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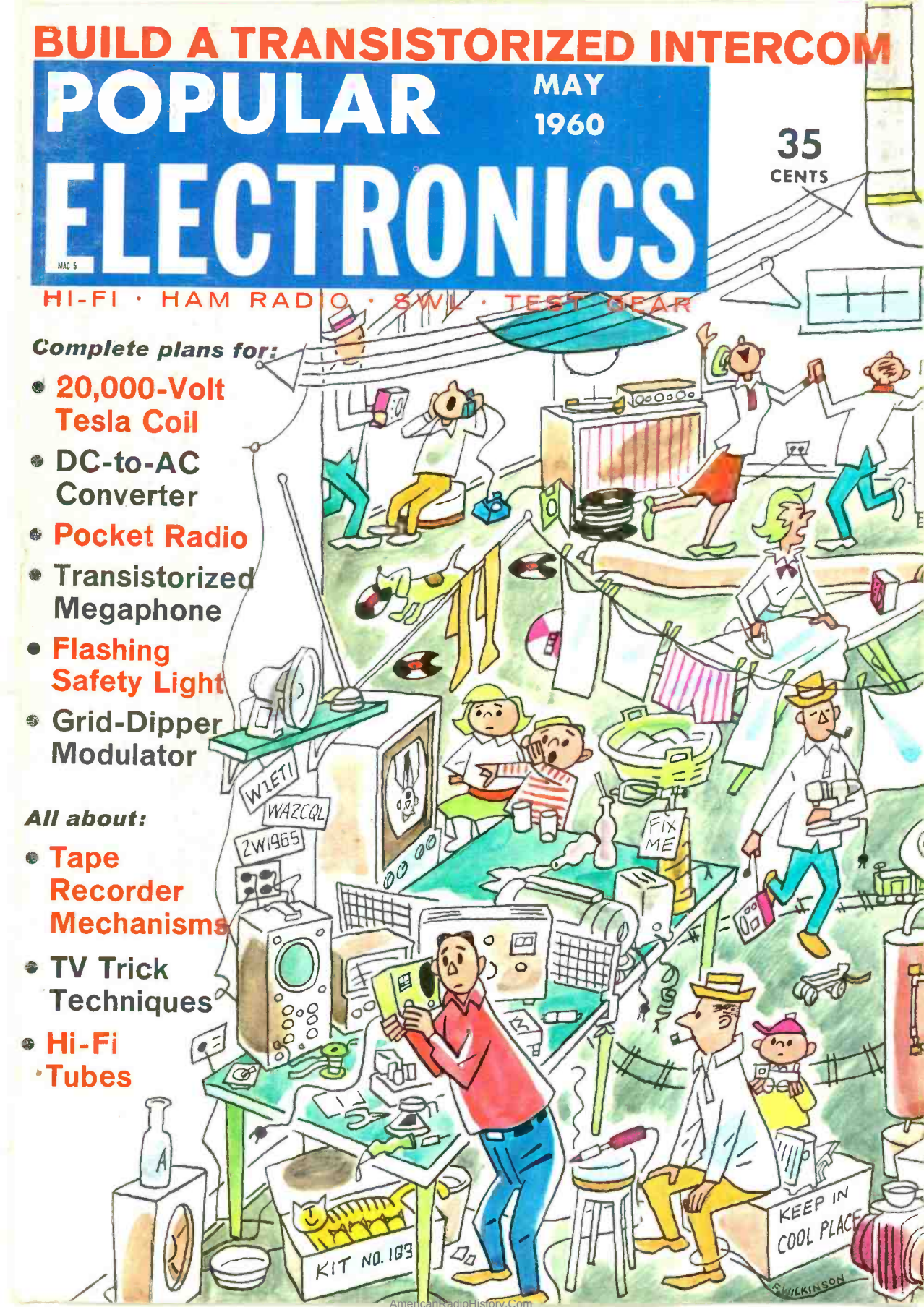

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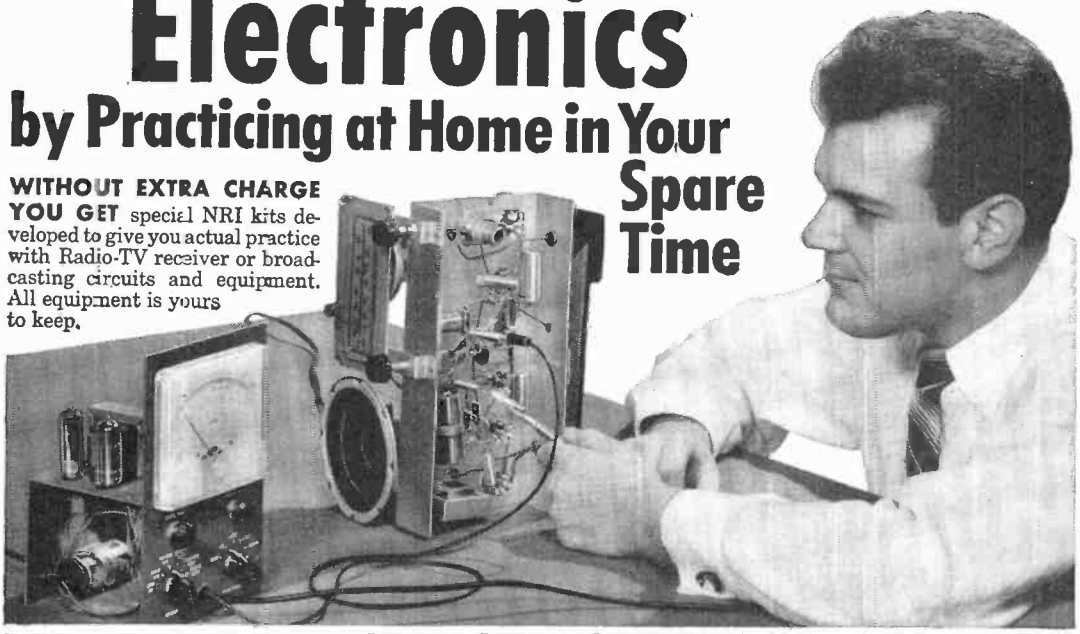

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POPULAR ELECTRONICS

MAY 1960

VOLUME 12 NUMBER 5

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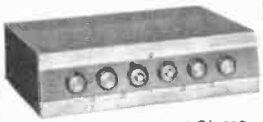

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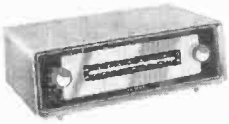

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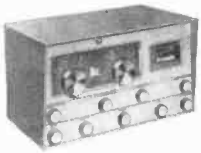

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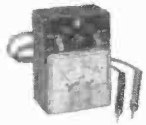

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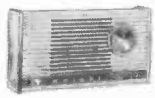

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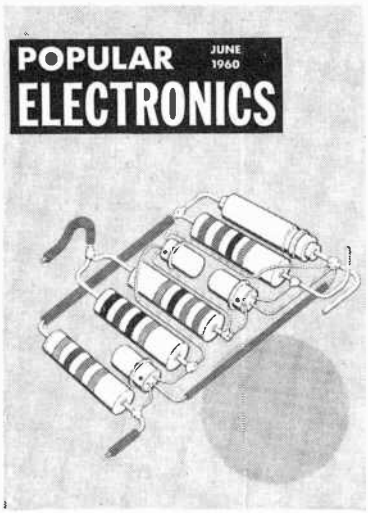

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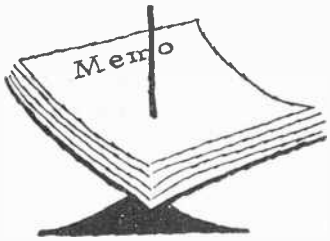

Notes from the Editor

STEREO RECORDS. How many stereo records did you buy in the last year? If you're like most consumers, you didn't buy very many. For it's no deep and dark secret that, for the most part, sales of stereo records have been sorely disappointing.

One of the major arguments to explain this unhappy situation is that people are confused. They've heard a lot about stereo and they honestly would like to buy a stereo system. But since they've also heard (and rightly) that good stereo is expensive, they're putting off buying a set. Consequently, many people are still using their old phonographs and are not buying stereo records. They are not buying monophonic records either—because they are afraid mono will become obsolete.

A possible solution to the problem would be a stereo record that could be played monophonically without damage—that would stand up to a year or two of mono service and still provide dual-channel performance when the user decided to "go stereo." Just such a compatible stereo record is now the talk of the hi-fi industry. One of the smaller record companies, Design, has come up with a system which it claims will give the record business its much-needed shot in the arm.

In collaboration with several engineering firms, Design is producing compatible records cut by the vertical-lateral method. The electrical "sum" of both stereo tracks is engraved in the lateral channel (thus allowing "full mono" reproduction), with the "difference" signal recorded vertically. Because the amplitude of the "difference" signal is reduced slightly, the process of stamping out the compatible records is much less critical than stamping conventional 45-45 stereo records. The new records can be played stereophonically with any 45-45 stereo cartridge or monophonically with any quality mono pickup.

But demonstrations of the records so far have not been conclusive. Some observers feel that reducing the vertical component of the stereo signal will definitely degrade performance. On the other hand, many listeners have found the compatible record to be generally satisfactory.

If this system proves to be a true solution to the compatibility problem (or can be improved sufficiently to become so), it would be a three-way boon—to record manufacturers, to record retailers, and to the public. Production facilities could be greatly simplified, resulting in greater efficiency. Record dealers could cut their stock in half. And consumers could forget about their mono records becoming obsolete.

Oliver Read

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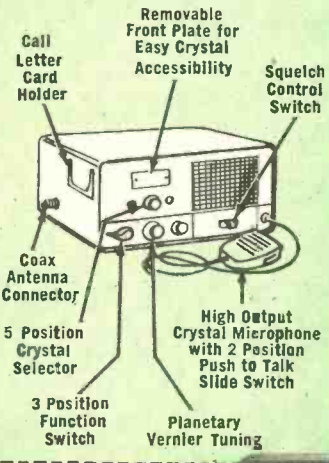

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FCC Report

By ROBERT E. TALL
Washington Correspondent

Citizens Band Rule Changes

THE Federal Communications Commission has finally made its long-expected move to amend the Class D Citizens Radio Service Rules. Permissible communications in the Citizens Band have been redefined and certain types of communications clearly prohibited. Use of the band for "amateur-type" and long-range communications is now definitely outlawed. The amendments to Part 19 of the FCC Rules became effective on March 15.

In a nutshell, Citizens Band stations are authorized primarily to communicate with other units of the same station, and they are permitted to communicate with other stations only when necessary for the exchange of substantive messages related to the business or personal activities of the individuals concerned. Also, except for communications between units of the same station and emergency or Civil Defense applications, communications between two Class D stations are limited to five consecutive minutes followed by a two-minute silent period during which the stations shall monitor the frequencies used and permit other stations to use the frequencies.

In addition, to get the channel-cluttering pseudo-amateurs off the band, the new rule changes require that all transmissions from Class D stations be addressed to specific persons or stations within the ground-wave range of their five-watters. Use of the skip sky-wave is prohibited. Calling "CQ" to elicit response from a random or unknown station is also prohibited. And use of a "test" call for the purpose of inviting DX contacts with unknown stations is strictly illegal.

The amendments to the FCC Rules place the Commission on much firmer ground with respect to cracking down on

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This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

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that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Mario Bidese, 342 Alexander Avenue, Greensburg, Pa.	1st	12
Richard M. Wilhoit, 2104 Santa Paula, Las Vegas, Nev.	1st	12
Larry R. Perrine, 7 Normandy Place, Champaign, Ill.	1st	15
Emerson F. Lawson, 111 Excelsior Ave., Union, S.C.	1st	12
Marion Woolsey, 3246 Warwick, Kansas City, Mo.	1st	12
Harold W. Johnson, 5070 Hermosa Ave., Los Angeles, Calif.	1st	15
Arthur W. Hardy, 66 Dresser Ave., Great Barrington, Mass	1st	12
Ralph Frederick Belsner, 2126 Grand, Joplin, Mo.	1st	12
N. B. Mills, II, 110 Se. Race St., Statesville, N.C.	1st	12
Dean A. Darling, 403 S. Chase Ave., Columbus 4, Ohio	1st	12
Paul D. Bernard, 408 First Ave., N.E., Watertown, S.D.	1st	18
Gerald L. Chopp, 518 Aubudon Road, Kohler, Wisc.	1st	12

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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.

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Address _____

City _____ State _____

I am interested in: ☐ Home Study, ☐ Kansas City classes, 03-E
☐ Hollywood classes, ☐ Seattle classes, ☐ Washington classes

rule violators who have gotten off with only warnings in the past. Enforcement has now begun in earnest.

The most ambitious enforcement case undertaken by the Commission in connection with the Class D Service is the possible license revocation of a Citizens Band equipment manufacturer for "wilful" violations of the Communications Act and the FCC Rules. This manufacturer has already been charged with advising buyers that they could begin operating their transceivers under the license of the manufacturing company prior to receipt of their own personal radio licenses.

Despite the hundreds of Citizens Band license revocation cases under way, however, the amendments—strangely enough—give Citizens Banders several interesting rallying points. For example, the FCC has suggested that Citizens Banders might still request a rule change that would have Class D stations assigned specific frequencies, as is the case with Class A Citizens stations and commercial radio services. Another suggestion invites requests to have "specific channels allocated for certain exclusive uses or certain categories of users, such as emergencies, boats, and gas stations."

While the obvious thrust of the FCC rule changes is at the Class D service, a pat on the back was extended to the bulk of CB users. The Commission "regrets" that any of the present users of Citizens Band equipment have been "misled" into buying equipment for amateur-type communications. It is also "convinced" that the majority of licensees are using their stations within the intended scope of the service.

Use of the band by persons traveling about the country and in need of information or services was given the green light. However, when you are operating outside of your home radio inspection district, each station identification should be followed by the station's geographical location. If not, a pink ticket for DX'ing will be in your letter box when you return.

Furthermore, the Commission labeled "permissible" the practice some service-stations and motels have of advertising their CB call signs and encouraging communications from transients. Also in the clear is the exchange of "useful and substantive messages" between boats, hunting and fishing parties, and coordinated business activities. —30—

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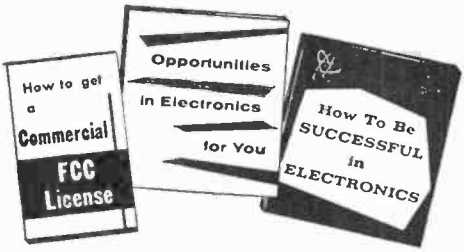

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TWA has opportunities for radio operators with a 2nd class license or better. Must be able to type at least 35 wpm. Free transportation for self and family. Vacation and many other benefits.

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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

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"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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Cleveland Institute of Electronics

Desk PE-64, 4900 Euclid Ave., Cleveland 3, Ohio

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- ☐ Radio-TV Servicing
- ☐ Home Experimenting
- ☐ Manufacturing
- ☐ Telephone Company
- ☐ Amateur Radio
- ☐ Other .....

In what kind of work are you now engaged? .....

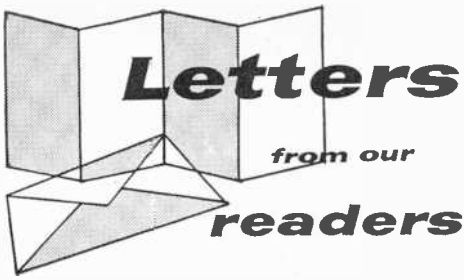
In what branch of Electronics are you interested?

Name..... Age....

Address .....

City..... Zone.... State.....

PE-64



Speaker Installation Tip

■ Recently a problem arose while I was installing a multiple speaker system—in which it is very important to have all of the parallel-connected speakers operating in phase. As the wiring had been installed previously and was not color-coded, I had no way of determining which wire was which at the various locations. (I had no extra length of wire to make an extension for my ohmmeter to check continuity.)

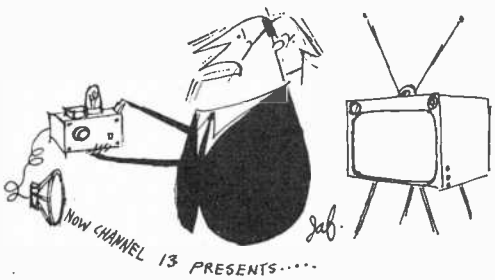
I solved this problem by connecting a silicon diode across the wires at the first speaker location and checking the resistance between the wires at all subsequent locations. When the positive lead of the ohmmeter was on the wire connected to the cathode of the diode, the reading on the ohmmeter was quite low (about 500 ohms); when the leads were reversed, the reading was almost infinite.

With these readings as a guide, it became a simple matter to phase out the system by connecting the ohmmeter leads at each speaker location to read the lower resistance value and then marking the wire connected to the positive lead of the ohmmeter.

CHRISTOPHER W. FARRELL
Lantana, Fla.

Puzzled

■ Perhaps you can explain the following phenomenon that I witnessed. While I was working on a single-tube 6V6 audio amplifier, I momentarily touched the input with my finger. Much to my amazement, audio from the TV program that was



playing in the next room came out of the speaker. There must be a rational explanation for this. Can you provide it?

RICK MUETHING
Dayton, Ohio

Our guess, Rick, is that radiation from the TV set's i.f. section is to blame. Somehow your body was acting as an antenna and your finger detected

The Sounding Board

First Users of New Model 644 Mike Rave About Performance

The all-new Model 644 Sound Spot Microphone introduced by Electro-Voice early this year has already started to prove itself in its initial installations. Here are just a few of the comments received from sound installers and audio specialists throughout the country:

"Move anywhere on the stage and be heard easily throughout the auditorium" . . .

"Better pick-up of a band across a football stadium than any parabolic microphone ever tried" . . .

"By using the 644's we turn up the system to more than needed sound without feedback —but with old microphones we could just barely crack the control open" . . .

This amazing microphone utilizes a slotted tube on the front that can actually discriminate between sounds arriving from random directions and reduce pick-up from sides and rear by 20 db or more. This new design concept enables the 644 to offer as much as four times greater working distance than the best cardioids; greatly reduced feedback; retention of "on-mike" presence despite extended working distance; excellent performance out-doors because of elimination of wind noise . . . and it is still priced low enough ($110.00 list) to fit most budgets.

World's Toughest Audience Tests, Approves, Selects E-V Ultra-Compact Units

Recently, in New York, Boston, and Los Angeles nearly 300 sound room personnel of top high fidelity dealers were given the opportunity to spend an afternoon listening to and rating the "sound" produced by three of Electro-Voice's new ultra-compact speaker systems (Regal, Esquire, Leyton) and six other currently popular competitive ultra-compact systems. All nine systems were placed behind an opaque curtain and each listener's selector switch was coded but unmarked so he had no way of knowing which system he was hearing. The result of the listening test was that more than 80% ranked Electro-Voice Esquire and Regal units either first or second. And Electro-Voice's economical Leyton was ranked third by over 50% of the participants—thus outscoring systems at double its price.

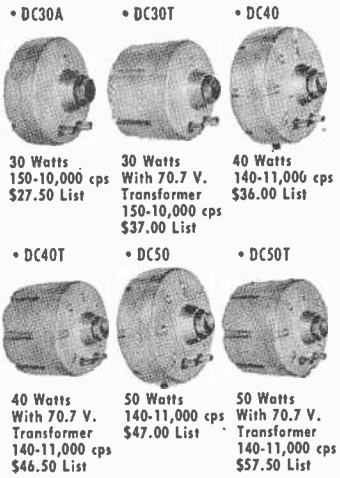
Now, we don't think this proves a single thing except that knowledgeable people in New York, Boston, and Los Angeles could recognize the unusual clarity and purity of sound that we build into any Electro-Voice speaker system. We discovered long ago that it is impossible to build a speaker that sounds the same to every listener. So we strive to create instruments that let our customers listen to the music rather than the speaker.

New Convertible Drivers Bring Public Address Performance To Hi-Fi Levels

The basic characteristics needed to satisfy any critical sound job—wide range, low distortion, and high efficiency—are all combined in E-V's new group of drivers. But there has been one great plus added to the unmatched performance of these units. *The same driver can be used on reentrant horns and in compound horns.* This means that a single driver will fit the famous E-V Compound Diffraction Horn as well as conventional reflector horns.

These drivers feature such exclusives as: ceramic magnets; edge-wise wound voice coils; and dual concentric centering. They are easier to install with their push-type polarized connectors and permit easy diaphragm replacement in the field.

If you are planning a P.A. system don't fail to consider these rugged, weatherproof drivers that have eliminated "peaked" response to provide the tonal balance needed for good musical reproduction and the rising frequency response necessary for clear, crisp voice projection. Available as listed below as well as with 45-ohm voice coils for high-powered inter-com:



What Does E-V's Magneramic 31 Do That Your Magnetic Cartridge Can't Do?

The stereo cartridge has rightly been termed the "gateway" to your sound system. If the response characteristics of the cartridge lack fidelity of reproduction, the system performance will not possess the essential brilliance of the recorded sound. Similarly, if the cartridge fails to provide adequate electrical input to the amplifier, much of the recorded definition and authority may be attenuated. The factor of cartridge output influences not only the system gain—but the quality and definition of the sound as well.

In distinct contrast to magnetic type cartridges, the E-V Magneramic 31 produces an output of 8 millivolts—over 60% higher than most magnetics. Thus, it is possible to play your system at noticeably lower amplifier gain and speaker pad settings. This bonus output is often the difference between marginal and outstanding performance, particularly when employing low-efficiency speaker systems. Lower amplifier gain settings also reduce the likelihood of introduction of tube thermals and transformer hum into the system.

For more information write Dept. 50P.

Electro-Voice®
Buchanan, Michigan

Letters

(*Continued from page 16*)

the signal. Exactly how you did this is hard to say. Perhaps you could go into business renting yourself out as a new TV audio component.

Tape Correspondence Fans

■ Each month I anxiously look forward to the arrival of POPULAR ELECTRONICS and am always well rewarded for my patience. As I am an avid tape correspondence fan, I particularly enjoy your articles having to do with tape recording.

I thought your readers might like to know that a new organization has been formed for tape enthusiasts: Universal Tape Network, Box 50, Douglas, Mass. This club will be glad to give interested parties full information about its program.

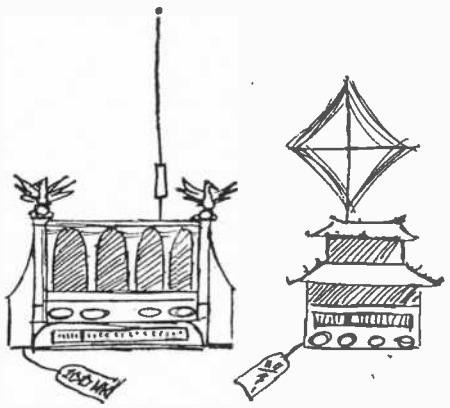
Keep those articles rolling on tape, tape recording, and tape recorders.

RICHARD E. ZASTROW
Garnett, Kansas

We're planning to do just that, Richard. See Joseph Marshall's article on tape recorder mechanisms on page 56 of this issue. Mr. Marshall will put the spotlight on tape again next month when his topic will be tape-recorder electronics.

Imported Receivers

■ As we all know, German and Japanese radios are now fairly common in this country. I have noticed, however, that there are very few imported



communications receivers available, and I wonder why this is so. Undoubtedly some of the foreign receivers, such as the British-made Marconi and Eddystone units, are fine instruments. Yet, rarely do you see these receivers in this country.

I know that you can buy some of the foreign receivers through New York distributors, but I'm wondering if there is some reason why they do not receive wider distribution. Are they too expensive or are American manufacturers afraid of competition?

KENNETH GREENBERG
Chicago, Ill.

There's no easy answer to your question, Kenneth, but we think that if manufacturers make a product that's good enough and try hard enough to sell it, it'll sell—even though it carries extra import duties. —30—

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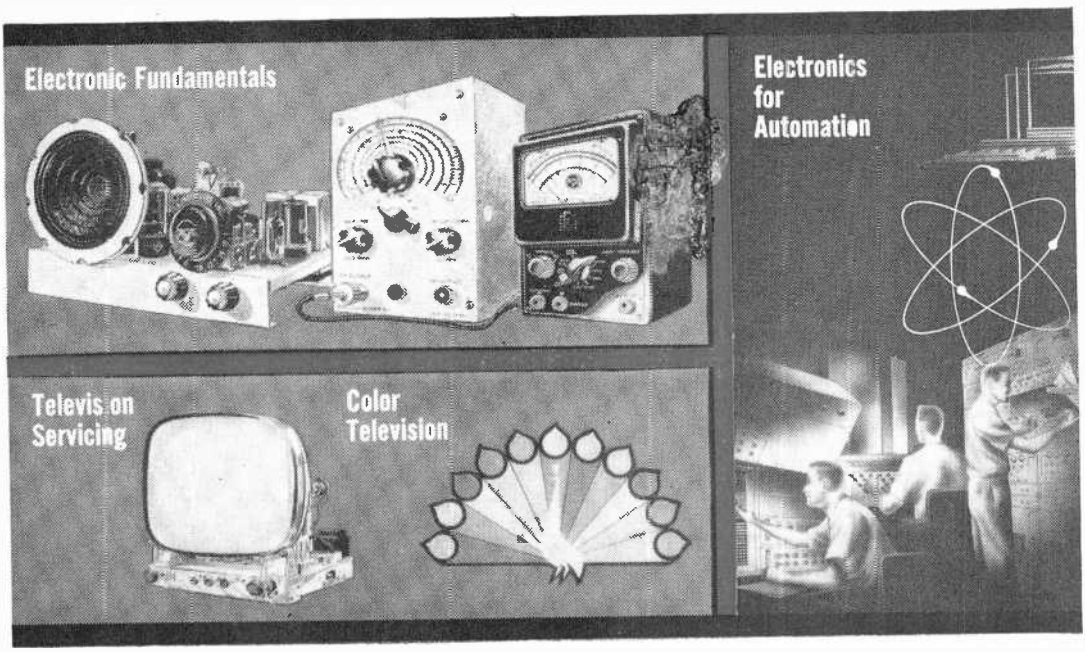

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POP'tronics Bookshelf

"BASIC ELECTRONICS, Volume 6" by Van Valkenburgh, Nooger, and Neville, Inc. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 130 pages. Soft cover, $2.90.

Anyone who has the previous five volumes in this series on basic electronics will want to complete his collection with the sixth volume. Using the same format of large illustrations and one concept per page, this book presents the fundamentals of transistors and semiconductors in its first half and the basics of FM in its second half. Simply and clearly written, it is highly recommended; the section on transistors alone is worth the price of admission.

"MOST-OFTEN-NEEDED 1960 RADIO DIAGRAMS" compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. 192 pages. Soft cover. $2.50.

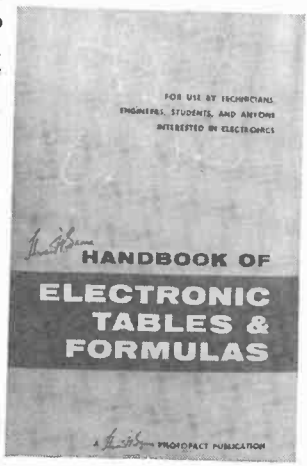
Schematic diagrams and pertinent servicing information are provided for practically all radios currently in production. The material is well organized and complete; alignment instructions are included for many models. Recommended for the service technician.

"HANDBOOK OF ELECTRONIC TABLES AND FORMULAS" compiled and edited by Donald Herrington and Stanley Meacham,

Bookshelf (*Continued from page 20*)

published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 128 pages. $2.95.

Here is a handy little book that contains just about all the facts and figures on electronics you'll ever need to have around. Starting, of course, with Ohm's law, it presents formulas, standards, constants, symbols, codes, service and installation data, mathematical tables, etc. A special feature is a six-page fold-out chart of the latest official frequency allocations. Nicely bound and well organized, this book is highly recommended to the experimenter, the service technician, and, in fact, to anyone who is interested in electronics.



"ELECTRONIC GUIDE" International Edition, compiled and published by References for Research Division, Electronic Guide Publishing Co., 4131 Toluca Lake Ave., Burbank, Calif. 191 pages. Soft cover. $7.50.

This book categorizes articles in the electronics field that were published by some fifty leading periodicals in seven nations of the Western world during 1959. The articles are listed under ten different subject headings including "Antennas and Aerials," "Audio and High Fidelity," "Power Supplies and Power Applications," "Sonics and Ultrasonics," etc. Recommended as a useful reference book.

"WAVES AND THE EAR" by Van Bergeijk, Pierce, and David. Published by Doubleday & Co., Inc., Garden City, N. Y. 235 pages. Soft cover. 95 cents.

The nature of sound, the ear's workings,

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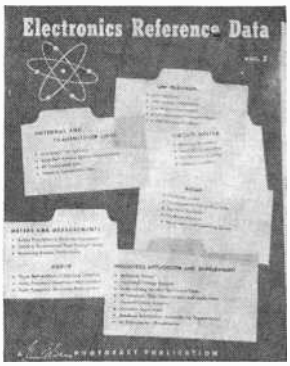
Bookshelf

(*Continued from page 22*)

and the brain's subsequent interpretations of the ear's "messages" are discussed in informal, lively, and very readable style. Recommended as a stimulating introduction to a fascinating subject.

"ELECTRONICS REFERENCE DATA, VOL. 2" published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 5, Ind. 118 pages. Soft cover. $2.50.

This volume is an anthology of articles which originally appeared in "The Aerovox Research Worker." A great deal of useful information is presented, including coverage of such subjects as antennas and transmission lines, u.h.f. television, circuit design, audio, radar, meters and measurements, etc. Recommended as a worthy addition to any collection of technical reference material.

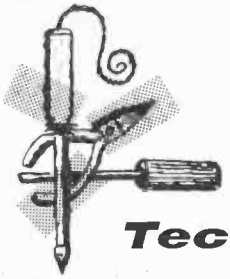


Miscellaneous Literature

"Television Tape Recording" is the title of a new 47-page booklet by George Goodall of Ampex, available for $1.00 from Robins Industries Corp., 36-27 Prince St., Flushing 54, N. Y. It covers magnetic video recording at the intermediate technical level.

A series of interesting bulletins on microphones is available from Electro-Voice, Inc., Buchanan, Mich. Called "Microphone Facts," they contain information intended primarily for the audio engineer but which should be useful to amateurs as well.

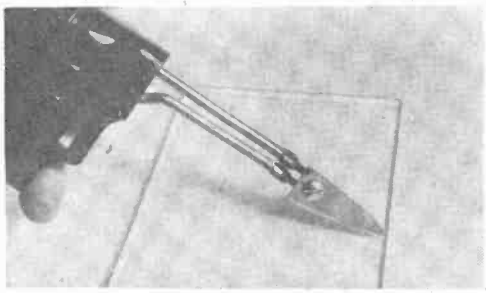
The "Audio Designer's Handbook," a 33-page booklet containing audio design information and 14 pages of amplifier circuits, has been announced by Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, Long Island, N. Y. Copies are available for $1.50 each. —30—



Tips and Techniques

CUTTING TIP FOR SOLDERING GUN

You can improvise a cutting tip for your soldering gun quickly and easily from a tin



can. Cut a triangular-shaped piece from the can and drill a small hole near the vertical edge. Then attach the cutting tip to the gun's tip with a small screw and nut as shown.—*Jerome Cunningham, Chicago, Illinois.*

CLOTHES-HANGER ANTENNA

A wire clothes-hanger—straightened out and bent into various shapes—will often make a useful antenna for short-wave receivers. Scrape one end bare and bend it into a loop to go under the screw of the antenna binding post. If your set has an antenna post with a hole through the screw, you may have to file the wire to size before it can be inserted through the hole. In most cases, the wire is stiff enough to allow the post alone to serve as support.—*Lt. Col. Eugene F. Coriell, Wright Patterson Air Force Base, Ohio.*

GROUP CODE-PRACTICE OSCILLATOR

A standard broadcast receiver can be used to amplify an ordinary buzzer-type code-practice oscillator for group code-practice sessions. Place the oscillator near the receiver, turn the receiver on, and key the buzzer. It may be necessary to tune the receiver to bring in the signal—try

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Exclusive features make this RCA VOM kit the buy of a lifetime! Extra 1-volt and 0.25 volt (250 mv) ranges for wider usage in transistor servicing—new handle clip accommodates probes and test leads for extra carrying convenience. Assembles in a breeze!

FEATURING: ohms-divider network fuse-protected • easier-to-read scales • extra-large 5¼ inch meter • polarity reversal switch • excellent frequency response • full-wave bridger rectifier • low circuit loading • standard dbm ranges.

SPECIFICATIONS: Input Resistance—20,000 ohms per volt on DC; 5,000 ohms per volt on AC • Accuracy—± 3% DC; ± 5% AC (full scale) • Regular Scales—2.5, 10, 50, 250, 1000, 5000 volts, AC and DC; 50, μa 1, 10, 100, 500 ma, 10 amps (DC) • Extra Scales—250 mv. and 1 volt (dc) • Frequency Response—AC-flat from 10 cycles to 50 Kc (usable response at 500 Kc) • Ohms—3 ranges: Rx1—(0-2,000 ohms); Rx100 (0-200,000 ohms); Rx10,000 (0-20,000,000 ohms) • Dimensions—W. 5¼", H. 6⅞", D. 3⅛"

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SPECIFICATIONS: Vertical Amplifier (Narrow Band Position)—Sensitivity, 3 rms mv/inch; Bandwidth, within −3 db, 20 cps to 150 Kc • Vertical Amplifier (Wide Band Position)—Sensitivity, 100 rms mv/inch; Bandwidth, within −3 db, 5.5 cps to 5.5 Mc • Vertical Input Impedance—At Low-Cap cable input...10 megohms, 10 μμf (approx.); At Direct-cable input...1 megohm, 90 μμf (approx.) • Sweep Circuit—Sawtooth Range, 15 cps to 75 Kc; Sync, external, ± internal; Line Sweep, 160° adjustable phase.

RCA WV-77E (K)

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SPECIFICATIONS: Measures: DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges; AC Volts (RMS)—0.1 volt to 1500 volts in 7 overlapping ranges; AC Volts (peak-to-peak)—0.2 volt to 4000 volts in 7 overlapping ranges; Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment • Accuracy—± 3% of full scale on dc ranges; ± 5% of full scale on ac ranges • Frequency Response—flat within ± 5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14, and 40-volt peak-to-peak ranges • DC Input Resistance—standard 11 megohms (1 megohm resistor in probe)

*User Price (Optional)

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RADIO CORPORATION OF AMERICA

ELECTRON TUBE DIVISION **HARRISON, N. J.**

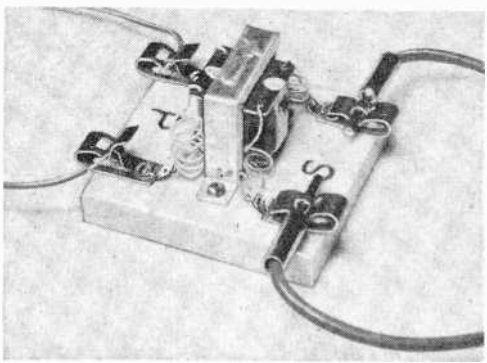
Tips

(*Continued from page 26*)

placing the buzzer on top of the radio if the volume is low.—*Milton Charlton, Toronto, Ont., Canada.*

EXPERIMENTAL TRANSFORMER HOOKUP

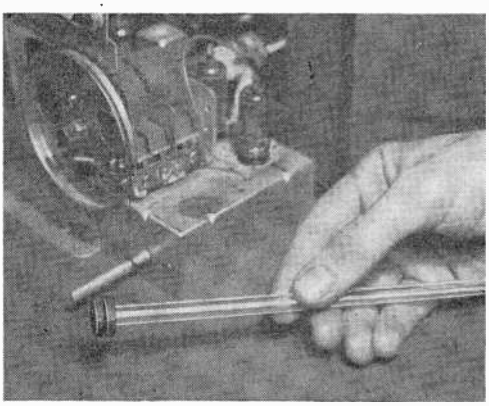
To prevent wear and tear on fragile leads of miniature transformers, mount the transformers on wooden bases and solder their leads to Fahnestock clips. You will then be able to connect and disconnect them



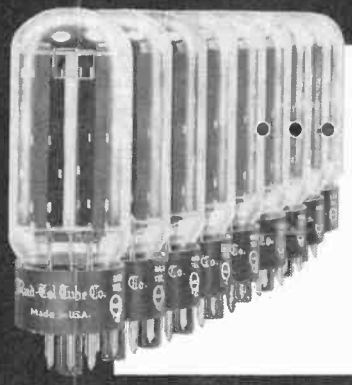
to your heart's content without worrying about broken leads. If you have miniature transformers with no screw-hole mounting brackets, simply use household cement to attach them to the wooden bases. Primary and secondary windings and impedances can be lettered on the bases in pencil or ink.—*Art Trauffer, Council Bluffs, Iowa.*

VERSATILE TOOL FROM TUBING

A length of small-diameter hard plastic tubing is a handy servicing tool. Slipping a rubber grommet over one end turns the



tubing into a tube tapper, and the other end can be used "as-is" as a prod. A small diagonal slot sawed or filed in the side near



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	1AX2	.62		4BC8	.96		6AR5	.55		6CM7	.66		8BQ5	.60		12BK5	.70
	1B3GT	.79		4BE6	.54		6AS5	.60		6CN7	.65		8CG7	.62		12BL6	.56
	1DN5	.55		4BN6	.75		6AT6	.43		6CR6	.51		8CM7	.68		12BQ6	1.06
	1G3	.73		4BQ7	.96		6AT8	.79		6CS6	.57		8CN7	.97		12BY7	.74
	1J3	.73		4BS8	.98		6AU4	.82		6CU5	.58		8CX8	.93		12BZ7	.75
	1K3	.73		4BU8	.71		6AU6	.50		6CU6	1.08		8EB8	.94		12C5	.56
	1L6	1.05		4BZ6	.58		6AU7	.61		6CY5	.70		10DA7	.71		12CA5	.59
	1LA6	.69		4BZ7	.96		6AU8	.87		6CY7	.71		11CY7	.75		12CN5	.56
	1LC6	.79		4CB6	.59		6AV6	.40		6DA4	.68		12A4	.60		12CR6	.54
	1LN5	.59		4CS6	.61		6AW8	.89		6DB5	.69		12AB5	.55		12CU5	.58
	1R5	.62		4DE6	.62		6AX4	.65		6DE6	.58		12AC6	.49		12CU6	1.06
	1S5	.51		4DK6	.60		6AX7	.64		6DG6	.59		12AD6	.57		12CX6	.54
	1T4	.58		4DT6	.55		6BA6	.49		6DQ6	1.10		12AE6	.43		12DB5	.69
	1U4	.57		5AM8	.79		6BC5	.54		6DT5	.76		12AF3	.73		12DE8	.75
	1U5	.50		5AN8	.86		6BC7	.94		6DT6	.53		12AF6	.49		12DL8	.85
	1X2B	.82		5AQ5	.52		6BC8	.97		6EU8	.79		12AJ6	.46		12DM7	.67
	2AF4	.96		5AT8	.80		6BD6	.51		6EA8	.79		12AL5	.45		12DQ6	1.04
	2BN4	.60		5BK7A	.82		6BE6	.55		6EB8	.94		12AL8	.95		12DS7	.79
	2CY5	.71		5BQ7	.97		6BF6	.44		6H6GT	.58		12AQ5	.52		12DZ6	.56
	3AL5	.42		5BR8	.79		6BG6	1.66		6J5GT	.51		12AT6	.43		12EL6	.50
	3AU6	.51		5CG8	.76		6BH6	.65		6J6	.67		12AT7	.76		12EG6	.54
	3AV6	.41		5CL8	.76		6BH8	.87		6K6	.79		12AU6	.50		12EK6	.56
	3BA6	.51		5EA8	.80		6BJ6	.62		6S4	.48		12AU7	.60		12EZ6	.53
	3BC5	.54		5EU8	.80		6BK5	.80		6SA7GT	.76		12AV5	.97		12F5	.66
	3BE6	.52		5J6	.68		6BK7	.85		6SK7GT	.74		12AV6	.41		12F8	.66
	3BN4	.63		5T8	.81		6BL7	1.00		6SL7	.80		12AV7	.75		12FM6	.45
	3BN6	.76		5U4	.60		6BN4	.57		6SN7	.65		12AX4	.67		12K5	.65
	3BU8	.78		5U8	.81		6BN6	.74		6SQ7	.73		12AX7	.63		12SA7M	.86
	3BY6	.55		5V6	.56		6BQ5	.65		6T4	.99		12AZ7	.86		12SK7GT	.74
	3BZ6	.55		5X8	.78		6BQ6GT	1.05		6T8	.80		12B4	.63		12SN7	.67
	3CB6	.54		5Y3	.46		6BQ7	.95		6U8	.78		12BA6	.50		12SQ7M	.73
	3CF6	.60		6AB4	.46		6BR8	.78		6V6GT	.54		12BD6	.50		12U7	.62
	3CS6	.52		6AC7	.96		6BS8	.90		6W4	.57		12BE6	.53		12V6GT	.53
	3CY5	.71		6AF3	.73		6BU8	.70		6W6	.69		12BF6	.44		12W6	.69
	3DE6	.62		6AF4	.97		6BY6	.54		6X4	.39						
	3DK6	.60		6AG5	.65		6BZ6	.54		6X5GT	.53						
	3DT6	.50		6AH6	.99		6BZ7	.97		6X8	.77						
	3Q5	.80		6AK5	.95		6C4	.43		7AU7	.61						
	3S4	.61		6AL5	.47		6CB6	.54		7A8	.68						
	3V4	.58		6AM8	.78		6CD6	1.42		7B6	.69						
	4AU6	.54		6AN4	.95		6CF6	.64		7Y4	.69						
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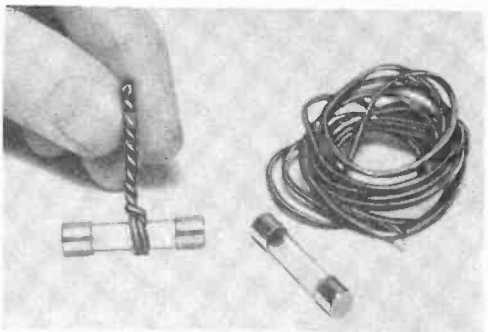
Tips

(*Continued from page 28*)

one end is helpful in dial stringing or wire jiggling.—*Jerome Cunningham, Chicago, Illinois.*

WIRE FUSE PULLER

You can have a pretty tough time removing a blown cartridge fuse from its holder in a TV set's high-voltage cage or



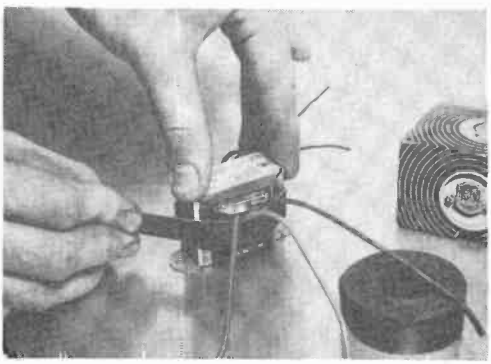
similar cramped place. It's not so difficult, though, if you wrap some plastic insulated hookup wire around the fuse barrel as shown.—*James Clifford, Detroit, Mich.*

WASHER STOPS REAMER

Next time you have to enlarge a chassis hole with a reamer and want to be sure not to enlarge the hole too much, slip a metal washer over the reamer for a depth stop. Select a washer that roughly matches the size hole desired.—*Charles Lang, San Francisco, Calif.*

TAPE THOSE TRANSFORMER LEADS

To keep the wire leads of a transformer from ripping the paper insulation, wrap a



strip of tape around the transformer as shown. This will also help prevent the leads from breaking off or coming loose.—*John A. Comstock, Wellsboro, Pa.* —30—

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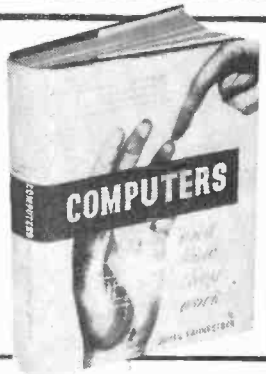

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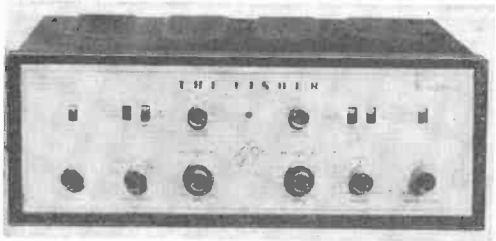
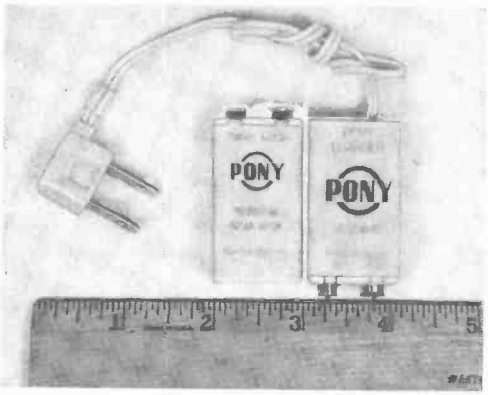


switch, and a wide-range channel balance control. Harmonic distortion is only 0.8% at full rated output. For further information, contact J. J. Parks, *Fisher Radio Corp.*, 21-21 44th Drive, Long Island City 1, N. Y.

RECHARGEABLE BATTERY

A rechargeable 8-volt battery is being offered by *B & K Manufacturing Co.*, 3726



N. Southport Ave., Chicago, Ill. Designed to replace conventional 9-volt batteries used in transistor radios, the "Pony" unit can be charged overnight. A total service life of over 100 times that of dry cell bat-

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products

(*Continued from page* 32)

teries is claimed by the manufacturer. Price (battery and charger), $4.95.

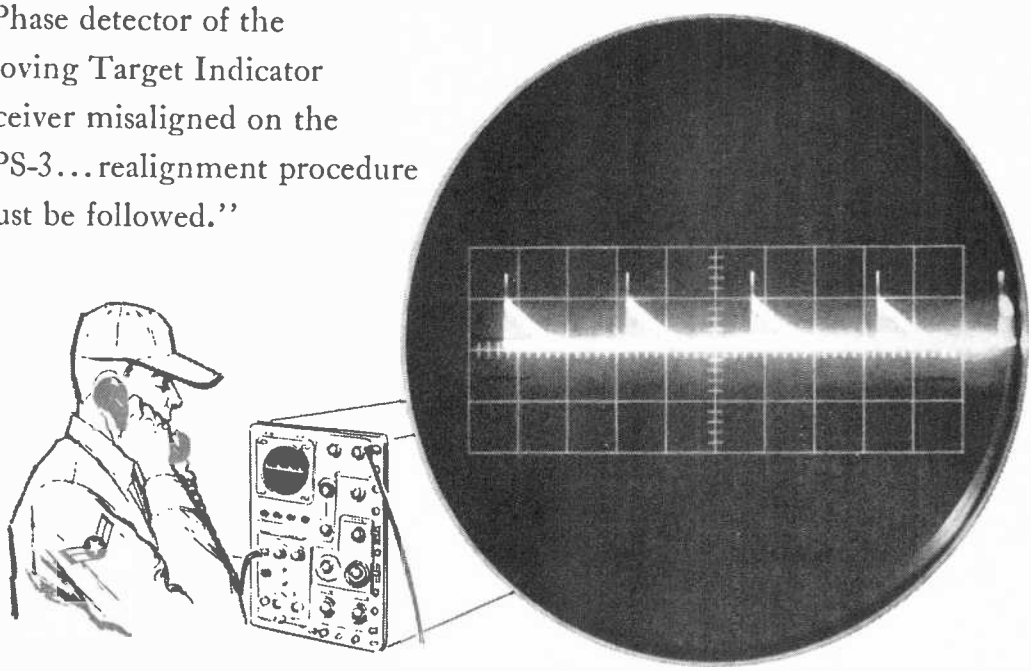
WIND INDICATOR

A battery-powered wind velocity and direction indicator has been introduced by *Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y. The transmitter assembly can be mounted on any 1¼" pipe or mast. The indicator is housed in a wooden cabinet and provides two wind-speed scales—0-25 mph and 0-100 mph—and a third scale for direction. Speed accuracy of ±5% is claimed. Price, complete with 60' cable and a 1½-volt battery, $59.95.

ELECTRONIC ORGANS

Two new electronic organs are being marketed by *Electro-Voice, Inc.,* Buchanan, Mich. The de luxe model, called the "Baron," is a console type featuring a built-in eight-watt amplifier and high-fidelity loudspeaker. The second model, the "Baroness," eliminates the console base and has no foot

"Phase detector of the Moving Target Indicator receiver misaligned on the FPS-3... realignment procedure must be followed."



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products

(*Continued from page* 34)

pedals or swell shoe. Cabinetry for both models was designed by Paul McCobb. The "Baron" is priced at $545.00 and the "Baroness" is $445.00.

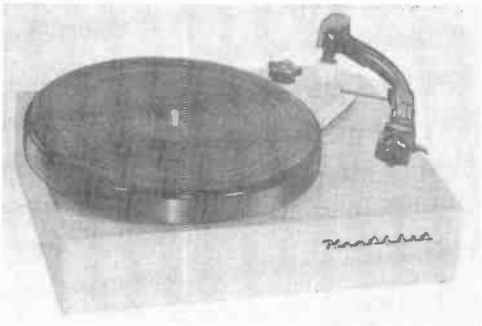
CB TRANSCEIVER

A Citizens Band transceiver that is available either as a kit or factory wired has recently been announced by *EICO,* 33-00 Northern Blvd., Long Island City, N. Y. The unit covers up to twenty miles, depending on the terrain and antenna height. Circuit

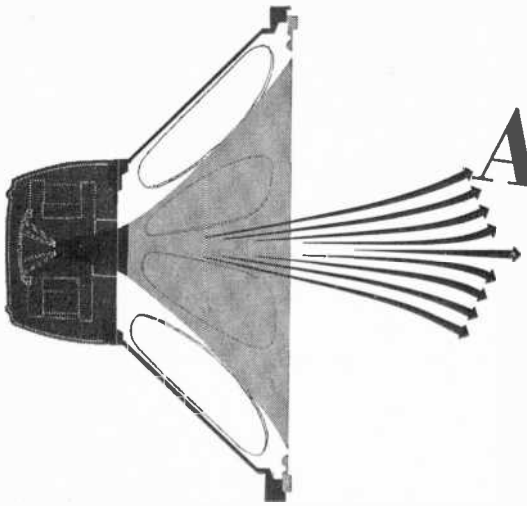
features include a 5-watt crystal-controlled transmitter, a superhet receiver with r.f. stage and noise limiter, and sealed oscillator circuit elements. Prices: Model 760 (117 volts a.c.) $89.95 wired, $59.95 kit; Model 761 (117 volts a.c. and 6 volts d.c.) $99.95 wired, $69.95 kit; Model 762 (117 volts a.c. and 12 volts d.c.) $99.95 wired, $69.95 kit.

RECORD PLAYER KIT

The Model AD-10 stereo record player kit comprises a preassembled mechanical unit made by Garrard of England, a wooden



base, a Sonotone STA4-SD ceramic stereo turnover cartridge with .7-mil diamond and 3-mil sapphire stylii, and all necessary



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- What You Should Know Before Buying Stereo
- Stereo Simplexing Simplified
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- Stereo Cartridge Directory
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(*Continued from page* 36)

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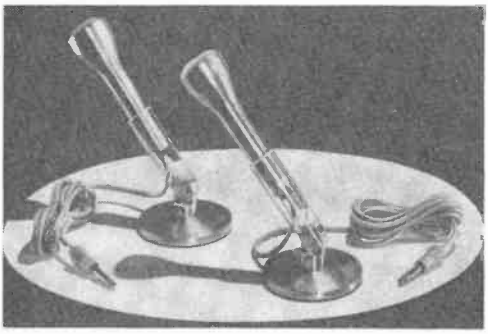

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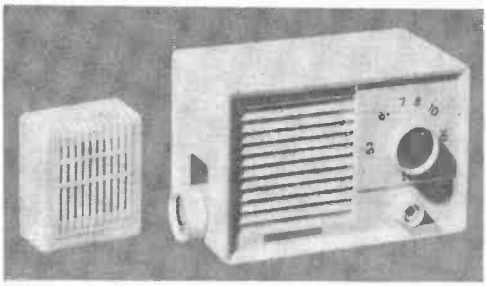

com position. Master station size: 6½″ x 3½″ x 4⅜″. Remote speaker size: 2¾″ x 3″ x 1½″. Price, complete: $15.93. —30—

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

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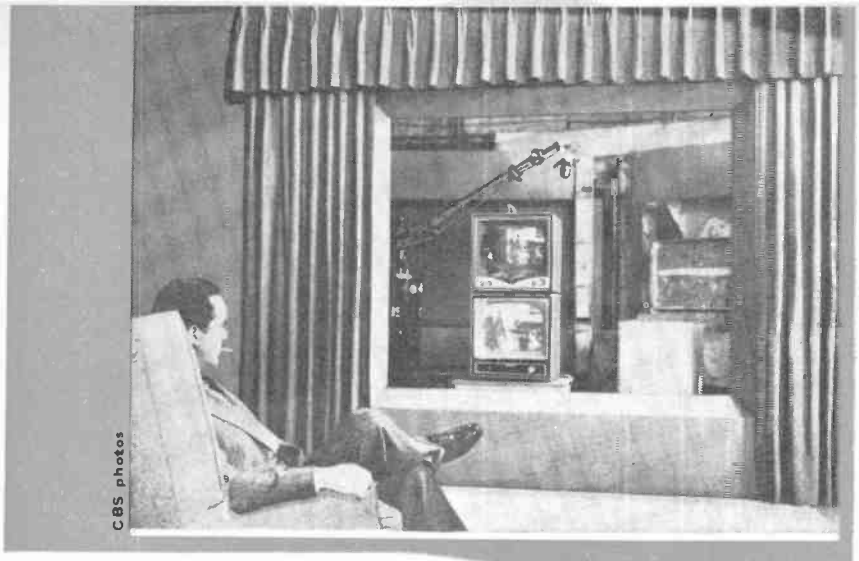


CBS photos

TV's Trick Techniques

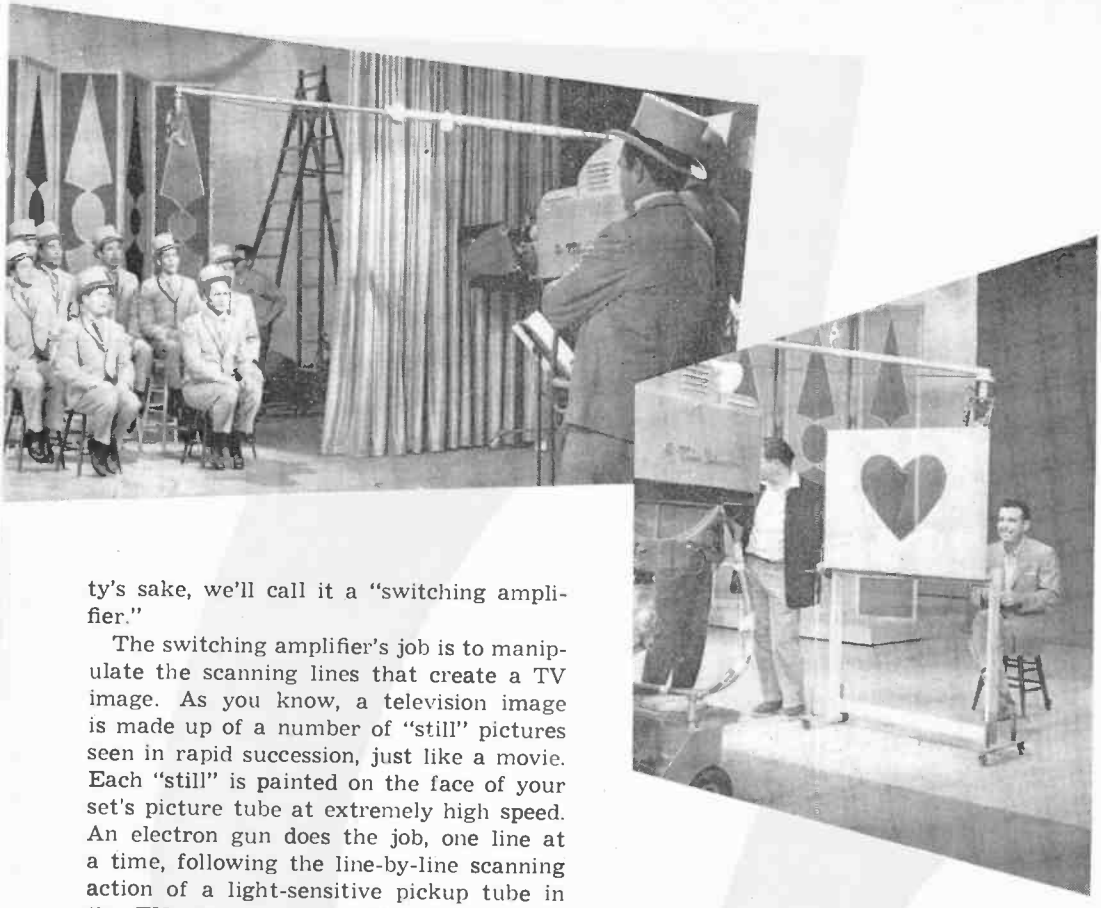
By ART ZUCKERMAN

WHEN Edward R. Murrow ran the "Person to Person" show, he had the craziest picture window in the world. Ed would lean back in his famous easy chair, and you would get the idea that he was talking directly to the people in the picture window—people who were hundreds of miles away.

Ever wonder how it was done? You can bet that the window wasn't a studio monitor. No receiver that big was ever built. And it wasn't a projected picture, either. The "picture window" you saw was actually nothing more than a hole cut into the side of the studio set. The trickery was done by "insetting" one TV image into another.

Insetting is the technique used for creating "split-screen" scenes and the many other picture-on-picture effects you've seen on video shows. It's all done with an electronic device called a special-effects amplifier. For all its fancy name, this is nothing more than a high-speed electronic switch. For simplici-

Here's the lowdown on one type of video cheating that is perfectly legal



ty's sake, we'll call it a "switching amplifier."

The switching amplifier's job is to manipulate the scanning lines that create a TV image. As you know, a television image is made up of a number of "still" pictures seen in rapid succession, just like a movie. Each "still" is painted on the face of your set's picture tube at extremely high speed. An electron gun does the job, one line at a time, following the line-by-line scanning action of a light-sensitive pickup tube in the TV camera. With this in mind, let's see where the switching amplifier fits in.

Geometric Insets. Suppose we want a split-screen effect. First we aim two cameras at different subjects, and feed their outputs into the switching amplifier. At the beginning of each scanning line, the switching amplifier is adjusted to pass only the signal from Camera One. When the electron beam reaches the halfway point, the switching amplifier switches in Camera Two. After the scan is completed, Camera One is put back on the air for the start of the next line. Thus, Camera One "paints" the left half of the picture, and Camera Two "paints" the right half.

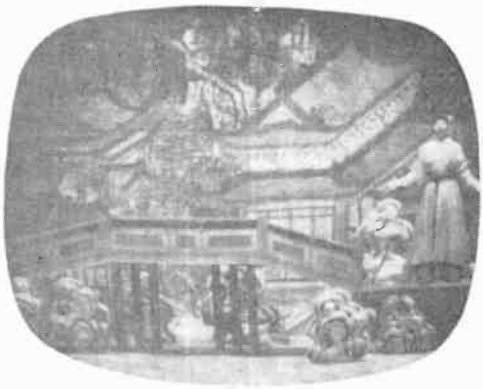
The same method created Ed Murrow's picture window. For the top part of the picture, the camera in Murrow's studio was switched in. But when the scanning action reached the spot on the studio set wall where the window was to be inset, the remote camera that was picking up Ed's "guests" was switched in.

Very interesting, you may say, but how does the switching amplifier know when to do its stuff? It's told by an electronic kick-in-the-pants called a keying pulse. When the switching amplifier receives this pulse, it switches camera inputs. When the pulse stops, it switches back to the original input.

An instrument called a "special-effects generator" produces the keying pulse. The duration of each pulse and the time between pulses can be changed to put the inset anywhere it's wanted. You can get any shape inset you like—diamond, square, circle, stripe. You can also make the inset change shape and even expand so one scene seems to explode into another.

Color Control. Fabulous as these effects are, they represent the most rudimentary forms of insetting. Instead of just insetting a rectangular piece of one picture into another, how about taking an actor out of his surroundings and putting him in a setting many feet or even miles away?

This effect calls for more advanced tech-

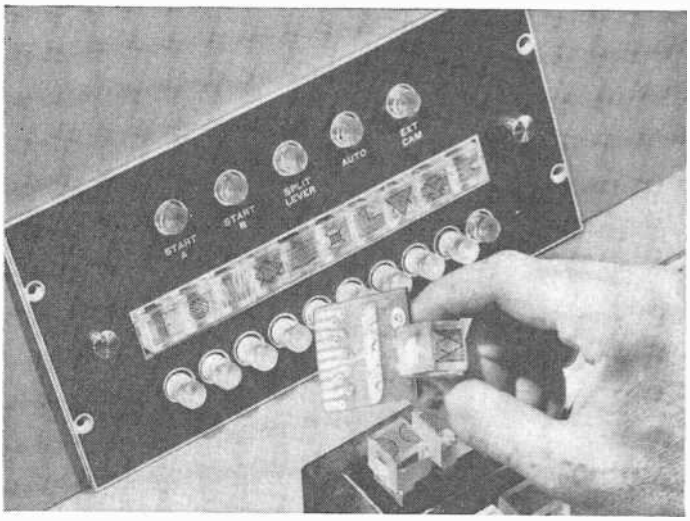


"VideoScene" process uses backgrounds which are one-sixth life size. Here Japanese singing star Miyoshi Umeki is inset into a miniature Japanese garden. Colored backdrop behind Miss Umeki "keys" the switching amplifier, signaling it when to switch on the background camera. (CBS photos)

"Chroma-Key" makes possible insets in full color. Many NBC color shows, including the Tennessee Ernie Ford Show shown in this series of photos, use this system regularly. (NBC photos)

niques. It means that you want Camera One to be switched in only when it's actually scanning the actor himself. When it's not scanning him, you want the simulated setting to come in via Camera Two.

It took the invention of the color television camera to make such a fancy effect possible. With a color-discriminating device such as a color TV camera, a specific color can be used to key the switching amplifier. Whenever Camera One picks up this color, it triggers the switching amplifier, causing it to switch in the output of Camera Two.



Up to 154 effects can be produced with this RCA special-effects generator. One of the most advanced units available, it uses plug-in modules that tell the switching amplifier when to switch camera inputs.

In actual practice, the actor stands in front of a backdrop which is painted a solid color. Blue is generally used because there is little blue in skin tones. The camera aimed at the actor does the keying.

When the camera scans the blue backdrop, the switching amplifier receives a pulse that makes it pick up the signal from Camera Two, the one covering the setting. When the scanning line in the camera tube reaches the actor, and therefore sees no more blue, the pulse stops, and the switching amplifier flips on Camera One again to pick up the actor. Obviously the actor can't wear a blue shirt or tie, or you'd see right through him.

"Chroma-Key." NBC's "Chroma-Key" process is a very refined system that employs the principles outlined above. With Chroma-Key, which is designed primarily for colorcasts, Color Camera One is focused on the subject and Color Camera Two picks up the setting. Both feed their signals to the switching amplifier in the usual way, but a sample of Color Camera One's output is also fed to a "Chroma-Keyer." This is a gadget that filters out the signal representing any specific color and then amplifies it.

Normally, the Chroma-Keyer is set to single out the blue signal. Every time the subject camera scans the blue backdrop, the Chroma-Keyer puts out a strong pulse. This pulse keys the switching amplifier.

To do its job well, a Chroma-Keyer has to make some pretty subtle color distinctions. For example, purple is composed of 50% blue and 50% red. But when it receives the combined blue and red signals representing purple, the Chroma-Keyer won't react. Only a highly saturated blue will generate the keying pulse.

But suppose you want to do an inset with a subject on which you must show blue—a sponsor's product that comes in a blue package, for example. This problem can be solved by setting the Chroma-Keyer to filter out red signals and then using a red backdrop behind the subject to trigger the Chroma-Keyer. However, you would not be able to show any red in the subject.

"VideoScene." The CBS "VideoScene" process has much in common with Chroma-Key, but there are lots of differences, too. At present, it's used only for black-and-white telecasts, but the "subject" camera—the one aimed at the actor—is a color camera. Only two of the color camera's three pickup tubes are put to work, however. One picks up the picture and the other puts out a signal only when it scans the blue backdrop behind the actor. This blue pickup tube generates the keying pulse directly.

Lighting is very tricky with the Chroma-Key system, since the backdrop must receive very flat lighting to keep the color in-

(*Continued on page* 110)

By
KEN GILMORE

Could it be that the recent investigations of radio and TV are leading to a . . .

SHOWDOWN for the FCC?

WHEN the Federal Communications Commission sat down last December to decide what it should do about quiz scandals, payola, and fraudulent advertising, John C. Doerfer, Chairman at that time, said: "This is an important moment in American history. These hearings may well determine the future course of our system of broadcasting." He did not say—although it is equally true—that the FCC's decisions might also determine the future of the FCC itself.

While no one so far has publicly suggested that the FCC be scrapped, there has been a flood of bitterly critical statements from lawmakers, educators, business and civic leaders, and the general public. Senator William Proxmire of Wisconsin has asked for drastic revisions in the Commission and its operations. Even the conservative *New York Times* has called for "vigorous, creative new leadership at the FCC." Attorney General William Rogers, in a sharply worded special report to President Eisenhower, said that the Commission has been sitting on its hands instead of doing its job. Television critic Jack Gould summed up the FCC's endless delays and hearings as "government by vigorous postponement."

Has the FCC fallen down on the job? Here are the facts behind the FCC's latest nightmare, the quiz scandals.

Rigged Quiz Shows. On July 31, 1958, the Commission received an affidavit from a former contestant stating that the "Dotto" quiz show had been rigged. The Commission wrote a letter to CBS asking if the charge were true. CBS replied that it was looking into the matter, and promised to root out any rigging practices it found. On this evidence, the Commission dropped the case. It didn't even bother to question the former contestant who had signed the affidavit.

In September — two months later — a grand jury in New York set out to investi-

Charles Van Doren's dramatic confession of being involved in fixed quizzes sparked country-wide criticism of shady broadcasting practices and of the FCC.

gate quiz shows. The jury asked the FCC for copies of the affidavit, and requested that an FCC official appear before the jury to help with the investigation. The Commission told the jury it was busy making a general study of broadcast practices at the time, and could not comply with either request while this study was under way. With all this smoke, the Commission saw no reason to suspect fire.

In the fall of 1959—a year later—the Special Subcommittee on Legislative Oversight held its spectacular hearings, highlighted by Charles Van Doren's dramatic confession. Finally, in the face of mounting public indignation and criticism, the FCC opened its own hearings on December 7th to see what, if anything, it could do.

But the quiz scandal was merely the fuse that set off the explosion of public anger. One witness after another blasted the FCC for allowing: too much crime and violence; untruthful, offensive, excessive advertising; and generally shoddy programing on radio and TV. The Commission was besieged from every quarter for its alleged sins.

How did this situation develop? And what is the FCC really responsible for, by law?

The Public Interest. Back in the early days of radio, anyone could throw together a few tubes and wires and become a radio station operator. Soon, the air was so full of squeals, squawks, and interference that something had to be done to bring some order into the chaos.

Congress created the FCC to act as a sort of traffic cop—to assign frequencies and set up minimum standards of operation. One of the principles it set down: the airwaves belong to the public, *not* to the broadcasters who use them. Consequently, broadcasters would have to operate in the "public convenience, interest, or necessity." Anyone who failed to do so might have his license revoked.

How well has the FCC done the job of seeing that broadcasters operate in the public interest? Under present practice, the Commission is extremely careful when issuing *new* licenses. It holds lengthy hearings to compare the promises of all contenders as to how they will serve the public. It finally picks the one whose promises seem best, and issues the license. From that day on, it virtually ignores the licensee —his past promises are forgotten.

According to Commissioner Doerfer in a speech last November before the Television Bureau of Advertising, the Commission has been "most liberal" in its interpretation of what constitutes public service. In fact, the Commission has not refused to renew a license since 1932. (It did revoke one license

John C. Doerfer, who recently resigned as Chairman of the FCC, makes ready to testify before a congressional subcommittee.

in 1946 for fraud.) When Doerfer was asked recently what policy the Commission used for deciding whether a station's operation had been in the public interest, he admitted that "there isn't much policy."

With this attitude on the part of the FCC, it is not surprising that the public periodically gets fed up with broadcasting practices. During World War II, for example, there was widespread criticism that the FCC did not make stations fulfill their pre-licensing pledges. After its usual study, the Commission issued a publication which came to be called the "Blue Book." Its main point was that stations must live up to their pre-licensing promises about public service. If they had not met those promises when renewal time came around, they would be required to explain why.

The ensuing uproar shook Washington. Some supporters of the book were publicly accused of being Communist sympathizers, and broadcasters claimed that the little book "would destroy the American Way of Life." The outcome of the whole affair was that the "Blue Book" was simply allowed to fade away, and the FCC has not made much effort to control standards since.

In 1951, when complaints about TV programing and over-commercialization began to increase, the Commission announced that "a public conference will be scheduled at a date to be announced later, for the discussion of television broadcasting problems from the viewpoint of the public, the Commission, and the industry." To this date—more than nine years later—the conference has not been held.

Self-Regulation. Even in cases of flagrant abuse, the FCC has established a hands-off policy. For example, since 1957, the Federal Trade Commission has notified the FCC of over 100 cases of stations engaging in false or misleading advertising. What action has the FCC taken?

According to an FCC public notice, the Commission brought the FTC's complaints to the attention of the stations involved so that they—the stations—would "be in a position to consider taking action consistent with their operation in the public interest." None of these stations has ever been asked at renewal time to explain or justify its actions. License renewal is, in fact, virtually automatic. A Commissioner recently admitted that a staff member routinely spends only about five and one-half hours checking each renewal.

Whenever examples of flagrant disregard for the public interest are brought to public attention, the FCC inevitably expresses its faith in the industry's ability to "clean its own house." As recently as February 5, Chairman Doerfer recommended that stations, advertising agencies, and others involved in broadcasting set up a system of voluntary codes, and award a seal of approval to all programs and advertisements that meet code standards. Said Doerfer, "I have a strong belief that the most effective way to correct abuses in the broadcast industry is through prompt and farsighted self-regulation."

How well do voluntary codes work? Three years ago the National Association of Broadcasters began a campaign to get

rid of objectionable commercials. The code board decided that TV commercials on hemorrhoidal remedies should be banned. At the time, *Preparation H,* a remedy specifically banned by the board, had ads on 148 TV stations, 84 of which were subscribers to the code. Two weeks later, 17 stations had resigned from the code rather than give up the ads. Twenty-one others allowed their seals to be revoked. Naturally, the 64 stations who were not members of the code to begin with were not affected at all.

While the institution of an industry-wide code such as proposed by Chairman Doerfer would no doubt do much good—after all, most broadcasters are responsible citizens—it offers no remedy for those who will not abide by voluntary controls. Withholding a seal of approval is an empty and meaningless gesture in these cases. Vigorous and prompt action by the FCC under its power to demand that broadcasters operate in the public interest or lose their licenses is the only thing that will impress irresponsible operators.

Tough Job. In all fairness, it must be admitted that careful, fair regulation would be a tough job. There is a serious shortage of both staff and money. Then, too, with all the publicity about radio and TV, many of us tend to forget that this is just one of the FCC's jobs. In addition, it must: license hams and commercial engineers; assign frequencies for broadcast, experimental, emergency, governmental, military, and other services; and consult with foreign governments about matters where international cooperation is required.

But in spite of the difficulties, there are things that could be done. A first step would be change the laws so that the FCC can fine violators, or suspend their licenses for a short time. At present, the FCC's only weapon—license revocation—is such a drastic step that the Commission hesitates to use it. The FCC has asked for this change, and others.

Wanted: Leadership. Of course, the question arises, why didn't the FCC ask for laws which would provide practical methods of regulation years ago, instead of waiting until it was under fire? And here, perhaps, is the heart of the matter. For what is most desperately needed is a Commission that will take the initiative, and not have to be pushed into action.

This, in fact, was the basic issue that led to the recent resignation of Chairman Doerfer. The immediate storm of controversy resulted from the personal favors he admitted he had accepted from one of the country's largest broadcast station owners. But it had become clear that Congress and the people felt a need for firmer leadership.

The traditional lack of leadership is partly the fault of the system, rather than of the Commissioners themselves. These men—in spite of their tremendous responsibilities—are not highly trained civil servants who have devoted a lifetime to an exacting career. They are rarely experts in the specialized field of broadcasting. They are simply political appointees who may or may not be reappointed. Their pay—$20,000 a year—does not match the responsibility of their jobs.

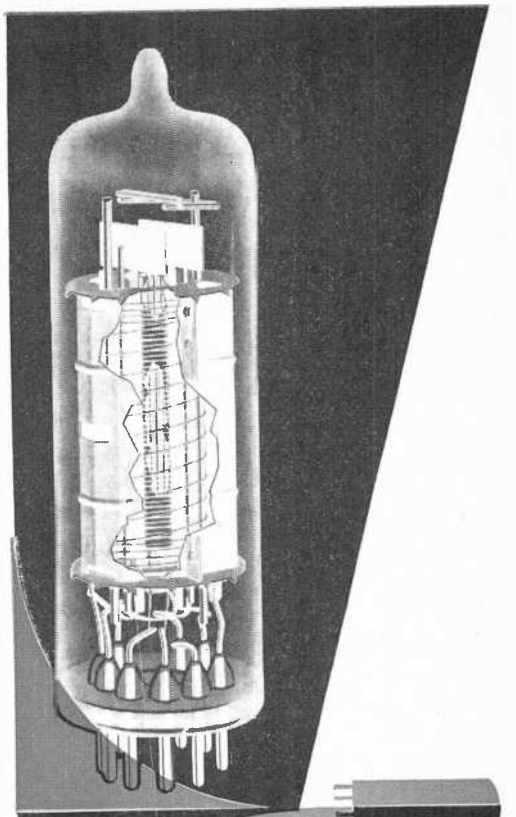
The Commissioners are frequently subjected to Congressional pressure. Many Congressmen hold and have held interests in broadcast stations. This pressure, however subtle, has done little to increase the Commission's feeling of independence. Under the circumstances, it is not unusual that the FCC's first goal frequently seems to be keeping out of trouble and controversy.

Reorganization. Some people think that the entire concept of an unwieldy, slow-moving, pressure-sensitive Commission may be out of step with the times. In a similar case, Congress decided it was. In 1958, the Civil Aeronautics Administration —another independent regulatory agency like the FCC—was abolished and replaced with an agency headed by a single, efficient administrator.

One commentator suggests that a capable administrator might be able to lay down standards of honesty and program balance without the years of hearings and indecision characteristic of multi-membered boards. Many believe policy is more likely to be made and enforced by a single man, responsible to Congress and the President, than by a board of commissioners.

Whether or not this kind of thinking gains much momentum depends on the actions of the various boards—including the FCC—in the next few years. With an aroused public and a dissatisfied Congress watching its every move, the FCC is facing a showdown. What it does in the very near future will not only determine the course of the broadcast industry, but may also spell life or death for the FCC itself. —30—

Special tubes for special uses help boost the hi in today's fi



Tubes for Hi-Fi

By JOHN MILDER

NOW THAT transistors and other semiconductors have become the glamour girls of electronics, engineers in many fields treat the vacuum tube like a movie queen of the twenties—worthy of respect, but not much interest. In the hi-fi world, though, tubes are as important as ever—and with good reason. Over the past few years, new and better tubes have performed the double-barreled job of boosting the high in the fi, and at the same time reducing circuitry, cost, and size.

Hi-fi tubes fall generally into three categories: voltage amplifier tubes, power output tubes, and rectifiers. Voltage amplifier tubes in preamplifiers and amplifiers boost small input signals enough to drive power amplifiers to their rated output. Power output tubes take on the job of pushing and pulling heavy currents through an output transformer to supply signals to a loudspeaker. Rectifiers have the simple but important function of converting a.c. from the power line into pulsating d.c.

Voltage Amplifiers. Perhaps the most popular of all voltage amplifiers is the ubiquitous 12AX7, a high-gain dual triode of small dimensions but big performance. Although the 12AX7 was originally designed for non-hi-fi purposes, its heyday really began after the introduction of the early G. E. and Pickering phonograph cartridges, the first widely accepted hi-fi pickups. The low outputs of these cartridges made necessary an earlier stage of amplification ("preamplification").

The tube used as a preamplifier had to have low hum and noise, since even a minute amount of extraneous noise would be magnified by the many following stages of amplification. The 12AX7 filled the bill satisfactorily and soon made a secure niche for itself in preamp circuits, along with its lower-gain counterpart, the 12AU7, and, to some extent, the middle-of-the-road 12AT7.

Over in Europe, though, Philips of the Netherlands (a company roughly comparable to the giant electronics companies in

this country) decided that the 12AX7 was one lily that could stand some gilding, and set about designing an improved version in the early 1950's. Eventually imported here by Amperex and Mullard, Philips' new 12AX7, known in Europe as the ECC83, was one of the first tubes designed specifically for hi-fi.

Employing a coil heater to reduce hum, a double-tongue mica spacer to reduce microphonics, and carefully controlled cathode materials, the ECC83 was quickly chosen by many hi-fi manufacturers in preference to the 12AX7. And it has remained a fixture in its multiple roles of preamplifier, tone control, first-stage voltage amplifier, and phase inverter. A tube of similar premium quality, the 7025, is currently manufactured in this country.

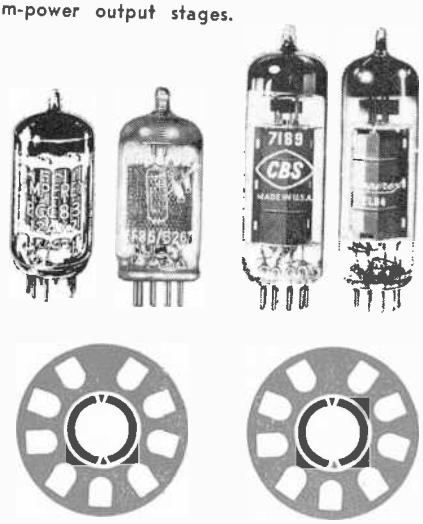
Over the past two years, the ECC83's popularity in preamps and power amplifiers has been contested a bit by a miniature pentode that goes under three different designations: the EF86 (Philips), the Z729 (Genalex—the General Electric Co. of England), and the American 6267. This tube features very high gain with extremely low noise and distortion. It has become widely used in preamp circuitry as well as in the first stage of power amplifiers, and it is frequently employed in tape recorder input stages.

Hi-fi circuits have also made room for hybrids like triode-pentodes. Although they are a little too noisy for use in preamp circuits, triode-pentodes are often employed as voltage amplifiers and phase splitters in power amplifiers. Such tubes as the 6BA8-A and the 6AN8 used in the popular Dynakit circuit (both originally video tubes) have been challenged recently by the 7199, a tube designed by RCA specifically for hi-fi circuitry.

Power Output Tubes. New power output tubes, along with new output transformers, have quietly revolutionized audio circuitry. Due in large measure to tubes like the Mullard-Amperex EL34/6CA7, the Tung-Sol 6550, and the Genalex KT88, the audiophile now can choose from a wide variety of high-power, high-performance amplifiers. To understand how power output tubes have affected amplifier design, let's take a look at the amplifier situation of a few years ago.

Back in 1954, when hi-fi was just beginning to receive public acceptance, choosing an amplifier from the shelves of an audio store was a far from routine experience. Almost every store selling hi-fi equipment was the scene of fairly heated arguments over the merits of amplifiers in general, and triode, tetrode, and pentode output tubes in particular. It was pretty hard to buy any amplifier without having to defend your choice.

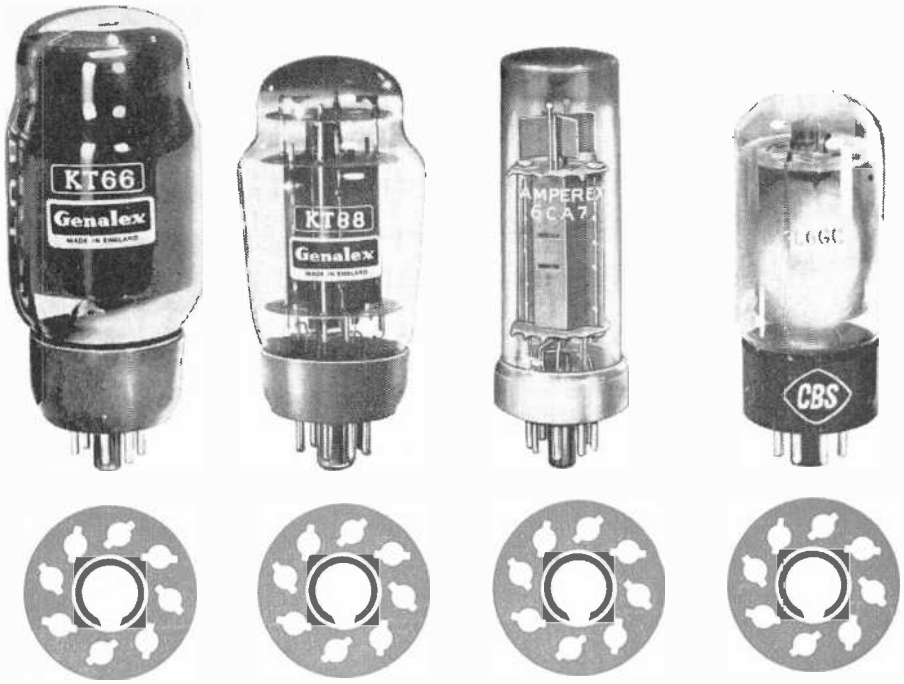
Two of today's best voltage amplifiers are the ECC83 and the EF86. The 7189 and the EL84 are tubes used in medium-power output stages.



All-triode amplifiers had long been noted for their very clean sound (the Brook amplifier with 2A3's in the output stage was one good example). But they were usually complicated, expensive, low-powered (7-15 watts on the average), and, more often than not, lacked the advantages of inverse feedback. Amplifiers using beam power tubes produced more power (18-25 watts on the average) but they naturally fell victim to the increased distortion of the tetrode.

The popular Williamson circuit partially solved the problem by connecting tetrodes as triodes. It used Genalex KT66's, beam-power tubes capable of about 30 watts output. In Williamson's circuit, connected as triodes, they produced about 15 watts at extremely low distortion.

If the choice seems a bit confusing now, it was even more so at the time. It was up to the audiophile of 1954 to decide between all-triode amplifiers with 2A3's or 6B4's, "Williamsons" with KT66's, 807's, or 5881's,



Widely used high-power output tubes include the KT66, the KT88, the EL34/6CA7, and the improved 6L6GC.

and units using tetrodes such as 6V6's or 6L6's. And if he wanted anything approaching today's 50-watt amplifiers, he had to dig deep into his wallet.

The situation improved somewhat with the introduction of the "Ultra-Linear" or distributed-load circuit. Using new transformers with special primary taps connected to the output tube screens, the Ultra-Linear circuit allowed tubes like the KT66 to produce from 30 to 50 watts at low distortion. Then tube designers went to work in earnest and came up with today's EL34, 6550, and KT88—tubes designed to take fuller advantage of any circuit.

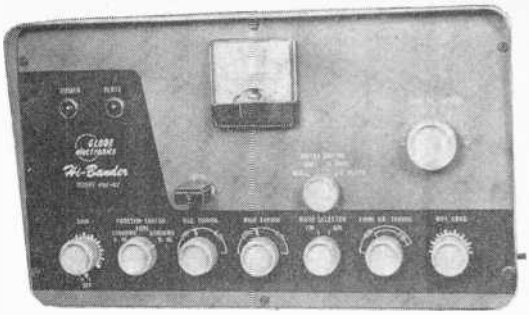
Drive Requirements. The most obvious feature of today's output tubes is their ability to produce far more power than their former counterparts. The extra power is more than welcome for driving low-efficiency speaker systems. Just as important, though, is the fact that the new tubes produce their rated power with small driving voltages. This has often enabled amplifier designers to dispose of a stage of voltage amplification, with many attendant benefits.

The simpler circuitry allows better control of phase distortion, easier application of feedback, and simpler, more economical construction. The last of these advantages has been a tremendous dividend for the kit-builder, who can now build even a dual stereo amplifier in less time than it once took to complete a medium-power Williamson circuit, and do it at much less cost per watt.

The EL34, used in such amplifiers as the Dynakit Mark II and the EICO HF-60, is a good example of what the new tubes offer —increased output, higher transconductance and lower drive requirements. Its smaller brother, the EL84 (see cutaway drawing on page 49), also has some marked advantages over its old counterpart, the 6V6; it offers almost three times more transconductance and thus demands considerably less drive voltage. Both the EL34 and the EL84 use a gold-plated grid and special grid radiating fins for low primary grid emission. This permits use of a larger grid resistor and, therefore, results in higher gain from the driver.

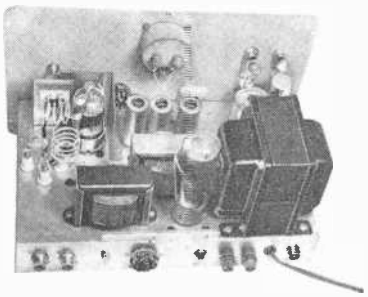
One of the newest of the high-power tubes, the KT88, will actually deliver 27 watts in triode-connected class A service and up to 100 watts in Ultra-Linear operation. It is used in such amplifiers as the

(*Continued on page* 116)



6 and 2 Meter Transmitter

Globe "Hi-Bander" delivers 60 watts c.w., 50 watts 'phone



WITH both the six- and two-meter bands now open to hams, a single transmitter for these bands is bound to be a popular unit. The "Hi-Bander" VHF-62 puts out 60 watts c.w. or 50 watts 'phone on either band. Made by Globe Electronics, Inc., of Council Bluffs, Iowa, this versatile rig comes in kit form for $119.95 or completely wired for $149.95.

Circuit Features. Considering its power and complex circuitry, the transmitter is quite compact, measuring only 8" x 8" x 14". An array of front panel switching and tuning controls makes each of the four r.f. stages readily accessible for tuneup. The link-coupled 6146 final operates straight-through on both six and two meters.

On the six-meter band, a crystal operating slightly above 8 mc. is tripled by a 5763 oscillator to a little over 25 mc. This is followed by a 5763 doubler and a 5763 buffer driving the 6146 final in the 50-mc. band. On two meters, another 8-mc. crystal is tripled to about 24 mc. by the oscillator. But the second 5763 operates as a tripler and the third as a doubler, driving the final in the 144-mc. region. In the audio section, a pentode-triode 6U8 drives a 6L6 modulator and provides adequate gain for quality crystal mikes.

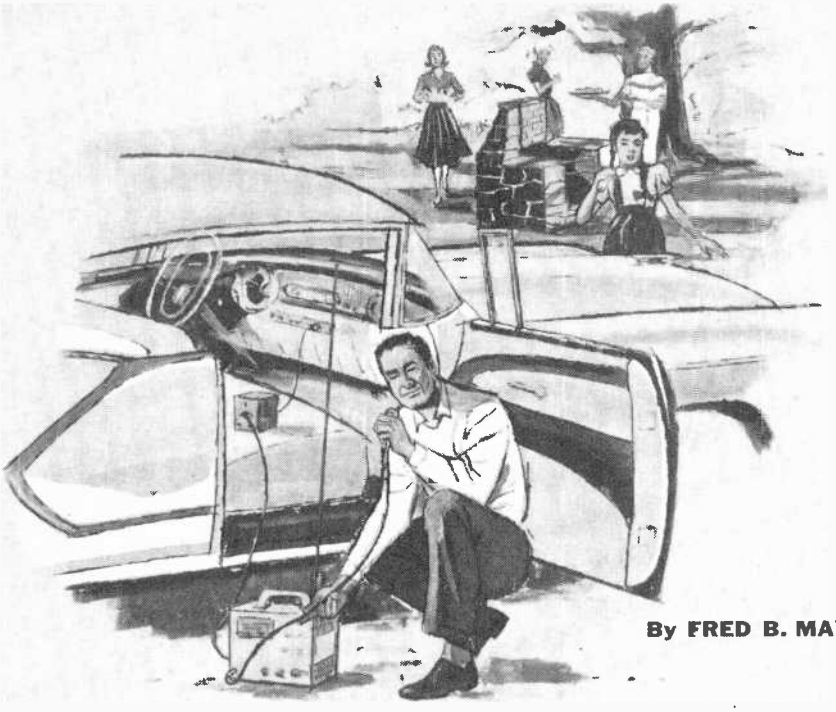
You'll find a big, burly power transformer in the power supply that will stand up under plenty of long rag-chew stints. If you want to use an external power supply for mobile work, you'll find the accessory power socket convenient. This socket can also be used for powering VFO's or other low-drain devices.

Two coax r.f. output jacks are provided, one for six meters and one for two meters. The dual output is a blessing if you use separate antennas. But with all-band antennas, you'll have to switch the antenna from jack to jack.

Comment. The wiring is straightforward. As you might expect, a lot of coils are necessary for a rig that multiplies from 8 to 144 mc., but adequate room is provided for all components. To compensate for the relatively complex r.f. section, the audio circuitry features printed coupling networks. These handy "packaged" units include not only the coupling capacitor and plate and grid resistors, but the screen-dropping resistor and bypass capacitor as well.

The Globe "Hi-Bander" has that chock-full-of-power look. And plenty of power the VHF-62 has—more than enough to make a big sound on six and two meters, or to drive a high-power linear amplifier.

—30—



By FRED B. MAYNARD

Transistorized DC-to-AC Converter

. . . powers 117-volt a.c. appliances in your car

SPRING IS HERE and you'll soon be using your car for camping and hunting trips. Wouldn't it be handy to be able to use your electric shaver or short-wave set on these trips? Here's a compact transistorized converter that will allow you to do just that. It plugs right into your car's cigarette-lighter receptacle and provides 117 volts a.c. at enough power to operate many small electrical units.

Also a valuable gadget for traveling sales people, the transistorized converter will operate a low-power office dictating machine, allowing the user to do some of his paper work on the run. It will even power a small soldering iron, in case emergency repairs are called for.

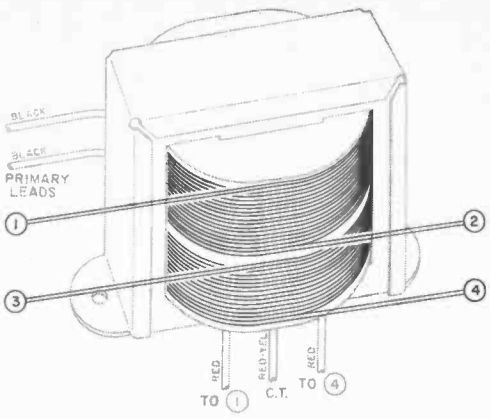
The converter operates from a 12-volt automobile electrical system with an efficiency of about 75%. It puts out nearly 117 volts at approximately 60 cps when powering a 40-watt load. And although it costs about $15 — nearly as much as a ready-made unit -- you'll find that it drains much less from your battery than commercially available vibrator converters. Then, too, there is no vibrator to replace.

Construction is relatively simple when you follow the pictorial diagram. The unit is built in a 4" x 5" x 6" aluminum box which also serves as a heat sink for the transistors. Use the transistor mounting kit specified in the parts list to

assure good heat transfer from the transistors to the box. Mount *L1* away from the other components since it gets very hot during operation.

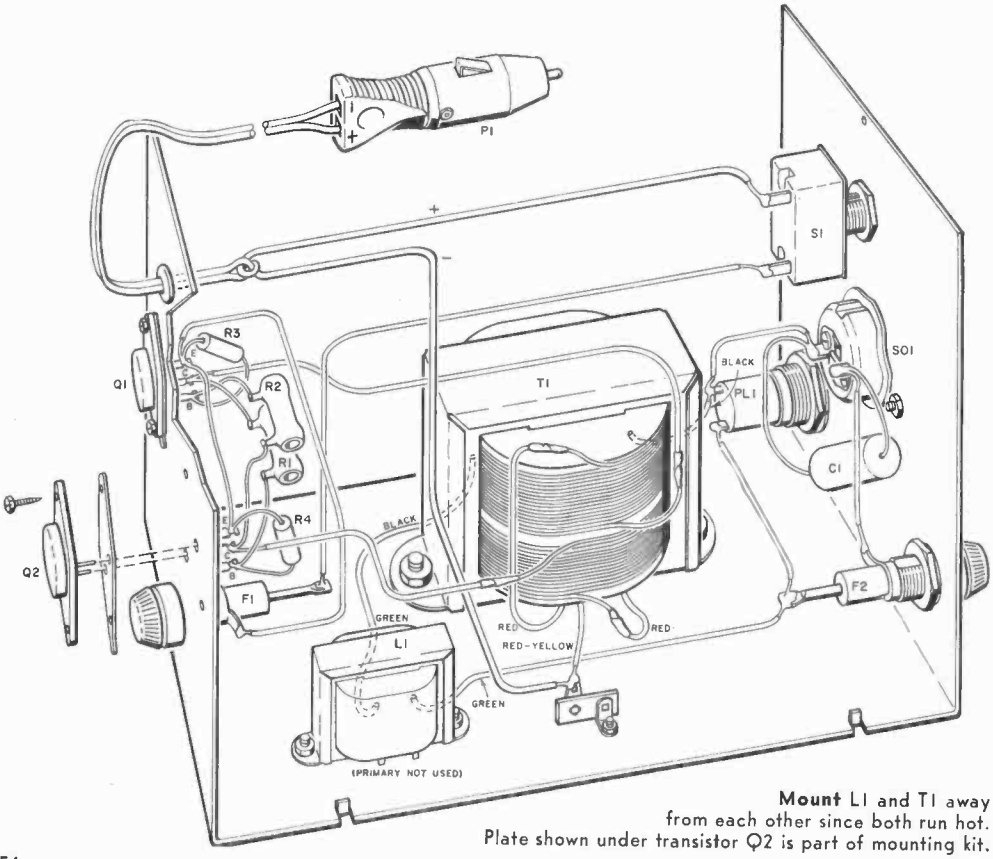
The cigarette-lighter plug (*P1*) is connected to the converter with rubber-insulated lamp-cord. Pass this lead through a grommet on the transistor side of the box.

To raise the converter's output voltage to 117 volts, transformer *T1* must have its 24-volt center-tapped winding rewound for 20 volts. This is accomplished easily without disturbing the original transformer windings by placing two 16-turn voltage-bucking windings side-by-side over the original windings as shown on the pictorial detail at right. Use about 10½ feet of No. 20 Formvar wire for each 16 turns. The direction of the windings is not important as long as both are wound the same way. Be careful not to scrape the Formvar insulation from the wire when passing it between the frame and the original windings. Tape the completed windings in place with plastic tape.

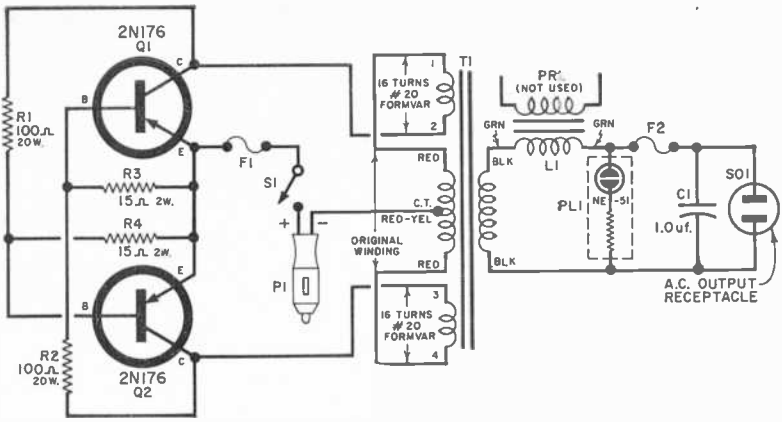


Transformer T1 needs two additional windings to raise converter's output voltage. Secure windings with plastic tape.

Now the new windings must be connected to the 24-volt center-tapped winding so that the voltages buck. This is a trial-and-error process. First solder one lead from either end of the 24-volt winding to either one of



Mount L1 and T1 away from each other since both run hot. Plate shown under transistor Q2 is part of mounting kit.

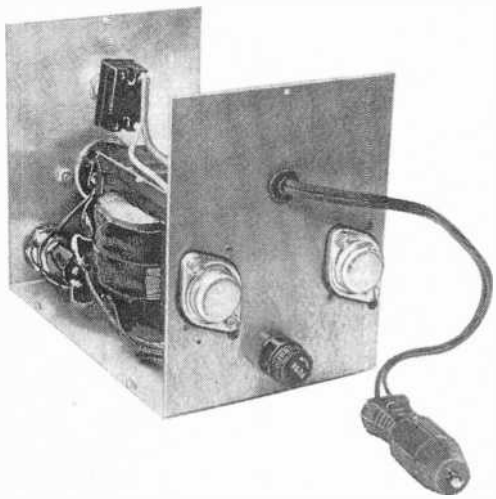


Check the polarity at car's cigarette-lighter socket before wiring plug. Choke L1 is secondary of 117-volt filament transformer.

PARTS LIST

C1—1-μf., 400-volt paper capacitor
F1—5-amp., 250-volt fuse (Littlefuse 3AG or equivalent)
F2—¾-amp., 250-volt fuse (Littlefuse 3AG or equivalent)
L1—6.3-volt, 1.2-amp. secondary of filament transformer (Stancor P6134 or equivalent—117-volt primary not used)
P1—Cigarette-lighter plug
PL1—NE-51 neon lamp
Q1, Q2—2N176 power transistor
R1, R2—100-ohm, 20-watt wire-wound resistor
R3, R4—15-ohm, 2-watt resistor
S1—S.p.s.t. toggle switch
SO1—Standard a.c. receptacle
T1—Filament transformer; 117-volt primary; 24-volt, 2-amp. CT secondary (UTC FT-10 or equivalent)
2—Power transistor mounting kits (Motorola MK-20 or equivalent)
1—Pilot light assembly (Dialco 931 or equivalent)
1—4" x 5" x 6" aluminum box (Bud CU2107A or equivalent)

Transistors Q1 and Q2 use box as heat sink. Power transistor mounting kits are necessary to isolate Q1 and Q2 electrically from box.



the outside leads (1 or 4) of the 16-turn windings. Solder the lead from the other end of the 24-volt winding to the remaining outside lead (1 or 4). Then apply 117 volts a.c. to the primary of the modified transformer, and measure the voltage across the two inside leads (2 and 3) of the new windings. If this voltage is *lower* than the voltage across leads 1 and 4, the trial has been a success, and you simply connect leads 2 and 3 to the transistor collectors as shown on the schematic. If the voltage across leads 2 and 3 is higher than that across leads 1 and 4, just reverse the connections from the original 24-volt winding to leads 1 and 4. Repeat the measurements to double-check.

To operate the converter, switch *S1* off and insert *P1* in the automobile cigarette-lighter socket. Plug in the appliance at *SO1*. Up to 40 watts can be drained at normal house-supply voltage; appliances drawing between 40 and 50 watts will reduce the output potential to about 100 volts.

Now switch on *S1* to apply the 12 volts to the converter. Operation will be instantaneous. One word of caution, however: always keep an appliance plugged into *SO1* when the converter is in operation. This will keep the output voltage down and prevent damage to the converter. —30—

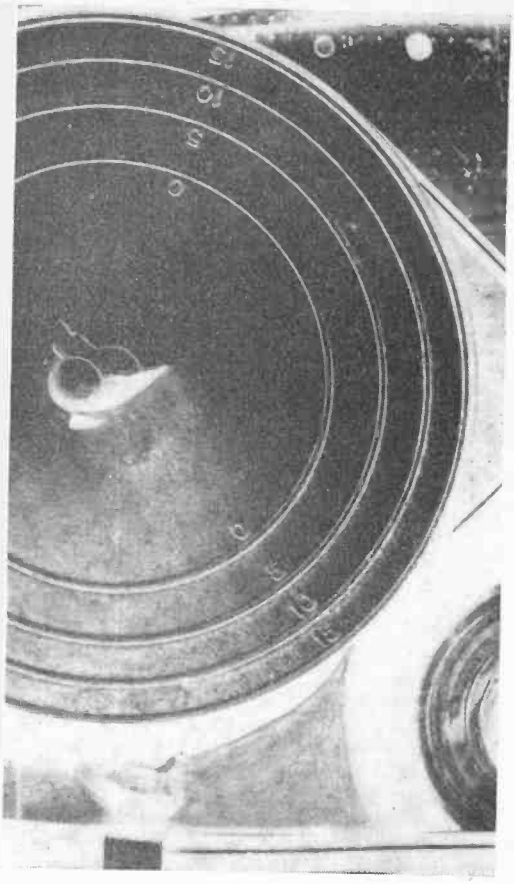
HOW IT WORKS

Transistors *Q1* and *Q2* operate as a multivibrator oscillator generating square waves at a frequency close to 60 cps. The generated square waves are stepped up in voltage by transformer *T1* to about 117 volts. Hash filter *L1-C1* clips high-voltage spikes from output of *T1*. Receptacle *SO1* connects to output of "hash" filter. Presence of output voltage at *SO1* is indicated by pilot lamp assembly *PL1*.

INSIDE the Hi-Fi Tape Recorder

Tape Transport Mechanisms

By JOSEPH MARSHALL



THE MECHANICAL PROBLEMS in designing a tape deck are easily defined. We must have a mechanism that (1) pulls the tape past the heads at a constant speed, (2) winds the tape onto a take-up reel after it passes the heads, and (3) rewinds (and sometime winds) the tape rapidly after record or playback.

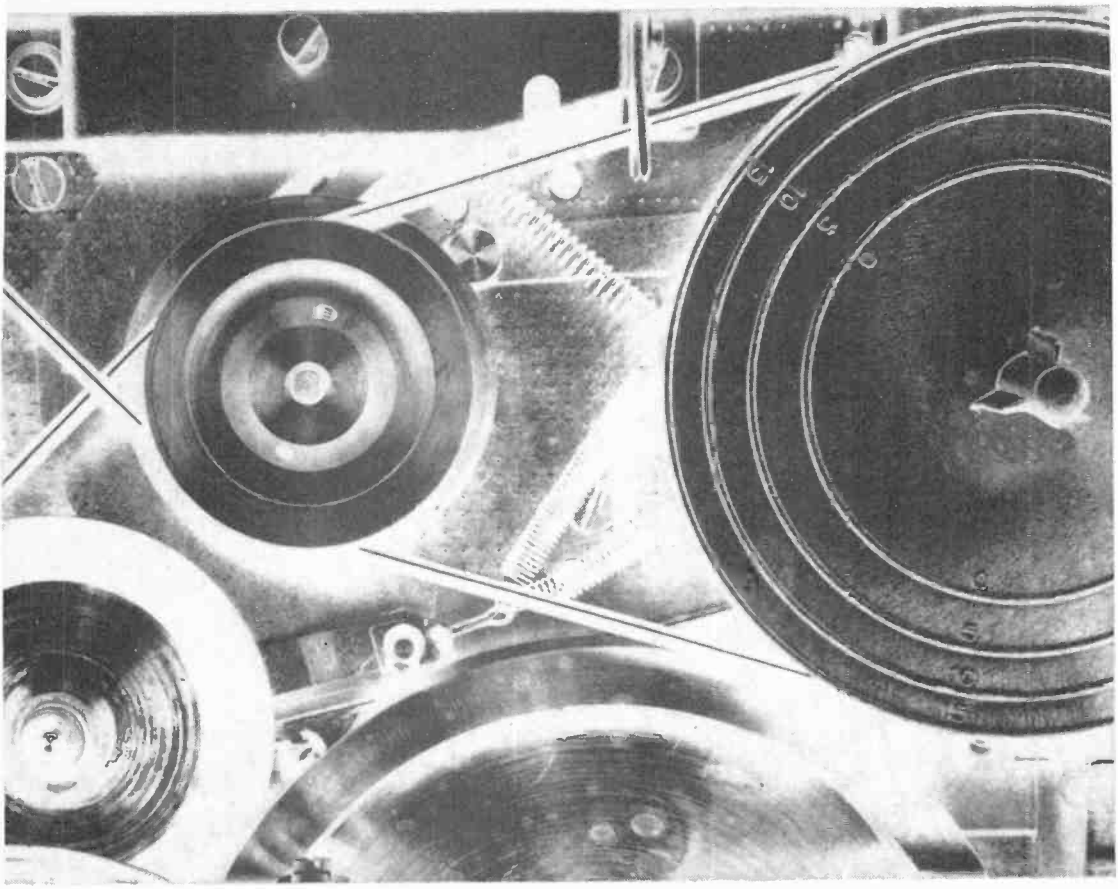
As is usual in the hi-fi field, however, solving these problems satisfactorily and economically isn't as easy as it might seem at first thought, and it has taken brilliant engineering to produce good tape recorders at a price most people can afford to pay.

Moving the Tape. Simply having the take-up reel pull the tape past the head would be an obvious way to move the tape. This method, however, would not work well because one revolution of a nearly empty reel would move the tape much more slowly than one revolution of a nearly full reel. It might be possible to devise a drive system that would revolve the take-up reel progressively slower as the tape piled up on it, but it would be very difficult for such a system to maintain a constant tape speed.

The universally accepted solution is to move the tape by pinching it between two rollers. A rubber pressure roller holds the tape firmly against a motor-driven revolving shaft, or capstan, and the tape moves at a constant speed. This is called "capstan drive."

After the tape passes the tape head, it has to be wound onto the take-up reel. The problem here is that the reel should turn fast when it is empty and more slowly as it begins to fill up. This can be arranged by driving the take-up reel with a slipping mechanism.

When the capstan delivers tape to an empty reel—at a speed of 7½ inches per second, let us say—an entire revolution may be necessary to take up this 7½ inches of tape. But as the reel begins to fill up, each complete revolution will take up more than 7½ inches of tape. The capstan, however, still delivers tape at the rate of only 7½



inches per second, and the tape begins to exert a greater pull on the take-up spool.

As the load increases, the drive begins to slip and full power is not communicated to the take-up reel. As a result, the take-up reel will turn at a steadily decreasing speed as it fills up, but it will always provide enough tension to take up the tape delivered by the capstan drive.

Shifting our attention to the tape supply system, we encounter the problem of maintaining constant tension on the tape as it is fed to the capstan. The tape must provide a constant load to the capstan. Most tape recorder designers handle this problem by using a slipping drive on the supply reel to provide tape tension.

By combining these three mechanical elements, we end up with a tape transport system like that shown in Fig. 1. There are three different forces in action: (1) the capstan drive pulling the tape past the heads, (2) the take-up reel winding up the tape as it comes from the capstan, and (3)

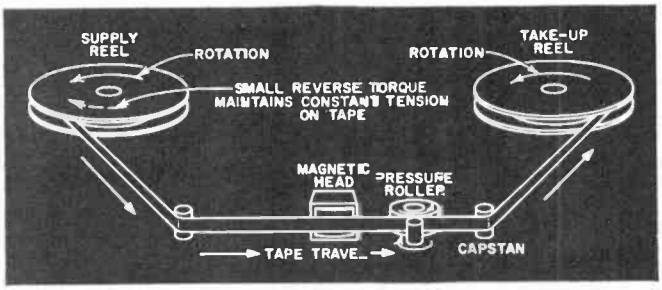
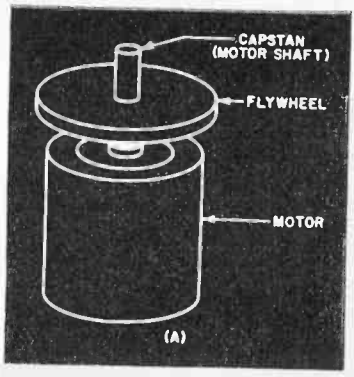
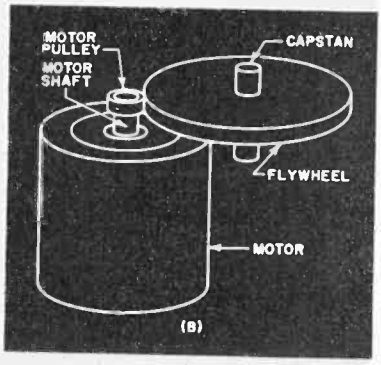
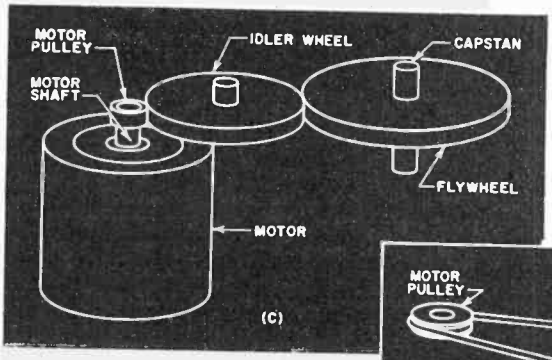
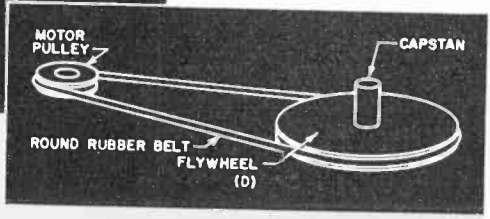


Fig. 1. Basic elements of a tape transport system are the capstan drive, tape take-up reel, and the tape supply reel.









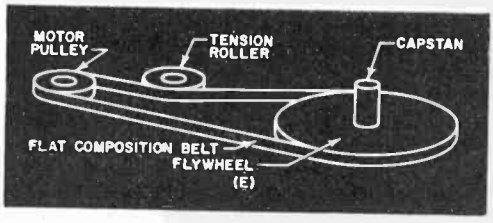


Fig. 2. Various types of capstan drive systems are direct drive (A), rim drive (B), idler wheel drive (C), round rubber belt drive (D), and flat composition belt drive (E).

Diagrams adapted from "Tape Recorder Manual, Vol. 3," copyright 1959 by Howard W. Sams

the supply reel feeding the tape to the capstan under constant tension.

As in disc recording, it is essential to maintain as constant a speed as possible, and ways of achieving speed regulation are generally similar to those used in record players. Speed regulation begins with the motor, and, other factors being equal, hysteresis motors are preferable to four-pole motors because their speed is independent of line-voltage fluctuations. Usually, a heavy flywheel in the drive system smooths out any remaining speed variations.

Capstan-Drive Systems. Capstan drives can be divided into four general categories: direct drive, rim drive, idler drive, and belt drive (see Fig. 2).

In the direct-drive system shown in Fig. 2(A), the motor shaft itself serves as the capstan, with the flywheel mounted directly on the shaft. Because there is no linkage of any kind between motor and capstan, the possibility of slippage, belt stretching, flat spots on idlers, etc., is minimized.

In the rim-drive system of Fig. 2(B), the flywheel is mounted on the capstan shaft and is driven by a pulley on the motor shaft. Usually the flywheel has a rubber tire on its rim and the motor pulley is metal, but occasionally this arrangement is reversed, with a rubber motor pulley driving a metal flywheel.

Idler drives interpose an idler wheel between the motor and the capstan flywheel, as diagramed in Fig. 2(C). The idler is usually mounted on a

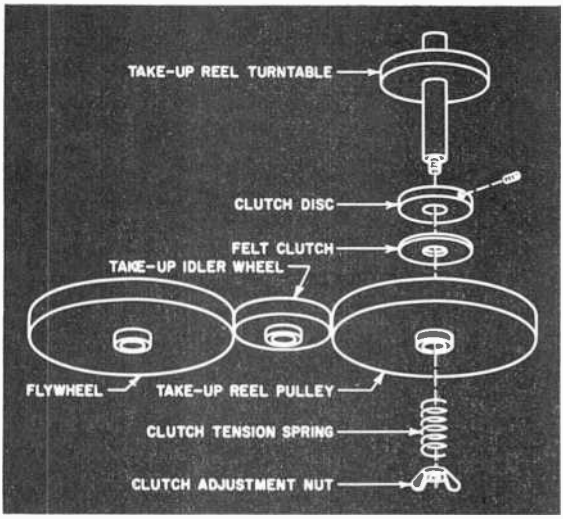
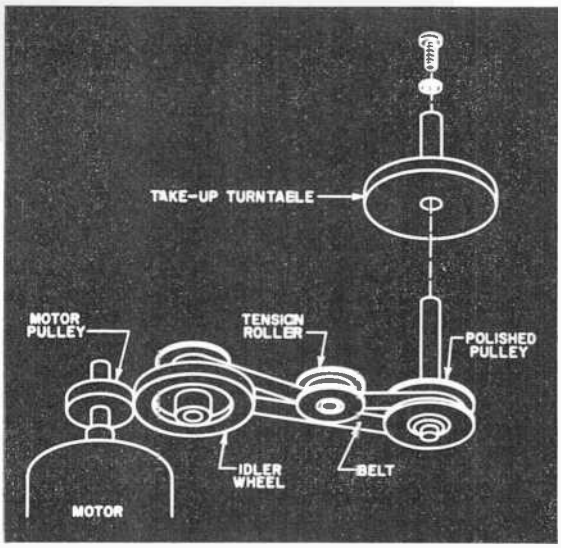


Fig. 3. Slipping-clutch drive system. The amount of slipping is determined by tightening or loosening the clutch adjustment nut.

Fig. 4. Slipping-belt method for achieving a slipping drive.



moveable plate and is held by a spring against the motor pulley and the capstan flywheel.

In belt drive, the motor shaft is coupled to the capstan by means of a continuous belt. To maintain constant tension, the belt may be elastic as in Fig. 2(D), or it may be a composition belt under tension by a roller as in Fig. 2(E).

Slipping Drives. Both the supply and take-up reels require slipping drives. There are two commonly used mechanical slipping drives: the clutch type, and the belt type. The slipping-clutch type is illustrated in Fig. 3. Here, the take-up reel turntable rests on the take-up pulley, and there is a felt disc between them which communicates the torque from the pulley to the turntable. The felt clutch provides direct drive from the pulley to the turntable as long as the load does not exceed a certain limit. But when this limit is reached, it will begin to slip and then the take-up turntable will receive only part of the torque and will turn more slowly. Adjustment of the point at which the felt disc begins to slip is made by tightening the nut at the bottom of the assembly.

The slipping-belt linkage is illustrated in Fig. 4. In this case, the take-up reel turntable is securely fastened to a pulley which has a highly polished surface. When the load on the take-up reel increases beyond a certain point, the belt begins to slip on the pulley, reducing the speed of the take-up turntable. An adjustable tension roller maintains the correct tension on the belt. Back-tension on the supply reel is supplied by similar slipping-clutch or slipping-belt systems.

Another way of providing a slipping drive is to use separate motors for the supply and take-up drives. This system is arranged so that the supply reel tends to revolve count-

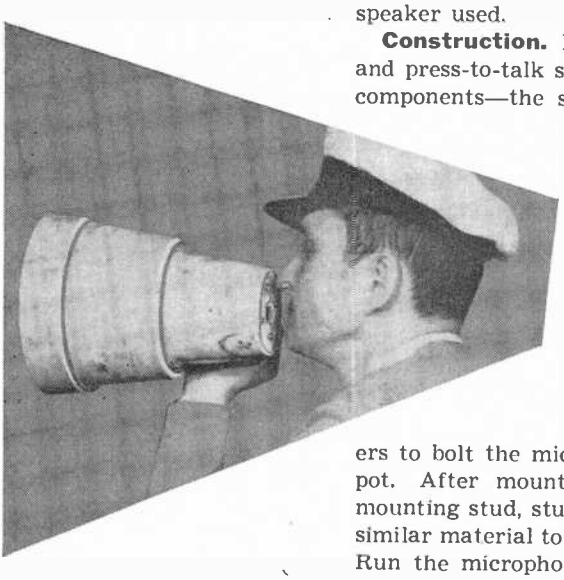
(*Continued on page* 112)

power megaphone

SUMMERTIME TRANSISTORIZED PROJECT by LOU GARNER

YOU CAN USE a power megaphone at many outdoor events. It's handy when boating, for example, or for calling the gang to chow at picnics and beach parties. And it's just the ticket for announcing umpires' decisions and scores at outdoor games or for gathering in lost souls who have wandered off in the woods.

The low-cost unit shown here can be built for under $15. Its megaphone-like housing consists of two plastic flower pots bolted together. Choose pots so that the top of the smaller rear unit fits within the bottom of the pot in front; the larger pot must be big enough to accommodate the speaker used.



Construction. Mount the microphone cartridge (*Mic.*) and press-to-talk switch *S1* in the smaller pot. All other components—the single-stage transistor amplifier, loudspeaker, and batteries—are mounted in the larger pot. Any standard carbon microphone cartridge will do, but it's best to choose a sensitive unit. The author's megaphone uses a mike picked up at a local surplus store for about three dollars. If you prefer a standard commercial unit, obtain a Shure Type R10 cartridge.

Use plastic foam rings or washers to bolt the microphone to the bottom of the smaller pot. After mounting the switch and the rear-handle mounting stud, stuff the smaller pot with plastic foam or similar material to cut down acoustic feedback and rattle. Run the microphone and switch leads through the hole in the bottom of the larger pot.

Choose a quality loudspeaker with as heavy a magnet as you can afford, and attach it to a circular piece of perforated Masonite with plastic foam rings or washers. Cut the Masonite to fit the larger flower pot; the holes in the Masonite should be large enough to serve as sound ports. Transistor *Q1* and bias resistor *R1* are mounted on a small aluminum chassis attached to the rear of the speaker; machine screws secure the battery holders to the rear of the larger flower pot.

Two different microphone connections are possible, depending on the individual characteristics of the cartridge. In either case, one microphone lead connects to the

transistor's base electrode and the other to either the −3- or −6-volt battery terminal as shown on the schematic. Try both, and use the connection delivering maximum output at minimum distortion. If you decide upon −3 volts, be sure to disconnect the lead between the microphone and the −6-volt terminal.

Operation. With wiring completed and checked, install the batteries, being certain to use fresh ones (a high-resistance cell can cut power output drastically). Take care to observe polarities: positive terminals on the battery holders can be identified with dabs of red fingernail polish.

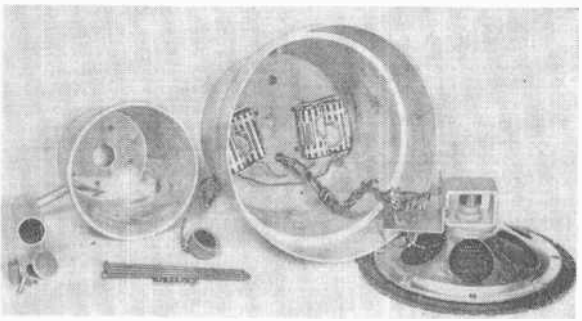
Hold the microphone close to your mouth, pointing the unit in the direction you wish to project your voice. Depress the push button and speak in a slightly-louder-than-normal voice. Release the button to turn the unit off.

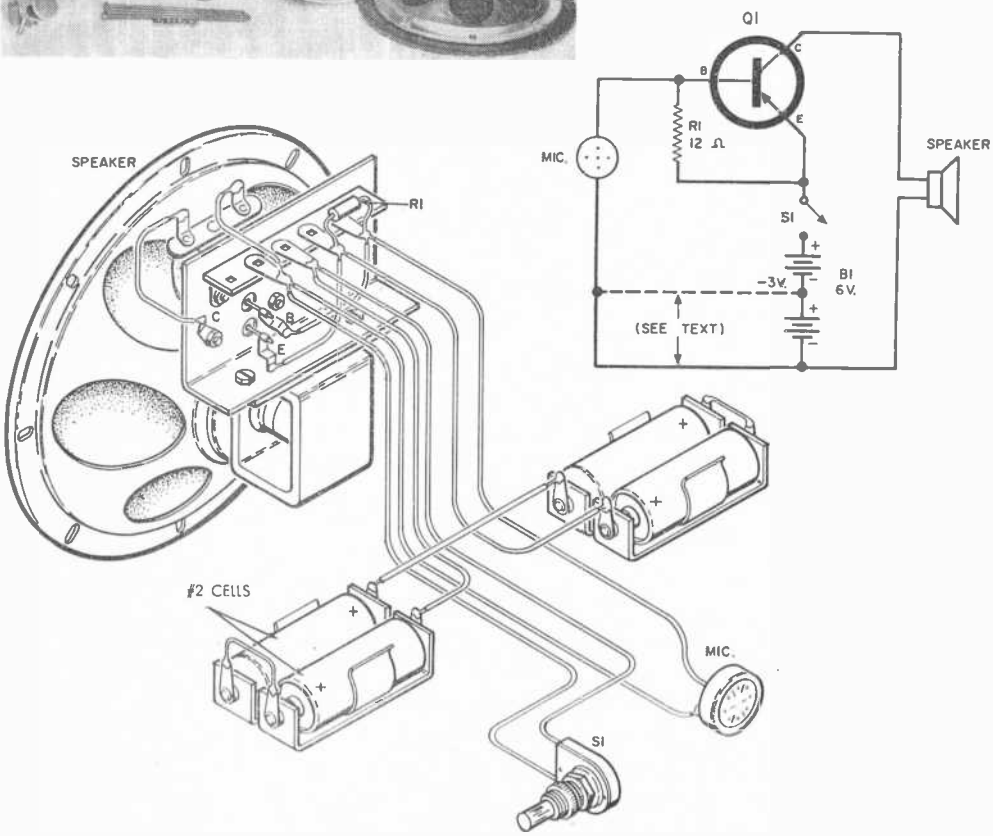
HOW IT WORKS

The megaphone is a single-stage common-emitter amplifier using a *p-n-p* power transistor. Audio input is supplied by the carbon microphone; the PM loudspeaker serving as a collector load is coupled directly to the transistor. Resistor *R1* stabilizes base bias; power is supplied by a 6-volt battery. The microphone is connected to either the −3- or −6-volt battery terminal, depending on the sensitivity of the mike used.

PARTS LIST

B1—6-volt battery (Four Burgess #2 cells in series)
Q1—2N255 transistor (CBS)
R1—12-ohm, ½-watt carbon resistor
S1—S.p.s.t. momentary-contact push-button switch
Mic.—Carbon microphone cartridge (see text)
2—Plastic flower pots (see text)
1—Small aluminum chassis (see text)
Spkr.—PM loudspeaker (see text)
Misc. perforated Masonite, handle, battery holders, terminal strip, etc.





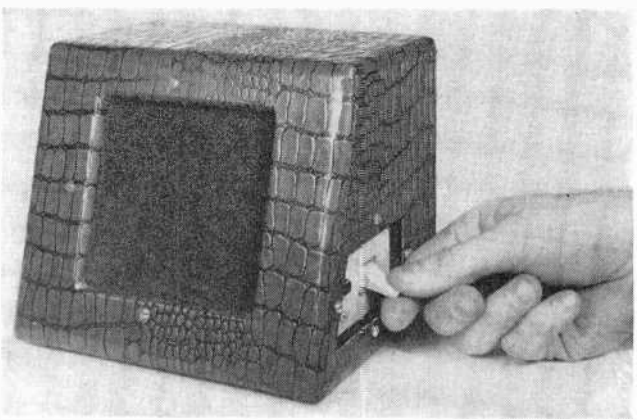
battery-powered intercom

SUMMERTIME TRANSISTORIZED PROJECT by LOU GARNER

CHANCES ARE you'll find dozens of uses for a two-station intercommunication system at your summer vacation spot. An intercom could be installed between the main lodge and the boathouse at a fishing camp, for example. At a hunting camp, it might provide communication between the lodge and the dog kennels. Or, in a simpler setup, it could be installed between any two cabins or tents.

Lack of a power line often restricts use of electronic equipment. But the intercom described here has no such limitations. Because it's fully transistorized, the unit needs only standard flashlight cells to operate.

The complete system consists of two stations connected together with two-conductor "zip-type" line cord. The remote station is simply a small PM loudspeaker mounted in a metal or wooden baffle. The master station



contains a similar loudspeaker, plus the system's amplifier, power supply, and operating controls.

Construction. Assemble the master unit in a small wall-type loudspeaker baffle equipped with button-type "bumper" feet. The PM loudspeaker and pair of dual-battery holders are attached to the baffle with machine screws and nuts.

Assemble the transistorized amplifier on a small "chassis" made up of aluminum and perforated Masonite. An all-aluminum chassis can be used if the transistor cases are insulated with mica washers. Chassis size, circuit

layout, and wiring are not critical, but care must be taken to observe all d.c. polarities. The model uses Lafayette SP-147 transistors, low-cost equivalents of the CBS 2N255 specified in the parts list on the next page.

Once assembled and checked, the amplifier chassis can be attached to the baffle with long sheet-metal screws. Cut out a piece of the baffle's side wall to permit access to on-off switch *S2* and talk-listen switch *S1*.

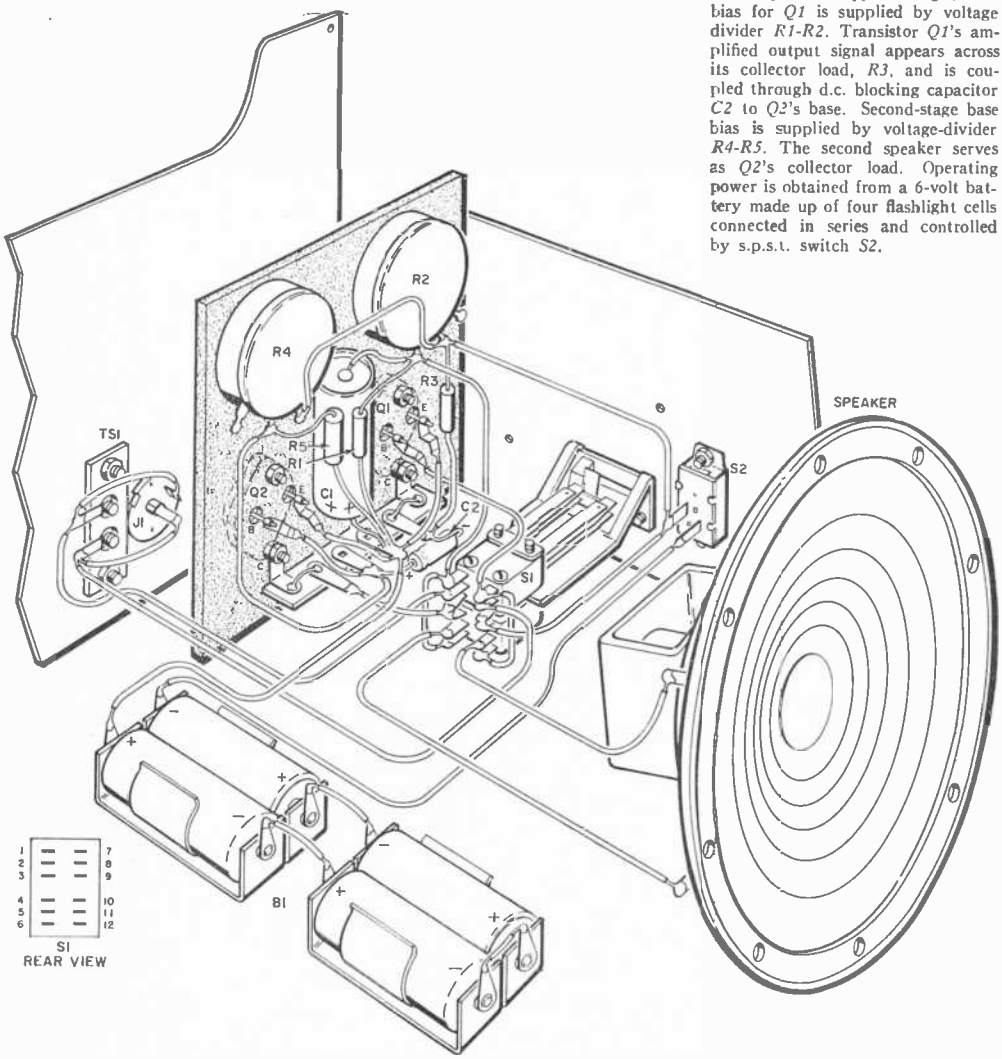
For connection to the remote station, dual outlets are provided—a conventional two-terminal screw-type strip, and a two-conductor jack (*J1*). These dual outlets are hooked up in parallel and permit use of the master station in both permanent and temporary installations. For temporary setups, the line from the remote station can be terminated in a plug matching the master station's jack.

Operation. After the wiring has been completed and checked for errors, install the four flashlight cells. You can use dabs of red fingernail polish to identify battery

HOW IT WORKS

The intercom is a two-stage resistance-coupled amplifier using *p-n-p* power transistors in the common-emitter arrangement. When *S1* is in its "talk" position, the master unit's built-in speaker serves as a microphone, with the amplifier driving the external remote speaker. Turning *S1* to "listen" reverses the speaker roles.

In operation, the input signal obtained from the speaker serving as a microphone is applied to *Q1;* base bias for *Q1* is supplied by voltage divider *R1-R2*. Transistor *Q1*'s amplified output signal appears across its collector load, *R3*, and is coupled through d.c. blocking capacitor *C2* to *Q2*'s base. Second-stage base bias is supplied by voltage-divider *R4-R5*. The second speaker serves as *Q2*'s collector load. Operating power is obtained from a 6-volt battery made up of four flashlight cells connected in series and controlled by s.p.s.t. switch *S2*.

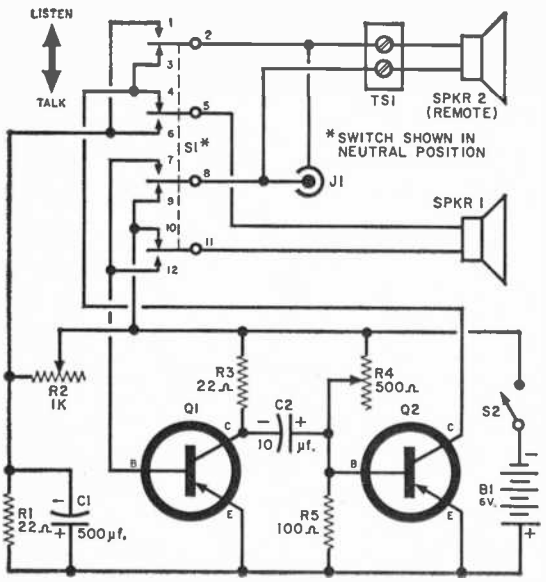


polarity in the holders. Connect the remote station with a length of line cord.

Next, turn *R2* and *R4* full on. Turn the unit on by closing *S2*, and turn *S1* to its "listen" position. Have a friend talk into the remote station speaker while you adjust *R2* and *R4* for maximum sensitivity and power output, respectively. Once these adjustments have been made, *R2* and *R4* can be left untouched unless one or both transistors are replaced.

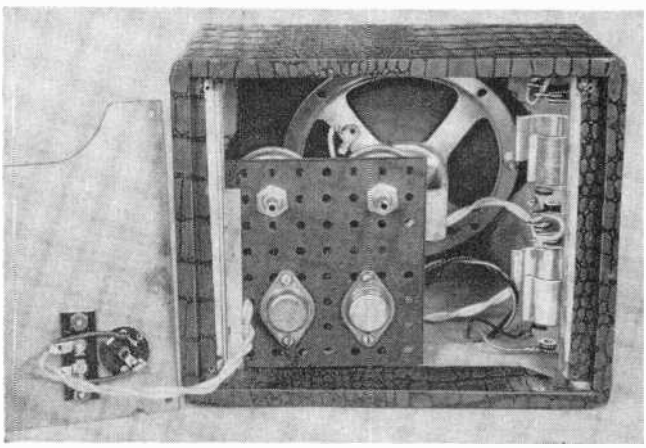
In normal use, *S1* is left in its "listen" position. This enables the person at the remote unit to answer without having to operate a switch or control.

You'll find that this simplified circuit has less sensitivity and power than most commercial intercoms. But the unit's performance will be satisfactory as long as background noise levels are not high.



PARTS LIST

B1—6-volt battery (four Burgess #2 cells in series)
C1—500-µf., 15-volt electrolytic capacitor
C2—10-µf., 15-volt electrolytic capacitor
J1—RCA-type phono jack
Q1, Q2—2N255 transistor (CBS or equivalent)
R1, R3—22-ohm, 1-watt resistor
R2—1000-ohm wire-wound potentiometer
R4—500-ohm wire-wound potentiometer
S1—4-p.d.t. spring-return lever switch (Lafayette SW-68 or equivalent)
S2—S.p.s.t. switch
TS1—Two-terminal screw-type terminal strip
Spkr. 1, Spkr. 2—5" PM loudspeaker, 3-4 ohm voice coil
1—Wall-type speaker baffle
1—Desk-type speaker baffle
1—Aluminum chassis (see text)
Misc. dual-cell battery holders, terminal strip, bumper tacks, wire, etc.



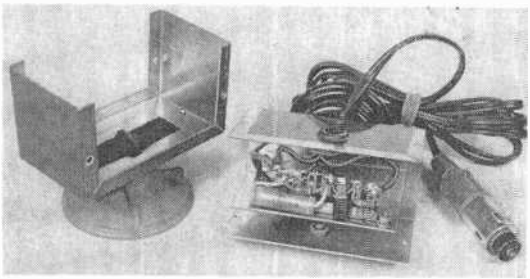
auto safety flasher

SUMMERTIME TRANSISTORIZED PROJECT by LOU GARNER

A SIMPLE engine breakdown or flat tire can turn from a minor inconvenience to a major tragedy if it occurs at night on an unlit highway. The parked car, even if driven off the highway onto the road's shoulder, can become a deadly target for other motorists.

Such danger can be minimized with this easily assembled safety flasher. Plugged into your car's cigarette-lighter receptacle, the device supplies a rapidly flashing bright-red light to warn approaching motorists. What's more, the unit's transistorized circuit requires so little current that the instrument can be left operating for hours—even overnight—without excessively draining your car's battery.

Construction. The circuitry is assembled on a small aluminum chassis which is in turn mounted inside an



aluminum Minibox. The chassis can be made from a discarded cookie sheet: simply cut out a small piece using a pair of tin snips or a hacksaw, then bend it to shape in a vise.

Take special care to observe all d.c. polarities when wiring. This applies not only to electrolytic capacitors *C1* and *C2*, but also to plug *P1*. Most American-made automobiles manufactured since 1955 have a negative ground, but you'd best check your car battery to determine whether its positive or negative terminal is grounded to the car frame. Wire *P1* accordingly.

Machine screws hold transistor *Q1* in place, with base

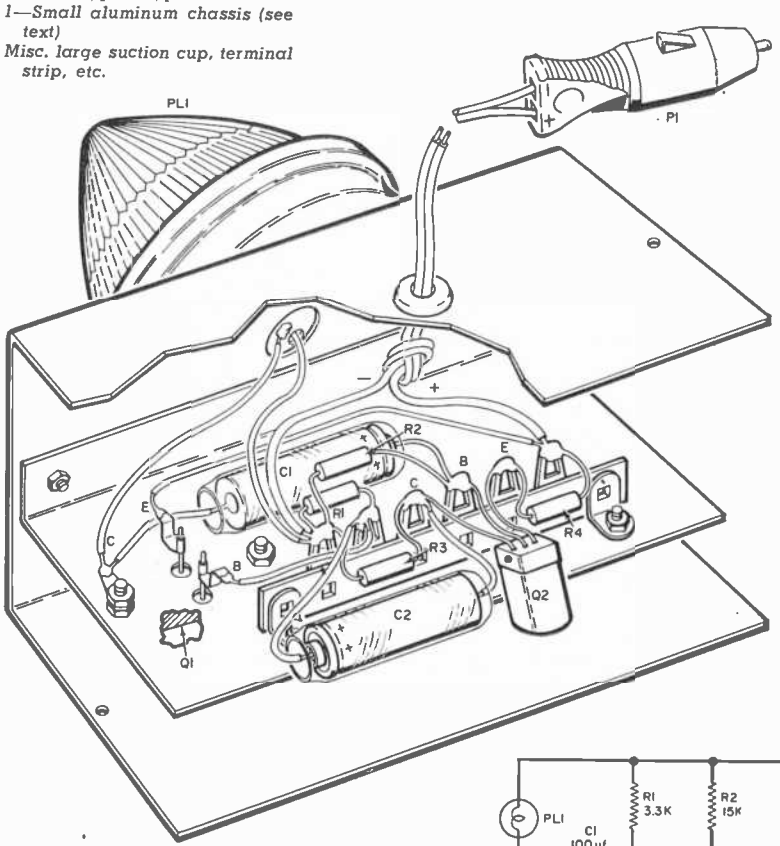
PARTS LIST

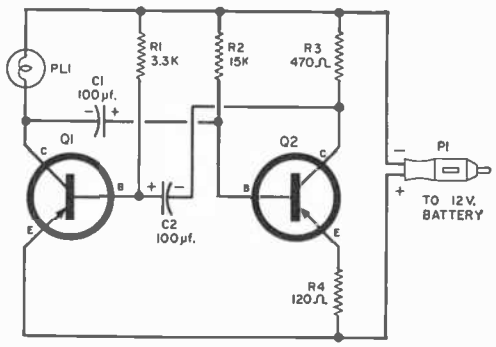
C1, C2—100-μf., 15-volt electrolytic capacitor
P1—Cigarette-lighter plug and cord (Mallory R675)
PL1—12-volt clearance-light assembly (Pathfinder 666P)
Q1—2N554 or 2N307 transistor
Q2—CK722 transistor
R1—3300 ohms — all resistors
R2—15,000 ohms — all resistors
R3—470 ohms — ½ watt
R4—120 ohms — ½ watt
1—4" x 2¼" x 2¼" Minibox
1—Small aluminum chassis (see text)
Misc. large suction cup, terminal strip, etc.

and emitter connections made with small clips. The smaller transistor, *Q2*, is soldered directly to the terminal strip which acts as a tie-point. Use care when installing *Q2* to avoid overheating. In soldering, grasp each lead with a pair of long-nose pliers between the point being soldered and the body of the transistor itself. The pliers serve as a heat-sink to conduct heat away from the transistor.

Operation. To use the completed unit, uncoil the power cord and attach the flasher to your car's body (a large suction cup on the bottom will hold the flasher on the car's top, hood, or rear deck). Remove the car's cigarette lighter and insert the flasher's power plug (*P1*) in its place.

If the flasher doesn't operate immediately, unplug it, wait a few seconds, then plug it in again.





HOW IT WORKS

The flasher is a collector-coupled multivibrator with a low repetition rate. In operation, transistor *Q1* conducts, supplying a signal which "cuts off" transistor *Q2*. After a period determined by the time constant of *R2-C1*, transistor *Q2* starts conducting, cutting off the first unit. After a period determined by the time constant of *R1-C2*, *Q1* repeats its cycle.

Current drawn by transistor *Q1* lights 12-volt bulb *PL1* which serves as *Q1*'s collector load. Since the heavy current flow is in relatively short pulses, the average current drain is quite low, assuring minimum drain on the car's battery.

transistorized

pocket receiver

SUMMERTIME TRANSISTORIZED PROJECT by LOU GARNER

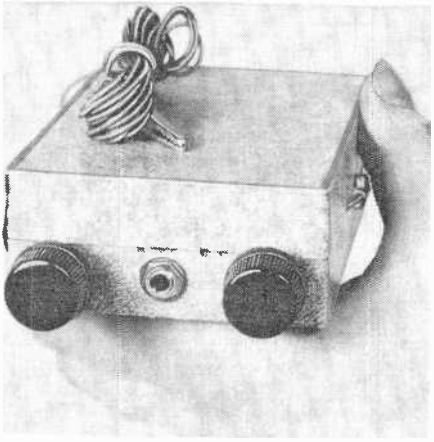
HERE'S a little receiver you can assemble in a single evening. It is an excellent construction project for the hobbyist who has "graduated" from the crystal set but isn't quite ready to tackle a superhet. The small size of the completed unit makes it especially attractive: the entire receiver is about as big as a package of king-size cigarettes.

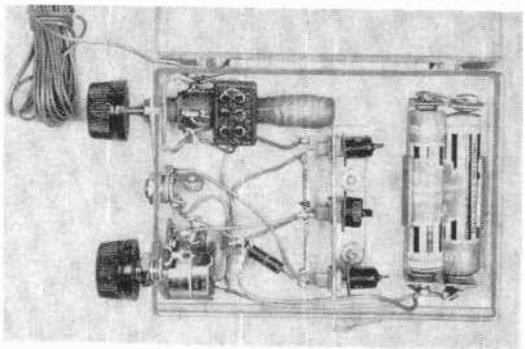
Although the radio lacks some of the features of commercial superheterodynes, its three-stage circuit has amazing sensitivity. You'll find that it will pick up most local stations within its tuning range with the short external antenna specified.

Construction. The receiver is housed in a small clear-plastic case. In the author's model, the case was given a finished appearance by applying a layer of self-adhering Contact plastic. But you can leave the case "as is," if you prefer, or finish it with a coat or two of enamel.

Small transistor sockets are mounted on a tiny "L-shaped" chassis cut from a scrap piece of aluminum. Operating power is supplied by a 3-volt power pack made up of two penlight cells in series. A standard battery holder is used for convenience in replacing batteries; positive terminals are identified with dabs of red fingernail polish.

Adjusting coil *L1*'s ferrite "slug" tunes the set. But since the variation in coil inductance is not adequate to cover the entire AM broadcast band (540-1600 kc.), a





compression-type, 45-380 μμf. capacitor (*C1*) is used to tune *L1* for best coverage of stations in your area. Simply set *C1* for optimum local-station pickup with *L1* in the middle of its range.

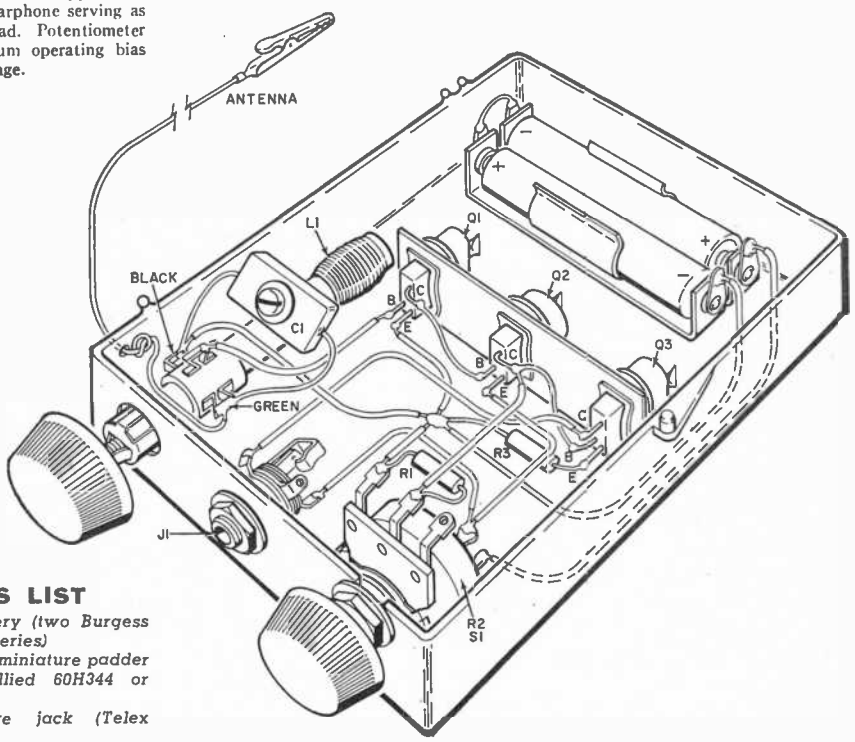
Attach a 6′ to 8′ flexible lead to *L1*'s green terminal to act as an external antenna. Solder a small alligator clip at the end so the lead can be clipped to a window screen or a longer antenna for reception of more distant stations.

Operation. Install the battery and the transistors, after trimming the transistor leads to about ¼″. Extend the antenna lead and connect a high-impedance (at least 2000-ohm) magnetic earphone to output jack *J1*.

Turn the set on and adjust *R2* until you hear a slight hissing in the earphones. Then tune in the desired station by adjusting *L1*'s slug; readjust *R2* for best volume. –30–

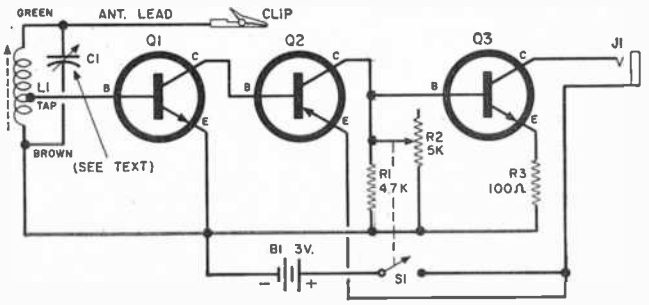
HOW IT WORKS

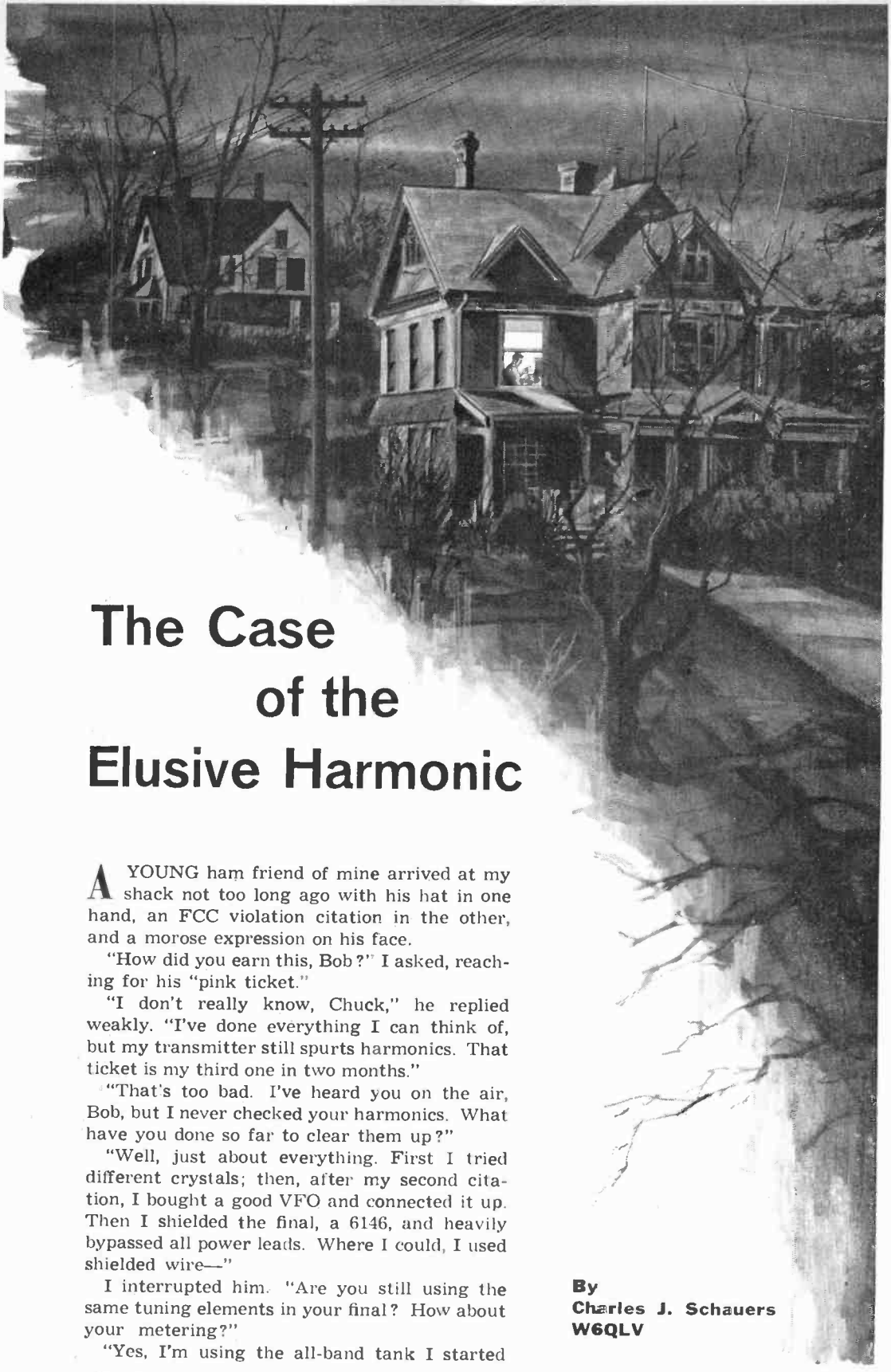
The receiver is basically a detector followed by two stages of audio amplification. All stages are direct-coupled through use of complementary *n-p-n* and *p-n-p* transistors; the common-emitter arrangement is employed in all three stages. First-stage transistor *Q1*, operated without base bias, detects the incoming r.f. signal selected by tuned circuit *L1-C1*. Transistors *Q2* and *Q3* amplify the signal for application to the magnetic earphone serving as *Q3*'s collector load. Potentiometer *R2* selects optimum operating bias for the output stage.



PARTS LIST

B1—3-volt battery (two Burgess #7 cells in series)
C1—45-380 μμf. miniature padder capacitor (Allied 60H344 or equivalent)
J1—Subminiature jack (Telex JPM-02)
L1—Ferrite antenna coil (Lafayette MS-299)
Q1, Q3—2N170 transistor
Q2—2N107 transistor
R1—4700-ohm, ½-watt resistor
R2—5000-ohm miniature potentiometer, with switch S1 (Lafayette VC-27)
R3—100-ohm, ½-watt resistor
S1—S.p.s.t. switch (part of R2)
1—Small aluminum chassis (see text)
1—3⅝″ x 2¾″ x 1 3/16″ (approx.) plastic box
1—High-impedance magnetic-type earphone (Lafayette MS-260 or equivalent)
Misc. battery holder, miniature knobs, alligator clip, etc.





The Case of the Elusive Harmonic

A YOUNG ham friend of mine arrived at my shack not too long ago with his hat in one hand, an FCC violation citation in the other, and a morose expression on his face.

"How did you earn this, Bob?" I asked, reaching for his "pink ticket."

"I don't really know, Chuck," he replied weakly. "I've done everything I can think of, but my transmitter still spurts harmonics. That ticket is my third one in two months."

"That's too bad. I've heard you on the air, Bob, but I never checked your harmonics. What have you done so far to clear them up?"

"Well, just about everything. First I tried different crystals; then, after my second citation, I bought a good VFO and connected it up. Then I shielded the final, a 6146, and heavily bypassed all power leads. Where I could, I used shielded wire—"

I interrupted him. "Are you still using the same tuning elements in your final? How about your metering?"

"Yes, I'm using the all-band tank I started

By
Charles J. Schauers
W6QLV

with and I do have a final plate meter. . . ."

"Go on," I urged.

"So, after working over the whole transmitter, I thought I had it whipped—but then comes this third ticket. I guess I forgot something when I put the thing together."

"I guess we'd better take a run over to your house and have a look at the monster. I'll grab my frequency meter, volt-ohmmeter and a few pet tools, and we'll take off."

"That will be fine," he said with a wide smile. "I hope we can fix it!"

"We will," I replied.

WHEN we arrived at Bob's home, he quickly led me to the room where he had installed his station.

"Got a diagram of the transmitter?" I asked.

"Yes, but it's not drawn too good."

This was an understatement!

"My goodness, you certainly have done a lot of changing. How come you didn't draw a new diagram incorporating each change?" I asked, carefully picking my way through the scrawl.

Embarrassed, he quickly produced another sheet of paper, a ball point pen, and a ruler. We sat down at his desk, deciphered the nearly illegible mess, and came up with a clear diagram. Basically, there did not seem to be much wrong.

With VOM in hand, we carefully checked all voltages. The screen voltage on the final 6146 was 300 volts—somewhat too high. Then I connected a 75-watt light bulb to the final output and asked Bob to show me how he tuned the rig.

He set his VFO to 7187 kc., flipped the transmitter's plate switch on, and began dipping the final.

"Hold it!" I said. "How about your final grid current—where's the meter for measuring it and your tune-operate switch?"

"Don't use any," Bob replied.

"Well, you must have a grid current meter if you want to tune the set properly."

Bob opened a drawer and produced an 0-150 milliammeter and a s.p.d.t. switch.

"Meter's too big," I said, "Do you have one with an 0-10 scale?"

He went further into the same drawer and came up with an 0-15.

"Good, we're in business. Now how about an r.f. choke—about 2.5 millihenries?"

Bob tried another drawer. After rummaging through it for a while, he finally pulled out a choke and handed it to me. I connected it into the final grid circuit temporarily, and again turned on the transmitter. The meter needle danced up to 12 mils!

Immediately switching the set off, I turned to Bob.

"You've been operating like this?" I asked in amazement.

"Yes, what's wrong?" he countered.

"Wrong? Boy, you have enough drive here for three 6146's!"

His face fell.

"It's a wonder that 6146 is still alive," I said. "I'll bet its grid is cooked good."

"I have a spare tube," he offered.

"Let's leave the old one in until we finish our tests here."

"NOW what do we do?" Bob asked.

"First, we install a 50,000-ohm wirewound pot. Got one?"

Going to a converted bookcase in the corner of the room, Bob pulled out a box labeled "Pots." He took out one marked "100K."

"This too big?"

"I'd rather have a 50K if you can find one," I replied.

A few minutes later he looked up beaming, a 50K wire-wound pot in his hand. I installed it in the screen circuit of the 6U8, turned on the set, and adjusted the drive for 2.5 ma. (See Fig. 1.)

"What we should do is install a clamp tube in the screen circuit of the 6146," I remarked, "but we'll worry about that later."

"I thought of that," Bob said, "but I didn't think it was necessary as long as the drive holds up."

"We'll change the screen resistor in the 6146 and then check the final tuning again."

As Bob tuned the final and the light bulb indicator came up to full brilliance, I said: "Didn't you notice two dips as you dipped the final?"

"No," he replied, a little bewildered.

"I think I noticed two dips; try it again," I told him.

Going through the tuning procedure again (after checking his drive), he did notice two distinct dips.

"Well, I'll be. . . ."

"*I'm* not surprised," I said. "With that so-called all-band tank you have in there, you're bound to have two dips; and I'll bet

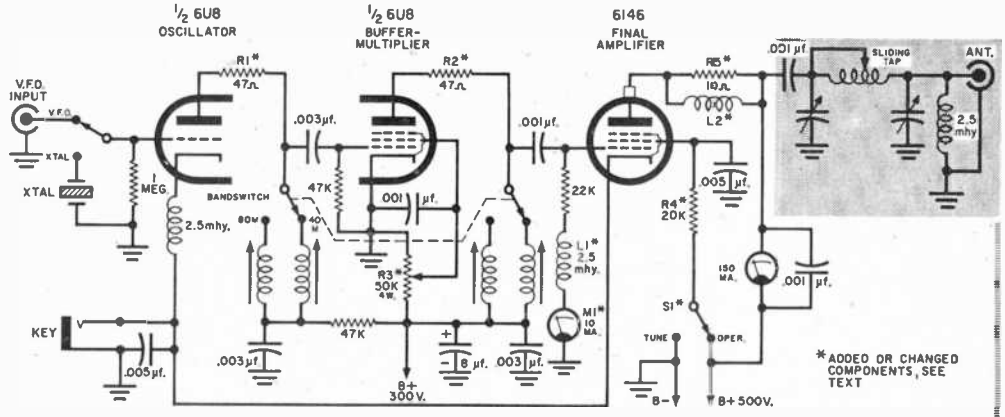


Fig. 1. Resistors R1, R2, R5, and choke L2 added to circuit of typical transmitter eliminate parasitic oscillations; increasing the value of R4 reduces screen voltage to proper value. Final tank circuit (shaded area) is modified as described in text.

Added or Changed Parts

L1—2.5-millihenry choke
L2—6½ turns of #18 enamel wire-wound on R5
M1—0-10 ma. meter
R1, R2—47-ohm, ½-watt resistor
R3—50,000-ohm, 4-watt potentiometer
R4—20,000-ohm, 10-watt wire-wound resistor
R5—10-ohm, 1-watt carbon resistor (see L2)
S1—S.p.d.t. switch

the main reason for your harmonics is that you've been dipping on the second dip. But let's warm up the frequency meter and give it a proper check."

While we waited for the frequency meter to warm up, we talked a little.

"This harmonic business is tricky," I commented. "Many factors in transmitter design control it. It isn't something you can take lightly. When we get through with the transmitter, we'll check your antenna."

"You mean an antenna can make harmonics, too?" Bob asked.

"An antenna doesn't 'make' harmonics; it just radiates those that are fed to it," I replied. "Of course, a 'single-band' type of antenna, if installed properly, is the best guarantee against antenna harmonic radiation. But when you use a so-called all-band antenna, and use too much grid drive and an improperly designed all-band final tank which is tuned incorrectly, you'll have harmonics so strong they're liable to be heard in Australia! And you more than likely will cause a lot of TVI."

Bob's face took on a serious look. "Gosh, no wonder I got three tickets."

WHEN the meter had warmed up I switched it to "Absorption." In this position, a tuned circuit (for 7 mc.) is connected in series with a diode and an attenuated microammeter. (See Fig. 2.)

I turned on the transmitter and tuned it. Then, with the frequency meter, I checked for the fundamental at 7187 kc. The meter needle swung up to 80. This was at the first dip of the final tuning capacitor. Then I swung the dial to the second dip and the meter read around 35. I plugged a 21-mc. coil in the frequency meter and looked for the third harmonic at 21.540 kc. The meter needle moved up to 70—indicating a terrific third harmonic.

Returning to the first dip, I rechecked for the third harmonic—the meter read around 9. Then I rechecked the fundamental at this dip—the meter was back to 80 again.

"Bob, the harmonics generated on the first dip are not too bad, but with the second dip of your final the harmonics are stronger than your fundamental! This is

(*Continued on page* 109)

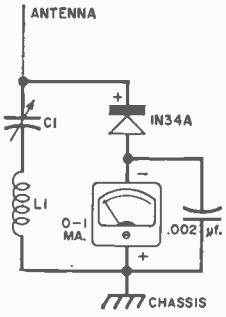


Fig. 2. Sensitive absorption frequency meter uses 1-ma. meter indicator. A short antenna is attached for field strength measurements. See article on "Simple R.F. Meter" in October 1958 issue of Popular Electronics for values of L1 and C1.

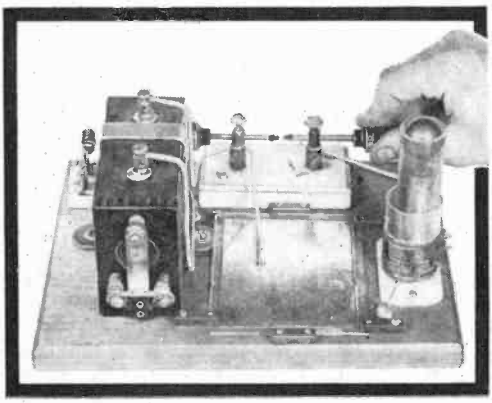
TESLA'S Trickery

Famed inventor Nikola Tesla liked to startle friends with his own brand of lightning. Build this tiny Tesla coil and you, too, can be an electronic trickster

By KENNETH RICHARDSON

NIKOLA TESLA, father of artificial lightning, often produced 48'-long lightning bolts in his laboratory. He enjoyed demonstrating such pyrotechnics to unsuspecting guests visiting his workshop. The exhibitions never failed to fill his guests with so much awe that they had an instantaneous urge to make for the nearest exit and the safety of the out-of-doors.

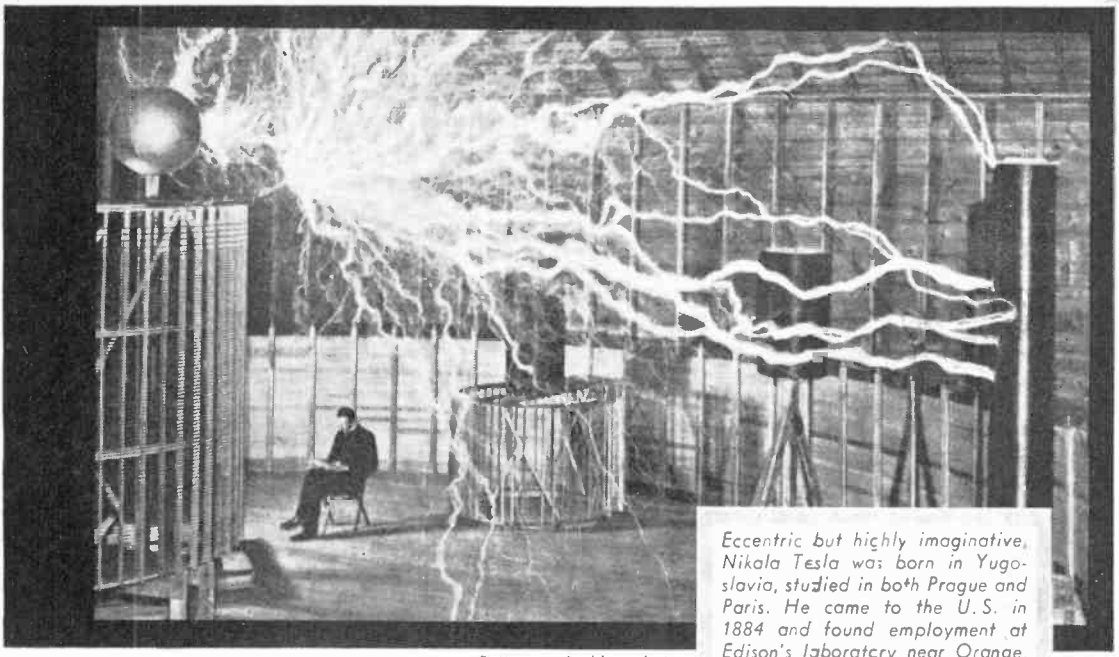
You can reproduce Tesla's feats on a smaller scale—and experiment with 20,000 volts—by building this simple Tesla coil. You'll amaze your friends with its eerie purple glow and the multitude of tricks you'll be able to perform. The Tesla coil has practical applications, too—you can use it for testing the vacuum in radio tubes, for instance.



This miniature unit costs about ten dollars to build—even less if you have a well-stocked junk box. Three parts must be homemade: the glass-plate capacitor (*C1*), the spark gap (*SGP1*), and the Tesla transformer windings (*L1* and *L2*). All other parts are standard except the Ford spark coil (*T1*) which is available from Polk's Model Craft Hobbies, 314 Fifth Ave., New York 1, N. Y., for $5.25, prepaid. Auto ignition coil *T2*, auto radio vibrator *VB1*, and capacitor *C2* can be used in place of the spark coil as shown on the schematic diagram (page 76).

Construction. Assemble the parts on a plywood baseboard or a kitchen cutting board 8½" x 12". Attach a banana jack to the baseboard in the center of the Tesla primary so that it can be connected to the Tesla secondary. Use No. 14 insulated wire for interconnecting wiring.

Capacitor *C1* can be made from a 4" x 5" piece of glass 1/16" thick. Cement pieces of aluminum foil to both sides of the glass, using either quick-drying clear lacquer or coil dope. The foil should be about 3¼" x 4¼" in order to leave a margin of ⅜" around the glass plate.



Bettmann Archive photo

Eccentric but highly imaginative, Nikola Tesla was born in Yugoslavia, studied in both Prague and Paris. He came to the U.S. in 1884 and found employment at Edison's laboratory near Orange, N. J. Shortly afterwards, he opened his own laboratory in New York City. Among the first to find an application for alternating current, Tesla patented the induction motor in 1888. Later, his ideas helped make the Niagara Falls power project possible. He also developed new forms of dynamos, transformers, induction coils, capacitors, arc and incandescent lamps, and other electrical devices. So striking was Tesla's effect on the electrical world that his 80th birthday in 1936 was celebrated with forums and meetings throughout Europe.

Spark gap *SGP1* consists of two metal rods held in binding posts so that the distance between the rod ends can be adjusted. Mount the spark gap on a 2" x 4" x ½" plastic or porcelain base.

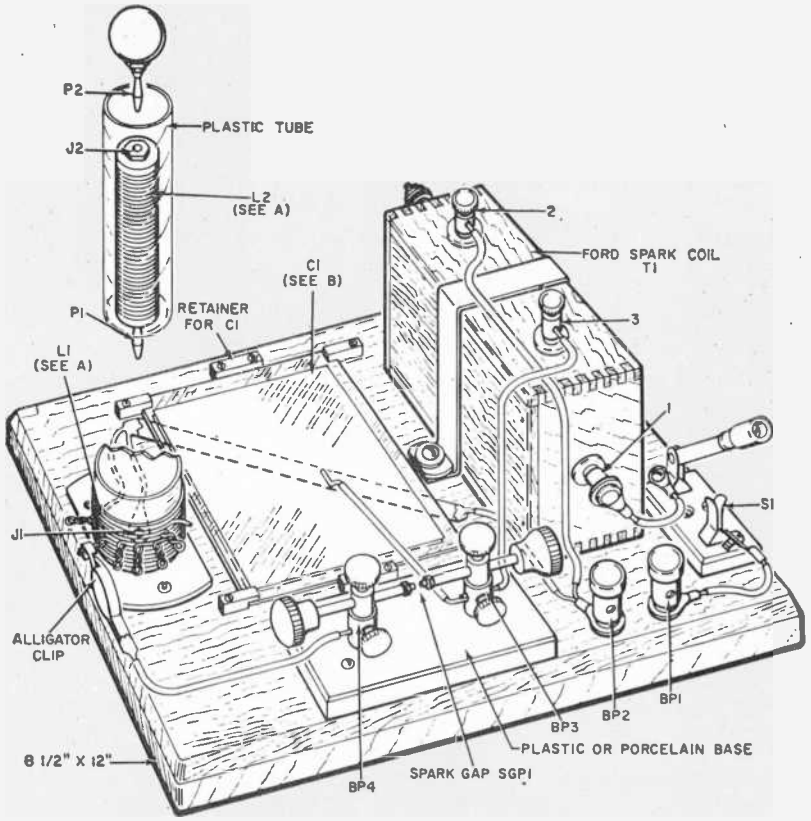
The Tesla transformer itself is made up of two windings. The primary is wound on a tube which is then cemented to the baseboard. The secondary is wound on another tube and is constructed so that it can be plugged in and out of the primary. This makes it possible to experiment with various secondary windings at will.

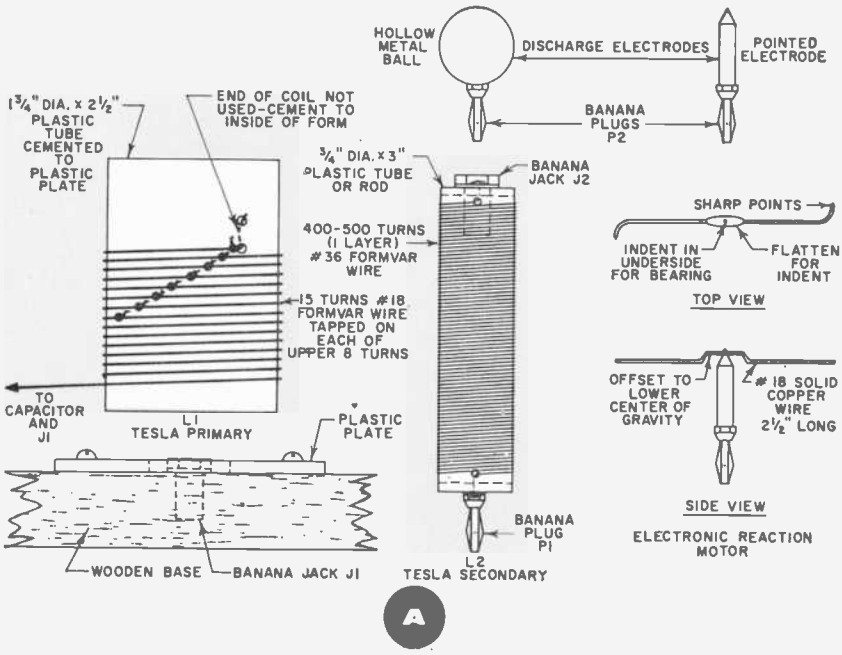
For the Tesla primary, wind fifteen turns of No. 18 Formvar enameled copper wire on a plastic or Bakelite tube about 1¾" in diameter and 2½" long. A cylindrical plastic jar or pill bottle can also be used. Start winding near the bottom end of the tube. Space the turns from each other by simultaneously winding a string of about the same diameter as the wire between each turn. The upper eight turns should each be wound with a projecting twist; the twists should be staggered around the tube as shown. To keep the wire and string in place, paint or spray the coil with clear quick-drying lacquer or coil dope.

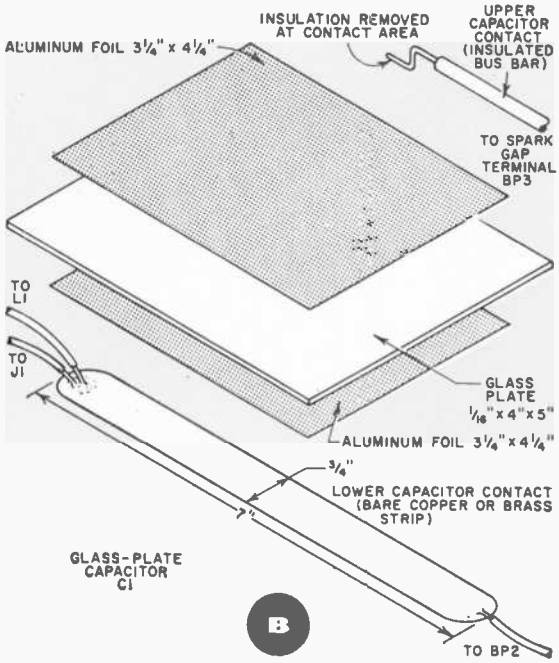
Obtain a plastic tube or cylindrical plastic pill bottle about ¾" in diameter and at least 3" in length for the Tesla secondary. Close the tube ends with plastic discs drilled for banana plugs and cut to fit the tube snugly. Attach plug *P1* to the bottom disc and jack *J1* to the top disc and cement in place.

The Tesla secondary should be wound closely in one layer consisting of 400 to 500 turns of No. 36 Formvar wire spaced to fit on 2½" of the tube. Solder the wire ends to *J1* and *P1* and cement the winding in place. Slip a 1"-i.d. plastic tube around *L2* as shown in the pictorial to prevent corona discharge from *L2*'s sides.

The power supply for the unit can consist of four No. 6 dry cells in series, or a 6-volt "hot-shot" battery, or any 6-volt storage battery. Or, instead of a battery, a 10- to 12-volt transformer operating from







Wiring the unit is simple once components are assembled on 8½" x 12" breadboard (see pictorial, opposite page). Detail "A" (below the pictorial) gives data on the Tesla transformer primary and secondary windings L1 and L2. Detail "B" (left) shows how to construct glass-plate capacitor C1. Wiring is point-to-point, using No. 14 insulated hookup wire.

PARTS LIST

BP1, BP2, BP3, BP4—Screw- or pressure-type binding post
*C1—Glass-plate capacitor **
C2—0.1-μf., 1000-volt capacitor (optional)
J1, J2—Banana jack
*L1, L2—Tesla transformer winding **
P1, P2—Banana plug
S1—Knife switch
*SGP1—Spark gap **
T1—Ford (Model T) spark coil
T2—6-volt auto ignition coil (optional)
VB1—6-volt auto radio vibrator (Lafayette MS-14 or equivalent—optional)
*1—4" x 5" x 1/16" glass plate **
1—8½" x 12" breadboard
*1—6-volt battery or 10-12 volt a.c. power supply **
Misc. plastic tubing, Nos. 18 and 36 Formvar wire, No. 14 hookup wire, aluminum foil, alligator clip, binding posts for T1, etc.*

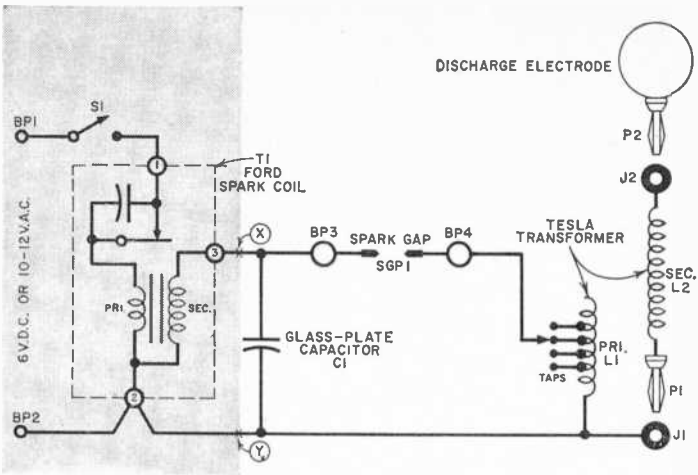
** See text for details*

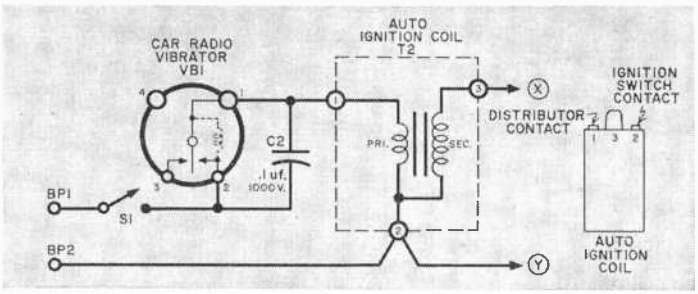
the 117-volt a.c. line can be used—a large chimes transformer is ideal. The higher voltage is needed for a.c. operation to overcome *T1*'s primary impedance. To make connections to *T1* more easily, solder three binding posts to *T1*'s terminals (1, 2, and 3) as shown.

Adjustment. With the wiring completed, plug the Tesla secondary (*L2*) into jack *J1* as is shown on the pictorial diagram. Adjust the length of the spark gap (*SGP1*) to about 1/16" to ⅛". Then connect the alligator clip from *BP4* to one of *L1*'s taps. Be sure that the upper wire on glass-plate capacitor *C1* is making good electrical contact; bend the wire if necessary. Open switch *S1* and connect *BP1* or *BP2* to an a.c. or d.c. supply.

Now close switch *S1*. A steady stream of brilliant crackling sparks should appear at spark coil *T1* and spark gap *SGP1*. If there is no sparking at *SGP1*, adjust its spacing to about 1/32". Be careful not to touch the spark gap or capacitor terminals —you'll get a nasty but harmless shock if you do. And you'd best keep small fry at a safe distance.

Hold a piece of metal close to the Tesla discharge electrode. You should see a small discharge taking place, perhaps ¼" long. The discharge can be seen best if room lighting is subdued or extinguished entirely. To adjust for maximum power, turn the unit off and move the clip up or down turn by turn on primary winding *L1*, testing after each adjustment. You'll eventually find the optimum position for the clip. When the unit is working properly, sparks should leap a distance of about an inch or





Spark coil T1 can be replaced with vibrator and ignition coil combination if desired. Parts required for vibrator supply appear as optional items in parts list; use alternate shaded schematic at lower left.

HOW IT WORKS

The high-voltage discharge at the output of the Tesla coil is the result of two step-up transformers cascaded so that the output of the first is stepped up again by the second. Automobile spark coil *T1* serves as the first transformer. The vibrator in the primary circuit interrupts the d.c. input and induces a very high voltage in the secondary. Operation is essentially the same with a 60-cps a.c. input.

The second transformer is the Tesla transformer (*L1, L2*). In this transformer, the spark gap serves the same general function as the vibrator in the primary of *T1*, and it also converts the output of *T1* into extremely jagged pulses, rich in harmonics throughout the r.f. region. A narrow band of r.f. is selected by tuned circuit *L1-C1* and stepped up by the action of the Tesla transformer. The very high r.f. voltage appears across *L2*.

an inch and a half to a bare finger or to a piece of metal held in the hand.

Operation. For best results, place the unit in a pitch-dark room with the spectators gathered closely around. Close switch *S1* and you'll see a beautiful corona discharge from the high-voltage electrode. The corona is caused by ionization of the surrounding air due to the high-voltage, high-frequency discharge. After a few moments you'll notice a pungent odor around the unit; this indicates formation of ozone, a form of oxygen generated by some commercial air purifiers.

Now hold a small fluorescent or neon lamp near the discharge electrode. It will start glowing even when several inches away. Wave it rapidly and you'll see a series of flashes in the lamp, one for each of the sparks occurring across the spark gap. Shield the spark gap if its light interferes with viewing the discharge.

Try holding the glass part of an ordinary clear-glass 117-volt light bulb in your hand while touching the metal base to the discharge electrode. Lightning-like (but harmless) sparks will jump from the filament to your fingers. Also, a striking blue or lavender-colored glow will appear inside the lamp due to its nitrogen content. Radio tubes will glow blue if they are gassy; neon lamps will also light.

You can build a tiny "motor" that will spin at high speed when mounted on the pointed discharge electrode (see Detail A). It reacts mechanically to the discharge from the sharp points on the rotor (the discharge creates a sort of electronic "wind").

—30—

INFRARED HEATER

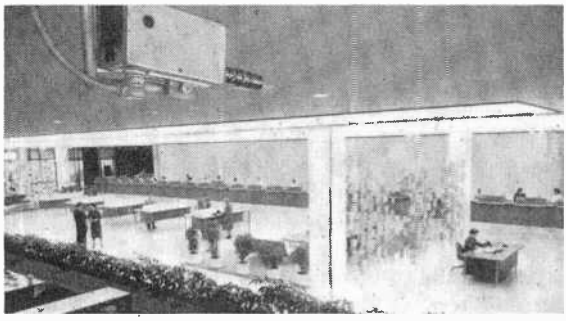
Keeping warm in the snow is this West German miss, Marion Liebig, who was Miss Hesse of 1959. The artificial sunshine of an infrared lamp makes her comfortable while a shivering bystander looks on. The lamp is powered by bottled gas. (Wide World photo)

HEART TRIGGER

Roy Smith, a 77-year-old retired coal miner, owes his life to an electronic device. The battery-powered unit, which he wears strapped to his chest, puts out pulses that signal his heart, and tell it when to beat. (Wide World photo)

TV GUARDS BANK

Bank robbers will find themselves on television if they try to hold up the First National Bank of Miami. A closed-circuit system allows a single guard to monitor seven TV cameras which cover strategic areas in the bank. In addition, guards on the banking floor are equipped with miniaturized portable two-way radios. The electronic equipment is manufactured by RCA.

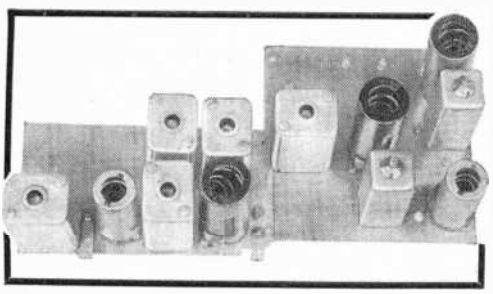


On the Citizens Band

By TOM KNEITEL, 2W1965

DO YOU have the "super-regenerative blues?" Does someone on channel 11 "swamp you out" when you're listening on channel 7? If you use a Heath CB-1, Irv Megeff, 2W1377, of Essco (58 Walker St., New York 13, N. Y.) has solved your problem. Irv has whipped up a completely new receiver for the popular Heath unit, one of the most widely used transceivers.

Irv's solution is a dual-conversion superhet (less power supply) that actually replaces the receiver part of the CB-1. The whole thing is so small that it fits *inside* the CB-1 cabinet. It's made up of a 6BA6 r.f. stage, a 6AQ8 first oscillator-mixer with a bandpass filter, a 6AN8 second oscillator-



mixer, a 6BA6 second i.f. at 455 kc., and a 12AU7 infinite-impedance second detector and a.v.c. circuit.

Powered from the CB-1 power supply, the new receiver feeds into the audio circuits and speaker. It takes about 30 minutes to install—there are just a few holes to drill plus a couple of wires to connect. Drop Irv a card for full details.

A number of inquiries have been received regarding the Class A, B, and C Citizens Radio Services—asking what they are and why we don't cover them here.

Class A stations operate in the u.h.f. 460-mc. band. They are almost exclusively used by commercial outfits, and are assigned one specific frequency for operation. The equipment is allowed to run 60 watts input but is very expensive (about $600 per transceiver, plus $100 for the base-station antenna).

Class B is the grandfather of Class D, except it never really matured. "B" stations run 5 watts input only on 465 mc. and, as a rule, are limited to line-of-sight. Because of the short communicating distances possible, there was never much public interest generated in Class B.

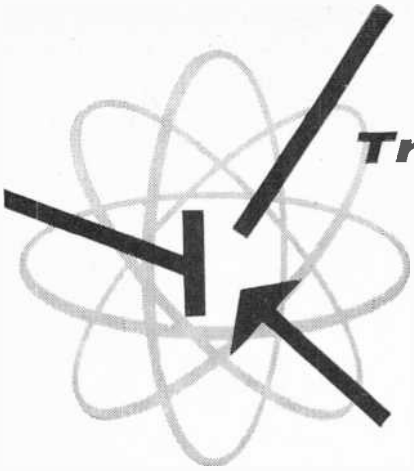
Class C stations are for radio-control only. As there isn't too much information available about Class A and B operations, and Class C is covered in POP'tronics' R/C construction projects, we don't devote space to these three services on a regular basis in this column.

There's always a character in the crowd who makes his own rules, though. For instance, we recently heard three Class D stations operating on 26.995 mc., one of the five 11-meter channels set aside for Class C R/C stations. Two more stations were heard on 27.145 mc., another "C" channel. Obviously, such operators have devised their own solution to the crowded Class D channel problem. Don't play this game. Properly operated Class D equipment will provide good communications on the legal frequencies.

With vacation-planning time upon us, we pass along the following advice for mobile CB'ers.

If you plan on motoring through Canada and utilizing your CB transceiver for emergency use, you'd better change your plans. The Department of Transport (Canada's FCC) has advised us that because 11 meters is used by hams in Canada it is unavailable for use by visiting CB'ers.

Mexico has better prospects. But you'll have to send the Mexican Government a photostat of your car ownership papers, a 'stat of your FCC license, and—last but not least—$100. In exchange, you'll receive a temporary Mexican license and Mexican call letters (XEØ-prefix). Further information and forms may be obtained from Direccion General de Telecommunicaciones, Mexico D.F., Mexico. —30—



Transistor Topics

By LOU GARNER

RECENT COUNTS indicate that there are close to 3000 different semiconductor diodes and rectifiers, and between 1500 and 2000 different transistors now offered by major semiconductor manufacturers. New types are being introduced on an almost day-to-day basis.

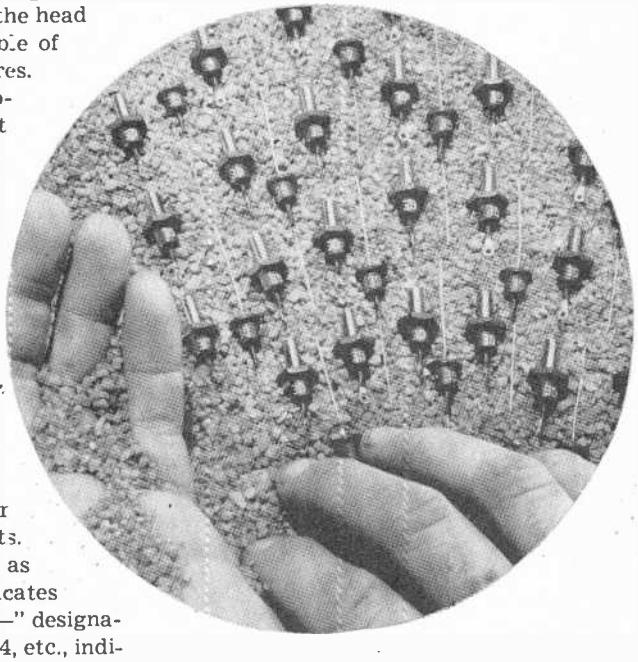
Physically, the diode types range from tiny units not much larger than the head of a pin to giant rectifiers capable of handling hundreds of amperes. Transistors vary in size from subminiature units so small that dozens can be fitted into a thimble to powerful units capable of switching more than a kilowatt.

Along with this almost overwhelming number of diodes and transistors, an increasing variety of special-purpose semiconductor units is being developed.

As a general—but unfortunately far from universal—rule, a semiconductor's type number gives a clue to its number of electrodes, or "active" elements. Thus, a "1N—" designation, such as 1N34A, 1N69A, and so on, indicates that the device is a diode; a "2N—" designation, such as 2N229, 2N255, 2N384, etc., indicates that the device is a triode; a "3N—" designation, such as 3N35, 3N37, etc., indicates that the unit is a tetrode.

Still in the development stage is a new semiconductor device that may revolutionize our homes, transportation, and industry. It has been found that certain semiconductor *p-n* junctions can be heated *or cooled* by passing a current through them. The direction of current flow determines whether heating or cooling occurs. Known as the "Peltier effect," this phenomenon is reversible in many cases. In other words, heating or cooling the junction externally develops an electrical voltage.

It is not too hard to envision a *fully electronic* air-conditioning system for the home with this device. A single unit could serve both to heat the home in winter and cool it in the summer. Going a step further, we can imagine a future all-electric home,



Among the many types of semiconductor rectifiers currently being offered by major manufacturers are these miniature General Electric units.

with the power needed for its electronic air-conditioner, radar range, color television sets, two-way "Televisiphone," and other appliances supplied either by banks of sun batteries or an external bank of "Peltier junctions."

Readers' Circuits. Chuck Van Dusen (395 W. Franklin, Pomona, Calif.), president of the Fremont Junior High Radio Club, writes that the members of his club are concentrating on transistor-circuit experimentation this year. Chuck has submitted a simplified photoelectric relay circuit (Fig. 1) with only five electrical components.

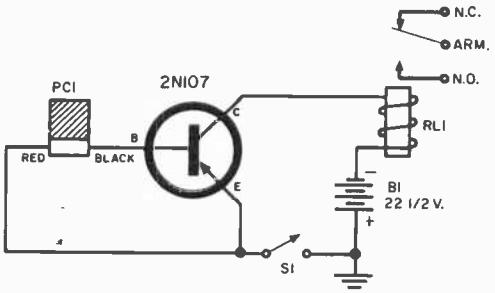
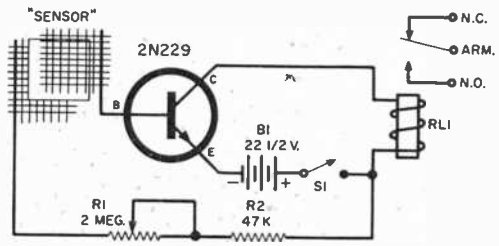


Fig. 1. Submitted by Chuck Van Dusen of the Fremont Junior High Radio Club, this photoelectric relay uses only five components.

Fig. 2. Moisture- and rain-detector developed by reader Gene Richardson employs homemade sandwich "sensor" as triggering device.



A G.E. Type 2N107 *p-n-p* transistor is used as a d.c. amplifier. An International Rectifier Type B2M "Sun Battery" serves as photocell (*PC1*), and the transistor is connected to a Sigma Type 4F relay (*RL1*), having an 8000-ohm coil. Operating power is supplied by an Eveready No. 412 22½-volt battery, controlled by a s.p.s.t. toggle or slide switch, *S1*. Neither layout nor lead dress is critical, and the unit can be assembled in a small metal box, an old cigar box, a plastic case, or whatever suits your fancy.

In operation, the photocell furnishes base bias current to the 2N107 whenever it's illuminated by an external source of light. This, in turn, permits collector current to flow through the relay's coil, pulling the armature and closing the normally open (N.O.) contacts. Chuck says that his model will operate when exposed to as little as 10 to 15 foot-candles.

In the same mail with Chuck's letter, we received a note from reader Gene Richardson (Alexandria, Va.) who, like Chuck and his friends, is experimenting with transistorized control circuits. Gene's circuit (Fig. 2) is a moisture- or rain-detector which utilizes a Sylvania Type 2N229 *n-p-n* transistor. As in Chuck's circuit, standard components are used throughout and neither layout nor lead dress is especially critical.

Control *R1* is a 2-megohm potentiometer, *R2* is a 47,000 ohm, ½-watt resistor, *S1* a s.p.s.t. toggle or slide switch, and *B1* a small 22½-volt dry battery. Again, a Sigma 4F relay (8000-ohm coil) is used.

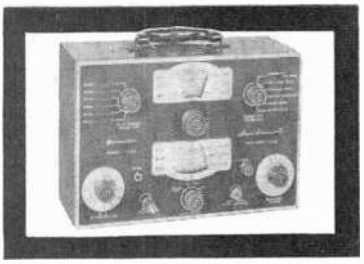
The *"Sensor"* is homemade and consists of a "sandwich" made up of two six-inch squares of bronze screening separated by a similar-sized square of plastic or "Saran" screen. The plastic screen serves to separate and insulate the two metal screens, with the entire assembly securely mounted in a small plastic or painted wooden frame.

In operation, a drop of rain or other moisture on the *Sensor* "bridges" the plastic screen, connecting the two outer screens. This permits base-bias current to be applied to the transistor through current-limiting resistor *R2* and sensitivity control *R1*. As before, the application of base bias to the transistor allows collector current to flow through the relay coil, actuating the device.

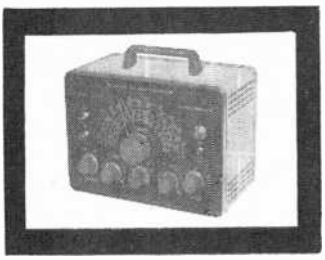
The two circuits are similar, except for the means of obtaining base bias and the type of transistor used. In each one, the relay contacts serve as a switch to operate an externally powered alarm signal.

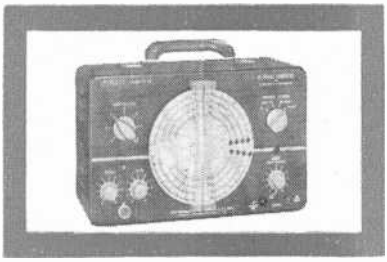
Plastic Transistors? From the U.S.S.R. comes news that a Soviet scientist has invented a plastic transistor which exhibits properties quite like those of transistors made with germanium. The plastic is a wool substitute known as polyacrilonitrile. For use in semiconductor devices, the substance is treated by bombarding it with rays from radioactive matter.

(*Continued on page* 108)



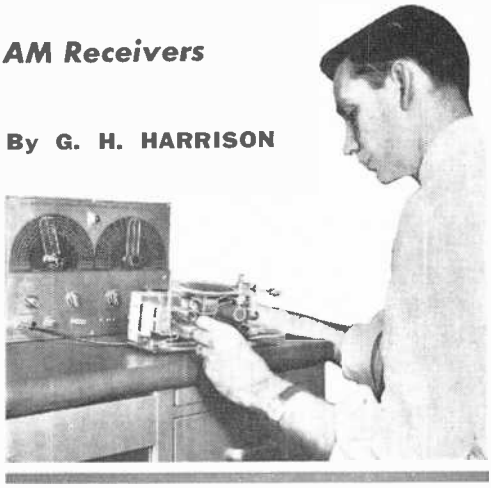
Test Instruments





the Signal Generator

Part 2 *Aligning AM Receivers*



By G. H. HARRISON

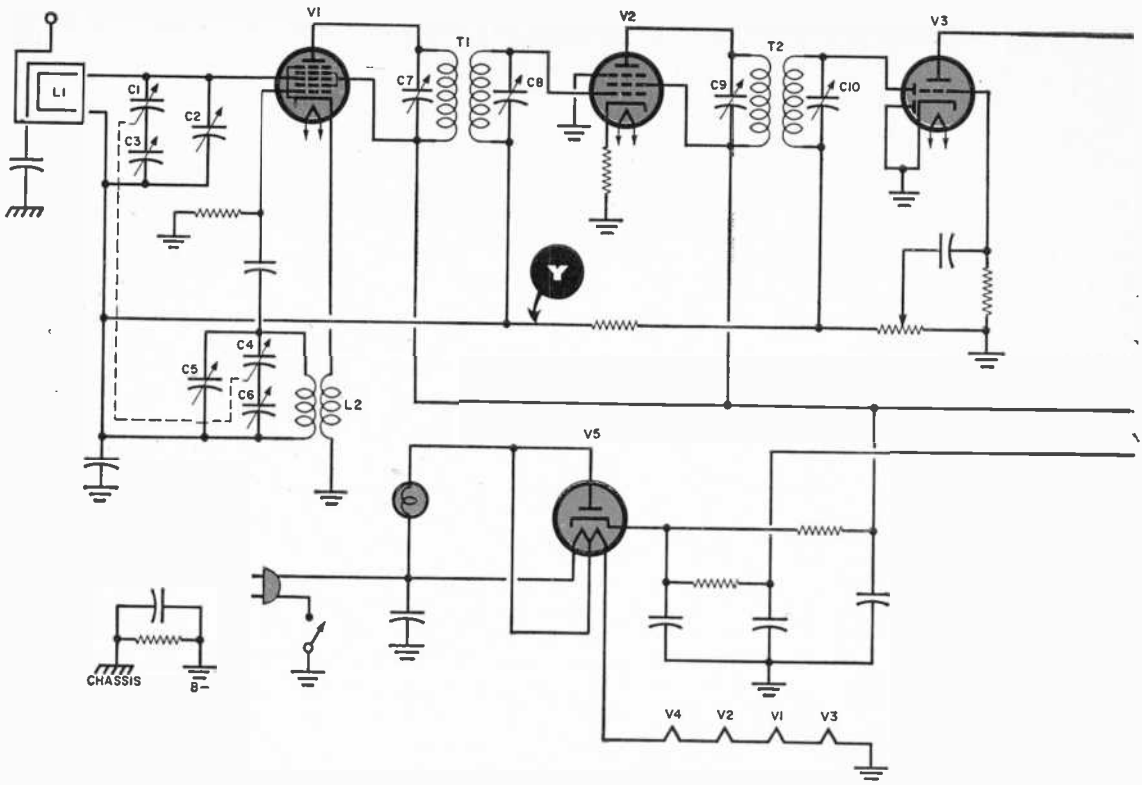
GO INTO any radio serviceman's shop, TV production line, or engineering laboratory, and you're sure to find an r.f. signal generator or two. The reasons are simple enough, for this versatile instrument is used for a wide variety of checking and measuring purposes. But it's in aligning AM radios that the signal generator finds its most common application. To understand why, let's take time to look at an ordinary AM receiver.

How Superhets Work. Superheterodyne receivers are for all practical purposes the only kind in general use today. As you probably know, they operate by "mixing" —or heterodyning—two frequencies to produce a third, or "beat" frequency, which is then amplified. This means that the receiver must have circuits operating at three different frequencies simultaneously. Two of them must be continuously variable, yet the difference between the two must remain constant as they tune through a wide frequency range.

For example, when you tune in a radio station at 1400 kc., the r.f. (radio frequency) sections of a typical receiver will be tuned to 1400 kc., the i.f. (intermediate frequency) section to 455 kc., and the oscillator to 1400 + 455 or 1855 kc. The oscillator must always be 455 kc. above the r.f. sections. Thus, when the r.f. sections are at 600 kc., the oscillator must operate at 1055 kc.; with the r.f. at 1000 kc., the oscillator must be at 1455 kc.; and so on.

Keeping these frequencies in their proper relationship to each other across the entire tuning band is known as "tracking." Alignment is the process of getting the oscillator and r.f. stages to track properly. It also includes tuning the i.f. stages, but this is relatively easy.

An r.f. signal generator supplies all the



signals needed to align receivers quickly and efficiently. But alignment is complicated in practice because manufacturers supply a wide variety of alignment controls in various receivers. The instructions that follow will serve as a general guide for aligning any receiver, but some adaptation will be needed to cover variations in individual radios. (If you have the manufacturer's alignment instructions, you can follow them with good results.)

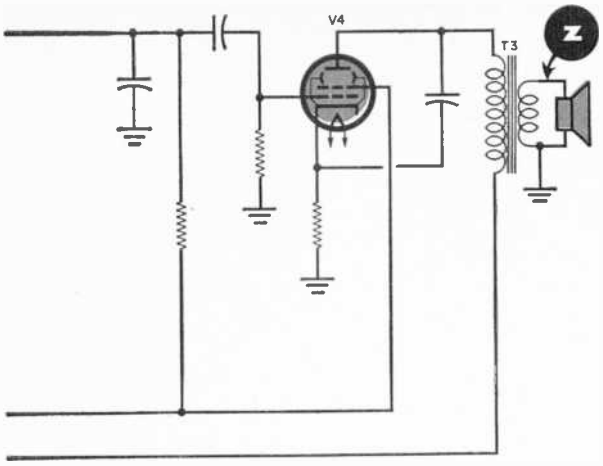
Alignment Controls. In general, a receiver may have as many as four variable controls for aligning the oscillator and mixer sections. A receiver with one or more r.f. stages ahead of the mixer will have even more. For simplicity, let's forget about the r.f. stages, remembering that for alignment purposes they are to be treated in the same way as the mixer itself.

Two *trimmer* capacitors, one in the oscillator and one in the mixer circuit, are used to align the high end of the band. Two *padder* capacitors, one in each circuit, align the low end. The padders (*C3, C6* in the diagram) are in series with the main tuning capacitors; the trimmers (*C2, C5*) are in parallel with the combination.

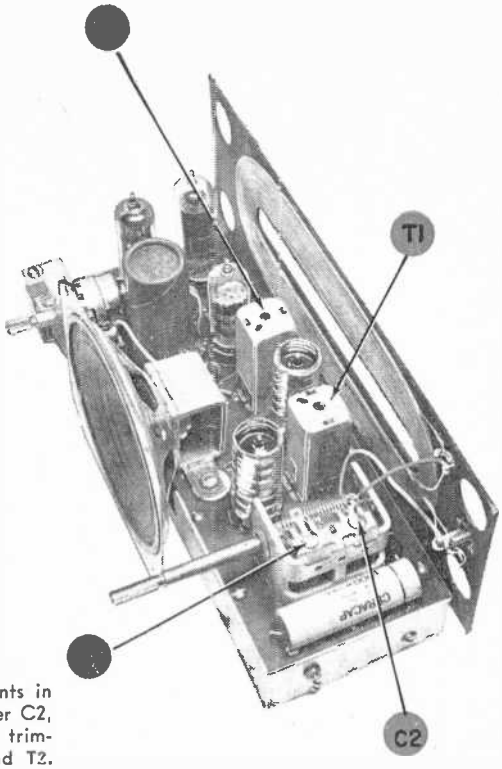
Separate padder capacitors, such as those indicated by *C3* and *C6*, are seldom seen in actual receivers. More often, the designer substitutes a tuning slug in the oscillator coil to take the place of the padder. In other cases, the outer plates of the main tuning capacitor are slotted, so they can be bent. Moving these plates in and out is roughly equivalent to varying a series capacitor, such as *C3* or *C6*.

In practice, end-plate bending is a little tricky. Don't try it unless (1) you are very sure of what you are doing, and (2) it is absolutely necessary. Since exact adjustments are difficult, and since the whole capacitor section can be shorted out, it is usually better to leave the plates alone.

Preliminary Adjustments. Before aligning, turn on both the receiver and the signal generator. Turn the receiver volume control to maximum, and its tone control (if any) to the minimum bass position. While the receiver and signal generator are warming up (allow a minimum of 15 minutes before actual alignment is begun), connect an a.c. voltmeter across the speaker voice coil ("Z" in the diagram) or a VTVM between the a.v.c. bus ("Y") and ground. Although the second method is more accurate, either is satisfactory. It is



Millions of radios built during the past 20 years use circuits similar to this one. Although controls vary from set to set, alignment procedure is much the same.



Major alignment adjustments in a.c.-d.c. set are mixer trimmer C2, oscillator trimmer C5, and trimmers on transformers T1 and T2.

even possible to do a fair job of alignment by simply listening for the loudest volume in the speaker, but a meter is far more accurate than your ear.

Connect the ground lead from the signal generator to the receiver chassis, and couple the signal generator output to the receiver's antenna circuit. If you have not done this before, you'll be surprised at how loose the antenna coupling can—and should —be. Many times, the generator's "hot" lead can simply be stretched out along the bench near the receiver's antenna, with no direct connection at all. If this doesn't give enough signal, drape the hot lead over the antenna, or make a loop of two or three turns of insulated wire, slip it around the antenna, and couple the hot and ground signal generator leads to the ends of the loop. A little experimentation may be necessary to find the right degree of coupling. The looser the coupling, the better.

If you happen to be working on a set that is severely out of alignment, you may have to clip the generator lead directly to the grid of the tube in each circuit to be aligned, starting with the last i.f. and working forward one step at a time. In any event, you'll get best results if you do the final "peaking" with very loose coupling between the signal generator and the receiver.

How to Align. You are now ready to begin the actual alignment.

1. Set the receiver dial to the low frequency end—around 555 kc.

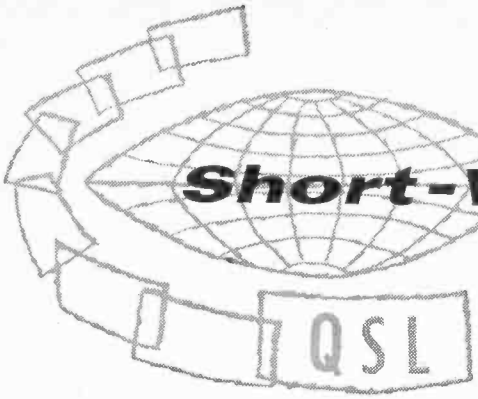
2. Short out the set's local oscillator. The simplest way to do this is to clip a short piece of wire across the rotor and stator sections of the oscillator tuning section of the ganged capacitor (*C4*). Short out *C6* (if any) as well.

3. Set the signal generator to 455 kc. (or the i.f. frequency of the receiver, if different). If you are using a VTVM in the a.v.c. circuit as a tuning indicator, set the signal generator for unmodulated r.f. output; otherwise, set it for modulated output.

4. Use the lowest output range of the signal generator, and increase the output until a small reading appears on the output meter.

5. Using a non-metallic (plastic or fiber) screwdriver or alignment tool, carefully adjust the i.f. trimmers (*C10, C9, C8,* and *C7,* in this order) for maximum output on the meter. Swing the alignment adjustments

(*Continued on page* 120)



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

ONE of the veteran DX'ers in the New England area is Anson Boice, of 93 Whiting St., New Britain, Conn. Anson has been DX'ing since March, 1929, when he began with a two-tube breadboard set. Holder of call letters WPE1BD, he is 47, married, and has six children. By occupation, he is a filler-room operator in a local dairy.

The first station Anson ever heard was PCJ, operated by Philips Industries in Hilversum, Netherlands. The announcer on the show, incidentally, was Eddie Startz, now well know to all DX'ers as the M.C. on Hilversum's "Happy Station" program.

Anson Boice, WPE1BD, works with a Hammarlund HQ-100 and a Grundig receiver. His current equipment also includes a Webcor tape recorder and a POP'tronics antenna tuner.

Anson's original two-tuber was soon replaced with a five-tube Sears-Roebuck receiver. And this was followed in turn by three Hallicrafters models: the S-22R, SX-28, and SX-43. He now uses a Hammarlund HQ-100 for general reception and a Grundig four-speaker receiver for hi-fi reception. Additional equipment in his listening post includes a Webcor tape recorder and a POP'tronics antenna tuner. His antenna system includes an eight-foot vertical and four inside antennas, as well as a bow-tie rotary TV antenna.

A top DX'er, "Ans" regularly sends reports to short-wave broadcast stations. He has 82 countries verified out of an even hundred heard. His best veri dates back to May, 1948, and confirms reception of YDE, Batavia, Java (now Djakarta, Indonesia) when this station was broadcasting with 500 watts on 15,150 kc. Other highly prized veries come from Austria (6000 kc.), Cayenne (6215 kc.), Togoland (5036 kc.), Solomon Islands (5970 kc.), and the Forces Station in Malta on 7270 kc.

Anson's favorite stations are *R. Netherlands, R. Japan, R. Australia, R. Sweden,* and the Swiss Broadcasting Service. Unlike most DX'ers, he has no favorite short-wave bands—he listens wherever conditions permit.

In addition to being one of our regular POP'tronics monitors, Anson is a state director for the Newark News Radio Club, a six-year monitor for *R. Japan,* and a member of the BBC's "Listener's Panel."

Aluminum Antennas. Many short-wave operators live in apartment buildings or hotels where outside antennas are not permitted. And they frequently have difficulty finding an inside antenna that is sensitive enough to pick up more than the usual run of stations. When Martin Van Gorder,

(*Continued on page* 121)

POPULAR ELECTRONICS
AFTER CLASS feature

The Language of VECTORS

Vectors, like shorthand, are used to compress a lot of information into a small space. Here's an easy-to-follow introduction to the subject

Part 1

By SAUNDER HARRIS

"ARE you looking for company, Ken?" Larry called up the stair well to his fellow electronics experimenter.

"Sure am, Larry," Ken replied. "I could use your sparkling company about now. I've been cracking the books all afternoon."

Larry took the stairs two at a time and reached the attic in a jiffy. "How's the course coming, old buddy?" he asked as he entered Ken's ham shack. "With 20-meter DX as hot as it is this afternoon, you must have latched on to something pretty interesting to keep you off the air."

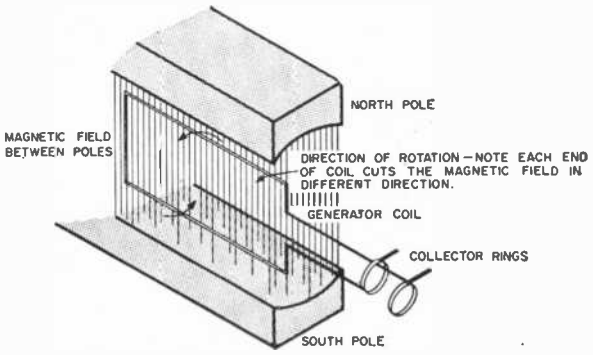
"You're modulating 100%, Larry," Ken said as he looked up from the desk where he had been working. "I'm just finishing my lessons on phase angles and vectors, and for the first time in ten years of fooling around with electronics I really understand what phase relations mean. If you can stand some new knowledge in your thickening skull, I'll be glad to pass it along. Pull up a chair."

"Okay, professor," agreed Larry, sitting down alongside his friend. "I really would like to understand more about phase. I know it's important in a.c. circuits and that sometimes current leads voltage and sometimes it's the other way around, but that's all. Fire away and teach me something."

"It will be my pleasure," Ken declared, taking up a pencil and paper. "We'll start right where phase starts—at an a.c. generator." He began sketching as Larry watched.

"Follow what I've drawn?" Ken asked.

"Sure thing. The center coil revolves between the two poles. Since each of the pole pieces is a magnet, one a north and the other a south pole, there is a magnetic field between them. As the coil revolves, it cuts the field and a voltage is generated in it. Current flows through the coil and is taken off at the collector rings."



"Good enough, Larry. You *do* remember your basic electrical theory. Now, let me ask you . . . is this a steady voltage?"

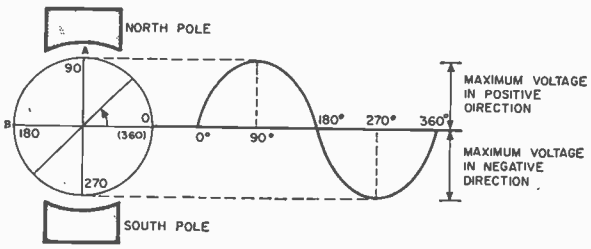
"No, it's not steady because it's an a.c.

voltage. I'm not too clear on what causes an a.c. voltage to vary, though. Here's where the explaining starts, Ken."

"Right. To make the picture clear, I'm going to call in some vectors."

When Larry winced, Ken laughed. "Whatever serious study you do in electronics will involve a knowledge of vectors, Larry. They're part of the language engineers use in designing circuits."

Ken took a fresh sheet of paper and started another drawing.



"The circle on the left," he said, "is another view of the generator. The diagram on the right represents the value of the generated voltage for any coil position. For example, in the 0° position, the coil is parallel to the magnetic field between the two poles and no lines of force are being cut. Since a voltage is generated only when the coil cuts through the magnetic field, the voltage at this point is zero. That's the way it's shown on the diagram.

"As the coil turns," Ken continued, "it cuts a greater number of lines of force. The voltage gradually increases until it reaches a maximum value when the coil is in the 90° position. I've marked this position *A*, and you can remember it easily because it makes a right angle with the 0° position.

"From this point on, the angle at which the coil cuts through the magnetic field decreases and the voltage drops along with this decrease. At the point where the coil has turned through 180°, which I've marked *B*, it's back parallel to the magnetic field and not cutting any lines of force. The voltage here is back to zero.

"This is shown on the diagram by the curved line cutting the base line at the point marked 180°. Do you follow this so far, Larry?"

"Yes, Ken, but how come the curved line drops below the base line after the 180° point?"

"That's a fair question," Ken answered. "Look at the first drawing of the generator again. You can see that the top of the coil is turning counterclockwise. And now follow the top of the coil as it turns. At the point where it has turned through half a circle or 180°, it reverses the direction in which it cuts the magnetic field. This means that the polarity of the voltage being developed within the coil is also reversed.

"So, Larry, if the top portion of the curved line in my second drawing is considered positive voltage, the lower portion would be negative. The point where the coil top reversed its field is the point marked 180°. Do you get it now?"

"I sure do." The light of new knowledge glinted in Larry's eyes. "I also see how the term 'alternating current' came into being. It's because each wire in the generator circuit alternates between plus and minus voltage.

"Let me ask another question, Ken. Is this the same type of voltage that's developed in an oscillator circuit?"

"Yes it is, Larry. Of course, there's a big difference in the frequencies you can develop by mechanical means, such as the generator we discussed, and those developed by electronic means, such as an oscillator tube. In normal house-current use, the generator develops a voltage which goes through 60 cycles a second. (A cycle is what we call each complete 360° turn of the generator coil.) On the other hand, an oscillator circuit which has no moving parts can develop voltages up in the millions of cycles per second."

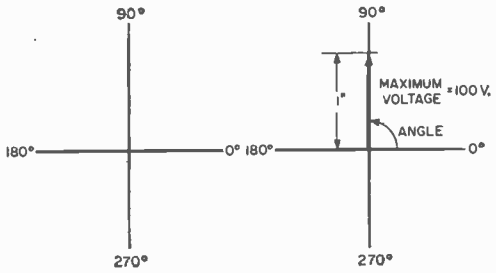
KEN paused a minute and Larry took the opportunity to ask, "What's so important about vectors? The way you explained things so far is mighty clear to me."

"As far as we went, Larry, vectors weren't needed," Ken replied. "But when you get into engineering problems with complicated circuits and a great many voltages and currents running around, you can't keep track of them with words. You need mathematics to make the picture understandable, and the part of mathematics used in engineering work is called vector analysis.

"Even if you never study engineering formally," Ken went on, "understanding a bit about vectors will make it possible for you to study on your own using engineering books. What we're doing is learning the ABC's of a new language—vectors."

Smiling, Ken quickly drew two diagrams on the sheet of paper he had been using.

"Each of these sets of lines," he explained, "represents the same 360° that the



circle did in the last drawing. Leaving out the circle saves time and work, and, being just as lazy as you and I, the mathematicians developed this crossed-line system. They call these lines a coordinate axis, but don't let the big words throw you."

"Is this co . . . whatever you call it a vector?" Larry asked.

"No, it isn't. Just keep your solder cool, and I'll introduce you to one vector in half a sec. Let's think of the point where the lines cross—the center point—as the pivot for the generator coil. When the cycle starts, the coil is lying right along the 0° line. As it turns through its cycle in the direction of the arrow in the second set of axes, I can stop it at any point in its swing by drawing a line out from the center. For example, in this sketch I've stopped the coil in the position where it's turned through 90°. You can see where I've made the line thicker at the 90° point.

"That thick line is a vector. Remember, Larry, that the voltage was a maximum when the coil turned through 90°. Well, let's say the maximum voltage generated is 100 volts. We'll let a length of one inch represent this amount of voltage. So, if the voltage I want to represent by this vector is the maximum—100 volts—and this is generated when the coil is in the 90° position, I make the vector one inch long and place it along the 90° line."

"You mean, after all that talking, a vector is only a line?" Larry was disgusted.

"Only a line! Why, you . . . ! Don't let an engineer hear you say that. It's a very special line and not every line can be a vector. It has certain very special characteristics. From what we've said, can you tell me what they are?"

Larry thought about it a minute, then replied, "Well, I guess the length of a vector means something. In this case it measured 100 volts. I'm not sure I get what other point you're driving at, Ken."

"I don't blame you for not getting it all at once," Ken said. "Vectors aren't the simplest of subjects at first, but when you understand them you'll find that they make sense. In the end, you'll use them all the time in following what makes a circuit tick.

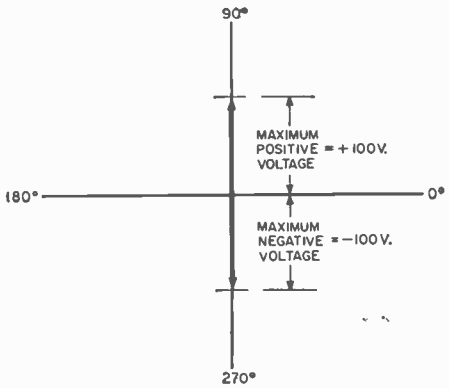
"The two important points about vectors are, first, the length or *magnitude* of the vector, and second, its *direction*, or the way it's pointing. You can say that every vector has two characteristics: magnitude and direction. These are the important differences between a vector and an ordinary line."

LARRY was eager to continue. "I think I have the idea, now, Ken. Why not give me a simple test involving vectors and see how I make out."

"Fine," said Ken. "Keeping in mind all that we discussed, let's see you add the vector for the voltage with the coil in a 90° position to the voltage vector for the coil in the 270° position."

When Larry looked puzzled about getting started, Ken said, "The way you start any problem in vectors is to draw in the two lines of the coordinate axis and then to plot the vectors. When you do this, you have a picture of the problem. That's the reason vectors are such an important tool in simplifying complicated electrical problems."

Larry went to work following Ken's instructions.



"How's that?" he asked when he had completed the drawing.

"Fine," replied Ken. "But the big ques-

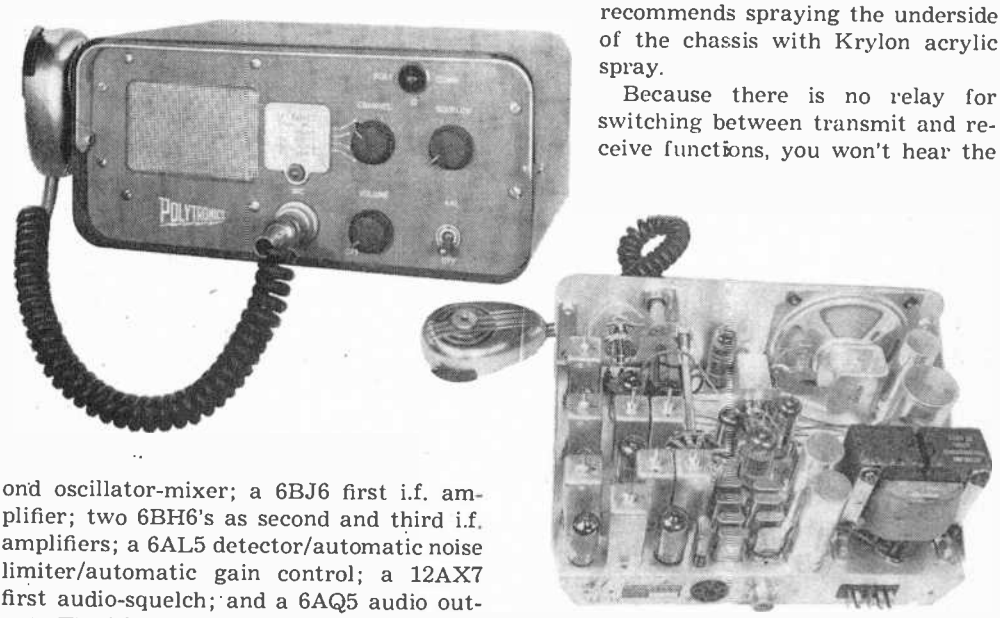
(*Continued on page* 117)

Four-Channel Citizen's Band Transceiver

Rugged, compact, and versatile, the Poly-Comm II operates from almost any power source

CURRENT and prospective Citizen's Banders should take a long look at the new Poly-Comm II transceiver. Both transmitter and receiver are crystal-controlled in this four-channel unit. The Poly-Comm operates from 117 volts a.c. and 6 or 12 volts d.c., and is available from Polytronics Laboratories, Inc., 253 Crooks Ave., Clifton, N.J., for $179.50.

The Poly-Comm's receiver section employs nine tubes: a 6BJ6 r.f. amplifier; a 12AT7 first oscillator-mixer; a 12AT7 second oscillator-mixer; a 6BJ6 first i.f. amplifier; two 6BH6's as second and third i.f. amplifiers; a 6AL5 detector/automatic noise limiter/automatic gain control; a 12AX7 first audio-squelch; and a 6AQ5 audio output. The i.f. frequencies are 6.0 mc. and 455 kc.; 16 tuned circuits appear between antenna and detector.

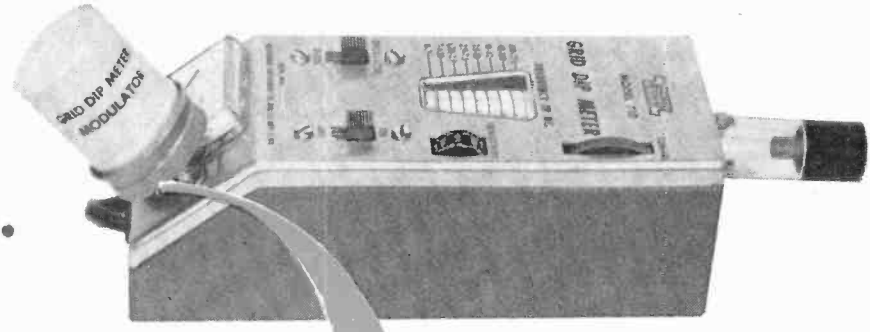


Four tubes make up the transmitter, two in the modulator section and two in the r.f. section. The modulator section is common to both transmitter and receiver, with one triode of a 12AX7 used as a microphone amplifier, driving a 6AQ5 modulator. In the r.f. section, a 12BH7A operates as an oscillator-tripler, driving a 6EM5 power amplifier. (A 9-mc. crystal is tripled to about 27 mc. and fed to a straight-through plate-modulated final for 3 watts power output.) One transmit and one receive crystal come with the unit; additional crystals can be plugged into the Poly-Comm to provide the remaining three channels.

A cadmium-plated steel chassis, Teflon-insulated wiring, and a weather-proofed 4" speaker equip the transceiver for marine installations. For extended use near salt water, however, the manufacturer recommends spraying the underside of the chassis with Krylon acrylic spray.

Because there is no relay for switching between transmit and receive functions, you won't hear the usual click from the press-to-talk switch. A newly developed circuit (patent-applied-for) makes switching in the Poly-Comm entirely electronic. A portion of the transmitted signal is applied to the receiver's first r.f. stage, which acts as a diode, creating a bias that causes the a.g.c. line to cut off the receiver.

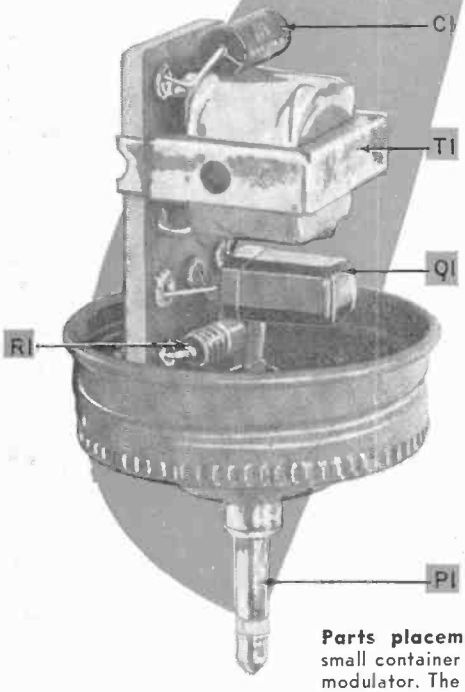
A five-mile minimum range is guaranteed for mobile-to-mobile operation in open flat terrain, and a ten-mile minimum for base-to-mobile operation under specified conditions. Channel separation is excellent. And, while the unit isn't completely weatherproof, it is the nearest thing yet in CB equipment for marine installations. —30—



MODULATE YOUR GRID-DIP METER

. . . with this easy-to-build plug-in accessory

By R. L. WINKLEPLECK

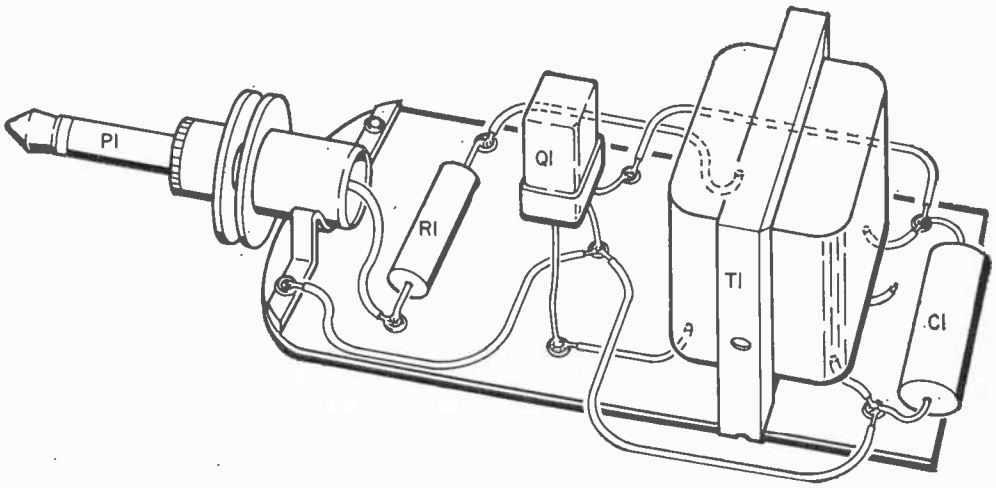


Parts placement is not critical. Any small container can be used to house the modulator. The phone plug should match the phone jack on the grid-dip meter.

MOST EXPERIMENTERS who have used a grid-dip meter (GDM) as a signal generator know that it suffers from one major weakness in this application: the r.f. signals produced are unmodulated. It's difficult to use a GDM to check a receiver by ear, since no modulation of the r.f. signal from the GDM means no audio from the speaker of the receiver under test. Lack of a modulated output makes it virtually useless for alignment purposes, too.

But modulating your grid-dip meter is easy with the handy accessory shown here. It plugs into the phone jack on the GDM and requires no changes in the meter's circuitry. Plug it in, and your GDM is instantly modulated. Unplug it, and your GDM is precisely as it was before.

The modulator draws all its power from the meter, and its modulation frequency can be varied by adjusting the GDM's sensitivity control. This plug-in accessory



HOW IT WORKS

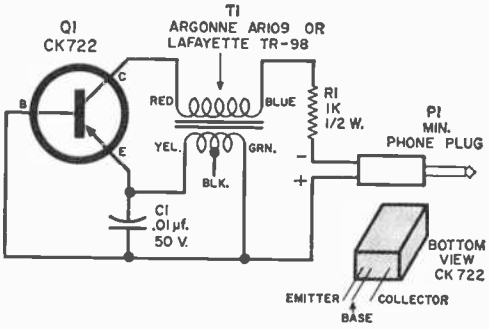
The modulator is a one-transistor feedback oscillator which operates without a battery and is driven by current in the grid circuit of the GDM. Transformer *T1* provides audio feedback between the collector and emitter circuits of the transistor. Capacitor *C1* tunes the emitter circuit to the frequency of oscillation, and resistor *R1* limits current surges. The unit acts as a grid modulator by varying the GDM grid current at an audio rate.

will work with almost every grid-dip meter on the market that has a phone jack. And you can build it in one evening for less than three dollars.

Construction. The author's model was built in a 35-mm. film can. Any small container will do, but choose one small enough to clear the controls and switches on the grid-dip meter. Cement the miniature phone plug to the lid of the can. If your GDM has a standard-size phone jack, use a mating plug and mount it on the container with a nut.

All other components of the modulator are mounted on a ¾" x 1½" piece of perforated phenolic board attached to the underside of the lid. Component arrangement is not critical. Complete all wiring before the circuit board is attached to the lid of the can. Check the schematic or instruction manual of the grid-dip meter before wiring the phone plug. Polarity at the GDM phone jack must be observed or the modulator will not oscillate.

Another transistor can be substituted for the CK722 used here, but the frequency of oscillation may vary. The value of capacitor *C1* will also affect the frequency. If you



Various transistors and transformers can be substituted in the GDM modulator circuit. Changing the value of the capacitor will vary frequency of oscillation.

use a transformer other than one of those indicated on the schematic diagram, the circuit may refuse to oscillate; in this case, try reversing the leads to either the primary or secondary of the transformer.

Operation. Plug the modulator into the phone jack of the grid-dip meter, and place the GDM near the receiver antenna or i.f. circuit. Adjust the meter to the frequency of the circuit under test.

Now position the GDM sensitivity control for the desired audio tone and modulation level. You'll find that the frequency of oscillation varies with the voltage at the phone jack. The author's model oscillates in the range from 100 to 1000 cps.

When you want to go back to normal grid-dip meter operation, simply unplug the modulator. —30—

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

WHY BUY USED HAM EQUIPMENT?

A RECENT letter from Earl, K4FQU, describes how he started his ham career as a Novice with a Johnson Adventurer transmitter, adding a VFO and a screen modulator when he got his General license. Later, he acquired a used Globe LA-100 linear amplifier, boosting the Adventurer's output to a couple of hundred watts and giving him a modern phone/c.w. transmitter at a price he could afford. Earl suggests that I tell other readers who are somewhat short of cash about the advantages of buying used ham equipment. So here goes.

How Much Can You Save? Obviously, the main reason for buying used instead of new ham equipment is to save money. Prices vary, of course, but a used current-model ham receiver or transmitter will generally cost 20% to 30% less than a similar new unit. And the cost gradually decreases for older and older equipment, with the exact price depending on the condition of the equipment and the demand for it.

A few figures selected at random from used-equipment lists will show you what to expect: Hallicrafters SX-101 receiver—used, $255.00 to $300.00; new, $399.50; Hammarlund HQ-100 receiver—used, $129.00; new, $189.00; Heathkit DX-20 transmitter—used, ready to operate, $29.00 to $35.00; new (but unassembled), $35.95; Johnson

Ham of the Month

John L. Reinartz, K6BJ, put his first ham station on the air in 1908 at the age of 14, earning the money to buy the parts as a 10-cents-a-day blacksmith's helper. In 1923, he and Fred Schnell worked M. Leon Deloy in Nice, France, from Connecticut on 100 meters for the first two-way crossing of the Atlantic Ocean via short-wave radio. They used a special transmitter circuit John had developed and the "Reinartz" tuner he invented in 1921 to achieve an hour-long transatlantic communication on each of two successive nights.

Two years later, in 1925, John published his theory of how short-wave signals are reflected above the earth and returned to it many miles away. Using this theory, he managed to work 5TS in California from Connecticut at high noon on 20 meters—an almost unbelievable accomplishment at that time.

Among many other accomplishments, John Reinartz developed a regenerative detector and a loop antenna for use in microwave radar. In recognition of his outstanding work, he was made a "Fellow" of the Institute of Radio Engineers in 1958.

On January 30, at the age of 66, John retired as head of the Amateur Department of the Eimac Tube Company in order to devote all his time to hamming and fishing. We at POPULAR ELECTRONICS join all his other friends in saying, "Well done, John L. Reinartz, K6BJ, a real ham!"

Väliant transmitter—factory-wired, used, $350.00; new, $439.50.

Where to Buy. All ham supply houses that accept trade-ins on new equipment have "reconditioned" equipment departments to dispose of ham gear accepted as trade-ins. Used or second-hand equipment is always reconditioned to put it in satisfactory working order before it is offered for sale.

It is a poorly kept secret that these dealers consider themselves fortunate to break even on used-equipment sales. But without such sales, they would be unable to accept used-equipment trade-ins.

In buying used equipment by mail, the integrity of the seller is all important. If you buy from a dealer who advertises regularly in POPULAR ELECTRONICS or other reputable electronics magazines, your risk is reduced to a minimum. The equipment will be as represented, and its price will be fair. The intense competition between dealers for your business insures a fair price.

Warranties. Will you be satisfied with used equipment? Probably, if you consider buying it in the first place (not everybody will, for various reasons). Bill Harrison, W2AVA, of Harrison Radio in New York City, says that some beginning hams shy away from buying used equipment because they feel that they aren't experienced enough to make a wise choice. But, once they have purchased a piece of used gear, many hams come back again and again for more of the same.

Most dealers offer "new-equipment" warranties on the used equipment they sell. Their exact provisions vary somewhat, but they generally offer a 10-day free-trial period. If you aren't satisfied with your purchase within this time, you may return it for full credit or refund (depending on the dealer). In addition, most dealers will allow you full credit on used gear if you trade back the equipment within 90 days.

In practice, most dealers lean over backwards to satisfy any legitimate complaints about the used equipment they sell, because they know a satisfied customer is their best advertisement. The boys at Walter Ashe Radio in St. Louis report that they have fewer complaints or call-backs on their used-equipment sales than they do on new-equipment sales. Allied Radio in Chicago finds the percentage about the same for both new and used equipment. Judging from my mail and personal observation, these percentages seem correct.

Larry Lenon, WV6GDM, at the controls in Long Beach, Calif. He uses a Hammarlund HQ-160 and a Heathkit DX-40. See News and Views.

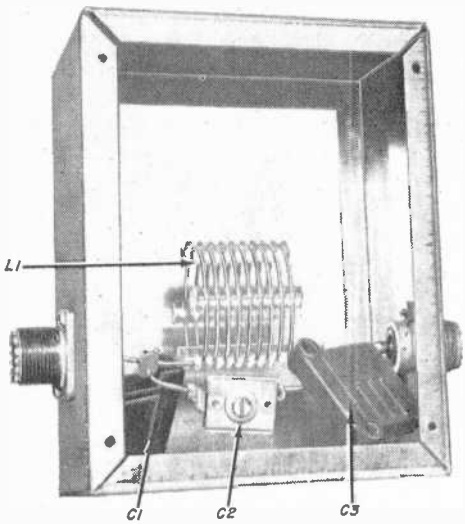
One disadvantage of buying used ham gear is that you cannot always get exactly what you want when you want it, because dealers' stocks are constantly changing. If the item you want is not immediately available, most dealers will hold the first available one for you if you leave a small deposit.

Only you can decide whether your particular equipment needs will be met best by buying new or used equipment. If in doubt, you probably should choose new equipment, or seek the advice of an experienced ham.

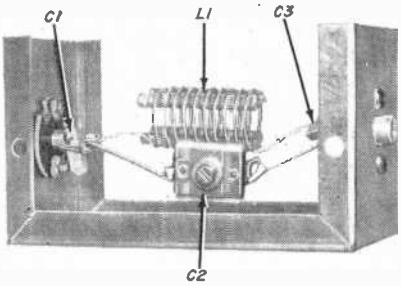
SUPPRESS THOSE HARMONICS

Second harmonics from ham signals in the 80- and 40-meter bands are often evident from 7.3 to 8.0 mc. and 14.3 to 14.6 mc.

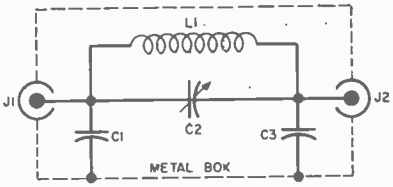
80 METER FILTER



40 METER FILTER



Simple filters suppress harmonics on the 80- and 40-meter bands. Chassis for 80-meter unit is large enough to hold the 40-meter filter as well.



PARTS LIST

80-Meter Filter

C1, C3—0.0003-μμf., 2500-volt mica capacitor (Aerovox 1447 or equivalent)
C2—25 to 280 μμf. mica trimmer capacitor
L1—Nine turns of #14 wire, 1¼" diam., 1½" long (section of Illumitronics 1006T coil stock)
J1, J2—Coaxial connector (Amphenol 83-1R or equivalent)
1—3" x 4" x 5" aluminum box (Bud AU-1028 or equivalent)

40-Meter Filter

C1, C3—160-μμf., 500-volt silver mica capacitor
C2—9 to 180 μμf. mica trimmer capacitor
L1—Ten turns of #16 wire, 5/8" diam., 1¼" long (part of B & W 3006 Miniductor)
J1, J2—RCA-type phono jack
1—2¼" x 2¼" x 4" aluminum box (Bud CU-2103A or equivalent)

Legally, harmonics from a ham transmitter must be at least 40 db below its fundamental output, but in practice any harmonic strong enough to be heard over a mile from your antenna can earn you a "pink ticket" from the FCC, as many hams can tell you. The simple filters shown here will attenuate your transmitter's harmonic output at least 20 db.

Parts values are given for both the 80- and 40-meter bands. The 80-meter filter uses mica capacitors with a 2500-volt d.c. working voltage for *C1* and *C3*, and incorporates standard coaxial connectors. It will handle a kilowatt easily.

The 40-meter filter incorporates silver mica capacitors with a 500-volt d.c. working voltage for *C1* and *C3*, and RCA-type phono pin jacks are used as connectors. It handles 150 watts.

Both filters can be built into the box specified for the 80-meter filter. A piece of aluminum should be inserted between the two filters, however, to isolate them from each other.

If desired, higher-voltage capacitors can be used in the 40-meter filter to increase its power-handling capabilities. Likewise, lower-voltage capacitors can be used in the 80-meter filter for lower-powered rigs.

After the filters are completed, adjust *C2* with a grid-dip meter coupled to the coil. Tune the 80-meter unit to resonance at 6 mc. for maximum suppression of 80-meter Novice harmonics, or to 6.24 mc. for maximum suppression of 75-meter harmonics. Resonate the 40-meter filter at 11.48 mc. If you don't have a grid-dip meter handy, install the unit in the antenna-feed line and adjust *C2* for minimum signal while a local ham listens for your harmonic.

Do not leave the wrong filter in the circuit when you change bands, or you will probably burn out *C2*.

(*Continued on page* 114)

RADIO PAGING

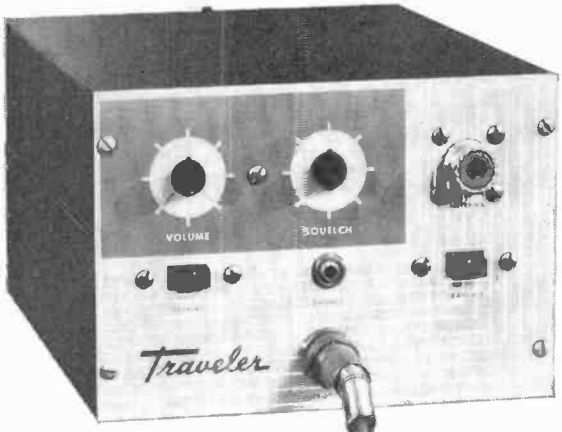
This miniature radio permits employees at the Invalides Air Terminal in Paris to listen to messages from the central telephone room, with passengers no longer annoyed by distracting loudspeaker calls. After the employee's attention is attracted by a "beep beep," he holds the receiver to his ear to hear the message. (UPI photo)

MAMMOTH MAGNET

Scheduled to go into action soon is the world's largest permanent magnet. Made by Arnold Engineering Co., subsidiary of Allegheny Ludlum Steel Corp., it will help pump liquid sodium at an atomic reactor being built in Idaho. It weighs 1720 pounds and is made of Alnico V.

SPECTACULAR TV TOWER

A new ultra-modern TV tower has recently been built near Heidelberg in West Germany. The 124-foot structure has an observation tower for visitors and a tank for storing drinking water. An antenna placed atop the tower will make the total height of the installation 258 feet. (Wide World photo)



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INTERNATIONAL

Traveler

NEW ALL TRANSISTOR PORTABLE TRANSCEIVER

- **Truly Portable**
- **All Transistor**
- **Built-in rechargeable battery and charger**

A completely new, truly portable, all transistor Transceiver for the Citizens Radio Service. Compact: 4" x 6" x 7¾". Weighs less than 5 lbs.

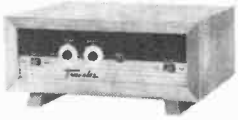
Small but mighty . . . The Traveler packs **15 transistors** providing maximum "talk power" and "reception." Built-in speaker plus separate phone jack.

Special High Frequency transistors are utilized in the transmitter. The receiver's dual conversion superhetrodyne RF circuits use special High Frequency transistors. Provides microvolt sensitivity.

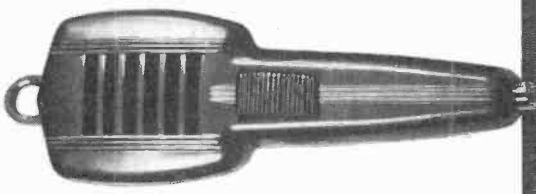
Truly effective noise limiter and squelch, two channel crystal controlled transmitter, two channel crystal controlled receiver. Powered by **nickle cadmium battery** which outlasts conventional rechargeable battery by 20 times.

See the exciting new TRAVELER 2-way radio at your International dealer today, or write for additional information.

Complete with portable battery and built-in charger, microphone, 2 sets crystals, whip antenna, carrying strap, and mobile mounting bracket .....only **$249.50**



THE TRAVELER is also available as a 115 VAC transistor model. Beautiful "hand finished" wood case complete with 2 sets crystals, and microphone.....only **$199.50**



The perfect communicator in the home, the office, the car, as well as outdoors. Inconspicuous atop the desk. Adjust the special shoulder strap and it becomes your companion in the field. Quick clamp mounting bracket for mobile use.

INTERNATIONAL
CRYSTAL MANUFACTURING CO., INC.

18 NORTH LEE
OKLAHOMA CITY, OKLAHOMA

May, 1960

FROM HEATH...

14 NEW KITS

AA-50 $79.95

HI-FI RATED 25/25 WATT STEREO AMPLIFIER-PREAMPLIFIER KIT

A complete 25/25 watt stereo power and control center (50 watts mono) . . . 5 switch-selected inputs for each channel . . . new mixed center speaker output . . . stereo reverse and balance controls . . . special channel separation control . . . separate tone controls for each channel with ganged volume controls . . . all of these deluxe features in a single, compact and handsomely styled unit! Five inputs for each 25 watt channel are provided: stereo channel for magnetic phono cartridge (RIAA equalized); tape head input; three high level auxiliary inputs for tuners, TV, etc. There is also an input for monophonic magnetic phono cartridge, so switched that monophonic records can be played through either or both amplifiers. The automatically mixed center speaker output lets you fill in the "hole-in-the-middle" found in some stereo recordings, or add extra monophonic speakers in other locations. Nearly all of the components are mounted on three circuit boards, simplifying assembly and minimizing possibility of wiring errors. 30 lbs.

New Heathkit Stereo Hi-Fi Components . . .

plus Exciting New Kits for the Ham, Technician,

Boating Fan and Hobbyist

AD-10
$33.95

MANUAL STEREO RECORD PLAYER KIT

Made by famous Garrard of England, the AD-10 is a compact 4-speed player designed to provide trouble-free performance with low rumble, flutter and wow figures. "Plug-in" cartridge feature. Rubber matted heavy turntable is shock-mounted, and idler wheels retract when turned off to prevent flat spots. Powered by a line-filtered, four-pole induction motor at 16, 33⅓, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. Mechanism and vinyl covered mounting base preassembled, arm pre-wired; just attach audio and power cables, install cartridge and mount on base. With 12″ record on table, requires approximately 15″ W. x 13″ D. x 6″ H. Color styled in cocoa brown and beige. 10 lbs.

HEATHKIT®

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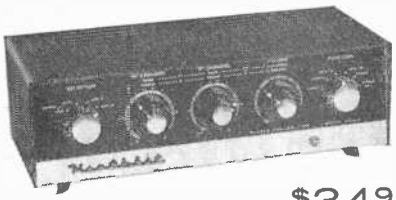
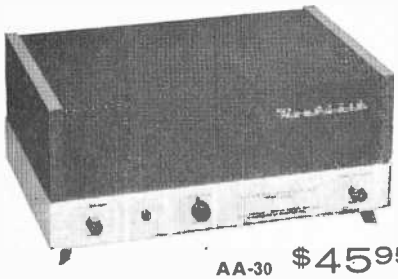


AA-20 $34.95

ECONOMY STEREO PREAMPLIFIER KIT

Although these two new Heathkit models are designed as companion pieces, either one can be used with your present stereo system. The preamplifier (AA-20) features 4 inputs in each stereo channel and gives you a choice of 6 functions. It will accommodate a magnetic phonograph (RIAA equalized), a crystal or ceramic phonograph, and two auxiliary sources (AM-FM tuners, TV, tape recorders, etc.) and is completely self-powered. The six-position function selector switch gives you instant selection of "Amplifier A" or "Amplifier B" for single channel monophonic; "Monophonic A" or "Monophonic B" for dual channel monophonic using both amplifiers and either preamplifier; "Stereo" and "Stereo Reverse". 8 lbs.



AA-30 $45.95

HI-FI RATED 14/14 WATT BASIC STEREO AMPLIFIER KIT

Two 14-watt high fidelity amplifiers, one for each stereo channel, are packaged in the single, compact, handsomely styled amplifier (AA-30). Suitable for use with any stereo preamplifier or with a pair of monophonic preamplifiers, it features individual amplifier gain controls and speaker phase reversal switch. Output terminals accommodate 4, 8 and 16 ohm speakers. 21 lbs.

SA-2 $54.95

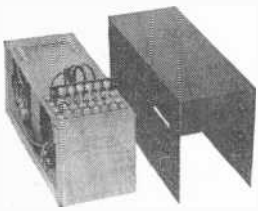
HI-FI RATED 14/14 WATT STEREO AMPLIFIER KIT

A tremendous dollar value in the medium power class, this top-quality stereo amplifier-preamplifier combination delivers full 14 watts per stereo channel (28 watts monophonic) to drive your stereo system with ease, while versatile controls give you fingertip command of its every function. In addition to "stereo" and "stereo reverse" functions, the SA-2 provides for complete monophonic operation. Inputs on each stereo channel accommodate "magnetic phono" (RIAA equalized), "crystal phono", "tuner" and high level auxiliary input for tape recorder, TV, etc. Other features include a speaker phase-reversal switch, clutched volume controls, ganged tone controls, filament balance controls, and two AC outlets to accommodate accessory equipment. Handsomely styled in black with inlaid gold design. 23 lbs.

SA-3 $29.95

UTILITY RATED 3/3 WATT STEREO AMPLIFIER KIT

Your least expensive route to stereo, the SA-3 delivers 3 watts per stereo channel (6 watts monophonic), adequate for average living-room listening. The high level preamplifier has two separate inputs for each channel and is designed for use with ceramic or crystal cartridge record players, tuners, tape recorders, etc. Featured are ganged bass and treble tone controls, clutched volume controls, channel reversing switch, speaker phase reversal switch and mono-stereo function selector switch. Attractively styled with satin-black cabinet. 13 lbs.



AN-10 $19.95

MIXED LOWS STEREO CROSSOVER NETWORK KIT

The AN-10 makes it possible for you to convert to stereo or improve your present stereo system by using just one bass "woofer"; saves buying a second bass speaker, permits using more economical "wing" speakers, improves the bass response of any stereo system. Delivers the non-direction bass frequencies of both channels below 250 cps to a single woofer and passes the higher frequency stereo channels to a pair of wing speakers. Rated at 25 watts per channel. Matches 8 or 16 ohm woofers, 8 ohm high frequency speakers, or Heathkit SS-1-2-3 speaker systems. 10 lbs.

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HEATHKIT® GIVES YOU MORE IN THESE TEN WAYS:

1. **Building a Heathkit is easy**—Check-by-step instruction manuals make it virtually impossible for you to fail.
2. **Building a Heathkit is quick**—No complicated, technical jargon for you to decipher; at most, a Heathkit takes only a few evenings to assemble.
3. **Building a Heathkit is economical**—Mass production and purchasing economies are passed directly along to you, our customers.
4. **Building a Heathkit is educational**—As you build, you learn . . . more about electronics, more about the component units and when and where to add them.
5. **Building a Heathkit is fun**—Nothing quite equals the sense of achievement you receive when you successfully complete a Heathkit unit and "tune-in" for the first time.
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7. **Your Heathkit is available on Convenient Credit**—Our time payment plan makes it possible for you to order now . . . pay later.
8. **Your Heathkit is Tops in Quality**—The very finest in electronic equipment comes to you in kit form from the Heath Company.
9. **Heathkit Dealers can Serve you Locally**—Carefully selected Heathkit representatives are available in most localities.
10. **Heathkit Service is Customer Service**—Our staff of technical experts is always ready to answer your questions or help you if you have any difficulty.

GC-1
$99.95
$10.00 dn., $9.00 mo.

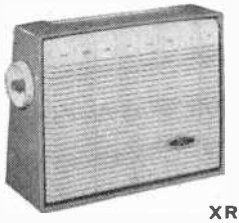
TEN-TRANSISTOR "MOHICAN" GENERAL COVERAGE RECEIVER KIT (GC-1)

An excellent portable or fixed station receiver. Many firsts in receiver design, ten transistor circuit, flashlight battery power supply and new ceramic IF transfilters. The amazing miniature transfilters used in the GC-1 replace transformer, inductive and capacitive elements used in conventional circuits for shaping bandpass; offer superior time and temperature stability, never need alignment, provide excellent selectivity. Telescoping 54" whip antenna, tuning meter, flywheel tuning and large slide-rule dial also featured. Covers 550 kc to 30 mc in five bands. Electrical bandspread on five additional bands cover amateur frequencies from 80 through 10 meters. Operates up to 400 hours on 8 standard size "C" batteries. Sensitivity: 10 uv, broadcast band; 2 uv, amateur bands, for 10 db signal-to-noise ratio. Selectivity: 3 kc wide at 6 db down. Measures 6½" x 12" x 10". 20 lbs.

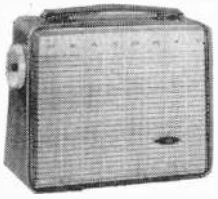
HEATHKIT XP-2. Plug-in power supply for 110 VAC operation of GC-1. 2 lbs. **$9.95**

HD-19
$34.95

HD-20
$14.95



XR-2P
$29.95
(6 lbs.)



XR-2L
$34.95
(7 lbs.)

6-TRANSISTOR PORTABLE RADIO KIT (XR-2 Series)

Unsurpassed quality and styling are combined in these handsome sets to provide you with superb and dependable portable entertainment wherever you are—wherever you go! Choose the gleaming, two-tone molded plastic model or the handsome simulated leather-and-plastic combination—both feature a gracefully curved grille in smart beige plastic. The XR-2P complements the handsome grille with a mocha colored case of high-impact plastic, while the XR-2L encases the beige grille in suntan color Sur-U-Lon simulated leather. Vernier tuning control gives you smooth, precise station selection. Six Texas Instrument transistors are used for quality performance and long life; a large 4" x 6" PM speaker with heavy magnet provides "big set" richness of tone. Ready to play after simple assembly—transformers prealigned. Six flashlight batteries used for power (500—1,000 hrs.) (Batteries not included).

HW-19 (10 meter)
HW-29 (6 meter)
$39.95
each

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Over 150 items of stereo, marine, amateur and test equipment are illustrated and described in the complete Heathkit Catalog.

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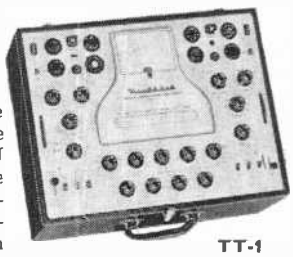
New! One switch operation

"HYBRID" PHONE PATCH KIT (HD-19)

Transfer calls from ham rig to telephone by flipping a single switch! Allows voice control (VOX) or manual operation. VU meter monitors output to 600 ohm line and serves as null depth indicator. Separate receiver and transmitter gain controls. Provides better than 30 db isolation between receive and transmit circuits. All leads filtered to minimize RF feedback. Matches receivers with 3 to 16 ohms impedance. 4 lbs.



TT-1

$134.95

$13.50 dn., $12.00 mo.

NEW 100 KC CRYSTAL CALIBRATOR KIT (HD-20)

This versatile ham aid provides marker frequencies every 100 kc between 100 kc and 54 mc. Use to align all types of communications equipment. Features transistor circuit dependability, battery power portability, and crystal control accuracy. .005% crystal supplied. 1 lb.

Two brand new models

HEATHKIT 10 & 6 METER TRANSCEIVERS

Complete ham facilities at low cost! Ideal for beginning and veteran hams for local net operations. Transmitter and receiver are combined in one easy-to-use instrument. Features neat, modern styling, press-to-talk transmit/receive switch, built-in AC power supply, variable receiver tuning, variable gain control, and amplifier metering jack. Operates mobile using vibrator power supply. Microphone and two power cables included. Handsomely styled in two-tone mocha and beige. Less crystal.

VIBRATOR POWER SUPPLIES: VP-1-6 (6 volt), VP-1-12 (12 volt). 4 lbs. Kit; **$8.95** each. Wired; **$12.95** each.

EK-1

$19.95

MUTUAL CONDUCTANCE TUBE TESTER (TT-1)

The impressive list of its features make this tube tester a fine value. Tests Gm (amplifiers) from 0-24,000 micromhos, Emission, Leakage, Grid current (¼ microampere sensitivity), Voltage regulators (built-in variable DC power supply), Low power Thyratron and Eye tubes. Features 300, 450, and 600 ma constant current heater supplies, life test, Hybrid tube test, built-in switch operated calibration circuit. Large easy-to-read meter, and constant tension free-rolling roll chart mechanism. Individual selector switches allow testing any tube type, regardless of basepin connections, protecting against obsolescence. Assembly simplified by 7 wiring harnesses and transformer terminal board. Assembly skill of technician or higher recommended, time 40 hours average. Black leatherette case with white trim, nylon feet, removable top. 27 lbs.

EDUCATIONAL KIT (EK-1)

Teaches, as you build, the basic "yardsticks" of electronics—opens up fascinating areas of study for youngsters and adults alike. The combination kit and text-workbook gives you a practical demonstration of the principles of voltage, current and resistance; the theory and construction of direct current series and parallel circuits, voltmeter, ammeter and ohmmeter circuits and the application of ohms law to these circuits. The completed meter is used to verify ohms law and the maximum power transfer theorem, one of the most important theorems in electronics. The finished kit, a practical volt-ohm-milliammeter, may be used in a variety of applications. Procedures for checking home appliances and automobile circuits included with the kit. The EK-1 will serve as a prerequisite to following Heathkit Educational kits. Get started NOW in this new and exciting series of "learn-by-doing" educational kits. 4 lbs.

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*The convenience of Local Heathkit Sales and Service costs but a few dollars more.

By
JOHN T. FRYE
W9EGV

Carl and Jerry

The Black Beast

THE BRIGHT May morning found Carl and Jerry furiously pedaling their bicycles along a dirt road paralleling the river west of their home town.

"As I told you," Carl was explaining to his puffing companion, "yesterday afternoon I was trying out my new spinning reel along the path that runs between the bottom of the limestone bluff and the river. On the very first cast I let go of the line at the wrong time, and my favorite flat-fish lure sailed backwards into some scrub trees growing right against the base of the cliff. In trying to free the lure, I spied this narrow opening that looks like the mouth of a cave. I didn't have a flashlight; it was getting late; I knew my favorite pal would want to explore the cave with me; so I came home."

"What you really mean is that you were scared to go in by yourself," Jerry said with a sniff as he braked his bicycle to a sliding halt at a point where a steep path led down to the river.

Carl led the way down this path and then along a narrow, rocky ledge between the water and the cliff for a hundred yards or so. Then he clawed his way through some stunted trees and thorn bushes, and finally stopped triumphantly in front of an opening a couple of feet wide and about six feet high in the white limestone wall. The boys turned on their flashlights and very cautiously entered the narrow tunnel. It twisted and turned for some hundred feet and then suddenly emerged in a domed, nearly circular room at least twenty feet in diameter.

"Hey, Jer, look at that!" Carl breathed in a hoarse whisper as his flashlight beam came to rest on a dim, crude picture painted on the smooth white wall of the cave. As the circles of light from the two flashlights followed each other around the room, paintings and drawings as high as a man could reach were revealed on the walls.

"They must have been painted by Indians many years ago," Jerry whispered, shivering in the chill damp air of the cave. "Hey! What are we walking on?" he exclaimed as he tripped over something.

Carl shined his light down at their feet and then said softly, "Oh, oh!" The floor of the cave was strewn with large bloody bones with bits of flesh still clinging to them.

"Man, let's get out of here," Carl exclaimed as he headed for the tunnel opening. "Maybe the—the—the thing that lives here comes home for lunch."

The boys left the cave a lot faster than they had entered it.

"No ninety-pound weakling lives in there," Jerry asserted. "Those bones belonged to an animal at least cow-size."

"Yeah, and look at this," Carl added as he reached up and plucked a tuft of black coarse hair from a thorny branch hanging down over the cave. "Whatever it is, it's black and hairy and taller than we are."

"A black beast!" Jerry exclaimed in awe as he stared at the lock of hair in Carl's hand. "Let's find out what it is!"

"Like how?" Carl questioned dubiously.

"Hm-m-m-m, that's a good question. We can't stay down here and watch the cave without danger of the thing's scenting us."

"And probably gnawing on us like he did on those bones," Carl added. "But we can't watch from the top of the bluff because that overhang of rock conceals the cave mouth from sight up there."

"I got it!" Jerry exclaimed. "Remember when we used a simple capacitance relay to make that chicken-stealing coon at my uncle's farm take his own picture? Well, I've been experimenting with a new-type capacity relay described in the February *Electronics World*. We can camp safely on top of the bluff and let this relay tell us when anything or anyone enters the cave."

"What's special about this relay?"

"The sensing probe can be some distance from the relay and connected to it through a coaxial cable. The relay has two identical low-frequency r.f. oscillators: one fixed-tuned with a 300-$\mu\mu$f. capacitor, and the other tuned by a semi-variable capacitor in parallel with the capacitance of the coax line. This oscillator is set about 1000 cps higher in frequency than the fixed oscillator. The heterodyned difference beat between the two oscillators is amplified and fed through a low-pass filter to the control grid of a thyratron tube with a relay in its plate circuit.

"As long as nothing is near the probe, the low-pass filter prevents the 1000-cycle signal from reaching the thyratron and firing it; so the relay contacts remain open. When a body approaches the sensing probe, the additional capacity thus produced lowers the frequency of the tunable oscillator and also the difference-frequency heterodyne fed to the amplifier. This lower frequency passes readily through the filter, fires the thyratron, and closes the relay.

"There's only one joker," Jerry added

thoughtfully as his eye measured the distance between the cave and the overhanging ledge. "The RG-8/U coaxial cable I've been using has a capacitance of 29.5 μμf. per foot. It's about twenty feet from the cave to that overhang where we could conceal the gadget and then run lamp cord from the relay contacts on up to the alarm at the top of the bluff."

"And 20 times 29.5 is 590 μμf.—far in excess of the 300-μμf. total capacity required to tune the oscillator to the right frequency," Carl finished.

"Of course, there are special coaxial cables with less capacity, but none in this town . . ."

"I can solve your problem!" Carl interrupted as he started back toward the path. "I'll tell you about it on the way home."

ONCE HOME, they set feverishly to work. A twenty-foot length of RG-8/U was firmly anchored at one end and the remainder stretched out straight. The anchored end had its inner conductor tinned and a No. 30 wire carefully soldered to it. Heavy leads from a low-voltage high-current transformer were run to the two ends of the center conductor. By means of an autotransformer in the primary circuit, the current through the inner conductor was gradually increased until the conductor grew noticeably warm. Carl watched the dielectric material around the conductor carefully, and when he decided it was softened the proper amount by the heat, he unsnapped the leads from the transformer, grasped the end of the conductor with a pair of vise-grip pliers, and, walking backwards, easily pulled the conductor out of the cable and the No. 30 wire into the cable in its place.

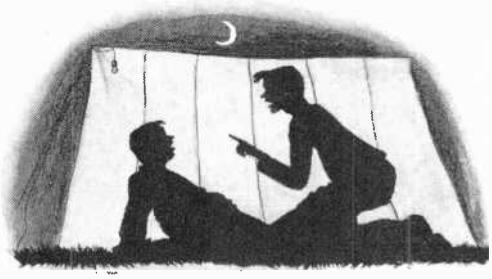
Since the capacity of the cable was chiefly a function of the ratio of the inside diameter of the shield to the diameter of the conductor, replacing the conductor with the No. 30 wire drastically reduced the capacity of the cable—and incidentally raised its characteristic impedance. Now, with the reworked cable in place and the capacitance relay powered from batteries, the oscillator could easily be tuned to the proper frequency.

Soon the boys were pedaling slowly back toward the cliff burdened with gear for an overnight camp plus a long length of strong rope and Carl's .22 rifle. They tied the rope to a tree on top of the bluff directly above the cave, and Carl lowered himself to the overhang of rock. There he set up the capacitance relay with its battery power supply.

The coax cable was run down to the cave, and a lamp cord was run to the top of the bluff from the relay contacts. Both were concealed by vines growing on the face of the cliff. A small wire was connected to the bottom end of the coax inner conductor and artfully concealed around the opening in the cliff. Carl adjusted the variable frequency oscillator so that the relay contacts remained open until Jerry approached the opening; then they closed. They even closed when he tried to sneak in on his hands and knees.

The boys pitched their tent right at the edge of the bluff. They connected a battery and small light bulb in series across the two wires coming up from the relay contacts and fastened the lamp to the ridge-pole of their little tent. It was dark by the time they finished supper; and now, with nothing more to do except wait, the weariness resulting from the day's strenuous activities overtook them. After fighting sleep for a short time in the warmth of their campfire, they gave up, crept into the tent, and almost immediately lost consciousness.

WHEN Carl was snapped wide awake some time later by a light shining in his face, he instinctively felt that several hours had passed. Reaching over, he roughly poked his still-sleeping companion in the ribs. "Come on, wake up! Something's entered the cave and turned on the light."



Jerry sat up and rubbed his eyes sleepily. "Maybe we ought to wait until morning," he said with a shiver as he looked at the darkness outside.

"None of that!" Carl said sternly. "We go look now before he gets away. Remember this was your idea."

Stealthily the two boys, Jerry carrying the flashlight and Carl carrying the rifle, stole down the steep path and back along the narrow strip of rock leading to the cave. Not a sound could be heard except the singing of the night insects and the gurgling of the river.

"You go first with the rifle. I'll be right behind you with the light," Jerry suggested in a shaky whisper as they stopped in front of the yawning, pitch-black opening in the rock.

"Okay, but just don't get in my way if I suddenly decide I want out," Carl warned.

Slowly and cautiously the two boys entered the tunnel. Carl held the rifle stiffly out in front of him, and Jerry walked right on his heels with the glowing flashlight thrust through the crook of Carl's elbow.

Nothing happened until they reached the last right-angle turn in the tunnel. Suddenly Jerry clutched Carl's shoulder. "Listen!" he hissed. "Didn't you hear something?"

"How can I with you breathing in my ear like an asthmatic grampus?" Carl retorted as he edged around the turn.

The beam of the flashlight shining across the room revealed nothing, but as the two boys stepped from the tunnel, a pair of hairy arms reached out from the side and grabbed both the rifle and the flashlight, wrenched them out of the boys' hands, and sent the two stumbling forward to their knees in inky darkness. Carl was on his feet like a cat, but when he turned toward where he thought the tunnel opening was, he ran against a great hairy creature that smothered him in a vise-like grip.

"Kick him! Bite him, Jer," Carl shouted

as he sank his teeth into a loose fold of the skin of the beast.

"I wouldn't do that," a deep chuckling voice answered. "I don't think my dad will like it if you chew a hole in his beloved old raccoon coat."

At this instant the flashlight came on and revealed a large smiling young man dressed in a bulky fur coat. Over at one side of the room was a camera on a tripod.

"So you boys want an explanation, and you've got one coming," the personable youth went on. "My name is Dick Palmer, and I'm a junior at the state university. About a month ago I stumbled upon this cave. I have a hunch these pictures were made by the mound builders that used to live around here. Photography is a hobby of mine, and I instantly got the idea of photographing the pictures and selling them to one of the big picture magazines. I need the money to finish my college education.

"I've been driving back here every night I could get away from school to photograph these walls. It took a lot of experimenting with lighting and so on, but I finished the job tonight. Yesterday afternoon I had a little free time and drove over, but just as I got here, you," he said, nodding at Carl, "discovered the cave. I simply had to have a few more hours to finish up; so last night I stopped at a butcher shop and got a big bag of beef bones to spread around the cave and maybe convince you that this was the lair of a dangerous animal.

"When I heard you two coming down the tunnel tonight and saw that rifle, I decided I'd better disarm you first and explain later. You sounded a little trigger-happy."

"Why the fur coat?" Jerry asked.

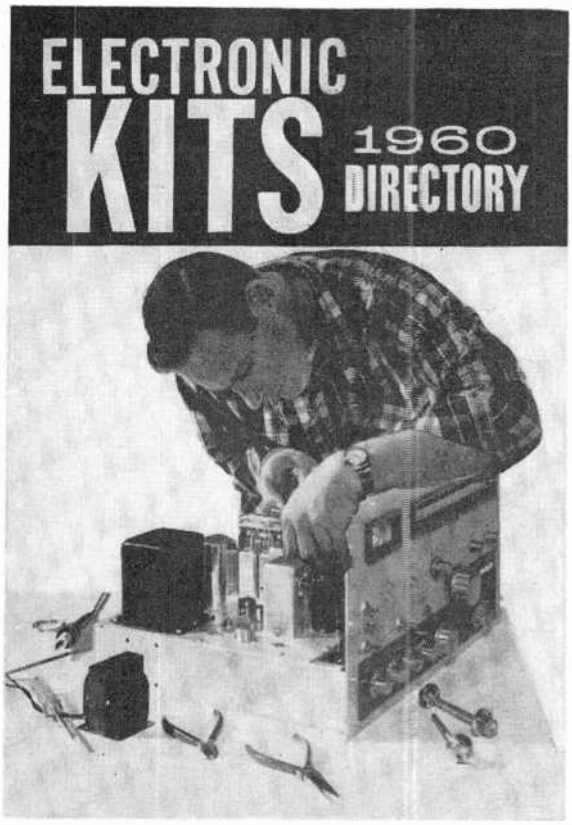
"It gets darned chilly in here; so I've been wearing the old fur coat dad had in college to keep me warm. Now *I've* got a couple of questions. How come you're prowling around here at midnight, and how did you know I was in here?"

"COME on up to our camp on top of the bluff, and we'll show you, and give you a cup of hot chocolate," Jerry offered.

"And you needn't worry that we'll blab about that cave," Carl added. "You found it, and it's your secret."

"Fine, men. If I'd known you were that sort, we could have saved all of us a lot of trouble."

"And goose pimples!" Jerry admitted with a grin. —30—



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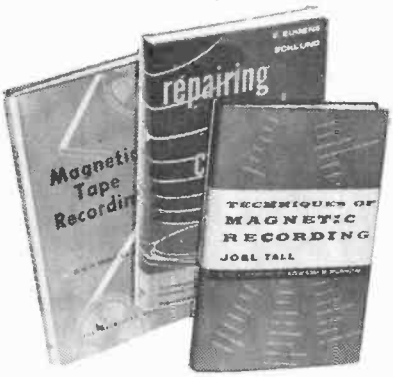

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Transistor Topics

(*Continued from page* 80)

When this announcement was first made by the U.S.S.R. government news agency, *Tass,* there was a considerable flurry among American semiconductor manufacturers. It seems that several U. S. firms have been working along similar lines for some time, but their work is still in the preliminary stages.

If plastic transistors do become a commercial reality, your columnist's prediction of "two-bit" transistors may turn out to be overly pessimistic. "Two-for-a-nickel" may be the future price!

Product News. The Heath Company (Benton Harbor, Mich.) has revised its popular "XR-" series of transistorized portable receiver kits. Two improved versions are now being offered both by mail order and through local distributors. Both are high-performance six-transistor sets powered by six standard flashlight batteries. Model XR-2P, selling for $29.95, mail order, uses an all-plastic case in two-tone beige. The XR-2L, selling for $34.95, is similar electrically, but features a plastic front panel and a "sun-tan" leather case.

RCA's Semiconductor Division (Somerville, N. J.) has introduced a line of drift-field transistors for FM and AM-FM radio receivers and tuners. All are *p-n-p* alloy units. Included are the 2N1177, 2N1178, and 2N1179, designed for use as r.f. amplifiers, local oscillators, and converters, and the 2N1180, designed for use as an i.f. amplifier at frequencies up to 10.7 mc.

A Canadian firm, the Seabreeze Manufacturing Co. (Toronto), has a new record-player/amplifier combination that can be converted into a radiophonograph by plugging in a small transistorized "tuner" cartridge. The cartridge has a tuning dial at one end, measures 3½" by 1½" and weighs only 3 oz.; yet it houses a complete superhet circuit.

G.E.'s Communication Products Department (Lynchburg, Va.) has announced a transistorized multiplex-carrier system which can handle as many as 600 voice channels.

That does it for now. With May here, can summer—and portable radio time—be far away? Don't miss the four summertime transistorized projects starting on page 60 of this issue. Back next month . . .

Lou

se of the Elusive Harmonic

(*Continued from page 71*)

pretty awful. One way to eliminate the double dip—and the harmonics with it—is to change to a pi network in the final. We can salvage the coils and capacitor from the present tank."

"Okay with me," Bob said.

Two hours later, we had installed the pi final.

"How have you been checking your frequency?" I asked then.

"Well, I've been using my receiver with the r.f. gain turned down."

"You should have an absorption frequency meter—similar to the one I have but not as elaborate," I said. "Even a very simple one will do." (See Fig. 3.)

"But regardless of the type you use, don't couple tightly to any tuned circuit or you'll always obtain a broad reading. Incidentally, a very sensitive transistorized device which can be used as a field strength meter as well as an absorption frequency meter when it's calibrated is described in the October 1958 issue of P.E. Better look up the article and make one," I suggested.

Bob said he would.

AFTER spending nearly four hours on the transmitter and making many changes (see Fig. 1), I was satisfied that it was okay and there was little likelihood that Bob would get another ticket.

We went outside then and checked his dipole antenna, which had been cut for the 7-mc. band. It was in good condition, and the length was correct.

"Do you have a standing-wave ratio meter?" I asked him as we walked back into the house.

"No, I don't," he replied, "but I'm figuring on getting one."

"When you go to a beam antenna and get your General Class license, you'll need one," I told him.

After we checked the TV for interference, we worked a station about 100 miles away. His reports on our signal were very

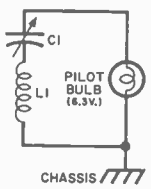

Fig. 3. Simple absorption frequency "meter" uses pilot lamp as indicator. The values of L1 and C1 are the same as in Fig. 1.

good—and there were no harmonics at all.

"I don't think you'll have any more trouble now, Bob," I said, "but I'll check with you over the air when I get home. Okay?"

He agreed, and I picked up my equipment and started to make my way to the front door.

"Remember, Bob, when propagation conditions are very good, a little harmonic can travel quite a distance. So be sure when you tune up to check not only the fundamental frequency but also for second and third harmonics—especially when you have only a single-ended final."

"I will, Chuck," he answered smiling, "and thanks a lot for your time and trouble."

"Not at all," I said. "We hams must stick together and help each other. One of these days you'll pass on what you learned today to some other ham and my efforts will have been rewarded." —30—

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TV's Trick Techniques

(*Continued from page 44*)

tensity from varying and thus "confusing" the keying circuits. The CBS VideoScene system is much simpler to light. The keying backdrop is made of a special reflective material, the brainchild of Minnesota Mining & Manufacturing Company, which is designed to beam the light squarely back at its source.

At CBS, engineers put a powerful blue light on the camera to illuminate the pick-up area. The way this blue light is made to come right from the camera's lens is ingenious. A beam splitter—a type of one-way mirror—is mounted in front of the lens at a 45° angle. The lower side is a reflective surface, but the upper side is transparent, and the lens of the camera sees right through it. However, blue light projected onto the lower surface reflects onto the subject and the reflective background sends it right back to the camera to key the switching amplifier.

Miniature Sets. VideoScene has one other very interesting feature. It can insert an actor into a miniature set and then have the two cameras "pan," or move together. This is done by equipping both cameras with zoom lenses and linking them together with a servo system.

The camera aimed at the setting dupli-

cates every action of the camera picking up the actor. When the actor's camera pans to follow him, the setting camera pans, too. If the first camera zooms out its lens for a close-up, the second camera also zooms. As a result, the relationship between subject and background is always the same, yet you can get any number of camera effects—panning, close-ups, long shots, etc.

With VideoScene the background setting is either a model or a picture about one-sixth life size. The "subject" cameraman usually watches the composite picture on his viewscreen and checks the relationship of the setting to the actor. Operating from the one camera, he can zoom in for a close-up of the actor, pull back for a medium shot, and then zoom back in—this time for a close-up of some detail of the miniature setting.

VideoScene's model sets are attractive to the CBS brass because of the space they save. Actors no longer have to break their necks rushing from one set to another. By altering the scale, the actors can be made Tom Thumbs in a monster world, or they can become giants in Lilliput.

NBC's versatile process, Chroma-Key, has its points, too. How about a multiple Chroma-Key effect with two Chroma-Keyers, two switching amplifiers, and three pickups? Here's an example.

The background is a photo of a Paris sidewalk cafe, which is covered by the "background" camera. The "subject" camera picks up a group of actors sitting at tables in front of a blue keying backdrop. To be mixed in with these two elements is a special film of cars and trucks. For purposes of keying, the film is colored blue wherever there are no images of vehicles.

The first composite picture is made up of the filmed vehicles inset into the pickup of the actors. This picture, in turn, is inset into the photo of the sidewalk cafe. So viewers at home see the actors sitting in the cafe while street traffic apparently passes in front of them.

Chroma-Key sees service on the regular NBC color shows—the Dinah Shore, Steve Allen, Perry Como, and Tennessee Ernie Ford shows. VideoScene, unveiled by CBS on the Ed Sullivan Show early in 1959, has been used a good deal for commercials. Between the two systems, you really can't believe your eyes these days! —30—

Inside the Tape Recorder

(*Continued from page* 59)

erclockwise while the take-up reel revolves clockwise. The torques of the motors are adjusted by series resistors so that in the *Play* or *Record* position the take-up motor operates at greater torque than the supply motor. When the capstan is pulling the tape along, the torque on the supply reel keeps the tape under proper tension as it goes to the capstan, and the take-up reel motor has sufficient torque to take up the tape delivered to it by the capstan.

Fast Forward and Rewind. After the tape has been recorded, it must be rewound onto the supply reel. Since it would be an awful nuisance if rewinding the tape took as long as recording or playing it, we need a *Fast Rewind* function.

The problem here is relatively simple because we do not need to maintain a constant speed. Basically, all we have to do is release the tape from the pinch of the capstan and then apply full torque to the supply reel.

Most recorders have a *Fast Forward* speed to enable a portion of a tape to be located quickly. This is provided simply by reversing the *Fast Rewind* operation: the take-up reel rather than the supply reel is driven with full torque.

It is apparent that since the drive requirements of the capstan, the take-up reel, and the supply reel are all different, the easiest and neatest drive system is one which uses three motors—one to drive each of these moving elements. This is the solution to the motor problem applied in most professional and some high-quality home tape recorders.

With three motors, the "slipping" for the take-up and supply drives is done electrically. The only drawback to this solution is the high cost of three good motors. Therefore, in most home-type machines—and in some semi-pro machines—a single motor is employed.

When only one motor is used, the various necessary types of drive require that the mechanical system be quite complex. By careful design and precise mechanical assembly, however, single-motor recorders can achieve results which approach those of multi-motor jobs.

Wow and Flutter. Because the magnetic heads of a tape recorder are not responsive to vibration, rumble is not a problem with tape recorders. On the other hand, flutter and wow—variations in speed—are very serious, partly because the "pinching" friction drive of a capstan is not a perfect way of communicating torque to slick tape surfaces. Furthermore, wear on capstan and idler, the accumulation of oxides from the tape and even of lubricants (some tapes are lubricated to reduce friction and wear on the face of the magnetic heads) can cause slippage and wow. The tape-moving mechanism has to be well-designed, well-adjusted, and well-maintained to move the tape with a minimum of wow.

Flutter and wow are expressed as a percentage of a reference level. The best professional tape decks hold both down to 0.1% or less when the decks are properly adjusted. This would be 60 db down from the reference level and quite inaudible. Semi-professional and top-quality home recorders have wow and flutter figures from 0.1 to 0.2%; home recorders run from 0.2% up, or from 54 db down.

As tape speed is decreased, wow and flutter become more pronounced. A deck that yields an 0.1% figure at 7½ ips might give 0.15% at 3¾ ips and 0.2% or more at 1⅞ ips. Thus, the higher speeds not only provide a better high-frequency response (see last month's article in this series) but also greater speed constancy.

Head Arrangements. A minimum of two heads is needed for recording and playback. One head can do double duty for both recording and playback, but in addition, a separate erase head is needed to demagnetize the tape ahead of the recording head.

Most professional and some semi-professional decks have three heads: erase, record, and playback. Separate record and playback heads offer a number of advantages. For one thing, each can be designed for optimum performance. For another, a separate playback head allows "off-the-tape" monitoring. Since the playback head is always placed after the record head, we can play back the tape a fraction of a second after it has been recorded. A variety of head combinations are available today to take care of the many types of recording.

For playback only, the output of a tape deck can be fed directly into a modern high-fidelity preamplifier. But to permit recording as well as playback, we need some additional electronic circuits which we will discuss next month. —30—

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☐ **30 ONE PERCENT-ERS** Resistors: prec. carbo-film, ½, 1, 2W. Reg. $30. $1

☐ **12S FT. MICRO-WIRE** For submini work. ±24 to 32. Insl. tinned stranded. $1

☐ **8 RCA PLUG'N'JACK SETS** Matched pairs. For tuners, amps, recorders. $1

☐ **60 CONDENSER SPEC.** Molded, mica, ceramic, oil, paper, discs. $15 val. $1

☐ **100 HALF WATTERS** Carbon resistors. 30 values. 1% too. $1

☐ **10 LUCITE BOXES** Snap top box types to 4" sq. For all parts. $1

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☐ **MIKE TRANSF'M'R** Mini size. Sealed. 100 ohms to 100,000 ohms. $1

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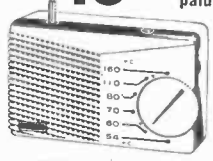

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Among the Novice Hams

(*Continued from page* 93)

News and Views

Bob Secor, WV6JCJ, 6242 Rockwell St., Oakland 18, Calif., is carrying on the family tradition. His dad is K6VSO, and his brother, Terry, is K6VSN. Bob uses his dad's Heathkit DX-100B transmitter with a pair of 150-watt light bulbs connected in the primary circuit of its plate transformer to get the power down to below the Novice limit of 75 watts. He uses crystal control, of course. . . . . **Alan Richards, WA2EGA,** 194-10C 65 Crescent, Flushing 65, N. Y., really took advantage of his ten months as a Novice. He earned a 25-wpm code-proficiency certificate and made over 525 contacts. Not bad for a 15-watt transmitter with a 65′ end-fed antenna! Alan spent most of his time on 80 meters, where he worked 25 states. But he is "high" on 40 now, after working three new states in three days. His "General" transmitter is a surplus ARC-5, which he plans to push to 140 watts. Check with him if you need help with code or theory.

Don McLaughlin, WV6HVE, 2016 Marine St., Santa Monica, Calif., has made 260 contacts in 35 states and six countries in two months. He pushes out 50 watts through a Heathkit DX-20 transmitter and a 40-meter dipole, 40′ high. He receives on a Hallicrafters S-38E aided by a Heathkit QF-1 Q-multiplier. Don divides his operating time between 40 and 15 meters. . . . . **Donald C. Girard, K9LGA,** 18 S. Culver St., Chippewa Falls, Wis., has been a ham for two years. The 40- and 20-meter c.w. bands are his favorites. He uses a Heathkit DX-40, plus a VF-1 VFO to feed separate 20- and 40-meter doublet antennas, and he receives with a Hallicrafters SX-99. Donald is more interested in working all states than he is in DX'ing. He has worked 46 states (44 confirmed) and six countries. Drop him a card if you need a Wisconsin contact.

Bob Milliren, KN5UGJ, 3200 Covert, Fort Worth, Texas, had his ticket quite a while before getting on the air, due to an "equipment shortage." But in four months his DX-20 and Knight "Space Spanner" receiver have accounted for 24 states on 7188 kc. He uses two

MORE AND MORE HAMS

More than 200,000 U. S. citizens now hold amateur radio operator licenses, and the number of station licenses is approaching 204,500. The "extra" station licenses are held by clubs and by operators who have stations at more than one fixed address. Collectively, these ham licenses represent an increase of more than 285% since World War II.

Individuals holding operator licenses range from beginners to seasoned old-timers. There are no age limits. Boys and girls of seven have qualified for the beginner's license, and many persons over 70 still find amateur operation an engaging hobby. The average ham age is estimated to be about 34.

antennas at right angles to each other. . . . . **Neil, KN7IPP,** Route 1, Box 23-HP, Gig Harbor, Wash., has switched from 40 to 15 meters, because it gives him a chance to make a few contacts before he has to do his homework. He reports that for a long time he heard very few Novices on 15 with his Hallicrafters S-38D receiver. Then he repeaked the antenna trimmer for 15 meters and discovered the band was loaded with signals. . . . . **Jim Dionne, KN1MEM/K1MEM,** 35 High Rock St., Westwood, Mass., uses a DX-40 transmitter and an SX-99 receiver. He has had too many antennas to mention. Jim works the three low-frequency Novice bands, but 15 is his favorite. His record is 35 states, five Puerto Ricans, and England. Although he has a Technician license, he doesn't care for the v.h.f. bands. He's waiting for his General to come through, and he offers to help others obtain their tickets.

Tony Bodo, KN9UEN, 4725 Pennsylvania Ave., Gary, Ind., usually operates on 7198 kc. late, late at night, transmitting with a Globe Chief 90A which feeds a folded dipole antenna and receiving on a National NC-125. Tony can read, write, and speak German, Croatian, and Serbian, as well as English; so you have a choice when you work him. . . . . **Mike Bisgood, WA6AQY,** 4467 Mt. Everest Blvd., San Diego 17, Calif., was a Novice for seven months and worked 33 states, including Alaska, with a converted surplus ARC-5 transmitter running 60 watts. Now, after 11 months as a General, he uses a home-built all-band VFO-controlled transmitter at 40 watts. Mike is also building a 300-watt amplifier for the transmitter. His receiver is a Hallicrafters S-85 with an added Q-Multiplier. Mike is another who offers to help prospective hams.

Michael Eilers, KN8OOK, 2533 Leahy St., Muskegon Hts., Mich., worked KL7CDF for his fiftieth state, but he still needs three QSL cards before he can apply for the certificate. Michael's longest QSO's have been four hours on two meters, and two hours, six minutes on 40 meters. He still has no Rag-Chewer's Club certificate, although four different members have nominated him. His DX-20, 40-meter dipole, and SX-99 have worked together to give him 1013 contacts and 496 QSL cards. . . . . **Larry Lenon, WV6GDM,** 1600 E. 53rd St., Long Beach 5, Calif., really gave his dad a sales talk on ham radio. As a result, his dad's Citizens Band beam has been converted to a 15-meter beam, helping Larry work 48 states, Canada, and Midway Island; and Dad is now waiting for his Novice license. Larry uses a Hammarlund HQ-160 and a Heathkit DX-40.

"Short Course for the Novice License" is the title of a four-page bulletin prepared by EICO, Long Island City, N. Y., and available from electronic and ham supply houses free of charge. It answers the question, "How do I get a Novice license?"

Let's have your news and views, pictures, and suggestions for next month. 73,

Herb, W9EGQ

Tubes for Hi-Fi

(*Continued from page* 51)

Heathkit W-6M 70-watter and the Dynakit Mark III.

Along with the simpler, less expensive circuitry, the new high-power output tubes offer other advantages which are not so obvious. Since their plates will accept almost twice the voltage at which they normally operate, all of the new tubes can be operated very conservatively, thus increasing their life expectancy. Their lower plate resistances help to secure higher damping factors for modern speaker systems, and their stable behavior in the Ultra-Linear circuit is important for driving modern electrostatic tweeters.

The new medium-power output tubes have achieved similar results. Miniaturization of tubes like the EL84/6BQ5 provides audio designers with a bonus that permits the construction of compact but well-ventilated amplifier-preamplifier combinations for stereo. Until very recently, the EL84 has been the unchallenged kingpin of medium-power circuits, but during the past year the 7189 and 6973 have been gaining a place in compact amplifiers. The newest addition to the medium-power field, the EL86/6CW5, operates at relatively low plate voltage and relatively high plate current.

With stereo focusing attention on simple, low-power amplifiers again, the arrival of the ECL82/6BM8 is worth noting. This European import features a triode section for voltage amplification and a pentode section for power output. It seems to be a natural for low-power circuits, and was first featured editorially in this country in POPULAR ELECTRONICS, April, 1959.

Rectifiers. Although rectifiers never attract much attention until they break down, tube designers have come up with some new ones to fit the needs of modern amplifiers.

The imported GZ34 and its smaller relative, the EZ81, have become very popular. They feature indirect heating, which prolongs the life of filter capacitors and other components by sparing them the usual jolt they receive during amplifier warm-up. Both of these tubes have very small voltage drops as a result of extremely close plate-cathode placement.

There is a new version of the familiar 5U4 available from CBS (the 5U4GB) which

claims elimination of back emission through the use of a new plate material. And the present 5V4 also offers indirect heating, although its d.c. output of 175 ma. is not as high as that of the GZ34, nor are its peak voltage readings as high.

All in all, vacuum tubes continue to dominate hi-fi circuitry. And, after borrowing heavily from existing types, hi-fi has gradually grown its own family of tubes. Importers like Amperex and Mullard were prime movers in creating this family, but American manufacturers have been taking more time off recently from industrial and TV activities to add to the breed. With the benefits that new tubes have been bringing to hi-fi circuitry, the audiophile is sure to be "hearing from" them for some time to come. -30-

The Language of Vectors

(*Continued from page 87*)

tion is what the drawing you made means to you electrically. If you can explain that, you're well on your way to understanding vector analysis. Start explaining."

"Hmm . . . ," Larry's face frowned with the effort of his concentration. "Well, I'm not absolutely sure. But looking at the drawing, I would say that the +100 volts and the −100 volts cancelled each other out. So I guess the result of adding the two voltages would be zero volts."

He looked up with a relieved expression. "Sure, that's it, zero volts. I guess it's like a tug of war where one team is as strong as the other—they cancel out their strength and no one moves."

"You're right, Larry. That's a good way to put it," said Ken. "Adding vectors is a lot like matching two teams in a tug of war. The result will be the amount that one team's magnitude in strength, or volts, amperes, ohms, or whatever units you're measuring exceeds that of the other team."

Larry looked confused again so Ken added, "What happened, did I lose you?"

"You sure did, Ken. Everything was okay with volts, but now you've slipped in amperes and ohms. You mean vectors can represent other units besides volts?"

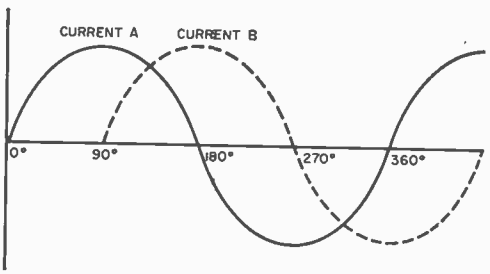
"They certainly can, Larry. Remember that this all started with a discussion of a generator. Well, at the same time a voltage was developed, a current was flowing. If you wanted to let the vectors represent

this current, you could have done that just as well. You would let a certain length of vector—say one inch—represent one amp of current, and you would have current vectors. You're the one who controls the labels on the vectors. They stand for the things you want them to stand for.

"Let's take a case where vectors represent currents and show how phase angles are represented by vectors. Are you clear on the physical meaning of a phase angle, Larry?"

Larry looked embarrassed. "To tell you the truth, Ken, I've used the term, but I've never really understood what it meant. This would be a good time to get it straight. How do phase angles come about, anyway?"

"You're not the only one to be confused by phase angles. It's a confusing subject. Here's another place where a vector diagram will clear things up for you. Let me show you what I mean with a drawing of two curves." And Ken made another rapid sketch.



"What I've just drawn," explained Ken, "is a case where two currents—I've called them current *A* and current *B*—are flowing through the same circuit. But they don't reach their maximum or minimum values at the same time. As you can see from the curve, when current *A* starts flowing at the 0° point, current *B* hasn't begun. It isn't until current *A* has reached a maximum value at 90° that *B* starts to flow. We say that there is a 90° phase angle between the two currents.

"This relates back to the generator coil we first drew," Ken continued, "where the voltages and currents rose and fell according to the number of degrees the coil had turned. That's where the term 'phase angle' comes into the picture. All it does is measure the difference between the value of the currents at any one time and express it in degrees. In this case we would say

that current *A* is *leading* current *B* by 90°. We could also say that current *B* is *lagging* current *A* by the same amount. The two statements mean exactly the same thing, you see.

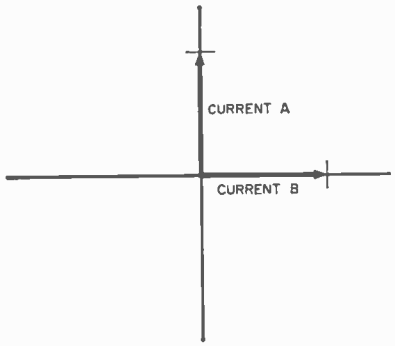
"Are you with me, Larry, or did I lose you again?"

"I'll say this," said Larry. "If you had discussed such a mess before we got to the vector drawings, I would have been at a loss. Now, I honestly think I can see what you mean."

"Fine. Let's see you take this curve picture and draw it in vector form." Ken passed the paper he had been working on to Larry.

"Okay," agreed Larry. "Let's see, first I draw the coordinate axis, like this. Then along the 90° axis I'll put in current *A* to show that it leads by 90°. From your drawing, Ken, both of the currents are the same strength, which means that I draw the two vectors the same length."

Larry paused a moment to reflect. "Now, if current *B* is behind *A* by 90°, I would draw it right along the horizontal axis, like so. Here, Ken, how does this drawing look to you?"



"Nice going, Larry. It looks as though you've got it down pat. I want to add one point, however. You can also show vectors for current and voltage on the same diagram. In fact, for a complete circuit analysis, you usually will."

Ken looked at his watch. "Wow, it's getting late and I'm about talked out for now. How about some milk and apple pie, Larry? We'll save the rest of the vector discussion for the next session."

"I'm with you on both counts, professor," answered Larry. "Thanks for the info, and I'll bet I lead you to the eats by 90 degrees!" —30—

Test Instruments

(*Continued from page* 83)

back and forth slowly through maximum several times to make sure you have located the most sensitive point, and go back and forth over the trimmers several times until no further improvement can be made. When necessary, decrease the output of the signal generator to keep the output meter reading in the lower part of the range.

6. Remove the short across the oscillator tuning capacitor and tune the receiver to 1400 kc. Set the signal generator to the same frequency and adjust the oscillator trimmer (*C5*) and the mixer trimmer (*C2*) for maximum output.

7. Tune the signal generator and receiver to 600 kc. Now adjust *L2* or bend the plates of *C4* or adjust *C5*, depending on the controls provided on your particular set, until the meter reads maximum. If no provision is made for low-end tuning, you may have to rely on the trimmers for tuning both ends. In this case, you will have to make some compromise between peak high-end and peak low-end tuning.

As you tune for maximum, "rock" the tuning capacitor slowly back and forth in the vicinity of 600 kc. When the most sensitive point is found, the dial of the receiver may not indicate exactly 600 kc. even though you know the circuits are tuned to 600. Generally, the difference will be slight.

8. Tune the low end of the r.f. circuit by varying *L1* (if it is a rod antenna), or bending the plates of *C1* or adjusting *C2*, depending on the set. As in the case of the oscillator, you may have to compromise-tune both ends with the trimmer. (In some cases, both ends may have to be compromise-tuned with *L1*.)

9. Since steps 7 and 8 will upset the previous tuning in step 6 to some extent, repeat these three steps until no further improvement can be made.

If you have a multi-band receiver, the same general alignment process can be applied to each band in turn (the i.f. section, of course, need be aligned but once). When the alignment is complete, all local stations should come in loud and clear, and you will also probably be able to receive many new and distant ones.

Next month: a detailed look at some other signal-generator uses, and a few hints on signal-generator maintenance and calibration. —30—

Short-Wave Report

(*Continued from page 84*)

WPE8BX, Detroit, Mich., ran into this trouble, he installed an unusual aluminum foil antenna.

The other day your Short-Wave Editor tried Martin's setup. We bought a roll of regular aluminum wrap (Reynolds, Alcoa, or other brands can be used), and put up two strips along the molding. The strips are about 15' long and are mounted on opposing walls. We attached the feeder line to the ends of the foil strips with cellophane tape. While preliminary tests indicate that this antenna is not as sensitive as our outside long-wire on the standard broadcast band, it does very well for itself on the short-wave bands.

We do not feel that a foil-strip antenna is the best in the world, but it can be highly efficient and could possibly provide the means for apartment and hotel DX'ers to get more out of their receivers. Try one, and let us know how it works for you. We would especially like to hear from DX'ers who operate in buildings with steel frameworks.

Current Station Reports

All times shown are Eastern Standard and the 24-hour system is used. At time of compilation all reports are correct. Stations often change schedules and/or frequencies with little or no advance notice. Please send your reports to P. O. Box 254, Haddonfield, N. J.

Afghanistan—Kabul is noted at 0955-1030, in native language to 1000 and in Eng. to 1030 with news and Oriental music, on 11,730 kc. The 9573-kc. outlet, used for tests in Eng. at 0700-0730 and 0800-0830, has not been heard recently and presumably has been dropped. *(WPE1AAC, WPE1BY, WPE4BC, WPE5RB, WPE8BGF, WPEØAE)*

Angola—*R. Clube de Huila,* Sa da Bandeira, 5024 kc., was heard at 1600 with guitar and Portuguese selections. A talk began at 1618. S/off, 1630. *(WPE1BM)*

Australia—VLY25, Melbourne, 25,735 kc., has been used irregularly in experimental service with no definite time schedule. *(WPE8HF, WPE9ADP, BL)*

According to the latest schedule, VLW (2 kw.) and VLX (10 kw.), Perth, operate at 0530-1030 (to 1100 on Saturdays) and at 1700-1900 (from 1730 on Saturdays) on VLW6, 6140 kc., and on VLX9, 9610 kc., and at 1915-0515 on VLW9, 9610 kc. (from 1815 on Saturdays) and on VLX15, 15,425 kc. *(WPE2ACO)*

Belgian Congo—OTM, Leopoldville, 9385 kc., is noted from 1530 to 1600 s/off with orchestral music; French news from 1555 to s/off. *(WPE2AXS)*

Belgium—Brussels has Eng. to N.A. on Sundays, Tuesdays, and Thursdays at 1730-1800

on 11,850, 15,335, and 11,720 kc., and daily except Wednesday at 1930-2000 (Saturdays from 1815) on 11,850 and 9665 kc. *(WPE8BAG, WPE9ADP, WPE9NY, WPEØADY)*

Ceylon—The Commercial Service of *R. Ceylon*, Colombo, 15,265 kc., is still noted with s/on at 2030 after tone signal and playing of "Strike Up the Band." Music with Eng. anmts until 2100. The BBC news at 2100 is no longer heard; it has been replaced by home news from Ceylon. *(WPE1BY, WPE4BFY, WPE8CV)*

Chile—CE1515, *R. Corporacion*, Santiago, can be heard evenings on 15,150 kc. from 2130,

Emilio Fernandez, above, operates in Havana, Cuba, using a National NC-60 receiver and a 50'-long antenna.

all-Spanish, American and L.A. music; 5-kw. power. *(WPE8AGY)*

Colombia—HJGC, *R. Sutatenza*, Bogota, 5075 kc., is noted at 1930-2214 with a fair signal. News is given on the hour and the rest of the programing consists of American and L.A. tunes. Address for reports: *Accion Cultural Popular*, Escuelas Radiofonicas, Calle 20, No. 9-45, Bogota, Colombia. *(WPE3ALX)*

Denmark—OZF, Copenhagen, 9520 kc., operates to N.A. at 2030-2130 and 2200-2300 (last half hour of each period is in English). Letters are answered during the "Saturday Night Club" program. *(WPE2BYZ, WPE2CKS, WPE3AVA, WPE4AHA, WPE4BHC, WPEØSN)*

Dominican Republic—HI4B, *R. Santiago*, 6315 kc. (varies), can be noted on Tuesdays with "American Hit Parade" from 1800 to 1830 with anmts in Eng. and Spanish. It has been heard until 2238 with L.A. music and frequent ID's. *(WPE1BM, WPE3HP)*

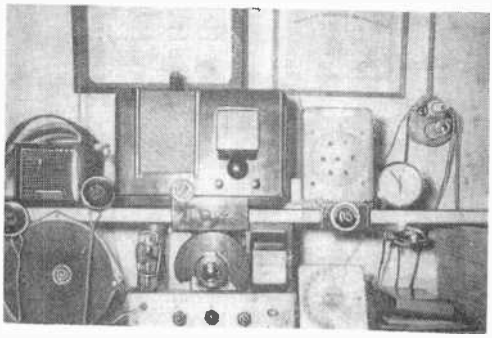
Ecuador—A partial list of the Eng. programs from HCJB, Quito, includes: "Southern Cross Salute" at 0130-0530 on 15,115, 11,915, 9745, and 6050 kc., and at 0900-1130 on 17,890, 15,115, and 11,915 kc.; "Quito Calling" at 1400-1815 on 17,890, 15,115, and 11,915 kc.; "Caribbean Call" at 1830-1900 on 17,890, 15,115, and 11,915 kc.; and "Ecuadorian Echoes" at 2100-0000 on 15,115, 11,915, and 9745 kc. These are all on daily except Mondays. Reports go to Casilla 691, Quito. *(WPE1RH, WPE4BFX, WPE5CN, WPE6AHO, WPE8HF, WPE9NY, VE3PE3G, DD, TL)*

Egypt—Cairo has been noted on new 17,690-kc. channel at 1225-1300 in native language, 1300-1330 in Eng., and 1330-1400 in French. *(WPE4BC)*

Another new channel is 4765 kc., apparently a move from 4782 kc. Tune in for classical music until 1702 s/off; announcements in Arabic. *(WPE3NF)*

Formosa—*The Voice of Free China*, Taipei, carries Eng. to N.A. at 2030-2045 and 0505-0555 on 17,755, 15,345, 11,815, and 7130 kc. The 7130-kc. channel is also noted with Chinese at 0740, the higher frequencies with Chinese at 1000-1100. *(WPE1BY, WPE3NF, WPE7TM, WPE8OF, WPE9AGB, WPEØADY, VE7PE1R, DK)*

French Equatorial Africa—Brazzaville has Eng. daily at 2015-2100 on 11,725 kc., at 1400-1500 (to Africa) on 9730 kc., at 2030-2130 on 17,720 and 9625 kc., and at 0015-0030 on 9625 kc. The "American Letterbox" program is



Max Ovodock, Jr., whose listening post at Philadelphia, Pa., is shown here, tunes 1500-4000 kc. with a Philco "60," 5800 to 18,000 kc. with a G.E. H630.

aired Fridays at 2030 on 11,725 kc. Reports go to Box 108, Brazzaville. *(WPE1AFM, WPE2AFL, WPE4FM, WPE5AEL, WPE5CN, WPE6AVN, WPE9ARA, WPE9NY, MM)*

Gabonese Republic—*R. Gabon*, Libreville, has settled on 5025 kc. and is noted weakly from 1515 in French, improving in strength to 1700 s/off. It features a non-stop musical program from 1600 to 1700. *(WPE1BM, WPE3NF)*

Germany—*Deutsche Welle*, Cologne, has two new 100-kw. xmtrs in use. The schedule now reads: to Far East at 0200-0515 on 21,650, 15,275, and 11,795 kc. and at 0530-0600 (a special Arabic program) on 21,650, 17,815, and 15,405 kc.; to Near East at 1100-1415 on 15,405 and 11,795 kc.; to Africa at 1230-1545 on 15,275 and 17,815 kc.; to South America at 1730-2045 on 11,945 and 9735 kc.; to Eastern N.A. at 1830-2145 (Eng. at 1930-1945) on 11,-

795 and 9640 kc.; and to Western N.A. at 2200-0115 (Eng. at 2300-2315) on 11,945 and 11,795 kc. German lessons are given on the N.A. periods on Mondays (beginners) and Tuesdays (advanced). (*WPE2ACO, WPE2DM, WPE2VY, WPE3AWB, WPE7CE, WPE8FV*)

Haiti—*The Evangelical Voice of the West Indies* is commonly known as 4VEH, while in reality 4VEH itself has been off the air for over a year and is being rebuilt. Each xmtr has its own individual call sign and the stations currently on the air are 4VWI on 9770 kc. and 4VEC on 6000 kc. Station 4VE is off the air and will be replaced by one of the newer xmtrs. The 15,360-kc. channel has dropped the 2100-2200 Sunday program due to poor response. (*WPE2LH, WPE6EZ*)

Honduras—*R. Tegucigalpa,* 6035 kc., is noted at 2340-0100 with pop music, frequent ID's and no commercials. (*VE7PE1R*)

Israel—*Kol Zion (The Voice of Israel),* Tel-Aviv, 9009 kc., now has a program to W. Africa in Eng. at 1615-1645 and in French at 1645-1715. The IS is the first nine notes of "Hatikvah." (*WPE2AXS, WPE2TA, WPE3EK, WPE3PV, WPE4BFX, WPE4TP, WPE9DN*)

Martinique — Fort-de-France has been noted on the unusually low frequency of 2420 kc. at 1935 with classical music, dual to the stronger 5994-kc. channel. The higher channel is often noted around 1800 with music. (*WPE3NF, SR*)

Netherlands—Hilversum has Eng. on weekdays as follows. to New Zealand and Australia at 0400-0450 on 21,480 and 17,775 kc.; to Africa, India at 0900-0950 on 25,610 and 21,565 kc.; to N.A. and Europe at 1615-1705 on 15,220, 11,730, and 6020 kc.; and to N.A. at 2030-2110 on 9590 and 6025 kc. A DX program is aired on Mondays during the N.A. segments. "The Happy Station Program" is broadcast on Sundays only: to tne Far East and Europe at 0530-0700 on 21,565, 15,220, and 6020 kc.; to India, Africa, and Europe at 1100-1230 on 25,610, 21,480, 17,775, and 6020 kc.; to Spain and South America at 1600-1730 on 15,220, 11,730, and 6020 kc.; and to N.A. at 2100-2230 on 9590 and 6025 kc. (*WPE1AFM, WPE2RV, WPE3BAP, WPE5GQ, WPE6ALQ, WPEØBO, WPEØGA, RB, FC, R. Netherland*)

Nicaragua—If you need this country, try for YNX, Managua, 6025 kc., around 2245-2300, or YNMS, *R. Philips,* Leon, 7660 kc., around 2100 Both stations have all-Spanish programing with a lot of L.A. music. (*WPE1BY, WPEØGA*)

North Vietnam—Hanoi is noted: on 7019 kc. at 0600-0700 and at 0800 with a native language program; on 11,840 kc. with Eng. at 1030; and on 11,745 kc. at 0300-0400 with dictation-speed news. (*WPE1AAC, WPE3NF, WPE5RB, WPE8BGF*)

Pakistan—Karachi has Eng. to E. Pakistan at 0900 and dictation-speed news to the Middle East at 1035-1045, both on 11,674 kc. The English program is also heard well in the U. S. during the 1930-2000 program on 15,335 and 11,885 kc. (*WPE3CN, WPE9DN*)

Paraguay—*R. Paraguay* (Asuncion) is tuned at 1910-0800 and 1000-1600 on 5015 kc. *R. Encarnacion* (Encarnacion) is heard at

0900-1200 and 1700-2100 on 11,945 kc. (*WPE2FY*)

South Korea—Korea B/C Service, Seoul, has Eng. to N.A. at 0030-0100 with news at 0030-0400 on 11,745 and 17,745 kc. (*WPE5SH, WPE6AA, WPE9AGB*)

Sudan—Khartoum, 11,855 kc., is again being heard around 2315 s/on to past 0000 with Arabic news and music. This one has been "wandering" and at the moment is back to the old channel. (*WPE4BC, WPE9KM, SR*)

A verification letter lists Eng. at 0730-0800, Arabic at 2315-0030 daily except Fridays (to 0600 on Fridays) and at 0930-1600 daily on 5034, 9600, and 11,750 kc., although the latter channel is obviously in error. (*RK*)

Surinam—PZC, Paramaribo, 15,405 kc., was noted during the 2000-2038 Eng. portion on a Monday, reading listener's reports and saying that replies were en route. This would seem to indicate a new "Listener's Corner" type of program and, further, that this station now is verifying. (*WPE1BD, WPE2ACO, WPE5AG, WPE6AA, WPE9KM*)

Sweden—Stockholm, 11,810 kc., has Eng. to Eastern N.A. at 2045-2130 and to Western N.A. at 2215-2245. A DX program is given during the last ten minutes of each period on Mondays. (*WPE2TA, WPE3CN, MM*)

Switzerland—According to the latest program schedule from the United Nations in New York, the following is the xmsn schedule for U.N. Radio, Geneva: 0830-0845 (Saturdays) in Hungarian and 0845-0910 (Monday to Friday) in Russian, both over HED5, 9545 kc.; 0930-0945 (Saturdays) in Persian on 17,770 and 11,905 kc.; and 1420-1435 (Monday to Friday) in Arabic on 11,810, 9575, and 6010 kc. (*WPE2ACO*)

Tunisia—Tunis, 9630 kc., has been heard at 1320 and 1500 with Arabic music and language, at 1435, 1600, and 0100 with Arabic news. The only Eng. noted so far was a brief Eng. ID at 1455. (*WPE3NF, WPE4BC, WPE9KM*)

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corp.
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
L.A.—Latin America
N.A.—North America
R.—Radio
s/off—Sign-off time
s/on—Sign-on time
xmsn—Transmission
xmtr—Transmitter

Turkey—TAT, Ankara, is back on 9515 kc. at 1815-1900 to North America. Other portions of Ankara's schedule read: 0600-0700 on 15,195 kc.; 0600-0630 on 9515 kc.; 0830-0915 and 1000-1100 on 17,820 kc.; 1100-1615 on 9745 kc.; and 1200-1500 and 1545-1645 on 7285 and 9745 kc. A mailbag program is noted on Sundays during the N.A. period. (*WPE1PW, WPE4FM, WPE5AG, WPE8HF, WPE9AGB, WPE9KM, WPEØAE*)

USA—WRUL, Scituate, Mass., is in the process of having its control transferred from World Wide B/C System to Metropolitan B/C Systems, Inc. The programing may change upon completion of the transfer. KGEI, Bel-

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Stanley Schwartz *(WPE1AAC)*, Bridgeport, Conn.
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Anson Boice *(WPE1BD)*, New Britain, Conn.
Jerry Berg *(WPE1BM)*, W. Hartford, Conn.
Alan Roth *(WPE1BV)*, Bridgeport, Conn.
Harold Bertino *(WPE1PW)*, Dorchester, Mass.
J. Block *(WPE1RH)*, Terryville, Conn.
Paul Buer *(WPE2ACO)*, Harrison, N. Y.
George Goolde *(WPE2AFL)*, Chappaqua, N. Y.
Robert Newhart *(WPE2AXS)*, Merchantville, N. J.
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Stewart West *(WPE2LH)*, Union, N. J.
William O'Brien *(WPE2RV)*, Syracuse, N. Y.
Charles Schwartzbard *(WPE2TA)*, Passaic, N. J.
Paul Edelson *(WPE2VY)*, Brooklyn, N. Y.
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William Bing *(WPE5AG)*, New Orleans, La.
Arno J. M. Feltner *(WPE5CN)*, New Braunsfels, Texas
C. A. Rickman *(WPE5GQ)*, Miami, Okla.
Pedro Vasquez *(WPE5RB)*, APO, San Francisco, Calif.
David Penney *(WPE5SH)*, New Orleans, La.
Stewart Mac Kenzie, Jr. *(WPE6AA)*, Long Beach, Calif.
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J. Art Russell *(WPE6EZ)*, San Diego, Calif.
Jim Gallucci *(WPE7CE)*, Portland, Ore.
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Ken Shaffer *(WPE8BAG)*, Dayton, Ohio
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F. H. Cloudman *(FC)*, Wassenaar, Netherlands
Denis Dandenau *(DD)*, W. Warwick, R. I.
Danny Kolhage *(DK)*, Key West, Fla.
Ruth Kalish *(RK)*, Flushing, N. Y.
Bill Lund *(BL)*, Santa Monica, Calif.
Tony Lewis *(TL)*, Mono Road, Ont.
Mike McAlister *(MM)*, Pomona, Calif.
S. M. Rowell *(SR)*, Minneapolis, Minn.
Radio Nederland, Hilversum, Netherlands
EPI News Service, Berne, Switzerland

mont, Calif., is also in the process of being transferred from KGEI, Inc. to the Far East B/C Corp.; KGEI will be used as part of the *Call of The Orient* and will probably have all or nearly all religious programing. *(WPE6AA)*

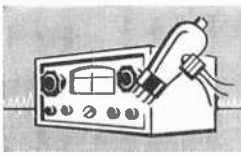
USSR—*Radio Moscow* will have Russian language courses on Sunday evenings which will run until mid-June. The exact time is not known. *(WPE9MS)*

The DX program from Moscow is now being aired on the second and third Sunday of the month at 2315-2330. *(WPE6ABX)*

Uruguay—Montevideo has been noted on 11,900 kc. at 1900-2100 and on 15,385 kc. at 1930-2100 in Spanish with U.S. and L.A. music. The English program on 15,385 kc. at 2000 has evidently been dropped. *(WPE8AGY, SR)*

Vatican City—The Vatican plans to build new radio stations in all parts of the world, with one to be started shortly in the Philippines. The reason for the new stations is that the present Vatican Radio cannot reach everywhere. *(EPI News Service, via WPE6EZ, WPE1BY)*

-30-



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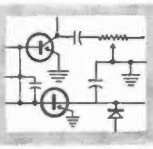

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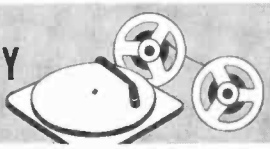

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AMERICAN—Overseas Jobs. Higher Pay. Transportation Paid Now!! Free Information. Employment Headquarters, 79 Wall Street, Dept. G. E. 1 New York 5.

JOBS; High pay. Foreign countries, USA. All trades. Write Dept. 55G, National Employment Information, 1020 Broad, Newark, N. J.

OVERSEAS Employment. American Firms and United State Government. Comprehensive job information $2.00. Foreign Opportunities, Box 172, Columbus 16, Ohio.

LEATHERCRAFT

FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791—M-34, Fort Worth, Texas.

MISCELLANEOUS

"WINEMAKING: Beer, Ale Brewing." Illustrated. $2.20. Eaton Books, Box 1242-C, Santa Rosa, California.

HUGE mails 10¢ Gigantic mails 25¢. William Greener NB, Burley, Idaho.

SPECIAL! Rubber stamp with pad—Three lines $1.00 Ideal Rubber stamps, Box 21, Camden, Tenn.

1000 BUSINESS Cards embossed, send $3.50 to Cal-Mil Printers, 15918 Halldale Avenue, Gardena, California.

SEND me your name and I'll tell you about a method that lets you take giant bass out of waters that other folks say are "fished out." Facts free. Write Eric B. Fare Highland Park 38, Illinois.

DIGNIFY your business: 1000 embossed business cards $3.95 samples. Edward Printing Service 7430 Selwick Dr. Parma 29, Ohio.

KEY chains, personalized ashtrays, smoke sets—hundreds of useful novelties for home, office and gifts. Inexpensive items. Write for free catalog. House of Brand, Dept. PE-1, 3458 Fish Avenue, New York 69, New York.

POPULAR ELECTRONICS *Advertisers' Index—MAY 1960*

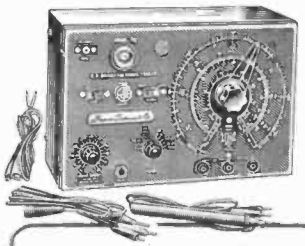
EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship *at our risk* one or more of the testers described on these pages.

Superior's New Model 76

ALL PURPOSE BRIDGE

IT'S A **CONDENSER BRIDGE** IT'S A **SIGNAL TRACER**
IT'S A **RESISTANCE BRIDGE** IT'S A **TV ANTENNA TESTER**



Model 76 ALL PURPOSE BRIDGE
Total Price $26.95
Terms: $6.95 after 10 day trial, then $5.00 per month for 4 months if satisfactory. Otherwise return, no explanation necessary.

✓ **CAPACITY BRIDGE SECTION**
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

✓ **RESISTANCE BRIDGE SECTION**
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ **SIGNAL TRACER SECTION**
With the use of the R.F. and A.F Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

✓ **TV ANTENNA TESTER SECTION**
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

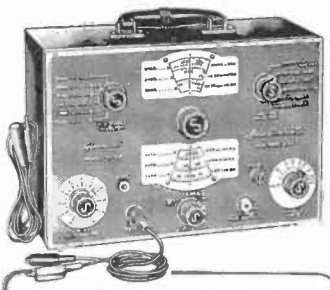
Complete with R.F. and A.F. probes and test leads **$26.95 Net**

Superior's New Model TV-50A **GENOMETER**

7 Signal Generators in One!

✓ *R.F. Signal Generator for A.M.* ✓ *Bar Generator* ✓ *Marker Generator*
✓ *R.F. Signal Generator for F.M.* ✓ *Cross Hatch Generator*
✓ *Audio Frequency Generator* ✓ *Color Dot Pattern Generator*

This versatile All-Inclusive **GENERATOR** Provides **ALL** the Outputs for Servicing:
A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV



Model TV-50A GENOMETER . . .
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

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.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 180 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).

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.

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.

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.

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only **$47.50**

DID YOU EVER?

Order merchandise by mail, including deposit or payment in full, then wait and write . . . wait and write?

Purchase anything on time and sign a lengthy complex contract written in small difficult-to-read type?

Purchase an item by mail or in a retail store then experience frustrating delay and red tape when you applied for a refund?

Obviously prompt shipment and attention to orders is an essential requirement in our business . . . We ship at *our* risk!

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CO-MAKERS
EMPLOYER NOTIFICATION

The simple order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

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**

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

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 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.

ALL COLOR TUBES

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

Housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only **$38.50**

Model 83—C.R.T. Tube Tester
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC, INC.
Dept. D-738 3849 Tenth Ave., New York 34, N. Y.

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.

- ☐ **Model 76 .....Total Price $26.95** $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ **Model TV-50A ..Total Price $47.50** $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 82A...Total Price $36.50** $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 83 ..Total Price $38.50** $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 70...Total Price $15.85** $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ **Model 80 ....Total Price $42.50** $12.50 within 10 days. Balance $6.00 monthly for 5 months.

Name .....

Address .....

City ..... Zone..... State.....

All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

Model 70—UTILITY TESTER
Total Price...$15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakages, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

INCLUDED FREE ***This 64-page book—practically a condensed course in electricity. Learn by doing.***

Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique. • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads

Only $15.85

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

Model 80 ALLMETER . . . . . .
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.
- **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.
- **CAPACITY RANGES** permit you to accurately measure all condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES:
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES: — 6 db to + 18 db.
+ 14 db to + 38 db + 34 db to + 58 db

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only **$42.50**

TRY FOR 10 DAYS *BEFORE* you buy! *THEN* if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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