How to Add a Space Dimension to Stereo Headphones

ELECTRONICS ILLUSTRATED

CONSISTENTLY THE BEST IN HOBBY ELECTRONICS

JANUARY 1971
By the Publishers of
MECHANIX ILLUSTRATED
50¢

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Two Great Projects for Hams and CBers!

Solid-State Transmitter for Hams

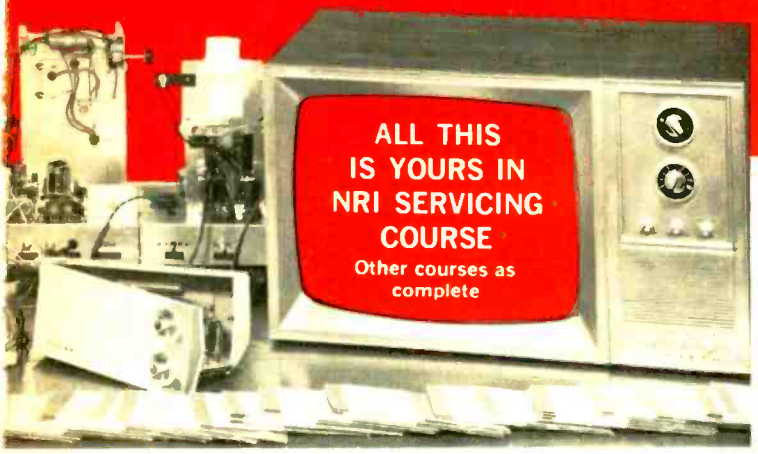
Now...the Video Gramophone! ✶ The Big Bang Speaker System

All-Band Mobile Whip ✶ Changing a Color TV Picture Tube

Add Organ Tones to Piano ✶ Facts on Electronic Franchises

Tropic of Cancer DX Award ✶ Easy-to-Build Battery Tester

ectronics the NRI "hands on" way



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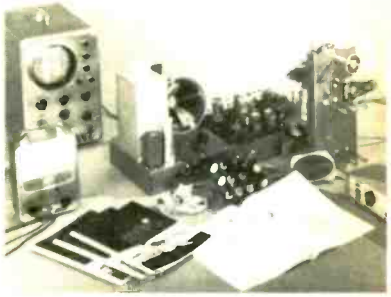
Programmed lab equipment gives you priceless confidence

You learn with your hands as well as your head



The NRI pioneering "discovery" method of home study is the result of more than half a century of simplifying, organizing, dramatizing subject matter. You learn by doing in each of NRI's major courses, demonstrating theory you read in "bite-size" texts programmed with lab equipment you build and use. Electronics comes alive in a unique, easy-to-understand, fascinating way. You learn with your hands as well as your head. The "why" of circuitry and equipment operations comes clear through demonstration. You gain experience with solid-state devices as well as conventional tube circuits. You progress rapidly to the ultimate goal of NRI training — to make you employable in Electronics by giving you experience equivalent to months, even years, of on-the-job training.

Discover how fast and fascinating training at home with NRI can be

There is no end of opportunity for the trained man in Electronics. You can earn extra money in spare time, have your own full-time business, or qualify quickly for career positions in business, industry, government. Discover the ease and excitement of training at home with the leader — NRI. Discover how NRI job-simulated training gives you priceless confidence. Experience is still the best teacher, and that's what you get when you train for Electronics with NRI. Mail the postage-free card today for the new NRI Color Catalog. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

NRI has trained more men for Electronics than any other school

RONALD L. WOOD, Fargo, N.D., holds a First Class FCC License and is employed as a studio and master control engineer/technician with station KXJB-TV. He wrote to NRI to say, "Many thanks to NRI for the Electronics training I have received."

RANDY ACERMAN, Camden, N.J. has his own TV service business. He is the official TV repair center for the Radio Shack store and Goodyear Tire Co. in his area. He says, "I have seen other schools' texts and most can't hold a candle to NRI lessons."

CRAIG D. SPARKS, Cambridge, Mass., is a Communications technician for AT&T Long Lines Dept. "I was hired because of my NRI training. I was given credit for 18 months experience and my starting pay raised. They were impressed NRI trained me well enough to get a First Class FCC License."

Pick your field of ELECTRONICS

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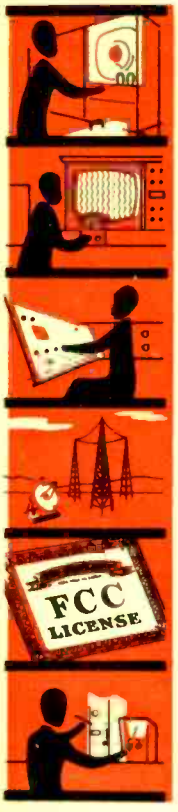
Take your choice of unique training plans that cover the most important areas of opportunity in TV-Radio, Broadcasting-Communications and Industrial-Military Electronics. NRI also offers you the only home-study course in Amateur Radio. Brief descriptions of 12 NRI training programs below, are explained in detail in the FREE NRI Catalog we send you. Read how NRI has applied more than 50 years of experience developing easy-to-understand programs designed to make you *employable* in Electronics. Proof of the quality of NRI training is tens of thousands of successful graduates and the reputation for high educational standards NRI holds throughout the Electronics industry. Move ahead in this fast growing industry. Mail the postage-free card. No one is going to call on you. NRI does not employ salesmen. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.



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Learn to fix all TV sets. Course includes your choice of black-and-white or Color TV training equipment. Also learn to fix radios, stereo, hi-fi, etc. A profitable field full or part-time.

ADVANCED COLOR TV

For men who know black & white TV circuitry. 18 lessons, 50 experiments cover all circuits including set-up alignment. Only Color course with equipment specifically designed for training. End product is your own set.

INDUSTRIAL-MILITARY ELECTRONICS

From basic principles to computers. Comprehensive training teaches fundamentals, then takes you into such modern-day miracles as servos, telemetry, multi-plexing, phase circuitry, others.

COMPLETE COMMUNICATIONS*

Teaches and provides actual practice in operation, service, maintenance of AM, FM, and TV broadcasting stations. Also covers marine, aviation, mobile radio, facsimile, microwave, radar.

FCC LICENSE*

Prepares you for First Class FCC Radiotelephone License exams. You begin with fundamentals, advance to required subjects covering equipment, procedures.

BASIC ELECTRONICS

A concise course in Electronic terminology and components. A wealth of useful information to help you better understand the field. For anyone who wants a basic understanding of Radio-TV Electronics.

ELECTRONICS FOR AUTOMATION

Not for beginners, but for men with some knowledge of Electronics who want an understanding of process control, ultrasonics, telemetering and remote control, electromechanical measurements, other subjects.

AVIATION COMMUNICATIONS*

Prepares you to install, maintain, service direction finders, ranges, markers, Loran, Shoran, Radar, landing systems. Earn your FCC License with Radar Endorsement.

MARINE COMMUNICATIONS*

Covers transmitters, direction finders, depth indicators. Radar, Sonar, other equipment on commercial ships, pleasure boats. Prepares for FCC License with Radar Endorsement.

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Learn to install and maintain mobile transmitters and receivers used by police and fire departments, public utilities, construction firms, taxis, etc. Prepares for FCC License.

AMATEUR RADIO

Includes all new lessons and training equipment so you can build your own 3-bank phone/cw receiver and transmitter. Basic and Advanced training prepares you for FCC Novice, Advanced and Extra Class Licenses.

ELECTRICAL APPLIANCE REPAIR

Prepares you quickly to repair all types of appliances, including air conditioning, refrigeration, small gasoline engines. An easy, practical course leading to profitable part-time or full-time business of your own.

* MONEY BACK AGREEMENT

You MUST PASS your FCC License exam (any Communications course marked) or NRI refunds in full the tuition you have paid.

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If you have served in the Armed Forces since January 31, 1955, or are in service now, check GI line in the postage-free card.

Over 50 Years of Leadership in Electronics Training

ELECTRONICS ILLUSTRATED

A Fawcett Publication
January 1971 Vol. 14 No. 1

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COVER: Ektachromes by John Capotosto

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NEW "TREASURE HUNTER" KIT

Finds metals, pipes several inches underground. EICO TH-30 Solid State Treasure Hunter locates iron, steel, tin, gold, silver, copper etc. Beep pitch increases as you near object.

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EICO®

CIRCLE NUMBER 6 ON PAGE 13

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Sound n' Color

Color Organs, Translators, Strobes

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TRANSLATORS

The electronics you need to create audio-stimulated light displays.

MODEL 3460 1 Channel. Kit $24.95, Wired $39.95.

MODEL 3465 3 Channel. Kit $39.95, Wired $69.95.

STROBE LITES

Burst of white light flash in cadence of each beat of audio.

Model 3470 Adjustable Rate. Kit $29.95, Wired $44.95

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ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Conn. 06830. Second-class postage paid at Greenwich, Conn., and at additional mailing offices.

EDITORIAL OFFICES: 67 W. 44th St., New York, N.Y. 10036 (phone 212-661-4000). Contributions must be accompanied by sufficient postage and will be handled with care, though the publishers assume no responsibility for return thereof.

ADVERTISING OFFICES: 67 W. 44th St., New York, N. Y. 10036 (phone 212-661-4000); Midwestern Representatives, Kingwill Co., 5526 N. Elston Ave., Chicago, Ill. 60630 (phone 312-774-9660); 1532 Guardian Bldg., Detroit, Mich. 48226 (phone 313-WO 2-4860); 3807 Wilshire Blvd., Los Angeles, Calif. 90005 (phone 213-287-8258); 681 Market St., San Francisco, Calif. 94105 (phone 415-EX 7-3441); 1422 W. Peachtree St., N.W., Atlanta, Ga. 30309 (phone 404-TR 5-0373).

SUBSCRIPTIONS: $3 per year (6 issues) in U.S. and possessions and Canada. All other countries $4 for 6 issues. All subscription correspondence, including changes of address (Form 3579), should be addressed to ELECTRONICS ILLUSTRATED, Subscription Dept., Fawcett Bldg., Greenwich, Conn. 06830. Foreign subscriptions and sales should be remitted by International Money Order in U.S. funds payable at Greenwich, Conn.

PRINTED IN U.S.A. BY FAWCETT PRINTING CORP., LOUISVILLE, KY. 40201. Microfilm copies of current and back issues are available from University Microfilms, 313 N. First St., Ann Arbor, Mich. 48103.

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VARIABLE BALANCE STEREO HEAD PHONE

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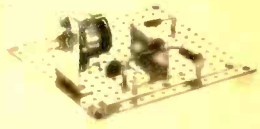

EXPERIMENTER'S CIRCUIT BOARD KIT

Contains a 3¾" x 4" perforated board, 15 terminals (No. J4-636) and 4 mounting feet w/screws. Build small circuits, hobby and science projects, etc.
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"Y" Audio Adaptor has a phono pin jack on one end and dual phono pin plugs on the other.
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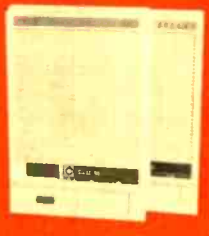

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Just plug into any electrical outlet. Completely portable. Expand system anytime with additional units. Two unit system complete in display pack.
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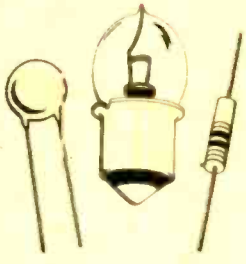

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Type PR2 • 2.5 volt • 0.50 amp •
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Attractively packaged 2 per pack, showing values, color codes and formulas.

STANDARD 1000 VOLT CAPACITOR

High quality, compact and reliable.

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CIRCLE NUMBER 4 ON PAGE 13

Broadsides

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

If you've finished building all the projects in this issue of EI and can't wait till the next one, you need help. In addition to consulting the nearest guru, take a peak at the new **Hobby Projects** Manual Vol. II from International Rectifier. The 64-page color manual should provide enough electronic information for the beginner and advanced experimenter to wallow in. With all this building going on, you'll need the quick digest of **semiconductors** which is offered by IR. The manual is 85¢ but the digest is gratis from International Rectifier, 233 Kansas St., El Segundo, Calif. 90245.

Contrary to popular belief, records are still alive and well. To keep them that way, Thorens has developed a line of **turntables** that will keep you from using your discs in the next Frisbee tournament. The American distributor of the line has just released a brochure on the new TD-150 MKII and entire TD-125 line of trancription turntables. The booklet is free from Elpa Marketing, New Hyde Park, N.Y. 11040.

High-current **DC power supplies** are not easy to come by and a complete listing of the brutes is valuable to those in need. For Christie Electric's offering in this field, get their AC-70 catalog. It covers 300 basic and modified power supplies whose options include magamp, SCR and load regulated only. Christie Electric Corp., 3410 West 67th St., Los Angeles, Calif.

If you've ever wondered why your head can sound like a concert hall, a good place to turn is the new brochure from Koss Electronics. Besides a colorful look at the company's latest in dynamic and electrostatic **headphones**, there is a section of drawings and information on how the devices work. Send to Koss Electronics, Inc., 2227 N. 31st St., Milwaukee, Wis. 53208.

The trend in catalogs these days is toward quick reference. A prime example of this type is found in the listing of **resistors, potentiometers, trimmers,** tap switches and RF chokes available from Ohmite. The lickety-split index is yours for the asking from Ohmite Manufacturing, 3660 Howard St., Skokie, Ill. 60076.

What ATT is to telephones and ALCOA is to aluminum, so is Lafayette to consumer electronics. The folks at Lafayette are celebrating their golden anniversary and their present to you is a thick catalog of **everything electronic** under the sun. Included are the latest Lafayette models of CB, Ham and Hi-Fi gear—enough to make the steadiest of us drool. This is one book that is a must on your bookshelf, no matter what you're electronic interest. Send for your free copy to Lafayette Radio Electronics, Box 10, Syosset, L.I., N.Y. 11791.

BUILD 20 RADIO
and Electronics Circuits

PROGRESSIVE "Edu-Kit"® HOME RADIO COURSE

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Training Electronics Technicians Since 1946

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
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YOU DON'T HAVE TO SPEND
HUNDREDS OF DOLLARS FOR A RADIO COURSE

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

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

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

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

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

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble. I 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 bassis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 611AE, Hewlett, N. Y. 11557

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:
Check one box to indicate choice of model

☐ **Deluxe Model $31.95.**
☐ **New Expanded Model $34.95 (Same as Deluxe Model plus Television Servicing Course).**

Check one box to indicate manner of payment
☐ I enclose full payment. Ship "Edu-Kit" post paid.
☐ I enclose $5 deposit. Ship "Edu-Kit" C.O.D. for balance plus postage.
☐ Send me FREE additional information describing "Edu-Kit."

Name _____

Address _____

City & State _____ Zip _____

PROGRESSIVE "EDU-KITS" INC.
1189 Broadway, Dept. 611AE, Hewlett, N. Y. 11557

CIRCLE NUMBER 10 ON PAGE 13

Feedback from Our Readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036

● TOLD YOU SO

I really dig the action on the police bands. Your article (BUGGING THE FUZZ, Nov. 70 EI) was a big help, especially the codes. You're right about that mobile biz, because I got stopped for speeding and the cops saw my radio. One summons worth of fun.

Paul Cramer
Chicago, Ill.

● COFFEE, TEA OR CUBA

Your cheapie converter for aircraft ($3.83 AIRCRAFT MONITOR, Sept. 70 EI) was easy to build. (By the way, C1 should be a silvered mica.) I took it on a flight from New York to Miami and the rubber chicken really hit the fan. When the stewardess heard me listening to the pilot she was sure I was going to pull a fast one and asked me to give it to her. I guess she just didn't want me to know how long we (the plane) were going to be stacked up.

Joe Drew
Cleveland, Ohio

● GIRL WATCHER

I enjoyed your story on the electronic orbs (ELECTRONICS EYES, Nov. 70 EI) and I can think of a few more uses for the system. When I go to the beach, I hate to be too obvious when I stare at those luscious bikinis. With those electronic eyes in my back I could ogle to my heart's content.

Alan Streaver
Providence, R.I.

You don't call that obvious?

● WAYNE OF ARABIA

Wayne Green's proposals for a hobby band in his Nov. Ham Shack have some good points. His enemies at the ARRL probably will wish that he stayed with Hussein in Jordan.

Peter Morrow
Jacksonville, Fla.

● BONES ON BOARDWALK

I used your electronic dice (NEON CRAP SHOOTER, Nov. 70 EI) to play a game of Monopoly. I rolled doubles so many times that I spent half the night going directly to jail. I wish I knew a game where doubles win.

D.C. Spectorsky
Portland, Ore.

● CB SWAMI

Tom Kneitel has finally done it. He has jumped in over his head, in a world where he is a complete amateur. I used to fool around with a Quija board (THE LONG NIGHTS OF UNCLE TOM, Nov. 70 EI) and other stuff. I paid the price for such supernatural tomfoolery, and believe me I wouldn't do it again.

J. Faust
Berlin, Germany

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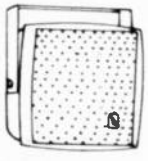

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CIRCLE NUMBER 15 ON PAGE 13

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

Uncle Tom answers his most interesting letters in this column. Write him at Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036.

★ *I've listened around for you on the ham bands but I have never been able to to hear you. Could you please tell me your frequency on the ham bands?*

Roger Kellerman
Peterson, N.J.

About three times a week.

★ *Would it be possible to build a CB rig from the cheap parts available from old TV sets, radios, and such? Where could I get plans for this?*

Wayne F. Studley
Fayette, Mo.

It can be done, but it just isn't too practical. Back in the early days of CB there was a company making high quality black-box CB transmitters from military surplus MN-26 direction-finder receivers. They went broke trying to market them.

Eight-Track Dept. I'm not at all happy about the general mechanical quality of eight-track stereo cartridges. It seems that at least 10 per cent of them are defective and will not play properly. It is possible to pry open the cartridge, untangle the snarled tape, and then snap the case back together again. Tape manufacturers aren't too keen on your attempting this for when you look inside and see the few measly feet of tape you were soaked about $8 for, you will probably go back to discs. I have been able to splice no less than four separate tapes together in the space available in a single cartridge and there was still room to spare!

★ *Radio station XTRA (690 kc from Tiajuana, Mexico) advertises over the air that it is the world's first stereo AM radio station, but that it takes two radios to accomplish the trick. Do you have any news of this?*

Albert W. Swisher
Hollywood, Calif.

It's an interesting experiment in cheap and dirty stereo. What they are apparently doing is running two inputs through sideband filters into their transmitter. The result is two independent sidebands containing a carrier. If you use two receivers of decent selectivity it is possible to achieve a limited stereo effect in this manner.

★ *I have high current leakage somewhere in my transmitter and the plate current won't dip. How do you suggest that I tune the transmitter under such conditions?*

A. R. W.
Opeleika, Fla.

Very carefully.

★ *While tuning around 8720 kc I heard a station announcing KEA860 on 35.22 mc. Can you give me any information on this station, including where I can write to them for a QSL?*

Marcus Berman
Montclair, N.J.

This is a 250-watt radio-paging station located atop the Empire State Building in New York City. Your reception on 8 mc was probably due to an image in your receiver. If you want to hit them up for a QSL try writing to Mr. Stanley Blumenthal, Chief Engineer, Aircall, 224 38th St., N.Y.

★ *Last night on 20-meter CW I heard a station identifying itself as RCI. It was calling UHGI on 14.060 mc. I answered him with ORZ? (who are you?) and he came back with UHGI? I told him that I was WB60LI and then he replied NO WRK (I will not work you). Eventually, he contacted UHGI and they QSO'd. What was this all about?*

Steve Burris
Santa Ana, Calif.

(*Continued on page* 12)

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Uncle Tom's Corner

Continued from page 10

RCI is located in Novosibirsk, USSR. The other station is probably a spy trawler. The CIA will be around to give you your QSL.

★ *I have been trying to think up ways to legally increase my mobile CB range. One idea which I came up with is to add a loading coil to a quarter-wave steel whip to effectively lengthen it to a more efficient half-wave antenna. How would I make such a coil?*

Jerry D. Swisher
FPO San Francisco, Calif.

It's a good idea, which has long been on the commercial market in the form of continuously loaded fiiberglass whips. Most CB antenna companies offer these at less than the cost (and much less effort) than trying to roll your own.

★ *Recently, while in Key West, Fla., I found that my short-wave receiver was alive with Cuban two-way communications stations. Has Uncle Sam hit upon the idea of monitoring these transmissions for intelligence purposes?*

Henry Segall
Atlanta, Ga.

Among the various military groups doing this work are the U.S. Army Composite Operations Group No. 8783 at the University of Miami's South Campus and the Army's Communications Group Field Detachments No. 1 (at the foot of Collins Ave., on Miami Beach) and No. 2 (somewhere near Perrine, Fla.). The two Field Detachments report directly to the Pentagon.

★ *I sent a reception report to a radio-telephone station in Puerto Rico but my report bounced as having an insufficient address. The station was WW120 on 10101 kc. How can I contact them for a QSL?*

James Montesion
Rockaway Beach, N.Y.

Try The Radio Corporation of Puerto Rico, Box 3745, San Juan, P.R. Enclose a stamped, self-addressed return card for them to fill in with the QSL information.

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Up Scope. This oscilloscope/vectorscope from Lectrotech is a wide-band, triggered-sweep scope that will make most service problems easier to handle. Model TO-50 is all solid-state with a 10-mc bandwidth. The CRT has an edge lit calibrated scale. $339.50. Lectrotech, Inc., 4529 N. Kedzie Ave., Chicago, Ill. 60625.

SKY Spy. This miniature VHF receiver lets you listen to airplanes and control towers. The pencil-shaped receiver has a detachable, spring-base antenna and is tunable in the 108-140-mc band. The receiver is kept small by miniature circuitry, the use of an earphone instead of a speaker and by using two tiny hearing-aid batteries. It has a battery life of 25 hours. $18.95. Saxton Products, 215 N. Route 303, Congers, N.Y. 10920.

Electronic Marketplace

Noise Reducer. A cassette tape deck utilizing the Dolby B noise-reduction processor has been announced by Harman - Kardon. The CAD5 is said to have a frequency response that extends beyond 12,500 cps. It has an electronic speed control that assures minimum speed variation to reduce wow and flutter. The CAD5 also has a recording overmodulation light. $229.95. Harman-Kardon, 55 Ames Ct., Plainview, N.Y.

[*Cont. on pg.* 20]

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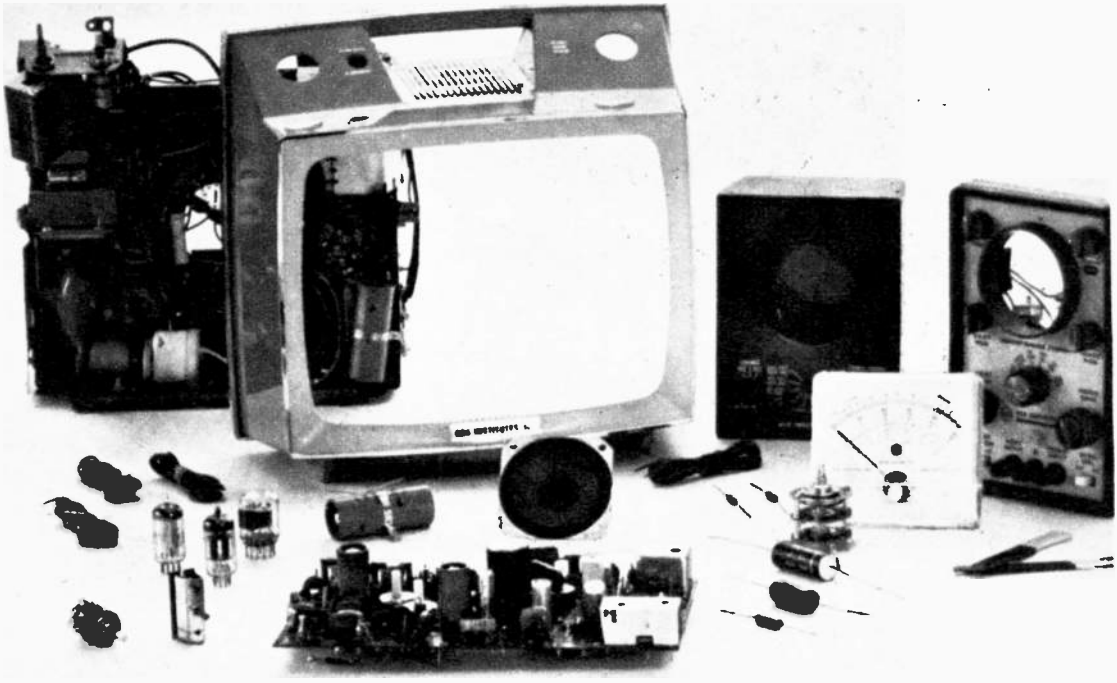
CIRCLE NUMBER 20 ON PAGE 13



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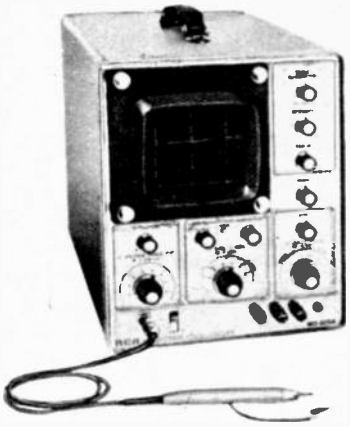
Electronic Marketplace

The Smaller The Scope. Included in RCA's line of test equipment for 1970 is a solid-state 5-in. oscilloscope, Type WO-505A. The WO-505A has



a gain of 15 mw peak-to-peak per in. on the high-gain range of the vertical amplifier. Included also are: flatface cathode-ray tube, return-trace blanking circuit and illuminated graticule. $298.50. RCA Electronics, Camden, N.J. 07029.

The Changing Cartridge. The Quatron Corp. has introduced a new automatic tape-cartridge changer. The changer allows one to use 12 cartridges and play all channels of all tapes in sequence, or the first channel of all tapes, or endlessly repeat a single tape, all at the push of a

button. Individual tapes and channels can be played manually at any time and a cartridge can be rejected or repeated. An automotive version of the Quatron changer utilizes a remote control panel on the dash, while the equipment is stored in the trunk. $299.00. Quatron Corp., Rockville, Md. 20852.

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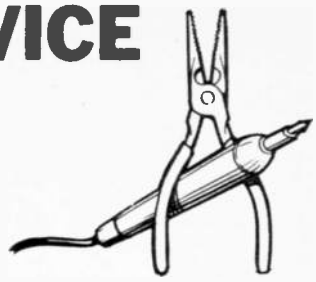
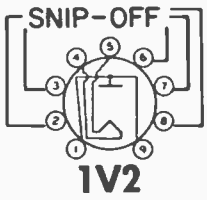


By
ART MARGOLIS

ONE of the commonest troubles to be found in the electronics of a cassette recorder does not have to do with transistors but with the small electrolytic capacitors that are used for coupling and bypass. They often open up. Typical values of these capacitors are 100 μf at 25 V, 5 μf at 25 V, etc. They cause the audio to go dead while the mechanical parts of the recorder keep operating.

—

Repeated burnout of a 1V2 or 2AV2 focus-rectifier socket in a color TV can be halted. It seems that the 5,000 V at the socket tends to burn a path by arcing from pin to pin till the socket has a carbon path that extends from pin 5 (the filament) to pin 9 (the anode). Snip off all unused tube pins, that is, pins 2, 3, 6, 7 and 8 (see diagram) and fill those socket holes with corona dope. This should prevent the burnout from happening again.



—

Take some sticky wax and put a coat of it inside each of your socket wrenches. That way bolts will hold in the socket so you may guide it to its destination—up, down or in any direction, regardless of the pull of gravity.

—

If you have an inexpensive, odd-shape speaker that get the grogs due to a rubbing voice coil, it can be repaired easily. Take a wad of absorbent cotton and wedge it between the cone and frame, close to the coil. When you've found the best location by trial and error, glue it for the repair.

—

If you are all set to rejuvenate a dull b&w picture tube, don't give it a *hot shot* except as a last resort before actually discarding the tube. This shot places about 1,000 V on the control grid and lots of tubes will destruct. Safest rejuvenation procedure is to overheat the filaments by injecting about 8 V instead of the prescribed 6.3 V.

—

One of the commonest ailments of a color TV can be confusing at first but is actually quite simple to cure. The symptom is no brightness, sound okay. A look in the back of the set reveals the horizontal-output tube lighting a cherry red. What has happened is the high-voltage rectifier tube has died and subsequently overloaded the horizontal oscillator, which causes the output tube to burn up. Replacement of the high-voltage rectifier and horizontal-output tube is the cure.

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CIRCLE NUMBER 8 ON PAGE 13

ELECTRONICS ILLUSTRATED / January 1971

Solid-State Ham Transmitter for 40 and 80

Two transistors for 18 watts of input power and a clean CW signal.

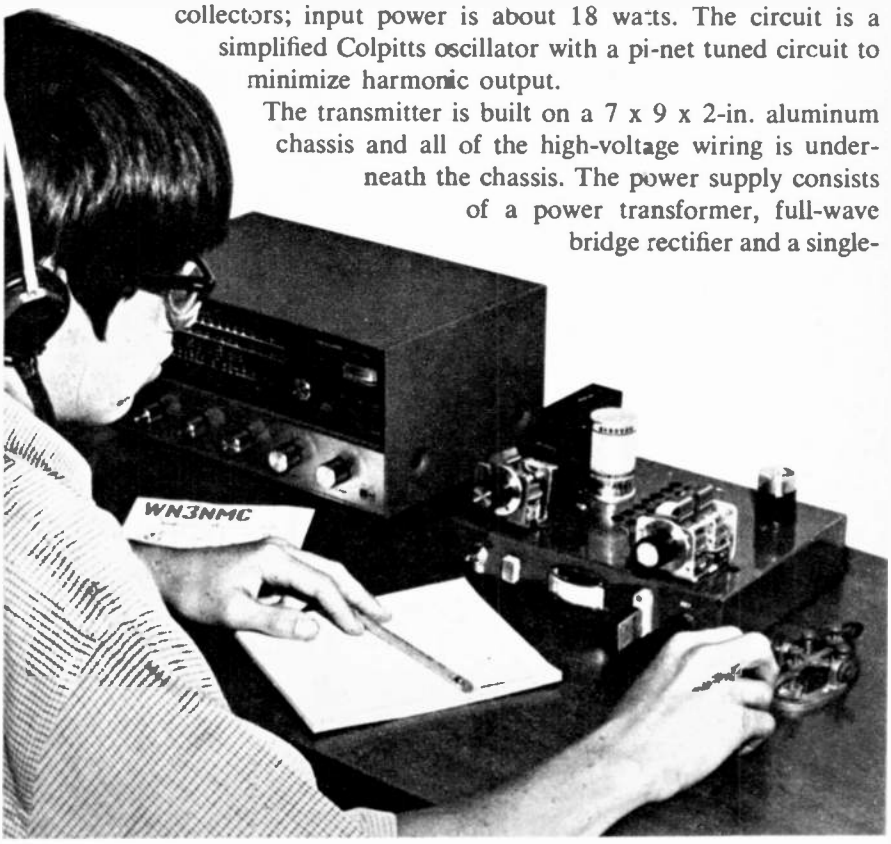
By CHARLES GREEN, W6FFQ

TRANSISTORS may have swept vacuum tubes off the radio, TV, CB and hi-fi scene, but as yet they haven't come on very strong in ham transmitters. The reasons for this are the high cost of high-power RF transistors and output-stage impedance-matching problems.

A way to get around this is to use high-voltage transistors originally designed for the output stage of 117-V line-operated audio amplifiers. High-voltage transistors allow high-impedance matching to the input of a pi-net antenna tuner, instead of complicated taps and special tuned circuits required by low-voltage, low-impedance transistors.

Our solid-state CW transmitter is crystal controlled and uses plug-in coils for the 80- and 40-meter ham bands. Two high-voltage transistors are connected in parallel. There's approximately 175 V on their collectors; input power is about 18 watts. The circuit is a simplified Colpitts oscillator with a pi-net tuned circuit to minimize harmonic output.

The transmitter is built on a 7 x 9 x 2-in. aluminum chassis and all of the high-voltage wiring is underneath the chassis. The power supply consists of a power transformer, full-wave bridge rectifier and a single-



Solid-State Ham Transmitter for 40 and 80

section filter that includes a choke.

How It Works

Transistors Q1 and Q2 are connected in parallel in a Colpitts oscillator circuit (note the similarity to an equivalent vacuum-tube Colpitts oscillator). The emitters of Q1 and Q2 are kept above RF ground by L1. The RF voltage across the crystal is divided across the internal capacitance of the emitter-base junctions of Q1, Q2 and C1.

When the key (plugged in J1) is pressed, the RF generated by Q1 and Q2 is coupled via C8 to the pi-net tuned circuit consisting of C7, C9A/B and plug-in coil L4 (or L5). Coil L4 (or L5) couples the high-impedance output of Q1 and Q2 to the low impedance of the antenna.

Meter M1, connected in the Q1, Q2 collector circuit indicates proper tuning of the pi-net circuit. The necessary DC power is supplied by T1 and BR1 and is filtered by L3 and C12A, C12B.

Construction

The transmitter is built on a 7 x 9 x 2-in. aluminum chassis. Most of the parts are mounted on a 2 x 4-in. piece of perforated board. For best performance, follow our component and wiring layout.

Start construction by cutting ventilation holes in the rear and top of the chassis, as shown in Fig. 5. Also drill holes in the chassis bottom plate and on the rear apron to

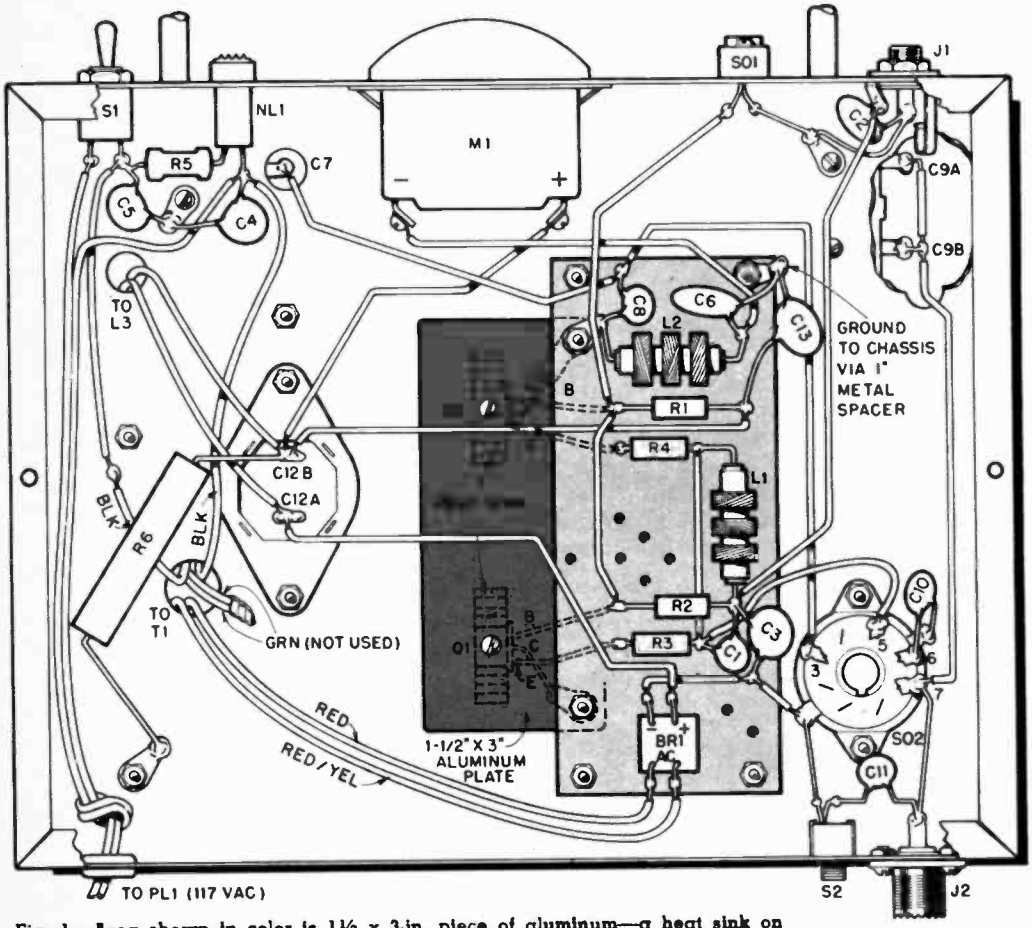


Fig. 1—Area shown in color is 1½ x 3-in. piece of aluminum—a heat sink on which Q1 and Q2 are mounted. Gray area is perforated circuit board. Parts are grounded to the chassis by a 1-in. spacer at upper right corner of the board.

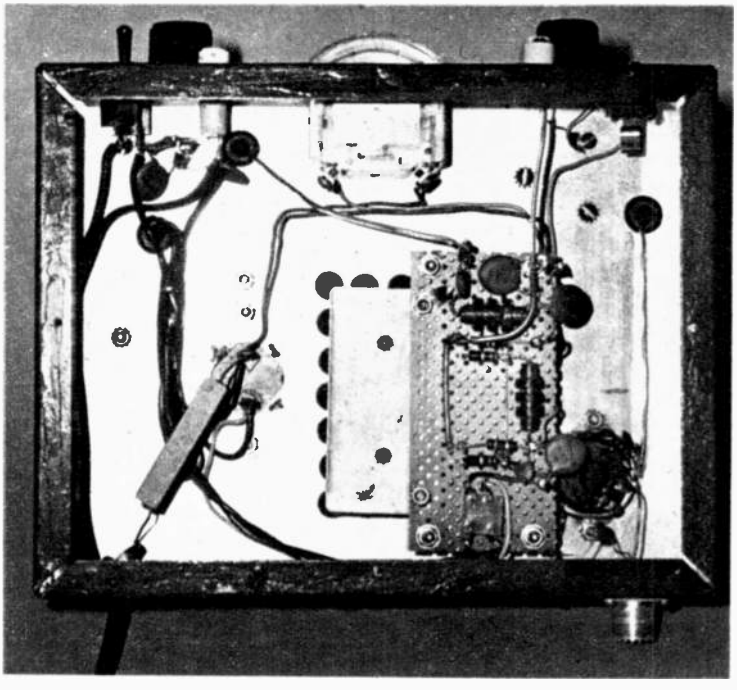


Fig. 3—Underside of chassis. Note open layout of our model. Duplicate parts placement to assure proper operation. There are 21 ⅜-in.-dia. ventilation holes over the aluminum plate on which the transistors, Q1 and Q2, are mounted.

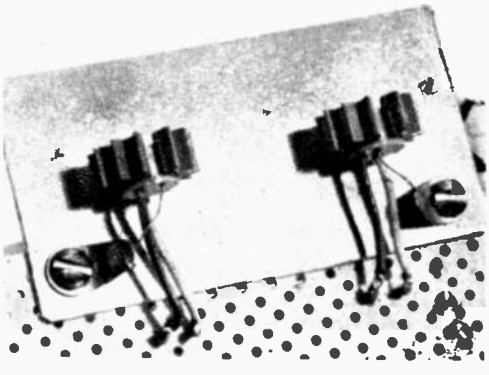


Fig. 2—Photo shows how Q1 and Q2 are mounted on aluminum plate. Finned heat sinks are Motorola HEP-158. Collectors are connected to solder lugs.

allow maximum air flow through the chassis and around the Q1 and Q2 sheet-aluminum heat sink. The size of the holes is not critical (we drilled ⅜-in. dia. holes) as long as the top of the chassis and bottom plate holes cover an area of about 1½ x 3¼-in.

Mount variable capacitors C7 and C9 at the front of the chassis near the corners, and then mount the remaining chassis componets where shown. Keep them spaced out in the same positions as in our model. We used an edgewise meter for M1 to save space.

Mount the remaining components on the front and rear of the chassis, as shown in Figs. 3 and 5. Mount S1 and S2 so that their up position is *on*. Install rubber grommets in the chassis holes through which wires pass. Use lock washers on all mounting screws to prevent them from loosening.

Cut a 2 x 4 in. piece of perforated board and cut a 1½ x 3-in. piece of aluminum. Fit Q1 and Q2 in their heat sinks and mount the heat sinks (with their centers 1½-in. apart) on the piece of aluminum as shown in Fig. 2. Mount the piece of aluminum on the edge of the perforated board as shown in Figs. 1 and 3 so that the heat sinks are between the board and the underside of the chassis. Connect the collector leads of Q1 and Q2 to solder lugs installed on the board (Fig. 1) at the aluminum panel's mounting screws. Connect their emitter and base leads to push-in terminals on the perforated board. Mount the perforated board on to the bottom of the chassis with 1-in. metal spacers at each corner so that the aluminum panel is directly under the chassis ventilation holes.

Mount and wire the board components as shown in Fig. 1. Four separate dilicon diodes (Motorola HEP-158, 600 PIV, 1 A; or equiv.) can be used in place of the full-wave bridge assembly (BR1). Wire the remaining chassis components keeping all of the wir-

Solid-State Ham Transmitter for 40 and 80

ing (except the RF leads) close to the chassis. We used No. 18 bus wire covered with plastic sleeving for the RF leads in our model. Keep the RF leads away from the components and do not have any sharp bends in them.

The two plug-in coils (L4 and L5) are made from Barker & Williamson No. 3016 Miniductor coil stock as shown in Fig. 4. Coil L4, the 80-meter coil is 32 turns. Coil L5, the 40-meter coil is 16 turns. The coils are mounted in the bases of discarded octal tubes. We cemented 14-dram plastic pill bottles over the coils to protect them, but plastic tubing can also be used. Install a jumper wire in the 80-meter coil (L4) between pins 5 and 6.

Tune-Up and Operation

Connect a 7-watt lamp (using short leads or coax) to J2, and set S2 to *off* (C1 out of circuit). Plug the 80-meter coil (L4) in SO2 and plug an 80-meter crystal in SO1.

Set C7 and C9 to maximum capacitance, plug a key in J1 and plug in the line cord. Set S1 to *on*, momentarily press the key and quickly tune C7 for minimum indication (sharp dip) on M1. Press the key again and tune C9 for about a 100-ma indication on M1. Retune C7 for minimum indication.

Repeat the adjustments of C7 and C9 until M1 indicates 100 ma after final adjustment of C7. Do not press the key for too long while tuning up the transmitter. After tune-up is completed, allow the transistors to cool

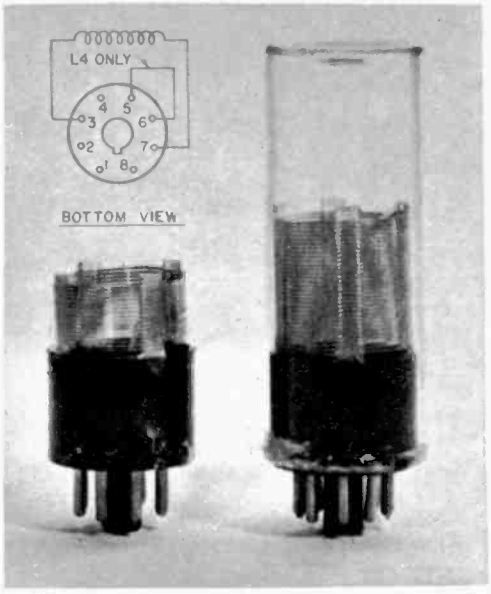


Fig. 4—Coils. 40-meter coil (L5) is shown at left; 80-meter (L4) is at right. Both are made from Barker & Williamson No. 3016 Miniductor coil stock. L5 is 16 turns and L4 is 32 turns.

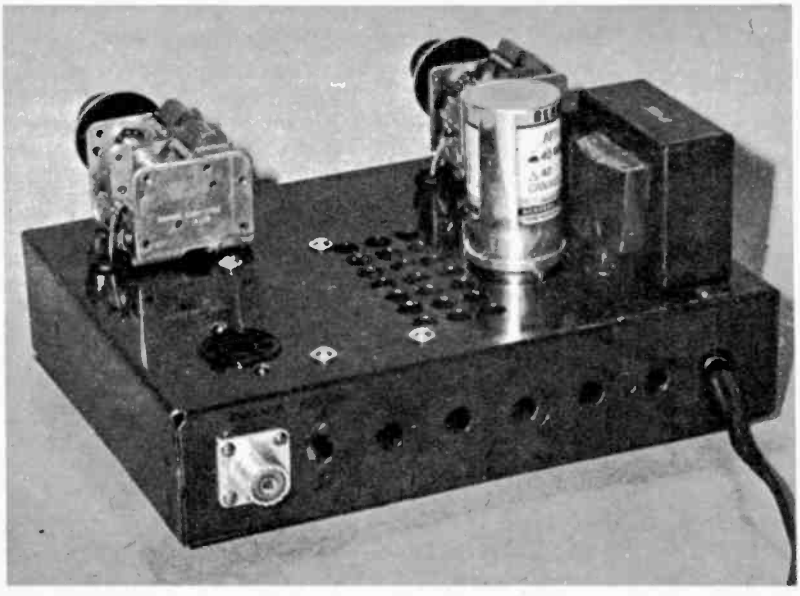


Fig. 5—Rear of transmitter. Note ventilation holes on top and on rear apron. Output connector J2 is at left of rear apron. Switch S2 is to right of it. Coil goes in socket above SO2.

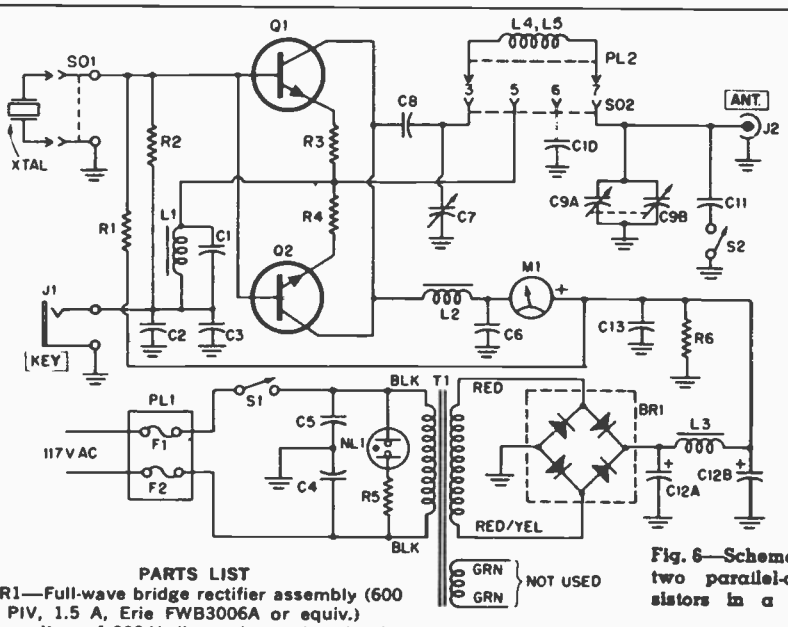


Fig. 6—Schematic. Oscillator is two parallel-connected transistors in a Colpitts circuit.

PARTS LIST

BR1—Full-wave bridge rectifier assembly (600 PIV, 1.5 A, Erie FWB3006A or equiv.)
Capacitors: 1,000-V disc unless otherwise indicated
C1—100 $\mu\mu f$
C2—.01 μf
C3,C4,C5,C6,C13—5,000 $\mu\mu f$
C7—10-365 $\mu\mu f$ variable capacitor (Calectro A1-227)
C8—1,000 $\mu\mu f$, 3,000 V
C9A,C9B—Dual 10-365 $\mu\mu f$ variable capacitor (Calectro A1-228)
C10—200 $\mu\mu f$
C11—500 $\mu\mu f$
C12A,C12B—40/40 μf, 450-V electrolytic
F1,F2—1-A fuse
J1—Open-circuit phone jack
J2—SO-239 coax connector
L1—1 mh RF choke (J. W. Miller 4662)
L2—2.4 mh RF choke (J. W. Miller 4666)
L3—Filter choke: 1 hy, 240 ma, 50 ohms (Triad C-24X or equiv.)
L4,L5—Coils made from Barker & Williamson No. 3016 Miniductor (Lafayette 40 F 16259. See text)
M1—200 ma DC milliammeter (Emico Model 13, Lafayette 38 F 31450)
NL1—Neon pilot lamp assembly (Radio Shack 272-338. Includes R5)
PL1—Fused AC plug (Radio Shack 270-1249)
PL2—Octal tube base
Q1,Q2—40321 transistor (RCA)
Resistors: ½ watt, 10% unless otherwise indicated
R1—100,000 ohms
R2—2,700 ohms
R3,R4—33 ohms
R5—100,000 ohms (part of NL1)
R6—20,000 ohm, 10-watt wirewound resistor
S1,S2—SPST slide switch
SO1—Crystal socket
SO2—Octal tube socket
T1—Power transformer; secondaries: 135 V @ 50 ma, 6.3 V @ 1.5 A (Triad R-30X. 6.3-V winding not used)
Misc.—7 x 9 x 2-in. aluminum chassis and bottom plate, perforated board, push-in terminals, TO-5 heat sinks for transistors Q1,Q2 (Motorola HEP-502), 1-in. metal spacers

down for a few minutes, then recheck the final tune-up and readjust if necessary for a 100 ma minimum indication of M1. Observe that the 7-watt lamp lights indicating RF power is being delivered to the lamp.

If a 72-ohm or 50-ohm dummy load is available, connect it in place of the lamp and tune the transmitter for a 100 ma minimum indication. A dummy load should have a 10-watt rating. It can be made up of paralleled resistors connected to a coax plug. It may be necessary to set S2 tc *on*, placing C1 in the antenna circuit, for proper tune-up on the 80-meter band when using a dummy load. Repeat the tune-up procedure with the 40-meter coil (L5) and a 40-meter crystal.

After you are satisfied that the transmitter is operating properly, remove the dummy load and connect either an 80-meter or 40-meter antenna whose impedance is 52 to 72 ohms (depending upon the coil and crystal in the transmitter) to J2. Check for proper tune-up with the transmitter feeding the antenna. The transmitter (as is the case with most pi-net output circuits) works best with an antenna cut to the transmitting frequency.

Set S2 to *on* (as necessary) for best loading into the antenna. The value of C11 may have to be changed to fit your particular 80-meter antenna. The final tuning of C7 should result in a collector current of about 100 ma (minimum indication).

Good Reading

By Tim Cartwright

FIFTY IC PROJECTS YOU CAN BUILD. By Ronald Benrey. Hayden Book Co., New York, N.Y., 120 pages. $3.75

Two hobbyists were asked to design an electronic gadget to solve a crunching problem. The wife of a home-owner, while parking the family car, would constantly drive into the garage and hit the wall. To save bumper and building, the home-owner asked if the hobbyists could design a warning alarm. The first replied; "I could build a capacity-operated proximity detector. Cost would be about $35."

The second hobbyist said: "Hang a ping-pong ball from the garage ceiling. When it strikes the windshield, your wife will stop. Cost, about 10¢."

What's this tale got to do with a book on IC projects? Plenty, since the preface promises that ICs here must make sense in terms of "simplified construction, lowered cost or improved performance when compared to a similar device built with conventional components." What follows, however, is electronic overkill. Dozens of old favorites—from audio amplifiers to control gadgets—are given the IC treatment when they could have been built with a lone transistor, or none at all. For example: The old Farmer-Crossing-the-River riddle is shown as an electronic game constructed with five ICs (which equal 25 transistors). A similar circuit, with no transistors, is widely known to achieve the same result with a few switches.

"I believe," says the author, "that electronics should be a means to an end, not an end in itself." Ping-pong, anyone?

TWENTY SOLID STATE HOME AND HOBBY PROJECTS. By R. M. Marston. Hayden Book Co., New York, N.Y., 112 pages. $3.75

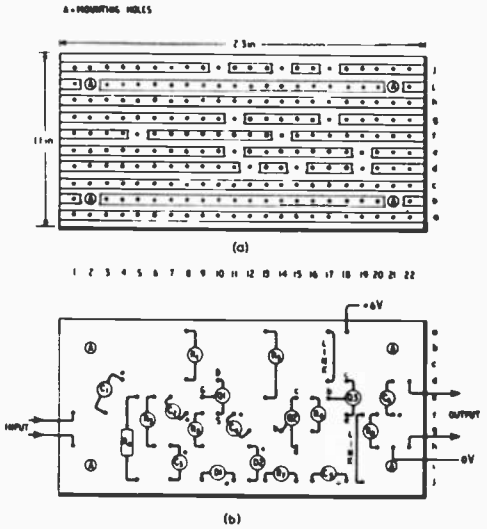
A second projects book (by the same publisher) is eminently more successful. Although its ideas are growing whiskers, each is presented with a clarity that other projects books would do well to emulate. The author methodically describes the operation, theory and construction of each device. The schematic is analyzed for the builder and check-out steps are covered. An excellent feature is the Veroboard (foil circuit) layout and parts placement (see Fig. below) for each project. This treatment makes the book especially useful for the beginning experimenter. Projects include light-operated gadgets, amplifiers, sirens and others.

RCA RECEIVING TUBE MANUAL, RC-27. Published by RCA Electronic Components, Harrison, N. J. 672 pages. $2

The 97 pages of basic tube theory which opens this publication are easily worth $3. The 80 pages of practical circuits, including parts lists and schematic, are certainly worth $3. In between are nearly 600 pages of information on receiving and picture tubes, voltage regulators and other bottled delights. This alone is worth $4. Put them all together and you'd pay $10. Since the new manual is only $2, it's the most shocking bargain on the book rack.

BETTER SHORTWAVE RECEPTION. By William I. Orr and Stuart D. Cowan. Radio Publications, Inc., Wilton, Conn. 160 pages. $3.95

This is a new edition of a durable publication on shortwave listening. It contains useful chapters on buying a receiver, alignment and antennas. One section on accessories you can build describes construction of items like a crystal calibrator and Q-multiplier. The book devotes scant space to more recent developments, e.g., transistors, low-cost SW portables and higher-frequency bands. It still belongs in the avid SWL's library.



Parts layout from Twenty Solid State Projects. Veroboard is in (a), components are found in (b).

Universal Battery Tester

By **RONALD M. BENREY** THE radio is dead. You remove the battery, check it with a voltmeter and discover 9 V across its terminals. Puzzled, you replace the battery and measure its voltage again. To your surprise, you now get a reading of 2 V. Conclusion: There is only one correct way to test a battery: measure its output voltage under load.

This technique makes sense when you consider that a dry cell is a chemically powered generator of electricity. And the best way to judge the performance of an electrical generator is to put it to work to see whether it can do the job it was designed to do.

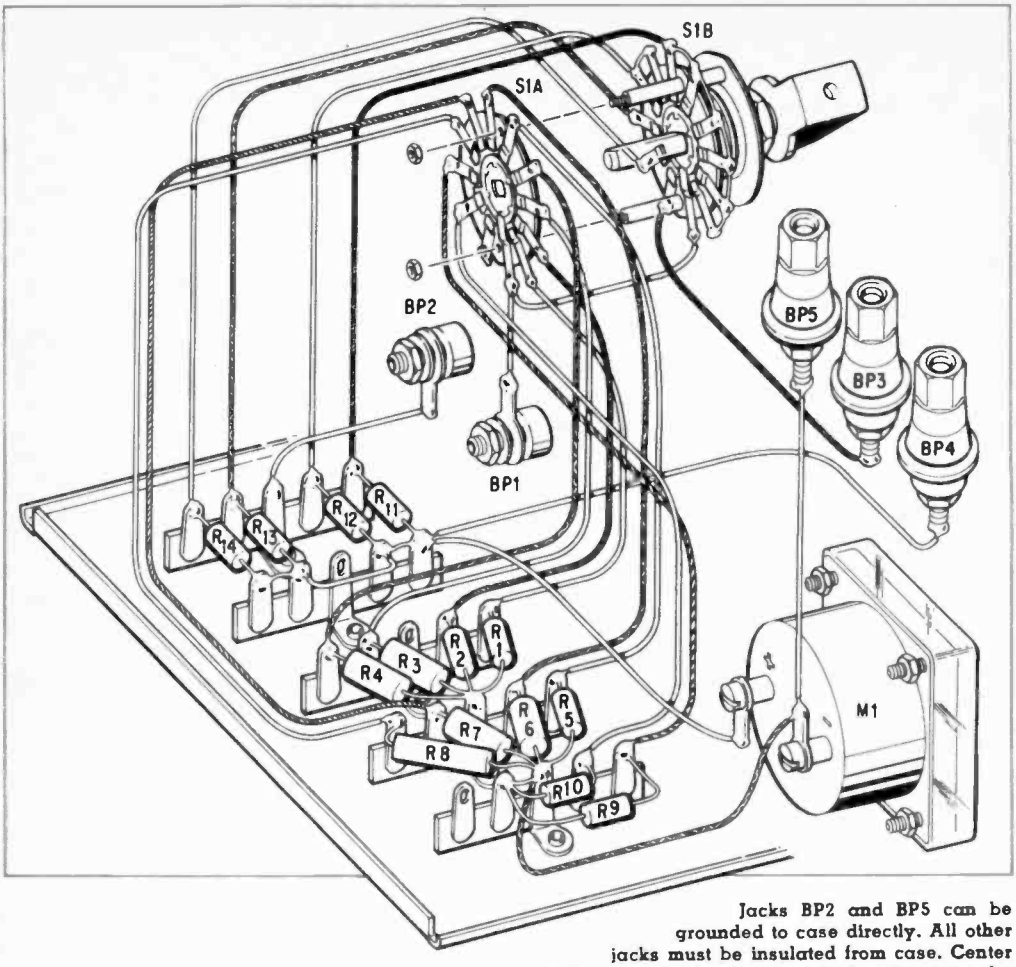
A dry cell can be thought of as a series circuit—a source of voltage in series with a resistance. Surprisingly, the source voltage usually doesn't change substantially over the useful life of the battery. You can see this by measuring the output voltage of a dead battery with a high-impedance voltmeter—a VTVM or a VOM. You'll find it close to the battery's rated voltage.

What does change during a battery's life is internal resistance. A loaded *voltmeter* (a device that causes the battery to deliver a normal service current) will indicate the effect of high internal resistance. The difference between rated and output voltage and the voltage under load is proportionate to the internal resistance of the battery.

The cutoff point for this difference depends on the application of a battery. You might tolerate a weak flashlight beam but not distorted sound from a transistor radio. A practical cutoff value is two-thirds of the battery's rated voltage. A 1½-V cell is considered dead when its output measured under load drops to 1 V This is the cutoff voltage considered in the design of this loaded-voltmeter battery tester.

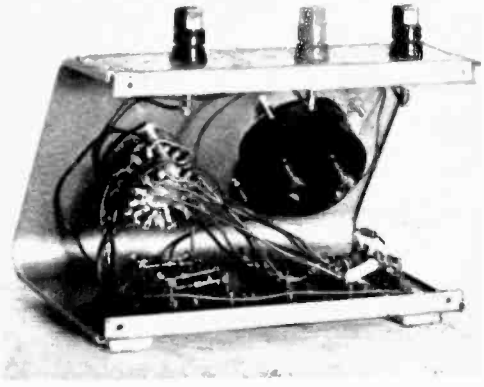
Our tester is a voltmeter with a load resistor across its input terminals. Switch S1 selects appropriate load and meter-series resistors to test the 10 most popular dry-cell batteries. The resistors specified in the Parts List will enable you to test the following batteries: 1.4-V mercury, penlite zinc, C zinc, C alkaline, D zinc, D alkaline, 6-V lantern, 6-V alkaline, 9-V transistor radio 15-V photoflash. The scale on the tester above covers other batteries. An eleventh position on S1 brings external-resistor binding posts BP3, BP4 and BP5 atop the unit into play. By connecting resistors to these posts you can test virtually every battery made. We'll explain how to determine the value of the resistors later.

In all cases, the value of the load resistor (R1 through R10) is calculated so the resistor draws about half the battery's recommended test current. The meter series re-



Jacks BP2 and BP5 can be grounded to case directly. All other jacks must be insulated from case. Center lug on each five-lug terminal strip must be grounded to case (scrape paint for good contact).

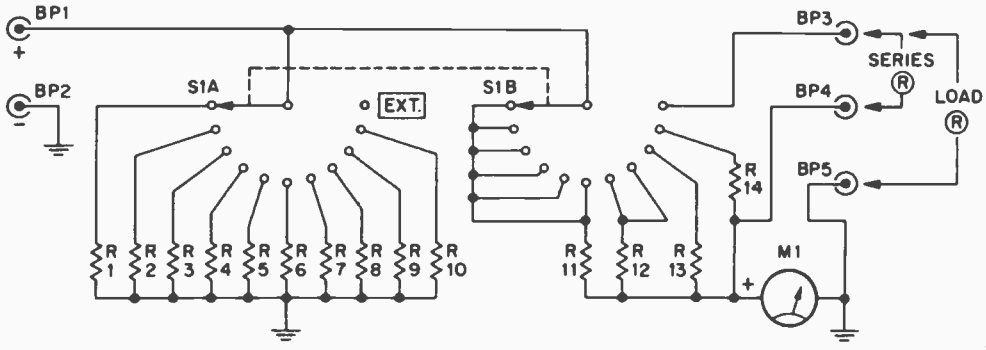
Universal Battery Tester



Because of shape of sloping-panel cabinet, you'll find it easier to make all connections to rotary switch before installing it on the front panel.

sistor (R11 through R14) is calculated to make the meter indicate exactly half-scale (0.5 ma) when the battery's output voltage, under load, is ⅔ its rated value. Thus, a meter indication below half scale means a bad battery. An indication between 0.6 and 0.75 ma indicates a relatively new battery.

Construction. The cabinet is a 7-in. wide sloping-panel aluminum case (Bud AC-1613-A). Mount five-lug terminal strips (center lug grounded) in the bottom of the case to hold the resistors. Input jacks BP1 and BP2 are banana jacks. Note that the negative jack (BP2) can be grounded to the case as can be external-resistor binding post BP5. Be sure that the positive input banana jack (BP1) and the other jacks are insulated from the case. After mounting the meter, pry off the plastic front and place a *good* mark



Resistors R1-R10 are load resistors that are connected across battery by S1A. Resistors R11-R14 are the meter series resistors. Load and series resistors for other batteries connect to BP3-BP5.

PARTS LIST

BP1,BP2—Insulated banana jacks

BP3,BP4,BP5—Insulated binding posts

M1—0-1 ma DC milliammeter

R1—270 ohm, ½ watt, 10% resistor

R2—120 ohm, ½ watt, 10% resistor

R3—390 ohm, 1 watt, 10% resistor

R4—68 ohm, 1 watt, 10% resistor

R5—22 ohm, 1 watt, 10% resistor

R6—4.7 ohm, 1 watt, 10% resistor

R7—47 ohm, 1 watt, 10% resistor

R8—10 ohm, 5 watt, wirewound resistor

R9,R11—2,000 ohm, ½ watt, 5% resistor

R10—15,000 ohm, ½ watt, 10% resistor

R12—8,000 ohm, ½ watt, 5% resistor

R13—12,000 ohm, ½ watt, 5% resistor

R14—20,000 ohm, ½ watt, 5% resistor

S1—2-pole, 11-position non-shorting rotary switch (Mallory 1321L, Allied Radio Stock No. 56 C 4256)

Misc.—Test leads, case, terminal strips, wire, hardware

in the area between 0.5 and 1.0 ma, and a *bad* mark in the area between 0 and 0.5 ma, as shown in the photograph on the first page of this article.

The table at the end of this article lists battery manufacturers' test currents for several batteries not included on switch S1. If a battery you wish to test is not listed, consult a battery manual to determine the test current; divide this current in half to determine the *load* current.

To find the value of external load resistor *R*, use the formula R=E/I. *E* is the battery voltage and *I* is the load current.

For example, the load resistor for a 9-V battery with a 10-ma load current (manufacturer's test current is 20 ma) is 9/.010= 900 ohms (the closest standard resistor is 910 ohms, 5 per cent.)

Next, you must calculate the power rating for the load resistor. All this takes is the formula W=EI. W is the power in watts, E is voltage and I is current (amperes). For the above example W= 9 × 0.010 which works out to about 1/10 watt. Thus, a ½-watt resistor is adequate. As a matter of fact you could even use a ¼-watt resistor.

To find the value of the external series resistor, divide the battery voltage by 1.5 (for a mercury battery divide by 1.4) and multiply the number by 2,000.

LOAD-CURRENT TABLE

Battery Type (Eveready Nos.)	Mfrs. test current (ma)*	Voltage
E89	60	1.5
E90E	85	1.5
E91	150	1.5
E94	300	1.5
E340E	20	1.5
904	20	1.5
912	20	1.5
724	25	6.0
246	15	9.0
266	20	9.0
276	30	9.0

* Divide test current by 2 to get load current

"CIE training helped pay for my new house," says Eugene Frost of Columbus, Ohio

Gene Frost was "stuck" in low-pay TV repair work. Then two co-workers suggested he take a CIE home study course in electronics. Today he's living in a new house, owns two cars and a color TV set, and holds an important technical job at North American Aviation. If you'd like to get ahead the way he did, read his inspiring story here.

IF YOU LIKE ELECTRONICS—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay TV repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future—but soon found he was stymied there too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses... preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Aviation. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"

Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

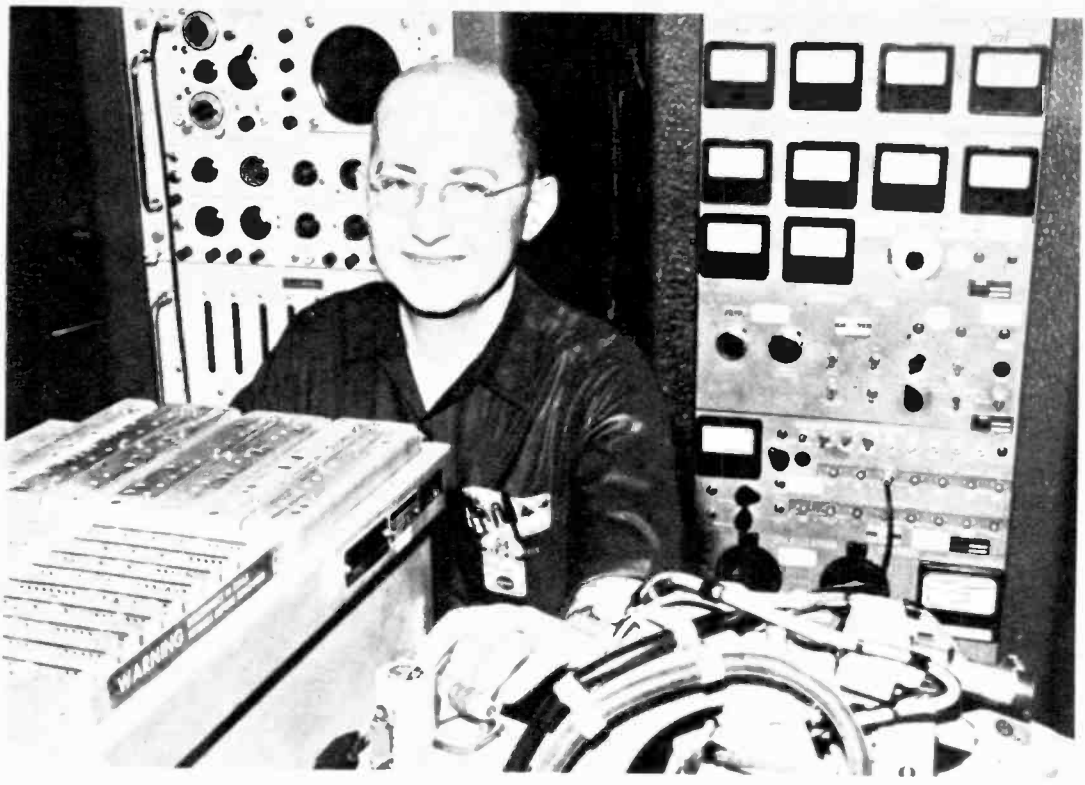
Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and



replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" ...learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screwdriver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are desperately needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

How can you get the training you need to cash in on this booming demand? Gene Frost found the answer in CIE. And so can you.

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Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed In Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you'd like to get ahead the way Gene Frost did, let us send you this 40-page book free. With it we'll include our other helpful book, "How To Get A Commercial FCC License." Just fill out and mail the attached card.

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How to Change a Color Picture Tube

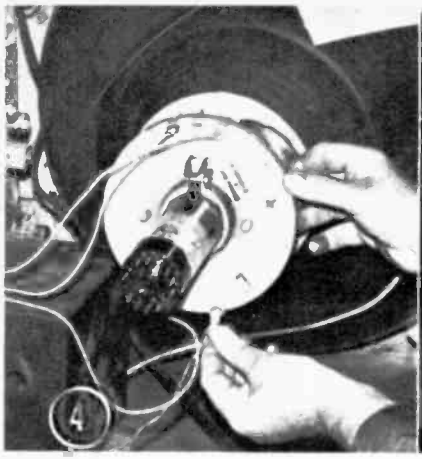
BIGGEST contributor to the high price of a color TV set is the picture tube. Set owners pray as much for its long and healthy life as they do for better programs. On the day the tube goes West and has to be replaced, you're likely to suffer mild vertigo when the serviceman gives you an estimate for a new tube plus installation. You can save your crying towel a tear or two by doing the job yourself. Almost anyone with a little electronics know-how can replace a color picture tube successfully. No great skills or special tools are required.

Replacement tubes can be purchased from electronic parts distributors or from mail-order houses. A new tube will run from $90 to $170 but you can get a $5 to $25 allowance on your old dud, provided it is still under vacuum and the glass is reusable. The new

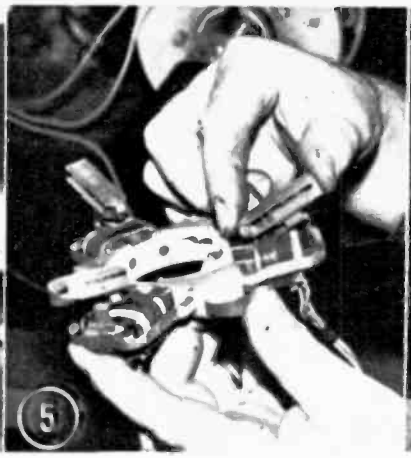
Band is attached to new tube. Be careful to see that the hole in the band is between glass ridges. The ridges indicate the top of the round tube.

Tube with straps and brackets attached is lowered into cabinet. Safety goggles and gloves were worn at all times when handling picture tube.

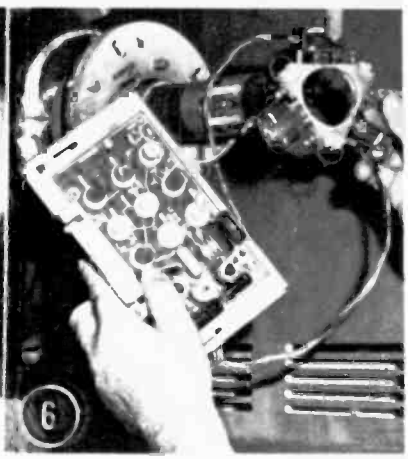
Tube is in the cabinet and the brackets are fastened down. The straps were carefully tightened on tube after brackets were attached to cabinet.



Slide deflection yoke on neck so it's perpendicular to neck and in same location as on old tube.



Convergence magnets are put in the convergence yoke. These magnets should be equidistant from center.



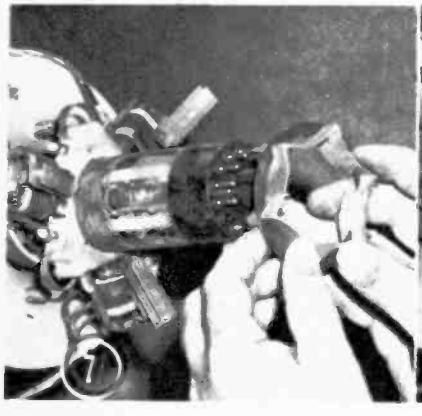
Slide convergence yoke to the same point as on old tube. Convergence board will be used later.

tube may not have the same number as your old one because manufacturers change the number when a tube is improved. You're in for a bonus if you get one of the new rare-earth-phosphor tubes. They provide brightness never possible from older tubes.

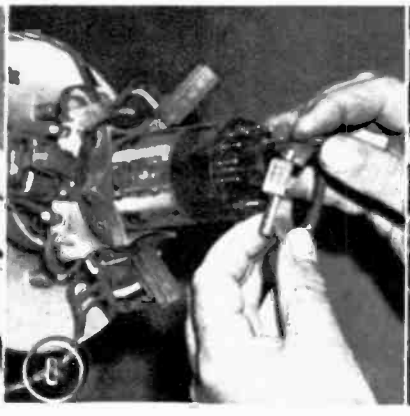
The physical care of a picture tube is of prime consideration. Older tubes and their replacements are subject to implosion and you should wear gloves and goggles when handling them. Newer tubes are implosion-proof and can be handled less delicately—but care should be taken, anyway.

There is no specific way to proceed once you have the set lying on its face with its back off. Like a woman, each set is different in its own way. Your set itself will provide you with the necessary instructions. Make copious sketches of the position of the parts on the tube's neck. If your color TV is a kit, like the Heathkit GR-53 shown here, so much the easier because you simply reverse the order of the installation instructions when removing the old tube. Make careful measurements of distances between all parts and note the exact positions on the neck relative to, say, the edge of the tube's base.

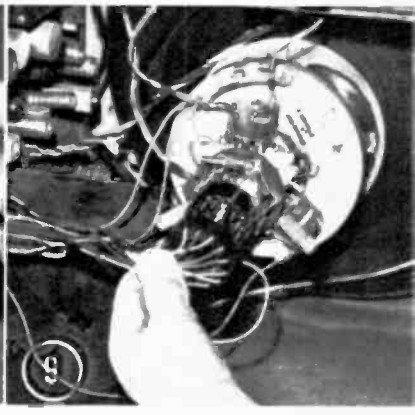
Keep writing and sketching as you disassemble. What you're really putting together with words and diagrams is your own assembly manual because reading backwards through the notes later will give you the pro-



Slide purity magnet on neck and align the tab on it with the tab that is on the convergence yoke.



Put blue lateral magnet on neck of tube over blue gun, which is at the 12 o'clock position on tube's neck.



CRT socket is finally plugged on the end of tube. Carefully recheck placement of parts at this time.

How to Change a Color Picture Tube

cedure for putting the rig together again.

First remove the CRT's socket. Attach a heavy wire to a screwdriver and connect the other end of the wire to an earth ground, such as a cold-water pipe. After making sure your fingers are clear of the shaft of the screwdriver, discharge the CRT's side anode by sliding the shaft under the rubber cap and against and prongs of the connector.

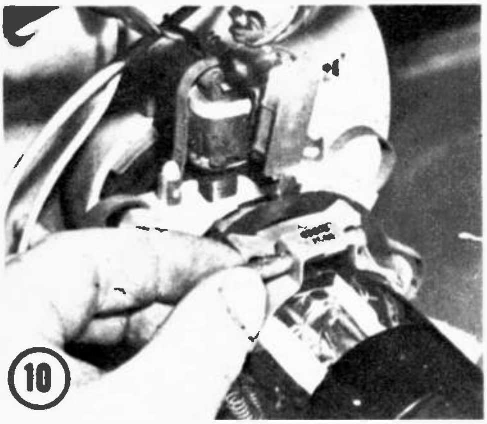
Disconnect the high-voltage lead. Now (making notes as you go) remove all parts remaining on the neck. After this is accomplished loosen the ground wire and brackets around the CRT, lift the tube out of the set and place it on its face. Remove the metal strap from the tube. (You also may be dealing with a loop of wire that is the automatic degaussing coil.)

Take the new tube out of the box and place it face down on soft material next to the old tube. Never pick up or hold either tube by the neck. Instead, grasp the outside edges of the heavy glass face plate. Place the old tube in the box and out of the way.

The procedure for installing the new tube is the reverse of the steps you followed to remove the old tube. Begin by mounting the straps and brackets on the new tube (Fig. 1). In the case of a round tube, be sure that the two ridges on the rim of the tube will be pointed up when the brackets are attached in the cabinet (Fig. 2). Then put the tube in the cabinet (Fig. 2) and secure the brackets (Fig. 3). If your set has a built-in degaussing coil, install it at this time.

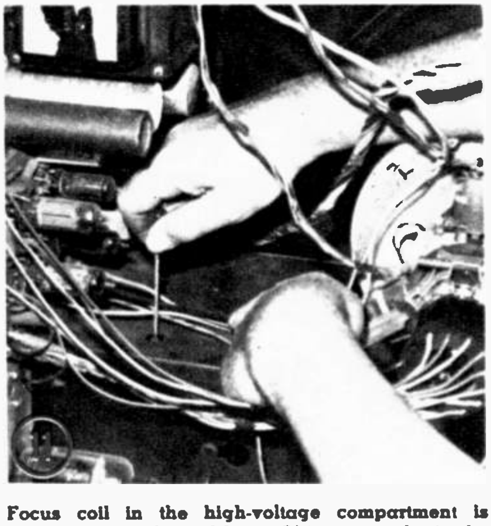
The last thing to come off the neck of the old tube was the deflection yoke, so it is the first to go on the new tube (Fig. 4). Be careful to position it on the neck exactly as it sat on the old tube; make sure it is perpen-

[*Continued on page* 99]



10

Blue lateral magnet is adjusted during static convergence with blue, red and green convergence magnets to produce white dots in center of screen.

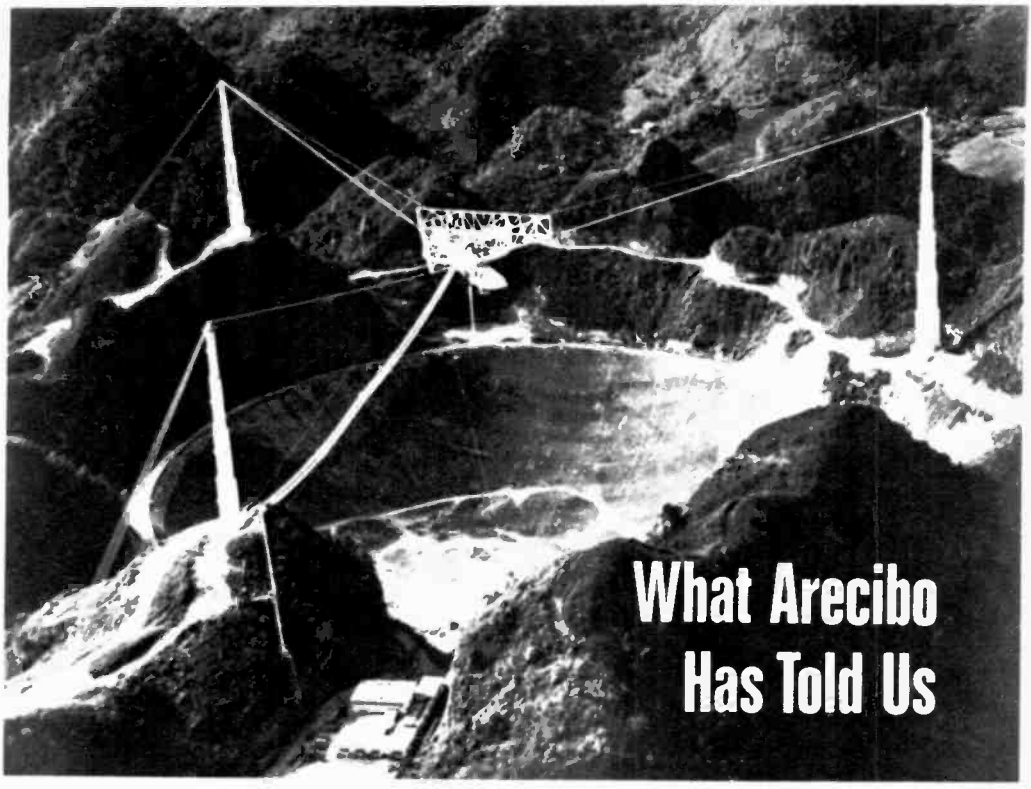


11

Focus coil in the high-voltage compartment is shown being adjusted here. Object is to obtain the sharpest trace lines in center of picture tube.

12

Dynamic convergence begins for new tube; a dot generator is necessary for this. Check a color program to see if this was done correctly.



What Arecibo Has Told Us

By **ROBERT D. FREED** LIKE a sleeping giant, it lies nestled in the sugarloaf hills of western Puerto Rico. But a passive appearance belies the beast's vigilance as it keeps a perpetual watch on the ionosphere and outer space. The behemoth is the Arecibo Observatory's radio/radar/telescope and its immense size can hardly be grasped unless seen first-hand or from the air.

Having known of the antenna since it went into operation in 1963, EI decided to visit Arecibo to learn what secrets it has revealed to a waiting world. The temperature was 5° on the January morning we left JFK International Airport for San Juan, the first stop on the trip. A little over three hours later we stepped off our jet into an 88° tropical climate that quickly dried out our winter-weary bodies. Westward, ho, the next morning to the observatory. It's some 12 mi. south of the town of Arecibo (pop. 29,000), which is about 50 mi. west of San Juan (see map).

Two hours after leaving San Juan we arrived and were met by Dr. Gordon H. Pettengill, the Director. But before anything else we just had to look at that antenna. We were awed. If a picture of something is worth a thousand words, the original thing must be worth a million.

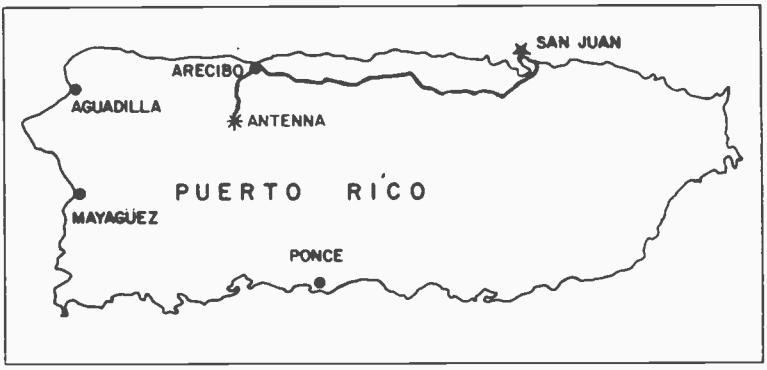
But first, some facts and figures about the antenna. Construction, started in 1960, took 2½ years and cost $9.3 million. The antenna's reflector is a section (1,000-ft. dia.) of a sphere whose radius is 870 ft. It is made of panels of wire mesh (½-in.-sq. openings) that are suspended on cables which are, in turn, tied to the ground. The ground contours form more-or-less a natural bowl.

The reflector's surface area is almost 20 acres. Above it (435 ft.) is a structure that supports a movable 96-ft. line feed. The rig weighs 525 tons and is suspended by steel cables attached to three towers above and beyond the rim of the reflector.

What makes the Arecibo antenna different from other reflecting-type radio/radar/telescopes is the shape of its reflector, which is spherical. Traditionally, radio/radar/telescopes have parabolic reflectors. The point-source feed of such reflectors always must be at the focus so the transmitted energy will be radiated in parallel lines. Therefore, to aim a parabolic antenna the reflector and feed point have to be moved together. And to move one the size of the Arecibo antenna would not be feasible.

But by using a spherical reflector (which has a circular cross section) it is possible to aim the antenna by simply moving the *line feed* along an arc on the sphere's half-radius. The reflector doesn't have to be moved. Arecibo's line feed can be moved 20° each side

The Arecibo Observatory is located in a mountainous region 12 miles south of the city of Arecibo. Arecibo is a 50-mile, two-hour drive westward from San Juan. The observatory is open to the public on Sundays from 2 to 4:30 pm. Route we drove from San Juan to antenna is shown in color.



What Arecibo Has Told Us

of the reflector's zenith (center, vertical) axis and the energy always will be radiated in parallel lines. The line feed also can be rotated in azimuth. It is thus possible to keep an object under study within a 40° cone for up to almost three hours. The radar frequency is 430 mc. Peak power is 2.5 million watts. The antenna operates 24 hours a day, every day of the year. At Arecibo, research is carried on in three areas: ionosphere, radar astronomy and radio astronomy.

Ionospheric research uses the antenna as a radar to look straight up at the ionosphere. But using radar to study the ionosphere isn't exactly new. Low-frequency radar studies before Arecibo revealed only the height of the bottom side of the ionosphere. It was not possible to study the top side. Prior to 1961, studies of the top side could only be made using rockets and satellites, which are expensive and have a short life.

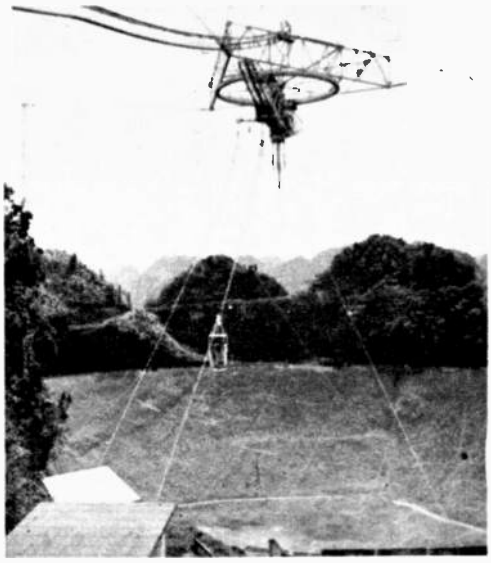
Since Arecibo's signal is 430 mc, it does not get reflected by the ionosphere's bottom layer; it goes straight through. However, part of the signal is reflected by a mechanism called Thompson Scatter. As a consequence of this, although only a very small part of the transmitted signal is reflected, it is possible to probe the interior, bottom and top sides of the ionosphere and observe the effects of scattering throughout it. The ionosphere can now be studied to 10,000 km, although the distance at Arecibo has been limited to 2,000 to 3,000 km.

Because the scatter is from individual electrons in motion, the motion introduces doppler shift. This broadens the returned signal and the width is related to ionospheric temperature.

Arecibo has been able to get an accurate profile of the ionosphere in terms of electron density, electron temperature at all heights and ion composition and temperature—at all hours of the night and day.

Other things were discovered. One was a modulation calculated theoretically a few years ago and looked for called plasma-line modulation. It is a modulation by electrons heated by the sun and produces sidebands on the reflected signals at plus and minus the plasma frequency. Because of a known relationship between the plasma frequency and the electron number density, this modulation is used as an internal marker to calibrate the scattering intensity and thus the radar system.

Another discovery is called the conjugate-point effect. In winter when the sun is below the equator, sunset in the Northern Hemi-



Looking at antenna from in front of operations building. At lower left is cable-car house. Note cable car going up to feed-support structure.

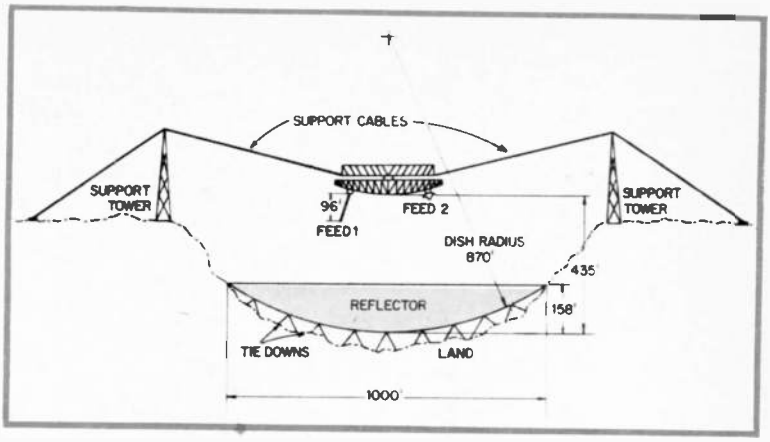
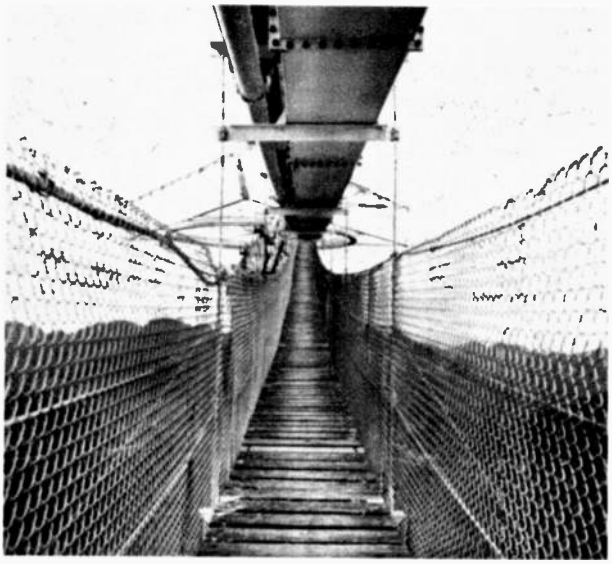


Diagram shows dimensions of elements of antenna (not drawn to scale). Not all support cables are shown here. Feed 1, at half-radius, is 96-ft. long and can be moved on arc from left (where shown) to right to aim antenna 20° each side of vertical axis (zenith axis). Support to which feed is attached can be rotated in azimuth. Feed 2 supports other special-purpose antennas.

sphere will occur earlier than it will at the same magnetic longitude in the Southern Hemisphere. When studying the ionosphere at a particular point in the Northern Hemisphere, a change will be noticed at sunset. A second phenomenon will also be observed about two hours later. This phenomenon is caused by and corresponds to the sunset in the Southern Hemisphere—at the magnetic conjugate point. It shows that much of the ionospheric heating overhead at Arecibo is caused by electrons spiraling in along magnetic-field lines from below the equator.

In terms of high-frequency radio communications, how has ionospheric research benefited us? According to Dr. Pettengill, it is hard to identify any immediate benefits. Arecibo's ionospheric research is aimed at improving our knowledge of the physics, chemistry and weather of the earth's upper atmosphere. It undoubtedly benefits the prediction of radio propagation in an indirect way, but it is so basic that the immediate applications are hard to visualize.



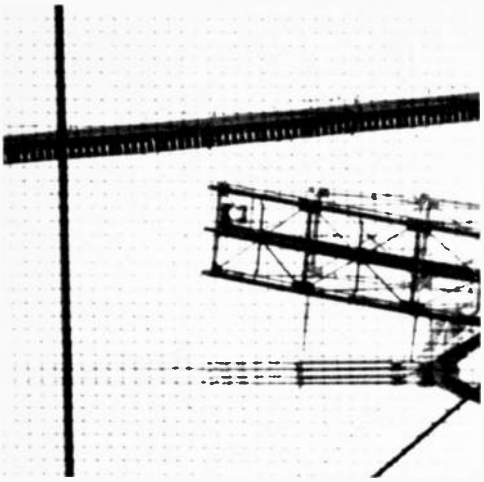
A catwalk goes from base of a support tower to feed-support structure. Rectangular object at top of the photo is the signal-carrying waveguide.

In radar astronomy, Arecibo has been exploring the moon and the planets. The technique, basically, is to measure the time it takes a signal to go to a planet and return. Such measurements are made with an accuracy of a few microseconds (out of a total travel time of as much as 1,600 seconds). The moon has been studied in great detail, but work in this area is being phased out because of the Apollo landings. The planets Mercury and Venus are now being explored. (Mars can't be studied until late 1971.)

By making measurements it is possible to determine the orbit of a planet with an accuracy of a few parts in 10^8 which is three to four orders of magnitude better than could be made by optical measurements. Such studies have been very valuable to NASA in providing precise guidance for the Mariner space vehicles on their journeys to Mars and Venus.

Radar astronomy is also used to observe a planet's surface and determine its radius—especially that of Venus which is completely enveloped by clouds. Because a train of pulses (rather than a single pulse) is sent out to a planet, the return can be analyzed into a spectral-type display. Since the surface of a planet isn't smooth, energy will not be reflected uniformly. A plot of the reflected energy discloses areas of unusual smoothness

What Arecibo Has Told Us



View from ground up through reflector. Notice the corner of feed support and catwalk. The openings in the wire-mesh reflector are ½-in. sq.

Dr. Gordon H. Pettengill, Director of the Observatory. Reflector (overhead) is tightly tied down to keep its surface tolerance to ± 1.5 cm.

or roughness. The strength of the returned signal tells what the surface is made of—water, sand, rock, oil, etc.

If a planet is rotating there will be a dispersion in the doppler shift of the returned signal. This reveals the planet's direction of rotation and period of rotation. Such information has disclosed that Venus turns on its axis in the opposite direction to that of the Earth. It has also been determined that Mercury rotates on its axis with a period equal to two-thirds of its orbital period. It has been previously assumed that Mercury rotated synchronously with its orbit—that is, one side always faced the sun.

And there has been radar mapping of the surface of Venus, Mercury and the moon. In the case of the moon, surface resolution has been better than 5 km. In the case of Venus the present resolution is a few hundred km.

However, during the summer of 1970 the Government approved funds to resurface the reflector to permit radar operation (with a new transmitter) at 2,400 mc (12 cm, S-band). This will improve the effectiveness of the radar by more than 1,000 times and permit mapping of Venus to a resolution of 3 or 4 km—about as good as resolution on the moon is now. The new surface will consist of aluminum panels with holes in them. The shorter wavelength of the radar signal (because of the higher frequency) will narrow the beam and increase the upper usable frequency by about a factor of 10. Resurfacing is expected to start early in 1971 and will take two years to complete. It will permit many new experiments.

In radio astronomy the antenna is used as the radio equivalent of the Mt. Wilson and Mt. Palomar optical telescopes. Arecibo's big bowl takes radio energy, focuses it and records it. The antenna is just aimed at all parts of the sky to study the characteristics of incoming signals. The simplest experiments have been the detection of a source, measuring how strong it is at different frequencies and what its spectral index is; it's a form of sky mapping.

And there are more sophisticated experiments such as long-baseline interferometry. This involves other radio telescopes which are linked by stable atomic-frequency sources. The results have surpassed optical observations in angular resolution. Arecibo has distinguished the size of some sources with a resolution 1,000 times better than can be done optically. Using this technique, which can provide for Arecibo a baseline as wide as the radius of the Earth, the effective telescope aperture for some purposes may be considered as large as 6,000 km.

About 40 per cent of radio-astronomy ob-

(*Continued on page* 98)

DX a Ring around the World...and Win a Tropic of Cancer Award

FIRST there was the book that was mailed in a plain brown wrapper, then a scintillating movie which you wouldn't let your daughter see. Now there is the Tropic of Cancer Award that is sure to bring more beads of perspiration to your brow than either of the previous efforts.

Astronomically speaking, the sun reaches its greatest inclination and declination at 23½° above and below the equator. The line of latitude above the equator which marks this point is known as the Tropic of Cancer (see map below and on next page). This line passes through some of the most exotic countries in the world.

By way of celebrating our 10th year of giving DX awards, EI challenges hams to have (and log) two-way communications with, and SWLs to receive, eight of the designated 16 areas along that famous latitude. These areas are:

1) The Pacific Ocean
2) Mexico
3) The Atlantic Ocean
4) Spanish Sahara
5) Mauritania
6) Mali
7) Algeria
8) Libya
9) United Arab Republic
10) Saudi Arabia
11) Oman
12) India
13) Pakistan
14) Burma
15) Mainland China
16) Formosa

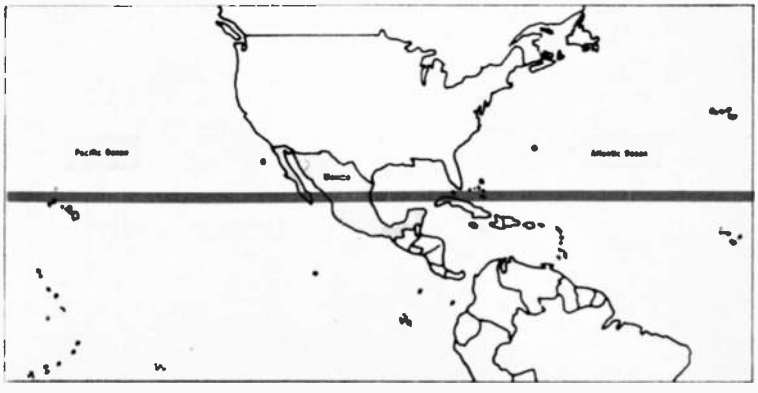
The areas denoted as Oceans refer to a report from a DX country in that ocean. These countries will count for this award even if the country does not lie on the Tropic of Cancer.

Fifty Counties, Too. As a special bonus for this Tenth Award Period, which begins with the publication of this issue, there will be a 50 Counties Award—one award for SWLs and one for hams. The counties may be in Canada as well as the United States. (The equivalent of counties in Alaska are Election Districts and in Louisiana they are Parishes.) Applicants must log 50 counties —two-way communications in the case of hams, reception in the case of SWLs. In addition to these two awards, all of our past wards are being offered again.

On the next two pages is the Official DX log which must be used to apply for any of the awards. If you need additional copies of the log, copy it exactly by hand, or duplicate it on an office copying machine.

You must be able to substantiate each entry on your log with a valid QSL. Pay attention to transmitter location—which counts for all awards except Major Cities-25, for which the studio location counts. Don't send your QSLs with the log. (We'll request them later if they have to be checked.) Mail your log to:

EI's DX Club
67 W. 44 St.
New York, N.Y. 10036



The Tropic of Cancer is indicated by the dark line. DXers are challenged to get QSLs from eight of the 16 areas shown along this line. The rest of the map is on the next page.

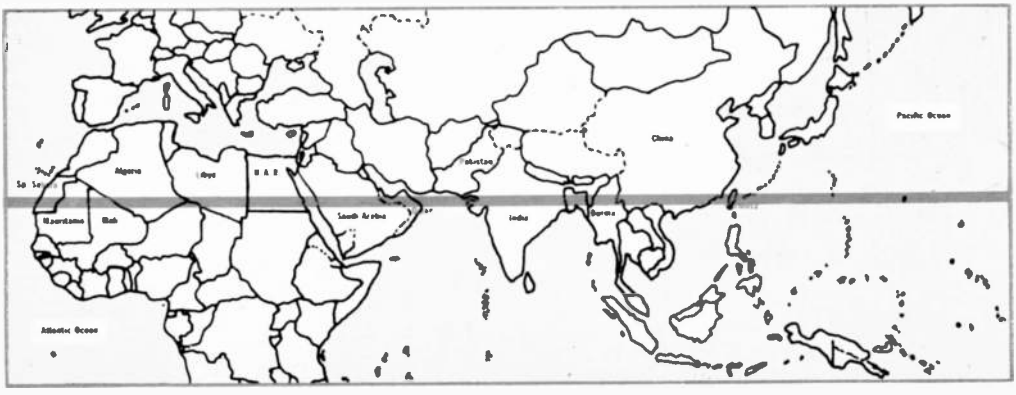
Tropic of Cancer Award

All entries must be postmarked no later than April 30, 1971—the end of this Award Period. Late entries will be returned.

If you want a complete list of all countries, cities and outposts that quality for the awards offered in the past, write for our Official World DX List. Send your request with a self-addressed, stamped envelope to EI's DX Club at the above address.

HANDY GUIDE TO EI'S DX AWARDS

CLASS OF AWARD	TYPE OF AWARD		FREQ. LIMITS	REQUIREMENTS
	SWL	HAM		
General 100 (DX Century)	X	X	None	Reception of or two-way communications with stations in at least 100 different countries
General 50	X	X	None	Reception of or two-way communications with stations in at least 50 different countries
Special	X	X	None	Reception of or two-way communications with stations in at least 10 different countries.
BCB Stateside Special	X		535-1605 kc	Reception of stations in at least 25 different states or provinces
Broadcast Band	X		535-1605 kc	Reception of stations in at least 15 different countries
All-Continents	X	X	None	Reception of or two-way communications with stations on all six continents
United Nations-25	X	X	None	Reception of or two-way communications with stations in at least 25 different UN member countries
Major Cities-25	X	X	None	Reception of or two-way communications with at least 25 of the most populated world cities (Populations based upon 1967 Information Please Almanac published by Simon & Schuster New York, N.Y.)
Outposts-6	X	X	None	Reception of or two-way communications with at least 6 different outposts (complete list in Official World DX List).
25 Counties	X	X	None	Reception of or two-way communications with at least 25 American or Canadian counties.
50 Counties	X	X	None	Reception of or two-way communications with at least 50 American or Canadian counties
Tropic of Cancer	X	X	None	Reception of or two-way communications with at least 8 of the 16 areas along the Tropic of Cancer.



ELECTRONICS ILLUSTRATED DX CLUB

OFFICIAL DX LOG

INSTRUCTIONS: PRINT neatly or use typewriter—DO NOT WRITE! Check SWL or HAM to designate type of Award and enter class of Award you are applying for (see chart on opposite page). In listing below, complete all blanks for each entry. Under *Date*, use figures (such as 12-1-70); all log entries must be dated January 1, 1960 or later. Under *Time*, use Greenwich Mean Time and 24-hour clock (0000 to 2359 hours). Make up identical copy of this log if you need more space. Tenth Award Period ends April 30, 1971.

NAME ..... HAM CALL .....
(last name) (first name and initial)

ADDRESS .....

CITY ..... STATE AND ZIP .....
(or country)

TYPE OF AWARD ☐ SWL ☐ HAM

CLASS OF AWARD ..... DATE .....

	DATE (GMT)	TIME (GMT)	FREQ. (kc)	STATION CALL	LOCATION (city, state or prov., country, county when applicable)	QSL
1						card ☐ letter ☐
2						card ☐ letter ☐
3						card ☐ letter ☐
4						card ☐ letter ☐
5						card ☐ letter ☐
6						card ☐ letter ☐
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21						card ☐ letter ☐

	DATE (GMT)	TIME (GMT)	FREQ. (kc)	STATION CALL	LOCATION (city, state or prov., country, county when applicable)	QSL
22						card ☐ letter ☐
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The Listener

By C. M. Stanbury II

High Road To Peking

COMMUNIST China has become the first nation to employ a satellite for direct transmission to the home. The orbiting broadcaster was launched on April 24, 1970 and it broadcast on 20009 kc.

This step is far ahead of any U.S. efforts at direct transmission. It was proposed that educational TV might control a satellite for the U.S. and use the rentals from commercial networks to support itself. Apparently all the network affiliates in the States had no desire to be left out of the TV picture and the idea was shelved.

Listeners of R. Peking at the time of the launch were bombarded with the triumphal word and even given times that reception of programs from the satellite might occur. All times given were in Peking time, making for confusion on the part of listeners, here and abroad.

Those who sent in reception reports to R. Peking were acknowledged with a special edition of the Peking Review. A form letter, the closest thing to a QSL that will ever come out of Peking, was included and warmly suggested that "you are welcome to continue to tune in our station and write us."

In the case of easy to come by stations such as R. Peking, a letter will suffice, but be careful with reports on tougher stations.


PEKING REVIEW 18

The Great Call Issued by Chairman Mao "WE TOO SHOULD PRODUCE MAN-MADE SATELLITES" Has Come True!

CHINA SUCCESSFULLY LAUNCHES ITS FIRST MAN-MADE EARTH SATELLITE

The special edition of the Peking Review which was offered as verification of reception of the satellite broadcast—something short of a QSL.

Argentine DX. How many stations can you log from Argentina? The question has become confused because of government involvement with the stations in the country, producing something like our own Voice of America.

We have verifications from four stations: R. Nacional, R. El Mundo, R. Antartida (1190 kc) and R. Libertador (now on 780). In addition we have logged transmission from Radiodifusion Argentina al Exterior, R. Belgrano and R. Splendid (often reported on 9740 kc). At the time of reception both of these latter stations were not government owned.

In the past few years the Argentine radio scene has changed considerably. R.A.E. added R. Belgrano's 6090- and 11780-kc transmitters to its own. They began broadcasting every weekday night at 2200 EST. Later on, the government took control of the entire Belgrano operation, working the station under the name of the Emisoras Commerciales Argentina. R.A.E. is still operating however, despite some reports to the contrary.

Early in 1970, E.C.A. experimentally aired its own international service on 9760 and 11754 kc. ID's were given for R. Belgrano, R. El Mundo and R. Splendid on these broadcasts. It would seem that the individual identities are for the Argentine's sake only, for all you are going to hear are programs from the E.C.A.

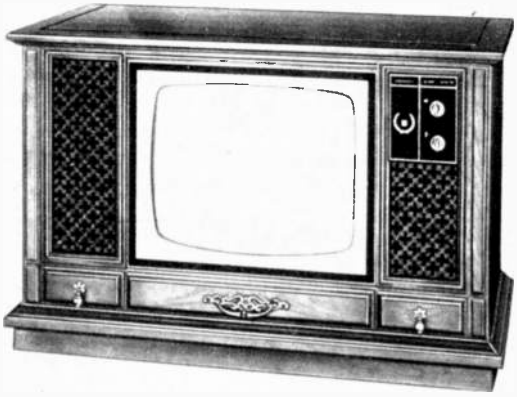
Propagation Forecast. Conditions during the daylight hours will continue to be good to excellent, with all bands from 15 to 26 mc remaining good for short-wave DXing. The amateur 10 meter and the 11-meter Citzens Band will also be open, with reception possible up to about 1,000 mi.

At night the 4, 6, 9 and 11-mc bands will be open for DX and the 15-mc band will be open from southerly locations such as Latin America until about 2000 in your local time.

Broadcast-band DX will continue to be good to excellent because of low noise levels in the northern hemisphere at this time of year.

New from Heath...in time

New Heathkit® solid-state modular color TV

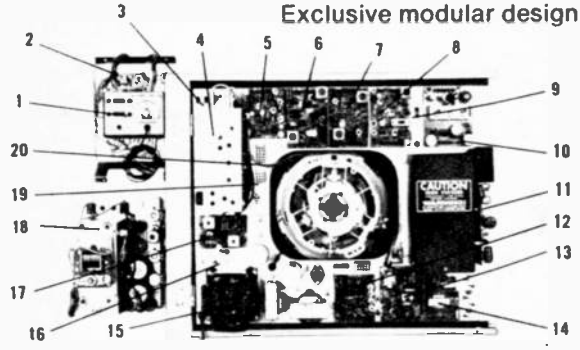


The result of over five years in research and development, these sets represent one of today's greatest color TV values. Here's why: a total of 45 transistors, 55 diodes, 2 silicon controlled rectifiers, 4 IC's containing another 46 transistors and 21 diodes plus 2 tubes (picture and high voltage rectifier) combine to deliver performance and reliability unequalled by any conventional tube set. Other features include: MOSFET VHF tuner; high-gain 3-stage solid-state IF; emitter-follower output; automatic fine tuning; VHF power tuning; built-in degaussing plus manual degaussing coil; automatic chroma control; adjustable noise limiting and gated AGC; "instant-on"... sound instantly, picture in seconds; bonded-face, etched glass picture tubes; adjustable tone control; exclusive hi-fi outputs; and 48-hour factory service facility for modules. The sets are designed to be owner-serviced . the only sets on the market with this exclusive feature. A built-in dot generator, volt-ohm meter, and modular snap-out epoxy circuit boards make routine adjustments and service a snap... virtually eliminating service calls and offering significant savings over the life of the set. It all adds up to the color TV buy of a lifetime in the GR-270 and GR-370 . . ready now for Christmas giving!

Kit **GR-270,** 227" 20V tube, 114 lbs. **$489.95***
Kit **GR-370,** 295" 23V tube, 127 lbs. **$559.95***
Kit **GR-370MX, GR-370** with RCA matrix tube, 127 lbs. **$569.95***

- Modular plug-in circuit board construction
- MOSFET VHF tuner and 3-stage IF
- Pushbutton channel advance.
- Hi-fi sound outputs — for amplifier
- Designed for owner-servicing

Exclusive modular design



1 Exclusive check-out meter
2 Tilt-out convergence/secondary control panel
3 Gun shorting switches
4 3-stage IF assembly
5 Plug-in AGC/Sync circuit board
6 Plug-in 3.58 MHz oscillator circuit board
7 Plug-in Chroma circuit board
8 Plug-in Luminance circuit board
9 Service and Dots switches
10 Plug-in Video Output circuit board
11 High voltage power supply
12 Plug-in Vertical Oscillator circuit board
13 Plug-in Horizontal Oscillator circuit board
14 Plug-in Pincushion circuit board
15 Conservatively-rated power supply components
16 Circuit breaker protection
17 Plug-in Sound circuit board
18 Master control panel
19 Hi-fi sound output
20 Plug-in wiring harnesses and connectors for faster assembly

Choice of 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. 30-½" H x 47" W x 17¾" D. Assembled GRA-304-23, 78 lbs. $129.95*

Deluxe Early American Cabinet...factory assembled of hardwoods & veneers and finished in classic Salem Maple. 29¹⁵⁄₃₂" H x 37¼" W x 19¾" D. Assembled GRA-303-23, 73 lbs. $114.95*

Contemporary Walnut Cabinet...factory assembled of fine veneers & solids with an oil-rubbed walnut finish. 29¹⁵⁄₃₂" H x 35¹⁵⁄₁₆" W x 19⅜" D. Assembled GRA-301-23, 60 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. 27¹⁵⁄₃₂" H x 41⅞" W x 19¾" D. Assembled GRA-202-20, 85 lbs. $114.95*

Contemporary Walnut Cabinet and Base Combination. Handsome walnut finished cabinet sits on a matching walnut base. Cabinet dimensions 20¹⁵⁄₃₂" H x 31¹⁵⁄₁₆" W x 18⅝" D. Base dimensions 7¾" H x 27¾" W x 18⅝" D. Assembled GRA-203-20 Cabinet, 46 lbs. $49.95* GRS-203-6 above cab. w/matching base, 59 lbs. $59.95*

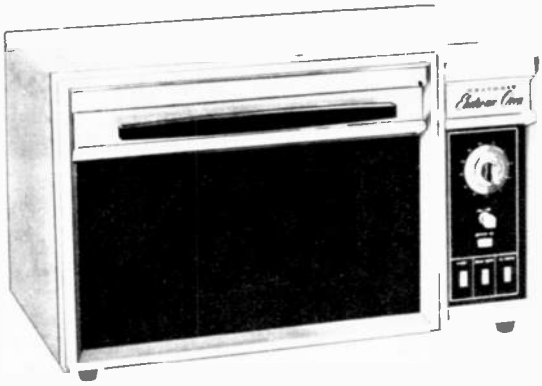
Handy Roll-Around Cart and Cabinet Combination. Features the GRA-203-20 walnut cabinet plus a walnut-trimmed wheeled cart with storage shelf. Assembled GRA-203-20 Cabinet, 46 lbs. $49.95* GRA-204-20 Roll-Around Cart, 19 lbs. ..$19.95* GRS-203-5 Cart & Cabinet Combo, 65 lbs. $59.95*

CIRCLE NUMBER 3 ON PAGE 13

for Christmas giving

New Heathkit Electronic Oven

...only $399.95*



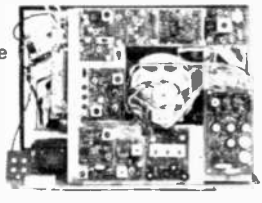
Now, through the miracle of microwave energy, a cooking revolution that frees you from conventional kitchen drudgery forever!

Imagine a baked potato in 4 minutes, baked beans in a little over 6 minutes; a five-pound roast in 45 minutes. This is the miracle of microwave cooking. And now Heath brings you this modern miracle for the first time in money-saving, easy-to-assemble kit form. For busy families on the go, meal preparation is a matter of minutes. You can cook on china, glass, or even paper dishes since only the food becomes hot. Your cooking dish can be your serving dish. Frozen foods can be defrosted in minutes for quick spur-of-the-moment frozen meals cooked right in their own containers. And there is not the slightest cause for concern about the safety of your Heathkit electronic oven. Exclusive door design prevents microwave leakage from the oven cavity. And with a SAFETY INTERLOCK SYSTEM UNIQUE IN THE INDUSTRY, not only does the oven stop cooking if the door is opened, but the door can't be opened unless the interlock is operating properly. A second independent door interlock is also provided for maximum protection. And all interlock mechanisms are tamperproof. Assembled in accordance with the manual, the GD-29 meets all the new federal standards for safety and radio interference. No special precautions are required when operating. The Heathkit electronic oven is as safe as your conventional oven! Quality components are used throughout: magnetron tube by Litton, the uncontested leader in the field; avalanche diode circuitry for longer tube life; simplified wiring harness with push-on quick-connectors for reliability and ease of assembly. GD-29 prototypes endured grueling "life-tests" equivalent to over 60 years of continuous service. A further assurance of uncompromised reliability. Another feature is portability: the Heathkit electronic oven operates on regular household current. Plug it in anywhere... on a countertop, a wheeled cart, in the kitchen, on the patio, at the cottage... anyplace a grounded 120V AC power outlet is available. Make this a Christmas to remember by putting a Heathkit electronic oven under the tree. It's a gift your wife will thrill to... and a present the whole family will enjoy... meal after meal after meal!

Kit **GD-29**, 80 lbs **$399.95***

New Heathkit portable solid-state color TV

- Big set performance, portable convenience
- MOSFET VHF tuner & 3-stage IF
- Modular, self-service design
- 102", 14 V picture tube

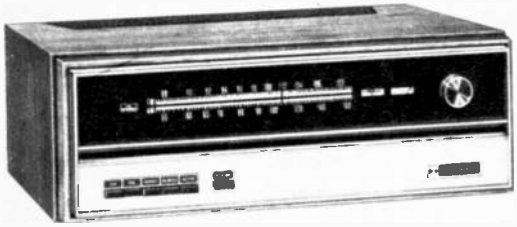


What do you do for an encore after you've created the solid-state GR-270 and GR-370 big-screen sets? Simple. Make them portable. That's virtually what's been done in the new Heathkit GR-169 solid-state portable color TV. Heath engineers took the same cool-running solid-state circuitry from the large screen chassis and packaged it in an easy-to-assemble compact chassis... with the same nine plug-in glass epoxy circuit board modules used in the big sets. In fact the only difference is the smaller preassembled horizontal deflection and high voltage power supply. The same MOSFET tuner and high gain 3-stage IF found in the big sets offer superlative color performance. And, as in the larger sets, complete owner-service features are provided by inclusion of built-in dot generator and degaussing along with an exclusive volt-ohm check-out meter. 48-hour factory service facilities for modules are also provided with the GR-169. Other features include: built-in antennas and connections for external antennas, instant picture and sound, complete secondary controls available behind the hinged door on the front panel, high resolution circuitry for sharp, crisp pictures; adjustable noise limiting to keep external interference to a minimum. If you're looking for big set color fidelity and performance with portable convenience... put the new Heathkit GR-169 on your Christmas shopping list now!

Kit **GR-169**, 48 lbs **$349.95***

CIRCLE NUMBER 3 ON PAGE 13

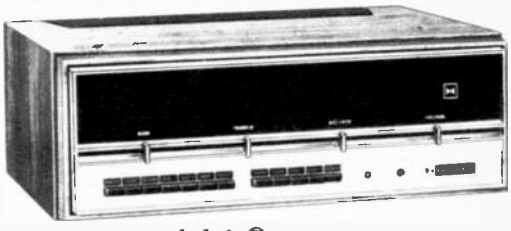
New Heath-gift ideas... for



New Heathkit® AJ-29 AM-FM-FM stereo tuner

This is the feature-packed tuner section of the famous Heathkit AR-29 stereo receiver . . . now available as a stereo "separate." The pre-assembled, factory-aligned FM tuner boasts 1.8 uV sensitivity for whopping station pulling power using FET design for superior overload characteristics. Three IC's in the IF section offer superior AM rejection, hard limiting, temperature stability, and outstanding reliability. Other features include a computer-designed 9-pole L-C filter for greater than 70 dB selectivity; new "blend" and "mute" functions; and a built-in AM rod antenna that swivels for best reception.

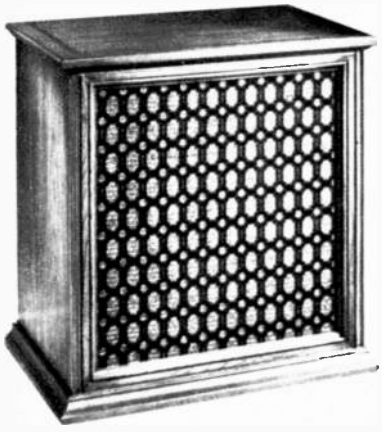
Kit **AJ-29,** 19 lbs., less cabinet **$169.95***
Assembled **AE-19,** oiled pecan cab., 9 lbs. **$19.95***



New Heathkit® AA-29 100-watt stereo amplifier

Power-packed amplifier section of the Heathkit AR-29, the AA-29 stereo "separate" marks another milestone in superior Heathkit amplifier design. Its 70-watts of continuous power is more than enough to drive even the most inefficient speaker systems. A massive, fully-regulated and filtered power supply, 4 conservatively heat sinked output transistors and the best IM and harmonic distortion specifications in the industry add up to sound fidelity you never expected to hear outside the theater. Modular plug-in circuit boards make assembly easier . . . snap out in seconds for future servicing.

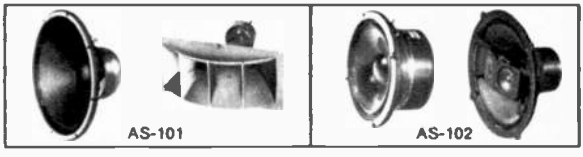
Kit **AA-29,** 27 lbs., less cabinet **$149.95***
Assembled **AE-19,** oiled pecan cab., 9 lbs. **$19.95***



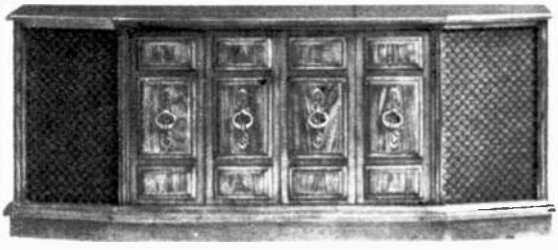
New Heathkit® floor model speaker systems

In the new Heathkit AS-101 and AS-102 speaker systems, Heath engineers have combined the best of both worlds of sound and beauty. The AS-101 Heath/Altec-Lansing 2-way system features a 15" woofer and sectoral horn delivering from 35 to 22,000 Hz with uncompromising accuracy. The AS-102 Heath/Bozak 3-way system uses a 12" woofer, 6" mid-range, and two 2½" tweeters in an infinite baffle design to produce clean natural reproduction from 40 to 20,000 Hz. Both systems are housed in assembled Mediterranean pecan cabinets, 29⅝" H x 27¾" W x 19⅞" D.

Kit **AS-101,** 53 lbs. **$259.95***
Kit **AS-102,** 39 lbs. **$259.95***



New Heath stereo equipment credenza



Romantic Mediterranean styling in wife-pleasing one-piece console design . . . yet with plenty of room for your favorite separate stereo components. Six-and-a-half feet of solid craftsmanship executed in North American Hickory veneers and solid oak trim, finished in oiled pecan. Completely assembled and finished, ready for installation of Heath or other components. Speaker enclosures are ducted port reflex design, pre-cut for 12".speakers. An adjustable shelf has room for stereo receiver, cartridge or cassette tape player or separate tuner and amplifier. Below the shelf is room for your turntable and record storage. Accessory matching drawers on ball bearing slides are available for turntable and tape player.

Model **AE-101,** 90 lbs. **$189.95***

CIRCLE NUMBER 3 ON PAGE 13

home, shop and ham shack

New Heathkit® IC 15 MHz frequency counter...199.95*

A highly accurate, low cost frequency meter for anyone requiring accurate frequency measurements. Compare these features to counters selling for over twice this low price: accurate counting, 1 Hz to over 15 MHz; integrated circuitry; automatic trigger level for wide range input without adjustment; five digit readout with Hz/kHz ranges and overrange indicators for eight digit capability; high input impedance; storage circuitry for non-blinking, no-count-up readout; computer-type circuitry, no divider chain adjustment; temperature-compensated crystal time base oscillator; BNC input with cable; double-sided, plated-thru circuit board with sockets; three-wire, removable line cord; heavy-duty aluminum case handle/tilt stand and die cast zinc front panel; no special instruments required for accurate calibration.

Kit **IB-101**, 7 lbs. **$199.95***

IB-101 SPECIFICATIONS: Frequency Range: 1 Hz to greater than 15 MHz. **Accuracy:** ±1 count ± time base stability. **Gate Times:** 1 millisecond or 1 second with automatic reset. **Input Characteristics: Sensitivity:** 1 Hz to 1 MHz, less than 100 mV rms. 1 MHz to 15 MHz, less than 250 mV rms. After 30 minutes warmup. **Trigger Level:** Automatic. **Impedance:** 1 Meg ohm shunted by less than 20 pf. **Maximum Input:** 200 V rms, DC–1 kHz. Derate at 48 V per frequency decade. **TIME BASE: Frequency:** 1 MHz, crystal controlled. **Aging Rate:** Less than 1 PPM/month after 30 days. **Temperature:** Less than ±2 parts in 10^6/degree C. 20 to 35 degrees C after 30 minutes warmup. ±.002% from 0 to 50 degrees C. **GENERAL: Readout:** 5 digits plus overrange. **Temperature Range:** Storage, -55 to 80 degrees C. Operating, 0 to 50 degrees C. **Power Requirements:** 105-125 or 210-250 VAC, 50/60 Hz, 8 watts. **Cabinet Dimensions:** 8¼" W x 3⅞" H x 9" D not including handle. **Net Weight:** 4½ lbs.

See these and 300 other Heath-gift suggestions at one of the following Heathkit Electronic Centers:

Anaheim, Calif. 92805
330 E. Ball Road

Boston Area
Wellesley, Mass. 02181
165 Worcester St.

Chicago, Illinois 60645
3462-66 W. Devon Ave.

Chicago Area
Downers Grove, Ill. 60515
224 Ogden Avenue

Cleveland, Ohio 44129
5444 Pearl Road

Dallas, Texas 75201
2715 Ross Avenue

Denver, Colorado 80212
5940 W. 38th Ave.

Detroit, Michigan 48219
18645 W. 8 Mile Road

Fair Lawn, N. J. 07410
35-07 Broadway (Rt. 4)

Houston, Texas 77027
3705 Westheimer

Los Angeles, Calif. 90007
2309 S. Flower St.

Milwaukee, Wisc. 53216
5215 W. Fond du Lac

Minneapolis Area
Hopkins, Minn. 55343
101 Shady Oak Road

New York, N.Y. 10036
35 W. 45th Street

Philadelphia, Pa. 19149
6318 Roosevelt Blvd.

Pittsburgh, Pa. 15235
3482 William Penn Highway

St. Louis, Mo. 63123
9296 Gravois Ave.

San Diego Area
LaMesa, Calif. 92041
8363 Center Drive

San Francisco Area
Redwood City, Calif. 94063
2001 Middlefield Road

Seattle, Wash. 98121
2221 Third Avenue

Washington, D. C. Area
Rockville, Md. 20852
5542 Nicholson Lane

All Heathkit Electronic Centers are units of Schlumberger Products Corporation. Heathkit Electronic Center Prices Slightly Higher.

During 1971, consult Heathkit Catalog Supplements and local newspapers for announcements of new Heathkit Electronic Centers opening in these places:

Long Island Area
Westbury, New York

Miami, Florida

San Francisco Area
El Cerrito, California

Cincinnati, Ohio

Los Angeles Area
Woodland Hills, California

Atlanta, Georgia

Prices listed are factory mail order. Retail prices are slightly higher.

. . . or send for your FREE factory mail order catalog

New Heathkit® HW-101 SSB transceiver

The Hams at Heath have done it again . . . with an uprated version of the Heathkit HW-100, one of the most popular pieces of ham gear on the market! The HW-101 features improved receiver circuitry resulting in better than 0.35 uV sensitivity for 10 dB S+N/N. Image and IF rejection are better than 50 dB. Other improvements are a new 36-to-1 ball-bearing dial drive; new selectable SSB or CW filters and attractive new front-panel styling.

Kit **HW-101**, 23 lbs. **$249.95***

New Heathkit wattmeter/SWR bridge

Two switch-selected ranges allow measurement of RF output from 10-200 W and 100-2000 W. Built-in calibrator permits 10% accuracy throughout the 80-10 M ham bands.

Kit **HM-102**, 3 lbs. **$29.95***

HEATHKIT

HEATH COMPANY, Dept. 39-1
Benton Harbor, Michigan 49022
a Schlumberger Company

☐ Enclosed is $_____, plus shipping.
Please send model (s) _____
☐ Please send FREE Heathkit Catalog. ☐ Please send Credit Application.
Name _____
Address _____
City _____ State _____ Zip _____

*Mail order prices; F.O.B. factory.
Prices & specifications subject to change without notice. CL-394R

CIRCLE NUMBER 3 ON PAGE 13

CB Phone Patch

By HERB FRIEDMAN, KBI9457

THAT upper-class status symbol—a car telephone—can be yours without an investment in the Ma Bell Establishment. The luxury and convenience of a mobile telephone requires only an inexpensive phone patch and your CB rig. Of course, you won't be able to originate calls in every part of the country, but you won't be spending about $1,000 for a Ma Bell mobile phone and $1 a call.

How it Works. The phone patch is connected to the phone lines and to your base-station transceiver's speaker output and mike input. When a phone call is received at the base, your XYL simply calls you on the CB rig and then connects the phone patch. The received call is then relayed via CB to your car. When you talk, someone at the base station sets the rig to receive, and your transmission is fed into the phone line.

It is not necessary to key the patch because it uses a special transformer that is connected to the transceiver's mike input and speaker jack. Figure 3 shows how it's done. Transformer T1 is a Lafayette walkie-talkie modulation transformer. It has a 500-ohm center-tapped primary (red leads), a speaker-impedance secondary (yel/grn leads) and a 3,000-ohm secondary (brn/wht leads) that is used for the mike input. When the CB rig is receiving the speaker output is fed to the transformer and then to the phone line through the 500-ohm winding. When the CB rig is switched to transmit, the incoming phone signal is fed via the 5,000-ohm level control (R2) to the mike input. There is no interaction between the speaker and mike circuits.

Meter M1, a VU meter, indicates the signal level fed into the phone line and warns you if the signal is too strong, thus causing overload. Chokes L1 and L2 in combination with C2 and C3 keep RF leakage from the CB rig off of the phone line.

Switch S1 connects the patch to the phone line. Another switch, S2, (visible only at the top in the photo in Fig. 2) must be connected as a transmit/receive switch in place of the PTT switch on the CB mike. When using the patch the mike is disconnected, so S2 must replace the PTT switch. (Monitoring and transmitting by the base operator is done through the telephone handset.)

Construction. Wiring and layout aren't critical but duplicate the layout in the pictorial and photograph. A metal cabinet should be used; either an instrument case as shown or a 5¼ x 3 x 2⅛-in. Minibox. RF chokes L1 and L2 should be mounted close to S1. Capacitors C2 and C3 should be close to the chokes. Except for C1 and R2, all major components are mounted on a 2 x 4¼-in. piece of perforated board installed on the meters' terminals. Use Key-

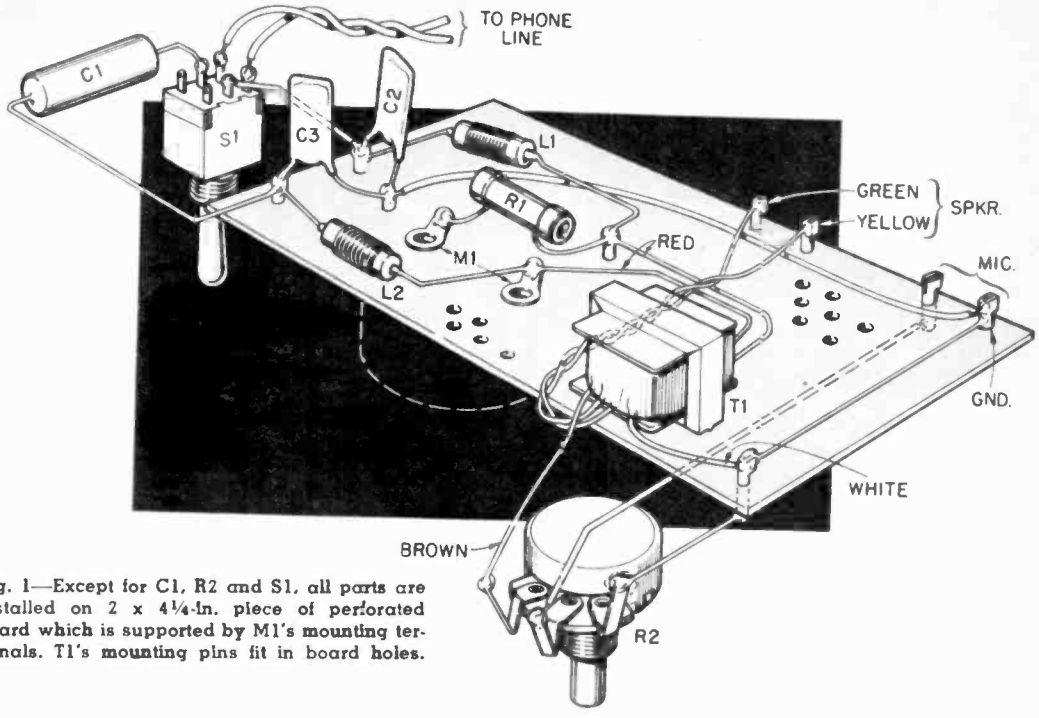


Fig. 1—Except for C1, R2 and S1, all parts are installed on 2 x 4¼-in. piece of perforated board which is supported by M1's mounting terminals. T1's mounting pins fit in board holes.

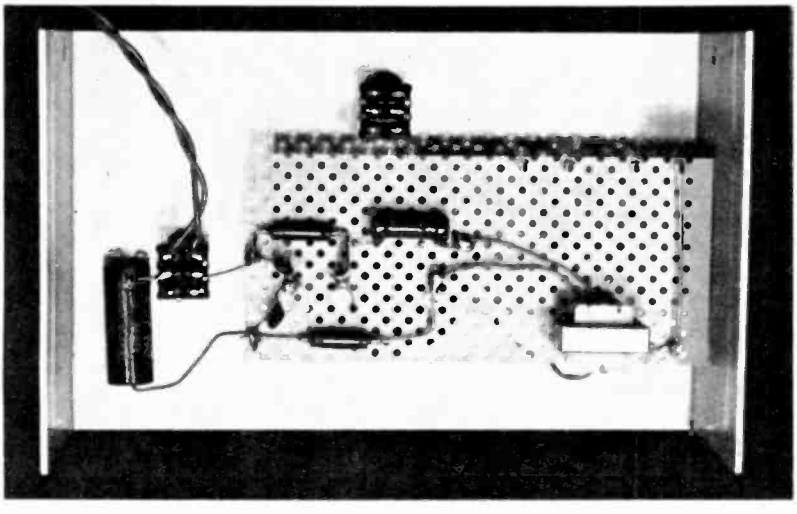


Fig. 2—Switch S2, the transmit/receive switch, is at the top in photo at left. We do not show wiring because it depends on connections in your CB rig. Modulation-level control R2 is not visible because it's under transformer.

stone G-pattern perfboard because the hole spacing exactly matches T1's mounting tabs.

Locate the perfboard up against the cabinet's side and mark M1's terminals on the board. Drill the board for a No. 4 or No. 6 screw and install the board on the back of the meter. Be sure to place the supplied meter-terminal solder lugs between the screw heads and the perfboard.

Tie points are T-28 push-in terminals. Though the meter screws are adequate to support the board, take extra care to support the board with your fingers when installing the push-in terminals. If you don't, the force required to seat the terminals will crack the board. To mount T1, line up the tabs with holes in the board and using a gentle but firm pressure, seat the tabs in the holes. Then fold the tabs over with long-nose pliers or a screwdriver.

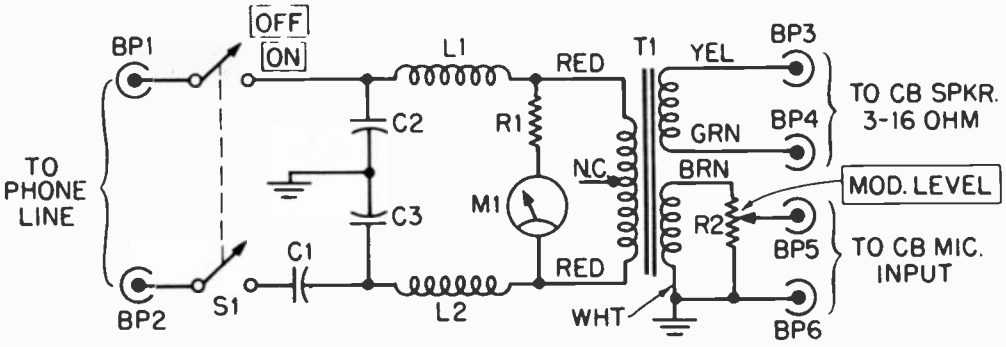


Fig. 3—C2,C3,L1,L2 are RF filter. Transformer T1 handles signals coming from and going to CB rig.

CB Phone Patch

Connecting to the Transceiver. Note that T1's speaker winding is not grounded. Some solid-state CB rigs have both speaker leads above ground, and a grounded speaker lead can pop a transistor. If your transceiver has one of the speaker leads grounded, it will automatically ground one of the T1's leads —and it doesn't matter which one.

The patch is connected to the speaker either via the transceiver's remote-speaker jack or by connection to the speaker.

The patch's mike connection is made at the transceiver's mike jack. Don't try to connect the patch *across* the mike leads. Obtain a matching mike plug and connect the patch to the plug. If the mike is wired directly to the transceiver you must splice connectors into the mike cord.

Switch S2 must be connected in place of the PTT switch on the mike. Since there are many types of PTT switching we cannot show specific wiring. Simply duplicate the PTT connections at S2.

Connecting to the Phone Lines. The easiest way to connect the patch to the phone line is with a standard telephone jack. If you don't have a plug-in phone it might be advantageous to convert to a jack-and-plug system. The patch's phone wires must connect to the phone's talking pair—the wires normally connected to terminals marked L1 and L2 inside the phone. (Normally the red and green wires, but check them.) If your phone has three wires coming in (one is the ground), find the talking pair. If you have a party-line phone you have at least three wires (one extra for the ringer); again, locate the L1, L2 talking pair.

PARTS LIST

BP1-BP6—Five way binding post
C1—.5 μf, 200 V tubular capacitor
C2,C3—.001 μf, 100 V tubular or disc capacitor
L1,L2—4.7 μh RF choke (J. W. Miller 74F476AP)
M1—VU meter (Lafayette 99 F 50247)
R1—3,600 ohm, ½ watt, 10% resistor (supplied with M1)
R2—5,000 ohm pot (any taper)
S1—DPDT slide or toggle switch
S2—DPDT slide or toggle switch (see text)
T1—Modulation and audio-output transformer; primary: 500 ohms, center tapped; secondaries: 8 ohms and 3,000 ohms (Lafayette 99 F 61327)
Misc.—5¼ x 3 x 2⅛-in. Minibox, perforated board
Note: The two RF chokes (L1,L2) are available for $1.50 postpaid from Custom Components, Box 153, Malverne, N.Y. 11565. N.Y. State residents add sales tax. No foreign orders.

If you have a modern phone with a dial light there may be four wires coming in. Two are for the dial-light power and two for talking; connect to the talking pair.

Using the Patch. After you have established the phone and CB conversations, connect the phone patch to your transceiver. You can monitor and enter the conversation through the telephone handset. When feeding from the phone to the CB rig, set S2 to *transmit* and adjust R2 for a good modulation level.

When feeding from the transceiver to the phone line, set S2 to *receive* and control the level from the transceiver to the phone line with the transceiver's volume control. Always adjust the volume control so the input to the line, as indicated by M1, never peaks above O VU (or 100 per cent). Excess phone-line level will overload the lines, cause cross-talk and annoy the phone company.

Hi-Fi Today

* Expensive Platter Players

By John Milder

DESPITE the usual spectacle of inflation everywhere you look, the trend in audio equipment over the past few years has been vaguely deflationary. Oh, there have been more expensive (sometimes excruciatingly) components every year but the performance-per-dollar trend—watts per dollar in amplifiers and receivers are most outstanding—has been quite encouraging. The raw material most of us use for listening, the LP record, actually is cheaper now than an equivalent album of 78-rpm records was before World War II.

All of which is to underline the chagrin with which I discovered recently that the price of record-playing gear has taken a big leap upward. Not that there isn't plenty of stuff in the under-$100 class but the things that make the audiophile's mouth water—the fancier automatics and transcription turntables—are beginning to cost a fortune.

Item: Benjamin's new Miracord 770-H (see photo below), the top of the Miracord line, weighs in at $225—or $75 to $100 more than the top price three years ago.

Item: Dual's new 1219, at $175, is $45 more than the model it replaces (the 1019) and $75 more than the 1009 that helped the company make its breakthrough (both in performance and sales) not many years ago.

Items: Two major entries in the transcription-turntable arena, the Thorens TD-250 and Sony TA-3000, bow at more than $250, not including a tone arm.

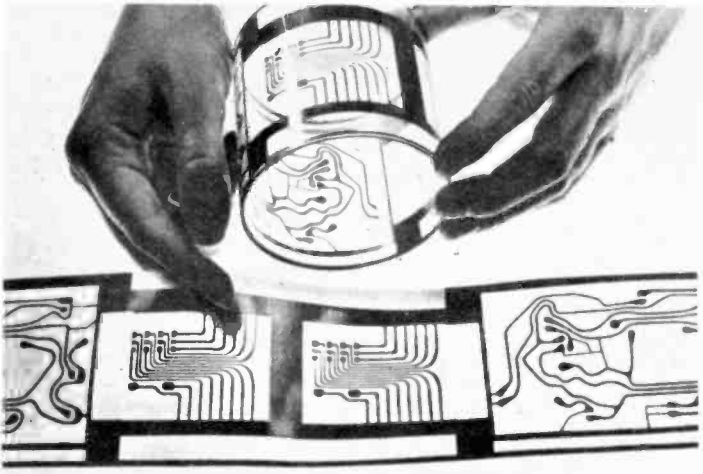
The Miracord 770-H turntable by Benjamin costs about $225, which is $75-$100 more than any previous turntable from this company. What's in store?

The price jump has been across the board. In the luxury automatic category, only the Garrard SL-95B has held the line (at $130), and I'm not sure whether it's to remain the top-priced model for the year ahead.

I wouldn't doubt that all of the new features listed for the new models are as real as their manufacturers think they are, but I think the value of the new gadgets does not warrant such enormous increases in price. What worries me is that I'm beginning to sniff a situation that parallels the old snow-shovel marketing ploy. There, you can't get the three or four cents worth of non-stick coating on the shovel until you buy the top-of-the snowbank model that comes with the special ice-scooper and the taillight. It warns off cars that might roar up your driveway while you shovel at midnight. If that kind of good old American marketing know-how becomes the rule in record-players and other components, as it threatens to, we might as well go back to watching TV in the evenings.

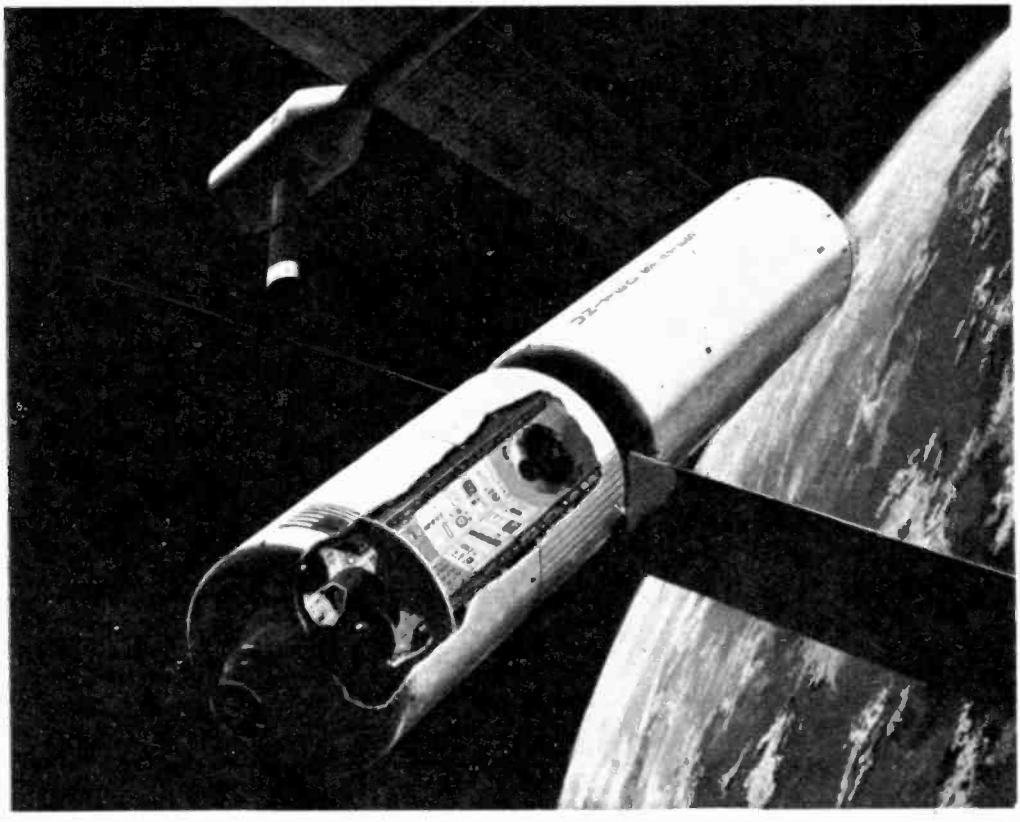
A round of applause to Pickering for a new line of cartridges that just snap into place in a tone arm and don't need all those teeny-tiny screws and teeny-tiny screwdrivers that have driven lots of audiophiles (and all equipment reviewers) up the wall for so many years. Maybe a lot of people have the store install their cartridge for them these days, but anyone who fumbles on his own will be grateful for Pickering's innovation. For store-installed situations, the simple vertical-tracking-angle adjustment provided with the new models will be more than welcome.

Before we get away from record-gear improvements (and from taillights on snow shovels), let me note that Empire's new Troubador turntable-arm ensemble comes with a little light that lets you see what you're playing even in a dark and smoke-filled room. With tongue out-of-cheek, let me say that this strikes me as one of the greatest amenities ever offered in audio gear. Now if they can just get the light to detach and follow me while I crawl around in front of the record cabinet looking for that first Grateful Dead record.

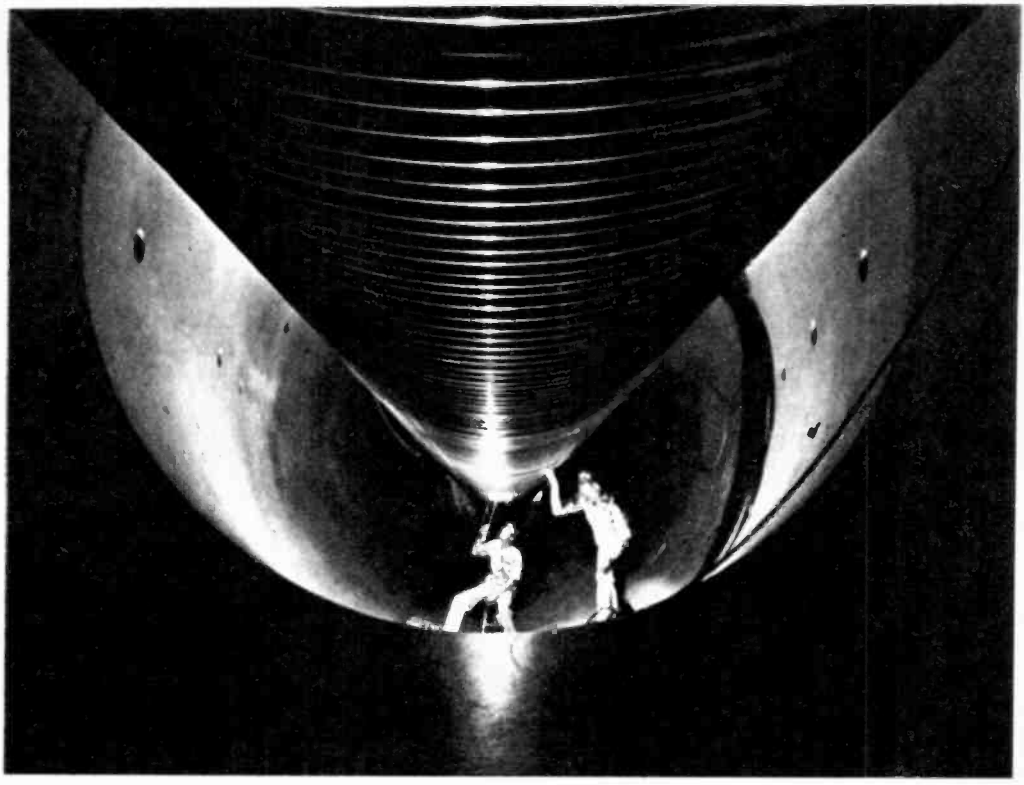


SMILE, SAY RESISTOR . . . Printed circuits from a film process are now a reality. Western Electric has developed a system of manufacture of printed circuits in which the regular process is reversed. With the Western Electric method, a circuit is placed on a clear piece of film. This is chemically treated with the PC board and the copper circuit is placed on the board rather than etched away as with the regular PC manufacturing process. The result is a flexible board of plastic that can be formed to fit any of the new shapes required in modern phones.

Electronics in the News



It's A Nice Place To Visit . . . With the conclusion of the Apollo program, NASA will turn its sights toward placing an orbiting space station into operation. The artist's conception shown above is indicative of what General Electric's engineers believe that the space village will resemble after its launch, which is anticipated in the latter part of 1974. The module above will serve as a main vehicle to which will be attached several smaller laboratory modules. Electronics will be used extensively on this mission, especially in monitoring and testing the most important part of the program—man.



A Lot Of Potential . . . Brookhaven National Laboratory of the Atomic Energy Commission has announced that its Van de Graaff accelerator achieved the unbelievable recently by accelerating hydrogen ions to 30-million electron volts. Brookhaven Labs says that the accelerator is capable of accelerating any negatively- or positively-charged particle man is able to produce. This would include heavier elements for which they are able to produce energy on the order of 300-million volts. The system operates on the simple principle of likes repelling and opposites attracting, with one terminal at each end and one at the center.

New Choo-Choo . . . Riders of the nations railroads will be green with envy soon, when San Francisco's BART system becomes operative. The all-electronic system requires no personnel on board. Photo below shows cab in which attendant may ride to monitor operation. Photo below, right, shows electronic sign with time to destination.

CB Corner

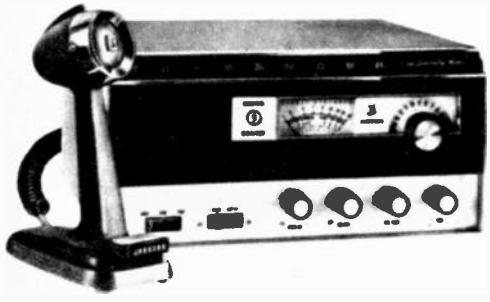
By Len Buckwalter, KQA5012

Siamese CB

NOW that Channel 9 is officially reserved for emergency calls, CBers everywhere are both delighted and dismayed. They're glad because they have won a clear channel for helping people in distress—peeved because they can't work it. How can we monitor Channel 9, runs the complaint, if we can't operate on it at the same time? The solution, of course, would be to purchase two transceivers—one tuned to 9, ready to grab the emergencies, the other for regular communications.

Too expensive, you say? Maybe so, but someone's come up with a new breed of hardware that equals two CB rigs, but not at twice the price. It's the Messenger One Twenty Four/9, an electronic Siamese twin that E. F. Johnson expects to market by December 1970 (see photo below). The engineers take a conventional CB transceiver (one receiver plus transmitter) and graft to it a second receiver. You tune the 9 section for standby monitoring but can simultaneously operate on any channel on the One Twenty Four section for routine communications. When an emergency call arrives, a signal lamp lights. The Channel 9 receiver contains stages from RF to the detector. A relay injects the Channel 9 audio into the One Twenty Four amplifier so the audio is superimposed on the audio of whatever other channel you may be listening to. So warned, you switch to 9 for the rescue.

According to a Johnson spokesman, this is not the only proposed model (there'll be mobile versions, too) or even a final answer to the problem of monitoring 9 without sacrificing regular communications. It is, however, the first serious stab at solving the monitor problem. The standard Model One Twenty Four costs $299 and the additional 9 monitor boosts its cost by $40. The saving is achieved by permitting the second receiver to share stages with the conventional circuit.



New E. F. Johnson Messenger One Twenty Four/9 is a combined transceiver and Channel 9 monitor. Incoming emergency call causes a light to flash.

CB in Bloom. I thought I'd heard of every possible use for CB until a friend called to ask some advice. A garden club in Westchester County, N.Y., wanted of all things, walkie talkies for communications while puttering among the pansies. My friend had located some cheap surplus equipment recently returned from commercial service. But he dropped the idea like a hot petunia when it was explained that such ex-commercial units are good for hams, but otherwise run afoul of FCC regulations.

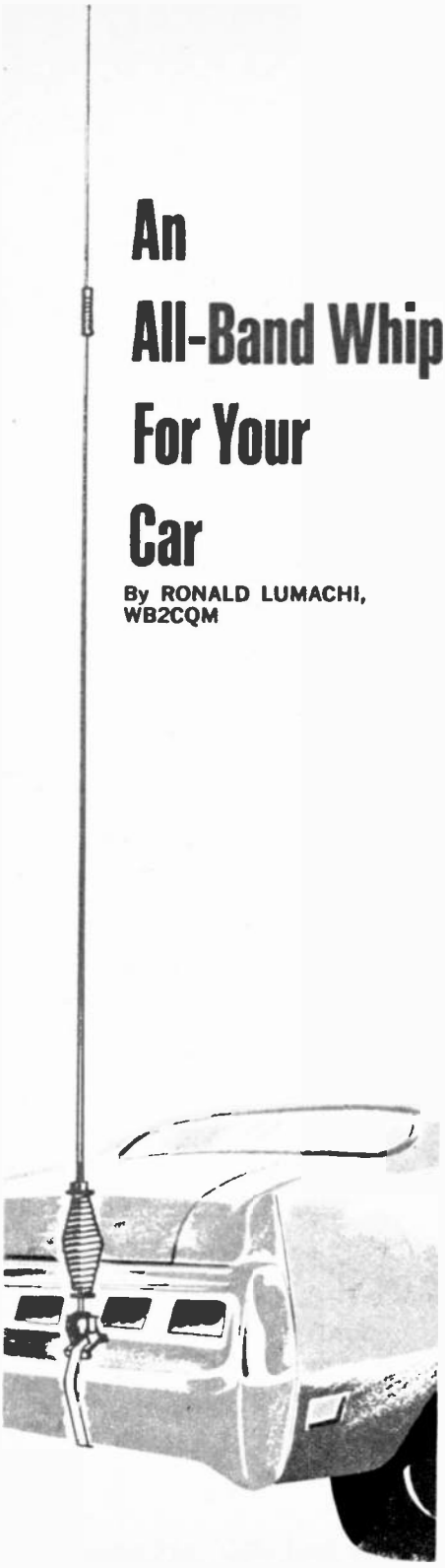
The group found that the job could be done easily by a couple of CB walkie talkies. And they cost about the same as an annual frequency check required by commercial two-way gear. So don't be startled if you're in New York State and a faint cry comes over the CB set: "Help, Gwendolyn, I'm being devoured by the Venus Fly Trap!"

ConFUZing. Here's a bug that has baffled a service technician in trying to locate the reason for low transmitter output in a mobile rig. You could have it, too. Suspecting low supply voltage, he measured 12 V (a correct amount) at the rig's power input lead. And on the bench the rig worked properly when powered by 12 VDC, so the problem wasn't in the circuits. What he failed to measure while in the car was a serious loss of voltage across the rig's fuse. After some time, the holder loses tension or contact resistance or corrosion blocks the current flow.

About 1A of current flows in a typical solid-state rig while transmitting. That means that if a mere 3 ohms of resistance creep into the fuse holder, 3 precious volts (out of 12) are lost. The remedy is ridiculously simple: Remove the fuse and rotate its metal caps in a cloth until they're shiny. Clean the fuse contacts, too, and pinch them for more tension, if possible. A once-a-year treatment should keep the fuse trouble-free.

An All-Band Whip For Your Car

By RONALD LUMACHI, WB2CQM



OUTFITTING a car for mobile operation is generally an expensive matter. The transmitter, receiver, power supplies, mounts, suppression kits and wiring add up to a substantial cash outlay. The antenna system is another item that can easily add $70 to $80 to the cost. But for $15 you can make an all-band mobile whip that will work as well as any commercially-made antenna. That's a big saving and it will make mobile operation a lot more enjoyable.

Our antenna is basically a center-loaded whip that radiates equally well in all directions. By inserting a coil (or spacer) between the upper and lower sections of the whip, and fine tuning the telescoping upper element by changing its length, the antenna will resonate in the Citizens Band and the 10, 15, 20, 40 and 80-meter amateur bands. The antenna's impedance is 46-54 ohms (depending on frequency); consequently, it will match the output network of almost every transmitter (250 watts or less) using RG58/U coax.

Construction

The basic antenna you start off with is a 102-in. Lafayette CB bumper-mount antenna which comes with a stainless-steel mounting strap. The antenna is inexpensive, however, it is well constructed and will last a long time. Cut off a section exactly 24 in. from the top of the whip; this section may be discarded. The dia. of the whip at this point is exactly 0.138 in. which is the outside dia. of a No. 6 screw. Thread the end of the whip (Fig. 3) using a 6-32 die. One end of the wood-dowel coil support will be screwed on the whip at this point. The telescoping upper element goes in the other end of the support.

The Coils

Coils could be handwound, however, the preformed coils specified are easy to work with. File or sandpaper three flat surfaces on each dowel in order to accommodate the plastic supports on the coil. When filing the flats on the hardwood dowels (Fig. 2), be certain that the coils fit snugly on the dowel; the flats will prevent coil movement. Because of the design, there is no strain on the coil.

Cut the wood coil-support dowels to the lengths shown in the Table. Drill ¼-in.-dia. holes approximately 1 in. deep in each end of the dowels.

Coat the dowels with several layers of varnish to prevent weathering. File or grind round one end of the hexagonal spacers (internally threaded for a 6-32 screw) and solder

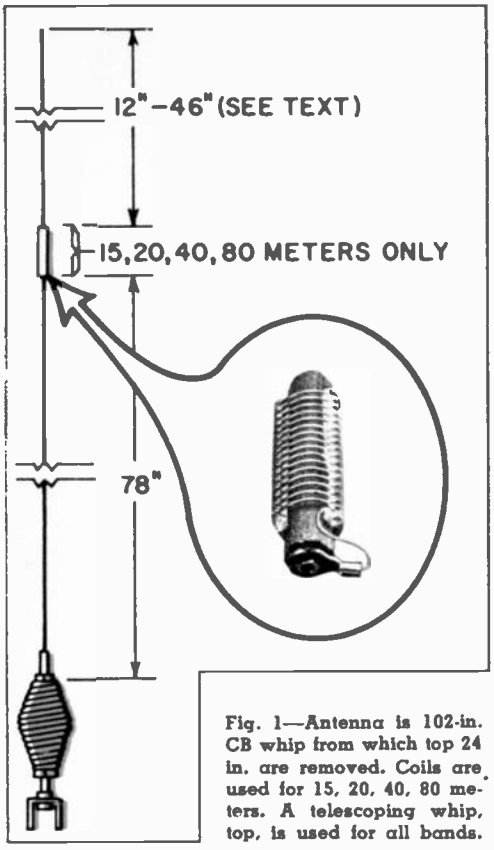


Fig. 1—Antenna is 102-in. CB whip from which top 24 in. are removed. Coils are used for 15, 20, 40, 80 meters. A telescoping whip, top, is used for all bands.

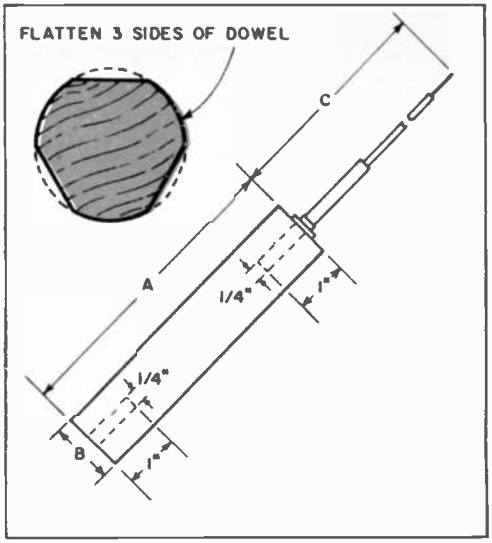


Fig. 2—Wood forms on which the loading coils are mounted; the lengths are different for each band. Refer to table below for the lengths and diameters.

Band	Dimensions (in.)			Air Dux coil No. and turns
	A	B	C	
10 m	spacer	spacer	12	none
CB	spacer	spacer	16	none
15 m	3	3/4	15	604T, 7 1/2
20 m	3	1	29	816T, 32
40 m	3	1	42	832T, 56
80 m	7 1/2	1	46	832T, 96

An All-Band Whip For Your Car

a ¼-in. lug on the end of the spacer as shown in Fig. 5. Force fit the lug spacer in one end of the wooden dowel as shown in Fig. 6. Refer to the Table and cut each coil form to length. Mark each coil for reference.

Slip the coil on the dowel support and fit the remaining spacer/lug in the other end. Solder the ends of the coil to the lugs. Either end of the coil may now be screwed on the threaded end of the whip.

The upper radiating portion of the antenna is a telescoping whip antenna that is used for fine tuning within the limits set by the coil. The whip antenna comes supplied with a 6-32 adaptor (Fig. 6, center) that allows it to be coupled securely to the whip and spacer.

Attach the stainless-steel bumper mount; the mount is universal and will fit any bumper. Connect the braid from a length of RG58/U coax to the mount and attach the center conductor to the antenna below the

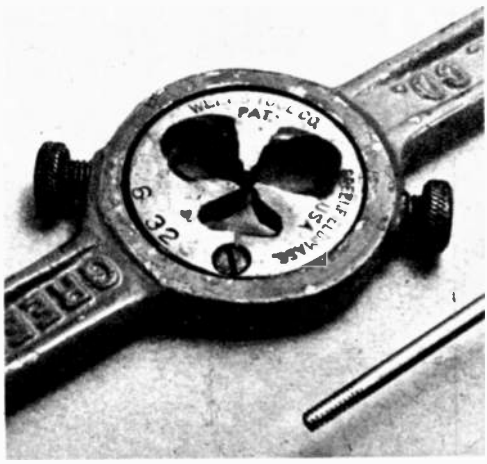


Fig. 3—The dia. of CB whip 24 in. from top is 0.138 in.—the dia. of 6-32 screw. Thread whip end using 6-32 die which is shown above in stock.

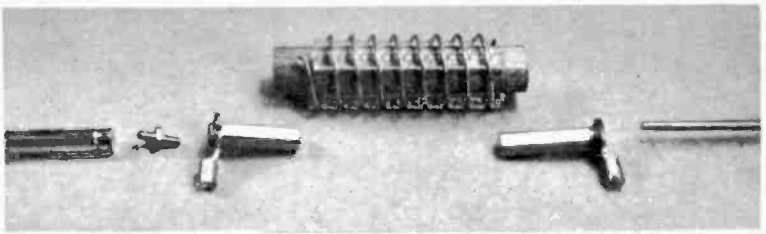


Fig. 5—15-meter coil. At far left is telescoping whip. Objects near coil are hex spacers on which are soldered lugs for the coil wires.

Fig. 4—At right is spacer used (instead of coils) for 10 meters and CB. Telescoping upper section is at left and top of whip antenna is at far right.

heavy spring as shown in Fig. 7. Threaded bolts are conveniently located for both connections. Attach the whip section of the CB antenna on the bumper mount.

Select a coil and install in between the lower whip and upper telescoping antenna. Adjust the telescoping whip to the dimension shown in the Table. Adjustment of the upper section will fine-tune the antenna for the frequency you're going to operate on. Strive for maximum power output with a minimum SWR. For optimum results, always readjust the upper section when changing bands.

The coils may be wrapped with plastic tape for an added degree of protection. Operation on CB and 10 meters does not require a coil. Substitute a brass spacer (Fig. 4) for the coil and adjust the telescoping portion to the length shown in the Table.

PARTS LIST

Antenna, telescoping, 46½ in. (Burstein-Applebee, 3199 Mercier St., Kansas City, Mo. 64111. Stock No. 10A3035, $1.95 plus postage)
Antenna, bumper mount CB (Lafayette 42 F 01596WX)
Coils: Air Dux Nos. 604T, 816T, 832T (Jeff-Tronics, 4252 Pearl Rd., Cleveland, Ohio 44109. 93¢, $1.13, respectively, plus postage)
Die stock (BA 37A3214. $1.34)
Die, 6-32 (BA 37A3223. 80¢)
Dowel, wood; 3 ft. x ¾-in. dia.
Dowel, wood; 3 ft. x 1-in. dia.
Spacer, brass hex; 1 in. x 6-32 (BA 12A1390. 10/$1.23)

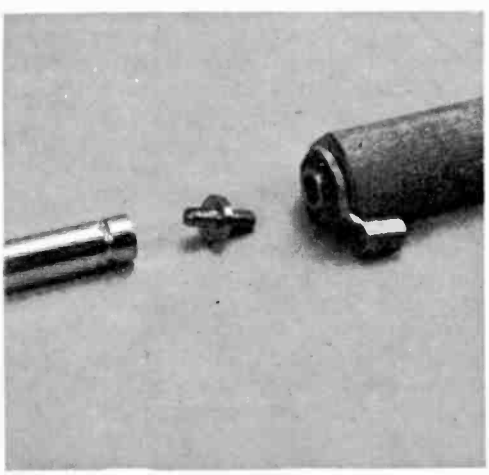


Fig. 6—4-40/6-32 adaptor is used to attach the telescoping whip at left to hex spacer in dowel coil support. The coil has not been installed yet.

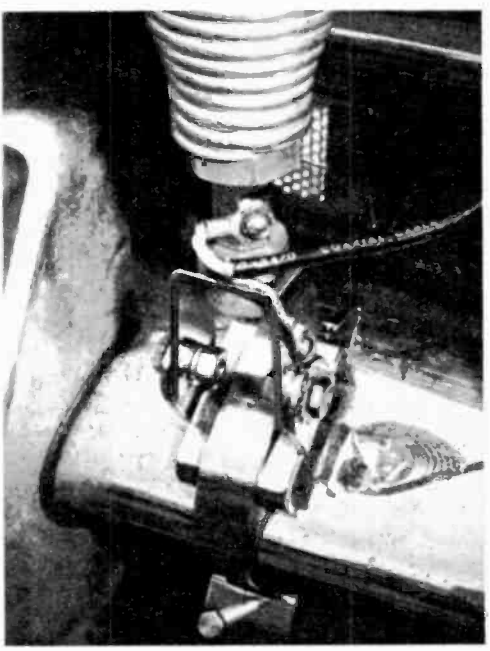
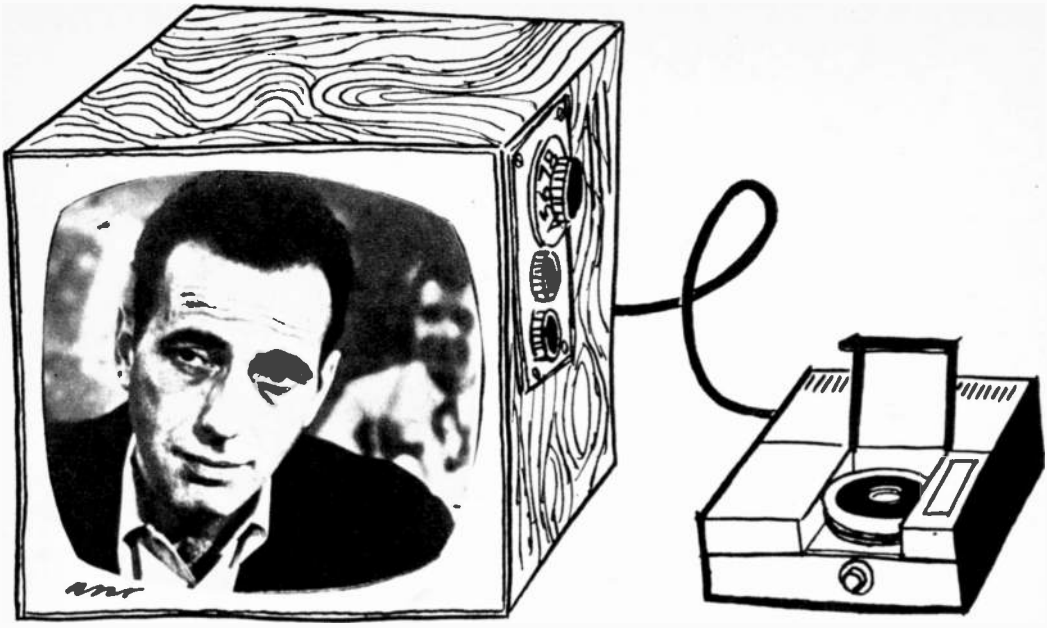


Fig. 7—Installed bumper mount. Coax's center conductor is attached below heavy spring. Braid is grounded to car at solder lug on bracket.



Coming! (?)... The Video Gramophone

Manufacturers are crazy about the video player, and if they have their way, no home will be without a phonograph for the eye.

By LEN BUCKWALTER

THE name of the game in electronics always has been King of the Mountain. When one research and development team comes up with a new and useful electronic device, war breaks out among manufacturers aiming for the top of the pile. The latest reason for such combat is the video player. As with color television and phonographs in years gone by, a half dozen companies have announced entry into a field estimated at a billion-dollar market with the intention of seeing their competitors fall by the wayside in a joust of enormous proportions.

The video player, termed by an industry spokesman as the phonograph of the eye, will be a reality soon. All that remains now is to see who can win the most points.

The video player is designed to fill the void left by broadcast television. The theory is that small and select audiences will be important enough to make feasible the production of special-interest programming. Without worrying about ratings and the subsequent effect on advertising support, the video-player companies will derive their income from the sale or rental of program material to the individual. The program director of one of the large companies has said that he can produce almost any program for 25,000 viewers and still make it profitable.

Whether the players live up to the promises and aspirations of a greedy industry remains to be seen. Almost simultaneously with the announcement of a new product, each company has said that a whole library of old movies will be made available. Invariably, these are classics of the screen, all offered at a one-time rental for a fee of something like $3. One company, AVCO Cartrivision, has announced that it will put movies with X ratings on cartridges, seemingly hoping to fill the void that will be left when all those

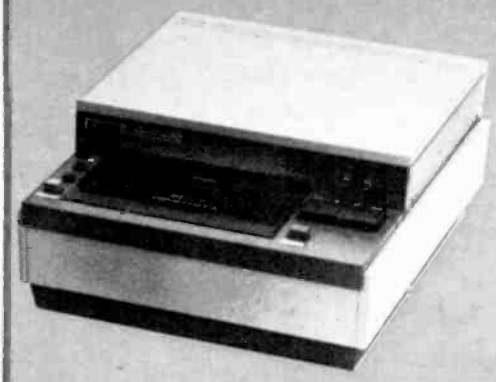


Fig. 1—The Sony Videocassete. The Sony system plays recorded color programs and with an adaptor will record off-the-air on cassettes.

Fig. 2—Avco's Cartrivision. Admiral will market it for $900. You can play shows, record off the air or tape your own home TV shows.

THE CONTENDERS

Fig. 3—RCA's SelectaVision. A novelty in home entertainment. SelectaVision employs lasers and holograms to produce color pictures.

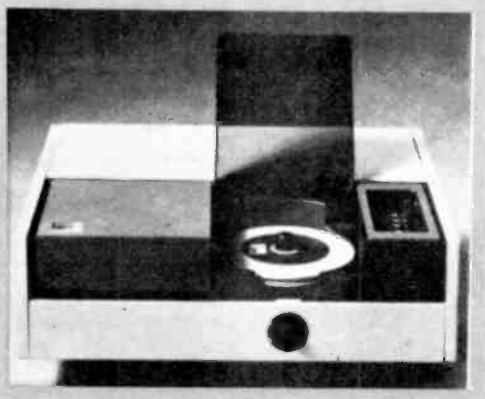


Fig. 4—CBS' EVR. It uses a flying-spot scanner and b&w movie film with color information stored at side of the picture. Uses cartridge, too.

sizzlers are rejected for network broadcast.

Negotiations are under way for all kinds of new programming which will be offered for sale. As it stands now, all that the companies are sure to offer are old movies. Although there are big differences in each system, the winner of this race undoubtedly will be the one who can offer the largest diversity in programming.

The programming facet of the video player is known to the industry as software and it seems that the manufacturers are letting it take a backseat to the actual machine when it comes to promotion. The differences in these machines are enormous in some cases and a knowledge of these differences will give the befuddled consumer an idea of what is at stake.

The four leading contenders are shown in Figs. 1 through 4. They are Sony's Videocassette player, Avco's Cartrivision, RCA's SelectaVision and CBS' EVR.

Cartrivision. The AVCO system typifies the approach taken by magnetic tape advocates who offer both playback and recording. An important difference between older video recorders and the new instruments is the plunk-in cartridge. With Cartrivision there's

Coming! (?)... The Video Gramophone

a triple choice: you may play prerecorded video shows, record programs off the air, or shoot a video version of home movies by adding an optional TV camera. The Cartrivision tape moves only 3.8 in.-per-second but the effective speed is over 500 ips as three video heads sweep across the tape at 12,000 rpm. This high speed is for the wide frequency response demanded by color video.

AVCO will offer its cartridges in color-coded magazines. There's red (for *rent*), mainly feature films at a rental cost of about $3; black (for *buy*), for programs you might wish to own (for example, a tape of Cassius Clay vs. Floyd Patterson); and yellow (*yours*) for blank cartridges containing raw tape for home recording.

Although Cartrivision was first demonstrated as part of a 19-in. color set at a cost of about $900, the company hopes to introduce an adapter to work with any color receiver by late 1971. The add-on device should sell for $400-500. The price of a blank cartridge is $9.98 for 15 minutes and $24.98 for two hours. Prerecorded tapes (with sports highlights, instructional fare, etc.) should run from about $8 to $25.

Supporters of magnetic tape boast it's the most versatile medium around today. Tape will record, play back, needs no processing and may be erased and reused. Critics, on the other hand, say the home recording feature will prove unnecessary in the overall field of home video playback. They also point to video tape's relatively high cost, and those spinning heads which may need replacement every 1,000 hours, by a serviceman. The home-movie feature isn't very practical, either, because there's no cheap color TV camera for the amateur and a color video recorder is hardly something you can tote to a picnic. Nevertheless, Cartrivision has scored an impressive performance in operat-

Fig. 5—Engineer checks the process used in making holograms for SelectaVision. Process goes from film (left) to plastic (right).

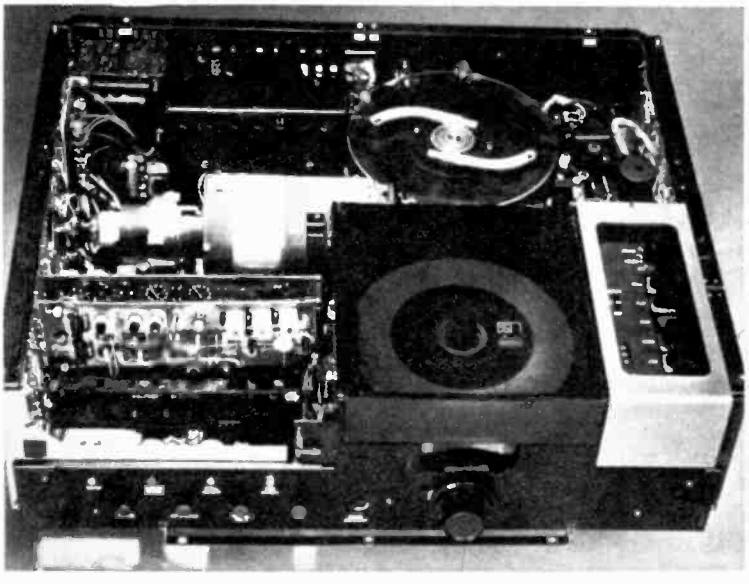


Fig. 6—Interior of CBS' Electronic Video Recording system (EVR). Visible is the self-threading reel inside machine (top) which takes up film from cartridge. Flying-spot scanner, which converts information on film to color picture, is at left.

ing convenience and it appears to be well beyond the experimental stage.

Videocassette. This Sony entry, is expected to be available by late 1971 as a playback-only device which will retail for about $400. An 8 x 5-in. cassette will play up to 90 minutes through a standard color or b&w receiver. An advantage of the format, says Sony, is the potential re-use of prerecorded tapes. After you've purchased a program and viewed it many times you can return the cassette to the program supplier for re-recording with fresh material. The cost of a blank, 90-minute cassette is expected to be $20. Sony also announced it will introduce a $100 adaptor to enable the player to record programs off-the-air onto a blank cassette.

Philips is expected to introduce its own version of the videocassette (called VCR) by early 1972 at about $600. But unlike the Sony machine this instrument will record, as well as playback. A novel feature of the Philips is a built-in TV tuner and clock timer so the instrument can dub programs while you're away from home.

Those are the leading proponents of magnetic tape cartridges, and more manufacturers (like Matsushita and Magnavox) are expected to join the group. But just as formidable is the faction which scraps oxide-coated magnetic tape in favor of optical film.

EVR. Columbia Broadcasting System's effort is EVR—Electronic Video Recording. It's been around for several years and has already made an impact as an audio-visual aid for industry and education. Now that the consumer market is heating up, EVR may be retooled for public consumption.

EVR draws its operating principle from way-back-when. The system is based on the flying-spot scanner, a technique used by hams to cheaply convert optical images into electrical signals. If you look closely at an EVR recording it resembles an ordinary strip of movie film minus the sprocket holes. The film is black-and-white, but it encodes color information in separate frames alongside the b&w image. You might say that EVR is a movie system which electronically plays through the color receiver.

EVR offers a compelling argument in the matter of quality. It claims that resolution is three times that of magnetic tape and a recent demonstration proved the system capable of excellent clarity and color. The format is a handy 7-in.-dia. cartridge that plays 50 minutes in b&w or 25 minutes in color. (Since CBS has not yet announced plans for a con-

[*Continued on page* 99]

Fig. 7—At right are the three program options of Avco's Cartrivision. The movie tape at left would rent for $3 per showing. At center is blank cartridge for home recording and at right is prerecorded football tape which Avco will sell for $25.

Fig. 8—Three of the leading cartridges are shown for purposes of size comparison. Differences can be easily seen as Avco has a square cartridge, Sony has a rectangular cassette and CBS uses a round cartridge for its film. Standardization?

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A leading computer company: "He has some appreciated abilities not found in graduates of other programs. He has a knowledge of oscilloscopes of any size and complexity—how to use them, repair and service them. His circuit analysis is above average for a man with this experience."

An electronics company: "Perhaps the most valuable asset these 30 men have is the ability to adapt to new work projects with little hesitancy. Their training has enabled them to efficiently perform a variety of tasks and (thus) increase their potential for advancement."

A top TV-radio manufacturer: "I have personally been pleased to note that the men you have sent us show Bell & Howell Schools have consistently kept up with the times in the electronics field."

A major aerospace firm: "It has been our experience that your men have been able to stay abreast of the rapidly changing technical picture in the aerospace industry. They have been able to meet the challenge and consequently maintain an excellent competitive position."

Note: Firm names available on request.

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Electro-Lab-at-home plans offer you many unusual advantages

Bell & Howell offers 4 different Electro-Lab-at-Home Plans—one of which is

completely new. This new Plan covers Computer Control as well as basics. Another has been newly expanded to encompass the entire field of home entertainment servicing—including color TV, radio, record and tape players—the works!

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This is why we are able to present the most modern theory. And that theory is reinforced by the latest, most useful applications. You'll also receive personal guidance from exceptionally well qualified instructors—men with considerable practical experience and the ability to "get-it-across".

Our exclusive Electro-Lab® includes a remarkably instructive, self-contained circuit design console. It enables you to rapidly "breadboard" a great variety of circuits—like those you'll encounter in today's real world of Electronics. You'll also receive 16 big shipments of components—including everything you need to build your own portable, 5-inch wideband oscilloscope and a fully transistorized volt meter. You will have two of the best precision instruments money can buy—professional quality gear you'll want to keep and use throughout your career.

We provide 8 films to help make the more complicated (yet basic) information easier to understand. These films simplify by picturing what happens—a step at a time. We also lend you a projector so you can run each film as often as you want!

Free-for-life — national employment service. Whatever your interest, or experience is, we will help you locate the better-paying positions in Electronics—completely without cost. This service is available to you at *any* time—now or in the future.

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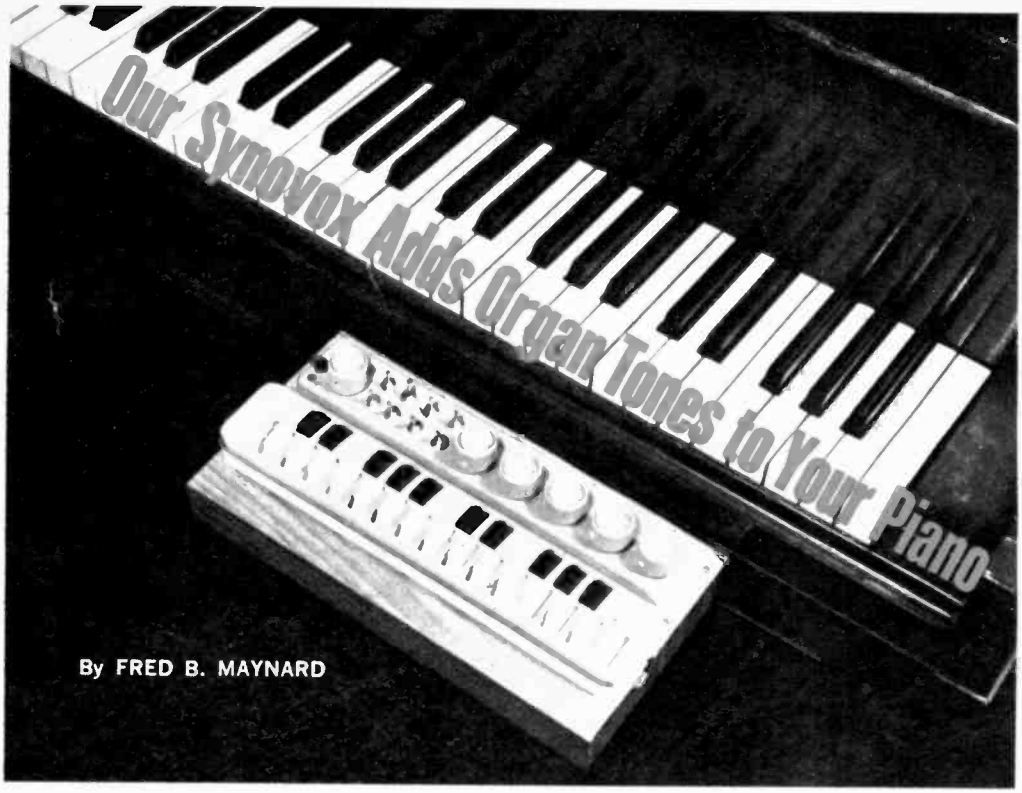


YOU may think you're the hottest pianist since Fats Waller, but your audience may be ready to run to the nearest exit the minute you start playing. The way to keep the crowd from charging out in search of the lost chord is to add the sound of an organ to your piano. The way to do this without tampering with the piano is with the Synovox—a two-octave-keyboard music synthesizer. To understand what this is, think of a flute, violin and trumpet. Each can play middle C, yet they sound different. This difference, called timbre, is due to the addition of harmonics to the fundamental frequency.

The Synovox generates fundamental square-wave tones over a range of two octaves as well as a first sub-harmonic, third, fifth and seventh harmonics (sine-wave tones). These can be mixed in any proportion using five potentiometers. The result is music with hundreds of different tone colors. Vibrato can be switched on for special effects.

It's a monotonic instrument; that is, it plays one note at a time. The circuit includes 10 low-cost integrated circuits and two transistors. Construction is straightforward and the parts cost, including the keyboard, is about $70, using all new components.

The Circuit

Figure 8 is the complete schematic of the Synovox. Integrated circuit IC1 is the tone generator. This is a HEP-556 three-input gate which, along with C5, C6, C7, R9, R10 and 24 tuning resistors (R39-R62), provides a 25-note two-octave chromatic musical scale. The oscillator frequency, when high C is played, is about 15,700 cps. This then is divided by 15 to provide C = 1,046 cps. (Transistor Q1 and the associated R/C network is a 6-cps vibrato generator.) The output of IC1 drives IC7. Integrated circuit IC7 is an octave shift divider that divides the oscillator frequency by two. Both the input and output of IC7 go to *octave switch* S9. The wiper of S9 goes to the inputs of IC2 and IC8. When S2 is in the *high* position, the highest C frequency is 1,046 cps, and the lowest C frequency is 261 cps. When S9 is on the *low* position, the entire instrument range, therefore, shifts down one octave.

The other integrated circuits are harmonic generators. Integrated circuits IC2, IC3 and IC4 are connected with feedback so

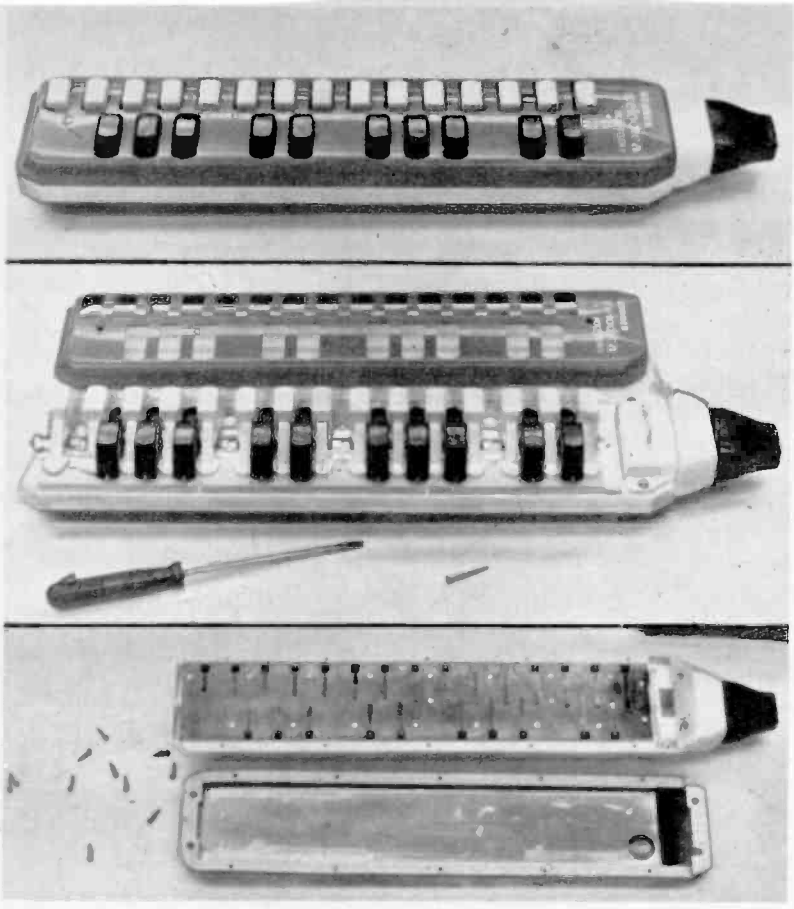


Fig. 1—Photo at top is of Hohner Melodica—a keyboard harmonica. It is modified for use as keyboard for Synovox. Center photo shows metal keyboard cover removed. Bottom photo shows underside with plastic cover removed. Reed plate must also be removed and discarded. Bottom cover is used as control panel for pots and eight switches.

Fig. 2—Keyboard underside. Resistor strip is at top. At bottom are screws which come through keys. Note how wiper wires are attached to screws.

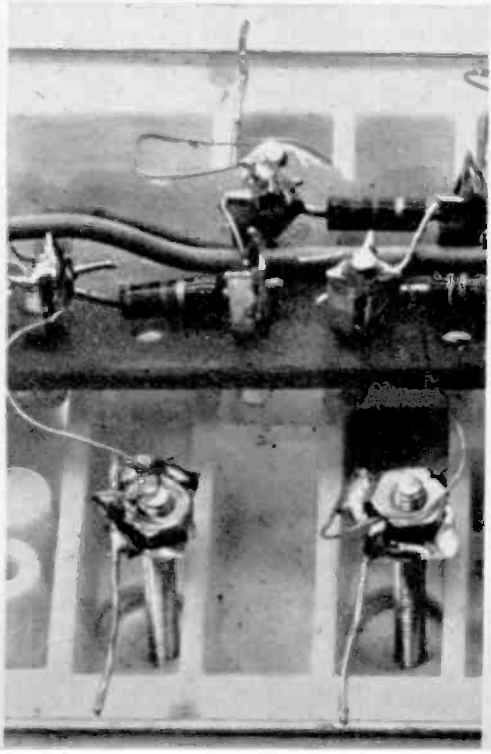
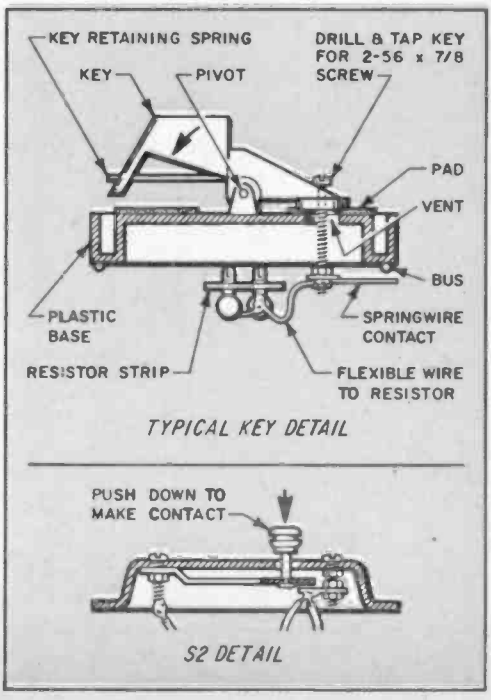
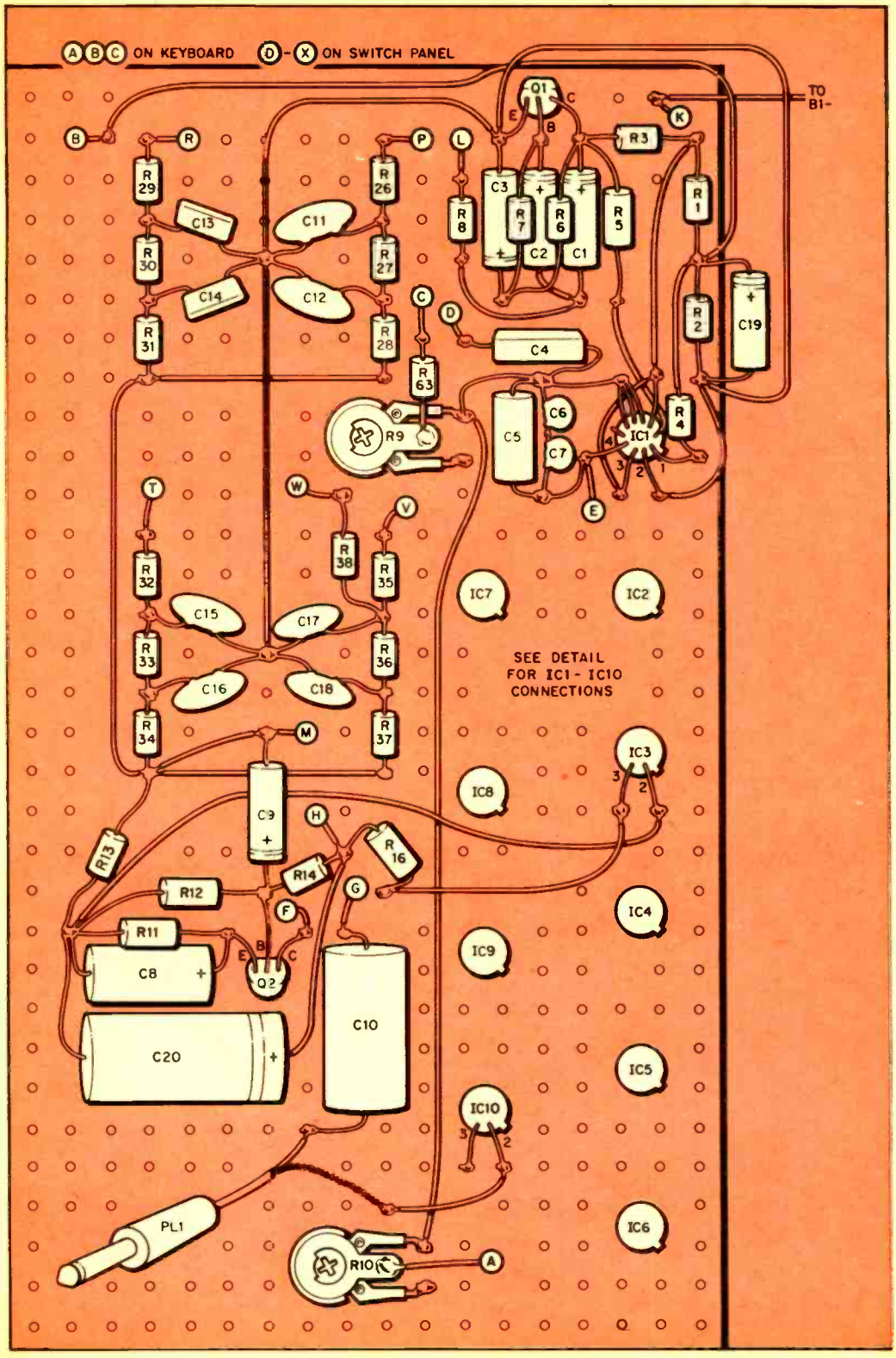


Fig. 3—Top diagram shows detail of key construction. Bottom diagram shows how existing valve in plastic back is modified to make switch S2.




A B C ON KEYBOARD
D - X ON SWITCH PANEL
TO B1-
Q1
R3
R29
R30
R31
R26
R27
R28
R8
R7
R6
R5
R1
R2
R4
R63
R9
C13
C14
C11
C12
C3
C2
C1
C19
C4
C5
C6
C7
IC1
R32
R33
R34
R38
R35
R36
R37
C15
C16
C17
C18
IC7
IC2
SEE DETAIL
FOR IC1 - IC10
CONNECTIONS
IC3
IC8
IC4
IC9
IC5
IC10
IC6
C9
R13
R14
R16
R12
R11
C8
Q2
C10
C20
PL1
R10

they will divide any input frequency by five. This output (one-third the input frequency) is the third harmonic. The output signal also drives IC5 and IC6, which are connected as a divide-by-three counter. This provides a fundamental output, F, and a drive for IC10, which divides by two to produce the fundamental and a sub-harmonic, an octave lower (F/2 output). The same input that drives IC2 also drives IC8. Integrated circuit IC9 is connected with IC8 to provide a second divide-by-three counter. This output provides the fifth harmonic. Integrated circuit IC7, the octave shift divider, also provides a so called seventh harmonic.

These five outputs, F/2, F, 3, 5 and 7, are

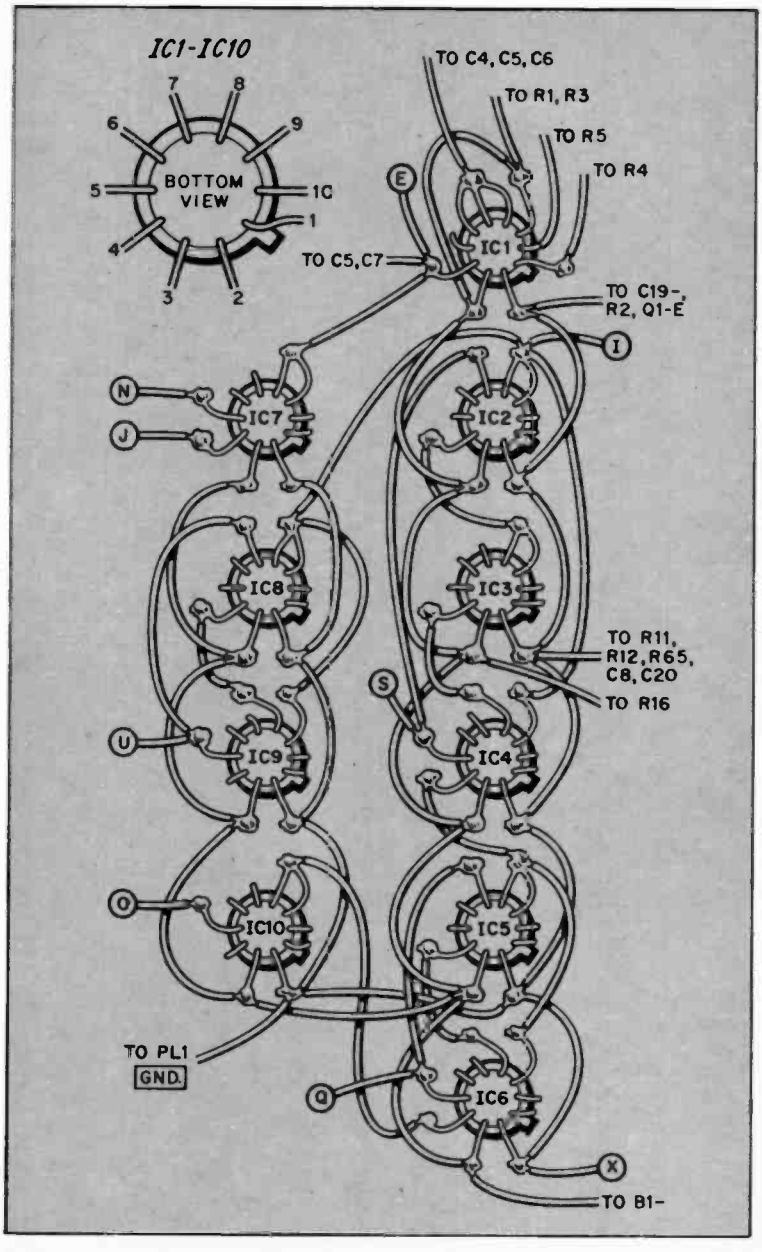


Fig. 4—Pictorial at left shows location of parts and wiring on 5 x 10-in. perforated board. Leads with circled designations A,B,C go to keyboard (Fig. 6, right). Leads with designations D through X go to switches and pots on control panel (Fig. 6, left). PL1 goes to amp.

Fig. 5—Pictorial at right shows numbering of leads of all ICs. Also shown are connections between ICs and other points in circuit. Leads with letter designations go to switches and to pots on control panel.

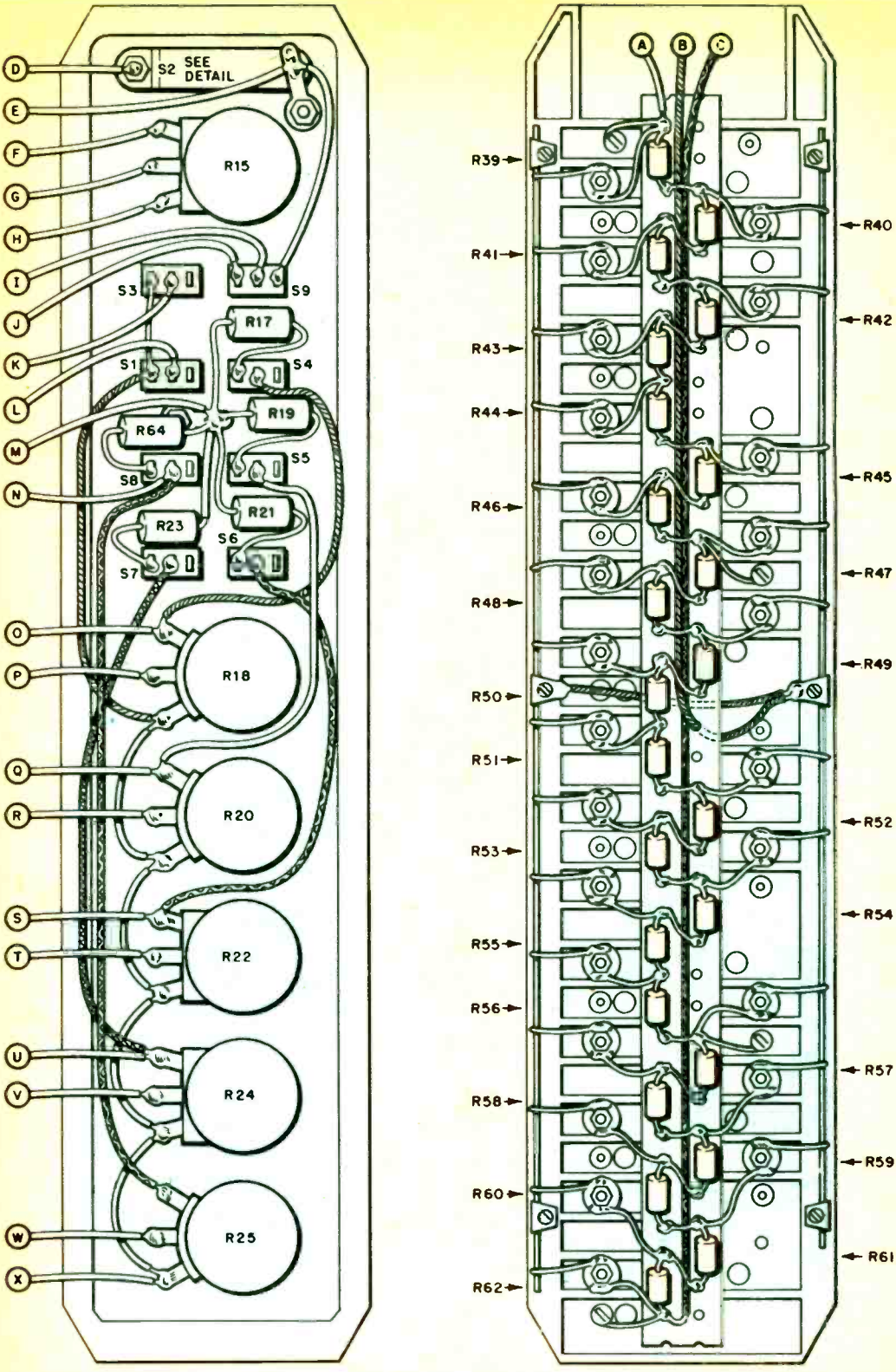


Fig. 6—Left pictorial shows location of parts and wiring on control panel. Panel is plastic back of Melodica. Right diagram shows underside of keyboard. Connect added bus wires at the outside edges.

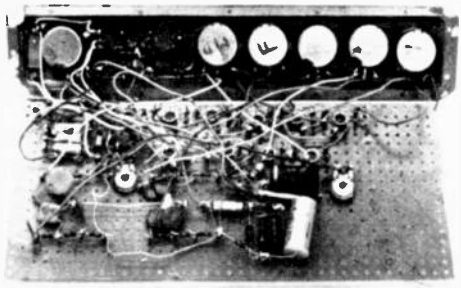


Fig. 7—Circuit board and underside of control panel before installation in 6 x 11½-in. box made of ½-in. thick wood. Keyboard is to be added.

connected to pots R18, R20, R22, R24 and R25. The outputs of these pots go to four low-pass filters (R26, R27, R28, C11, C12, etc.) which convert the square waves from the generators to sine waves.

The output of each filter goes on a common line to preamp Q2, a linear amplifier whose load resistor is *volume* control pot R15. The signal at the wiper is fed via C10 to an external amplifier. The five outputs, F/2, F, 3, 5 and 7 are also routed via switches S4 through S8 and resistors R17, R19, R21, R23, R64 to the input of Q2. When these switches are closed, square waves are added to the output.

Construction

The parts in our model are mounted on a 5 x 10-in. piece of perforated board; push-in terminals are used for tie points. The ten ICs are mounted upside down with the leads looped over to the terminals as shown in Figs. 4 and 5. Pins that are not used should be cut off. Make sure that the leads do not short against other leads or the IC case.

Vibrato, generated by a 6-cps sine-wave oscillator (Q1), is injected to pin 10 of IC1 by R5. You can try higher or lower values of R5 to change the vibrato depth. Switches S1 to S8, and six pots are mounted on a separate control panel.

Quality organ keyboards are quite expensive and home-made keyboards don't usually work well or have the best touch. Our keyboard is perfectly playable and costs less than $15. It is made from a Melodica—a keyboard harmonica which is available at most music stores. We used a 25-key Soprano model which provides a two-octave chromatic range. These keys are different in size from a piano or organ keyboard, but are played in much the same way.

Key switches must be added to each key. These switches consist of a spring-wire wiper that touches a common bus wire when the key is pressed. First remove the plastic bottom panel from the Melodica shown in Fig. 1; it is held with small screws. This exposes the reed plate which you remove by prying and pulling out about 30 small tacks. This exposes the wind chambers and the bottoms of the key pads. Remove the metal top panel (two screws) over the keys to expose the key mechanism. Cut off the mouthpiece with a hacksaw.

The keys have a rocker action. (See Fig. 3.) When a key is pressed down, the rear end, with the valve pads, lifts up. Carefully drill a 1/16-in.-dia. hole through the center of each pad and thread the hole with a 2-56 tap. Screw a 2-56 x 7/8-in-long round-head screw from the top through the back of the air vents until the head is tight against the plastic of the pad.

Prepare two bus wires from straight No. 14 or No. 16 bare solid hookup wire. Mount these along the flat edges on both sides of the bottom of the Melodica sound chamber as shown in Figs. 2 and 6. Do not solder against this plastic because it melts very easily. Instead, make small brackets or clamps which can be fastened to the plastic with screws.

On each 2-56 screw, run on a 2-56 hex nut so it is about ⅛ in. from the end of the screw. Make spring wipers from .005 in. to .010-in. dia. spring-steel wire, as shown in Figs. 2 and 3. Slip these wipers over the screws, and put a second nut on each. Tin the end of each with solder, and solder a piece of fine wire (from stranded hookup wire) about 2-in. long on each.

Next, prepare the tuning-resistor strip as shown in Fig. 2 and 6. This is a ¾ x 10¾-in. strip of perforated board with push-in terminals. Install tuning resistors, R39 through R62. (If you want more perfect tuning, use trimpots instead of resistors.)

The final chore is soldering the fine wires from the wiper on each key to the resistor junctions on the strip. Allow a big enough loop in these wires to enable each key to make full movement without binding. Three insulated hook-up wires connect the keyboard and resistor assembly to the circuit board. We used the bottom panel of the Melodica for the control panel, although, if preferred, plywood or other material may be

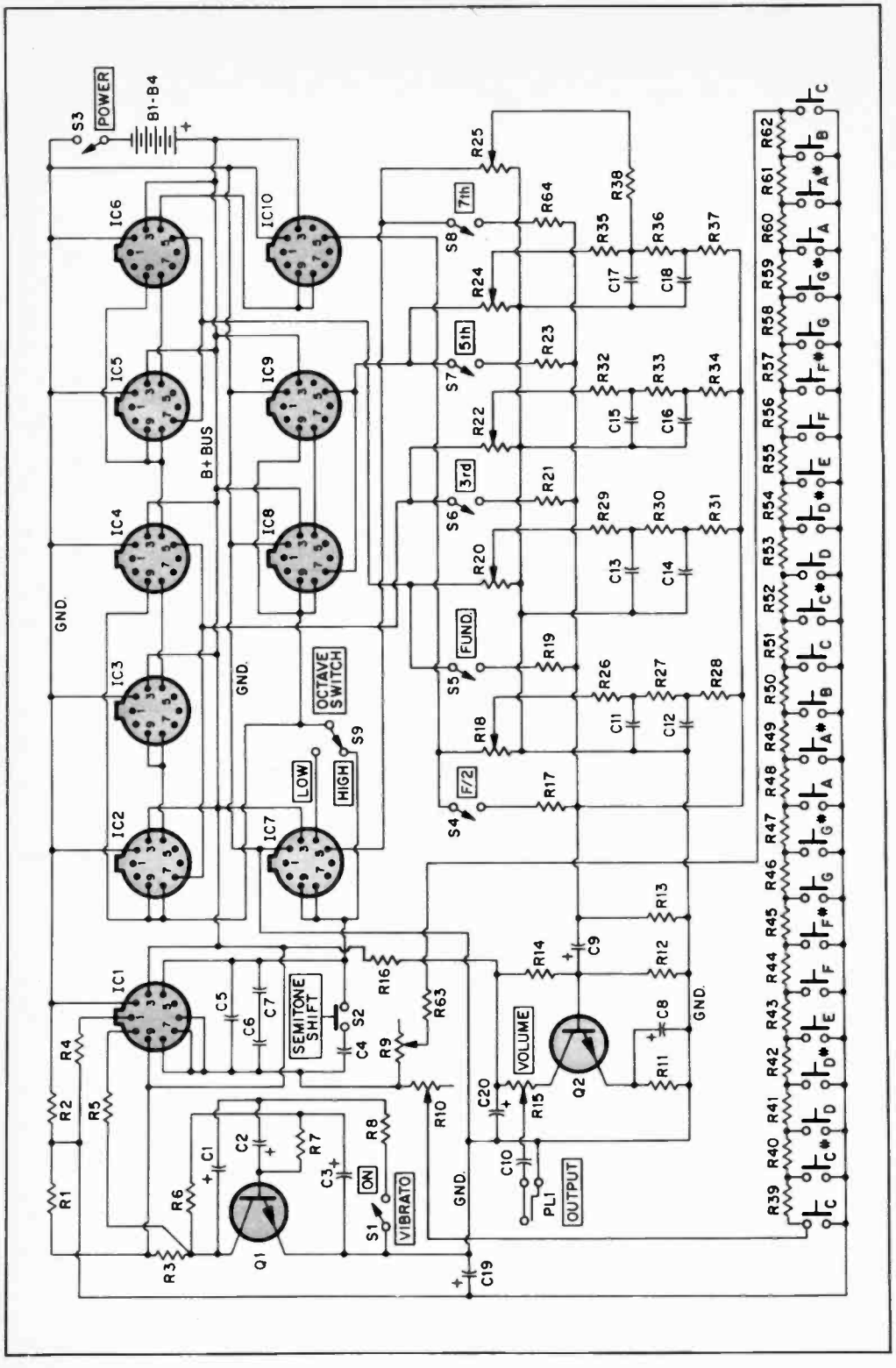


Fig. 8—Schematic. Frequency of oscillator IC1 is controlled by C5,C6,C7,R9,R10 and R39 through R62. IC1's output is divided by other ICs to produce harmonics which are added to output by switches S6, S7, S8. S5 adds fundamental to output and S4 adds a suboctave of the fundamental. Q1 is vibrato oscillator.

Our Synovox Adds Organ Tones to Your Piano

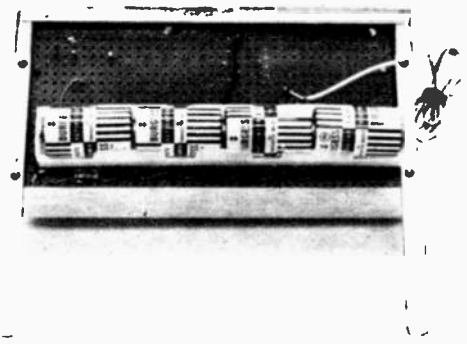


Fig. 9—Completed Synovox. Four D cells go in holder on underside. Metal strips at right and left secure project to piano under the keyboard.

used. Drill the panel for the six pots and the eight switches.

Switch S2 is partly provided in the Melodica. It is an air control button at one end of the plastic bottom panel. Remove the rivet holding the spring strap and substitute a 2-56 screw and nut to hold it. A second screw and a second lug were inserted near the movable end of the spring and adjusted so that the contacts touch when the button is pressed. This produces a half-tone downshift by paralleling C4 with C5, C6 and C7.

The construction is completed by building a suitable cabinet. The circuit board should fit in the bottom as shown in Fig. 9. The keyboard assembly and control panel straddle the top of the box and are held with screws.

If batteries are used for power, four D cells may be mounted in a holder underneath as shown in Fig. 9. The project draws about 180 ma at 6 V, so alkaline-energizer cells should be used to provide longer life. Use a shielded cable about 6-ft. long from C10 to an external amplifier.

Tuning and Playing

The tuning system for this instrument consists of 24 resistors in series, plus pots R9 and R10. The 24 resistors, R39 to R62, must be five per cent values. First adjust R9 and R10 alternately until the three C notes on the keyboard sound like true octaves. This will place the instrument in good tune with itself. If individual notes are off, experiment with different value resistors for R39-R62.

The instrument may not, however, tune to a standard scale. It may be sharp or flat, probably not much more than a half a tone either way. This can be corrected by making C5 larger to flatten the scale or smaller to sharpen it. Note that the half-note shift (S2 and C4) flattens the entire scale a half tone. Capacitor C4 is 510 $\mu\mu$f, more or less. In our model C6 and C7 were shunted across C5 to flatten the scale. If the scale is already flat, try another capacitor for C5, or go to a smaller value and build up with shunt capacitors. –

PARTS LIST

Capacitors: At least 25 V unless otherwise indicated
C1,C2—1 μf, 10-V electrolytic
C3—2 μf, 10-V electrolytic
C4—510 $\mu\mu$f, 5% silvered mica
C5—.01 μf tubular
C6,C7—.0015 μf disc
C8—200 μf, 3-V electrolytic
C9—10 μf, 25-V electrolytic
C10—1 μf, 200-V mylar (not electrolytic)
C11,C12—.1 μf disc
C13,C14—.05 μf disc
C15,C16—.02 μf disc
C17,C18—.01 μf disc
C19—5 μf electrolytic
C20—250 μf electrolytic
IC1—HEP-556 integrated circuit (Motorola)
IC2-IC10—HEP-558 integrated circuit (Motorola)
PL1—Phone or phono plug
Q1,Q2—HEP-50 transistor (Motorola)

Resistors: ½ or ¼ watt, 5% unless otherwise indicated. All values in ohms
R1—470, 10%
R2—1,800, 10%
R3—6,800, 10%
R4,R16—560, 10%
R5,R13—10,000, 10%
R6,R7—47,000, 10%
R8—1,200, 10%
R9—1,000-ohm Trimpot (Mallory MTC13L1)
R10—1 megohm Trimpot (Mallory MTC16L1)
R11—200 R12—20,000
R14—150,000, 10%
R15—5,000 ohm audio-taper pot
R17,R19,R21,R23,R64—220,000, 10%
R18,R20,R25—1,000 ohm audio-taper pot
R22,R24—10,000 ohm audio-taper pot
R26 through R38—15,000, 10%
R39,R41—820 R40—750
R42,R43—680 R44—620
R45—560 R46—470
R47—510 R48,R49,R50—430
R51—330 R52,R54—300
R53,R55,R56—270 R57—200
R58—220 R59,R60—180
R61—160 R62—130
R63—1,500
S1,S3-S8—SPST slide or toggle switch
S2—Normally-open pushbutton switch (on Melodica)
S9—SPDT toggle or slide switch
Misc.—Perforated board, push-in terminals, Hohner Soprano Melodica, 25 keys from middle C (Lafayette 13 F 66327), D cells (B1-B4)

The Big Franchising Deal in Electronics

For ambitious capitalists who would like to combine their interest in electronics with small-business ownership—how about trying a franchise?

By FOREST H. BELT

IN the American tradition, most young men grow up with a respect for capitalism and the power of the dollar. It is part and parcel of this belief that many men yearn to own their own businesses and be their own boss. In this highly industrialized society, private ownership has been shown to be a very risky enterprise. It was not until the rise of the franchise system of marketing that small business could command its place in the nation's economy.

The last few years have seen a rash of franchises, many with TV and movie personalities offering their name as an inducement to purchase quickly cooked food. Franchises are gaining more and more attention, especially with the help of newspaper ads such as the ones simulated above.

At this time there are a variety of franchises available that will allow people with the desire for self-ownership and an interest in electronics the opportunity to try a career as the owner of a franchise electronics business.

There are three major companies that offer diversified electronics franchises. This means a store that will sell equipment and parts for most areas of electronics, not just specific items such as television repair or audio tapes.

These companies are Lafayette Electronic Sales (P. O. Box L, Syosset, N. Y. 11791), Allied Radio Shack (Franchise Division, 2615 W. 7th St., Fort Worth, Texas 76107) and Team Central (720 29th Ave. S. E., Minneapolis, Minn. 55414). You should be familiar with at least two of these names for Lafayette and Allied Radio Shack are giants in the mail-order business.

If you are in a position to examine these three stores, one conclusion you might reach would be, "boy, they sure look alike." The differences are great and it is only the customer's view that makes it seem like there are a great number of similarities.

Figs. 1 and 2—The only difference between a company-owned store and a franchise electronic store is the sign out front. Franchise operations are called associate stores and they are required to display the name of the store owner. There is a reputation at stake, so they are careful how company name is used.

One similarity that all stores share is the house-brand equipment that you will see. Each company that offers one of these diversified franchises also stocks the store with its own brand of equipment. Most of it is made in Japan by quality manufacturers. All three, Lafayette, Allied Radio Shack and Team enjoy a good reputation for equipment so that actual products should not be a great factor in choosing a franchise. It is how each company is offering to help you sell the merchandise that should be the prime determining factor in the selection of an electronic franchise.

These companies that are engaged in franchise operations also operate company-owned stores in the major population centers. The only difference the customer will see between

Figs. 3 and 4—Two of the biggest areas of business for the electronics store are the replacement parts dept. (below) and the audio dept. (at right). Company helps choose the fastest selling merchandise.

Figs. 4 and 5—The franchise store owner keeps his customers by servicing equipment which he sells (left). The parent company guarantees most equipment. For the customer who wants to know more about electronics, most stores maintain bookracks with textbooks and the latest electronics magazines and journals.

The Big Franchising Deal in Electronics

the company store and the franchise store is the sign out front (see Figs. 1 and 2). The franchise store will have *associate store* following the company name, along with the name of the store owner. On the inside the two stores are very similar and it is here that the prospective franchisee should invest his time in analyzing each store.

Basically the company that sells you a franchise is selling three things. First, it has an established name in the field, with a reputable product line to boot. Second, it has experience in running the company stores, which, except for the sign in front, are the same as franchise operations. Third, it offers valuable business advice that the small businessman might not otherwise have at his disposal.

The first thing is the name. Allied Radio Shack and Team Central put a fixed price on the value of their title. This expense is called a franchise fee. That is, for the right to open a store with their name on it you must pay Allied Radio Shack $3,000 and Team Central $5,500. In addition to the name you are buying a program of marketing help. This will include blanket advertising, free mailers, radio spots, press kits and help in the management of your store.

Lafayette does not charge a flat fee, rather, it charges a royalty that each store owner must pay which amounts to one per cent of gross sales. These are the only fixed amounts that you can plan on spending regardless of your geographical location.

After you have paid the fee and signed an agreement with a company you must secure real estate for your store. (This is not necessarily the order in which it will take place, but this order will best show how the costs are derived.) Cost of the store will depend entirely on location, as real estate values differ from place to place. Radio Shack estimates the cost at two-and-one-half to three per cent of fixed costs. Team says that you'll need about $3,000 initially for the store and fixtures. Lafayette believes that costs vary so greatly that it will only give estimates.

The largest cost the franchise store owner will have to incur is the establishment of inventory. Rather than taking one of everything, each of these companies has developed a computer inventory system that will select the fastest selling and most desirable merchandise for the new store.

[*Continued on page* 97]

The Ham Shack

By Wayne Green
W2NSD/1

BEHOLD the dedicated DX chaser. Estranged and distant from his family . . . friendless . . . and of little value to his employer.

Serious DX chasing requires several personality traits for success. First of all there is the need to sacrifice anything and everything in order to have the finest rig, the highest tower and the biggest beam possible.

Next it it necessary to spend thousands of hours to rack up impressive country totals. This means last minute cancellations of dinner engagements because of a DXpedition or a forgotten contest. It means weekends of solemnity and nights with only a view of the back of the DXers neck for his wife and family when they want to go out to a movie, to visit friends, or just watch television.

A new country during the day means a day lost at work—never mind what deadlines the boss is trying to meet.

Well, you say, the family, employer and ex-friends may suffer, but at least this chap is speaking out for America into the remote parts of the world, carrying the message that democracy is great.

In a pig's eye. This guy has irritated operators in over 300 countries in his single-minded drive to get new countries no matter what or who is in his way. He has never even talked with 99 per cent of the DX operators on the air, preferring to spend his time listening for newcomers. If anyone has the gall to call him after he has finished with a rare contact, he ignores them and tunes on down the band.

His God is the list published in QST and the driving force is his well warranted feeling of inferiority. He compensates by making the Honor Roll in QST. Whenever he makes a contact with a new country he feels that he has proven that he is not inferior. The rarer the contact, the smugger the DXer.

What makes a country rare? Simple. The fewer fellows that are able to contact a country, the rarer it is. One active station in a country can take it out of the rare category.

The best thing that can happen to a DX chaser is to happen onto a new country that few have ever contacted, making him one of the first to get it. The next best thing that can happen to our friend is to have that new station close and not make any more contacts.

The DX chaser is psychologically unable to pass up a pileup, even if it is on something common. He has to continually prove that he is superior to everyone else and he does this by climbing aboard the pileups and getting through. He has no intention of ever sending a QSL card for the contact. He just wants to prove to all those other poor slobs that he can get through right on top of them.

Newcomers to amateur radio can easily recognize pileups for they sound exactly like the normal CB channel.

What Went Wrong With CB? The hams didn't really begrudge the loss of 11 meters to the CB'ers at the time. They expected that this band would act as a training ground for entry into ham radio. It didn't work out that way. The ham ranks continued to grow until the announcement of incentive licensing and the tax on ham licenses, at which time amateur growth was stopped in its tracks.

What happened to the dream of CB-inspired hams? Pollution, you might call it, seems to have been the trouble. CB soon swelled its ranks to hundreds of thousands, all fighting to work each other on 23 little channels. Then, as skip appeared in the late 60's, the choice became either to drop out entirely or else go the big beam, linear and unlicensed skip-call route. The honest element dropped out, frustrated and disgusted.

The most logical place to cultivate an interest in amateur radio is in high schools. An amateur-radio club can be afforded by any school. The interest of a local amateur or radio club is necessary to get a high school radio club started.

How about calling up the principal of your local high school and see if he will cooperate with you in announcing some talks on amateur radio? If you offer your time as an advisor you might get a club started. A talk or two about amateur radio coupled with visits to some of the more impressive local ham shacks might just sink the hook and result not only in an active club, but more young people going into electronics and communications in a few years.

EI Kit Report

A Slightly Stupendous Speaker System

ACOUSTRON LWE IV

WHEN the acoustic-suspension bookshelf speaker system made the scene some 15 years ago, it marked the beginning of a revolution whose message was big bass from a small box. The era of large enclosures at first looked like it was over. Not by a long shot. It's still the large system that delivers really top-drawer sound. Nothing can come close to the sound produced by an array of large speakers in a massive enclosure.

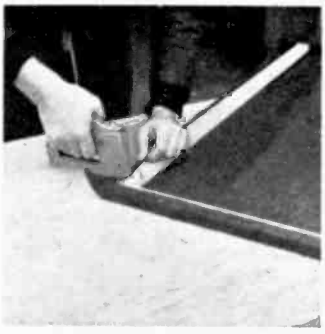
In the Acoustron LWE IV speaker system, the idea of producing big sound from large speakers is carried even a step further. The system provides frequency- and level-sensitive feedback to the amplifier to improve speaker performance.

The IV is 51½-in. high, 36¼-in. wide, 20-in. deep and weighs 250 lbs. Behind the grille cloth is an array of speakers consisting of four 15-in. woofers, four 8-in. lower mid-range, four 6-in. upper mid-range and two 5-in. exponential-horn tweeters. Crossover frequencies are 150, 1,000 and 4,000 cps, respectively. The IV's nominal impedance is 4 ohms and it is capable of handling 200 watts of program material.

The speaker is described by Acoustron (2418 Bartlett St., Houston, Texas 77006) as having *electronic suspension*. Curious to know what this was, we obtained a copy of patent No. 3,449, 513 issued to the inventor, Louis W. Erath (that's where LWE comes from). According to the patent, the system (which includes an external amplifier) is designed to accomplish the following: 1) Compensate

Unpacking the "instant" kits. Two massive crates weighed 600 lbs.

Making grille-cloth frames. Our listening room is at the left.



Grille cloth, open-weave burlap, is being stapled to wood frames.

Gluing wood tape to the edges. Mid-range, tweeters are in center.

Applying stain finish to cabinet. We applied wax after stain dried.

Because speakers are recessed, grille-cloth frame mounts flush.

Away we go on dolly up ramp and into listening room for testing.

Woofer, lower- and upper-mid-range, tweeter, room-gain controls.

for hearing-response variations at different frequencies and sound levels (Fletcher-Munson Curves). 2) Provide constant sound output. 3) Compensate for the non-linear characteristics of a speaker. 4) Provide voice-coil overload protection. 5) Emphasize low-frequency sound at low loudness levels but not at high loudness levels. 6) Provide electrical feedback to an external amplifier to increase its gain at low loudness levels but not at high loudness levels.

Inside the air-tight cabinet is a feedback network which is the electrical equivalent of an ideal speaker. The network has two parts. The frequency-sensitive part provides feedback to the amplifier to boost its low-frequency response low volume levels. This feedback is also affected by speaker response and to the radiation of sound in a room. This is a function of the acoustics of the room (corrected for by the room-gain control on the back of the cabinet). The level-sensitive part of the network cancels the effect of the frequency-sensitive network at high volume levels and protects the speakers from damage.

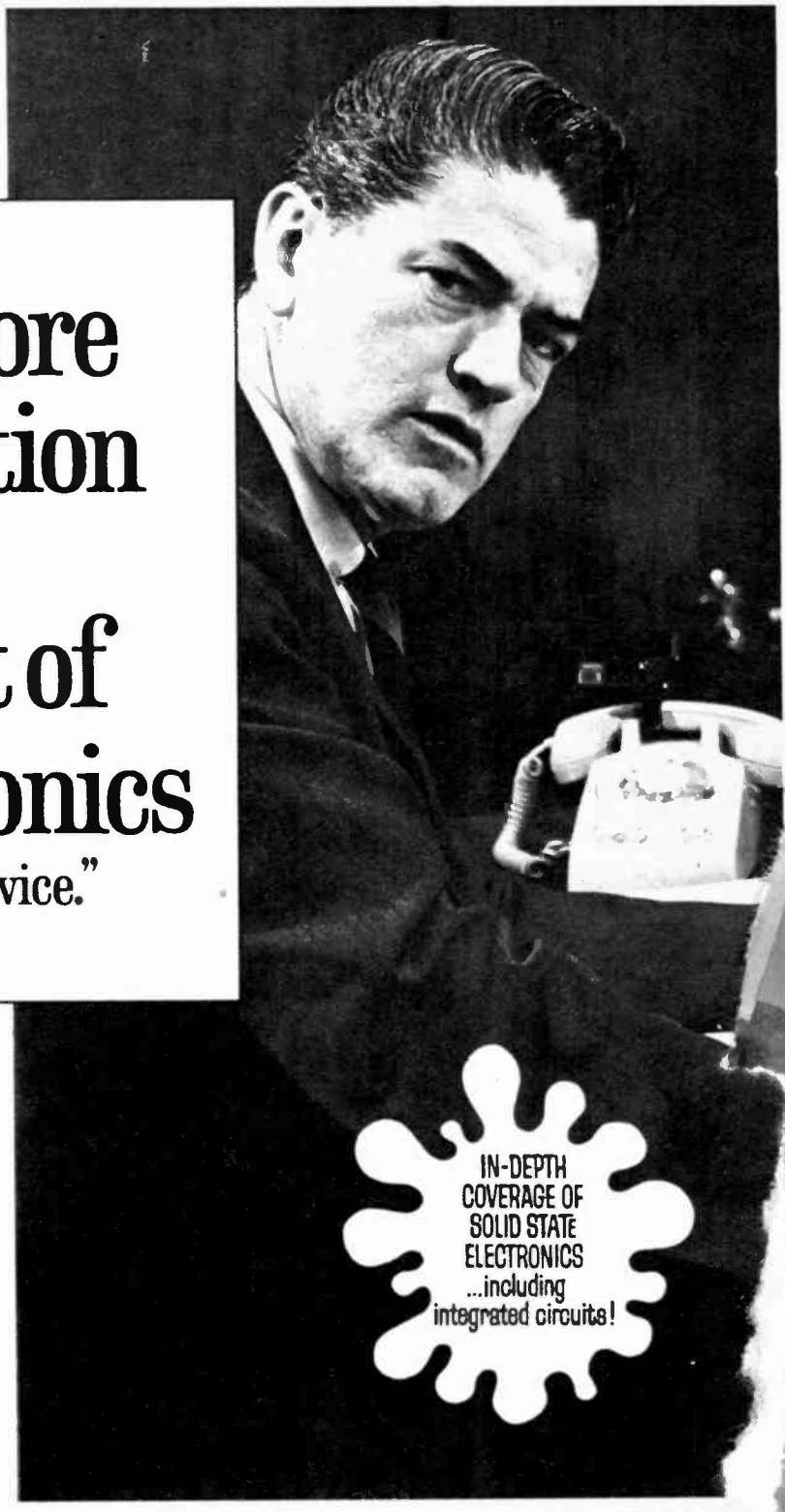
The network is connected in such a way that it provides a feedback signal from all the speakers. This requires a modification to your amplifier. You get instructions, a special cable and a connector with the speaker to make the modification.

Our instrument measurements indicated the feedback is predominantly above 300 cps. It produced additional output from the amplifier below 300 cps, increasing to about 6db at 150 cps and maintaining the boost down to 20 cps. Essentially, everything below 150 cps gets a 6db boost. Why the boost? According to the patent, to compensate for the ear's insensitivity to low-frequency sound at low volume levels.

The level-sensitive feedback removes the equalization at high-volume levels. The circuit that does this consists of a lamp and a LDR (light-dependent resistor). High power levels cause the lamp to light which in turn reduces the LDR's resistance, thereby attenuating the 6db bass boost.

On paper this all looks great, but what does the IV sound like? The IV is so efficient that a half-watt drive signal produced a sound level that almost rattled windows. A 10-watt drive signal produced pain. We could notice no reduction of the bass boost when the sound level was increased from ½ watt to 10 watts. Since the speaker system is rated to handle up to 200 watts of program material, the lamp circuit might have some effect on reducing the bass boost. But we couldn't even stand near the speaker when it was driven with 10 watts, so we were unable to test the performance of the lamp circuit (level-sensitive feedback) at high-power levels.

Because of feedback we assumed the distortion is very low. In fact, the sound from the IV is so outstanding there isn't much room for improvement. When the feedback was connected so it could be switched on and off while maintaining the same sound output, a listening panel unanimously felt that the feedback produced a richer, smoother, less boomy [*Continued on page* 96]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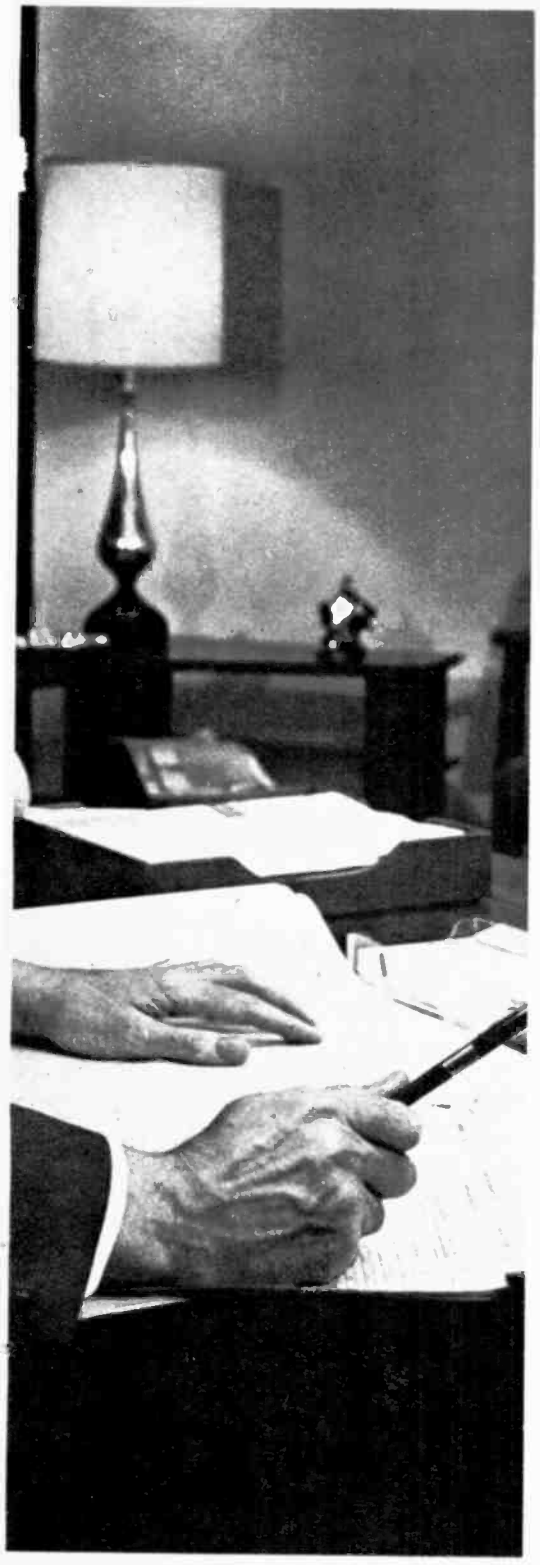

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How to Give Stereo Headphones a Space Dimension

By HARRY KOLBE

ALTHOUGH the development of amplifiers, speakers, cartridges, tuners and tape recorders has reached a high level of sophistication, such things as room acoustics, speaker placement, listener location and ambient noise still disturb serious stereophiles.

Headphones, it seems, would solve these problems. They do provide a special kind of listening pleasure unlike that produced by speakers. For one thing, phones immerse you in sound. And not only is the fidelity of phones better than that of many speakers, it is private, too. Besides, you can listen to music as loud as you want without bothering others.

You might conclude that headphone listening is ideal. Not so. Anyone who has used phones for long periods of time will tell you that although all of the aforementioned benefits are real, the sound isn't. The stereo effect is exaggerated—in fact it is downright unnatural. All the sound seems to come from closeup left and right. Little sound comes from the front where it should come from. The sound does not resemble the acoustic experience you get in a room or a concert hall. Interesting and exciting, yes. But it is not what artists, composers and directors had in mind.

Space-Dimension Theory

The peculiar stereo effect produced by phones is caused by distorted space dimensions. Our space corrector eliminates this distortion and restores the true sound. To understand what it does let us first examine the reasons for the unnatural sound of simple headphone stereo.

The curves in Fig. 1 (bottom) show the differences in level between signals reaching the left and right ears from a sound source positioned 45° to the left. The sound intensity is the same for both ears at 200 cps. At 3,000 cps the level is up by 5db for the left ear and down 10db for the right ear. If your hearing is equal in both ears, the same set of curves will be obtained for a speaker placed 45° to the right.

This shows that different factors are responsible for the stereo effect at high and low frequencies. At frequencies below 2,000 cps the principal factor for producing stereo is the time delay between the left and right ears. Above 2,000 cps the stereo effect is created mainly by the relative intensities perceived at the left and right ears.

For a listener wearing stereo phones, the left-channel sound goes only to the left ear and right-channel sound goes only to the right ear. As a result, all sound appears to come from the left and right. You feel as though there's a wall in the center of your head and that some of the musicians are sitting on one side of the wall, others on the other. You feel like you're sitting in the middle of the band.

Normal stereo listening with speakers is shown in Fig. 2. Here, the sound from the left speaker goes to the left ear and also to the right ear. It arrives at the right ear a little later, having gone around your head. The opposite occurs to the sound from the right speaker.

To correct the distortion created by phones it is necessary to restore the low-frequency time-delayed sound from the left channel to the right ear and right to left. In other words the sound from a source at right delivered to the left phone must be delayed by the amount of time it takes to travel the distance from the right side to the left ear. The sound for a left source fed to the right phone is delayed the same time. An additional requirement is that the delayed crossfed sound must diminish progressively in intensity as the frequency goes up to approximate the curves in Fig. 1.

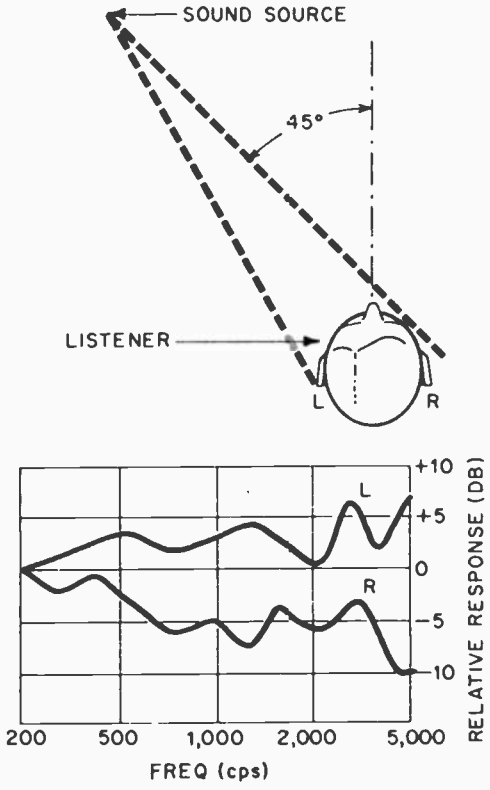

Fig. 1—Top sketch shows why sound from left source reaches right ear after left ear. Reverse is true for sound from right. Curves show relative sound intensity at each ear vs. frequency.

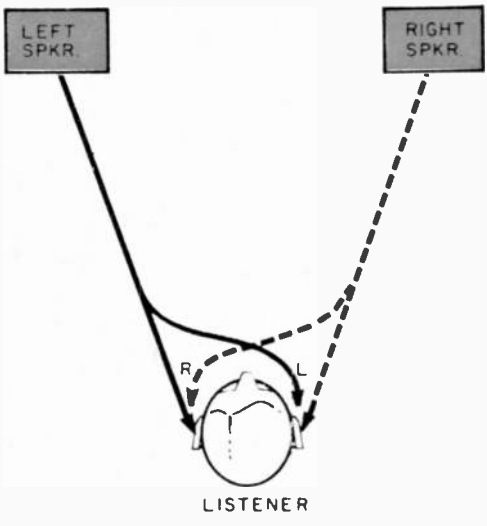

Fig. 2—Sound from left speaker takes a bit longer to reach ear and vice versa. This is natural with speakers but is not possible with phones.

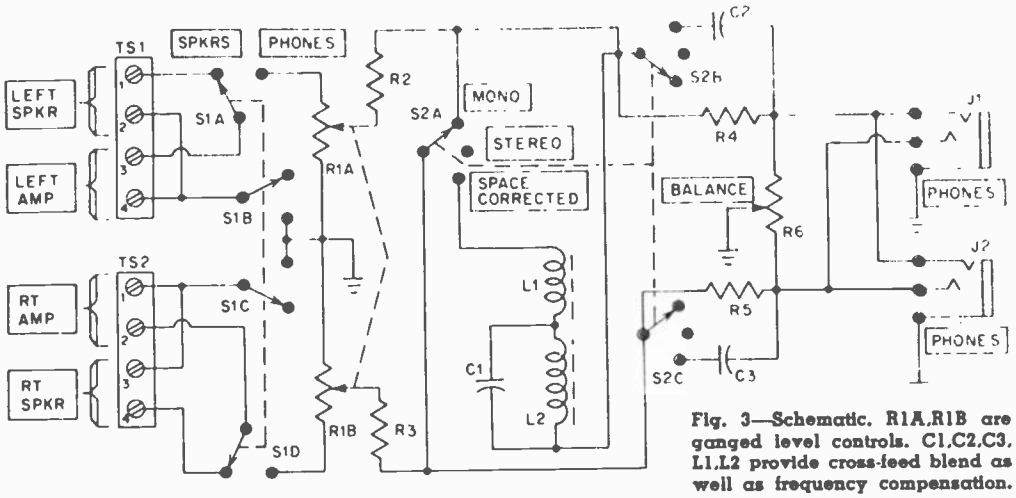

Fig. 3—Schematic. R1A,R1B are ganged level controls. C1,C2,C3, L1,L2 provide cross-feed blend as well as frequency compensation.

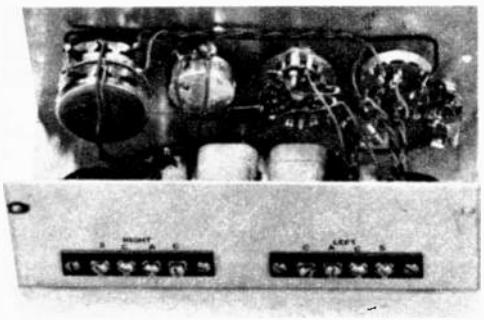

Fig. 4—Rear view. Controls on front panel are (left to right) level, balance, mode and speaker/phone switch. Make connections to rear strips.

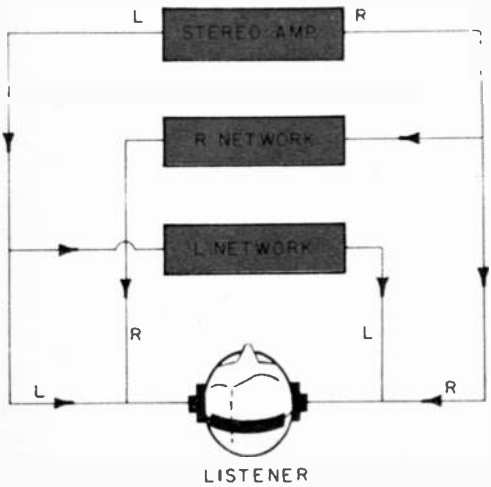

Fig. 5—Circuit takes L and R outputs of stereo amplifier, feeds them to L and R phones directly and then modifies them before cross feeding.

PARTS LIST

C1—1 μf, 100 V mylar capacitor (not electrolytic)
C2,C3—2 μf, 100 V mylar capacitor (not electrolytic)
J1,J2—Stereo phone jack
L1,L2—10 mh toroid inductor, 1.3 ohms (Triad EC-010A. Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. $6.20 plus postage. Stock No. 4F036)
R1A,R1B—Dual 100-ohm linear-taper pot (Allen Bradley JD1N200P-101UA. Newark 10F586. $5.85 plus postage)
R2,R3—120 ohm, 2 watt, 10% resistor
R4,R5—47 ohm, 2 watt, 10% resistor
R6—25 ohm, 5 watt wirewound pot
S1—Four pole, two-position rotary switch (Mallory 3142J. Lafayette 30 F 40078 or equiv.)
S2—Three pole, three-position rotary switch (Centralab PA-1007. Allied 56 A 5068 or equiv.)
TS1,TS2—Four lug screw-type terminal strip
Misc.—3 x 8 x 6-in. cowl-type Minibox

How to Give Stereo Headphones a Space Dimension

Stereo phone listening with the dimension correction is shown in Fig. 5. Our project's circuit is based on an LCR network designed by B. B. Bauer of CBS Laboratories.

It contains complete control facilities for phone listening. Two jacks (J1, J2) permit the simultaneous use of one or two 4- or 8-ohm dynamic headphones; low-impedance phones must be used for proper operation. A switch (S1) is provided to change from phone to speaker listening. Mode switch S2 allows you to select mono, stereo and space-dimensioned stereo.

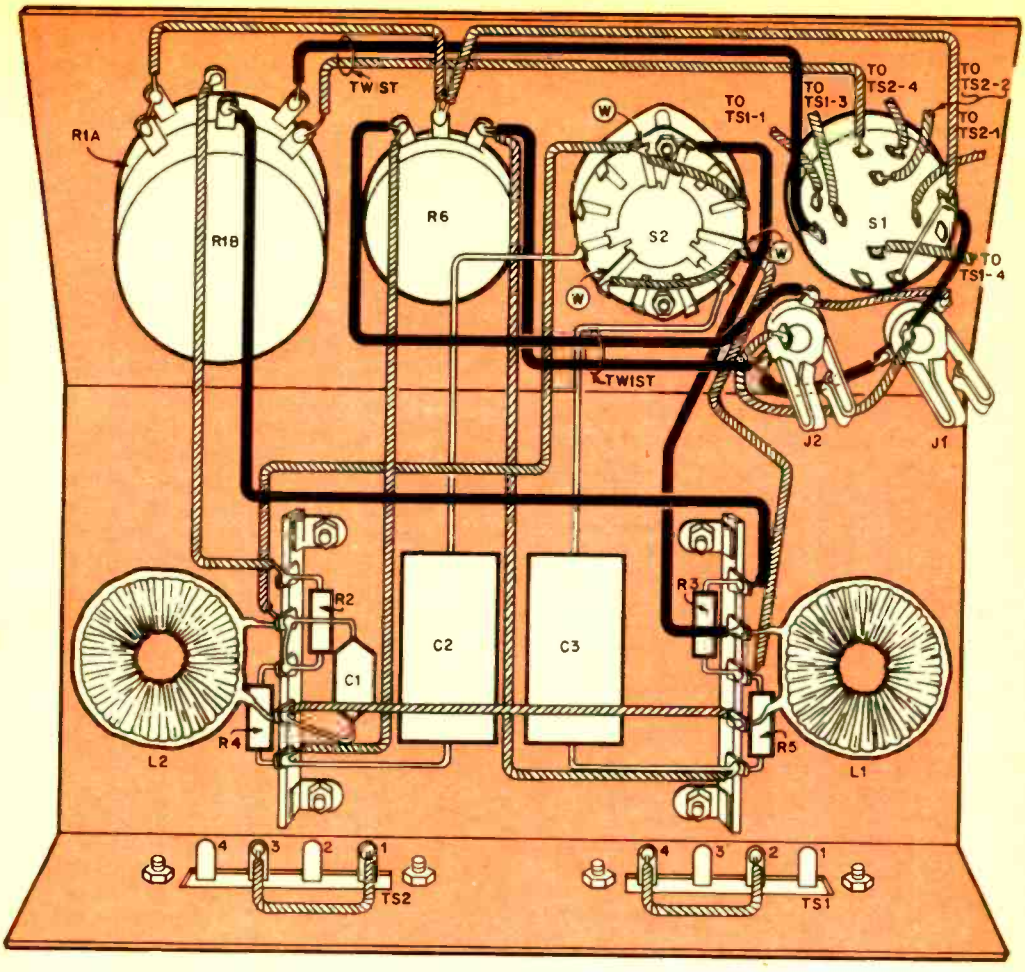

Fig. 6—Pictorial. Letter W on S2 indicates wiper lug. For clarity, leads are not shown going from S1 to TS1,TS2. However, destinations of leads are shown at S1. Twist leads in two groups.

How to Give Stereo Headphones a Space Dimension

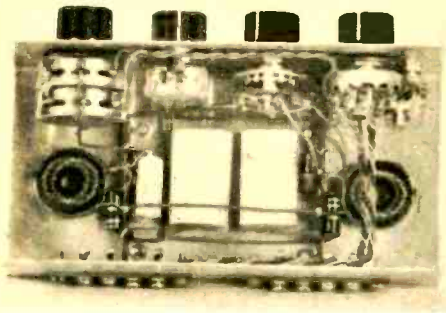

Fig. 7—Top view. Our toroids are open design; those specified in Parts List are encased. Cement them with epoxy to bottom of the cabinet.

Construction

Construction of the control center is simple and straightforward. The layout is not critical. The unit will fit very nicely in a 3 x 8 x 6-in. cowl-type Minibox. The two toroid inductors, L1 and L2, that we used are cemented to the chassis. The inductors specified in the Parts List look different but are electrically the same. They, too, can be cemented with epoxy to the cabinet. The leads going from the parts on the front panel to the rear-panel terminal strips should be twisted as shown in the photo in Fig. 7. We do not show the wires going to the terminal strips in the pictorial in Fig. 6 for purposes of clarity.

To hear the big difference, put on a stereo record and switch S2 from *stereo* to *space corrected*. In the *stereo* position you'll feel you're in the midst of the band. In the *space-corrected* position you'll feel you're in front of the band and listening to a wall of sound.

Stupendous Speaker System

Continued from page 87

bass. The most apparent effect was the 6db bass boost.

The IV has tweeter, upper- and lower-mid-range level controls that provide four 3db steps of attenuation, and a six-position room-gain control. Room gain, according to Acoustron, is a phenomenon that builds up sound near the resonant frequency of the room and affects a speaker's radiation resistance. The frequency is around 100 cps, in average rooms, and depends on the volume and shape of the room. The room-gain control changes the feedback to compensate for this. The lowest setting of the control is for a room volume of 1,000 cu. ft. The highest setting is for a room volume of 10,000 cu. ft.

In our 17 x 14 x 8-ft. (1904 cu. ft.) listening room we found that between the extreme positions of the control there was a 6db change in feedback at 60 cps that tapered off as we went down to 30 cps and up to 150 cps. Our listening panel could hear a slight difference even though the change could be measured.

The IV is supplied as an *instant* kit for $725. This means that the cabinet is unfinished and there is no grille cloth. (It is also available with an oiled-walnut finish and grille cloth for $950.) The cabinet is filled with acoustic material. The eight mid-range speakers are in a separate compartment.

The end product is a speaker system with smooth overall response, good definition and massive overwhelming sound. The bass goes so deep that after the test frequency gets so low it cannot be heard, you feel the floor and walls vibrating. The low end is clean, tight and something you have never heard and never will hear from a compact speaker system. Recordings deliver sound you never knew existed. The effect is a solid wall of sound, so immediate in its presence that you feel you are seated among the performers.

The sound is live, brilliant and . . . well, stupendous is the best adjective. After hearing the IV, we doubt that you will ever again be able to enjoy a small speaker system.

(Acoustron makes other systems starting with the Model VI, a 19 x 10 x 9-in. bookshelf model, to one that dwarfs the IV. It is the 27-speaker Model VIII which is 90 x 49½ x 23 in.)

Franchising Deal in Electronics

Continued from page 84

Even with these cost reducing plans, all three companies agree that at least $20,000 in initial inventory is required before the store can operate successfully. In addition to the real estate and inventory, the new store owner must prepare himself for initial business fluctuations and for establishment of customers. This cushion of capital is often referred to as working capital, but call it as you may, at least $5,000 of the stuff is required before a business can open practically. When you add up all the costs from beginning to end, including fixtures and grand-opening advertisements, the cost will run from $30,000 to $37,500.

What can you expect to make from this kind of an investment? None of the companies queried made any kind of guarantee. Besides quoting U.S. government figures on the success that franchises enjoy, they listed what they considered to be typical figures of existing franchise operations.

Team Central offers the case of one store owner who had sales of $144,754 the first year with a net profit of $10,049; and sales of $404,202 for a net profit of $37,012 in the fifth year of business. Radio Shack notes a store with $182,332 in sales that yielded a net profit of 16.8 per cent or $30,654. It is obvious from these figures that a person who is a creative and diligent worker and a good salesman can produce exciting returns on the investment that he has made.

If you feel the profits of capitalism rushing through your veins, the best thing you can do is take a cold shower. An investment of this size and scope requires cool and unbiased evaluation. First, write to each company mentioned above and see if there are frenchises available in your area. Now consider the facts. Go to your attorney. Each of the companies offers many little benefits too numerous to mention here, but they all add up. Things like insurance and guarantee of leases; help in inventory evaluation and site selection—all of these combine to form the business that you are ready to lay down a small fortune for.

Contact the Small Business Administration at the field office nearest you. They will be able to provide you with a ream of information that will help you to evaluate all the

[*Continued on page* 98]

Franchising Deal in Electronics

Continued from page 97

franchise opportunities so that you might decide which, if any, of the companies offer an agreement that is suited to your financial position and personal requirements.

The Small Business Administration is a good source for some of the capital required to run a franchise electronic business. The field office will be able to provide all the necessary information for a Small Business loan. Economic conditions have tightened the grip on cash for investments, but your hometown bank would be a good place to go for information on business loans. Borrowing from friends and relatives is not recommended by business professionals.

Finally, the decision is yours. If you have a suitable bankroll and yearn for financial independence in the field of electronics, a franchise store might be just what the doctor ordered. The initial investment is high, but the prospects for success are equally as high. With a cool mind for business you can turn your American dream into a reality but consider the pros and cons to prevent any chance of a nightmare.

What Arecibo Has Told Us

Continued from page 44

serving time is devoted to the study of pulsars, which were discovered only three years ago by the British. Pulsars were thought at first to be possibly related to some kind of an artificial object out there. But there was no way for observers to attribute this effect to signals from intelligent beings. Pulsars turned out to be strictly a natural phenomenon. They're believed to be caused by the natural rotation of a star remnant called a neutron star whose dia. is about 6 to 10 mi. It has the mass of the sun, and because it has such a small dia., it is extremely dense. It's a degenerate conglomeration of protons and neutrons all jammed together with no electrons in orbit—pure nuclear matter. Because it's so small and dense, if it had an angular momentum anything like our sun has, it would have to be rotating much more rapidly. And that rotation is what gives rise to the periodicity in the signals we receive. Somehow there's a region on the surface which is active like a sunspot, and is giving off energy. It's like a lighthouse which sends out a beam of light.

Change a Color Picture Tube

Continued from page 40

dicular to the neck.

Proceed to the convergence yoke (Fig. 5) taking care to position the DC convergence magnets correctly. The magnets should be equidistant from the center. Now take the assembled convergence yoke and slip it on the neck parallel to the deflection yoke in the spot as on the old tube (Fig. 6).

The last step and the next couple may not be in this exact order with some sets (e.g., one particular Zenith model already would have the purity rings on at this point) but this was the order for this particular set.

Take the purity ring and slide it on so it is flat against the convergence yoke (Fig. 7). Now install the blue lateral magnet (Fig. 8). Be careful to position this directly over the blue gun, which is at the 12 o'clock position. Place the socket on the CRT as in Fig. 9.

You now must make convergence adjustments. In sets other than kits, you'll need a dot generator to make them. Static convergence is made by adjusting the static-convergence magnets and the blue lateral magnet (Fig. 10). A focus adjustment will have to be made as shown in Fig. 11. Remove the dynamic-convergence board and place it at the top of the set, as shown in Fig. 12 to make dynamic-convergence adjustments. For detailed information on convergence refer to THE ABC's OF COLOR TV SERVICING in the Nov. '69 and Jan. '70 issues of EI.

Coming! . . . The Video Gramophone

Continued from page 69

sumer version of EVR, these specs are open to change.) Motorola is now under license to manufacture EVR players for schools and industry at $795, but this could drop to about $400 for a home equivalent.

What about recording on EVR? It's not practical in the home, and the company frankly states it's not interested in it. The medium is for entertainment and training, says CBS, and it expects to offer programs of more sophistication than feature films.

SelectaVision. This is RCA's entry in the race and easily the most novel in concept. The company deserves special mention for technical derring-do since SelectaVision operates with lasers and holograms. Instead

(*Continued on page* 103)

EI's 1970 Index

C—Construction Project
F—Feature Article
TP—Theory & Practice
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El's 1970 Index

SPECIAL CONSTRUCTION PROJECTS

SPECIAL FEATURE ARTICLES

THEORY & PRACTICE

Coming! . . . The Video Gramophone

Continued from page 99

of magnetic tape or film, an image is physically formed on a strip of inexpensive plastic, the kind used for wrapping hamburger in a supermarket. The plastic costs pennies and prerecorded tape is expected to run less than $10 for a half hour. Further, the material can be easily duplicated with a high-speed embossing technique similar to that used for phono discs.

The technical secret is a mini-laser within the player unit. Rather than optical images, the tape contains coded picture information in the form of light interference patterns (holograms) which appear as hills and valleys in the material. When the laser plays on the patterns during playback, the beam reconstructs the original scene.

Despite RCA's ingenious effort at a first laser for the home, a practical player has yet to emerge. The company demonstrated video images with only a hint of tint and no sound track has yet been recorded by hologram. A player at about $400 is slated for 1972, but this could prove premature without considerable refinement.

Each of these video playback systems is so different that you may still feel unsure. If that's the way you feel, imagine what the manufacturers must be going through. It is easy to see that at least some of the system's designers will have to smoke a peace pipe. It is likely to happen with the makers of the magnetic tape players. If they can agree on the size and shape of the cartridge, consumers will be a little more at ease when it comes to buying the player.

The Pocketbook. A consumer survey has been conducted as to the acceptable price of these video players. The results showed that there would be a market for a million a year at less than $300, but almost none would be sold for more than $500. Prerecorded programs would have to be priced at under $10 to win acceptance, the survey reports. There is a tape-of-the-week plan in the works that could be a practical way to distribute programs.

The video gramophone is descending on the American public like a hawk after a juicy rabbit, and it remains to be seen who survives. Chances are there will be a lot of snarls on the faces of those claiming the invention of the future.

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