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POPULAR ELECTRONICS

FEBRUARY
1960

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(see page 43)



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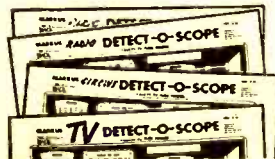
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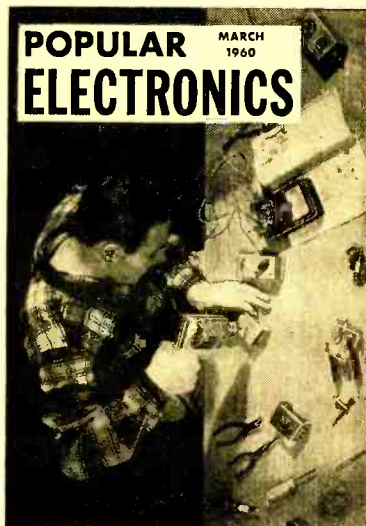
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In addition, of course, you'll find our regular line-up of electronic feature articles plus specialized articles for the ham, the technician, the Hi-Fi fan, and the SWL enthusiast.

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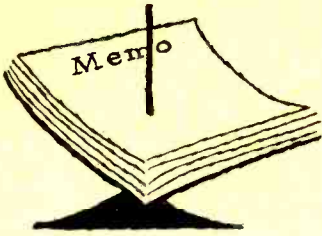
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Notes from the Editor

THE CLASS D DILEMMA. No radio communications service in the history of our country has captured the public's fancy and interest like the new Citizens Radio Service. But its phenomenal acceptance has been plagued ever since its inception by warnings from the FCC that equipment for this new service was not being used in the manner specified in its original rules (Part 19). Advertising by some manufacturers implied that there were no restrictions as to "personal use" of these portable units and that call letters were available to anyone who would fill out an FCC application form.

The fabulous growth of this new radio service may equal any other radio communications growth in its potential for meeting the FCC requirements consistent with "public interest, convenience and necessity." Has our Class D Citizens Radio Service met these requirements? I, for myself, feel that the first CB users, the FCC, and the industry got off to a very big—but bad—start. It is predicted that over 85,000 licenses will be issued by June 1, 1960. In terms of dollar investment for equipment, the figure would exceed 15 million dollars by next summer even if only one unit per license were purchased. This reflects "public interest" in no uncertain terms.

Meeting requirements of "convenience" can be likened to the telephone—plus portability. Doctors, salesmen, farmers, and others find valuable, convenient use for CB.

What about "necessity"? This requirement is fulfilled by users of CB aboard boats in the protection of life, limb and property, as well as by the busy MD traveling a countryside road and needing to call his home or office.

The FCC has very properly exercised its authority to crack down on violators using Class D for any sort of hobby-type communications. Hundreds of operators have received violation citations from the FCC. But we know of no individual (during 1959) that had his license suspended or revoked as the result of so-called violations. Organized groups are forming throughout the country to crusade for Citizens Radio—not entirely for what it was intended to be—but for limited hobby communications as well.

Many members of these club groups, I am told, are elderly folk who do not feel capable of learning code or theory. They don't want to be hams and thrill to world-wide communications. What they want is local communications when the "party line" is dead.

Some CB groups are planning emergency and disaster networks and have offered their facilities to local Civil Defense units. These deeds are not for selfish interest either.

There is little doubt that these thousands of CB'ers mean to take their case to the FCC. But they will need their own organized efforts if they are to influence any change in Part 19 Rules to permit non-restricted personal use.

Olin Read

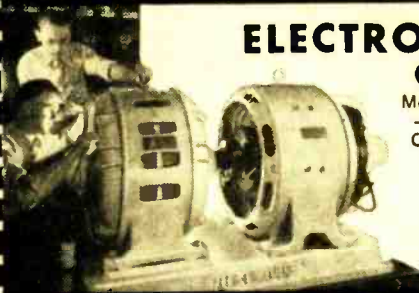
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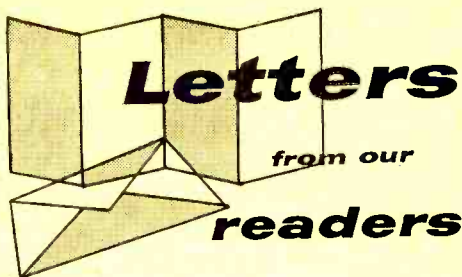
V-70



Z-80



SA-40



Letters

from our

readers

"Police Special" Modifications

■ Some of your readers may be interested in the changes I made when I constructed the "Police Special" receiver described in your July 1959 issue. I found that the substitution of a 12BZ7 tube for the 12AT7 specified in the article resulted in better oscillation over the entire police band. I also took one turn off coil *L1* and used a 4-watt wire-wound 100,000-ohm potentiometer for sensitivity control *R5*.

I am well pleased with the performance of the Police Special. This was my first project and I truly enjoyed building it.

Cecil Lindsey
Fresno, Calif.

Microns and Micro-Inches

■ It has come to my attention that some publications and advertisers have been describing tape recorder head gap widths in terms of "microns" rather than "micro-inches." I would like to point out that a micron is one-millionth of a meter and a micro-inch is one-millionth of an inch. A gap width specified in microns would be almost 40 times wider than the true gap width.

Philip N. Bridges
Rockville, Md.

Thoughts on Tape

■ I was very much interested in the article in your October 1959 issue entitled "Stereo Tape Is Back—To Stay," by Mr. Ernest John. The information on tape cartridges was most welcome. However, there are two points on which I disagree with Mr. John. He makes the following two statements, one right after the other:

And since the two stereo channels are always spaced apart by the other two channels, there is actually less chance of crosstalk. The only trouble with four-track reel-to-reel tape is that which afflicts any reel-to-reel system: it's awkward to handle.

In my opinion, the first statement is in error. What Mr. John should have said is: "And since each pair of stereo channels is always spaced apart by the two channels of the other track, there is less chance of crosstalk between channels of the same track." It is obvious that crosstalk will be at a minimum between the two active channels due to their physical separation. Even if there were crosstalk, it would not be serious because the crosstalk would be of the same nature. What happens in the four-track system is that the crosstalk is between the inactive channels and the active channels. Clearly, this type of crosstalk is far more objectionable than crosstalk between channels of the same track because one track is

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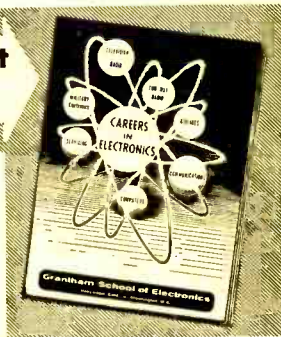
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Ralph Frederick Beisner, 2126 Grand, Joplin, Mo.	1st	12
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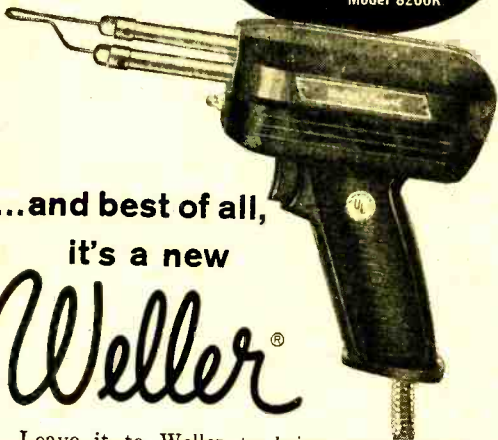
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Letters

(Continued from page 10)

being played backwards and is of a different character from the other.

Now let's consider Mr. John's second statement, which concerns the awkwardness of the reel-to-reel system. This system is, in my opinion, easy to handle provided you have a good machine and use good reels. The two best reels I know of are the Audiotape reels with the C slots and the reels used on the Reeves Soundcraft 5" "Plus-100" tape. Each has its advantages: with the Audiotape reel, you have to insert the tape through the side of the reel but you only have to turn the reel a half turn; with the Soundcraft reel, you don't have to insert the tape through the reel sides but you have to turn the reel around once or twice.

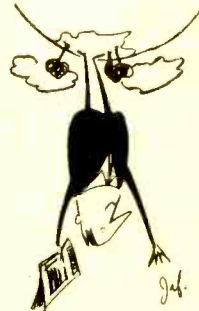
The main problem to be solved in the reel-to-reel system is how to fasten the end of the tape to the reel quickly and still have the tape wound firmly enough so that it will start easily, yet let go when it runs out. And, of course, it's still cumbersome to wrap the first few turns on the take-up reel. When this is licked, I believe the reel-to-reel system will be just as simple as any cartridge system.

TERRY L. CLAYTON, OP Div.
 USS Hornet CVS-12
 FPO San Francisco, Calif.

Reader Clayton is right on the first point: crosstalk from four-track tapes is worse than crosstalk from two-track tapes. However, users of four-track tapes report that crosstalk is rarely a problem. In discussing the difficulties of the reel-to-reel system, Mr. Clayton appears to agree—rather than disagree—with Mr. John.

Australian Comments

■ As your magazine seems to have been available in this "Down Under" town for a comparatively short time, I only recently made its acquaintance. After I bought a copy at a bookstall "on spec," I immediately decided to subscribe. Since then, I



have been scouring the second-hand bookshops for earlier issues, but all I have been able to find are the May, June, and July (1959) issues.

I wonder if any of your readers have any old copies that they don't want? I would be happy to send them copies of "Radio, Hobbies, and Television," an Australian magazine, in exchange.

I run an ex-Australian Army NO22 set—10 valves, 2 to 8 megacycles—but unfortunately can only listen because I have not yet obtained my

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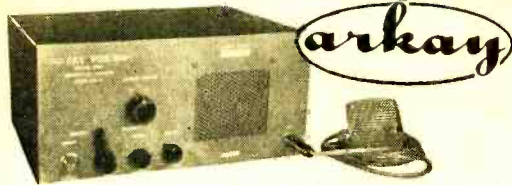
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Letters

(Continued from page 12)

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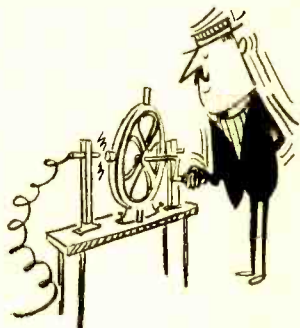
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H. H. DAVIS
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Vertical vs. Horizontal

■ The article titled "Your Antenna: Key to World-Wide DX" which appeared in the November 1959 issue was quite interesting and informative. However, it made no mention of vertical antennas. Is a vertical rod antenna as efficient as a horizontal long-wire antenna? You can usually get the upper end of a vertical rod somewhat higher than most horizontal wires.

KEN GREENBERG
Chicago, Ill.

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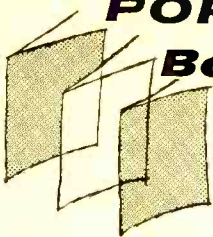
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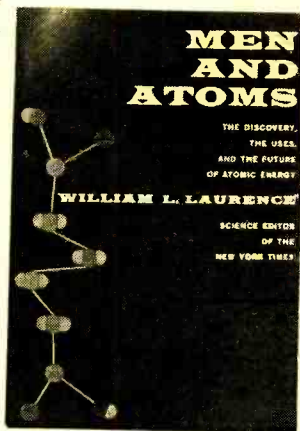
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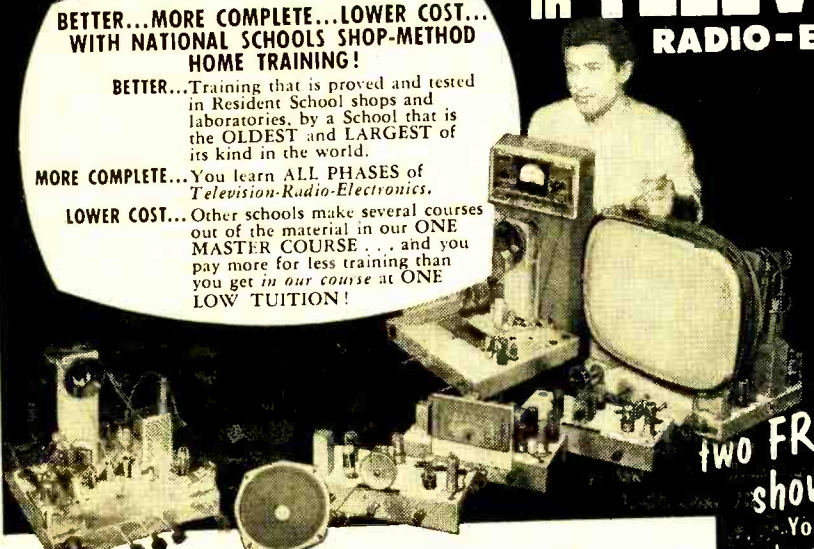
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Bookshelf (Continued from page 16)

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"MEDICAL ELECTRONICS" by Edward J. Bukstein. Published by Frederick Ungar Publishing Co., 131 E. 23rd St., New York 10, N. Y. 168 pages. \$3.50.

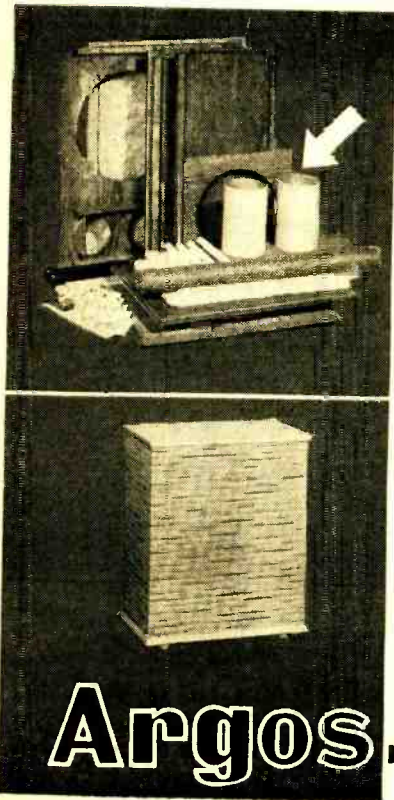
The collaboration of electronics and medicine has resulted in highly accurate techniques for measuring heart action, blood pressure, muscle potential, etc. Electronics has also made significant contributions to the field of therapy. This book, written at the electronic technician's level, surveys various types of electronic medical equip-

ment, including the electrocardiograph, the electroencephalograph, ultrasonic therapy equipment, etc. The use of many schematic diagrams and considerable circuit analysis throughout the book provides sufficient background to allow the knowledgeable technician to repair such equipment if called upon to do so.



"BASIC ELECTRONIC TEST PROCEDURES" by Rufus P. Turner. Published by Rinehart and Co., Inc., 232 Madison Ave., New York 16, N. Y. 316 pages. \$6.50.

From radio to rocketry, the basic problems of electronic testing are the same—the evaluation of electronic properties such as resistance, voltage, phase, power factor, etc. In this book, the author gives the reader step-by-step instructions for using all types of test equipment to measure electronic phenomena accurately and efficiently. In addition, the operation of each type of equipment is covered briefly to enable the reader to understand the problems involved. As the book is quite complete and clearly written, it is recommended to every-



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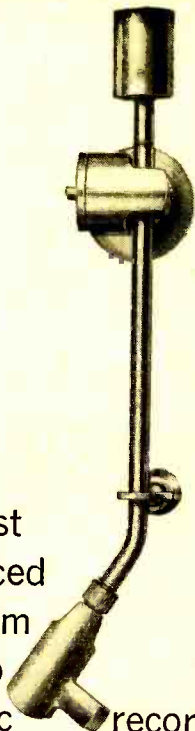
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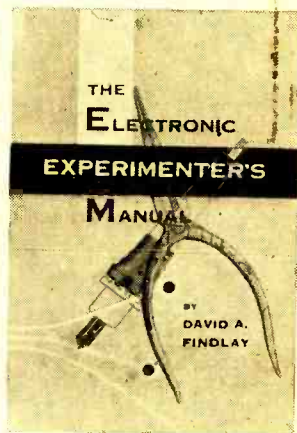
Bookshelf *(Continued from page 18)*

one who wants to get the most out of his electronic test equipment.



"THE ELECTRONIC EXPERIMENTER'S MANUAL" by David A. Findlay. Published by Ziff-Davis Publishing Co., One Park Ave., New York 16, N. Y. 169 pages. \$4.95.

Here is a book written exclusively for those who like nothing better than puttering with a soldering iron, an old chassis, and some electronic components. The author tells the electronic experimenter everything he needs to know about setting up his workshop — what tools and other equipment he will require, how to build a workbench, how to make special tools, etc. Also included are complete plans for building eight useful pieces of test equipment and eight interesting electronic projects. Recommended as a helpful and money-saving book for the electronics enthusiast.



Free Literature Roundup

H. H. Scott has announced a new 1960 catalog of hi-fi equipment. Included in its 20 pages are pictures of typical home installations of stereo equipment, an explanation of stereo and high fidelity, and complete descriptions and specifications for all "Stereomaster" components. Write to H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass., for your copy.

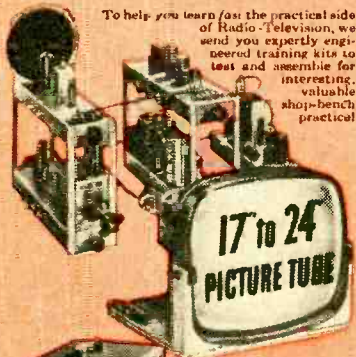
Not quite free—but almost—is the new Radio Shack catalog, the "1960 Guide to Electronic Buying." Some 40,000 items of electronic merchandise are listed. Over 100 pages are devoted to hi-fi equipment and over 200 to industrial and service items. This catalog is available for 35 cents from Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.

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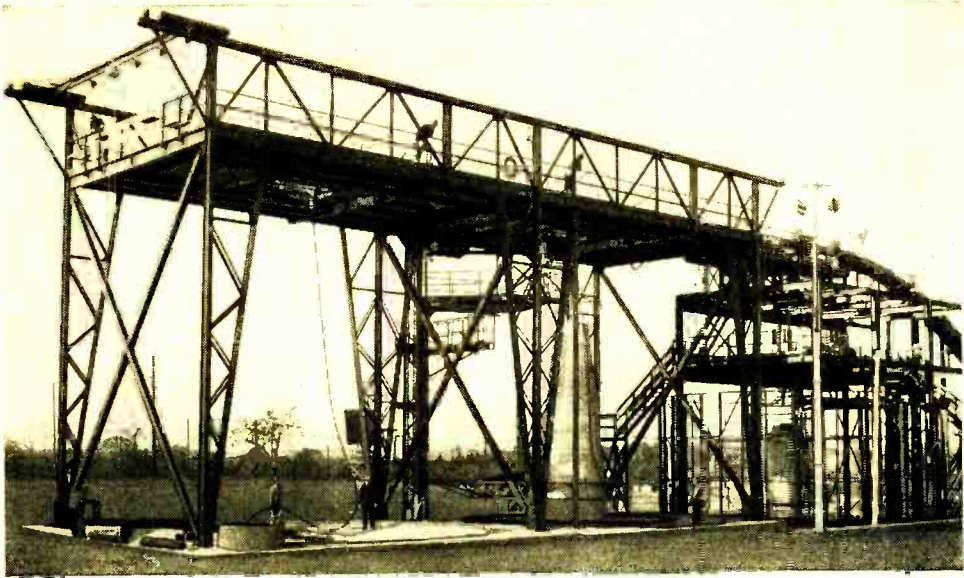
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SHIP WITHOUT AN OCEAN

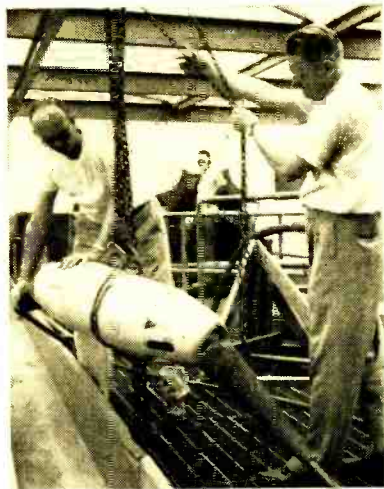
How do you lay a cable on the ocean floor—a cable that is connected to scores of large, heavy amplifiers? How do you “overboard” such a system in a continuous operation, without once halting the cable ship?

Bell Telephone Laboratories engineers must answer these questions in order to lay a new deep-sea telephone system designed to carry many more simultaneous conversations. They’re experimenting on dry land because it is easier and more economical than on a ship. Ideas that couldn’t even be attempted at sea are safely tested and evaluated.

In one experiment, they use a mock-up of the storage tank area of a cable ship (above). Here, they learn how amplifiers (see photo right), too rigid and heavy to be stored with the cable coils *below* decks, must be positioned *on* deck for trouble-free handling and overboarding.

Elsewhere in the Laboratories, engineers learn how best to grip the cable and control its speed, what happens as the cable with its amplifiers falls through the sea, and how fast it must be payed out to snugly fit the ocean floor. Oceanographic studies reveal the contours of the ocean bottom. Studies with naval architects show how the findings can be best put to work in actual cable ships.

This work is typical of the research and development effort that goes on at Bell Labs to bring you more and better communications services.



Experimental amplifier about to be “launched” from “cable ship.” Like a giant string of beads, amplifiers and connecting cable must be overboarded without stopping the ship.



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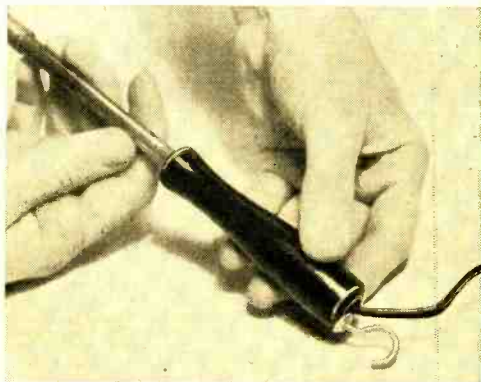
Tips

(Continued from page 22)

with broad-head roofing tacks or short wood screws.—*Louis E. Garner, Jr., Silver Spring, Md.*

SOLDERING IRON HANGER

Turning a cup-hook or screw eye into the wooden handle of your soldering iron will provide a convenient way to hang the iron up when it isn't in use. Hanging an iron



by its cord is bad practice as eventually the wires will break away from the heating ele-

ment inside the handle of the iron.—*Jerome Cunningham, Chicago, Ill.*

ALIGNMENT TOOL SOURCE

An alignment tool seems to be one of the shortest-lived accessories on the electronic test bench. Made of plastic, these tools are burnt, broken or lost at a rapid rate. However, a visit to your local five-and-ten can provide you with two sturdy substitute alignment tools for only 25 cents. Sold at the cosmetic counter, simple manicuring accessories like that shown are strong and have good insulating properties. For use with smaller i.f. cans or slug-tuned



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This goose lays
JENSEN NEEDLES!"

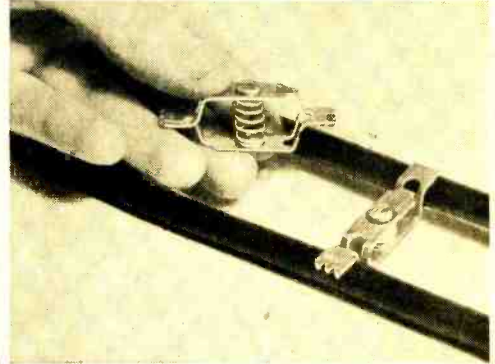
Tips

(Continued from page 24)

coils, it is a simple matter to trim down the stick with a razor blade.—*Dave Muirhead, New York, N. Y.*

DUAL-CLIP CLAMPS CABLES

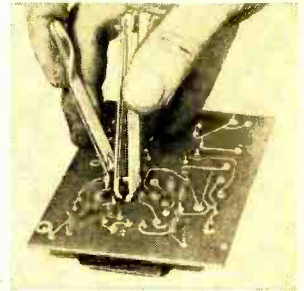
A dual-clip (Mueller #22) can be used to clamp together a couple of cables that run parallel to each other. You can also attach



the cables to a wall or other surface by removing the clip screw and replacing it with a wood screw or self-tapping screw.—*John A. Comstock, Wellsboro, Pa.*

PRINTED CIRCUIT BOARD WIRING

A handy tool for trimming the ends of wires on etched or printed circuit wiring boards can be purchased at your local drug store. The type of toenail clip sold under the "Trim" brand name, among others, has fairly good steel and a straight-across cutting edge



which is ideal for getting in flush to the surface of the circuit board. As long as you don't attempt to cut anything heavier than the component leads protruding through the board, the cutting edge of the clipper will remain sharp.—*David Gordon, New York, N. Y.*

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(Continued on page 30)

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1B3	.95	5T8	.86	6BG6	2.25	6J5	.70	12AX4	.95	12C6	1.10
1S5	.60	5U4G/GB	.75	6BH6	.70	6J6	.60	12AX7	.65	12C7	.65
1T4	.55	5U8	.75	6BH8	.90	6K6	.80	12B4	.70	12C8	.65
1U4	.45	5V6	.55	6BJ6	.65	6L6	1.15	12BA6	.60	12C9	.60
1U5	.55	5Y3GT	.55	6BK5	1.40	6P4	.60	12BD6	.60	12D6	1.10
1X2A/B	.95	6AB4	.55	6BK7A/B	.90	6P7	.80	12BE6	.60	12E6	.60
2AF4	1.00	6AC7M	.90	6BL7	1.55	6SC7	.80	12BH7	.80	12F6	.65
3AF4	1.05	6AF4	1.05	6BN6	.75	6SK7	.95	12BQ6	1.10	12G6	.65
3AL5	.46	6AG5	.65	6BO5	.70	6SL7	.70	12BY7	.80	12H7	.80
3AU6	.55	6AG7M	1.25	6BQ6	1.10	6SN7	.85	12C5	.60	12I6	.65
3AV6	.45	6AH4	1.30	6BQ7A	1.10	6SQ7	.85	12C6	1.10	12J6	.65
3BN6	.75	6AH6	1.35	6BR8	.95	6T4	1.00	12C7	.65	12K5	.70
3BU8	.75	6AK5	.85	6BU8	.70	6T8	.95	12C8	.65	12L6	.65
3B76	.60							12C9	.60	12S7	.85
3BZ6	.60							12D6	1.10	12SN7	.90
3CB6	.60							12E6	.60	12SO7	.90
3CF6	.65							12F6	.65	12V6	.55
3C56	.60							12G6	.65	12W6	.75
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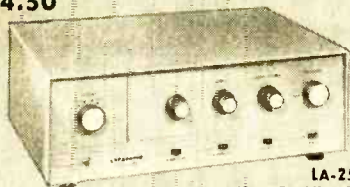
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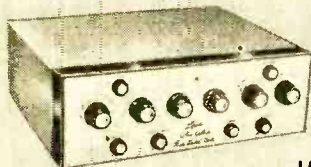
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KT-600 IN KIT FORM
79.50



LA-600
COMPLETELY WIRED
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PROFESSIONAL STEREO CONTROL CENTER

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

A truly professional stereo preamplifier and master audio control center—solves every stereo/monaural control problem. Features unique Bridge Control for variable cross-channel feed for elimination of exaggerated channel separation effects—plus controlled 3rd channel output. Has all-concentric controls—including clutch-operated Volume Balance control. Provides complete and advanced facilities for accepting, controlling and providing undistorted signal for any and all program sources. Sensitivity 2.2 mv for 1 volt out (low level inputs). Dual low impedance "plate follower" outputs 1500 ohms. Response 5-40,000 cps \pm 1 db. Less than .03% IM distortion. Less than .1% harmonic distortion. Hum and noise 80 db below 2 volts (high level inputs). Uses 7 new 7025 low-noise dual triodes. Size: 14"x4½"x10¾". Shpg. wt., 16 lbs. Complete with all parts, tubes, deluxe cabinet and detailed instruction manual.

KT-600 WX Stereo Preamplifier Kit 5.00 Down Net 79.50
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KT-310 IN KIT FORM
47.50



LA-310
COMPLETELY WIRED
72.50

STEREO/MONAURAL POWER AMPLIFIER KIT

● 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL ● EMPLOYS 4 PREMIUM-TYPE 7189 TUBES ● 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING ● RESPONSE BETTER THAN 35-30,000 CPS \pm 1/2 DB AT 16 WATTS ● LESS THAN 1% HARMONIC OR IM DISTORTION

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6ANB, 4-7189, GZ-34 rectifier. Sizes 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. wt., 22 lbs.

KT-310 WX Stereo Power Amplifier Kit 2.00 Down Net 47.50
LA-310 WX Stereo Power Amplifier, wired and tested 5.00 Down Net 72.50

KT-500 IN KIT FORM
74.50



LT-50
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124.50

FM-AM STEREO TUNER KIT

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

A precision engineered, highly stable tuner—perfect for lifelike stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye an AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps \pm 1/2 db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13¾"W x 10¾"D x 4¼"H. wt., 22 lbs.

KT-500 WX FM-AM Stereo Tuner Kit 5.00 Down Net 74.50
LT-50 WX Same as above, wired & tested 5.00 Down Net 124.50

KT-236
IN KIT FORM



52.50

36-WATT INTEGRATED STEREO AMPLIFIER KIT

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

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

KT-236 WX Stereo Amplifier Kit 5.00 Down Net 52.50

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- HF-683WX Same as HF-681, but with 2 Laf Eliftoflex Series Bookshelf Enclosures (please specify finish). Shpg. wt., 143 lbs. 10.00 Down Net 229.95
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Tips

(Continued from page 26)

corks in the open ends of each element and making sure they are snug-fitting, this vibration can be cured to some extent. Also put a cork in the top opening of your vertical mast to prevent rain and snow from falling into it and causing it to rust.—*Emil Kasprzyk, Jr., Floresville, Texas*

ALLIGATOR CLIP TEST PROBE

You can free the hand that usually holds the "hot" lead of a VOM or VTVM test probe by making yourself an alligator clip test probe. Simply solder a suitable alligator clip to a standard phone tip jack as shown. The tip of the test probe will fit perfectly into the phone tip jack, thus providing an ideal means of keeping the meter in the circuit during lengthy test proceedings.—*H. Leeper, Canton, Ohio*



CHECK TUBES FOR AIR LEAKAGE

To check a vacuum tube for air leakage, simply look at the color of the getter material inside of the tube. The getter is used to trap residual air which is left in the tube after manufacturing and is normally a dark, shiny black as seen from the outside of the tube. If air leaks into the tube over a period of time because of a crack or other fault, the getter material will turn white.—*Bob Culter, Oswego, Ore.*

"RECAP" FRICTION DRIVE WHEELS

When the rubber wheels of an auto-radio's friction-drive tuning mechanism become worn, the dial tends to slip. Often the wheels are so worn and glazed that use of ordinary non-slip compound doesn't help. If this is the case, try "recapping" each tire with a strip of electrician's plastic tape. Clean and sand each tire lightly before applying the tape. This is at least a good temporary repair until an exact replacement set of drive wheels can be obtained.—*James Clifford, Detroit, Mich.*

—30—



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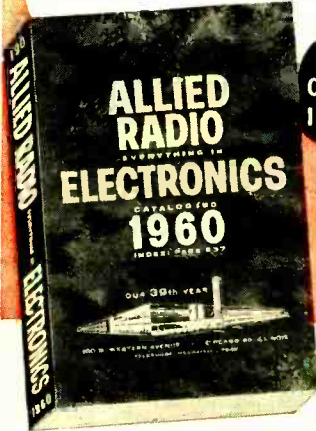
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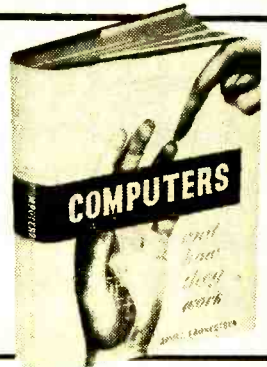


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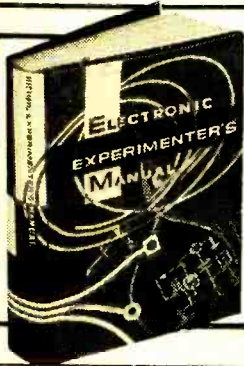
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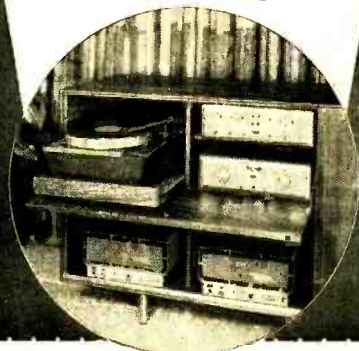
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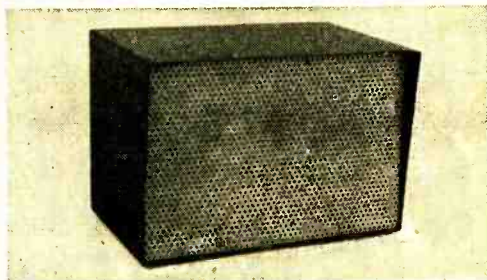
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products

(Continued from page 32)

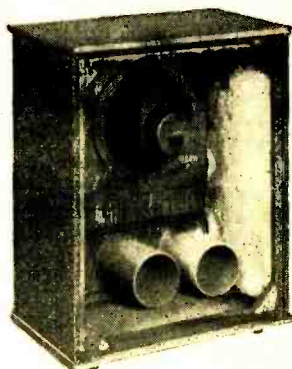
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(Continued on page 38)

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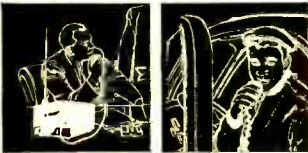
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Push-to-talk operation, 3 crystal controlled transmit positions, two crystal controlled receive positions, dual conversion superheterodyne receiver tuning all 23 channels. Five watts plate input. Crisp and clear full modulation. Series Gated automatic noise limiter. 2.5 audio output. Fifteen tube performance. The Executive has 10 tubes and 1 diode. Four tubes are multi-purpose. Universal power supply, 6 VDC, 12 VDC, 115 VAC is built-in. Certified tolerance .005%. Size 5½" x 8½" x 9". Weighs only 12 pounds.

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Complete Training FOR BETTER RADIO-TV SERVICE JOBS



Let these two great Ghirardi training books teach you to handle all types of AM, FM and TV service jobs by approved professional methods—and watch your efficiency and earnings soar!

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This 660-page volume is the ideal guide for servicemen who realize it pays to know what really makes modern radio-TV receivers "tick" and why. Gives a complete understanding of basic circuits and circuit variations; how to recognize them at a glance; how to eliminate guesswork and useless testing in servicing them. 417 illus. Price separately \$6.75.

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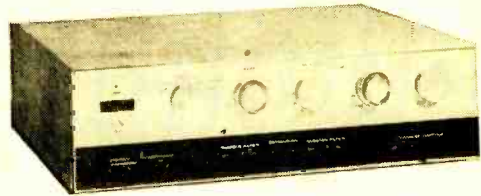
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products

(Continued from page 34)

clutch-mounted tone controls. Frequency response is from 25 to 20,000 cps ± 0.5 db at 60 watts. At full output, harmonic dis-



ortion is less than 0.75% and IM distortion is less than 2%. The power supply uses silicon diodes for good voltage regulation and long life. Price, \$149.95.

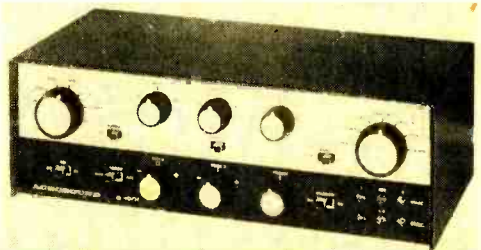
CAPACITOR SUBSTITUTION BOX

An eight-position capacitor substitution box is available from Olson Radio Corp., 260 South Forge St., Akron, Ohio. The Model SW-142 offers capacitances of .25, .1, .05, .02, .01, .005, .002, .001 μ f. The capacitors are rated at 600 volts and are impervious to moisture. Test leads and clips are included. Price, \$3.00.



STEREO PREAMP KIT

The Model S1001 stereo preamplifier kit recently announced by Acro Products Co., Kit Div., 410 Shurs Lane, Philadelphia 28,



Pa., has separate treble and bass controls for each channel, seven inputs for each channel, scratch and rumble filters, input

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- ★ No Knowledge of Radio Necessary
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Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of \$22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronic training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easy-learned, thorough and interesting background in radio. You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

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

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronic circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc. In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets. A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals. Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.



Reg. U. S. Pat. Off.

Unconditional Money-Back Guarantee

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, radio 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

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- ELECTRONICS TESTER
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH-SET
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- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB
- CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

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

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

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 in 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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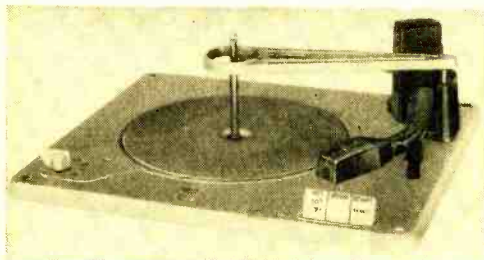
products

(Continued from page 38)

level controls, third channel output, d.c. filament supply, and a phasing switch. It employs four 7199 low-noise triode-pentode tubes. Size, 4½" h x 13¾" w x 6⅝" d. Price for self-powered model, \$79.50; without power supply, \$69.50.

STEREO-MONO RECORD CHANGER

Model AG 1024, a fully automatic four-speed Norelco stereo-mono record changer, has been announced by the *North American*



Philips Company, Inc., High Fidelity Products Div., 230 Duffy Ave., Hicksville, N. Y. Features include: push-button op-

eration; automatic intermix of 7", 10", and 12" records of the same speed; and a balanced shaded-pole motor. The Model AG 1024 comes complete with a spindle and empty cartridge shell. Price, \$39.50.

MULTI-RANGE RESISTOR KIT

Ten Type M-R resistors—providing a total of 200 resistance values from 0.5 to 50,000 ohms—are included in a new multi-range kit announced by the *International Resistance Co.*, 401 N. Broad St., Philadelphia 2, Pa. These resistors are of either two or four different values, each having its own pair of leads. By various connection of the leads in series, parallel, and series-parallel arrangements, up to 47 different values can be provided by one unit. Price, \$6.60.



-30-

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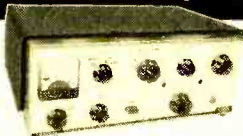
Easy creative fun to build... a lifetime of big-set entertainment wherever you go... designed so that even the novice can build it & obtain a handsome professional assembly & outstanding performance. American-made, modern super-heterodyne all-transistor circuitry, plus finest quality parts throughout, assure you of highest durability & stability.

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Kit \$79.95 Wired \$119.95

"Ideal for veteran or novice" — *ELECTRONIC KITS GUIDE*. "Top quality" — *POPULAR ELECTRONICS*. "Well designed" — *ELECTRONICS WORLD*. 80 thru 10 meters with one-knob band-switching. Full "clean" 90W input, 65W external plate mod. Matches loads 50 to 1000 ohms. May be used as basic exciter unit. TVI shielded. Tubes: 6146, 6CL6, 2-6AQ5, GZ34. Attractive "living room" low-silhouette design. 15" w, 5" h, 9" d.



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Kit \$49.95 Wired \$79.95
Cover E-5 \$4.50

Delivers 50W undistorted audio. Modulates transmitters having r.f. inputs up to 100W. Unique over-modulation indicator. Output transformer matches 500-10,000 ohms. Low-level speech clipping & filtering. Inputs for xtal or dynamic mikes, phone patch, etc. 7 tubes. 6" h, 14" w, 8" d.



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Kit \$29.95 Wired \$49.95

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1AX2	.62	4BC8	.96	6AR5	.55	6CM7	.66	8BQ5	.60	12AX4	.67	12DS7	.79	19AU4	.83					
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1DN5	.55	4BN6	.75	6AT6	.43	6CR6	.51	8CM7	.68	12AZ7	.86	12EL6	.50	19T8	.80					
1G3	.73	4BQ7	.96	6AT8	.79	6CS6	.57	8CN7	.97	12B4	.63	12EG6	.54	21EX6	1.49					
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1K3	.73	4BU8	.71	6AU6	.50	6CU6	1.08	8EB8	.94	12BD6	.50	12EF6	.53	25BQ6	1.11					
1L6	1.05	4BZ6	.58	6AU7	.61	6CY5	.70	10DA7	.71	12BE6	.53	12F5	.66	25C5	.53					
1LA6	.69	4BZ7	.96	6AU8	.87	6CY7	.71	11CY7	.75	12BF6	.44	12F8	.66	25CA5	.59					
1LC6	.79	4CB6	.59	6AV6	.40	6DA4	.68	12A4	.60	12BH7	.73	12FM6	.45	25CD6	1.44					
1LN5	.59	4CS6	.61	6AW8	.89	6DB5	.69	12AB5	.55	12BK5	.70	12K5	.65	25CU6	1.11					
1R5	.62	4DE6	.62	6AX4	.65	6DE6	.58	12AC6	.49	12BL6	.56	12SA7M	.86	25DN6	1.42					
1S5	.51	4DK6	.60	6AX7	.64	6DG6	.59	12AD6	.57	12BQ6	1.06	12SK7GT	.74	25EH5	.55					
1T4	.58	4DT6	.55	6BA6	.49	6DQ6	1.10	12AE6	.43	12BY7	.74	12SN7	.67	25L6	.57					
1U5	.57	5AM8	.79	6BC5	.54	6DT5	.76	12AF3	.73	12BZ7	.75	12SQ7M	.73	25W4	.68					
1X2B	.82	5AQ5	.52	6BC7	.94	6DT6	.53	12AF6	.49	12C5	.56	12T7	.62	25Z6	.66					
2AF4	.96	5AT8	.80	6BC8	.97	6E8U	.79	12AJ6	.46	12CA5	.59	12V6GT	.53	35C5	.51					
2BN4	.60	5BK7A	.82	6BD6	.51	6EA8	.79	12AL5	.45	12CN5	.56	12W6	.69	35L6	.57					
2CY5	.71	5BQ7	.97	6BE6	.55	6EB8	.94	12AL8	.95	12CR6	.54	12X4	.38	35W4	.52					
3AL5	.42	5BR8	.79	6BF6	.44	6H6GT	.58	12AQ5	.52	12CU5	.58	17AX4	.67	35Z5GT	.60					
3AU8	.51	5CC8	.76	6BG6	1.66	6J5GT	.51	12AT6	.43	12CU6	1.06	17BQ6	1.09	50B5	.60					
3AV6	.41	5CL8	.76	6BH6	.65	6J6	.67	12AT7	.76	12C85	.56	17C5	.58	50C5	.53					
3BA6	.51	5EA8	.80	6BH8	.87	6K6	.79	12AU6	.50	12DB5	.69	17CA5	.62	50DC4	.37					
3BC5	.54	5EU8	.80	6BJ6	.62	6S4	.48	12AU7	.60	12DE8	.75	17D4	.69	50EH5	.55					
3BE6	.52	5I6	.68	6BK5	.80	6SA7GT	.76	12AV5	.97	12DL8	.85	17DQ6	1.06	50L6	.61					
3BN4	.63	5T8	.81	6BK7	.85	6SK7GT	.74	12AV6	.41	12DM7	.67	17L6	.58	117Z3	.61					
3BN6	.76	5U4	.60	6BL7	1.00	6SL7	.80													
3BU8	.78	5U8	.81	6BN4	.57	6SN7	.65													
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3CS6	.52	6AC7	.96	6BR8	.78	6V6GT	.54													
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3DE6	.62	6AF4	.97	6BU8	.70	6W6	.69													
3DK6	.60	6AG5	.65	6BV6	.54	6X4	.39													
3DT6	.50	6AH6	.99	6BZ6	.54	6X5GT	.53													
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4AU6	.54	6AN4	.95	6C6B	1.42	7B6	.69													
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See Page 40 for EICO'S BEST BUYS in "HAM" GEAR and TRANSISTOR RADIOS

11-Meter R/C Transmitter

FOR the radio-control enthusiast, transistors are a real boon. Current-hungry tubes and piles of defunct batteries are rapidly becoming a relic of the past. And the ever-decreasing price of high-frequency transistors is putting more and more R/C devices in the hands of the hobbyist and home owner. A "natural" application for R/C (and transistorization) is the garage-door opener—and that's what the gadget described below was designed for, although it is equally suitable for other R/C applications.

Two Versions. The four-transistor job shown on the cover of this issue operates on the Citizens Band frequency of 27.255 mc. and broadcasts an amplitude-modulated signal rather than a c.w. (unmodulated) one. The real advantage of a modulated-signal unit lies in the fact that stray signals on the Citizens Band frequencies (or the garage-door opener of your next-door neighbor) won't trigger off your receiver because it can be set to respond to your modulation only and ignore all others.

If desired, a simpler unit can be constructed without the modulation provisions and only two transistors and their associated components need be used. The over-the-counter price for the modulated unit's components runs about \$26, with the transistors responsible for somewhat less than half the total cost. Of course, the component cost of the two-transistor job will run correspondingly less.

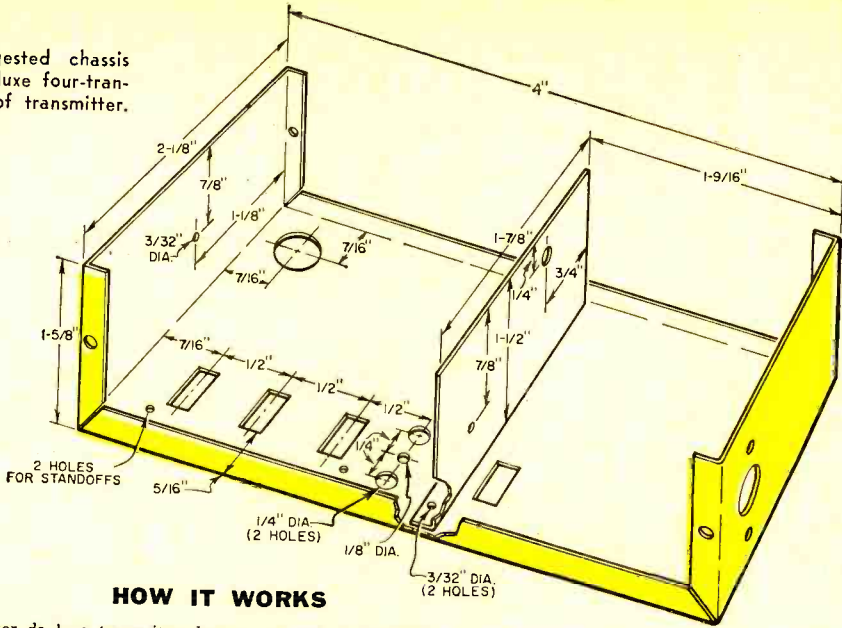
Any commercial tube-operated or transistorized R/C receiver tuned to the correct frequency could be used with the two-transistor



**Compact transistorized unit
can be used as part of
a garage-door-opening system
and for a variety of other
remote control applications**

By DON HALL

Fig. 1. Suggested chassis layout for de luxe four-transistor version of transmitter.



HOW IT WORKS

The four-transistor de luxe transmitter has an r.f. and a multivibrator audio section, while in the two-transistor circuit the multivibrator is omitted. The r.f. section includes a crystal oscillator and a keyed power amplifier.

Free-running multivibrator *Q1* and *Q2* (in the de luxe version) feeds its audio output via *L1* (which keeps r.f. out of the audio circuits) to the power amplifier. *R2* and *R5* are the collector load resistors; *R3* and *R4* are the base resistors; *C1* and *C2* are the cross-coupling capacitors. Capacitor *C7* provides for faster turn-off of the amplifier.

The multivibrator switches the bias voltage of the power amplifier (*Q4*) on and off at an audio rate and thereby keys the transmitter. In the simpler unit, one resistor (*R13*) is substituted for *R5* and *R10*, and the power amplifier puts out a c.w. (steady carrier) signal when *S1* is depressed.

Crystal oscillator *Q3* is a common-base stage with feedback through crystal *XL* taken from a tap on the collector coil *L2*. This tap position is adjusted to obtain good oscillation starting with minimum feedback as the crystal tap. *R6*, *R7*, and *R9* are bias resistors; *R8* is a decoupling resistor; *C3* and *C4* are r.f. bypass capacitors, while *C5* tunes the collector circuit to the crystal frequency. Output is adjusted by positioning the *C6* tap on *L2*.

Power amplifier *Q4* is operated in the common emitter mode. *R10*, *R11*, and *R12* are the bias resistors. *C8* and *C9* are the r.f. bypass capacitors, *C11* is the collector tuning capacitor and should be tuned for maximum transmitter output. The output coupling capacitor is *C10*. Depending upon the antenna used, it may be necessary to have *C10* tap into *L3*; for short antennas *C10* is connected at the collector of *Q4*, as in the schematic.

The power output stage of the transmitter is designed to come under the power requirements of Part 15 (Low Power Communication Devices) of the FCC rules—and no operating license is required. Just make sure to use the proper crystal.

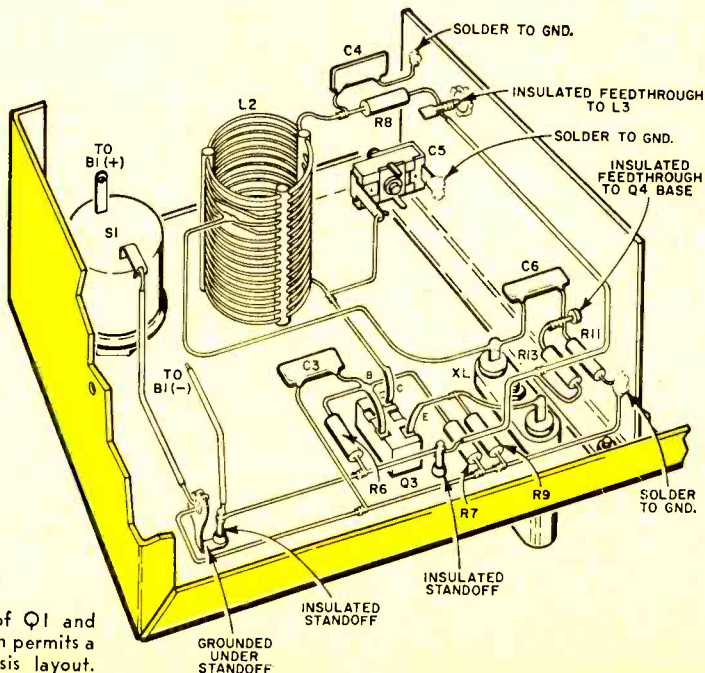


Fig. 2. Omission of *Q1* and *Q2* in simpler version permits a more compact chassis layout.

sistor transmitter. The modulated transmitter, however, requires a specially designed receiver that will respond to the audio modulation frequency. Plans for the de luxe receiver are available at no charge from Texas Instruments, P. O. Box 312, Dallas, Texas.

Construction Hints. The chassis-layout drawing (Fig. 1) shows a suggested arrangement for component mounting holes. Exact dimensions of the holes and their spacing will, of course, depend upon the specific components used.

The shield dividing the chassis in two sections is made from a piece of scrap sheet metal. If aluminum is used, mount ground lugs with nuts and bolts instead of soldering the ground connections directly to the shield as is shown in Figs. 2 and 3.

Two bus bars run the length of the

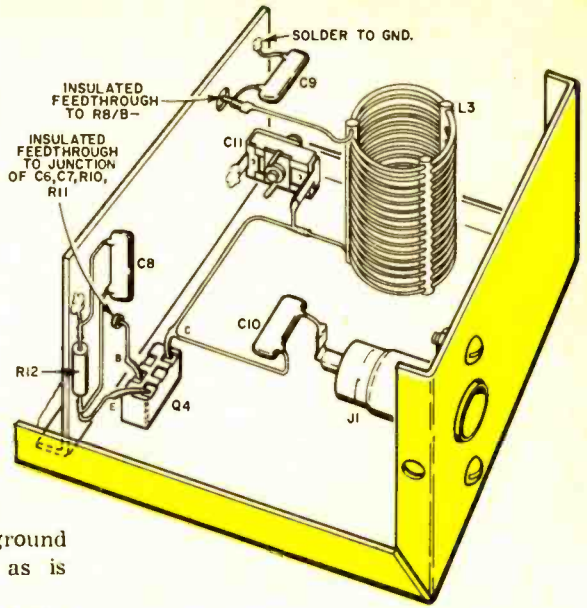


Fig. 4. Output section of unit is similar for both versions. However, feedthrough from base of Q4 connects to junction of C6 and R11.

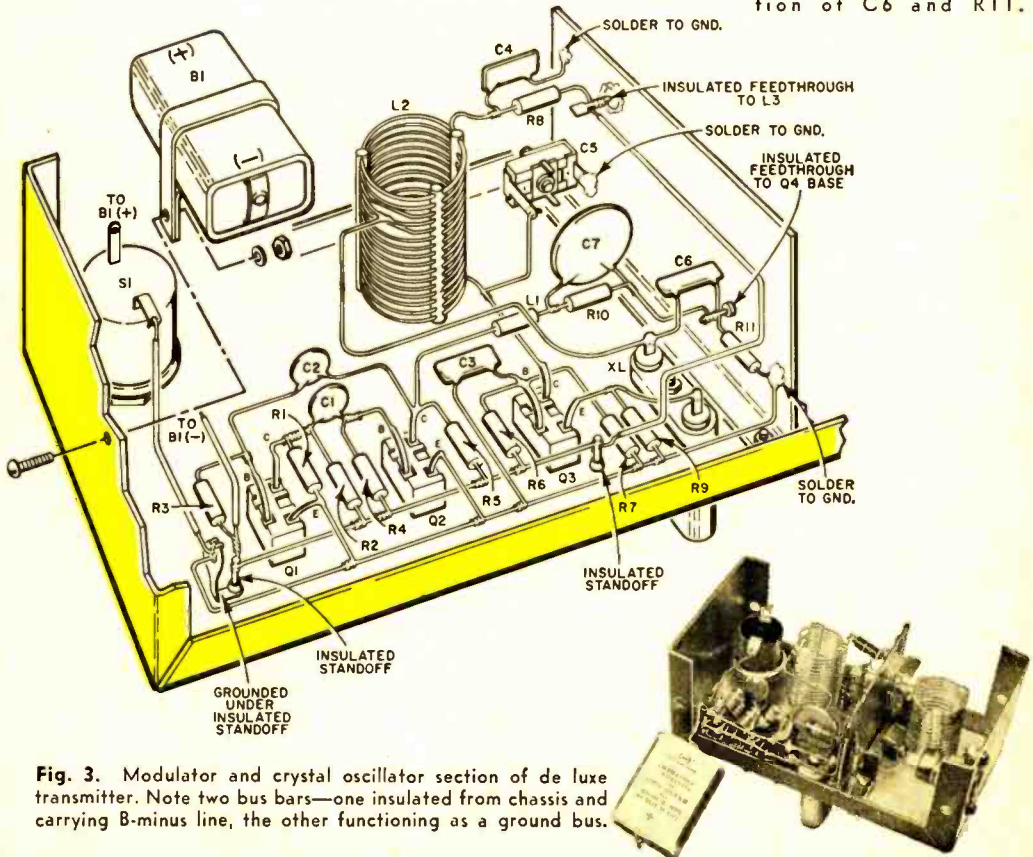
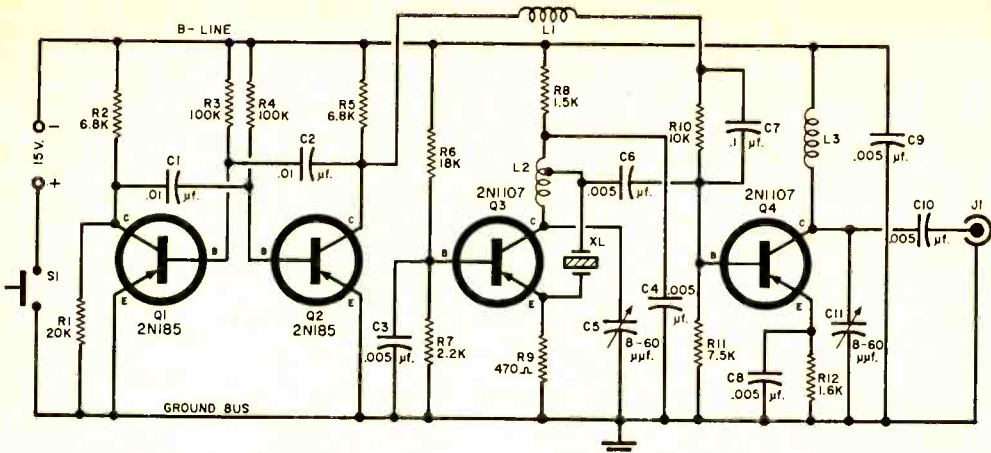


Fig. 3. Modulator and crystal oscillator section of de luxe transmitter. Note two bus bars—one insulated from chassis and carrying B-minus line, the other functioning as a ground bus.



PARTS LIST

- C1, C2—0.01 μ f.
- C3, C4, C6, C8, C9, C10—0.005 μ f. All fixed capacitors low-voltage ceramic
- C5, C11—8-60 μ f. mica trimmer (Arco 404)
- C7—0.1 μ f.
- J1—Antenna socket (any convenient type)
- L1—15- μ h, r.f. choke (Delevan 1537-40 or equivalent—Delevan Electronics Corp., 77 Olean Rd., East Aurora, N. Y.)
- L2—16 turns of #22 wire, 5/8" dia., 1" long, tapped 3 1/2 turns from ground end (AirDux 516 or equivalent)
- L3—15 turns of # 22 wire, 5/8" dia., 15/16" long, tapped 1 1/2 turns from ground end for 50-ohm load (AirDux 516 or equivalent). Tap should be adjusted for best results with antenna used
- Q1, Q2—2N185 or 2N1370 transistor
- Q3, Q4—2N1107 transistor
- R1—20,000 ohms
- R2, R5—6800 ohms
- R3, R4—100,000 ohms
- R6—18,000 ohms
- R7—2200 ohms
- R8—1500 ohms
- R9—470 ohms
- R10—10,000 ohms
- R11—7500 ohms
- R12—1600 ohms
- R13—16,000 ohms (see how it works)
- S1—Push-button switch (normally open)
- XL—27.255-mc. crystal and socket
- Misc. insulated tie posts, hardware, etc.

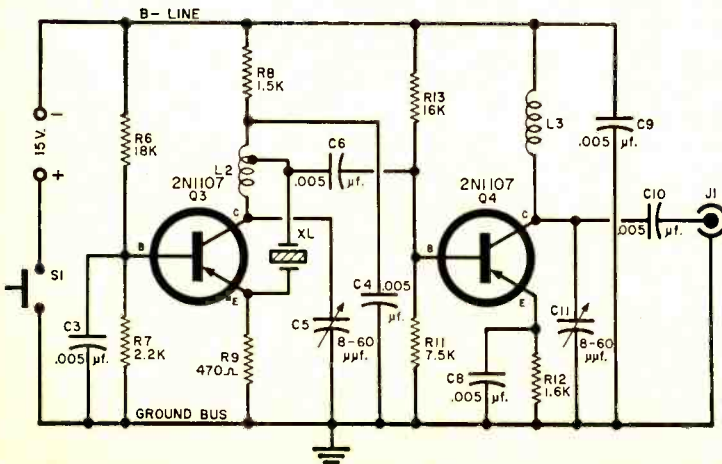
All resistors
1/2 watt, 10%

In de luxe unit, Q1 and Q2 are used as multivibrator. Simpler transmitter (below) omits multivibrator components and includes R13.

chassis in the section of the unit illustrated in both Figs. 2 and 3. The *Ground Bus* provides a common ground connection point for all components which have one side grounded. Adjacent to the ground bus is the "hot" *B-Minus* bus bar with its component connections. Miniature insulated tie post standoffs are used in the author's model to keep the *B-Minus* bus away from ground.

When you install the components, make sure each component is connected to the correct bus bar, as it's easy to make an error here. Keep all leads as short as possible (a necessity with h.f. units), and make sure that the leads do not short to each other or to ground.

The battery is mounted by means of a small strap cut from sheet metal and the positive terminal is soldered directly to one of the terminals of push-button switch S1. If a different type of switch is used than that shown, a short lead can be soldered between the positive pole of the battery and switch terminal. —30—

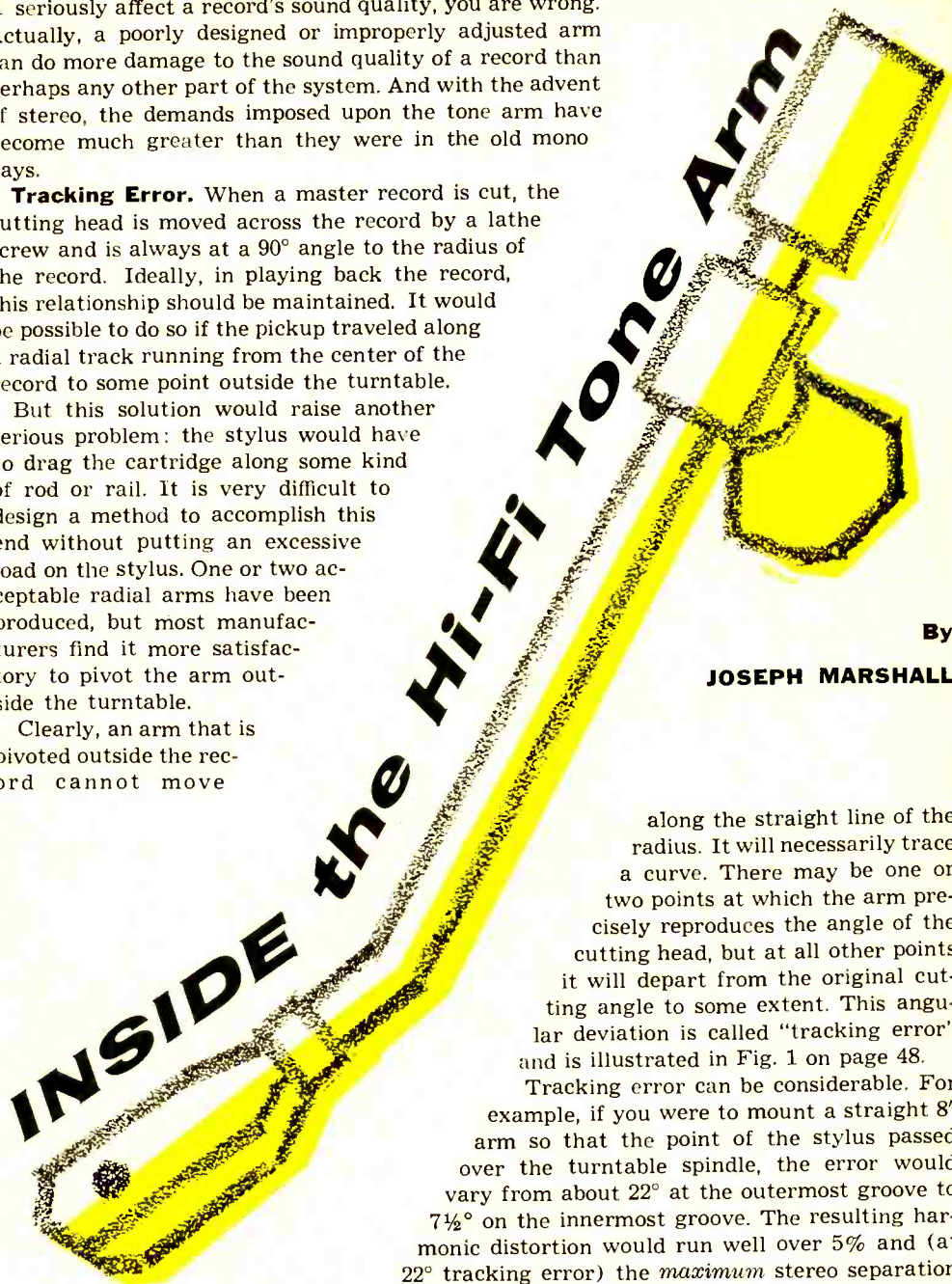


IF YOU think the tone arm of a high-fidelity system can't seriously affect a record's sound quality, you are wrong. Actually, a poorly designed or improperly adjusted arm can do more damage to the sound quality of a record than perhaps any other part of the system. And with the advent of stereo, the demands imposed upon the tone arm have become much greater than they were in the old mono days.

Tracking Error. When a master record is cut, the cutting head is moved across the record by a lathe screw and is always at a 90° angle to the radius of the record. Ideally, in playing back the record, this relationship should be maintained. It would be possible to do so if the pickup traveled along a radial track running from the center of the record to some point outside the turntable.

But this solution would raise another serious problem: the stylus would have to drag the cartridge along some kind of rod or rail. It is very difficult to design a method to accomplish this end without putting an excessive load on the stylus. One or two acceptable radial arms have been produced, but most manufacturers find it more satisfactory to pivot the arm outside the turntable.

Clearly, an arm that is pivoted outside the record cannot move



By

JOSEPH MARSHALL

along the straight line of the radius. It will necessarily trace a curve. There may be one or two points at which the arm precisely reproduces the angle of the cutting head, but at all other points it will depart from the original cutting angle to some extent. This angular deviation is called "tracking error" and is illustrated in Fig. 1 on page 48.

Tracking error can be considerable. For example, if you were to mount a straight 8" arm so that the point of the stylus passed over the turntable spindle, the error would vary from about 22° at the outermost groove to 7½° on the innermost groove. The resulting harmonic distortion would run well over 5% and (at 22° tracking error) the *maximum* stereo separation on a stereo disc would be limited to only 30 db—not taking into consideration the separation losses in the cartridge and amplifier. To meet high-fidelity standards, tracking error should be no more than 1.4° on the innermost grooves and 4° on the outermost grooves. At first consideration it would seem impossible to keep tracking error this low, but ways *have* been found to do it.

For one thing, the longer the arm, the shallower

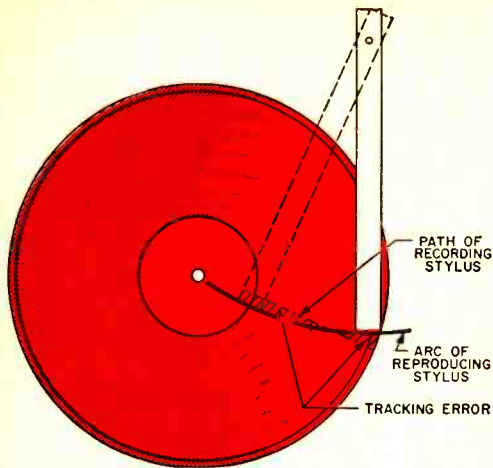
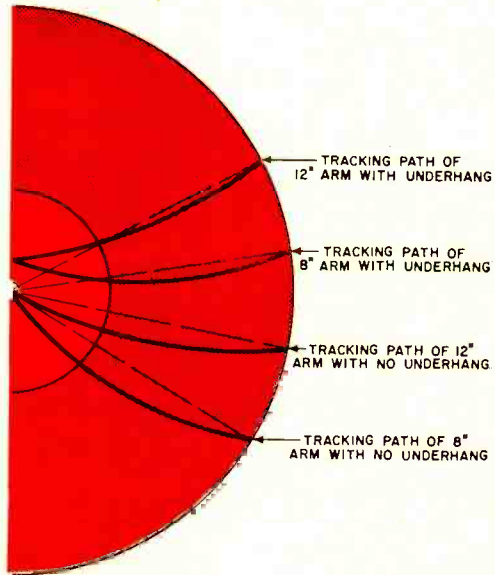


Fig. 1. Tracking error occurs in the area shaded with the diagonal lines.

Fig. 2. Effects of various amounts of underhang and differing arm lengths on the amount of tracking error.



the arc it will trace becomes and the closer it will come to the straight line of a radius. If we could use an arm several feet long, the arc could be close enough to a straight line to provide a very small tracking error. But an arm longer than 16 to 18 inches is usually out of the question, and even these lengths are longer than is convenient for most home applications.

Decreasing Tracking Error. A more practical way of reducing tracking error takes into account the fact that records are recorded only on the outer three or four inches, so there is no point in worrying about tracking the inner two inches. If we mount the arm a little farther out, it will *underhang* the turntable spindle and the stylus will come short of the center of the record. This will reduce tracking error, especially on the innermost grooves where it is most serious. The effects of arm length and underhang on tracking error are indicated in Fig. 2.

Another way of improving tracking is shown in Fig. 3. The lower arc is the path of a straight 8" arm with no underhang or overhang. The solid lines indicate the actual path of the arm and stylus, while the broken lines indicate the path the arm would have to take to provide perfect tracking. Note that on the outermost groove the tracking error is about 22°. Now suppose that we offset the head of the same arm by about 22°. The angle of the arm at the point where the needle rides the outer groove would be exactly right. As the arm moved inward, however, an error would begin to occur. At the halfway point, there would be an error of about 8° instead of the

14° we had with the straight arm. Beyond this point, things would get worse and the error would be greater than before.

However, we can correct this situation by moving the arm closer to the turntable so that the arm *overhangs* the spindle. This maneuver will have the effect of reducing the offset of the arm at the inner grooves while maintaining it at the outer grooves. By choosing optimum values of offset angle and amount of overhang, we can achieve a tremendous improvement in tracking. The upper arc in Fig. 3 is for an 8" arm with an offset of 28°. There are now two points where there is no tracking error at all, and the error is 2° or under at all other points.

Offsetting a longer arm permits even better tracking. The longer arm requires less offset and a smaller overhang. Practically all arms have an offset, although sometimes the offset is not obvious. Thus, although the Pickering 190D and the Shure "Studio Dynetic" arms appear to be

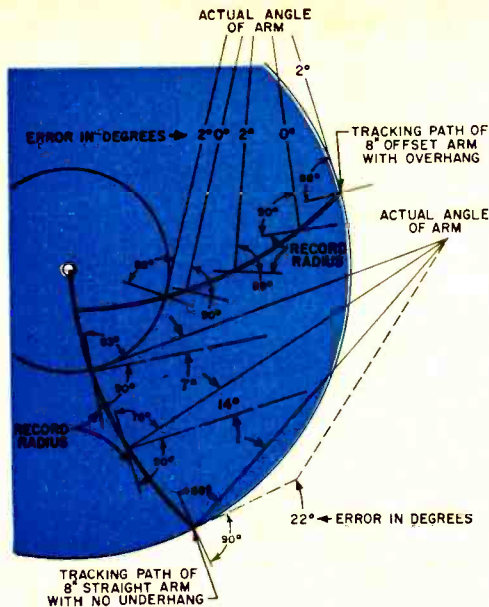
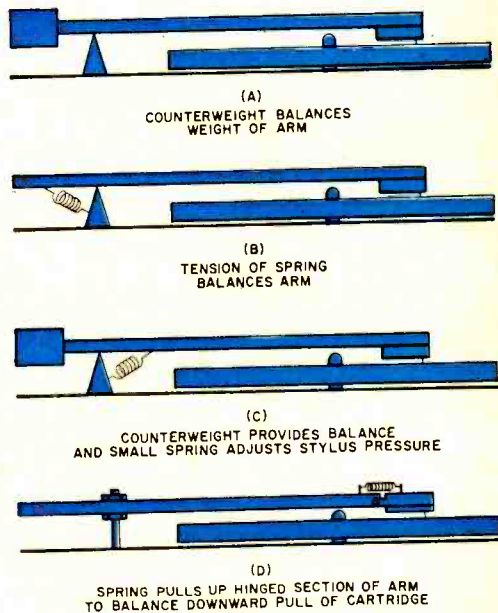


Fig. 3. Comparison of the amount of tracking error from an 8" straight arm with no overhang or underhang and an 8" offset arm with overhang.

Fig. 4. Four ways to counteract the weight of the tone arm and cartridge.



straight, they actually provide offsets by the way the pickup is oriented in its mounting. By combining these various ways of improving tracking, modern tone arms achieve tracking errors of 1° maximum and thus prevent degradation of fidelity and stereo separation.

Free Movement. Assuming the arm has low tracking error, its next problem is to move freely up and down and from side to side. Unrestricted lateral movement is necessary because the stylus has to pull the arm across the record. Vertical freedom is necessary because the arm must be able to track warped records.

There are two general approaches in designing a tone arm that will permit these two types of motion. One is to use the same pivot point for both the vertical and the lateral movement. In this design, the entire arm moves up and down when it tracks a warped record. If something weren't done to prevent it, this would place the entire weight of the arm on the stylus.

Weight is nothing more than the force of gravity working on the mass of an object. If the force of gravity is counteracted by another force, weight can be reduced, or in effect, eliminated at a given point in space. One way to do this is to balance one weight with an equal weight or counterweight. We can extend the arm on the other side of the pivot point, install a counterweight on it, and adjust it to achieve a near balance.

Actually we do not want an exact balance. The stylus must be held in place in the groove by a light pressure. So we adjust the counterweight to provide a stylus pressure of from 1 to 8 grams. A mass so nearly balanced becomes very light and easy to lift—as those of us know who have used a see-saw with someone else of nearly equal weight. The counterbalance approach to tone-arm design is shown in Fig. 4(A). The Grado, Pickering, and Rek-O-Kut arms are examples of this approach.

Another way of applying a counteracting

force is by means of a spring. See Fig. 4(B). Here the pull of the spring is adjusted until it almost—but not quite—equals the weight of the arm. The difference provides the needed stylus pressure. But the trouble with this arrangement is that a spring is not a linear source of force. It exerts less force as it compresses and therefore causes the arm to become, in effect, heavier as it is raised. For this reason, spring balance is employed only with arms in changers and manual players where the use of a counterweight balance is not feasible because of various mechanical considerations.

However, several counterweight-balanced arms use a small spring for fine adjustments of stylus pressure. See Fig. 4 (C). In this design, the arm is first balanced with the counterweight and then the spring tension is increased to provide the proper stylus pressure. Note that the spring pulls the arm *toward* the record and thus tends to hold the stylus in place. Such arms have a high degree of stability and will operate satisfactorily even if the turntable is not perfectly level. Some of the newest arms—the ESL, the Audio Empire, and the Dynaco—employ the combined counterweight and spring-balance system.

The second approach to achieving free tone-arm movement is to use two pivot points: one at the mounting point for lateral movement, and one somewhere between this point and the cartridge for vertical movement. This technique is shown in Fig. 4(D). Since only the end of the arm moves up and down, the amount of mass we have to deal with is comparatively small, and a simple spring-balance system can serve nicely. In most cases, little more than the weight of the cartridge has to be moved. The Gray SAK-12 and Fairchild 280A arms are examples of this type of design. However, in the Shure "Studio Dynetic" arm, a small counterweight on a threaded rod balances the weight of the cartridge; this arm achieves high stability at stylus pressures as low as 1 gram.

Whatever pivot arrangement is used, friction in the pivots should be as low as possible. Many types of bearings are used in tone arms, and while each has its special advantages, it seems that, with proper design, various types can produce equivalent performance. The simple thrust bearing is used by Audax, Fairchild, Grado, Gray (lateral), Shure, and Weathers. Ball bearings are used by Audio Empire, ESL, Gar-

rard, London-Scott, and Rek-O-Kut. The Dynaco features gimbal pivots in both bearings, and Pickering and Stromberg-Carlson use a single needle-point suspension. In addition, several arms employ viscous-damped bearings.

Viscous Damping. At first glance, viscous damping seems to violate the principle of keeping friction low. A viscous-damped arm opposes any rapid and sharp motion—such as being dropped onto the record accidentally. But at the speed at which the arm customarily travels over a record, the friction of a viscous-damped arm is insignificant.

Viscous damping has several advantages. First, it produces a high degree of stability even at very low stylus pressures; the Weathers arm is stable with only one gram of pressure. Secondly, it provides a high degree of damping against arm resonance, another serious problem in arm design. Some degree of viscous damping is employed in one or both pivots of the Gray, Weathers, Stromberg-Carlson, and London-Scott arms.

Resonance of the arm at any frequency within the audio range must be avoided. The simplest way to minimize the possibility of resonance is to make the arm out of a material which is not prone to vibration in the audio range—such as wood. Both Weathers and Grado make their arms out of wood. When other materials are used, all the physical characteristics of the arm—such as shape, cross section, length, and weight—must be carefully coordinated to keep the arm from resonating above 20 cps. A counterweight helps in solving this problem because its mass tends to damp resonance.

It is highly desirable, especially with stereo records, to reduce stylus pressure to the least amount necessary for good tracking. One way of achieving this reduction is to design the arm specifically for the cartridge and tailor the characteristics of the arm to complement the cartridge. Examples of such integrated combinations are the Weathers, the Shure "Studio Dynetic," the Dynaco, and the London-Scott.

Though modern tone arms differ in many respects in their design approach to the problem of providing good performance, they have all been specifically developed to meet the highly critical demands of today's records and provide excellent results when they are properly installed.

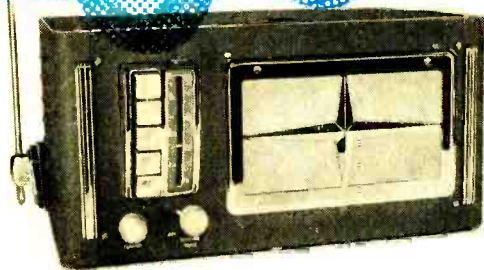


ON ALMOST ALL COUNTS, the average automobile receiver is designed and manufactured to higher performance standards than is the typical home radio. From a design viewpoint, the car radio must have sensitivity enough to pick up local stations away from the major cities, coupled with better than average selectivity to minimize interference problems. Furthermore, it must deliver relatively large amounts of distortion-free audio power to override road and car noises, especially when the auto is traveling at turnpike speeds with several windows open.

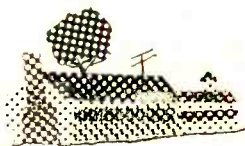
Construction-wise, the car radio must be well shielded to keep out ignition noise and other electrical interference, and be well built mechanically to stand up under road vibration and shock.

And in addition to high over-all quality in design and construction, most auto sets have built-in operating features seldom found in any but the most expensive of home receivers: push-button tuning, wide-range tone controls, and, often, sensitivity or r.f. gain controls as well as the usual volume control.

If all this sounds like a "commercial" for automobile radios—it is! Why? Because the majority of car radios can be converted to a.c. operation with ridiculous ease. In general, only a few parts, a little "know-how," a small amount of wiring skill, and a few hours time are required. And the resulting receiver, when mounted in a suitable cabinet, is far superior to all but the most



Convert a CAR RADIO for HOME USE



**Simple power supply modifications
enable a. c. operation**

By E. G. LOUIS

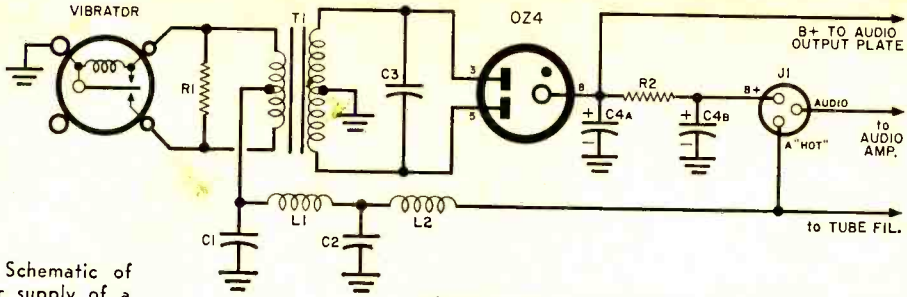


Fig. 1. Schematic of the power supply of a typical older car radio.

expensive home sets. What's more, old car radios still in good operating condition (or easily repaired) are available "for a song" in most localities from radio servicemen or junk dealers.

"Finding" a Radio. With hundreds of old automobiles "junked" daily, most of which are equipped with receivers, there are so many sources of auto sets that you can afford to be a little "choosy" about the type and model radio you pick. Old car radios can be picked up at junk yards, auto wreckers, garages, and, frequently, from new and used car dealers. The latter will often take a car "in trade" with the idea of junking it, and will be happy to let you have the radio for a nominal price—if you remove it yourself.

The price you'll have to pay will vary considerably, depending on your bargaining ability, whether the set is in working condition, and whom you contact. As a general rule, it shouldn't exceed ten dollars, except for late model sets; if the set is more than five years old, the price may be as low as one buck—or you might even pick up the radio "for free." The unit shown in the

photographs was salvaged from a 1950 model Chevrolet.

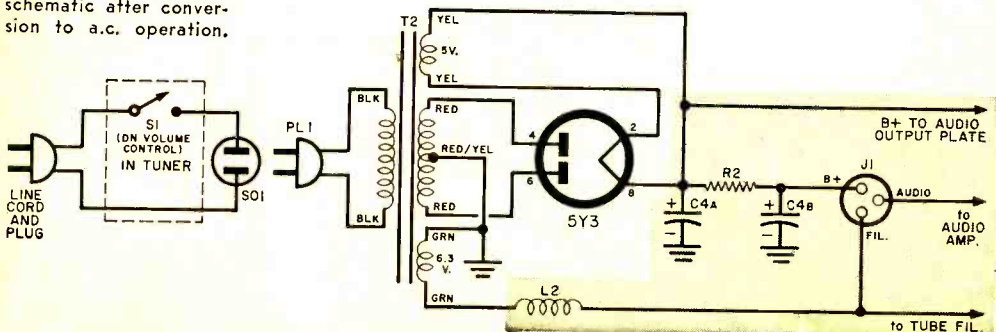
Now as to the type of set. First of all, pick a receiver using an "all-tube" design. Sets with one or more transistors are not as easy to convert to a.c. operation as are all-tube radios. A six-volt receiver is your best bet—and will probably be cheaper!

Try to find one in good operating condition so you won't have to repair it. If there's a missing tube, fuse, or vibrator, don't worry about it. A tube is easily replaced, and you won't need the vibrator after conversion. On the other hand, if you know a little about servicing, or have a friend who does, you can pick up an inoperable receiver at a much lower price. (See the Jack Darr article on "How to Repair Auto Radios" in the May, 1959, *POPULAR ELECTRONICS*.)

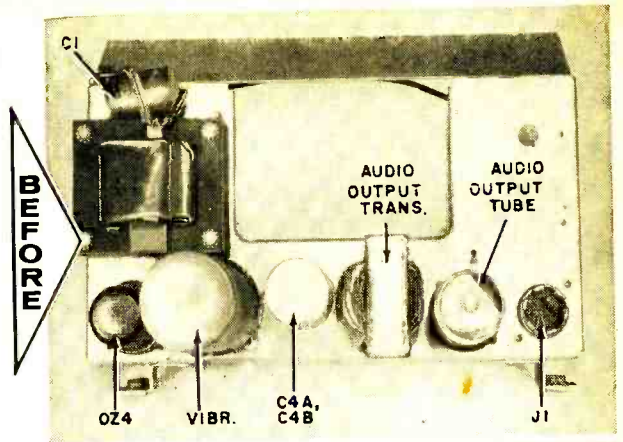
There are several types of sets to avoid: those which have been physically damaged in an accident; those equipped with "signal seeking" or "search tuning" mechanisms (a receiver having manual and/or push-button tuning is okay); those which may have been "cannibalized" for parts; and those equipped with field coil rather than PM speakers with Alnico magnets.

Once you've obtained a suitable receiver, you'll find it worthwhile to get the schematic wiring diagram and Service Data for the set. They can be obtained as part of a folder of diagrams from your regular radio

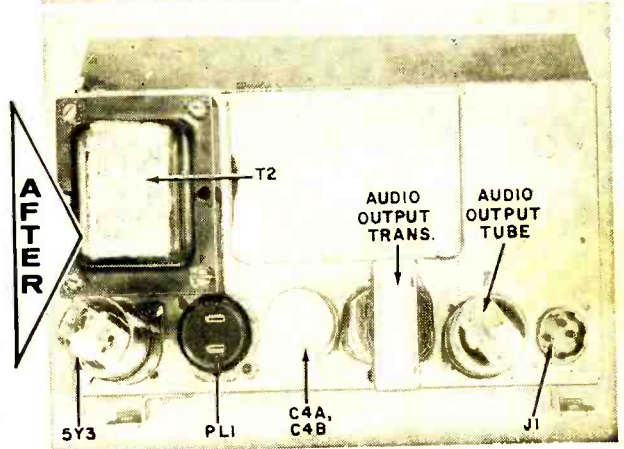
Fig. 2. Power supply schematic after conversion to a.c. operation.



Audio amplifier/power supply chassis of a typical auto receiver. Some models also have the r.f. section on the same chassis.



Revisions include replacement of original vibrator power transformer with 117-volt model and installation of male a.c. chassis-mounting plug in place of vibrator socket.



parts distributor; simply tell him the make and model number of the receiver—the data is generally printed or stamped on the set's chassis or case.

Next, check out your receiver. Correct obvious mechanical defects such as missing knobs and loose or missing chassis or case screws. Have the tubes tested, replacing any weak or burnt-out units. In general, make all the checks you can (without operating the set) to make sure that everything—except for the vibrator—is in good operating condition.

A. C. Conversion. At this point, you'll have to make a decision—whether to use a simple "make do" conversion or whether to go "whole hog" and rewire the power supply. For the simpler conversion, you'll need a heavy-duty filament transformer, one supplying 6.3 volts at about 10 amperes (assuming you have a six-volt set, as suggested earlier); a suitable transformer is available from Barry Electronics, 512 Broadway, New York 12, N. Y., for \$3.75 (Stock No. NYT-7091). For a "de luxe" job,

you'll need a general-purpose power transformer having high-voltage and filament windings; actual specs for this transformer, as we shall see, will vary somewhat.

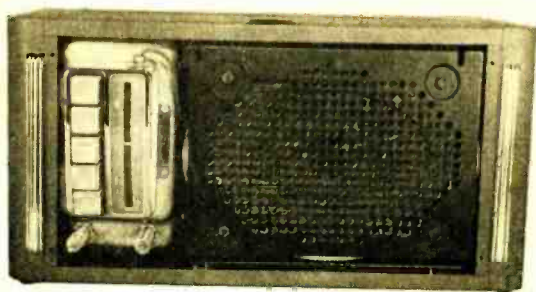
First, however, examine your receiver. Some sets are assembled in a single case. In others, the power supply, and possibly the audio output stage, will be on a separate chassis, with an interconnecting cable. The loudspeaker may be built-in or separate. In the set converted by the author, the receiver came in two separate units—a "tuner" and a power supply/audio chassis with the loudspeaker attached to the latter.

Check the dial light connection. In some sets a separate lead is provided so that the dial lights up only when the car lights are turned on. In such a case, you should reconnect the dial light lead to the "hot" (ungrounded) side of one of the tube filament terminals.

The original power supply circuit used in the radio the author converted is shown in Fig. 1. Most car radios designed for six-volt operation have almost identical circuits,

except that the rectifier tube may be a type 6X5 instead of the OZ4 shown. The three-terminal socket, *J1*, is used for the tuner cable; B+ is supplied to the tuner, while the detected audio signal and a "hot" six-volt connection is obtained from it.

In operation, the vibrator serves as a mechanical switch to convert the six-volt d.c. battery voltage to pulsating d.c., which



One technique for mounting a two-section receiver in a standard steel equipment cabinet is shown at left. Panel must be cut out to fit the components. A wooden cabinet may be used instead, probably with a slight improvement in tonal quality.

High-current filament transformer below is type used for the simpler conversion.

is stepped up by transformer *T1* and rectified to furnish the B+ voltages for the tubes' screens and plates. Various noise-filtering elements in the circuit (such as *L1* and *L2*) should be left unmodified. Filament voltages are obtained directly from the six-volt source.

The Easy Way. The simplest method of converting to a.c. operation is to substitute a 6.3-volt, 10-amp. filament transformer for the battery voltage. Connect one side of the transformer's 6.3-volt secondary winding to chassis ground, the other side to the radio's "hot" power lead. Do not connect the center tap (if present), but tape it up to avoid a short to ground. The transformer's primary, of course, is connected to a standard line cord and plug.

With the plug inserted in a wall outlet, turn the set on. If the vibrator works, and the radio has "life," fine. Otherwise, remove the vibrator and connect *one side* of the vibrator transformer's primary winding to circuit ground.

In this case, we've simply substituted a.c. for the pulsating d.c. normally supplied to *T1*.

"De Luxe" Version. Here, the vibrator transformer is replaced with a standard power transformer. See Fig. 2. If a type OZ4 tube is used in the original circuit, replace it with a standard rectifier, such as a 5Y3. If your set uses a 6X5 rectifier, retain it, by all means.

Power transformer specifications are not

too critical. In general, the basic "specs" are determined by the circuit in your receiver. Choose a transformer having a 117-volt primary, center-tapped high-voltage secondary, a 5-volt filament winding (not needed if a 6X5 rectifier is used), and a 6-volt filament winding. The high-voltage winding should supply about 250 volts on each side of center tap. The transformer

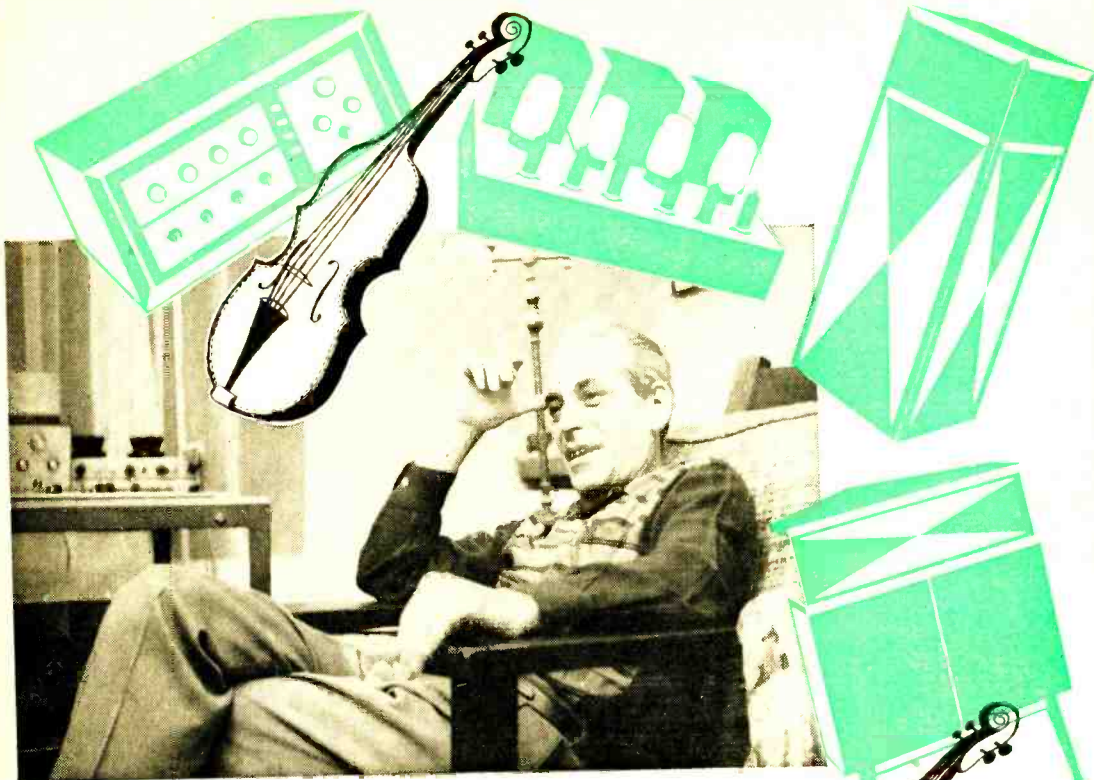


should be marked 250-0-250 or 500 v.a.c., CT (center-tapped).

Current ratings of the transformer will depend on the number of tubes in the receiver. If your set uses push-pull output tubes, the high-voltage secondary should have at least a 90-ma. rating, and the 6.3-volt winding should be rated at not less than 3 amperes. If a single output tube (such as the 6V6, 6F6, 6AQ5, 6AR5, 6K6) is used, a 50-ma. high-voltage winding is okay, and a 2.5-amp., 6-volt winding will do. The 5-volt rectifier filament winding may be rated at 2 amperes in either case. Try to pick a power transformer which fits into the same space as the original vibrator transformer (*T1*).

In most auto radios, the "hot" 6-volt d.c. lead is fed through a fuse and then connects to the on-off switch ganged to the set's volume or tone control. This connec-

(Continued on page 120)



The Frustrated Fiddler

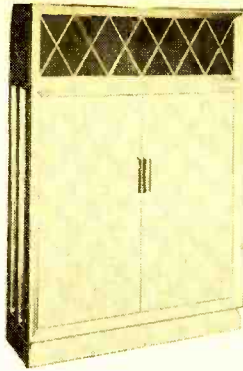
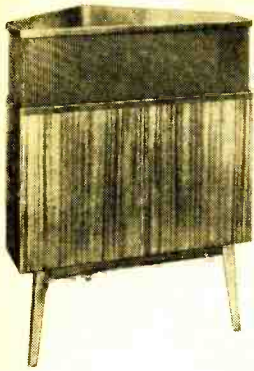


AT a time when most industries put the emphasis on teamwork, audio remains one of the few fields where it is possible for a man to make a success as a "loner"—to build a career solely on the strength of his own ideas. A case in point is A. Stewart Hegeman, a hold-over from the days when rugged individualists—relying only on their creative imaginations—laid the technical groundwork for our modern industries.

Of course, there have been others whose original ideas advanced the art of audio. Men like Voigt, Briggs, Villchur, Klipsch, Williamson, and Keroes all have made far-reaching contributions. But the efforts of these design-

By **HANS H. FANTEL**

*When Stewart Hegeman decided
on a career in engineering,
the music world's loss
was high fidelity's gain*



Two of the first commercial components to which Hegeman contributed were the Brociner "M-4" (left above) and the Brociner "Transcendent" speakers.

Unusual mid-range and high-frequency components installed in the Hegeman "Professional" speaker are pointed out above.

ers mostly were concerned in specific areas. For example, Voigt, Villchur, Briggs, and Klipsch are loudspeaker designers; Williamson and Keroes are primarily "circuit men." By contrast, Stewart Hegeman's work spreads over the entire field of audio. From loudspeakers to amplifiers and pre-amps, from tuners to tape recorders, Hegeman has left—and is leaving—his creative mark on every facet of the high-fidelity industry.

The name of Hegeman is to hi-fi what the names of Bentley and Bugatti are in automotive lore. Like those renowned car builders, Hegeman has gained his fame as the creator of "classics." Some of the hi-fi components to which he has contributed, such as the Brociner "Transcendent" and "M-4" loudspeakers, have become collectors' items. His current crop of brain-children includes the Lafayette KT-600 stereo control unit, the Harman-Kardon "Citation" kits, and the EICO HFS-2 speaker system.

The Man Himself. Recently, to meet the man behind these units, we visited Hegeman at his home in the pleasant, tree-shaded little New Jersey town of Glen Ridge, where he and his family occupy an ancient and rambling Victorian frame house.

Hegeman is a trim, gray-haired man with intense, deep-set eyes and the wiry frame often found in persons of boundless energy and stamina. As we talked, Hegeman's personality quickly came through; although outwardly quiet and relaxed, he is a man who has firm opinions about his particular field and about life in general.

His individuality shows in small ways. For instance, he is an inveterate coffee drinker, and at work or at play, when coffee time rolls around, all activity ceases while Hegeman takes time out for coffee—preferably black and boiling hot.

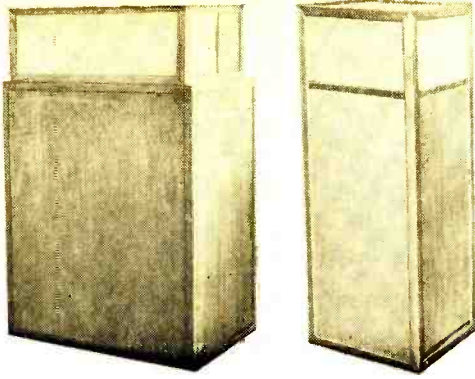
Cautiously sipping some of his steaming brew, we glanced around Hegeman's family parlor. Audio instruments and equipment in varying stages of completion were along every wall and in every corner. Apparently Hegeman's entire house is his laboratory.

"What got me started in audio?" he anticipated our question. "Well, you might say I'm a frustrated fiddler. I originally wanted to be a concert violinist, but I never was any good on the violin. For me, engineering turned out to be the easiest way to get close to music.

"In the early days, though, when I studied electrical engineering at Princeton, nobody bothered about sound reproduction. They didn't even have a special radio course then! But I was always fascinated by music. I built one of the first electric phonographs down at Princeton around 1930, and in one way or another I've been improving it ever since."

Early Career. After graduation, Hegeman put in some 15 years at Western Electric as a test engineer, developing measurement techniques for telephone equipment—techniques for which he earned several patents. On the side, he operated a ham radio station. But his main hobby was building experimental audio systems.

When high fidelity finally began to come into its own about 1948, Hegeman saw a chance to turn his hobby into a vocation.



Speaker system at left (above) is the extraordinary Hegeman "Professional." The EICO HFS-2 unit is a scaled-down version of this design.

He quit Western Electric and set himself up as an independent audio consultant. With only brief interruptions, he has maintained this independence ever since. In an age when practically all consumer goods are designed with an eye to cost and profit, Hegeman creates equipment to meet his own exacting requirements. His primary motivation is quality. Consequently, many of his designs have been offbeat, complex—and usually expensive.

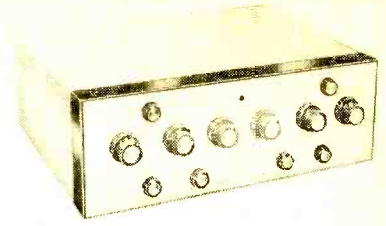
The first hi-fi manufacturer Hegeman became affiliated with was Victor Brociner, with whom he designed a distinguished line of components such as the "Transcendent" and "Model 4" loudspeakers, the "Mark 12" amplifier, and the CA-2-UL-1 two-chassis preamp-amplifier. Each of these represented a major advance in sound reproduction and they still rank among the best components ever made.

"Price was a secondary consideration," says Hegeman. "We simply wanted to produce the best equipment possible. Of course, not many people could plunk down upwards of \$700 for a Transcendent speaker. But those who did never regretted it."

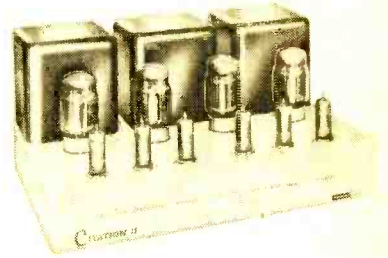
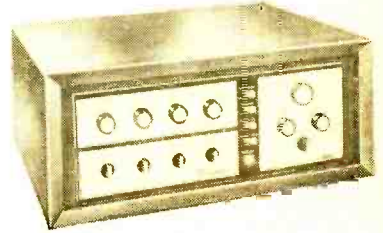
After the demise of the Brociner company, Hegeman did a two-year stint as chief engineer of Westminster Recording Company. He revamped that company's lab, started their "Sonotape" pre-recorded tape division and supervised their "Lab

Future projects are shown at right. Tape recorder is a prototype, as is transistorized stereo pre-amp in background. Above the Citation I pre-amp is the FM tuner kit designed for Dynaco.

February, 1960



Flexibility and low distortion are primary virtues of the Lafayette KT-600 stereo preamplifier (above) designed by Hegeman and Aaron Newman.



Newest Hegeman creations are the Harman-Kardon "Citation" stereo amplifier and preamplifier. These come both in kit form and factory-wired.



Series" records, which are, even today, representative of monophonic records at their best.

Radical Loudspeakers. Meanwhile, however, Hegeman was mulling over the idea of an entirely new kind of loudspeaker which would depart from established concepts of speaker design and which he hoped would set a new standard of sound reproduction. Driven by this vision, he left Westminster to devote himself fully to the development of one of the most remarkable loudspeakers ever produced, the "Hegeman Professional."

The complete novelty of the Professional's concept and appearance upset audio apple carts all over the place. But none of this was the result of any willful or commercial desire to be "different." Every off-beat design detail was justified by brilliant engineering reasoning.

The Professional was clearly a labor of love. Hegeman has never licensed it for manufacture by anyone else. It is available only on a custom basis directly from him because he insists on personal quality control over every unit. However, a scaled-down and simplified version of the Professional's design is sold by EICO as the Model HFS-2.

In the Hegeman Professional and EICO HFS-2 speakers, the most eye-catching item is the tweeter. Sometimes described as looking like a double-walled ice-cream cone, this tweeter, which is employed as the treble unit in both systems, is the first loudspeaker to achieve in actual design the theoretical ideal of a free-floating, rimless cone.

The outer rim of the tweeter just sticks up in the air with no suspension whatever to limit or deflect its motion. This absence of any physical constraint permits free piston motion of the cone, which represents the theoretical optimum.

"The secret to this tweeter's natural, open feeling is its omnidirectional sound radiation," explains Hegeman. "What I wanted to achieve was a sound radiation field that would duplicate the acoustic characteristics of a musical instrument playing in a room. The upright tweeter spreads the sound in a full circle. What's more, the sound doesn't just go all around; it also goes upward. This also restores in playback the natural ratio of direct to reflected sound that we hear in live music."

Also unusual is the bass section of the

Professional. It employs a pair of 22-foot conical horns terminated by small slots instead of the usual horn mouths. Hegeman maintains that the slots keep the impedance "seen" by the woofer's cone constant over the whole frequency range and prevent standing waves and reflections.

Clearly, the loudspeakers are Hegeman's favorites among his creations. Their unique concept has grown slowly in his mind ever since his first experiments with the famous British Lowther drivers. The Lowther-Hegeman horn of 1949 is the honored ancestor of the current generation of Hegeman speakers, and the basic family traits of wide-angle sound dispersion, absence of point-source effect, and carefully calculated horn loading are common to all Hegeman-designed speakers.

Later Designs. Hegeman's newest achievements are in electronic kit design: the Lafayette KT-600 stereo preamplifier control unit, developed in conjunction with Aaron Newman of Lafayette, and the Harman-Kardon "Citation" series.

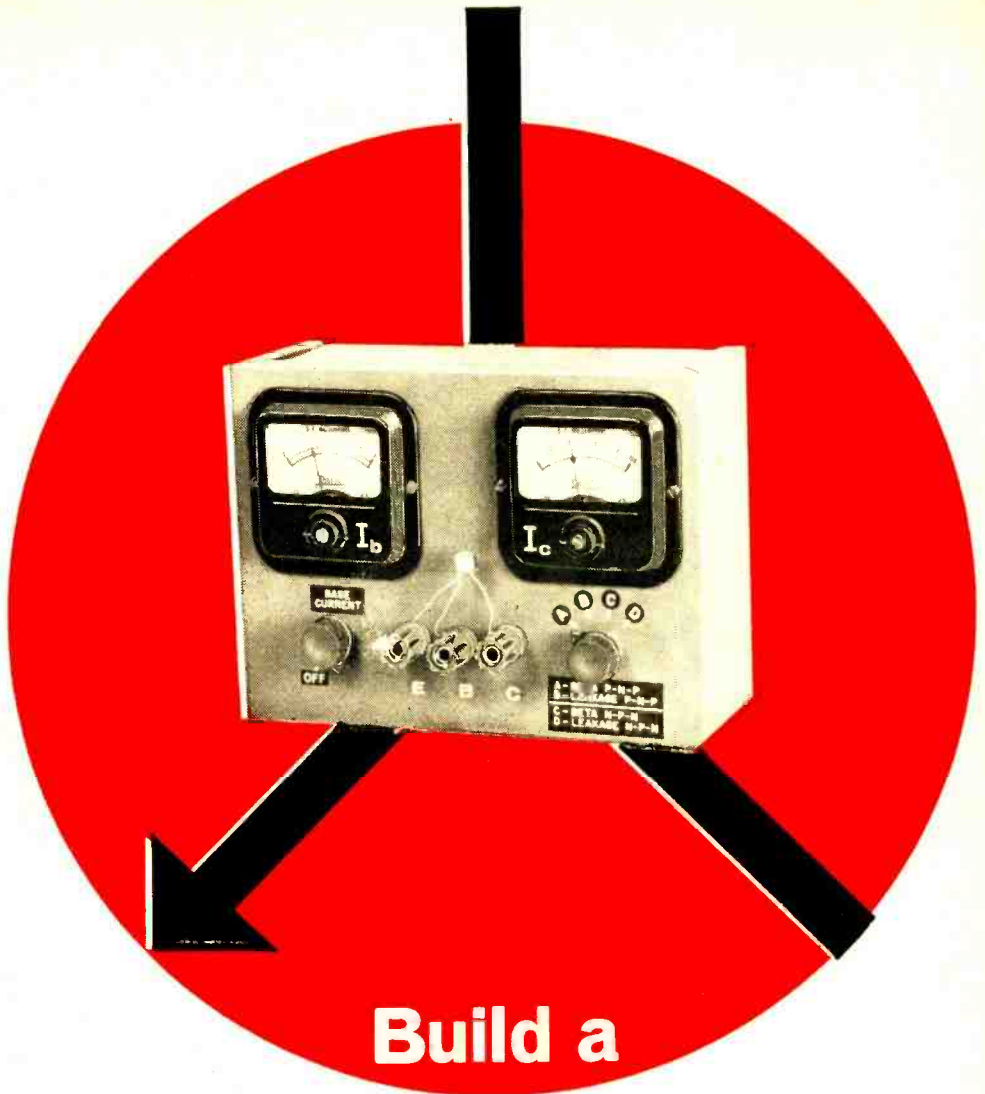
"When we designed the KT-600, we wanted the audio fan to have all the basic control facilities in his home that would be used in a lab setup," says Hegeman. This unit has 19 knobs on the front panel and quite a few adjustments in the rear. "We wanted the record collector to be able to equalize any record made at any time since the beginning of electronic recording. That's why there are 28 possible combinations of bass turnover and treble roll-off."

The most novel feature Hegeman introduced in the KT-600 was a stereo balancing circuit operating on the null principle. It plays the signals of both channels against each other in opposite phase. If you use a mono record as a signal source, both channels will carry the identical signal. When the null is adjusted properly, the two signals will cancel out—automatically balancing the two channels perfectly.

The KT-600 was also the first stereo preamplifier to feature a "Bridge" control for cross-feeding (blending) the two stereo channels for any desired degree. This control is handy in correcting "hole-in-the-middle" effects and lets the listener select the optimum amount of stereo separation for his particular room.

In addition to being perhaps the most flexible control unit available today, the

(Continued on page 116)



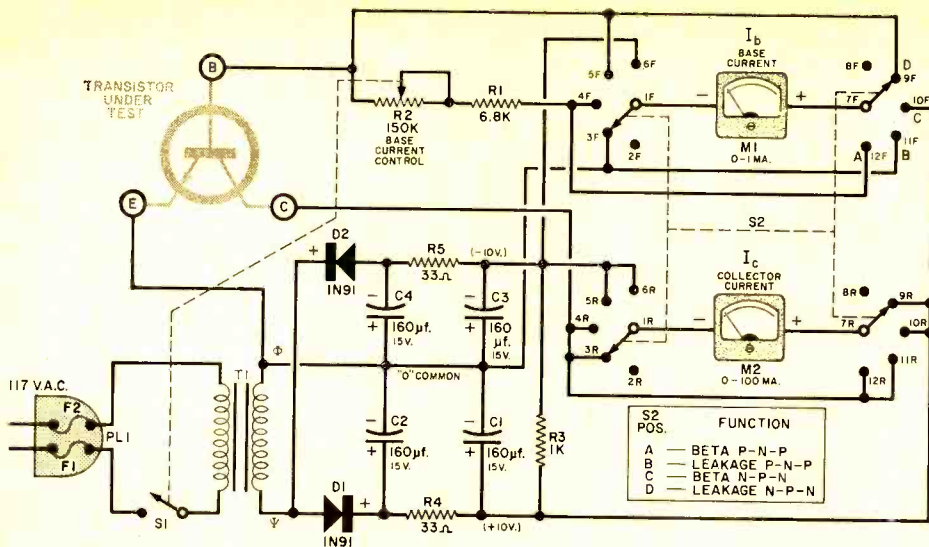
Build a Dual-Meter Transistor Tester

*You can check both audio
and power transistors with
one easy-to-operate unit*

By
R. J. SHAUGHNESSY

SOMETIMES you'll finish building a transistorized project and find that it doesn't work. It's easy enough to recheck your wiring, but if you do and the unit still doesn't work, then what? Were the transistors good before you put them in the circuit? Were they burned out accidentally? It's obvious that you need a transistor tester to check the transistors before you wire them into the circuit and to check them again if the circuit stops working.

This tester measures the two important characteristics of almost all audio and power transistors: current gain (*Beta*) and collector-to-base leakage (I_{co}). Only transistors which have a 5-ma. maxi-



Transistor tester base current control R2 should be wired so that maximum resistance is obtained when ganged switch S1 is open.

imum collector current cannot be tested with this unit; see the manufacturer's data for special testing techniques for these low-current jobs.

Two meters are built into the tester to allow the base current and the collector current to be monitored simultaneously under various bias settings. This monitoring feature enables a transistor to be tested under actual circuit load conditions.

For maximum flexibility, no sockets were incorporated in the tester proper. The transistor under test is simply connected by its leads to the tester terminals. An adapter which plugs into the tester's binding posts can be built which will accommodate the various types of power and audio transistor sockets.

Parts used in the tester and optional adapter are not critical. With all new components, cost of the tester is about \$15.

Construction of the tester is begun by mounting all the components directly on the cabinet. Before mounting function switch S2, crimp all jumper leads to the switch terminals. After the switch is mounted, connect and solder the remaining leads to it.

The transistor tester adapter can be built into the smallest Minibox that will accommodate a standard three-lead transistor socket (in-line or circular type) and a power transistor socket. When a transistor

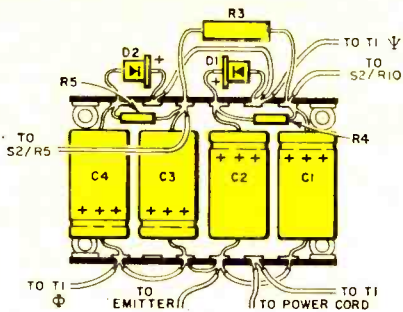
TESTER PARTS LIST

- C1, C2, C3, C4—160- μ f., 15-volt capacitor
- D1, D2—1N91 germanium diode (Sylvania)
- F1, F2— $\frac{1}{2}$ -amp. 3AG fuse (to fit PL1)
- M1—0-1 ma. meter (Shurite 950-9300Z)
- M2—0-100 ma. meter (Shurite 950-9307)
- PL1—Fuse plug (E1-Menco EL-32)
- R1—6800-ohm, $\frac{1}{2}$ -watt resistor
- R2—150,000-ohm potentiometer (IRC Q13-328)
- R3—1000-ohm, 1-watt resistor
- R4, R5—33-ohm, $\frac{1}{2}$ -watt resistor
- S1—On-off switch mounted on rear of R2 (IRC 76-1)
- S2—Four-pole, four-position rotary switch (Centralab PA-1013)
- T1—6.3-volt filament transformer (Triad F-13X)
- 1—7" x 5" x 3" Minibox (Bud CU-2108A)
- 3—Five-way binding posts
- 2—Pointer knobs
- 2—Six-lug terminal strips

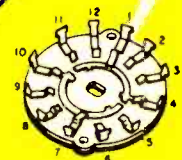
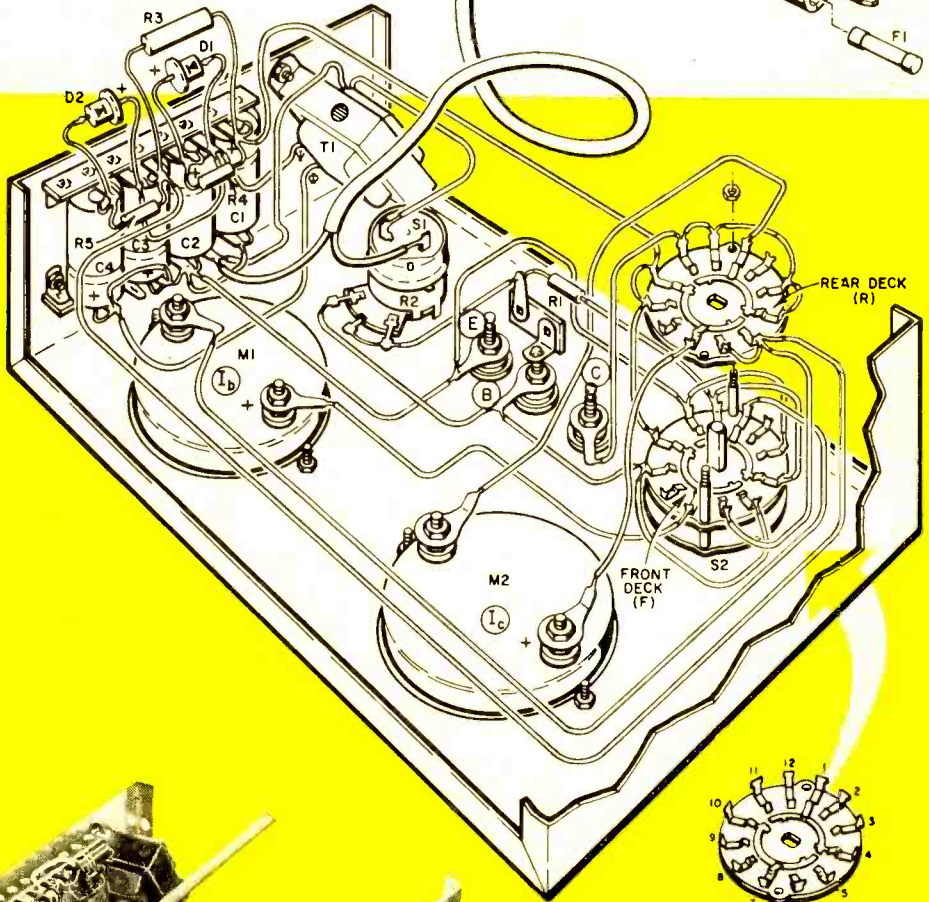
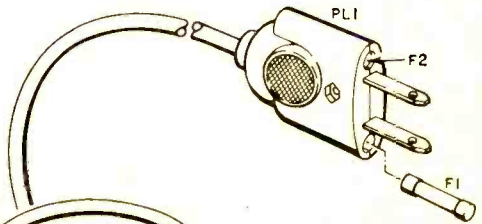
is being tested, the adapter's banana plugs (which are connected to the appropriate pins on the transistor sockets) plug into the tester's universal binding posts.

Testing for leakage is simple. Rotate function switch S2 to *Leakage N-P-N* or *Leakage P-N-P*, depending on the transistor in question. Connect the transistor base lead to the tester's emitter binding post. Then connect the transistor collector to the collector binding post. Leave the transistor emitter lead unconnected. (The transistor emitter is left unconnected for all leakage measurements.) Now turn on the tester by advancing the *Base Current* potentiometer (R2). If the 0-100 ma. collector current meter (M2) is not deflected, the leakage current is within acceptable limits.

You can safely measure the exact leak-

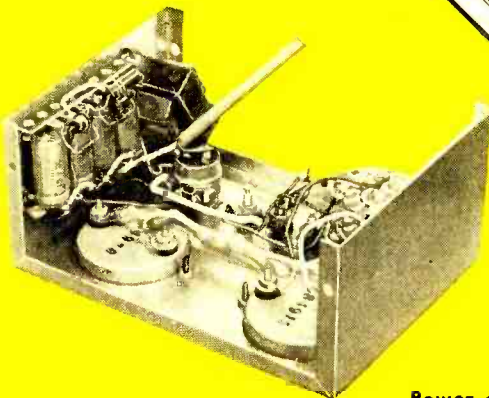


Observe polarity of diodes and capacitors in tester power supply detail (left).

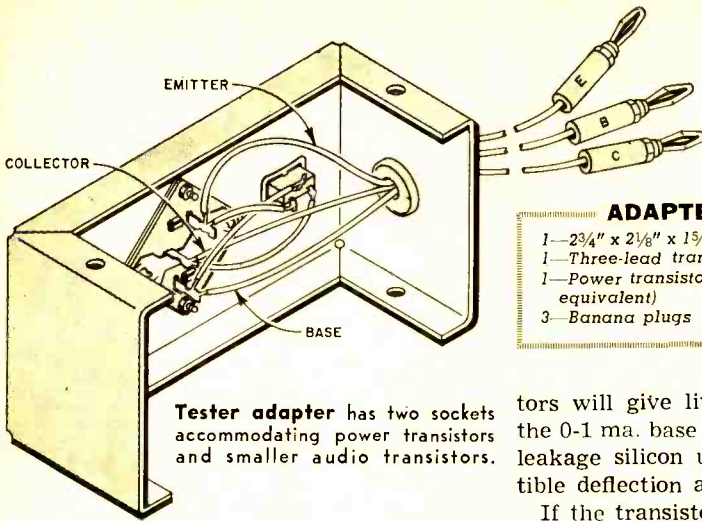


S2 FRONT AND REAR DECK DETAIL

Two-wafer ganged function switch is used in tester as shown in pictorial diagram above. Both wafers are identical. Note that pins two and eight are not used.



Power cord of tester is led through grommet in mating half of Minibox before soldering it in place.



Tester adapter has two sockets accommodating power transistors and smaller audio transistors.

ADAPTER PARTS LIST

- 1—2¾" x 2½" x 1½" Minibox (Bud CU 2100A)
- 1—Three-lead transistor socket
- 1—Power transistor socket (Motorola MK-10 or equivalent)
- 3—Banana plugs

tors will give little—if any—deflection of the 0-1 ma. base current meter. Some low-leakage silicon units will give no perceptible deflection at all.

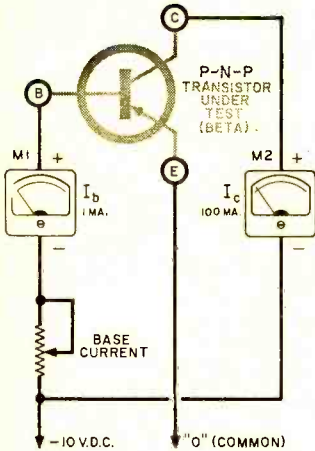
If the transistor passes the leakage test, you can safely perform the current gain (*Beta*) test. Current gain cannot be read directly on the tester, but *Beta* is very easily found by dividing the collector current reading by the base current reading.

The Beta test is made by setting *S1* to *Beta N-P-N* or *Beta P-N-P*. Make sure the power is off. Connect the transistor base, emitter, and collector leads to the corresponding binding posts. Check the manufacturer's specifications for the maximum collector current for the transistor under test and *never* exceed this value as read on the 0-100 ma. collector current meter. Now switch on the tester, but leave the *Base Current* pot full counterclockwise. Record the base current and collector current meter readings. Dividing the collector current by the base current (current gain) of the transistor under test.

Now increase the base bias current with the *Base Current* potentiometer. This will cause an increase in the collector current. Once more, record the meter readings and compute the current gain. Continue this process until you have several values for current gain.

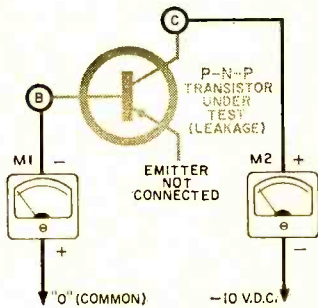
Note that *Beta* is constant except at the higher collector currents; this is a normal transistor characteristic. Check your computed values for the current gain against the manufacturer's specs to see if the transistor is up to snuff.

You'll soon find that you'll have more confidence in the circuits you build and trouble-shoot. Using the tester, you'll be able to give transistors a rapid checkout and use them to best advantage. —30—

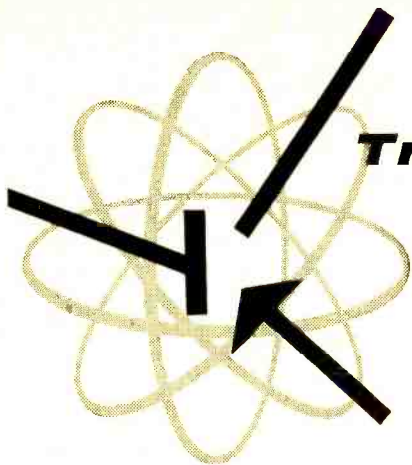


Current gain (Beta) test for n-p-n transistors is identical to p-n-p test shown in simplified schematic but polarities of meters and power source are reversed by switching *S2*.

Leakage test effectively puts two meters in series with transistor as shown in simplified schematic. Polarities for n-p-n transistors are reversed as in *Beta* test.



age current on the more sensitive 0-1 ma. base current meter (*M1*). Turn off the tester and reconnect the transistor base and collector leads to the corresponding tester binding posts. Do *not* connect the emitter lead; keep the function switch in the "leakage" position. When you turn on the power, you'll find that most transis-



Transistor Topics

By LOU GARNER

IT'S hard to believe, but the transistor's high efficiency and extended life span have turned out to be "too much of a good thing" in one respect. The transistorized, solar-battery powered transmitters used in artificial satellites can continue to broadcast their data for years—which is fine, up to a point. But as more and more artificial satellites and space probe rockets are launched, the airways will soon become cluttered with an overwhelming number of transmissions. Since there is a limited amount of space in the radio spectrum, new satellites may find their broadcasting being interfered with by signals sent out by satellites launched years earlier.

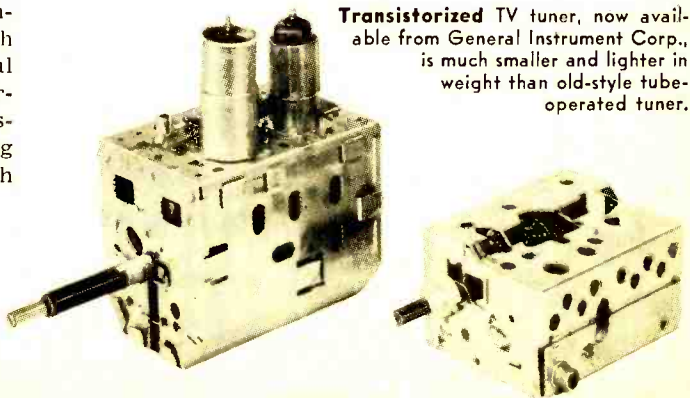
To prevent this unhappy situation from occurring, the Army Ballistic Missile Agency has had the Bulova Watch Company design a special "silencer" to turn off solar-powered transmitters. Assembled in a cube measuring about two inches on each side, this interesting device weighs about two and one-half pounds. Fully transistorized itself, it develops approximately one-billionth of one horsepower, yet can be set to switch off a transmitter

automatically after an interval of from zero to nine thousand hours.

Looking to the future, we can envision larger artificial satellites spaced in regular orbits around the sun, to be used as outer-space "mileposts" or marker beacons by interplanetary cargo and passenger ships. Their transistorized transmitters would be powered either by giant banks of solar batteries or by nuclear "fuel cells" to insure adequate output power.

Reader's Circuit. Our mailbag frequently includes letters from POP'tronics readers in South America, Europe, and Africa; and we've even received mail from as far away as India. Interestingly enough, many of these readers are experimenting with circuits—and using components—just like those popular with stateside hobbyists. The circuit in Fig. 1 was submitted by Alexis Pertuz, a high school student in Bogota, Colombia.

Alexis' circuit is that of a five-transistor AM broadcast-band receiver, with U.S.-distributed components being used throughout. Essentially a t.r.f. design, it includes a doubler-type diode detector and a three-



Transistorized TV tuner, now available from General Instrument Corp., is much smaller and lighter in weight than old-style tube-operated tuner.

stage audio amplifier. A class AB push-pull output stage is employed, and *p-n-p* transistors in the common-emitter arrangement are used in all stages.

In operation, r.f. signals are picked up and selected by tuned circuit *L1-C1*. A tap on *L1* matches the high impedance of the tuned circuit to the moderate input impedance of the r.f. amplifier *Q1*, assuring minimum tuned circuit loading and thus maximum circuit "Q" and selectivity. Tran-

The second audio amplifier stage, *Q3*, is transformer-coupled to the class AB push-pull output stage (*Q4*, *Q5*) through *T1*. Output stage bias is furnished by voltage-divider *R9-R10* and series base resistor *R8*. The push-pull stage, in turn, is coupled to its PM loudspeaker load through impedance-matching output transformer *T2*. A small open-circuit jack (*J1*), across the speaker, is provided for earphone operation. The d.c. power is furnished by a 6-volt

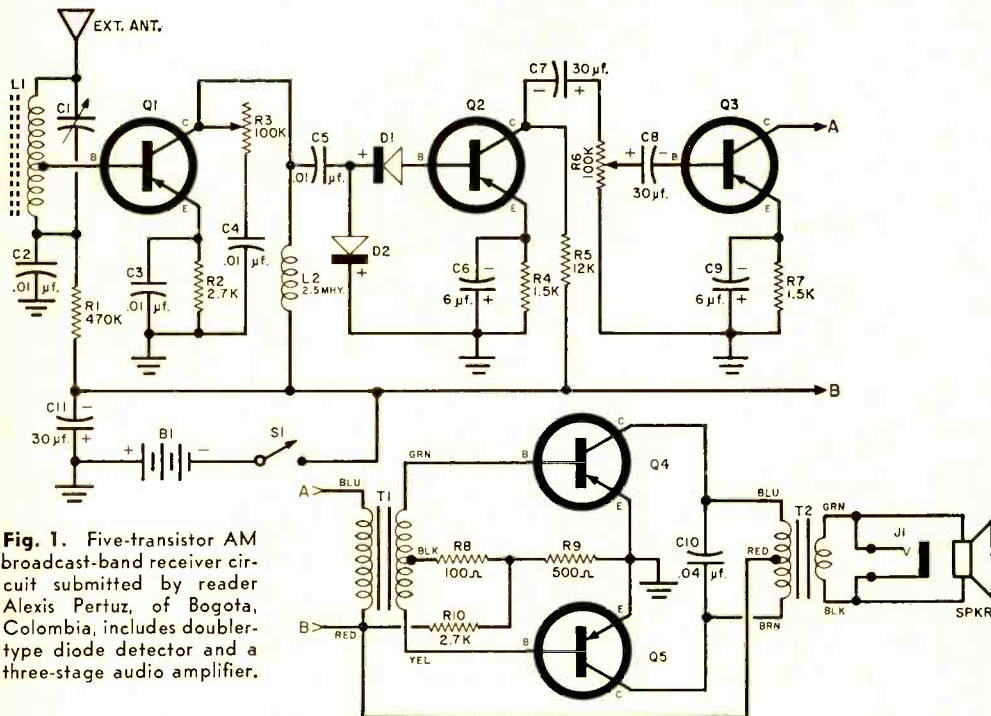


Fig. 1. Five-transistor AM broadcast-band receiver circuit submitted by reader Alexis Pertuz, of Bogota, Colombia, includes doubler-type diode detector and a three-stage audio amplifier.

sistor *Q1*'s base bias is furnished through *R1*, bypassed by *C2*, in conjunction with emitter resistor *R2*, bypassed by *C3*. A small r.f. choke, *L2*, serves as *Q1*'s collector load, with the amplified r.f. signal appearing across this coil coupled through *C5* to the doubler-type diode detector *D1-D2*. The r.f. gain is controlled by bypass capacitor *C4* and series resistor *R3*.

From the detector, the resulting audio signal is amplified by a two-stage resistance-capacity-coupled audio amplifier, *Q2-Q3*. Potentiometer *R6* serves as an audio gain control. Large-value electrolytic capacitors, *C7* and *C8*, are used for interstage coupling to prevent attenuation of low-frequency signals.

power pack, *B1*, controlled by a s.p.s.t. on-off switch, *S1*, and bypassed by *C11*.

You can duplicate the receiver using readily available components. Coil *L1* is a standard ferrite loopstick (Lafayette MS-330) and *C1* is a small 365- μ f. variable capacitor. *L2* is a common 2.5-mh. choke. All electrolytic capacitors should have a minimum working voltage of 15 volts.

In the output stage, *T1* is an Argonne Type AR-175, with a Type AR-119 being used for *T2*. Any standard PM loudspeaker may be employed—a small unit (2" to 4") for pocket-sized sets, a larger unit (4" to 8") for better tone quality.

Transistor *Q1* is an RCA Type 2N147 "drift" type, *Q2* and *Q3* are G.E. 2N107's



Voltage reference packs made by International Rectifier come in miniature sizes for printed-circuit board installation and larger sizes for conventional mounting.



Although provision is made for an external antenna, Alexis indicates that the receiver has more than ample gain for the reception of local broadcast stations using only its built-in "loop" (L1).

Reference Packs. "Pre-packaged" assemblies using semiconductor components are becoming increasingly popular for many circuit applications. Typical units are the voltage reference packs manufactured by the International Rectifier Corporation (1521 E. Grand Ave., El Segundo, Calif.). These are made in sizes ranging from miniature units designed for circuit board mounting and providing a single output voltage to larger units which can operate from a.c. or d.c. sources and can supply two or more regulated outputs.

Voltage reference packs, in general, supply a known accurately controlled d.c. output voltage which is main-

tained constant regardless of variations in ambient temperatures or in input supply voltages. They are used to replace standard cells or dry cell batteries in such equipment as digital voltmeters, regulated power supplies, potentiometric recording instruments, fire control systems, autopilots, missile guidance control gear, and aircraft instrumentation and communication equipment.

and Q4 and Q5 are RCA 2N109's. Almost any crystal diodes can be used for D1 and D2; Alexis used 1N48's, but 1N34's or 1N34A's should work as well.

The power pack is made up of four pen-light cells connected in series to furnish six volts. However, Alexis indicates that the receiver will work satisfactorily on a 9-volt battery without circuit changes.

Neither circuit layout nor lead dress should be especially critical, although the usual care should be taken to keep signal leads short and direct. The receiver is suited to either "chassis-type" or "circuit board" construction, depending on individual preferences.

Neither circuit layout nor lead dress should be especially critical, although the usual care should be taken to keep signal leads short and direct. The receiver is suited to either "chassis-type" or "circuit board" construction, depending on individual preferences.

Heat Dissipators. Excessive heat can destroy a transistor. Even a moderately high temperature can bring about a deterioration in over-all circuit performance. Often, the problem is not so much that of high ambient temperature as that of getting rid of heat developed within the transistor itself. High power transistors used near their maximum ratings can become quite warm. To help dissipate internally developed heat in semiconductor devices, the International Electronic Research Corporation (145 West

(Continued on page 110)

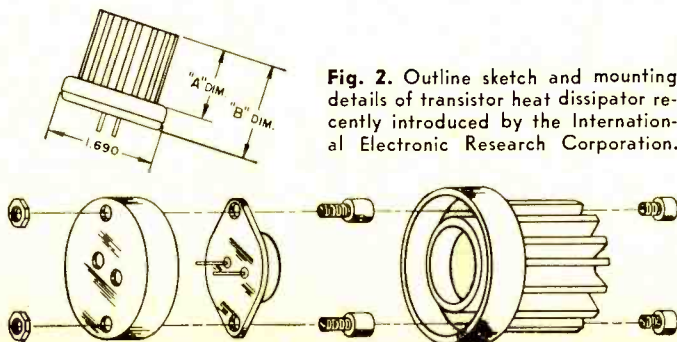
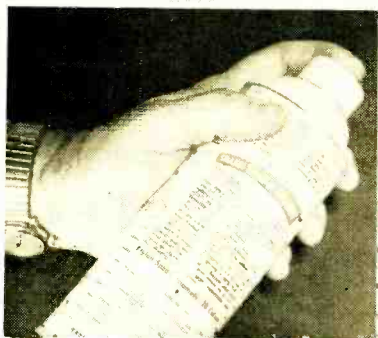


Fig. 2. Outline sketch and mounting details of transistor heat dissipator recently introduced by the International Electronic Research Corporation.

Professional Spraying Techniques



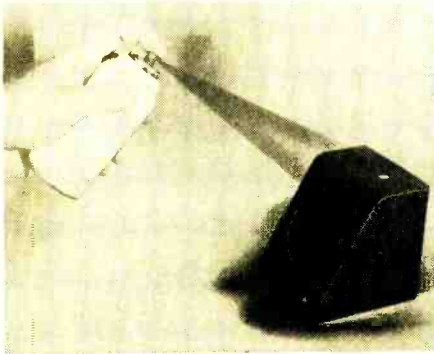
1 Once you've selected the spray you're going to use, shake, shake, and shake it again! If the finish is a pigmented enamel, make sure the metal agitator ball inside the can is moving freely. And don't forget to shake the can from time to time as you use it.



Here are 10 hints that will improve the results of your next paint-spraying job



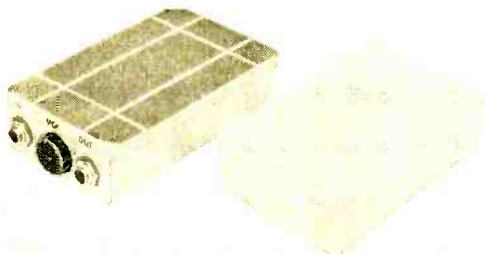
3 Low-cost handles, available through many suppliers, will convert an Aerosol spray can into a pistol-grip "spray gun." Some workers find this arrangement handy.



2 Make sure the object to be sprayed is clean and dry, and that all grease and finger marks have been removed. Hold the can about 10" to 12" from the surface when you spray and move it in straight, parallel strokes, depressing the button *before* you start each stroke. Never stop in the middle of a stroke. For a heavy coat, apply two or three thin coats, allowing the surface to dry between coats. For best results, use spray at average room temperature in a well-ventilated area.



4 Clear plastic spray is a "must" for protecting decal-type name plates and control labels. For best results, apply two thin coats to the panel *before* applying the decals, allowing each coat to dry thoroughly. After the decals are applied and have dried, spray on two or three finishing coats.



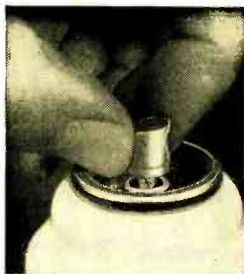
5 A sprayed-on finish will convert a transparent plastic box into an attractive instrument case. For a textured finish, spray the *outside* of the box. For a glossy finish, spray the *inside* of the box only.



6 As a general rule, a spray finish should be applied to a panel or chassis after all machine work (drilling, punching, etc.) is completed, but before parts are mounted and wired. If it is necessary to spray a finished piece of equipment, be sure to protect all control shafts, jacks, binding posts, switches, etc., with some standard masking tape.



7 When you have finished spraying, clean the valve and spray head by inverting the can and pressing the button until the valve is cleared out. The excess paint may be sprayed against a scrap piece of wrapping paper or an old newspaper.



8 If the spray head or valve becomes clogged and sprays erratically or not at all, a thorough cleaning may be needed. In most cases, the spray head can be removed by grasping it tightly, as shown, and pulling up with a slight twisting motion. Use care during this operation and don't apply sidewise pressure—which might bend or break the valve stem.



9 Once removed, the spray head can be cleaned with a fine wire or needle and a drop or two of lacquer thinner or general-purpose solvent. If you use a wire, you can form a "handle" by winding a small coil behind the straight section of the wire.



10 The valve stem and supply tube can be cleaned by applying a few drops of general-purpose solvent, allowing it to stand for a few seconds, then shaking it out. When the valve stem and spray head are clean, the spray head can be re-installed simply by twisting it lightly into place. Use enough pressure to force the spray head onto the stem, but not enough to activate the valve.



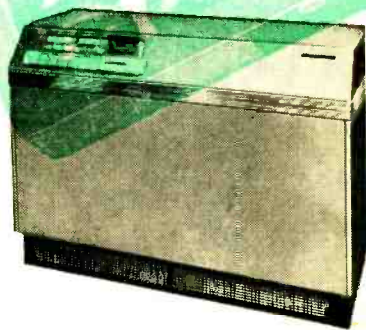
COMPUTERS

Yesterday and Today

THE nameless Neolithic man who hacked out the first wheel may well be the world's most celebrated caveman, but for sheer creative genius he had a strong rival in one of his less publicized contemporaries: the hairy character who first discovered that by manipulating his own fingers he could "describe" all quantities between one and ten. By so doing, he not only founded the science of mathematics (whose decimal system, based on varying powers of ten, is forever linked to the fact that human beings have ten fingers), but at the same time he was operating the world's first digital computer.

After this world-shaking discovery, it was only a question of time before counters other than fingers came into use—columns of pebbles laid on the ground, pellets of bronze or ivory that slid back and forth on a grooved board, beads strung on wires within a frame. All these devices gradually evolved into the abacus—the standard calculating instrument of all the civilizations of antiquity, and still widely in use throughout the Far East.

Each of the abacus' parallel bead-strung



Far from bursting on the scene fully developed, computers have been in a state of constant evolution for over 300 years

By DICK YATES

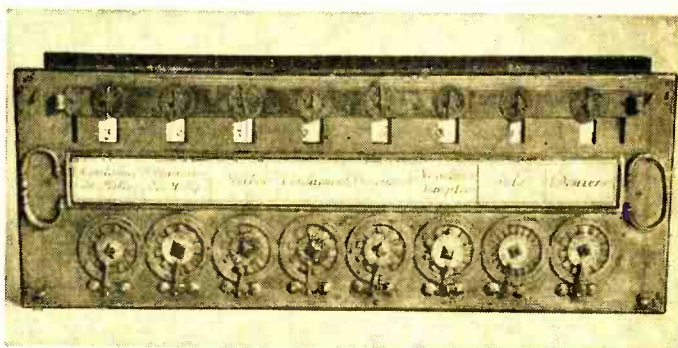
wires represents one place in the notation system (units, tens, hundreds, and thousands) and each holds two groups of beads: one of five beads, each representing a single unit of that power; and one of two beads, each representing five units. Learning to use an abacus takes time, but surprisingly enough, an experienced operator can perform computations as fast as a man working a modern desk calculator.

Early Calculating Machines. Only after the passage of many centuries was the first major advance over the abacus made. In 1642, the French philosopher and scientist Blaise Pascal—then only 19 years old—invented the first true adding machine; Pascal's calculator was the first in a long and

facture because of the technological limitations of the period, but Babbage's designs remain valid today. The logical organization of many modern electronic computers bears a remarkable similarity to those of his "engines."

The next important development was the mechanical tabulator capable of simultaneously registering horizontal and vertical sums and of processing large amounts of data rapidly in sequence. The first of these machines, designed as an aid to statistical analysis, was invented in 1872 by Charles Seaton, then chief clerk of the United States Bureau of the Census. This was followed in 1887 by the work of Dr. Herman Hollerith, also a Census Bureau official, who

Pascal's calculator of 1642. The device was "programed" by turning the bottom wheels. Each revolution of a wheel caused the adjoining wheel on the left to advance one notch, or digit. The numbers behind the little windows provided "read-out." The six wheels on the left operated on the decimal system and could handle numbers up to 999,999. The two divisions at far right were for use in adding sous and deniers, French money of the time.



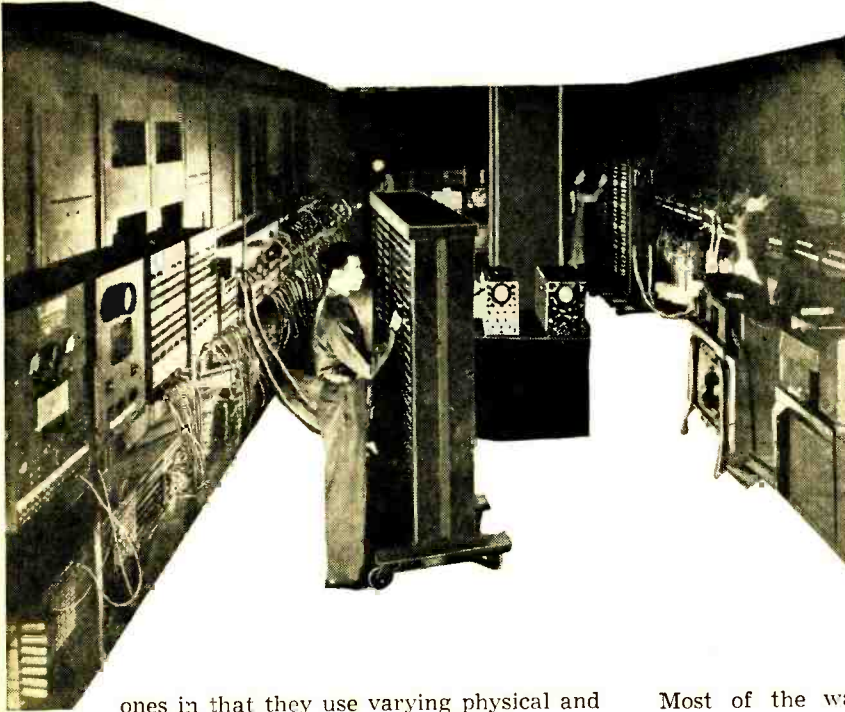
illustrious line of mechanical calculating devices. Twenty years later, in England, Sir Samuel Morland developed a more compact calculator that could multiply (by cumulative addition) as well as add and subtract. And in 1682, the German Wilhelm Leibnitz perfected a machine that could perform all four basic arithmetical functions as well as the extraction of square roots. Leibnitz' principles are still employed in modern calculating machines, the only major difference being the introduction of electric power to speed up the movement of the mechanical parts.

Another great name in the development of automatic computation is that of Charles Babbage, a mathematics professor at England's Oxford University, who in 1812 designed what he called a "difference engine" for mechanically performing advanced mathematical calculations "without mental intervention." Neither that machine nor a later Babbage invention, the "analytical engine," proved practical for general manu-

adapted a punched-paper control system to statistical work. His punched-card methods, together with those developed in 1890 by another American, James Powers, laid the groundwork for the now-familiar punched-card tabulating systems.

Electronic Computers. As early as 1919, electronics came tentatively onto the scene, when an article by W. H. Eccles and F. W. Jordan, published in the first issue of *Radio Review*, described an electronic "trigger circuit" that could be used for automatic counting. But the Eccles-Jordan circuit, like the Babbage difference engine, was ahead of its time.

Then came World War II. Under the pressure of military needs for ballistics data on newly developed weapons, the new science of electronic data processing came into its own. The intensive effort of those years produced two basic types of electronic computers—analogue and digital—and the distinction is an important one to bear in mind. Analogue systems differ from digital



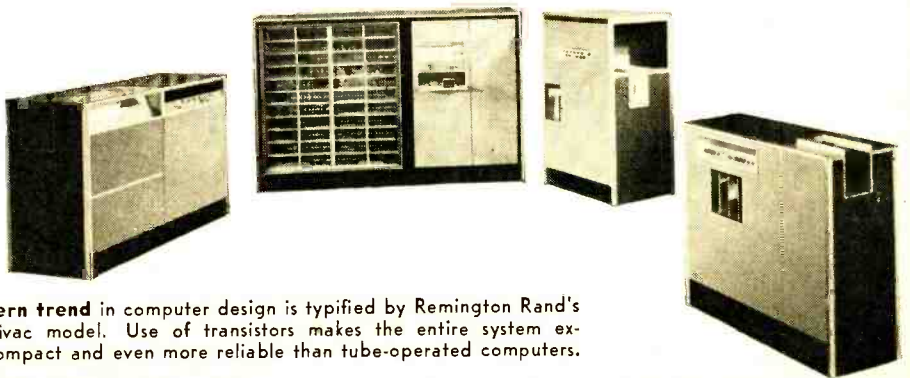
ENIAC, the first "all-electronic" digital computer, was installed in 1945 at the University of Pennsylvania.

ones in that they use varying physical and electrical *magnitudes* (voltages, light intensities, shaft positions and the like) as factors analogous to mathematical values, rather than *pulses* representing actual numbers.

Just as the abacus is a simple digital computer, the slide rule (on which mathematical values are expressed in terms of linear relationships) is an analog device. So is the automobile speedometer, whose mechanism does not actually count the revolutions of the wheel and repeatedly divide to determine the number of miles per hour, but rather senses the rate of revolution and interprets that rate in terms of a reading on a miles-per-hour dial.

Most of the wartime needs were for analog computers, many of which were successfully built under government contract at a number of American universities. In certain cases, however, machines were required which would provide answers to ballistics equations faster and with greater precision than analog systems were capable of doing. It was the attempt to fulfill these specifications that gave rise to the development of digital computing systems.

In 1944, at Harvard University, Dr. H. H. Aiken completed a semi-electronic system called the Automatic Sequence Controlled Calculator, known also as the Harvard Mark I, for the Navy's Bureau of Ordnance. And in the next few years Dr. Aiken built



The modern trend in computer design is typified by Remington Rand's latest Univac model. Use of transistors makes the entire system extremely compact and even more reliable than tube-operated computers.

three improved models, known as the Harvard II, Mark III and Mark IV.

The ENIAC. Meanwhile, a second major contribution was progressing at the University of Pennsylvania's Moore School of Engineering. Early in 1943, an associate professor of electronics named Dr. J. W. Mauchly gave the Army Ordnance department the design for a general-purpose, all-electronic digital computer called the ENIAC, which was ultimately completed in 1945. The first problem assigned to the ENIAC was a calculation in nuclear physics which would have taken 100 man-years to solve by conventional methods. The ENIAC came up with the answer in two weeks, of which only two hours were spent in actual computation, the remainder being devoted to operational details and reviews of the results.

ENIAC represented the first major break with the past in that it was entirely electronic except for its means of "input" and "output" (the process of feeding data into the machine and of delivering the results); unlike the Mark I, however, it was not automatically sequenced. Modern computers can thus be said to have evolved from a wedding of the techniques employed in ENIAC and Mark I.

Other pioneer work during the war and immediate postwar years included projects at such organizations as: Princeton's Institute for Advanced Study, where outstanding developments were made by the late Dr. John von Neumann; Bell Laboratories; M.I.T.; and the National Bureau of Standards.

Enter Univac. After the war, Dr. Mauchly joined in partnership with Prof. J. Presper Eckert, who had been chief engineer of the ENIAC project, and the two men formed a company in Philadelphia to develop new computers and promote their use in commercial applications. The Eckert-Mauchly firm, which later became a subsidiary of Remington Rand Inc. (now, in turn, a division of Sperry Rand Corporation), was responsible for the development of the Univac in 1950.

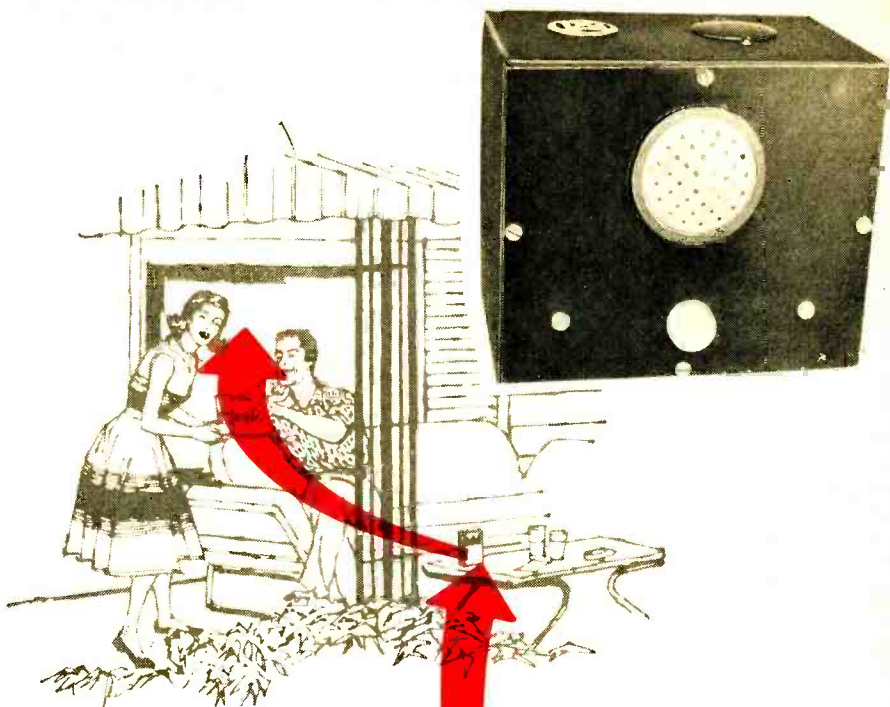
Generally regarded as the most successful electronic data processor in the world today, and certainly the most famous, the large-scale Univac system was the first to handle both numerical and alphabetical information equally well. It was also the first to divorce the complex input and output problems from the actual computation op-

eration. Particularly important was another major innovation from an earlier Eckert-Mauchly model: the Univac was wholly self-checking. It checked its own accuracy in each step of each computation and thus eliminated the need for running problems through a second time for verification. With the Univac, electronic data processing came of age.

The many post-Univac computers produced in the past few years have further opened a new era in man's ability to organize and make use of factual information. Electronic computation has already brought about substantial changes in patterns of living, and scarcely a week goes by without someone's finding a new use for computers, a new way in which electronic data automation can be applied to eliminate the drudgery of making complex calculations "by hand." Meanwhile, rapid strides are being made in the further refinement and development of computers themselves, particularly in the miniaturization and improvement of their components through the use of smaller and more reliable transistors, resistors, diodes, etc.

Proper Perspective. In the first tumult of publicity about computers during the early fifties (particularly when the Univac won national prominence for successfully predicting the outcome of the 1952 Presidential election), the misleading term "giant brain" caused a good deal of confusion—and some uneasiness—with its implication that science had given birth to a thinking device superior to the human mind. Nowadays, most people know better. They know that, by human standards, the "giant brain" is a talented "idiot," that it is wholly dependent on instructions and thus can't really think at all—that it is, in other words, only a machine. This simmering down of the public's "gee-whizz" attitude toward computers is a healthy sign, for no tool can ever be truly useful if it inspires awe in its users instead of trust.

To the same end, it's a good idea to think of the computer in its historical perspective—not as an overnight phenomenon, but as the fruit of a practical science with its roots far in the past. Pascal, Leibnitz, Babbage and the others, if they were alive today, would probably not be astonished by the "miracle" of electronic data processing. More likely, they would simply be pleased to find that their pioneer work had been brought to fulfillment.



Electronic House-Sitter

Easy-to-build unit lets you monitor household activities at a distance

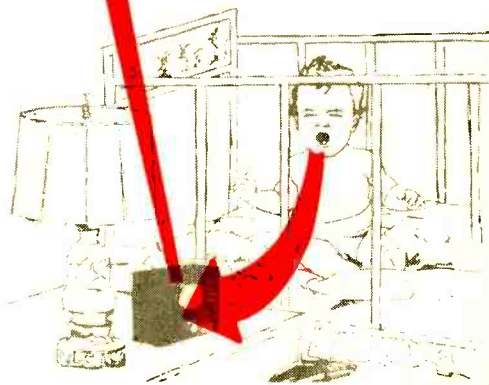
By LOUIS E. GARNER, Jr.

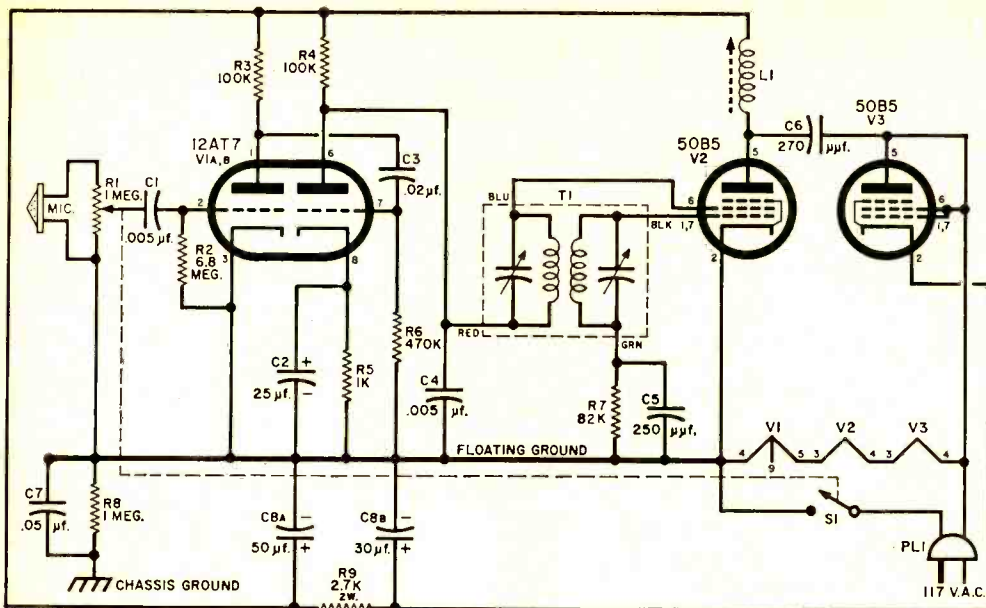
FOR a few dollars' worth of parts and several evenings' work, you can own an "Electronic House-Sitter," a useful little gadget that will:

- Let you know immediately if someone knocks on your front door, even though you are visiting a neighbor.
- Serve as a remote baby-sitter while you're out-of-doors, telling you the moment the baby wakes and starts to cry for his bottle.
- Allow you to listen to your favorite records or radio programs while you're working, yet call you immediately if the telephone rings.

The Electronic House-Sitter is a low-power transmitter operating in the AM broadcast band. It can be used in conjunction with any radio, though transistorized models are usually preferable because they are self-powered and small enough to be slipped into a spare pocket. With the transmitter broadcasting any sounds occurring in its vicinity, and a transistorized receiver in your pocket, you can wander all over the neighborhood and still know what's going on at home.

No separate antenna is required; the unit employs the house wiring as an antenna. A





PARTS LIST

- C1, C4—0.005- μ l., 600-volt paper capacitor
- C2—25- μ l., 25-volt electrolytic capacitor
- C3—0.02- μ l. disc capacitor
- C5—250- μ l. ceramic capacitor
- C6—270- μ l., 600-volt capacitor
- C7—0.05- μ l., 600-volt paper capacitor
- C8a, C8b—30-50- μ l., 150-volt electrolytic capacitor
- L1—Ferrite-core loopstick antenna coil (Meissner No. 14-9015)
- PL1—Polarized line cord plug (see text)
- R1—1-megohm potentiometer
- R2—6.8 megohms
- R3, R4—100,000 ohms
- R5—1000 ohms
- R6—470,000 ohms
- R7—82,000 ohms
- R8—1 megohm
- R9—2700-ohm, 2-watt resistor
- S1—S.p.s.t. switch ganged with R1
- T1—455-kc. i.f. transformer (Meissner No. 16-6658)
- V1—12AT7 tube
- V2, V3—50B5 tube
- MIC—Crystal microphone cartridge (Lafayette PA-27)
- 1—4 $\frac{7}{8}$ " x 3 $\frac{7}{8}$ " x 1 $\frac{1}{4}$ " aluminum chassis
- 1—4" x 5" x 6" metal utility box (Bud CU-729B)
- 2—Seven-pin miniature tube sockets
- 1—Nine-pin miniature tube socket

all resistors
 $\frac{1}{2}$ watt unless
 otherwise noted

Wireless house-sitter uses "floating" ground to keep power line clear of chassis and eliminate possibility of dangerous shocks.

ing an appropriate hole in the case and covering it with a snap hole plug. Be sure to include ample ventilation holes to allow tube heat to escape.

All major parts except the microphone and output coil are mounted with standard

HOW IT WORKS

Sound is picked up by the crystal microphone and fed to a conventional two-stage resistance-coupled amplifier (V1). The amplified audio frequency signal appears across R4 and is superimposed on the voltage applied to the screen grid of oscillator V2. This modulates the r.f. signal. The r.f. oscillator (V2) is unique in that it operates as a combination oscillator and frequency doubler. Oscillator transformer T1 is tuned to one-half the frequency of output tank coil L1 which resonates in the broadcast band. Thus, the r.f. output is kept at a low level.

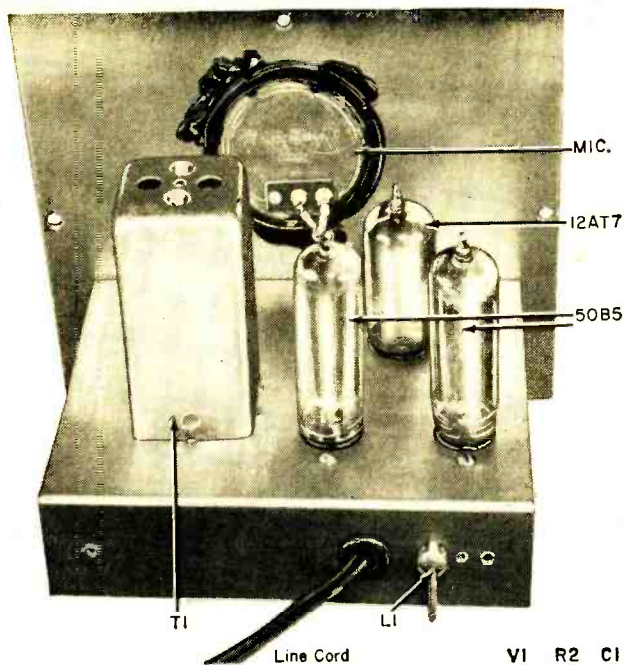
The screen grid of V2 serves as the "plate" of a triode oscillator. Transformer T1 furnishes the feedback path between screen and control grids necessary to obtain oscillation. The r.f. developed in the "triode" is doubled in V2's plate circuit by tank coil L1, which is tuned to the broadcast band by its ferrite core and distributed wiring capacities. Resistor R7, bypassed by C5, serves as the oscillator's grid-leak resistor and shunt capacitor. The modulated output signal appears across L1 and is coupled through C6 to the "hot" side of the 117-volt a.c. line.

The power supply is a conventional half-wave rectifier using a 50B5 (V3) with its screen and control grids connected to its plate. The "ground" side of the power line connects to a "floating" ground circuit through S1, and the "floating" ground in turn is connected to the chassis through C7, shunted by R8. Combined with the use of a polarized plug (PL1), this "floating" ground insures a shock-free chassis, although a transformerless supply is used.

special circuit keeps the output power within the limits stipulated by the FCC.

Assembly. Made from standard, readily available components, the gadget can be wired in two or three evenings, even by a builder with limited experience. It is a.c.-operated and measures only 4" x 5" x 6" over-all.

When drilling the case and panels, you should make provisions for reaching the oscillator transformer (T1) adjustments after assembly. This can be done by punch-



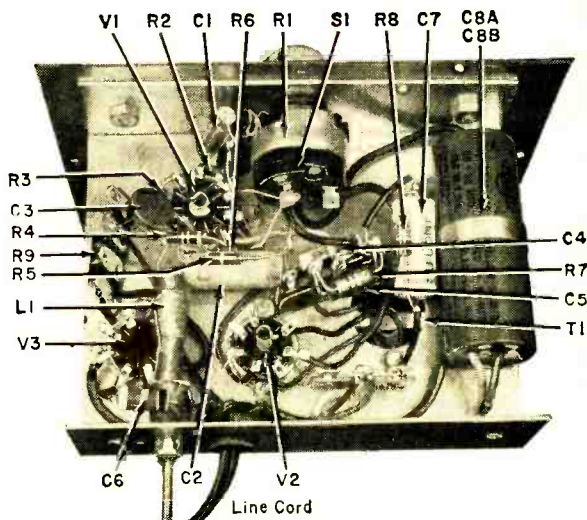
Parts layout is not critical. Only R8 and C7 should be connected directly to chassis. All other components which are grounded are connected to floating ground tie points or bus bar.

machine screws, nuts, and lock-washers. The microphone is furnished by the manufacturer with a rubber gasket which is cemented to the instrument's front panel. Coil L1 is fitted with a familiar spring snap mounting and is simply slipped into an appropriate hole.

If you're unable to locate a commercial polarized plug for PL1, you can make your own by soldering a small piece of wire around the edge of one prong of a conventional line plug. This makes one wider prong which serves as the "ground" side of the line where a correspondingly polarized wall socket is used.

Adjustment and Test. With assembly completed, you are ready for preliminary tests. But double-check all wiring *before* installing the tubes or connecting to line power. If everything checks out, install the tubes and plug in the unit.

Turn the instrument on and allow a minute or two for warm-up. Use a 5000 ohms/volt (or better) voltmeter set for its 50-volt d.c. scale (or a VTVM) to check for d.c. voltage across R7 (grid "end" is negative). Switch to a lower scale if necessary. If

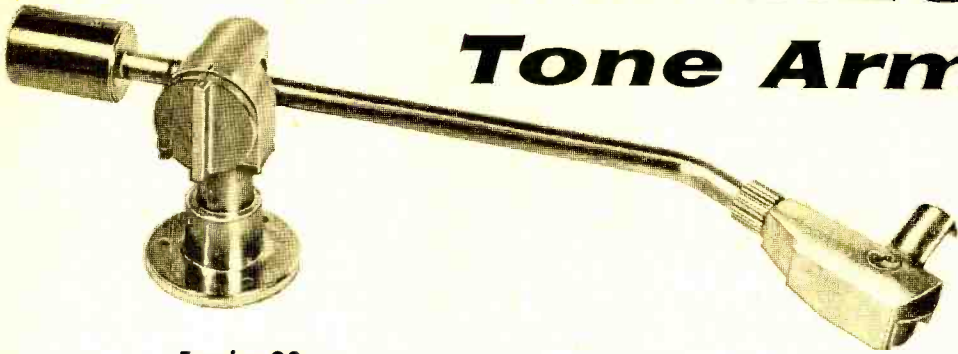


there is no d.c. voltage across this resistor, the oscillator is not working. Try adjusting T1's trimmer capacitors, checking again for a d.c. voltage. Also check for about 125 volts d.c. between pin 5 of the 50B5 oscillator (V2) and the "floating" ground. If you are still unable to obtain oscillation, try reversing T1's secondary connections.

Once you are sure the oscillator is working, mount the instrument in its cabinet, and remove the snap plug covering T1's adjustments.

Since the Electronic House-Sitter is used
(Continued on page 118)

STEREO Tone Arm



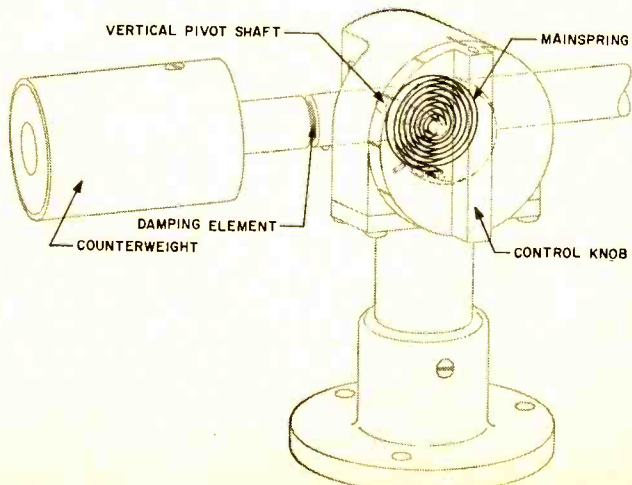
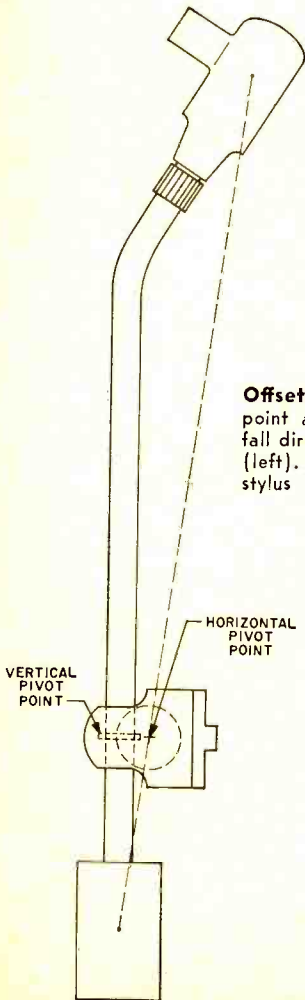
Empire 98
features unique
stylus pressure system

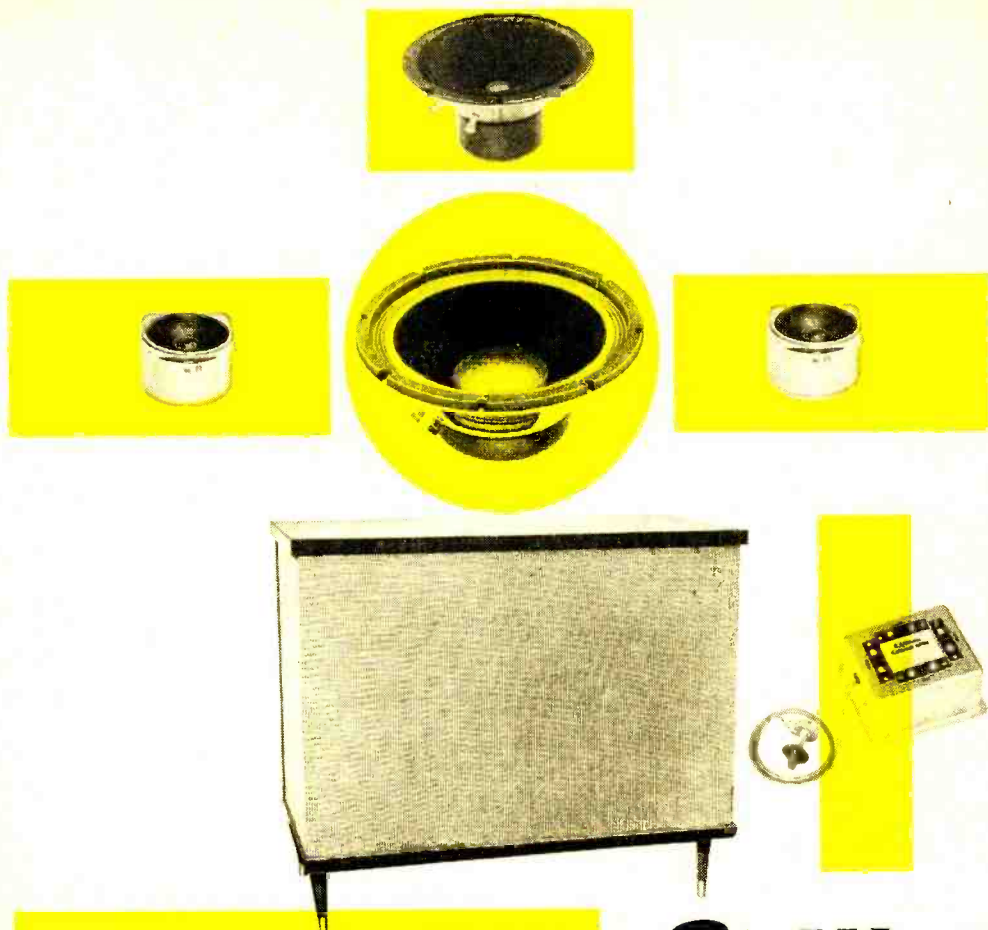
ONE of the newest and most advanced stereo tone arms available is being produced by a relatively new manufacturer, Audio Empire, 1075 Stewart Ave., Garden City, N. Y. The Empire 98 should do much to establish Audio Empire as a name synonymous with high quality in the high-fidelity field.

The first thing about the Empire 98 that strikes the eye is the unusual housing at the main pivot points. This housing serves two purposes. First, it enables the vertical pivot point to be offset from the center of the horizontal pivot point. This makes it possible to put the arm's center of mass directly over the horizontal pivot point (see diagram at left) and thus achieve "dynamic balance" meaning that the arm is balanced in *all* planes. Secondly, the housing contains the "works" of a unique system for adjusting stylus pressure.

(Continued on page 112)

Offsetting the Empire 98's vertical pivot point allows the arm's center of mass to fall directly over the horizontal pivot point (left). "X-ray" view of pivot housing and stylus pressure system is shown below.



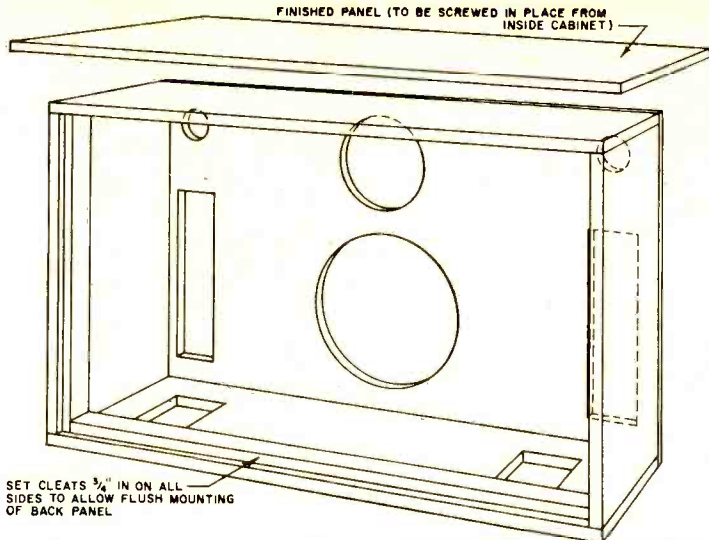


How to build a 3-Way Speaker System

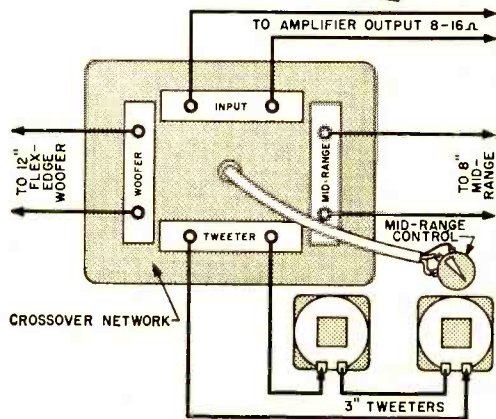
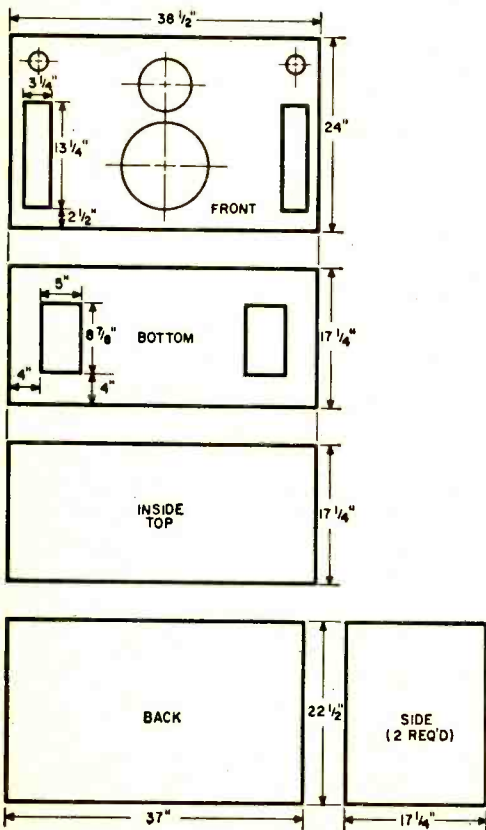
THE THEORY of bass reflex design is still confusing to the audiophile despite (or perhaps because of) the many articles that have been written about it. Rather than cast another stone into the already muddy waters of bass reflex design theory, we are presenting here a good practical cabinet which was developed for a three-way speaker system manufactured by Cletron, Inc., 1974 East 61st St., Cleveland, Ohio.

First a word about three-way systems in general. Although there have been numerous arguments concerning the use of single speakers to cover all frequencies, most of the authorities agree that a division of the audio frequency range between two or more speakers is the preferred technique for achieving wide-range response at

*In this age of specialization,
it's a sound idea
to have each of the speakers
in a system handle
a specific frequency range*



All joints are butted, glued and screwed. Cleats (1" x 3") are cut to size and used for the mounting of the rear panel; they may also be used to reinforce the butt joints. Panels are cut from $\frac{3}{4}$ " fir plywood to the dimensions shown. Cabinet is lined with hi-fi felt and Mello-tone grille cloth is wrapped around cabinet front and sides.



Hookup of Cletron speakers. Crossover control affects mid-range frequencies only. Note series-connected dual tweeters for maximum treble dispersion.

low distortion. And so most speaker manufacturers have provided a variety of bass woofers, treble tweeters, and mid-range squawkers (with associated networks), each designed to handle the range that it "knows best" and then acoustically recombine the separate frequency bands into the illusion of orchestral reality so sought after by the audio fan.

It is here, in the acoustic-reassembling process, that the two- and three-way speaker systems run into difficulties and criticism. Improperly designed crossovers and unmatched speakers are responsible for more bad sound than the novice would believe possible. All manner of errors are made

(Continued on page 119)



Across the Ham Bands

By
HERB S. BRIER
W9EGQ

THE LINEAR AMPLIFIER STORY

LAST MONTH we talked about adding a VFO and a modulator to a low-power, crystal-controlled c.w. transmitter to increase its versatility. Sooner or later, you will undoubtedly want to increase your transmitter *power*, in order to get out better, especially if you can operate only on weekends or in the evenings when interference is heaviest.

Now that most manufacturers of amateur transmitting equipment include linear amplifiers for all ham bands between 3.5 and 148 mc. in their equipment lines, you may be considering the possibility of lifting yourself out of the low-power class by using your present transmitter to drive such an amplifier. It can be done, of course. But does this offer any advantages over simply replacing your present low-power

transmitter with a more powerful one? In order to answer that question, we should first know a little about r.f. power amplifiers.

Amplifier Operation. Actually, the essential difference between a linear r.f. power amplifier and a conventional class C amplifier is in the way they are operated. For example, if you operate the amplifier tubes with a high negative grid bias and increase the input signal to beyond the point that gives maximum output, you have a class C amplifier. Its efficiency will be high—approximately 75% in practical class C amplifiers—but its output signal will look like it's on a pogo stick. Fortunately, the amplifier output tuned circuit will smooth out the distortion and deliver a sine-wave signal to the antenna.

In a linear amplifier, the grid bias on the tubes and the input signal are adjusted so that the output signal is an exact (linear)

Ham of the Month.....

Our Ham of the Month for February is H. S. "Howy" Bradley, W2QHH, Hamilton, N. Y. Howy's specialty is working DX stations and obtaining their QSL cards to earn the various achievement awards offered by ham organizations throughout the world.

Most of us have trouble enough working all the states and getting one QSL card from each one to earn WAS. W2QHH has worked all states on *every* ham band between 1.8 and 29.7 mc. He has the WAS certificates to prove it, too. WAC? W2QHH has worked all continents on six ham bands. DXCC? W2QHH has 284 countries worked and confirmed since World War II. In addition, he has worked 100 or more countries on five ham bands.

Space does not permit describing all the rest of Howy's 90-odd certificates, but here is a sampling of them: DXCC-phone, WAC-YL, WAS-YL, YLCC-1000 (who said YL hams are scarce?), AAA (All Africa Award), 4X4, KZ5-100. He also has a 35-wpm code certificate, an A1-operator certificate, and several public service awards from the ARRL.

Howy doesn't think there is any thrill in working DX with high power; he never runs over 55 watts and often uses as little as 10 watts input to a Johnson Ranger transmitter feeding a 135' end-fed antenna 30' high. He receives on a Collins 75A2.

When not hamming, Howy is a mailman and a stamp collector.



reproduction of the input signal. Used in this manner, the amplifier has a practical efficiency of approximately 65%.

Class C amplifiers make good c.w. amplifiers due to their high efficiency. Also, as the output signal varies in exact step with any change in plate voltage, such an amplifier can be modulated for phone operation by feeding a high-power audio signal into

watt of input as it does when fully excited. This is the price paid for eliminating the high-power plate modulator. And it is the reason that linear amplifiers, except the 1000-watt ones with oversize tubes, have lower power ratings for AM operation than for c.w. or single-sideband operation.

Making a Choice. With this information, deciding whether to add an amplifier to your present transmitter or to buy a complete new transmitter becomes a matter of determining which gives you the most power into the antenna per dollar, remembering that it is not worth the effort to increase transmitter power unless you at least double the amount of input power getting into your antenna.

Check several manufacturers' catalogs and you will find a couple of linear amplifier kits rated at 500 watts input on c.w. and single-sideband, and 200 watts on AM phone, for between approximately \$170 and \$250. Allowing for circuit losses, they will deliver an output of over 300

watts on c.w. and single-sideband, and 60 watts on AM phone. Also in the same price range are a pair of 150-watt AM phone, 180-watt c.w. transmitter kits, which will deliver 100 watts output on phone and 125 watts on c.w.

Obviously, the linear amplifiers will give you far more watts per dollar on c.w. than the complete transmitters, even if you add the original cost of your present transmitter to their cost. But for AM phone work in this price and power range, the opposite is true.

However, as you compare higher-power units of equal quality, whether in kit or wired form, the linear amplifiers look better as AM amplifiers. In fact, a 1000-watt linear amplifier will deliver a 300-watt AM signal to your antenna at a lower cost than you can obtain the same power output from

(Continued on page 121)



Ken, KN6JHI, Sherman Oaks, Calif. See News and Views.



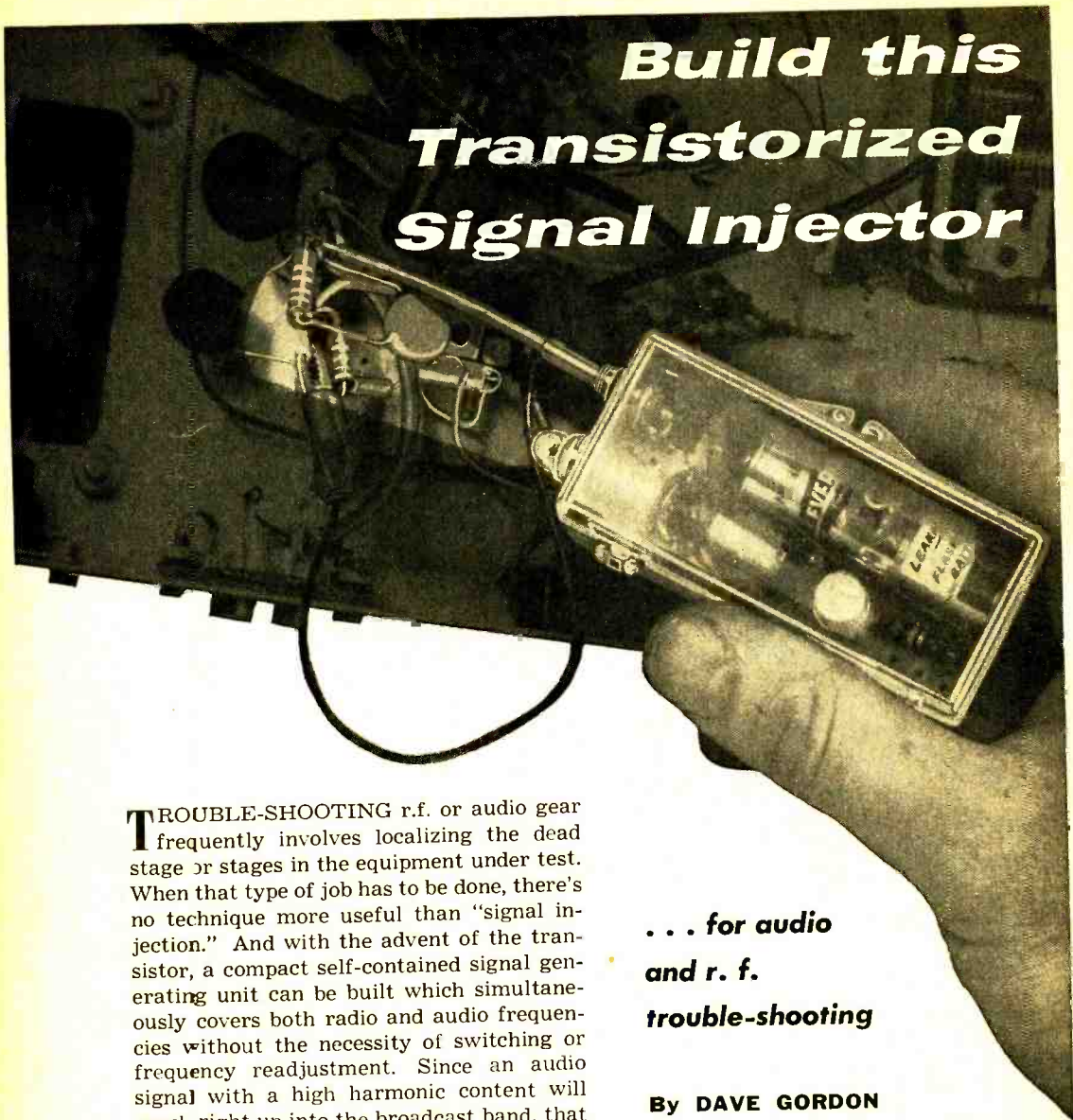
Bob, K8OKT, Allen Park, Mich.

its plate circuits, to "swing" the d.c. plate voltage from zero to twice its unmodulated value (for 100% modulation).

Linear amplifiers are used to amplify any signal whose exact waveform must be preserved, such as the signal from a low-power AM or single-sideband phone transmitter. With linear amplification, you eliminate the high-power modulator needed for the class C amplifier. An AM signal fed into the linear amplifier is adjusted until the r.f. voltage at the control grid of the amplifier tube is just half the value that gives maximum undistorted output. Consequently, when this signal voltage doubles on modulation peaks, the linear amplifier can deliver the required peak power output without distortion or overload.

Such operation cuts the average efficiency of the amplifier in half. Therefore, it delivers only half as much power output per

Build this Transistorized Signal Injector



TROUBLE-SHOOTING r.f. or audio gear frequently involves localizing the dead stage or stages in the equipment under test. When that type of job has to be done, there's no technique more useful than "signal injection." And with the advent of the transistor, a compact self-contained signal generating unit can be built which simultaneously covers both radio and audio frequencies without the necessity of switching or frequency readjustment. Since an audio signal with a high harmonic content will reach right up into the broadcast band, that is the type of signal the injector shown here is designed to produce.

Construction. The author's model was constructed in a small plastic box that originally housed a phonograph cartridge. Any container will do; the exact construction technique is best left up to the builder. A small strip of perforated phenolic serves as the base for the components, and here again the mounting technique is up to the builder. There are no special precautions to be taken other than the normal observance of battery polarity and color coding of the transformer's leads.

Almost any inexpensive *p-n-p* transistor

... for audio
and r. f.
trouble-shooting

By DAVE GORDON

will work well in the circuit with the values given. Current drain of the transistor is so small that the 1½-volt "AA" cell can be soldered directly into the circuit without fear of the need for frequent replacement.

The unit is switched on by inserting the miniature phone plug probe. A slight modification must be performed on the jack to allow it to function as a switch (see diagram). The probe end is a 1½" length of bus bar wire soldered to the "hot" center terminal of the miniature phone plug.

Operation. The signal injection technique involves applying the probe to each

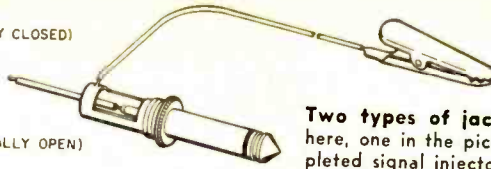


ORIGINAL JACK (NORMALLY CLOSED)

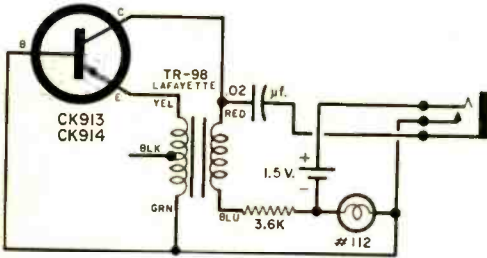
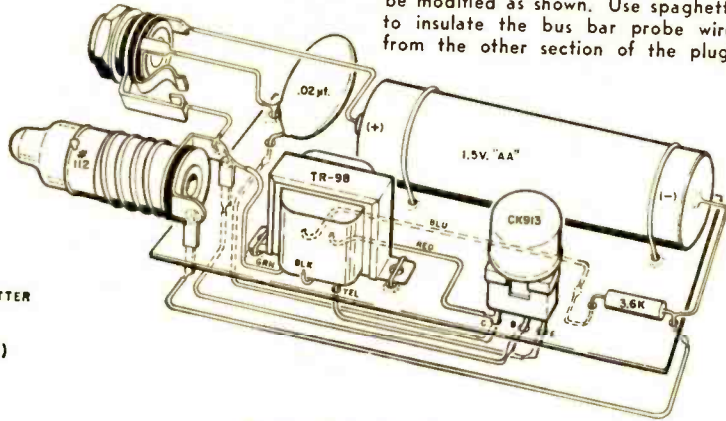


AS MODIFIED (NOW NORMALLY OPEN)

BENT DOWN



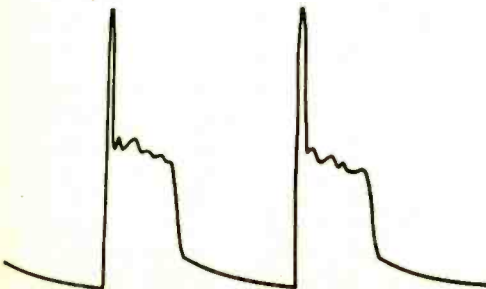
Two types of jacks are illustrated here, one in the pictorial of the completed signal injector (below) and the other at far left. Either type must be modified as shown. Use spaghetti to insulate the bus bar probe wire from the other section of the plug.



Perforated phenolic board is used as the "chassis." Components are held in place by threading their leads through the board. To avoid confusion, unused holes are not shown in the pictorial.

HOW IT WORKS

When the injector circuit is switched on, a small amount of current passes through the collector-base circuit of the transistor and the transformer's high-impedance winding. Current is induced in the secondary which causes a small current flow in the emitter-base circuit. If the secondary is correctly phased, there will now be an increase in the collector current (I_{co}) due to normal transistor action which will continue until magnetic saturation of the transformer's core takes place. At this point there can be no further increase of collector current—a static condition exists and the magnetic field collapses. Another cycle is started by the collapse of the field. The squared-off waveshape of the output is due to transformer saturation and intermittent cutoff of the magnetic field.



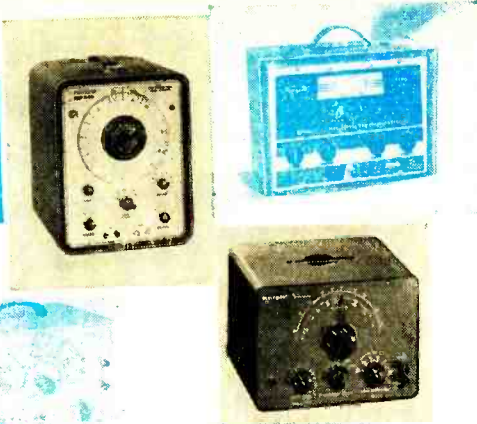
stage of the circuit working from the output stage to the input stage. As you work back toward the input—from plate to grid of each tube—the signal should get progressively stronger as each stage of amplification is added.

To prevent either overloading the unit under test by too high an input signal or loading it down by the injector's low impedance, it's a good idea whenever possible not to use the ground clip of the injector, but to hold it between your fingers to provide a sort of counterpoise to the injector's output.

The prefocused "spotlight" included in the injector comes under the heading of a de luxe optional accessory. It's extremely handy for probing into those dark corners of the chassis, but remember that the bulb draws many times the current of the transistor, so use the bulb as little as possible. It can be switched on and off by loosening or tightening it in its socket.

Output waveform of the signal injector has about a 1000-cycle fundamental frequency. Note high peak on the leading edge which extends the harmonics.

**Test
Instruments**



the Audio Generator

By **LARRY KLEIN**
Technical Editor

Part 2 Sulzer Bridge-T Circuit

AS YOU might suspect from the number of circuit designers' names associated with oscillators (Wien, Clapp, Hartley, Colpitts, etc.), there's more than one way to skin a cat—or generate a signal. Some of these oscillator circuits are suitable for use in audio-frequency generators, but—for several reasons—most are not.

In order to qualify for audio generator use, the oscillator's frequency-selecting setup must be relatively simple and easily variable, and its output must be relatively distortionless and constant over the desired frequency range. This is a pretty tall order, and it's no wonder that only a few types of oscillators make the grade.

Before we get involved with any other type of oscillator, let's go back for a moment for a "refresher" look at the Wien bridge.

In last month's discussion, we saw that an understanding of negative and positive feedback was essential to an understanding of oscillator circuits in general.

The Wien bridge, as you will recall, relies upon a tuned series-parallel positive feedback network ($R1$, $C2$, and $R5$, $C3$ in Fig. 8) which determines the frequency of oscil-

lation. In addition, the Wien circuit has a negative feedback loop ($R9$, $B1$) to stabilize the oscillator's output. This system works pretty well, as the number of Wien oscillators in use will attest.

Sulzer Circuit. The only serious rival to the supremacy of the Wien bridge in the audio generator field was developed by Peter Sulzer of the U. S. National Bureau of Standards laboratories. A johnny-come-lately as far as "standard circuits" go, Mr. Sulzer's brain-child is rapidly finding employment in a number of instruments within the service-technician's and hobbyist's price range.

A fine example of a straightforward adaptation of the Sulzer circuit to an instrument available in kit form is provided by the Knight-Kit audio generator. The complete schematic of this unit is shown in Fig. 9. The essence of the Sulzer circuit is found in the two-stage amplifier which uses a high-gain pentode voltage amplifier ($V-1$) feeding a pentode power amplifier ($V-2$).

Although superficially the Sulzer circuit appears very similar to the Wien arrangement in that both positive and negative

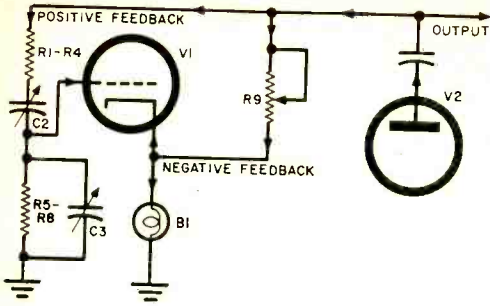


Fig. 8. Basic Wien bridge circuit includes negative feedback and frequency determining positive feedback loop.

feedback are used, the two circuits take a different approach to the problem of frequency selection.

The Wien bridge has an untuned (non-frequency-discriminating) negative feedback loop and a tuned positive feedback loop. The positive loop, tuned to a selected frequency, overrides the negative feedback at that frequency—and the circuit oscillates.

Fig. 9. Knight-Kit audio signal generator features low distortion output over exceptionally wide frequency range.

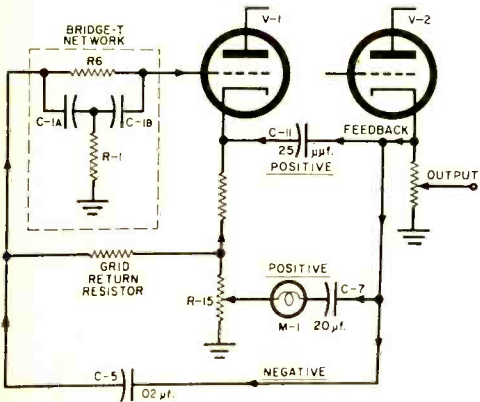
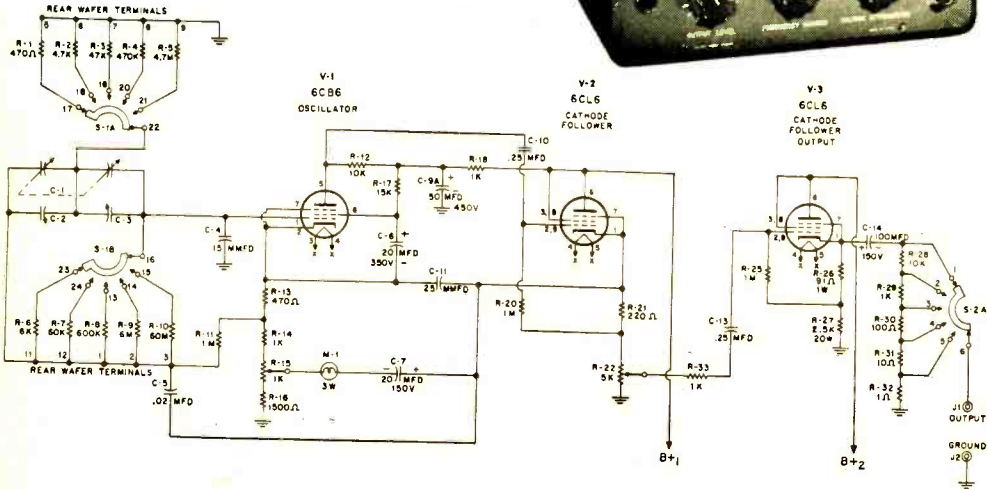


Fig. 10. The Sulzer circuit employs positive feedback and a negative feedback loop nulled at one frequency.

lates. Operation of the Sulzer circuit, on the other hand, depends on an *untuned* positive feedback loop and a negative feedback loop which is tuned at the desired frequency of oscillation.

Separate Loops. If the circuit of Fig. 9 were stripped down to its feedback elements, it would appear as in Fig. 10. Now that we've cleared away the surplus circuitry, no less than *three* feedback loops are revealed (one negative and two positive), all issuing forth from the cathode of V-2 (the 6CL6 power tube). The two separate positive feedback loops (these are the ones responsible for the oscillation) are returned to the cathode of V-1 (the 6CB6) by two separate paths.

(Continued on page 114)

FOR MANY YEARS the E. F. Johnson Co. of Waseca, Minnesota, has been manufacturing top-notch ham equipment, so it's no great surprise that they have come up with a well-engineered Citizens Band transceiver. The Viking "Messenger" is particularly well suited for portable applications as it is small enough to fit under the dashboard of a car, on a boat, or even on a desk. An effective range of up to 30 miles is claimed by the manufacturer; the range is not limited by the design of the unit but rather by the Citizens Band's line-of-sight transmission characteristic.

Both the superhet receiver and the transmitter are crystal-controlled. This means no hunting for the channel you want. A flip of the small front-panel switch and you're ready to receive and transmit on any one of five channels. It's even easier than tuning a TV set because you don't have to make fine tuning adjustments when you switch from channel to channel.

Two other front-panel controls are provided: "volume" and "squelch." When you're receiving, the squelch control is adjusted for a golden silence. The instant someone calls you, the calling voice pops out as from an office intercom. Without this control, you would have to listen to background noise and static while waiting to be called.

Since the microphone houses the press-to-talk switch, the unit can be operated with one hand. The illuminated "transmit" indicator on the front panel flickers with your voice to show that you're actually on the air. When you release the press-to-talk button, the "transmit" indicator goes out and your caller comes back.

A look inside the heavy-gauge steel cabinet reveals the professional-looking construction job and the use of quality components, including ceramic insulation where needed. The under-chassis wiring is nice and tidy, and the over-all appearance of the unit suggests that here is a piece of equipment that will provide many years of service with a minimum of repair.



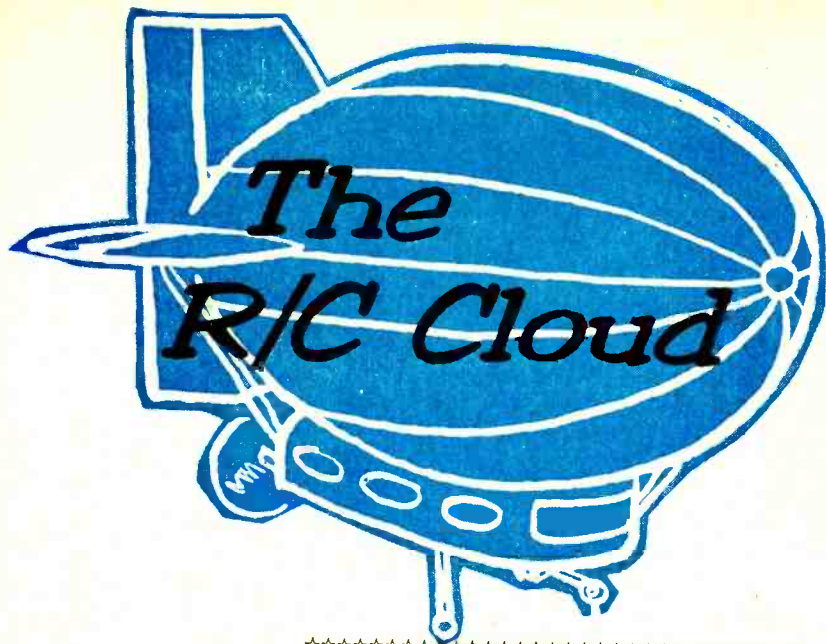
New Citizens Band Transceiver

**Viking Messenger crystal-controlled unit
permits five-channel switch tuning**

Several outwardly identical models are available which operate on 6, 12, or 24 volts d.c. in addition to 117 volts a.c. There is also a 230-volt a.c. model. The basic price of \$129.75 is for the model that operates on 117 volts a.c. only; models incorporating the d.c. power input feature are \$139.75.

The "Messenger" seems to be a well-engineered and versatile transceiver, and private citizens who have a need for short-distance radio communications—either for personal or business use—should investigate its features.

-30-



DISMAY—closely followed by horror—scampered across her face. The cups on the serving tray rattled and coffee slopped out of the pot.

"You're doing it again!" she wailed. "All this time I thought you were repairing the electric clock as you promised—and instead, *you're doing it again!*"

I glanced up from the components laid out before me on the workbench. Calmly, I wiped spilled coffee from my face.

"Do you mind putting that tray down," I requested pleasantly, "before you continue with your hysteria?"

"I got a right to have hysterics," she said emphatically, placing the tray on the workbench and herself in a nearby chair. "How many other wives have to put up with husbands who insist upon making radio-controlled gismos that *always* bring disaster? I ask you, how many?"

"Probably thousands," I murmured, carefully filling the 6-volt wet battery with electrolyte. "You're a courageous group of women—the whole, emotionally unstable lot of you."

"W-What is it?" she asked, indicating the beautifully wrought, ingeniously designed model airship suspended over the bench.

I pushed aside the servo-rudder linkage systems and made room for my coffee cup.

I leaned back and regarded the lady with a tolerant smile.

"It's a scale-model of a well-known dirigible," I told her. "I call it 'The Cloud' because it's bound to have a silver lining, figuratively speaking. This is *one* R/C model which has been cunningly designed to be absolutely *foolproof* against all manner of disaster!"

"Wanna know something?" she squinted thoughtfully at me. "You're a die-hard."

"All we men of determination and tireless brilliance are die-hards," I admitted. "That's why we ultimately demonstrate success. We never quit until we've licked the problem!"

I sipped some coffee. "In this case, I am happy to announce that the heretofore problem of R/C models meeting untimely ends has been vanquished!"

"?" said her expressive eyebrows in unison.

"It's quite simple. I've merely eliminated all the possibilities of trouble which were responsible, in one form or another, for the destruction of earlier models! If your stolid, domestic mind can grasp the meaning of this accomplishment, you are welcome to congratulate yourself for having snagged a genius." I studied my fingernails, modestly.

"I don't believe it! I just can't bring my-



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

TRAFFIC NETS

DURING recent months many of our Short-Wave Monitors have received acknowledgments of reports or other brief messages pertaining to this column which were sent via amateur radio rather than by mail. It is not our intention to go into a lengthy discussion of amateur radio here, nor do we wish to encroach upon the domain that is so ably handled by our colleague, Herb Brier. We would, however, like to discuss briefly the amateur radio traffic systems as they apply to us.

The purpose of traffic nets is to pass third-party messages in a quick, efficient manner from the point of origin to final delivery. All basic rules and regulations covering amateur radio are observed, and strict net procedure is followed. Most nets are "directed," that is, one station is in complete charge of all operations within a particular net. It is the duty of the control station to open the net, check all stations into the net, route all traffic (messages), and close the net when business is completed.

All nets operate on specific frequencies and at definite times. Many operate only on weekdays while some are on a seven-day-per-week basis. Your Short-Wave Editor is a member of the New Jersey Net which opens at 1900 EST daily on 3695 kc. If you can copy code, listen for "CQ NJN" followed by a roll call of stations.

An outbound message from W2PNA is prepared with point of origin information, address, message, and signature. And a brief notation is included on the message blank showing to whom the message was

THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM

REC'D No. 121 W2PNA CK16 Collingswood NJ Dec 10 1959

To: John Beaver
1706 East 7th St
Pueblo Colo --

Many thanks for your report of Dec 10 x our report forms are being sent 73 --

Hank Bennett W2PNA

RECD SENT TO NJN 3282L

THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM

REC'D No. 107 W2PNA CK17 Collingswood NJ Oct 29 1959

To: Lee Lannoy
1367 Servais St.
Green Bay Wis --

Many thanks your letter August 14 x have you received your call letters yet x please advise --

Hank POPTRONICS

RECD SENT TO NJN W2PNA

THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM

REC'D No. 8 W2PNA CK18 Green Bay Wis Nov 1 1959

To: Hank W2PNA POPTRONICS

Have received call WPE 9 A D F x thank you kindly your interest

Lee Lannoy

RECD SENT FROM NJN W2PNA 11/7/59 1912 EST

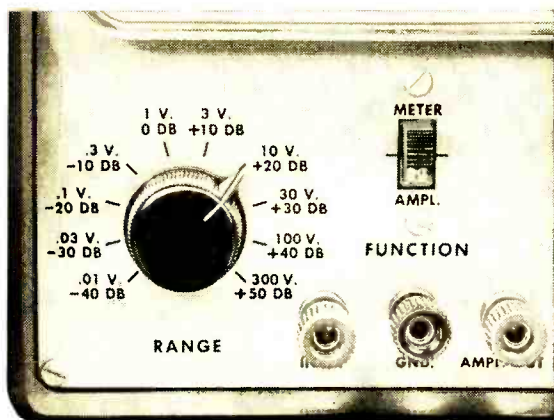
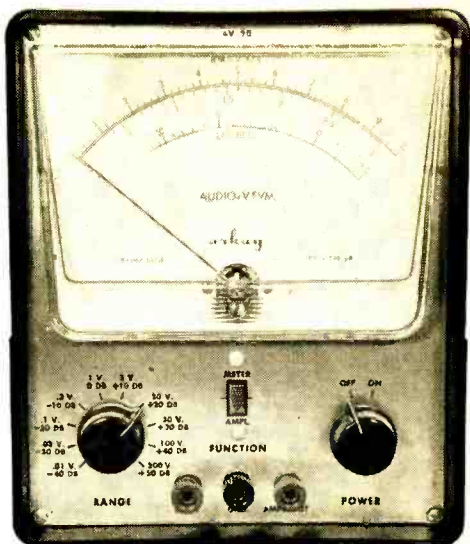
sent (by station call sign and/or net identification), the date and time.

Recently we needed the WPE call of one of our monitors. Two of the blanks above show the message that was sent and the reply. An interesting point was brought out as a result of this reply. The operator that passed the message on claimed that an

(Continued on page 126)

The AUDIO VTVM

Arkay AV-20 — a specialized hi-fi instrument in kit form



WHEN an audio engineer wants to measure the output of a magnetic phono cartridge, the signal voltage through a preamp, or the hum level of an amplifier, there's one instrument he invariably reaches for—the audio vacuum-tube voltmeter.

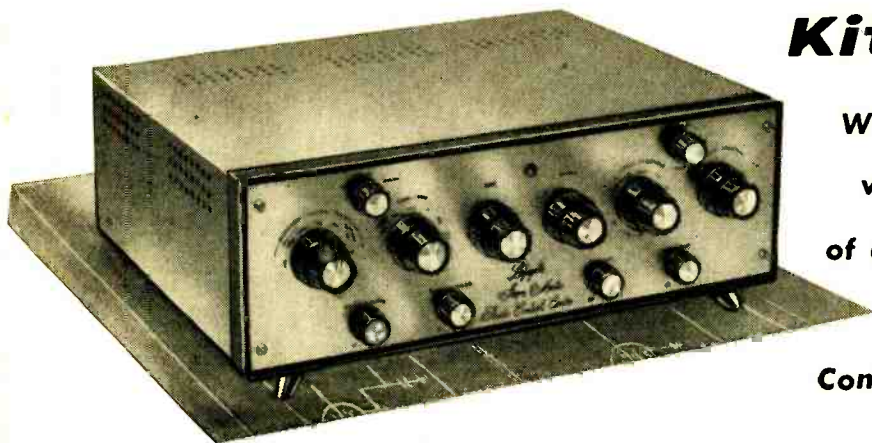
Because of its built-in amplifier, the audio VTVM can provide reliable measurements down to below .001 volt over a wide frequency range. The top voltage range is usually 300 volts—which is certainly all the audio voltage you'll ever need to measure. A standard VTVM (if available) or even a VOM can take over long before the 300-volt range is required.

Features. As is common with these highly specialized instruments, the AV-20 (Arkay, 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y.) has no provision for d.c. voltage or resistance measurement. However, there is an easily read db scale with a range of over 100 db which is just fine for making hum level and frequency response checks.

The db scale, to the novice unfamiliar with its meaning,

(Advertisement)

The Most Talked About Stereo Control Center Kit...



With all the
versatility
of a Broadcast
Station
Control Center

WHEN we at Lafayette first started thinking in terms of a Stereo Control Center, we were determined to reach a new high in the electronics/high fidelity world.

When the drawing board plans were completed and checked out, we were proud of our achievement.

When the vision became reality, when the Lafayette KT-600 reached the market, we knew we had accomplished our mission.

But in all honesty, we never expected the tremendous acclaim of approval that went up from coast to coast — from experts, magazines, stereophiles. We were even proud when the imitations appeared.

Features. Our aim was to incorporate as many features, old and new, as possible.

"A very effective means is provided for matching the electrical outputs of both channels exactly . . . (with) level adjustments . . . set for a null . . ."

High Fidelity Magazine-Oct. 1959

"Another unique feature . . . is the incorporation of a 'presence control'."

Electronics World-May 1959

Performance. Our aim was to construct a unit that would satisfy experts, please stereophiles, and convert novices.

"This unit should not add in any way any coloration to the sound reproduction." Electronics World-May 1959

"The KT-600 is essentially flawless . . . highly unlikely to be a source of distortion in an audio system."

Audio Magazine-May 1959

"For all practical purposes . . . may be considered a distortionless device . . ."

High Fidelity Magazine-Oct. 1959

Construction. Our aim was twofold—easy to assemble, sure to last.

". . . there's little chance of making a mistake in putting the unit together."

Popular Electronics-Nov. 1959

"Components and hardware are of the quality one expects in a high-grade instrument." Audio Magazine-May 1959
". . . instructions were terrific!"

P. L., B'klyn, N. Y.

To sum it up. Our aim was the best unit ever made.

"The Lafayette KT-600 is unquestionably one of the most flexible stereo control units available today."

High Fidelity Magazine-Oct. 1959

"The KT-600 is the most remarkable electronic instrument I have seen . . ."

H. K., Akron, Ohio

"Congratulations on a fine kit."

H. D., Red Bank, N. J.

"Everything excellent!"

C. J., Randolph, Mass.

". . . one of the finest stereo preamps available . . ." W. M., Santa Rosa, Cal.

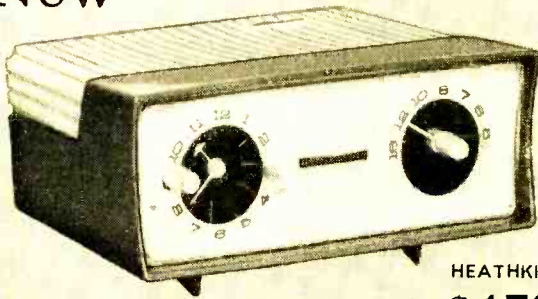
"I have thoroughly enjoyed building the KT-600 . . ." W. N., Marianna, Ark.

The **KT-600** kit, a product of Lafayette Radio Corporation, 165-08 Liberty Avenue, Jamaica 33, New York **\$79.50**
Factory wired (**LA-600**) **\$134.50**



Transistor Clock Radio Kit

New



HEATHKIT TCR-1

\$45⁹⁵



LEATHER CARRYING CASE
HEATHKIT No. 93-3

Shpg. Wt. 2 lbs.

\$4⁹⁵

Everything A Clock Radio Can Offer And Portable Too!

- Completely portable, all transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble—even by beginners

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuitry . . . then slash the price at least in half, and you have the new HEATHKIT "Your Cue", Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment any time, any place. It can also be

used with the Heathkit Transistor Intercom system, below, to provide music or a "selective alarm" system.

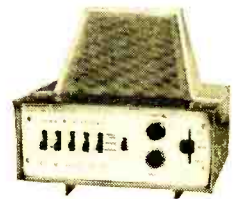
An "alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used, with reduced battery life. The handsome two-tone cabinet, measuring only 3 1/2" H. x 8" W. x 7 1/2" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking or camping. Shpg. Wt. 5 lbs.

Transistor Intercom Kit

Master unit can call any one, any combination, or all five remote stations. Remote stations can turn system "on" and call another. Each remote unit equipped with "privacy" switch. Master unit can be connected to new transistor clock-radio shown above (or any radio not AC-DC operated) to supply music or alarm to system; separate listen and talk volume controls; handsome case of two-tone ivory and turquoise high-impact plastic. Remotes are "look-alike" miniatures of master. Eight flashlight batteries power system up to 300 hours. Master and remotes sold separately; order up to five remote stations for each master station ordered.

INTERCOM AC POWER SUPPLY (XP-1): Adapts Intercom for permanent operation from household AC current. Fits in space normally occupied by battery supply. Shpg. Wt. 2 lbs. Heathkit XP-1 \$9.95




BATTERIES NOT INCLUDED

HEATHKIT XI-1 Master. **\$27⁹⁵**
Shpg. Wt. 6 lbs.

HEATHKIT XIR-1 Remote. **\$6⁹⁵**
Shpg. Wt. 4 lbs.

HEATH COMPANY / Benton Harbor, Michigan

 a subsidiary of Daystrom, Inc.

New Stereo Amplifiers

14/14-WATT STEREO AMPLIFIER KIT (SA-2)

A complete dual channel amplifier/preamplifier combination the new Heathkit SA-2, in one compact, handsomely styled unit provides all the modern features required for superb stereo reproduction . . . yet is priced well within your budget.

The SA-2 delivers 14 watts per stereo channel, and 28 watts total monophonic. Maximum flexibility is provided by the 6-position function switch which gives you instant selection of "Amp. A" or "Amp. B" for single channel monophonic; "Mono. A" or Mono. B" for dual channel monophonic using either preamp with both amplifiers; and "stereo" or "stereo reverse". A four position input selector switch provides choice of magnetic, phono, crystal phono, tuner, and an extra high level auxiliary input for use with tape recorder, TV, etc. The magnetic input is RIAA equalized and features 3 mv sensitivity—adequate for the lowest output cartridges available today.

The dual-concentric volume control is equipped with a friction clutch which can be set to lock the two controls together once the balancing of the two amplifiers has been accomplished.

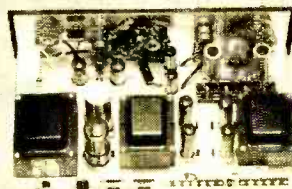
Ganged dual tone controls adjust bass and treble response of both channels simultaneously. Proper speaker phasing may be conveniently accomplished with the speaker phase reversal switch located on the rear chassis apron. A hum balance control is provided for each channel. Two AC outlets, one controlled by the power switch, provide convenient accommodation for accessory equipment. As beautiful as it is functional, the SA-2 features the latest Heathkit styling in vinyl-clad steel with leather-like texture in black with inlaid gold design. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ± 1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched; 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4 $\frac{1}{2}$ " H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

best stereo buy ever!



HEATHKIT SA-2
\$52⁹⁵



ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste. You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ± 1 db from 50 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%, 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 65 db below full output. **Controls:** dual clutched volume; ganged treble, ganged bass; 7-position selector, speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12 $\frac{1}{2}$ " W. x 6 $\frac{1}{2}$ " D. x 3 $\frac{1}{4}$ " H.

Go stereo for just \$29.95

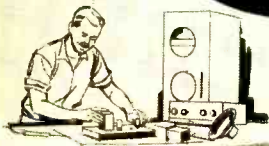


HEATHKIT SA-3
\$29⁹⁵

New



Amplifiers



HEATHKIT EA-3
\$29⁹⁵

"BOOKSHELF" 14-WATT HI-FI AMPLIFIER KIT (EA-3)

Without doubt one of the finest investments you can make in a top quality amplifier and preamplifier combination. Features three switch-selected inputs, separate bass and treble tone controls, RIAA equalization and a special hum balance control. Tastefully styled in black simulated-leather with brushed gold trim. Shpg. Wt. 15 lbs.

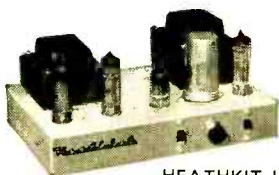
NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: Hi-Fi rating 14 watts; Professional rating 12 watts. **Power response:** ± 1 db 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.



HEATHKIT FM-4
\$34⁹⁵

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned IF transformers and assembled tuning unit makes construction simple and guarantees top performance. Flywheel tuning and new soft, evenly lit dial scale provide smooth, effortless operation. Housed in attractive vinyl-clad steel case with gold design and trim. A multiplex adapter output is also provided. Your best buy in an FM tuner. Shpg. Wt. 8 lbs.



HEATHKIT UA-2
\$22⁹⁵

UNIVERSAL 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Living up to its title "universal" the UA-2 performs with equal brilliance in countless Hi-Fi and PA applications. Easily meets 14 watt hi-fi and 12 watt professional standards. Power response is ± 1 db from 20 cps to 20 kc at 17 watts output. Harmonic distortion is less than 2% and IM distortion is less than 1% at 14 watts output. Output taps are provided for 4, 8 and 16 ohm speakers. High quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Shpg. Wt. 13 lbs.



HEATHKIT W-7A
\$54⁹⁵

55-WATT HI-FI AMPLIFIER KIT (W7-A)

Best buy in its power class! Combines modern components, unique output transformer, power supply and circuit design to bring you a superb high fidelity amplifier at less than a dollar a watt. Power response is ± 1 db from 20 cps to 20 kc at full 55 watt output. Total distortion is less than 2% at full output. Output taps are 4, 8 and 16 ohms plus 70 volt line for use in wired music systems. On-off switch, gain control, and max, or unity damping switch are located on the front panel. Clean, open circuit layout are precut, cabled wiring harness for easy assembly. Shpg. Wt. 28 lbs.

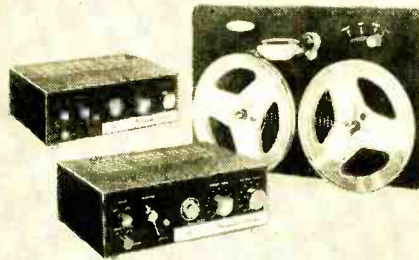


STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Available in two outstanding versions! SP-2A (stereo) and SP-1A (monophonic). SP-1A convertible to stereo with conversion kit C-SP-1A. Use as the control center of your entire high fidelity system. Six inputs in each channel accommodate most any program source. Switch selection of NARTB or RIAA, LP and 78 rpm record compensation.

HEATHKIT SP-2A (two-channel stereo). Shpg. Wt. 15 lbs. **\$56.95**
HEATHKIT SP-1A (single-channel monophonic). Shpg. Wt. 13 lbs. **\$37.95**
HEATHKIT C-SP-1A (converts SP-1A to SP-2A). Shpg. Wt. 4 lbs. **\$21.95**

New **HEATHKIT** Tape Recorders



Have fun making your own recordings with one of these outstanding tape recorder kits

STEREO MONO TAPE RECORDER KITS

Our most versatile tape recorder kit, you can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and playback both Stereo and Monophonic programming or the two-track Monophonic record-playback version (TR-1A). Precision bearings and close machining tolerances hold flutter and wow to less than 0.35%. NARTB equalization, separate record and playback gain controls and a safety interlock. Provision for mike or line inputs with 6E5 "magic eye" tube as sound level indicator.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-1 Tape Electronics Kit. Shpg. Wt. 24 lbs. \$10.00 DN., \$9.00 MO. **\$99⁹⁵**

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 26 lbs. \$15.00 DN., \$13.00 MO. **\$149⁹⁵**

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 36 lbs. \$15.00 DN., \$13.00 MO. **\$149⁹⁵**

PROFESSIONAL QUALITY TAPE RECORDER KITS

Precision tape mechanism complete and tested, build only the amplifier. Two circuit boards for easy assembly, and high stability. Separate record and playback heads and amplifiers for monitoring while recording. Includes sound level meter, counter, pause control, record interlock, 2 (switch-selected) speeds 3¾ and 7½ IPS. Response: ±2.5 db 30 to 12,000 cps at 7½ IPS. NARTB equalization. Compares to \$350 to \$400 units. Shpg. Wt. 30 lbs.

MODEL TR-1E: 4-track stereo playback, monophonic record & play. **\$169⁹⁵**

MODEL TR-1D: 2-track stereo playback, monophonic record & play. **\$169⁹⁵**

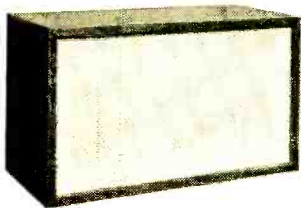
MODEL TR-1C: monophonic record playback. **\$159⁹⁵**

MODEL C-TR-1D: converts TR-1D to TR-1E, 2 lbs. **\$14.95**

MODEL C-TR-1C: converts TR-1C to TR-1D, 2 lbs. **\$19.95**

MODEL C-TR-1CQ: converts TR-1C to TR-1E, 2 lbs. **\$19.95**

New Acoustic Suspension Hi-Fi Speaker System Kit



HEATHKIT AS-2M
(mahogany)
\$79⁹⁵

HEATHKIT AS-2U
(unfinished)
\$69⁹⁵

HEATHKIT AS-2B
(birch)
\$79⁹⁵

The Acoustic Research speaker is accepted as most praiseworthy in the world of hi-fi sound reproduction. Heathkit, sole kit licensee from AR Inc., now offers a kit version of this remarkable speaker system in money saving, easy to build form. The 10" acoustic suspension woofer delivers clean, clear extended range bass response and a specially designed "cross-fired" two-speaker tweeter assembly provides outstanding high frequency distribution. Response at 10 watts input ±5 db from 42 to 14,000 cps. Impedance 8 ohms. Cabinets are preassembled and available prefinished in birch or mahogany and unfinished in furniture-grade birch only. Shpg. Wt. 32 lbs.

HEATH COMPANY / Benton Harbor, Michigan

HD a subsidiary of Daystrom, Inc.

New



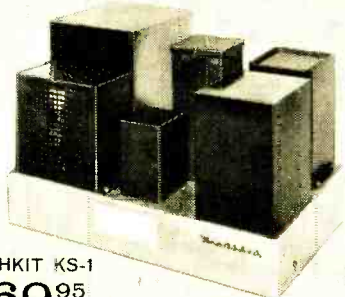
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Maximum power
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HEATHKIT KL-1
\$415⁰⁰

Top power,
plus economy and safety



HEATHKIT KS-1
\$169⁹⁵



HEATHKIT XC-2
\$36⁹⁵



HEATHKIT UT-1
\$28⁹⁵

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

Operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4-400's) push the "Chippewa" to top performance levels while a centrifugal blower provides maximum cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meters): Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 60 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma. grid current; 0 to 100 ma screen current; 0 to 5000 plate voltage, 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19 1/2" W. x 11 1/2" H. x 16" D.

KILOWATT POWER SUPPLY KIT (KS-1)

Ideal companion for the "Chippewa" Linear Amplifier . . . and supplies plate power to most other RF amplifiers in medium to high power class. Features oil-filled, hermetically sealed plate transformer and 60 second time delay relay. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma. peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifier. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave, single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17 1/2" W. x 12" H. x 13" D.

2 METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2 meter band. Use also with receivers tuning a 4 mc segment between 22 and 35 mc with appropriate crystal. Shpg. Wt. 7 lbs.

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

Converts "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation. May also be used to provide filament and plate voltage for wide variety of ham gear. Shpg. Wt. 15 lbs.

FM TEST OSCILLATOR KIT (FMO-1)

Complete FM test facilities in one compact, easy to use instrument. First of its kind on the market.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc, 400-cycle audio. **Controls:** main frequency selector, modulation switch/concentric level control, marker oscillator switch/concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7 3/4" H. x 4 3/4" W. x 4 3/4" D.

RF SIGNAL GENERATOR KIT (RF-1)

High precision performance . . . for troubleshooting and aligning RF and IF circuits of all kinds. Preassembled and aligned bandswitch/coil assembly. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2%. **Output:** Impedance, 50 ohms; voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30% depth; external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6 1/2" W. x 9 1/2" H. x 5" D.

New Test Equipment



HEATHKIT RF-1
\$27⁹⁵

HEATHKIT FMO-1

New Citizen's Band Transceiver



**WIRED OR
KIT FORM!**

- No Tests to Take—No Operators License Required
- Any Citizen 18 or Older can Have Own Station
- Hundreds of Business and Personal Uses

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

Have your own wireless communications system! Make necessary personal contacts with family, friends, or associates from your car, home, boat or office. Light, compact, easy to use, the Transceiver reliably covers distances from one to ten miles depending on location, antenna and type of installation. Transmitter frequency is crystal controlled. Receiver tunes any of the 23 channels assigned to the 11 meter "Citizen's Band". Operates from 117 volt AC line using internal power supply, or from 6 or 12 V. batteries using separate vibrator power supply. Can be transferred in minutes from fixed to mobile operation. All pertinent FCC regulations, and station license application forms are furnished. Comes complete with microphone, two power cords, station identification card, set of stick-on call letters and crystal for one channel. Smartly styled in rich mocha and beige. Shpg. Wt. 10 lbs.



Kit Model, Heathkit CB-1 \$42.95
Wired Model, Heathkit W-CB-1 \$60.95 (\$6.10 dwn. \$6.00 mo.)
Both Models Include Transceiver, crystal, microphone and Two Special Power Cords.

ANTENNAS

- CBU-1 "UTILITY" ANTENNA\$9.95
Good coverage, portable antenna for temporary mobile or fixed installations. Shpg. Wt. 3 lbs.
- CBM-1 "MOBILE" ANTENNA\$19.95
Best coverage mobile antenna. 9' whip. Bumper mount. Shpg. Wt. 7 lbs.
- CBF-1 "FIXED LOCATION" ANTENNA\$19.95
Excellent coverage. ¼ wave, 9' elements. 50' connecting cable and mounting bracket. Shpg. Wt. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE OF CB-1


- 6-VOLT VIBRATOR POWER SUPPLY
KIT: model VP-1-6, Shpg. Wt. 4 lbs.\$7.95
WIRED: model W-VP-1-6, Shpg. Wt. 4 lbs.\$11.95
- 12-VOLT VIBRATOR POWER SUPPLY
KIT: model VP-1-12, Shpg. Wt. 4 lbs.\$7.95
WIRED: model W-VP-1-12, Shpg. Wt. 4 lbs.\$11.95

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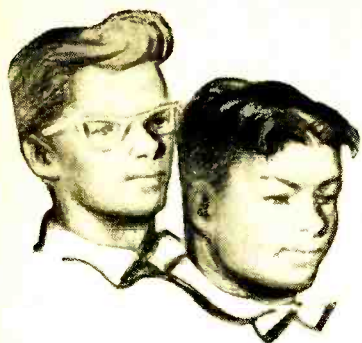
NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

QUAN.	MODEL NO.	KIT NAME	PRICE

By
JOHN T. FRYE
W9EGV



Carl and Jerry

Improvising

"BOY! It's slick as glass out there!" Jerry exclaimed as he peered through the ice-coated windows of the bus in which he and his chum, Carl, were returning from a shopping trip to Center City. "And look at what the ice is doing to those telephone and power lines. I doubt if you could find a 500-foot length of either all in one piece."

"Yeah," Carl said in a low voice as he shut off the news broadcast he had been listening to on his transistor radio; "and a howling blizzard that caught the weather forecasters flat-footed is following up the ice storm. It's blanketing this whole section of the country—"

"Folks!" the bus driver said suddenly, without taking his eyes off the glazed road along which the bus was creeping. "We're going to tie up at the next farmhouse. The road passes through a game preserve in the middle of a swamp along here, and there won't be another house for five miles. With driving conditions getting worse by the minute, we'd never make it. It's growing



dark, and we'd be foolish to take a chance on being stranded all night in a ditch in this storm."

As he finished speaking, a dimly lighted window loomed out of the dusk on the right side of the road; and there was a sniffing

sound as the driver began lightly touching the air brakes. The road through the swamp was built up on top of a high grade, and the house was some eight or ten feet below the crown of the road. A black-topped drive led from the highway across a culvert and into a garage beside the house. The garage doors were open, and the car that evidently belonged in it was lying on its side in the deep ditch at the end of the culvert.

The driver eased the huge bus to a stop on the highway opposite the house. At that instant a bareheaded man came running from the house and scrambled and clawed his way up the icy incline to the bus.

"Am I ever glad to see you!" he exclaimed to the driver as the latter opened the door of the bus. "My boy's taken bad sick, and when I tried to get my car up on the road to take him to the doctor, it slid off into the ditch. The telephone and electricity have been out for hours. If a couple of you will help carry him out—"

"We stopped here because we couldn't go any farther," the driver explained gently. "We wanted to take shelter with you until the storm lets up."

The man's shoulders slumped as he turned towards the house. "Come on in," he said lifelessly. "You're welcome, but I've got to get help for my boy."

As Carl and Jerry and the driver helped the three women passengers down the slippery incline, the sleet suddenly changed to snow; and the huge flakes came so thick and fast as to be almost smothering. But inside the living room, dimly lit with an emergency coal-oil lamp, a cheery fire in a large stove made everything warm and cosy. On a couch behind the stove a boy about Carl and Jerry's age was writhing and moaning in pain. A white-faced woman

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PORT ARTHUR COLLEGE Port Arthur
Texas
Established in 1909

were so thick that the outline of the bus, only seventy-five feet away, could barely be made out.

The driver turned on the lights, started the motor, and began easing power to the Diesels. At first the bus refused to budge; then suddenly the rear wheels started to spin and the rear of the bus slewed around into the driveway. Slowly, in spite of everything the driver could do, the huge vehicle slid backward down the incline until the rear of the bus came against a rock garden built in front of the house. There it stopped, with the front wheels on the road and the headlights boring up into the whirling snowflakes.

"I'm sorry," the driver said to the boy's father. "I didn't think it would work, but I had to try. How about a couple of us trying it on foot?"

As if in answer, a voice from the transistor radio in Carl's hand said: "Attention everyone in the storm area. Do not go outside. Stay indoors. This is the worst storm in years. Winds are gusting up to sixty miles an hour, piling the snow into enormous drifts. Even walking is impossible. Do not, I repeat, *do not* leave a place of safety for any reason."

"Sir, do you have a radio in your car?" Jerry suddenly asked the boy's father.

"Yes, but why?"

"My friend here and I are radio hams. If you'll let us, I believe we can make a transmitter out of your radio and summon help. We'd like to try."

"Go ahead. Doing anything is better than just sitting here. I suppose you want the radio out of the car."

"Yes, and the battery, too. While you fellows help Carl get them out, I'll try to move the tuning range of Carl's transistor receiver into the 75-meter ham band."

"How you gonna do that?" Carl asked as he handed over his receiver.

"By taking turns off both the oscillator coil and the tuned loopstick antenna," Jerry answered. "If the transistor used as an oscillator will just keep going up around four megacycles, this should work."

The man got some tools from his garage, and the three of them started to work on the car. Jerry went back into the house and sat down at the table beside the coal-oil lamp. With a pair of tweezers borrowed from one of the women, he fished out the end of the oscillator coil winding he wanted

(Continued on page 104)



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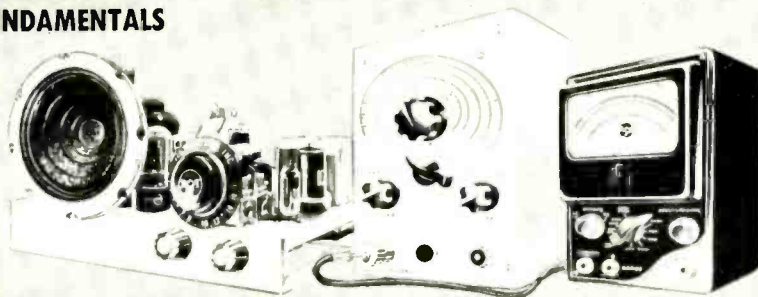
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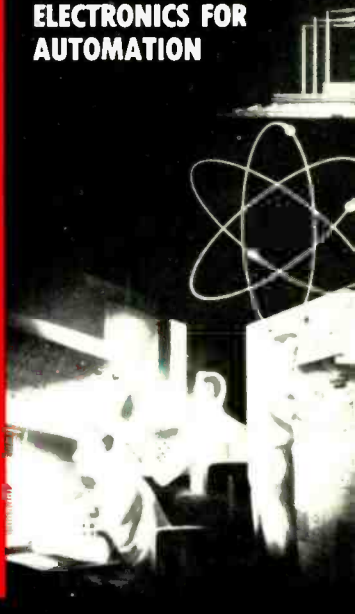
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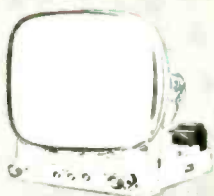
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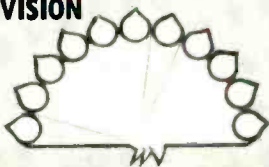
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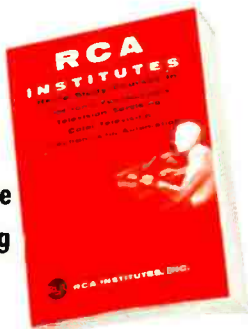
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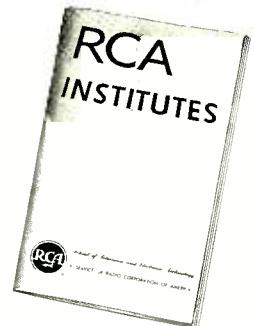
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100's of control uses.

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Incl. world's tiniest; only **\$1**
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- ★ 12 Watts
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and began carefully stripping off turns. Every few turns he stopped and reconnected the end of the shortened winding, then checked to see how far a broadcast station originally received at 1600 kilocycles had moved down the dial. As this station grew weaker, he took turns off the loop winding to peak it back up. Finally the station was coming in at 540 kc. on the dial, and now when he tuned down to the other end of the dial he could hear some weak amateur stations. By further trimming of the antenna coil and peaking up the trimmer capacitors, he raised the volume of the ham signals until they could just be understood.

At this point the men, plastered with snow and chilled to the bone, came in lugging the car battery and the radio.

"Good old Hank is monitoring the state fone net frequency as he always does when there's a chance of a communications emergency," Jerry reported to Carl as the latter held his blood-red hands towards the warmth of the stove. "If we can put out any signal at all, he'll hear it."

Hank was a bed-fast amateur in the boys' home town who was noted both for his technical knowledge and for his operating excellence. Any time that there was an

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10BP4	\$ 7.95	16WP4	\$12.00	17TP4	\$17.00	21EP4	\$13.50
12LP4	8.50	16PT4	9.95	19AP4	16.00	21FP4	14.50
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16KP4	9.95	17HP4	12.50	21AMP4	15.75	24DP4	24.50
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1 YEAR WARRANTY

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

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emergency on the ham bands, day or night, Hank could be depended on to be in there with his keen ears and powerful signal.

"Hey, we're in luck!" Jerry exclaimed as he removed the top cover from the receiver. "This thing uses push-pull tubes in the output stage. That means we can use one of the power tubes as a self-excited oscillator and the other as a modulator. Am I glad now I just finished reading an article

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Angola, Indiana

on early tube transmitters! If I can only remember the circuits—"

"You can and you will," Carl said with conviction. "You can't remember a three-item grocery list for your mother, but I don't think you ever forgot a single line of a circuit diagram in your whole life."

"Let's see, now," Jerry mused as he sketched a rough diagram on the back of an envelope. "I think we'll tie the plate and screen of our oscillator tube together and make a triode of it for the sake of simplicity. One section of this tuning capacitor riveted to the chassis can tune the tank circuit, which means that one end of the tank coil must be grounded. That's okay if we use this modified Hartley circuit. The cathode goes to a tap near the grounded end of the tank coil. The other end of the coil goes through a small capacitor to the grid, and a five- or ten-thousand-ohm grid leak goes from grid to ground. The plate is at ground potential as far as r.f. is concerned, and we'll tie it right to the plate of this other output tube serving as a modulator. That will let us use 'Heising modulation.'"

"What are you going to use for a mike?"

You can't use the speaker without a transformer to match its low impedance into a grid, and you're already using the output transformer."

"I'm going to use the carbon mike in the telephone handset."

"You still need a mike transformer."

"Not when I use the mike for the cathode resistor of my first audio stage so as to make a grounded-grid amplifier of it," Jerry corrected.

A wood chisel heated in the stove served as a soldering iron as the two boys made the circuit changes outlined. A thin copper tubing gas line found in the garage was formed into a tank coil of some twenty well-spaced turns about two and a half inches in diameter. This coil was simply allowed to lie on the wooden table top, and leads from the tuning capacitor and the oscillator cathode were run to it. Tubes not needed were removed from the receiver to save power. A dial lamp soldered across a single turn of wire served as an oscillation indicator, and this lighted brilliantly when held near the tank coil of the hay-wire transmitter; furthermore, it flashed en-

(Continued on page 108)

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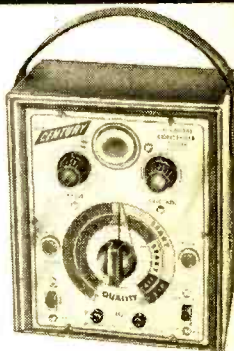
- ✓ Quality of condensers even with circuit shunt resistance... (This includes leakage, shorts, opens, intermittents)
- ✓ Value of all condensers from 200 mmdf. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

out-of-circuit checks:

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

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value... in-circuit or out-of-circuit
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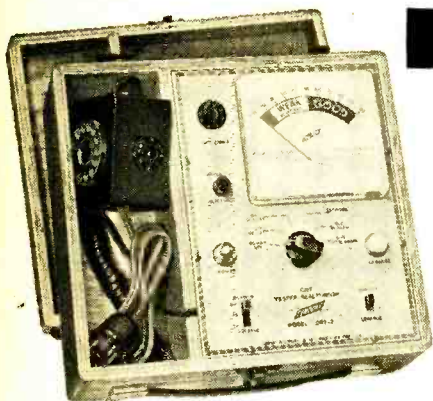


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See for yourself at no risk why thousands of servicemen all over the country selected CENTURY test equipment—above all others. Send for instruments of your choice without obligation... try them for 10 days before you buy... only then, if satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.



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- ✓ **THE MULTI-HEAD** (Patent Pending) . . . A **SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** — A tremendous advance over the maze of cables and adapters generally found with other testers.
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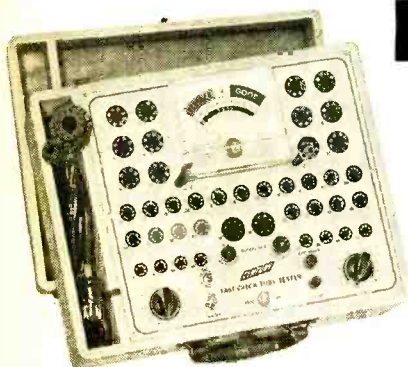
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courageously when the mike was tapped. Ice was broken off a 120-foot length of the downed telephone line in front of the house, and one end of this was connected directly to a turn of the tank coil about one-third of the way down from the "hot" end. The other end was run out the window and attached with a plastic napkin ring for an insulator to a telephone pole that was still standing. The transmitter was tuned to the frequency on which Hank and the other net members were talking by checking with the transistor receiver.

When all was ready, Jerry turned on the switch and gave Hank's call several times, signed his own, and said. "Emergency traffic!" When the makeshift transmitter was cut off, Hank's alert voice came from the little transistor receiver: "Station calling with emergency traffic, go ahead. You're not very strong, and you have about as much frequency modulation as you do amplitude modulation, but I think I can read you. Other stations copy along."

Quickly Jerry outlined their situation. Hank gave him a 'Roger' and told him to stand by. After a few minutes that seemed like hours to the group whose tense faces were lighted by the coal-oil lamp, Hank was back: "The state police are going to send out their 'copter to pick up the boy. The storm is dying down, and they think they can make it if they can just find you. Do you have any lights with which you can signal?"

"The headlamps of the bus!" the driver exclaimed. "They're pointed up in the air!" This information was relayed, and it was



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phones; each set is designed as an automatic dial master phone and may call any of ten stations. And Toho Electronics, also in Japan, has introduced a fully transistorized wirephoto transmitter.

- There are several items from Germany. Dr. med. Noeller, Children's Hospital, Heidelberg University, has designed a sub-miniature transistorized transmitter which, with its self-contained battery, measures only $\frac{5}{32}$ " x $\frac{1}{4}$ " over-all; it is swallowed by the patient and transmits data on pressure, temperature, and the pH value within the stomach or intestinal system. Grundig Radio-Werke GmbH, Fuerth/Bay, is producing a miniature transistorized tape recorder. And a Hamburg firm, Protona GmbH, has introduced a fully transistorized FM walkie-talkie weighing only 25 ounces.
- The Metropolitan Water Board, Sydney, Australia, is using a transistorized indicator system for low-level sewage pumping stations.
- In Leningrad, Russia, the Aerophysical Institute has reported the development of a semiconductor thermometer which determines the optimum planting time for wheat and corn.

Product News. Aldens, a Chicago mail order house, is advertising a 3-band, 7-transistor portable receiver which sells complete with battery and leather carrying case for only \$49.95. The set tunes the AM broadcast band from 540 to 1600 kc. and short-wave bands from 3.5 to 12 mc.

Motorola, Inc. has announced price cuts in its line of Zener diodes. There is also news of price cuts on power transistors made by Delco Radio.

The General Instrument Corporation, (Chicopee, Mass.) has started large-scale manufacture of fully transistorized TV tuners. These units use three Philco micro-alloy diffused transistors (MADT) and offer a performance comparable to that obtained from vacuum-tube operated tuners with respect to gain, signal-to-noise ratio, and image and i.f. rejection. Designed for operation on 12 volts, these tuners require only 8.5 ma. current.

Before too long, the Raytheon Manufacturing Company, pioneer manufacturer of low-cost "experimenter's transistors," is expected to announce two new types—*p-n-p* units selling for *under* 90¢ each to the user.

That does it. See you next month.

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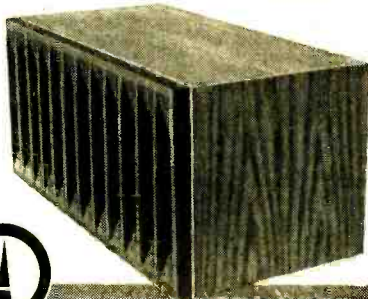
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Keeping pace with progress

Stereo Tone Arm

(Continued from page 76)

To adjust the stylus pressure, the weight of the cartridge and the front part of the arm is first "zero-balanced" by the sliding counterweight on the rear of the arm. Then, a calibrated control knob on the side of the housing is used to set the stylus pressure anywhere in the 0-8 gram range. This is accomplished by means of an eight-turn spiral mainspring, the outer end of which is connected to the control knob and the inner end to the shaft which supports the arm in the vertical bearings. As the control is advanced, the tension on the spring decreases, causing the arm to exert more pressure on the stylus.

Since the spiral spring has many turns, the stylus-pressure dial can be calibrated with great accuracy (within plus or minus 0.1 gram, according to the manufacturer). And because the spring is connected to the arm at almost the exact center of the vertical pivot's axis, the stylus pressure will remain constant even when warped records are being tracked.

Other features of the Empire 98 which add to quality performance include the use of ball bearings for both the lateral and the vertical movements, and a hard rubber decoupling element in the rear of the tone arm to support the counterweight section. This latter design nicety contributes to the extremely low resonance of the arm—which is between 10 and 13 cps, Audio Empire claims. Maximum tracking error is only 0.75°.

The Empire 98 is a product born of imaginative engineering and conscientious manufacture. Anyone in the market for a new tone arm would do well to consider it. Finished in either satin chrome or satin gold (real gold, no less), it is available in 12" and 16" models.

-50-



"You ground the lead, yes, but not to the meter."

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The R/C Cloud

(Continued from page 87)

"You are about to see my reputation re-established as the creator of foolproof R/C models."

We adjourned to the patio where I filled the airship with hydrogen from the tank I'd purchased, (after discovering that cooking-gas wouldn't provide the necessary "lift,") and I attached the safety-line securely to the gas-escape valve device.

"In case you're counting on the safety-line getting away from me, I think you'd better know that I'm tying it to my waist," I declared smugly. "Care to hand over the winnings now instead of later, dear?"

"I'll wait," she demurred sullenly.

HUMMING a merry little tune, I launched "The Cloud." Gracefully, it rose into the air, rolling slightly in the vagrant air currents as it reached higher altitudes.

"There you are!" I exclaimed. "Nary a thing going wrong! No difficulty, no disaster! Watch how—" I jabbed the control buttons on the transmitter unit, "—it responds, accurately and totally."

"Gee," she said. "Lookit the big eagle flying around up there."

"All untoward elements have been brilliantly—"

"Golly, that's a mean-looking eagle. Hey, I think it sees your model!"

"—and scientifically elimin—GET AWAY FROM THAT DIRIGIBLE! SHOO! BEAT IT!" I yelled.

The eagle began to circle around "The Cloud," closing in on it with each revolution. Frantically, I jabbed the control buttons in an effort to get the model out of the curious bird's range.

"I don't think that eagle likes your model," she murmured jovially. "Lookit him follow it!"

"If we only had a BB gun," I moaned, jabbing the controls again in an attempt to keep "The Cloud" out of range of those sharp, cruel talons.

"BB guns?" She smirked. "They've been scientifically eliminated, remember?"

"Shut up and heave rocks at him!" I barked. "Maybe I can get the model down before—" I started hauling in the safety-line with desperate energy, "—he manages to effect any damage with those sharp—"

Without warning, the eagle suddenly dove upon "The Cloud." His talons ripped

February, 1960

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into the balsa-wood with a crunch that carried all the way down to us. Then, with a triumphant shriek he flapped away.

As I stood paralyzed with grief, "The Cloud" descended in a number of jagged fragments, its props still whirling courageously even as they smashed onto the patio brickwork.

"Don't forget to double next week's pin money, genius!" snickered Mrs. K. "I knew that crazy gismo was for the birds." —30—



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Test Instruments

(Continued from page 84)

A 20- μf . electrolytic capacitor (C-7) and a 3-watt incandescent lamp (M-1) provide the major path. The lamp performs the same function here as it does in the Wien bridge. Since its filament resistance varies directly with the amount of current flow through it, the lamp counters any tendency for the oscillation to "run away," thus providing automatic gain control. Potentiometer R-15 sets the over-all amount of positive feedback.

A minor secondary positive feedback path is via the 25- μf . capacitor (C-11) connected between the cathodes of the two tubes. This small capacitance provides positive feedback at the very high frequencies only, and thereby boosts the gain at the frequencies where the normal circuit constants would cause loss of output.

The negative feedback loop (also taken from the cathode of V-2) is connected to the grid of V-1 via a .02- μf . capacitor and a

frequency-discriminating RC network. This network is the secret of the Sulzer circuit's operation.

The Bridge-T. Known as a "bridge-T" network (because of its configuration), this circuit passes all frequencies *except* the one to which it is tuned. At that frequency, the bridge-T network looks like a very high impedance. Since the negative feedback applied to the grid of V-1 must travel via the bridge-T, certain special events take place.

First of all, remember that the circuit constants in the Sulzer generator are so arranged that the *negative* feedback generally overrides the positive feedback and so prevents oscillation. However, when the amount of negative feedback is reduced at *one* frequency, the two-stage amplifier formed by V-1 and V-2 goes—whoops, this is for me! The amplifier then turns into an oscillator—but *only* at the frequency where the negative feedback isn't around to exert its restraining influence.

In the Knight-Kit circuit (Fig. 9), the bridge-T components C-1_A, C-1_B are the two sections of a two-gang variable tuning capacitor. The resistors shown as R-1 and R-6 in Fig. 10 are actually two *sets* of resistors in the Knight-Kit. As in the Wien oscillator, the pairs of resistors are selected by a two-pole switch (S-1) and used to establish the decade frequency range (usually multiples of 20 to 200), and the adjustment tuning capacitor sets the specific frequency of operation.

There's no theoretical reason why the resistors couldn't be variable elements and the capacitors the switched ones. However, you can see the practical difficulties that would arise in manufacturing a two-section pot with the desired specifications. Both sections would have to track each other perfectly and one section would need to have a linear, precisely calibrated resistance range of 6000 ohms to 60 megohms. That's the sort of assignment that would drive a potentiometer engineer into semiconductor work—where circuit resistances seldom go over a quarter megohm.

A survey of the various models of generators reveals a number of special features such as metering, square-wave output, switched attenuation, choice of output impedances, etc. We will look into this next month, and see how these circuit "accessories" work and what they will do for you on your test bench.

-50-

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The Frustrated Fiddler

(Continued from page 58)

KT-600 also excels in overall performance. An independent testing laboratory recently reported: "For all practical purposes, this preamplifier may be considered a distortionless device."

In his latest project, the Harman-Kardon "Citation" kits, Hegeman had the task of combining the ultimate in audio quality with the utmost simplification of the actual kit assembly work.

"It was an ideal assignment," muses Hegeman. "They set up a special division for me and gave me a completely free hand. They just told me to produce the best possible stereo power amp and preamp kit—and make it so simple that it could be built by the complete novice."

Rising to the challenge, Hegeman designed a power amplifier with a whopping 60 watts output *per channel*. With this ample power reserve, he was able to keep distortion down to virtually unmeasurable amounts. To assure freedom from possible combination tones of transonic distortion products falling within the hearing range, he adapted video circuits to audio purposes.

A significant innovation in both the Citation I preamp and the Citation II power amp is the use of multiple feedback loops instead of the customary single loop. Hegeman feels that this technique allows precise adjustment of feedback for the individual needs of each stage without sacrificing stability.

To insure easy construction, Hegeman specified the use of military-type subassemblies in the Citation kits, with every resistor and capacitor laid out neatly on terminal boards. Special templates allow the kit builder to shape all wiring into professional-type harnesses.

Future Plans. Hegeman is hardly a man to dwell on past achievements. He is more eager to talk of the future. At present, he has an FM tuner kit in the final stages of development. Designed for Dynaco, the tuner has a unique feature that kit builders lacking elaborate test equipment will appreciate: it can be accurately aligned without instruments.

At the same time, he is also winding up the design of a stereo basic amplifier. Designed for Lafayette, this unit will be a dual 50-watt unit.

Next on the agenda are final touches on

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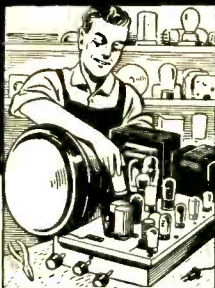
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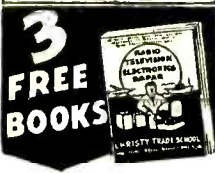
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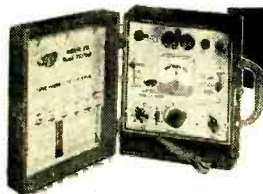


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a prototype transistorized tape recorder that he claims will outperform any recording device ever produced.

Hegeman considers transistors his major challenge for the future. He has already produced an experimental seven-transistor preamplifier that in terms of distortion, transient response, and signal-to-noise ratio surpasses anything he has done before. But the high cost (upwards of \$400) makes the device commercially unfeasible.

"But transistors are getting cheaper," Hegeman says hopefully. "If my guess is right, five years from now there will be no more vacuum tubes in audio." His face lights up with anticipation of what he expects to be a truly exciting period of development in all aspects of electronic sound reproduction.

As he talked of the future, it occurred to us that Hegeman actually represents something timeless and enduring in the tradition of American engineering: the inventive genius, working alone and independently, whose creative mind strikes the sparks of progress.

—30—

Electronic House-Sitter

(Continued from page 75)

with a standard receiver, you'll need a radio to make further adjustments. Place the receiver near the transmitter. Turn both instruments on and tune the receiver to a "dead" spot on its dial between 800 and 900 kc.

Now close *T1*'s trimmers fully. Turn up the set's volume control and set *R1* about two-thirds up. Then adjust *T1*'s trimmers slowly, backing each out an equal amount until a signal is picked up on the radio. This signal may be heard as a slight hum, as a "hiss," or as a squeal, depending on the relative adjustments of the volume and gain controls.

For closer adjustment, move the receiver across the room, and readjust *T1*'s trimmers. Then adjust *L1* for maximum pickup by the receiver.

Operation. To use the instrument, simply plug it into a wall receptacle in the room where you would like to have maximum audio pickup. Turn the unit on and adjust gain control *R1* for desired pickup level as heard on your pocket receiver. Best results are obtained when an earphone is used with the receiver.

—30—

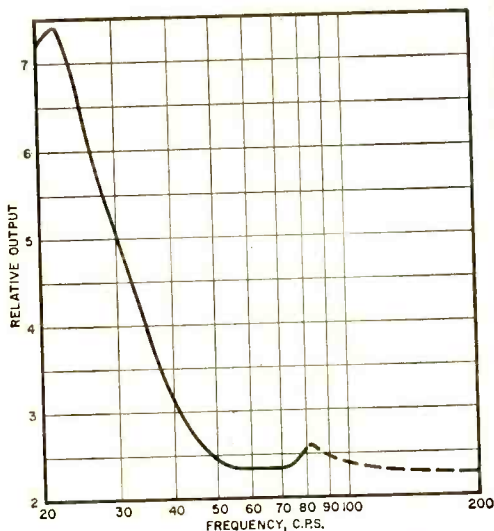
Three-Way Speaker System

(Continued from page 78)

by the unknowing beginner. Mid-range speakers with a frequency response cutoff at 2000 cycles are "matched" to tweeters that just begin to operate at 3500 cycles. High-efficiency woofers are put in the same system with low-efficiency tweeters, or vice-worser. Speakers have their impedances mismatched, their frequency response mismatched and their purposes misapplied with a complete disregard for the laws of acoustics and electronics.

Does the novice have an easy way out of this morass? Yes, says Cletron—and provides in one neat package (Model C-33812, \$98.00) a three-way speaker system including crossover that produces fine integrated sound in a cabinet designed for it.

The plans for the bass reflex cabinet given on page 78 are not critical in that the



Fundamental resonance of speaker is 22 cycles, with a smooth impedance curve beyond that point.

dimensions can be varied over a fairly wide range without running into tuning difficulties. The lack of critical dimensions is due both to the very low resonance of the Cletron woofer and the extra-large size of the cabinet.

When the woofer is installed in the cabinet, its resonant frequency checks out to be about 22 cycles (see graph above), which is certainly as low as you could ever want. Any speaker with a fundamental resonance in the 25-40 cycle area should work out equally well.

-30-

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Convert Car Radio for Home Use

(Continued from page 54)

tion must be removed and the switch re-wired to control the line voltage applied to the new power transformer (T2).

Depending on the individual set converted, you may have to apply your ingenuity in rearranging components and wiring. For example, in the set shown, the on-off switch was ganged to the volume control and part of the tuner assembly. To make the conversion, a line cord and plug was run to the tuner chassis, through the on-off switch (S1) and to a short "output" line and receptacle. The vibrator socket was replaced with a male a.c. chassis plug (PL1).

Final Assembly. Once the conversion wiring is finished, connect a short piece of hookup wire to the set's antenna terminal and check over-all performance. If alignment is indicated (if stations don't come in at right point on dial), realign the set following the Service Data instructions.

The next problem is finding a cabinet for the set. The author chose a commercially available metal cabinet (Bud C-1783-G), used decals to label the controls, and dressed up the loudspeaker grille with a rear deck speaker installation kit. If you prefer, you can install the completed set in a homemade wooden cabinet; you might achieve somewhat better tone. Since most car radios are quite compact, they are ideal for "bookshelf" installations.

Regardless of the type of cabinet, you'll have to plan panel layout to suit your receiver. In the author's set, an upright (vertical) dial arrangement was used; this lent itself nicely to the cabinet chosen. A horizontal dial would require a different layout. And you may want to use a different loudspeaker, mounted separately.

You'll need an external antenna. If the set is installed in a metal cabinet, you might mount a small car antenna right on the cabinet itself, as in the model (Ward CF-6 or equivalent side cowl mounting antenna). Or you can connect a short length of antenna wire to the set, running it along a wall baseboard or under a rug.

Most car radios have a built-in antenna trimmer. This will be identified in the Service Data, and should be adjusted for best reception with the final antenna used.

The last step: turn the set on, tune in your favorite station—and relax!

-30-

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Across the Ham Bands

(Continued from page 80)

a plate-modulated transmitter. Total power drawn from the power line will be approximately the same in either case.

Driving Power. In examining the specifications of different linear amplifiers, you will note that the amount of driving power they require varies considerably. Without going into the reasons for this, the best thing to do is to select one that requires somewhat less driving power than the r.f. output power of the transmitter you are going to use to drive it. Then, if you have too much driving power, you can easily cut it down with a power reducer between the driver and the amplifier. For the purpose, assume that the output of your present transmitter is approximately 60% of its input power. It is undoubtedly more, but you should allow for a factor of safety.

In the above discussion, I have stressed AM phone operation, since it is the type preferred by a majority of hams. Nevertheless, single-sideband is much more efficient, watt per watt, although more expensive at low power levels. Also, a low power single-sideband signal is easily amplified to any desired power level in a linear amplifier operating at full efficiency.

SCREEN-MODULATE THE DX-20

By adding screen modulation to the Heathkit DX-20 50-watt, a popular c.w. transmitter, you can turn it into an economical, 25-watt phone transmitter with excellent speech quality. You can either build the modulator unit in a 4" x 5" x 6" cabinet or you can save time and effort by ordering an E. F. Johnson Co. Model 250-40 screen modulator kit. If you get the kit, assemble it according to the instruction manual but substitute a 50,000-ohm, 10-watt resistor for the 20,000-ohm resistor specified for R42.

Modify the DX-20 to accommodate the modulator by mounting an octal tube socket on its rear chassis apron to the left of the antenna loading capacitor. Center the socket 1 3/8" from the bottom of the chassis with its guide key up. Then mount a 6.3-volt, 0.6-ampere filament transformer beside the 5U4 tube socket, moving the existing 0.1- μ f. tubular capacitor towards the front of the chassis by bending its leads, to make room for the transformer.

Connect the transformer primary leads

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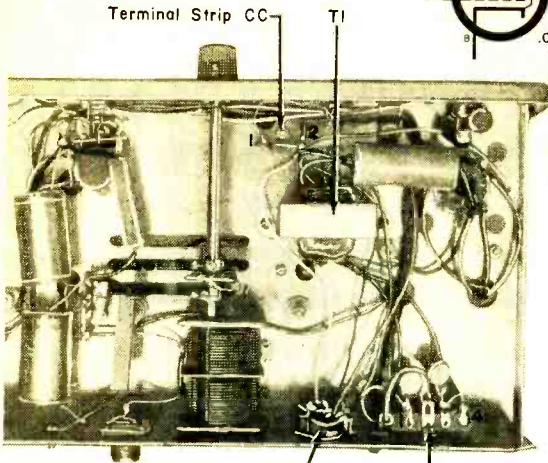
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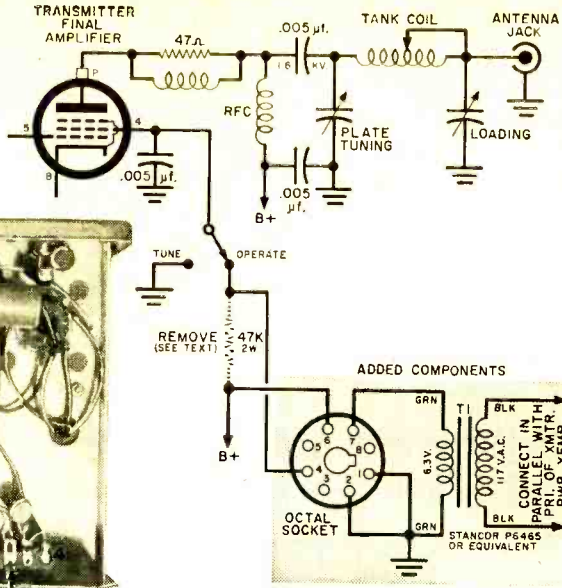
ADDRESS

CITY STATE

The DX-20 Heathkit transmitter is modified for AM operation as shown. Screen modulator is plugged into octal socket.



Added Octal Socket Terminal Strip DD

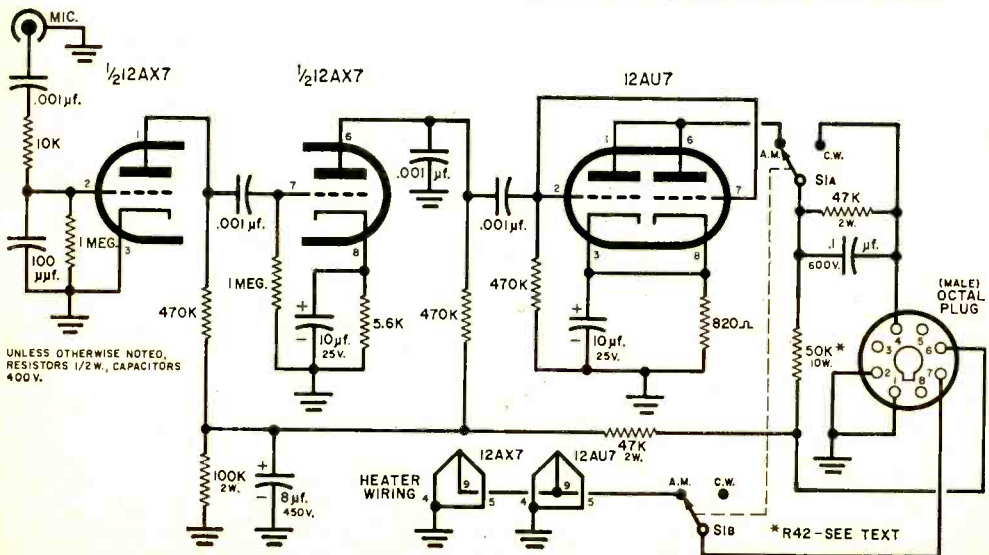


to terminals 1 and 4 of terminal strip DD. Ground one of its 6.3-volt leads and terminals 1 and 2 of the new octal socket to a solder lug. Ignore the 6.3-volt center tap. Connect the other 6.3-volt green lead to terminal 7 of the socket. Now remove the 47,000-ohm, 2-watt screen-grid resistor

from terminal strip CC. Connect terminal 1 of CC to terminal 4 of the octal socket and terminal 2 of CC to terminal 6 of the socket. This completes the modification of the transmitter.

Plug the modulator into the new octal socket. With its "AM-CW" switch in the "CW" position, the DX-20 will perform exactly as it did before modification. And with the switch in the "AM" position, you'll have a phone transmitter. Refrain from shouting or "swallowing the mike" when you talk, or overmodulation and a "mushy" speech quality will be the end result.

Screen modulator can be built from Johnson Model 250-40 kit (below) or you can wire your own. Octal plug mates with octal socket of modified transmitter.



News and Views

Ken Ferguson, K4ROB, 123 Crews St., Greenwood, S. C., transmits with a Heathkit DX-100B and receives with an Electro-Voice RME-4350A. His antenna farm grows a couple of dipoles and a Gotham vertical antenna. Ken likes 40-, 20-, and 15-meter c.w., and has worked 40 states, 36 confirmed, and seven countries. He offers to sked anyone needing a South Carolina contact on either phone or c.w. for WAS. . . . **Ronnie Guard, K4EPI**, 225 First Ave., Fayetteville, Tenn., got his Novice license last January, but a variety of reasons kept him off the air until a month or so ago. Then he worked 26 states, 16 confirmed, in 14 days. He uses a Globe Scout transmitter and a Hammarlund HQ-110 receiver. Having two 40-meter doublets at right angles to each other permits him to use the one that gives the best results for a particular direction. Ronnie has not used his Technician license; he says there is not much v.h.f. activity in his area. He expects to have his Conditional by the time you read this.

Carl A. Schultz, WV2IMG, 32 Skyview Drive, Cohoes, N. Y., operates on the Novice-Technician segment of the two-meter band (145 to 147 mc.) using a Gonset Communicator III feeding an 8-element beam. Carl is on the air from 8:00 to 10:00 p.m. daily. . . . **Scotty, WY6DNM** (12), 6526 Cartwright, San Diego 20, Calif., started his ham career with a Heathkit DX-40 running 75 watts into a "long-wire" antenna and an inexpensive receiver. With this setup, it took him eight months to work

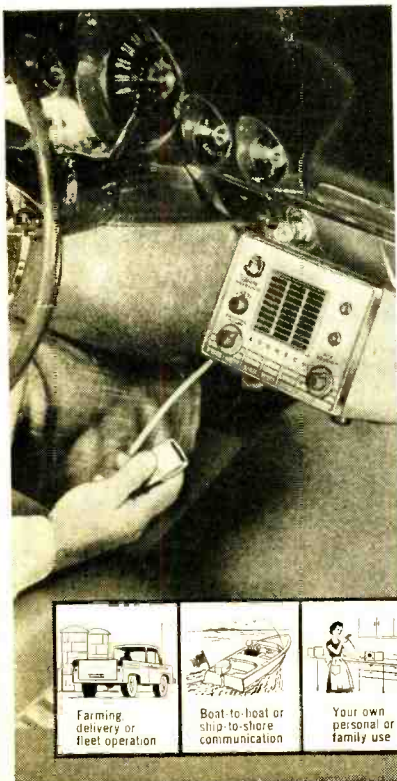
THIRD PARTY MESSAGES

Effective December 12, 1959, the FCC announced that Venezuelan and United States amateur radio stations may exchange international messages or other communications with third parties. The communications are restricted to conversation or messages of a technical or personal nature, which normally would not be handled by public telecommunications services. Needless to say, no fees or considerations may be accepted by hams for extending this service.

Other countries which have similar third party agreements with the United States are Canada, Chile, Costa Rica, Cuba, Ecuador, Liberia, Mexico, Nicaragua, Panama, and Peru.

four states on 40 meters. Then he put up a "Hy-Gain" trap doublet antenna and got a second-hand HQ-129X receiver. In less than a month, he worked 29 states and seven countries, including Japan, Australia, New Zealand, and the Philippine Islands. Scotty says, "Just proves you can't work 'em if you can't hear them."

Glenn E. Zook, KN9STH, 1006 W. 16th St., LaPorte, Ind., keeps his Globe Chief 90A transmitter mostly on 15 meters, where it feeds a home-built two-element beam. On 40 and 80 meters, he uses a home-brew 60-watter into a 40-meter dipole. Glenn just traded in his Hallicrafters S-107 receiver on an SX-110, but the S-107 must have been dragging them,



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too, because in three months on the air he made about 280 contacts in 35 states and Canada. His best DX is KC4USB in Antarctica.

Do you need a Wyoming contact? **Tommy Margoli, KN7IUF**, Moneta, Wyo., operates on 40 meters. He uses a Heathkit DX-40 transmitter to excite a 40-meter dipole 35' high. His receiver is a National NC-188 with a Q-Multiplier and a crystal calibrator added. Tom's record is 10 states worked, 9 confirmed, for a couple of weeks on the air.

Howard Feldman, KN1KAT, 49 Western Promenade, Auburn, Maine, uses a Globe Scout 680-A transmitter to excite a 125' "long wire," and he receives on a Hallicrafters SX-99. He also operates mobile with an ARC-5. Howie's "brag list" includes Puerto Rico, four Canadian provinces and 18 states worked. . . .

"West" **Verlander, KN5VQR**, P.O. Box 338, Cut Off, La., has worked 37 states and three countries in 11 weeks, running 75 watts on 40 meters and 50 watts on 15. He uses a folded dipole on 40 and a Cubical Quad on 15. West also has a transistor transmitter for 40 meters and wants some skeds to see how it gets out. **Steve Biren, WA2EGK**, 52-38 Little Neck Parkway, Little Neck 62, N. Y., excites a 40- and 20-meter multiple dipole antenna with a DX-40 and a VF-1 VFO; he receives with a Hammarlund HQ-100 receiver. Steve has worked 36 states. Some of his DX includes Czechoslovakia, Netherlands, Scotland, Germany, and the Virgin Islands. He wants skeds with Delaware, South Carolina, and W/K7, and offers to help anyone obtain a ham license.

It's never too late! **Will Perrine, KN9ULX**, Route 4, Box 6, Richmond, Ind., received his license at the age of 80 in October. Look for him on 40 meters. . . . **Ken Karlstad, KN6JHI**, Sherman Oaks, Calif., got a little earlier start. Only 11, he has worked 48 states, including

FOR CANADIAN READERS

The new *Radio Amateur Licensing Handbook*, by J. E. Ketchin, Regional Supervising Radio Inspector, Department of Transport (Canada), tells you how to obtain a ham license in Canada. It is published by Radiotelephone Directories of Canada, Ltd., West Pender St., Vancouver 3, B.C. Richard Diller, VE2PE2P, thought our Canadian readers might want to know about it.

Alaska and Hawaii, and six countries. A 3-element, 15-meter beam, a Heathkit DX-40 transmitter, and a Hallicrafters SX-100 receiver helped establish this record. Ken is now studying for his General license. . . . **Warren Napier, K8OLY**, Box 24, Ranelle, W. Va., has just gotten his General. As a Novice, he worked 21 states, mostly on 80 meters—because he likes to rag-chew. Warren uses a Heathkit AR-3 and a DX-40, but he is trying to convince his father that he needs a Hallicrafters SX-110 receiver. His pet peeve is hams who criticize beginners.

Write that letter and send that picture to me now. 73,

Herb, W9EGQ

On the Citizens Band



By TOM KNEITEL, 2W1965

A BRAND-NEW CB Call Book is just out, and it's the "most." It's an inch thick and lists all Class D stations licensed as of December 31, 1959, which comes to about 50,000.

Various sections of the Call Book contain all sorts of interesting and useful technical information for CB'ers. Stations are listed numerically, by call letters, and the operators' names and addresses are given. If you want a copy, send \$3.95 to George Beyers, 10W0376, % International Crystal Manufacturing Co., 18 North Lee, Oklahoma City, Okla.

When you write for the Call Book, you might as well be a sport for an extra 25 cents and ask International Crystal to send you one of its 16" x 24" CB call area maps to put up on your wall.

A Class D Citizens Radio Handbook has been prepared by Leo G. Sands. Its nine chapters go pretty deeply into the history of CB, recent technical developments, data on simple installation and maintenance techniques, etc. The material covered will be of interest to both laymen and technicians.

For more information on the Citizens Radio Handbook, write to Electronics Book Service, a division of the Ziff-Davis Publishing Company, One Park Ave., New York 16, N. Y.

Here's a helpful hint for CB'ers from Don Langdon, 2W2634. Don has a transmitter which must be tuned up to the maximum brilliance of a light bulb in his antenna circuit. Noting how difficult it is to find the exact spot where the bulb is at its brightest, Don picked up a photographer's light meter. When this is placed next to the bulb, it gives a metered reading, making the tuning task a snap.

Don't miss editor Oliver Read's editorial this month on page 8. The "Class D Dilemma" which exists now can be solved only by the organized efforts of Citizens Band operators themselves.

—30—

February, 1960

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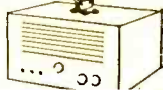


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Short-Wave Report

(Continued from page 88)

error was made in the call sign. In an after-net discussion, we pointed out that the call sign was typical of those being assigned by POPULAR ELECTRONICS to SWL's all over the world and was not in error.

In days ahead we hope to send many messages to our reporters via amateur radio as well as by mail, thus expediting replies. It is anticipated that amateur operators will become increasingly aware of the WPE call signs and recognize them as belonging to their brother hobbyists—the Short-Wave DX'ers.

Current Station Reports

The following is a resume of the current 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 frequency and/or schedule with little or no advance notice. Please send your reports to P. O. Box 254, Haddonfield, N. J.

Afghanistan—Kabul, 15,384 kc., has been noted at 1225-1300 with instrumental music; news in Eng. at 1235. At 1300 the frequency changes to 15,390 kc. and continues to s/off at 1330-1400 (variable). A low-frequency outlet is noted in England on 4710 kc. from 1150 to 1200 s/off. (RY, WPEQAE)

Algeria—*Algeria Renaissance*—Voice of Free Algeria, Algiers, a previously unidentified station, is heard on 8220 kc. from 1600 with Arabic chanting, from 1610 with speeches. At 1630-1700 there is more music and talks, not in Arabic. The 1700 s/off is abrupt with no further ID. (WPEQAE)

Bolivia—R. La Cruz del Sur, La Paz, transmits to Argentina over 9444 kc. at 0615-1215 and 1630-2130; Eng. lessons at 1945. Reports go to Cajon 8, La Paz, Bolivia. (WPE1BY)

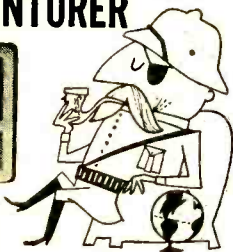
Brazil—New stations include one on 9513 kc. at 1800 with clock chimes and Portuguese language, and another on 15,215 kc. around 1815-2100 closing with pop music. The latter station has been missing recently, which indicates a possible change of frequency. (WPE3NF, WPE9KM)

PRA8, Recife, 6015 kc., can be noted Mondays at 0020-0200 with jazz music and frequent ID's. (VE7PE2R)

R. Marajoara, Belem, 15,245 kc., is usually excellent evenings with musical programs until 2230 s/off. Other good signals to be heard: R. Brasil Central on 9755 kc. at 2200; R. Globo, Rio de Janeiro, on 6035 kc., at 1830; and R. Tupi, Rio de Janeiro, 9610 kc., at 0130. (WPEQEH)

Cameroun—R. Cameroun I, Yaounde, has moved to 9662 kc. and is noted from 0030 s/on with drums IS, French ID, a trumpet number, and continuing with native music. ID is Ici Yaounde, Radiodiffusion du Cameroun. The assigned frequency is 9657 kc. (WPE3NF)

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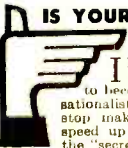
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arranged that a portion of the highway just south of the bus should be cleared for a landing spot for the helicopter. Everyone, even the women, went out into the slackening snow storm to help scrape and shovel the deep-piled snow from the road. They were barely finished when the throbbing sound of the whirlybird came from the sky, and in a matter of moments it settled gently down on the road. The sick boy was carried out on the couch and transferred to the aircraft, and it lifted up into the cone of light from the bus headlights and flew swiftly toward a waiting hospital.

EVERYONE went back into the house and sat tensely around the little butchered-up transistor receiver. Daylight was just breaking over the snow-smothered landscape when Hank's sleepy drawl came from the speaker:

"All is well. The boy has just come down from surgery and is fine. The appendix had not burst, and there were no complications. A snowplow, followed by a wrecker, is on the way out to you. Give me an okay, and then please take that alleged transmitter off the air. I don't think I've had to copy a signal that lousy since I first got my license thirty years ago!"

"Roger and out!" Jerry said with a grin as he patted the improvised transmitter affectionately; "I'd say, pretty is as pretty does!"

-30-

Transistor Topics

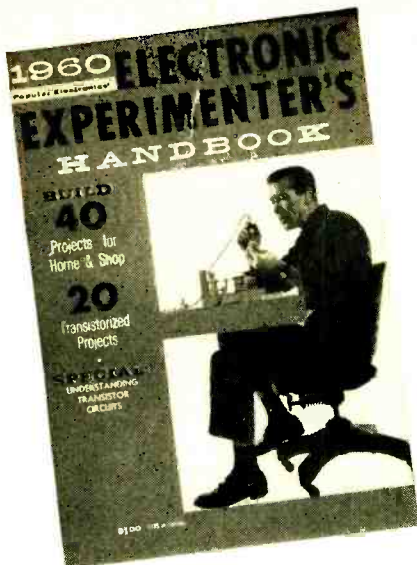
(Continued from page 65)

Magnolia Blvd., Burbank, Calif.) has introduced a line of especially designed heat dissipators.

These units are made in a variety of styles to match the most popular transistors and power diodes. They are available through regular parts distributors and, in quantity, direct from the manufacturer. A typical IERC heat dissipator, designed for use with transistors in the familiar JETEC TO-3 "diamond" package, is illustrated in outline form in Fig. 2.

Overseas News. Semiconductor devices are being used in larger and larger quantities in the design of foreign-made products. Here are a few spot items received from our overseas sources.

• Nippon Audio Kogyo Co., Ltd., Tokyo, Japan, is manufacturing transistorized tele-



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Canada—*R. Canada* now broadcasts as follows: at 2200-2300 to Northern Canada on 11,720 and 9585 kc.; at 0645-0745 to Canadian Forces on 21,600 kc. (also from 0700 on 17,820 kc. and at 0745-0800 Sunday only), at 0730-0745 with "Alouette" program in Eng. and French (Saturdays only) on 21,600 kc., (and on 17,800 kc. at 0745-0800); at 1700-1800 to Northern Canada on an experimental basis on 15,320 kc. Reports go to CBC International Service, P. O. Box 6000, Montreal. Reports on the Northern Service xmsns should be sent to CBC Northern Service, Box 806, Ottawa. (WPE5GQ, WPE9ADP, WPE9BR, WPE9KM, VE7PE2R, EK)

Cape Verde Islands—CR4AA, Praia, 3955 kc., closes at 1700 with "A Portuguesa." CR4AO, Sao Vincente, has been found on 3950 kc. from 1745 with Portuguese vocals. Both of these stations were formerly listed on 3960 kc. You'll have to tune hard for them if you want to avoid ham radio QRM. (WPE3NF)

Czechoslovakia—Prague has been noted on a new frequency, 9665 kc., at 2128 s/on in native language, and at 2230 s/on in English. (WPE4BC, WPE9KM)

Ecuador—A new DX program, "Caribbean Call," is noted on 15,115 kc., on the last Friday of each month at 1830. Reports go to HCJB, *The Voice of the Andes*, Casilla 691, Quito, Ecuador. (WPE9ARA, WPE9ATB)

Egypt (United Arab Republic)—Cairo carries Eng. at 0900-0930 to India, Pakistan, and the Mid-East on 11,990 and 17,780 kc., Sundays only with "Yours For The Asking" at 0900-0930 on 11,990 kc., at 1630-1730 to Europe on 12,030 kc., and at 0900-0930 on 17,995 kc. with Eng. news and Eastern music. Another outlet is on 4790 kc., tuned at 1600-1730 but in Arabic only. (WPE2ABM, WPE2BQE, WPE4PG/1, WPE8MS, BB, VP)

Ethiopia—ETHA, Addis Ababa, continues to use 9608 kc. with Arabic and Eng. news. So-

Free Leaflets

Your Short-Wave Editor has available, at no charge, three new leaflets. One is a GMT time-conversion chart for all of the U.S. time zones. A second is a listing of clubs and SWL card printers. The third leaflet describes the various reporting codes (RST, SINPO, QSA-QRK, and others). Send your request to P.O. Box 254, Haddonfield, N. J.

mali has been noted at 1100-1130, Amharic at 1200-1220. (RH)


France—Paris is on a new frequency, 15,365 kc., at 2305 in Arabic. (WPE9KM)


French Equatorial Africa—*R. Tchad*, Fort Lamy, 4904.5 kc., is heard as early as 1528 in French with closing around 1600. (WPE3NF)

Germany—*R. DDR*, Berlin, 7300 kc. (formerly 7150 kc.) is noted at 1436 in German and at 1700 in English. A dual channel is 9730 kc. (WPE3NF)


The building of a second wing for the *Deutsche Welle* broadcasting station at Julich has now been completed, and seven tubular steel antenna masts approximately 100 meters

February, 1960





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Gilbert & Ellis Islands—A verification letter
for VSZ10, 6050 kc., Tarawa, gives the sched-
ule at 0230-0400 on Fridays with 500 watts.
(*WPE0AE*)

Guatemala—A veri letter from *R. Tikal*,
Ciudad Flores, Peten, gives the frequency as

SHORT-WAVE ABBREVIATIONS

Anmts—Announcements	N.A.—North America
B/C—Broadcasting	QRM—Station interference
CBC—Canadian B/C Corp.	R.—Radio
Eng.—English	s/off—Sign-off
ID—Identification	s/on—Sign-on
IS—Interval signal	xmsn—Transmission
kc.—Kilocycles	xmtr—Transmitter
kw.—Kilowatts	

6190 kc. although it is actually closer to 6250
kc. The station is requesting reports. Try for
it from 2105 to 2320/close. (*WPE0EH*)

Guinea—Conakry is back on 4910 kc. and
has been noted in French to 1630 s/off. It was
last heard on 7125 kc. (*WPE3NF*)

India—Delhi is tuned on 11,925 kc. with
English. Bombay has been noted on 9555 kc.
at 0800-0830 in Tamil. Guahati, 9575 kc., can
be heard at 0215-0329 with native music and
Hindi anmts. (*WPE5AG, WPE9DN, WPE0AE*)

Iraq—YIH62, Baghdad, 6030 kc., has Eng.
news at 1500. Arabic talks at 1530-1600, Arabic
news to 1606 s/off. (*WPE1BM*)

Japan—Tokyo is using 9525 kc. (JBD) to
N.A., dual to 11,705 kc., at 0000-0200. The 15-
325-kc. channel has been dropped. (*WPE6EZ*)

Kenya—Kenya B/C Service, P. O. B. 777,
Nairobi, has verified by card and included this
schedule: 4885 kc. in Eng. at 2230-0000, 0500-
0715, and 1000-1515 daily, and at 2330-0615 and
1000-1415 Sundays. (*WPE0AE*)

Liberia—ELWA, Monrovia, P. O. Box 192,
has a regular Tuesday program in Eng. at
1800-1945 on 15,200 and 21,515 kc., and at
2000-2145 on 11,986 and 21,515 kc. Another
outlet on 4770 kc. is noted at 1700-1715 with
a religious program. to 1748 with organ music,
all English. ELWA expects a new 50-kw.
xmtr to be on the air shortly. (*WPE1AMW,
WPE2BWY, WPE3PV, WPE6BL, WPE0LN,
WPE0TA, BG, HU, EK, VP*)

Luxembourg—*R. Luxembourg* is good at 0130
in Flemish on 6090 kc. Listen for the IS at
0027 on a piano. (*WPE8MS*)

Madagascar—Tananarive, 9515 kc., s/on at
2229 with African music and "La Marseillaise"
and a program in French. (*WPE0VU*)

Netherlands—Hilversum has changed some
programs and times. There is Eng. to N.A.
and Europe at 1615-1705 on 15,220, 11,730, and
6020 kc., with a new DX program on Mon-
days, Eng. to N.A. at 2030-2120 on 9590 and
6025 kc., and the "Happy Station Program"
on Sundays at 2100-2230 on 9590 and 6025 kc.
(*WPE1AW, WPE1LB, WPE2BDK, WPE2BNL,
WPE3PV, WPE4PG/1, WPE6EZ, WPE8HF,
JC, EK, RY*)

Netherlands New Guinea—Biak, 5040 kc., is

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Say You Saw It in POPULAR ELECTRONICS

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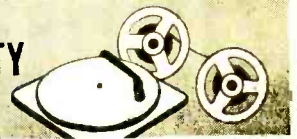
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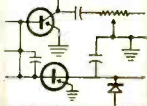
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MODEL 83

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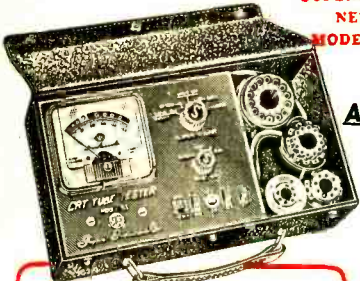
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From 50 degree to 110 degree types
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Test ALL picture tubes—in the carton—
out of the carton—in the set!

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

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



Model 83—C.R.T. Tube Tester
Total Price **\$38.50**
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if satisfactory. Otherwise return,
no explanation necessary.

● 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

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In the laboratory where determinations of intensity (counts) of a reading are necessary, the WF-10AWB provides sensitivity far surpassing many laboratory counters.

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- Three counting ranges: 0-100/1,000/10,000 counts per minute.
- Handy reset button.
- Ideal for survey work as the complete unit weighs only 5½ lbs.
- Sight and sound indications by neon

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- Included at no extra charge—U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

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ADDED!**

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

MOSS ELECTRONIC, INC.

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PRINTED IN U.S.A.

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

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- 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.

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Model 82A comes housed in handsome, portable, Saddle-Stitched Texon case. Only.... **\$36.50^{Net}**



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Superior's **STANDARD PROFESSIONAL**
 New Model **TUBE TESTER**
 TW-11

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.

- Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

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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.

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CHARGES ADDED!

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Model 80 ALLMETER
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NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

SUPERIOR'S NEW MODEL 79 **SUPER-METER** WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER
Plus CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS
Also Tests SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic pro-

duction. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily requires an extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

• D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500
• A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000
• D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
• RESISTANCE: 0 to 1,000/100,000 Ohms, 0 to 10 Megohms.
• CAPACITY: .001 to 1 Mfd., 1 to 50 Mid.
• REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
• INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
• DECIBELS: -6 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test po-

tentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All Electrolytic Condensers from 1 MFD to 1000 MFD. All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only **\$38.50**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

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.
- 7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per 0 to 15/75/150/300/750/1500/7500 Volts.)
- 6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per 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**

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