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NOVEMBER
1959

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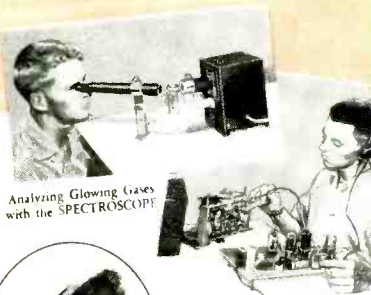
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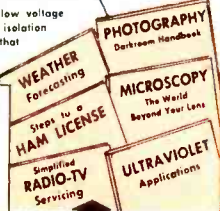
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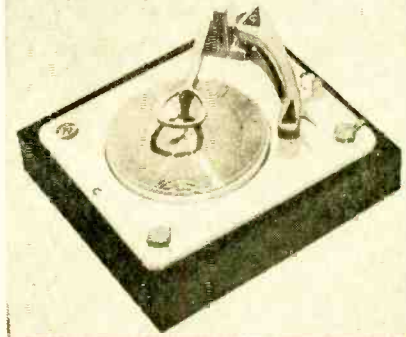
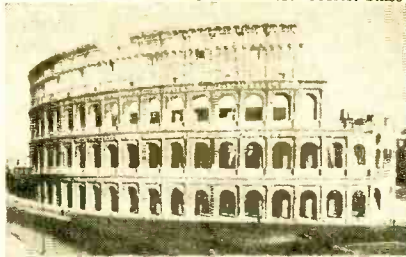
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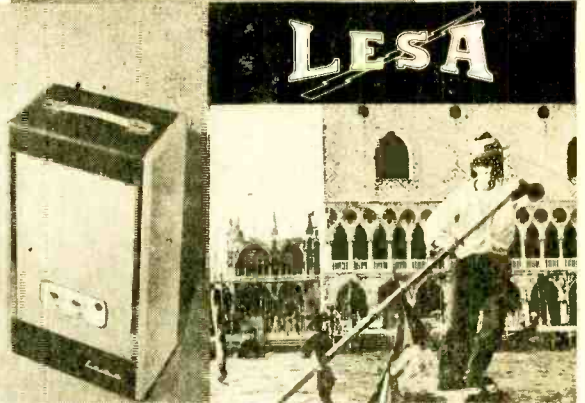
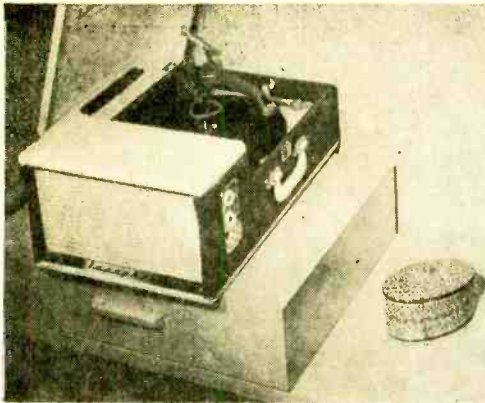
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POPULAR ELECTRONICS

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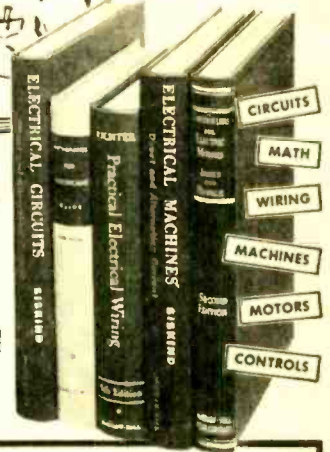
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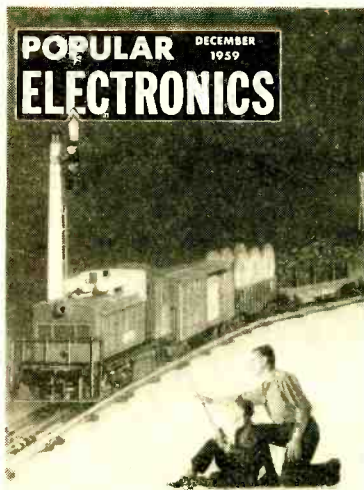
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This month's cover photo by Bruce Pendleton
Equipment shown: National NC-303 receiver,
Barker & Williamson 5100-B transmitter,
and Cornell-Dubilier "Ham-M" beam rotator,
supplied by Harrison Radio Corporation

COMING NEXT MONTH



(ON SALE NOVEMBER 24)

Electric trains have become almost as much a symbol of the Yule season as Santa Claus and the Christmas tree; in the December issue, POPULAR ELECTRONICS will show you how to add a Citizens Band Remote Control to your "O" or "O-27" gauge setup. Other construction projects will include a money-saving dry cell rejuvenator and a "quick-mount" mobile antenna mount adapter. (See page 120.)

You'll also meet computer expert Jim Stewart, ace trouble-shooter for Remington Rand's New York office; although he's had no college training, Jim has risen to the top of his profession in just five years. And if you're a tape recorder fan, you'll want to read an article which reports on portable tape recorders—how good they are, how portable they are, and what they cost.

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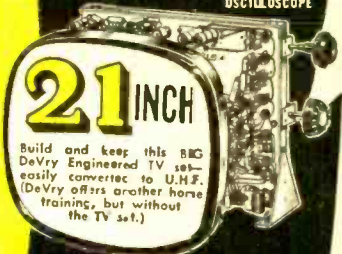
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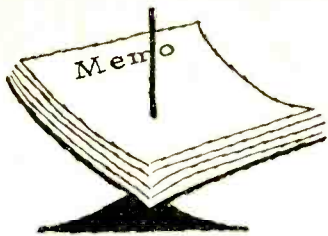
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Notes from the Editor

HOW GOOD ARE ELECTRONIC KITS? In conversations with my "non-electronic" friends, the topic frequently swings over to electronics—particularly hi-fi and ham radio. Since I'm tagged as an old-timer in these fields, I bear the brunt of answering many questions of a technical or semi-technical nature. Frequently asked questions go something like this: "Ollie, what about these electronic kits? Are they what they're cracked up to be?" As a solder-scarred veteran of kit design and builder of many popular and new kits advertised in this magazine, I feel I know the kit situation from both sides of the fence.

From the kit designer's point of view, his job is complicated by the fact that he must consider "tolerance" of parts he will be working with and the technical level of the people who will be building his kit. He knows that most resistors and capacitors will range within 20% of their marked values. This means that in a design that calls for a 10,000-ohm resistor, the circuit must perform even when the resistor varies in value from 8000 ohms to 12,000 ohms. The designer must produce a unit which is so non-critical that the average person can put it together and expect top-quality results even though the individual components are off specification by as much as plus or minus 20%.

The designer must also consider the inexperienced kit builder. There's no point in using circuits where the distributed capacitance of the wiring is critical when some kits are going to be wired neatly and others will end up looking like rats' nests. Consequently, the design of the unit must be flexible enough to allow for anything short of a wrong connection being made.

Personally, in my thirty years of growing up with the kit industry, I can recall very few finished kits (of reputable suppliers) that failed to live up to advertised specifications. The great majority of the kits I have built have actually surpassed their advertised specifications. This is no doubt due to the fact that most kits are rated conservatively.

What this conservative rating means to the prospective kit builder is that he has the percentages in his favor. Barring outright wiring mistakes or a defective component, the home constructor can expect to produce a kit-built unit which will at least equal the manufacturer's specifications. And, with careful attention to good soldering and wiring techniques, he will in many cases be rewarded not only with a sense of personal satisfaction and pride of ownership, but also by a unit which performs even better than the manufacturer claimed.

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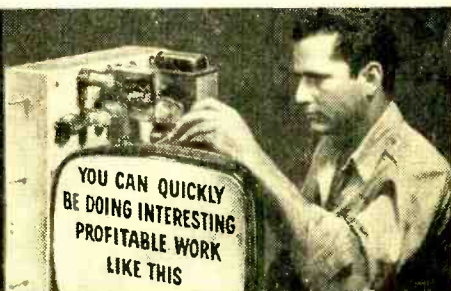


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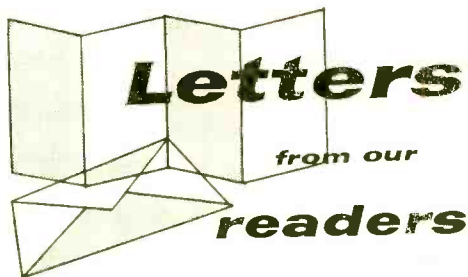
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From a Russian Ham

■ Greetings from Russia to all the readers of POPULAR ELECTRONICS. A 21-year-old engineer in the milk industry, I must confess that much of my spare time is spent on my favorite hobby, ham radio. I first became interested in hamming back in 1954, and after studying Morse Code at the Moscow Central Radio Club, I received my license towards the end of 1955. Since that time I have made many warm friends through ham radio contacts.

In 1958 I joined the Radio Society of Great Britain. At that time I had a policy disagreement with the Moscow Central Radio Club and organized a radio club in my own district of Moscow. I am now chairman of this club, which has its own radio station. We have made a good reputation for ourselves in the short period of



time we have been active. I hope the boys in America will be QSO'ing us soon.

My home station rig at present consists of a VFO-controlled transmitter with an input of 40 watts. My receiver is a seven-tube superhet.

I want to thank POPULAR ELECTRONICS for this opportunity to say hello to American hams and DX'ers, and I send you all my best wishes and hopes for good DX'ing. Till we meet on the air someday, 73,

EUGENE W. KEN, UA3GI/UA3PE1A
Moscow, U.S.S.R.

VTVM Calibration

■ Recently I replaced the rectifier tube in my VTVM and decided to recalibrate the instrument. After referring to "Check Your A.C. Calibration" (August 1958 issue), I built the device and tried it out. However, when I measured the d.c. voltage across points C and D, I found it to be very low.

A little reflection made me realize what was the trouble: a VTVM will not measure pulsating d.c. and the small capacitor called for did not filter the d.c. adequately. The substitution of a 200- μ f. capacitor in its place cured the trouble completely;

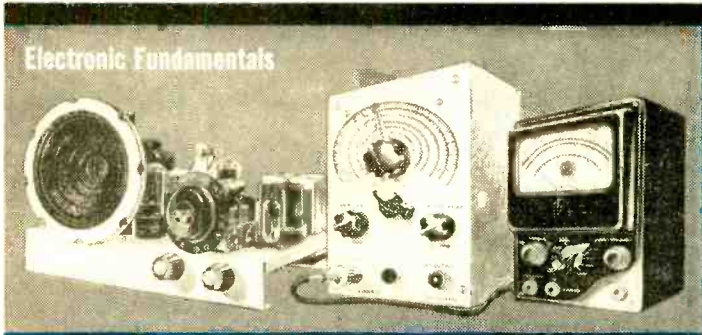
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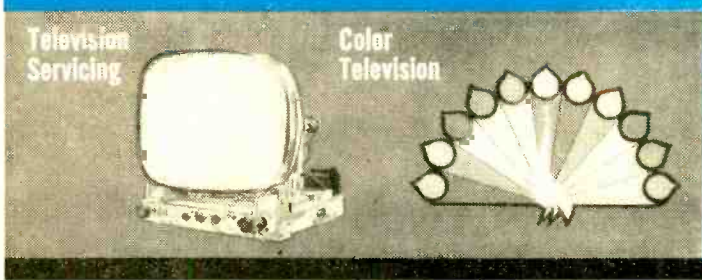
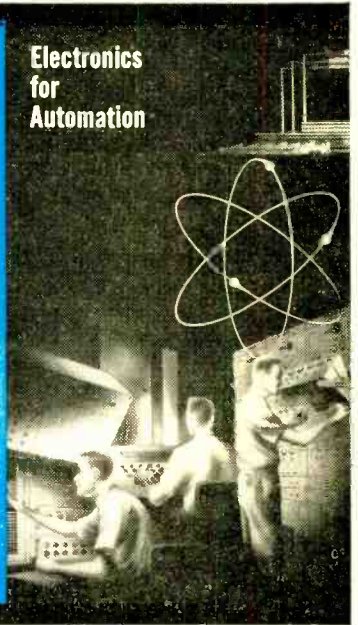
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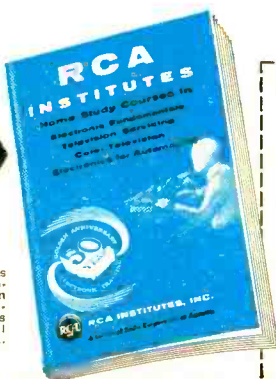


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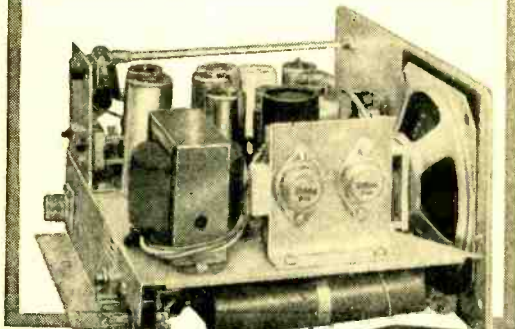
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Commaire Dept. B*

VOCALINE
COMPANY OF AMERICA, INC.
OLD SAYBROOK, CONN.

Letters

(Continued from page 10)

I am passing this information along as other readers may have had the same difficulty I did.

IRVIN B. REA
Mt. Morris, N. Y.

"Side-Swiper" Swap?

■ Can any of your readers tell me where I can get one of the old-time telegraph keys called a "side-swiper"? This key did not work like the ordinary key used on c.w., and it was not a bug key. It had contacts on each side, and the lever was in the middle—the key was operated from side to side. It was popular in the 1920's and early 1930's. If anyone has an old "side-swiper" lying around, please write me. Maybe we can work out a swap.

DAVID A. CROWLEY, SR., W2FFR
14 Smith St.
Elizabeth 4, N. J.

Museum Item?

■ Could you tell me if the old Brunswick radio, Model S-14, with hand-blown tubes, is worth anything?

GLENN
KURZENENABE
Camp Hill, Pa.

Not to us! Would anyone else be interested?



Wireless Microphone Transistor

■ Just as I got all hepped up to build the wireless microphone described in your August issue, I found that none of my catalogs carried the 2N112 transistor indicated on the schematic diagram. Is there another transistor I can use in this circuit?

STEVE BAKER
Greencastle, Ind.

If you can't lay hands on a 2N112, either the RCA 2N140 or the Raytheon 2N484 will work satisfactorily in the wireless microphone.

Back Copies

■ Over the past four years I have accumulated numerous copies of POPULAR ELECTRONICS. Now I find that I am forced to dispose of them. Rather than throw these valuable magazines away, I would like to give them to a school or radio club. They can be had for the cost of mailing.

M. C. WOOD, JR.
8018 Danbury Drive
Norfolk 3, Va.

Calling All CB'ers

■ For two years I have been reading your magazine from cover to cover, and I was especially pleased to see your "On the Citizens Band" column. For a long time now, I have considered the possibility of having an organization for Citizens

Always say you saw it in—POPULAR ELECTRONICS

BIG JOB BOOM FORECAST!

Can You Get Ready in Time?

Right now job opportunities are tight all along the line. Economists now predict a period of mild ups and downs. Look for the "big break" to come in the next three years, they say. That's when good jobs will open up as never before. And men who are preparing themselves *now* will ride the crest of the boom.

DARK OUTLOOK FOR UNSKILLED WORKERS

Those with little or no training will find the going tough. Fewer openings. More competition for existing jobs. The tide is against the unskilled worker. It's getting stronger. Nor will the boom help. The new opportunities will go first to the skilled, next to the semi-skilled.

BIGGEST DEMAND IN THESE FIELDS

What's ahead? According to the best estimates, here are the industries due for the sharp employment rise: Heavy transportation equipment. Mechanical, electrical, chemical, aeronautical and highway engineering. Industrial electronics.

All metals. Business services. Natural gas and oil. Paper products. On the other end of the scale, employment may lag in agriculture and leather. Check the trends in *your* field. Are you prepared to switch, if necessary?

GETTING YOURSELF READY—NOW

All the experts agree: Education, skill, specialized training will net the greatest rewards in the coming boom. The time you spend improving yourself is perhaps the wisest investment you can make *right now*. Your future success and happiness could hinge on your mastering a certain subject or acquiring a special skill. But there are obstacles. You may have a family to support. Or a job to hold down. You may feel you're too old to learn.

HOW I.C.S. CAN HELP YOU

For the man who can take his training hard and fast—without time off from his job or heavy expense—I.C.S. offers real advantages. A total of 259 courses to choose from (see partial list below). A spare-time

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Can you be ready for the next job boom? You can if you act quickly. Your first step: mark and mail the coupon below. What you do right this minute may determine how you make out in the coming boom!

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Letters

(Continued from page 12)

Band operators. With the addition of the 11-meter band to the Citizens Band, I believe that such a club is practically a necessity. I would like to hear from any readers who would be interested in such a club.

VALE TARESKI
P. O. Box 202
Bottineau, N. D.

SWL Report

■ Although I have been an avid SWL for a year, I only recently became aware of your excellent magazine. I also am interested in ham radio but as yet have not gone very far in that direction.

At present I am rather limited by apartment space as well as by equipment. My receiver is a Knight "Space Spanner" with a single-wire antenna that is looped around a double window frame in my living room. However, this arrangement has enabled me to log transmissions of from good to excellent readability and strength from 24 countries on six continents. My favorites are: *Deutsche Welle*, Cologne, Germany (my XYL is from Germany); *Radio Berne*, Switzerland; the BBC; and, to an extent, *Radio Moscow*. My prize receptions are from Melbourne, Australia and *Radio Peking*, China (with reception from Peking at R-5, S-8 in January 1959; this was a one-time reception only).

The majority of my listening is on the 19-, 25-, and 31-meter bands, with 25 meters preferred. Thirty-one is usually good also except that in the evenings *Radio Canada's* strong signal overpowers

much of the band on my simple receiver. As for QSL's, until just lately I hadn't gone after them much but now I have my first one from *Radio Rome*.

FRANK S. KOTELES
Muskegon Heights, Mich.

Multi-Purpose Tracer

■ After constructing the "Simple A.F.-R.F. Signal Tracer" described in your July issue, I discovered that this gadget is really a multi-purpose device.

I have successfully used it as a crystal set by connecting an antenna to the probe, a good ground to the clip, and hooking in a tuned circuit across the two. The tracer can also be used as a private listening unit if you connect the output of a crystal or ceramic phonograph cartridge to the input leads.

By the way, I have found that the switch used to cut the diode in and out of the circuit is not necessary since leaving it permanently connected apparently does not affect its operation in checking out audio circuits.

Have no more time for words now; I'm going to try and figure out more uses for this simple but versatile instrument.

LOUIS PHILLIPS, KN9SPD
Kokomo, Ind.

That's the way to use the old noggin, Louis. If you can devise some more applications for the tracer, let us know—maybe we can go into business together!

—30—

Introducing the Ultra-New Globe Chief Deluxe

"Globe — The First Word in Amateur Radio — The Last Word in Styling & Operation!"

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MODERN NEW "LOW LOOK"

- ✓ 75 watt meter indication for Novice use.
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The Globe Chief Deluxe truly lives up to its name! Gracefully styled with the new "low look" cabinet of pleasing proportions and a tastefully designed panel, its smart, modern appearance is second to none. Improved circuitry and new components provide outstanding performance for the advanced amateur or the novice. Appearance and performance add up to value that cannot be matched anywhere. Improvements include a new 1300 mufd loading capacitor for continuous variable loading on all bands and for improved TVI and harmonic suppression, selectable keying (grid-block or cathode); all Globe Accessories such as a VFO, screen or plate modulator may be plugged in without modifications; internal control for antenna relay; all switching functions performed by rotary switches — no unsightly or hard-to-use slide switches. Standard coaxial antenna fittings. This adds up to unsurpassed quality and value. Kit contains pre-punched chassis, all parts and tubes, and complete manual for easy assembly. Compact: 15 1/4 x 6 1/4 x 11 1/4". Shipping weight: 31 lbs.



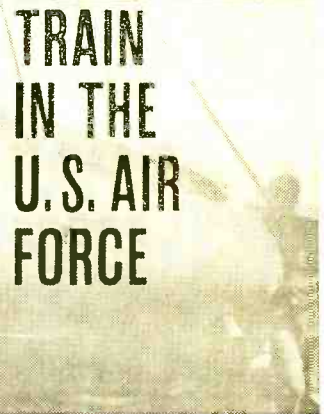
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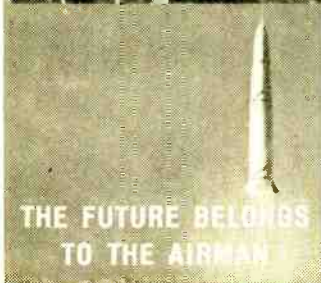
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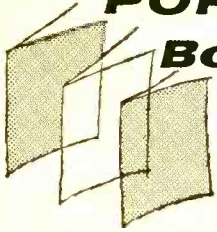
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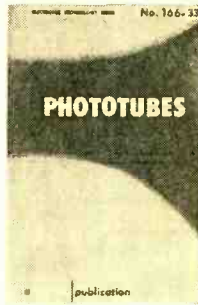
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POP'tronics Bookshelf



"PHOTOTUBES" edited by Dr. A. Schure. Published by John F. Rider Publisher, 116 West 14th St., New York 11, N. Y. 96 pages. Soft cover. \$1.80.

This little book is the 33rd volume in the Rider Electronic Technology series. Like others in this series, it packs a lot of information into a limited space. Going beyond the fundamental principles of phototubes covered in an earlier volume, the text delves into the concept of the quantum theory, luminous intensity and flux,



threshold frequency and wavelength, color sensitivity of photomaterials, phototube structure, layer emission, and many other subjects which pertain to photoelectricity.

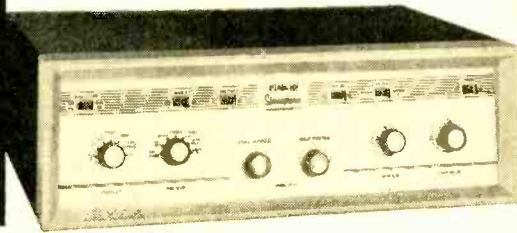


"TELEVISION ANTENNA HANDBOOK" by Jack Darr. Published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 248 pages. \$3.95.

Not many people possess the credentials necessary for writing a book on the subject of television antennas. One of the few that do is Jack Darr. A frequent contributor to POPULAR ELECTRONICS and other electronics periodicals, Mr. Darr has a well-deserved reputation as a writer who can transmit information and still inject wit and humor into everything that comes from his typewriter. He is also constantly in touch with the practical side of electronics through his TV repair shop in the thriving little community of Mena, Arkansas.

In this book, Mr. Darr thoroughly covers the subject of antenna maintenance and installation, and is particularly concerned
(Continued on page 20)

**The last
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you'll ever
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to buy!**



*a 40-watt stereo
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in kit form
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PACO is the kit division of **PRECISION** Apparatus Co., Inc., world famous manufacturers of laboratory electronic instruments for over a quarter century.

The new PACO Model SA-40 offers you greater reserve power capacity than any other preamp-amplifier in its category. Its exceptional circuit design assures highly stable performance with extremely low distortion. And...the SA-40 provides maximum flexibility in any stereophonic high fidelity system present or contemplated.

outstanding specifications:

POWER OUTPUT: 20 watts per channel, 40 watts total

RESPONSE: 30 cps to 90 Kc \pm 1 db

DISTORTION:

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less than .1% at 10 watts per channel

Intermodulation — less than 1% at full rated output

FRONT PANEL CONTROLS: 14 controls including separate bass and treble controls

POWER SUPPLY: Silicon diode, low impedance for minimum distortion

EXTERNAL DESIGN: gold and satin black hooded case with panel illumination and satin gold panel

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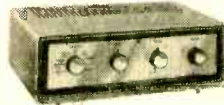
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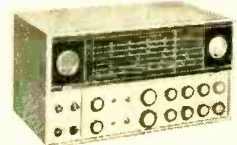
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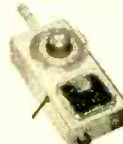
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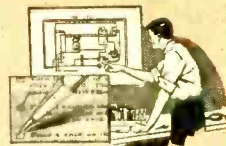
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Bookshelf (Continued from page 16)

with the "how-to-do-it" aspect. Practically every antenna problem is discussed in detail, with the different solutions for each one being pointed out. The book is really loaded with worthwhile information and is highly recommended as a reference guide for TV service technicians.



"TRANSISTORS IN RADIO, TELEVISION AND ELECTRONICS" by Milton S. Kiver. Second Edition. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. 424 pages. \$7.95.

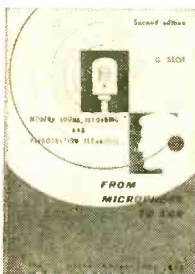
In the three years since this book first appeared, there have been enough changes in transistor manufacture and application to warrant the new edition. As the book is written for the technician, emphasis is on practical transistor application in radios, television receivers, and other electronic circuits. The many schematic and pictorial diagrams help the reader to understand the text. Of special interest are detailed chapters on servicing transistor equipment,

experimenting with transistors, and designing transistor amplifiers. This is one of the best books on transistors at the intermediate level.



"FROM MICROPHONE TO EAR" by G. Slot. Second Edition. Published by the Macmillan Co., 60 Fifth Ave., New York 11, N. Y. 258 pages. \$4.50.

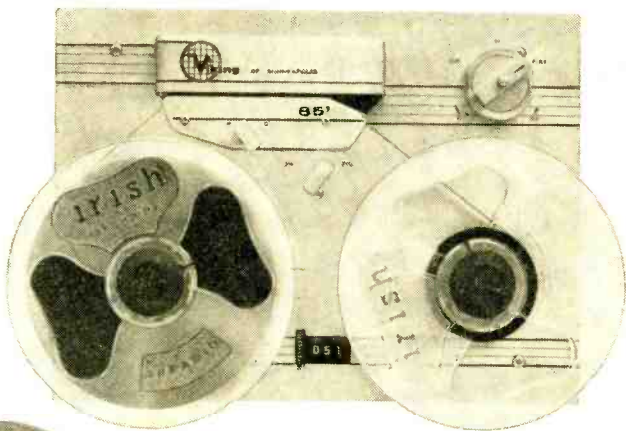
The basics of audio and hi-fi are covered in this book. The author, an engineer at the



Philips Company in Holland, writes in an admirably clear and concise style. He describes the whole process of recording and reproducing sound in layman's terms. A section on stereo is especially good—complete with many drawings

and photos. However, the book has a definite European slant and the great majority of the examples of hi-fi equipment discussed are made by Philips. It is doubt-

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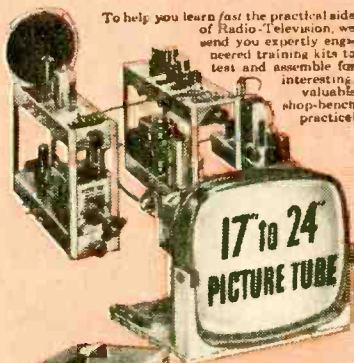
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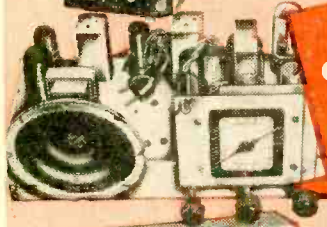
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Bookshelf *(Continued from page 20)*

ful that an American book would appear that failed to discuss high-power amplifiers and, in particular, the popular "screen-tapped" or "Ultra-Linear" circuit. But in the main it is quite a good book, and is recommended as an introduction to hi-fi and stereo.



"BUILDING THE AMATEUR RADIO STATION" by Julius Berens, W2PIK. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 128 pages. Soft cover. \$2.95.

Intended for the Novice or General Class ham who is planning to build his own station, this book gives plans for putting together two different amateur stations, each comprised of a transmitter, receiver, power supply, control box, rack, and antenna. The Novice transmitter is a 15-watt c.w. design, and the General Class transmitter offers 50 watts on c.w. and 25 watts on voice. Also included are sections describing and explaining the many controls and features available on commercial amateur radio units.



Free Literature Roundup

Two indispensable catalogs of electronic equipment are now available from Allied Radio and Lafayette Radio respectively. They are the 1960 catalogs, hot off the presses. For your copies, write Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill., and Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

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-30-

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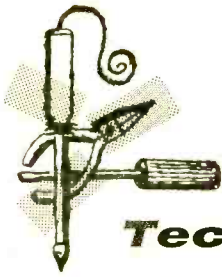
And here's the biggest bonus of all. You can get this Bell Stereo Amplifier now for only \$149.95 complete with cover. See it . . . hear it . . . check its features. And while you're at your Bell dealer's, see the matching Bell Stereo Tuner that makes your stereo system complete.

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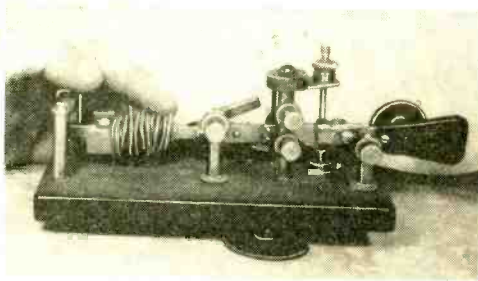
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Tips and Techniques

SM-0000-TH SENDING

For smooth, rhythmical sending with a bug at lower speeds, the spacing between dots must be increased. Wrap two or three



layers of solder around the vibrating keying arm, and then separate the dot-making

points as far as you can—being careful to avoid “missing.” With the key thus weighted and adjusted, it is possible to send clean, crisp code at 5 wpm.—*Peter Barna, Wilmington, Calif.*

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When you need “non-standard” voltages for experiments, don’t forget that your tube tester is a good source of a.c. from 1 to 117 volts. All you have to do is solder two lengths of test probe wire with clips attached to pins 2 and 7 of an octal tube base. By running the tapped-off voltage through a rectifier-filter system, many useful values of d.c. voltage can be obtained.—*Wm. A. Irvin, Tampa, Fla.*

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If you own a paper-bound tube manual, you have probably found that the pages fall out after the manual has received a little rough treatment. Try clamping it between two thin boards, drilling through the “sandwich” with either a hand drill or an electric drill, and then putting standard notebook rings through the holes. This little operation will keep your tube manual’s

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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 trouble-shooting using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material.

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FROM OUR MAIL BAG

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. Snauf, 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 Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

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

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

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

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH \$7

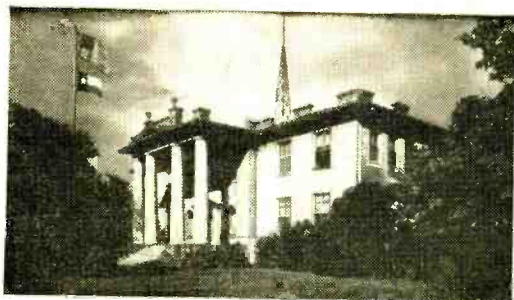
- Send "Edu-Kit" postpaid. I enclose full payment of \$22.95.
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PORT ARTHUR COLLEGE

PORT ARTHUR, P-881, TEXAS
Founded in 1909

Tips

(Continued from page 24)

pages from being spread all over your work area. Also, the manual will be much more convenient to use since it will open out flat.—*Allen Humphries, Saugus, Mass.*

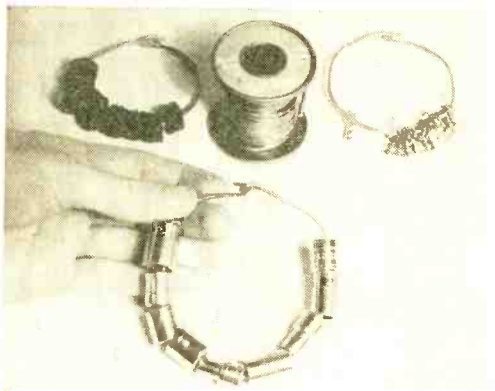
JAR HOLD-ALL

Discarded jars which are fitted with spade lug bolts used to hold "cans" to a chassis make dandy containers for spare parts. When they are hung on the wall with "L" hooks, the contents are instantly visible. Cost is low and jars of any size can be used.—*A. P. Zanelli, Tampa, Fla.*



HARDWARE HANGERS FROM SOLDER

You can make handy hardware hangers from lengths of wire solder. Just slip your soldering lugs, grommets, and socket wrench sockets over the hangers as shown and it will be easy to find whatever you happen to need. Inter-linking hooks bent in



the hanger ends keep the hardware and sockets from slipping off.—*James A. Clifford, Detroit, Mich.*

TIN LITZ WIRE EASILY

A fair-sized thumbtack pushed into your work board or table makes an excellent miniature solder pot for tinning litz wire. Puddle a little solder on the head of the tack with your soldering iron and dip in the end of the wire to be tinned. The outer in-



Verdict:

Collaro

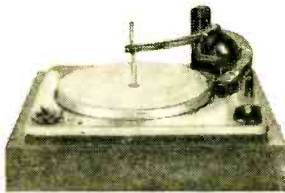
stereo
record players
are **innocent**
of rumble,
wow, flutter



or any noises
that
interfere
with enjoyment
of music



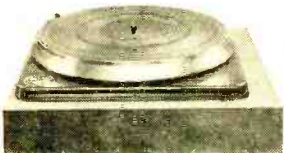
The Constellation, Model TC-99—\$59.50



The Continental II, Model TSC-840—\$49.50



The Coronation II, Model TSC-740—\$42.50
*The Conquest II, Model TSC-640—\$38.50



Transcription Turntable, Model 4TR-200—\$49.50



Manual Player, Model TP-59—\$29.95



Every Collaro stereo record player is built with typical British attention to every detail. They are precision engineered and rigidly tested to give truly professional performance and the ultimate in operating convenience. Here are some of the more important features that make Collaro the logical choice for stereo or monophonic records. • Performance specifications exceed NARTB standards for wow, flutter and rumble—with actual performance test reports accompanying each model TC-99. • Extra-heavy, die-cast, non-magnetic turntables (weighing up to 8½ lbs.). Extra-heavy weight is carefully distributed for flywheel effect and smooth, constant rotation. • Shielded four-pole motors are precision balanced, screened with triple interleaved shields to provide extra 25 db reduction in magnetic hum pick-up. • Detachable five-terminal plug-in head shells (on TC-99, TSC-840, TSC-740, TP-59) provide two completely independent circuits, guaranteeing ultimate in noise reduction circuitry. • Transcription-type stereo tonearms are spring-damped and dynamically counterbalanced to permit the last record on a stack to be played with virtually the same low stylus pressure as the first. • All units are handsomely styled, available with optional walnut, blond and mahogany finished bases or unfinished utility base. There's a 4-speed Collaro stereo record player for every need and budget! Prices slightly higher in the West. For free catalog on the Collaro line, write to: Rockbar Corporation, Dept. PE-11 Mamaroneck, N. Y. (*Not shown. Similar in appearance to The Coronation.)

Learn at Home

in your spare time

to Fix Electric Appliances



Better Pay—More Opportunities

Get into a field where there is important work and opportunity for the trained man. Millions of electric appliances are sold every year. Every wired home now has an average of 8. Many of them need service and repair. Owners pay well to have them fixed quickly, properly. This is your opportunity for a better job, your own part time or full time business. NRI can give you the training you need, at home, in your spare time.

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You need proper equipment to service today's automatic appliances. With this course you get parts to build professional type, multi-use Appliance Tester. You learn to use it. Takes guess work out of servicing. Mail coupon for FREE book and Sample Lesson. See how easy it is to learn. Find out about NRI—a school that for more than 40 years has been training men, through home study, for success, good pay jobs. Our reputation, record, experience back up this course. Address National Radio Institute, Dept. D4M9, Washington 16, D. C.



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Tips

(Continued from page 26)

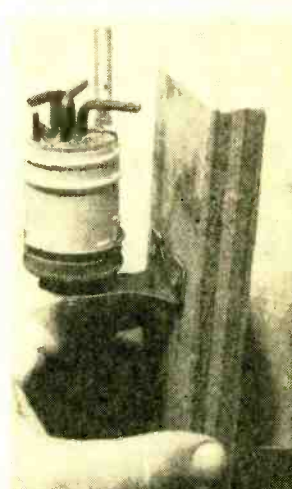
sulation will char off, and with a little manipulation you'll have a beautiful tinning job.—*John Bachtell, Woodhaven, L. I., N. Y.*

REJUVENATING DRY CELLS

If you ever want to squeeze a few more hours of service out of some dry cells that have had it, try giving them a drink—not whisky, but just plain water! Drill a few small holes near the top of a cell and then soak it in water for awhile. Sometimes this will cause the chemicals in the dry cell to revive and the cell will come back to life. Frequently a good drink of water administered in this fashion will mean up to 20 or more hours of useful service from an apparently dead cell.—*Russell C. Boe, Houston, Texas.*

KEEP ALLEN WRENCHES HANDY

You can keep your Allen wrenches or drills handy in a "holster" made from a 35-mm. film can or a frozen fruit juice container. If the can is packed with a small roll of corrugated cardboard, it will hold the wrenches neatly. Fasten a shade roller bracket to the lid of the can for shop wall mounting; this bracket makes a convenient holder, yet the can may be readily removed and placed in a tool box for use outside of the shop.—*Glen F. Stillwell, Manhattan Beach, Calif.*



SIMPLE PHONE TIP CONNECTION

The next time one of your phone tips breaks off, simply bend the end of the flexible foil phone cord wire over the end of an ordinary wooden match, and then push the matchstick into the sleeve of the phone tip. Break off the matchstick close to the end of the tip and push the insulation up against it. This procedure will result in a tight-fitting reliable connection.—*Art Trauffer, Council Bluffs, Iowa.*

—30—



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Quickly

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We guarantee to train you until you receive Your FCC License

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The Master Course in Electronics will provide you with the mental tools of the electronics technician and prepare you for a First Class FCC License (Commercial) with a radar endorsement. When you successfully complete the Master Course, if you fail to pass the FCC examination, you will receive a full refund of all tuition payments.

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Electronic Technicians

Goodyear Aircraft Corp. has openings for electronic technicians, to work as assistants to engineers on developmental electronics projects such as missile systems, radar, antennas and analog computers.

And our trainees get good jobs

"Investment in training really pays off!"

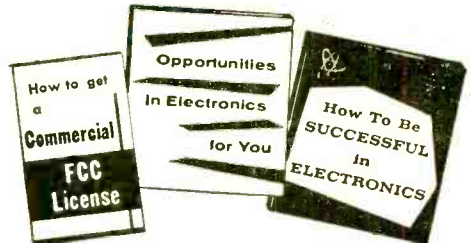
"I am now employed by the Western Electric Company as an electronic tester. My status as a student of Cleveland Institute was an important factor in my being employed. Knowledge gained through the course has proved amazingly helpful and affords me a feeling of complete confidence."

T. E. Spence, Greensboro, N. C.

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4900 Euclid Ave. Desk PE-58 Cleveland 3, Ohio

November, 1959



Cleveland Institute of Electronics

Desk PE-58 4900 Euclid Ave., Cleveland 3, Ohio

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In what kind of work are you now engaged?

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PE-58

KIT: HSK33 turntable, 49.50; SAK 12 1/2" tone arm, 23.95; TBA base, 17.95.



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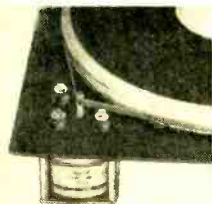
DELUXE ASSEMBLED: 33H turntable, 79.50; 212-SX tone arm, 34.00; 33C base, 23.95.

If you have decided to go *real hi-fi* and want the security of professional playing equipment, then naturally you'll step up to a **GRAY** turntable and arm combination.

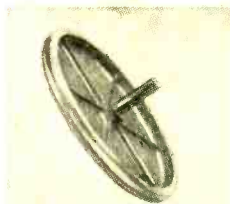
Whether you choose the custom deluxe factory assembled units or the economical precision kits, you get all the engineering extras exclusive with **GRAY**.

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Oversized platter and bearing assembly

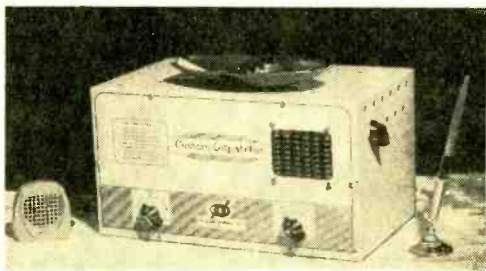
GRAY High Fidelity
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CITIZENS BAND KIT

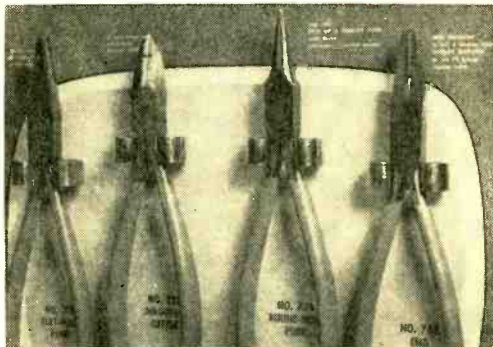
The "Custom Dispatcher" Citizens Band transceiver kit has recently been announced by *Chickasha Electronics, Inc.*, 828 Chocktaw Ave., Chickasha, Okla. Both the transmitter and the receiver circuits are



crystal-controlled, and squelch and noise limiting is incorporated. Power input is 5 watts; sensitivity, 1 microvolt. The transceiver operates on 6 or 12 volts d.c., or 117 volts a.c. Price, \$69.95, the kit is furnished complete with all parts, a microphone, and crystals.

ELECTRONICS PLIERS

Four pairs of Channellock pliers especially designed for all types of electronics work have recently been introduced by *Champion DeArment Tool Company*, Meadville, Pa. Design features include long-reach jaws and handles, precision-matched



jaws and points, and hand-honed, hardened cutting edges. The line includes a pair of flat-nose pliers (\$3.10), a diagonal cutter (Continued on page 34)

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NEW! Lafayette 50 Watt Complete Stereo Phono System



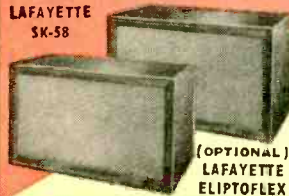
LAFAYETTE LA-250



GARRARD RC121/11
WOOD BASE



LAFAYETTE
SK-58



(OPTIONAL)
LAFAYETTE
ELIPTOFLEX

COMPLETE
STEREO SYSTEM
174.50

NEW GE
VR-227

This superb system will add a new dimension in living to your home with all the excitement and realism of a live concert. The new Lafayette LA-250, 50-watt stereo amplifier (25 watts each channel) forms the heart of this outstanding stereo hi-fi phonograph music system—the features, versatility and advanced circuitry of this unit are second to none. Also included is the famous Garrard RC121/11 intermix 4-speed automatic record changer with full manual or automatic operation supplied with your choice of stereo cartridges—the new GE VR-22 (.7 Mil) diamond stereo cartridge, Pickering 371-7D (.7 Mil) diamond stereo cartridge, Shure M7D (.7 Mil) diamond stereo cartridge or the new Electro-Voice 31 MD7 (.7 Mil) diamond stereo cartridge. Supplied with the Lafayette wood base cut for the RC121 in your choice of finishes. These outstanding components are coupled

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| GARRARD RC 121/11 STEREO CHANGER | 41.65 |
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| 2- LAFAYETTE SK-58 FAMOUS FREE EDGE 12" COAXIAL SPEAKERS @ 29.50 | 59.00 |

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You Save 44.05

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Unquestionable Economy—Elegant Styling

LAFAYETTE 36-WATT INTEGRATED STEREO AMPLIFIER KIT

NEW!

KT-236
IN KIT FORM
52.50



- 36-WATTS MONAURALLY—18 WATTS PER CHANNEL ●
- FREQUENCY RESPONSE 15-30,000 CPS \pm 1 DB ● UNIQUE "BLEND" CONTROL ● CONCENTRIC CLUTCH—OPERATED VOLUME CONTROL ● DUAL CONCENTRIC BASS AND TREBLE CONTROLS ● 4-EL84 TUBES IN PUSH PULL

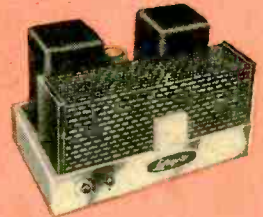
This exciting new amplifier kit combines dual preamplifiers and dual 18 watt power amplifiers on one compact chassis. Instant selection from monophonic to stereophonic is provided by the turn of a switch. An amazing new "Blend" control gives continuously variable channel separation from full monophonic to full stereo. The concentric clutch-operated volume control offers independent or simultaneous level adjustments of both channels. Dual concentric bass and treble controls furnish 4 independent tonal adjustments. Harmonic distortion less than 0.15% at normal listening level. 1.M distortion is less than .3%. Hum and noise 70 db below rated output. Complete with cage, legs and detailed instructions. Shpg. Wt., 24 lbs.

KT 236 Stereo Amplifier Kit 5.25 DownNet **52.50**

DELUXE 70 WATT BASIC AMPLIFIER

KT-400
IN KIT FORM
69.50

LA-250
COMPLETELY WIRED
94.50



- CONSERVATIVELY RATED AT 70 WATTS ● INVERSE FEEDBACK ● VARIABLE DAMPING ● METERED BALANCE AND BIAS ADJUST CONTROLS ● AVAILABLE IN KIT AND WIRED FORM

Here's ultra-Stability in a 70 watt basic power amplifier employing highest quality components. Features matched pair KT 88's and wire range linear Chicago output transformer, variable damping control and meter for bias and balance. Frequency response 10-100,000 cps \pm 1 db. Hum and noise 90 db below full output. 1M distortion less than 1 1/2% at 70 watts, less than 9.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps \pm 1 db. Output impedance 4, 8 and 16 ohms. Size 14 1/2 x 10 x 7 3/4" including cage and knobs. Shpg. Wt., 40 lbs.

KT-400 Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. 6.95 Down, Net **69.50**

LA-70 Same as above completely wired and tested with cage and instruction manual 9.45 DownNet **94.50**

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Lafayette Kits are exclusive products of Lafayette Electronics. Each Lafayette Kit must meet or exceed its published specifications, or your money is refunded in full.

Lafayette Superior Quality Hi-Fi Kits

50 WATT INTEGRATED STEREO AMPLIFIER



KT-250
IN KIT FORM
64.50

LA-250
COMPLETELY
WIRED
89.50

- RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level)
- UNIQUE "BLEND" CONTROL
- PREMIUM EL86 OUTPUT TUBES
- 50 WATTS MONAURAL—25 WATTS EACH STEREO CHANNEL
- CLUTCH-OPERATED VOLUME CONTROL
- SEPARATE BASS & TREBLE CONTROLS

A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 8, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 1% Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 Stereo Amplifier Kit—6.45 Down Net 64.50
LA-250 Stereo Amplifier, wired & tested—8.95 Down Net 89.50

PROFESSIONAL STEREO CONTROL CENTER



KT-600
IN KIT FORM
79.50

LA-600
COMPLETELY
WIRED
134.50

- RESPONSE 5-40,000 CPS ± 1 DB
- UNIQUE STEREO & MONAURAL CONTROL FEATURES
- PRECISE "NULL" BALANCING SYSTEM
- CONCENTRIC INPUT LEVEL CONTROLS

A truly professional stereo preamplifier and master audio control center—solves every stereo/monaural control problem. Features unique Bridge Control for variable cross-channel feed for elimination of exaggerated channel separation effects—plus controlled 3rd channel output. Has all-concentric controls—including clutch-operated Volume Balance control. Provides complete and advanced facilities for accepting, controlling and providing undistorted gain for any and all program sources. Sensitivity 2.2 mv for 1 volt out (low level inputs). Dual low impedance "plate follower" outputs 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Less than .1% harmonic distortion. Hum and noise 80 db below 2 volts (high level inputs). Uses 7 new 7025 low-noise dual triodes. Size: 14" x 4 1/2" x 10 1/2". Shpg. wt., 16 lbs. Complete with all parts, tubes, deluxe cabinet and detailed instruction manual.

KT-600 Stereo Preamp Kit—7.95 Down Net 79.50
LA-600 Stereo Preamp Kit, wired and tested—13.45 Down Net 134.50

Outstanding Design — Incomparable Performance

STEREO/MONAURAL POWER AMPLIFIER KIT



KT-310
IN KIT FORM
47.50

LA-310
COMPLETELY
WIRED
72.50

- 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL
- EMPLOYS 4 PREMIUM-TYPE 7189 TUBES
- 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING
- RESPONSE BETTER THAN 35-30,000 CPS $\pm 1/2$ DB AT 18 WATTS
- LESS THAN 1% HARMONIC OR IM DISTORTION

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural/Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Size 10-9/16" d x 5 1/4" h x 13 1/4" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shpg. wt., 22 lbs.

KT-310 Stereo Power Amplifier Kit—4.75 Down Net 47.50
LA-310 Stereo Power Amplifier, wired and tested—6.95 Down Net 72.50

FM-AM STEREO TUNER KIT



KT-500
IN KIT FORM
74.50

LT-50
COMPLETELY
WIRED
124.50

- 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance
- Multiplex Output for new Stereo FM
- Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator
- Extreme Sensitivity and Wide Frequency Response.

A precision engineered, highly stable tuner—perfect for life-like stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps $\pm 1/2$ db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13 1/4" W x 10 1/2" D x 4 1/2" H. Shpg. wt., 22 lbs.

KT-500 FM-AM Stereo Tuner Kit—7.45 Down Net 74.50
LT-50 Same as above, wired & tested—12.45 Down Net 124.50

Lafayette Radio

165-08 Liberty Ave. JAMAICA, N. Y.
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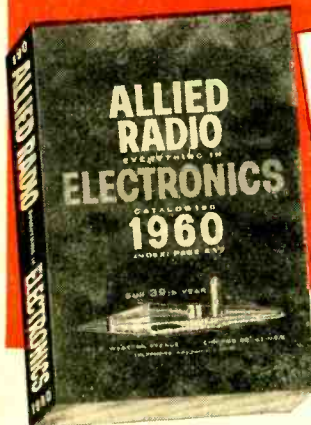
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products

(Continued from page 30)

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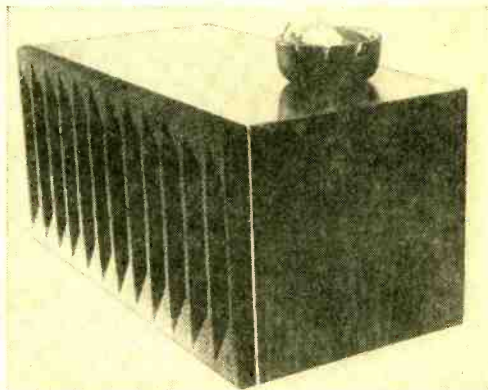
STEREO CARTRIDGE

Audio Empire, a new name in the hi-fi field, has recently announced its first high-fidelity product, the Empire 88 "Stereo/Balance" stereo cartridge. A new type of stylus lever design affords an extremely low dynamic mass and the stereo outputs are within 1 db of each other. Frequency response is from 20 to 20,000 cps \pm 2 db; channel separation, 25 db; output level, 5 millivolts per channel; compliance (vertical and lateral), 5×10^{-6} cm/dyne. Available with 0.7-mil diamond stylus for \$24.50, with 0.7-mil sapphire stylus for \$18.50. (*Audio Empire*, Precision Products of Dyna-Empire, Inc., 1075 Stewart Ave., Garden City, L. I., N. Y.)



SPEAKER SYSTEMS

Two Audax bookshelf speaker systems have recently been announced. Styled by George Nelson, the cabinets are made of oiled walnut and are finished on all four sides. A new type of speaker grille com-

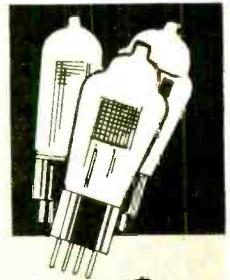


posed of Dynel is incorporated into the systems esthetic and acoustical design.

Both of these systems use the new Audax "Paraflex" speakers. Model CA-80 (shown in photo) contains two 8" extended-range

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| OZ4 | 3BC5 | 6AB4 | 6BA6 | 6C16 | 658GT | 7B5 | 12A17 | 12S17 | 38 |
| 1A7GT | 3BN6 | 6AC7 | 6BC5 | 6CM6 | 65A7 | 7B6 | 12AU6 | 12SK7 | 39/44 |
| 1B3GT | 3BZ6 | 6AF4 | 6BC8 | 6CH7 | 65DTGT | 7B7 | 12AU7 | 12SA7GT | 41 |
| 1C6 | 3C86 | 6AG5 | 6B06 | 6CN7 | 65F5 | 7B8 | 12AV6 | 12SQ7 | 42 |
| 1C7 | 3Q4 | 6AH4GT | 6BE6 | 6CQ8 | 65F7 | 7C4 | 12AV7 | 12V6GT | 43 |
| 1F4 | 354 | 6AM6 | 6RF5 | 6CR6 | 65G7 | 7C5 | 12AX3GT | 12W6GT | 45 |
| 1F5 | 3V4 | 6AK5 | 6BG6G | 6C56 | 65H7 | 7C6 | 12AX7 | 12X4 | 50A5 |
| 1G4 | 4RQ7A | 6ALS | 6BH6 | 6CUS | 65J7 | 7C7 | 12AZ7 | 14A7/12B7 | 50B5 |
| 1H5GT | 4E58 | 6AMB | 6B16 | 6CU6 | 65K7 | 7E5 | 12B4 | 14B6 | 50C5 |
| 1I4 | 4B27 | 6ANB | 6BK5 | 6D6 | 65I7 | 7E6 | 12BA6 | 14O7 | 50L6 |
| 1I6 | 4CB6 | 6AQ5 | 6BK7 | 6DE6 | 65Q7 | 7E7 | 12BA7 | 19 | 56 |
| 1H5GT | 5AMB | 6AQ6 | 6B17GT | 6D66GT | 65R7 | 7F7 | 12B06 | 19AU4GT | 57 |
| 7B5 | 5ANB | 6A07 | 6BN6 | 6DQ6 | 614 | 7F8 | 12B5 | 19BG6G | 58 |
| 755 | 5A1B | 6AR5 | 6BD6GT | 6F5 | 6U8 | 7G7 | 12B16 | 1916 | 71A |
| 714 | 5AVB | 6AS5 | 6BQ7 | 616 | 6V6GT | 7H7 | 12B7 | 1918 | 75 |
| 7U4 | 5AZ4 | 6AT6 | 6BR8 | 616 | 6W6GT | 7H7 | 12BQ6 | 24A | 76 |
| 7U5 | 5BR8 | 6AU4GT | 6BS8 | 614 | 6X4 | 7Q7 | 12B7 | 25Z6GT | 77 |
| 7V2 | 5J6 | 6AUSGT | 6BY5G | 615 | 6XSGT | 757 | 12BY7 | 26 | 78 |
| 8X2 | 5R4 | 6AU6 | 6BZ6 | 616 | 6XB | 7X6 | 12CA5 | 27 | 80 |
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| 2CY5 | 5V4G | 6AV6 | 6CB6 | 6K7 | 7A5 | 7Z4 | 12F5 | 35B5 | |
| 3A4 | 5V4GT | 6AWB | 6CD6G | 6N7 | 7A6 | 12A8 | 12K7 | 35C5 | |
| 3A5 | 5X8 | 6AX4GT | 6CF6 | 6O7 | 7A7 | 12A85 | 12L6 | 35W4 | |
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products

(Continued from page 34)

speakers and Model CA-100 has two 10" woofers plus two cone tweeters. Prices: Model CA-80, \$99.95; Model CA-100, \$139.50. (Auda, Inc., Division of Rek-O-Kut Co., Inc., 38-19 108th St., Corona 68, N. Y.)

BATTERY CHARGER

Terado is offering a new "Hi-Power" battery charger for use with 12-volt batteries. The Model 50180 plugs into standard auto cigarette lighter receptacles and charges a 12-volt battery overnight. The 2¼" x 2½" x 4½" unit features two silicon diode rectifiers in a full-wave circuit. A built-in light indicates battery condition. Complete with 8' a.c. cord, \$19.95. (Terado Company, 1057 Raymond Ave., St. Paul 8, Minn.)

LOW-PRICED STEREO AMPLIFIER

The AF-4 low-power economy-priced stereo amplifier, recently announced by EICO, features two 4-watt sections and has complete facilities for accommodating any type of stereo or mono program source. In-



dependent, concentric level and tone controls are provided and feedback circuitry is used throughout to reduce distortion. Price in kit form, \$38.95; factory-wired, \$64.95. (Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y.)

STEREO HEADPHONES

Cushioned hi-fi headphones especially designed for stereo use are being offered by Koss, Inc., 227 N. 31st St., Milwaukee 8, Wis. The Model SP-3 "Stereophones" have a frequency response from 30 to 15,000 cps, and can be used for mono as well as stereo operation. Connection to a hi-fi amplifier is simple since the impedance of the "Stereophones" is 4 ohms. Adapters to match 600-ohm and 12,000-ohm outputs are also available. Complete with 8' cable and plug, \$24.95.

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| 1S5 | .51 | 5AQ5 | .52 | 6AQ5 | .50 | 6BQ7 | .95 | 6J6 | .67 | 12AT7 | .76 |
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| 3AL5 | .42 | 5J6 | .68 | 6AV6 | .40 | 6CB6 | .54 | 6Y6G | .65 | 12AZ7 | .86 |
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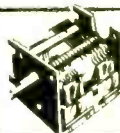
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Carl and Jerry

By
JOHN T. FRYE
W9EGV

The Ghost Talks

"IT'S CERTAINLY going to be a warm Halloween tonight," Carl thought. The late October sunshine felt good on his shoulders as he crossed the back yards on his way to the electronic laboratory in the basement of his friend, Jerry. Carl clattered noisily down the outside steps and through the door, but Jerry was so intent on some parts on the bench in front of him that he only grunted a greeting without looking up.

After peering disdainfully at the odds and ends of electric gear scattered over the

bench, Carl said, "I give up; what's it gonna be? An anchor for a space station?"

"It's my Doorbell-Pinner Discourager," Jerry replied. "Here's a 30-ohm surge-limiting resistor, a silicon diode rectifier, and a 10,000-ohm plate-circuit relay, all to be connected in series across our door chimes. This 1000- μ f., 25-volt electrolytic capacitor connects across the relay winding. The normally open relay contacts are wired in parallel with the porch light switch. Can't you take it from there?"

"Hm-m-m-n," Carl said slowly as his forehead wrinkled in concentration above his horn-rimmed glasses; "when someone pushes the doorbell button, about 18 volts a.c. is applied to the chimes. This will be rectified by the diode, and current through the relay will close the contacts, turning on the porch light."

"Good boy!" Jerry applauded; "and the voltage across the relay winding will charge the capacitor. Current from this discharging capacitor will hold the relay closed even after the button is released. In fact, with this capacitor and relay combination, the porch light stays on for a full

(Continued on page 92)



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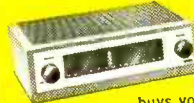


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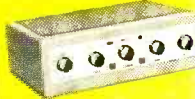
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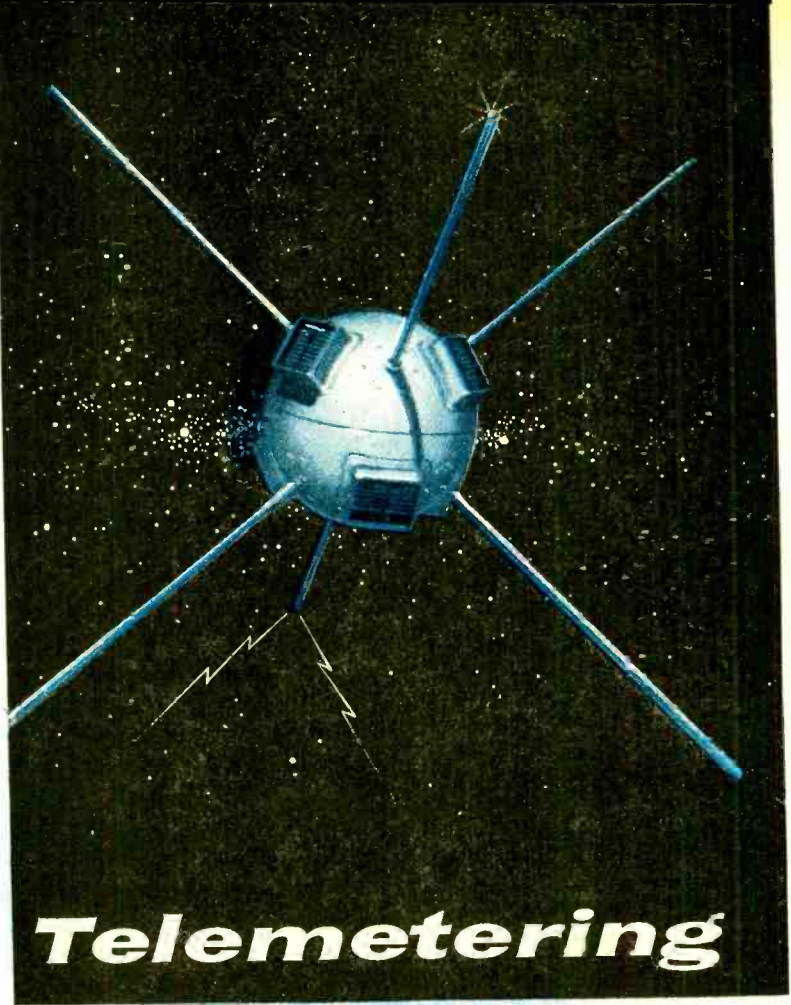


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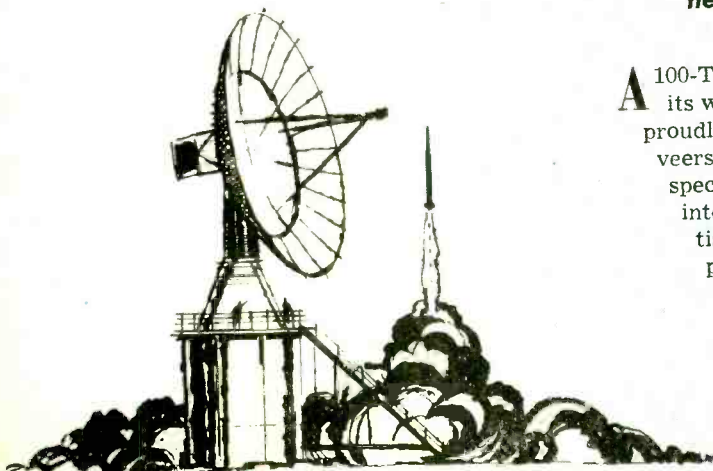


Vital Link to the Stars

Of little importance until recently, telemetering is now

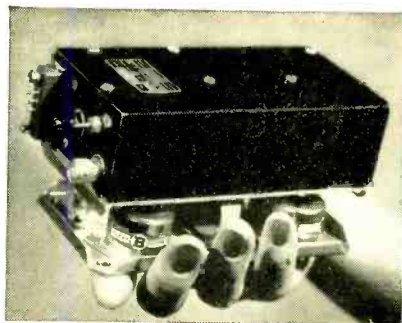
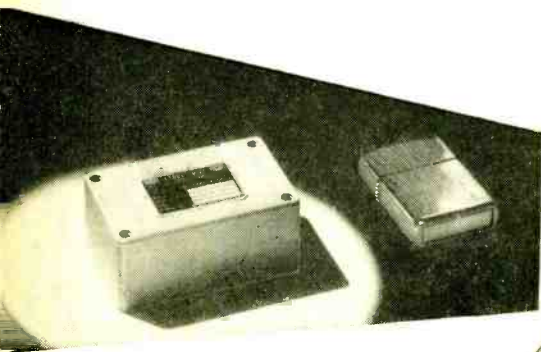
one of the fastest-growing

fields in electronics

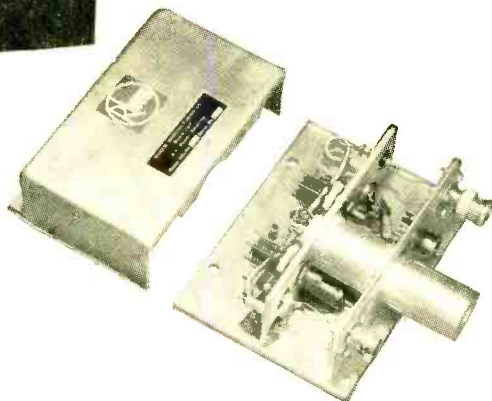


A 100-TON 85-foot missile fights its way up into the sky, arches proudly out over the ocean, falters, veers wildly, becomes a surging spectacle of flame, then plunges into the ocean. After the scientists recover from their disappointment, how can they find out what caused the failure? The answer is telemetering—the process of taking measurements

By EARL STOWELL



Telemetering components are always compactly packaged. Above is a transistorized subcarrier oscillator made by United Electro-dynamics. At right above is a Parsons crystal-controlled two-watt FM transmitter. A telemetering r.f. amplifier is at right; this Rheem unit covers 215 to 245 mc.



at one place and simultaneously sending them to another place for interpretation or "read-out."

Telemetering should not be confused with remote control. When you set the temperature control of a modern stove, you are using a type of remote control to regulate the oven temperature. But if the stove has a signal lamp that goes on when the correct temperature is reached, this is a form of telemetering—because information (the temperature) is measured at one place and is then sent to another for "read-out."

Sending Back the News. Only in recent years has there been a need for telemetering. In the early days of flying, for example, when planes were much simpler than they are now, a test pilot would take a new plane up for its initial run and would then report back to the designers what changes should be made. But nowadays things happen so fast on test flights that it's impossible for the pilot to notice everything that's going on. And today's aircraft are so expensive and complex that if an accident occurs, a method of determining the reason for the accident is essential. Telemetering provides the means for solving these very real and important problems.

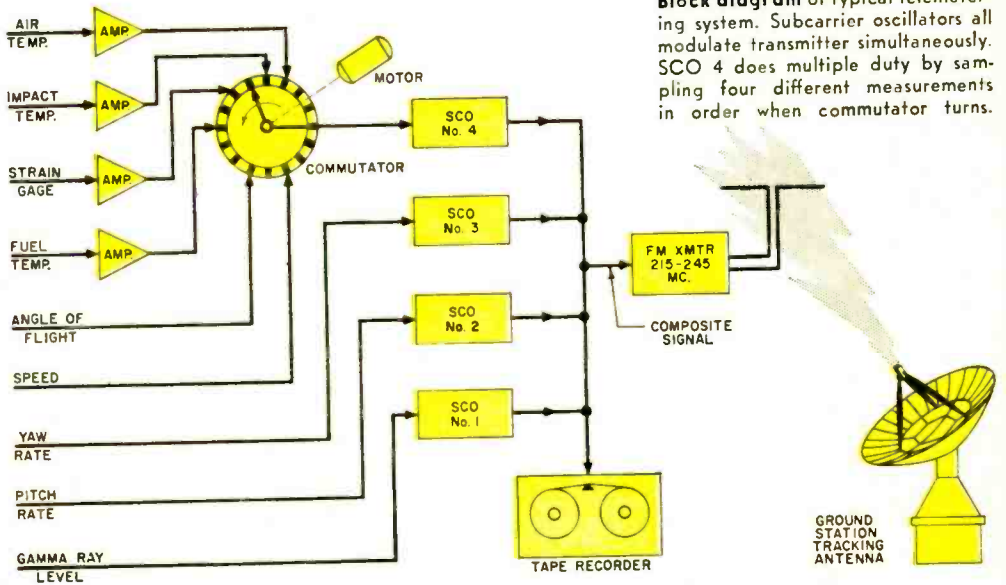
Weather-study instruments developed in the Thirties provided a clue for the design of telemetering equipment. A German scientist devised a simple but effective system for determining atmospheric conditions at various altitudes. He attached a battery-powered radio transmitter to a balloon and then hooked up some sensing elements to it that delivered varying voltages in proportion to altitude, temperature, and humidity. As the balloon floated through the sky, a three-point rotating switch connected each of the instruments in turn to the transmitter. Even today, this simple technique forms the basis of many telemetering systems.

Instrumentation. Telemetering systems seem complicated, but their complexity comes from the amount of detail involved, rather than from their inherent circuit complications.

The first links in a telemetering chain are the measuring instruments, which are designed to produce output voltages in ratio to their readings. For instance, to measure temperature between 0° and 100°, a measuring instrument with an output range from 0 to 5 volts would deliver no output at 0° and 5 volts at 100°. A tempera-

ture of 50° would result in an output of 2.5 volts. It is more common, however, to use a measuring instrument that puts out ± 2.5 volts, with zero representing half-scale;

After being coded, the information from the measuring instruments modulates the r.f. output of a battery-powered transmitter. Most telemetering systems use FM



Block diagram of typical telemetering system. Subcarrier oscillators all modulate transmitter simultaneously. SCO 4 does multiple duty by sampling four different measurements in order when commutator turns.

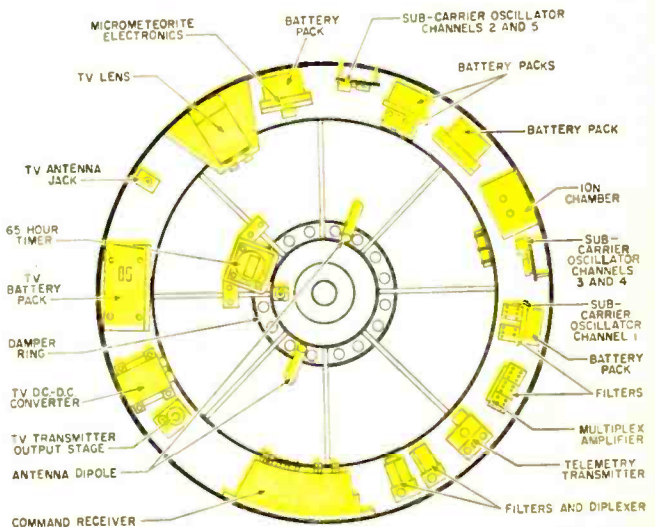
hence, -2.5 volts would indicate a temperature of 0° and +2.5 volts would mean 100°.

These voltage variations from the measuring instruments must be coded before they are fed into a transmitter. For example, information can be indicated by varying the *duration* of the pulse; this method is called PDM (Pulse Duration Modulation). Or the *amplitude* of the pulse might be varied (PAM, or Pulse Amplitude Modulation). Another method is PCM (Pulse Code Modulation) or its close relative PPM (Pulse Position Modulation) in which the position of two short pulses with relation to each other is the code.

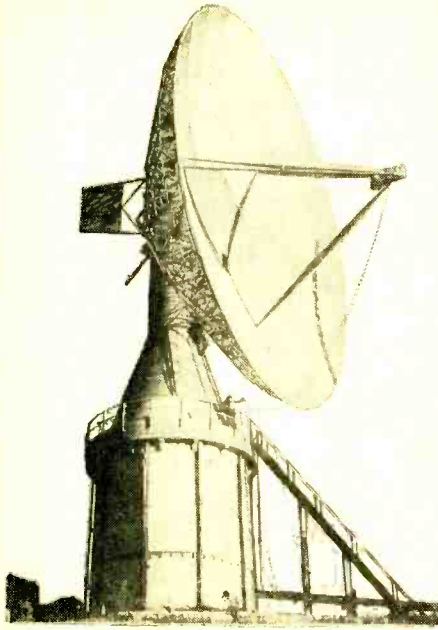
For extreme accuracies, a digital system is used. In this system, each measurement is changed to a binary number which may then be handled with high accuracy—up to 0.01% if required—and the output can be fed directly into a digital computer.

transmitters which provide about 2 watts output in the 215-245 mc. band. Some transmitters, however, put out as much as 100 watts.

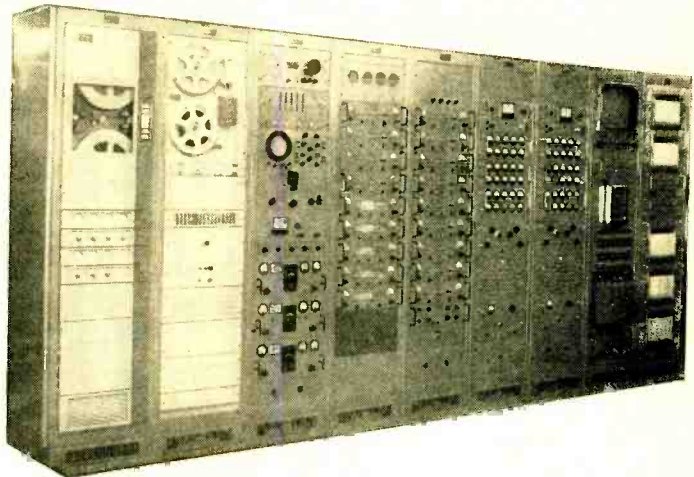
Final Link. At the ground station, specially designed antennas pick up the r.f. sig-



Cross section of telemetering pay load carried by the "Pioneer I." Although short-lived, the "Pioneer I" provided a great deal of data.



Ground installation is last link in telemetering chain. High-gain antennas, such as the 60' "dish" above by Radiation, Inc., feed signals into elaborate electronic "brains." First two racks of Parsons ground system at right contain tape recording equipment; in the third rack are receivers and test equipment; the next two hold bandpass filters and discriminators; racks 7 and 8 are demodulators and patch-panel racks; the next-to-last one contains oscilloscope and associated equipment; rack at far right holds five strip recorders.



nals which are demodulated, sorted out, and turned into understandable form. In some cases, the signals are decoded as fast as they are received; this is called "real-time" telemetering. Most of the information is recorded by tape recorders for later study. Some advanced telemetering systems feed selected information directly into computers for immediate processing, as mentioned above, making it possible to notify a pilot of danger developing before he is aware of its presence.

Because telemetering installations are usually tailored to a particular job, there are as many telemetering systems as there

are engineers with imaginations. But if you know the general principles involved, you will be able to understand any telemetering system with a little study.

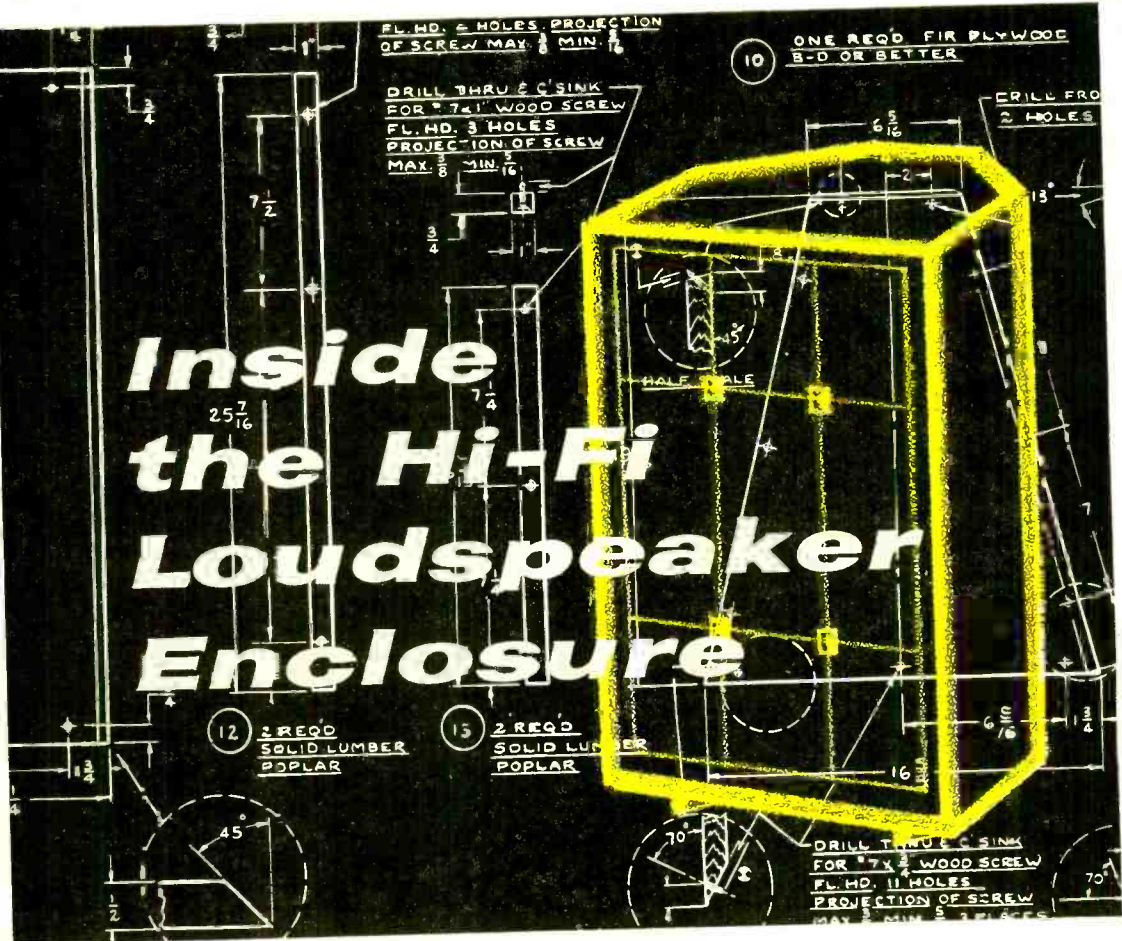
Problem and Solution. Let's take a typical telemetering problem and then follow through on its solution. Assume that we want to send up a missile for testing. Since it's doubtful that the missile will return to the ground in one piece, we must get the information we need while the missile is in flight. Suppose we want to know its angle of flight, speed, yaw and pitch rates, the level of gamma rays encountered by the missile, and various other measurable data.

Now, how do we get this information? We start by building a battery-powered FM transmitter into the missile. Then, if we have many measurements to send back to the ground, we can use a combination of two frequency-saving methods of feeding the transmitter.

First, we use *subcarrier oscillators* to create *multiplex subchannels*. Some systems use up to 18 subchannels—all of which can be handled by the same transmitter. For instance, if the first subcarrier oscillator (SCO 1) has a center frequency of 400 cps, a ± 2.5 -volt input signal from the sensing element will cause SCO 1 to vary from 370 to 430 cps. Accordingly, SCO 18 has a center frequency of 70 kc., and its output frequency will vary from 64.75 to 75.25 mc.

The outputs from the SCO's all modulate the FM transmitter simultaneously and the receiver on the ground sorts out and

(Continued on page 107)



Infinite baffle, bass-reflex, ducted-port, or horn? Here are some important facts on each **By JOSEPH MARSHALL**

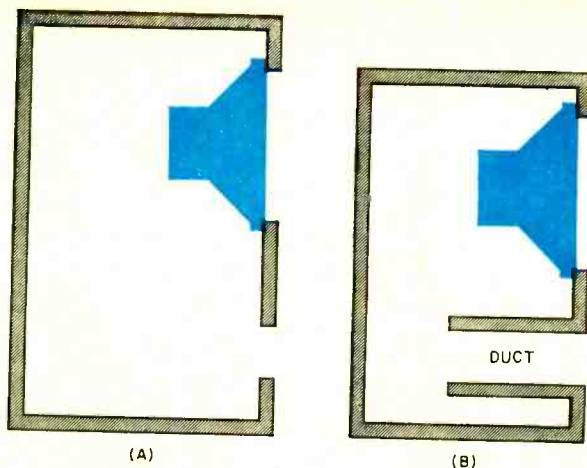
REGARDLESS of the quality of a loudspeaker, it won't sound good until it is mounted in a properly designed enclosure. As the cone of a speaker moves forward, it compresses the air in front of it and "rarefies" the air behind it. Waves longer than the distance from front to back are cancelled if the areas of compression and rarefaction coincide. This means that little useful low-frequency output can be produced by a speaker in free air.

To avoid this cancellation, the front and back waves must be separated by a dis-

tance of at least one-half the wavelength of the lowest frequency we want to hear. The ideal baffle would provide an infinite distance from front to back. But "infinity" is impossible to attain in practice; the closest approach to infinite baffling is most commonly achieved by mounting the speaker in a wall between two rooms. This kind of infinite baffle is, indeed, one of the best of all baffles.

Practical Infinite Baffles. In comparison with other types of baffling, the "between-the-rooms" method is inefficient on

Fig. 1. Bass-reflex enclosure (A) uses the speaker's back wave to augment its direct radiation. Ducted-port enclosure (B) works on the same principle and can be physically smaller than a bass-reflex enclosure which has the same resonance.



the bass end. On the other hand, compensation can be made for bass deficiencies by mounting two or more speakers close together. The mutual coupling provided by this technique boosts output at low frequencies by the square of the increase in piston area. In other words, two identical speakers close-coupled will have four times the low-frequency output of one speaker alone, and three will increase the low-frequency output nine times—theoretically, at least.

Since some landlords and wives take a dim view of having their walls cut into, a more common type of infinite baffle is simply a closed box, with only a single hole for the speaker. Although this enclosure is not a true infinite baffle, it does work well with some speakers and is used exclusively by such a top-notch speaker designer as Bozak.

The infinite baffle enclosure has only one major disadvantage. As the space behind the speaker is reduced, the air becomes harder to compress. This raises the speaker's resonant frequency and thereby limits the bass response of the system. The smaller the box, the greater this effect. The one way to keep a small speaker system's resonant frequency respectably low is to use in it a speaker with exceptionally high compliance.

Infinite Baffle Variations. This is exactly what Edgar Villchur did when he designed his revolutionary AR1 speaker system. Villchur first designed a special woofer with such high compliance that its free-air resonance was around 10 cps. Since the speaker itself had so little restoring force, a small totally enclosed box was

essential in order that the air inside the box could provide the necessary amount of restoring force. As is well known today, this rather unusual approach was very successful and the AR1 systems are capable of response to 30 cycles and even lower.

Other manufacturers have come up with somewhat similar designs. Jensen, KLH, JansZen, and others are successfully using the idea of high-compliance speakers in small enclosures.

Another very clever approach to infinite baffling has been made by H. H. Hartley, the British speaker designer. In his enclosures, Hartley hangs a whole series of sound-absorbing felt curtains behind the speaker. By the time the back wave reaches the last curtain, it has been almost entirely dissipated. Because the box is not solidly closed, the air inside it does not raise the resonant frequency of the system.

Bass-Reflex. A minor disadvantage of the infinite baffle is that it puts the back wave to no useful purpose. There are other enclosure designs, however, which do use the back wave to augment the direct sound from the front of the speaker. The "bass-reflex" enclosure in Fig. 1(A) is the most familiar.

Here we have a simple box, but in addition to the hole for the speaker, we add another hole, or "port." The internal dimensions of the enclosure are so designed that the speaker's back wave emerges from the port and reinforces the front wave. Increased bass output is the result.

The bass-reflex enclosure is a more complex acoustical device than the infinite baffle because it is a type of Helmholtz

resonator and has a resonant frequency of its own. In the early days, this self-resonance produced a coloration of the sound that many people disliked. However, by careful design and by matching the cabinet to the speaker, current bass-reflex enclosures use the resonator effect to partially cancel out the resonance of the

has been greatly accelerated by the stereo boom and the need for compact speakers. Some commercial systems which use the ducted-port principle are the University S-10, the Jensen TR-10, and the new Audax "Paraflex" systems.

Horn Enclosures. When you want to call over a long distance, it is almost in-

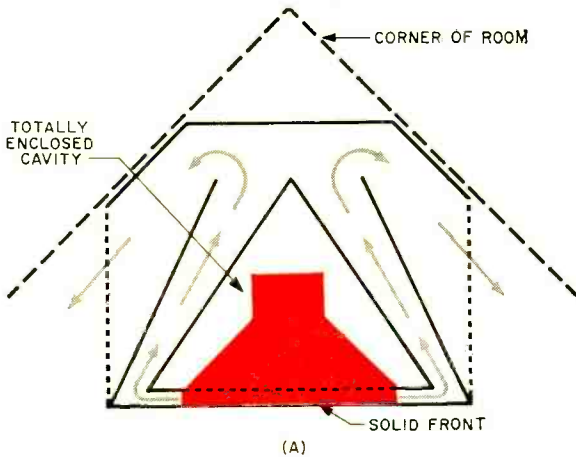


Fig. 2. Horn systems are both the most efficient and the bulkiest type of enclosures. The front-loaded horn (A) uses only the front radiation from the speaker. The back-loaded horn (B) radiates the front wave directly and horn-loads the back wave.

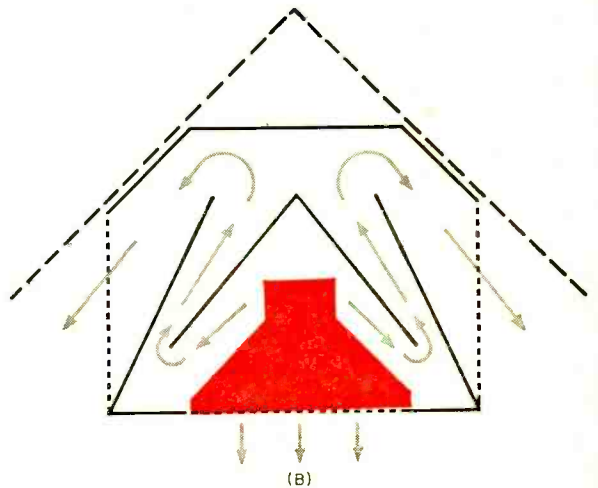
speaker, and thus make possible smoother reproduction.

Some manufacturers—notably Altec Lansing—think the bass-reflex is the best of all loudspeaker enclosures. A few of the better-known bass-reflex systems are the Altec Lansing "Corona" and "Laguna," the Stephens E-2 system, and Kingdom Products' "Audette" line.

Ducted-Port. The bass-reflex enclosure can be refined by adding a tunnel, or "duct," to its port. This variation of the bass-reflex is called a "ducted-port" enclosure. See Fig. 1 (B).

Adding this duct to the port lowers the resonant frequency of the enclosure. Thus a ducted-port enclosure can be smaller than a bass-reflex enclosure with the same resonance. By combining the ducted-port enclosure with a low-resonance speaker, good response to about 40 cps can be obtained in an enclosure of very small size.

The trend toward the ducted-port design



stinctive to cup your hands to your mouth. This increases vocal efficiency in two ways: it couples the vocal cords more effectively to the air, and it concentrates the sound in a narrower beam.

Horn loudspeakers operate on the same principle. The cone of the speaker is coupled to the air by an expanding horn, thus improving the efficiency. Horns can be up

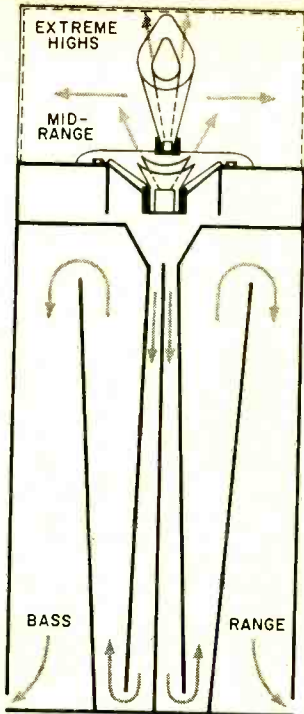


Fig. 3. Unusual approach to horn design is used in EICO HFS-2 system. Bass is radiated from slots which terminate dual conical horns. Mid-range and high frequencies are sprayed upward and outward from top of enclosure.

to 50% efficient. In comparison, the infinite-baffle and bass-reflex systems are usually only from 1% to 7% efficient.

To be effective at low frequencies, however, horns have to be long and big. The problem of length can be solved by folding the horn much in the manner that musical horns such as the trumpet and the trombone are folded.

The taper of a horn can take several shapes, varying from a straight, or conical, horn to such curves as the exponential and the catenoid. At one time, when horns were more popular than they are today, there were tremendous controversies as to which of these curves was best.

To radiate well at frequencies below 50 cycles, a horn must have a mouth diameter of from 6 to 10 feet, depending on the taper. A horn of this size would obviously be impractical for use in a home. By placing the horn in a corner, however, the walls, floor, and ceiling become extensions of the horn, and the entire room becomes the mouth of the horn. This technique is used in the design of horns for the home.

The most famous horn enclosure was developed just after the war by Paul Klipsch—and is called, appropriately enough, the "Klipschorn." This is a front-loaded horn,

that is, the front of the speaker works into the horn and the back into a closed box. The folds of the Klipschorn are extremely intricate, but the results are superb. Separate speakers, also loaded by horns, are used for the mid and high ranges. Other well-known horn systems using the front-loading principle are the Electro-Voice "Patrician" (also designed by Paul Klipsch) and the Jim Lansing "Hartsfield." See Fig. 2(A).

Back-loaded horns are also frequently used. In this type of system, the front of the cone radiates sound directly and the back wave from the speaker is fed into a folded horn. See Fig. 2(B). Examples of back-loaded horns are the Electro-Voice "Aristocrat" and the Jim Lansing "Harkness."

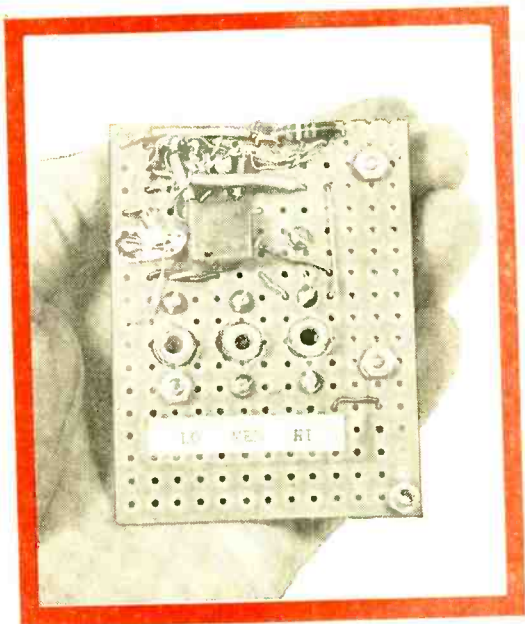
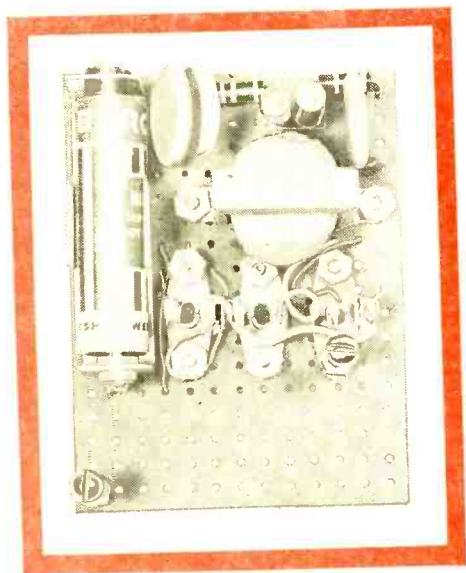
A new variation on the horn is the EICO HFS-2 system, designed by Stewart Hegeman. In this unusual enclosure, the back of the cone works into two folded conical horns. See Fig. 3. However, the horn mouths have only a narrow slot opening, providing a very wide radiation pattern. The front of the cone faces upward and also has a wide radiation pattern. The result is a speaker of excellent sound quality and with unusually wide dispersion.

Design Trends. Stereo has presented some special demands on speakers. Compactness, of course, is a great advantage when one has to fit two speakers into a room. Speaker enclosure designers have responded to the challenge by turning out small-sized systems with amazing sound qualities. The old rule of thumb, "The bigger the enclosure, the better the bass," is now becoming obsolete. There is no longer any necessary relation between the size of an enclosure and its ability to cover the bass range.

The most significant movement in enclosure design today is the trend toward enclosures for use with one specific speaker. This "togetherness" idea is particularly important because a speaker system sounds its best only when the speaker and the enclosure are matched to complement each other. Whereas in earlier years integrated systems were largely restricted to the more expensive models, today this design philosophy is resulting in higher performance speaker systems in every price range.

"Tune in" next month for a discussion of stereo cartridges—the different types available and the advantages of each. —30—

Sine-Wave Test Generator

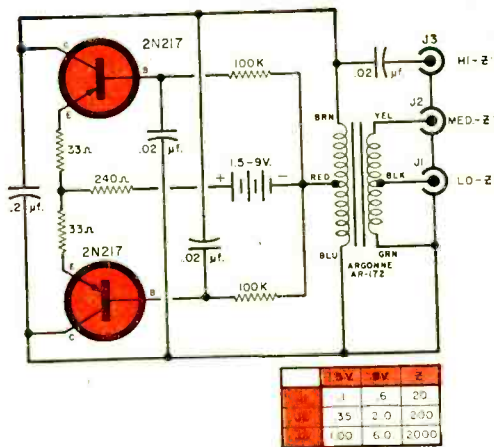


By
R. ZARR

MANY transistorized audio oscillators have been built and described, but few can boast a really pure sine wave. This Hartley oscillator circuit generates an undistorted 2-kc. signal suitable for operating bridges, hi-fi testing, filter experiments, etc. The push-pull feature eliminates even harmonics, increases the output to 5 mw., and reduces distortion. A choice of three distinct output impedances and voltages are available.

Listed below the schematic diagram are the approximate no-load voltages and output impedances for a 1.5-volt and a 9-volt battery supply. The drain is only 1.5 ma. with a penlight cell supply; it is 9 ma. with a 9-volt battery. Note the very low impedance at *J1*—nearly any low value of load can be connected here without appreciable voltage loss.

Components are not critical as to layout

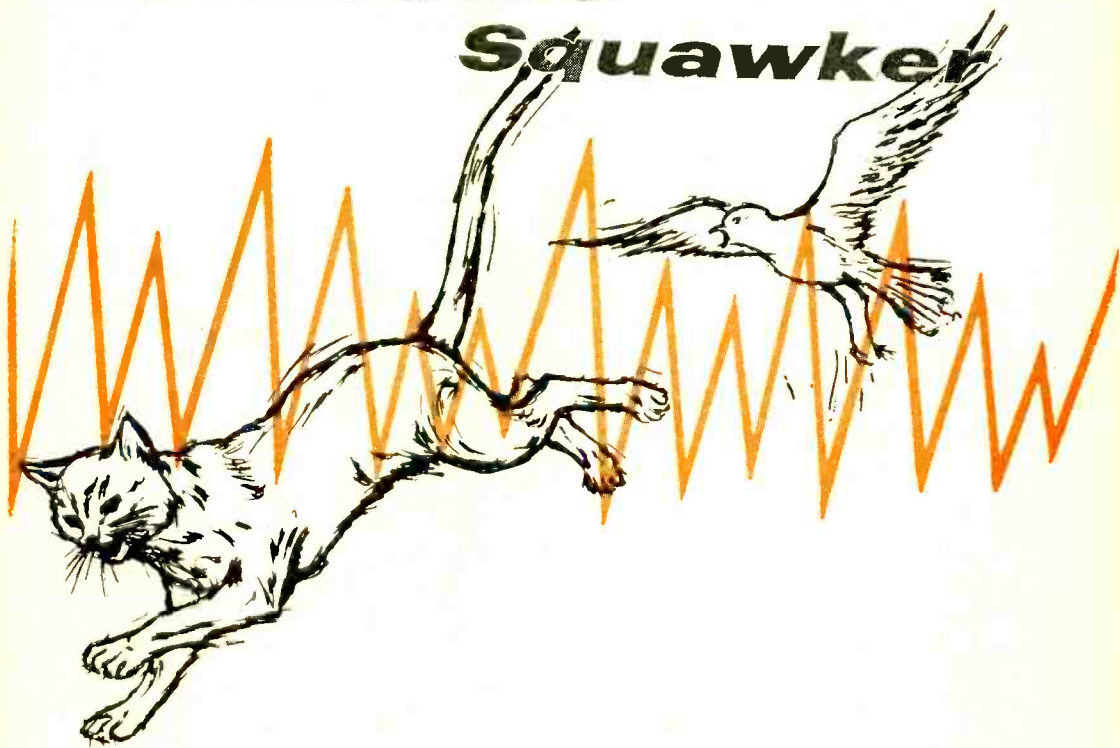


or value. Only the 240-ohm resistor may need adjustment; if it is too low for the transistors the waveform may suffer somewhat, and if it is too high the output will fall off. Frequency of operation can be lowered if desired by adding capacitance across the .2- μ f. capacitor.

The two RCA 2N217 transistors have flexible leads and fit into adjacent pins of a 7-pin in-line socket—each transistor uses three pins with the center pin unoccupied. For the battery supply, the author employs a holder into which a "Z" penlight cell can be slipped for low power or an RCA VS309 (9 volts) for high power.

-30-

Supersonic Squawker



EVER hear of "lo-fi"? Here it is—transistorized, battery-powered and frequency-adjustable. What's the purpose of lo-fi? Well, if you've ever been bothered by dog, cat, or bird congregations in your area—and wanted to shoo them off painlessly—then this lo-fi squawker is the answer to your prayers.

Construction. The complete unit is housed in a 3" x 5" x 9" metal cabinet and uses two modular subassemblies. Module A is the relaxation oscillator and module B the transistor oscillator. Both subassemblies and the tweeter are mounted on the front panel. The tone control and switch are mounted on the cabinet, which also contains the batteries.

Each module is wired on a 2½"-wide phenolic or Bakelite board. All components are mounted on the front sides of the boards except power transistor Q_4 , which is on the back of module B. Parts placement is not important, but the arrangement shown eliminates most crossing of wires. The non-power transistors and other components are mounted to the boards by

means of flea clips or copper pins. This method allows easy parts replacement, if necessary.

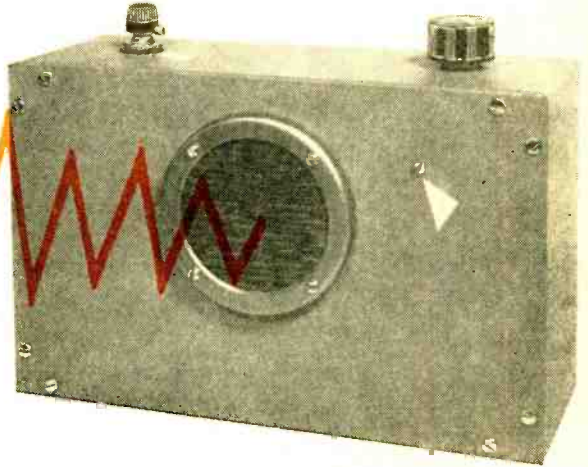
The upper right-hand and lower left-hand corners of module A should have eyelets or pins installed for connection to module B. Since the speaker has no provisions for mounting a transformer, T_1 is fastened to the bottom of module B. A simple bracket bolted to the inner bottom of the cabinet holds the batteries in position. Mount tone control R_4 and on-off switch S_1 on top of the cabinet.

Testing. After module A is wired according to the diagram, power may be ap-



Transistorized noise generator chases unwelcome guests

By I. C. CHAPEL



PARTS LIST

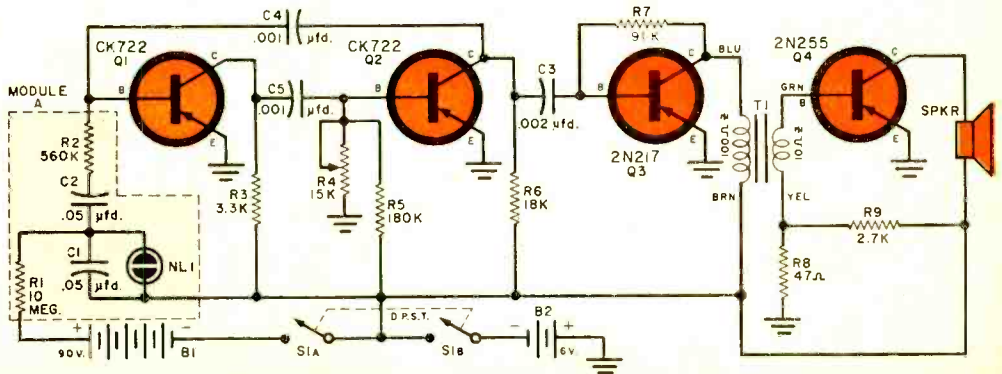
- B1—90-volt battery (three Burgess U20 batteries in series)
- B2—6-volt battery (Eveready 510S)
- C1, C2—.05- μ f. capacitor
- C3—.002- μ f. capacitor
- C4, C5—.001- μ f. capacitor
- NL1—NE-2 neon lamp
- Q1, Q2—CK722 transistor
- Q3—2N217 transistor
- Q4—2N255 power transistor
- R1—10 megohms
- R2—560,000 ohms
- R3—3300 ohms
- R4—15,000-ohm tone control
- R5—180,000 ohms
- R6—18,000 ohms
- R7—91,000 ohms
- R8—47 ohms
- R9—2700 ohms
- S1—D.p.s.t. toggle or rotary switch
- T1—Interstage transformer, primary 100 ohms, secondary 10 ohms (Stancor TA2 or equivalent)
- SPKR—Tweeter speaker with 16-ohm voice coil (Calrad CT-1 or equivalent)
- 1—3" x 5" x 9" metal cabinet

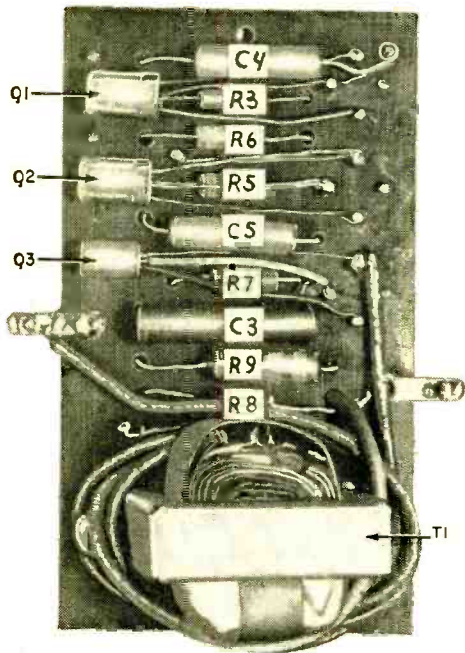
All resistors
1/2-watt
composition

HOW IT WORKS

Components C1, R1, NL1 and B1 comprise a relaxation oscillator that pulses at a rate (approximately 100 per minute) determined by the time constants of C1 and R1. This signal is applied to Q1 and Q2 which, together, operate as an audio oscillator. Potentiometer R4 controls the frequency of oscillation.

The combined output of the oscillators feeds a driver stage (Q3) which is followed by an interstage transformer (T1). This transformer feeds the 2N255 power amplifier (Q4), the output of which is connected to a direct-radiating 20-watt tweeter.





MODULE B

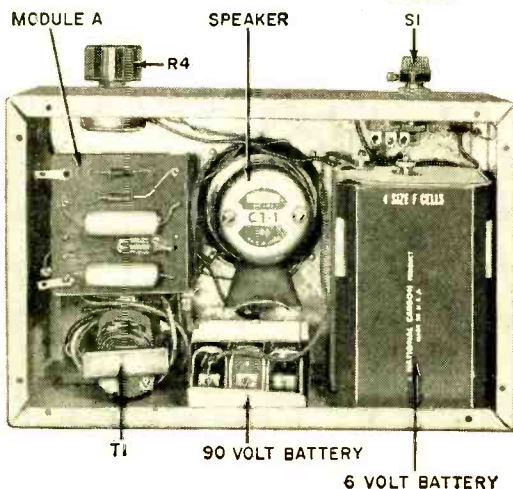
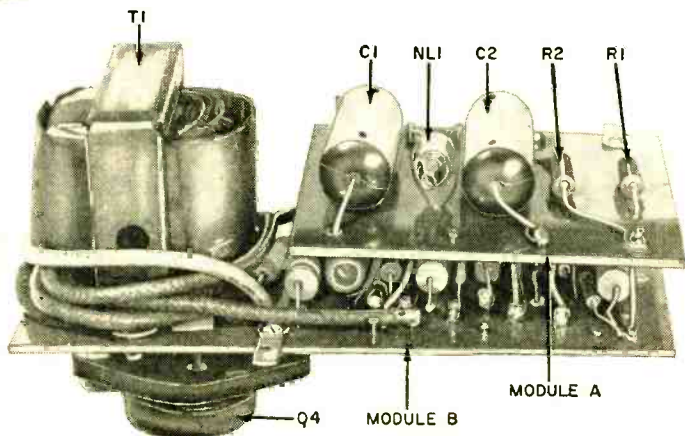
plied. This unit is complete within itself and can be tested without connection to the other circuits. The frequency of the transistor oscillator ($Q1$ and $Q2$) can be changed by variation of $R1$ and $C4$. The values given for $C1$ and $R1$ cause a pulse rate of about 100 per minute in the neon lamp relaxation oscillator.

Module B can be tested without connecting it to module A if a 100,000-ohm resistor is connected from the base of $Q1$ to ground. The power drawn by module B is about 90 ma. at 6 volts. The signal level, measured across the speaker voice coil is approximately 10 db.

-30-

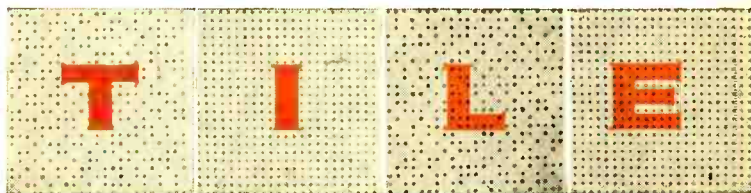
Parts arrangement of module B used here eliminates most crossing wires. Output frequency of the "Squawker" can be lifted into supersonic range by changing value of $C4$ and/or $R4$.

Subassemblies interconnected and ready to be installed in cabinet (right). Note mounting of power transistor $Q4$ immediately below transformer on module B.



Rear view of cabinet with back panel removed shows relative placement of major components. Use a larger cabinet if you find wiring or assembly too crowded.

ACOUSTICAL



How well does it work?



By
ANDREW LORANT

THE ACOUSTICS of a listening room are more critical for stereo than they are for mono reproduction. Poor acoustical conditions can completely destroy the stereo effect while a room with good acoustical characteristics can enhance it. A useful tool for controlling the acoustical characteristics of a room is acoustical tile, an inexpensive material that fits in with modern concepts of room decor.

To determine the practical effects of installing acoustical tile in a typical listening area, POPULAR ELECTRONICS has sponsored a special research study. Recently completed, this study was conducted in a basement room—such as may be found anywhere in the country—30 feet long, 11 feet wide, and 7½ feet high; the walls of the room were of concrete block construction, the floor asphalt tile.

Sound measurement tests under six different acoustical conditions were made, the results and interpretations of which are

given on the following pages. The measurement technique was as follows:

A General Radio Model 1551A Sound-Level Meter was placed on the center line of the room at distances of 3, 6, 9, 12 and 15 feet from two stereo speakers. Then, with only the left speaker producing sound, measurements of the sound level at each distance were taken, with the microphone of the sound-level meter alternately facing left and right, simulating a listener's left and right ears.

The sound source for the speaker was "white noise," the noise encountered between stations in tuning an FM radio. This sound source is useful in audio testing because it contains audio power which is evenly distributed over the entire audible frequency range. The white noise was played back from a tape and amplified by a high-quality amplifier.

Since the sound produced by the left stereo speaker should appear louder to the left ear than to the right ear, the object of the tests was to measure the difference in sound levels at the left and right ears when the room was treated with varying amounts of acoustical tile. The sound-level meter was placed with its mike 2½ feet from the floor.



TEST

1

Conditions: Ceiling covered with $\frac{1}{2}$ " Gypsum Board (plaster board) nailed against $1\frac{1}{2}$ " x $7\frac{1}{2}$ " joists, thus simulating an average "bare" room. (See photograph below.) Measurements to be taken with and without a thin 9' x 12' carpet on the floor.

| Without Carpet | | | | With Carpet | | | |
|-------------------|---------------------------|------------------|-----------------|-------------------|---------------------------|------------------|-----------------|
| Feet from Speaker | Sound Level (in decibels) | | | Feet from Speaker | Sound Level (in decibels) | | |
| | Left | Right | Difference | | Left | Right | Difference |
| 3 | 80 $\frac{1}{2}$ | 79 | 1 $\frac{1}{2}$ | 3 | 80 $\frac{1}{2}$ | 78 $\frac{1}{2}$ | 2 |
| 6 | 80 | 79 $\frac{1}{2}$ | $\frac{1}{2}$ | 6 | 80 | 78 $\frac{1}{2}$ | 1 $\frac{1}{2}$ |
| 9 | 79 $\frac{1}{2}$ | 79 | $\frac{1}{2}$ | 9 | 78 $\frac{1}{2}$ | 78 $\frac{1}{2}$ | 0 |
| 12 | 79 | 78 $\frac{1}{2}$ | $\frac{1}{2}$ | 12 | 78 | 78 | 0 |
| 15 | 78 $\frac{1}{2}$ | 78 $\frac{1}{2}$ | 0 | 15 | 78 | 78 | 0 |

Test Results

Observations: Since actual listening tests have shown that a difference in sound level of at least 1 db between the left and right "ears" is required for good stereo listening, the acoustically untreated room was deemed unsatisfactory for stereo at distances of more than 5 feet from the speakers. Placing the carpet on the floor resulted in slight improvement. The unsuitability of the room for music reproduction was further pointed out by the small degree of sound level fall-off from the front to the back of the room (there was an over-all sound-level difference of only 2 db as measured 3 feet from the speaker and 15 feet from the speaker).



TEST

2

Conditions: $\frac{1}{2}$ " perforated acoustical tile (standard design) cemented to Gypsum Board ceiling.

| Without Carpet | | | | With Carpet | | | |
|-------------------|---------------------------|------------------|-----------------|-------------------|---------------------------|------------------|------------|
| Feet from Speaker | Sound Level (in decibels) | | | Feet from Speaker | Sound Level (in decibels) | | |
| | Left | Right | Difference | | Left | Right | Difference |
| 3 | 78 | 75 $\frac{1}{2}$ | 2 $\frac{1}{2}$ | 3 | 78 | 75 | 3 |
| 6 | 78 | 76 | 2 | 6 | 77 | 75 | 2 |
| 9 | 76 $\frac{1}{2}$ | 75 $\frac{1}{2}$ | 1 | 9 | 75 $\frac{1}{2}$ | 74 $\frac{1}{2}$ | 1 |
| 12 | 75 $\frac{1}{2}$ | 75 | $\frac{1}{2}$ | 12 | 75 | 75 | 0 |
| 15 | 75 $\frac{1}{2}$ | 75 | $\frac{1}{2}$ | 15 | 75 | 75 | 0 |

Test Results

Observations: The stereo effect was now good up to 9 feet from the speakers, a substantial improvement over the results of Test 1. In addition, the total front-to-back attenuation increased to 2 $\frac{1}{2}$ db without the carpet and 3 db with the carpet.

TEST

3

Conditions: Same as for Test 2, but with temporary light draperies hung along entire left side of wall. (See photograph on next page.)

| Test Results | Without Carpet | | | With Carpet | | | | |
|--------------|-------------------|---------------------------|-------|-------------------|---------------------------|------|-------|------------|
| | Feet from Speaker | Sound Level (in decibels) | | Feet from Speaker | Sound Level (in decibels) | | | |
| | | Left | Right | | Difference | Left | Right | Difference |
| | 3 | 77½ | 75 | 2½ | 3 | 77 | 74½ | 2½ |
| | 6 | 77½ | 75 | 2½ | 6 | 76½ | 74½ | 2 |
| | 9 | 75½ | 75 | ½ | 9 | 75½ | 74½ | 1 |
| | 12 | 74½ | 74 | ½ | 12 | 74½ | 73½ | 1 |
| | 15 | 74 | 75 | -1 | 15 | 74 | 74 | 0 |



Observations: This test was undertaken to evaluate the possible effects of applying acoustical tile on the walls. Although no improvement was made without the carpet in place, the stereo range was extended to 12 feet with the carpet. At 15 feet from the speaker, the attenuation of the direct sound from the speaker was actually more than that of the reflected sound from the right wall and caused the peculiar reverse effect indicated by the measurements made at this distance.

TEST
4

Conditions: ½" acoustical tile cemented to Gypsum Board ceiling; wall behind speakers and rear half of each side wall covered with ¼" Weldwood from floor to wainscoting, with acoustical tile from there to ceiling.

| Test Results | Without Carpet | | | With Carpet | | | | |
|--------------|-------------------|---------------------------|-------|-------------------|---------------------------|------|-------|------------|
| | Feet from Speaker | Sound Level (in decibels) | | Feet from Speaker | Sound Level (in decibels) | | | |
| | | Left | Right | | Difference | Left | Right | Difference |
| | 3 | 81½ | 78½ | 3 | 80 | 77 | 3 | |
| | 6 | 80 | 78 | 2 | 6 | 78 | 76½ | 1½ |
| | 9 | 79 | 77½ | 1½ | 9 | 77½ | 76 | 1½ |
| | 12 | 78 | 77 | 1 | 12 | 78½ | 75½ | 1 |
| | 15 | 77 | 76 | 1 | 15 | 75½ | 74½ | 1 |

Observations: Again the stereo range was extended—this time to 15 feet. The front-to-back attenuation has also been improved, with the total attenuation at the left "ear" amounting to 4½ db (the difference between the sound levels at 3 feet and 15 feet); attenuation at the right "ear"—which previously had been negligible—increased to 2½ db.

TEST
5

Conditions: Same as for Test 4, but with the remainder of the side walls covered with ¼" Weldwood from floor to wainscoting, with acoustical tile from there to ceiling. (See photo on next page.)

| Test Results | Without Carpet | | | With Carpet | | | | |
|--------------|-------------------|---------------------------|-------|-------------------|---------------------------|------|-------|------------|
| | Feet from Speaker | Sound Level (in decibels) | | Feet from Speaker | Sound Level (in decibels) | | | |
| | | Left | Right | | Difference | Left | Right | Difference |
| | 3 | 79 | 76½ | 2½ | 3 | 78 | 75½ | 2½ |
| | 6 | 77½ | 76 | 1½ | 6 | 77 | 75 | 2 |
| | 9 | 76½ | 75 | 1½ | 9 | 75 | 74½ | ½ |
| | 12 | 75½ | 75½ | 0 | 12 | 75 | 75½ | -½ |
| | 15 | 75½ | 75 | ½ | 15 | 74½ | 74½ | 0 |

Observations: The installation of the remainder of the paneling resulted in disappointing measurements. Not only was the stereo range decreased to less than 12 feet from the speakers, but also the "reversal" effect, previously experienced in Test 3, showed up again between 12 and 15 feet. Obviously, reflection from the wood panels along the front half of the side walls was to blame. As replacement of the paneling would have been neither practical nor esthetic, a solution was sought by mounting the speakers slightly higher from the floor.



TEST

6

Conditions: Same as for Test 5, but with speakers 3 feet above floor.

| With Carpet, Microphone 2 feet above floor | | | | With Carpet, Microphone 4 feet above floor | | | | Test Results |
|---|---------------------------|-------|------------|---|---------------------------|-------|------------|--------------|
| Feet from Speaker | Sound Level (in decibels) | | | Feet from Speaker | Sound Level (in decibels) | | | |
| | Left | Right | Difference | | Left | Right | Difference | |
| 3 | 77 | 74½ | 2½ | 3 | 78 | 75 | 3 | |
| 6 | 76½ | 74½ | 2 | 6 | 77 | 75½ | 1½ | |
| 9 | 75 | 73½ | 1½ | 9 | 76 | 75 | 1 | |
| 12 | 74 | 72½ | 1½ | 12 | 75 | 73½ | 1½ | |
| 15 | 73½ | 72½ | 1 | 15 | 73½ | 73 | ½ | |

Observations: The higher placement of the speakers resulted in the extension of the stereo effect to 15 feet. Measurements taken with the microphone at 4 feet from the floor indicated that good stereo listening could be expected when the listener was seated in a chair of normal height.

The measurements under test conditions clearly show that the application of acoustical tile can improve the stereo characteristics of a listening room by increasing the amount of acoustical stereo separation. In addition, the improvement in the reverberation characteristics is also quite evident. While the reverberation was excessive in the untreated room (the reverberation time was 1.8 seconds at 500 cps), the finished room had a reverberation time of 0.3 second. Although this may be on the "short" side for a room with a monophonic system, it is very satisfactory for a stereo

listening room of about average dimensions.

To determine if your listening room will benefit from the installation of acoustical tile, you can make preliminary tests by hanging some old drapes on the walls. Aural judgment of the results will indicate whether treatment with acoustical tile would be desirable. In each installation, however, a compromise between optimum acoustics, esthetics, and practical considerations will usually be necessary.

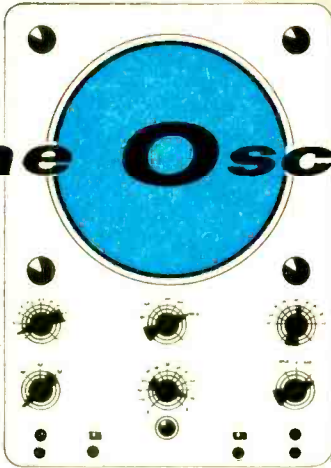
Next month, POPULAR ELECTRONICS will present various techniques for applying acoustical tile.

-30-



Test Instruments

The Oscilloscope



Part 3

Voltage Amplifiers

By LARRY KLEIN

Technical Editor

IN THE LAST two installments of this series, we checked into the operation of cathode-ray tubes and sweep oscillator circuits. Both elements were found to possess very special characteristics essential to the operation of the modern oscilloscope.

Let's return to the CRT for a moment. Although we haven't mentioned it before, lots of voltage is needed to swing a cathode beam across a tube face. Under typical operating conditions the usual tube requires about 50 volts on the deflection plates to move the spot one inch.

Considering this circumstance, how do we go about boosting an input signal (which may be less than one volt) to the voltage required for a 4"-high trace? The answer is simple—we amplify it. And here's where we come logically to an investigation of the oscilloscope's voltage amplifiers.

Simplest Circuit. Looking at an early, simple type of scope amplifier, we find a single high-gain pentode tube in a circuit like that of Fig. 1. As you see, there's very little difference at this level of development between a scope amplifier and any other high-gain amplifier.

The output voltage from the 6SJ7 is ap-

plied to one of the vertical deflection plates; the other plate is grounded. Notice that the vertical positioning potentiometer can apply either negative or positive (with respect to ground) voltage to deflection plate D_{v1} . When the pot slider is centered (at "0" voltage to ground), the spot should be centered vertically. The 4.7-megohm resistor isolates the positioning pot from the signal voltage.

There are certain inherent disadvantages in this circuit, however. Its frequency

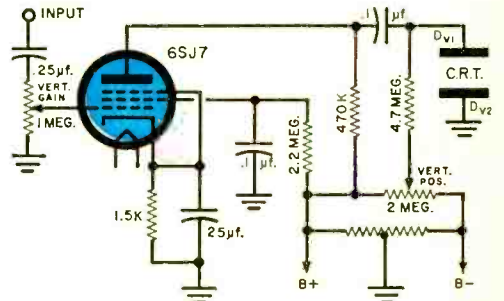


Fig. 1. Typical single-ended amplifier used in early scopes. Circuit has limited frequency response and low sensitivity.

Electronic Water Witch

***New electronic system
probes the earth
for underground water***

TRADITIONALLY, drilling for water has been a "hit-or-miss" affair. Water is hard to find, and luck is a well driller's most valuable asset. Recently, however, a new technique of finding water far underground has been developed which promises to take the guesswork out of well drilling.

Headed by Dr. Paul Kintzinger, a group of hydrology experts at the New Mexico Institute of Mining and Technology has devised a system of sending electronic "fingers" hundreds of feet below the sub-soil to search for underground water reserves. Not only does this modern "water-witching" rig report if water is there or not, it also tells the exact depth at which the water lies, and whether it contains undesirable chemicals.

Valuable Data. Such advance data is top-drawer information for the well driller and his customer. It eliminates the time and cost of drilling exploratory wells—or



Underground water is located by pulsing current into the ground and then measuring the decay rate of the pulse. The two outside electrodes "fire" the initial current into the ground for a period of about three seconds. The induced polarization decay potential is then picked up by the two inner electrodes and is fed into an integrator-recorder system. By measuring the rate of decay, scientists can determine if water is present, its chemical content, and how far down it is.

**By
ROBERT M. HYATT**

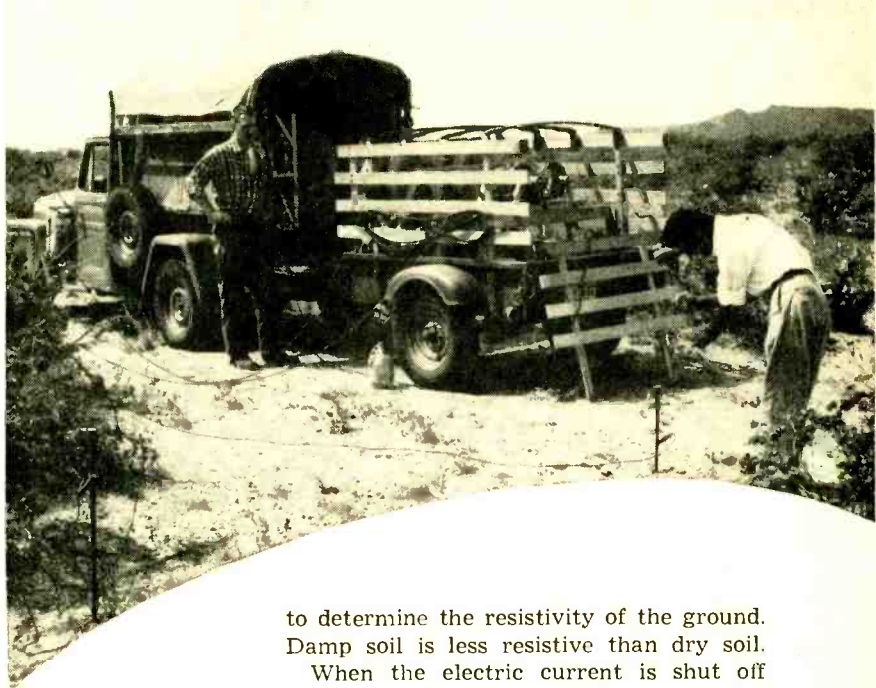
one with a flow of "bad" water, unfit for domestic, agricultural, or industrial use. Also, knowing beforehand just how deep he must go allows the driller to establish a cost figure in advance of drilling.

Dr. Kintzinger began pioneering in electronic water finding about 1953, and now heads the water research program at the New Mexico school. It was here that he and a few other specialists developed their

with power-driven reels of cable hauled in a small trailer. From 300 to 600 volts from a generator driven off the jeep's engine are shot into the ground through the outer electrodes. After about three seconds, the current is turned off momentarily and is then pulsed again, but this time in reverse polarity.

As this voltage "plays" through the soil, it is measured by the two inner electrodes

"Water-witching" rig is transported by a jeep and a trailer. More compact commercial units may become available shortly.



technique, known as *induced electrical polarization*.

The theory is not new. Since it was first observed before 1920 by Conrad Schumberger, various methods of employing electricity and polarization have been used extensively in ore and oil exploration. But this is the first time the idea has been applied successfully to water finding.

Electronic Fingers. The mechanics of Dr. Kintzinger's process are comparatively simple. Four electrodes are driven into the ground like tent pegs equally spaced in a straight line. They may be placed a few feet apart or several hundred feet apart. The two outer electrodes serve as "positive" and "negative" poles in the circuit.

The entire apparatus is housed in a jeep,

to determine the resistivity of the ground. Damp soil is less resistive than dry soil.

When the electric current is shut off after each three-second pulse, a strange phenomenon occurs. Instead of dying abruptly, the pulse "hangs fire," or decays gradually. The two inner electrodes relay a record of this decay rate to a tape recorder. Then, analysis of the tape tells the water hunters if water is present, how far down it is, its purity, etc.

A comprehensive test can often be made in an hour or two. Tests have been conducted in several arid portions of the Southwest, as well as sections of the Middle East. If the first test draws a blank, the operators move the rig to a new location and probe until water is found. The time and cost of such tests are negligible when compared to drilling exploratory wells.

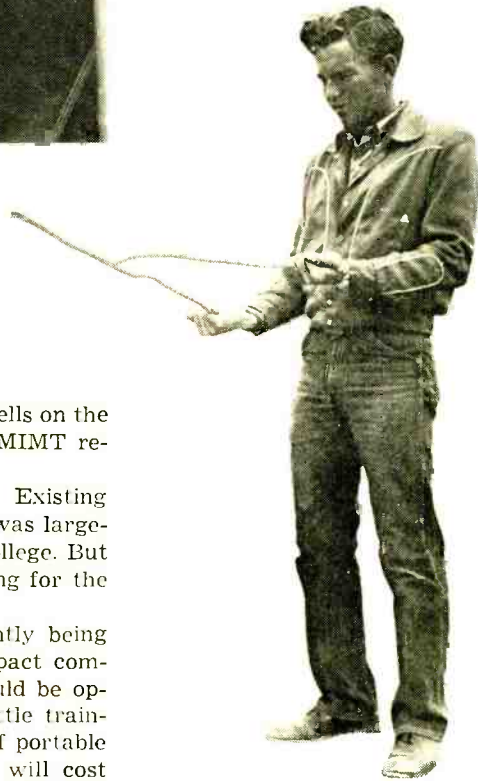
Scores of field tests have proved the efficacy of the technique. The cities of Alamogordo and Carrizozo in New Mexico



water may be the answer to the need for reclamation of vast areas of the earth's arid and unproductive regions. Many countries are acutely concerned with the problem of how to supplement their water reserves—and even how to locate them.

A distinguished educator from the Middle East, after hearing about this technique of finding water, told Dr. E. J. Workman, president of NMIMT, "If you can do this in my country, you can do a greater service than all the economic and cultural aid programs now in progress." —30—

Modern-day "water witch," Dr. Paul Kintzinger, looks over part of his electronic water-finding gear.



successfully drilled their water wells on the basis of findings made by the NMIMT researchers.

Commercial Possibilities. Existing equipment of the water hunters was largely dreamed up and built at the college. But several firms are already dickering for the manufacturing rights.

Whereas the apparatus presently being used is rather sprawling, a compact commercial rig is visualized that could be operated by persons with only a little training. It is believed that a foolproof portable unit will soon be available that will cost about \$2000 and can be hauled on a small cargo trailer. The generator will be driven by a small gasoline engine.

The field for such a unit is widespread. Probable purchasers of such units will be well-drilling companies, irrigation system builders, farm and ranch owners, etc.

World-Wide Reclamation. This revolutionary method of locating underground

Traditional water-witching technique is displayed here by Harley Park, Dr. Kintzinger's assistant. The willow twig he is holding is supposedly sensitive to the "vibration" of underground water.



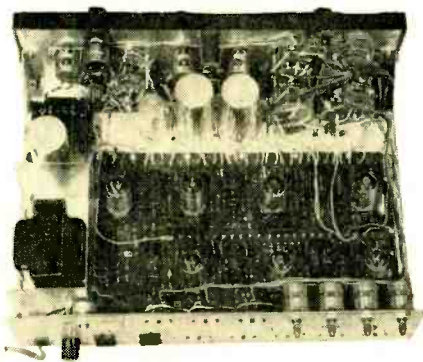
Stereo Control Center Kit

THE Lafayette KT-600 stereo control preamplifier is perhaps the most elaborate piece of hi-fi equipment to appear in kit form. It features 18 front-panel controls plus five more in the rear, for the fantastic total of 23 controls in all. Dual concentric controls for 12 front-panel control functions simplify the appearance of the front panel, however.

Everything about this kit is done on a grand scale. The circuit employs no less than seven tubes; every conceivable control and switching function is included; even the assembly manual is awesome—it is some 80 pages long and weighs in at slightly less than one pound!

Since the assembly manual is so complete and detailed, there's little chance of making a mistake in putting the unit together. The explicit step-by-step instructions and giant pictorials will enable even the novice to assemble the kit with little difficulty. Printed-circuit boards further reduce the possibility of wiring errors.

The constructor is advised to take his time, however. This is not a particularly difficult kit to put together, but it does require a considerable amount of time—perhaps 20 hours or so. The best plan of attack is to spread your labors over a period of a week or two, never working more than three hours per session. This



Lafayette KT-600 provides facilities for complete mono and stereo control

technique will prevent errors caused by sheer fatigue creeping in.

The circuitry is very interesting, and in some ways it is unique. Basically, it consists of twin preamplifier circuits, each employing three dual triodes. This accounts for six of the seven tubes. The other tube, also a dual triode, provides phase reversal for one channel and functions as the output stage

for the "third channel" output—a circuit which combines both stereo channels for use in driving an extra amplifier-speaker system to fill in the "hole in the middle," or excessive stereo separation.

An unusual calibration circuit is employed which allows the user to balance out the entire system accurately by ear. This circuit plays one channel against the other out of phase, and then the level controls for the two stereo channels are adjusted until *minimum* sound is heard from the speakers. Thereafter, no adjustment for inter-channel balance is necessary.

In use, the KT-600 performs in exemplary fashion. Not only do the controls do everything they are supposed to do, but distortion is so low as to be insignificant. Sound quality was judged to be excellent. The manual provides very complete instructions for connecting the KT-600 in a stereo system and for using it to best advantage.

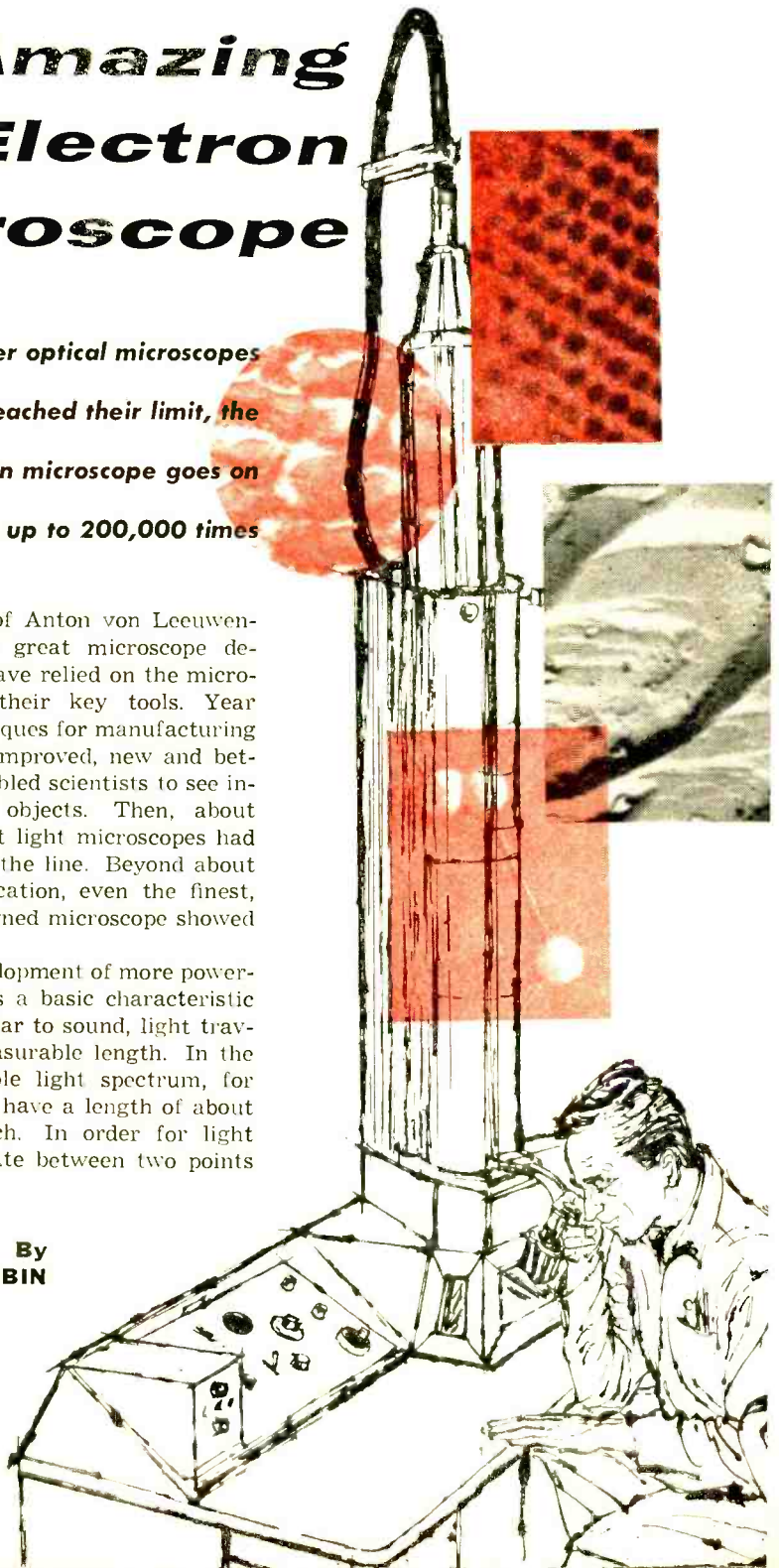
The Amazing Electron Microscope

*Long after optical microscopes
have reached their limit, the
electron microscope goes on
magnifying . . . up to 200,000 times*

SINCE the time of Anton von Leeuwen-
hok—the first great microscope de-
signer—scientists have relied on the micro-
scope as one of their key tools. Year
after year, as techniques for manufacturing
optical glass were improved, new and bet-
ter microscopes enabled scientists to see in-
creasingly minute objects. Then, about
1890, it seemed that light microscopes had
come to the end of the line. Beyond about
2000 times magnification, even the finest,
most perfectly designed microscope showed
only a fuzzy blob.

Blocking the development of more power-
ful microscopes was a basic characteristic
of light itself. Similar to sound, light trav-
els in waves of measurable length. In the
middle of the visible light spectrum, for
example, the waves have a length of about
6/250,000 of an inch. In order for light
waves to differentiate between two points

By
MORRIS M. RUBIN



of an object, they must be separated by about one-third the length of a light wave, or about 2/250,000 of an inch. Objects smaller than about half a wavelength cannot be magnified clearly by a light microscope, no matter how perfect its lenses.

Scientists reasoned that since the basic difficulty was caused by the relatively long wavelengths of "ordinary" light, if it were possible to employ some type of light which had shorter wavelengths, greater useful magnification could be achieved. This possibility was explored, and by utilizing *ultraviolet* light (which has a wavelength only one-third that of visible light), microscopes were designed which could magnify up to

the same way light is bent and refracted by optical lenses.

Therefore, it seemed logical that light, the limiting factor in the process of magnification, could be replaced by a stream of electrons which would have a much shorter wavelength and so would allow greater magnification. With this important concept under their hats, scientists began work on the design of an electron microscope.

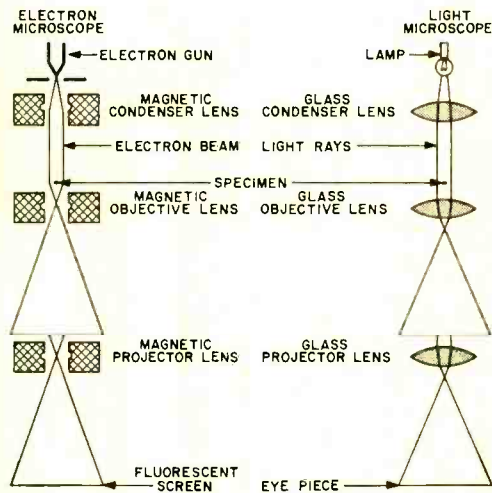
By the late 1930's, experimental microscopes were in operation in Europe, Canada, and the United States. And then, in 1940, RCA marketed the first commercial American electron microscopes. These initial instruments, though crude by present-day standards, were fantastically superior to the best light microscopes ever produced.

Whereas even an ultraviolet microscope was limited to a magnification of 5000 times, these early electron microscopes were capable of enlargements of 100,000 times. Today's models magnify more than 200,000 times—enough to see an object *one-millionth* the diameter of a human hair—and by enlarging the image still further by photographic means, useful magnifications of over one million diameters are possible!

Electrons Replace Light. Similar in principle to light microscopes, the electron microscope uses a series of lenses to magnify the specimen in a step-by-step process. But while a light microscope uses glass lenses to bend light rays, the electron microscope's "lenses" are coils of wire—similar to the deflection coils of a television set—which bend and deflect a stream of electrons.

The operation of the electron microscope as compared with a light microscope can be quickly grasped by referring to the diagram at the left. Electrons emitted by the electron gun pass through the condenser lens which concentrates the beam of electrons on the specimen. Since the specimen has been sliced so thin as to be partially transparent, the electrons pass through it in varying numbers depending on the density of the specimen at any one point. Thus a pattern of varying electron densities is produced.

Although this pattern is invisible to the eye, it could be shown by placing a fluorescent screen below the specimen. In practice, however, the electrons pass through the objective lens, which provides the first step of magnification. Just before they



Comparison of electron microscope and ordinary light microscope. The basic principles are the same, but the electron microscope uses coils of wire to deflect and focus an electron beam magnetically rather than glass lenses to bend and refract light.

5000 times, over double the limit of visible-light microscopes.

At this point, the light microscope reached the zenith of its design capacities. If scientists wanted more magnification, they had to find a new way of getting it.

Electrons to the Rescue. The theory of the electron microscope was suggested in the 1920's. Experiments showed that electrons acquired a measurable characteristic wavelength when they were speeded up by subjecting them to high-voltage fields. The higher the voltage, the greater was the velocity of the electrons, and the shorter became the apparent wavelength. Further, it had been proven that electrons could be bent or refracted by magnetic fields in much

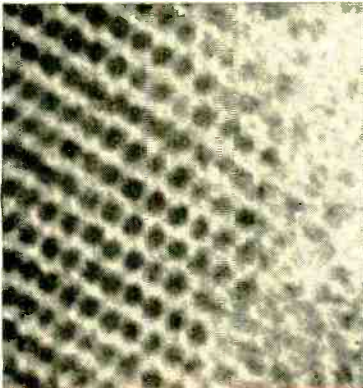
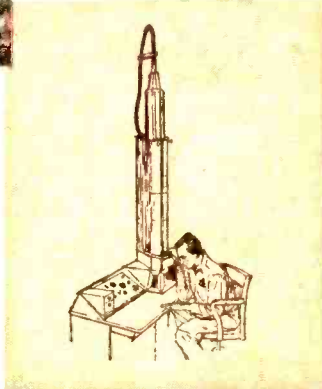
Can You Identify These Pictures?

All were taken with the aid of an
electron microscope

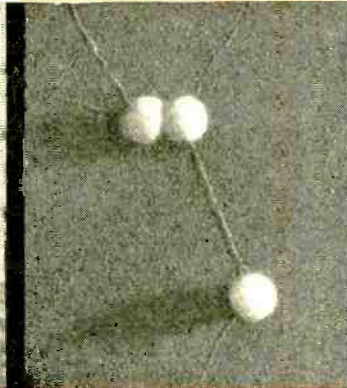
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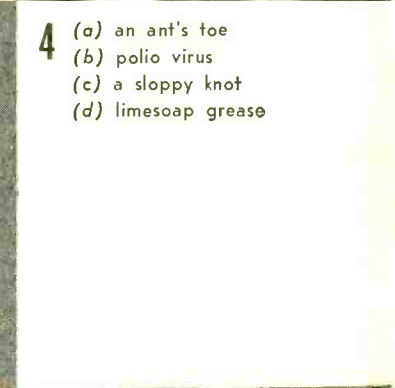
- 1** (a) metal surface
(b) human skin
(c) leather
(d) wool rug



- 2** (a) wing of a fly
(b) moon craters
(c) protein molecule
(d) cellulose fiber



- 3** (a) lead carbonate
(b) golf balls
(c) nucleic acid
(d) cotton balls



- 4** (a) an ant's toe
(b) polio virus
(c) a sloppy knot
(d) limesoap grease



- 5** (a) Sahara Desert
(b) silk fiber
(c) quartz
(d) Monday morning
at Coney Island

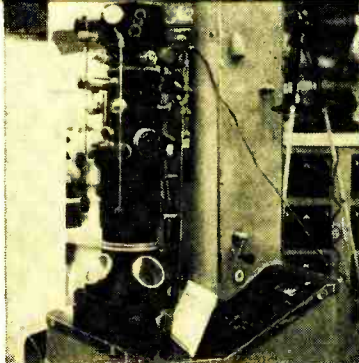
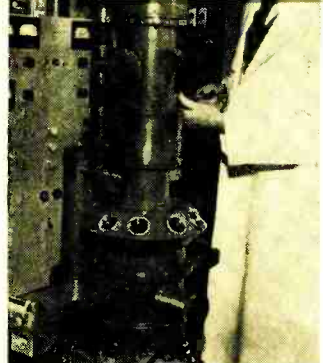
1. (a); total magnification 160,000X; courtesy of Philips Electronics, Inc.
2. (c); total magnification 425,000X; courtesy of College de France and RCA
3. (c); total magnification 112,000X; courtesy of Dr. C. E. Hall, M.I.T.
4. (d); total magnification 68,000X; courtesy of Esso Research & Engrg. Co.
5. (c); total magnification 14,680X; courtesy of Dow Chemical Co. and RCA



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Co-inventor of the first RCA electron microscope, Dr. James Hillier, is shown at left with RCA's Model EMB, marketed in 1940. At right is a 1959 Russian unit exhibited at the recent Soviet Exhibition in New York.

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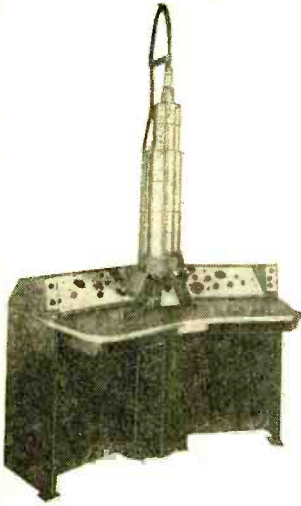
POPULAR ELECTRONICS

434 S. WABASH AVE.
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view objects that are any thicker—the wing of a fly, for example.

The solution to the latter problem has been the development of special devices that can carve off slices of the object to be viewed which are thin enough to allow the passage of electrons. It's easy to see (Continued on page 111)



Two of the most widely used electron microscopes are shown here. At left is the RCA EMU-3, capable of 200,000X magnification. Above is the Norelco EM100B, which magnifies to 90,000 times.

reach the projector lens, a "spread-out" representation of the density pattern is formed, the center area of which is then further magnified by the projector lens.

The enlarged specimen can be viewed directly on a fluorescent screen (which looks and works like a television screen), or the image can be photographed by special cameras—usually built right into the electron microscope. Enlargement of the resulting photographs allows further magnification of the specimen.

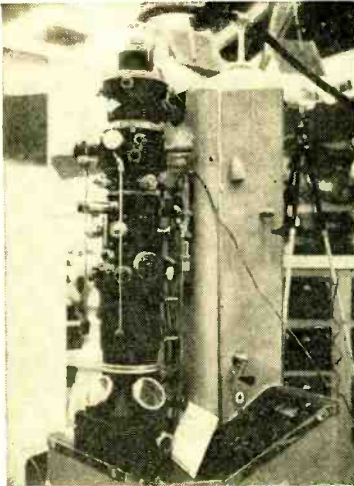
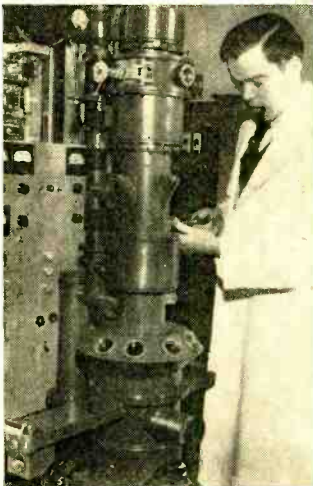
Price Tags. In addition to its optical system, an electron microscope must have an ultra-stable high-voltage supply and a highly efficient vacuum system. This com-

plexity accounts for the big price tags on today's electron microscopes—from \$12,000 to \$40,000, depending on the magnification desired, the make, etc.

Norelco (Philips of Holland) and RCA are the largest producers of these units. Also active in the field are manufacturers in Germany and Japan. And the Russians have gotten into the act, too, by producing an electron microscope which seems to be an adaptation of a 1940 RCA model.

Limitations. Useful though the electron microscope may be, it still has its limitations. Since the high-voltage electrons are fatal to living organisms, the electron microscope cannot be used to view live bacteria, viruses, etc. Also, the beam of electrons can't penetrate more than 1/25,000-of-an-inch, so the electron microscope cannot be used to view objects that are any thicker—the wing of a fly, for example.

The solution to the latter problem has been the development of special devices that can carve off slices of the object to be viewed which are thin enough to allow the passage of electrons. It's easy to see
(Continued on page 111)

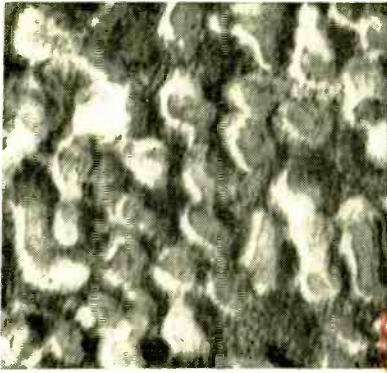


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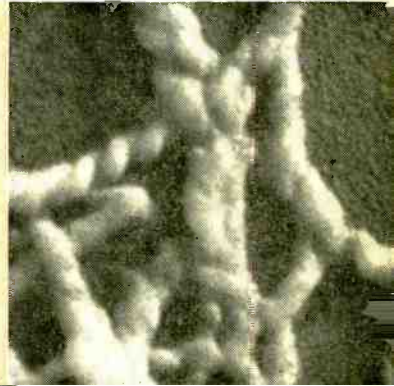
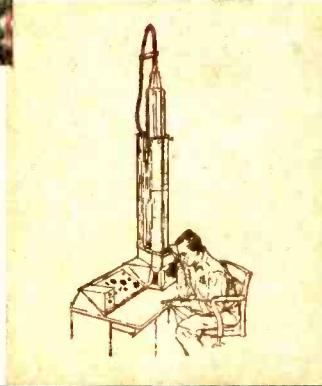
Can You Identify These Pictures?

All were taken with the aid of an electron microscope

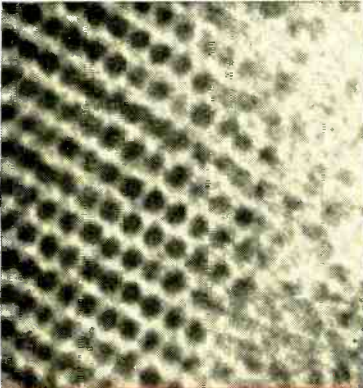
(answers are at bottom of page)



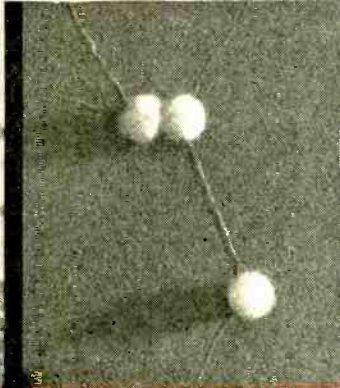
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YOUR ANTENNA—



KEY TO WORLD-WIDE DX

A SHORT-WAVE receiving set brings the whole world right into your home. Listening to broadcasts from distant lands affords not only a challenge and technical thrill but gives you a general education as well. Despite the propaganda and slanted news you sometimes hear, you develop a better understanding of foreign countries, their people, and their problems. Short-wave radio offers good music, plays, and other enjoyable programs, and it enables

you to study foreign languages first hand.

You can enjoy more short-wave programs if you plan your antenna installation carefully. One of the keys to consistent long-range reception is a directional antenna. Its orientation is often the prime factor in receiving hard-to-get stations or in improving the general performance of your listening post. Even a very simple antenna can provide an improvement in signal strength and reliability if it is

*How to plan your antenna installation to pull in those
hard-to-get foreign stations*

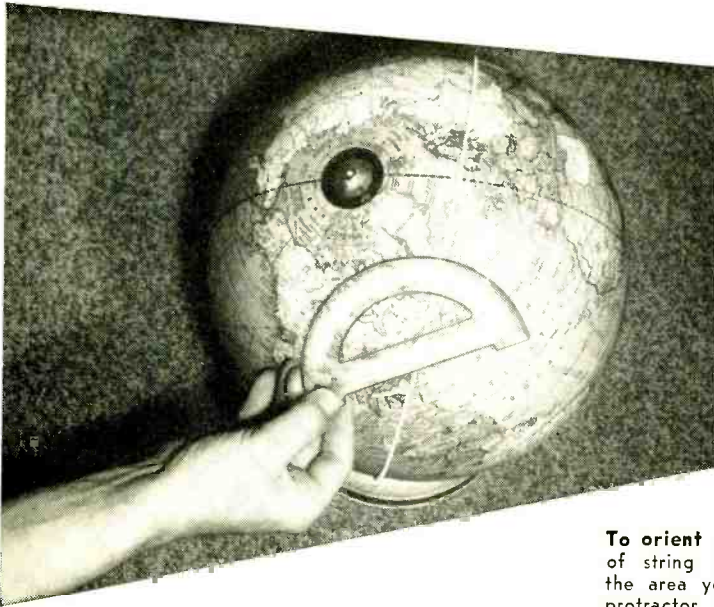
By **EDWARD M. NOLL**

“aimed” in the right direction. Also, a highly directional antenna can eliminate pickup from unwanted stations.

The Shortest Path. A short-wave signal takes the shortest path around the earth. But here it's easy to become confused. For example, a flat map would seem to indicate that the shortest route from, say, Chicago to Moscow would be eastward across the

On the higher 17 – 21 mc. bands, the same antenna becomes an approximate $3/2$ -wavelength type and the sensitivity pattern takes on a clover-leaf shape with a narrow “8” at its center.

Typical sensitivity patterns for half-wavelength, full-wavelength, and $3/2$ -wavelength dimensions are illustrated. Using these patterns, you can determine if a loop



To orient your antenna, tape a piece of string between your location and the area you want to pick up. Use a protractor to get the bearing in degrees from true north or magnetic north.

Atlantic and then across Europe. But reference to a globe would quickly show the shortest path to be over the North Pole.

Consequently, you don't put up a receiving antenna with maximum sensitivity toward the east when you want to pick up Europe and Asia. You turn the antenna toward the shortest route as the crow flies—north, over the top of the earth.

Choosing an Antenna. You may have noticed that most signals picked up from one direction are on one band while signals from another direction are on a different band. The explanation for this is simple. The directional sensitivity of any fixed-length antenna changes with frequency.

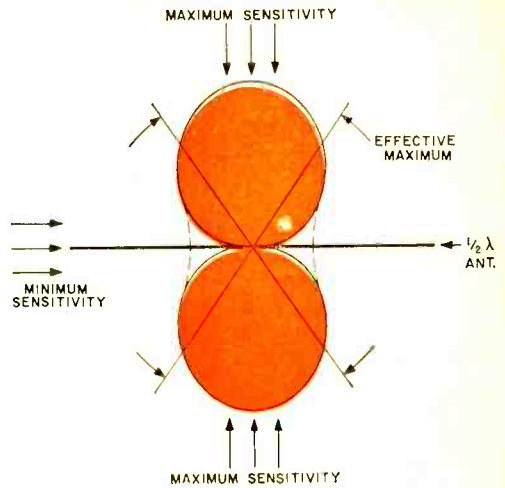
For example, a half-wavelength antenna at 6 – 7 megacycles has a figure-eight sensitivity pattern. However, the very same antenna has a nearly full wavelength dimension in the 11 – 15 megacycle spectrum and has a “four-leaf clover” sensitivity pattern.

or a null faces the direction from which you wish to receive a special station.

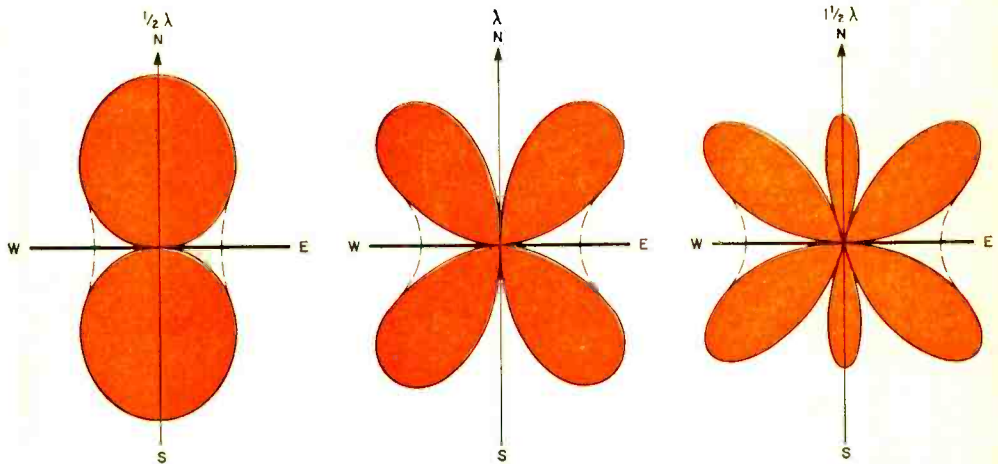
It is important to remember that once the electrical length of an antenna exceeds $3/2$ -wavelengths it acquires many narrow sensitivity lobes. These multiple lobes make for spotty directional performance. In one direction there may be good sensitivity while just 10° to 20° on either side the response may drop off to almost nothing. In this case, one never knows if a loop or a null faces the desired direction.

Antenna Construction. Cut your antenna to meet your particular requirements. Some short-wave listeners prefer to cut the antenna to the lowest frequency band in which they are interested. Thus they have a figure-eight pattern on this band and a severely lobed pattern does not

Effective maximum pickup angle for a half-wave antenna is about 75° in each sensitivity lobe. Pattern in dashed area varies with height of antenna above ground and other factors.



The **sensitivity pattern** for the same half-wave antenna (below, left) changes when it is used to receive signals on twice the frequency (center) and three times the frequency (right).



develop on the highest frequency band.

Some typical *half-wave* ($\lambda/2$) antenna lengths for use on the short-wave bands are: 62.4 feet at 7.5 mc., 52 feet at 9 mc., 42.5 feet at 11 mc., 31.2 feet at 15 mc., 27.5 feet at 17 mc., and 22.3 feet at 21 mc. Note that one half of the length given is located on each half of the center feed point of a dipole antenna. Use 72-ohm coax for leadin.

If mounting space is available, you may want to consider installing two antennas. The low-frequency version can be erected and oriented for good general coverage and perhaps to emphasize your favorite low-frequency s.w. stations. A shorter antenna can be used for the high-frequency bands.

Orienting Your Antenna. Lining up your antenna to get the signals you want is a simple matter if you use a world globe

and a piece of string. Tape the string between your location and the city, country, or continent you wish to hear. Note the bearing from your location to the point you have selected in relation to true north. A protractor will be handy in reading the bearing in degrees.

Next, locate true north at your antenna mounting site. Use an accurate road map, courthouse or city-hall map to do this. Or true north can be found by shooting the North Star at night or the shadow of the high noon sun. A magnetic compass could also be employed; but remember that a compass points to magnetic north rather than true north.

Finally, erect your antenna for maximum sensitivity toward the stations you want to pick up.



New FM TUNER Kit

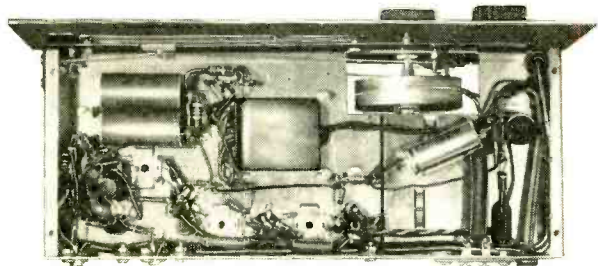
ALTHOUGH we have no statistics to prove it, we'll bet that there are as many Heath FM-3's in operation as any other FM tuner ever made. The FM-3 brought hi-fi into countless homes for the first time. Though perhaps not the most sensitive tuner in the world, nobody could deny that it was (and is) a whale of a tuner for \$26.95. Now, apparently in response to requests for a more sensitive unit, the Heath Company (Benton Harbor, Mich.) has come out with the FM-4, a tuner that boasts a sensitivity of 2.5 microvolts for 20 db of quieting.

The FM-4 kit sells for a few dollars more than the FM-3, but it's well worth it if you need the extra sensitivity. In addition, the FM-4 has a.f.c. and is actually easier to put together than the FM-3.

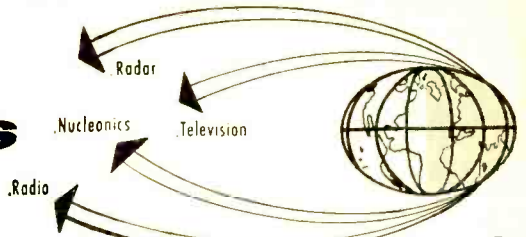
Perhaps the most interesting feature of the FM-4 is its pre-wired factory-aligned front end. The heart of this unit is a dual-triode 6DTS, one section of which functions as a grounded-grid r.f. amplifier and the other as an oscillator-converter. In combination with two i.f. stages and a ratio detector, this tuning circuit really pulls in the stations. And for the home builder, it has two very important advantages: (1) it reduces the time required to assemble the tuner by about one-third, as compared with the time needed to put together the same tuner without the pre-wired front end; and (2) it practically eliminates any alignment problems.

Just under ten hours was required to assemble the FM-4 model we checked out, and only basic tools were needed. With no touch-up of the alignment, 18 local FM stations in the New York area were picked up, most with excellent fidelity. The finished kit not only worked well, but was noteworthy for its attractive appearance.

Heath FM-4's pre-wired tuning unit insures ease of assembly



After Class



By
FORREST H. FRANTZ, SR.

TRANSDUCERS

Part 2—Parameter Changers

LAST MONTH we talked about the class of transducers most familiar to the electronic hobbyist—voltage generators. This category covered loudspeakers, speedometers, roughness gauges, etc. The other major class of transducers is comprised of “parameter changers” which vary resistance, capacitance or inductance when subjected to non-electrical forces.

Resistance-varying transducers include among their ranks a number of units having different purposes. It is known that the resistance of a conductor varies with temperature. If a resistance thermometer is connected in a Wheatstone bridge circuit calibrated in degrees, the change in resistance with temperature is readily measured. The advantages of large temperature range and remote indication should be apparent, particularly in trying to monitor a satellite.

“Micro-meteorites” are particles of space “dust” so small as to be unavoidable but possibly large enough to “erode” holes in a space ship or space suit. Space scientists use another kind of resistance-varying transducer—the *erosion gauge*—to investigate the danger involved. When installed in a space satellite, this gadget modulates a signal broadcast back to earth based on resistance change. The more micro-meteorites encountered, the faster a conductive coating on a plate wears away and increases in resistance.



Internal resistance of these Clairex photocells changes with amount of light falling on them.

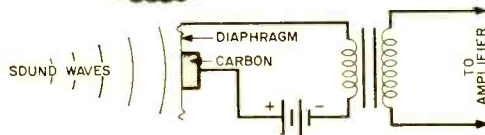


Fig. 1. Operating circuit of a carbon microphone (such as Elgin National unit at left) which varies its internal resistance under the impact of sound waves.

The carbon microphone operates on much the same principle as the erosion gauge. Sound waves vibrate a diaphragm attached to a small container of carbon granules. The changing resistance which occurs when the carbon grains get “all shook up” is easily translatable to current changes in a transformer primary. See Fig. 1.

Variation of resistance is also the basic

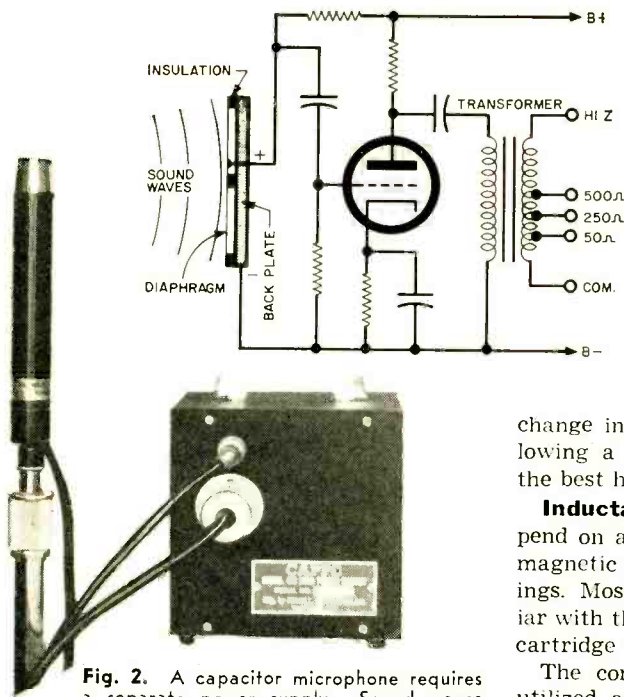
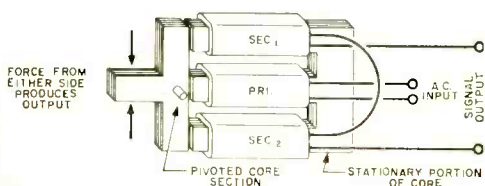


Fig. 2. A capacitor microphone requires a separate power supply. Sound waves impinging on the microphone diaphragm cause variation in the charge on the plates at an audio rate, and this potential variation is fed to the input grid of a triode. The unit shown above is a Capps CM2001.

principle on which the strain gauge—used to measure strains in materials—operates. The resistance strain gauge consists of a length of fine wire fastened to a paper backing. The gauge is cemented to the specimen under test, and as the specimen is stressed, the wires stretch, causing a decrease in cross-sectional area and an increase in length. This results in a measurable increase in resistance.

Capacity-varying transducers depend on a movement of one of the plates of a capacitor for operation. If one of the plates of a capacitor is very thin and elastic, sound waves will cause it to move, and the variation of capacity will be proportional to the sound. This device is commonly called a capacitor microphone. See Fig. 2.



Capacity transducers can be employed to measure displacement by connecting them in the tuning circuit of an oscillator. Then, when a movable plate is moved by an external force, the frequency of the oscillator, which can be measured very accurately, is changed. When the principle is employed with a sensitive bellows, small changes in air pressure can be measured. And in the Weathers FM phono cartridge, a small change in capacity caused by a stylus following a record groove produces some of the best hi-fi imaginable.

Inductance-varying transducers depend on a change of the reluctance in the magnetic circuit of the inductor's surroundings. Most electronic enthusiasts are familiar with the G.E. variable-reluctance phono cartridge using this principle.

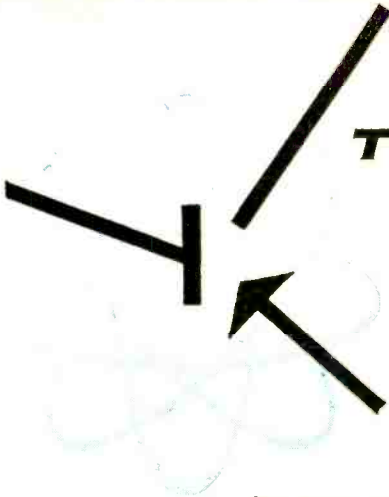
The common headphone which may be utilized as a transducer, (see "Low Cost Microphones," POPULAR ELECTRONICS, April, 1955), is actually a voltage-producing type. However, its change in inductance can be used to vary a tuned circuit's oscillation frequency.

Another type of transducer which may be classified as inductance-varying is the differential transformer shown in Fig. 3. An a.c. voltage is applied to a primary winding. Two similar secondary windings are connected in series and phased so as to buck each other. When a movable core of ferromagnetic material is in the neutral position, the secondary voltages are equal and opposite and the output is zero. When the core is slightly displaced, the voltage in one of the secondaries increases while that in the other decreases. The total difference voltage appears across the output terminals and is easily measured, amplified, or used to control a process.

The transducer is the connecting link in electronics. From hi-fi to space satellites, wherever there is energy to be converted, a quantity to measure, a process to control—in short, a job to do—electronics can accomplish it with transducer coupling. —30—

Fig. 3. Differential transformer whose output is determined by the position of the pivoted core section.

Transistor Topics



By LOU GARNER

JUST over a decade ago, when the invention of the transistor was first announced, nearly everyone agreed that it was a revolutionary device. But there was widespread disagreement as to its ultimate effect on the whole electronics industry.

Ultra-conservatives and pessimists stoutly maintained that the unit was little more than a laboratory curiosity, and probably would not see widespread commercial use for "at least a couple of decades." They had good reason for their attitude—the early point-contact transistor was a noisy, unstable, hand-made device that demanded a fantastic price.

On the other hand, the extreme optimists saw in the transistor an answer to a long-standing adage among electronics experts: "There's nothing wrong with electronic gear that getting rid of the vacuum tube won't cure." These happy individuals freely predicted the early demise of the vacuum tube. Many felt that it would pass into the limbo of obsolete devices—along with the coherer detector and Fleming valve—with in a "year or two."

Both groups were wrong . . . yet both were right in a modified way.

The vacuum tube is still with us, and is still used in much larger quantities than transistors. But the transistor started making its presence felt within a year or so after it became a practical commercial device. In one field it has completely dis-

placed the vacuum tube (hearing aids), and it is making serious inroads in other areas once dominated by tubes.

In practice, however, commercial transistor applications have followed a process of rapid *evolution* rather than *revolution*. Transistors were first used in increasingly large quantities in the hearing aid industry. Then manufacturers started to use them in portable receivers . . . but in small quantities. Several companies introduced "hybrid" sets which employed miniature vacuum tubes in their r.f. and i.f. sections and transistors in their audio amplifiers.

As r.f. transistors were introduced at competitive prices, the hybrid portable disappeared, with current manufacturers pro-



Gift suggestion for transistor experimenters: the transistor symbol is featured on a variety of jewelry items available from Columbia Studio, such as the cuff links shown here, in black and sterling silver. See text.

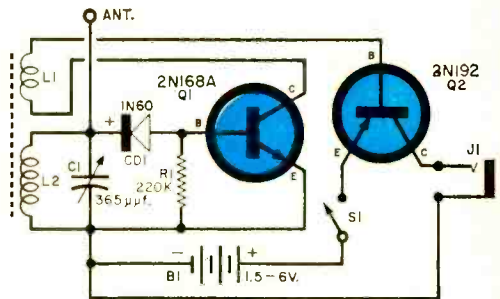


Fig. 1. Pocket radio circuit submitted by reader Steve Greenfield utilizes two transistors direct-coupled through a tickler winding.

ducing either all-tube or all-transistor portables. Another hybrid receiver . . . the car radio . . . has survived, however, and is

still being produced in large quantities—chiefly because of the introduction of low B-plus voltage (12-volt) vacuum tubes.

On the industrial scene, transistors soon found their way into compact military

an excellent gift for the younger members of the family. Since it is battery-powered, there is no danger of accidental shock or severe burns to probing fingers. And every child delights in having his own radio.

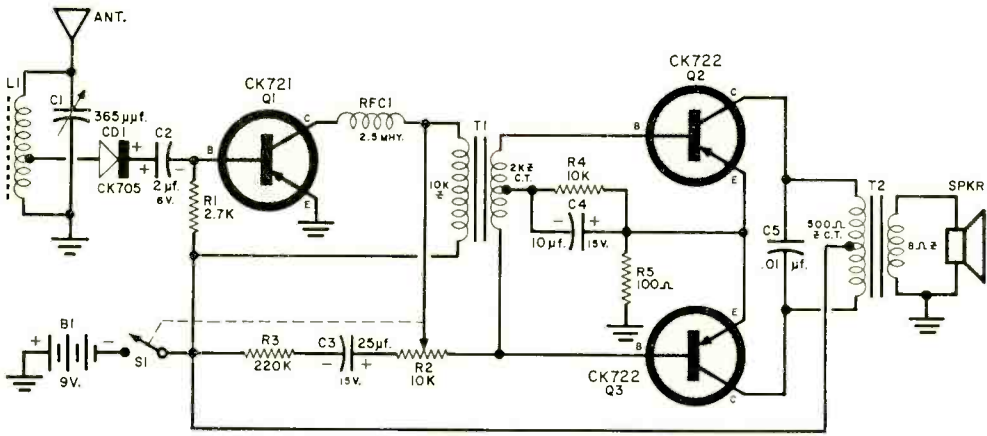


Fig. 2. Bill Bougatsos' receiver features loudspeaker operation.

equipment and lightweight airborne gear. Here size, weight, power requirements, and reliability have always been more important than cost. The transistor's excellent reliability, as compared to tubes, also has had an important effect on its use in industrial control devices and electronic computers. Few late-model computers use vacuum tubes in their designs.

More recently two new fields have opened up for the transistor—television and two-way radio communications. At least one domestic manufacturer (Philco) and one foreign manufacturer (Tokyo Shibaura Electric) are producing transistorized TV sets, and several firms have such receivers "in the works." The Dage Division of Thompson Ramo Wooldridge has developed a completely transistorized closed-circuit television system for military applications. And in the communications field, Motorola, GE, RCA and Bendix are but a few of the firms producing two-way radio systems which feature fully transistorized receivers and hybrid transmitters; they are being used by the police and by public utilities, and are finding increased application in the building trades, transportation, and marine fields.

Readers' Circuits. If you're starting to think about the approaching holiday season . . . a small transistorized receiver is

Both of the receiver circuits presented this month are designed to receive the AM broadcast band, are easy to wire, and use standard components.

The two-transistor receiver circuit in Fig. 1 was submitted by Steve Greenfield (2725 Sedgwick Ave., New York 68, N. Y.). By utilizing the complementary properties of *n-p-n* and *p-n-p* transistors to achieve direct coupling between stages, Steve has worked out a design requiring a minimum of electrical components. He reports that the unit has good sensitivity and much better selectivity than is usually found in such sets. Stronger local broadcast stations can be picked up without an external antenna, but a short antenna lead should be connected to *L2* in weaker signal areas.

In operation, r.f. signals are picked up and selected by tuned circuit *L2-C1*, then detected by a conventional diode (*CD1*) appearing across base resistor *R1*. From here, the detected signal is amplified by a two-stage direct-coupled audio amplifier using *n-p-n* (*Q1*) and *p-n-p* (*Q2*) transistors in the common-emitter configuration, and, finally, is applied to a 2000-ohm magnetic earphone connected to output jack *J1*. Feedback coil *L1* acts as a short circuit as far as the audio signals are concerned, but couples back enough of the r.f. component of the detected signal to provide

some regeneration, improving circuit gain and over-all selectivity.

Steve's circuit can be assembled in a small plastic box or on a conventional metal chassis. Layout is non-critical, but good wiring practice should be observed. The two-winding r.f. coil is hand-wound on a ferrite core (Lafayette No. MS-331); L_2 consists of approximately 45-55 turns of # 22 DCC wire and L_1 is made up of between 5 and 10 turns of the same size wire. L_2 should be wound in a single layer, solenoid fashion, with L_1 wound on top of and in the same direction as L_2 .

Once construction is completed and wiring checked for accuracy, you may want to experiment with the circuit arrange-

ment. Except for the unique way of biasing the output stage to achieve a control over output volume, Bill's circuit is conventional. The r.f. signals picked by the antenna-ground system are selected by tuned cir-

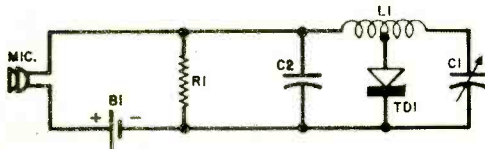


Fig. 3. Simple FM transmitter circuit featuring the new "tunnel" diode.

The "tunnel" diode is being produced in experimental quantities by General Electric Company. Above right, it is utilized in a vest-pocket transmitter; below right, the complete transmitter is compared in size to a 50¢ piece. See text for full details.



ment. Try the diode connections as shown and reversed, then utilize the connections which give best performance. Also try reversing the connections to L_1 and experimenting with the exact number of turns used. Finally, try different supply voltage values (1.5 to 6 volts), using the value which gives maximum gain and output power with minimum distortion or "clipping."

The three-transistor receiver circuit illustrated in Fig. 2 was sent in by Bill Bougatsos (5729 Park Ave., Apt. 1, Montreal, Canada) and features loudspeaker output. Bill indicates that his set has good sensitivity and selectivity when connected to a 6' antenna and a good ground.

cuit L_1-C_1 and detected by diode CD_1 , with the detected audio signal coupled through C_2 to a single-ended audio stage (Q_1). From here, the amplified audio signal is transformer-coupled (through T_1) to a push-pull power amplifier (Q_2, Q_3), and then applied to a PM loudspeaker through impedance-matching output transformer T_2 . Bill used $p-n-p$ transistors in the common-emitter arrangement in both stages.

This circuit is easy to duplicate using standard construction techniques. Neither layout nor lead dress should be critical, and commercial components are used throughout. Antenna coil L_1 is a Miller No. 2004, and C_2, C_3 and C_4 are low-voltage miniature electrolytic capacitors. Transformer T_1 is an Argonne No. AR-109, and T_2 is
(Continued on page 108)

Filter Cord Cuts Interference

Since the start of radio, one of the greatest annoyances plaguing the listener has been electrical interference. Not only does QRM cut down the enjoyment of AM broadcasts, but it severely limits DX possibilities for hams and SWL's. Some interference enters through the electric lines; some enters through the antenna. In either case, an inexpensive "filter cord" may be helpful.

A filter cord consists simply of an extension cord with a .05- μ f., 600-volt capacitor connected across the leads. If interference is entering the receiver from the electric mains, plug the filter cord into the a.c. outlet and plug the set into the filter cord outlet. If the interference is entering through the antenna, track it down and connect the filter cord to the device which is causing the interference. Electric

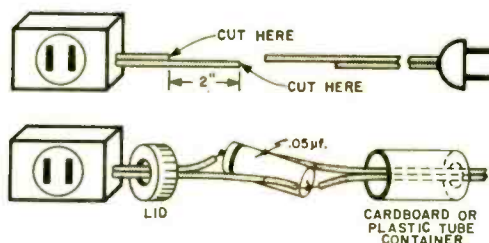
motors and shavers are most troublesome.

This gadget will not cure all types of electrical interference, but it will prove effective in a large number of cases. It is perfectly safe to use if it is built as shown, but do not put it in a metal container. Although one side of the a.c. line is grounded, the high side of the filter cord line could

short to a metal container and you would expose yourself to the full line voltage on contact with the container and ground. Don't take chances! Use cardboard or plastic.

For extremely stubborn cases of power line interference, hum, or other noise, see the article entitled "Do You Have a Buzz?" in the December 1957 issue of POPULAR ELECTRONICS, which discusses many causes of interference and their cures.

—Forrest H. Frantz, Sr.



Simple BFO Pitch Control

Most small, inexpensive communications receivers are usually very good buys. But you'll find that adding a variable pitch control to the BFO (beat frequency oscillator) will be a tremendous asset in tuning SSB signals. You will also be able to change the audio pitch of a received c.w. signal without detuning the receiver.

The easiest way to add this control is to place a small variable capacitor (3-15 μ f.) across the existing BFO coil and capacitor. Mount it as close to the BFO coil as you can, and use the shortest possible interconnecting wires.

Then, by tuning the capacitor, you vary the pitch. (This system will not work in receivers that incorporate a "tickler" coil to provide i.f. feedback.) Keep the new BFO capacitor well shielded to prevent coupling to the receiver front end.

Tune the capacitor using a long flexible shaft with an insulated coupling link on the shaft of the capacitor. You can drill a hole

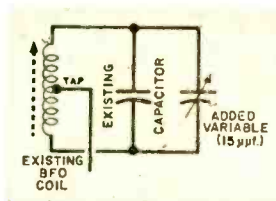
in the front panel or top of the receiver cabinet and pass the tuning shaft through. Use a knob similar to those that are supplied with the set and you'll have a good-looking finished product.

To calibrate the pitch control, tune in a moderately strong AM signal using 1' of wire for the antenna, and switch on the BFO. Adjust the pitch control until the whistle produced becomes lower in tone and finally is not heard (zero beat). The BFO is now adjusted in the center of the i.f. passband. Mark this point on the pitch control dial scale.

Or try using a commercial calibrated BFO knob or dial.

You can calibrate the pitch control for several audio tones with an audio generator. Considering its surprisingly small cost, this little unit is certainly worthwhile. You'll find it will really come in handy for separating those c.w. stations.

—Brian Desind, K3GBT





Across the Ham Bands

By
HERB S. BRIER
W9EGQ

COLLECTING QSL CARDS

THE other day young Howie, W2QHH, came over to my ham shack and complained about not getting a QSL card from a new state he had contacted. He asked me as an old-timer if I had had as much trouble getting QSL cards. You bet I did. Just like Howie, I couldn't understand why a fellow ham wouldn't reciprocate with a QSL card.

When I was a neophyte ham, I set myself a goal. I decided that if I got 100 QSL cards, I would hang them on my shack wall for everyone to admire. I finally made it, too—100 cards divided among 11 states. And a funny thing happened then. I sort of lost interest in getting more cards just to have more cards, if you know what I mean. Instead, I was only interested in another QSL if it confirmed a new state or was better than what I had.

When a QSL arrived from a new state, one of the duplicates came down from the wall and went into a shoe box, and the new one went up in its place. And when a QSL came that gave me a better signal report than any other card I had from that area,

I switched cards. But, about that time, the ARRL announced that the new WAS (Worked All States) certificate was available, and I went 'all out' to get one, along with most of the other hams all over the country.

Many hams had already worked all the states and only needed a couple more cards to qualify for their WAS certificates. Consequently, the poor fellows in the rarer states like Vermont, Nevada, South Dakota, and Delaware were run ragged by requests for QSL cards, just as they are today.

"Certificate Chasers." Since those days, ham groups throughout the world have offered similar certificates by the hundreds; and now there are "Certificate Chasers" who have more of them than most of us have QSL cards.

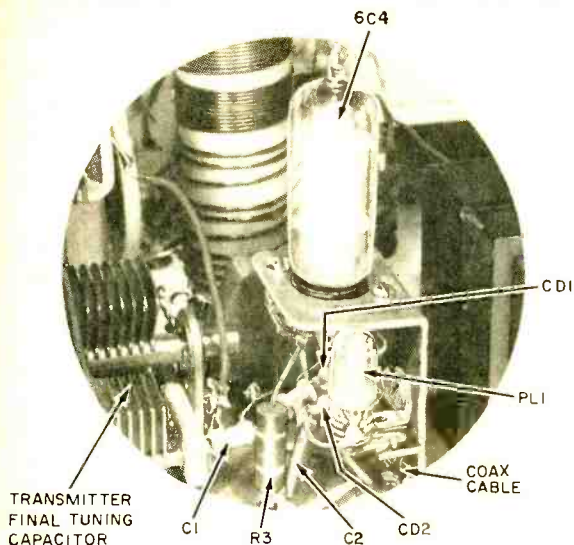
Nevertheless, WAS is still the most sought-after excuse for collecting QSL cards. To obtain yours, simply submit written proof of two-way contact via ham radio with the 50 states to the American Radio Relay League, Inc., 38 LaSalle Road, West Hartford, Conn. Include suffi-

---Ham of the Month---

Our November "Ham of the Month" is Charles A. "Butch" Ehrhardt, K9PQR, 5256 N. Marshfield, Chicago, Ill., a sophomore at Waller High School and a transistor experimenter. Charles's ham career started when he received a Heathkit AR-3 for Christmas two years ago. He got on the air the following summer with his Novice license and a 15-watt transmitter.

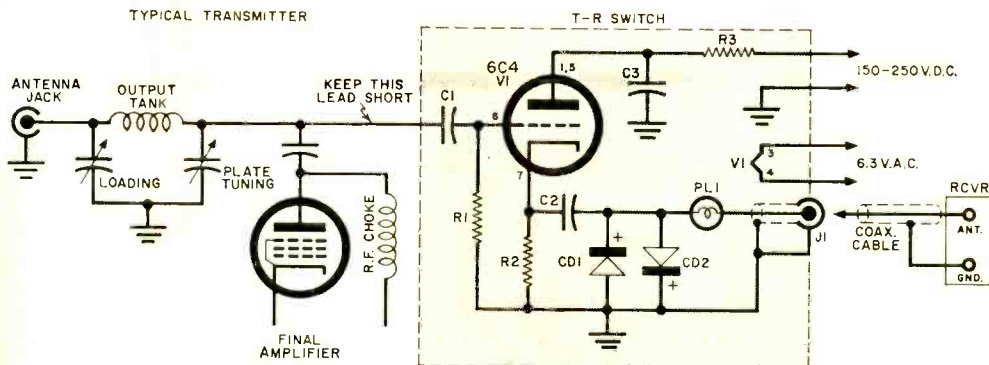
At a school science fair, Charles entered a transistorized printed-circuit audio oscillator which used a "sun battery" as a frequency control; he won first prize, and two more firsts at subsequent fairs. This spring Charles's entry included some fairly sophisticated circuits together with his ham station. Again he won several prizes, including one at state level, and a special commendation from Bell Telephone Company. Charles and several other science fair entrants demonstrated their projects on TV in Chicago.





PARTS LIST

- C1—25- μ f., 1000-volt ceramic capacitor (Sprague 5GA-Q25 or equivalent)
- C2, C3—.005- μ f., 600-volt ceramic capacitor
- CD1, CD2—1N34 diode
- J1—Coax connector receptacle (Amphenol SO-219 or equivalent)
- PL1—2-volt, 60 ma. lamp (Type 48)
- R1—1-megohm, 1-watt resistor
- R2—470-ohm, $\frac{1}{2}$ -watt resistor
- R3—15,000-ohm, $\frac{1}{2}$ -watt resistor
- V1—6C4 tube
- 1—Ceramic 7-pin miniature tube socket
- Misc. mounting bracket, hardware, coaxial cable



Simple T-R switch eliminates relays and boosts r.f. to a receiver. Plate and filament power for the switch is taken from the transmitter. Connect B+ lead of the T-R circuit to the screen grid of the final amplifier or any other voltage source in the range indicated. See page 116 for complete details.

cient postage with your application to get your cards back.

Ed Handy, W1BDI, ARRL Communications Manager, advises that you double-check your cards against an alphabetical list of the states before mailing them. He reports that many WAS applications are slowed down or rejected because the applicant has doubled up on one state and forgotten another one.

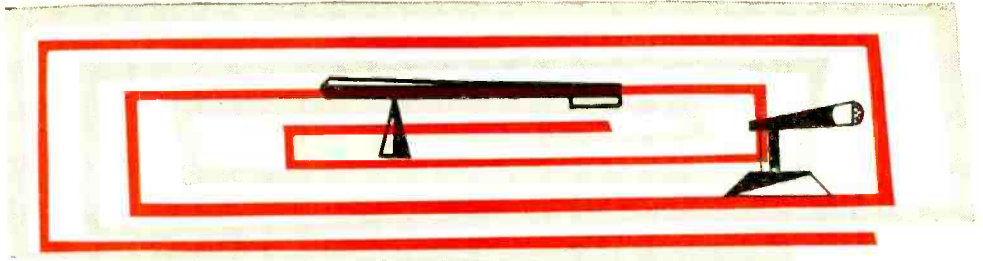
Other popular ARRL QSL certificates are WAC (Worked All Continents) and DXCC (DX Century Club). You must be a member of the ARRL besides having the necessary six cards to qualify for WAC,

and you need confirmations from 100 or more countries for DXCC. The "big boys" are working around the 275 country level on this last one!

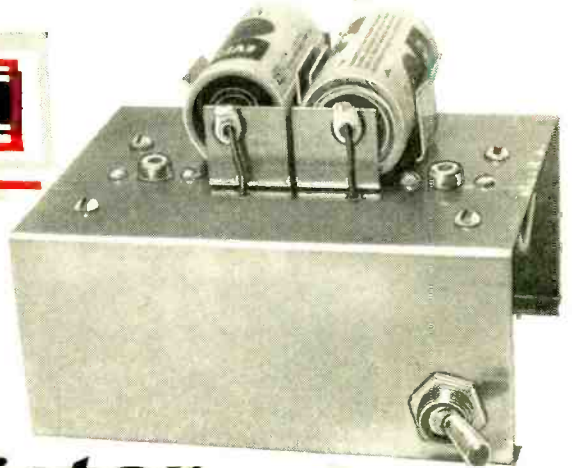
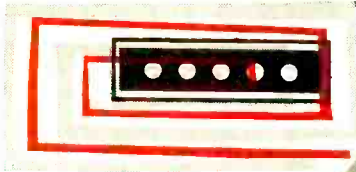
A comprehensive Ham Certificate Directory is available for \$2.00, postpaid, from William Clark, W3RPG, 8 Francis Drive, Harrisburg, Pa.

Upping Your Percentage. Many certificate seekers claim that working the necessary stations is easier than obtaining the necessary proof. This is because too many hams promise to QSL but never do so even after receiving your card.

(Continued on page 114)



By **LEE BEEDER**

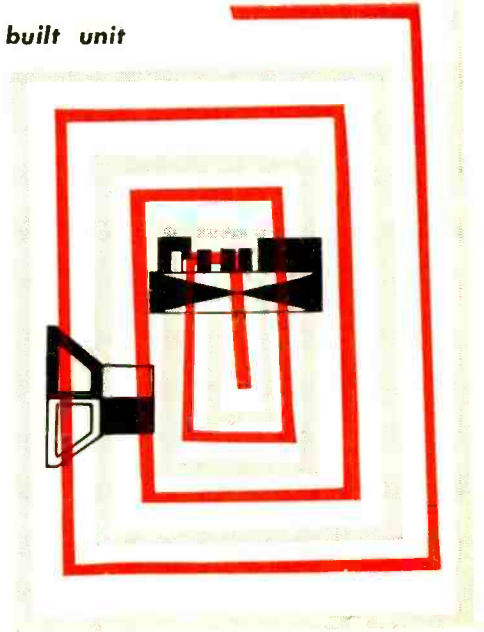


Hi-Fi Transistor Preamp

**Remote operation of low-impedance mikes or phono
cartridges is possible with this easily built unit**

THIS two-stage transistor preamp enables you to enjoy the advantages of a low-impedance microphone or cartridge with any high-impedance input amplifier or tape recorder. Thus, you can be free from the necessity of remaining close to the amplifier or recorder and can take your mike from room to room, or even outside the house. Recording opportunities, formerly prohibited by distance, will be within your grasp.

You'll find, too, that this preamplifier is free of virtually all hum, noise and microphonics that usually accompany high amplification of a low-level sound source. Furthermore, it provides a flat response from 20 to 20,000 cps when used with a high-quality low-impedance phono cartridge, eliminating the usual high-ratio



PARTS LIST

B1—3-volt battery (two "C" cells connected in series)

C1, C2—10- μ f., 25-volt electrolytic capacitor

C3—500- μ f., 25-volt electrolytic capacitor

C4—.02- μ f. tubular or ceramic disc capacitor

C5—.25- μ f. tubular or ceramic disc capacitor (optional)

J1, J2—RCA type phono jack

Q1—2N133 transistor

Q2—2N132 transistor

R1, R5—10,000 ohms

R2, R4—18,000 ohms

R3—2,200 ohms

R6—1,000 ohms

R7—2,000 ohms

R8—330 ohms

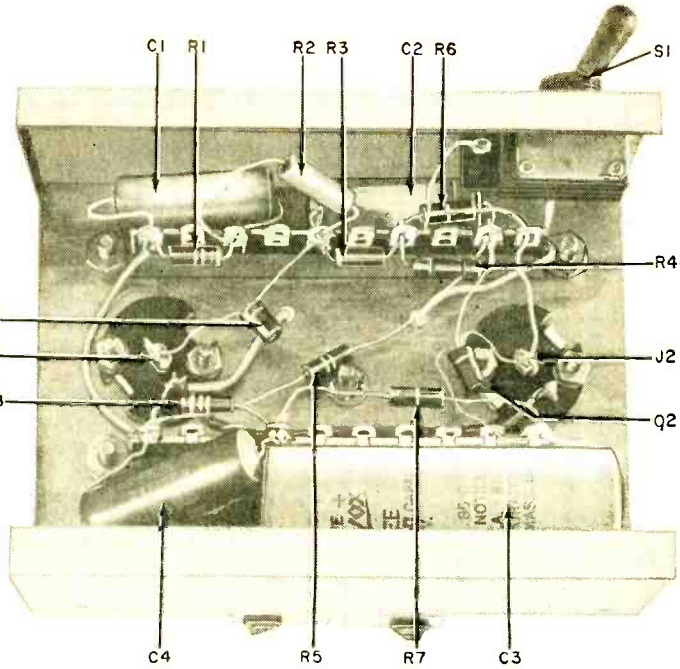
S1—S.p.s.t. switch

1—2" x 4 1/2" x 3 1/4" chassis (ICA 29077)

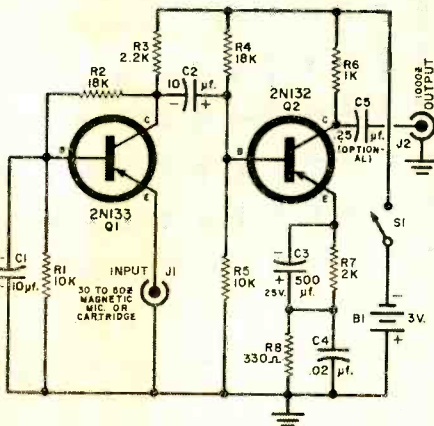
1—Battery holder

2—10-lug terminal strips

All resistors 1/2 watt



Use 18,000 ohms for R2 or select value by connecting signal source at J1 and adjusting R2 for a 1.2-volt drop across R3.



HOW IT WORKS

The signal from the microphone or cartridge is introduced into the 30 to 50 ohm impedance presented by the emitter leg of Q1 which is operated as a common base stage. Resistors R1 and R2 bias Q1 with C1 bypassing R1.

The amplified audio signal at the collector of Q1 appears across resistor R3 and is coupled through C2 to the base of Q2 in the second stage. Bias on Q2 is provided by voltage divider R4, R5 in combination with R7. Capacitor C3 bypasses R7.

Transistor Q2 uses stabilizing resistor R7 and bypass capacitor C3 in the emitter leg to prevent degeneration. In addition, the large capacitance value of C3 helps assure superlative bass response. A high-frequency correction network (R8, C4) in the emitter of Q2 extends response up to 20,000 cps.

The amplified signal at the collector of Q2 appears across load resistor R6 and is fed directly to output jack J2. If desired, a d.c. blocking capacitor of about .25 μ f. can be employed between the collector of Q2 and output jack J2.

step-up transformer and attendant hum. Or any 30 to 50 ohm professional-type low-output dynamic or ribbon mike can be used. In only three to four hours, and for approximately \$12, you can add this useful accessory to your hi-fi equipment.

Construction is simplicity itself as there are only six items to mount on the chassis: the two terminal strips, the two phono jacks, the s.p.s.t. switch and the battery holder. The battery holder is the only part located on the top of the chassis. The remaining components are mounted point-to-point by their leads as shown.

If you do not attempt extreme miniaturization, the components will fit easily without crowding. Be sure to observe the proper polarity of the electrolytic capacitors (C1, C2 and C3) as indicated on the schematic diagram.

The input and the output circuits both have low impedance and each can be used with shielded mike cable up to 250 feet in length. This permits you to "break in" the preamp just about anywhere between the phono cartridge or mike and the input to your amplifier or tape recorder.

As all of the components are conservatively rated, the preamp should give you many years of service. This feature, coupled with the other advantages, makes it a handy item for your audio setups.



"...the fact that I was taking your course was a major factor in my getting the new job last month. . . . I was also promoted from Engineer to Field Engineer."

—GENE DONDLINGER,
2500 Robinhood Rd.
Winston-Salem, N.C.

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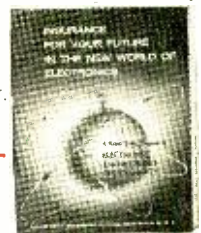
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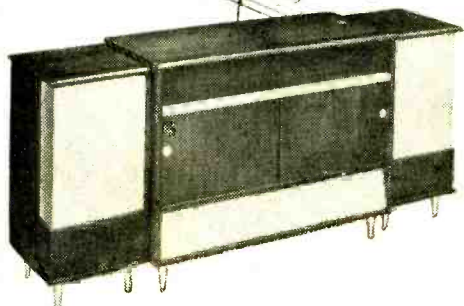
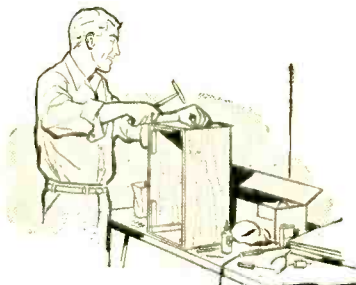
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\$149⁹⁵

each
(shpg. wt. 162 lbs.)

STEREO EQUIPMENT CABINET KIT

Model SE-1B (birch)
Model SE-1M (mahogany)

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(shpg. wt. 42 lbs.)

STEREO WING SPEAKER ENCLOSURE KIT

Model SC-1BR (birch—right end)
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Model SC-1MR (mahogany—right end)
Model SC-1ML (mahogany—left end)

STEREO EQUIPMENT CABINET KIT

A thing of beauty as well as utility, this stereo equipment cabinet ensemble houses your complete stereo hi-fi system. It consists of a stereo equipment center flanked by two stereo speaker enclosures. The kit is supplied with mounting panels pre-cut to accommodate Heathkits and interchangeable blank panels are also furnished. The pre-cut panels accommodate the Heathkit AM-FM Tuner (PT-1), Stereo Preamplifier (SP-2), and Stereo Record Changer (RP-3-S). The changer slides out smoothly for easy record loading. Convenient record and tape storage space is provided. Ample room is provided in the rear of the center cabinet for a pair of matching Heathkit amplifiers from 12 to 70 watts. The stereo wing speaker enclosures are open-backed, cloth-grilled cabinets designed to hold the Heathkit SS-3 or similar speaker enclosures. The cabinets are available in beautifully grained 3/4" solid core Philippine mahogany or select birch plywood suitable for the finish of your choice. Entire top features a shaped edge. Hardware and trim are of brushed brass and gold finish.

MODEL MF-1

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DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

Get the most from your LP microgroove records. Designed to Heath specifications by Fairchild Recording Equipment Corporation, the MF-1 is one of the finest pickup cartridges on the market today. Shpg. Wt. 1 lb.



TRADITIONAL
Model CE-2T (mahogany)

CONTEMPORARY (not shown)
Model CE-2B (birch)
Model CE-2M (mahogany)

\$43⁹⁵
each

ENJOY A HOME HI-FI SYSTEM NOW! PAY LATER . . .



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CHAIRSIDE ENCLOSURE KIT

Put your entire hi-fi system right at your fingertips with this handsome enclosure. Available in either traditional or contemporary models and constructed of beautiful veneer-surfaced plywood suitable for the finish of your choice. It is designed to house the Heathkit AM and FM Tuners (BC-1A and FM-3A), the WA-P2 Preamplifier, the RP-3 Record Changer, and adequate space is provided for any Heathkit amplifier designed to operate with the WA-P2. All parts precut and predrilled for easy assembly. Shpg. Wt. 46 lbs.



NEW

HEATHKIT EA-3
\$29⁹⁵

NEW! 14-WATT HI-FI ECONOMY AMPLIFIER (EA-3)

From HEATHKIT audio labs comes an exciting new kit. New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the preamplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste.



*Build it in
one Evening*

HEATHKIT SS-2
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"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

With performance comparable to speakers costing many times more, the SS-2 employs a Jensen 8" woofer and compression-type tweeter to provide total frequency response of 50 to 12,000 CPS. Shpg. Wt. 26 lbs.

ATTRACTIVE BRASS TIP ACCESSORY LEGS: convert the SS-2 into handsome consolette. Shpg. Wt. 3 lbs. No. 91-26. \$4.95.

BASIC FIR MODEL: same as SS-2 except constructed of non-premium plywood without trim or grille cloth. Shpg. Wt. 26 lbs. Model SS-3. \$34.95.



HEATHKIT FM-3A \$26⁹⁵

HIGH FIDELITY FM TUNER KIT

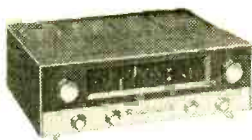
The thrills of FM entertainment are yours at budget cost with this handsomely styled tuner. Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Shpg. Wt. 8 lbs.



HEATHKIT W-7M \$54⁹⁵

"EXTRA PERFORMANCE" HI-FI 55 WATT AMPLIFIER KIT

Offering full fidelity at less than a dollar per watt, the power output of this remarkable amplifier is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout this entire range. Shpg. Wt. 28 lbs.



HEATHKIT PT-1
\$89⁹⁵

MONAURAL-STEREO AM-FM TUNER KIT

This professional quality 16-tube tuner offers you outstanding AM, FM or stereo AM/FM performance at minimum expense. Features include individual flywheel tuning and automatic frequency control. A multiplex jack is also provided. Shpg. Wt. 24 lbs.



HEATHKIT SP-2
\$56⁹⁵

MONAURAL-STEREO (two channel mixer) PREAMPLIFIER KIT

Control your entire stereo system with this 2-channel preamplifier. A remote balance control with 20' of cable allows balancing the stereo system from listening position. Shpg. Wt. 15 lbs.



HEATHKIT TR-1A \$99⁹⁵

Includes tape deck, tape recorder electronics, microphone and roll of blank tape.



HIGH FIDELITY TAPE RECORDER KIT

Whether making your own recordings or playing pre-recorded tapes you'll enjoy the many fine features of this tape recorder kit. Included are fast forward and rewind functions and choice of 7½ or 3¼ IPS tape speeds. Printed circuit boards simplify assembly. Shpg. Wt. 24 lbs.

HEATHKIT RP-3
\$64⁹⁵

(stereo model RP-3S \$74.95)



AUTOMATIC HI-FI RECORD CHANGER KIT

Combining the convenience of an automatic record changer with true turntable quality the RP-3 obtains full fidelity from your hi-fi and stereo records while treating them with the care they demand. A "turntable pause" feature prevents records from dropping on moving turntable or disk. Plays at 33½, 45, 78 and 16 RPM. Shpg. Wt. 19 lbs.

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HEATHKIT TX-1
\$234⁹⁵

"APACHE" HAM TRANSMITTER KIT
Features 150 watt phone input and 180 watt CW input. Provision for single-sideband transmission using the SB-10 External Adapter. Shpg. Wt. 110 lbs.



HEATHKIT RX-1
\$274⁹⁵

"MOHAWK" HAM RECEIVER KIT
Covers from 160 through 10 meters on 7 bands with an extra band calibrated to cover 6 and 2 meters using a converter. Outstanding SSB reception. Shpg. Wt. 66 lbs.



HEATHKIT SB-10
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SINGLE SIDEBAND ADAPTER KIT
A compatible plug-in adapter unit for the "Apache" Transmitter, the SB-10 covers 80, 40, 20, 15 and 10 meter bands. Produces USB, LSB or DSB signals, with or without carrier insertion. Shpg. Wt. 12 lbs.



HEATHKIT DX-40
\$64⁹⁵

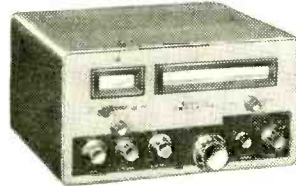
PHONE AND CW TRANSMITTER KIT
Providing phone and CW operation on 80, 40, 20, 15, and 10 meters, the DX-40 features built-in modulator and power supplies. Shpg. Wt. 25 lbs.



HEATHKIT MP-1
\$44⁹⁵

MOBILE POWER SUPPLY KIT
Furnishes all power required to operate both MT-1 Transmitter and MR-1 Receiver from 12-14 volt battery. Delivers full 120 watts continuously or 150 watts intermittently. Kit includes 12' battery cable, tap-in studs for battery posts, power plug and 15' connecting cable. Shpg. Wt. 8 lbs.

Mobile Fun! With all New Heathkit Mobile Ham Gear

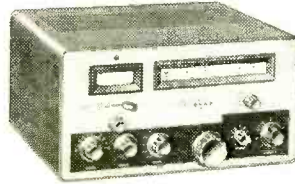
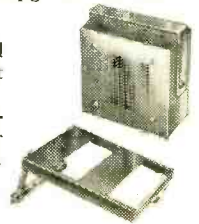


HEATHKIT MR-1
\$119⁹⁵

"COMANCHE" MOBILE HAM RECEIVER KIT
Handsome styling, rugged construction, top quality components and economy are all wrapped up in the "Comanche". It is an 8-tube superheterodyne receiver operating AM, CW and SSB on the 80, 40, 20, 15 and 10 meter amateur bands. Operates from 12 volt car battery through the MP-1 Mobile Power Supply. Can be converted in minutes to a fixed station unit by using an AC power supply. Shpg. Wt. 19 lbs.

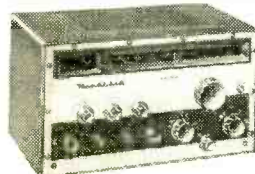
MOBILE ACCESSORIES
Quality 5" PM speaker in rugged steel case with mounting brackets. Heathkit AK-7. \$5.95. Shpg. Wt. 4 lbs.

Mobile base mount holds both transmitter and receiver. Universal floor mounting bracket. Heathkit AK-6. \$4.95. Shpg. Wt. 5 lbs.



HEATHKIT MT-1
\$99⁹⁵

"CHEYENNE" MOBILE HAM TRANSMITTER KIT
The fun and convenience of mobile operation are yours with the compact and efficient "Cheyenne" Transmitter. Featuring high power with minimum battery drain, the unit provides up to 90 watts phone input and covers 80, 40, 20, 15 and 10 meters. Featured are a built-in VFO, modulator, 4 RF stages with a 6146 final amplifier pi network (coaxial) output coupling. The "Cheyenne" is designed as a companion to the "Comanche" receiver and is powered by the MP-1 Power Supply. Shpg. Wt. 19 lbs.



HEATHKIT VHF-1
\$159⁹⁵

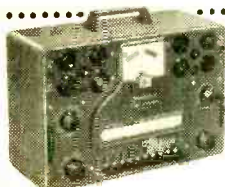
"SENECA" VHF HAM TRANSMITTER KIT
General, technician or novice class hams wishing to extend transmission into the VHF region will find the "Seneca" ideal. A completely self-contained 6 and 2 meter transmitter, the VHF-1 features up to 120 watts input on phone and 140 watts input on CW in the 6 meter band. Included are controlled carrier phone operation, built-in VFO for both 6 and 2 meters, and four switch-selected crystal positions. Shpg. Wt. 56 lbs.



HEATHKIT V7-A
\$25⁹⁵

ETCHED CIRCUIT VTVM KIT

World's largest selling VTVM, the V7-A measures AC voltage (RMS), AC voltage (Peak-to-peak), DC voltage and resistance. Features 7 AC (RMS) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. In addition there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Seven ohmmeter ranges are provided. Battery and test leads are included with kit. Shpg. Wt. 7 lbs.



HEATHKIT TC-3
\$39⁹⁵

TUBE CHECKER KIT

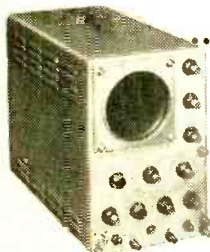
An invaluable aid to servicemen, the TC-3 tests for open, short, leakage, heater continuity and quality of all tube types commonly encountered in radio and TV servicing. Checks 4, 5, 6 and 7-pin large, 7 and 9-pin miniature, 7-pin sub-miniature, octal and loctal tubes and pilot lamps. A blank socket provides for future tube types. Shpg. Wt. 12 lbs.



Model 355.

TV PICTURE TUBE TEST ADAPTER

For use with TC-3 or earlier model TC-2. Includes 12-pin TV tube socket, 4' cable. Octal connector and data. No. 355. Shpg. Wt. 1 lb. \$4.50.



HEATHKIT OP-1
\$179⁹⁵

"PROFESSIONAL" 5" DC OSCILLOSCOPE KIT

Offering complete versatility, the OP-1 features DC coupled amplifiers and also DC coupled CR tube unblanking. Triggered sweep circuit operates on internal or external signals and may be either AC or DC coupled. Transformer operated power supply has silicon diode rectifiers. Shpg. Wt. 34 lbs.



HEATHKIT OM-3
\$39⁹⁵

"GENERAL PURPOSE" 5" OSCILLOSCOPE

Ideal in servicing as well as routine laboratory work, the OM-3 features wide vertical amplifier frequency response, extended sweep generator operation and improved stability. Vertical response is within ± 3 db from 4 CPS to 1.2 mc. Sweep range covers 20 CPS to over 150 kc. Shpg. Wt. 22 lbs.



HEATHKIT T-4
\$19⁹⁵

VISUAL-AURAL SIGNAL TRACER KIT

Doubling as a utility amplifier, test speaker, or substitution transformer, the T-4 represents an outstanding buy. Traces RF, IF and audio signals in AM, FM and transistor-type radios. Shpg. Wt. 5 lbs.



HEATHKIT SG-8
\$19⁵⁰

RF SIGNAL GENERATOR KIT

Aligns RF, IF and tuned circuits of all kinds. Provides extended frequency coverage in five bands from 160 kc to 110 mc on fundamentals and up to 220 mc on calibrated harmonics of the fundamental frequencies. Shpg. Wt. 8 lbs.



HEATHKIT CT-1
\$7⁹⁵

IN-CIRCUIT CAPACI-TESTER KIT

Check capacitors for "open" or "short" right in the circuit. Detects open capacitors from 50 mmf up and checks shorted capacitors up to 20 mfd. Checks all bypass, blocking and coupling capacitors of the paper, mica and ceramic types. Shpg. Wt. 5 lbs.



HEATHKIT TO-1
\$16⁹⁵

TEST OSCILLATOR KIT

Provides fast and accurate selection of test frequencies most used by servicemen in repairing and aligning modern broadcast receivers. Five fixed-tuned frequencies are quickly selected for trouble-shooting. Shpg. Wt. 4 lbs.

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add that "extra" speaker

HEATHKIT US-1
\$750

12" UTILITY SPEAKER

This high quality auxiliary speaker offers many possibilities in audio, radio and TV work and will handle up to 12 watts with a frequency response from 50 to 9,000 CPS ± 5 db. Speaker impedance is 8 ohms and employs a 6.8 ounce magnet. Shpg. Wt. 7 lbs.



HEATHKIT BR-2
\$1895
(less cabinet)

BROADCAST BAND RADIO KIT

Fun to build, and a fine receiver for your home. Covers complete broadcast band from 550 to 1600 kc. Built-in 5 1/2" PM speaker and rod-type antenna. Transformer operated power supply. Excellent sensitivity and selectivity. Shpg. Wt. 10 lbs.

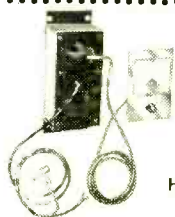
Cabinet optional extra: No. 91-9A. Shpg. Wt. 5 lbs. \$4.95.



HEATHKIT AK-1
\$995

MICROPHONE ACCESSORY KIT

Useful in countless applications, this kit consists of a rugged high fidelity crystal mike and three holders; a mike stand adapter, a lavalier neck-band and desk stand. An 8' cable with phone plug is included. Shpg. Wt. 1 lb.



check engine RPM

HEATHKIT TI-1 \$2595

ELECTRONIC TACHOMETER KIT

Easy-to-build and simple to install. Operates directly from the spark impulse of any 2 or 4 cycle engine with any number of cylinders. Operates on 6, 8, 12, 24 or 32 volt DC systems and is completely transistorized. The easy-to-read indicator shows RPM from 500 to 6,000. A calibration control is also provided. Shpg. Wt. 4 lbs.



Fun for the whole family

HEATHKIT XR-1P
\$2995

6 TRANSISTOR PORTABLE RADIO KIT

This easy-to-build portable radio offers fun and enjoyment for the whole family. Features 6 transistors, large 4" x 6" PM speaker for "big-set" tone quality, and built-in rod-type antenna. Uses standard size "D" flashlight cells for extremely long battery life (between 500 and 1,000 hours). The modern molded plastic case with pull-out carrying handle is two-tone blue with gold inlay and measures 9" L. x 7" H. x 3 3/4" D. Shpg. Wt. 6 lbs.

Complete Engine "Tune-Up" Facilities!



NEW

HEATHKIT IA-1A \$5995

ELECTRONIC IGNITION ANALYZER KIT (IA-1A)

Just clip the two test leads to operating engine (400 to 5,000 RPM) and check condition of coil, condenser, points, plugs and wiring. Shows either primary or secondary circuit patterns, parade or superimposed secondary patterns. Shpg. Wt. 20 lbs.

MODIFICATION KIT for IA-1 Models: Provides switch selection of primary and secondary circuit patterns, or, choice of parade and superimposed secondary patterns. Shpg. Wt. 2 lbs.
Heathkit MK-6..... \$4.95



Let your boy learn radio

HEATHKIT CR-1 \$795

CRYSTAL RADIO KIT

Any youngster interested in radio or electronics will enjoy building and using this fine little crystal receiver. Frequency coverage is from 540 to 1600 kc. A sealed germanium diode is used for detection—no critical "cats whisker" adjustment. Headphones included. Measures 6" L. x 3" W. x 2 1/8" D. Shpg. Wt. 3 lbs.



HEATHKIT TK-1
\$995

COMPLETE TOOL SET

This handy tool kit provides all the basic tools required for building any Heathkit. Includes pliers, diagonal sidecutters, screwdrivers, and soldering iron with holder. Pliers and sidecutters are equipped with insulated rubber handles that provide protection from electrical shock. All of the tools are of top quality case hardened steel for rugged duty and long life. Shpg. Wt. 3 lbs.

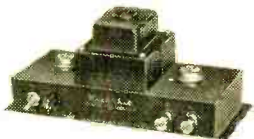


HEATHKIT DF-2
\$69⁹⁵

2-BAND TRANSISTOR RADIO DIRECTION FINDER KIT

Economically powered by 6 standard flashlight cells, the DF-2 provides you with a completely portable 6-transistor standard and beacon band receiver of unusual quality and performance. Covers the beacon band from 200 to 400 kc and broadcast band from 540 to 1620 kc. A tuning dial light is provided for night operation. Large 4" x 6" speaker provides superb tone reproduction. Shpg. Wt. 9 lbs.

HEATHKIT PC-1
\$24⁹⁵



12 VOLT POWER CONVERTER KIT

Household electricity right on your boat or in your automobile is yours with this 12-volt power converter kit. Operate your radio, electric razor, lights, etc., directly from your 12-volt boat or car battery. Power rating is 125 watts continuously and 175 to 200 watts intermittently. Note: not recommended for record players, tape decks, power tools or radio transmitters. Shpg. Wt. 8 lbs.

MARINE CONVERTER KIT



HEATHKIT MC-1
\$39⁹⁵

Charge your 6 or 12 volt batteries at dockside even while your boat's electrical system is in use. Provides up to 20 amperes continuously for charging 6-volt batteries or 10 amperes continuously for charging 12-volt batteries, regardless of type. Charging current is continuously monitored by a 25 ampere meter. Shpg. Wt. 16 lbs.

MARINE BATTERY CHARGE INDICATOR KIT

See at a glance the exact percentage of charge in your boat batteries. Checks from 1 to 8 storage batteries instantly. Operates on 6, 8, 12 or 32 volt systems. Note: for mounting on non-ferrous metals or wood only. Shpg. Wt. 3 lbs.



HEATHKIT CI-1
\$16⁹⁵



HEATHKIT FD-1-6
(6 volt)
FD-1-12
(12 volt)
\$35⁹⁵ each

FUEL VAPOR DETECTOR KIT

Protecting against fire and explosion on your boat, the FD-1 indicates the presence of explosive fumes and shows immediately if it is safe to start the engine. The kit is complete including spare detector unit. Shpg. Wt. 4 lbs.

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Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

THE CODE SITUATION

EVER SINCE the early days of radio, there have been numerous code methods conceived for reporting the signal strength and readability of the signal received from a transmitting station by a listener. With the passing of time, these codes have become fairly well standardized.

QSA-R. One of the earliest codes that your Short-Wave Editor remembers is the old QSA-R code, well known among the amateurs of the 1930 era. The QSA stood for "The strength of your signal is (1 to 5)." The R stood for readability (1 to 9) and actually may have been the abbreviation for QRK ("the readability of your signal is . . ."). As with all the codes, the higher the number following the letter or letters, the better the report.

A few years later, the R became known as S, but still stood for readability. During this transition, the QSA portion became merely Q. A typical report of this period for a good, clear, loud signal was "Q5S9."

While the stations in the amateur services used the Q-S code, the short-wave stations and their listeners generally used the QSA-QRK code,

which was very similar to the QSA-R code. The QRK code only went as high as 5, however, while the R numbers went from 1 to 9.

Other Q signals that were in wide use during this period (and still are) include: QRM (interference), QRN (atmospherics), and QSB (fading).

Q-S and RST. Today there are two well-known codes in use in amateur circles. One is the Q-S system, explained above, and the other is the RST system. The former is used by the 'phone stations and the latter by the Morse operators.

In the RST method, the letters stand re-

GLENWOOD, NEW JERSEY

WPE20N

| | | | | | | | | | | | |
|-------|--------|-----|----|-----|-----|-----|--------------|-----|-----------------|-----|-----|
| RADIO | UR SIG | HRD | HR | RST | QNT | QNT | QSA | R | CALLING/WORKING | | |
| | | | | | | | SIG NEEDS | | | | |
| | | | | | | | QSA | QRN | QRN | QSB | QSA |

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WPE9 PRINT

| | |
|-------------------|---------------------|
| RADIO _____ | RCVR _____ |
| UR _____ | SIGS WRKED HR _____ |
| UR SIGS RST _____ | 195 _____ |
| SMITTER _____ | REMARKS _____ |
| PLEASE QSL ON TN7 | NY BEST 73 |

SWL — Tim Friday

Good-looking QSL cards like those shown here which feature POPULAR ELECTRONICS call letters can be obtained from local printers or by mail from QSL card specialists.

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- | | | | | | |
|-------|--------|--------|----------|-----------|--------|
| 0A2 | 5X8 | 6BH6 | 6SF5 | 7Z4 | 19BG6G |
| 0Z4 | 5Y3GT | 6BJ6 | 6SF7 | 12A8 | 19J6 |
| 1A7GT | 5Y4G | 6BK5 | 6SJ7 | 12A05 | 19T8 |
| 1B3GT | 6A7 | 6BK7 | 6SK7 | 12AT6 | 24A |
| 1H4G | 6AB4 | 6BL7GT | 6SL7GT | 12AT7 | 25AV5 |
| 1H5GT | 6AC7 | 6BN6 | 6SN7GT | 12AU6 | 25B06 |
| 1L4 | 6AF4 | 6BQ7 | 6SQ7 | 12AU7 | 25DN6 |
| 1L6 | 6AG5 | 6BZ6 | 6S7 | 12AV6 | 25LGGT |
| 1NSGT | 6AG7 | 6C4 | 6T4 | 12AV7 | 25W4GT |
| 1Q5GT | 6AH4GT | 6C5 | 6T8 | 12AX4GT | 25Z5 |
| 1R5 | 6AH6 | 6C6 | 6U8 | 12AX7 | 25Z6 |
| 1S5 | 6AK5 | 6C8G | 6V6 | 12AX7 | 26 |
| 1T4 | 6AL5 | 6C8G | 6W4GT | 12B4 | 35A5 |
| 1U4 | 6AL7 | 6CF6 | 6W6GT | 12BA6 | 35B5 |
| 1V2 | 6AM8 | 6CF6 | 6X5 | 12BA7 | 35C5 |
| 1X2 | 6AN8 | 6C7 | 6X8 | 12BE6 | 35L6GT |
| 2A3 | 6AQ5 | 6C7 | 6Y6G | 12BF6 | 35W4 |
| 2AF4 | 6AQ6 | 6C7 | 7A4 /XXL | 12BH7 | 35Y4 |
| 3BC5 | 6AQ7GT | 6C6 | 7A5 | 12BQ6 | 35Z5GT |
| 3BN6 | 6AR5 | 6C7 | 7A5 | 12BR7 | 37 |
| 3BZ6 | 6AT6 | 6C7 | 7A5 | 12BY7 | 39/44 |
| 3CB6 | 6AT8 | 6C7 | 7A5 | 12CA5 | 42 |
| 3CF6 | 6AU4GT | 6C7 | 7A5 | 12J5 | 45 |
| 3CS6 | 6AU5GT | 6C7 | 7A5 | 12K7 | 50A5 |
| 3LF4 | 6AU6 | 6C7 | 7A5 | 12L6 | 50B5 |
| 3Q4 | 6AU8 | 6C7 | 7A5 | 12Q7 | 50C5 |
| 3S4 | 6AV5GT | 6C7 | 7A5 | 12SA7 | 50L6GT |
| 3V4 | 6AV6 | 6C7 | 7A5 | 12S7 | 50X6 |
| 4BQ7A | 6AW8 | 6C7 | 7A5 | 12S7GT | 56 |
| 4BZ7 | 6AX4GT | 6C7 | 7A5 | 12SQ7 | 57 |
| 5AS8 | 6AX5GT | 6C7 | 7A5 | 12V6GT | 58 |
| 5AT8 | 6B8 | 6C7 | 7A5 | 12W6GT | 71A |
| 5AY8 | 6B8G | 6C7 | 7A5 | 12X4 | 75 |
| 5AW4 | 6BC5 | 6C7 | 7A5 | 12Z3 | 76 |
| 5BK7 | 6BC8 | 6C7 | 7A5 | 12Z3 | 77 |
| 5J6 | 6BD6 | 6C7 | 7A5 | 14A7/12B7 | 78 |
| 5T8 | 6BE6 | 6C7 | 7A5 | 14B6 | 80 |
| 5U4G | 6BF5 | 6C7 | 7A5 | 14Q7 | 84/6Z4 |
| 5U8 | 6BF6 | 6C7 | 7A5 | 19 | 117Z3 |
| 5V4G | 6BF6 | 6C7 | 7A5 | 19AU4GT | 117Z6 |
| 5V6GT | 6BG6G | 6C7 | 7A5 | | |



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Steve Foisey, WPE11C, Keene, N. H., does his listening with a National NC-125 receiver and a 100' antenna, 30' high.



Joseph Potenza, Stamford, Conn., and his Hallicrafters S-38E receiver. Joe is a member of the Boys' Life Radio Club and the National Association of Armchair Adventurers.

spectively for a *Readability, Strength, and Tone*. The readability portion ranges from 1 to 5 and the strength and tone each range from 1 to 9. In the tone portion, the 9 indicates a pure d.c. note, free from ripple or chirp, while 1 indicates a rough, raw, a.c. spark-gap type of note.

SINPO. The newest code on the reporting scene is the *SINPO* code, which is rapidly becoming popular in the short-wave broadcasting field. Don't ask your ham friends about *SINPO*; chances are they've never heard of it.

Many short-wave outlets, particularly *Radio Japan*, are leading the movement towards general usage of *SINPO* and are asking their listeners to report to them in that code. See accompanying table.

Using *SINPO*, a report for a station's signal that is loud and clear and free from any interference would be "*SINPO 55555*." If you have an *S*-meter on your receiver, you can use the *S*-reading for the *S* report. For the *I* report, list the call letters or name of the interfering station whenever possible.

In sending your reports to the stations, be sure to remember that they need more than just the *SINPO* reports; they also need program details matched to the exact times heard so that they will know without doubt that you heard specific stations.

(Continued on page 121)

| SINPO Code | Q Code Equivalent | Meaning | Ratings (1 to 5) |
|------------|-------------------|----------------------------------|---|
| S | QSA | Signal strength | 5—excellent 4—good 3—fair 2—weak 1—barely audible |
| I | QRM | Interference from other stations | 5—none 4—slight 3—moderate 2—severe 1—extreme |
| N | QRN | Atmospheric noise; static | 5—none 4—slight 3—moderate 2—severe 1—extreme |
| P | QSB | Disturbed signal; fading | 5—none 4—slight 3—moderate 2—severe 1—extreme |
| O | QRK | Intelligibility; signal quality | 5—excellent 4—good 3—fair 2—poor 1—unintelligible |

The *SINPO* code is completely defined in table at right which shows comparable *Q* signals.

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of superb
quality*

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modest
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MODEL RRL-12

Features the sensational new Sphericon Super Tweeter for sweet, smooth high frequency response to inaudibility. 25" x 15 7/8" x 12 1/2" deep. From \$114.95 unfinished.

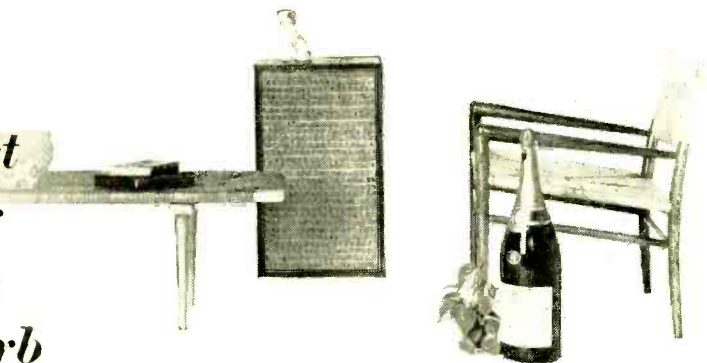
MODEL RRL-8

The impossible becomes reality! An 8" system with full bass response down to below 40 cps! 22 1/4" x 12 1/4" x 10 3/8" deep. From \$95.50 unfinished.

MODEL S-80

Excellent wide-range response from a system measuring only 21 3/4" x 11 1/2" x 9 1/4" deep. From \$56.95 unfinished.

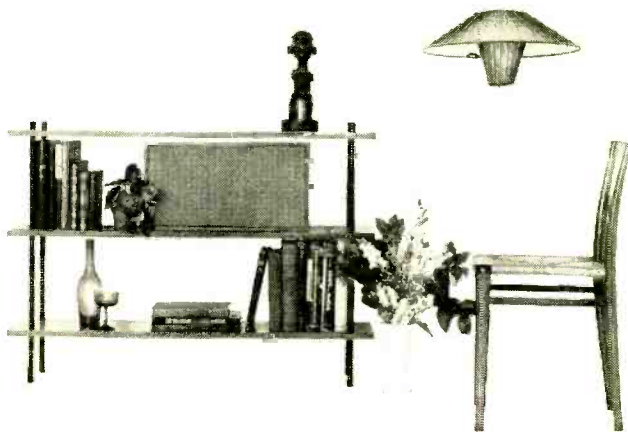
ALL THREE MODELS finished on four sides for use as highboy or lowboy. Beautiful oiled walnut finish for RRL-12 and RRL-8 in addition to mahogany, walnut and limed oak; S-80 in mahogany, walnut and fruitwood.



Model RRL-12 12" 3-Speaker RRL System



Model RRL-8 8" 3-Speaker RRL System



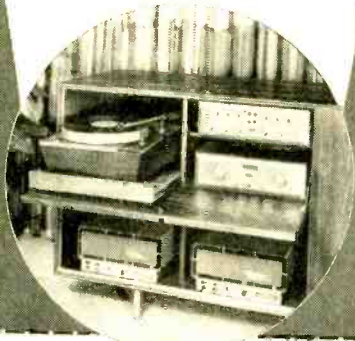
Model S-80 8" 2-Way High Efficiency System



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today!



Reeves Soundcraft Corp., Gt. Pasture Rd., Danbury, Conn.

Carl and Jerry

(Continued from page 38)

minute after the push-button circuit is opened; then the relay drops out and shuts off the light."

"That's going to be a nasty shock to the kid who tries to pin your doorbell and is depending on a few seconds running start before you can get to the door and turn on the light," Carl said with a grin; "but isn't it a lot of trouble for just one night?"

"Oh, I'm going to leave it connected," Jerry explained. "It will be nice to have the light come on instantly when a guest rings the doorbell. On top of that, when we come home at night to an empty house, we won't have to fumble around in the dark hunting first the door key and then the keyhole. We'll just push our own doorbell and have the porch light come on. Then after we are inside it will turn itself off. Of course the regular porch light switch can be used normally any time."

Carl was gazing curiously at a couple of devices that looked like electric motors connected together with a five-wire cable.

"Those are 'synchros' or selsyn motors," Jerry answered his friend's questioning look. "Maybe you remember reading about them in the *After Class* feature of the April, 1958, *POPULAR ELECTRONICS*. Let me show you how they work. Hold on to the rotor shaft of that one while I turn the shaft of this one."

As Jerry turned the shaft of the one synchro, the shaft of the other twisted loose from Carl's fingers. Every move of the rotor of Jerry's unit was instantly and exactly duplicated by the rotor of the unit Carl was watching. Even though the mo-



Always say you saw it in—**POPULAR ELECTRONICS**

tors were several feet apart, their rotors kept in step as though they were mounted on a single shaft.

"HEY! I almost forgot what I came over for!" Carl suddenly exclaimed. "Norma next door wants us to do her a favor. She's having a Halloween party for her sorority tonight, and for a finale she wants to take the whole bunch out to the old Bruner place at the edge of town and hold a seance at midnight. You know the place I mean?"

"Sure, it's the only haunted house left in these parts. But where do we come in?"

"She wants us to supply the 'spirit' for the seance. I went out with her this morning and looked the place over. There's an attic above the room in which the seance will be held, and she thought we could hide up there and maybe use a hidden speaker under the table to answer the girls' questions. Her uncle works for the power company, and he has already put in a temporary meter and an outlet on a pole behind the house for us to use. She admitted she was pretty confident she could sweet-talk us into helping her."

"Guess she knows her power or our weakness," Jerry remarked with a rueful grin; "but we ought to do better than just use a speaker. I'm getting an idea already. Go down to the dime store and pick up one of those nasty-looking life-size plastic skulls and a bottle of phosphorescent paint. I'll get some stuff together and meet you out at the Bruner place."

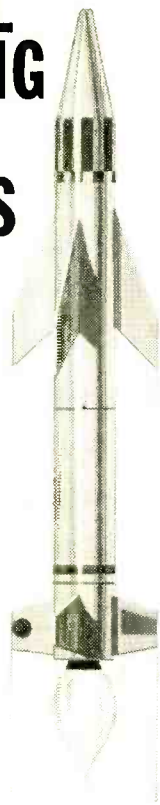
An hour later the two boys were standing inside the cobwebbed old house. A round table with its veneered top blistered and peeling, several benches and rickety chairs were the only furniture in the large, low-ceilinged room. Carl and Jerry removed the top of the table from the large hollow pedestal leg and used a keyhole saw to cut a circle about ten inches in diameter out of the center. Then one of the selsyn motors was mounted down inside the pedestal, and the circle of wood was securely fastened to its vertical shaft. A small speaker was also fastened down inside the pedestal.

When the table top was put back, the circle in the center moved freely about; yet the crack around its edge was not easily seen. Wires from the sychro and the speaker were run down through the leg, through a hole in the floor, across, and

(Continued on page 96)

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NEW

CRT TESTER-REACTIVATOR Model CRT-2

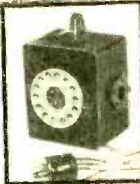
NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.



Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*

Model CRT-2
\$57.50
Net

TERMS: \$13.50 within 10 days. Balance \$11 monthly for 4 months.



The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST

- ✓ for quality of every black and white and color picture tube
- ✓ for all inter-element shorts and leakage up to one megohm
- ✓ for life expectancy

REPAIR

- ✓ Will clear inter-element shorts and leakage
- ✓ Will weld opens between any two elements in the tube gun

REACTIVATE

- ✓ The unique controlled "SHOT" (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore, the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- ✓ The "BOOST" method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

- 1. THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** — A tremendous advance over the maze of cable and adapters generally found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 110 degree types from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A special cathode switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.
- 2. WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place, allowing you to control the first time to properly control the reactivation voltage. This eliminates the danger of stripping the cathode of the oxide coating. It enables you to see the speed of reactivation and whether the build-up is lasting. You will see if the cathode contamination is too great and if the picture tube is too far gone to be reactivated.
- 3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers . . . high enough to really do the job — yet controlled to avoid damage to the picture tube.
- 4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT** — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
- 5. VISUAL LIFE TEST** — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement when necessary.
- 6. TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES** — Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these types with the same thoroughness as the regular types with complete safety.
- 7. SEPARATE FILAMENT VOLTAGES** — Including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
- 8. TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES** — found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary picture tube testers. The CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

ADDITIONAL FEATURES

- Employs the time proven dynamic cathode emission test principle
- Large 4 1/2" meter with heavily damped movement for smooth action, accuracy and long life
- Provides separate shorts test for each element in the picture tube
- Filament continuity is shown on a separate glow indicator
- An easy to read instruction manual contains all the latest testing information on old and new type picture tubes
- Housed in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord.

* patent pending

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute "must" for every serviceman.

in-circuit checks:

- ✓ Quality of condensers even with circuit shunt resistance. (This includes leakage, shorts, opens, intermittents)
- ✓ Value of all condensers from 200 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- ✓ Quality of condensers . . . (This includes leakage, shorts, opens and intermittents)
- ✓ Value of all condensers from 50 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ High resistance leakage up to 300 megohms
- ✓ New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammer-tone finish steel case . . . comes complete with test leads



Model CT-1
\$34.50
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NOW a Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

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The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltage, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses. Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read from .2 ohms to 1 billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I-F, stage-by-stage gain and detector inputs.

OUTSTANDING FEATURES

- Completely portable — self powered with long life batteries — permits use everywhere
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Housed in hammer-tone steel-case — complete with MULTI-PROBE

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
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Model VT-1
\$58.50
Net

TERMS: \$14.50 within 10 days. Balance \$11 monthly for 4 months.

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- ✓ Checks quality of over 700 tube types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-tube types, O24s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

SPECIFICATIONS

- No time consuming multiple switching . . . only two settings are required instead of banks of switches located inside cover. New listings are added without costly roll chart replacement
- 41 phosphor bronze electrolytic tube sockets never need replacement
- Checks each section mounted on panel
- Large 4 1/2" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out
- Special scale on meter for low current tubes
- Compensation for line voltage variation
- Long lasting etched aluminum panel
- Separate gas and short jewel indicators
- Line isolated — no shock hazards

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.



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then up through a partition to the roughly floored attic of the crumbling building.

In the attic the boys cut a trap door directly over the center of the table. The plastic skull was painted with phosphorescent paint, and a strong, thin, black thread was fastened to the top. This thread was run over a pulley so positioned that when the skull was let down through the trap door it came to rest exactly in the center of the cut-out portion of the table top.

The speaker was connected to a small amplifier, and a "private" microphone of the type used for making tape-recorded notes in a courtroom was connected to the input of the amplifier. Tests showed that when Jerry was talking into this mike Carl could not hear him directly right beside him; yet the voice came loudly, though muffled, from the speaker in the pedestal leg of the table. The five wires from the synchro were connected to its companion unit in the attic.

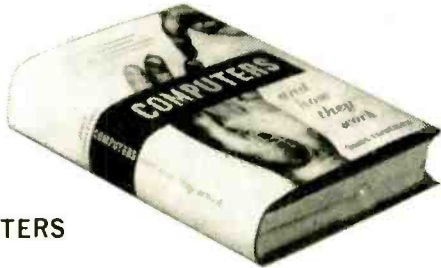
"Well," Jerry said finally as he wiped the grime off his face with his sleeve, "I guess that about does it. Now let's high-tail it for home and brief Norma. We want to know when the party will get here; we want the room in absolute darkness during the seance; and we don't want anything except a little lace doily on top of that table. It will cover up the saw kerf around the cut-out piece. Let's not tell her about the skull. We'll give her as big a thrill as her guests get."

AFTER SUPPER Carl and Jerry watched a couple of Halloween shows on TV



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until about ten-thirty; then they rode their bikes out to the old Bruner farm. The night was moonless, but a few stars peeped through the scudding patches of cloud overhead.

As the boys got off their bicycles and pushed them around behind the dark and empty house, the place somehow seemed much different than it had that afternoon. It was no longer just empty and deserted. There was something brooding and menacing about the rotting building. Only a couple of fan blades were left in the windmill that stood beside the house and these rocked back and forth in the tugging wind, producing a rusty, grating screech with every movement.

The boys climbed up into the attic and gave their equipment a final careful test. Then the skull and a lamp to keep the phosphorescent paint "charged" was placed inside a covered box. The boys sat there in pitch darkness waiting for the girls to arrive.

"Hey, Jer." Carl said in a hoarse whisper, "how come they say this place is haunted?"

"Old man Bruner who lived here was a very mean, cruel man," Jerry whispered back. "One winter day he sent his young son out to pasture the cattle on the frozen ground. When the boy came home that night, one of the cows had lost its bell. Old man Bruner gave the boy a lantern and told him to go hunt for the bell, and he said the kid couldn't get into the house until he found it. It got colder in the night, and the next morning the boy was found frozen out there in the meadow by the creek. Folks swear that on cold winter nights you can hear the cowbell, see the light of the lantern out there in the field, and hear the child weeping."

"Br-r-r," Carl said with a shiver. "What a sweet, lovable character!"

At this moment there was the sound of cars stopping outside, and in a couple of minutes a dozen giggling, whispering young women carrying flashlights and clutching each other tightly tiptoed through the door.

"Okay, girls, let's all gather around the table," Norma said. "It's only five minutes until midnight, and we want to be ready to receive the spirit. Then turn out your flashlights and all join hands."

The chairs were soon arranged so that the girls were seated in a circle about the table. As the boys peered down through

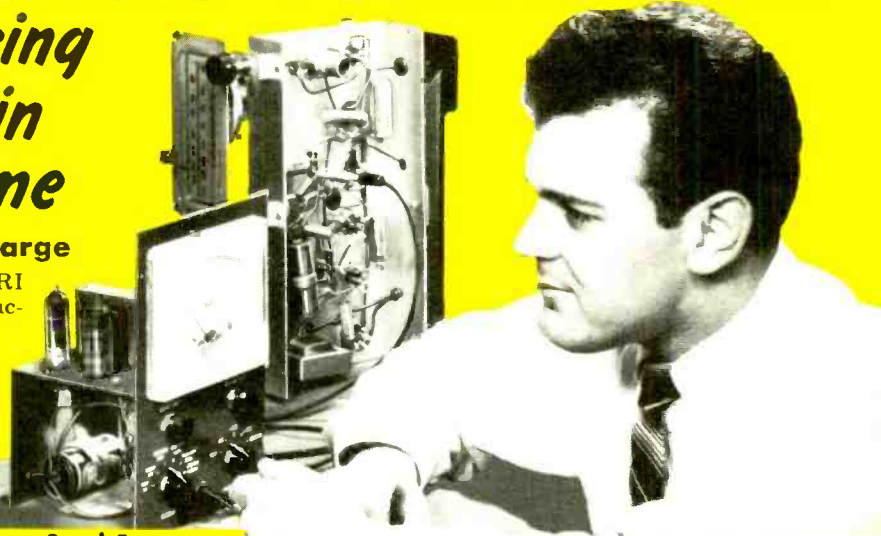
(Continued on page 102)

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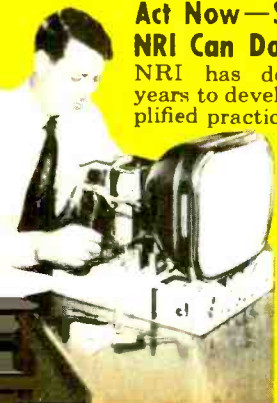
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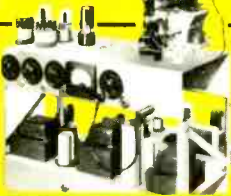


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peepholes in the attic floor, one by one the flashlights winked out.

"Is the circle complete?" Norma asked.

As the affirmative chorus subsided, Norma went on in a slightly shaky voice: "If any spirit can hear us, make your presence known."

Three deliberately spaced muffled thumps came from the table. Carl was tapping the microphone with a pencil.

"Are you going to talk to us by spiritual rapping?" Norma asked in a puzzled, quavering voice. "Rap once for 'Yes' and twice for 'No.'"

At this instant the boys noiselessly lifted the glowing, grinning skull out of the box and started it on its slow, deliberate descent through the trap door. There were several shrieks and screams from below, but a hollow, German-sounding voice commanded: "Schtop dot yelling! And rouse mit dot knocking stuff. I talk for mineself."

"Who—who are—or were—you?" Norma stammered as the skull settled down lightly on top of the table.

Instantly it turned to face her and replied, "I vass Hans Bruner. This vass mine place."

"Hey! That German accent's pretty good!" Jerry whispered as he looked up from the synchro with which he was controlling the skull's movements.

"My grandfather had the same name as mine, but he spelled it with a 'K.'" Carl took his mouth out of the opening of the special mike to whisper back.

"Mr. Bruner," a girl said timidly from across the table. The skull wheeled to stare at her expectantly with its hollow eye sockets. "Are you happy?"

"Happiness, bah!" the guttural voice grated as the skull shook itself from side to side in vigorous disapproval. "Happiness is for fools. I vass strong."

"Why do you stay here?" a girl at the side of the table asked.

"Because I wait on my stupid, careless boy," the skull said as it swiveled around toward her.

"What's he doing?" Norma asked.

"Hunting a cowbell he lost; but listen! I hear him coming now."

In the deathly silence that followed a sound like a tinkling cowbell could be heard outside the door. That did it. There was a chorus of continuing shrieks and screams

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as the girls all crowded out the door and into their cars and roared off into the night.

“WELL, we sure scared them,” Carl said as he and Jerry stood in the open door looking at the disappearing tail lamps. There was a sudden chill in the night air.

“Yeah.” Jerry said absent-mindedly. He seemed to be listening for something.

“What are you listening for?” Carl demanded.

“Did you imagine you heard a cowbell just before the girls screamed?”

“I didn’t imagine I heard one; I heard one; and I still hear it faintly.” Carl said flatly. “And look! Over there by the willows along the creek! Isn’t that a light bobbing around? Maybe it’s a lightning bug.”

“In October!” Jerry scoffed. “But maybe it is; and maybe there’s a cow with a bell somewhere out there in the darkness; and maybe that sound of a boy crying is coming from the windmill; but I’m not going to stay and find out. Right now I feel like I can get on that bike of mine and beat those girls back to town. We can come back for the stuff tomorrow, in daylight. After all, it is Halloween, and it’s after midnight, and there’s some stuff going on around here I don’t understand and don’t like.”

His answer was the sound of gravel spinning beneath the wheels of Carl’s bike.

“Wait, Carl! Wait for me!” Jerry called as he leaped astride his own bicycle and started pedaling madly down the road after his chum.

—30—



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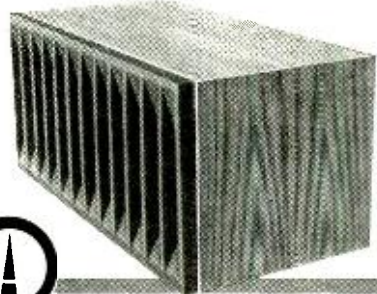
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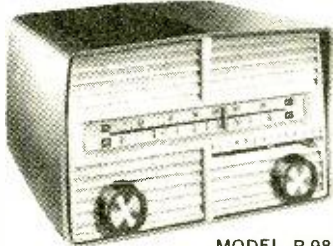
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Test Instruments

(Continued from page 58)

boost network. By making $C2$ adjustable, exact frequency compensation can be obtained. You can see how this is applied practically in the two attenuation switching positions X10 and X100 shown in Fig. 2.

Amplifier Analysis. The attenuator switch usually feeds a cathode-follower which may be an individual triode (such as a 6C4) or the section of a triode/pentode tube as shown in Fig. 2. There are two good reasons for the use of a cathode-follower at this point: (1) the high *input* impedance of the cathode-follower minimizes loading of the circuit supplying the signal you want to observe, and (2) the cathode-follower's low *output* impedance enables the use of a low-value gain control (10,000 ohms in the case of the Paco). Low-impedance gain controls are free from the high-frequency roll-off problems caused by 1- and 2-meg-ohm potentiometers. However, because of the low impedances, it is necessary to use a very large coupling capacitor (20 μ f.) to prevent loss of the lower frequencies.

The pentode portion of $V2$ in Fig. 2 op-

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crates as a straight voltage amplifier with no tricks, except for the use of a rather small plate load resistor (10,000 ohms) to keep the output impedance low.

The resistor-shunted "peaking" coils we meet here and there in the circuit are designed to adjust the frequency response of the amplifier for maximum "flatness" through its operating bandwidth. Some scopes actually have slug-tuned coils, but these are usually found only in scopes which have extremely wide bandwidths.

Push-Pull and Positioning. Still referring to Fig. 2, the next tube in the lineup, the dual-triode 12BH7 (*V2*), has quite a job. It simultaneously operates as a phase inverter, voltage amplifier, vertical positioning tube, and push-pull driver for the vertical plates of the CRT.

The phase inverter function of the tube is performed by the standard "long-tailed pair" or cathode-coupled arrangement such as is found in a large number of audio amplifiers. Temporarily we'll ignore the vertical positioning network and track the signal fed to the control grid of *V2a*. The signal appears both at the plate of *V2a* and across the 1200-ohm cathode resistor which the *V2a* triode shares with *V2b*.

When the signal at the grid of *V2a* is positive, the signal at its cathode is also positive. The positive swing at the cathode of *V2b*, however, is equivalent to a negative swing at *V2b*'s grid (which is a.c.-grounded by a .02- μ f. capacitor). And when the opposite-phased signals appear at the plates of *V2a* and *V2b*, we have what we're looking for—phase inversion and push-pull drive for the CRT's deflection plates.

Vertical trace positioning is achieved by changing the bias voltage applied to the grids of *V2*. As the grid bias of one tube is raised by the vertical-positioning pot, the bias voltage applied to the other tube is lowered. The voltage change at the grids is reflected by an amplified but opposite change in the respective plate voltages of the two triodes. Since there are no blocking capacitors, the plate voltages of *V2a* and *V2b* serve also as a push-pull positioning voltage source.

Why all the emphasis on push-pull? For many of the same reasons that p-p is used in high-fidelity design. These include hum cancellation, reduction of second harmonic distortion, and higher signal voltage output for the same B-plus supply.

The last point deserves clarification. No-

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tice that the single-ended driver shown in Fig. 1 operates with one deflection plate ($Dv2$) at ground potential. Hence, positioning voltages and signal voltages are always applied between $Dv1$ and ground. The beam deflection is proportional to the voltage present between $Dv1$ and ground.

In the push-pull situation, the positioning and signal voltages appear as equal but oppositely phased voltages on each pair of deflection plates. With a single-ended amplifier, a 50-volt r.m.s. signal (on $Dv1$) may displace the CRT's spot one inch. However, if the push-pull amplifier places a 50-volt signal on $Dv1$, it will simultaneously feed a 180° out-of-phase 50-volt signal to $Dv2$. The total voltage difference between the two plates will be 100 volts and the spot will therefore be deflected two inches.

The Horizontal Approach. As you are no doubt aware, every scope has a horizontal amplifier in addition to its vertical one. In general, horizontal amplifiers follow similar circuit principles but are designed for lower sensitivity (i.e., less gain) and a lower frequency response than the vertical amplifiers.

Most oscilloscopes will have provision for front-panel switching of the horizontal amplifier from "sweep" to "external." Direct connection to the horizontal deflection plates (as well as the vertical plates) is provided by a switching arrangement such as that shown in Fig. 2. A simplified version of the basic scope amplifier switching is shown in Fig. 4.

Next month, we are going to put the oscilloscope to work in the type of jobs it does particularly well—waveform analysis and trouble-shooting. We will investigate a standard full-wave power supply and see what the scope can reveal about its inner workings.

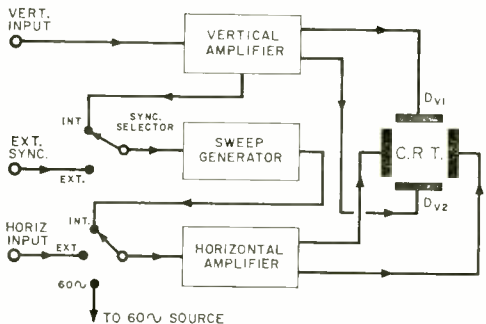


Fig. 4. Simplified switching diagram of a typical scope. Specific scopes may have different setups.

Telemetry

(Continued from page 44)

decodes the different SCO frequencies.

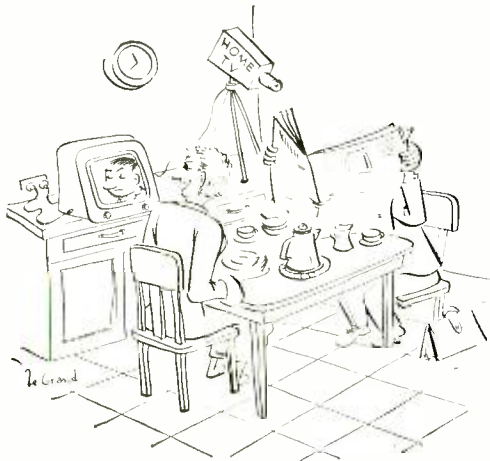
Secondly, one or more SCO's can perform multiple service by means of a simple mechanical system. A rotating switch with multiple contacts can be wired up to connect several sensing elements to a single SCO one at a time. As a small external motor rotates the switch, each sensing element is sampled in order. See block diagram on page 43.

In the event that the missile should be recovered intact, it's a wise precaution to include a small tape recorder in the airborne system. Should the transmitter go off the air for any reason, the recorded tape would be vitally important.

Expensive but Economical. Although telemetry systems are fairly expensive, in our rocket projects they more than pay their way. Telemetry makes each test flight—no matter how apparently disastrous—at least partially successful. Design weaknesses can be analyzed long after the flight is over, and troubles can be ironed out before another test is attempted.

In industry, too, telemetry pulls its own weight. Recently, a major airframe company spent two million dollars for telemetry equipment to be used in testing jet transport planes. The saving in test time will easily pay for the system.

Telemetry offers a rapidly growing field to those who like something new and exciting. To the rest of us, it promises safer flying and information which will speed our conquest of outer space. —30—



"More coffee, dear?"

November, 1959

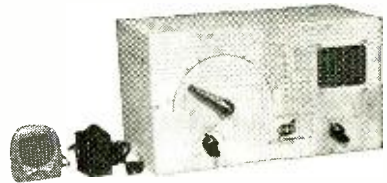
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Transistor Topics

(Continued from page 75)

an Argonne No. AR-164 or the equivalent. Any PM loudspeaker having a 6 to 8 ohm voice coil can be used; as a general rule, the larger the loudspeaker, the better output volume and tone quality you'll obtain. And any 9-volt transistor battery will do.

The "Tunnel" Diode. A completely new type of semiconductor device, developed in Japan, is now being produced in experimental quantities by General Electric Company. Dubbed the "tunnel" diode, this unit resembles other diodes in that it is essentially a *p-n* junction. However, the barrier region is made very thin and special care is taken in fabricating the device. The result is a component in which electrons seem to travel across the barrier region as if moving at the speed of light, although they do not appear to have sufficient energy to surmount the barrier on the basis of applied voltage alone. In a sense, the electrons pass through a "tunnel" in the junction barrier.

In operation, circuit current first rises gradually as forward bias voltage is in-

creased, just as in a conventional diode. But then an interesting thing takes place. As bias voltage is increased further, the circuit current peaks and *then starts to drop*, finally reaching a minimum value (or "trough") before it starts to rise again. A decrease in circuit current with an increase in applied voltage is the familiar *negative resistance* effect encountered in some tetrode vacuum tube circuits and used, in the past, in the common Dynatron oscillator. In practice, any negative resistance connected across a tuned circuit becomes an oscillator; it makes little difference whether the negative resistance is the result of tube or semiconductor action.

One possible application of the tunnel diode is shown schematically in Fig. 3. Here, the new device (*TD1*) has been used in a simple FM radio transmitter or "wireless" microphone. Component values are not shown, since these depend on the electrical characteristics of the diode used.

Although current units are experimental, the tunnel diode has remarkable properties. Theoretically, its upper frequency response should be over 100,000 *megacycles*. It can operate on input powers as low as 1 milli-

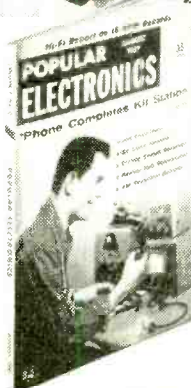
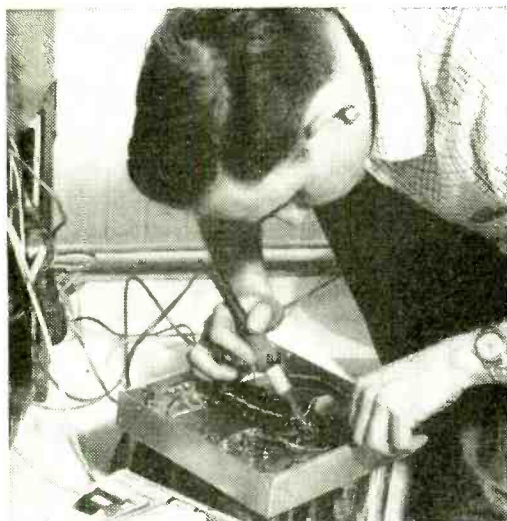
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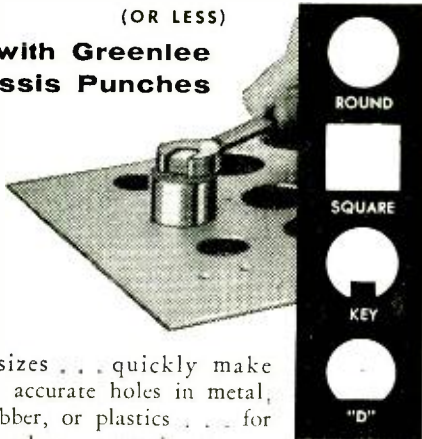
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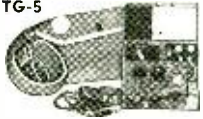
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watt, but can handle currents of 5 amperes or more (theoretically, units can be assembled with current-handling capacities many times this value). It has a very low noise figure, and can operate at temperatures from a few degrees above absolute zero to over 600° F.

Tunnel diodes can be made of germanium, silicon, or other semiconductor materials, and can be used as amplifiers, switches and oscillators.

Gift Suggestions. Choosing suitable gifts for your technical friends can be a real problem. Electronic components make good gift items for the home builder, of course, but only if you know the status of your friend's lab stock or have an idea of the projects he's planning.

Columbia Studio (480 Seventh Avenue, New York 18, N. Y.) has recently come up with a set of unique items quite appropriate for anyone working with transistors. Included in the line are a variety of men's jewelry items, such as a key chain, cuff links (see photo), money clip, tie bar, and so on. All feature a stylized schematic symbol of a transistor executed in black ceramic and sterling silver.

The tie bar sells for \$2.95, the cuff links for \$4.95 (or a set of both for \$6.95), and other items are proportionately priced. Mail orders are accepted.

Product News. International Rectifier Corporation (1521 E. Grand Ave., El Segundo, Calif.) has introduced another version of the popular "Zeniac" zener diode substitution box. The Model B Zeniac offers a selection of eleven basic 10-watt silicon zener diodes covering the zener voltage range from 3.6 to 30 volts. As you may recall, the original Zeniac, reported here several months ago, featured 1-watt diodes.

Lafayette Radio (165-08 Liberty Ave.,



New version of the "Zeniac" zener diode substitution box (Model B) introduced by International Rectifier Corporation.

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Jamaica 33, N. Y.) is featuring a three-transistor transistorized receiver in its latest catalog. Equipped for both earphone and loudspeaker reception, the compact set nets for \$16.95, including a leather carrying case, earphone and battery. Stock No. is FS-203.

Tektronix (P. O. Box 831, Portland 7, Oregon), a well-known West Coast instrument manufacturer, has introduced a transistorized portable oscilloscope. With a vertical response from d.c. to 5 mc. and a sensitivity of 10 millivolts per division, the Type 321 has a calibrated sweep from 0.5 microsecond to 0.5 second per division.

That does it fellows. See you next month.

Lou



Amazing Electron Microscope

(Continued from page 66)

how such a "slicer" works with softer materials, but how do we go about slicing off a layer of steel 1/25,000-of-an-inch thick? The answer to this question is surprisingly simple. A "replica" of the steel's surface is

made on a soft material—such as wax. The replica is easy to slice and, when it is mounted on an exceedingly thin transparent membrane, it takes the place of the original object in the microscope.

Importance. About one thousand electron microscopes are now in use in laboratories across the nation. While they are invaluable tools in research aimed at finding the causes of diseases, especially cancer, they are also useful in solving a wide variety of industrial problems. For example, the wearing qualities of rubber tires can be judged by careful examination of an electron microscope photograph, thus eliminating the need for long and tedious road tests.

But it is in the study of cells that the electron microscope finds its most exciting application. Cells are grown, nourished, and reproduced through a process of protein synthesis. With the aid of electron microscopes, scientists have been able to see these processes—which are truly the "secrets of life"—for the first time.

Man is an insatiably curious creature. One of his most efficient means of satisfying his hunger for knowledge and understanding is the electron microscope. —30—

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On the Citizens Band



By TOM KNEITEL, 2W1965

THIS MONTH finds us writing the column while peering out from underneath two fantastic stacks of mail. One stack says, "Don't limit the use of Citizens Radio!" The other loudly cries, "No hamming on 11 meters!"

Here is an excerpt from a letter which we received from Richard Dorf, W2QMI:

"The Citizens Band was established for the purpose of allowing radio communications by those without sufficient interest in radio to permit them to pass Amateur Radio examinations. It is intended that the service be used to transmit messages from one point to another—not to satisfy anyone's button-pushing or look-Ma-I'm-broad-casting urges.

"The amateur service, on the other hand, exists, not primarily for communication, but for the advancement of radio through the technical and operational interests of enthusiasts. With today's requirements for a ham ticket, getting a legitimate license is simple enough for those who want to get on the air and rag-chew."

We quoted from Dick's letter because we couldn't say it any better ourselves.

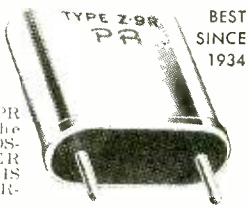
Regardless of what the "pioneer" CB users thought, or how the FCC's Part 19 reads, CB is not intended to be used as a lazy-man's ham band. Among the taboos on the band are "CQ'ing" (including so-called "testing" operations) and "DX'ing." If you want to see how far you can hear, fine; but resist the urge to work the distant unknown station. Citizens Band frequencies are shared with other stations on a "party line" basis, and improper operation will only make it difficult for those who really need this service.

Now we know that the above remarks are going to cause the mailman to have a miserable November, what with his having to drag us sacks of irate letters. Not that we don't like to receive mail, but please understand that all we can do is recommend that you obey the law. If and when the laws are changed, you'll hear about it.

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 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125
 27.135, 27.155, 27.165, 27.175, 27.185, 27.205
 27.215, 27.225

Z-9R, PR CRYSTALS, Calibrated .005% \$2.95 Net



RECEIVER CRYSTALS

When ordering Receiver Crystals, specify I.F. Frequency, also whether I.F. is above or below Transmitter Frequency.

Z-9R, PR Citizens Band Receiver Crystals, .005% \$2.95 Net

GET PR'S NOW FROM YOUR JOBBER

PETERSEN RADIO COMPANY, INC.

2800 WEST BROADWAY

COUNCIL BLUFFS, IOWA

There seems to be some confusion regarding the use of 27.255 mc., the "radio control" channel. This channel may be employed for voice communications by Class D stations using the 5-watt input; you may *not* run 30 watts on voice, as has been mentioned in a number of letters received here. The 30 watts is for radio control *only*. Because of the large number of Class C R/C stations on 27.255 mc., we do not recommend it for voice communications.

We had the good fortune recently to have a chat with Ed Manville of Vocaline. Vocaline is, in case you don't already know, the outfit which put Class B (465-mc.) CB on the map. Well, now they are coming out with a trim-looking Class D unit. We understand the receiver circuit is so selective that you can set off an H-bomb on the channel next to the one you are monitoring and the set will ignore it with a cold indifference.

This "fine tuning" factor is going to mean a lot when the band jams up with stations in a particular area. Unless your receiver is sufficiently selective, you may run into trouble from nearby stations operating on channels adjacent to yours.

It really is a small world. While tuning over the band we noticed two unbelievably strong stations. After a little investigation, we found that one station, 2W2088, was operated by Siggy Morel, who lives in our own apartment building. The other station, 2W2513, is run by Lou Belok, who lives in the building next-door.

We are always hearing stations on channel 11 announcing that they are on channel 8. At first we thought that our trusty old kilocycle inhaler was gremlin-infested, but we have since been told that for some unknown reason the neat little units made by Gonset have a different channel-numbering system than is generally in use on CB. We don't know if this is true, but we saw with our own eyes a Gonset marked "Channel 8 27.085 mc." on the front panel. And 27.085 mc. is channel 11. Live and learn.

Please heed our warning about not "hamming" on 11 meters. The FCC has been handing out "pink tickets" (violation notices), particularly for "CQ'ing," "DX'ing," and off-frequency operation. You wouldn't want to do anything which might make for trouble with Uncle Sam, and possibly contribute to even stricter rules being imposed on CB.

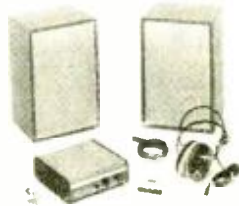
-30-

ENJOY TRUE STEREO NOW

WITH YOUR PRESENT RECORD PLAYER

Here is a whole new adventure in stereo listening, dramatic beyond belief, that will make you the envy of your neighborhood. The Linlar Stereo Kit is specially designed to convert your present record player to exciting three-dimensional stereo, quickly, easily and inexpensively. Nothing to build or assemble; just hook up. Linlar Stereo Kits come in two models: (1) With one genuine Permoflux Dynamic Stereophone, or (2) With both a stereophone and two Permoflux *matched* stereo speakers. The binaural stereophone gives you the most faithful reproduction of the original recording, completely eliminating room distortion. Matched stereo speakers are preferred for casual or group listening.

In addition you will obtain up to 100 percent more listening pleasure from your LP and 78 RPM records.



HERE'S WHAT YOU GET AT FACTORY-TO-YOU PRICES

Stereo Kit A-1

- 1 Genuine Permoflux Dynamic Stereophone
 - 1 Stereo diamond needle (LP) cartridge, turnover type, with sapphire needle for 78 records
 - 1 Twin stereo amplifier: total 10 peak watts (Retail value, \$125)
- KIT PRICE \$69.50**

Stereo Kit A-2

- 1 Genuine Permoflux Dynamic Stereophone
 - 2 Permoflux matched stereo speakers
 - 1 Stereo diamond needle (LP) cartridge, turnover type, with sapphire needle for 78 records
 - 1 Twin stereo amplifier: total 10 peak watts (Retail value \$175)
- KIT PRICE \$99.50**

Stereo Kit B-1

- 1 Genuine Permoflux Dynamic Stereophone
 - 1 Stereo diamond needle (LP) cartridge, turnover type, with sapphire needle for 78 records
 - 1 Twin stereo amplifier: total 5 peak watts (Retail value \$100)
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FREE

IF YOU SEND FULL PAYMENT WITH YOUR ORDER WE WILL SHIP PREPAID AND YOU WILL ALSO RECEIVE, FREE OF CHARGE, ONE 12-INCH STEREO ALBUM. 20% DEPOSIT IS REQUIRED ON ALL C.O.D. ORDERS.

MONEY BACK GUARANTEE

If you are not completely satisfied with your Linlar Stereo Kit you may return it within 10 days for a full refund.

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LINLAR INC. Dept. PE11

4101 San Fernando Road, Glendale 4, Calif.

Please enter my order for the following:

| Item | Quantity | Price | Total |
|-----------------------|----------|---------|-------|
| Linlar Stereo Kit A-1 | | \$69.50 | |
| Linlar Stereo Kit A-2 | | \$99.50 | |
| Linlar Stereo Kit B-1 | | \$59.50 | |

All prices subject to change without notice and are F.O.B. Glendale, California. California residents add 4% sales tax.

- Send prepaid and include free demonstration stereo record. I am enclosing payment in full.
- Send C.O.D. I am enclosing 20% deposit.
- Send free literature on Linlar Stereo Kits.

Name

Address

City Zone State

TRANSISTORIZED...CITIZENS BAND
**WALKIE-TALKIE
 RADIOPHONES**



\$89.50 each
**Complete
 Ready-to-
 Operate**

Only the **ELCOLAB**
 model **RT-27-A** offers

you all of the following features:

- Completely portable and self-contained. No plug-ins, no antenna cables, and no external power source required.
- Transistorized circuitry operates from six size "D" flashlight cells available anywhere.
- Weighs only 6 lbs. with batteries and measures 8" x 5" x 3".
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- Transmitter tunable to any of the 22 channels by changing crystal. One crystal supplied with each unit.
- Meets FCC requirements for Class "D" citizens radio service.
- License obtainable free of charge by any U.S. citizen over 18.
- Telephone handset with push-to-talk switch offers maximum convenience, reduces battery drain, and permits more privacy than a hand-speaker and separate microphone.
- Transmitting range from 1 1/2 mile to several miles depending on obstructions and elevation.
- Receiver will detect signals as weak as one microvolt and has automatic volume control to prevent overloading of strong signals and noise clipping to reduce interference caused by autos and electrical appliances.
- Free R.F. power indicator with each order.
- Also available for the 6 or 10 meter amateur bands at no extra cost. (Many now in use for civil defense.)

Available only from the Ecolab factory. Mail your order with full payment or \$10.00 deposit balance C.O.D. For each unit ordered, include sufficient postage for 7 lbs. plus insurance. N.Y.C. Residents include sales tax.

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HOLLIS 8-2720

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Available only from **WESTERN RADIO, Dept. REL-11, Kearney, Nebr.**

Across the Ham Bands

(Continued from page 78)

Actually, the percentage of hams who fail to QSL intentionally is not as high as the complaints would have you believe. Of course, there are a few "rugged individualists" who will not QSL under any circumstances, and some cards are inevitably lost or overlooked. However, at least 50% of all hams answer all QSL cards received immediately, and the rest intend to do so, but they "forget" easily.

Therefore, your percentage of replies to the QSL cards you send out will pretty much depend upon how much your card impresses the forgetful group. I don't recommend that you wait for the other fellow to QSL first, because doing so habitually indicates that you really do not care whether you get QSL cards or not.

Based upon long experience, promptness, accuracy in filling out the card, and neatness are the important things in getting answers to your cards. For beginners, the importance of putting a complete address on all cards sent cannot be overstressed, because a card addressed to "Amateur Radio K9—, Somewhere, Some State," is rarely delivered to the right place, except possibly in a very small town.

In filling out your QSL cards, the essential information to include is: call letters of the station worked, signal report, type of emission and band used, and date and time of contact. On cards going to foreign amateurs employing GMT (five hours ahead of EST), use of the 24-hour system is highly recommended. For a final touch, mail your card in an envelope. It impresses the recipient, and your card arrives in much better condition.

Working Foreign Hams. Suppose you were located in a foreign country and every few weeks your QSL bureau forwarded you a batch of 100 or more QSL cards. And suppose that in between these times, you got a trickle of cards air-mailed directly to you, and these cards were accompanied by International Postal Reply Coupons. Which cards would you answer first?

I suggest that you send cards to foreign stations via their QSL Bureau only when you do not have a better address, or if you have several cards going to the same country and do not particularly care how long it takes to get replies. Of course, you have no choice on cards going to iron-curtain

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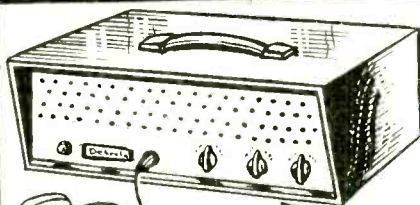
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Complete Diagram Furnished

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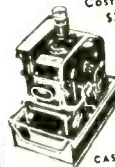
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HERE'S PROOF...

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| Name | License | Weeks |
|---|---------|-------|
| Ben Taylor, 29 N. Franklin St., Chambersburg, Pa. | 1st | 12 |
| Ben Moore, P.O. Box 160, Opp, Alabama | 1st | 12 |
| Donald R. Tins, 250 Park Terrace, Hartford 6, Conn. | 1st | 15 |
| Ruben O. Okamoto, P.O. Box 375, Hanalei, Kauai, Hawaii | 1st | 12 |
| Billy W. Krebs, Route #3, Smithfield, N.C. | 1st | 12 |
| J. H. Berkey, 10621 Bufileton, Los Angeles 47, Calif. | 1st | 9 |
| Donald H. Ford, Hyannis Rd. Cape Cod, Barnstable, Mass. | 1st | 12 |
| James D. Hough, 400 S. Church St., First Troy, Wis. | 1st | 12 |

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(Mail in envelope or paste on postal card)



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Hollywood • Seattle • Kansas City • Washington

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name _____ Age _____

Address _____

City _____ State _____

I am interested in: Home Study, Resident Classes 93-S

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| | | | |
|---------------|---------------|---------------|---------------|
| 10BP4 \$ 7.95 | 16WP4 \$12.00 | 17TP4 \$17.00 | 21EP4 \$13.50 |
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| 16EP4 12.75 | 17CP4 17.00 | 21AP4 22.10 | 21ZP4 13.50 |
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| 16KP4 9.95 | 17HP4 12.50 | 21AMP4 15.75 | 24DP4 24.50 |
| 16LP4 10.95 | 17LP4 11.50 | 21ATP4 15.75 | 27P4 39.95 |
| 16RP4 9.95 | 17QP4 9.95 | 21AUP4 15.75 | 27RP4 39.95 |

1 YEAR WARRANTY

Aluminized Tubes \$5.00 more than above prices. Prices include the return of an acceptable similar tube under vacuum. These tubes are manufactured from reprocessed used glass bulbs. All materials including the electron gun are brand new.

ALL PRICES FOB CHICAGO, ILLINOIS. Deposit required. When old tube is not returned, refundable at time of return. 25¢ deposit required on C/O shipments. Old tubes must be returned prepaid. Tubes shipped Rail Express.

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—PICTURE TUBE OUTLET—

3032 MILWAUKEE AVE., CHICAGO 18, ILLINOIS
Dickens 2-2048

"QUALITY" 24 WATT (DUAL 12 WATT) BASIC STEREO AMP



FEATURES: Full 24 watt Stereo, 48 watts Peak Power Output, 12 watts each Channel, 9 tube complement, Frequency Response ± 1 Db., 20-20,000 Cps. Kit Form. **\$39.95**

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countries, because individual addresses are not printed in the Call Book.

Some foreign hams advise stations they work to "QSL via—." When you receive such instructions, send your QSL card with a stamped and self-addressed return envelope, and you'll find that you will soon receive your contact's QSL card in return.

Your QSL Bureau. Most of the foreign cards to U. S. hams arrive via the ARRL QSL Bureau. To receive your share, put your name and address in the normal place on a few stamped, business-size envelopes, and print your call letters in the upper left-hand corner. Send these envelopes to your Call-Area QSL Manager, whose address heads your call-area listing in the Call Book. In return, he will mail the cards he has for you about once a month. But do not expect him to handle your out-going foreign cards or QSL cards between U. S. hams.

SIMPLE T-R SWITCH

The cathode-coupled T-R (transmit-ceive) switch shown on page 78 works very well and can be built for a few dollars.

Between transmissions, the 6C4 tube boosts received signals since it acts as a cathode-coupled r.f. amplifier between the transmitter tank circuit and the receiver. During transmissions, the large r.f. voltage in the transmitter tank circuit develops a large negative bias voltage at the grid of the 6C4. This cuts off the plate current in the 6C4 and limits the r.f. voltage at the cathode to a value low enough to prevent excessive r.f. power from reaching the receiver antenna circuit.

For further protection of the receiver, the 1N34 diodes act like a virtual short circuit across the cathode circuit during transmissions, and the pilot lamp operates as a fuse. These components have no effect on operation during "receive" periods.

The T-R switch is built on an aluminum bracket about 2" high and 1½" wide and is mounted in the transmitter near the stator of the final tuning capacitor. The 25-μmf. capacitor (C1) is connected between the grid of the 6C4 and the stator terminal of the final tuning capacitor with leads as short as possible.

Heater voltage for the 6C4 is taken from the transmitter filament winding, and its plate voltage is obtained from the screen terminal of the transmitter output tube socket.

Mount a connector at the rear of the transmitter to bring the output of the T-R switch to the receiver. Make the connections with coaxial cable having the input impedance of the receiver used.

With the T-R switch in operation, the transmitter should work exactly as it did before, and the receiver may have just a bit more gain. However, the big difference will be that the receiver will work the instant the transmitter key is released, making "break-in" operation a cinch. You will also be able to tune the transmitter plate capacitor to resonance before pressing the key by tuning it for maximum signal into your receiver.

This T-R switch should work satisfactorily with any transmitter running up to 100 watts or so in which the oscillator is keyed simultaneously with the amplifier.

News and Views

Stan Hill, K8KFL, 707 Harrison St., Princeton, W. Va., spent three months as a Novice and has been a General for about a year. With a Hallicrafters S-38 receiver and a Heathkit DX-20 transmitter, he has worked 46 states and 26 countries. Check with Stan if you need a W. Va. contact on any band from 10 through 80 meters. He needs Alaska, Arizona, Nevada,

The 15,000-buck stereo cartridge

New stereo records buck a phono needle up, down and sideways...change its direction as many as 15,000 times a second! If the cartridge isn't up to this rough-riding, it grinds away at the record.

What's the answer? A ceramic cartridge with high compliance—the ability to stay on course—plus low tracking pressure. Sonotone's "8T" stereo cartridge has both. Tracking pressure? Less weight than this page. Performance? You'll hear the difference when you get Sonotone.

Prices of Sonotone Stereo cartridges start at only \$6.45 (including mounting brackets).

FREE! "Stereo Simplified" booklet — tells you how stereo operates. Write to:

Sonotone

Electronic Applications Division, Dept. CG-119

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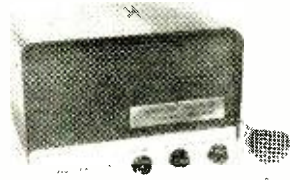
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- ✓ SOCKETS AND SMALL PARTS RIVETED TO CHASSIS FOR QUICK-E-Z CONSTRUCTION
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- ✓ RADIO & TV NEWS SAYS: "Even with 5 watts, it is perfectly capable of transmitting and receiving over distances of 3000 miles or more when Old Mother Nature has the ionosphere in good working order."

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2 OR MORE — \$37.50 EACH
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PE-11

CLASS "D" CITIZEN BAND CRYSTALS



3rd Overtone: Hermetically Sealed
.005% tolerance—Meet F C C requirements, 1/2" pin spacing—.050 pin diameter. (.093 pins available, add 15¢ per crystal.)

\$2.95
EACH

22 CHANNELS

(add 5¢ per crystal for postage and handling)

The following Class "D" Citizen Band frequencies in stock (frequencies listed in megacycles): 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225.

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26.995, 27.045, 27.095, 27.145, 27.195, 27.255 **\$2.95**
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and Wyoming himself . . . **George Yahwak Jr., WA2CQH**, 119 North St., Auburn, N. Y., reports that at least one member of the Beatnik Net monitors 7164 kc. from 9:00 a.m. to 9:00 p.m. every day . . . **Benny Workman, KN5UUC/7**, c/o M. A. Workman, Aircraft Maint., 476 Fighter Group, Glasgow A. F. B., Montana, uses a Heathkit AR-3 receiver with a Q-Multiplier, and he transmits with a Heathkit Apache transmitter running 75 watts. This should answer the often asked question: "Can you reduce the power of an Apache to the Novice limit?"

Patrick "Mike" O'Brien, K8LEN, 1179 Sunset Blvd., Mansfield, Ohio, worked 32 states and Puerto Rico, England, and Japan as a Novice. His Heathkit DX-40 excites a Gotham

TELEPHONY CONTEST

The Radio Society of Great Britain will hold its 21/28 mc. Telephony Contest between 0700 GMT, Saturday, November 21 and 1900 GMT, Sunday, November 22, 1959. The object of the contest is to contact as many British stations as possible and exchange contest numbers. The first two digits of the number are the signal report, and the remaining three are the number of the contact. Scoring: 5 points per contact, plus a bonus of 50 points for the first contact with each "G" call area, i.e., G2, G3, GB, etc., plus an additional bonus of 50 points for every ten G3's worked. Here's your chance to work a bunch of British phone stations, if you have a Conditional or General Class license.

vertical antenna and a "1-element" 15-meter beam, and a National NC-109 handles the receiving chores . . . **Geoffrey Kraus, WV2GFP**, (16), 70-15 175 Street, Flushing 65, N. Y., has worked five states on 2 meters in two weeks on the air with a home-built transmitter and a 7-element beam, receiving through a converter on his Hallicrafters S-85. Geoff also works 15 and 80 meters using the 2-element beam described in P.E., May, 1959. He also plans to operate on "6" when his Technician License arrives . . . Via **Ben Carmichael**, the Atlanta Teen-Age Radio Club, W4IOF, Post Office Box 11501, Northside Station, Atlanta 5, Ga., offers to help prospective Novices obtain their licenses. The club has 50 active members and two adult advisers.

Hank Pettigrew, WPE4GR, 56 Pine Valley, Moultrie, Ga., would like to remind hams that SWL's feel bad when their reports are ignored just as they are getting started in the game . . . **Dick Turensky, KN9SSB**, 1970 Farbin Ave., Green Bay, Wis., has worked 85 stations in 15 states in four weeks on the air. Dick feeds a 100' antenna through a Heathkit AC-1 antenna coupler from a home-built transmitter, and he receives with an AR-3 receiver.

Before signing off, let me remind you that this is your column; so how about sending an item for it. Construction projects, good pictures, and "Ham of the Month" items as well as your "News and Views" are wanted. 73,

Herb, W9EGQ

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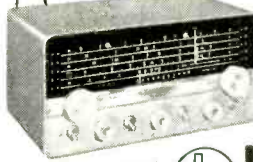


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| 0A2 | 5X8 | 6BM6 | 6SF5 | 7Z4 | 19R6GG |
| 02A | 5Y3GT | 6B8B | 6SF7 | 12A8 | 1916 |
| 1A7GT | 6Y4G | 6BK5 | 6SJ7 | 12AO5 | 1918 |
| 1B30T | 6Z7 | 6BK7 | 6X4 | 12AT6 | 24A |
| 1H4C | 6AB | 6BL7GT | 6X7 | 12AT7 | 25AUV |
| 1H5GT | 6AB4 | 6BN6 | 6SL7GT | 12AU6 | 25B06 |
| 1L4 | 6AC7 | 6B06GT | 6SN7GT | 12AU7 | 25DNG |
| 1L6 | 6AF4 | 6B76 | 6S07 | 12A76 | 25L6GT |
| 1L8 | 6AC5 | 6B76 | 6S57 | 12A77 | 25W1GT |
| 1Q5GT | 6AC7 | 6B27 | 6C4 | 12A77 | 25Z5 |
| 1R5 | 6A4GT | 6C5 | 6C5 | 12A77 | 25Z6 |
| 1S5 | 6A4GT | 6C4 | 6V5 | 12A77 | 25Z6 |
| 1T4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 1U4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 1U8 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 1V2 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 1X2 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 2A3 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 2A4F | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3BC5 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3BM6 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3BZ6 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3CB6 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3CF6 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3C59 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3L4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3Q4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3Q4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 3V4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 4B07A | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 4B7 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5A58 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5A78 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5A8 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5A4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5A4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5B4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5B4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5U4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5V4 | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
| 5V6GT | 6A8 | 6C6 | 6V5 | 12A77 | 25Z6 |
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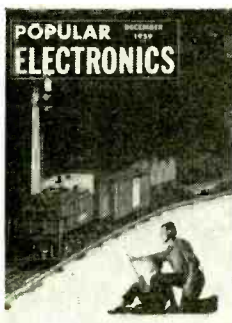
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Short-Wave Report

(Continued from page 88)

The following is a resume of current reports. All times shown are EST and the 24-hour system is used. Please remember that at time of compilation all reports are correct. Stations may change frequency and/or schedule with little or no advance notice. Reports should be sent to: Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS, P. O. Box 254, Haddonfield, N. J.

Belgium—Brussels broadcasts the "Belgian Magazine" in Eng. to N.A. and S.A. on Sundays, Tuesdays, Thursdays, and Fridays at 1730-1800 and 1930-2000 on 11,850 and 9655 kc. (also on 15,335 kc. to N.A., 15,280 kc. to S.A.), and on Mondays at 1930-2000 and Saturdays at 1815-2000 on 9655 kc. (also 11,850 kc. to N.A.). (WPE1BM, WPE7CB, WPE8MS)

Brazil—The call signs for the two active outlets of *R. Sociedade Gaucha*, Porto Alegre, are PRC21 (6135 kc.) and PRC23 (11,975 kc.). These stations are on the air from 0430 to 2300. (WRH)

A new outlet noted several times around 2000/close on 17,723 kc. appears to be located in Sao Paulo. (WPE9KM)

A verification from *R. Tamoio* (or *R. Tupi*) on 9610 kc. lists the call sign as ZYC9 and not ZYC8. (WPE3DS)

Bulgaria—*R. Sofia* now uses 9700 kc. only for its Eng. xmsn to England at 1435-1505 and 1640-1710. They have temporarily dropped the use of 6070, 7255, and 7670 kc. (WPE2ACO)

Sofia carries Eng. to N.A. daily at 2000-2030 and 2300-2330 on 9700 kc., with an additional daily concert at 1800-1825. The DX program is on the first Friday of each month. (WPE3UZ, WPE4BR, WPE7CB, WPE9DN, DC, DRC)

Burma—XZK2, Rangoon, has moved from 4795 to 4808 kc. (WPE9BR)

XZK3, Rangoon, has moved from 6035 to 6015 kc. and is noted at 0625 in a Burmese xmsn with a weak signal. (WPE3NF)

China—Here is the schedule to N.A. and L.A.: to N.A. in Eng. at 2030-2130 on 17,720 and 15,095 kc. and at 2300-0030 on 17,745 and 15,115 kc., and in Chinese at 1030-1100 on 15,115 and 11,975 kc. and at 2230-2330 on 17,745, 15,115, 15,095, and 11,820 kc.; to L.A. in Spanish at 2100-2200 on 17,745 and 15,115 kc. (WPE9DN, GA)

Comores Islands—*R. Dzaoudzi* is not on the air at present but will return with a new 1-kw. xmtr on a tentative frequency of 4960 kc. The 500-watt xmtr on 7340 kc. has shut down and will be replaced by the new unit. (WPEOAE)

England—The BBC is now definitely verifying with a QSL card showing Big Ben on the front and the veri message on the back. Reports go to: Senior Superintendent Engineer, External Broadcasting, BBC, Bush House, London, W.C.2, England. (WPE2ACO, JW)

Ethiopia—Addis Ababa has expanded xmsn time and now carries a program of National and International music at 1400-1600 on 9620 and 15,345 kc. Another xmtr has been added on 6184 kc. Reports sent should include five

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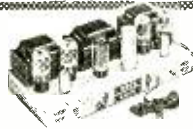


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France—French xmsns from Paris read: 0100-0145 to Oceania on 9620, 9755, 11,920, and 15,400 kc.; 0145-0215 to West and Central Africa on 9620, 11,920, and 15,400 kc.; 0218-0248 (Mondays only) to Antarctica on 9620 kc.; 0530-0600 to West Indies on 21,580 and 21,620 kc.; 0645-0700 to Central Africa on 21,620 kc.; 0800-1000 (Sundays to 1050) to Indochina on 15,160 and 21,620 kc.; 1100-1130 to Madagascar and Reunion on 11,845 and 17,765 kc.; 1130-1300 to Mid East on 11,845, 15,130, and 17,765 kc. (is off for 17,765 kc. is 1230); 1230-1245 (exc. Saturdays and Sundays) to Canada on 17,850 and 21,580 kc.; 1500-1600 to Danube-Balkan area on 3965, 5955, 9755, and 15,185 kc.; 1514-1545 to West and Central Africa on 15,160, 15,365, and 17,715 kc.; 1800-1830 to Indochina on 11,920 and 15,295 kc.; 1830-2000 to West Indies on 11,920 and 15,295 kc.; and 2030-2045 to Reunion on 11,920 kc. (WPE2ACO, WPE4OG)

French Guiana—R. Cayenne is testing on 6170 kc. at 0515-0600, 1145-1245, and 1830-2000. It has also been noted opening at 1730 in French. (WPE1BM, WPE3NF)

Germany—Deutsche Welle, Cologne, is scheduled as follows: to Far East at 0200-0510 on 21,735, 21,650, and 11,795 kc.; to Near East at 0930-1740 on 21,725, 21,490, and 17,875 kc.; and to Africa at 1300-1610 on 17,815, 15,275, and 11,945 kc. in Eng., German and French; to S.A. at 1700-2010 on 15,275, 11,795, and 9735 kc. in German, Spanish and Portuguese; to N.A. at 2030-2340 on 11,945, 11,795, and 9640 kc. in Eng. (2130-2150) and German; to Near East, Mid East and N. Africa at 0530-0550 on 21,650, 17,815, and 15,405 kc.

Missing Persons

The following persons have written to your Short-Wave Editor but neglected to include their return addresses. If they will contact us again, we will be happy to answer them.

- | | |
|---------------|---------------|
| Joseph Balogh | Leavitt Pines |
| Larry Daniels | A. G. Rapp |
| Tony Lewis | William Smith |
| Stephen Lieb | Tom Ziomek |

in Arabic. The DX program is at 2100-2115 on the second Monday of the month. (WPE9DN)

R. Berlin International (formerly R. DDR) is noted on 9730 kc. at 1700-1730 in English. (WPE2ACO, WPE8HF)

Bayerischer Rundfunk, 6085 kc., Munich, can be tuned in German at 1800-2100. News on the hour. (BS)

Greece—Athens has been noted on 11,778 and 15,345 kc. from 1215 to 1230 in Greek and to 1245 in English. Some QRM from Hilversum. (WPE8HF, GA)

Haiti—There have been some changes in the schedule for 4VEH, Cap Haitien, 9770 kc. The Eng. program on Mondays and Tuesdays will run from 2200 to 2300 on 6000 kc. (and also on 9770 kc. to 2200, on 15,360 kc. from 2200). The DX program is now on at 2145-2200. (WPE1BM, WPE6EZ)

Ireland—This country has no s.w. outlets for standard broadcasting. If you want to log Ireland, tune for EIP, *Shannon Aeradio*, on 8862.5, 8888, 8913.5, 13,264.5, 13,284.5, or 13,324.5 kc. around 0020 with weather reports, although they operate every hour on the hour. Reports go to Mr. T. O'Dalaigh, *Shannon Aeradio*, Ballygirreen, Newmart on Fergus, Co. Claire, Ireland. (WPEOEH, BS)

Japan—The Far East Network's new address is: U. S. Air Force, APO 925, San Francisco, Calif. It has been noted on 6160 and 3800 kc. at 1030-1100 with the "Jack Benny" program. (WPEIBM, WRH)

Malaya—The BBC Far Eastern Station, Singapore, is noted on 9725 kc. with Eng. news at 0600-0615, on 11,725 kc. with the BBC Overseas Service at 1115, and on 15,345 kc. with a BBC commentary to 0845 s/off. They will verify if the report covers several days; they will not verify "one-time" reports. (WPE6EZ, WPE8HF, RB)

Radio Malaya, Singapore, 7200 kc., has Eng. on Sundays at 0500-1800. Saturdays at 0815-1800, Monday to Friday at 0815-0900. (AK)

Mauritius—The 15,062-kc. outlet has been dropped and replaced with 6101 kc. (10 kw.) and 3325 kc. (1.5 kw.), with the schedule reading 2200-2315, 0300-0430, and 0800-1230 weekdays, 2200-0335 and 0800-1230 Sundays. As of this writing, the 611-kw. channel has been noted in the East at 2200 in French. (WPEIBM, WPE3NF, ZC4PE1A, DXRA)

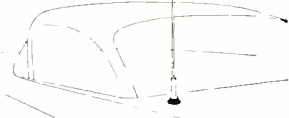
Middle Congo Republic—The latest schedule from Brazzaville reads: 0000-0205 on

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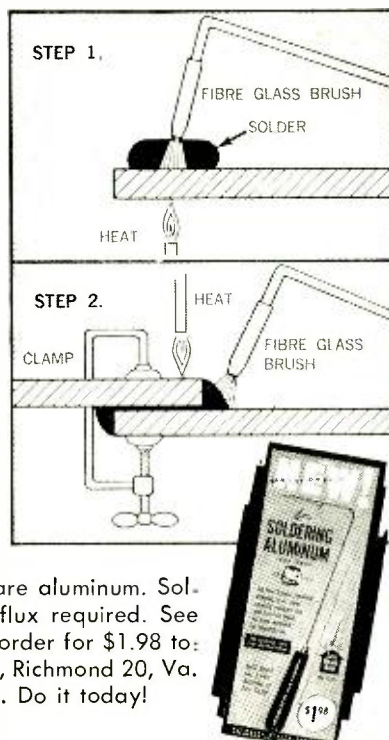
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SHORT-WAVE ABBREVIATIONS

| | |
|--------------------------------------|--------------------------|
| BBC—British Broadcasting Corporation | N.A.—North America |
| DX—Distance | QRM—Station interference |
| Eng.—English | QSL—Verification |
| IRC—International Reply Coupon | R.—Radio |
| kc.—Kilocycles | S.A.—South America |
| kw.—Kilowatts | s/off—Sign-off |
| L.A.—Latin America | s/on—Sign-on |
| | xmsn—Transmission |
| | xmtr—Transmitter |

1330, 1745, 2015, and 2145. "Paris Star Time" in Eng. is noted on Wednesdays at 2030-2100. (WPE1BM, WPE1TX, WPE2ACO, WPE8MS, WPE9DN, WPE9KM, WPE0EW, VE7PE1R, MAC, BD, TN, SW)

North Borneo—R. Sabah, Jesselton, carries an Eng. xmsn on 5980 kc. at 2330, 0600, and 0730. (WPE1BM)

Norway—Norsk Rikskringkasting carries "Norway This Week" in Eng. on 6130, 11,735, 15,175, 17,825, 21,670, and 25,900 kc. except as noted; at 0700-0725 to Far East, Japan, New Zealand and Eastern Australia; at 0900-0925 to Europe, and Indian Ocean areas (not on 11,735 kc.); at 1200-1225 to Mid Atlantic areas (also on 9610 kc. but not on 11,735 kc.); and at 1900-1925 to S.A. This may also be heard at 2100-2125 to N.A. and at 0000-0025 (Mondays) to Western N.A., Pacific areas and East Africa on 6130, 9610, 11,735, and 15,175 kc. only. All xmsns are broadcast on Sundays except the ones to Western N.A. (WPE8MS, MA, LB)

Pakistan—Karachi carries Eng. to Turkey at 1315-1400 on 11,674 and 7010 kc. and to England at 1415-1500 on 7010 kc. (formerly 15,205) and 9705 kc. (WPE6FT, WPE0AE, BR)

Poland—Warsaw is scheduled to N.A. in Eng. at 0630-0700 and 0730-0830 on 17,800, 15,275, and 15,120 kc., and at 1930-2030 and 2130-2230 on 17,800, 15,275, and 11,815 kc. (WPE3IZ, WPE4FY, WPE9DN, JC, AM, NW, and RW)

Rumania—Bucharest carries Eng. to N.A. at 2030-2100 and 2130-2200 on 7195 kc. and at 2330-0000 on 11,937 and 9570 kc. (WPE9DN)

Sierra Leone—Freetown was noted on 5316 kc. at 0140 s/on; Eng. local news at 0144 and native language from 0150. (WPE0EH)

South Africa—Paradys has been noted on 25,800 kc. in Eng. at 1100-1300 and on 3316 kc. around 2330, dual to 4810 kc. Eng. news at 0000. The Afrikaans Service is tuned on 3376 and 4895 kc. with opening at 2330. (WPE1TT, WPE3NF)

Sweden—Stockholm has Eng. as follows: to

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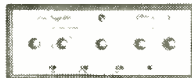
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Switzerland—Berne is now operating on 21.605 kc. at 0945-1130 to India and Pakistan. (WPE6EZ)

Tahiti—Papeete, 6135 kc., has not carried Eng. since last spring and no plans are being made to resume it. It would appear that sev-

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 DXplorers Radio Association (DXRA)
 World Radio Handbook (WRH)

eral DX'ers have actually been tuned to VLT6. Port Moresby, New Guinea, 6130 kc., when they reported hearing the purported 0230-0245 Eng. xmsn. (WPE0AE)

Tunisia—R. Tunis, 7210 kc., is operating at 0130-0330 in Arabic and French, with French news at 0135 and 0215. (WPE1BM, WPE3NF, WPE6CW, DXRA)

Vatican City—Vatican Radio has Eng. on 15.120 and 21.515 kc. on Mondays, Wednesdays, and Saturdays from 1100 to S. Asia. English is also noted at 1315-1329 on 15.120, 11.685, and 9646 kc. (WPE3AA, WPE0AE, VE2PE1A, BR, SS)

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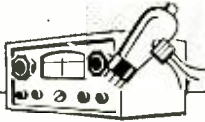
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CRYSTAL radio kit \$1.00; Preassembled \$1.25; Phone \$1.75; catalogue. Clearco Crystal Company, 2966 N. 4th, Milwaukee, Wisconsin.

WANTED

COMPLETE TV sound cut-off kit; install yourself, \$2.00 prepaid or C.O.D. Warren, 106 E. 46th, Austin 5, Texas.

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RECORDERS, Hi Fi. Free Wholesale Catalogue. Carston, 125-P East 88. N.Y.C. 28.

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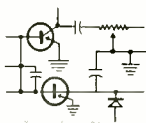
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November, 1959

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129

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MISCELLANEOUS

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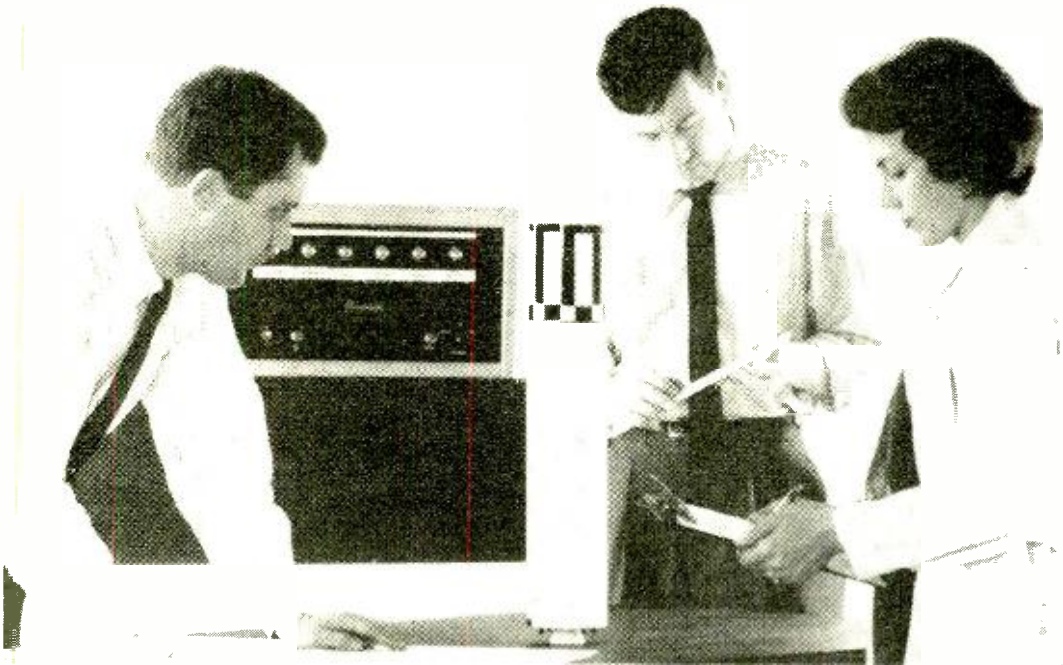


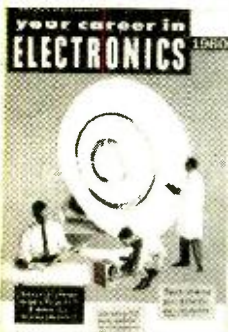
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MODEL 83

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Tests and Rejuvenates ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types
—from 8" to 30" types.

● Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes. ● Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types. ● Model 83 employs a 4" air-damped meter with quality and calibrated scales. ● Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode. ● Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton—in the set!

but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition. ● Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only **\$38⁵⁰**

Model 83—C.R.T. Tube Tester
Total Price **\$38.50**
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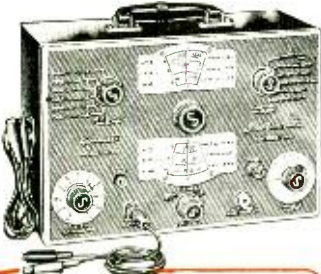
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7 Signal Generators in One!

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This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

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Model TV-50A GENOMETER
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R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only **\$47⁵⁰**

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Superior's New Model 82A **A truly do-it-yourself type**
TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

- 1 Turn the filament selector switch to position specified.
- 2 Insert it into a numbered socket as designated on our chart (over 600 types included).
- 3 Press down the quality button—

THAT'S ALL! Read emission quality direct on bad-good meter scale.

FEATURES:

- Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable, Saddle-Stitched Texon case. Only... **\$36.50 Net**



Superior's **STANDARD PROFESSIONAL**
 New Model **TW-11 TUBE TESTER**

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet **\$47.50 Net**

Model TW-11—Tube Tester
 Total Price \$47.50
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If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

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Superior's New Model 77 **VACUUM TUBE VOLTMETER** WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price

- Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading. Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values of sine wave, and peak-to-peak value of complex wave. Precise voltages that determine the "black" level in TV receivers are easily read.

micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

SPECIFICATIONS

- DC VOLTS—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance.
- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1,500 volts. • AC VOLTS (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts.
- ELECTRONIC OHMMETER—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 meg-ohms/10 megohms/100 megohms/1,000 megohms. • DECIBELS—-10 db to +18 db, +10 db to +38 db, +30 db to +58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • ZERO CENTER METER—For discriminator alignment with full scale, 750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only **\$42.50**

SUPERIOR'S NEW MODEL 79 **SUPER-METER** WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER

Plus CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENT
Also Tests SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic pro-

duction. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past few years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

- D.C. VOLTS: 0 to 7.5 15 75 150 750 1,500
- A.C. VOLTS: 0 to 15 30 150 300 1,500 3,000
- D.C. CURRENT: 0 to 1.5 15 150 Ma. 0 to 1.5 15 Amperes
- RESISTANCE: 0 to 1,000 100,000 Ohms, 0 to 10 Megohms.
- CAPACITY: .001 to 1 Mfd., 1 to 50 Mfd.
- REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
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