0001 farad = **0.1 coulomb**

What happens when the frequency of the power source is doubled? If the peak voltage (E) is unchanged, the capacitor will charge every half cycle to the same amount as before. But it will have to do this twice as fast because the energy is doubled. This means that the same amount of energy must flow into the capacitor in only half the time. And since the voltage is the same, we must have twice the current to supply this same amount of energy.

DOUBLING THE FREQUENCY DOUBLES THE CAPACITOR CURRENT





What does this mean? The frequency was doubled, and this doubled the current flowing into the capacitor. Yet, the input voltage remained the same. A pure capacitance lets twice as much current flow if the frequency is doubled.

Capacitive reactance is the opposition that pure capacitance offers to the flow of current. It is expressed in **ohms,** and its symbol is **Xc.** Capacitive reactance depends on frequency. As the frequency increases, the rate of change of applied voltage increases, and the current flowing also increases. As the frequency is reduced, the rate of change of voltage goes down, and less current flows.

At this point you can more easily see why capacitor current leads the voltage across the capacitor. It is necessary for the capacitor to charge up to the given voltage, and this charging is done by the current. Hence, the charging current will reach its maximum value at the time the charging is going on at the greatest rate; that is, when the rate of change of voltage is the most rapid.

As the capacitor approaches full charge, the voltage rate of change slows down, and the current decreases. When the capacitor is fully charged and its voltage has reached maximum, there is no charging current flowing at all—the current has already dropped to zero at this time. A similar process occurs during discharging. At all times, current leads the voltage by 90°, or one quarter of the cycle. In a steady-state AC situation, when the applied voltage is a sine wave, both voltage and current will be sine waves.

(Continued on page 94)

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Continued from page 90

Capacitive reactance depends on frequency. Since it lets more current flow as frequency increases, **capacitive reactance must decrease as the frequency increases.**

Capacitive reactance also depends on the size of the capacitance. As capacitance increases, more current must flow into the capacitor to charge it to the same voltage (since the amount of energy stored equals C times E). As a result, **capacitive reactance decreases when capacitance increases.**

The formula for capacitive reactance is:

$$X_C = \frac{1}{2\pi fC} \text{ ohms}$$

where,

f is the frequency in Hz,
C is the capacitance in farads.

Capacitive reactance can be used in calculating current in a purely capacitive circuit by Ohm's law.

$$I = \frac{E}{X_C}$$

Q15. What is X_C if f = 6,000 Hz and C = 200 mfd?

Q16. What is the current in this circuit?

Q17. What would the current in the above circuit be if the input signal were 0.01 volt at 120 kHz?

Your Answers Should Be:

A15. $X_C = \frac{1}{2\pi fC} = \frac{1}{2 \times 3.14 \times 6{,}000 \times 200 \times 10^{-6}}$

$= \frac{1}{7.53} =$ **0.133 ohm**

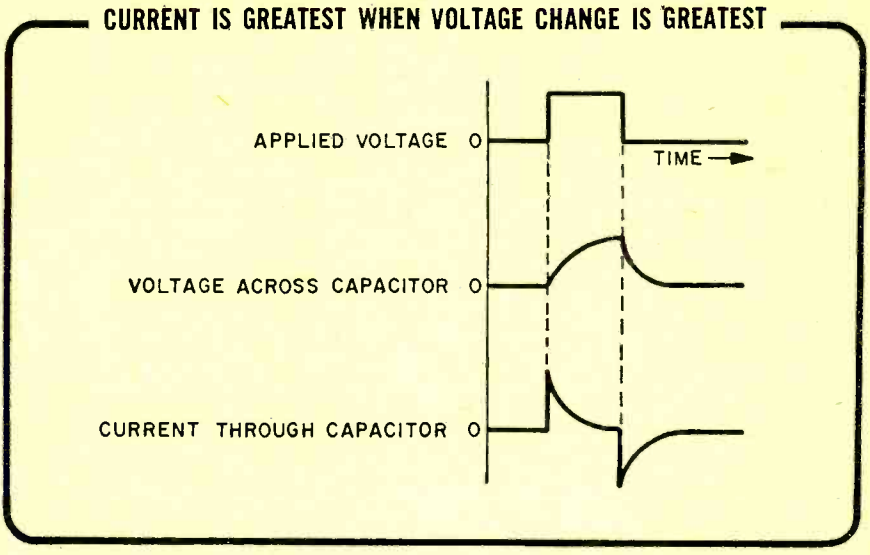
A16. $I = \frac{E}{X_C} = \frac{0.2}{0.133} =$ **1.5 amps**

A17. $I = \frac{0.01}{0.0066} =$ **1.52 amps**

PULSE RESPONSE OF CAPACITANCE

When a sharp pulse, such as a square wave, is applied to a circuit containing capacitance, the capacitance opposes the sudden change of voltage. This results in

a rounding off of the sudden voltage rise. Similarly, when the pulse voltage is suddenly decreased, the voltage across the capacitor does not decrease suddenly, but it trails off. Current is greatest when the change of voltage is greatest, so the current waveform will have a peak when the voltage rises suddenly, and another peak (but in the opposite direction) when it drops.



There is always some resistance in a practical circuit. By choosing the right value of capacitance and resistance, a circuit can be designed in which the voltage takes a predetermined length of time to reach a certain value. This type of circuit can provide a time delay.

STRAY CAPACITANCE

Capacitive reactance decreases as frequency increases. In communications, pulse, and radar work, where very high frequencies are used, **stray capacitance** can present quite a problem.

In a vacuum tube, an antenna, or a receiver chassis, there are always very small capacitances between adjacent conductors and between conductors and nearby objects which are meant to be isolated from each other. With the lower radio frequencies these capacitances are not important. But as the frequency increases, the capacitive reactances of these very small capacitances decrease. A decrease in reactance can actually cause leakage of the signal.

It is important to know, therefore, that at high frequencies, placement of wires and components is very important in order to keep the effects of stray capacitances to a minimum.

Q18. How does capacitance affect pulses?

Q19. Compare and contrast capacitive reactance and inductive reactance on these points:

1. **Effect of an increase in frequency on reactance.**
2. **Effect of reactance on DC.**
3. **Effect of phase relations in AC.**

Q20. What constant value appears in the formulas for both capacitive and inductive reactance?

Your Answers Should Be:

A18. Capacitance **rounds off the voltage waveform and produces spikes in the current waveform.**

A19. 1. X_C **decreases** as frequency increases, while X_L **increases.**
2. X_C **blocks DC,** while X_L **passes DC.**
3. Capacitance causes current to **lead** the applied voltage, while inductance causes it to **lag.**

A20. 2π appears as a constant in both formulas.

WHAT YOU HAVE LEARNED

1. Capacitance offers an opposition to a change in voltage.
2. A basic capacitor consists of metal plates separated by a dielectric.
3. A capacitor stores electrical energy in the form of an electric field as the capacitor charges, and releases this energy when it discharges.
4. Capacitance is a measure of the energy storage capacity of a capacitor. This capacity is measured in farads.
5. A capacitor blocks DC but allows AC to flow.
6. Pure capacitance in a circuit causes current to lead the applied voltage by 90°.
7. The amount of capacitance is determined by the area of the plates, the distance between them, and the dielectric material.
8. A capacitor stores energy and returns it to the circuit.
9. The opposition of capacitance to the flow of AC is called capacitive reactance.
10. The formula for capacitive reactance is:

$$X_C = \frac{1}{2\pi fC}$$

11. Capacitance rounds off the voltage waveform of a pulse.
12. Stray capacitance can cause signal leakage at high frequencies.

NEXT ISSUE: Part 9—Understanding RL Circuits

This series is based on material appearing in Vol. 2 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ $19.95. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

NewScan

Continued from page 80

tors top scientists are focusing their efforts on finding ways to recharge the battery chemically rather than mechanically. The only smell on the highways of tomorrow may be burned rubber!

Eye Beam

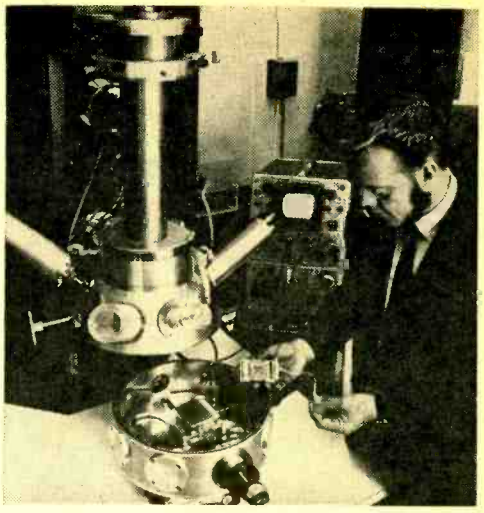
The hours spent testing some of today's miniaturized electronic circuitry can be reduced to seconds by use of an electron beam. Preliminary experiments with an electron beam probe to replace electrical probes used conventional tests of high density printed circuit boards were performed by scientists at the IBM Systems Development Laboratory in San Jose, California. High density printed circuit boards are used in computers, advanced military hardware, aerospace equipment and scientific research equipment.

The experiments were an attempt to solve the problem of quality control tests becoming more difficult and time consuming as technological advances shrink monolithic integrated circuitry. The efficiency of tests that check hundreds of tiny wiring connections with mechanically positioned electrical probes is limited by the thickness of the probes.

By contrast, the diameter of an electron beam can be made smaller than the thousandth-of-an-inch diameter typical of the connective wiring used on the latest printed circuit boards. Coupled with a method of rapid, automatic beam guidance, this creates a potential for both increased speed and accuracy of testing. One experiment with a typical circuit board demonstrated that four hours of testing with electrical probes could be shortened to four seconds.

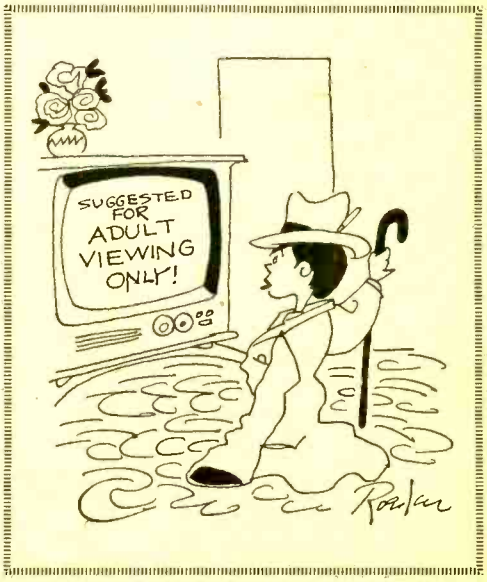
This greatly increased speed was achieved by a novel method of using an electron beam to distinguish connecting points in an individual circuit from those of other circuits on a printed circuit board. A beam from an electron gun, guided by a column of electron-optical lenses and deflection yokes, was first used to charge the individual circuit and then to scan the circuit board. A metal mask provided apertures for the beam to pass through at specific test points.

The secondary electron emission produced by the scanning was received by a photomultiplier device and converted to a cathode ray tube display. The initial charging of the individual circuit caused its secondary electron emission to be greater than that of other circuitry. As a result, the test points on the individual circuit appeared darkened on the display and could be checked for unwanted open and closed connections.



An experimental technique that could save hours of testing time for some of today's miniaturized electronic circuitry has been developed through use of the electron beam column. Using the beam first to charge an individual circuit to be tested and then to scan the circuit board produces a secondary electron emission that can be converted to a display on the cathode ray tube in the background and checked for unwanted open and closed connections. One experiment showed that four hours of conventional tests could be shorteend to four seconds.

Refined methods for collecting and measuring secondary electron emission from a large testing field and for programmed control of the beam are needed to make the beam-testing technique practical enough for general use. ■



en passant

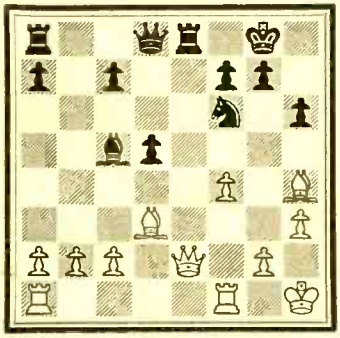
It's your move!

Here we go again with some openings that have not appeared in our discussions of earlier issues.

Scotch Game. This takes its name from a correspondence match in 1824 between Edinburgh and London. Old-fashioned and simple, it is seldom played in modern tournaments. In the Four Knights' Variation, which follows, Black neutralizes the premature 3 P-Q4 by attacking the King Pawn and establishing his own strong Queen Pawn.

1	P-K4	P-K4	9	O-O	O-O
2	N-KB3	N-QB3	10	B-KN5	B-K3
3	P-Q4?	PxP	11	N-K2	P-KR3
4	NxP	N-B3	12	B-R4	B-Q3
5	N-QB3	B-N5	13	P-KB4	B-B4#
6	NxN	NPxN	14	K-R1	B-KN5
7	B-Q3	P-Q4!	15	P-KR3	BxN
8	PxP	PxP	16	QxB	R-K1

Black



White

Equal chances.

Three Knights' Defense. This sidesteps the Four Knights' Game, but the solution is worse than the problem.

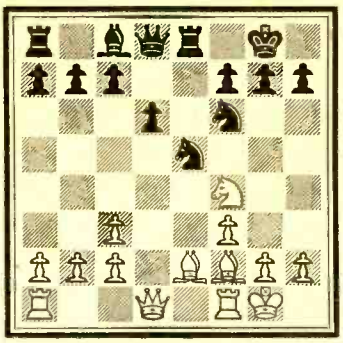
1	P-K4	P-K4	7	QPxB	NxP
2	N-KB3	N-KB3	8	O-O	P-Q3
3	N-B3	B-N5?	9	N-B4	N-Q2
4	NxP	O-O	10	B-K3	N-K4
5	B-K2	R-K1	11	P-B3	N-KB3
6	N-Q3	BxN	12	B-B2	....

(Game top of next column)

And the two Bishops give White a very slight advantage.

Tchigorin Defense. This eccentric defense, which misplaces the Queen Knight, does not quite make it.

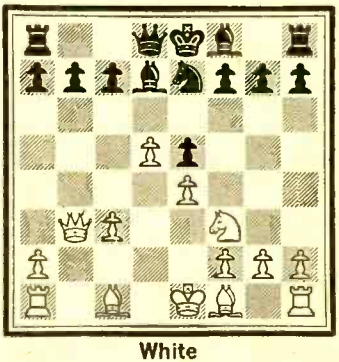
Black



White

1	P-Q4	P-Q4	6	P-K4	NxN
2	P-QB4	N-QB3?	7	PxN	P-K4
3	N-KB3	B-N5	8	P-Q5	N-K2
4	N-B3	N-B3	9	Q-R4#	B-Q2
5	PxP	KNxP	10	Q-N3	....

Black



White

White has a winning position. He has an advantage in space and will win either the Queen Knight Pawn or the King Pawn on his next move.

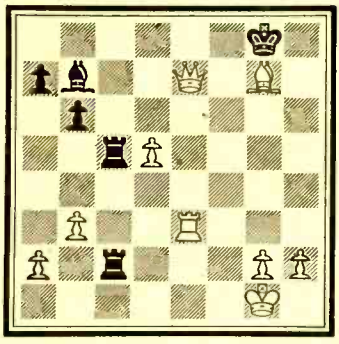
Game of the Issue. "One of the most brilliant games on record." Thus did Wilhelm Steinitz, the first recognized World Champion, describe the following partie between Zukertort and Joseph H. Blackburne, playing Black, a Queen's Gambit Declined, which was played at London, 1883.

Johannes Herrmann Zukertort, (1842-1889) born in Russian Poland, was a great rival of Steinitz and a man of many attainments—foreign correspondent, linguist, military man, musician, music critic. Chesswise, he had a genius for odds giving, he opened with closed, slow debuts, gained power as he went along, and often wound up in a burst of glory. His

greatest tournament triumph was at London, 1883, where he was first, ahead of Steinitz and all the other top players of the year.

1	P-QB4	P-K3	18	P-K4	QR-B1
2	P-K3	N-KB3	19	P-K5	N-K1
3	N-KB3	P-QN3	20	P-B4	P-N3
4	B-K2	B-N2	21	R-K3	P-B4
5	O-O	P-Q4	22	PxP e.p.	NxP
6	P-Q4	B-Q3	23	P-B5	N-K5
7	N-B3	O-O	24	BxN	PxB
8	P-QN3	QN-Q2	25	PxNP ! !	R-B7
9	B-N2	Q-K2?	26	PxP#	K-R1
10	N-QN5	N-K5	27	P-Q5#	P-K4
11	NxB	PxN	28	Q-N4 ! !	R/1-B4
12	N-Q2	QN-B3	29	R-B8# !	KxP
13	P-B3	NxN	30	QxP#	K-N2
14	QxN	PxP?	31	BxP#	KxR
15	BxP	P-Q4	32	B-N7# ! !	K-N1
16	B-Q3	KR-B1	33	QxQ	Resigns
17	QR-K1	R-B2			

Position after 33 QxQ



Why did Black resign? Because he only has a Rook for White's Queen and three Pawns and is threatened with 34 QxB or 34 Q-B8# K-R2 35 R-R3# K-N3 36 R-N3# K-R2 37 Q-R8 mate.

Zukertort's last nine moves were something special. Blackburne said that he claimed equity in its immortality for having compelled the brilliancy!

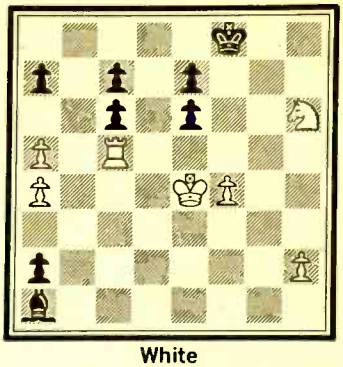
End Game Study #6

By E. N. Somov-Nasimovitsch

White to Play and Win

Composer Somov-Nasimovitsch arranges everything so that Black slips out of three mating nets, but is ensnared in the fourth. This is how it is done—

Black



White

1	**R-B2**	**B-N7 !**

If 1 . . . . **B-N2 2 RxP wins.**

2	**R-N2**	. . . .

Threatening 3 R-N8 mate.

2	. . . .	**K-K1**
3	**R-N8#**	**K-Q2**
4	**N-B7 !**	. . . .

Threatening 5 R-Q8 mate.

4	. . . .	**P-B4**

To provide a flight-square for the King. If 4 . . . . P-K4 5 P-B5, P-K3 6 P-B6 wins.

5	**R-Q8#**	**K-B3**
6	**R-Q2 !**	. . . .

Threatening 7 N-Q8 mate.

6	. . . .	**P-B5**

If 6 . . . . B-Q5 7 RxP wins.

7	**N-Q8#**	**K-B4**
8	**NxP#**	**K-B3**
9	**N-Q8#**	**K-B4**
10	**RxB !**	**P-R8=Q**
11	**R-N5#**	**K-Q3**
12	**R-Q5 mate!**	

News and Views. Super Bobby Fischer, U. S. grandmaster of Los Angeles, continues his rampage through the chess world. His latest triumph was the Second International Tournament at Buenos Aires where he won 13 games and drew 4—without a loss. Fiercely competitive, he clinched top place three rounds before the finish, racking up one win after another in

"My wife found her!"

a variety of brilliant methods. Vladimir Tukmakov, junior champion of the USSR, was next with 11½-5½, a signal performance, and Oscar Panno, a many time Argentine champion, was third with 11-6.

The First Manhattan Chess Club Masters Invitational Tournament was won by Bernard Zukerman of Brooklyn, an international master, with 4½-½. Veteran Alexander Kevitz, a former club champion, scored 4-1 for second. And Professor Neil McKelvie of CCNY finished third with 3½-1½. The event was a 16-man Swiss.

The world's first major tournament played by computers took place at the New York Hilton Hotel on September 1, 1970. It was directed by Prof. Monroe Newborn of Columbia University and 300 spectators watched the science-fiction-like goings on. Computers representing Alberta University, Bell Telephone Laboratories, Columbia University, Goddard Space Flight Center, Northwestern University, and Texas A. & M. University participated. In the first round, Columbia's $7-million job, programed by Dr. Hans Berliner, Postal Chess Champion of the World, made short work of Alberta, White, in an English Opening. The score: 1 P-QB4, N-KB3 2 P-Q4, P-K3 3 Q-Q3? N-B3 4 N-KB3, P-Q4 5 N-K5, PxP 6 QxBP, B-N5# 7 B-Q2, BxB# 8 KxB? NxN 9 Q-B5? N-K5# Resigns. White loses his Queen, Not exactly a masterpiece, but then they laughed at Ford and the Wright Brothers too.

The Greater New York Open had a total of 222 contestants. The upset winner was Expert Harry Baker of Brooklyn who made a 5-0 clean-sweep. Grand-master Robert Byrne of Indianapolis and Andrew Soltis were next in line with 4½-½.

The Second Annual National High School Championship, held at the McAlpin Hotel in New York during April, had 552 students from 26 States, D.C., and Puerto Rico, and was by far the largest USCF rated tournament ever held. Robert Newbold, 11th Grade, Polytechnic, Riverside, California, had the honor of winning it with the fine score of 7½ points. A signal victory. Just behind, with 7, was Craig Chellstorp, 12th Grade, Highland Park, of Highland Park, Illinois.

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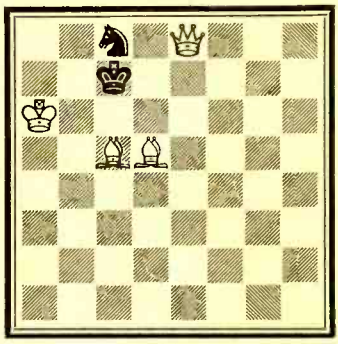
Problem 28
By W. A. Shinkman
Good Companions, 1919

Black



White

White to Move and Mate in Two.
Solution in Next Issue.

Solution to Problem 27: 1 R-QR6. If 1 . . . . PxR 2 Q-N8 mate. If 1 . . . . P-QN3 or P-QN4 2 Q-N2 mate. And if 1 . . . . P-KN3 or P-KN4 2 Q-R8 mate.

Page 1

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(Signature of editor, publisher, business manager, or owner)
V.C. STABILE

3526 July 1970

Great Men of Science

Continued from page 49

Aha! Why not place sodium *below* lithium rather than parallel with it at a distance?

Once his sodium card was in the new position, Dmitri placed after it the cards for magnesium, aluminum, silicon, phosphorus, sulfur, and chlorine.

Chlorine proved to be the key. For the card was hardly in place before Mendeleyev recognized that chlorine has properties similar to those of fluorine—the element above it in his pattern.

At recurring intervals in an arrangement of elements by atomic weight, reasoned the Russian, similar properties occur in groups or "periods." Prematurely—and mistakenly—he jumped to the conclusion that the point of radical change is at the seventh element in each period.

He laid his professional reputation on the line by publishing a *Periodic law* that says the properties of elements are periodic functions of their atomic weights.

Few really distinguished chemists and physicists of the era paid any heed to an absurd notion given to the world from remote St. Petersburg. A few critics pointed out that Mendeleyev's chart included a great many blank spaces.

"No matter," he muttered. "One day all of them will be filled."

In 1871 he went so far as to predict discovery of three new elements: ekaboron, ekaaluminium, and ekasilicon. Properties of each substance were described in detail.

His cumbersome names didn't stick. But his "prophetic" descriptions proved astonishingly accurate. "Holes in the chart" were filled in 1871 by discovery of gallium; in 1879 by scandium; and in 1886 by discovery of germanium.

Having won against heavy odds, the periodic table of the elements has undergone minor revision in recent decades. In its basic structure, however, it remains today practically as Mendeleyev prepared it in 1869.

Few scientific discoveries endure for a century. Though it is not the only key to the understanding of elements and their properties, the chart prepared by a university reject promises to retain its vitality long after 2001 A.D. has become a memory.

—*Webb Garrison*

Kathi's CB Carousel

Continued from page 64

Can a full coverage 23-channel rig sold with plug-in microphone, AC and DC power cables, mobile mount, and all crystals warm a CBer's heart? Priced at $129.95, the *Navaho TRC-23B* can easily introduce a newcomer to the very social world of Citizens Band radio. Want a pile of literature describing the *Navaho TRC-23B?* Write to Allied Radio Shack, 2725 W. 7th St., Ft. Worth, Texas.

"Lafayette's new IC does all this for 98¢!"

Page 1

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C. Total paid circulation	102,202	98,000
D. Free distribution *(including samples)* by mail, carrier or other means	89,511	90,224
E. Total distribution *(Sum of C and D)*	191,713	188,224
F. Office use, left-over, unaccounted, spoiled after printing	195,944	189,000
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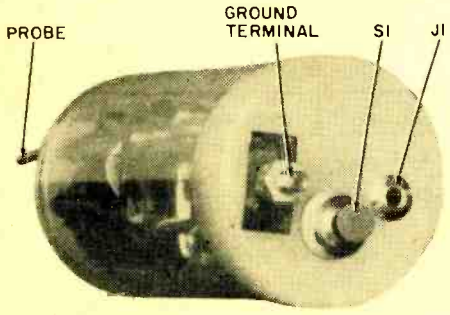
POD Form 3526 July 1970

Sig-Probe

Continued from page 62

closed circuit J1 back to the input of the amplifier, thus setting the circuit into oscillation, and feeds the signal thus generated out through the probe. This signal is of sufficient magnitude to brute force its way through most any circuit. Because it is rich in harmonics it can be used on both audio and RF circuits.

How To Make Sig-Prob. We used a clear plastic pill container 1⅜-in. in diameter and 3-in. long. This will accommodate the circuit board and the 9-V battery without having to resort to any special clamps or set screws to hold these components snugly in place and still permit easy removal to change the battery. Since the unit draws



We used plastic cap to cap off our project in style. Lid of pill case serves as mount for phone jack, power switch and ground lug.

but 1.25 mA when in the signal trace mode and 0.75 mA in the signal injector mode, and the battery isn't turned on except when either of these modes are actually being used, you can expect extremely long battery life.

The two 2N2926 transistors, 3 capacitors and 4 resistors are mounted on a ⅞ x 3-in. piece of perfboard as shown in our diagram. The probe, which is made from a 4 penny nail is anchored to the perfboard so that when the board is insered into the pill container the nail probe will extend through the bottom of the container. The push-button switch S1 and the closed circuit jack J1 along with a grounding terminal all are mounted on the plastic cap normally supplied with the container. Once the parts are mounted on the board and the circuit is checked out, cover the bottom of the board with a layer of plastic insulating tape to keep the metal case of the battery from shorting out any of the circuits on the board when the board and battery are slid into the pill container.

How To Use Sig-Prob. Since Sig-Prob will provide two different functions, (a) signal tracing, and (b) signal injection it should be obvious that you employ two different approaches in using it.

When used as a signal injector, you start by touching the probe first at the speaker and then progressing towards the *front end* of the set, if the trouble hasn't been located up to this point, eventually injecting a signal into the antenna. Starting at the input to the speaker, you should be able to hear a signal out of the speaker that will be low in volume. Then, as you progress from the base of the output stage to the base of the driver stage(s), and on through the detector, RF mixer and oscillator, (if the unit being tested is a super het) the signal should progressively increase in volume until you reach the stage that is malfunctioning, which is why you're tracing the signal in the first place. Once you've reached a stage where the signal from *Sig-Prob* is no longer heard in the speaker of the set under test you've undoubtedly located the trouble maker. Concentrate on this stage, checking resistance, voltage and current. Once you've found the defective component and replaced it, the set should work as good as new again.

When using *Sig-Prob* to trace a signal, provide a signal from an external source, such as a broadcast station or signal generator or other signal source, as the signal to listen for as you move *Sig-Prob* through each succeeding stage, starting at the input (antenna if unit under test is a radio) and eventually ending at the speaker, unless, of course, you find the offending stage before tracing that far through the set. In this application the headphone is plugged into J1 and you listen for the signal, you are using for test purposes, in the headphone as you move from point to point and stage to stage in the set. Again, at the point where you do not hear the test signal is where you'll find the offender. This indicates that the last stage checked is malfunctioning and you concentrate your search for a defective component (open resistor, shorted or open capacitor or diode, defective tube or transistor) by resistance, voltage and current measurements. ■

E-V's Landmark 100

Continued from page 70

and noise 65 db below 1000 uV input test level; FM frequency response is 1 db from 30 Hz to 15 kHz; separation is better than 38 db; capture ratio is 2.5 db and harmonic distortion is 0.5% at full output (1 kHz). The built-in ferrite loopstick antenna will provide ample signal for AM reception in most areas, as will the twin-lead dipole supplied with the complete package for FM reception. That is to be mounted within the location of the unit and oriented for best reception. However, for weak signal areas, or, where the most noise-free stereo reception is desired, provision is made to connect separate external antennae for both AM and FM signals.

The Record Changer. A Garrard 3000 record changer, fitted with an Electro-Voice *Stereo-V* magnetic cartridge is mounted on the base, above the tuner and amplifier units. It is protected by a clear plastic cover. The phono pickup response (on the model tested) is -1.5/+ 0.5 db from 40Hz to 18 kHz. Separation is 25 db at 1 kHz and 9 db at 16 kHz. Performance on high volume (tracking) is excellent.

All of the electronics and the record changer are mounted in an attractive walnut finished base, measuring 8½-in. high x 16⅛-in. wide x 16¼-in. deep with clear plastic cover over the changer.

Conclusions. We found the Electro-Voice *Landmark 100* is an outstanding performer when compared with many AM/FM-Stereo systems and certainly is remarkable when compared to compact systems. Its bass response really goes down low, and, considering the small size of the enclosures, it is difficult to believe what you hear. Mid range sound, particularly from high level records, is outstandingly clean. The truncated speaker housings produce the spread of sound usually associated with fairly large quality speaker arrays.

The *Landmark 100 System* comes complete with walnut finished speakers and mounting base, including the record changer and interconnecting cables for the speakers and sells for $399.95. For additional information write to: Electro-Voice Inc., Dept. DP, 600 Cecil St., Buchanan, MI. 49107 ■

DX Central Reporting

Continued from page 15

signals of Operation Deepfreeze's aero communications network. Antarctic ground links include McMurdo Sound, Eights Station, Cape Hallett and Pole Station, the latter being the world's southernmost DX.

Marilyn Scheer of Merion Station, Pa., asks if there are any international or national shortwave clubs?

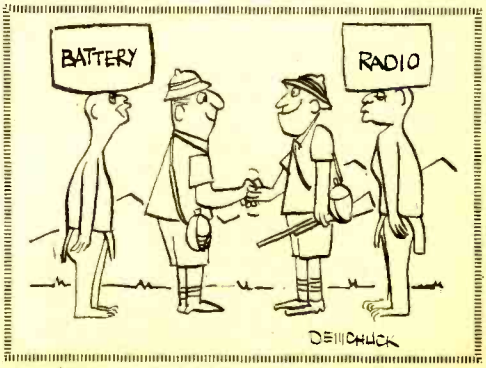
This question is frequently asked, Marilyn. The answer is yes, there are quite a few clubs that offer SWL's a number of services, the most important of which is a monthly bulletin with up-to-date data on stations. The oldest SW club in North America is the Newark News Radio Club, 215 Market Street, Newark, NJ. Other excellent organizations are the North American Shortwave Association, Box 989, Altoona, PA, and the American SWL Club, 1506 Dresser Street, Santa Ana, CA. A comer is the Midwest DX Club, 6636 Davis Street, Morton Grove IL. All are affiliated with the Association of North American Radio Clubs.

There also are clubs for medium wave, FM and TV listeners. For a nominal fee, usually about a half dollar, they will send you a sample copy of their bulletin, plus membership data.

Have you noticed that on some days the usually powerful time signals of WWV on 5, 10 and 15 mHz. are, because of propagational conditions, not up to par?

DXer Gerry Dexter, Lake Geneva, WI, did recently and came up with a pair of interesting "time-tickers".

The Argentine naval observatory station LOL was heard on 15,000 kHz., was heard from 2319 to 2334 GMT, with the typical ticks and an announcement in Spanish by a woman. A short time later, from 2350 to 0001 GMT, Gerry noted RID, a Soviet time station at Irkutsk in Siberia on 15,004 kHz. The call letters are given periodically in CW (Morse code).



No-Code Test

Continued from page 50

cations systems (except CB) operate in the VHF and UHF bands. The proposed new hobby class band is in the VHF portion of the radio spectrum. The technical problems of VHF operation are old hat and have long since been mastered.

Of course, the proposed new hobby class band is not good for coast-to-coast communication nor for inter-continent DX except when bouncing signals off a space satellite or the moon. But, it is good for distances ranging from 10 to 100 miles, depending upon antenna heights. Since VHF signals are reflected by solid objects, they can be received (and transmitted from) inside of tunnels and bridges, as well as inside of buildings.

You won't need a long wire antenna. On a car, all you need is a one-foot high, wire whip. At a fixed location, a foot-high ground plane antenna or a two-foot long coaxial antenna will suffice. For longer range, you can use a longer gain-type omni-antenna or a high-gain beam only two feet wide. If you live in an apartment building where the landlord won't allow you to install a roof-type antenna, you can get by with a two-foot dipole cemented to a window.

The proposed hobby class band is just above TV Channel 13 and far below the UHF TV channels. The existing 220 to 225 MHz ham band is currently available to Technician and higher class ham licensees, but is not widely used because of the availability of the 144 to 148 MHz (2-meter) ham band.

Equipment for the 220.5 to 224.5 MHz band is scarce at the moment. But, once the FCC allocates that band to hobby-class licensees, you can expect equipment to be available in abundance, and at prices comparable to CB equipment.

You can expect manufacturers to offer receivers which will be tunable to any frequency in the band, crystal-controlled transmitters, and channel-switchable FM mobile, fixed and portable transceivers. Also, you can expect scanner-type receivers which will sweep the band and lock onto a live signal.

You can build your own superregen or rhet receiver. And, if the rules, as oted, will permit it, you will also be able to build your own transmitter—from a hand-held one-watter to a 100-watt job. Don't consider higher-powered linear amplifiers. You won't need more than 100 watts to burn your way through. With a 10 db gain antenna, you'll be able to radiate the equivalent of 1000 watts, or the equivalent of 10,000 watts with a 20 db beam. However, it's not the watts that count as much as effective antenna elevation.

One of the biggest *plus* factors of all would be the 100% legal use of automatic *repeaters*. Commercial firms, municipal governments, and other users of two-way radio have for years been utilizing this very effective range-extension system for their VHF and UHF communications. And recently, even the ham operators have adopted the techniques, resulting in unprecedented popularity of the amateur bands above 144 MHz.

In essence, a repeater station is a sensitive receiver and a high-power transmitter situated atop a mountain (or in a very tall building in a metropolitan area). When a user station—say a low-power mobile operator—transmits on a specific frequency, the sensitive receiver picks up this signal and automatically retransmits it from the mountaintop with all the wallop that the high location and extra power can give. The range of the tiny mobile station then becomes the same as the high-power station on the hill.

If Wayne Green's proposal goes through, hobbyist radio operators in the new VHF band would see repeaters dotting the nation's high places; and then radio communications would take on a whole new dimension. For with such VHF repeaters, ordinary walkie-talkies carry the same punch as a mobile or base station, permitting solid two-way contacts over hundreds of miles with absolutely repeatable reliability.

Ponder, if you will, the impact extended range mobile and hand held walkie-talkies can have on emergency communications.

Do you want this dream to come true? If so, write your Congressman or Senator and ask him to urge the FCC to take immediate action on Wayne Green's petition (known by the FCC as RM-1633) to establish a Hobby Class Amateur Radio Operator license. Since it is the Congress which gives guide lines to the FCC and appropriates its funds, the Commissioners will listen to your elected representatives. ■

Squelch

Continued from page 44

squelch has more stages than simpler versions, but its excellent control action has led to wide application in higher-priced equipment. You can set the squelch to awaken these receivers on weak signals barely above the noise level.

Selective Call. Squelch circuits may silence a speaker between incoming calls but they're *non-selective*. You hear not only your own units, but anyone else who happens to speak on the same channel. Where CB is used in a business establishment this can prove distracting to office workers. They'll hear every bit of chit-chat on the channel. This may be cured by the specialized squelch known as *selective call*. It relies on a tone-code signal sent by the calling station, and a special decoder in the receiver to activate the audio stages.

The most popular technique for achieving selectivity is shown in Fig. 5; the reed relay. The reed is a short strip of metal which resembles, and behaves like, the reed of a harmonica. Its valuable quality is that when it's set into motion (plucked), the reed vibrates very precisely on one resonant frequency, usually a few hundred hertz per second—a tone you can hear. How it operates is shown in the simplified diagram of Fig. 5. All incoming audio—noise, voice, etc.—is applied to the relay coil where turns of wire change the audio currents into corresponding magnetic fields. Poised just above the coil is the metal reed which starts to vibrate under the pull of various magnetic fields from the coil. The total movement, however, is not sufficient to cause the reed to strike the lower contact connected to the B+ voltage. But when a station sends the correct tone, the reed commences to vibrate at its resonant frequency. Motion is so great that the reed repeatedly strikes the lower contact and sends pulses of B+ voltage down to the charging capacitor. There the pulses are stored and shaped into a steady DC control signal which *fires* (turns on) the control stage. The audio amplifier is now activated and the calling unit is heard. Only one reed is shown here, but in practical circuits it usually takes a combination of two reeds to create a code that won't cause false responses when the band is crowded with heterodynes that could simulate a single coding tone.

Similar circuits find their way into other applications. If you're watching a black-and-white movie on a color TV set, you won't be disturbed by a shower of colored confetti. Color receivers have a "color killer" which squelches any chroma feedthrough during B & W reception. And if you tune a recent FM stereo receiver, chances are you'll hear no noise between stations as you tune thanks to another squelch-type circuit. Squelch is working all out for you when you hear nothing! Just be sure that your receiver is not turned off! ■

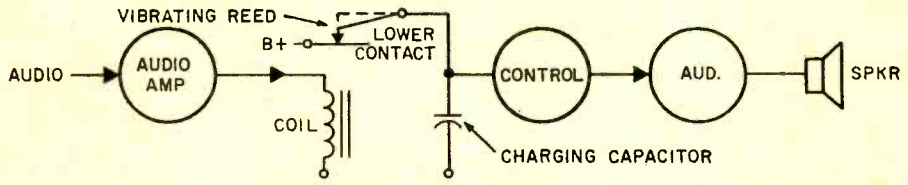


Fig. 5, Tone squelch, also called selective call, employs discrete tone signals to trigger squelch. By coding 2 or more tones, selective call is established.

Action Bands

Continued from page 34

length of wire, a 2 ft length for the 108-136 band, and 1.5 ft length for the 150-174 band. The wire should be vertical and connected directly to the receiver antenna terminal.

You'll get much better results with an outdoor antenna, however, don't use the same antenna for all three bands. Use a ground plane or coaxial antenna for the 30-50 MHz band, a ground plane or coaxial designed for the 108-136 band, and a ground plane, coaxial or colinear or other type of gain antenna for the 150-174 band. For maximum reception the antenna must be designed for the specific band. Don't try

to use a 30-50 MHz antenna for 150-174 band reception. Install the antenna as high as possible and connect it to the receiver through 50-ohm coaxial cable, preferably RG-8/U or a foam-filled type.

There are dual-band antennas (30-50 and 150-174 MHz), but they are not as effective as well designed single band antennas. There are also adjustable antennas, but who wants to climb up on the roof to tinker with the antenna when changing bands?

For peak performance on the 150-174 MHz band, you can use a gain-type antenna, but they are expensive. Using an antenna having 6 dB gain will double the signal strength at the receiver antenna terminals.

If you're interested in receiving from only one direction, or are willing to install an antenna rotator, you can use a much higher gain beam antenna designed for either the 30-50 or 150-174 band.

Mobile Antennas. Should you want to use a monitor receiver or converter in your car, you can use an AM auto radio antenna. However, you'll get better results by using a mobile radio type antenna designed for the band on which you want to receive.

For the 30-50 MHz band, you can use a mobile whip antenna mounted on the fender, bumper or cowl, or a loaded-type (shorter) antenna mounted on the car roof.

An 18-in. whip antenna, mounted on the center of the car roof, can be used with a 150-174 band receiver or converter.

For receiving on both bands, use separate antennas. And if you want to use the same antenna for an AM BCB auto radio and a monitor receiver or converter, you can get a special combination antenna designed for good vhf reception as well as for BCB. They're good space savers.

Ignition Noise. Ignition noise is often a problem on 30-50 MHz reception in automobiles, less so in the 150-174 band. To minimize ignition noise, install a noise suppression kit on the vehicle's engine, preferably one designed for vhf mobile radio use. Suppressors designed for the AM BCB may not be effective at vhf.

Station Identification. Many VHF/UHF communications band listeners have asked where to get information about the frequencies of stations in their areas. You can't get this information from the FCC because it would be quite a job for them to go through their files, which cover authorizations of some 5,000,000 transmitters throughout the nation and ships at sea.

Call books for the Public Safety, Industrial and Land Transportation Radio Services covering the entire country were never popular—who in Los Angeles cares about stations in Miami which he can't hear? This magazine publishes lists of public safety stations by localities, but not all in one fell swoop. It would take up too much space.

You can procure such lists for various localities from Communications Research Bureau, Box 56, Commack NY 11725. The CB Yearbook, by the editors of this publication (latest issue soon due on the newsstands), and our soon-to-be-published magazine COMMUNICATIONS WORLD, contain information on the various radio services. Or, you can ask a local two-way radio service shop for the frequencies of the local police, fire, and other communications stations.

All stations are required to identify themselves at specified intervals by stating their assigned call, but not at the beginning and end of every exchange of communications, as on the Citizens Band.

Mum's the Word. It's OK, except where prohibited by local laws, to listen in on privileged radio transmissions. Since it's comparable to wire tapping, you should not tell anyone what you've heard—unless, of course, you hear a *MAYDAY* (voice version of SOS) from a plane or ship. Naturally, you may tell others what the weather man said over an ESSA (Weather Bureau) station.

Where It's At. If you are now ready to join the ranks of the very-high-frequency-listeners and don't know where to buy a vhf receiver or converter, try your local CB radio equipment dealer or radio parts distributor. Or look through a mail order catalog (Allied, Lafayette, Olson, Radio Shack, Sears, etc.). You should also find them advertised in ELEMENTARY ELECTRONICS or other radio magazines.

Buying a good antenna may be more difficult. The typical dealer who sells monitor receivers might carry CB and ham antennas, but not land mobile communications antennas. However, he can order one for you. Or, look up the listings under "Radio Communications Equipment and Service" in the yellow pages for a commercial mobile radio dealer or service shop. They usually carry the right types of antennas in stock and can recommend the best type to suit your particular need. ■

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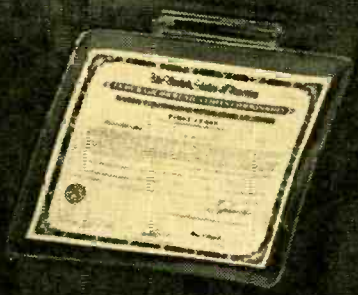

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- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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