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RADIO & TV NEWS

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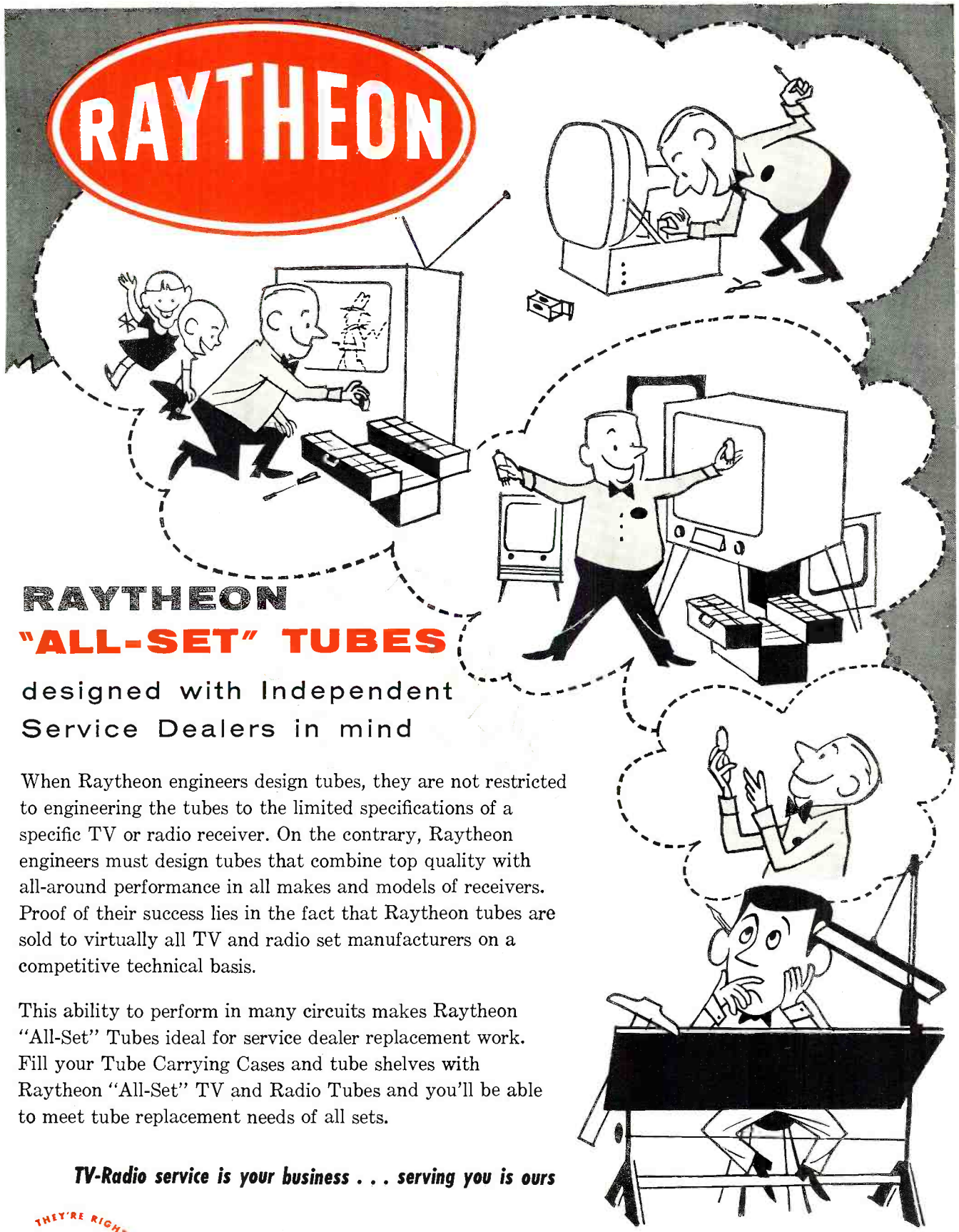
SPEAKER DAMPING WITH SERIES RESISTOR

NEGATIVE FEEDBACK TRANSISTOR AMPLIFIERS

1957 AUTO RADIOS: DODGE-CHRYSLER CORP.

ELECTRONICS AT REDSTONE ARSENAL
(See Page 59)

RAYTHEON



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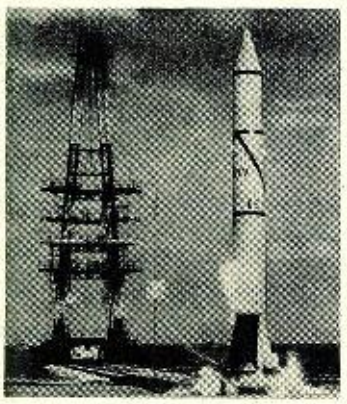

COVER PHOTO: The "Redstone," medium range ballistic missile, being fired at the A. F. Missile Test Center, Patrick AFB, Fla. The 69-foot weapon, shown in its vertical firing position, then tilts into a ballistic trajectory. (Ektachrome by U. S. Army Ordnance)

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MAY, 1957

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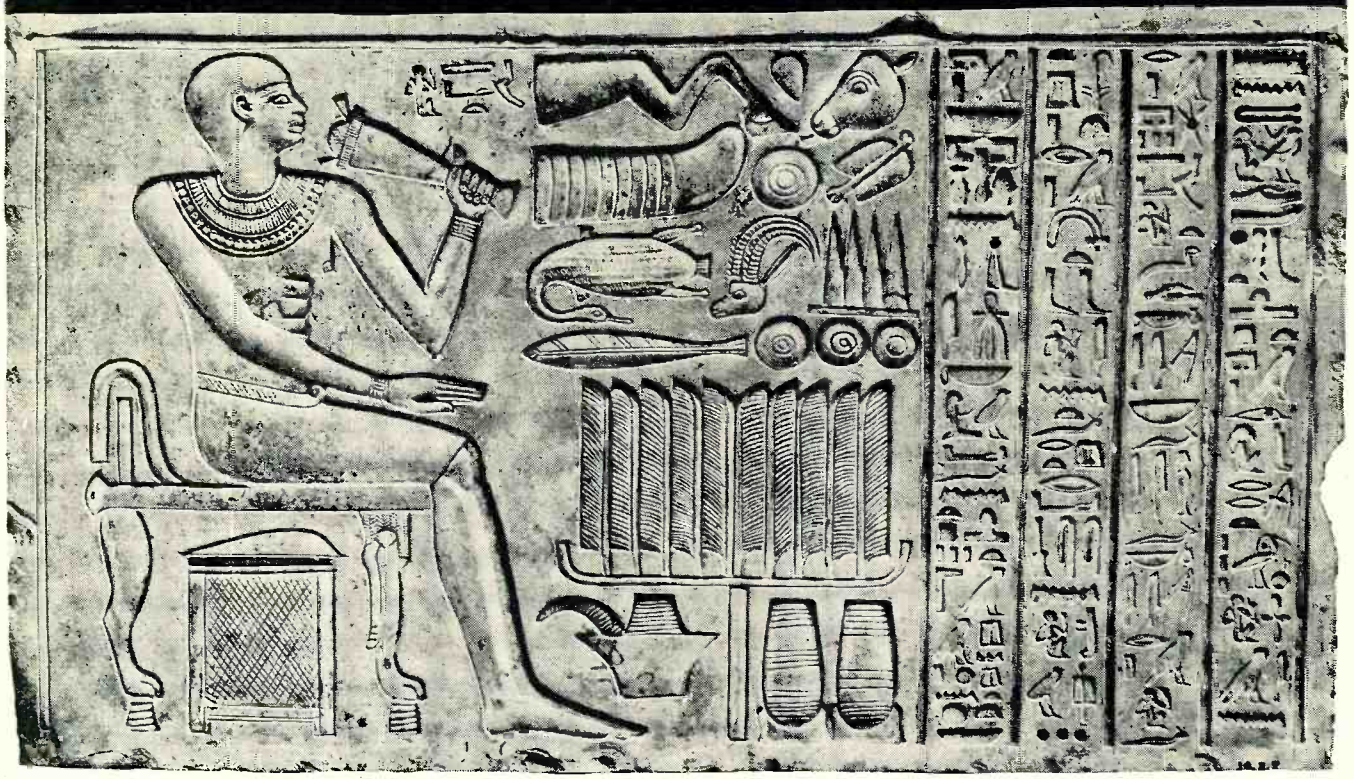

Photos courtesy of the Metropolitan Museum of Art

*hearken

ye

it is
indeed
that

the voice of

Unibrsity

(symbol for
loudspeaker)

(is) good

more than
anything

The pyramid builders had no high fidelity loudspeakers, but their ancient language had the "words" for this ultra-modern development . . . as demonstrated by this translation into hieroglyphics of University Loudspeakers' slogan.

It's a slogan University proudly introduced to the high fidelity field because it summarizes our aim: *to provide you with truly better listening.*

Words can try to describe this superior sound . . . but the rich tonal pleasure offered by these loudspeakers is experienced only when you *hear* them.

So whether in hieroglyphics . . . or in Chinese, Arabic, Greek, Sanskrit or Hindustani used in other University advertisements . . . this slogan conveys our sincere invitation to visit your dealer and . . .

LISTEN *University sounds better*®

HIGH FIDELITY

Translation into Early New Kingdom monumental type hieroglyphics by Cyril Aldred, associate curator of the Department of Egyptian Arts, the Metropolitan Museum of Art, N.Y.C.

"Listen, University Sounds Better" posed novel difficulties to Egyptologists when translated to hieroglyphics. For example, the simple English request, *listen,* became *hearken ye, it is indeed that.* There was no Egyptian verb for *to sound,* so *the voice of* was substituted. And since the Ancient Egyptians used no comparative forms of adjectives or adverbs, they had no word for *better;* instead, the labored construction *good, more than anything* was substituted.

For *University* the "easy" symbol of *school for scribes* could not be used, since the name refers here to a manufacturer. *A brand new "high fidelity" hieroglyphic was developed* by "vocalizing"—phonetically spelling out—University as *unibrsity* (there was no "v" in Ancient Egyptian). Then, just as the Egyptians did when inventing a hieroglyphic for an object, a picture of the loudspeaker was added . . . thus bringing a 4,000-year-old form of picture writing up to date on 20th century high fidelity sound!

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For the RECORD

SHOW TIME

THIS year's National Convention of the Institute of Radio Engineers was one of superlatives—from the attendance to the products on display—from the building which housed this vast conclave to the amount of electricity consumed in operating the equipment on exhibit.

The four-day meet was held March 18 through 21 at New York City's pride and joy, the Coliseum, and the Waldorf Astoria Hotel. This vast "convention city" housed some 17,000 different pieces of apparatus in two and a half miles of booths. Engineers, approximately 50,000 of them, flocked to the city from all over the United States and 35 foreign countries to look at the newest things in electronics and attend the 55 technical sessions at which some 280 papers were presented. Almost every field and phase of the modern world of electronics were represented but we noted a definite trend to emphasis on military electronic gear and the application of digital and analogue computers.

Many of the exhibits displayed actual missiles, others showed life-size mock-ups of the target-seeking devices, communications gear carried by our long-range aircraft and by helicopter as a "package" to be delivered to advanced positions, and improved radar and air traffic control equipment for maximum utilization of air space.

In all there were 800 exhibits, valued at 10 million dollars, occupying all four floors of what is said to be the world's largest exhibition and trade show structure. Those who have not yet had a chance to visit the Coliseum have a treat in store for them since the building was designed expressly as a show case and every facility for the visitor and exhibitor alike has been provided. We found it easier than in previous years to get around the show because the physical layout of the building is excellent, elevator service fast and frequent, paging system effective, and the aisles wide and congestion minimized. High level lighting on the exhibition floors makes it easy for the visitor to see every product displayed to the best advantage whether or not supplementary lighting is provided by the exhibitor.

The many different professional groups of the IRE held symposia during the convention with special interest centering on the applications of electronic equipment to medical research and diagnosis. The use of computers in medicine offers a challenge to engineers which would be hard to resist. Another field in which electronics is making giant strides, but which is still in its "teens," is aircraft operation and control.

"Solid-state physics," as exemplified by transistors, photo detectors, piezoelectric materials, magnetic materials, leak detectors, germanium rectifiers, controlled rectifiers using several rectifying junctions, electroluminescence —all came in for a lot of avid attention at the show. While the feeling was definitely that the vacuum tube is far from obsolete and that there will always be certain jobs that the tube can do better than its semiconductor counterpart, the transistor is here to stay and offers a vast field for investigation into new applications and improved parameters.

All-in-all it was an impressive affair, representing as it did the world's largest gathering of scientific brainpower and equipment. Truly an engineer's paradise.

A SECOND important segment of our industry is readying itself for its annual Electronic Parts Distributors Show which will be held May 20 through 23 at Chicago's Conrad Hilton Hotel.

Sponsored by the Radio-Electronics-Television Manufacturers Association; Sales Managers Club, Eastern Group; Association of Electronic Parts and Equipment Manufacturers; and West Coast Electronic Manufacturers Association, this year's meet will find a large segment of the audio industry represented for the first time. So important has this group become that a special "Sound Demonstration" area has been set aside for their exhibits on the fifth and sixth floors of the hotel. Sound, high-fidelity, and audio equipment of all types will be shown and demonstrated in these display rooms.

The other segment of the industry, manufacturers of parts and equipment, has been assigned a special area to show its line to the thousands of distributors in attendance.

As has been the case in previous years, the Parts Show will be "closed" to the public, so that manufacturers and their distributors can devote full time to products and problems affecting the industry. Those eligible to attend this affair have undoubtedly been contacted and have their badges by now, but for others who want details, the program for the Show is given on page 132 of this issue.

Two great shows for a great and growing industry! . . . . . O. R.

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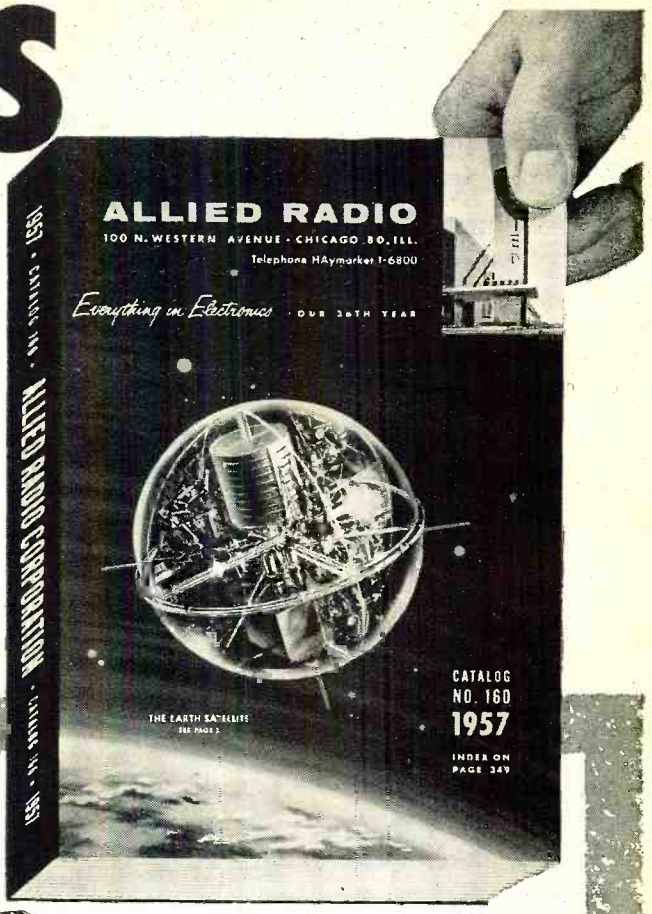

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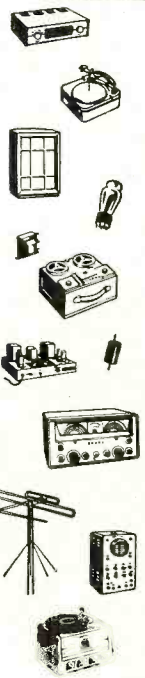

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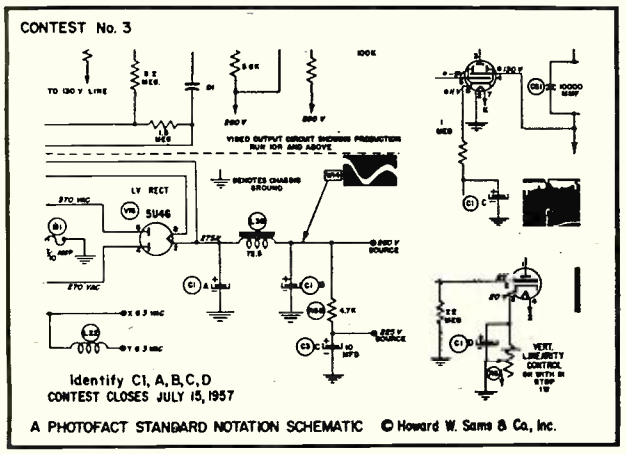
So act quickly...send in your entries early each month...you can't lose.



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HELPFUL HINTS

The unidentified capacitor in each entry will be a Pyramid Twist-Mount. All schematics are of TV sets made in the U. S. by a known manufacturer within the past 2 years.

Schematics for reference may be those published by the TV set manufacturers, Howard Sam's Photofacts, or by any other accepted publisher. You may enter as often as you like but be sure to include a box top (showing stock number) of any Pyramid Twist-Mount Capacitor, with your letterhead or business card with each entry.

WHO MAY ENTER

Any Radio-TV serviceman or employee of a Radio-TV service company may enter. Officers, employees, (members of their families) of Pyramid Electric Co. or its advertising agency are not eligible to enter the contest. All entries are limited to residents of the continental U. S. over 21 years of age.

All entries become the property of Pyramid Electric Co., none will be returned and the decisions of the judges are final. In case of ties, duplicate prizes will be awarded. This contest is subject to all federal, state and local laws and regulations.

MAIL THIS ENTRY BLANK NOW!

Pyramid Twist-Mount Contest, Dept J
Pyramid Electric Co.
P.O. Box 655, Tyler Park Station, North Bergen, New Jersey

Entry No. (1) (2) (3) (4)—(check one)—is: Pyramid stock No. _____

Twist-Mount values _____

Set manufacturer's name _____ TV set model No. _____
I enclose a box top (indicating stock number) of any Pyramid Twist-Mount Capacitor together with my business card or letterhead or my employer's.

Contestant's name _____ Position _____

Contestant's address _____

City _____ Zone ____ State _____

Employer's Firm name _____

Employer's address _____

City _____ Zone ____ State _____

My jobber's name and address _____

ENTER AS OFTEN AS YOU LIKE—FOR ADDITIONAL ENTRY BLANKS SEE YOUR JOBBER.

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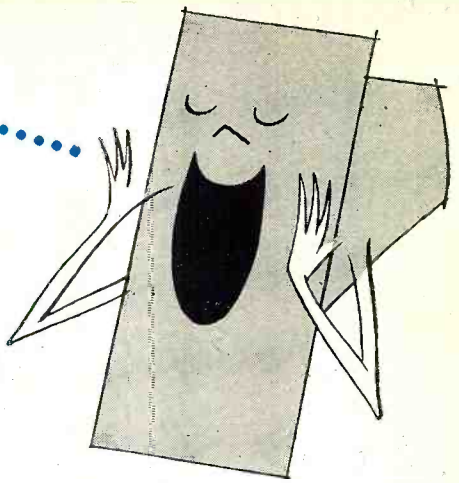
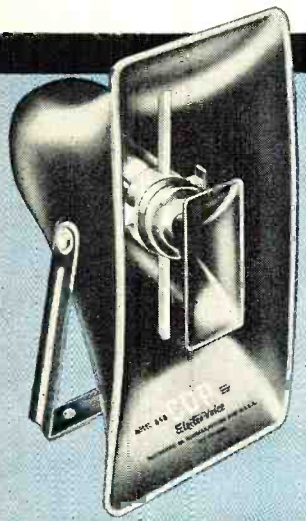
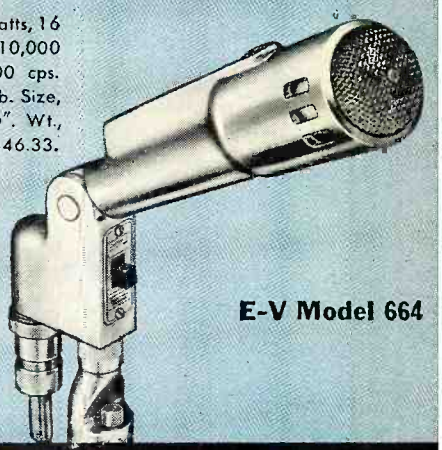




Model 848 CDP for the biggest jobs. 25 watts, 16 ohms. Response: 175-10,000 cps, crossover at 1000 cps. Sensitivity rating, 52 db. Size, 10½" x 20½" x 20". Wt., 12 lbs. List.....$75.

Model 847 CDP, 12 watts, 16 ohms. Response, 250-10,000 cps, crossover at 1500 cps. Sensitivity rating, 51 db. Size, 11¾" x 7¾" x 10$\frac{7}{32}$". Wt., 6½ lbs. List.....$46.33.



E-V Model 664

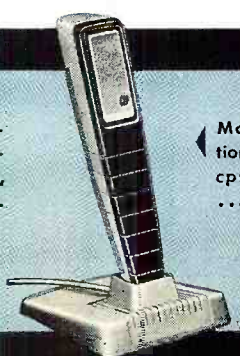
CDP Speakers—Compound Diffraction Projectors— are overwhelmingly superior to conventional P. A. horns because: CDP gives you two coaxially-mounted horns operating from a single diaphragm—a large one for lows, a small one for highs; 2½ additional octaves of sound reproduction, essential for highest intelligibility; sound dispersion through a solid 120° angle for the widest cover age obtainable.

E-V Model 664 High-Fidelity Cardioid Dynamic—Outperforms any other P. A. Cardioid in the World

UNIQUE E-V "VARIABLE D"® gives you amazing versatility, highly directional sound selectivity, smooth, peak-free response at *all* frequencies from 40 to 15,000 cps, no boominess. GUARANTEED to outperform any other P. A cardioid or YOUR MONEY BACK! List price, $82.50.

Model 636 slim dynamic omnidirectional microphone. 60-15,000 cps response range. List.....$70.

Model 623 dynamic omnidirectional microphone. 60-12,000 cps response range. List, ...$55.



Model 927 crystal omnidirectional microphone. 60-8000 cps response range. List, ...$22.50.

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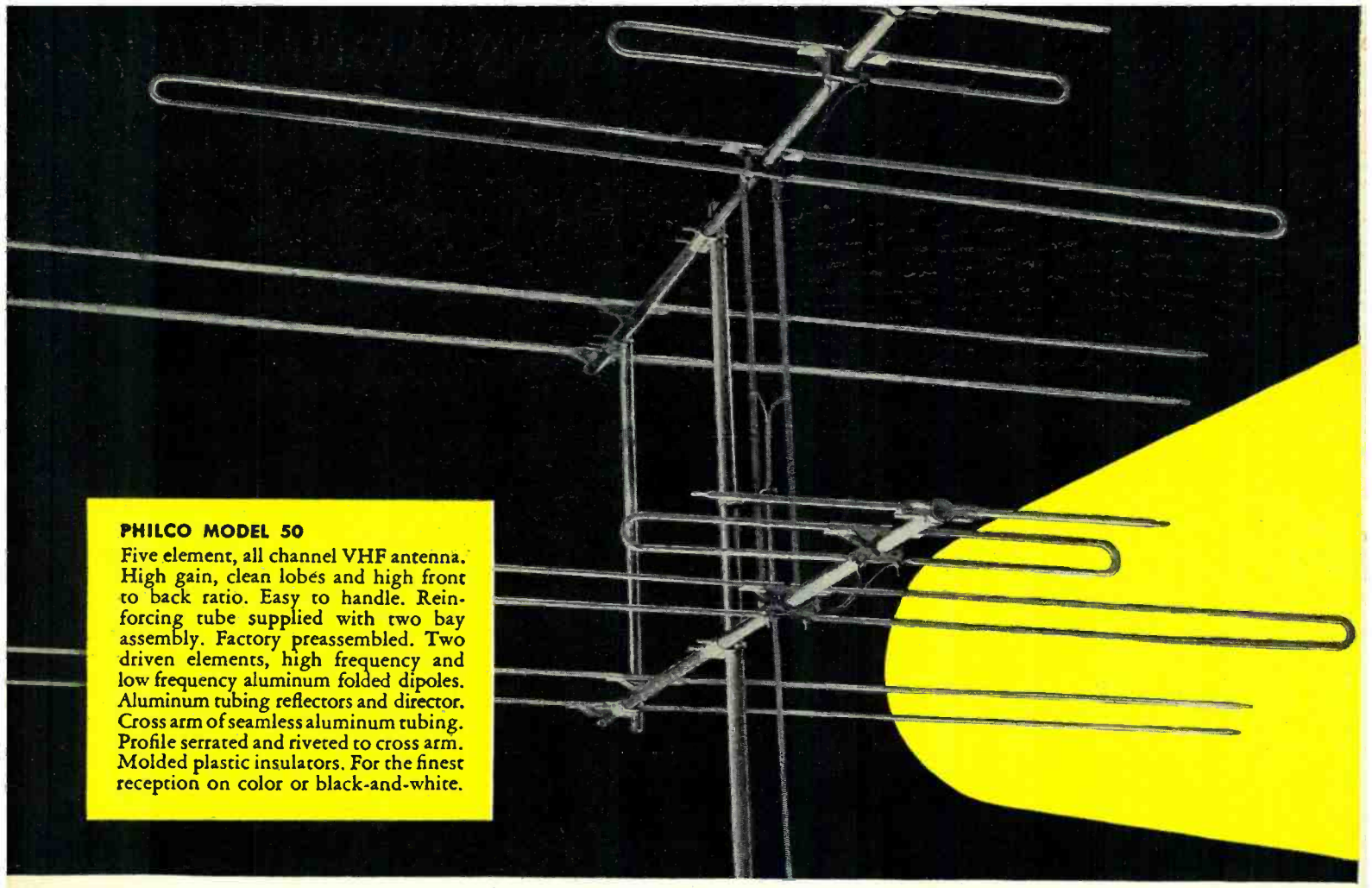
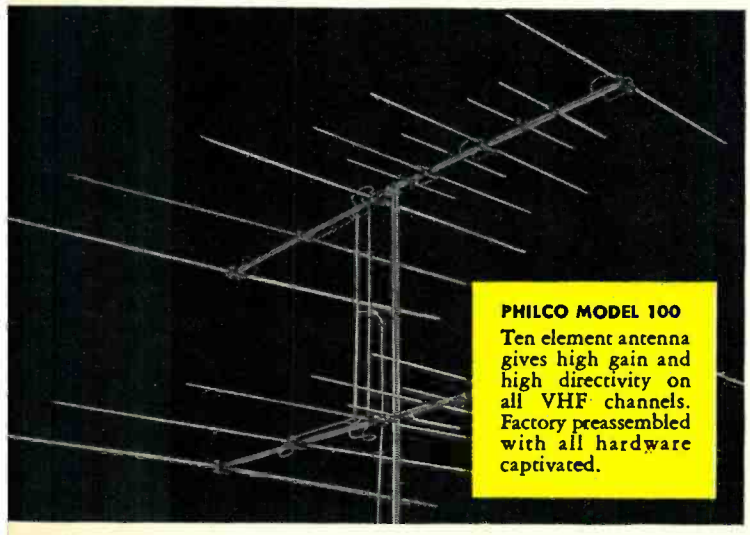
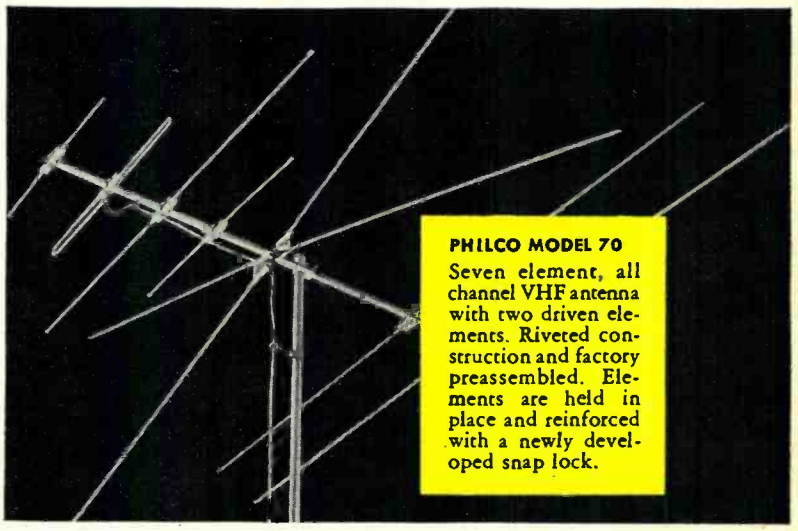


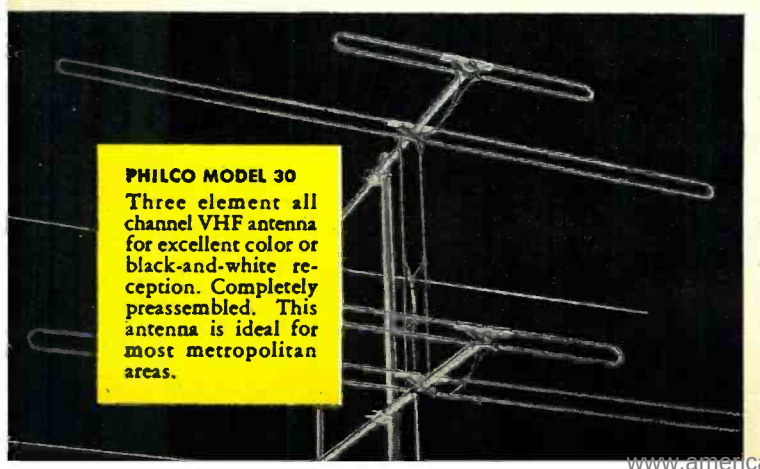
PHILCO MODEL 50
Five element, all channel VHF antenna. High gain, clean lobes and high front to back ratio. Easy to handle. Reinforcing tube supplied with two bay assembly. Factory preassembled. Two driven elements, high frequency and low frequency aluminum folded dipoles. Aluminum tubing reflectors and director. Cross arm of seamless aluminum tubing. Profile serrated and riveted to cross arm. Molded plastic insulators. For the finest reception on color or black-and-white.



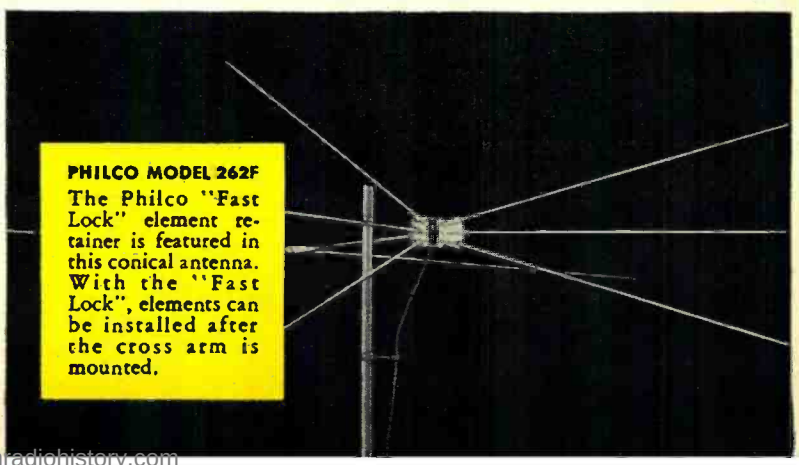
PHILCO MODEL 100
Ten element antenna gives high gain and high directivity on all VHF channels. Factory preassembled with all hardware captivated.



PHILCO MODEL 70
Seven element, all channel VHF antenna with two driven elements. Riveted construction and factory preassembled. Elements are held in place and reinforced with a newly developed snap lock.



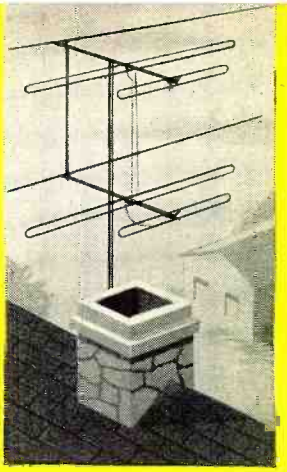
PHILCO MODEL 30
Three element all channel VHF antenna for excellent color or black-and-white reception. Completely preassembled. This antenna is ideal for most metropolitan areas.



PHILCO MODEL 262F
The Philco "Fast Lock" element retainer is featured in this conical antenna. With the "Fast Lock", elements can be installed after the cross arm is mounted.

Mr. Service Dealer

BIG NEWS from PHILCO!

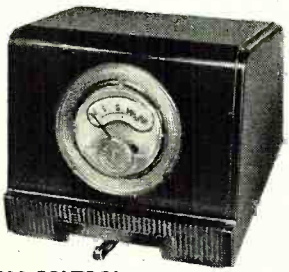


Fringe tested, color tested TV Antennas, now at volume prices!

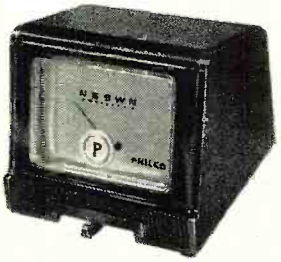
Give picture power equal to antennas priced two to three times higher. Compare! Now, Philco brings you a complete line of quality antennas with a wide range of models to give outstanding performance over the entire VHF range. These antennas were designed and engineered to reproduce the best pictures whether in strong signal areas or far out into the fringe and whether receiving a picture in color or black and white. In many locations you can give your customers stations they never received before. Field and laboratory comparison tests conducted under the most exacting circumstances on actual on-the-air programs give you the complete insurance that you can always sell Philco antennas with complete confidence in any TV area.

Philco Super Power TV Antenna ROTORS

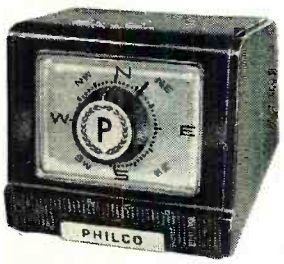
color or black-and-white at its best



P11 CONTROL
Manually operated antenna rotor that will easily handle two bays. Designed for years of dependable service. Fits masts up to 1⅜" diameter.



P4A CONTROL
A heavy duty rotor. Accurate direction control provided by manually operated motor switch and indicator meter. Plastic cabinet of modern design.



AP22 CONTROL
Heavy duty, long-life automatic rotor with new automatic control unit providing dependable and fool proof operation. Also available as AP1.

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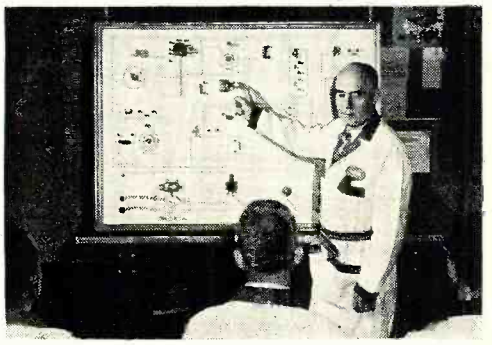

Jumbo-size operational panel of Guide's Autronic-Eye Circuit puts all parts out front for better, more efficient instruction.

Quick, accurate circuit diagnosis and repair to factory specifications boosts your profits. That's why so many qualified auto technicians attend these Guide training courses at no cost other than transportation and living expenses.

The Guide Lamp diploma, awarded only to those who successfully complete the course, is proof that you're equipped to give more and better service to more people—and that means business.

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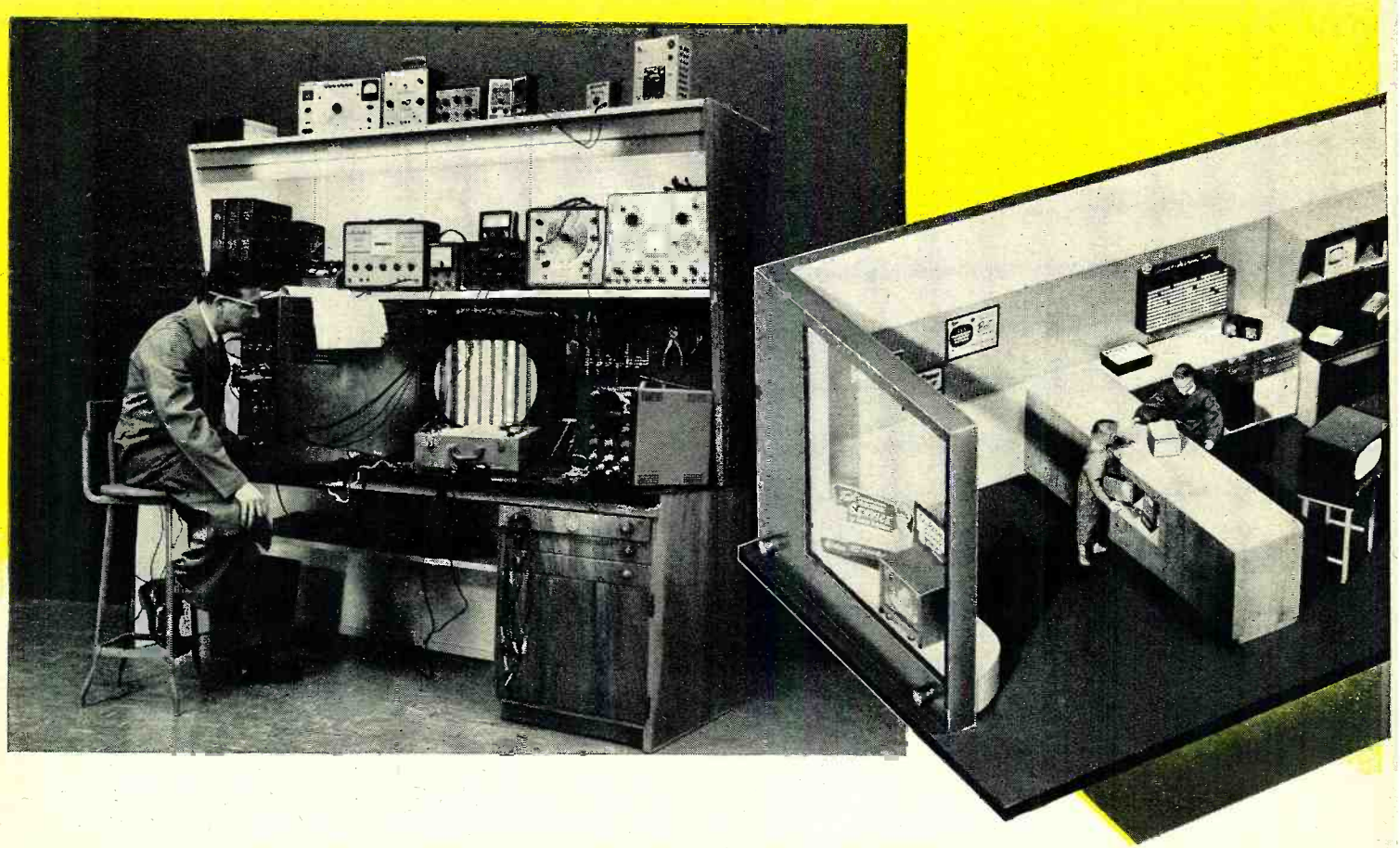


JOIN THE 50,000 PROGRESSIVE READY TO MODERNIZE WITH NEW

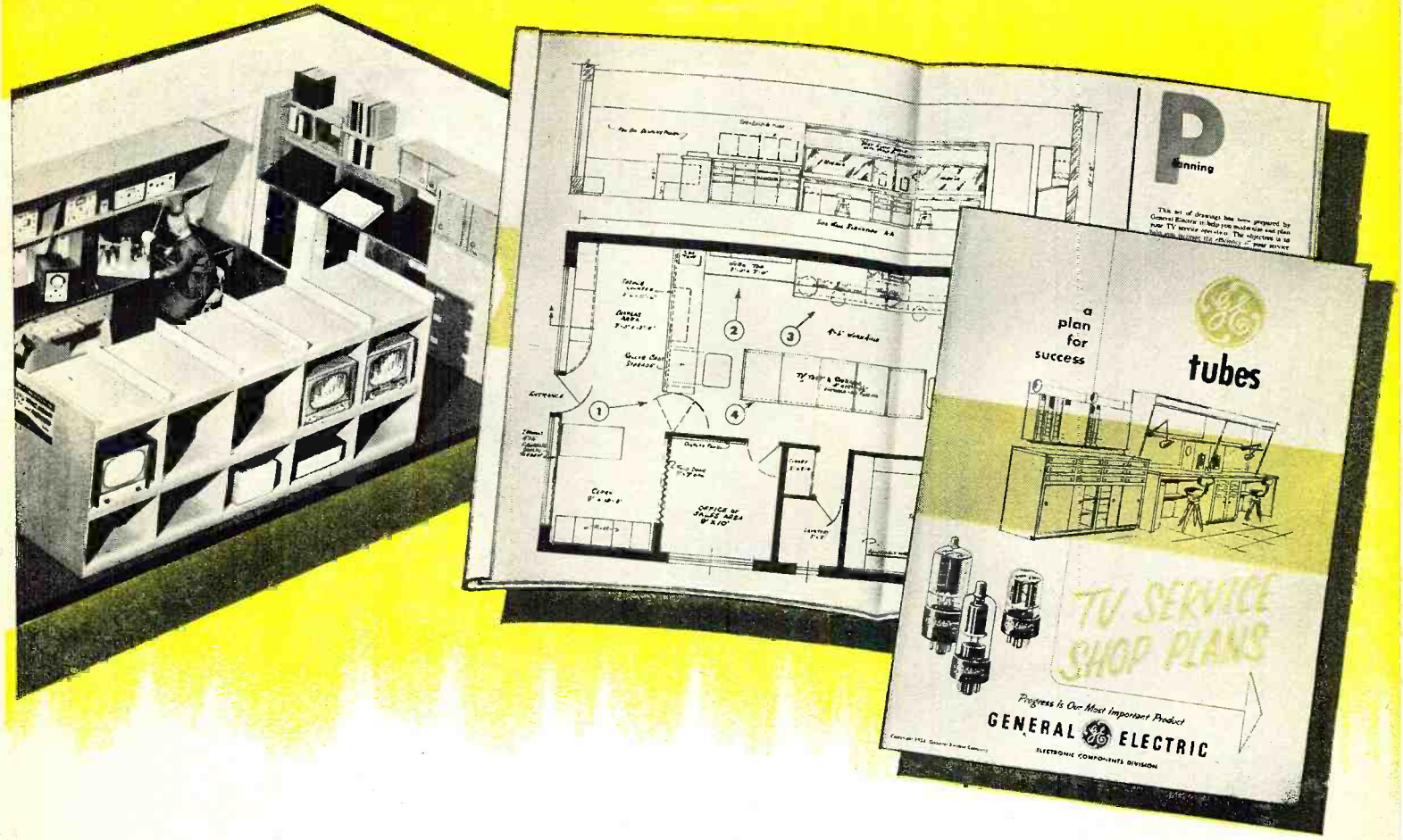
Over 50,000 TV-radio service dealers already have asked for the new General Electric shop plans (above) that were specially developed for the independent technician. Dealers in every part of the country know that today's growing market for service, calls for improved facilities... and that proper planning saves space, costs, time, and labor.

You too can modernize for the increased volume that lies ahead... by following the practice of other progressive technicians, and using General Electric's shop layout to equip your shop for top-efficiency service to more customers. Phone your local General Electric tube distributor for complete plans! They include dimension drawings and material lists, so a carpenter or builder can start work at once.

Progress Is Our Most Important Product

GENERAL ELECTRIC

161-1A20



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AND NOW

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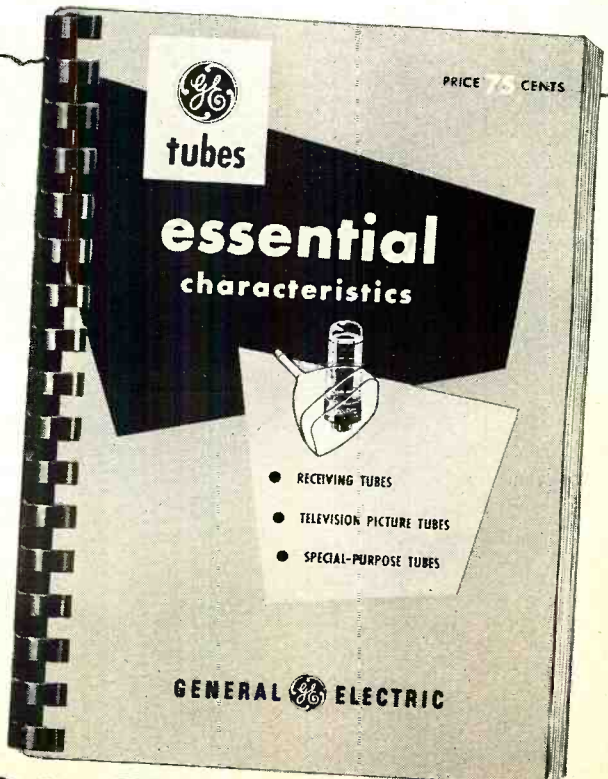
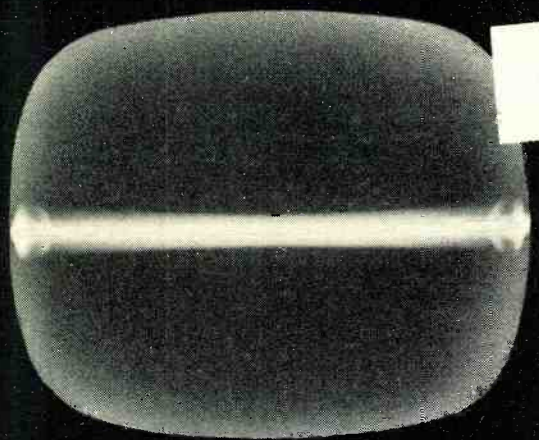
Most complete tube guide ever published—the new edition of "Essential Characteristics"! Over 1500 types, with descriptions, ratings, and basing diagrams. Pocket size. See your General Electric tube distributor immediately!

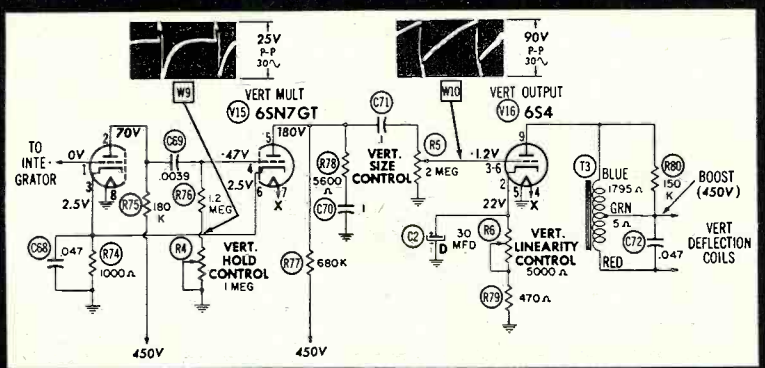


how long would it take you to solve this service problem?



(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

SYMPTOM:
Loss of Vertical Sweep



PHOTOFACT helps you lick problems like this in just minutes for only* 2½¢ per model!

Let's take a look at this problem: This trouble symptom is present when there is no driving signal to the vertical deflection coils and when the horizontal scanning is normal. Look for the following possible causes:

1. Defective multivibrator or output tubes
2. Open coupling capacitors C71 or C69
3. Open linearity control R6 or cathode resistor R79
4. Open size control R5
5. Open output transformer T3

With the applicable PHOTOFACT Folder at your fingertips, you trouble-shoot and solve this problem in just minutes. Here's how:

Using the Tube Placement chart (you'll find it in every PHOTOFACT TV Folder) you can quickly locate and check the multivibrator and output tubes.

Tubes okay?—then: Check waveform at grid of vertical output tube (W10). Wave shapes and peak-to-peak values appear right on the PHOTOFACT Standard Notation schematic. Waveform correct?—then: Check for open R6, or R79 or for faulty components in the output plate circuit. The DC resistance of the vertical output transformer and the lead colors are also shown right on the schematic.

Waveform incorrect?—then: Check voltages at the pins of the multivibrator tube. They're right on the exclusive Standard Notation schematic.

Whatever the trouble, you'll locate it faster and easier with a PHOTOFACT Folder by your side. Be sure to use the complete Replacement Parts List to select the proper replacement for the repair.

Use the servicing method you prefer—checking of waveform, voltage or resistance—you'll find all the information you need at your finger-tips in PHOTOFACT. For only *2½¢ per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

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Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

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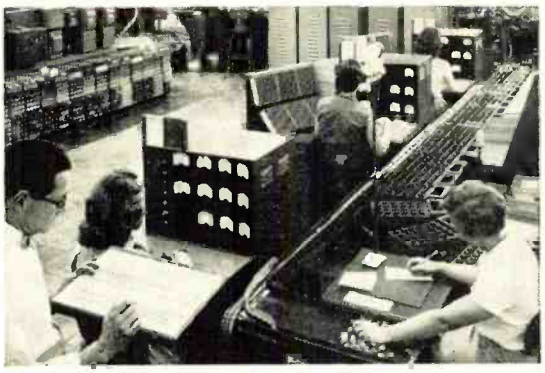

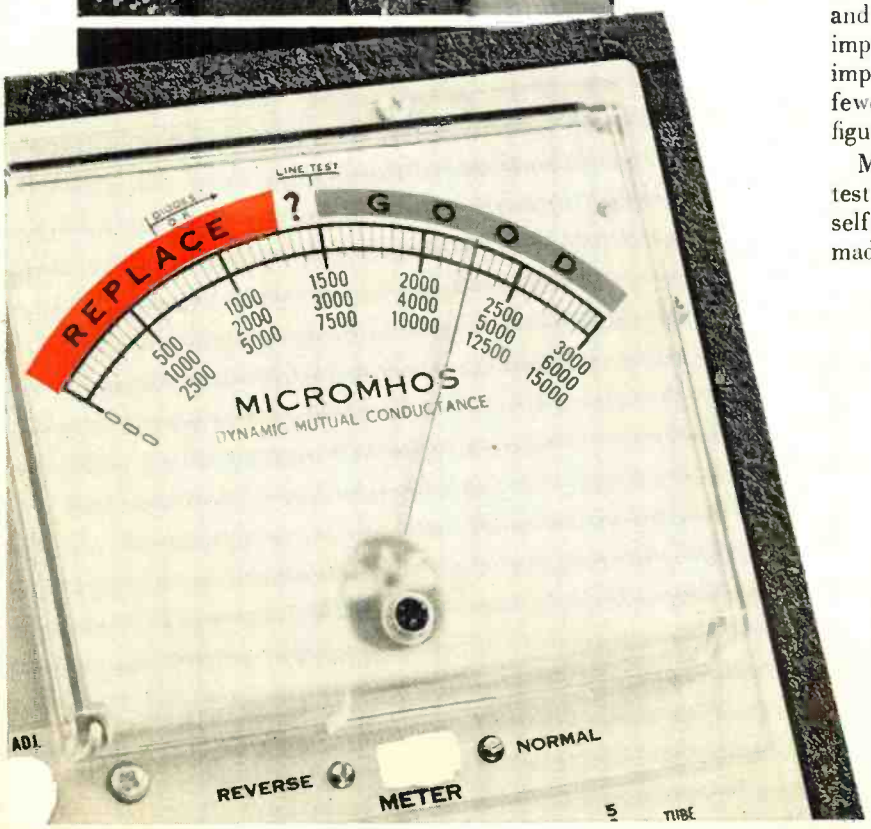

Here's why we added dealer meter testing

For years, you service-dealers have been checking your tubes in dealer meters. This was in addition to many exhaustive tests — materials control, production, quality, design, and life — that we tube manufacturers have been running ourselves. And you found it good insurance, or you wouldn't have continued to do this extra work.

As another step in our program to serve you independent service-dealers, and to correlate our tests with yours, we decided to do this job for you. Instead of making our last check a simple conventional short test, we put CBS tubes through the latest type of dealer meter.

If you are one of the thousands of dealers who have been buying CBS tubes, you know the result. You have been getting, in addition to a high average quality, practically no inoperables.

And you have discovered that double-checking CBS tubes confirms it. When you do test them in front of your customer, the tubes and you always look "good" to him. And the impression lasts because the tubes last. Most important of all, you have been experiencing fewer call-backs . . . and, if you took time to figure it out, more profit.

Make us prove our point. Try CBS tubes . . . test them, put them to work, find out for yourself: It is a fact that there are no better tubes made than CBS tubes.

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Spot Radio News

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By RADIO & TV NEWS
WASHINGTON EDITOR

THE EXPLOSIVE DE-INTERMIXTURE move to create *all-u.h.f.* and *all-v.h.f.* zones, a blueprint idea for over two years, became a reality a few weeks ago, when the Commission issued a proposal to shuffle channels in six cities that would become all-*u* areas.

Prominently among those asked to move up was WRGB in Schenectady, a channel-6 station since 1939; their new home may be channel 47. On the Pacific coast, KFRE-TV in Fresno, California, was told it would have change from its channel-12 allocation to 30. In Illinois, channel 8 was deleted from Peoria and moved to the Davenport—Rock Island—Moline area, adding a third v.h.f. channel there, with Peoria receiving two *u* channels; 25 and 31. Up in Elmira, New York, the FCC said that it wanted channel 30 in place of channel 9, which was to be shelved. Springfield, Illinois, was also booked for an all-*u* deal, two channels (26 and 36) being assigned to that city. The low-band channel (2) from Springfield was dispatched to St. Louis, which added a fourth *v* channel there and made that city all-*v*.

Four Commissioners disagreed with the proposal and said so loudly in long dissents. Commissioner John C. Doerfer said that he felt the switch would not create any incentive for manufacturers to build all-channel sets, or even offer any contribution to the promotion of increased use of the high bands. In his opinion, the change will deprive thousands in fringe areas of real TV service, since the low bands have twice the coverage.

"The spectrum belongs to the people," added the Commissioner, "not the broadcasters . . . Nevertheless, the prior claims of those entitled to a first service and an equitable distribution of unequal facilities are now to be subrogated for the competitive well-being of a few broadcasters."

According to Commissioner Richard A. Mack, the creation of new islands of u.h.f. will be of no help. And Commissioners Rosel H. Hyde and Robert T. Bartley noted that the actions were in conflict with moves in other areas where single v.h.f. channels were deleted.

Broadcasters affected will have an opportunity to voice their views during hearings in the early Spring months. The consensus at present is that most of the telecasters involved will make appeals to void changes.

TOLL-TV, another victim of a long chain of legal and technical battles in Washington, was being pelted again, as this column was being prepared; this time the Senate Interstate and Foreign Commerce Committee's TV

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Florida	Miami	WPST-TV	10	192-198	316
Indiana	Hatfield	.....	9	186-192	221
Illinois	La Salle	.....	35	596-602	14.3
"	Pekin	.....	69	800-806	19.9
Montana	Helena	.....	10	192-198	.402
Mississippi	Laurel	.....	7	174-180	99.77

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Alabama	Florence	WOWL-TV	41	632-638
"	Birmingham	WMBG	42	638-644
South Dakota	Reliance	KPLO-TV	6	82-88
Wyoming	Casper	KSPR-TV	6	82-88

* ERP = (effective radiated power, kw.)

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Name and Address	License	Time
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Prentice Harrison, Lewes, Delaware	1st	27 weeks
Gerald J. Collier, Columbus, Ohio	2nd	16 weeks
W. E. Evey, Ottawa, Kansas	2nd	24 weeks
Raymond L. Gersig, Pittsburgh, Pa	2nd	24 weeks

(Names and addresses of trainees in your area sent on request)

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In a year and a half, he received his first class FCC License. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience.

Bob Thompson
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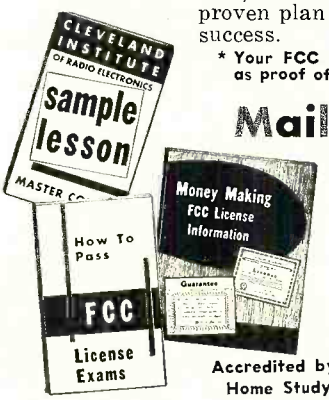

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- ☐ Amateur Radio
- ☐ Broadcasting
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investigating staff were manning the guns.

In a staff draft, the Commission was bluntly called on to act at the earliest possible moment on its rulemaking proposal, that is now over a year and a half old. The legal experts of the committee said that it felt that the FCC certainly is in position now to decide on the technical merits of the proposed systems and also whether legal authority to license or permit pay-TV operation exists within the Commission.

The Commission was also told by the committee that there was little substance to the argument that ... toll-TV ... "is so controversial, that even if the Commission has power to act, it should refrain from doing so until directed by the Congress." Such a delay, it was said, would be ... "a complete abdication of administrative responsibility."

Commenting on the possibility of large-scale tests, the Senate committee specialists said that they felt that this was the ... "only way in which certain information essential to the ultimate decision can ever be obtained." By permitting such a test, subject to careful safeguards, the Senate group added, the Commission ... "could ascertain the public's reaction to subscription television, the impact of the system on present-day sponsored television, the types of program which would be presented to subscription viewers, the assistance, if any, which might be given to u.h.f. and small-town broadcasting."

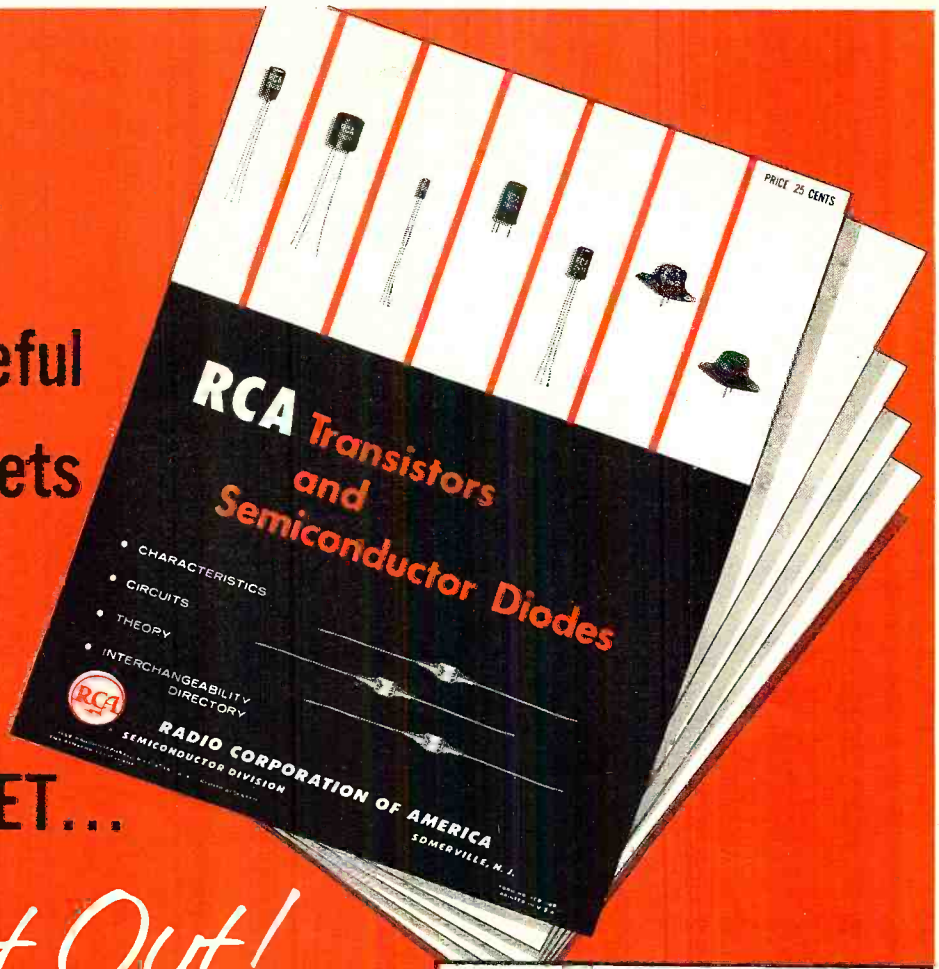
Noting that if the Commission felt it could not make a firm decision now, the committee report said ... "we would expect the Commission to be very reluctant completely to deny to subscription entrepeneurs the opportunity to offer their service to the public, merely because certain interests which might be affected economically by subscription operations 'predict' that such operations will destroy free television.

Shelving of toll-TV would be justified, the Senate staff report added, only if the pay idea resulted in ... "dire consequences foretold by its opponents", and if these conditions could not be resolved by FCC supervision and formal regulation. If toll-TV cannot provide a new and supplemental form of programming, without materially damaging the existing sponsored setup, then and then only, said the report, would pay-TV be ... "doomed to extinction."

AN ELECTRONIC PUNCHED-CARD transcriber, that makes possible more rapid feeding of data into an automatic computer, has been developed by the Bureau of Standards.

The device has been designed to convert numbers and instructions recorded on punched cards into a binary serial code. In this form information is suitable for direct rapid input into the computer or temporary storage as a magnetic re- (*Continued on page* 110)

Build 20 Useful Transistor Sets from this NEW RCA BOOKLET...



Just Out!

24 exciting pages of up-to-the-minute information are contained in this brand new booklet—*RCA Transistors and Semiconductor Diodes*—one of the newest members of the RCA family of authoritative publications.

Whether you are a student, service technician, experimenter, radio amateur, or design engineer—you're sure to profit from the wealth of knowledge in the sections on *Characteristics* and *Theory*. Of special interest, too, is the *Transistor Interchangeability Directory*, which lists more than 500 types produced by 27 different manufacturers. There is valuable experience to be gained in building your own transistor sets. And 20 of the latest tried-and-tested circuits with *all parts values*, including coil and transformer details, are given in this RCA booklet.

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- Telephone-Pickup Amp.
- 6-Transistor Receiver
- Three-Tube, Two-Transistor Receiver
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- Microphone Preamplifier
- RF and Mixer-Oscillator Stages for 3-Band Receiver

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Class A AF amplifier	2N77, 2N104, 2N105, 2N206, 2N215
Class A Low-noise AF amplifier	2N175, 2N220
Push-pull Class B AF amplifier	2N109, 2N217, 2N270
Class A 455-Kc IF amplifier	2N139, 2N218
Converter in 540-to-1640-Kc band	2N140, 2N219
Class A RF amplifier	2N247
Push-pull Class B Power amplifier	2N301, 2N301-A

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"Scotch" Brand's dry lubrication

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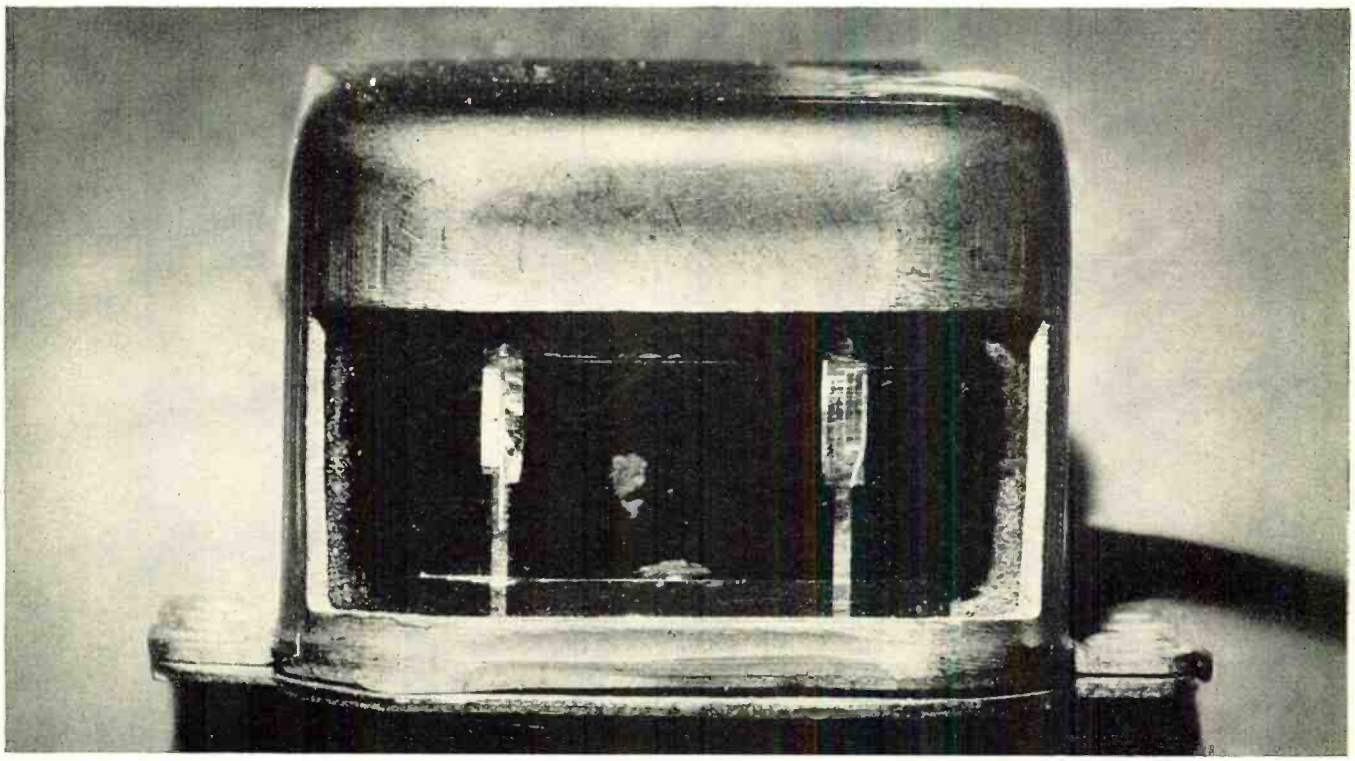

Enlargement of badly worn and pitted recorder head. Heads in this condition cause loss of high frequency response.

Know what's the most *vulnerable* part of your recorder? It's the sensitive magnetic head—the tiny, precision-made part where dirt or lack of proper lubrication can cause annoying wow, flutter and harmful friction.

It's relatively easy to keep your recorder head free of grime. But how do you keep it well lubricated?

"SCOTCH" Brand Magnetic Tapes do the job for you! *All of these fine tapes are "self-lubricating"*. Thanks to "SCOTCH" Brand's exclusive silicone lubrication process, these tapes glide smoothly over the magnetic head. No sticking . . . less friction . . . wow and flutter are cut noticeably, even in hot, humid climates!

"SCOTCH" Brand's dry lubrication stays put . . . lasts the life of the tape. And what a difference it makes in the sound of your recordings! You'll *hear* what we mean the next time you play a reel of silicone-lubricated "SCOTCH" Magnetic Tape.

Extra playing time *Extra strength* *Higher fidelity* *True economy*

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At first glance, Field Engineering may not seem to possess the potential and stature often associated with other engineering activities.

At *Hughes*, however, nothing could be further from the truth.

Men who undertake the responsible task of evaluating Hughes-produced military equipment in the field are in the enviable position of becoming thoroughly familiar with the complete design and operation of the advanced electronics systems involved.

Essentially, Field Engineering embraces all phases of support required to assure maximum field performance of Hughes armament control systems and guided missiles. E.E. and Physics graduates selected for this highly important and respected phase of our engineering activities work with the armed forces and airframe manufacturers at operational bases and plants in continental United States and overseas.

The knowledge, background and experience so gained assure unusual opportunities for more specialized development in other divisions of the Research and Development Laboratories at Hughes. In fact, few openings in engineering today offer the rewards and opportunities which are available to the Technical Liaison Engineers, Field Engineers, Technical Training School Engineers, Technical Manuals Engineers, and Field Modifications Engineers who comprise the Field Service and Support Division.

Engineers and physicists selected for this highly respected phase of our activities at Hughes enjoy a number of distinct advantages. These include generous moving and travel allowances between present location and Culver City, California. For three months before field assignments you will be training at full salary. During the entire time away on assignments from Culver City, you'll receive a generous per diem allowance, in addition to your moving and travel expenses. Also, there are company-paid group and health insurance, retirement plan, sick leave and paid vacations . . . and reimbursement for after-hours courses at UCLA, USC, and other local universities.

E.E. or Physics graduates who feel they are qualified to join the Field Engineering staff at Hughes are invited to write for additional information about this exciting and rewarding opportunity to establish a challenging career in electronics. Write to:

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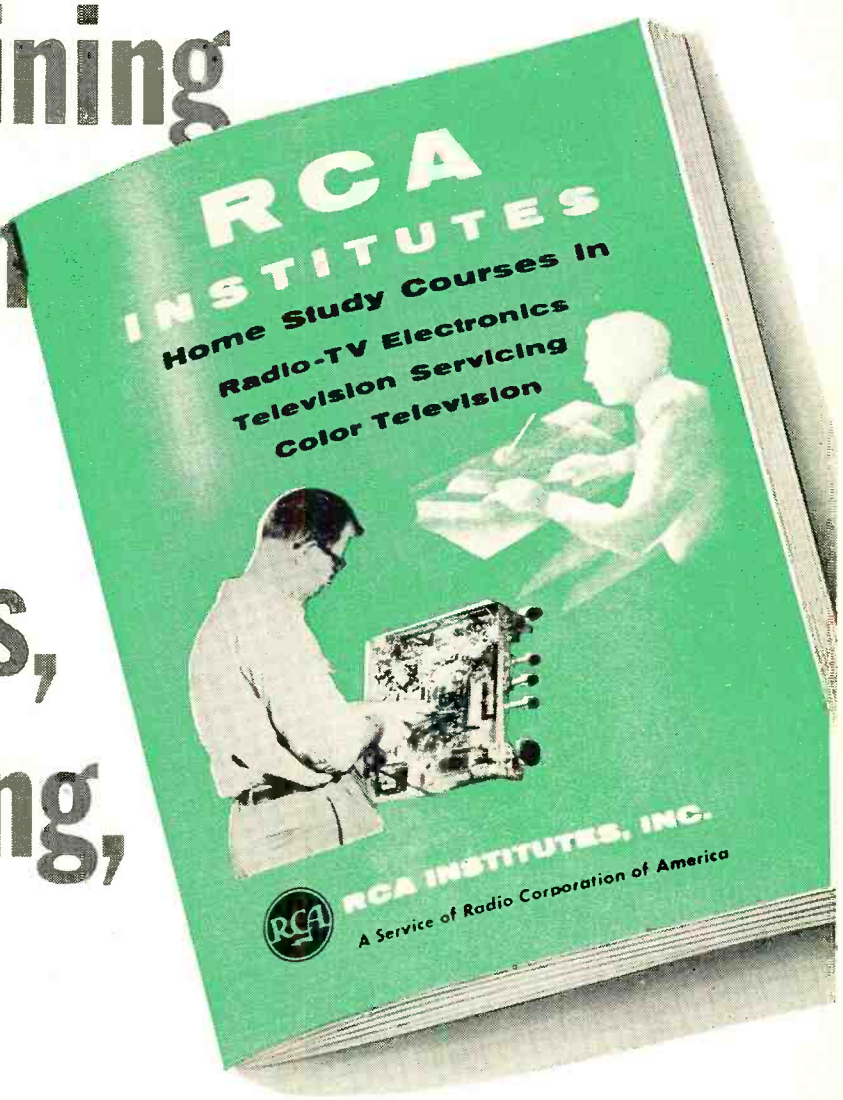

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Within the Industry

NORM EDINGER has assumed the responsibilities of marketing service manager for *Triplett Electrical Instrument Company*, Bluffton, Ohio.

Mr. Edinger is well qualified to fill this recently created position, having spent fifteen years in various phases of the company's instrument operations.

In announcing this appointment, it was pointed out that this promotion was another step in the firm's program of providing a more personalized liaison between the customers and factory operation.

* * *

RETMA's marketing data department has reported to organization members that the retail sales of radio receivers in 1956, excluding the sale of automobile sets, was the highest in the history of radio. More than 83,000,000 receivers were sold to consumers through retail outlets.

Although a decline was recorded in the number of television sets sold through retail outlets during the year, television sales in 1956 were reported to be one of the three best years in the history of television.

The number of television receivers manufactured during the year showed a decline as compared with 1955, however, more than seven million television sets were produced.

* * *

CECIL S. STOWE has been named sales promotion manager for *ORRadio Industries, Inc.*, manufacturer of "Irish" brand magnetic recording tape.

Mr. Stowe has been associated with the company since May, 1956. In his new capacity, he will be in charge of sales promotion and handle public relations.

His background includes fourteen years in the daily newspaper field and ten years in the retail merchandising field as a store manager.

A graduate of Alabama Polytechnic Institute, he served three years with the U. S. Marine Corps during World War II as a public relations officer.

* * *

THE ASSOCIATION OF ELECTRONIC PARTS AND EQUIPMENT MANUFACTURERS has been incorporated under Illinois laws as a not-for-profit trade association.

The purpose of the group, as restated in the new charter, is "to foster better understanding and business practices between manufacturers of electronic parts, equipment, and related items and the distributors through whom they sell their products and to engage in such industry activities as will promote better business relationships, more efficient operation, and better service for both supplier and customer in the electronics industry."

A basic change in the organization's structure is the creation of two classes of members; "General Members," including manufacturers of electronics parts, equipment, or related items sold to at least 25 independent parts distributors in 25 different cities, and "Term Members," who meet other qualifications but do not necessarily sell to the requisite number of distributors to qualify as general members. Term memberships are for a maximum period of two years, or until qualifying for general membership. Term members have no voting rights.

* * *

FRANK M. VILES, JR. has been appointed vice-president in charge of the manufacture of semiconductors of *Federal Telephone and Radio Company*, a division of *International Telephone and Telegraph Corporation*.

He joined the company in April, 1956, being appointed technical director of the components division. Prior to his association with this firm, he was administrative assistant to the general manager of *Litton Industries*. He is also a former general manager of *International Telemeter Corporation* and was associated with the *Philco Corporation*.

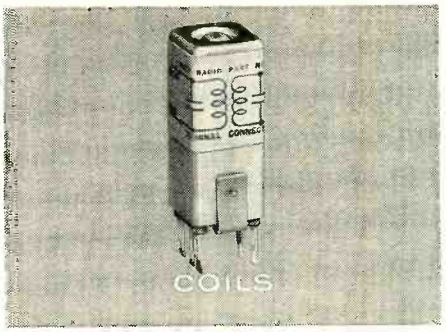
Mr. Viles is a member of the Institute of Radio Engineers, the Armed Forces Communications Association, and the American Institute of Management.

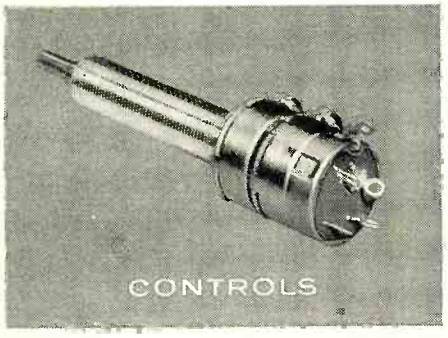
* * *

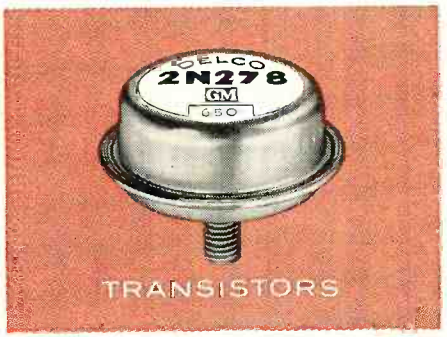
RETMA's general counsel, Glen McDaniel, stated that both tube and set manufacturers are now destroying worn out receiving tubes returned on warranties at the suggestion of the organization in a cooperative effort to dry up one of the sources for tube counterfeiting.

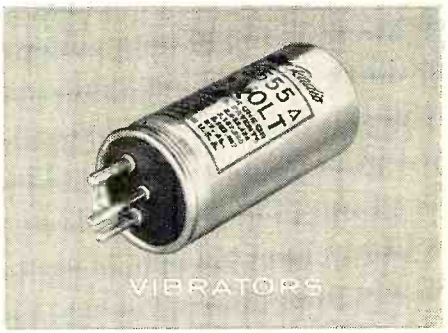
Upon the recommendation of its tube division, the association is also encouraging its members to cooperate with law enforcement agencies in tracking down tube counterfeiters and has established a special committee to alert all segments of the industry and the public to fraudulent tube practices.

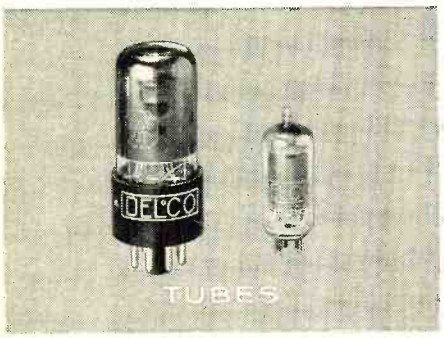
It was suggested to the public that











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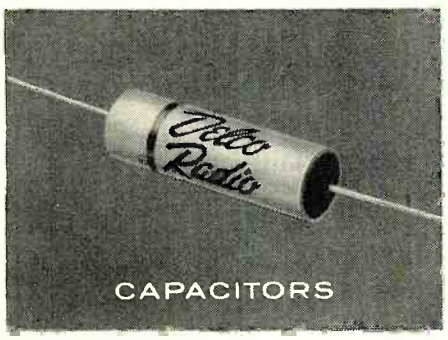

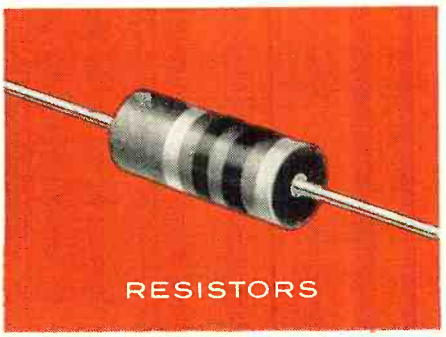

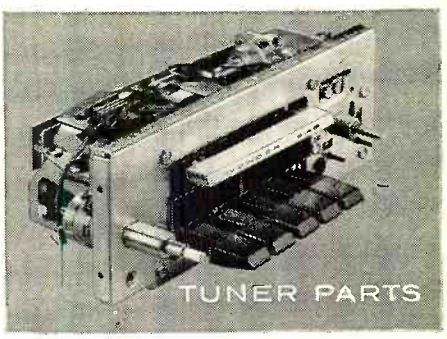

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they choose their radio and television service technicians with care, to make sure that they get the reliable ones, and avoid the small minority who are unscrupulous. They also should make it a point to ask the service technician to leave with the customer all out-of-warranty receiving tubes removed from the set when it is repaired.

Mr. McDaniel stressed the fact that the industry is seriously concerned over the frauds that have been committed over a period of years in the rebranding and redating of old and worn out receiving tubes and with the fraudulent sales that take place as a result of these practices.

* * *

JOHN E. LAU has been appointed to the newly created position of manager of sales promotion for the radio and television division of *Sylvania Electric Products Inc.*

In his new assignment, Mr. Lau, who has had extensive selling and promotional management experience in the radio and television field, will be responsible for the conception, planning, and execution of all promotional activities of the division, working in close coordination with the advertising department.

He joined the company after serving as merchandising manager for the distributor division of *Crosley Bendix Corporation* in Chicago.

* * *

MAGNETIC RESEARCH CORPORATION has announced the opening of its second facility, the engineering and special products division, Hawthorne, Calif. Headquarters for the company have moved to the new location, 3160 East El Segundo Boulevard . . . Construction is well under way on the new **ANNIN COMPANY** plant in the East Los Angeles, California area . . . Headquarters of the **NATIONAL ELECTRONIC DISTRIBUTORS ASSOCIATION** are now located in the Fisher Building, 343 South Dearborn, Chicago, Ill. . . . Construction has begun on a new 280,000 square foot plant for the semiconductor components division of **TEXAS INSTRUMENTS INC.** The new building will be located in Dallas . . . **STROMBERG-CARLSON**, a division of **GENERAL DYNAMICS CORP.**, announces the establishment of a developmental cathode-ray tube facility in San Diego, Calif. , . . **TELETRONICS LABORATORY, INC.** has acquired additional plant capacity at 300 Shames Drive, Westbury, Long Island . . . **GENERAL RADIO COMPANY** has begun construction on an 80,000 square foot addition to its Concord, Mass. branch manufacturing plant . . . **SPERRY RAND CORPORATION** has selected Clearwater, Florida as the site of its $2,000,000 electronics plant for research . . . The Scientific Instruments Division of **BECKMAN INSTRUMENTS, INC.** announced plans for a new research and development building which will add 100,000 square feet

(*Continued on page* 166)

Get this FREE Booklet Today!

Loaded with career-building facts—it can lead you to a bigger job, better pay, security and success in radio—TV—electronics

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ELECTRONICS' FUTURE CAN BE YOUR FUTURE

You can't keep up with the tremendous changes in the electronic industries. What's predicted for next year becomes outdated in a few months! All phases of the electronic industries are experiencing phenomenal growth. There are thousands of career openings, big ones. Industry can't find *enough* trained manpower to fill them—in manufacturing, testing, servicing, broadcasting and telecasting.

TAKE TV FOR EXAMPLE!

Four hundred and six stations are on the air! Many more are building or in the plans stage; 38,000,000 sets are in use. Color TV is just starting to really come alive! This same phenomenal growth picture is repeated in every phase of business employing electronics—crime prevention, aeronautics, firefighting, communications, to name but a few. CREI has the plan to keep you moving upward, to help you assume your rightful place!

CREI GRADS ARE IN DEMAND!

The big companies know CREI men have what it takes! CREI grads are at work in America's biggest corporations, in positions ranging from technicians to engineers to top management. Companies such as Canadian Broadcasting Corp., Douglas Aircraft Co., Glenn L. Martin Co., All-American Cables and Radio, Inc., Federal Electric Corp., U.S. Information Agency (Voice of America), and United Air Lines, are now paying for CREI training for their own technical staffs. Our placement bureau has more requests for CREI-trained men than we can presently supply.

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TAKE THAT FIRST BIG STEP! NO OBLIGATION

Fill out and mail the coupon. When you do, you'll be on the way to higher pay, a better job and complete career security. Act right away. Send for your *free* book today.

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CREI also offers resident instruction: at the same high technical level, day or night, in Washington, D. C. New classes start frequently during the year. If this type of instruction meets your requirements, check the coupon for Residence School catalog. Qualified residence graduates may earn the degree of Associate in Applied Science.

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THOUSANDS LIKE YOU HAVE SUCCEEDED WITH CREI'S PLAN! "CREI TRAINING IS BEST"

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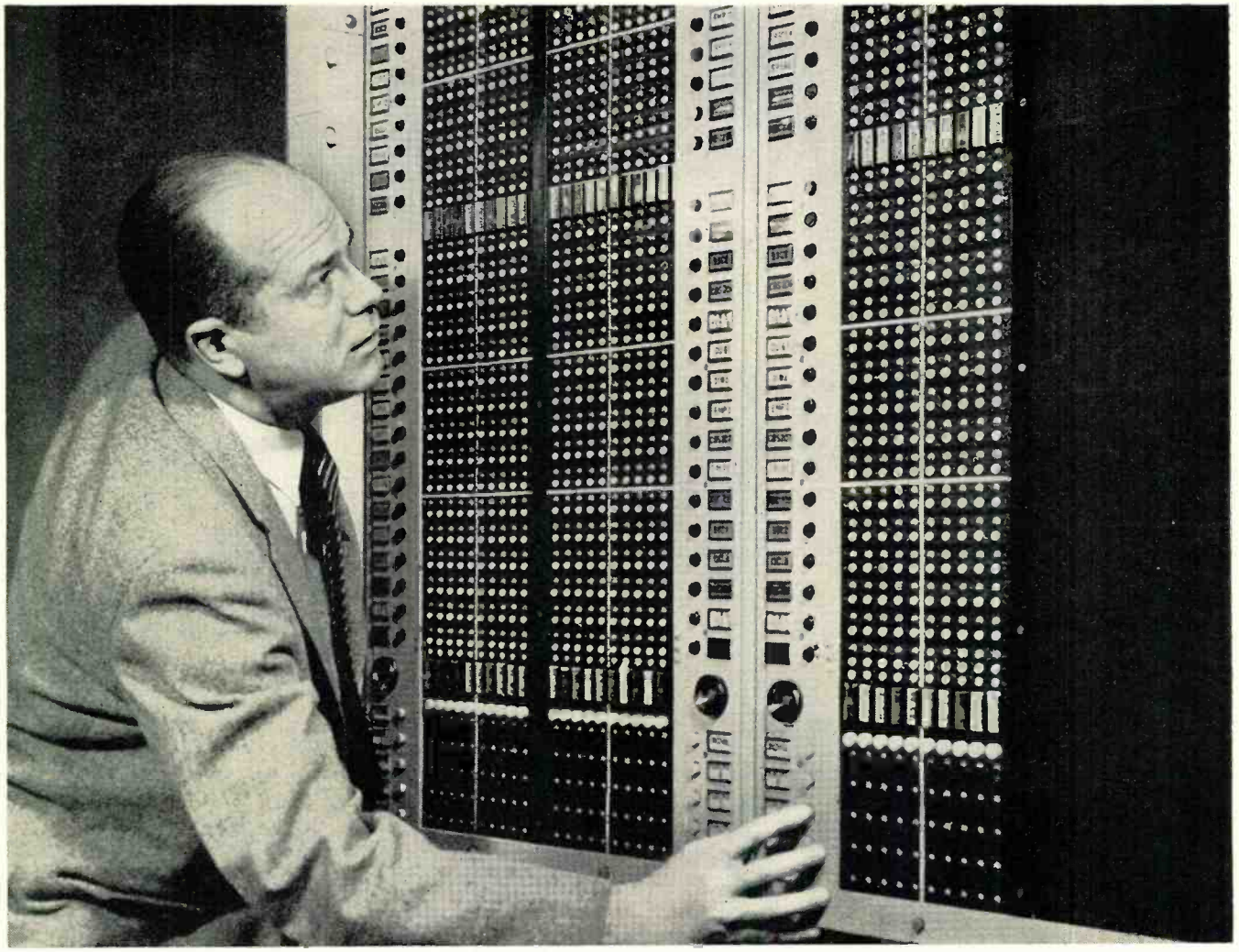
—Arlie D. Patton, San Antonio, Texas.

"—I know of no case in which a man who applied himself and completed the CREI course failed to better himself through promotion and increase in salary." . . .—Wendell L. Fraser, San Diego, Calif.

"—CREI has raised me to professional status as a radioman. Thanks to your instructors who always gave me needed help." —Victor Mentzer, Wilmington, Del.

"—I have been in radio and electronics for 24 years. I fully recommend CREI as the best school I have seen."—L. McManus, Montreal, Canada.



Bell Laboratories engineer Cyril A. Collins, B.S. in E.E., University of Washington, demonstrates new TV switching control panel for black and white or color. Complex switching connections are set up in advance; in a split-second a master button speeds dozens of programs to their destinations all over the nation. Special constant-impedance technique permits interconnection of any number of broadband circuits without picture impairment.

Telephone science speeds TV enjoyment

Telephone science plays a crucial part in your TV entertainment. An interesting example—one of many—is the latest TV switching center developed at Bell Telephone Laboratories.

Switching centers control the transmission of programs which come to your local TV station over Bell System facilities. To be available exactly on cue, programs must be switched at high speed and with very great accuracy.

To create the new switching center Bell Laboratories engineers borrowed from the switching control art which handles your dial telephone calls. They developed a special control panel which puts complex switching patterns within the easy grasp of one man. By pushing buttons, he sets up—and double-checks—forthcoming network changes far ahead of time. On cue he presses a master button which sends the programs racing to their respective destinations around the nation.

To connect the broadband circuits, the Laboratories engineers developed a new video switch which operates on a constant-impedance principle. The new switch permits the interconnection of any number of circuits, without the slightest impairment of transmission quality.

Thus the technology which serves your telephone also works for your TV enjoyment.

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NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

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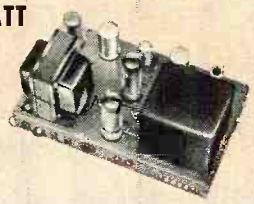
Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist: 20 cps:** 2% @ 4.2 w; ½% @ 2.5 w; **30 cps:** 2% @ 11 w; ½% @ 6.3 w; **40 cps:** 1% @ 12 w; ½% @ 9.3 w; **2000 cps:** ½% @ 12 w; **10 kc:** 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 3⅜" x 12" x 8¼". 13 lbs.

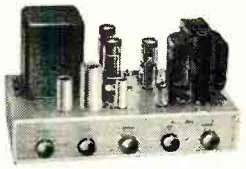
COMING SOON

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER



HF50 KIT $57.95 WIRED $87.95

Like the HF60 shown below, the HF50 features **virtually absolute stability, flawless transient response** under either resistive or reactive (speaker) load, & **no bounce or flutter** under pulsed conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.:** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps –60 kc; ±0.1 db 15 cps –30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching Cover **E-2 $4.50.**



NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52

with Preamplifier, Equalizer & Control Section

KIT $69.95 WIRED $109.95

Combines a power amplifier section **essentially identical** to the **HF50 power amplifier** with a **preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output).

Matching Cover **E-1 $4.50**

The specs are the proof... 7 NEW BEST BUYS by EICO®

NEW

HIGH FIDELITY PREAMPLIFIER

#HF61A KIT $24.95, WIRED $37.95

With Power Supply: #HF61 KIT $29.95, WIRED $44.95

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Senior "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) & **3 low-level inputs** (separate **front panel low-level input selector** permits concurrent use of changer & turntable). **Proper pick-up loading & atenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 8-100,000 cps; ±0.3 db 12-50,000 cps. **Extremely sensitive. Negligible** hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.

NEW

60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

KIT $72.95 WIRED $99.95

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: ±0.5 db 5 cps –100 kc; ±0.1 db 15 cps to 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 3 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both **bias** and **DC — balance** adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 $4.50.**

NEW

COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

KIT $49.95 WIRED $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; **2 low-level inputs** for proper loading with **all** cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer; interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs.

Matching cover **Model E-1, $4.50.**

NEW **COMPLETE with FACTORY-BUILT CABINET— 2-WAY HI-FI SPEAKER SYSTEM #HFS1 $39.95**

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Genuine 2-way book-shelf size speaker system. **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (**not** a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input —**Woofer:** ±4 db 80-1800 cps; **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. Power-handling capacity: 25 watts. Size: 23" x 11" x 9". 25 lbs. **Wiring Time:** 15 min.

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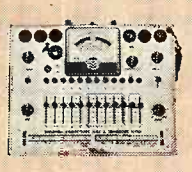


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication** of Gm, Gp & peak emission. **Simultaneous** sel of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages. 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage in ohms. **New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95

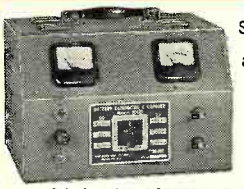
•

7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50

TUBE TESTER #625
KIT $34.95
Wired $49.95

- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50



Sep. volt-meter & ammeter
KIT $29.95
Wired $38.95

6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95

DELUXE MULTI-SIGNAL TRACER #147

20,000 Ohms/Volt MULTIMETER #565
KIT 24.95
Wired $29.95

1000 Ohms/Volt MULTIMETER #536
KIT $12.90
Wired $14.90

Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.
KIT $19.95
Wired $29.95

R-C BRIDGE & R-C-L COMPARATOR #950B

VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2	$4.95	
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **inereductor** for excellent linearity. **Extremely flat** RF output: **new AGC circuit** automatically adjusts osc. for max. output on each band with **min. ampl. variations. Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **3 fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-8 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower for** improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't burn-out circuit. 7 **non-skip ranges on every function.** 4 functions: +DC Volts, —DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe & 250 mc with PRF probe). Ohms: 0-2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

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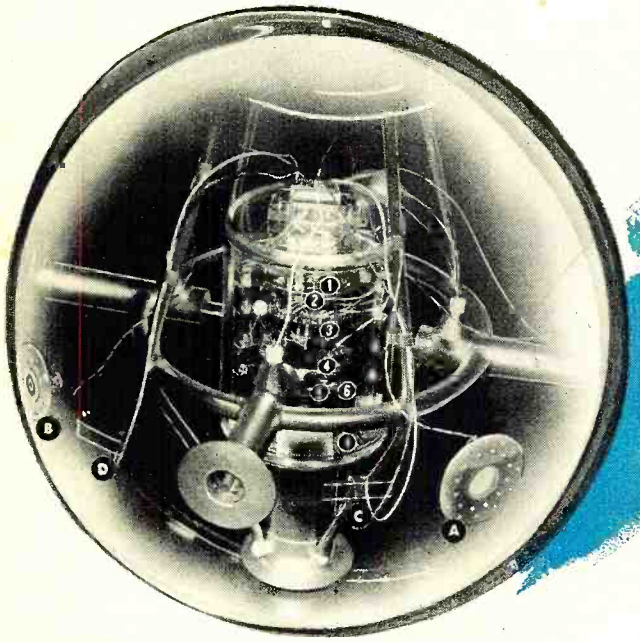


Model of the scientific earth satellite described below.

Research at the Threshold of Space

By **HOMER E. NEWELL, JR.**
U. S. Naval Research Laboratory

Electronics in the earth satellite and what we expect to learn from the "laboratory in space."

The instruments indicated by the lettering and numbers on the satellite are:

A. Solar cell, peak memory reset. Solar cell operating on energy from sun will reset peak memory storage unit once each orbit on transition from darkness to daylight.

B. Ion chamber, narrow band for ultraviolet detector. Peak ultraviolet sensitivity at the hydrogen Lyman-alpha line.

C. Thermistors, semiconductors made of various metal alloys, used for temperature measurement. The resistance changes with temperature.

D. Erosion gauge, nichrome ribbon evaporated on glass. Measures surface erosion caused by impact of micrometeorites. Resistance increases as film becomes pitted.

1. Minitrack transmitter. Supplies r.f. link for continuously telemetering the data from the satellite to ground. Operating life about 2 weeks with batteries.

2. Meteor storage, meteorite collision memory. Magnetic cores are used to store the number of "counts" from the meteoritic collision detector and transmit signals representing four decimal digits on four telemetering channels.

3. Telemetry coding system. Successively samples various signal input channels and appropriately modulates the Minitrack radio tracking transmitter for transmitting scientific data to a ground recording station.

4. Lyman-alpha storage, peak memory unit. Magnetic cores are used to store and code the telemetering system with a signal representing the maximum input value reached during one satellite orbit for subsequent readout when passing over recording stations.

5. Meteoritic collision amplifier. Amplifier output signal from a sensitive microphone is used to detect any collision that may occur with micrometeorites and provides input to the meteoritic storage counter.

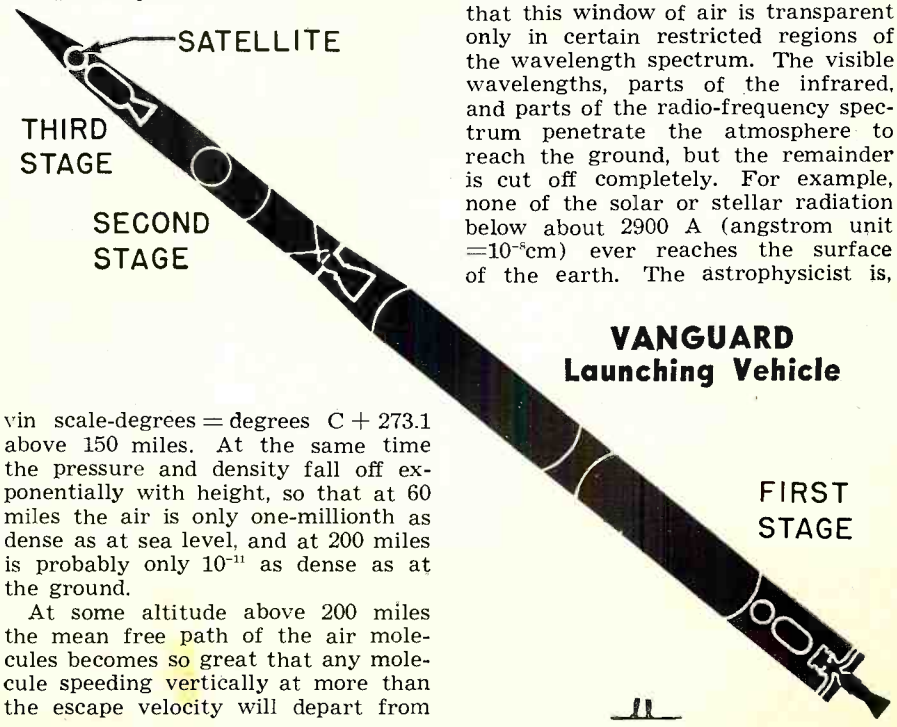
6. Lyman-alpha unit. Current amplifier for measuring the amount of ionization produced by far ultraviolet solar flare radiation.

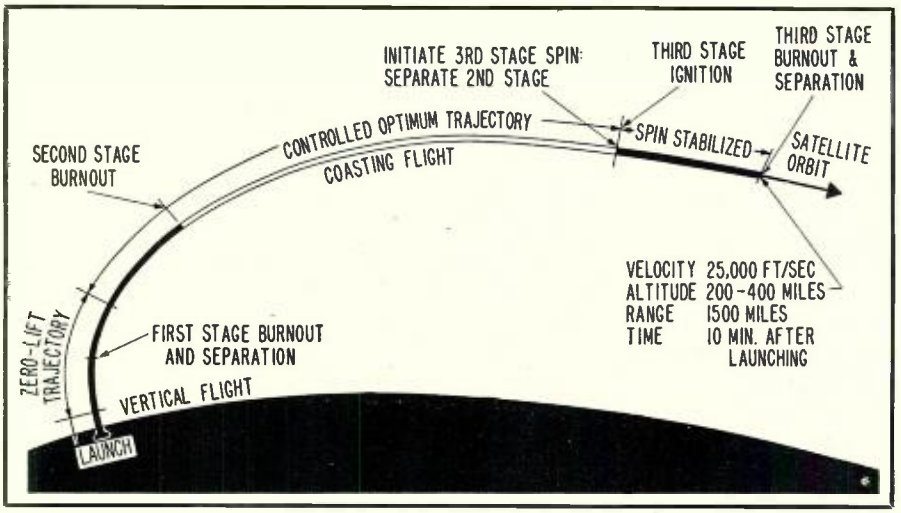
7. Mercury batteries used as the power source for all instruments.

DWELLING at the surface of the earth man moves about in what has often been called an "ocean of air." If all of the air in the atmosphere were at sea level temperature and pressure, this ocean of air would be about five miles thick. In fact, however, the atmosphere rises some hundreds of miles to merge at some unknown level with almost, but not quite, empty space. Below about 60 miles, atmospheric temperature varies with height between warm and very cold, but at higher altitudes gets very hot, probably more than 1000° K (Kelvin scale-degrees = degrees C + 273.1 above 150 miles. At the same time the pressure and density fall off exponentially with height, so that at 60 miles the air is only one-millionth as dense as at sea level, and at 200 miles is probably only 10^{-11} as dense as at the ground.

At some altitude above 200 miles the mean free path of the air molecules becomes so great that any molecule speeding vertically at more than the escape velocity will depart from the atmosphere into interplanetary space without colliding with any other air molecule. This height marks the beginning of what is often called the "exosphere," and may be termed the threshold to space.

Since the dawn of history, and earlier, man has looked out through the atmosphere at the sun, the moon, the planets, and the stars. The science of astronomy and astrophysics is based on observations made through this window of air, which at first thought may seem to be perfectly transparent. The fact of the matter is, however, that this window of air is transparent only in certain restricted regions of the wavelength spectrum. The visible wavelengths, parts of the infrared, and parts of the radio-frequency spectrum penetrate the atmosphere to reach the ground, but the remainder is cut off completely. For example, none of the solar or stellar radiation below about 2900 A (angstrom unit $=10^{-8}$cm) ever reaches the surface of the earth. The astrophysicist is,





Artist's concept of the satellite preliminary trajectory.

therefore, prevented from observing the sun or the galaxy in regions of the spectrum that could be highly revealing.

Even in the regions in which it is transparent the atmosphere imposes some restrictions. Because of turbulence and dust, the ultimate accuracies to which the astronomer can attain are limited quite severely, considering the present state of the art.

Geophysicists have studied the upper atmosphere and events occurring in it for over half a century now. Pressure, temperature, density, winds, the aurora, airglow, the ionosphere, meteors, cosmic rays, air composition, the earth's magnetic field, all have come under this scrutiny. During most of this period, all of the observations were made from the ground or near the ground. For a long time the highest altitudes attainable were those reached by balloons. As a result many of the conclusions about the high atmosphere were obtained in a highly indirect fashion. Often the theory connecting the observational fact with the ultimate object of study was highly involved and open to considerable doubt. In this respect the sounding rocket has been of great value to the geophysicist. During the past ten years it has been possible in such rocket vehicles to place measuring instruments in direct contact with the upper atmosphere. These rocket measurements have given the geophysicist the data needed to correct many of the theories used in interpreting ground based observations. Moreover, they have provided data unobtainable otherwise: ultraviolet and x-ray radiations from the sun; levels of ionospheric currents; high altitude values of the earth's magnetic field; chemical and ion composition of the air; auroral particles; very low energy and highly ionizing cosmic rays; and micrometeorite counts.

During his study of the earth's atmosphere the geophysicist has had a growing interest in things beyond the atmosphere. The sun, of course, is important because it is the single greatest source of energy input into the atmosphere. The auroras are now believed to be caused by charged particles entering the atmosphere from interplanetary space, originating in the sun. It is also thought that magnetic storms are associated with electric currents existing far beyond the earth's atmosphere. Meteors and micrometeorites come from interplanetary space. Whereas some cosmic rays may come from the sun, many of them probably arrive from galactic and intergalactic space.

Thus the astronomer, the astrophysicist, and the geophysicist all have a great interest in looking into outer space without having to look through the atmosphere. The astronomer would like to place his instruments above the air where seeing would be unimpaired. The astrophysicist would like to study the sun and stars from above the atmosphere so that he can observe them in important wavelengths that do not penetrate to the ground. Finally, the geophysicist would like to observe those solar and particle radiations and other phenomena which affect the atmosphere, the earth, or its magnetic field.

The vertical sounding rocket can be used to a limited extent for such observations. Its principal value, however, is for studying events occurring within the atmosphere, particularly for making measurements as a function of altitude at essentially a single instant of time. The glimpse that it can afford of conditions above the atmosphere and in outer space comes only near the peak of flight, and is brief, whereas most of the desired observations at or above the threshold to space become of real value only when carried out over extended periods of time. Examples are: monitoring the ultraviolet light from the sun over sufficient time that the data can be correlated with weather effects; and monitoring flare activity in the sun so that it can be correlated with ionospheric, magnetic, and auroral effects.

An observing platform at the threshold to outer space would meet the needs of astronomer, astrophysicist, and geophysicist alike. But one cannot just place such a platform at some point in space and expect it to stay there. Even if it were motionless to begin with, the gravitational attractions of the sun, the earth, the moon, and the planets would cause it to move. If it were much closer to the earth than to any of the other bodies in the solar system, it would simply fall to the ground. If it were far removed from any of the planets, the sun would be the controlling factor, and the platform would fall into the sun. The conclusion is that such an observing platform will necessarily be in motion, and the problem is to find some motion which does not destroy the usefulness of the platform for making observations.

The moon is obviously a highly acceptable platform for making physical observations outside the earth's atmosphere. In revolving about the earth the moon stays well outside the earth's atmosphere, and since it has no atmosphere of its own, it would be an ideal spot to locate telescopes, spectrographs, light and particle counters, etc. There is, however, some difficulty associated with setting up operations on the moon. One is led, therefore, to the idea of creating an artificial moon revolving close to the earth, carrying automatic equipment for collecting data, and a radio transmitter for sending the data to the ground. This can be accomplished using suitably designed rockets.

International Geophysical Year

The idea of creating an artificial satellite of the earth is far from new. For many decades rocket engineers have had such a thought in the back of their minds. Many enthusiasts have regarded the creation of a space platform as a principal objective of rocket development. The immediate motivation for the current United States artificial earth satellite program is to be found, however, in the International Geophysical Year.

From the beginning of July, 1957 to the end of December, 1958 about 50 nations will unite in an attack upon various important geophysical and solar problems. The participation of the United States in this program is under the direction of the United States National Committee (USNC) for the IGY, established by the National Academy of Sciences. Their observations will be made in a coordinated fashion from stations covering the entire globe. It is expected that these coordinated and correlated observations will lead to a number of major breakthroughs in such fields as meteorology, ionospheric physics, aurora and airglow, solar activity, cosmic rays, geomagnetism, latitude and longitude, oceanography, glaciology, gravity, and seismology. In addition to scientific value, such breakthroughs could be of great practical importance, possibly leading to better weather forecasting, improved radio communications, better navigation,

HEATHKIT

Audio Generator Kit

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- *Brand new circuit for extended frequency response and added stability.*
- *Ten accurate ranges from 0-.01 to 0-300 volts.*
- *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.95

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

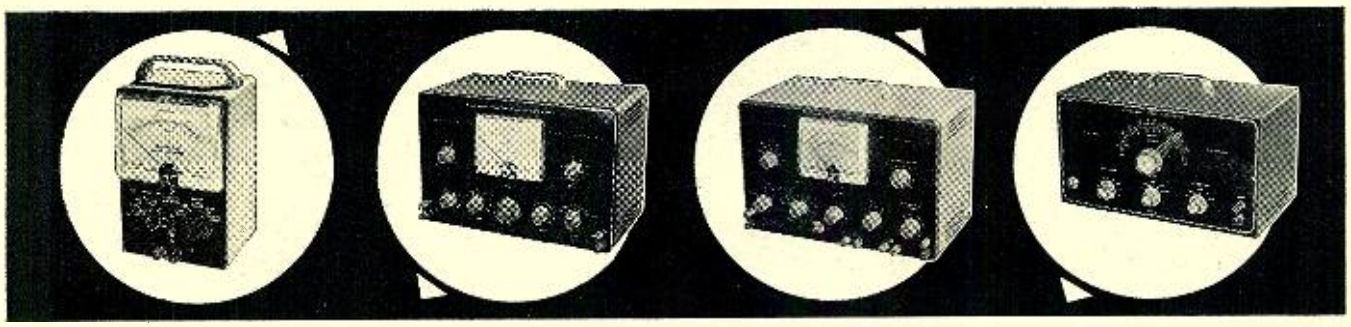
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. 1M scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$49.95

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

MODEL V-7A

$24.50

Shpg. Wt. 7 Lbs.

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

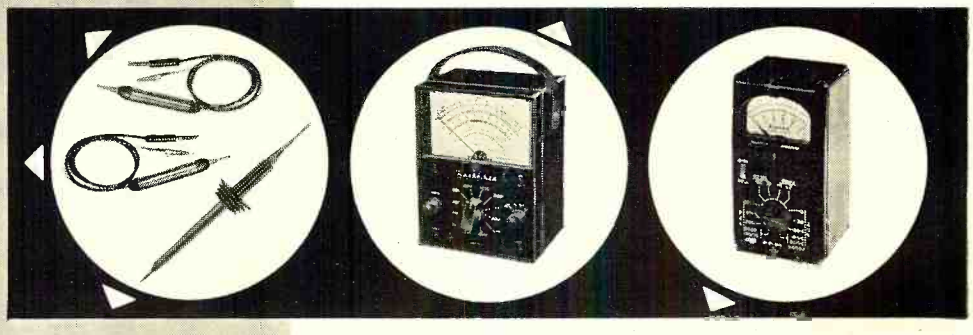
Shpg. Wt. 6 Lbs.

ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C

$5.50 Shpg. Wt. 2 Lbs.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 Lbs.

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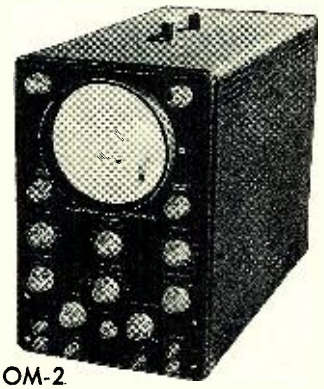
GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New HEATHKIT ETCHED CIRCUIT
5" Oscilloscope Kit

- *Brand new model with improved performance specifications.*
- *Full 5" scope for service work at a remarkably low price.*
- *Attractively styled front panel in charcoal gray with sharp white lettering.*
- *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.



MODEL OM-2
$42.50
Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

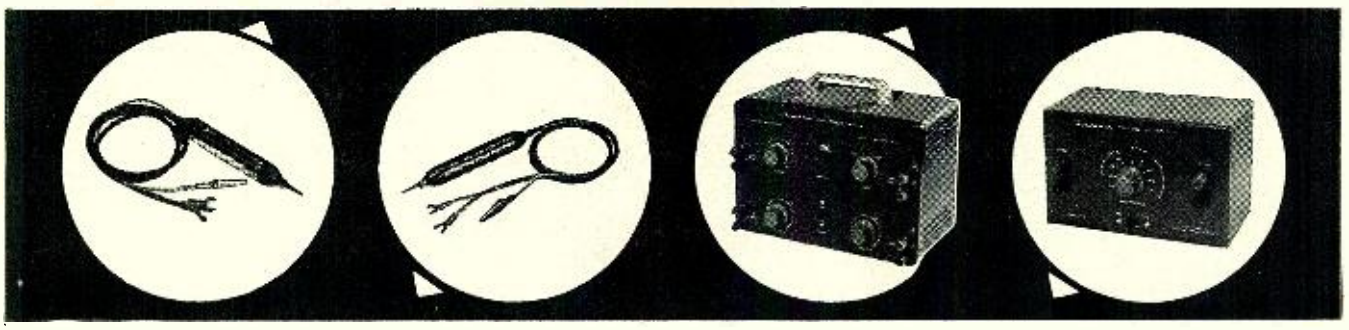
Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342
$3.50
Shpg. Wt. 1 Lb.

HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3
$21.95
Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C
$3.50
Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3
$12.50
Shpg. Wt. 4 Lbs.

New

MODEL O-11
Shpg. Wt. 21 Lbs.
$69.50

* *An improved model of what was already an outstanding instrument.*
* *Performance is unmatched in this price range.*
* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2 DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

5 BIG REASONS WHY

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ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

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- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

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DYNA-QUIK MODEL 500

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

NET $109.95

Dyna-Quik 500. Easily portable in luggage-style carrying case. Size: 15⅛ x 14½ x 5¾ in. Weighs only 12 lbs. Has 7-pin and 9-pin straighteners on panel.

Cuts testing time in half . . . Doubles tube sales.

Tests over 95%

OF ALL POPULAR TV TUBES*— *IN SECONDS*

It's easy and profitable to check all the tubes in a TV set with DYNA-QUIK—on every service call. Cuts servicing time. Creates more on-the-spot tube sales. Saves repeat calls, protects service guarantee.

DYNA-QUIK 500 *measures true dynamic mutual conductance*, completely checks tubes with laboratory accuracy under actual operating conditions right in the home.

Tests each tube for shorts, grid emission, gas content, leakage, dynamic mutual conductance and life expectancy. One switch tests everything. No roll charts. No multiple switching. Makes complete tube test in as little as 12 seconds. Large 4½-inch plastic meter shows tube condition on "Good-Bad" scale or in micromhos on scales calibrated 0-6,000 and 0-18,000. Used in home or shop, DYNA-QUIK is a proved money-maker!

DELUXE—PORTABLE

CRT MODEL 400

Tests and repairs TV Picture Tubes

CATHODE REJUVENATOR TESTER

Quickly spots and corrects picture tube troubles right in the home, without removing tube from set. Restores emission, checks leakage, repairs inter-element shorts and open circuits. Life test checks gas content and predicts remaining useful life. Grid cut-off reading indicates picture quality customer can expect. Eliminates tube transportation, cuts service-operating costs. Also saves money on TV set trade-in reconditioning. Earns dollars in minutes—pays for itself over and over again.

NET $54.95

Deluxe CRT 400. With 4½-in. plastic meter. Weighs only 5 lbs. Luggage style carrying case. Size: 11 x 7⅛ x 5".

Builds customer-confidence in your service. Makes new picture tube sales easier.

Proved in Use by Servicemen Everywhere.

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By **JOHN T. FRYE**

LOGIC AND BEYOND

BARNEY was not much of a bookworm. When possible he preferred to learn by doing rather than by reading; so it was something of a shock to Mac, his employer, to return from lunch and find his redheaded assistant perched on a high stool with his long legs threaded tortuously through its rungs as he scowled in concentration at a book in his lap.

"What's the matter; run out of comic books?" Mac asked. "That book looks to me as though it had *writing* in it."

"Oh don't worry; it's got lots of pictures, too," Barney said as a grin spread across his freckled face. "It's called 'Pin-Point TV Troubles in 10 Minutes.' I just picked it up at the parts store. It's published by *Coyne* and distributed by *Sams*."

"That title sounds mighty optimistic to me," Mac observed.

"It does swing a pretty big loop," Barney agreed; "but the distributor actually makes no wild claims. He says it is impossible for any book to deal with *every* intricate trouble that may occur; but he says the system described in this book covers the great majority of difficulties, both simple and complex, met daily by the technician. Really the book is built around a collection of check charts with cross references intended to allow the technician to spot quickly and accurately the most probable causes of each picture symptom."

"There must be more than charts in a book as thick as that."

"There is. Explanations of circuits and designs used in the majority of TV receivers produced since 1953 accompany the tables of symptoms and causes. Illustrated and described are methods for checking performance of various components as well as precautions to be observed when making tests or replacements. Instructions for making some of the more troublesome adjustments to a receiver are given. However, the book deals with locating trouble and correcting it rather than with principles and theory."

"Well, I can see where something along that line could be helpful. I know that *RCA's* 'Pict-O-Guides,' which did the same thing on a smaller scale, were mighty helpful to me when I was getting started in TV service. The human mind is a funny thing; it quite often refuses to use all it knows. When a technician is confronted with a particular symptom, he tends to expect it to be produced by the same thing that was wrong in the last set he serviced with that symptom. Quite often the proximity of this last case will blind him to all other possibilities.

"A check chart such as this will remind him of these other possible causes and permit him to check them in the best order. Some checks should be made simply because they are easiest and quickest made. Others should take precedence because experience teaches they cause the trouble most often. But in any case a really good check chart can be very helpful by presenting the *whole picture* of the symptom, with all its possible ramifications, to the technician so that he does not overlook any of them. But how did you happen to buy a technical book?"

"To confess the truth, I decided I needed something. Remember that case of intermittent hum in Mrs. Palmer's TV set I have been fighting for the past couple of weeks? Well, last night I finally cured it; but the experience has taken all the conceit out of me. I've concluded I'm not one tenth the TV technician I had supposed."

"Tell me more!" Mac encouraged. "I find the picture of you eating humble pie a strange and delightful one."

"OK. To refresh your memory, let's start at the beginning of the revolting story. The complaint was hum in the audio. When I arrived on the scene, I found the hum just a little above normal; but it was really not bad. Mrs. Palmer explained it was much worse at times. She was sure that the picture was not affected by the hum when it did become worse, and she thought—she could not be sure—that turning down the volume control had no effect on the hum when it was bad. Of course I thought of filter capacitors that opened intermittently, of heater-to-cathode shorts inside tubes, and the other usual causes of hum. Since the tubes were the easiest things checked, I started there. One of the i.f. amplifiers when tapped lightly produced a sharp increase in the hum."

"That's it!" Mrs. Palmer said when she heard the hum come up. "That's the sound I was telling you about."

"I replaced the tube with a new one, and observed that the slight hum I had noticed originally had disappeared. Then I took off, but I did not feel good about the job. You know that funny sort of a hunch you have about some service jobs in which you have not satisfied yourself that you cured the trouble, no matter what the customer thinks? Well, I had this feeling very strongly.

"The hunch was right, too, for about four or five days later Mrs. Palmer called and said the hum was back as bad as ever. In fact, I could hear it on the phone. I told her not to turn the set off and that I'd be right over. As I entered the door of her house, I could hear a very loud and raucous hum coming from the set; but as I closed the door behind me, the hum ceased abruptly and the set played as sweet as you please.

"However, having heard the sound myself, I was sure I could find it. I pulled the chassis and disconnected the filter capacitors one by one. There was no capacitor whose removal produced a hum anywhere nearly as loud as the one I had heard when I came in. What's more, every capacitor I cut out had some effect on the picture. I examined the whole audio system wire by wire, looking for some way that the filament voltage could reach a grid, but I couldn't find a thing wrong. Finally I replaced the chassis in the cabinet and let it run for a half hour while I tapped, pulled, and tugged at everything abovedeck without being able to make the hum return. Finally I told Mrs. Palmer that if she did not mind I should like to come over and watch TV with her and Mr. Palmer some evening, just so I might have a chance to catch the hum starting. She suggested last night.

"I took along a copy of RADIO & TV NEWS and went over. While they watched the set, I read my magazine. After the set had been on about an hour, suddenly, with no warning whatever, it burst forth with that terrific hum. I was on it like a cat on a mouse, but I moved very carefully so as not to cause the hum to cut out before I had a chance to do some checking. First I turned the volume control entirely off. The sound from the program disappeared, but the hum level stayed the same. Switching channels had no effect whatever. Finally I did something I don't ever recall doing before, and I still can't say why I did it: I reached in and pulled one speaker lead loose from its jack. The hum kept right on!

"By now I really thought I had popped my cork, but I cautiously pulled back a corner of the back and looked inside. The source of the hum was immediately apparent. The set is one of

(*Continued on page* 163)

output voltages result. For this same reason, in high-accuracy laboratory applications, switches with very low contact resistance must be used, since voltage drops across such resistances appear in the output.

For shop use, practically any two-gang switch will do. The *Centralab* types 1412 and 1413 are suitable. For laboratory applications, laboratory-quality switches, like those manufactured by *Shallcross* or *Daven,* are a must.

To allow adjustment, it may be advantageous to buy a potentiometer of somewhat higher resistance than necessary. It can then be shunted down to exactly the necessary value with parallel resistors.

The circuit in Fig. 2 uses a potentiometer for the "second decade." Sometimes, it is more desirable to use a tapped resistance in this second decade. An instrument may be needed that divides the output into, say, one part in ten thousand. This can be done with four decade switches.

Cascaded Dividers

Not many people will ever wish to build a four-decade divider—a three-decade unit is a more practical project. Fig. 3 shows such a three-decade divider, which would require the very best of components. Although it would be useful only in the laboratory, it is educationally important since it shows how Thomson-Varley dividers can be cascaded.

The resistors in each succeeding decade divider must be exactly one-fifth of the value of those in the preceding decade. This way, the total resistance of each decade is always equal to the resistance of *two* of the resistors in the preceding decade.

The third decade is conventional. But notice that it has *eleven* switch positions and *ten* resistors. Because the third decade has ten positions, the three decades can be set to 999 and then one additional step on the last decade adds one to this, bringing the output to 1000, which is unity. This means the output is equal to the input and there is no attenuation. The fact that this last switch has eleven positions is no problem. Eleven-position switches are common. This last divider arrangement could be used with Fig. 2 in place of the potentiometer. It is simply a matter of replacing a continuously variable attenuator with a calibrated step attenuator.

The Thomson-Varley decade divider is equally useful for both d.c. and a.c. applications. Using a value of 1000 ohms for the resistance of R, the circuit of Fig. 2, when fed with a standard clipped sine wave, makes an excellent voltage calibrator for the oscilloscope.

Connected to a bank of mercury cells, the decade divider is excellent for calibrating voltmeters and the like. Since the meter produces a loading error, the value of R should be lower. One hundred ohms would be an approximate total decade resistance for this application. The value of R would then be ten ohms.

Test instruments and signal generators need accurate decade attenuators and gain controls. This responsibility is easily taken care of by a Thomson-Varley divider.

Amplifier gain can be very accurately measured, at all frequencies, with the Thomson-Varley circuit. It is thus useful for running either frequency-response curves or making absolute voltage-gain measurements. To check gain, connect a Thomson-Varley divider to the output of an amplifier or amplifier stage. Then use a single-pole, double-throw switch to connect the vertical-deflection terminals of an oscilloscope to either the amplifier *input* or the divider *output*.

Now adjust the divider until its output, as shown on the scope, is equal to the amplifier input. The amount of attenuation required from the divider to exactly counterbalance the amplifier gain, which can be read easily from the markings on the divider, gives an accurate picture of the amplifier's gain. Suppose that the divider at the output of an amplifier stage must be adjusted to one-tenth the voltage across the entire combination in order to match the input voltage measured at the grid of this same stage. This would mean that the stage has a gain of 10.

An advantage of this method of gain measurement is that it is not affected by irregularities in the response of the oscilloscope, meter, or other device used to take the measurement, by variations in oscillator output, or by the many other concealed factors that may introduce errors into the measurement procedure.

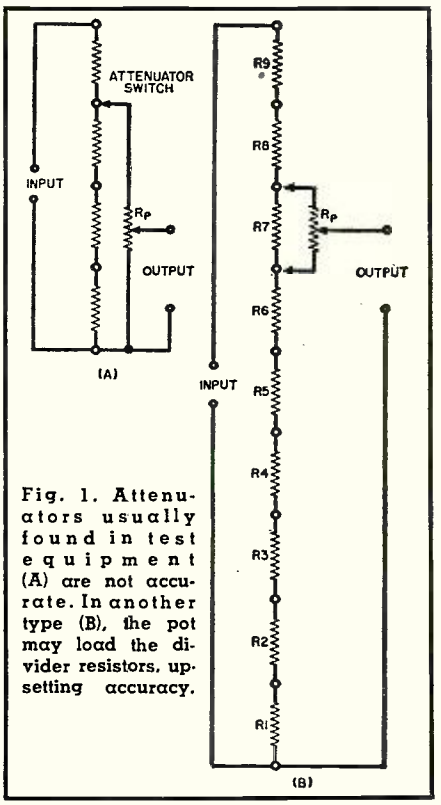
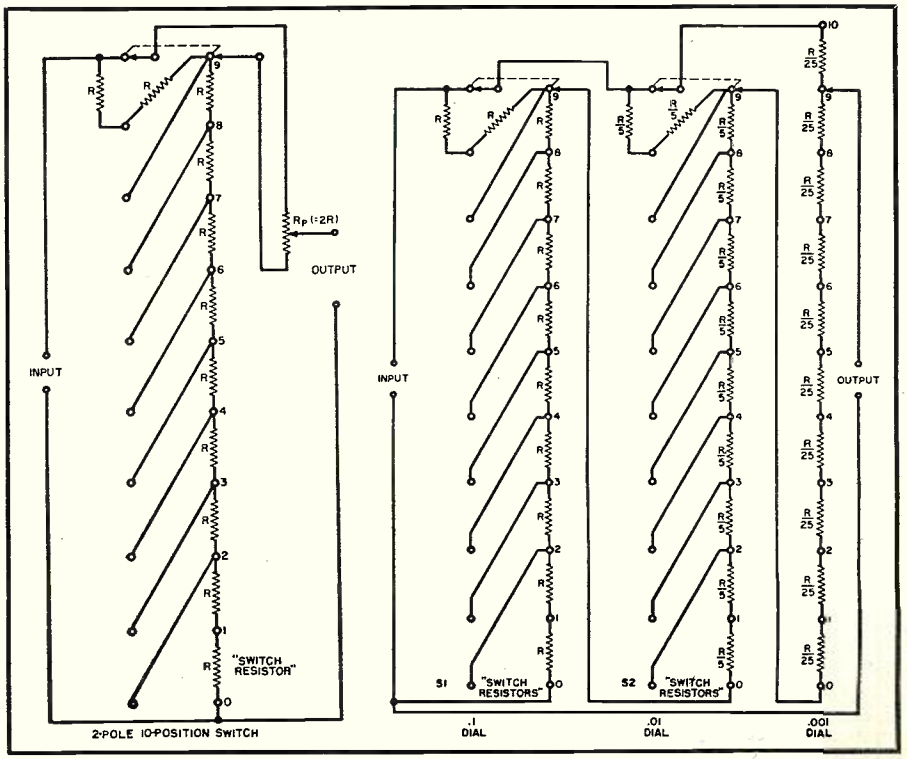


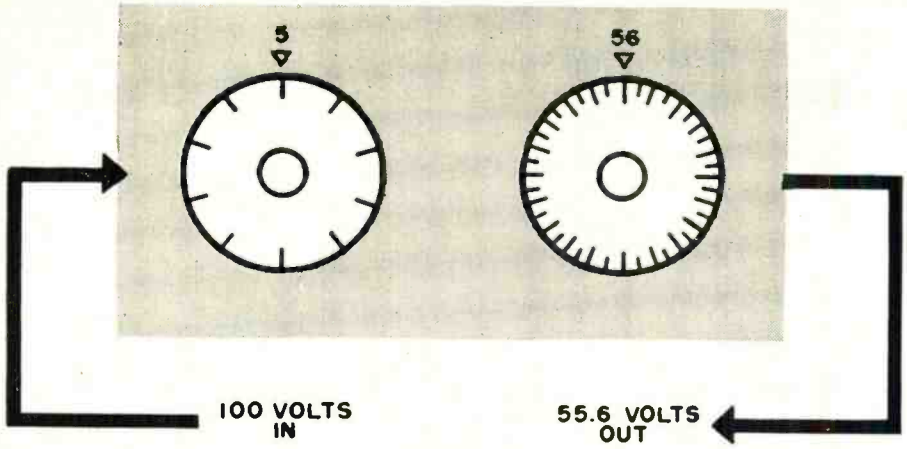
Fig. 1. Attenuators usually found in test equipment (A) are not accurate. In another type (B), the pot may load the divider resistors, upsetting accuracy.

The applications noted here are by no means a complete listing. Once the technician has taken the trouble to build such a divider, he will continue to find additional uses for it. If desired, the circuit of Fig. 2 can be built into a small aluminum case for bench use. The cost should be only a few dollars if deposited-carbon resistors are used. —30—

Fig. 2. This precision divider uses a potentiometer in the second decade.

Fig. 3. This 3-decade unit shows how precision dividers may be cascaded.





An Accurate Voltage Divider

By **EDWIN BOHR**

Ingenious wiring, using an inexpensive switch, enables easy construction of a Thomson-Varley precision divider for use in the service shop.

FOR CALIBRATING voltmeters, as an attenuator for signal generators, to provide accurate gain control, or for voltage comparison and amplifier measurements, the Thomson-Varley divider is hard to beat. This decade voltage divider is functional and easy to use. Nevertheless, many technicians and engineers have never heard of this useful circuit. Usually, those who know it do not use it because they think special unavailable switches are necessary.

Contrary to this widespread belief, the Thomson-Varley divider does not require esoteric switches or circuit arrangements. It can easily be built around switches available at even the smallest radio parts jobber.

What is a Thomson-Varley divider? To answer this we must look at attenuators or voltage dividers in general. The type of attenuator usually found in radio test equipment, such as audio signal generators and voltage calibrators, is shown in Fig. 1A.

The attenuator switch, in this circuit, is really a range-setting switch for the output potentiometer labeled R_p. Potentiometer R_p always varies the output from zero to the highest value permitted by the switch position. This circuit does not allow precise or accurately known voltage-division ratios. As can be seen, it is not a decade divider. With a true decade divider, the setting of any dial does not affect the volts-per-division (or "scale factor," as it is called) of any other dial.

Someone may do a little thinking and suggest Fig. 1B as a possible decade divider. For this circuit, the potentiometer R_p would shunt across any single divider resistor. The output, then, is determined by the voltage drops across the switch resistors and the potentiometer moving contact to ground.

This is not a practical circuit, however, unless the resistance value of R_p is at least one hundred times larger than any of the single resistors. Otherwise, the shunt resistance of R_p would reduce the voltage drop of any switch resistor that it was connected across. In some applications, R_p would have to be one thousand times larger than a single switch resistor in order to reduce the loading to an acceptable value.

True Decade Division

A modification can make this circuit into a true decade divider. We can do this by making the resistance of R_p exactly equal to one of the switch resistors. Then, if we have a special switch that substitutes R_p for any single switch resistor we wish, we have a true decade divider.

If R_p is inserted in place of R_1, for example, the voltage available at the output can be varied, by R_p, from zero to one-tenth of the input. Substituti[ng] for R_2, R_p varies the output from [one-]tenth to two-tenths of the input, so on. Unfortunately, this syste[m re]quires a switch that is just t[oo] plicated to be really practica[l] spread use. Nevertheless, of this type of circuit found in special test ci[rcuits]

Varley and Thomson—the latter may be more quickly recognized as Lord Kelvin—were both men of rare mental agility. They evolved a circuit that provided true decade voltage division, yet overcame many of the problems involved. However, even their arrangement generally demands a difficult-to-obtain selector switch. Fortunately, this final obstacle can be skirted by wiring and interconnecting a standard two-gang selector switch. The result is a simple circuit that is relatively easy to wire.

If each vertical row of contacts in Fig. 2 is considered to be one of the two wafers or poles in the 10-position switch used, the desired simplicity of operation can be achieved using the common type of switch mentioned plus the few relatively inexpensive resistors and the potentiometer.

Operation of the Divider

Fig. 2 shows this circuit. As with all Thomson-Varley dividers, there are *eleven* resistors in the string of switch resistors. The potentiometer R_p, at any position of the switch, connects across *two* of the switch resistors. Of course, the shunting condition previously noted still exists, but the Thomson-Varley circuit actually controls this effect and puts it to good use. This is made possible simply by adding an extra resistor.

Notice, again, that potentiometer R_p connects across *two* switch resistors in any position. If we make the value of R_p exactly equal to the resistance of these two resistors, the total resistance of the divider is $10R$. This is true because a resistance of $2R$ in parallel with another resistance of $2R$ is, of course, equal to R. Thus a drop of one-tenth of the input voltage is developed across R_p at all times.

This circuit of Fig. 2 is very useful in the shop and laboratory. For example, if the dial of potentiometer R_p is divided into one hundred divisions, we can select any portion of the input voltage with a resolution of one thousand scale divisions!

To show how easy it is to read this type of divider, suppose one hundred volts is applied to the input. Now, if the switch is set to five and the potentiometer dial to fifty-six, the output is, very simply, 55.6 volts.

For shop use, the resistors may be 1% deposited-carbon or even selected 5% composition types. Even a seventy-five cent replacement wirewound [con]trol could be used for [the] ter R_p. The [T]like any [o]than its [ex]

and is therefore used to establish the d.c. level.

The video signal on the blue and green cathodes is adjusted for proper grey tones on a monochrome picture. Blocking capacitors (C_2 and C_3) are needed to keep the relatively high "B+" at the cathodes of the picture tube from reaching the cathode of the 6W6 video-output stage, where the potential is lower. Since output from the 6W6 cathode is at a low impedance level, quite a bit of capacitance is needed to pass low frequencies. Accordingly two 10-μfd. units are used. A possible reason for splitting the capacitance needed is to balance it on either side of the delay line. Otherwise there might be reflections resulting from an unbalanced line. Although this novel circuit appears to have some advantages as far as bandwidth and video power are concerned, it is too early to compare it with more conventional systems.

Color Sync System

Almost all previous *G-E* color sets, experimental or those produced in limited quantities, have been distinguished from the sets of other manufacturers in that they employed a crystal ringing circuit in place of a 3.58-mc. local oscillator. The principle of this circuit is not new and several technical papers have been presented concerning it, but this is the first color set in production to make use of it.

When a crystal is excited with a short burst of signal at its natural resonant frequency, it tends to continue the oscillation for a considerable time after the excitation has been removed. The crystal acts like a very high-"*Q*" resonant circuit. This principle is used here. When a color-sync burst is received, it is separated from the horizontal pulse and amplified. Then it is applied to the crystal through an impedance-matching network. This network is inserted to make fullest use of the equivalent series-resonant circuit represented by the crystal.

The simplified *G-E* color-sync circuit in Fig. 4 shows the 6AU8 triode section connected as a burst keyer. Again, a type NE-2X neon bulb is used, but here it limits the amplitude of the keying pulse applied to the grid of the burst keyer. The crystal and tuned circuit shown in dotted lines form the tuned impedance-matching network, which changes the short color-sync [illegible] into a longer, decaying 3.58-mc. [illegible] pentode section of [illegible] 3.58-mc. sine [illegible]ed, so that [illegible] demodu-[illegible]de

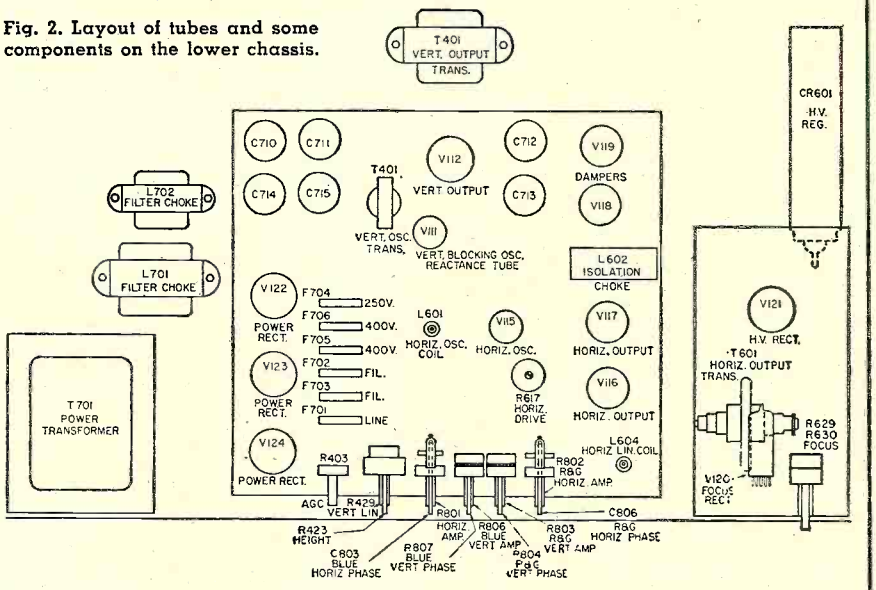


Fig. 2. Layout of tubes and some components on the lower chassis.

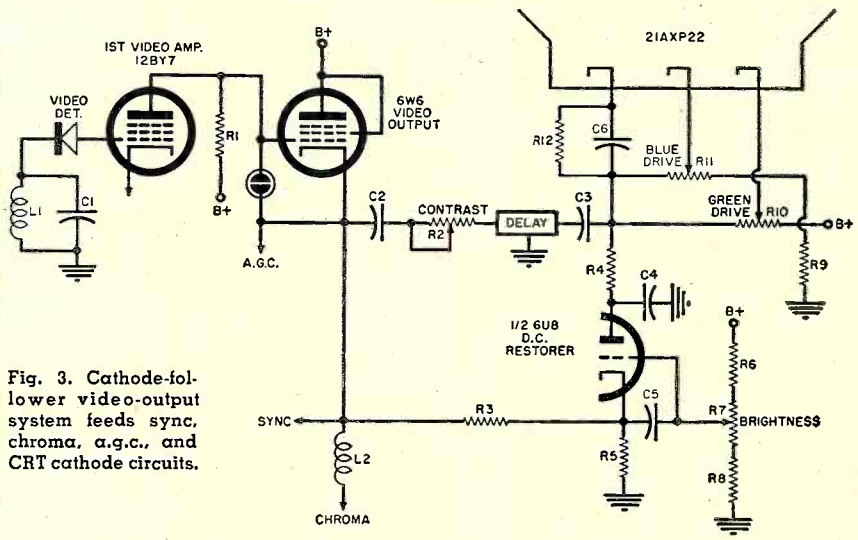


Fig. 3. Cathode-follower video-output system feeds sync, chroma, a.g.c., and CRT cathode circuits.

Fig. 4. A ringing circuit eliminates the 3.58-mc. oscillator and color killer.

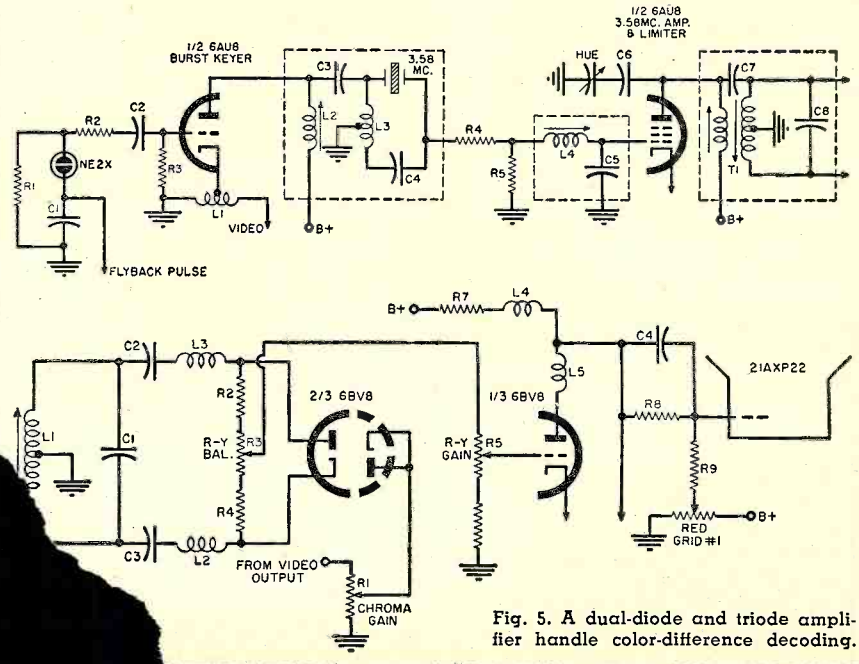
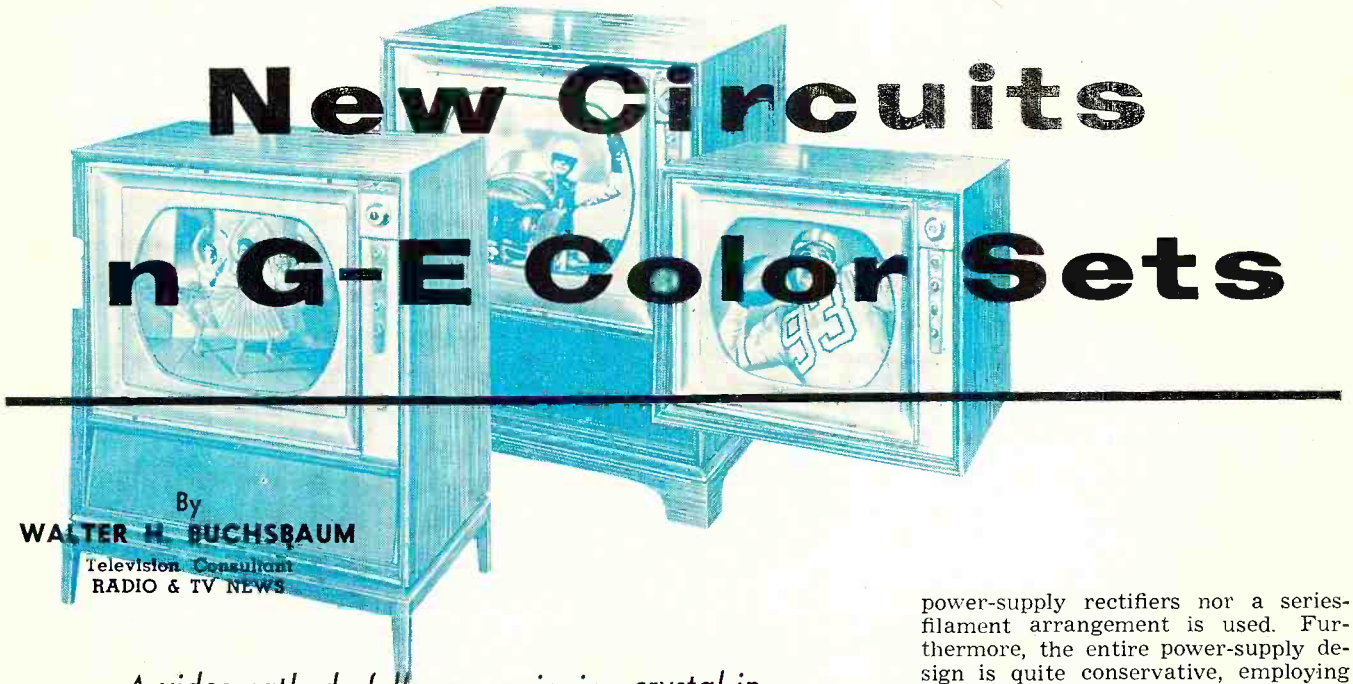


Fig. 5. A dual-diode and triode amplifier handle color-difference decoding.

New Circuits in G-E Color Sets



By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TV NEWS

A video cathode follower, a ringing crystal in the color-sync system, and elimination of the need for a color killer are some new features.

AFTER several preliminary models, the *General Electric Co.* is now producing a new color-receiver chassis using the 21-inch metal, shadow-mask picture tube found in almost all recent color sets. Since this tube is used, certain of the circuitry must needs be similar to that in previously described receivers; but, in most respects, the *G-E* color sets feature rather novel and often unique circuitry. It is worthwhile to examine these new circuits, explain their operation, and provide some information on troubleshooting and adjustment. Of course, the most frequently performed adjustments such as purity, convergence, and grey-scale set-up, are almost identical to these procedures in other color sets using the same 21AXP22 picture tube.

Over-all Circuit Features

The chassis and picture-tube arrangement of the new *G-E* color sets can be seen from Figs. 1 and 2. Only the vertical- and horizontal-sweep, flyback, and power supply are located on the main chassis. The i.f., video, and audio sections, as well as color-demodulator and color-synchronizing circuits, are all located on the printed-wiring board mounted vertically at the left side of Fig. 1. A total of 28 tubes is used, including three 5U4 power rectifiers.

In this *G-E* model, neither selenium power-supply rectifiers nor a series-filament arrangement is used. Furthermore, the entire power-supply design is quite conservative, employing no less than six time-lag type fuses, two *LC* a.c. line filters, two d.c. filter chokes, seven different filament windings on the power transformer and surge-limiting resistors across the electrolytic capacitors. All tubes are accessible from the rear of the set. Note also the layout of the h.v. cage with the corona-discharge type of voltage regulator, shown in Fig. 2. The same system is found in *Sylvania* color sets. It eliminates the need for h.v. adjustment.

Returning to Fig. 1, note the location of the width switch on the rear of the h.v. cage. All dynamic-convergence controls are grouped together. Two potentiometers, the green- and blue-drive controls, are mounted on the picture-tube socket assembly. Since these controls go directly to the cathodes of the picture tube, the arrangement is quite convenient.

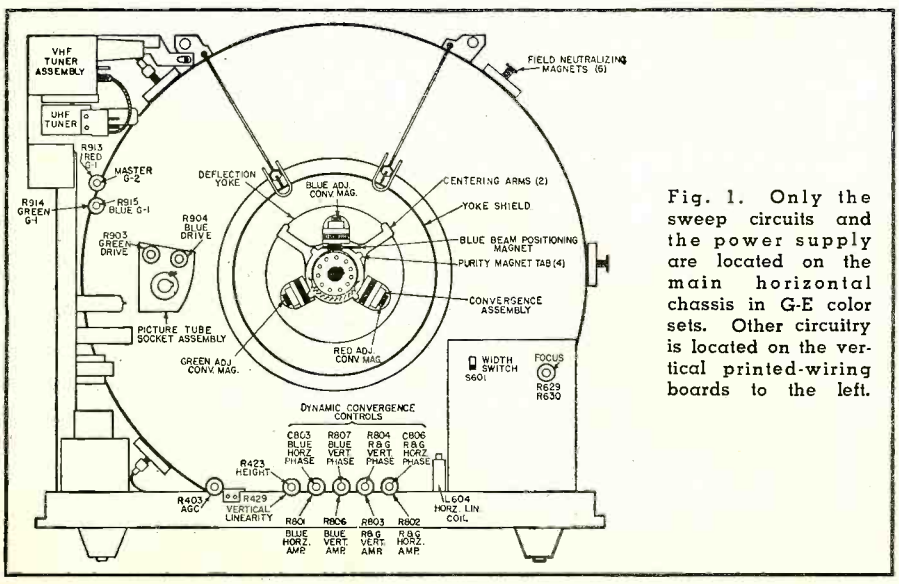


Fig. 1. Only the sweep circuits and the power supply are located on the main horizontal chassis in G-E color sets. Other circuitry is located on the vertical printed-wiring boards to the left.

Video Cathode Follower

The video or brightness signal circuit of the new *G-E* set, shown in Fig. 3, is really novel. One stage of conventional amplification, the first video amplifier (12BY7), feeds both black-and-white and chroma signals to the 6W6 video-output tube. Between grid and cathode of this stage, a type NE-2X neon bulb maintains a fixed bias, while the plate is connected to "B+." Sync, a.g.c. voltage, and the 3.58-mc. chroma signals are all extracted from the cathode of the 6W6. Note that, between video detector and the cathode of the 6W6, d.c. coupling exists.

From the cathode of the 6W6 to the three cathodes of the color-picture tube, the brightness signal passes through the contrast control and delay line. It also has its d.c. level restored by the triode section of the 6U8. This latter stage acts like a conventional d.c. restorer except that the grid is connected to the brightness control

Tube Tester Modernization

By
N. B. WYNNICK

A noval socket and a hand crank for the roll chart can prolong the usefulness of an obsolescent checker.

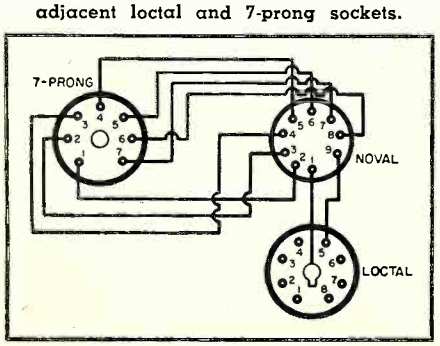
Fig. 1. Over-all view of checker shows location of new socket and hand crank.

MANY tube testers several years old have been rendered obsolete by the profusion of new tube types that have become available over the past decade. Of the half-dozen test sockets available on many old testers, for example, not one is a noval socket. This immediately eliminates the possibility of checking a broad category of now common multi-function tubes. Also, with the vastly increased list of tubes in current use, up-to-date roll charts have been increased in size proportionately. The knurled knob that operates many of these charts is the parent of slow motion and many thumb calluses.

Improvement of the old tester is a worthwhile project for any technician, especially since the required materials can either all be found in the shop junk box or bought at negligible cost. The author performed the job on his *Precision* 912P tube tester, but the procedure is largely applicable to many other similar models.

For the noval tube-testing feature, a noval socket and a few inches of hook-up wire will be needed. The socket used was of the under-chassis-mount type, so two machine screws, two nuts, and two lock washers were also required. After looking at both top and bottom of the tester chassis, it was deemed best to locate the new socket directly above the lock-in socket, between the meter and the 7-prong socket, in the spot indicated in Fig. 1. Because of the limited space and the protruding ears on this type socket, it was necessary to locate the gap between pins 1 and 9 so that it was slightly to the left of, or clockwise from, the corresponding keyways or gaps on the other sockets. The others all face straight down toward the bottom or handle edge of the tester. However, this non-conformity does not detract from appearance; nor does it produce any problems in use.

Fig. 2. Connections for the various lugs of the noval socket are taken from adjacent loctal and 7-prong sockets.



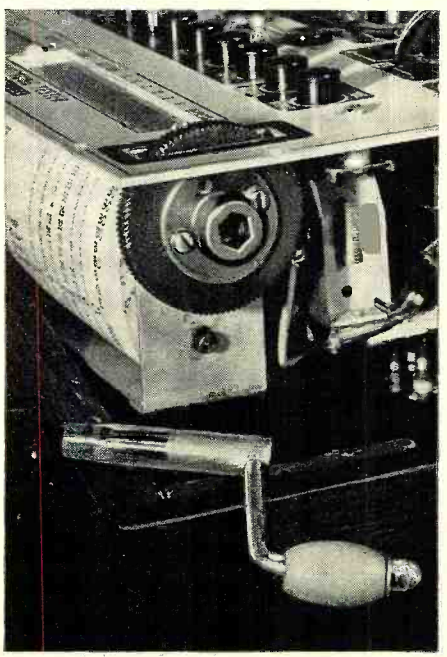
The socket hole was made by tracing the socket proper on the face of the chassis. A series of very small holes was drilled around the inner perimeter of the circle, very close to each other, and then the center piece itself was gently pushed out. A tapered, cylindrical grinding stone was fitted in the electric drill to grind the hole round. With the socket mounted, it was then necessary to determine the source of wiring to each pin. Fig. 2 illustrates the manner in which this was done, using convenient points on the 7-prong and lock-in or loctal sockets.

To test the noval tubes that require 19 filament volts on the *Precision* 912P, it was necessary to connect a 40-ohm wirewound resistor between lugs 9 and 12 of switch *B*. Lug 9 has a red-and-black wire already attached, and lug 12 is bare. If any difficulty is encountered in identifying these lugs, it is suggested that control switch *B* be turned to position 9. Then, by turning the chassis over and looking at the rear of the switch, lug 9 can be identified as the one to which the rotating lever is making contact; lug 12 can be identified in a like manner.

Operation of the roll chart by the composition thumb wheel provided, a tedious process with the old chart, is highly impractical with the new, longer roll chart incorporating larger print and spacing and the addition of later released tube type settings. The addition of a hand crank, shown in Figs. 1 and 3, to the existing drive mechan-

(*Continued on page* 164)

Fig. 3. Roll chart assembly lifted out of case to show how crank mount is added.



used on many TV receivers. To meet the particular requirements of this receiver, as well as in answer to other demands for such a type, *Sylvania's* Receiving Tube Division developed the 10DE7.

The new tube is a twin triode, one section of which has medium *mu,* and is generally similar to either section of the familiar 12AU7A. The other section, especially developed for vertical-output service, is a triode with high perveance. This means that a high value of plate current can be obtained, with zero bias, without having to apply a very high potential to the plate. This is just what is needed to obtain adequate vertical deflection from a normal TV receiver "B+" supply, without reliance on the boost potential.

Concerning the horizontal- and vertical-output transformers, although their external physical appearance does not depart noticeably from what we are accustomed to seeing, there has been some re-design, nevertheless. Closely allied to the design of the flyback transformer is its associated circuit. For comparison, a conventional horizontal-output stage (Fig. 6) is shown, as is the same stage in the *Sylvania* "110" (Fig. 7).

The arrows of Figs. 6 and 7 indicate the direct-current (electron) flow through section *A-B* of transformer T_1 in Fig. 6 and sections *A-B* and *C-D* of transformer T_2 in Fig. 7. In the former, d.c. flows only through section *A-B,* assuming little or no current in the "B boost" circuit; whereas, in the latter, there is also d.c. in the *C-D* winding. In both cases, d.c. in the *A-B* winding is that flowing in the output-tube plate circuit and damper. In Fig. 7 this current plus the d.c. flowing through the output-tube screen-grid circuit also pass through the *C-D* winding, *but in the opposite direction.* Since these opposing currents are about equal, their magnetic fields cancel each other, and the magnetic loading in the iron core of the transformer is greatly reduced.

This d.c. cancellation circuit is one of the factors contributing to the high efficiency of the horizontal-scan system, though by no means the only one. It enables a cost saving due to the use of a smaller core. Also, the smaller core results in a smaller average diameter for the transformer windings, which then results in tighter coupling between different sections. This leads to less leakage inductance and, therefore, in still more efficient operation.

Also worth comparison are capacitors C_1 in Fig. 6 and C_1 in Fig. 7. Despite the difference in location, each functions to filter boosted "B+". C_1 in Fig. 7 also isolates from the d.c. viewpoint, windings *A-B* and *C-D* from each other. C_3 in Fig. 6 keeps d.c. out of the deflection coils and also controls horizontal linearity. C_2 in Fig. 7 performs these functions and also provides additional filtering for the boosted "B+".

The Complete Receiver

While the vertical and horizontal deflection circuits embody departure, in the receiver under discussion, from preceding design practice, the remainder of the receiver, insofar as one can separate some portions of an integrated design from others, is conventional in circuit. In the matter of layout, lead dress, and shielding, special care had to be taken in view of the close spacing of components on the upper chassis board.

Also, with heat-generating components mounted on the conventional metal subchassis below the printed board, care had to be taken to prevent excessive temperature rise of the board itself and the components mounted thereon. Although it is not shown in accompanying illustrations, a heat-deflecting baffle is mounted underneath the upper board to direct warm air out through vent holes in the back cover of the receiver. Ventilation holes were also provided in the bottom of the receiver cabinet and the metal subchassis plate to promote air circulation.

Despite the measures taken to reduce ambient temperature rise, it was found that an increase in resistance occurred in the vertical deflection windings of the yoke as heat rose. This resulted in a reduction of vertical-scan amplitude, or width. Also, since the vertical-output stage is used as one half of the vertical oscillator, this increase in temperature also caused a change in the vertical scanning frequency. To minimize these effects, two thermistors were incorporated in the vertical circuits. A thermistor is a resistor especially designed to decrease its resistance value as its temperature is increased. The thermistors, then, act as regulators to compensate for the undesired changes.

The Consumer Viewpoint

What has been achieved in the "110" receiver that would make it desirable to the consumer? Its light weight and compact size, of course, give it a great deal of maneuverability. However, this is not the only receiver boasting light weight and maneuverability. Equally important is the fact that the use of "stripped-set" design has been avoided. High sensitivity and good noise immunity have been retained. The receiver will thus provide good picture and sound reception in many locations, using its own built-in antenna. Its use around the home and away from it is enhanced. In some physically portable receivers, practical portability is limited by the need to use a sensitive, stationary antenna to make up for the lack of receiver sensitivity.

Around the home, the shallow cabinet depth is of advantage in allowing the receiver to be placed on small tables located close to the wall, on kitchen cabinets, and other such places.

The Service Viewpoint

Examination indicates that the new *Sylvania* receiver is by no means difficult to service, when necessary. All vacuum tubes can be replaced without removing the chassis from the cabinet, after removal of the back cover. There are only two screws locking the chassis to the cabinet, and these are accessible on the outside edge of the cabinet without turning the latter over on its side. In addition to these screws, the chassis is held in position by specially designed chassis feet or supports, which engage in a cut-out

(*Continued on page* 157)

Fig. 6. Conventional horizontal-output/high-voltage circuit.

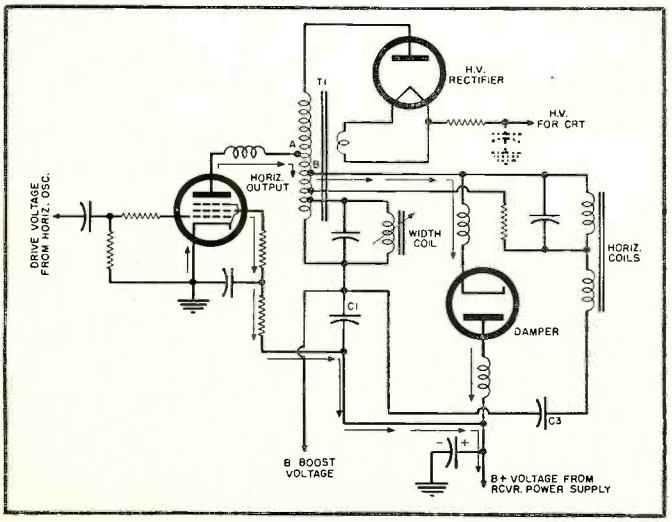
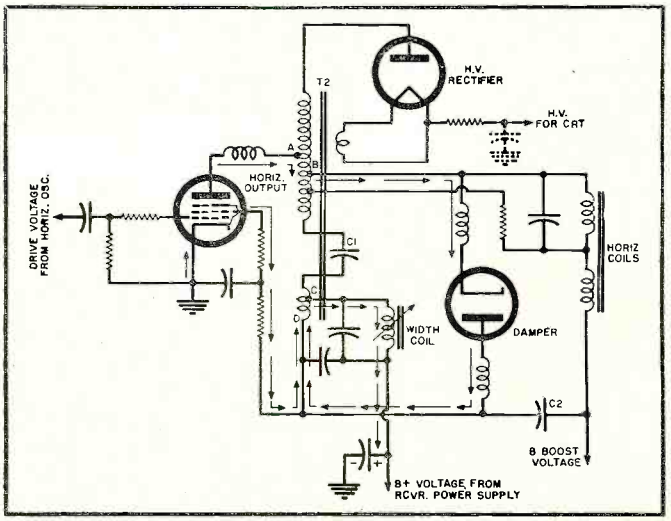


Fig. 7. Horizontal-output circuit for the "110" picture tube.



the wide-angle tube strikes the glass envelope in the region where the flare of the tube joins the neck. As the diagram of Fig. 4 shows, this difficulty is aggravated in the case of the 110-degree CRT. Other problems that arise are those of maintaining a small well-focused scanning spot over the entire area of the screen and of retaining good raster shape; that is, avoiding the effects of pin-cushioning and other distortions.

In considering these problems, it is difficult to separate from one another the CRT itself and the tubes, transformers, and circuit designs in the horizontal and vertical deflection circuits, including the yoke.

Concerning the picture tube itself, and particularly the glass envelope, the contours of the inside and outside glass surfaces, in the region where the neck joins the flare, must be carefully chosen and reproducible in mass production when held to close tolerances. This important aspect of the design was the subject of much discussion between the various engineers involved. It greatly influences the deflection yoke design and is one of the factors determining the amount of power which will have to be provided by the "B+" supply of the receiver.

It is of interest to note here that, since keeping the deflection yoke windings as close to the electron beam as possible and for as great a distance along the beam as possible will result in a reduction of the scanning power required, it is important to have a picture-tube envelope design which will ensure that this can be done. Since extending the yoke windings back along the neck of the envelope too far will result in "corner cutting" and/or interference effects due to excessive extension of the yoke windings over the picture-tube electrode assembly, it becomes important to be able to get the most benefit from extension of the windings along the flare of the envelope. In order to accommodate this situation most effectively, the contours mentioned previously were finalized in a form to agree closely with the path of the deflected electron beam.

The problem just mentioned is not the only one. There were others concerning the curvature of the faceplate and the effects this had on such conflicting factors as structural rigidity, raster shape, over-all focus, and the esthetic appearance of the viewing screen. Compromises had to be worked out carefully.

Nor was the glass envelope the end of all difficulties with the tube. An electrode assembly had to be developed that would work efficiently yet mount in the reduced diameter of the neck. This involved care in using closer spacing of electrodes, yet in avoiding the possibility of voltage breakdown despite the great potential differences between the various electrodes. Also, great care had to be observed in centering the gun. Even processes involving the deposition of the screen coating and aluminization had to be reviewed so as to be satisfactory within the reduced volume of the new tube envelope.

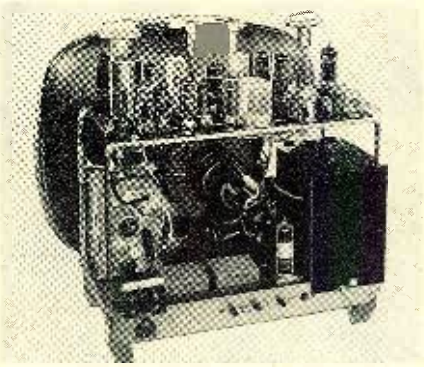


Fig. 2. The "two-story" chassis shown here takes advantage of the shallow picture tube to permit a shallow cabinet.

The Deflection Yoke

The deflection yoke, which is shown in Fig. 5, is new. Although designed by engineers outside the *Sylvania* organization, mutual problems had to be worked out. Safeguards against corner cutting had to be built into this unit too, in addition to those used in the tube and other deflection components; yet high sensitivity was required for the wider sweep. These two factors are essentially in conflict with each other. The magnetic fields produced by the yoke windings must be such that the picture obtained has good geometric shape, with minimum linear distortions, and good over-all focus. Also, crosstalk, or electrical coupling between horizontal and vertical windings, must be kept to a minimum or else interlace of the picture will be upset.

To take into account the factors just mentioned, attention must be given to the shaping of the various windings in the yoke, the manner in which they are wound, their relation to each other, and their disposition with respect to the electron gun and electron beam in the picture tube. As can be noted in Fig. 5, the resultant yoke shows somewhat more flare than those used with earlier CRT's, and appears to be designed to fit farther up the neck of the tube against the bell. The core on which the yoke is wound also shows this flare.

The horizontal-output system in the *Sylvania* "110" is designed for high efficiency. A clue to this efficiency is provided by the tube type used in the horizontal-output stage. Over-all ratings for the 12DQ6A are either equal to or less than the ratings of tubes which have, in most cases, been employed for horizontal deflection on receivers using picture tubes with a deflection angle of 90 degrees.

Due to the comparatively high efficiency in this circuit, it was not desirable to operate the tube or tube section used for the vertical-output stage from the boosted "B+" supply, as is often done in TV receiver design. Efficiency in the horizontal system being what it is, additional power required by the vertical stage would be comparable to the total power dissipated in the flyback transformer, horizontal-output tube plate circuit, and other portions of the horizontal system. The horizontal-output and damper tubes would then be pushed outside their safe ratings for reliable operation. The next step would be to replace these with tubes having higher ratings, and this would mean an increase in receiver cost.

What was required to provide vertical scan in the most economical manner was a tube that would not only provide the power needed for the vertical-deflection coils, but would enable this power to be obtained, with satisfactory linearity, from a 250-volt "B+" supply. Additionally, it was considered economically desirable to combine the function of the vertical oscillator, or driver tube, with that of the output stage. The concept, not new, has been

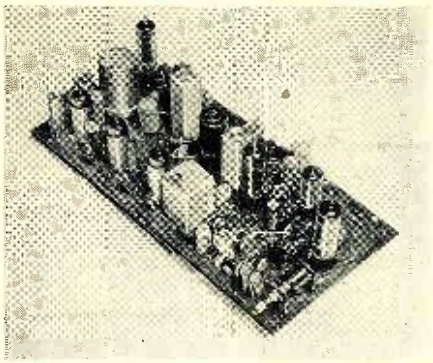


Fig. 3. The upper chassis, shown separately, is a printed board on which most receiver circuits are arranged.

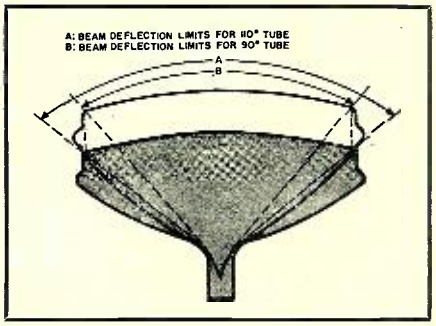
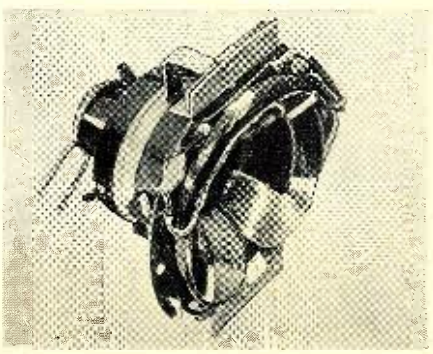


Fig. 4. Outline of the 110-degree CRT (shaded area) superimposed over outline of a 90-degree tube. Note differences in depth of the bell and limits of beam deflection. Also note the greater danger of "corner cutting," elaborated on in the text, with the wider angle tube.

Fig. 5. The "110" deflection yoke.



A Portable with the 110° CRT

By **DEREK SWAINE** and **W. DAN SCHUSTER**

Radio and Television Division
Sylvania Electric Products Inc.

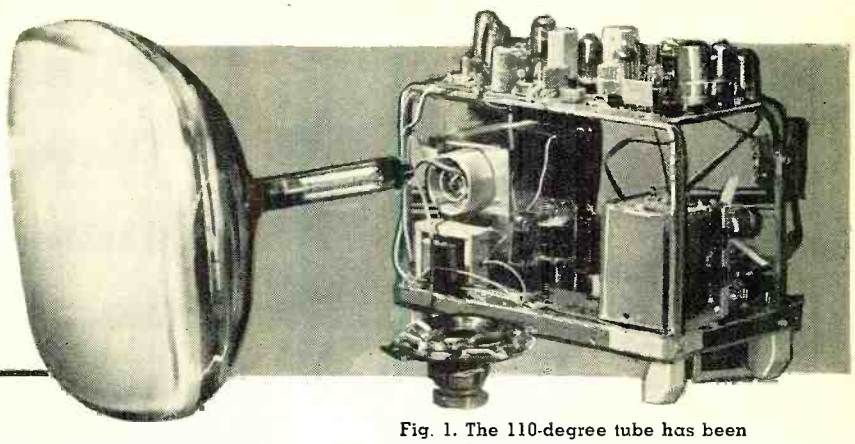


Fig. 1. The 110-degree tube has been drawn forward out of its mounting to provide a front view of the chassis.

As interesting as the wide-angle CRT itself are the circuit changes, redesigned components and new concepts in chassis layout it has engendered.

THE GREATEST single factor influencing the over-all dimensions and weight of a TV receiver is the picture tube. Not many years ago, for example, the minimum depth of a set using a 16-inch tube had to be 22⅝ inches. This was the total length of the then current 16-inch round tube with a 53-degree deflection angle, like the 16LP4. Weight of the tubes themselves was on the order of 20 pounds. Contrast this with today's 17BVP4 rectangular, 17-inch, 110-degree CRT, whose maximum length is 13⁹⁄₁₆ inches, weighing in at 10 pounds. It is shown in Fig. 1 together with its associated set.

With tubes like the 17BVP4 and its 110-degree cousins, a substantial step forward is possible in the direction of a lighter, more compact receiver that nevertheless produces an image of good size. The starting point, of course, is the tube itself, which incorporates some noteworthy features distinguishing it from earlier picture tubes; but also important in the story are the changes in deflection circuitry that grow out of use of this CRT and revisions in the philosophy of chassis layout that were developed to answer the challenge of having less space with which to work. The final receiver is a tribute to the cooperation that can be achieved among engineering and design elements in such ordinarily separated departments as those relating to CRT development, receiving-tube design, circuit design, component design, and physical layout and fabrication.

It can be seen from Figs. 1 and 2 that the chassis of the new *Sylvania* portable consists of two main parts, a lower chassis of conventional metal construction and an upper "printed-board" chassis. This allows required parts to be accommodated in a cabinet of reduced depth. Why was the single-plate, vertically mounted, form of construction not used? First, due to the shortened neck length of the new picture tube, there is a limited amount of space for the larger components to be mounted on a vertical plate, which would come close to the tube's bell. Also leads, cableforms, or costly mechanical couplings have to be used to accommodate the various primary controls if side mounting is to be avoided. Top controls were considered to be more desirable.

All of the controls in this portable, except for those on the tuner, are mounted as close as possible to the circuits with which they are associated. With the bulk of these circuits located on the upper chassis board, such problems as unwanted pick-up, excessive lead capacitance, and cross-coupling between circuits are avoided, and simple mechanical coupling is retained. The result has been a light, compact receiver with a picture of good size (150 square inches) while good circuit design has not been sacrificed. The cabinet is 13¹⁷⁄₁₆ inches high, 16⁹⁄₁₆ inches wide, and 15⅛ inches deep. Weight is 34 pounds. Yet the receiver features three full stages of video i.f. amplification on v.h.f. (five in u.h.f.); gated, amplified a.g.c.; and a noise-gated sync separator, to mention some design characteristics.

Included in the 16-tube complement are the CRT and five multi-purpose tubes. Two selenium power-supply rectifiers, a dual-selenium diode as the horizontal phase detector, and a germanium diode as the video detector perform functions often otherwise handled by conventional tubes. An additional tube and crystal are used in u.h.f. models.

In addition to the greater uniformity, reduced weight, and more compact design made possible by the use of a printed board for the upper subchassis, a convenience is provided for the service technician. The board is of the "see-through" type, so that circuit interconnections can be traced from one side when a light is played through from the other side. Also, it is relatively simple to remove the upper section, shown separately in Fig. 3, for service.

Not including tubes, about 135 parts are on the upper chassis board, with only about 50 on the lower plate. Thus, about 70 per-cent of receiver components and circuits are on the upper section. This estimate does not include the tuner, which is conventionally a separate entity. Relegated to the lower section are such components that need more generous spacing because of their heat production or because they do not lend themselves to automatically assembled circuits. These include the power supply and deflection circuits and components.

The Tube Itself

The length of a picture tube can be decreased in two ways without reducing screen area. One is to reduce the length of the neck portion itself. This will generally involve changes in the gun structure. The other method is to reduce the distance to the screen from the point where the neck joins the flare of the bell. The latter change, of course, involves an increase in the deflection angle. Both methods have been used in the new 110-degree tubes. Provided that the electron gun structure does not extend too far into the magnetic field of the deflection yoke and also provided that the magnetic field strength of the beam-centering unit used is not too great, the reduction in neck length is not a serious problem to the receiver designer. Where the deflection angle has been increased, this individual must face several problems.

One of the problems is the increase required in magnetic field strength to sweep the electron beam through the wider angle to scan the screen area fully. This problem has been alleviated to a considerable degree, it should be noted, by a reduction in the diameter of the picture-tube neck from 1⁷⁄₁₆ inches nominal to 1⅛ inches nominal. This permits the yoke windings to be brought closer to the electron beam.

Also to be reckoned with is the problem of avoiding "corner cutting" and the neck shadows that result from this phenomenon. This occurs when the more widely deflected electron beam of

age being applied to the speaker is only about one half of the input. This is to be expected since in this region the speaker impedance is about the same as the resistance of the series resistor so that the voltage divides equally between speaker and resistor. At the location of the two impedance peaks at 40 and 80 cps, however, the voltage applied to the speaker rises to practically the full value of the input. This is also to be expected since the speaker impedance has risen to a high value at these two frequencies. As a result, most of the applied voltage appears across the speaker while only a very small amount is lost across the series resistor. The voltage curve now shows two peaks corresponding to the impedance peaks in Fig. 1. Somewhat the same effect takes place at the higher frequencies. Above 1 or 2 kc. as the speaker impedance continues its gradual and normal rise with frequency, more of the applied voltage appears across the speaker and less voltage is lost across the series resistor. It can be seen, then, that the lower curve rises gradually toward the upper curve at the higher frequencies.

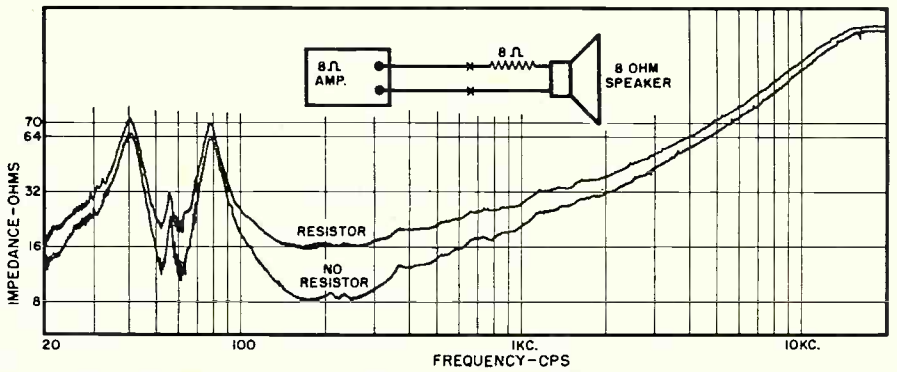


Fig. 1. Impedance curves of 8-ohm speaker in tuned baffle with series resistor.

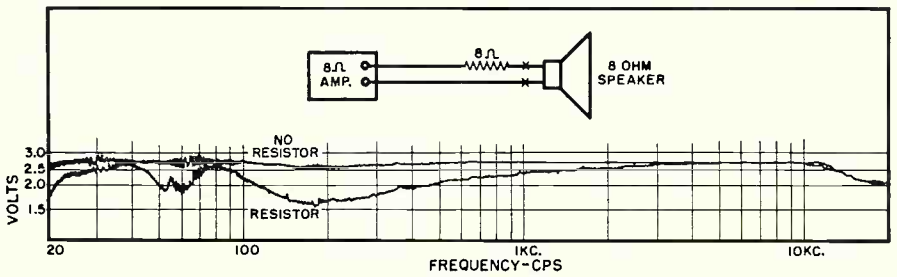


Fig. 2. Voltage delivered across the voice coil from a constant voltage source.

Speaker Response

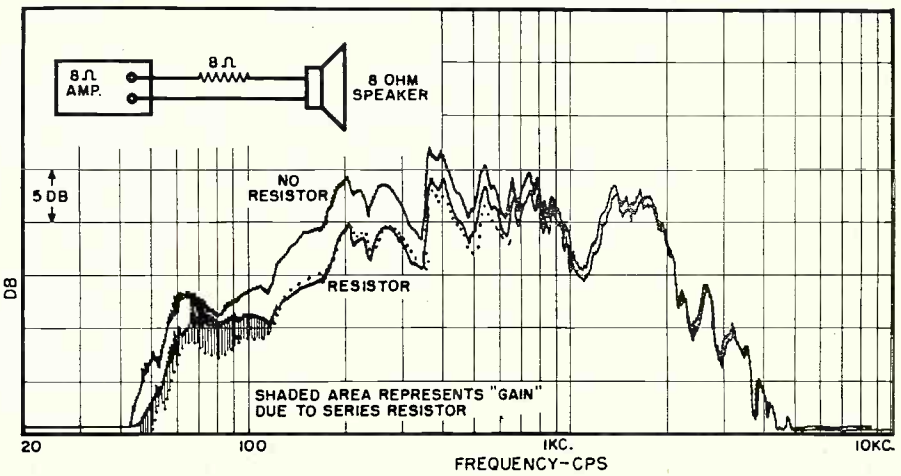
Now what does all this mean as far as the final performance of the system is concerned? We might guess that in accordance with the lower curve of Fig. 2 there would be a loss of response by about 6 db at the mid-frequencies around 200 cps. This would result from the fact that only one half of the input voltage would be applied to the speaker. Then, at the frequencies of the impedance peaks, an increased output should occur. Examination of the curves of Fig. 3 shows that this is what actually takes place. The upper curve shows the acoustic output of the speaker without the resistor in place, while the lower curve shows the acoustic output using the resistor. Note that the curve with the resistor is about 6 db lower than the other curve at frequencies around 200 cps. Then at lower frequencies, on the order of 70 to 80 cps, the response rises to almost that value of output obtained without the resistor. Actually, if the upper curve is superimposed on the lower one such that the responses at 200 cps coincide, then it is easy to see the amount of "gain" in low-frequency response due to the series resistor. Much the same effect occurs at the higher frequencies, above about 1 kc. Since the speaker in use had no measurable output below 40 or 50 cps, no effects could be noted here.

The addition of a series resistor would thus seem to be quite useful when a heavily damped speaker is used since the bass output of such speakers is frequently quite low unless proper loading is supplied by the enclosure. The resistor would appear to be most useful when such speakers are installed in infinite baffles where the bass response is not particularly enhanced.

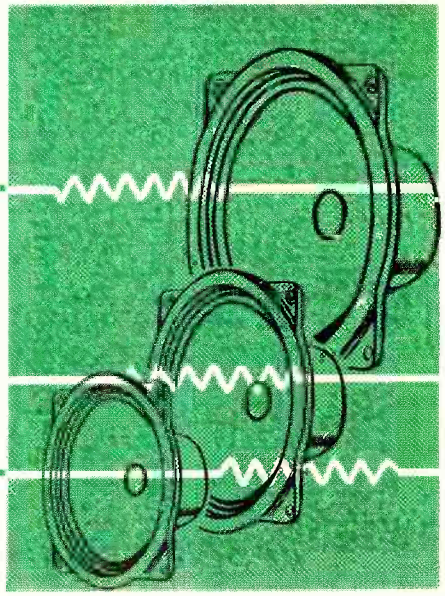
When the 8-ohm resistor is inserted in series with the 8-ohm speaker, then the primary impedance of the output transformer is increased. As a result, there will be an impedance mismatch to the plate circuits of the output tubes. This means, then, that not only will there be a power loss in the series resistor itself, but there will also be a power loss due to the mismatch. To minimize the effect of this mismatch, it is recommended that when such an arrangement is used, connection should be made to the 16-ohm tap on the output transformer instead of the 8-ohm tap, which would be used for the speaker without the resistor. In the case of a 16-ohm speaker used with a 16-ohm resistor this would, of course, not be possible unless the output transformer had a 32-ohm tap. In this case, then, we would have to tolerate the added power loss. With amplifiers that use a large amount of negative feedback, the change in power delivered due to the mismatch may not be too significant.

One final effect of an impedance mismatch should be considered and that is the change in distortion that would occur. In some cases, a rise in the primary impedance of the output transformer would result in more distortion, in other cases it would result in less distortion. What happens to the distortion depends on the circuit configuration and the operating conditions. In some circuits using push-pull pentodes operating class A or AB_1, distortion is apt to increase with an increase in load. On the other hand, with most circuits using push-pull triodes or push-pull pentodes operating class AB_2 or "Ultra-Linear," distortion will usually be reduced somewhat. —30—

Fig. 3. Acoustic output response curves of speaker showing final performance characteristics with and without the series resistor. Since the speaker used in the tests was a relatively low-priced unit, its low-frequency response drops off rather rapidly, as was expected. In reporting these results and since a woofer type speaker was used, no attempt was made to show results at the high-frequency end. There is, however, a boost at this end as well as at low end.



Speaker Damping with Series Resistor



Effects on loudspeaker response when amplifier's effective damping is reduced by series resistor.

FAIRLY recently, the questions "What is an amplifier's damping factor?" and "What damping factor should be used with a particular loudspeaker system?" have become rather common. Some aspects of the damping factor question have been answered already, but there are a good many other factors which we are just beginning to probe. A thorough discussion of these factors would involve the amplifier used and its circuitry, particularly the output transformer, as well as the speaker used and its enclosure. This article will confine itself to only one small phase of the subject, and that involves the modifying of an amplifier's effective damping factor simply by the addition of a series resistor in the loudspeaker circuit.

As a result of our recent assembly of a *Heathkit* "Legato" speaker enclosure system, your editors became quite curious as to the purpose of a certain series resistor that the kit manufacturer included. This resistor has a value equal to the nominal input impedance of the speaker system and it was recommended that the resistor be inserted in series with the speaker system if it were to be used with a power amplifier that does not have variable damping.

Assume, for example, that our speaker is connected to the 16-ohm output tap of a certain amplifier and we find that the actual source impedance of the unit is 2 ohms. Then the damping factor of this particular amplifier is 16/2 or 8. In general, as more negative feedback is used, the amplifier's source impedance falls, its damping rises, and its damping factor* increases. Modern tetrode amplifiers have damping factors on the order of 1 to 10, depending on the amount of feedback used. "Ultra-Linear" circuits may have damping factors ranging from 10 to 30.

Now what happens to our amplifier's damping factor when we insert a series resistor that is equal to the nominal impedance of the loudspeaker? Actually, we have not changed the amplifier itself so that one might say that its damping factor is unaffected. But as far as the loudspeaker load is concerned, the effect is just as though the damping factor of the amplifier has been reduced to just under 1. In the example just given, the effective damping factor with an added 16-ohm resistor is $16/(2+16)$ or about .9.

Following the kit manufacturer's instructions, then, would have produced a system with a damping factor of about 1. Note that the use of the resistor was not recommended when the speaker system is to be used with an amplifier having provision for variable damping. Under these conditions it would be possible to adjust the damping control for a damping factor of 1 without using an external series resistor. Readers familiar with the AR-1 speaker system will recognize that a similar arrangement is used there. A series resistor having a value that is close to the speaker's nominal impedance is used to lower the effective damping factor of the power amplifier used to drive the system.

In order to see (and hear) the effect of this series resistor, we made certain measurements which we have shown here. A fairly inexpensive 15-inch 8-ohm woofer mounted in a bass-reflex enclosure was used for all tests. No attempt was made to check the matching of enclosure to speaker (although the curves show that it was quite good). Nor were we particularly interested in the over-all response of the speaker itself. What we were interested in was strictly a comparison between the operation of the speaker both with and without a series 8-ohm resistor. In all cases the measurements were taken using an amplifier having a very high damping factor.

The curves shown in Fig. 1 represent the impedance seen by the amplifier under the conditions of loading simply by the loudspeaker itself and then when loaded by the loudspeaker and a series resistor. Impedance measurements were made at the points marked "*X*" in the diagram. It can be seen that there are less impedance variations seen by the amplifier when the loudspeaker circuit employs the series resistor. When the resistor is not used, the ratio of impedances from peak to trough (bottom curve) is 64 to 8 or 8 to 1. When the resistor is inserted (top curve), the ratio of peak to trough impedances is 70 to 16, or less than 4.5 to 1. Thus, with the series resistor inserted in the loudspeaker circuit, the amplifier sees less variations in impedance. The reason for this difference in impedance is that in the trough area the speaker impedance is almost wholly resistive and, therefore, adding an 8-ohm resistor to the 8-ohm impedance of the speaker results in a total impedance of 16 ohms. However, in the peak areas, the impedance of the speaker is only partly resistive and has greater motional impedance. Therefore the effect of the rather small series resistor compared with the rather large peak impedance is markedly less.

The addition of the resistor actually unloads the amplifier and effectively reduces the damping factor. Without the resistor, the speaker sees the low internal impedance of the amplifier. With the resistor, it now sees a higher internal impedance and, therefore, the system is less heavily damped.

The voltage curves of Fig. 2 were obtained directly across the speaker itself. The top curve was obtained with no resistor in the circuit. Note that the voltage across the speaker is quite constant over the entire range. The amplifier is operating as a constant voltage source with a high damping factor. But with the resistor in the circuit (lower curve), quite a change occurs as a result of de-regulating the amplifier. Note that in the trough area around 200 cps the volt-

* The damping factor of an amplifier is defined as the ratio between the nominal output impedance and the actual measured output impedance seen by the load. Refer to the article "Control of Amplifier Damping Factor" by David Hafler in the July, 1955 issue.

Electronics at Redstone Arsenal

This Alabama center for some of Army's "wonder weapons" relies heavily on electronics in research and development.

REDSTONE ARSENAL which has given its name to the medium range ballistics missile shown on this month's cover being fired from the Air Force Missile Test Center at Patrick AFB in Florida, has been to the Army's rocket and guided missile program what Detroit is to the nation's automobile industry.

Located in Huntsville, Alabama, the 40,000-acre installation is the control center of all Army activities in the new field of "wonder weapons." Redstone is charged, not only with research and development, but with industrial procurement, storage, and repair of the entire group of Army Ordnance missiles, plus the training of maintenance personnel.

From efforts largely centered here have come such weapons as the "Nike," "Honest John," "Corporal," "Redstone," and other missiles which comprise one of our first-line defense activities.

Guiding and controlling these complex units require intricate electronic, gyroscopic, and other systems made of thousands of separate parts. The "brain" of the rocket can be based on many systems, including response to light, temperature, time, direction, radar, radio, magnetism, heat, speed, or the density of the outside air. Instruments can be provided to handle these signals. To devise parts of the control so that they will respond invariably and promptly to the signals, under the extreme conditions imposed on the rocket in flight, is the real task. The missile is in the air for a short time only. Variations that occur in its flight must be sensed and instantaneously corrected.

These achievements would not have been possible were it not for the recent introduction of almost fantastic electronic equipment which forms the backbone of guided missile development.

Naturally, the complex weapons systems rely heavily on electronics during their actual operation. But just as important is the role of electronics during the designing and testing stages.

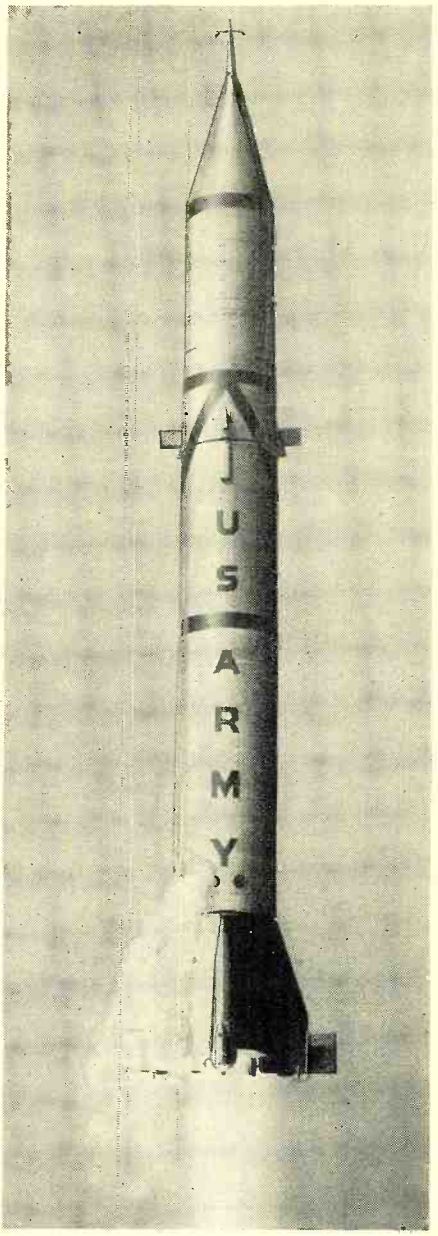
Early flight tests of a hypothetical missile could provide much valuable information to the scientist and engineer. But the cost of assembling and firing a completely untried missile or rocket is prohibitive. And thus the need arises for extensive static testing and simulated firings—all of this in preparation for the coming flight test.

When a missile is statically test fired, a lot of things begin to happen—and fast. The length of most static tests is measured in seconds. When 50 or more variables are to be recorded in a single test, it is easy to see why nerveless, lightning-fast instruments are relied upon to "freeze" the all-important data, so that comparatively slow-speed human beings can study the results at leisure.

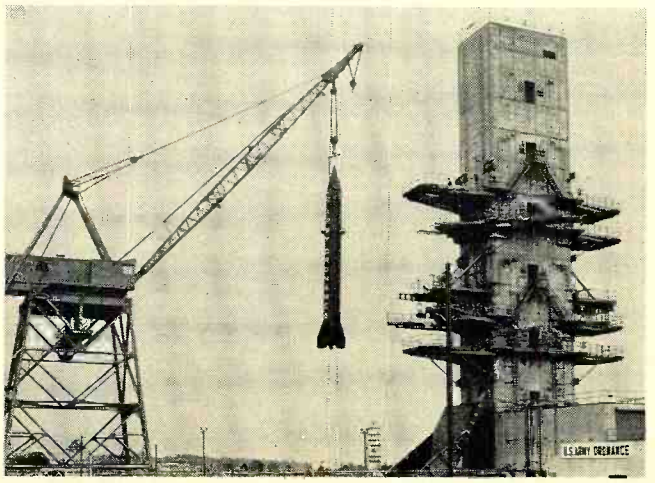
Hundreds of indispensable electronic recording and calculating instruments daily compile accurate data of importance to research and development that would be practically unobtainable without their aid. These electronic instruments save unknown thousands of valuable scientific manhours by relieving engineers and technicians of time-consuming, repetitious tasks of data collecting and routine computation.

For example, a new type computer can solve in five minutes a ballistic trajectory problem which would require a man more than a year to complete. The computer's solution would also be double-checked at the same time.

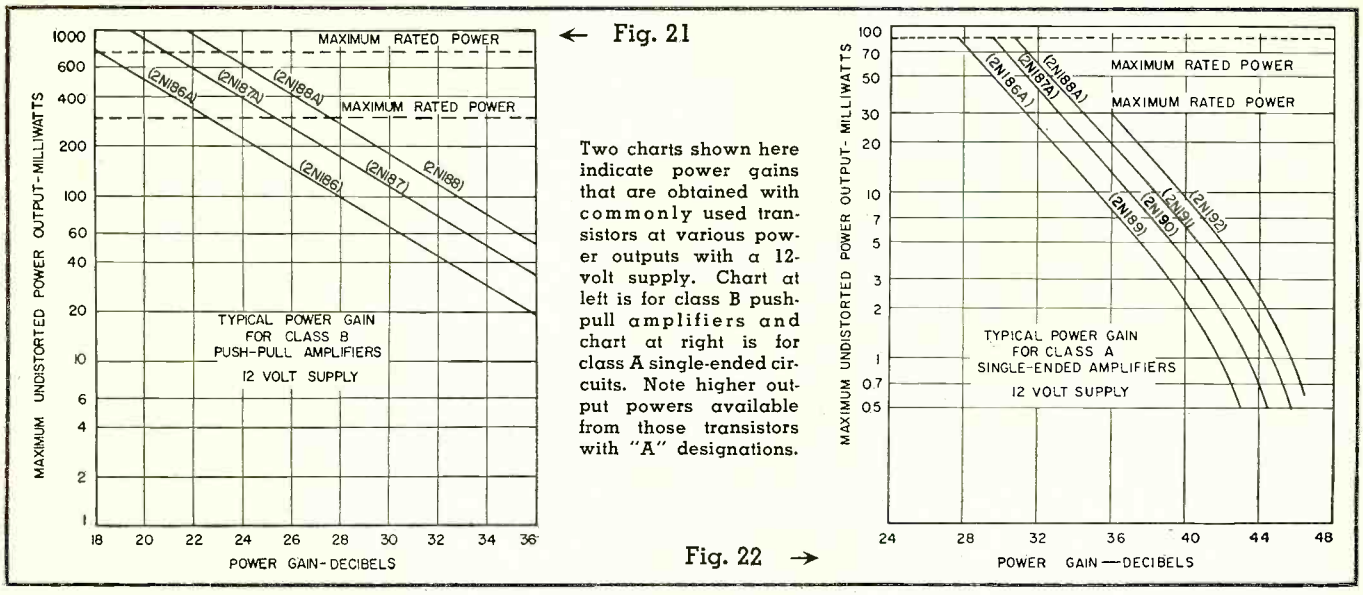
Thus the frontiers of science are being pushed ahead at an unprecedented rate—giving us a truly modern Army ready to provide a formidable defense arm for the free world. —30—



The "Redstone" medium range ballistic missile is fired from a vertical position and tilts into a ballistic trajectory during the early stages of its ascent. This 69-foot weapon is under advance development at the Army Ballistic Missile Agency, Ala.



Static testing of missiles is accomplished at the Agency's 15-story test stand. A giant crane is used to place the "Redstone" missile in place in steel vises which will hold weapon in place during subsequent testing procedures.



← Fig. 21

Two charts shown here indicate power gains that are obtained with commonly used transistors at various power outputs with a 12-volt supply. Chart at left is for class B push-pull amplifiers and chart at right is for class A single-ended circuits. Note higher output powers available from those transistors with "A" designations.

Fig. 22 →

be shown that the maximum a.c. output power without clipping using a push-pull stage is given by the formula:

$$P_{out} = \frac{I_{max} E_c}{2}$$

Since the load resistance is equal to $R_L = \frac{E_c}{I_{max}}$ and the collector-to-collector impedance is four times the load resistance per collector, the output power is given by the formula:

$$P_o = \frac{2 E_c^2}{R_{c-c}}$$

Thus, for a specified output power and supply voltage the collector-to-collector load resistance can be determined. For output power on the order of 50 mw. to 750 mw., the load impedance is so low that it is essentially a short circuit compared to the output impedance of the transistors. Thus, unlike small signal amplifiers, no attempt is made to match the output impedance of transistors in power output stages.

The power gain is given by the formula:

$$Power\ Gain = \frac{P_{out}}{P_{in}} = \frac{I_o^2 R_L}{I_{in}^2 R_{in}}$$

Since $\frac{I_o}{I_{in}}$ is equal to the current gain, *beta*, for small load resistance, the power gain formula can be written as:

$$P.G. = \beta^2 \left(\frac{R_{c-c}}{R_{b-b}} \right)$$

where: R_{c-c} = collector-to-collector load resistance
R_{b-b} = base-to-base input resistance
β = grounded-emitter current gain

Since the load resistance is determined by the required maximum undistorted output power, the power gain can be written in terms of the maximum output power by combining equations (the previous equations) to give:

$$P.G. = \frac{2\beta^2 E_c^2}{R_{b-b} P_{out}}$$

Class A Driver Stages

For a required output power of 250 mw., the typical gain for a push-pull output stage would be on the order of 23 db. Thus the input power to the output stage would be about 1 to 2 mw. The load resistance of a class A driver stage is then determined by the power that must be furnished to the output stage and this load resistance is given by the equation:

$$R_L = \frac{E_c^2}{2 P_o}$$

For output powers on the order of a few milliwatts, the load resistance is not negligible in comparison to the output impedance of the transistors, therefore, more exact equations must be used to determine the power gain of a class A driver stage. From four-terminal network theory, after making appropriate approximations, it can be shown that the voltage gain is given by the formula:

$$A_V = \frac{R_L}{h_{ib}}$$

where: h_{ib} = grounded base input impedance.

The current gain is given by the formula:

$$A_I = \frac{\alpha}{1 - \alpha + R_L h_{ob}}$$

where: h_{ob} = grounded base output admittance

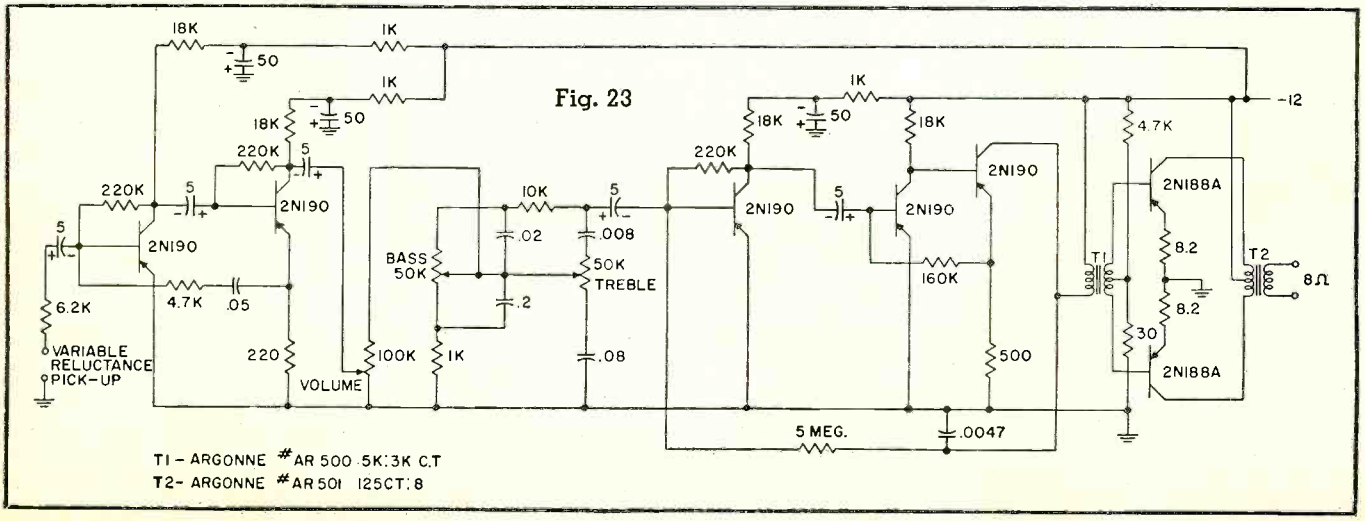
The power gain is the product of the current gain and the voltage gain, thus unlike the formula for high power output stages, there is no simple relationship between required output power and power gain for a class A driver amplifier.

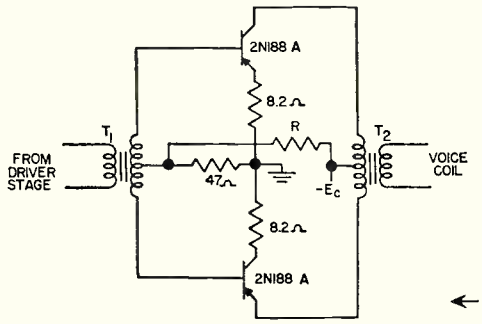
Design Charts

Figs. 16, 17, 21, and 22 are design

(*Continued on page* 109)

Fig. 23





← Fig. 18

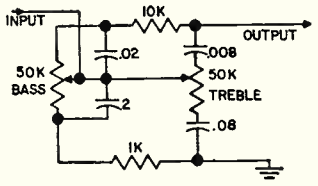


Fig. 19

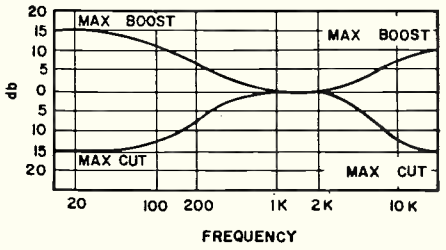


Fig. 20

formulas as are shown in Fig. 10A.

The approximate input resistance is equal to the current gain plus one times h_{ib}. Using this formula, the input resistance comes out 90 ohms. The exact expression for input resistance for this type of circuit is given in Shea's "Principles of Transistor Circuits" and is shown on the right hand side of Fig. 10A. A numerical evaluation of this formula gives the input impedance as 86.5 ohms as compared to 90 ohms from the approximate formula. In order to obtain the correct high-frequency roll-off with a reluctance cartridge, it should be loaded down with about 6200 ohms. Thus the circuit shown in Fig. 7 has 6200 ohms in series with the signal and it is obvious that the difference between 86.5 and 90 ohms is of little significance in the design of this amplifier. The expression for voltage gain for this amplifier is shown in Fig. 10B and is approximately equal to the feedback resistance divided by the input resistance which in this case is about 16. One final point concerning this type of amplifier is that a radio-frequency type transistor such as the *G-E* 2N168 should be used because the output capacitance of a so-called *p-n-p* audio transistor is very high and if an audio transistor were used with a 50,000 load resistance, the high-frequency gain would begin to fall off at roughly 5000 to 10,000 cycles.

The simple amplifier, just described, is not suitable when followed by another transistor amplifier. If the next stage is a transistor, the input impedance of the following stage is very low and there would be essentially no a.c. feedback in the amplifier. There will, of course, be d.c. feedback to stabilize the operating point.

A configuration suitable for transistor amplifiers is shown in Fig. 9. This circuit consists of two *RC*-coupled grounded emitter stages with negative current feedback from the emitter of the second transistor to the base of the first transistor. It is desirable to linearize the current gain with feedback since the input (reluctance pickup plus 6200 ohms series resistance) is essentially a current source. If the feedback capacitance is on the order of 5 μfd. the frequency response will be flat down to 20 cycles. By using a small capacitor, however, it is possible to effectively decrease the feedback at low frequencies and produce a bass boost. To compensate for the RIAA recording characteristics, the response of the preamplifier should have a 500-cycle turnover frequency with the response leveling out again near 50 cycles.

Using the servo-amplifier analogy, an analysis of the configuration of Fig. 9 yields the expression of Fig. 11. The turnover frequency is determined by the time constant of the feedback circuit and the low-frequency response plateau is a function of the open loop current gain. The performance of an actual circuit is shown in Fig. 12 and it can be seen that it is comparable to conventional vacuum-tube circuits.

By adding a resistor in shunt with the capacitor, a more positive control over the low-frequency plateau can be obtained. For example, for a 500-cycle turnover frequency the impedance of the capacitor at 500 cycles should be equal to R_2. A 50-cycle low-frequency plateau is obtained if the resistor shunting C is made equal to $9R_2$.

The biasing methods used in the amplifiers described thus far are suitable for *RC*-coupled amplifiers where the collector voltage is considerably smaller than the supply voltage. A problem arises, however, on the biasing of a driver stage which is transformer-coupled to the output stage. With a transformer load in the collector circuit, a biasing resistor from collector to base is no longer d.c. degenerative since the d.c. resistance in the collector circuit is small. One possible circuit for a small signal amplifier followed by a driver stage is shown in Fig. 13A. This type of biasing will stabilize the collector current of the driver stage, but a large bypass capacitor must be used for good low-frequency response as explained earlier. A better type of circuit is shown in Fig. 13B. The base of the driver stage is directly connected to the collector of the preceding stage and the emitter current of the driver stage is determined by the voltage at the base and the resistance in the emitter circuit. For the circuit shown, the bias current in the driver stage would be 4 ma. The biasing resistor to the base of the first stage is connected to the emitter of the driver stage rather than to the collector of the first transistor. This type of biasing by current feedback makes the bias points more stable than if each transistor were biased separately as in Fig. 13A. The reduction in the number of components by using direct coupling is also quite apparent. Perhaps the most important advantage of the direct-coupled circuit of Fig. 13B is that there are no capacitors to produce phase shift at low frequencies and possible instability. With this direct-coupled circuit it is possible to add another amplifier stage and use feedback around all three stages. A typical circuit of this type is shown in Fig. 14. The resistor from the collector of the driver stage to the base of the first stage makes the output voltage proportional to the input current which is very desirable. It is not necessary to use a d.c. blocking capacitor with the 5-megohm feedback resistance since the d.c. flowing through the resistor will not appreciably affect the bias point.

If the driver transformer has a 5000 ohm primary impedance, the over-all current gain of the amplifier will be 5 megohms/5000 ohms or 1000 as calculated by the formula in Fig. 8. Depending on the frequency response of the transformer, it may be necessary to add a capacitor from the collector of the last transistor to ground in order to prevent high-frequency oscillations. High-frequency oscillations occur because the high-frequency phase shift produced by three cascaded stages is enough to make the feedback at high frequencies positive rather than negative unless precautions are taken.

Class B Push-Pull Outputs

The design of driver and push-pull stages depends on the desired power output so it is necessary to start with the final stage and work backwards. In the majority of applications, the output power is specified so a design will usually begin at this point. The circuit of a typical push-pull class B output stage is shown by Fig. 18.

The voltage divider, consisting of resistor R and the 47-ohm resistor, gives a slight forward bias on the transistors to prevent crossover distortion. Usually about 1/10 of a volt is sufficient to prevent crossover distortion and, under these conditions, the no-signal total collector current is about 3.0 ma. The 8.2 ohm resistors in the emitter leads stabilize the transistors so they will not go into thermal runaway when the junction temperature rises to 60° C. Typical collector characteristics with a load line are shown in Fig. 15. It can

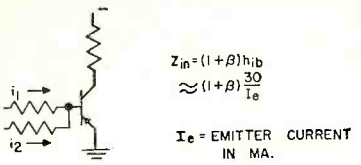


Fig. 1

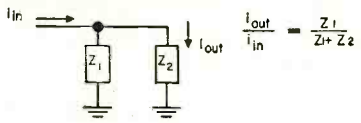


Fig. 2

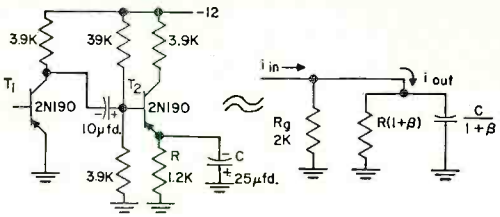


Fig. 3

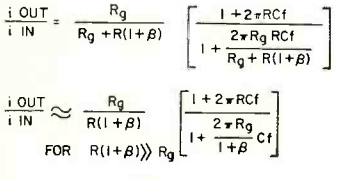


Fig. 4

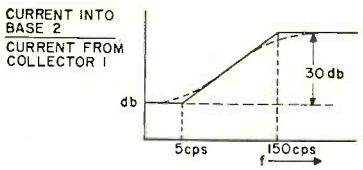


Fig. 5

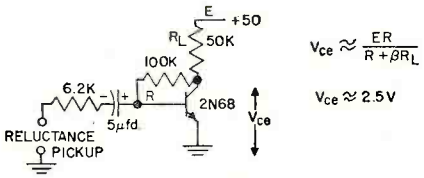


Fig. 7

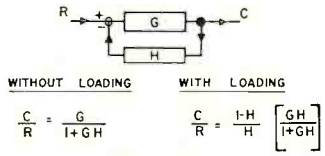


Fig. 6

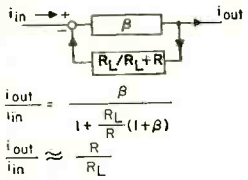


Fig. 8

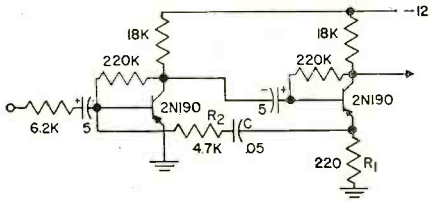


Fig. 9

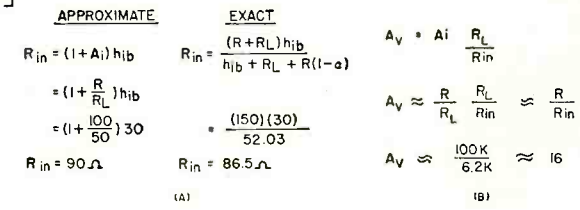


Fig. 10

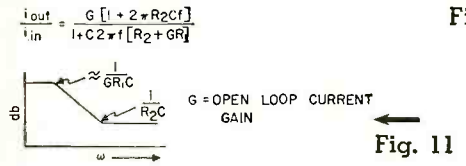


Fig. 11

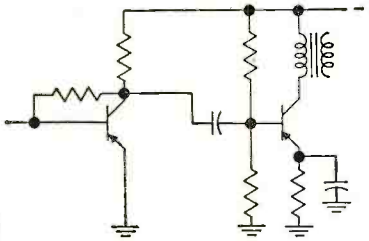
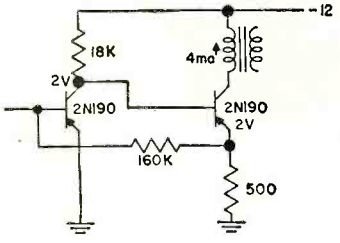


Fig. 13



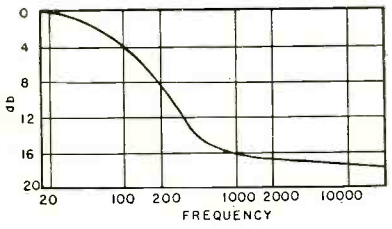


Fig. 12

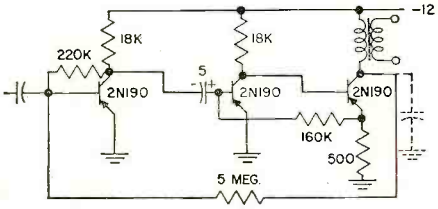


Fig. 14

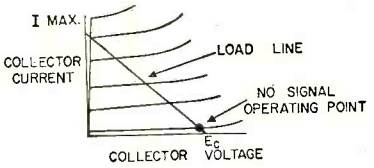


Fig. 15

Fig. 16

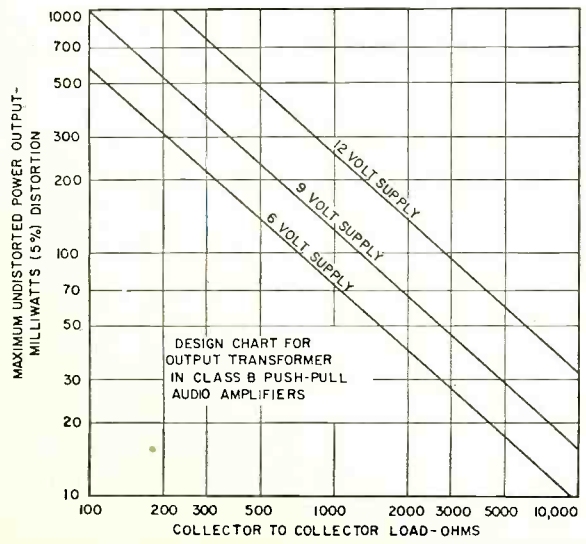
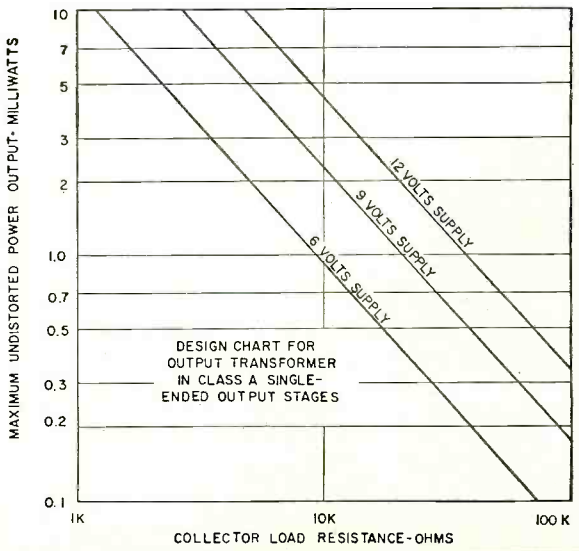
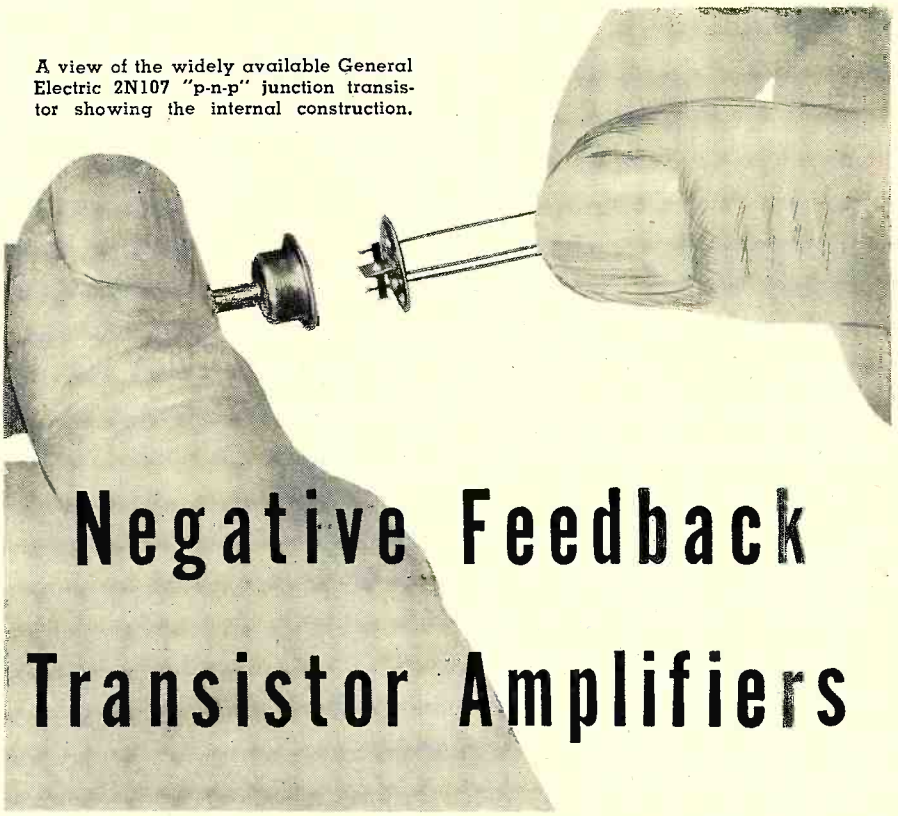


Fig. 17





A view of the widely available General Electric 2N107 "p-n-p" junction transistor showing the internal construction.

Negative Feedback Transistor Amplifiers

By **HUGH R. LOWRY**
Manager, Application Engineering
Semiconductor Products Dept.
General Electric Co.

Complete design data for transistor negative feedback audio amplifiers with high-fidelity characteristics.

VACUUM-TUBE audio amplifiers incorporating negative feedback have always been a popular item with the electronic hobbyist since there is a wealth of material in the literature giving design procedures and showing typical circuits which can be modified if desired.

This situation is not true with transistor audio amplifiers because, until recently, most of the engineering effort has gone into developing circuits that will produce the maximum available gain from a transistor. This type of circuitry gives unsatisfactory results from transistor audio amplifiers since the frequency response tends to be limited, the distortion high, and the performance extremely dependent on the characteristics of the individual transistor.

This article will describe how to design simple transistor negative feedback audio amplifiers that have characteristics good enough for even the "golden eared" group of audio enthusiasts. Before getting into actual circuits, however, it would be best first to review briefly a few basic facts about transistor circuits.

The first important point about transistors is that their input impedance is quite low. As shown in Fig. 1, the input impedance is approximately $Z_{in} = (1 + \beta)\, h_{ib} \approx (1 + \beta) \frac{30}{I_e}$ where β is the grounded-emitter current gain. *Beta* (β) is normally in the range of 30 to 100 making the input impedance roughly 1000 to 3000 ohms. With such a low input impedance, a transistor makes an excellent current adder. If two signals are fed from a source impedance high in comparison to the input impedance, the input current into the transistor will be essentially equal to the sum of these two currents.

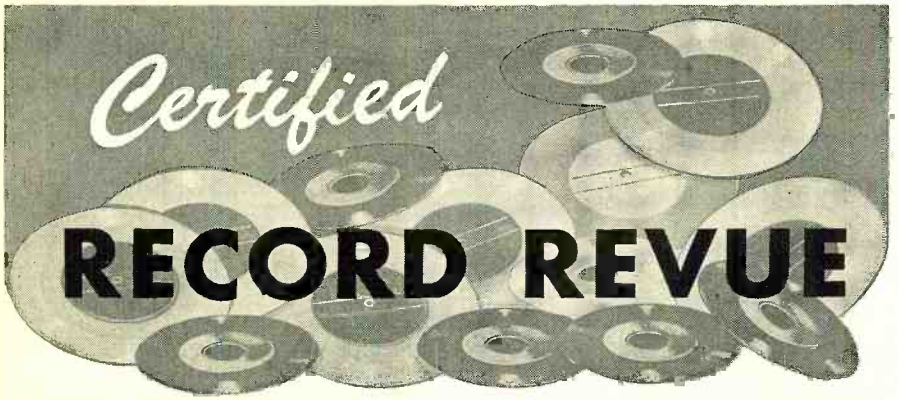
The second fundamental is the concept of a current divider as shown in Fig. 2. If a current source is fed into a network consisting of an impedance Z_1 and Z_2, the output current will be equivalent to $\frac{Z_1}{Z_1 + Z_2}$. An example of these two principles is the analysis of the low-frequency response of the circuit shown in Fig. 3.

Here a transistor biased in the conventional manner is being fed from a transistor amplifier with a 3900 ohm load resistance. The equivalent circuit for low frequency may be approximated as shown on the right on Fig. 3. This equivalent circuit consists of a current source which is feeding into the parallel combination of a generator resistance and input impedance of the transistor. Since the input impedance of a transistor is equal to $(1 + \beta)$ times the impedance of the emitter circuit, the emitter resistance must be multiplied by $(1 + \beta)$ and the bypass capacitor will be divided by $(1 + \beta)$. The formula for the transfer function is shown in Fig. 4 and it can be seen that if $R(1 + \beta)$ is much larger than the generator resistance, the low-frequency 3 db point is determined only by the generator resistance, current gain, and the emitter bypass capacitor. In other words, the emitter bypass capacitor is not bypassing the emitter resistance, but is bypassing a resistance equal to the generator resistance divided by $1 + \beta$. Fig. 5 shows the calculated frequency response of this circuit and it can be seen that even with a 25 μfd. bypass capacitor, the low-frequency response is down 3 db at 150 cycles.

The third fundamental is the concept of the gain of a servo type amplifier. This is shown in Fig. 6. Assuming that the feedback network, denoted by H, does not load the circuit, the gain is equivalent to G divided by $1 + GH$. With loading included, the gain is equal to $\frac{1 - H}{H}\left[\frac{GH}{1 + GH}\right]$.

These fundamentals will now be applied to the problem of high-fidelity audio amplifiers. To start off with, consider the case where a transistor is desired as a linear amplifier to work into a conventional vacuum-tube amplifier. It is also assumed that a variable reluctance pickup is to be used, that the supply voltage is 50 volts, and also that the emitter bypass capacitor be eliminated in order to obtain the best possible low-frequency response. A circuit that would meet these specifications is shown in the diagram Fig. 7.

The biasing is done with a resistance from collector to base and with the circuit shown, the collector-to-emitter bias voltage will be about 2.5 volts. The items of interest would be the current gain, the voltage gain, and the input resistance. If the circuit is analyzed as a servo-amplifier, assuming that the feedback current and input current are added without interaction, the equivalent circuit is shown in Fig. 8. The feedback factor will be equal to the load resistance divided by the load resistance plus the feedback resistance. Putting this into the formula of a servo-amplifier with loading, the current gain is seen to be essentially the feedback resistance divided by the load resistance. At this point, the readers who are familiar with transistor circuitry are probably wondering how good these approximations are since, as is well known, a transistor is a bi-lateral device, there will be a forward transmission through the feedback loop as well as other considerations that must be included in an exact analysis. The degree of approximation can be seen from a comparison of the input resistance using the approximate and exact



By BERT WHYTE

ON more than one occasion, many music lovers of my acquaintance have said to me, "Isn't this record business getting just a little bit out of hand." "How can anyone keep up with this tremendous quantity of releases, and how can the record companies expect the public to absorb the seemingly endless duplication of repertoire." Any thinking person must admit that these are fair questions. As to the quantity of record releases, there are two factors involved here. The first and most important point (and one which is not apparent to the average person) is that the record companies are riding the crest of an ever-expanding market. A market which is not even remotely saturated, and a market where the impact of high fidelity becomes greater every day.

Like J. P. Morgan's classic remark about yachts, "It's not the cost, it's the upkeep," the same is true of people who acquire hi-fi systems. Hearing music with quality beyond anything they imagined, their appetite for records is literally insatiable, and they find themselves buying records at a rate often far in excess of financial prudence. If you consider that the nation's prosperity has created a whole new group of people who can afford the pleasure of hi-fi and recorded music, the mad productivity of the record companies makes a little more sense.

Point two is that hi-fi has existed long enough now, so that many of the older audiophiles have now acquired discrimination. In point of time and the advance of techniques, their favorite music has been issued in recordings with sound qualities far beyond that which was available when they first began their hi-fi activities. They have also greatly broadened their musical horizons and now they are listening to and enjoying music which just a few years ago they would have considered quite esoteric. It all adds up to the fact that although the record market may appear to be rushing pell mell towards saturation, nothing could be further from the truth.

As proof of the rate of expansion of the hi-fi and record market, one need only cite the fact that the crowds were so great at the Los Angeles Hi-Fi Show in February, that the Institute of High Fidelity Manufacturers has decided that the New York Show in September and the next Los Angeles Show will be held for a full week! As further proof, one might mention that the market has grown so quickly that many hi-fi manufacturers have been unable to keep up with the demand for their products. Deliveries, even from many of the big names in the industry, have lagged and much planning is in progress to increase production. From the record critic's viewpoint, the flood of recordings has made our position immeasurably more difficult. Like anything else, there is a great deal of chaff with the wheat, much of which is almost apparent before stylus touches record. Yet even with careful culling, the weight of sheer numbers makes for a very high average of recordings which are worthwhile and which should be brought to your attention. Needless to say the exigencies of available magazine space dictate a certain limitation, and it boils down to the fact that a reviewer can either spend more time and give a more detailed review on a lesser quantity of recordings or bow to the wishes of many people who want more selectivity and thus report quite briefly on a larger number of recordings.

I personally feel that there can be no hard and fast rule in either case. Some recordings can be served quite adequately with a short review . . . others by their nature demand a more searching and careful evaluation and consequently a longer review. As of this month I'll try to strike a happy medium . . . the reviews in general will be shorter in order to report on a greater number of recordings, but I reserve the right to expand the review on any recording which I deem worthy of particular attention. Let's see how this will work out . . . if you have any comments I'd enjoy hearing from you.

STRAVINSKY
OEDIPUS REX

Soloists and Societe Chorale du Brassus with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London XLL1273. RIAA curve. Price $4.98.

This recording competes directly with Stravinsky's own version on a *Columbia* disc. The results are in Stravinsky's favor, but not overwhelmingly so. Ansermet lacks some of the cohesion of Stravinsky's effort, but beyond that there is little to cavil about. If anything, Ansermet has the better soloists and the *London* engineers have afforded him sound quality of a cleaner and brighter hue than the *Columbia* disc can muster. Recommended.

GROFE
GRAND CANYON SUITE
MISSISSIPPI SUITE

Hollywood Bowl Symphony Orchestra conducted by Felix Slatkin. Capitol P8347. RIAA curve. Price $3.98.

Slatkin is a sympathetic conductor for this music and his reading compares favorably with the recent *Victor* version with Fiedler and the Boston Pops. Soundwise, this is nice clean recording, but the sound is drier and leaner than the Boston version. This impression is heightened by the richer, more fulsome playing of the Boston group, whose excellence overshadows the fine work of the Hollywood musicians. The "Mississippi Suite" is splendidly executed and this first LP recording will be welcomed by many. To those who may be unfamiliar with the "Mississippi Suite," let us say that it is not important repertoire, but it is quite pleasant and really most atmospheric.

BARTOK
MUSIC FOR STRINGS, PERCUSSION, AND CELESTA
DANCE SUITE

RIAS Symphony Orchestra conducted by Ferenc Fricsay. Decca DL9747. RIAA curve. Price $3.98.

Too many conductors treat the "Music for Strings, Percussion, and Celesta" as a display piece for their percussion batteries. I'd be the last to deny that percussion is important in this score, but I do feel that many of the existing readings lose sight of the fact that this is a highly integrated, expositional work, the last three movements being logical developments of the material in the first movement. A successful reading requires an appreciation of this and on this premise, Fricsay's handling of the score is masterful. Percussion there is in this work and how magnificently Bartok has used it in all its subtle and savage variants! The sound in this disc is most unusual and is in keeping with Fricsay's conception of the score. Percussion is clean and well defined but it is neatly balanced with a really "big hall," lush and blooming type of sound, much more romantic than in other versions. The percussion thus is meaningful in the demands of the score but is never self-consciously obtrusive. Exceptional string and woodwind playing is a notable feature.

In the "Dance Suite," Fricsay runs into some stiff competition. Performance-wise he is a little slower paced than Autori on a *Bartok* disc or Solti on a *London* recording. There is more grace in this reading yet Fricsay is not lacking in rhythmic vitality. In matters of sound, this is not as wide range as the *Bartok* disc, nor as sharp and pungent as the *London* sound. Here, again, is the concept of a big concert hall sound, very rich and sonorous.

The preferences in either of these works is largely a matter of taste. In the "Strings, Percussion, and Celesta," if you want a bigger serving of percussion, the *Mercury* and *Westminster* discs will certainly satisfy this requirement, and the same can be said of the "Dance Suite" in the *Bartok* and *London* versions. Summing up, superb performances and fine playing with sound the best of its particular type.

BRUCKNER
SYMPHONY #9 IN D MAJOR

Symphony Orchestra of the Bavarian Radio conducted by Eugen Jochum.

BEETHOVEN
FANTASIA IN C MINOR FOR PIANO, ORCHESTRA, AND CHORUS

RIAS Chamber Choir and Berlin Motet Choir with Berlin Philharmonic Orchestra conducted by Fritz Lehmann. Decca DX-139. RIAA curve. Price $9.98. Two discs.

Bruckner, who is on the crest of a recording wave, pops up again—this time his monumental unfinished "9th" symphony, heard here in the original version rather than the usual edition which has many cuts and transpositions. This is a tremendous work and calls for a tremendous orchestra. As you might expect the scoring is extremely massive. As the first movement progresses this is apparent in the increasing use of brass for Bruckner's beloved organ-like brass chorales and fanfares.

Jochum evidently has a fondness for this work, for his conducting shows loving care and a reverent lingering on detail and phrasing, his tempi are more direct than the previous editions and his dynamics somewhat

(*Continued on page* 103)

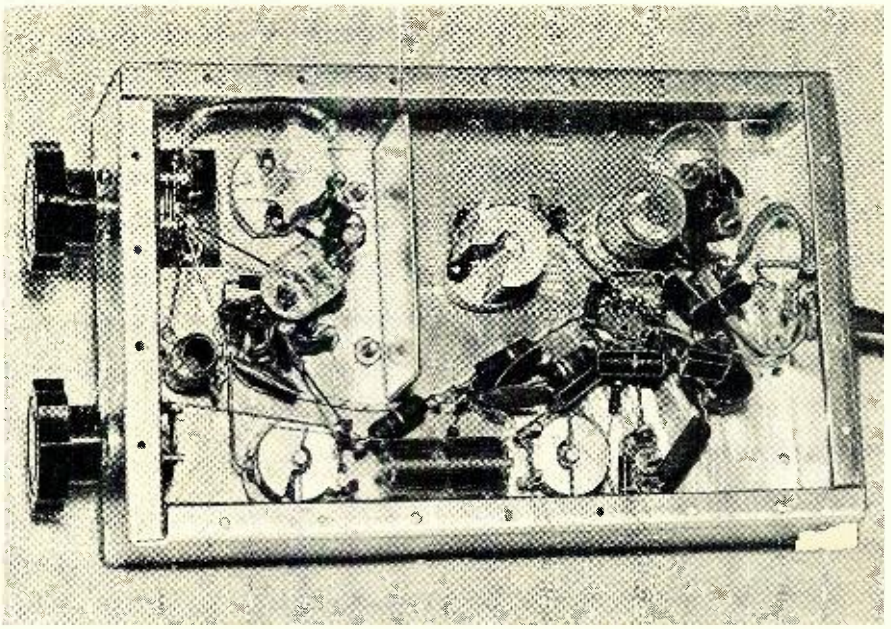
The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

appear at 3.75 and 3.3 mc. respectively.

The tuned circuit in the mixer plate lead is resonant at about 3.5 mc. and is of fairly high-"*Q*" design. A small silver mica capacitor of 27 $\mu\mu$fd. capacitance is connected directly from the 6J6 mixer plate to ground. This capacitor, together with the 100 $\mu\mu$fd. air trimmer, tunes the output circuit to resonance. The purpose of the fixed capacitor is to bypass the 24.75 mc. oscillator signal, which appears in the mixer plate circuit, to ground. This is necessary in order to eliminate the possibility of a spurious response at approximately 21.12 mc. The signal is coupled to the antenna terminal of the HRO by means of a 10-turn link coil wound over the "cold" end of L_5 and a low-capacitance shielded coaxial cable. A standard auto radio antenna lead-in cable makes a satisfactory output cable.

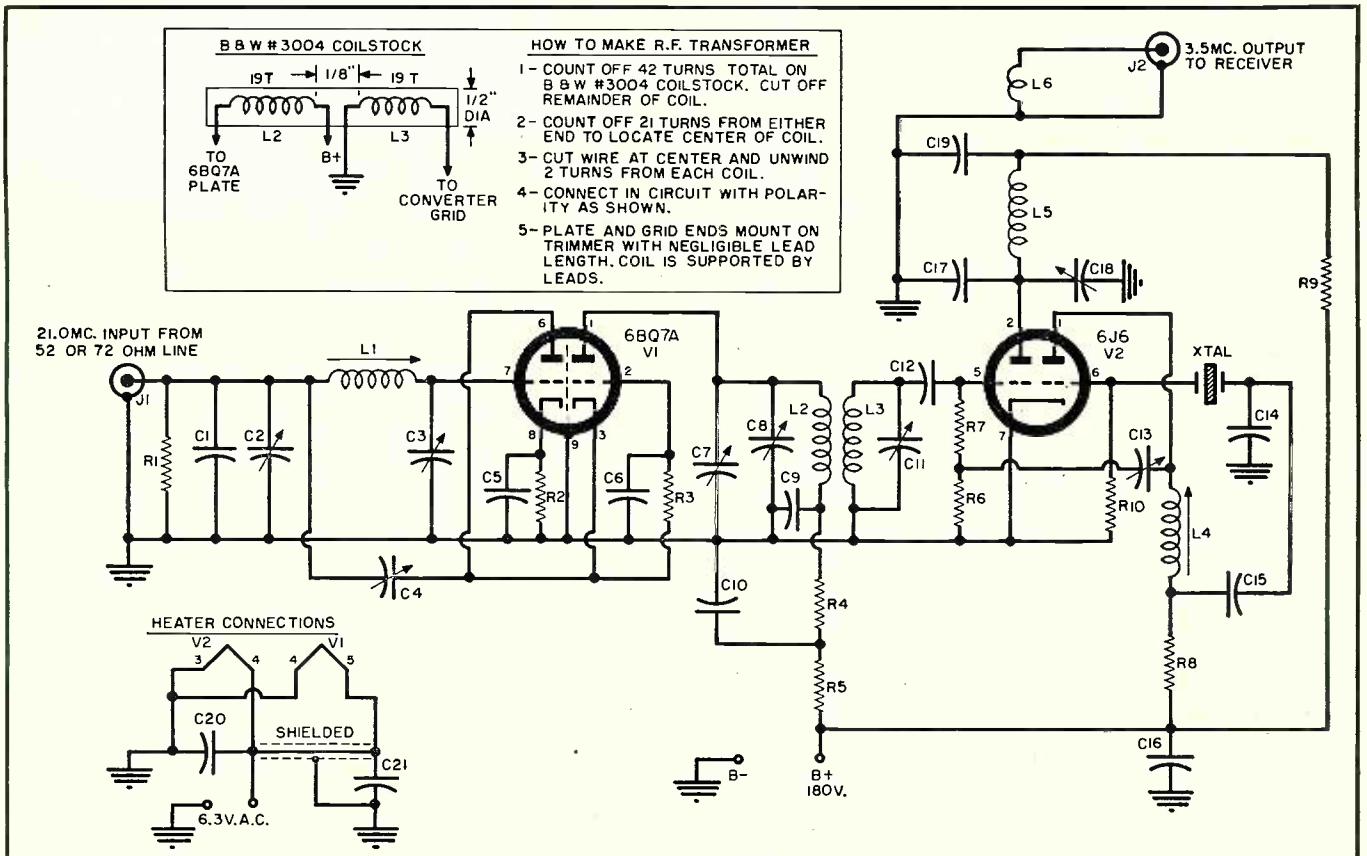
The converter is constructed on the metal top plate cover of a 5"x8"x2" "SeeZak" chassis box. This has the advantage that most of the wiring can

(*Continued on page* 161)



Under-chassis view of low-noise, super-DX, crystal-controlled converter unit. The various trimmer capacitors and coils are clearly visible in the photograph.

Fig. 1. Complete schematic diagram of the converter. Inset describes method used in the construction of the r.f. transformer.



R_1—100,000 ohm, ½ w. res.
R_2—220 ohm, 1 w. res.
R_3—470,000 ohm, ½ w. res.
R_4, R_6, R_7—27,000 ohm, ½ w. res.
R_5—12,000 ohm, ½ w. res.
R_8—56,000 ohm, ½ w. res.
R_9, R_{10}—47,000 ohm, ½ w. res.
C_1—100 $\mu\mu$fd. silver mica capacitor
C_2, C_{18}—100 $\mu\mu$fd. miniature var. capacitor
C_3—15 $\mu\mu$fd. miniature var. capacitor
C_4—1.5-7 $\mu\mu$fd. ceramic trimmer (for neutralizing)
C_5, C_6, C_9, C_{10}, C_{16}, C_{19}, C_{20}, C_{21}—.01 μfd., 600 v. disc ceramic capacitor
C_7, C_{11}—20 $\mu\mu$fd. miniature var. capacitor
C_8—10 $\mu\mu$fd. miniature var. capacitor
C_{12}—120 $\mu\mu$fd. silver mica capacitor
C_{13}—4.5-25 $\mu\mu$fd. ceramic trimmer (for oscillator injection)
C_{14}—50 $\mu\mu$fd. silver mica capacitor
C_{15}—500 $\mu\mu$fd. silver mica capacitor
C_{17}—27 $\mu\mu$fd. silver mica capacitor
L_1—20 t. #26 s.c.c. enamel wire, closewound on ⅜" dia. iron-slug-tuned form (J. W. Miller Type 4400)
L_2, L_3—R.f. trans. Single length of B & W #3004 "Miniductor." Each winding 19 t. #22 wire ½" dia. and 32 t. per-inch spacing. (See inset diagram above)
L_4—10 t. #26 s.c.c. enamel wire, closewound on ⅜" dia. iron-slug-tuned form (J. W. Miller Type 4400)
L_5—1¼ in. of #26 s.c.c. enamel wire, closewound on Amphenol #24 (¾" dia., no prongs) polystyrene coil form
L_6—10 t. #26 s.c.c. enamel wire, closewound over "cold" end of L_5. Wrap one layer of ½" electrical tape over cold end of L_5 before winding L_6
Note: The windings of L_1, L_4, L_5, L_6 are held in place by applying a coat of polystyrene coil cement.
Xtal.—8250 kc. crystal (may be surplus FT-243 type or commercial unit)
J_1, J_2—Phono jack
V_1—6BQ7A tube
V_2—6J6 tube

"Super-DX" 15-Meter Converter

By
HARRY D. HOOTON,
W6TYH

View of author's receiving position, with crystal-controlled converter on top of the receiver.

Low-noise, crystal-controlled, 21-mc. converter of good design and proven performance. Includes front "peaking" controls for 15 db additional gain.

LIKE many other amateurs, the writer owns one of the old HRO-7 communications receivers and is reluctant to part with it because of its very good signal-to-noise ratio. However, tuning on the 15-meter band is difficult due to the extreme frequency crowding on the general coverage coil. The use of a 15-meter bandspread coil, while improving the tuning rate, did not give outstanding results on weak DX stations. It was finally decided to experiment with a crystal-controlled converter in order to improve the sensitivity, stability, and bandspread.

Several broadband converter circuits were tried but most of them were extremely noisy. Since we are interested mostly in DX work, an attempt was made to develop a low-noise unit with high gain. After much experimental work, the converter to be described evolved and has proved to be very satisfactory and superior to the usual broadband type of circuit. See the complete schematic of Fig. 1.

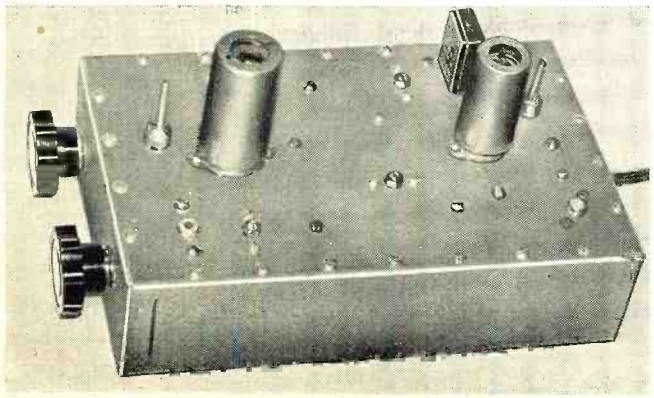
The main difference between this converter and those of previous designs is the use of rather high-"*Q*" tuned circuits in the 6BQ7A r.f. amplifier. The input circuit is a pi-section device which accurately matches either a 52- or 72-ohm coaxial line to the r.f. amplifier grid. The r.f. amplifier uses the popular "cascode" circuit and is neutralized by means of a small ceramic trimmer connected between the 6BQ7A common cathode-plate terminals and the "low" side of the pi network coil.

Effective neutralization permits the use of a high-"Q", selective input circuit which discriminates against cross-modulation effects from strong commercial signals in the vicinity of this amateur band. The use of sharply tuned circuits requires that trimmers must be brought out at the front of the chassis in order to obtain maximum performance on weak signals. The additional gain obtained by matching and peaking the input circuit is approximately 15 db as compared with the ordinary low-"*Q*" broadband coupling arrangement.

The signal from the 6BQ7A output circuit is applied to the 6J6 mixer grid through a double-tuned r.f. transformer. The "*Q*" of the tuned primary is fairly high and it is necessary to bring out a peaking control at the front of the chassis. The grid circuit of the mixer loads the secondary winding and its tuning is quite broad.

The best mixer noise figure was obtained with the input arrangement shown. The mixer grid leak consists of two 27,000 ohm resistors (R_6, R_7) in series to ground with the crystal oscillator signal injected at the junction of the two resistors.

The crystal oscillator is a third harmonic or "overtone" type of circuit arrangement which is very stable. This circuit has never failed to operate properly with either commercial or surplus crystals in good condition. The oscillator injection frequency of 24.750 mc. was selected after much experimental work in the elimination of spurious beats and "birdies" from the tuning range. With this injection frequency no spurious signals are present over the entire tuning range from 21.0 to 21.45 mc. Since the difference between the oscillator injection frequency and the signal frequency determines the "i.f." to which the receiver is tuned, the receiver must be tuned to 3.5 mc. in order to receive a 21.25 mc. signal. The extreme frequencies of the 15-meter band, 21.0 and 21.45 mc., will



Top-chassis view of 15-meter converter unit. Trimmer capacitor and coil slug adjustments are readily accessible. Output and input jacks can be seen on topside.

junction, no smaller current than I_{co} can be passed with reasonable voltage biases.

Fig. 5 corresponds to a very small portion of the transistor family—note that collector currents are in the range under half a milliampere. For many purposes, the difference between cut-off (the lowest we can go) and zero base current can be ignored—however not here.

A load line of 10,000 ohms has been placed on Fig. 5, showing the operation of the amplifier. A six-volt battery is used as a supply. The operating point is determined by the load line and the line of zero base current.

This explains the basis of the floating base bias. The d.c. collector current is just the cut-off current times approximately the transistor current gain, or $I_{co}(\beta + 1)$ with the base left floating. The signal comes into the base *via* a capacitor in each circuit, and varies the bias point slightly on either side of the zero base current point. The result is an amplified signal appearing across the load, as represented in Fig. 5 by moving slightly up and down the load line.

This type of circuit unfortunately has one disadvantage. If your transistor doesn't have the right amount of cut-off current, you may find yourself operating too close to either end of the load line, and thus clipping will occur. Much the same thing will happen if the input capacitor is leaky. Also, operating the transistor considerably above room temperature will increase the cut-off current and push the bias point into saturation.

Because of this last condition, the amplifiers described here should not be run above about 100° F.

The 2N105 transistor was chosen for these amplifiers because of the exceptional uniformity from transistor to transistor. The cut-off current does not vary much from one unit to the next, in contrast with other transistor models. In the author's experience, other, more popular, lines of transistors have not only showed very bad uniformity from one transistor to the next, but also have aged rather rapidly. Since aging always involves changes in cut-off current and gain, it is clear that these transistors are to be avoided.

It may be that recent vacuum baking and hermetic sealing techniques will eliminate the aging headache by driving out the offending oxygen and water vapor, but still the manufacturing tolerances must be considered. The 2N105 is one of few transistors available today that meets the strict requirements as to cut-off current and gain uniformity demanded by the floating base amplifier.

Construction

As mentioned earlier, the physical layout of the amplifiers is up to the reader. The only requirement is that the input from the mike be shielded to keep down hum due to stray 60-cycle fields. The amplifier itself, running from a battery, is otherwise completely free from hum.

Figs. 1 and 2 show views of one of the author's units, designed specifically for the *Astatic* JT-30 crystal mike shown with it. Fig. 4A is the schematic of this amplifier.

The input connector not only makes electrical contact but holds the microphone as well. A standard male chassis connector was used with a female-adapting ring. A push-to-talk switch was used, because of the intended use of the amplifier.

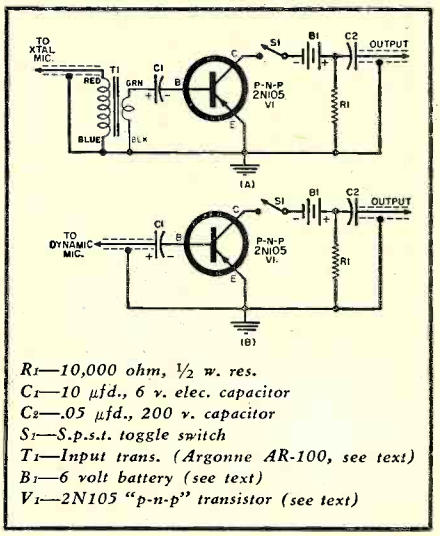
The transformer (*Argonne* AR-100) and the battery holder (as well as the other parts) are available from *Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y. All the parts required fit very easily into the box shown (*ICA* type 29435).

The dynamic mike preamp (Fig. 4B) was wired directly to the mike (*Lafayette* type PA-19). See Figs. 3 and 6 for details. It was made in a mailing box of cardboard; the holes for the toggle switch and output connector were punched out with a knife. This was strictly a "rush" construction job, and no care was taken in trying for neat wiring, etc. Nevertheless, the unit gave good performance until the case broke from wear. For a permanent amplifier, the author recommends something slightly stronger than cardboard!

With some microphones it might be possible to mount the transistor and other small parts right inside the mike case, eliminating all hum problems. In some installations, it may be practical to fasten the amplifier to the mike stand with some kind of clip. Alternatively, it could be built right inside the high-fidelity installation, even drawing power from the amplifier.

The 10,000 ohm load resistor in the circuit was chosen to provide adequate amplification with little chance of having trouble with high-temperature operation. On some microphones of low sensitivity, the preamp described here may not have enough gain. The author has not had any trouble along this line, but microphones have varying sensitivities, and possibly the reader has one partially dead, or otherwise insensitive. In that case, the load resistor can be increased up as high as 30,000 ohms with a little sacrifice in high-temperature operation.

Conversely, if the reader desires high-temperature operation but needs less gain, he can reduce the load resistance to 6000 or 7000 ohms.



R1—10,000 ohm, ½ w. res.
C1—10 μfd., 6 v. elec. capacitor
C2—.05 μfd., 200 v. capacitor
S1—S.p.s.t. toggle switch
T1—Input trans. (Argonne AR-100, see text)
B1—6 volt battery (see text)
V1—2N105 "p-n-p" transistor (see text)

Fig. 4. Floating base bias preamps for (A) crystal and (B) dynamic microphones.

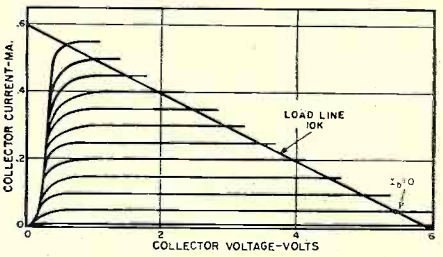


Fig. 5. View of collector family, showing gain below curve for zero base current.

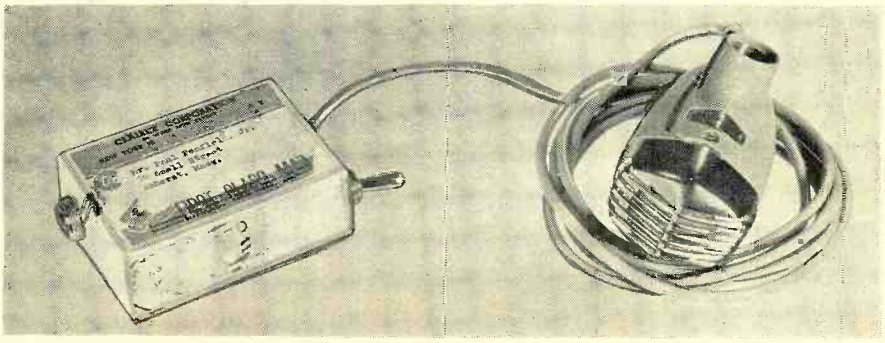
If six volts is not convenient, the preamps will operate with good results from 4.5 volts or even 3 volts.

The preamps here are limited in their quality of reproduction mainly by the components. Distortion is low, since the transistor is operated in a low-distortion area. That is, it is low right up to the point of clipping, where it will clip sharply.

The frequency response is determined by the transformer and the capacitors. The size of the capacitors has been determined to allow adequate low-frequency response.

The amplifiers have been used for tape recording with good results, and for public address work with equally gratifying results. The author believes that you'll be pleased with these simple, useful floating-base mike preamps. —30—

Fig. 6. A cardboard chassis was used for dynamic mike preamp.



Transistor Mike Preamps

Fig. 1. Crystal microphone preamplifier.

By **PAUL PENFIELD, JR.**

Two simple, easily built preamplifiers for connecting a crystal or dynamic microphone to your hi-fi system.

OFTEN the hi-fi enthusiast has some reason or other to connect a microphone to his hi-fi set-up. Some preamplifiers have provision for crystal mike input, but few can take a medium- or low-impedance mike. For this reason many are stymied. A good, cheap, simple mike preamp would be welcomed by these people.

Transistors seem a "natural" for this application, since there is no need for bulky, fragile, hot vacuum tubes, no hum problems, no need for high plate voltage, and no wasteful filament power. Accordingly the two preamps described here were designed and built. Several models of each have been built and used, and the design is considered free from flaws. The circuit is so simple that few if any mistakes can be made in wiring it, even by the most inexperienced constructor. The parts are small enough to fit almost anywhere.

Since a battery is used, there must be some "on-off" switch. The reader is free to design his own "on-off" switch, terminal arrangement, and physical layout, to suit his own needs. Two of the amplifiers built by the author are shown here, but don't feel restricted to these types of housing or connections. Any reasonable layout will do. Be sure only to keep the input lead shielded.

The Circuit

The circuit is particularly simple because of the bias arrangement, known as a "floating base bias." Note that, because of the 10 μfd. capacitors in each of the two circuits (Fig. 4) no direct current flows through the base. At first thought it might appear as if we would be biasing the transistor at cut-off, but this is not so. Actually the collector is passing current just equal to $(\beta + 1)I_{co}$ where β is the grounded-emitter current gain, and I_{co} is the transistor cut-off current. This is made a little clearer by the collector family of the transistor, Fig. 5. Actually, Fig. 5 is not accurate for the 2N105, the transistor used, but was drawn merely to point out the action involved.

In Fig. 5, the current axis has been expanded considerably, so we can investigate the transistor at very low bias currents. Note, first, that the line corresponding to zero base current is *not* as low as we can go. If we send the base a bit positive, it will send a small current *into* the base. Normally, the base of a *p-n-p* transistor is biased negative, so current can normally flow *out*.

There is nothing particularly magical about the value zero for base current. We can get useful amplification on either side of the zero line.

The lowest point we can go on Fig. 5 (the bottom line) corresponds to a collector current of just I_{co}. At this value, the base current is the same, and the emitter passes no current. Because of the physics of the collector

Fig. 2. Disassembled view of transistorized crystal mike preamp.

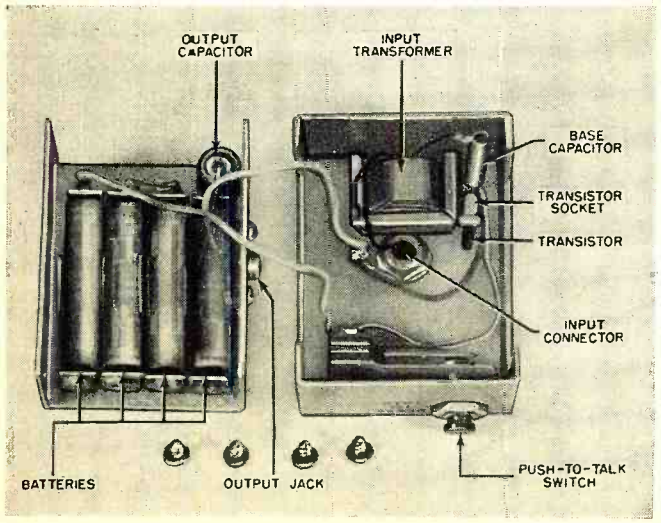
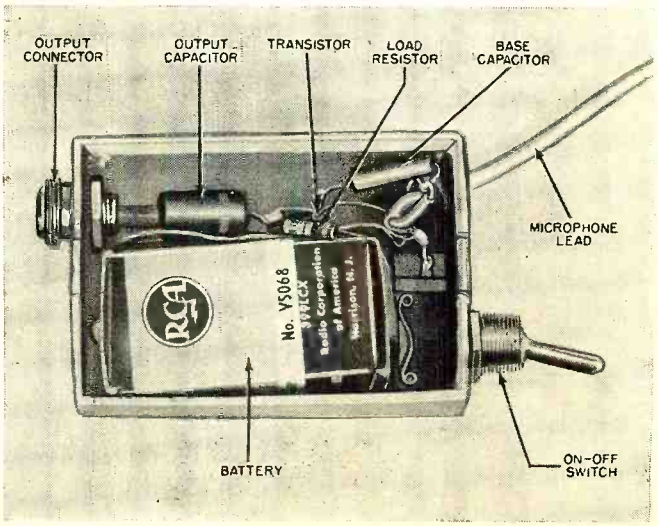
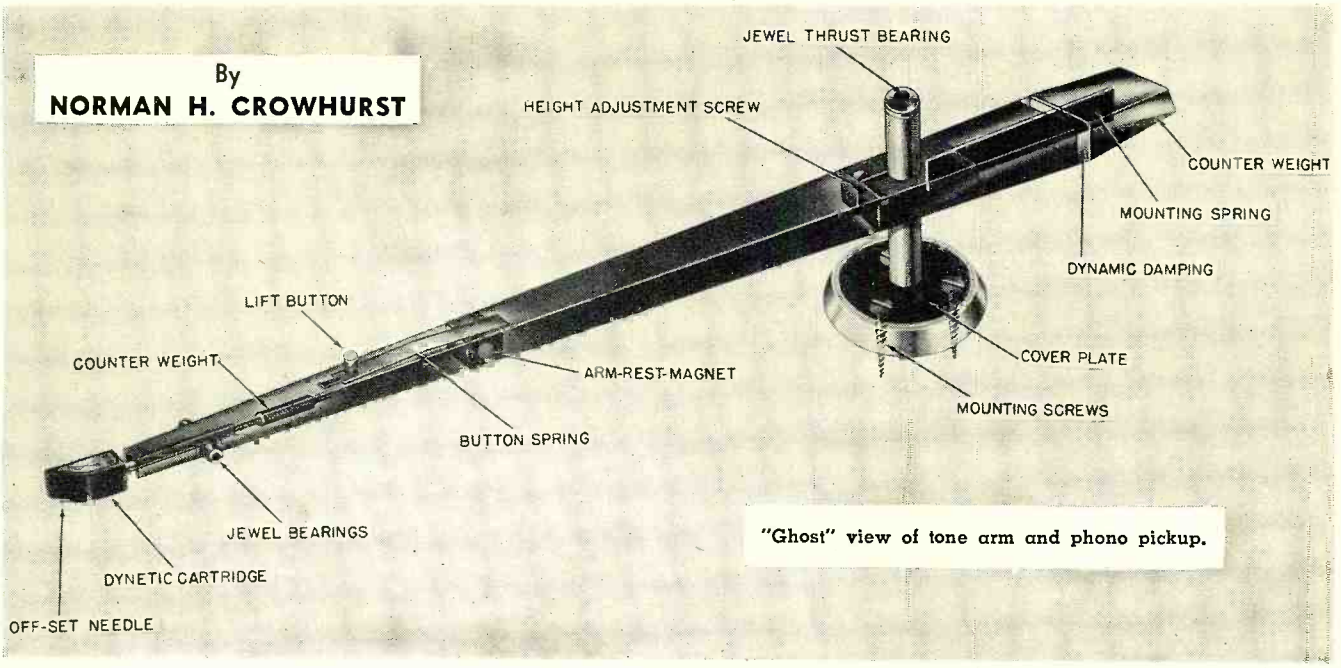


Fig. 3. Underside view of the transistorized dynamic mike preamp.





"Ghost" view of tone arm and phono pickup.

By
NORMAN H. CROWHURST

The "Dynetic" A NEW CARTRIDGE AND TONE ARM

New Shure tone arm and phono pickup features jeweled bearings along with optimum tracking force of 1 gram.

SHORTLY after the author's article, "Buying a Tone Arm," appeared in the January, 1957 issue of RADIO & TV NEWS, it was learned from Mr. Ben Bauer, vice-president of *Shure Brothers*, that they had been developing a new pickup and tone arm that happened to include many of the suggestions and ideas that were set forth in the article.

As was mentioned in the earlier article, it is not entirely impossible that a ceramic pickup may yet produce performance that will equal or excel that of the moving coil and magnetic variety. Knowing the *Shure* pickup line consisted of ceramic cartridges, we naturally expected a new development in this field. However, upon examining the new pickup, it was found not to be a "crystal"—but, to our surprise, a moving magnet type.

This new pickup, complete with its tone arm, represents a new design in the field. It is straight and tapered, from broad at the counterweight end to quite a small cross section where the pickup is mounted. Its over-all length is 15 inches. The distance from the tone arm pivot to the stylus point is almost 11 inches. It is a relatively long arm, and in some cases will cause mounting problems; but as with all long tone arms, it will give a much closer approximation to perfect tracking throughout the entire record than a shorter arm.

The pickup plugs in with a new type of concentric-sheath pre-aligned plug, because the head is so much smaller that any earlier fitting is impossibly too large. This, of course, is a step we have to face with progress toward pickups of this type.

The tone arm is rigid vertically. The pivot at the mounting point allows the tone arm to rotate in a horizontal direction across the disc only, and not to be lifted away from the disc when lifting the stylus. A push-button is provided on the top side of the tone arm for this purpose.

This conveniently solves another problem: a pickup with a stylus force of only 1 gram requires such light handling that the average person has difficulty in lowering the stylus. The push-button works against a spring, but the spring only touches the small pickup arm inside the tone arm to lift the stylus from the groove. The pickup arm is free of the spring when playing the disc. A fairly heavy push is needed to lift the stylus. This makes for much more comfortable handling, especially for anyone whose hand may not be too steady.

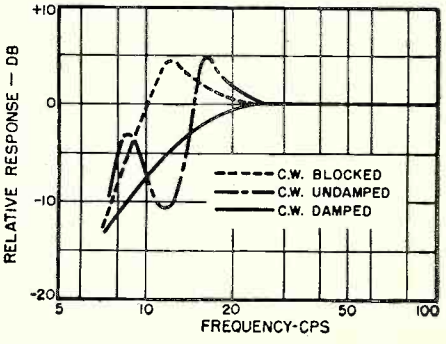
Tone Arm Resonance

Low-frequency tone arm resonance has been taken care of in a unique way. The counterweight on the rear end of the tone arm is not rigidly attached to the arm, but is suspended on a steel spring which is damped by means of an elastomer material. This has the effect of critically damping the low-frequency resonance that might otherwise occur between the compliance in the pickup and the rotational inertia of the tone arm about its pivot point. In conjunction with the tapered structure this arrangement effectively eliminates resonances from the tone arm. The curves tell the story better than words.

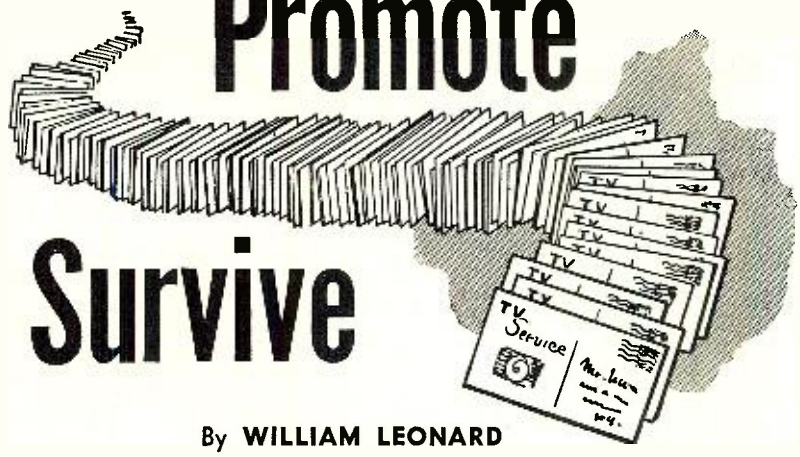
It is true damping affects frequencies below the audio range, below 20 cycles, but this is more advantageous than is realized. Equalization accentuates these frequencies due to the reduced velocity recorded. So even a slight motor rumble can be seriously

(*Continued on page* 98)

Effect of counterweight damping on the low-frequency response of the new unit.



Promote to Survive



By **WILLIAM LEONARD**

A realistic program takes into account the size, nature, and financial resources of the business.

THOUSANDS of small businesses are started each year with the idea that a business location and a name will automatically attract customers. This is especially true of TV service because even a mediocre technician can start one with very little capital. But the majority of them quietly fade away as soon as the owner has exhausted all of his money and credit.

Statistics on business failures attribute the "lack of adequate capital" as the chief cause for the high mortality rate among newly formed small businesses. While this may be technically true from the statistician's point of view, it completely misses the main reason for most small business failures.

The average person who opens up a new business cleans up the premises, perhaps repaints the store front, has a sign painted on the windows, and arranges the tools and stock to make an attractive appearance. He assumes that in a very short time everyone who lives in the area where his business is located will know what kind of a business he is operating.

Merchants with established businesses in residential shopping areas are constantly surprised by new customers who say, "I've lived in this neighborhood for five years and I did not know until yesterday that this kind of a store was here." Except for grocery and drug stores, most people do not pay attention to the products or services handled by the stores in their immediate neighborhood, or stores that they may pass every day.

This normal lack of interest among people in what shops handle makes it necessary for the service dealer to constantly promote his business to keep it in the public eye. He must get his sales messages across to the same people over and over again. This constant repetition connotes stability. It builds up the feeling that the business is reliable. It helps to break down the barrier of resistance the average person has toward dealing with an entirely new and unknown person.

A service business, of course, has rigid income limitations. The amount of money committed for advertising and promotion must be kept at a reasonable percentage of the gross income. Advertising expenditures must be productive as well as economical.

This naturally brings up the question about the most effective way to promote a service business at a cost the owner can afford. There is no simple formula for a promotion that can be applied to every service business irrespective of its location. A shop that must operate in a thirty-mile radius of its location requires a method of application of promotions different from that for the service dealer who can get ample business in a thirty-city-block radius from his shop.

Many factors are involved in determining the best way to use promotions for each specific business. The type of area or community where the shop is located has an important bearing on the way advertising and promotion is used so it will pay off. But careful planning and consistency of use are vitally important in all locations.

There are certain basic factors involved in charting a promotional plan for any service business. By developing a program with these factors in mind, any service dealer can apply effective promotions that will produce results in his locality.

In planning a promotion, the first factor to be considered is what the program is to accomplish. Is its primary objective to get immediate business? Or is its purpose to build confidence in the set owners' minds which will inspire them to call this particular business when they need electronic service?

The second factor is the size of the area the dealer wants to cover and the percentage of home owners he wants to reach. This is important in determining whether radio, newspaper, or direct mail advertising would accomplish the results most economically and effectively.

The third and perhaps controlling factor, in the long run, is the amount of money that is available for the promotional program.

While space does not permit a complete outline of how these basic factors have been applied by various types of service businesses, a specific example will serve to illustrate how they were successfully applied by one small service dealer. This service shop is operated by a technician and his wife. It is located in the business area of one of the residential districts in a medium-sized city. Service income is augmented by the occasional sale of a TV or radio set, dry batteries for portable radios, and some phonograph replacement items.

Phone-book advertising and service referrals by regular customers gave this dealer only about sixty-five percent of the business he could handle in off-peak seasons. He had tried newspaper ads but found that travel time was wasteful in some of the calls he got from that type of advertising. He felt he was not getting a sufficient percentage of the service business that was available in the immediate area.

The plan he developed was a rather simple one. He decided to use mailing cards to develop business within a twenty-five-block radius of his shop. The program was set up to be carried out consistently over a period of six months, with a provision for checking results to determine effectiveness.

He obtained the mailing cards through one of his parts jobbers. Such cards are provided by the various tube manufacturers. Those he ordered carried the imprint of his business name, address, and telephone number. Each of the six basic cards he used carried a different sales message.

Using a residential street directory, his wife addressed from twenty-five to thirty cards every day. These were mailed daily. By the end of the month, about 700 set owners had received one of the first cards in the series. The second card was mailed to this same list of home owners during the second month. This same plan was carried out with the remaining four cards during the six-month duration of the test.

The score of new business chalked up during this six-month program of direct mail was at least $1700 worth of additional business from about 140 new customers in the twenty-five-block area surrounding this shop. The total cash outlay for the cards and postage was approximately $130.00. This dealer has continued to use this type of direct-mail promotion regularly since this first test proved its effectiveness.

The important fact to remember about direct mail promotion is that it must be used regularly over a period of time to produce results. It is better for the small dealer to address and mail a few cards every day rather than to try to handle a large list in a single mailing. —30—

right and other features exclusive to the 918 can be ignored.

While most of the faults, trouble-shooting techniques, and remedies pertaining to auto radios follow closely their counterparts in standard-broadcast AM receivers, some difficulties are encountered that are peculiar to auto receivers, and sometimes may involve portions of the car that are not directly a part of the radio circuit. These faults cannot be found when the receivers are on the service bench, hooked up to a battery eliminator. For example, motor or other automotive noise may mar reception while the car and its radio are on the road, but it would scarcely be evident in the shop. In most cases where this occurs, it will be found that the suppressor capacitor on the generator, voltage regulator, or ignition coil is either defective or missing. Location and connection of these units are illustrated in Figs. 2, 3, and 4. Other possible causes of local noise are a loose antenna or loose spark-plug or coil high-tension wires.

Other difficulties that arise on the search-tuning models are the following: the dial pointer sweeps very slowly; the radio stops only on strong stations even when the "distance" search button is depressed; or the radio continues to search without stopping on any station. Defective tubes (particularly the 12AL8) as well as a defective antenna may cause some of these symptoms. However, the number of cases of improper operation of the automatic search mechanism that are the result of low auto-battery voltage would surprise many technicians who are unfamiliar with this type of tuner.

If the antenna is at any time replaced, it may be necessary to re-adjust the antenna-trimmer capacitor. This trimmer, as shown in Fig. 5, is at the right side of the receiver. Generally, proper match of the receiver to antenna can be achieved within a quarter turn of this adjustment. The adjustment is made with the receiver tuned in the vicinity of 1400 kc., but tuned *off* a station and with the volume turned up until a hissing sound is heard. Then, with the antenna fully extended, the trimmer is slowly rotated until the maximum amount of hiss is heard. The procedure may also be followed with a *very weak* station in the vicinity of 1400 kc., in which case adjustment is made for top volume.

Push-button adjustment is very simple, since the buttons are of the kind that mechanically move the tuning mechanism. To lock a button to a particular station, pull the button as far forward—toward the operator—as it will go. The radio is then tuned, manually and accurately, to the desired station, and the button is depressed to lock it to that station. Henceforward, depressing the button will always move the tuning dial to the locked-in frequency, until such time as it is desired to unlock the button to set it up for some other station.

On some of the radios that have rear-seat speaker and/or "Highway Hi-Fi" sockets, the accessory units will not be installed. In such installations, there should be a shorting bar between two terminals on each of the sockets. In the case of an inoperative receiver, the first check should be to see whether either or both of these bars is missing or loose before the unit is removed for service. —30—

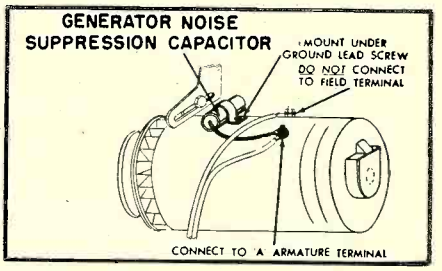


Fig. 2. Generator capacitor location.

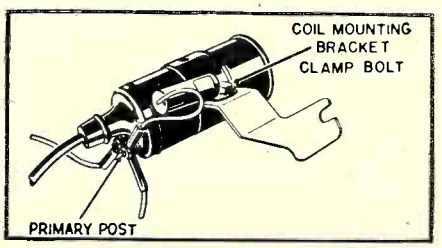


Fig. 3. Site of ignition-coil capacitor.

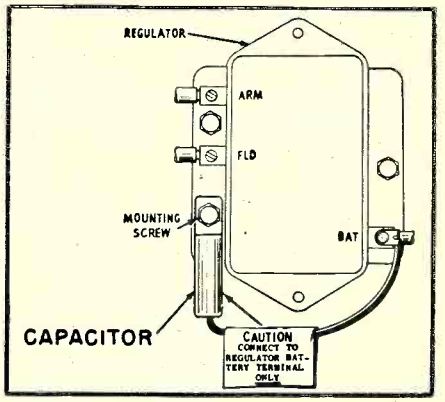
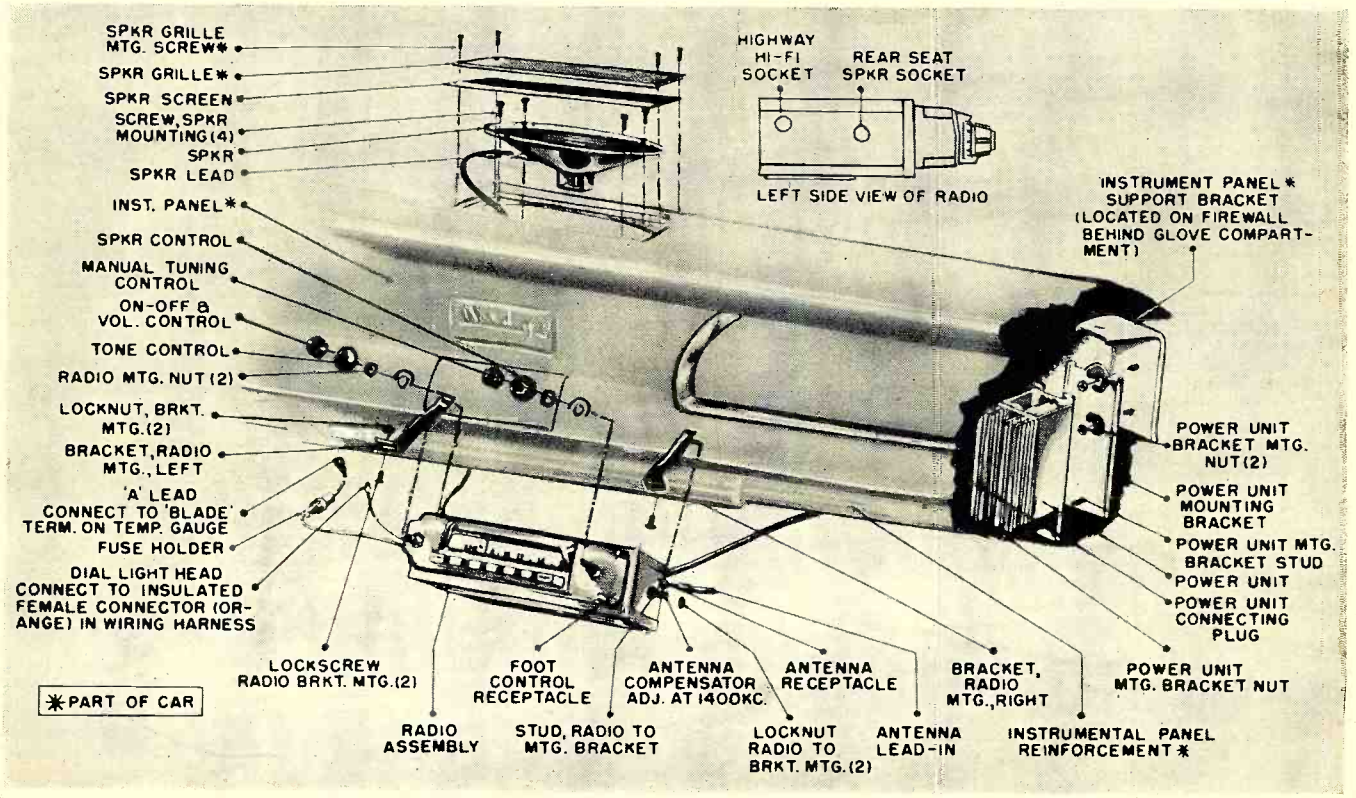


Fig. 4. Point of connection for the voltage-regulator suppressor capacitor.

Fig. 5. This exploded view, showing mounting details for the Dodge Model 918 radio, will help in dismantling and servicing.



1957 Auto Radios: Dodge-Chrysler Corporation

Fig. 1. Dodge Model 918 (top) is a hybrid receiver with 5 pre-selector buttons and a search mechanism. Model 845 (bottom right) provides the 5-push-buttons. A basic, manually tuned set, Model 624 (center), is also available.

The Dodge and other automobiles offered by this manufacturer feature hybrid auto radios with a choice of several added convenience facilities.

TRANSISTOR is king in this year's line of auto radios for the *Chrysler Corporation* cars. Every receiver offered for use in *Plymouth, Dodge, DeSoto,* and *Chrysler* automobiles is what the auto manufacturer refers to as "transistor-powered." Since there is more than one way of designing a receiver that uses both transistors and tubes, as do these sets, some clarification is necessary. All radios used in *Chrysler Corporation* cars are of the hybrid type of design first described in the September, 1956 issue of RADIO & TV NEWS ("No Vibrator in New Auto Set," page 60), using tubes operating with low plate potentials in addition to one audio output transistor.

A convenient point of departure for surveying the entire line is the trio of receivers being used in *Dodge* cars. These three make a good starting point on at least two counts: in the first place, the choice of operating features offered in this group represents the choice available in the other auto makes put out by this producer. In addition, two of these three models are also used in *Plymouth* and *DeSoto* cars.

Model 624, shown in Fig. 1, lays down the basic pattern of five tubes and one transistor. While some variations in tube type have been developed, the lineup of tube functions established by the hybrid auto-radio prototype described in the earlier article is unchanged. There is an r.f. amplifier (12BL6), a converter (12AD6), an i.f. amplifier (12BL6), a detector-a.v.c.-1st-audio stage (12AE6), a driver for the transistor (12K5), and the transistor itself (2N178). The 12BL6 replaces the 12AC6 used in the original hybrid design. The 12AE6 replaces the 12F8. Other tubes remain the same, and circuit changes are not radically different.

The manually tuned Model 624 shares this basic design with all *Chrysler* radios. Also in common with other *Chrysler* radios, it uses a more rugged, heavier-gauge metal chassis than heretofore, extensive temperature compensation for minimum drift, and an oval speaker with a 3.16-oz. magnet.

For the driver who doesn't like to keep one hand away from the wheel any more than he has to, and who pretty much knows what stations he'll be finding his listening fare on, Model 845 offers a choice of five push-buttons that can be set to pre-selected frequencies. For the rest, this receiver is very similar to Model 624, with a 12AF6 taking the place of the second 12BL6 as the i.f. amplifier, with a 12AJ6 being used as the detector-a.v.c.-1st-audio tube, and with a 2N176 replacing the 2N178 as the audio-output transistor. Except for the external housing and disposition of the controls, Model 845 is electrically identical to the Model 846 used in *DeSoto* cars and the 849 used in *Plymouth* autos.

Also added to the Models 845 and 846 is a continuously variable tone control. The latter receiver also features a second rear-seat speaker and a speaker control that is used to balance the distribution of sound-output power between front and rear speakers to suit individual preference. The pilot light on each of the sets in this push-button group is connected to the dimmer control for the entire dash panel so that it will have the same degree of brilliance as lighting elsewhere on the panel as the dimmer control is raised or lowered.

All three of these models use a linear-frequency type of tuner that makes station selection relatively easy at the high-frequency end of the dial. A glance at the tuning dial of the Model 845, in Fig. 1, shows that, instead of the crowding common at the high-frequency end, calibrations are fairly uniformly spaced along the tuning range. This is achieved by a tuning coil that is specially wound. A uniformly wound tuning coil would result in the common non-linear dial. The tuning coil, accordingly, is wound in a non-uniform way to cancel out this normal non-linearity in tuning.

For the *Dodge* driver who must have the ultimate in entertainment convenience while on the road, Model 918 (Fig. 1) provides most facilities found in the 845, plus a few others. As Model 919, laid out in a somewhat different way in a different housing, the same electrical unit is employed in *DeSoto* cars. Tube lineup is the same as that for the Model 624, with one change and one addition: the 12F8 replaces the 12AE6 as the detector-a.v.c.-1st-audio tube, and a 12AL8 is added for the trigger and relay-control stage, to operate the search tuner. The audio-output transistor is a 2N176.

In addition to the five push-buttons, the tone control, and the linear-frequency tuning coils, these models use a search tuner mechanism that sweeps in both directions along the dial and may be activated by either of two search buttons, both of which are physically lined up with the pre-selector push-buttons. The "local" search button, to the left of the five pre-selectors, sets the search mechanism up to stop on relatively strong signals only. When the "distance" button, to the right of the five pre-selectors, is depressed, the search mechanism operates with greater sensitivity, stopping also on relatively weak stations. Thus the mechanism may be operated to suit the area in which the vehicle is travelling at the time. The balance control for the front and rear speakers is also present. In addition, the 918 has a receptacle to accommodate *Chrysler's* "Highway Hi-Fi." This 16⅔-rpm record player, designed to operate in a moving vehicle, connects directly across the radio's volume control.

As with most auto radios in this age in which streamlined appearance is paramount, gaining access to the receiver and dismounting it for service represents a greater problem to the average technician than most receiver faults are likely to present. The exploded view of Fig. 5 should be of considerable assistance in this purely physical problem for *Dodge* cars, as well as for other autos in the *Chrysler* family. The detailed view is specifically for the Model 918, but mounting and connections to the 624 and 845 are essentially the same, except that details pertaining to the separate power unit on the

that a fairly snug fit is obtained if the aluminum case specified in the parts list is used. A few cardboard shims forced into place on either side of the battery secures the mounting and eliminates the need for a special bracket or holder. Standard clips are used for battery connections . . . with the battery terminals insulated with a piece of *Scotch* electrical tape.

Although wiring and layout are not critical, there are a few points which should be kept in mind to avoid trouble. First, battery and electrolytic capacitor polarities *must* be observed. Secondly, the power transistor (2N68) is mounted *directly* to the metal cabinet with a single machine screw; this type of mounting insures proper heat dissipation and transistor operation. However, since the transistor's collector electrode is connected, internally, to its shell, this means that the collector is connected directly to the case. Because of this, it is important that the metal case be left "floating" electrically, and that it *not* be used as a common "ground."

A small transistor socket was provided for the 2N35 transistor in the model, with connections to the 2N68 power transistor made by soldering directly to its heavy leads. However, both transistors may be wired permanently in place, if preferred. Whenever soldering directly to a transistor's lead, hold the lead with a pair of long-nosed pliers between the connection point and the body of the transistor. The pliers act as a "heat sink" to absorb excessive heat and thus to avoid heat damage to the transistor, which might otherwise occur.

After wiring is completed, double-check all connections, both for possible errors and accidental shorts to the case, *before* connecting the battery (B_1) or closing the "Power" switch (S_1). An operational test should be given the unit before it is "buttoned-up" in its case. Connect the battery, close S_1, and rotate "Frequency" control R_2 throughout its range. You should hear a high-pitched tone with R_2 set at maximum resistance. This will go higher in pitch as the value of R_2 is reduced, finally disappearing entirely. This is the point at which your hearing starts to fall off.

Calibration: For many general purpose applications, no frequency calibration is needed. However, if desired by the individual builder, a simple calibration chart may be prepared, correlating the settings of R_2 against operating frequency. The standard technique of comparing Lissajous figures may be employed. Connect a pair of test leads across the terminals of the HF-206 tweeter; these leads, in turn, are connected to the vertical input terminals of a cathode-ray oscilloscope. A standard audio generator is connected to the horizontal input terminals of the scope. "Frequency" control R_2 is then adjusted to various settings between its minimum and maximum resistance, and the audio generator tuned to present a 1:1 Lissajous figure on the scope's screen. The actual frequency of each setting may be read directly on the calibrated dial of the audio generator. Use at least twenty calibration points.

If you have an audio frequency meter available, you can employ a much simpler calibration procedure. A suitable instrument is the *Heath* Model AF-1 frequency meter. Simply connect a pair of test leads between the input terminals of the frequency meter and the terminals of the HF-206 tweeter. Frequency readings are made directly on the meter's dial as the control R_2 is adjusted.

If a precise output frequency is needed, the instrument should be set on frequency by comparison with a known source (either by using the Lissajous figures, as outlined, or by using a frequency meter) just prior to use, *irrespective of calibration.* The instrument is not designed to be a "frequency standard" and hence there is some small variation in operating frequency with changing ambient temperature conditions and as the battery (B_1) ages.

Circuit Modifications: Quite a number of circuit refinements are possible, depending on the requirements of the individual builder. For example, a *Sylvania* type 2N101 may be substituted for the type 2N68 shown, and without circuit modification. Both are *p-n-p* types and have similar characteristics. A *p-n-p* type, such as the 2N34, may be substituted for the type 2N35, *provided* an *n-p-n* type is used in the second stage . . . suitable types, *Sylvania's* 2N95 or 2N102 . . . and *provided* battery (B_1) and electrolytic capacitor (C_2) polarities are reversed.

The frequency range may be changed by using a larger or smaller capacitor in place of C_1. A larger capacitor here will lower frequency, a smaller unit will increase frequency. If a narrower range is desired, a 50,000 or 25,000 ohm potentiometer may be used in place of R_2. In changing the frequency coverage, two limits should be observed, however, do *not* attempt to operate below 3000 cps (3 kc.), for the tweeter is not designed to be used below this frequency. Nor should any effort be made to operate much above 30 kc., for the sound energy output of the tweeter falls off rapidly at these higher frequencies.

Applications

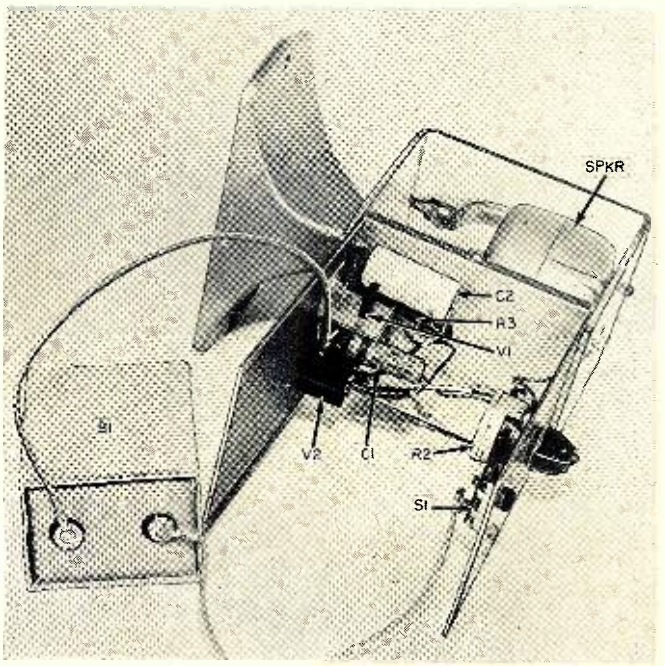
As suggested at the beginning of this article, the potential applications of the transistorized ultrasonic generator are quite numerous, depending more on the requirements and ingenuity of the individual user than on any inherent limitations within the instrument itself. Space prohibits a detailed discussion of *all* possible applications, but a quick summary of typical uses should enable the reader to determine applications in his own field:

Service Shops: As a readily available and easy-to-use source of high-frequency sound, the instrument could be used for checking the high-frequency response of microphones. TV technicians could use it to check tubes or other components for microphonic defects at the horizontal sweep frequency. And tweeters with characteristics similar to the HF-206 unit used could be tested by substitution.

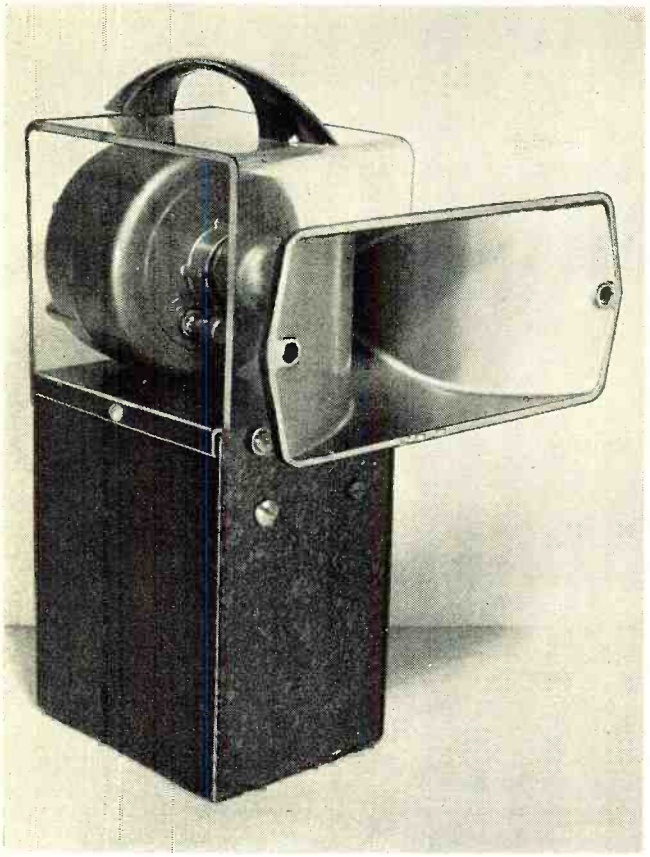
Hi-Fi Installers: An important application of the unit in this field is in customer demonstration . . . to demonstrate the importance of a tweeter in reproducing high frequencies, to show a prospective customer the directive effects of high frequencies, and to check out a proposed "Music Room" for unusual response to high frequencies. The instrument could serve as a powerful tool in "selling" a prospect on the value of a multiple speaker system and a speaker enclosure with suitable high-frequency dispersion.

Medicine: When calibrating, the in-

(*Continued on page* 165)



Inside view of transistorized ultrasonic generator. The 2N35 transistor is mounted on a small angle bracket on the back of the front panel while the 2N68 power transistor is mounted directly on the rear of the front panel of the unit.



Front view of transistorized ultrasonic generator. Note how the tweeter transducer is mounted atop the metal cabinet in a simple U-shaped bracket made from a three inch strip of one-quarter inch thick Lucite plastic material. A metal bracket may be used in place of the plastic if preferred by the builder.

vides a shift of 360°, placing the "input" and "output" signals *in-phase* and establishing one of the basic conditions needed in an oscillator. The final condition, feedback, is met by capacitor C_1.

In operation, when "Power" switch S_1 is closed, base bias for the first (2N35) stage is provided through R_1 and R_2. With base bias applied, the emitter-collector impedance of the stage drops and collector current can flow over the path from the negative terminal of B_1, through the emitter-collector of the 2N35, through R_3 and through the base-emitter of the 2N68 and S_1 back to the positive terminal of the power supply. The collector current of the first stage thus becomes the base bias current of the second stage, dropping the emitter-collector impedance of the 2N68.

Capacitor C_1 is charged by B_1 through the emitter-collector of the 2N68 and the emitter-base of the 2N35. The polarity of the charging current is such as to maintain both transistors in a "conducting" condition until the capacitor charge nears its peak value. As the capacitor (C_1) becomes fully charged, this charging current drops, as do the bias currents of the two transistors. With a drop in bias, the emitter-collector impedance of the 2N68 increases considerably, reducing the charging current.

Having reached a nearly full charge, C_1 then applies a voltage of reversed polarity to the collector of the 2N68, further increasing the effective impedance of this unit. A voltage of reversed polarity is also applied to the base-emitter of the 2N35 stage, effectively "opening" this circuit to current flow.

With its "charge" path opened by the change in voltage polarities, C_1 then discharges through the coil winding of the HF-206 "Super-Tweeter" and through bias resistors R_1 and R_2. As soon as the charge on C_1 drops sufficiently, the initial "starting" conditions are restored, and both transistors can start conducting again, recharging the capacitor, and continuing the oscillatory action.

Thus, with the operation of the circuit depending on the repeated charge and discharge of a capacitor, the unit is, in effect, a relaxation oscillator, and develops a non-sinusoidal voltage and current waveform. In practice, a pulsed type waveform is produced, due to the rapid charge of C_1 and its comparatively slow discharge. The pulse is rounded considerably, however, due both to distributed circuit and interelectrode capacities and to the inductive effects of the tweeter's coil.

The oscillator's repetition rate or *frequency* depends on the charge and discharge time of the capacitor. The "charge" time is a function of the capacitor's value, the base-emitter impedance of the 2N35 and the emitter-collector impedance of the 2N68. The "discharge" time is a function of the capacitor's value, of the impedance of the tweeter's coil, and of the combined value of R_1 and R_2. Increasing the value of any of the impedances in the circuit, or the capacity of C_1, will lower the operating frequency. Conversely, reducing the values of the circuit impedances, or the capacity of C_1, will act to increase the operating frequency.

In practice, both the "charge" and "discharge" impedances are varied simultaneously by making R_2 adjustable. As R_2 is reduced in value, a higher "starting" bias current is applied to the base-emitter of the 2N35, thus dropping its internal impedance. A drop in the 2N35's impedance increases the bias applied to the 2N68 and also drops its emitter-collector impedance, reducing the impedances affecting the "charge" time of C_1. As R_2 is lowered in value, however, this also reduces the impedance affecting the "discharge" time of C_1, since R_2 is an integral part of the discharge circuit. Thus, lowering the resistance of R_2 *increases* the operating frequency.

The reverse is also true. As R_2 is increased in value, a lower initial bias current is applied to the base-emitter of the 2N35, increasing its impedance. This, in turn, reduces the bias current of the 2N68, for the emitter-collector impedance of the first stage determines the bias of the second. With reduced bias current, the emitter-collector impedance of the 2N68, part of the C_1 "charge" path, is increased. At the same time, the "discharge" time is increased, due to the higher value of R_2. Thus, increasing the resistance of R_2 *lowers* the frequency of oscillation.

Construction Hints

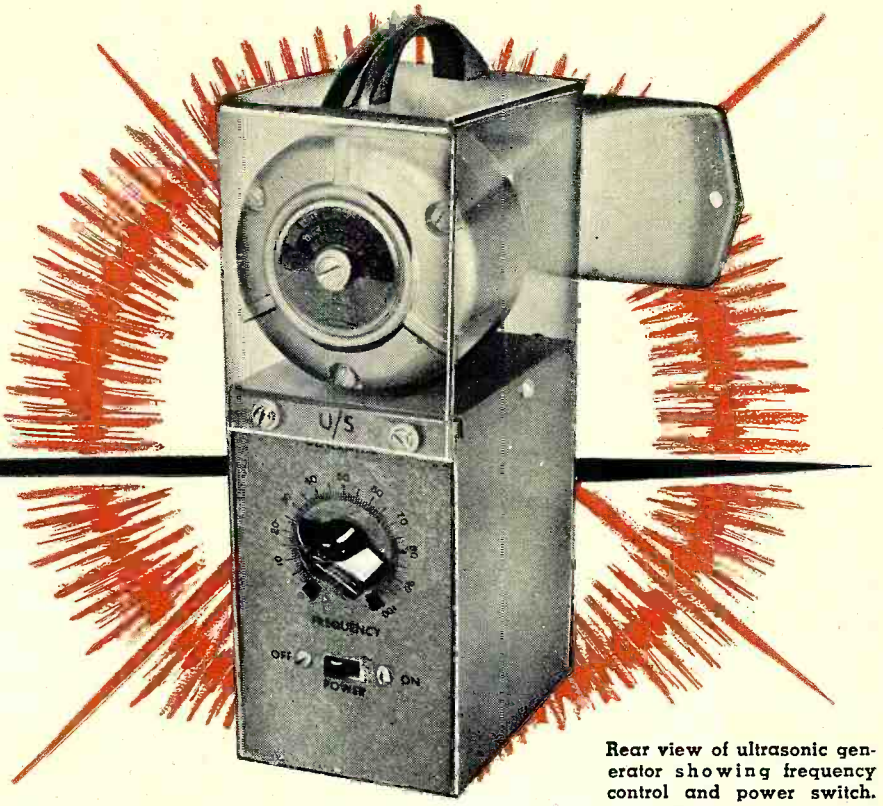
As a construction project, the ultrasonic generator is easily within the capabilities of the average electronics technician and hobbyist, even if his shop facilities are limited. Relatively little machine work is required and neither parts layout nor lead dress is critical. All components are standard and available from both local and mail order parts distributors.

Except for the HF-206 "Super-Tweeter," the entire circuit, including the 9-volt power supply battery, may be assembled in a 3″ x 4″ x 5″ aluminum case, with plenty of room for wiring ease. Decals may be used to label the controls. These should be applied after machine work is completed, but *before* components are mounted and wiring started, and should be protected, after application, with at least two or three coats of clear acrylic plastic (such as *General Cement* No. 8665). Rubber feet should be installed on the bottom of the case to prevent scratches on table tops.

In the model, the tweeter and the carrying handle are mounted on a simple U-shaped bracket made from a three inch strip of ¼″ thick Lucite. A metal bracket may be used here if preferred by the individual builder. If plastic is used, however, it may be machined with standard hand tools and formed to shape by bending over a heated metal rod. One of the "barrels" of a standard soldering gun is suitable for this job.

The large nine-volt battery is mounted in the base of the unit, with the weight providing over-all stability. Fortunately, the battery size is such

Transistorized Ultrasonic Generator



Rear view of ultrasonic generator showing frequency control and power switch.

Simple high-frequency oscillator with many possible applications employs unique complementary circuit.

By **LOUIS E. GARNER, JR.**

A READILY portable source of high-frequency sound energy has many potential applications in electronic work. A radio-TV repair shop could use such a unit for checking the high-frequency operation of microphones or, by a simple substitution technique, for tests of high-frequency tweeters. A hi-fi sales establishment could use such an instrument for customer demonstrations, showing the effectiveness of a tweeter and thus the value of a multiple speaker system. A hi-fi installer would find such a unit useful for demonstrating the directional characteristics of high-frequency sound and the need for suitable loudspeaker enclosures and high-frequency dispersal systems.

But direct applications in the electronics field do not, by any means, cover the full range of uses of such an instrument. To outline but a few, a portable high-frequency sound generator could find uses in medicine, in biology, in teaching, and in product testing. In medicine, the instrument could be used to study the psychological and physiological effects of ultrasonic energy on humans, to determine the maximum hearing range of individuals, to study the detrimental effect of disease and age on a person's hearing, and in similar work. In biology, the unit could be used for studies of the response to and effect of high-frequency sound on insects and animals. And physics or general science teachers would find the instrument useful for demonstrating many of the basic laws governing wave propagation, including reflection, resonance, and similar natural phenomena.

An inexpensive and easily built high-frequency and ultrasonic sound generator is shown in the photographs. This instrument is completely self-contained, requiring neither an external oscillator, a source of line power, a separate amplifier, nor a special transducer. This self-contained, and thus completely portable, design is made possible by the use of a fully transistorized circuit and a battery power supply, with the output transducer, a *University* "Super-Tweeter," included as an integral part of the equipment. The nominal frequency coverage is approximately 5 kc. to 25 kc., with an "overlap" at each end, giving an actual coverage, in the author's model, of from 4 kc. to better than 30 kc. Any operating frequency within this range may be obtained by adjusting a single control.

Circuit Description

The transistorized ultrasonic generator is designed around a practical version of a unique *complementary* oscillator circuit[1, 2]. Referring to the schematic diagram given in Fig. 1, a type 2N35 *n-p-n* low power transistor has its collector electrode direct-coupled through resistor R_3 to the base electrode of type 2N68 *p-n-p* "high power" transistor. Coupling resistor R_3, bypassed by electrolytic capacitor C_2, is included for current limiting purposes only, serving to protect the two transistors; it is not otherwise essential to circuit operation.

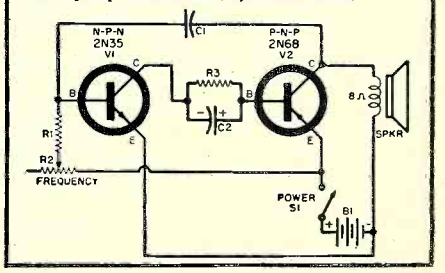
The 2N68 transistor, in turn, is direct-coupled to the driver coil winding of the HF-206 "Super-Tweeter," which serves both as the collector load for the second stage and as the output transducer, converting electrical energy into air vibrations.

Capacitor C_1, between the collector of the *p-n-p* transistor and the base of the *n-p-n* unit, provides the feedback necessary to start and sustain oscillation. Base bias current for the first stage is supplied through fixed resistor R_1 and "Frequency" control R_2. Power for the entire instrument is supplied by a single nine-volt battery, B_1, controlled by a s.p.s.t. slide switch S_1.

For purposes of a general analysis, the circuit arrangement may be considered as a two-stage direct-coupled amplifier, with capacitive coupling between the "output" and "input" terminations. The common-emitter configuration is used in both stages. Since the common-emitter amplifier provides an electrical phase-shift of 180° in a single stage, a two-stage chain pro-

Fig. 1. Schematic diagram of oscillator.

R_1—8200 ohm, ½ w. res.
R_2—100,000 ohm carbon pot ("Frequency")
R_3—100 ohm, ½ w. carbon res.
C_1—.006 μfd. tubular capacitor
C_2—100 μfd., 15 v. elec. capacitor
S_1—S.p.s.t. slide or toggle switch ("Power")
B_1—9-volt transistor battery (Burgess D6)
Spkr.—University "Super-Tweeter" No. HF-206
V_1—"n-p-n" transistor (Sylvania 2N35)
V_2—"p-n-p" transistor (Sylvania 2N68)



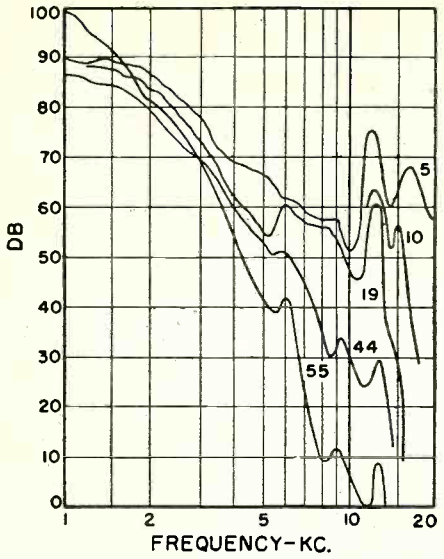


Fig. 3. Results of hearing tests made by M. G. Scroggie on persons of normal hearing between the ages of 5 and 55. Curves have been compensated for Fletcher-Munson threshold levels. (Curves redrawn from "Wireless World")

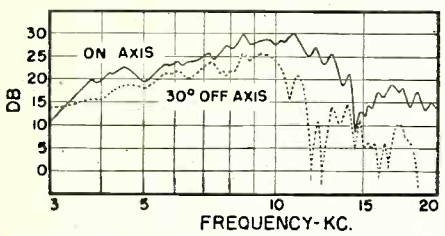


Fig. 4. Response curves of the 3-inch speaker used in the listening tests.

Scroggie used moving-coil headphones, we used moving-coil speakers, and this may account for the fact that our results showed much better standards of hearing at the high frequencies than did those of Mr. Scroggie and previous investigators. (After all, it is more natural to listen with two ears open to the air than with clamped-on headphones.)

A 3-inch unit with aluminum voice coil and light Bakelized cone was used as the sound generator. Although not flat, the response goes up to 20,000 cps (see Fig. 4) and the unit should be at least as good as a headphone. I was astonished that all those tested—ages between 20 and 46—could actually hear 18,000 cycles (usually with a boost of 50 db or more) as I am stone deaf in that region.

Now there are three people whose hearing and tonal judgment I have always rated very highly when assessing speaker performance. They are (1) my daughter, age 22; (2) our works manager, Mr. E. R. Broadley, age 46; and (3) myself. Please do not take the inclusion of myself as a sign of arrogance or conceit. We all think that what *we* hear is right because we never hear anything else.

As a matter of interest, response curves of these three subjects, prepared by Mr. Cooke, are shown in Fig. 5. As already mentioned, Mr. Scrog-coil and light bakelized cone was used phones, no doubt in a very quiet room, and in such circumstances the threshold-level Fletcher-Munson curve gives appropriate compensation. Our experiments were made without headphones in a laboratory where slight background noise may be expected to produce some degree of masking at low intensities. The results have therefore been compensated by the *Jensen* threshold curve for a critical listener in low noise level. (*Jensen* Technical Monograph No. 3, page 5, Fig. 5.)

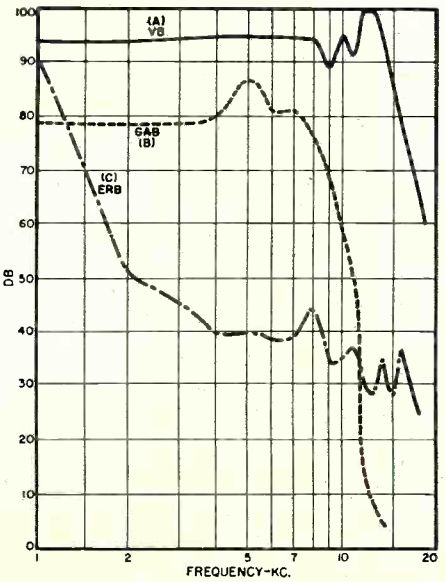
These tests show that it is possible for a young person of 22 to hear perfectly up to 14,000 cycles and quite well up to 18,000 cycles. Our sales director, Mr. Escott, age 31, and Mr. Cooke, age 32, kept within 15 db of this standard up to the 18,000 cycles limit imposed. Although I can actually hear 14,000 cycles, I was shocked to learn that I am some 90 db down at this frequency. The most interesting ears belong to Mr. Broadley, whose acuity is below mine up to about 10,000 cycles, but then remains very even up to 18,000 cycles, in spite of his 46 years. He has been making and testing loudspeakers along with me some 25 years, and I rate his judgment of performance very highly.

The general conclusion, as a result of these tests, is that loss of hearing with advancing years is frequently not as bad as has so often been assumed, and the faculty of hearing—in common with many other human accomplishments—is preserved by regular exercise or practice (like playing the piano or knitting).

It is a pity that deficiencies in hearing cannot be adjusted by "spectacles" which are so easy to prescribe for the eyes. Deaf aids are little better than resorting to any port in a storm.

Quality No. 6: Few people hear equally with both ears, but I believe

Fig. 5. Hearing curves taken with speaker held a few inches away from the right ear. Curves are corrected for loudness contour and are smoothed below 3000 cycles. Curve (A) is for Miss Briggs, age 22; curve (B) is for G. A. Briggs, age 66; and curve (C) is for E. R. Broadley, age 46. See text.



the natural tendency is to adjust the balance by turning the weaker ear towards the source of sound, so that quite wide variations could exist in one pair of ears without disqualifying the owner from a shrewd exercise of tonal judgment.

Quality No. 3: As with the gift of perfect pitch, the main basis of tonal discrimination is memory, coupled with the ability to hear and recognize resonances, harmonics, transients, and all the other qualities which go to make up a musical picture, plus a sensitive reaction to any form of distortion. An appreciation of music and regular concert-going to keep the ears fresh are obvious advantages. Anybody who unwittingly plays records too loudly or too softly is disqualified from the start, and it does not matter whether his amplifier is 10 watts or 100 watts. The "larger than life" platoon cannot be admitted into this select company.

Again in common with the gift of pitch, you either have tonal judgment or you have it not, and it is easily recognized in listeners when demonstrating sound equipment to various people, in spite of enormous variations in preference and taste. A spark of the talent—and talent it undoubtedly is—can develop into a flame by regular use.

I suppose the most skilled in the art are recording engineers who almost daily compare live with recorded speech and music and can recognize on a monitor speaker which piano out of a half a dozen studio models is being played. My complaint is that recording engineers hardly ever write about their activities (probably due to hush-hush policy) so views on the subject are left to be aired by semi-skilled but interested parties like your humble servant.

The most difficult application of tonal judgment—after recognizing that something is wrong—is the ability to recognize where the trouble originates. Poor recording, bad studio acoustics, line distortion, antenna or reception faults on FM, pickup distortion, amplifier faults, speaker trouble, listening room coloration, wrong setting of playback characteristics, wrong volume levels; these and many other sources of error need watching before final performance can be fairly judged.

For instance, the quality from FM at its best is so good that any shortcomings in the quality of program material are ruthlessly exposed on wide-range reproducers. A poor record *via* FM may sound as though the loudspeaker is out of center, and may actually sound better on a small speaker in a resonant cabinet than on a hi-fi system.

So we will conclude this article by stating that tonal discrimination is the most vital quality of the ear in audio activities, and that it involves placing a source of distortion quite as much as noticing it. In short, do not *always* blame the loudspeaker.

In our next article, we will have a look at room effects.

(*To be continued*)

Broadway, which reads: "Most Exclusive Place in Town—Everybody Welcome." It is now quite usual to see portable radio sets and record players advertised in England as "hi-fi"; but despite this the term means something when properly applied, and it is very difficult to replace by a better one.

Equipment

As the main basis of this and subsequent articles will be actual tests and experiments, a brief outline of the instruments available will not be out of place, although I always believe that the skill and judgment of the investigators mean more than the cost of the equipment employed.

Photographs of the *Wharfedale* laboratory are reproduced in Figs. 1 and 2.

In Fig. 1 the main item is, of course, our Mr. Cooke, but other items worthy of note are, from left to right, automatic response curve recorder, a.f. oscillator, microscope, stroboscope, vacuum-tube voltmeters, sound level meter, phase-angle and impedance meter, oscilloscope with camera, etc.

In Fig. 2 the corner enclosure on the left is built of bricks, and to the left of that is an artificial reverberation device of Danish design. Moving to the right (no doubt wisely) we see a small *RJ* cabinet followed by a larger enclosure with special acoustic filter, to which we shall probably refer again in a later article. Sitting atop this cabinet is a 3" tweeter with volume control, and on the windowsill is a *Janszen* electrostatic speaker. Then we have a sand-filled baffle accommodating three speakers, with an exploded view of a *Klipschorn* on the extreme right. (The fact that three out of the six speakers shown are of American design does at least indicate that we are broad-minded!)

Lab Acoustics

When listening to loudspeakers in unusual rooms, allowance must be made for differences compared to furnished rooms in which domestic speakers are normally used. For instance, the laboratory in question has a longer reverberation time and sounds much brighter than an ordinary room. Some beneficial acoustic treatment has been applied; perforated *Celotex* tiles absorb excessive high frequencies over part of the walls, and half a dozen acoustic absorbers, designed by R. E. Cooke, each 5 ft. x 2 ft., operate in the range 100 to 8000 cps. (One of these can be seen in each photograph.) These units combine the functions of a Helmholtz resonator, stagger-tuned over the frequency range 700-1300 cps, and a membrane absorber. Nevertheless, I still prefer to make a *final* loudspeaker test at home, when domestic types are involved.

Room effects obviously play havoc with any loudspeaker response, although they do not invalidate the merits of level response as a starting point.

The Ear

In view of the importance of listening tests, we cannot do better than devote the remainder of this article to an elementary study of the function of the *human ear* as related to the problems *of sound reproduction.*

Its main qualities could, I think, be classified very simply as follows: (1) Sensitivity, or general acuity of hearing; (2) Response, or variation of acuity with frequency; (3) Tonal discrimination and power to assess volume levels accurately; (4) Sense of pitch; (5) Musical reaction and talent; and (6) Uniformity of qualities 1 and 2 between left and right ear.

For our purpose, the most important is No. 3, tonal discrimination, but we will deal with the others first.

Qualities 4 and 5: It is obvious that any of the six qualities could be possessed to an exceptional degree by one person, with only fair or even poor ability in the others, although it is reasonable to assume that Nos. 4 and 5 usually go together. (It is difficult to imagine that even an ultra-modern composer cannot hit the right note—or at least the one he wants.)

But experience shows that professional musicians are often poor judges of quality No. 3, and may be defective in qualities 1 and 2. (Beethoven was deaf for many years.) The reason for No. 3 failure is that the musician usually spends so much time near to the source of sound. I remember at rehearsals in the Royal Festival Hall, the organist Ralph Downes always maintained that we were reproducing the organ too loudly when he came into the body of the hall to listen. Similarly, a member of an orchestra hears something quite different from the conglomeration of direct and reflected sound heard by members of the audience. Volume level has a lot to do with it; I always maintain that the art of attaining realistic reproduction starts with setting the volume control correctly. The slightest touch up or down can make all the difference. The organist, when playing on a console placed near the pipes, hears less than his audience, but a member of an orchestra hears more, so the training for No. 3 is poor in both cases.

It is also difficult for very musical people to ignore the music and performance, and concentrate on quality of reproduction. Many hi-fi fans err in the opposite direction!

Qualities 1 and 2: At the outset, we must be careful not to attach too much importance to acuity of hearing. We have already agreed that it has little to do with musical ability, and it is fairly easy to prove that sensitive ears are not necessarily discriminating ears, any more than a man with good eyesight is *ipso facto* an artist or a good judge of line and color.

But a reasonably good range of hearing is obviously required before any reliable assessment of tonal quality can be made. This was brought home to me recently during a rehearsal for a record concert, the items for which had been chosen by a talented musician and composer, who was apparently stone deaf above 5000 cycles and so remained quite oblivious to surface hiss, plops, and screaming highs which came from some records.

It is well known that hearing at high frequencies falls off with advancing years, but constant use of the ears in listening tests delays the decay.

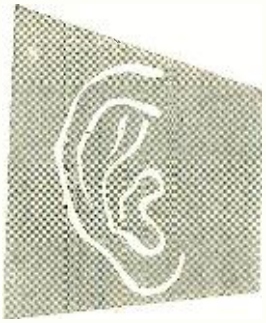
The September, 1956 issue of *Wireless World* contained an interesting article on age, hearing, and hi-fi, entitled "Too Old at —?" by M. G. Scroggie, who said that those of us who are not so young as we were may be wondering why we should spend a lot of money on equipment for reproducing frequencies we cannot hear. Some measurements made on a few individuals by Mr. Scroggie are reproduced in Fig. 3, the numbers against the curves indicating the ages of the people tested. Frequencies below 1000 cps are omitted because no significant differences occur.

After studying these curves, we decided to make a few tests ourselves on members of our staff, but whereas Mr.

Fig. 2. Another part of the lab showing some speakers used for comparative tests.

All About Audio and Hi-Fi

Fig. 1. Photograph of the main items of test equipment used in tests forming the basis of this series of articles. Mr. R. E. Cooke is recording some information.



-The Listening Ear

By **G. A. BRIGGS**
Managing Director
Wharfedale Wireless Works Ltd.

Part 1. An informative and interesting series that will discuss high fidelity reproduction from the listener's point of view. Opening article describes the main qualities of the human ear as they are related to sound reproduction.

EDITOR'S NOTE: *We take great pleasure in welcoming to these pages one whose wide experience and knowledge truly entitle him to be called a "noted authority" in the hi-fi field. Mr. G. A. Briggs' pre-eminence stems not from a theoretical, ivory-tower approach to the subject, but rather it is the result of endless experimentation, a well-developed sense of inquiry, and a serious (although good-humored) interest in good audio reproduction. Besides all this, Mr. Briggs has the peculiar ability to tell of his experiences in a crystal-clear, personal, down-to-earth manner that is a pleasure to read.*

G. A. Briggs is managing director of the Wharfedale Wireless Works Ltd., England, which is engaged in making loudspeakers. Mr. Briggs started constructing acoustic phonographs, radios, and loudspeakers as a hobby around 1930. He started making speakers commercially in 1933. He has also dabbled in pianos and during the course of the last 25 years he has had forty different instruments in his home. Mr. Briggs is the author of the best-seller, "Loudspeakers," which is now in its fourth edition, as well as the popular "Sound Reproduction," "Pianos, Pianists, and Sonics," and "High Fidelity—the Why and How for Amateurs." Also, during the last three years, he has conducted nine lecture-demonstrations on sound reproduction in Canada, England, and in Carnegie Hall, New York.

We feel quite sure all our readers will derive both pleasure and profit from Mr. Briggs' series, "All About Audio and Hi-Fi," which begins in this issue.

AS THE year 1956 was drawing to its quasi-peaceful close, I was very pleased to receive from the editors of this magazine an invitation to contribute a series of articles on audio topics, now generally designated as hi-fi. Because I am constantly making tests and experiments, it is very useful to have an incentive to place the results on record whilst they are fresh in the mind. In these experiments I have the valuable co-operation of our technical director, Mr. R. E. Cooke, B.Sc. (Eng.), who joined my firm some two years ago after spending a few years in the Designs Department of the *BBC* where he was engaged on problems connected with sound recording and reproduction.

Another reason for satisfaction is that I believe that any interchange of experience and opinion between our two countries is a good thing in the present state of the world, apart from the obvious fact that we can learn a lot from each other. (For instance, although we are fond of saying that you cannot make tea, I have developed the habit of using tea bags at home as a result of visits to America, and I should hate to go back to the messy business of loose tea leaves.)

American radio and audio magazines are read with avidity over here, and it would be a good thing if British journals could include more contributions from American writers, although the usual rates of pay are rather thin; translated into dollars they would just about keep a moderate smoker in cigarettes.

On the more technical side we have nothing in this country to compare with some of your fine technical magazines, and, when it comes to test reports on instruments and equipment, your consumer testing organization reports are unique for candor and thoroughness. (Your greyhounds are halfway round the track before ours have realized that the traps are open and the hares are off!)

To conclude this preamble, I would like to stress the point that music and its reproduction are intended for man's delight, and my main reason for writing on the subject is that I enjoy doing so. Let us therefore approach all problems in a gay rather than a somber mood.

Scope of Articles

The title, "All About Audio and Hi-Fi," may be rather ambiguous. It does *not* mean that I am going to tell you all there is to know about it. (I do not know it all, nor do I think I know!) It simply means that I have a roving commission to deal with all or any aspects of the subject. I sometimes think that the term "high fidelity" has just about reached the limit set by the large notice which appears on the front door of a dance hall on

seem, complications are still possible. For example, in completely shielded ignition harnesses, water condenses inside spark plug "cans" and heat causes high-tension wire-insulation breakdown after only a few hours of operation. The short period of quiet reception may hardly be worth the repair and replacement cost and effort, especially if a breakdown occurs with the boat at sea. Practically air-tight shields may be fine on an airplane where there is an abundance of cool air playing on the engine, but the same assembly in the dank, hot hold of a boat may not necessarily give satisfaction for long. A better arrangement has been to use special, shielded spark plugs in conjunction with ignition-circuit shielding. Such a plug is shown in Fig. 2. This method does add expense, and makes plug replacement in out-of-the-way places difficult, unless sufficient spares are carried.

A compromise arrangement is to shield the boat-engine compartment by copper or bronze screening connected to the radio ground plate. A suppressor resistor is used at the high-tension terminal of the ignition coil, with the usual capacitor bypassing the ignition key circuit. Since this method is effective as long as the shielding integrity is maintained, all connection of the edge surfaces of under-the-hatch screens and those on the decking alongside must be kept clean and secure. Many such installations have been quiet for a short while, but, as the corrosion inevitably set in, noise crept up. Continuing maintenance can, of course, keep ignition noise down.

However, screen installations which may be fitted directly to the engines offer practically the same effect, with less chance of deterioration from corrosion and the variable contacts which are experienced when the boat-engine compartment is screened. An example of an engine shield put together from a commercially available kit is shown in Fig. 3.

The second source of serious boat noise is the whine of the generator. Fortunately, this is due to simple d.c. arcing at the generator commutator and can be cured spectacularly by installing a capacitor of from .1 to .5 μfd. from the generator-armature terminal to ground. Care should be taken *not* to connect a capacitor to the field circuit on generators having a regulator, since this would result in rapid contact burning and regulator failure. On generators having both field and armature terminals, bypass only the larger of the two insulated terminals. A noise bypass capacitor connected to the generator armature is shown in Fig. 1.

Voltage regulators may sometimes be noisy, due to the vibrating contacts inherent in their design. In simple cases, the insertion of heavy-current r.f. chokes in the various leads at the regulator may eliminate the noise. Otherwise, it may be necessary to install the regulator in the grounded metal box, in addition to inserting the r.f. chokes. Do not connect bypass capacitors to the regulator terminals.

Diesel engines are often thought of as being the perfect answer to noiseless reception. On the contrary, some of the worst noise problems have involved diesels. Main among them has been generator and regulator noise, cured by the shielding and choke-filtering steps already discussed. Ironically, when an engine has no ignition noise, all of the other incident noises come into prominence. These are best illustrated by some actual happenings:

Once a pleasant fellow came into our shop and bought a radiotelephone. After it was installed in the chart room of his boat, the usual diesel generator noise was noted and cured by the routine measures already discussed. He shoved off on a week-end cruise with his new bride.

Monday the pleasant fellow entered the shop as the well-known "irate" customer. Outside the harbor, he and his bride had tried to telephone all of their relatives and could hear nothing on the radio except an ominous growl. Quite sure the trouble was nothing more than an overdose of bon-voyage champagne, we went down to his boat, turned on the engine and phone, and had nice, quiet conversations with the marine operators in New York, Boston, and Wilmington, Delaware. Obviously, inebriety. . . .

"But let's go out beyond Sands Point," the owner urged. We got under way. As soon as the engine was shoved into gear, all signals were obliterated by a horrible grinding noise. It turned out that his boat had a *Monel*-metal propeller shaft journaled in a bronze shaft strut, constituting a very powerful, underwater, natural, voltaic battery cell. The variable contact between the moving parts was as powerful a noise generator as any you might set up on purpose. Collector brushes on the shaft and a bonding strap to the strut were clearly indicated, and their installation short-circuited the noise source.

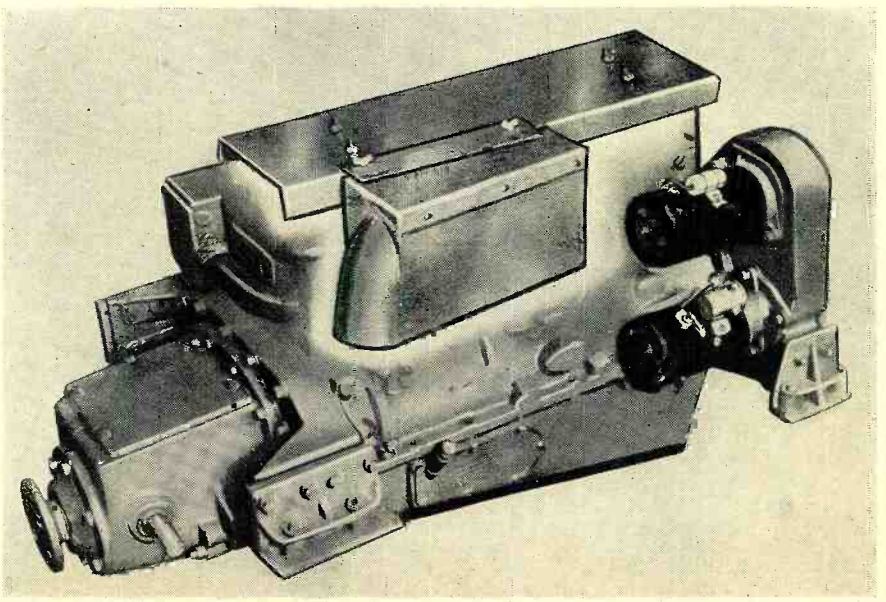
On another boat, having a gasoline engine, a radiotelephone installation was made, with the usual ignition and generator noises that were reduced to tolerable level without too much difficulty. The owner likewise went off on a cruise.

Another Monday, the same kind of trouble. Re-checking the telephone and engine proved the installation to be noise-free. Came the same invitation for a boat ride. We got under way, and, as soon as the boat got up to speed, sure enough noise did emanate from the loudspeaker. This time, though, it was a rhythmic popping noise. We pulled the engine out of gear and the noise stopped. With the engine back in gear, the noise started again in a few seconds.

Talking over the situation, we went on deck and lighted up, the owner leaning against the mast and the author against the rigging. There was a sudden crackle from the radio loudspeaker. On impulse, the writer grabbed the rigging and shook it—the same loud crackling resulted. It turned out that variable contacts in the turnbuckles and shackles of the rigging were excited when propeller vibrations hit the resonant period of the mast and rigging structure, resulting in a noise that sounded as bad as the worst untreated gas engine. Jumper wires around these points of variable contact cured the "engine noise."

The other electrical gadgets on a boat can be quieted with fairly simple procedures. Noise sources are mostly motors, or contactors. A husky enough bypass capacitor to absorb the arc will civilize them—and ground the cabinets and frames of such devices to the radio ground plate. Once acquainted with the sources of noise, technicians should be able to apply suitable cures. —30—

Fig. 3. A screen installation can be fitted directly over the engine to provide very good noise suppression from this source. The one on this engine is a Tiffiny "Sparkshield," with self-contained wing fasteners, available as a kit.



nterference Problems on Small Boats

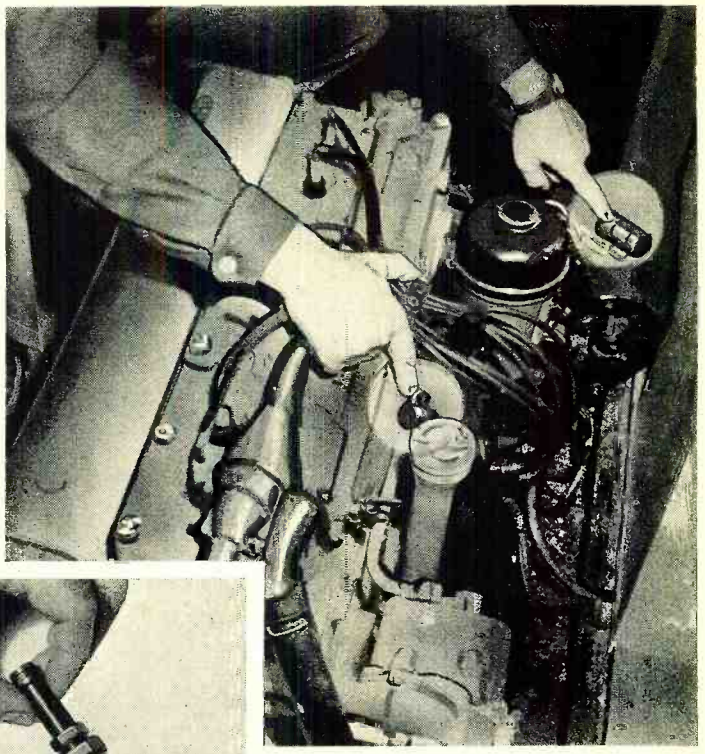


Fig. 1. Simplest treatment involves the installation of suppressor spark plugs, with noise bypass capacitors (indicated) both on the "key" terminal of the ignition coil and on the generator armature.

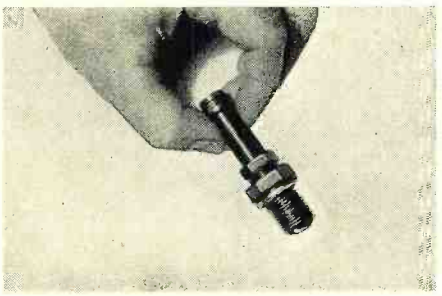


Fig. 2. A shielded spark plug of the kind that eliminates shield cans in flexible-conduit shielding systems.

By
ELBERT ROBBERSON

These tips on radio-noise sources in pleasure craft, with remedial measures, will interest technicians looking for servicing sidelines.

PLACE a sensitive radio receiver in an environment of clattering contacts, high-voltage spark discharges, heavy-current arcs, and you may expect trouble. Offhand, it seems silly to set up a system in such a location—but, unfortunately, these are the conditions under which installers of small-boat electronic equipment must operate. In spite of the seeming impossibility of obtaining satisfactory performance, the problems are not insurmountable.

The greatest source of small-boat radio noise is the gasoline engine. Since automobile radios by the thousands operate without interference, it would at first seem that silencing a boat engine was not much of a problem. After all, both engines have the same principle of operation. However, there is no comparison between cars and boats. Car radios, in the first place, are picking up multi-kilowatt stations on fairly low frequencies; the engine is shielded from the radio antenna by the hood and body of the car, and is bonded to the radio ground.

With the same engine and a radio expected to pick up the 10-to-perhaps-a-few-hundred watts of radiated signal power of a marine transmitter, all separated by nothing more conductive or shielding than a little plywood, the situation is greatly changed. In actual practice, it is generally found that boat engine noise can completely obliterate signals from any station farther away than shouting distance. Obviously, it is necessary to reduce the amount of radio noise generated by the engine, and to shield it as much as possible from the radio-input circuit.

A normal uncontrolled spark-plug discharge is a ragged, unquenched spark with frequency components covering much of the radio spectrum. This discharge may be re-shaped to one that is less interfering by installing suppressor resistors in the circuit. To reduce radiation of the remaining noise, a .5-μfd. bypass capacitor is installed at the ignition-coil terminal connecting to the ignition key. One such installation appears in Fig. 1. A suppressor resistor in the distributor-coil circuit will somewhat dampen the ignition discharge and reduce noise. Further noise reduction can be obtained by placing suppressor resistors at each spark plug, as well.

However, this system has the disadvantage of introducing extra objects in the ignition circuit, and sad experience has shown that some of the suppressor resistors on the automotive market do not have sufficient vibration and corrosion resistance to guarantee optimum performance. As a result, one may install a set of these suppressors and obtain comparative quiet on the radio, but in a short while, boat operators may complain that engine performance has fallen off, or that the engine even commences to miss on one or more cylinders or stop. The only remedy for this is to carry spare suppressors, with fairly frequent replacement being necessary.

Consequently, complete reliance on a network of spark suppressors as a means of boat-radio noise reduction is understandably on the wane. Where these suppressors work best—on an automobile—peak power is seldom required. On a boat, the engine must produce peak power for hours on end: often all of the time the boat is under way. Therefore, a noise-reduction system must be rugged and substantial, and have the least effect on engine-operating conditions.

Various spark plugs have been introduced that incorporate resistors designed to reduce engine-ignition noise in the radio. While these have a somewhat better noise-limiting effect than the external-type suppressors, many users report that, after a while, troubles similar to those experienced with external suppressor resistors result.

Automobile-radio installations naturally follow the lines of least expense, so let's look in another direction. On airplanes, common practice is to shield the entire ignition circuit in metallic conduit, so that not a peep of the spark noise can get out to the radio antennas. Small-boat radio installations have, accordingly, been made in the same way, with ignition coil, distributor, and spark plugs isolated by metallic shielding.

As effective as this practice may

and more effective means of mineral prospecting.

A large part of the International Geophysical Year effort will be devoted to a study of the upper atmosphere and the sun. To this end the United States National Committee (USNC) for the IGY has generated rocket and satellite programs. The former program is managed by a Technical Panel on Rocketry, created by USNC, and involves the firing of some 200 vertical sounding rockets during the IGY. The latter program is managed by a Technical Panel on the Earth Satellite Program (TPESP), also established by USNC, and involves the launching of a small number of instrumented satellites during the IGY.

The USNC turned to the Department of Defense (DOD) for assistance in launching the IGY satellites. DOD agreed to take on the job, and set up "Project Vanguard" under the general management of the Chief of Naval Research. "Project Vanguard" is truly a tri-service effort with the Army, the Air Force, and the Navy all taking part. Technical direction of this work has been assigned to the U. S. Naval Research Laboratory. There is widespread commercial participation in the development of the launching vehicle, the satellite itself, and their instrumentation. For example, the *Glenn L. Martin Company* is responsible for the over-all "Vanguard" launching vehicle, and has numerous subcontractors working on the different stages.

In the management of the scientific aspects of the satellite program, the TPESP has set up two working groups, one on tracking and computation (WGTC) and one on the internal instrumentation of the satellite (WGII). The WGTC acts as adviser to the TPESP on such things as optical and radio tracking of the satellite, on the reduction of tracking data and the computation of an orbit and ephemerides for the artificial moon, also on the use of such data for geodetic studies and for determining the density of the upper atmosphere. The WGII advises on experiments requiring operating instruments in the satellite. This working group has received almost three dozen proposals from various research agencies for experiments to be done in IGY satellites. The WGII is studying these proposals to assess their scientific importance, their appropriateness to IGY, their feasibility in a satellite, and whether or not they are best done in a satellite. Out of these studies there is developing a sort of priority listing of the proposed experiments, and eventually the TPESP will select those experiments actually to be flown in IGY satellites.

Instrumentation for Satellite

The Launching Operations: The IGY satellites will be launched from Cape Canaveral by means of a finless three-stage rocket. Rising vertically at first, the rocket will start tipping shortly after take-off, moving a little to the south of east in a trajectory that will ultimately lead to projecting the satellite into an orbit inclined at about 35° to the equator. The first stage will be discarded at the end of its burnout, and the second stage will then carry the third stage rocket with the 20-inch, 21.5-pound satellite attached to its nose up to 300 miles altitude about 700 miles from the take-off point. By the time the second stage with cargo has reached its peak altitude it will have been tipped over to the horizontal, thus aiming the third stage solid-propellant rocket along its intended orbit. At this time the third stage will be spun to provide stability, separated from the second stage, and fired. Following burnout of the third stage the satellite package itself may or may not be separated from the empty rocket depending on the requirements of the experiments being performed. If the satellite and the third stage rocket are separated, this will, in effect, result in two satellites, since the empty rocket casing will also continue to revolve around the earth in an orbit of its own.

During these launching operations, it will be necessary to monitor the vehicle and its equipment. This will be done both by tracking and by telemetering. For the tracking, ballistic cameras and theodolite systems, radar, and the Minitrack system to be described later will be used. Telemetering will be accomplished by means of what have now become conventional techniques, using various combinations of frequency, pulse-position, and amplitude modulation. Especially during the program of test firings prior to the first actual attempt to create a satellite there will be a need for extensive telemetering.

Optical Tracking of the Satellite: It is planned to make the first satellite in the form of a highly polished, silvery sphere, 20 inches in diameter. If the launching goes as planned, the orbit of the satellite will lie entirely above 200 miles altitude but may ex-

(*Continued on page* 112)

Artist's conception of the three-stage launching rocket that will place the scientific satellite in its orbit. Vehicle will resemble giant 30-caliber rifle shell. →

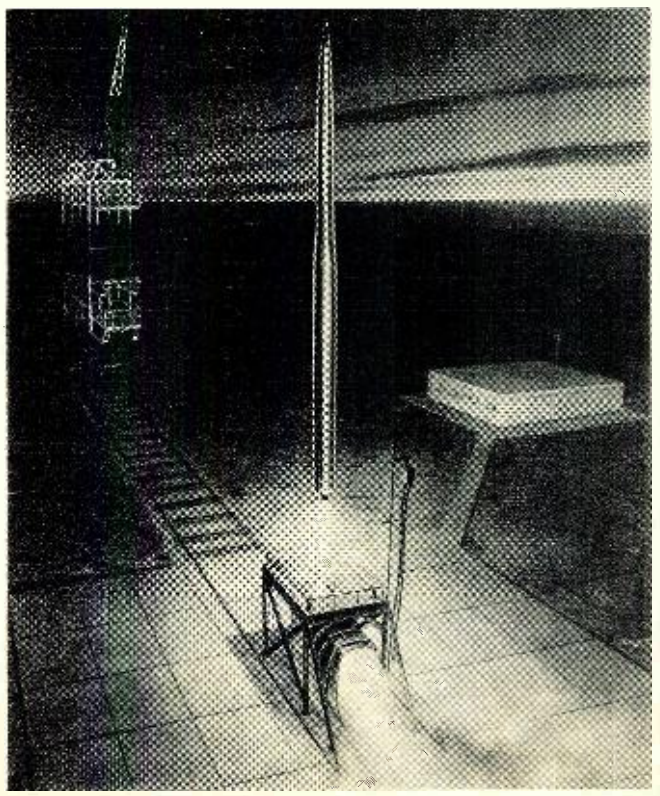
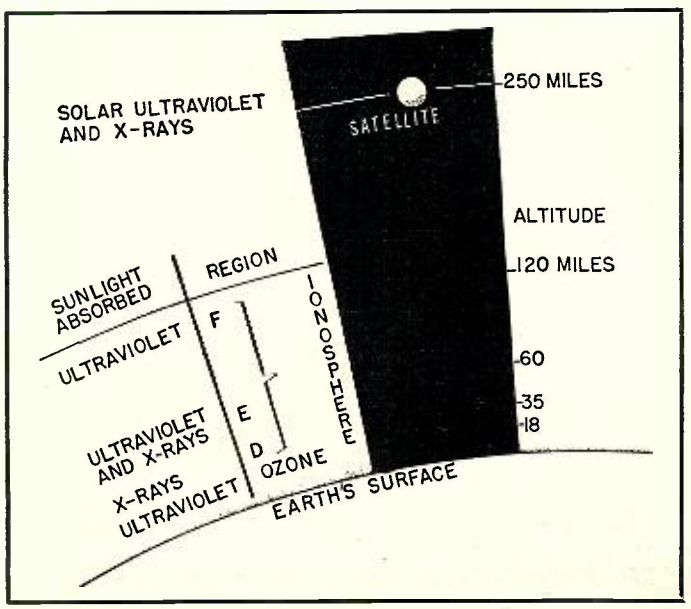


Diagram showing the distribution of ultraviolet radiation and layers of ionosphere with respect to the satellite position. ↓



BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*

MODEL SG-8

$19.50 *Shpg. Wt. 8 Lbs.*

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$48.95

Shpg. Wt. 16 Lbs.

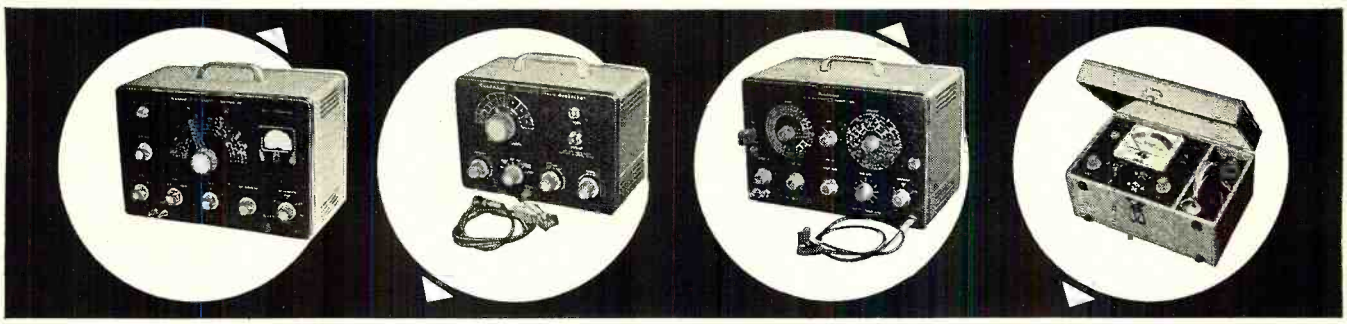
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit

MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

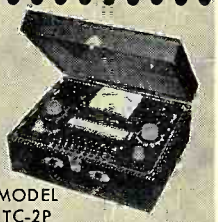
Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT



This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

PIONEER DESIGN . . .

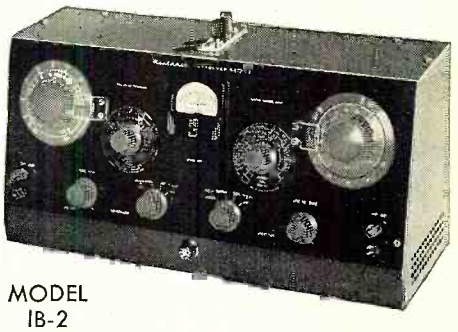
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

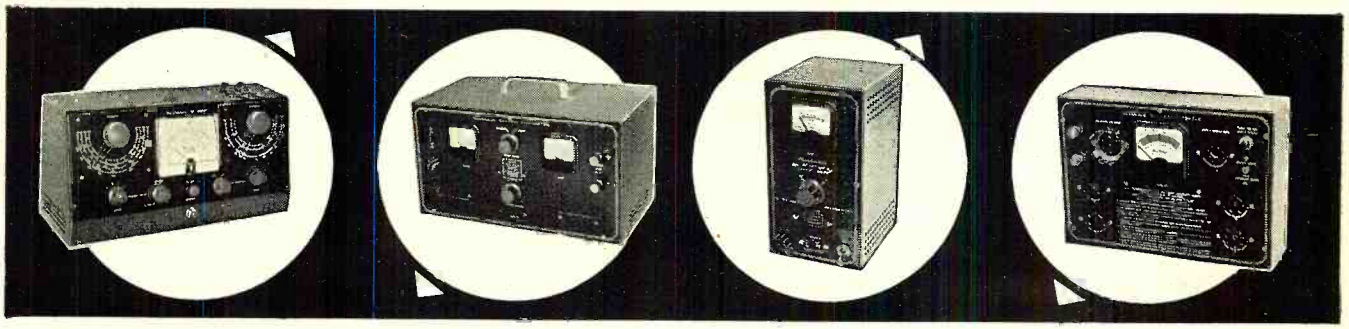
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

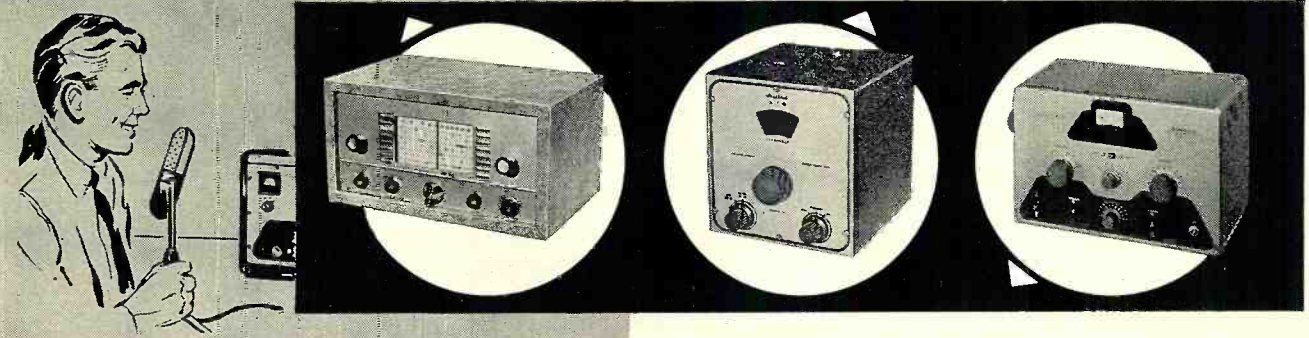
MODEL AR-3
$29.95
INCLUDING NEW EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 lbs. $4.95

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

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BENTON HARBOR 15, MICH.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20
$35.95
Shpg. Wt. 18 lbs.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

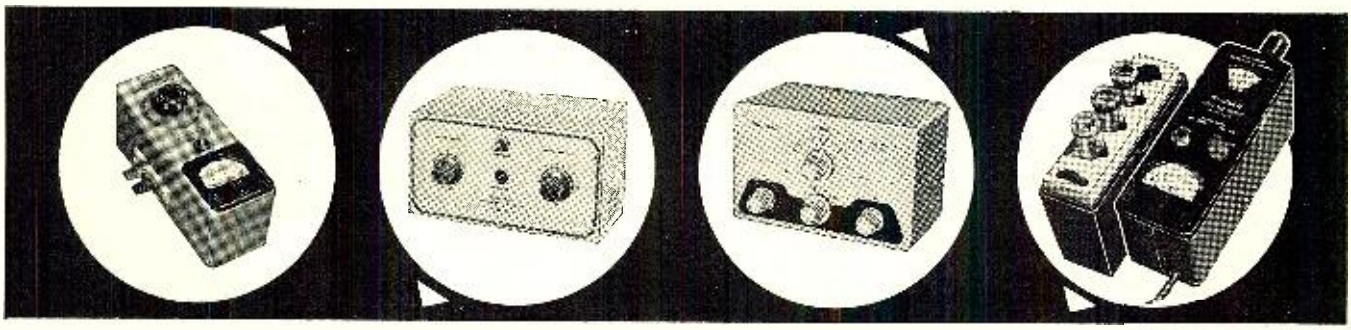
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX‡

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

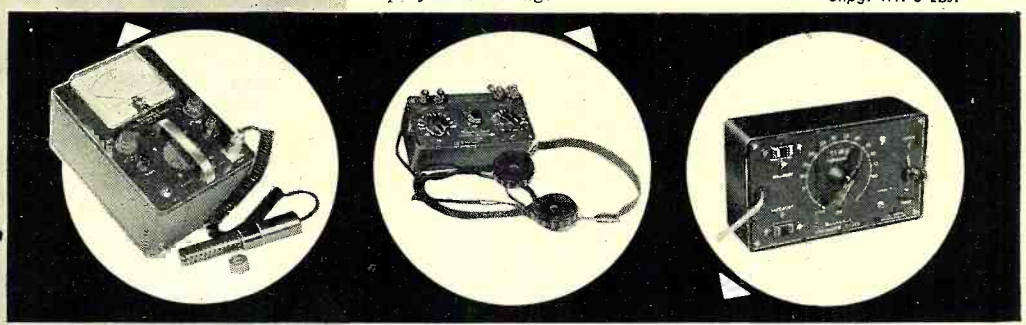
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception, This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.



- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

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COMPREHENSIVE INSTRUCTIONS . . .

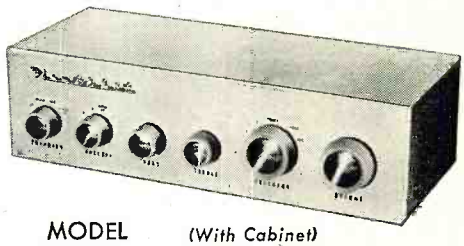
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.



MODEL WA-P2 *(With Cabinet) Shpg. Wt. 7 Lbs.*

$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

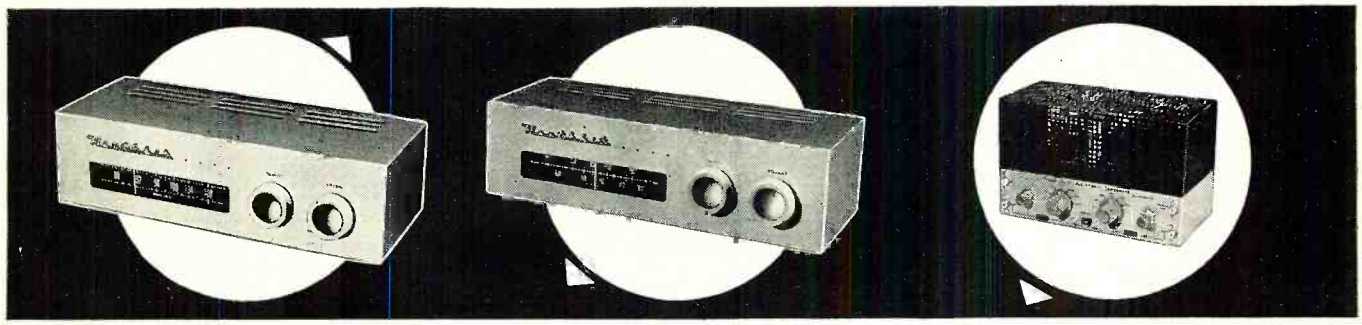
This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

$25.95

INCLUDING NEW EXCISE TAX

(With Cabinet) Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$25.95

INCLUDING NEW EXCISE TAX

(With Cabinet) Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95

Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

MODEL W-5M
Shpg. Wt. 31 Lbs. Express Only

$59.75

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- ✻ *Full 25 watt output with KT-66 output tubes.*
- ✻ *All connectors brought out to front chassis apron.*
- ✻ *Protective cover over all above-chassis components.*

HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and 1M distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and 1M distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only..... $49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only..... $69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only..... $39.75

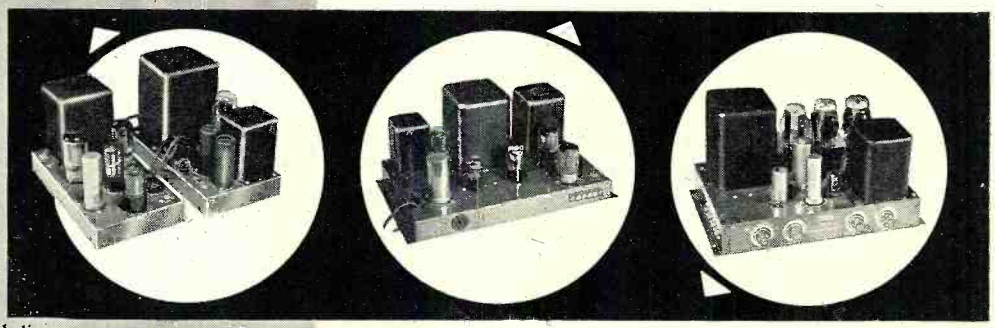
MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only..... $59.50

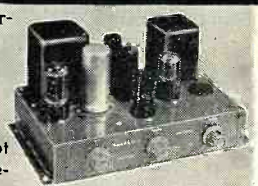
HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. *Shpg. Wt. 10 Lbs.*

MODEL A-7D
$17.95
INCLUDING NEW EXCISE TAX

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. **$19.95‡**





HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

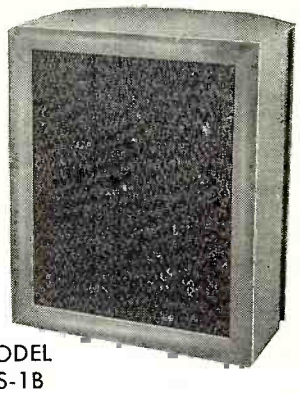
All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*



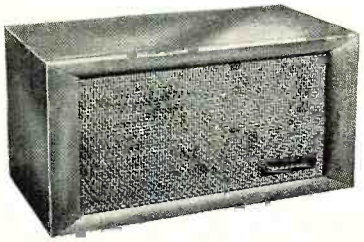
MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**



MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for_____
Please ship C.O.D. ( ) postage enclosed for_____pounds.

On Express orders do not include transportation charges — they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS include postage for weight shown. ORDERS FROM CANADA and APO'S must include full remittance.

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Address_____

City & Zone_____State_____
(PLEASE PRINT)

SHIP VIA
- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

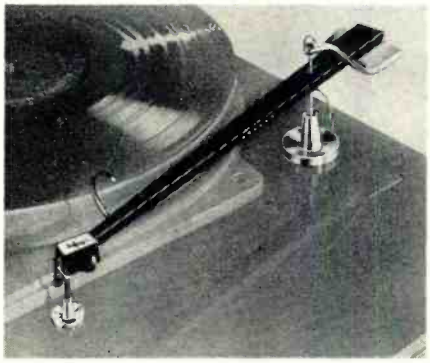
Hi-Fi-Audio Product Review

NEW PICKUP ASSEMBLY

A new lightweight, integrated arm and pickup assembly which features low arm mass and low friction for the precision, non-wearing reproduction of current and future microgroove recordings, is now being marketed by *Pickering and Company* of Oceanside, N. Y.

Known as the "Fluxvalve-Unipoise" pickup arm Model 194-D, the new unit consists of a molded pickup and arm with a single needle-point bearing to allow both horizontal and vertical motion. The integral cartridge is designed to use the high-compliance, low-dynamic-mass stylus inserts developed by the company. The pickup cartridge is an integral part of the assembly and is permanently sealed into the housing for life.

The arm mounts with a single hole in the mounting board and is easily adjusted to match the height of the turntable surface above the board. A



directly calibrated sliding weight allows for adjustment of the stylus force between one and six grams.

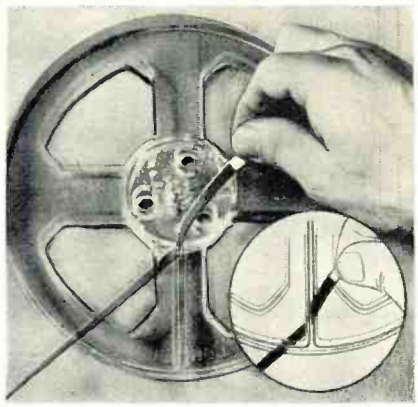
Write the manufacturer direct for full specifications on this new unit.

NEW TAPE REEL

Reeves Soundcraft Corporation of 10 E. 52nd St., New York 22, N. Y., is now supplying its recording tape on a new "Quick-thread" reel which has been especially designed to provide easier, faster loading.

The new reel features a loading slot accessible at the outer edge of the reel. Tape is inserted in this slot and automatically guided to the hub for instant, secure attachment. When loaded in this manner, the tape can actually be fastened without the fingers ever touching the reel.

Because of the wide angle formed by the spokes and the hub of the new reel, the tape can also be conveniently finger-loaded—a method commonly employed by professionals on 10½" reels. Each side of the reel has an indexing area with a special write-on surface to permit indexing of the reel



with all types of pens and any pencil.

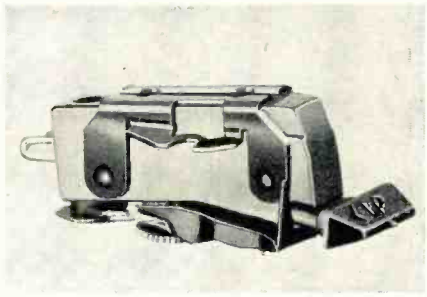
The new reels are being supplied with the firm's 5" and 7" tapes.

FIVE-VOLT CARTRIDGE

Shure Brothers, 210 Hartrey Ave., Evanston, Ill., is now merchandising a new five-volt phono cartridge that is especially designed for the replacement and "upgrading" markets.

Known as the W9, the new cartridge has a response out to 10,000 cps. This three-speed, dual-needle, dual-voltage crystal unit is said to improve the sound of even low-cost, low-gain phonographs using one and two tubes. The W9 uses the company's "Twin Lever" design principle which provides individual 78 rpm and microgroove response. The needle can be replaced in a matter of seconds, without tools, and without removing the cartridge from the tone arm.

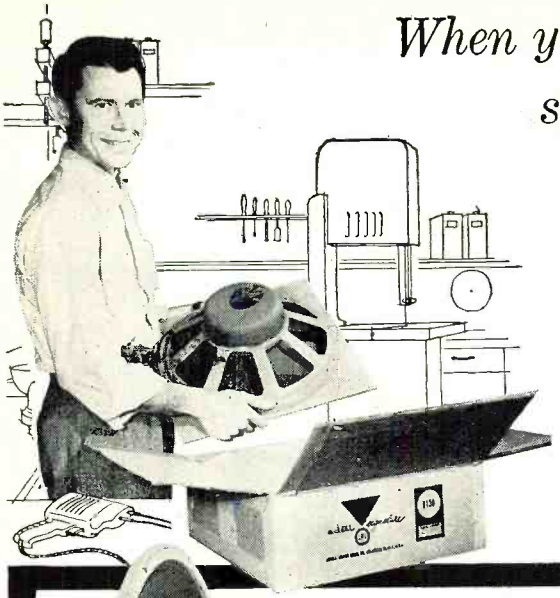
A flyer listing the specific replacements for which this unit is designed



is available from the company's distributors or from the advertising department of the manufacturer itself.

AUTO SPEAKER KITS

General Cement Manufacturing Company, 400 S. Wyman St., Rockford, Ill., is making it easier for service technicians to cash in on the vogue for bet-



When you build your High Fidelity sound system, use THE VERY BEST LOUDSPEAKERS YOU CAN GET

You are planning to build, or improve, your high fidelity sound system. Unstintingly, you will pour out your enthusiasm, time, and energy to get the finest music reproduction you can bring into your home. Get a loudspeaker that will do full credit to your handiwork . . . Install a JBL Signature Extended Range Loudspeaker, or two-way speaker system, in your enclosure.

JBL Signature Loudspeakers are made with the same careful craftsmanship, the same precision forming and fitting that you yourself would use if you set out to make the finest loudspeaker the world had ever heard. JBL Signature precision speakers are the most efficient loudspeakers made.

With a JBL Signature Loudspeaker in your high fidelity system, you can exhibit your components with pride, confident that those you have made yourself are being demonstrated in the most effective way possible.

MODEL D130—15" extended range loudspeaker The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.

MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.

MODEL D208—8" extended range loudspeaker A **precision transducer** in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.

MODEL 175DLH high frequency assembly The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens, the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.

MODEL 075 high frequency unit Another exclusive for James B. Lansing Sound, Inc. is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

JBL Signature two-way systems are available as kits

086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units—including the serpentine acoustical lens—which are used in The Hartsfield . . . units designed originally for installation in the most modern theaters in the world.

002 KIT Including some of the newest speakers made, the JBL Signature 002 Kit includes a D123 for low frequency reproduction, N2500 Network, 075 High Frequency Unit. The 002 Kit is moderately priced, yet gives the user all the advantages of a two-way system made with independent drivers.

001 KIT Probably the most popular high quality two-way system on the market, the JBL Signature 001 system consists of a 130A Low Frequency Driver, N1200 Network, 175DLH High Frequency Assembly. The D130 may be substituted for the 130A without disturbing the balance or coverage of the system.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

JBL *means*

JAMES B. LANSING SOUND, INC.

2439 Fletcher Drive • Los Angeles 39, California

Please send me the following:

☐ Free Catalog of JBL Signature Products

☐ Name and address of Authorized JBL Signature Audio Specialist in my community

TECHNICAL BULLETINS ON:

☐ D130 ☐ D123 ☐ D208 ☐ 175DLH ☐ 075 ☐ 130A ☐ 150-4C

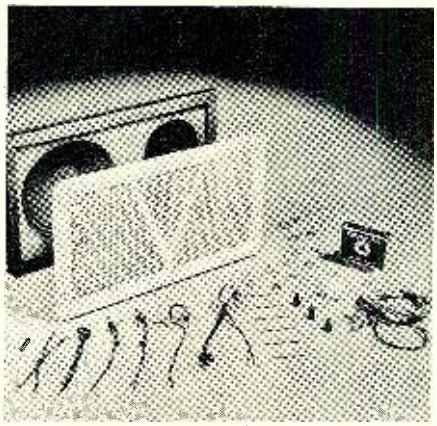
Name_____

Address_____

City_____ Zone____ State_____

ter sound reproduction in the family auto by offering a pair of speaker kits for such applications.

Incorporating two matched speakers (a tweeter and woofer), the kits are



designed for installation in the rear deck of any automobile. Everything necessary to make a satisfactory installation has been included. The kit provides a crossover network, a universal installation harness connector that fits all cars, high styled grille, three-way switch, all hardware items, and complete instructions.

Kit No. W9502 comes with a highly polished chrome grille while Kit No. W9503 is decorator grey. Write the company for full details and prices.

SHERWOOD FM TUNER

Sherwood Electronic Laboratories, Inc., of Chicago is now offering a new FM tuner which has a sensitivity of under 1 μv.

The Model S-3000's sensitivity is .95 μv. for 20 db quieting which, in effect, extends the FM station range to ap-

proximately 100 miles, according to the company. In addition, the new tuner incorporates a "Feather-Ray" tuning eye for positive sharp focus tuning, a "local-distance" switch to suppress crossmodulation, and flywheel tuning. Other features include a.f.c., a precision calibrated dial, cathode-follower output, output level control, and FM multiplex output. Delayed a.g.c. reduces IM to below 1½% at 100% modulation.

30-WATT AMPLIFIER

Fairchild Recording Equipment Company, 10-40 45th Ave., Long Island City 1, N. Y., has redesigned its 25-watt Model 255 amplifier to raise its rated output to 30 watts.

The additional power has been provided through circuit revisions and by use of EL34 output tubes and a GZ34 rectifier. The circuit changes have also improved stability and overall transient response. Average production units measure less than .1% IM distortion at full output.

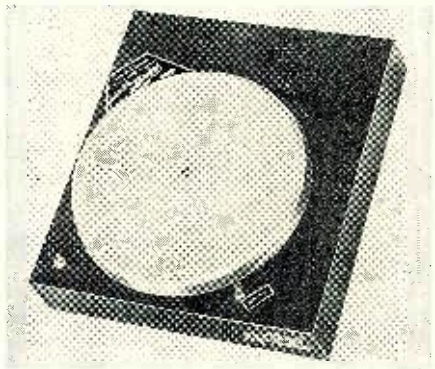
The 30-watt version is being offered at no increase in price.

DUO-SPEED TURNTABLE

Components Corporation of Denville, N. J., is now in production on a duo-speed professional-type turntable which is being offered in two models.

The new turntable features a positive-action speed control lever and a belt-driven, heavyweight, non-magnetic 12" turntable which insures constant speed and silent turning. The unit also includes a precision 4-pole constant-speed motor that is magnetically shielded and a non-slip cork pad to protect records.

The Model 45 is designed for handling 33⅓ and 45 rpm discs while the Model 78 will play 33⅓ and 78 rpm records. Rumble is −65 db and flutter



and wow less than 1/10 of 1% r.m.s. The base, shown in the photograph, is available at slight extra charge.

TRANSISTOR FOR AUDIO

The Semiconductor Division of *Radio Corporation of America,* Somerville, N. J. has recently introduced a new germanium alloy *p-n-p* type transistor which has been especially designed for the audio output stages of auto radios and marine, military, and other mobile communications gear.

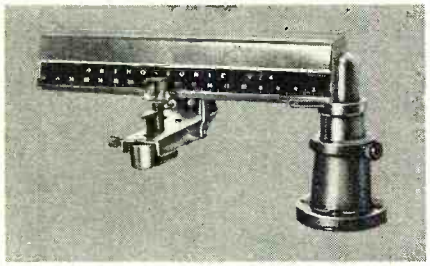
The 2N301 and 2N301A are especially well suited to mass-production applications. When used in class A service, a single unit can deliver a maximum-signal power output of approximately 2.7 watts with a power gain of 32.5 db; in class B push-pull service two of these units can deliver a maximum-signal power output of approximately 12 watts with a power gain of 30 db. Total harmonic distortion at maximum-signal power output is less than 10%.

NEW TONE ARM

Ortho-Sonic Instruments, Inc., 66 Mechanic Street, New Rochelle, N. Y. has added a new, shorter model radial pickup arm to its line of audio gear.

The Model #100/V/4 arm retains all of the features of the larger model except that it is designed to play records up to 12" diameter rather than transcriptions. The engineering prin-

ciples are the same, namely the cartridge transport travels in a straight line, thus duplicating the path of the



original cutting stylus with zero tracking error.

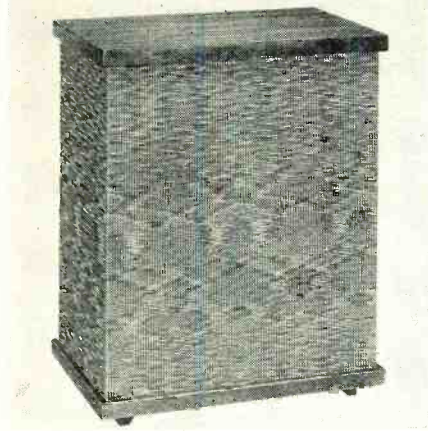
The arm measures only 7¼" in length so that it will fit even the smallest cabinets. The cartridge carrier will accept all popular cartridges either through simple slide-in method or with the usual mounting screws. Literature describing this arm as well as other of the company's products is available without charge.

"CALIFORNIAN" ENCLOSURE

Argos Products Co. of Genoa, Ill. is now marketing a new speaker enclosure in factory-built or pre-finished kit form.

Known as the "Californian", the top of the new enclosure is finished with long-wearing St. Regis "Panelite" and the interior design uses the *Jensen* "Bass Ultraflex" principle. The enclosure is available in two sizes, two colors, and in two forms.

The "Californian, Jr." is designed for use with 8 or 12 inch speakers and measures 19½" x 23⅜" x 13½" deep.



The "Californian" is to be used with 12 or 15 inch speakers and it measures 24" x 29" x 15" deep. Both are available assembled or in kit form in either blonde or mahogany finishes.

Write the manufacturer direct for prices and additional details.

BOGEN P.A. LINE

David Bogen Co., Inc., Paramus, N. J. is now offering a completely new line of public address amplifiers, comprising twelve models.

The new "Flex-Pak" line offers a new concept in styling, with its light weight and slim, modern look. The line is being offered in three series, the "L", "LX", and "LOM". The "L" se-

ries incorporates constant voltage output taps which eliminate difficult calculations to determine speaker matching transformers, special filters to improve speech clarity, equalized phono input for all cartridges, separate bass and treble controls, plug-in sockets for low-impedance transformers, pencil-in erase-out identification strips for all channels, and sturdy leather carrying handles.

The "LX" series incorporates all these features plus an anti-feedback control and a built-in remote gain-control circuit which allows changes in gain from distances up to 2000 feet. The "LOM" preamplifier has higher power output and gain than previous models made by the company, plus an improved circuit.

A catalogue containing complete engineering specs on these units is available on request.

AUDIO CATALOGUES

TURNTABLE OR CHANGER?

The answer to this question is covered in a colorful new booklet just released by *Rek-O-Kut Company,* 38-01 Queens Blvd., Long Island City 1, N. Y.

The purpose of the booklet is to simplify the essential differences between the turntable and changer for the ultimate purchaser. With this information at his fingertips, the user can choose this part of his hi-fi system with the assurance that he is buying the proper component.

The booklet is broken down into eight basic differences between the two items, eight factors that should be considered before purchasing. The company's entire line is illustrated in color as well.

HI-FI GEAR

George D. Barbey & Co., Inc., Second and Penn Sts., Reading, Pa., has issued a new 80-page catalogue covering all types of hi-fi gear.

A 16-page section carries a detailed, non-technical explanation of what is meant by "hi-fi" with the balance of the catalogue devoted to a listing of a wide variety of amplifiers, turntables, speaker systems, and other high-fidelity equipment.

The company has branches in Lancaster, Lebanon, and Pottstown, Pa. The catalogue can be obtained from any of the four stores.

DUOTONE BOOKLET

The Duotone Company, Keyport, N. J. has recently published a new and informative booklet which they are offering without charge on request.

Entitled "An Objective Study of Loudspeakers," the 16-page booklet tells all about speaker design, construction, and installation. Details on the firm's "Fidelity Focus" units are included.

A postcard to the company will bring a copy promptly.

LOUDSPEAKER DATA REPRINT

Rockbar Corp., 650 Halstead Ave., Mamaroneck, N. Y., has reprinted four articles on the *Goodmans* ARU and

friction-loaded enclosures in pamphlet form.

Written for the hi-fi hobbyist and layman, the articles originally appeared in this magazine, POPULAR ELECTRONICS, *Radio-Electronics,* and *Audiocraft.* Free copies of this reprint are available from the company on request.

"SCOTCH" TAPE SELECTOR

Which magnetic tape is the right one for a specific recording job is the subject of a new pocket-size folder which is being distributed without charge by *Minnesota Mining and Manufacturing Company,* St. Paul, Minn., to those requesting it by mail.

The two-color booklet, of interest to all tape users, describes the characteristics of six different types of "Scotch" brand magnetic recording tapes and how each tape is used. Besides giving recording characteristics of the tapes, the booklet features a handy reference table listing playing time of single and dual track tapes at 3.75 and 7.5 ips in a variety of reel lengths.

Write Dept. M7-56 of the company for a copy. —30—

FRESNO HAMFEST

THE 15th annual Fresno Hamfest has been scheduled for Saturday, May 11th in Fresno, California.

Registration will be held at the Fresno Memorial Auditorium and technical talks, hidden transmitter hunts (on 75, 10, 6, and 2 meters), code speed contests, mobile judging, and XYLs' luncheon will keep the attendees busy all day. In the evening a banquet will be held, featuring good food, good entertainment, awarding of prizes, and prize drawings.

Tickets for the hamfest are $6.00 each. Advance registrations must be postmarked by midnight May 5th to be eligible for the pre-registration prize. For further information and advance registrations, contact Steve Weber, W6QON, 1448 East Richert, Fresno, California. —30—

John L. Reinartz, K6BJ, of Eimac shows a rig he designed and built to hams at the Fresno hamfest. He will also attend this year's event and talk on "A New Approach to the V.F.O. Problem, as Used for SSB Excitation." The event takes place May 11.

Phase Inverters for Hi-Fi Amplifiers

By **MANNIE HOROWITZ,** Electronic Instrument Co., Inc., (EICO)

Characteristics and comparisons of common inverters with emphasis on the new "longtailed pair" circuit.

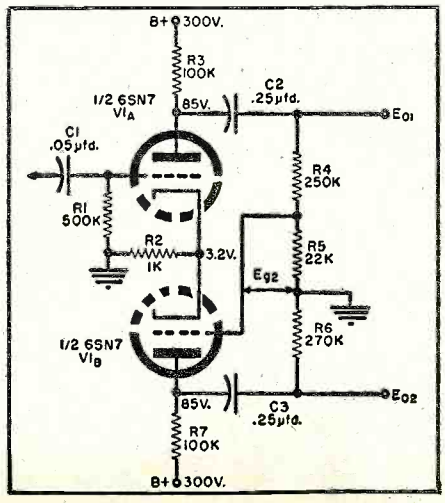
THREE types of phase inverter systems are currently being used in the majority of high-fidelity amplifiers. Each one of these three systems exhibits major shortcomings. A fourth method for phase inversion, popular for many years overseas, has now been adopted for use in some of the better quality amplifiers in the United States. This form, popularly known as the "longtailed pair" or "Clare cathode-coupled" phase inverter, possesses characteristics superior to the other types.

The primary purpose of a phase inverter is to supply signal voltages to the control grids of the two output tubes in push-pull operation. These voltages must be equal in magnitude, but 180° out-of-phase. This relationship must exist for several octaves above and below the audio spectrum, as well as over the entire audio band (20 to 20,000 cycles). Both conditions must be met to achieve the minimum distortion with the maximum output power and stability.

The three phase inverter circuits popular today are: 1. the conventional popular type, 2. the paraphase inverter, and 3. split-load cathodyne type. These are shown in Figs. 1, 2, and 3.

1. *The conventional popular type:* In the conventional popular type (Fig. 1), a portion of the output voltage from V_{1A} is fed to the grid of V_{1B}. When a signal is fed through a tube, there is an automatic phase shift of 180° from the grid to the plate. Thus, the two output voltages, E_{o1} and E_{o2}, are in the proper phase relationship.

Fig. 1. Conventional popular inverter.



The amount of voltage fed to the grid of V_{1B} is determined by the voltage divider resistors consisting of R_4 and R_5.

Let E_{g2} be the voltage at the grid of V_{1B} and E_{o1} the output voltage from V_{1A}. If the gain of V_{1B} is K_2, the output voltage from V_{1B}, E_{o2}, is

$$E_{o2} = K_2 E_{g2} = K_2 E_{o1} (R_5/[R_4+R_5]) \quad . \quad . \quad (1)$$

For perfect balance, $E_{o1} = E_{o2}$ or $E_{o2}/E_{o1} = 1$. Thus from equation (1) it follows that

$$E_{o2}/E_{o1} = K_2 (R_5/[R_4+R_5]) = 1 \quad . \quad . \quad . \quad (2)$$

From equation (2) it becomes obvious that perfect balance is entirely a function of the gain of the second section of the tube and the resistance ratios. In the balanced condition,

$$K_2 = [R_4+R_5]/R_5 \quad \text{(from equation 2)}. \quad (3)$$

Although the ratios of the resistors can be fixed for any value of K, K cannot be maintained at a constant value. The gain of the tube will vary with age, tube tolerance, and line voltage conditions. It will be impossible to satisfy equation (3) under all conditions of operation. As a result, the phase inverter will produce an unbalanced output, resulting in even-harmonic distortion.

A further disadvantage of this system is that the signal E_{o1} passes through one tube while the signal E_{o2} passes through two tube sections. This involves one more stage of coupling and one additional plate-to-cathode tube capacity in the signal output voltage E_{o2} than was the case for E_{o1}. This added phase shift due to coupling and tube capacities at extremely low (0 to 5 cycles) and extremely high (.05 to 1 megacycle) frequencies in one half of the phase inverter can lead to instability at these frequencies when the phase inverter circuit is included in a feedback loop.

2. *Floating paraphase inverter:* Fig. 2 is a schematic of the well-known floating paraphase inverter. A high degree of feedback, due to R_7, keeps the system well balanced.

The signal from V_{1A} is divided between R_5 and R_7 and fed to the grid of V_{1B}. Here the phase is shifted 180° and amplified.

The signal from V_{1B} is divided between resistors R_6 and R_7. Thus R_7 passes the current from both V_{1A} and V_{1B}. Since these two currents are out-of-phase, the resultant current in R_7 is the difference between these two currents. The voltage across R_7 is due to the difference of these currents rather than only the current from V_{1A}

(as may have been previously inferred). Since this voltage (due to the outputs from both V_{1A} and V_{1B}) is fed to the grid of V_{1B}, there is feedback around the second section.

The simple mathematical analysis can best indicate the operation and the degree of the shortcomings of this circuit.

Let I_1 be the current through R_5, I_2 the current through R_6 and $I_1 - I_2$ the resulting current through R_7. E_{g2}, the voltage across R_7, is also the voltage at the grid of the second section. E_{o1} and E_{o2} are the output voltages from V_{1A} and V_{1B}, respectively. The gain, K_2, of V_{1B} is:

$$K_2 = E_{o2}/E_{g2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Since the voltage across R_5 is $E_{o1} - E_{g2}$ and across R_6 is $E_{o2} + E_{g2}$ (since E_{o2} and E_{g2} are out-of-phase), then

$$I_1 = \frac{E_{o1} - E_{g2}}{R_5} = \frac{E_{o1} - E_{o2}/K_2}{R_5} \quad . \quad . \quad . \quad . \quad (5)$$

$$I_2 = \frac{E_{o2} + E_{g2}}{R_6} = \frac{E_{o2} + E_{o2}/K_2}{R_6} \quad . \quad . \quad . \quad . \quad (6)$$

$$I_1 - I_2 = E_{g2}/R_7 = E_{o2}/K_2 R_7 \quad . \quad . \quad . \quad . \quad (7)$$

Substituting equations (5) and (6) in (7) gives:

$$\frac{E_{o1} - E_{o2}/K_2}{R_5} - \frac{E_{o2} + E_{o2}/K_2}{R_6} - \frac{E_{o2}/K_2}{R_7} = 0 \quad (8)$$

Putting the equation over one common denominator, $K_2R_5R_6R_7$, and cross-multiplying, results in the simplified equation:

$$E_{o1}K_2R_6R_7 - E_{o2}R_6R_7 - E_{o2}R_5R_7\ (K_2+1) - E_{o2}R_5R_6 = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Factoring out the voltages E_{o1} and E_{o2} gives

$$E_{o1}(K_2R_6R_7) = E_{o2}(R_6R_7 + R_5R_7[K_2+1] + R_5R_6) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

or:

$$\frac{E_{o1}}{E_{o2}} = \frac{R_6R_7 + R_5R_6 + R_5R_7(K_2+1)}{K_2R_6R_7} \quad . \quad (11)$$

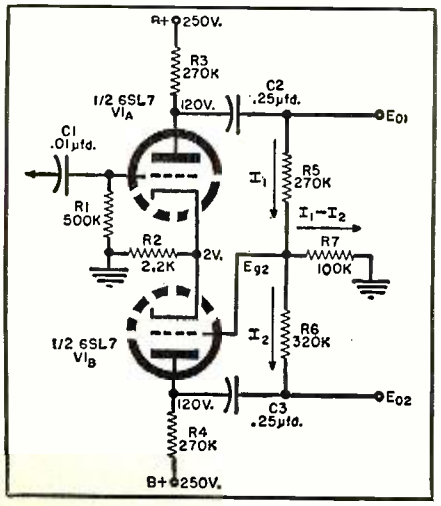
For perfect balance, $E_{o1}/E_{o2} = 1$. Substituting the values from Fig. 2 in equation (11) as follows,

$$\frac{E_{o1}}{E_{o2}} = \frac{3.2\text{x}10^{10} + 8.6\text{x}10^{10} + 2.7\text{x}10^{10}(K_2+1)}{3.2\text{x}10^{10}K_2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

shows that for perfect balance, when equation (11) is equated to 1, $K_2 = 29$.

It is conceivable that K_2 can equal half its original gain due to tube variations. Under this extreme condition, $K_2 = 14.5$. Then the ratio E_{o1}/E_{o2} will equal:

Fig. 2. Floating paraphase inverter.



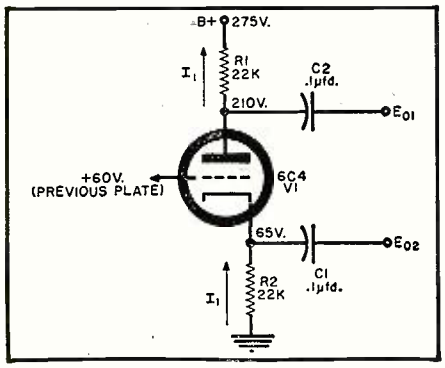


Fig. 3. Split-load phase inverter.

$$\frac{11.8\text{x}10^{10}+42\text{x}10^{10}}{46.5\text{x}10^{10}}=1.16.$$

This result shows a 16% unbalance with a gain variation of 50%. This is a reasonably good phase inverter, far superior to that shown in Fig. 1. However, the balance can be further improved.

3. *Split-load phase inverter:* The third and most popular phase inverter circuit, being used in the Williamson and Williamson-type amplifiers, is the split-load type (Fig. 3).

All signal current, I_1, passing through R_1 passes through R_2 as well. The currents through both resistors are identical since the plate and cathode currents of a single tube section are equal. The output voltage from the plate is $E_{o1}=I_1R_1$, while the output voltage from the cathode is $E_{o2}=I_1R_2$. The phases are proper since the output voltage at the plate is 180° out-of-phase with the output voltage at the cathode.

For perfect balance, $E_{o1}=E_{o2}$, then:

$E_{o1}=E_{o2}$ . . . . . (12)

$I_1R_1=I_1R_2$ . . . . . (13)

$R_1=R_2$ (cancelling the I) . . . . (14)

Thus. all that is required for a balanced output is that R_1 be equal to R_2.

The major disadvantage of this system is the unbalance in output impedance and the difference of relative capacities[1] at the output, which can be observed at high frequencies.

The output impedance for E_{o2} is low due to cathode follower action, while the output impedance at E_{o1} is high.

The output capacitances at the plate (C_{o1}) is twice the plate-to-cathode capacity (C_{pk}) added to the grid-plate capacity (C_{gp}) multiplied by a factor of $(1+1/K)$, where K is the gain of either output channel.

The output capacitances at the cathode (C_{o2}) is twice the plate-to-cathode capacity added to the heater-cathode capacity (C_{hk}) and the grid-to-cathode capacity (C_{gk}) multiplied by a factor of $(1/K-1)$.

The two output capacities can be written mathematically as follows:

$C_{o1}=2C_{pk}+C_{gp}(1+1/K)$ . . . . . (15)

$C_{o2}=2C_{pk}+C_{hk}+C_{gk}(1/K-1)$ . . . (16)

It is obvious from these equations that the two capacities are unequal. These factors usually lead to unbalance at frequencies on the order of 50,000 cycles or less, resulting in instability and square-wave distortion.

It should be pointed out the gain of the phase inverter section is 2 as a

maximum value. This results from the cathode-follower portion of the circuit which has a gain of less than 1 and from the plate portion whose output is made equal to the cathode portion. Since, however, this circuit requires only one triode section of a twin-triode tube, the other section is available for amplification. The total gain of both sections then compares favorably with previous circuits.

4. *Clare cathode-coupled phase inverter:* The longtailed pair phase inverter is well designed to overcome many of the shortcomings present in other systems. This form, used in the finest European amplifiers, is shown in Fig. 4 as it has been adopted and improved for the *Eico* 50- and 60-watt units.

(Note: In the discussion to follow, all currents and voltages refer to the signal currents and voltages and not the d.c. values.)

A qualitative analysis of this circuit is simple. An input voltage, E_1, is fed to the system. The voltage across R_3 (E_k) is due to the difference in current ($I_1 - I_2$) from the two sections of the tube, and is thus very small. It then follows that the voltage appearing at the grid of V_{1A} is $E_{g1} = E_i - E_k$.

The cathode voltage E_k is the sole voltage appearing between the grid and cathode of V_{1B}. In the circuit of Fig. 4, the capacitor C_1 is a short circuit for all signal current between grid of V_{1B} and ground. Thus the grid is at ground potential, with the only signal source between the grid and the cathode of V_{1B} being E_k.

The large value of the cathode resistor, R_3, affords a large amount of feedback to both halves of the tube. (See paraphase inverter for a more complete explanation of this.)

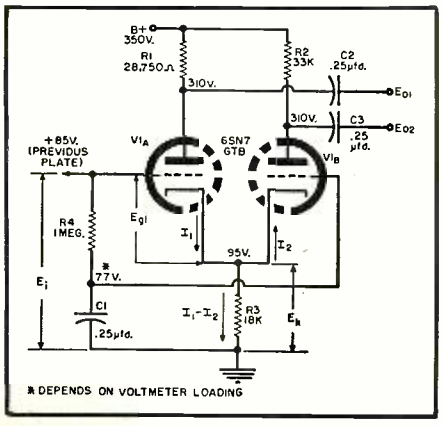
The output voltages are made equal by adjusting the circuit parameters. The output phase in V_{1B} has been shifted by 180° from that of V_{1A} due to the direction of application of the cathode voltage to the grid V_{1B}.

The mathematical analysis of this circuit results in several simple formulas which are useful in design and circuit analysis. The derivation of these formulas is indeed instructive.

The gain of the first section of the tube (K_1) is:

$$E_{o1}/E_{g1} = K_1 = \mu_1 R_1/R_{\mu 1} + R_1 = g_{m1} R_1 \quad . \quad (17)$$

Fig. 4. "Longtailed pair" phase inverter.



where: g_{m1} is the dynamic mutual conductance[2]
μ_1 is the amplification factor
R_{p1} is the plate resistance
E_{o1} is the output voltage
all from V_{1A}.

From this it follows that:

$$E_{o1} = E_{g1} g_{m1} R_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

Similarly, the output voltage from V_{1B} is

$$E_{o2} = E_k g_{m2} R_2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

where: g_{m2} is the dynamic mutual conductance of V_{1B}.

The currents in V_{1A} (I_1) and V_{1B} (I_2) are:

$$I_1 = E_{o1}/R_1 = E_{g1} g_{m1} \quad \text{(from 18)} \quad . \quad . \quad . \quad (20)$$

$$I_2 = E_k g_{m2} \quad \text{(from 19)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

The signal currents from each section flows through the cathode resistor. Since these currents are out-of-phase, the total cathode current is $I_1 - I_2$. The total cathode voltage, E_k, is, from equations (20) and (21)

$$E_k = (I_1 - I_2) R_3 = (E_{g1} g_{m1} - E_k g_{m2}) R_3 \quad . \quad (22)$$

and separating the variables,

$$E_k = E_{g1} \frac{(g_{m1} R_3)}{(1 + g_{m2} R_3)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (23)$$

Substituting this in equation (19) and combining the result with equation (18) to get the ratio of E_{o1}/E_{o2}, gives:

$$\frac{E_{o1}}{E_{o2}} = \frac{E_{g1} g_{m1} R_1}{g_{m2} R_2 \dfrac{(g_{m1} R_3) E_{g1}}{1 + g_{m2} R_3}}$$

and simplifying, gives the expression:

$$\frac{E_{o1}}{E_{o2}} = \frac{R_1 \times 1 + g_{m2} R_3}{R_2 \times g_{m2} R_3} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (24)$$

For perfect balance, E_{o1}/E_{o2} must be equal to 1.

Equation (24) indicates that balance is a function of the dynamic mutual conductance of the second section as well as the ratio of the plate load resistors, R_1/R_2. When the 6SN7 is operated as shown in Fig. 4, the balance is excellent over a wide range.

As an example in the use of equation (24), let us analyze the phase inverter circuit as used in the *Eico* HF-50 and HF-60 high-fidelity amplifiers (Fig. 4). The actual values of the component parts are given on the diagram. In the amplifier, the d.c. grid bias measures 10 volts. The tube manuals indicate that for 10 volts bias, the *mu* of V_{1B} of the tube (μ_2) is 17.5 and the plate resistance, R_{p2}, is equal to 13,500 ohms, when the plate supply voltage is 350 volts. Thus, from equations (17) and (19),

$$g_{m2} = \frac{\mu_2}{R_{p2} + R_2} = \frac{17.5}{13{,}500 + 33{,}000} = 3.76 \times 10^{-4} \text{mhos}$$

Substituting this and the components tabulated in Fig. 4 into equation (24) gives

$$E_{o1}/E_{o2} = \frac{1 + (3.76 \times 10^{-4})(1.8 \times 10^4)}{(3.76 \times 10^{-4})(1.8 \times 10^4)} \times \frac{28750}{33000}$$

$$= .872 \times \frac{1 + 6.77}{6.77} = 1.$$

These values for R_1 and R_2 are the perfect ones for absolute balance. However, the closest RETMA resistor to this value of 28,750 ohms is 27,000 ohms. This can be substituted for the exact value and result in only a 6% unbalance. It is nevertheless preferable to use the exact resistor as specified.

The *mu* of the 6SN7 can reach a minimum of 13.5 (considering the tube

manufacturer's 20% tolerance). The g_{m2} would then become 2.9×10^{-4} mhos (Equations 17 and 19). Substituting this extreme condition into equation (24) would result in the ratio E_{o1}/E_{o2} as follows:

$$.872 \times \frac{1+(2.9\times10^{-4})(1.8\times10^{4})}{(2.9\times10^{-4})(1.8\times10^{4})} = 1.04$$

or 4% unbalance. This negligible unbalance under an extreme condition of tube variation is as good as or better than any other type of phase inverter.

This type of phase inverter retains its balance at both the high and low frequencies.

The excellent high-frequency characteristics are due to the equal output impedances in both halves and equal stray and plate-cathode capacities due to circuit symmetry. The balance at the low end is maintained by the use of a large value for capacitor C_1 and large coupling capacitors leading to the output tubes (C_2 and C_3).

The primary disadvantage of this circuit is the loss of half the gain, as compared with other phase inverters. The addition of an extra stage of amplification ahead of the phase inverter compensates for this. This added amplification, coupled with perfect balance, permits more feedback to be used around the entire amplifier, with a complete absence of oscillation.

The phenomenal results possible with this circuit are evident in the *Mullard* 10-watt amplifier popular in Europe and in the *Eico* 50- and 60-watt amplifiers made in the U.S.A.

REFERENCES

1. Langford-Smith, F.: "Radiotron Designer's Handbook," Fourth Edition 1952, page 330.

2. Ibid, page 25.

—30—

LITZ WIRE FOR LOOPS

By GEORGE L. GARVIN

"LITZ" wire consists of a number of strands of wire, all insulated from each other and then entirely covered by either cotton or silk insulation. To all appearances there is no difference between Litz wire and ordinary covered wire. It has, however, long been recognized that coils, etc., wound with Litz have a much greater gain than other types.

Litz wire is hard to buy and harder to solder due to the enamel used on the strands, which are very fine.

The author finds that we usually have plenty of it available in the junk box, so when winding coils or loops, look for an old radio i.f. coil and you will find, upon close examination, that in nine out of ten cases it will be wound with Litz wire.

Tinning the ends of the Litz wire is no more difficult than ordinary solid enamel wire if properly prepared as follows: Obtain from the kitchen a small block from a cake of Bon Ami, about ½" square and 1½" long, then using this instead of a knife, gently draw the strands between the block and your thumb. Do this several times, meanwhile turning the wire around to catch all sides of the strands. The Bon Ami is so smooth and gentle it will not harm the wire, but will make it bright. Twist all strands together and tin with rosin core solder. —30—

The "Dynetic"

(*Continued from page 49*)

accentuated by poor response, particularly peaking, in this region. And this can cause serious intermodulation effects that *are* audible.

One's first impression, looking at this new tone arm, is one of better compatibility with the tiny stylus point which only applies a force of 1 gram to the disc. There is enough mass to insure that the pickup stays still while the stylus vibrates, right down to the very lowest frequency on the record, but there is not the absurdly large amount of mass that seems to "hang on" to most tone arms and degrade their performance in other respects. When stylus forces were in the region of an ounce or higher, bigger pickups and tone arms were a necessity; but now we are getting down to stylus forces in the region of a gram, it would seem logical that the mass of other relevant parts should be reduced or scaled down in similar proportion.

With a stylus force of only 1 gram, a lateral dynamic mass at the stylus of just over 1 milligram, and a compliance of 6×10^{-6}, it seems the lateral force needed to move the arm across the record should be very small, to take advantage of the highly sensitive "movement." With bigger, heavier arms it is *possible* that only a small force is necessary to move them, but the bigger and heavier an object is, the more friction is likely to be encountered in the moving of it. By using a much lighter arm, more delicately suspended, with careful attention to its shape so rigidity is maintained and resonance is avoided, it is possible to reduce very considerably the lateral force necessary to move it.

Jeweled Movement

Another step in this direction is the use of jeweled pivots for both vertical and horizontal movements.

The pivots for the required vertical movement consist of a sleeve and cap jewel on each side, and the pivot for horizontal movement is a single convex thrust jeweled bearing. While delicately balanced, both ways, it is also really rugged—a difficult combination to achieve.

Adjustment of stylus pressure is quite simple, by means of a small brass counterweight on the small arm assembly that carries the pickup itself. This counterweight can be screwed back and forth along a threaded rod to give quite fine adjustment of stylus force, from less than 1 to about 2 grams.

The only criticism in regards to this feature is one that will apply to a great many other tone arms on the market. This is that stylus force is rather difficult to adjust, because it is inaccessible from the normal playing position of the arm. In this case you either have to swing the arm clear of the turntable or you can stand on your head and do it from underneath, or else remove the arm from its vertical post. It is fairly easy to do the latter with this arm, because it only requires slacking off one screw and sliding the arm off the top of the post. Care has to be exercised in putting the arm back on, to make sure it is the correct distance above the record.

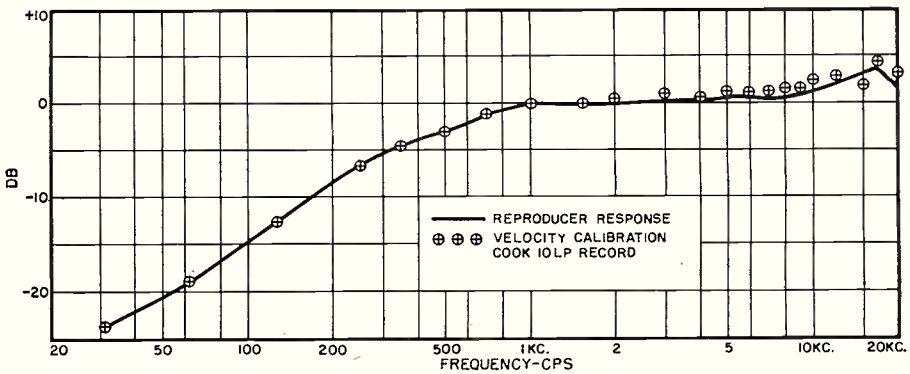
For some users, a disadvantage will be the short length of arm from the stylus point to the vertical pivot. This means the tone arm has to be placed quite close down over the record. It is not conveniently possible to set this arm so it will play one record stacked on top of another. It certainly could not be arranged to play up to three records stacked. Most fidelity enthusiasts will rejoin "who wants to?" and the author agrees with these sentiments! It provides sufficient latitude for practical amounts of record warp.

A New Pickup Transducer

The pickup itself employs some interesting new features. One is that the stylus arm provides the necessary offset angle. The "nose" of the pickup has one side straight and the other inclined at an angle approximately double the offset angle. The stylus arm mounts in a position central in the pickup and is offset so as to bisect the angle formed by the nose of the pickup.

It also represents a new departure in pickup design. As the coil does not

Graph shows a comparison between the actual measured response of the reproducer against the calibrated levels of a Cook 10LP test record. An ordinary equalizer-preamp used for conventional magnetic cartridges will be suitable for the "Dynetic."



move, most people are going to dub it a "magnetic" type. However, the manufacturer insists it is closer to a dynamic than a magnetic process and *Shure* calls it "Dynetic."

This pickup exactly reverses the usual process for either magnetic or dynamic types. It rotates the magnet and keeps the coil still. This is rendered possible by the development of modern magnetic material and an ingenious, but simple, construction that produces the very low lateral dynamic mass quoted, which is right down there with the moving coils. The stylus arm and magnet assembly is carried in a piece of elastomer material molded into the pickup which makes it easy to remove and replace styli.

This construction yields the advantage of the magnetic types that the coil can be wound to any impedance desired. The particular impedance chosen is one that produces optimum results working into a resistive load of about 27,000 ohms. The response curves for the pickup tell their own story.

The last question to be answered here is "How does it sound?" Well, this new development (probably one of a group that will be appearing very shortly) will throw the onus of responsibility for further progress toward hi-fi onto the record manufacturers.

The performance is very similar to that of a high quality moving coil pickup, but there are noticeable differences—just. These differences, in the author's opinion, represent an improvement in most instances, but it requires extremely critical listening to be sure. The effect seems to be slightly improved frequency response at both the low end and the high end, better uniformity—less resonance. But the differences noticed were far from conclusive. Different recordings altered the impression obtained.

This pickup confirmed that many modern recordings, claimed as high fidelity, do not possess anything like the ultimate in fidelity. Considerable distortion was noticeable on some discs, and particularly at some passages, whichever pickup was used.

One important feature of this new tone arm is since the stylus cannot be actuated by a force greater than one to two grams, it will not damage a record if it slides across the grooves. We allowed the stylus to slide sideways across the grooves of some of our favorite records, but it really was impossible to scratch them.

Another point of interest is with regard to the arm itself. It is so accurately counterweighted that even with one gram stylus force the record will still play when the turntable is tilted to an angle of about 30 degrees. This means that the pickup will play quite satisfactorily in the presence of horizontal shaking or vibration. It should be mentioned in this connection that as this vibration contributes a vertical component to the motorboard, it may be found necessary to increase the stylus force. However, two grams

should still make this quite adequate to hold the stylus in the grooves.

In conclusion, the author believes that this new pickup will prove to fulfill (or help to) the prediction in the last paragraph of the previously mentioned January article. This is a trend-setting design. As was pointed out then, one cannot consider the performance of a pickup separate from the tone arm, or of a tone arm separate from the pickup. The more closely we approach perfection in our quest for fidelity, the more necessary it is to regard these two components as integrated.

While there may be some "mechanical" advantages in standardizing a plug-in type cartridge, so different manufacturers' cartridges can easily be tried in the same arm, this approach suffers the disadvantage that the pickup cannot be designed to give its best performance *always,* because it cannot be designed as an integral part of a tone arm-pickup *assembly.* In this new design the plug-in feature makes the pickup replaceable, but not interchangeable with any other type. Similarly the stylus can be removed for replacement, but it is not interchangeable with styli for other pickups. —30—

MODIFICATIONS OF CONELRAD ALARM SYSTEM DESCRIBED IN OUR NOVEMBER, 1956 ISSUE.

APPARENTLY the article "An Air Raid Alarm for Home Receivers," described a Conelrad alarm system, which appeared on page 60 of our November, 1956 issue, has received quite a bit of attention from our readers. We have had quite a few letters from individuals and companies trying the circuit. As a matter of fact, the authors have informed us that one New England company has successfully built the circuit and is thinking about manufacturing it, utilizing a printed circuit board. However, some of the components were not shown with values used in the final model and in order to obtain the benefits of satisfactory operation using the latest circuit these should be changed as follows:

R_{13} to be 100,000 ohms, not 2.2 meg.
R_{14} to be 10,000 ohms, not 270,000 ohms.
R_{15} to be 56,000 ohms, not 2.2 meg.
R_{17} to be 10 meg., not 56,000 ohms.
C_{10} to be .001 μfd., not .02 μfd.

Certain other changes are desirable in order to provide less critical operation, although they are not essential. These are as follows:

R_1 to be 2.2 meg., not 4.7 meg.
R_2, R_3 to be 110,000 ohms ±5%, not 100,000 ohms.
R_6 to be 1 meg., not 1.5 meg.
R_9 to be 1 meg., not 150,000 ohms.
C_1 to be .005 μfd., not .01 μfd.
C_2, C_3 to be .0016 μfd., not .0015 μfd.
C_4 to be .0056 μfd., not .006 μfd.
C_6 to be .0015 μfd., not .001 μfd.
C_{11} to be .0015 μfd., not .01 μfd.

It is possible that a kit version of this circuit will be on the market in the near future. We suggest that any readers who are interested in such a commercial unit watch for it. —30—

Electric Shock Used to Halt Heart Twitching

Electrodes applied to the chests of shock victims restore beating of heart.

AN ELECTRIC shock treatment through electrodes applied to the surface of the chest was described recently by W. B. Kouwenhoven of the Department of Electrical Engineering and Dr. W. R. Milnor of the School of Medicine, Johns Hopkins University, Baltimore, Md.

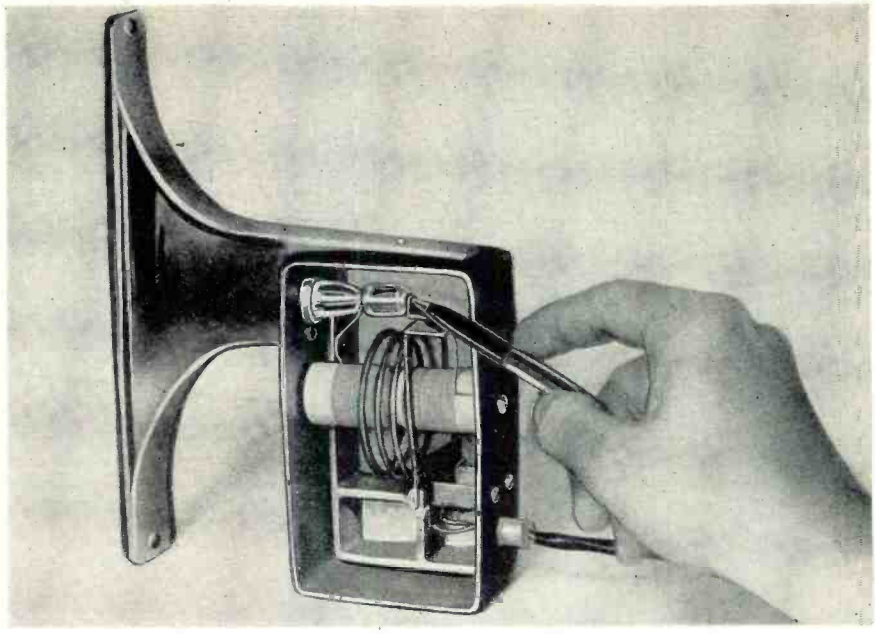
The new technique is now being used in the operating rooms of one of the nation's leading hospitals to halt heart twitching (fibrillation) which may occur during anaesthesia.

In a paper before the AIEE, "Field Treatment of Electric Shock Cases," the scientists reported that the new "closed chest" method of defibrillation is safe and practical. It is now being used extensively at Johns Hopkins Hospital, and the method will probably find use in other hospitals.

In treating ventricular fibrillation caused by electric shock, prompt action is essential. Tests and experience reveal that defibrillating electric shock by hand electrodes, delivered within one minute or less after the original shock, will save the heart 90 per-cent of the time. Sufficient current sent through the heart arrests the twitching completely. Speedy action in applying artificial respiration to overcome respiratory paralysis induced by electric shock is also vital. The scientists stressed, however, that even if delay occurs, respiration may prove successful and should be started at the first possible moment in order to be effective.

Shocks of just .1 ampere may interrupt normal heart rhythm and cause fibrillation, while a shock of several amperes will simply contract the heart and hold it in that state until the circuit is opened. Currents of large magnitude will often temporarily paralyze the breathing but the heart will usually resume beating when the circuit is broken. Currents may affect the lungs and not the heart because while the action of the lungs is controlled by the brain, the heart muscle operates involuntarily without any direction from the brain.

The two principal "pacemakers" of the heart are the sinoatrial node and the atrioventricular node, and either of these is capable of driving the heart without a signal from the brain, it was pointed out. —30—



Inside the shield case of new tweeter. Pencil points to quartz cell, heart of unit.

Ionic Cloud Tweeter Demonstrated

Additional information on "Ionovac", the ionized air transducer which was described in last month's issue.

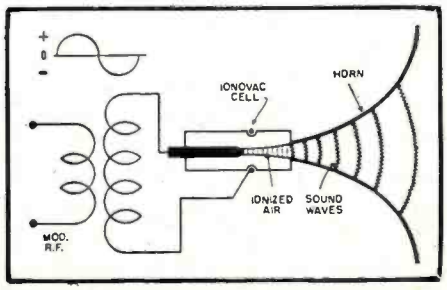
RECENTLY, the *DuKane Corp.* of St. Charles, Illinois, conducted a press demonstration of the "Ionovac," the new ionic cloud high-frequency transducer it is currently manufacturing. The unit, shown unshielded above, uses a small quartz cell in which corona discharge is set up. As a result of the changing ionization of air in the cell, sound waves are set up directly in the air without the need for the conventional diaphragm used in ordinary tweeters.

Although the demonstration was not too conclusive because of the limited signal source equipment and the high-hiss-level tape, the tweeter appeared to be remarkably clean without noticeable peaks or unnatural coloration. Your editor immediately thought of some of the better electrostatic tweeters, with which this unit can be favorably compared. There was no corona hiss in evidence while the unit was operating. With the tweeter horn mounted with its long dimension vertical, good horizontal dispersion of highs occurred.

The response curve of the unit is within 5 db from 2000 to 20,000 cps. Spot measurements taken well above this limit do not show much deviation from this level. The low-frequency limit is set only by the horn dimensions; in the unit shown above the horn cuts off just below 2000 cps.

Shown inside the open housing above are the r.f. link coils to which are fed 17 watts of 20 mc. amplitude modulated r.f. from a companion modulated oscillator and power unit. It is this unit, with its 2 per-cent distortion, that limits quality of the output. Extensive shielding prevents interference. Since there is quite a bit of heat produced at the electrodes within the cell, it is expected that these would have a life "only as long as a permanent phono stylus." Replacement is quite simple, though, since the little cell may be changed as a unit. Definite prices have not been set as yet, but it is expected that the tweeter with its oscillator will sell for $130 to $150. —30—

Principle of operation of the new tweeter.



Certified Record Revue

(*Continued from page* 54)

wider in scope. Strangers to this work may have a time warming up to it, but anyone with an open mind can't fail to be impressed by the originality of the writing in spite of some critics' plaint that all Bruckner is of Wagnerian derivation. Soundwise this is mighty impressive. The brass, so important in this work, sound out fullthroated and clean, strings are smooth, with plenty of body when needed. Woodwinds are on the mellow side and percussion is heavy and accurate. With wide frequency and dynamics, and a most pervasively "live" acoustic perspective, this is awesome on a really big speaker system.

The Beethoven work is an oddity that suggests a precedent to the finale of the "9th" symphony. It is pleasant enough but what happened in this recording is that despite the formidable forces employed the reading verges on the pedestrian and the sound dull and undistinguished. Surely Lehmann and the *DG* engineers must have had an "off" day. No matter, for the Bruckner is worth the price by itself and is highly recommended.

FRANCK
THREE CHORALES FOR ORGAN
VIVALDI-BACH
CONCERTO #2 IN A MINOR
Jeanne Demessieux, organist. London LL1433. RIAA curve. Price $3.98.

The Franck organ "Chorales" are certainly among the most beautiful repertoire composed for the "King of Instruments." This is the third recording to appear on LP and by all odds the best. Demessieux has sometimes been criticized as "timid" in her use of registration. I don't think that is a fair appraisal and certainly in this recording she has chosen her registrations with intelligence and conviction. Her reading of the Franck and the Vivaldi-Bach is comparatively free from the annoying mannerisms of tempo and phrasing exhibited by many organists. Her playing here is most expressive, with more than a little poetry and the result is a deeply moving listening experience. The organ sound is very clean, rich, and sonorous and the acoustic perspective has been wisely chosen. For hi-fi fanciers, this has some fine pedal sound, but none that really "thunders" in the sub-basement.

SESSIONS, ROGER
SUITE FROM "THE BLACK MASKERS"
HOVHANESS
PRELUDE AND QUADRUPLE FUGUE
LO PRESTI
THE MASKS
Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MG50106. RIAA curve. Price $3.98.

Gadzooks! In the "Black Maskers" we have one of the most rip-snortin' fire-breathin', cone-crackin' recordings *Mercury* has ever issued. I've heard some people complain about difficulty in tracking some of these *Mercury* whoppers. I can tell you this . . . it is always possible to get a defective copy of a record, but if you can't track this and other recordings like it, I'd suspect my equipment wasn't adequate for the job. The dynamic range on this disc admittedly is tremendous . . . stylus velocities go beyond 27 centimeters-per-second in some sections! In spite of this if your turntable and arm are nicely leveled, stylus pressure is correct and everything else is in balance you should have no difficulty playing this disc.

I have tracked it without distortion with a *Weathers* arm and cartridge, the new *Pickering* "Unipoise" integrated arm and cartridge with a half-mil stylus, and a *Fairchild* 225A in a *Gray* arm to mention a few.

So, on with the record. Previously available only in a subscription recording by the *American Recording Society,* the "Black Maskers" is a welcome addition to the LP lists. Be warned that this is a wild piece of music, loaded with dissonance and atonalities. Yet, because of its organization and its tremendous sonic impact, it is not very hard to assimilate. Of course, this is one of those recordings which, irrespective of the musical content, is bound to be used for demonstration by the hi-fi nuts. The sound is simply fabulous . . . brass and percussion, woodwind and strings . . . all are heard with the most varied and near infinite expression. The transients are huge and savage and will tax any hi-fi system severely. When you hear the awesome outpouring of sound in the last part of the 3rd movement, the "Dirge," as the brass and full organ combine in a mighty duet, you won't believe your ears! The other works on the disc are interesting in their own right, but the real plum is the Sessions work. Dr. Hanson shows his usual affinity for and understanding of the modern idiom and his performance is brilliant. And once again kudoes to Dr. Hanson for the superb playing he gets from his men as they traverse this terrifyingly difficult score. Don't miss hearing this outstanding recording.

MENDELSSOHN
MIDSUMMER NIGHT'S DREAM (OVERTURE AND INCIDENTAL MUSIC)
Soloists and RIAS Chamber Choir with Berlin Philharmonic Orchestra conducted by Ferenc Fricsay. Decca DL9846. RIAA curve. Price $3.98.

Of the many versions of this music on records, I find this performance by Fricsay and the Berlin Philharmonic, closer to the intent of the work and the most generally satisfactory. It has its faults . . . Fricsay hurries tempi here and there, the chorus is a little on the "blurry" side. But these minor faults are offset by Fricsay's light hand on the orchestral rein, his intelligent phrasing and dynamics and his knowing way in handling the chorus. The orchestra plays well and the soloists are of a high order of competence. The sound is smooth and spacious but is somewhat lacking in brilliance.

TCHAIKOVSKY
1812 OVERTURE
LISZT
MEPHISTO WALTZ
DVORAK
CARNIVAL OVERTURE
WEINBERGER
POLKA AND FUGUE FROM SCHWANDA
SMETANA
BARTERED BRIDE OVERTURE
Chicago Symphony Orchestra conducted by Fritz Reiner. Victor LM1999. RIAA curve. Price $3.98.

A quick glance at the contents of this recording is more than ample evidence that this is a good buy, in terms of quantity alone. Happily it has other virtues as well. Another recording of the "1812 Overture" might seem anti-climactic after Dorati's tremendous *tour de force* on *Mercury*. Yet everything has its place. For those who want a normal concert version *sans* the real bells and the real cannon shots, this will do very nicely. Reiner essays a reasonable tempo that allows for a great buildup and the finale is appropriately grandiose. If it all sounds a little tame after listening to the version with the cannon, etc., it just can't be helped. Console yourself with

the thought that this will shortly be issued on stereo tape by *Victor*, and this should up its "spectacular quotient" appreciably. The other works receive fine performances, especially the "Mephisto Waltz" and the record is worth its price for the new and magnificent version of Weinberger's ingratiating "Polka and Fugue from Schwanda," "Der Dudelsackpfieffer." (such a mouthful to say "bagpiper"). This is one of the best Reiner performances on record, full of verve and wit. The last part of the "Fugue" with orchestra and organ is a knockout! Exemplary sound throughout the disc.

COLE PORTER
SYMPHONIC SUITE BASED ON MUSIC OF PORTER
Stanley Black and his Orchestra. London LL1565. RIAA curve. Price $3.98.

Stanley Black is an exceptionally accomplished arranger and orchestrator and he puts his talents to good use here with this suite of Cole Porter numbers. All the old favorites are represented . . . "Night and Day," "Begin the Beguine," "I've Got You Under My Skin," etc. Black has arranged the tunes with a good deal of taste and as conducted by him and played by his fine orchestra, these oldies gain new interest and sound fresh and unhackneyed. Sound throughout is absolutely top drawer, extremely wide range with no transient or other distortions audible. Highly recommended.

BALLET MELODIES
Mantovani and his Orchestra. London LL1525. RIAA curve. Price $3.98.

If you've been blasting away with Stravinsky or Bartok, this is the kind of record that will assuage the ire of the "little woman." I hasten to add (before I get clobbered by my more intellectual female readers), that I naturally don't mean *all* women. But if you've got this problem (and a terrifying number of men do!) this potpourri of such ballet chestnuts as the "Waltz of the Flowers," "Dance of the Hours," "The Swan," "Invitation to the Waltz," etc., etc. should do the trick neatly. Mantovani displays plenty of his well-known schmaltz, and yet surprisingly enough subdues his soaring strings in a few of the numbers and plays them fairly "straight." No matter what your opinion of his musical expression, one cannot but help admire the precision of his playing and the high calibre of his musicians. As usual, the *London* engineers have afforded Mantovani a very full and rich sound with a large acoustic frame. Of its type, an outstanding disc.

CASTELNUOVO-TEDESCO
CONCERTO #2 FOR VIOLIN AND ORCHESTRA ("THE PROPHETS")
Jascha Heifetz, violinist with Los Angeles Philharmonic Orchestra conducted by Alfred Wallenstein.
STRAUSS, RICHARD
SONATA IN E FLAT FOR VIOLIN AND PIANO
Jascha Heifetz, violinist and Brooks Smith, pianist. Victor LM2050. RIAA curve. Price $3.98.

For fanciers of violin concerti here is an offbeat item that may give you reprise from the Tchaikovsky, Mendelssohn, *et al.* Castelnuovo-Tedesco is a modern Italian composer who makes his home in Beverly Hills, and it was for his distinguished neighbor, Jascha Heifetz, that he wrote this work. The three movements are entitled, "Isaiah," "Jeremiah," and "Elijah," despite which the composer denies any programmatic meaning. Nonetheless, certain Hebrew thematic material is recognizable in the score and this lends some substance to the title. It is a beautiful work, very lyrical

and romantic, surprisingly so for a modern composer. Heifetz is in magnificent form and copes with the not inconsiderable technical demands of the score with fluent ease. The orchestration is quite interesting and, all in all, a rewarding listening experience. The Strauss "Sonata" is a Heifetz specialty, and his performance is ravishingly beautiful. If you would understand the greatness of Heifetz, listen to his playing in the tumultuous scherzando in the finale. The sound in both works is very clean and in the concerto quite full bodied with wide dynamics, good violin transients, and a fine acoustic "liveness."

MILHAUD
SUITE PROVENCALE
SAUDADES DO BRASIL
Concert Arts Orchestra conducted by Darius Milhaud. Capitol P8358. RIAA curve. Price $3.68.

This delightful and provocative music is among the best work of Darius Milhaud, one of that formidable group of *avant garde* French composers known as "Les Sixe." Both works are liberally endowed with typical Milhaudian atonalities and dissonances, but do not let that deter you for a moment! These are highly listenable, as well as exciting from a hi-fi viewpoint. The "Suite Provencale" is especially welcome since the only other recording on LP is an ancient 78 rpm reprint on the *Camden* label. The "Saudades" was originally scored for piano and unhappily for those purists who want it in this form, the only existing version on a *Columbia* record has just been withdrawn from the *Schwann* catalogue. Needless to say, these performances with Milhaud at the helm can be regarded as definitive and with the superb, crisp clean sound and the quiet *Capitol* surfaces, make a most attractive off-beat addition to any record library.

CHAUSSON
SYMPHONY IN B FLAT
Detroit Symphony Orchestra conducted by Paul Paray. Mercury MG50108. RIAA curve. Price $3.98.

If you like Franck's "D Minor" symphony you're sure to like this work by his brilliant pupil Ernest Chausson. Cast in the same mold in employing the cyclic form, this is a richly melodic, lushly romantic score, with plenty of exciting moments for spice, such as the trumpet calls and rapid string figurations in the opening bars of the finale. Paray is at the top of his form here, bringing as much freshness and interest to this score as he did in his notable recording of the Franck "D Minor." This can easily be rated as the definitive recording, especially since the only close competition was the Monteux reading on a *Victor* disc now withdrawn from the *Schwann* catalogue. The sound is typical fine-grained *Mercury*, with superb string tone, rousing brass, everything finely etched and well-defined, no mean feat with this rather thick-textured score.

BERWALD, FRANZ
SYMPHONY IN C MAJOR
SYMPHONY IN E FLAT
Berlin Philharmonic Orchestra conducted by Igor Markevitch. Decca DL9853. RIAA curve. Price $3.98.

It is always an interesting experience to hear new music, whether it is an up-to-the-minute contemporary work or, as in this case, an old work discovered through musicological research. Berwald (1796-1868) was a Swedish composer, strongly influenced by Schubert and Berlioz among others, and through the work of the Berwald Foundation we now have the first recording of two of his most typical symphonies. The "C Major" work shows considerable inventiveness and the use

of devices which were far ahead of their time. This work reminds you of a classical symphony by Mendelssohn or Schubert but with much unconventional scoring. The "E Flat" work is less enterprising and stays fairly well within the classic form. These are not dull works, on the contrary they are full of life and are characterized by rollicking scherzos and boisterous finales. In listening it is obvious that Berwald was an exceptionally gifted orchestrator and thus his scores recorded here are fine display pieces for the talents of Markevitch and the Berlin Philharmonic. Markevitch seems quite at home with these works and he elicits some remarkably beautiful playing from the splendid Berlin group. Sound is of the spacious, "big liveness" type favored by the *Deutsche Grammophon* engineers. A very smooth sound, not as sharply focussed as most but with more than enough detail to balance the acoustics. Recommended to those of an inquiring mind as music new, different, and worthwhile.

BRAHMS
SYMPHONY #4 IN E MINOR
Vienna Philharmonic Orchestra conducted by Rafael Kubelik. London LL1485. RIAA curve. Price $3.98.

This recording somehow was misplaced around my house, but even though it is several months old, it is worth your attention. Kubelik can be a real whiz with Brahms, as I've heard him demonstrate on many occasions, yet recording-wise he often gets fouled up. I thought he had come a-cropper on this disc as I listened to the opening bars. "Too slow, too slow," I muttered to myself. Well, his opening movement *is* slow, but as the work unfolds you begin to see the logic and conviction of his plan as he builds towards a terrific finale. Throughout the score he is secure in his dynamics, his balance and phrasing, and his tempi gradually increase. He elicits some wonderful playing from his orchestra, with especially notable string and woodwind. Soundwise, this is one of *London's* very "live" spacious types of sound in which they also manage a splendid clarity of detail. Quite a trick and the over-all effect is extremely pleasing to the ear. Purists will probably not like this disc, but it should have its share of adherents who favor the fine *London* sound.

MOZART
PIANO CONCERTOS NOS. 1, 2, 3, 4
Carl Seeman, pianist. Decca DL9867. RIAA curve. Price $3.98.

These relatively simple early sonatas of Mozart can be a pitfall for the unwary pianist. The slightest idea of heavy-handedness or tempo-tampering can make a botch of them. Seeman is a first class Mozart scholar and pianist. His has just the right degree of self-effacement necessary to play these works properly. His playing is utterly graceful, his conception of them properly small-boned. With a very warm tone and a superb technical fluency these are readings which should find general favor. The piano sound is quite smooth and lovely with no trace of percussive harshness. Wide in range, and with no audible transient distortion, this all adds up to a most admirable disc.

VIVALDI
FOUR CONCERTOS
TWO SINFONIA
Solisti di Zagreb conducted by Antonio Janigro. Vanguard BG560. RIAA curve. Price $3.98.

Two concertos for oboe and strings, a concerto for bassoon and strings and a concerto for strings alone, the "alla Rustica," combine with two Sinfonia to make up the program of Vivaldi works played by that marvelous

group, the Solisti di Zagreb. As in their recent Bach disc the playing of this group is truly outstanding. Their tone, their precision, their ensemble balance, all are exemplary. Janigro conducts with obvious reverence and the results are superb. This is Vivaldi properly done . . . light, airy, full of wit and humor, no heavy-handed pedantry here! As with the other recording of this group the sound is sumptuous. It is notable for extremely wide frequency response, cleanness of line and a compelling sense of "presence".

DOUBLE 7
Winifred Atwell, pianist. London LL 1573. RIAA curve. Price $3.98.

Winifred Atwell is one of the most remarkable Negro artists I've ever heard. On this record, one side is devoted to ragtime piano, which I frankly don't like, musically or otherwise and the other side has some of the doggondest most fantastic boogie-woogie you ever will hear. Man, the furious energy of Miss Atwell is really somethin'. In such numbers as "Bumble Boogie," "Hamp's Boogie," and others she pounds away at the melody with her right hand and with the left socks out that incredible rompin' counterpoint that is the soul of boogie-woogie piano. A listen to a few of these numbers and you're limp! Miss Atwell is a pianist of no mean accomplishment having recorded the Grieg concerto with the London Philharmonic. From Grieg to boogie seems a long jump, but she handles it with a fluency and "naturalness" that is nothing short of astounding. Aiding and abetting this human whirlwind, the *London* engineers have come up with one of the most amazing piano sounds ever. Quite honestly, it's overdone . . . and deliberately so. The miking is ultra-close and captures every last iota of power from the instrument. The transients here are almost outrageous and if ever there was a fine record for transient-testing this is it! Don't miss this one! —30—

RADIO CLUB OFFICERS

THE Radio Club of America, Inc., the oldest group of its kind in the U. S., has re-elected Frank A. Gunther president for 1957. Serving with him are Walter A. Knoop, Jr., vice-president; O. James Morelock, corresponding secretary; Joseph J. Stantley, treasurer; and John H. Bose, recording secretary.

Directors for this year include: Ernest V. Amy, Ralph R. Batcher, George E. Burghard, Harry W. Houck, Fred A. Klingenschmitt, Renville H. McMann, Jr., Jerry B. Minter, Harry Sadenwater, Francis H. Shepard, Jr., and Albert A. Toth.

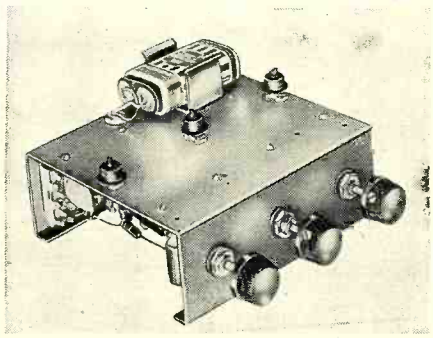
The club, which maintains headquarters at 11 West 42nd Street in New York City, boasts a membership of outstanding men in the field of radio engineering and invention, both in the United States and abroad. —30—

COMPACT 3-TRANSISTOR PREAMP

HERE is a well-designed preamplifier that will allow the audio enthusiast to connect a low-level magnetic phono cartridge or microphone to his power amplifier. The unit develops stable, low noise preamplification with extremely low current consumption (on the order of 1 ma. for the circuit constructed by the editor) and zero hum. There is complete absence of any microphonics inherent in vacuum-tube preamps. Battery operation permits installation as a remote amplifier with a high degree of portability. The maximum gain is about 40 db. According to the manufacturer, the frequency response is 20 to 20,000 cps, while the noise level on the high impedance input channel is about 48 db below 10 mv. and on the low impedance channel is better than 52 db below 2 mv.

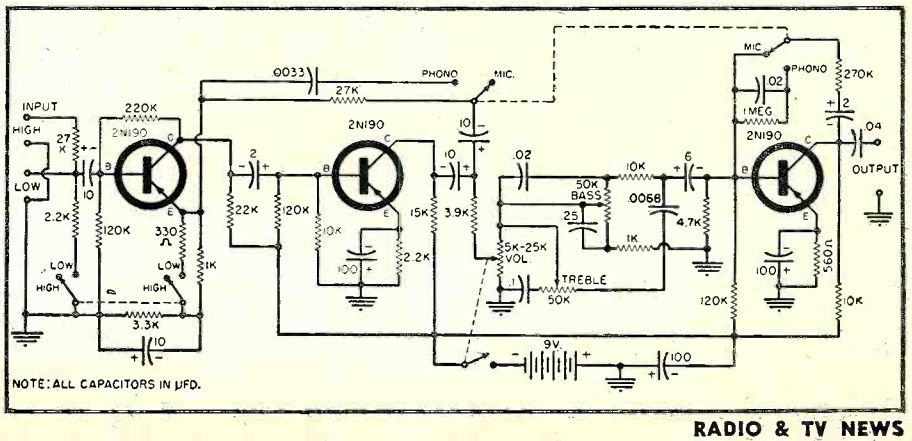
Separate bass, treble, and volume controls are provided. A switch is also provided for high or low level cartridges along with an equalization switch for phono or microphone inputs. Three G-E 2N190 audio transistors are used, which are powered by a 9-volt battery. The circuit consists of a two-stage equalizer and tone control preamplifier, using conventional bass and treble tone control circuits, followed by an equalized output amplifier stage.

All of the parts required to build this preamp are standard and may be purchased at most of the larger parts jobbers. For convenience, a complete kit of all parts, transistors, pre-punched chassis, battery, and detailed step-by-step instructions are available from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. as kit KT-117 at $18.45. —30—



Over-all view of transistorized preamp.

Complete schematic diagram of the compact, three-transistor preamplifier.



Transistor Amplifiers

(*Continued from page 58*)

charts for determination of transformer impedances and typical power gains for class A driver stages and class B push-pull stages. Their use can be best understood by working through a typical example. It will be assumed that it is desired to design a driver and push-pull amplifier capable of delivering 1 watt with a 12-volt supply. Using Fig. 16, for 1 watt of undistorted output power, the required collector-to-collector load resistance is 200 ohms. From Fig. 21 using a typical 2N187A, the power gain is 20 db. In numerical terms, a power gain of 20 db is 100. Therefore, the required input power to the driver stage would be: $P_{in} = 1000/100$ or 10 mw. From Fig. 17, for 10 mw. of undistorted output power, the load resistance is over 5000 ohms. From Fig. 22, assuming a 2N191 driver transistor, the power gain is 38 db. The typical power gain of the two stages using a 2N191 driver and 2N187's in the output would be 58 db. The secondary impedance of the driving transformer should be 3000 ohms center-tapped. The secondary impedance of the output transformer should be selected to match the impedance of the load.

A necessity for any hi-fi system is a set of tone controls to compensate for room acoustics, loudspeaker differences, listening level, and individual preferences. One acceptable circuit has been described in the literature[1,2] and is shown in Fig. 19. The detailed operation is described in the reference but briefly at 1 kc. the incoming current divides so 10/11th is shunted to ground and 1/11th goes on to the next stage. The low- and high-frequency response depends on the potentiometer settings and can be analyzed on a current transfer basis. With the component values indicated, the performance of the tone controls is shown in Fig. 20. This performance is quite comparable to tone controls used with vacuum tubes.

A circuit incorporating all design procedures herein described is shown in Fig. 23. This amplifier will produce more than enough undistorted output power for average listening levels in the home.

It can be seen that incorporating negative feedback in transistor amplifiers is quite simple with the main difference between transistor and tube circuits being that current feedback is used with transistors and voltage feedback with tubes. The use of current feedback in transistor amplifiers requires very few extra components and the performance advantages far outweigh the time taken in design.

REFERENCES

1. *Lo, Endres, Zawels, Waldhauer & Cheng: "Transistor Electronics," Prentice-Hall.*

2. *Lowry, Hugh R.: "All Transistor Hi-Fi Amplifier,"* RADIO & TELEVISION NEWS, *November 1956.*

—30—

Spot Radio News

(*Continued from page 22*)

cording. The system was said to be extremely fast—about 150 times faster than the present paper-tape inscriber—and can handle up to 600 cards per minute.

The new transcriber can be utilized either as a means of preparing and feeding coded mathematical routines to the computer or for recording information on magnetic wire from cards which are already in existing files. In the preparation of routines, it was pointed out, the use of punched cards offers an important advantage over perforated paper tapes. For the cards provide a flexible means of modifying routines by simple insertions and removals. Previously, alteration in programming required remaking an entire punched paper tape.

When information appears on a punched card, it is in the form of one or two holes per column, representing numeric and alphabetic characters, respectively. The transcriber serially scans 80 columns on each card with photoelectric cells and converts the data, one column at a time, into a 4- or 6-digit binary code at a rate (ordinarily) of 200 cards per minute. This speed is dictated by the maximum pulse density allowed on the associated magnetic wire system.

The circuitry is built up in two modes. One group is constructed with plug-in transformers and diode clusters. The other group utilizes diode-gated amplifier and delay-line packages.

The transcriber consists of two physically separate units. Most of the electronic circuitry is contained in the main chassis, while the photoelectric-reading station is mounted on the counting device. It contains the photocells, light source, and necessary circuitry for converting the basic hole patterns into voltages in fourteen different information channels. Twelve of the channels are for direct information transmittal and the remaining two are for control purposes.

The major portion of the circuitry is used to achieve the various complex timing functions which are inherent in a device of this type and to prevent misinterpretation of alphabetic data. One provision prevents false readouts during the inter-card gap, since at this time all of the information channels are energized. Another provision compensates for card skew during the reading process, and hole misalignment in the card itself.

All timing circuits are keyed to a strobe pulse which is initiated by the leading edge of each punched column. This means that card flow need not be synchronous nor data flow continuous.

Prior to being put into operation, acceptance tests were performed on the transcriber, in which a quarter of a million hexadecimal characters were converted without error into their binary equivalent. These figures were recorded under varying adverse conditions more severe than would be encountered in normal operation.

THE POSSIBILITY OF TRANSATLANTIC TV has aroused great interest recently in view of the approach of the maximum phase of the 11-year cycle of sunspot activity. Already some success has been achieved by *NBC*, who have, on occasion, been able to resolve recognizable pictures from the *BBC* television transmitter at Crystal Palace in London, using a British receiver and a special antenna system at a receiving station in Riverhead, Long Island.

In London, the *BBC* has been keeping watch on our TV channels to screen for its viewers any pictures which might be received. Some signals have in fact been received intermittently, but it has not been possible as yet to resolve any kind of a picture.

According to *BBC* spokesmen, the crux of the operation is the maximum usable frequency (m.u.f.) which is rarely high enough to sustain propagation across the Atlantic at the frequencies used by TV transmitters. However, around the sunspot maximum period, there are occasions when the m.u.f. rises into the 40-mc. region and even, though

much less often, into the 50-mc. region. At these times the lowest frequencies used for television in the United Kingdom (45 mc. visual and 41.5 mc. audio) may be receivable over here. The reception of reasonable pictures is a more difficult and chancy matter because of multipath reception which causes ghosting.

Reception of our signals in Britain is much more difficult because the lowest frequencies are those of channel 2 or 54 to 60 mc. Furthermore, these channels are shared by several stations, not necessarily radiating the same program, which makes the multipath problem acute.

As the sunspot maximum approaches, the m.u.f.'s have risen rapidly. In October, 1956, the m.u.f for the transatlantic circuit averaged 38.4 mc. at noon, Greenwich Mean Time. In November, this had risen to 44.6 mc., and in December to 45.4 mc. Long-distance reception from this country was good throughout the month of December. Broadcasts on 26 mc. were received on 29 days in England and hams on 50 mc. were received on 11 days. Many other signals on frequencies between 30 and 50 mc. were received, and there was occasional reception on 56 mc.

Observations are continuing at the *BBC*'s receiving station at Tatsfield, Surrey, where an American receiver is installed ready for use if reception of actual pictures seems likely. A second set is at Alexandria Palace in London, where there is a direct connection with the *BBC*'s TV network.

TO SERVE BETTER the rapidly expanding closed-circuit TV and television-distribution system industry, including master antenna systems and community antenna systems, a new committee has been formed by RETMA in Washington.

The new body will serve to cooperate with the FCC to advance the needs of the closed-circuit industry; act as a liaison with the American Institute of Architects on closed-circuit and distribution problems; help to consolidate information regarding requirements on *Underwriters'* approval and standardize on the telephone yellow-book page listings, and coordinate government-agency activities to gain recognition of the importance of closed-circuit and antenna-distribution operations.

TV ASSIGNMENT ACTIVITIES were up as this column was being prepared, with the largest number of grants in many months approved, as the table on page 20 of this issue indicates.

THE WIDENING USE of electronic techniques in commerce and industry will bring about a virtual revolution in the processes of management, members of a management association were told during a recent conference in New York City.

The future electronic environment was noted as already taking shape with the development of the high-speed data-processing and computing system.

Such a system, it was said, offers clear . . . "advantages in the solution of management problems. Furnished with information as to production costs, distribution patterns, consumer reactions, and other variables, an electronic computer may, for example, define the total probable sale of a given item during a specified period in the future. Acting on other appropriate data, the computer may provide reliable information as to the probable effect of changes in production facilities or the introduction of a new product. Such statements of the situation, based on current information prepared in electronic data-processing systems, could narrow down substantially the range of possibilities to be considered by management in making its basic decisions."

The effective use of electronics, electronic computers, and automation in industry and commerce, the management group was told, will bind together much more strongly all facets of an industrial unit or an enterprise in commerce . . . Management, it was stressed, will continue to be competitively successful only if it proceeds with understanding, recognizing that we are entering a new era—an era which includes as its foundation a new way to do business—electronically. . . . . L. W.

Threshold to Space

(*Continued from page 37*)

tend out as far as 1500 miles. At the nearer altitude, such a satellite should be just barely visible to the naked eye if present in the neighborhood of the observer within about an hour after sunset or before sunrise. With ordinary binoculars, on the other hand, the sphere should be quite easily visible, and at the request of the TPESP, the Smithsonian Astrophysical Observatory (SAO) is organizing an amateur program of looking for the satellite. In this program, called "Moonwatch," the observers will use binoculars. At each station a large number of binoculars will be set up so that their fields of view overlap forming an observational fan crossing the sky from north to south. Suitable timing will be provided so that the time as well as position of passage across the fan can be determined. This program of visual observing is also being extended internationally so that there will be stations located all around the world throughout the belt over which the satellite is expected to pass.

The primary purpose of the visual program, however, is to acquire the satellite and to get a rough estimate of its orbit. Precision tracking, to provide data for use in geodetic and air density studies, will be carried out using specially designed *Schmidt* cameras. These instruments, with 20-inch aperture and 20-inch focal length, will be able to photograph the satellite against the star field, even at the 1500-mile distance, positioning the satellite to within seconds of arc and a millisecond of time. These photographic stations are also being set up by SAO, and will be spread around the world in the expected orbital belt. About a dozen such stations are presently planned.

Radio Tracking of the Satellite: Optical observation of the satellite depends on a number of factors not under the control of the observer. As mentioned the sphere can be observed only at certain favorable times, so that any given station will be able to sight the satellite infrequently. The chance of such an optical sighting will be further reduced by poor weather.

Radio tracking can be achieved night or day, independently of weather. Moreover, a single antenna beam can be made to cross the sky from horizon to horizon. With a group of such beams running across the entire orbital belt a sort of radio picket fence can be established to contact the satellite each time it crosses the fence. This is what is to be done with the Naval Research Laboratory Minitrack system.

The Minitrack system uses radio interferometry. A continuously operating transmitter in the satellite will send a 108.0 mc. c.w. signal. This signal will be received at two an-

tennas on the ground separated by a large number of wavelengths, and compared in phase. The phase difference can then be used to determine one direction angle to the satellite. Two sets of such antennas at right angles to each other will be used to give the two angles needed to fix the direction from the ground station to the satellite. The radio fence planned will include stations running from Washington, D. C. to Santiago, Chile, a station in Antigua, British West Indies, and one at San Diego, California. This fence, including 11 stations in all, will provide on the order of 20 sets of observations per day. In the initial stages it is estimated that this data should suffice to determine the satellite's orbit to within a minute or so of arc and a millisecond of time. After a couple weeks of observing, the data should be adequate to give the orbit to within about a third of a minute of arc, which is not as accurate as the photographic results, but nevertheless approaches precision quality.

Using transistor circuitry a Minitrack transmitter has been constructed that weighs only a couple of pounds including the batteries for several weeks of continuous operation at from 25 to 50 milliwatts output.

Telemetering: The optical observations of the satellite do not require any equipment in the satellite, although a light source in the orbiting vehicle would be of assistance. Satellite-borne equipment is required, however, to send back the information obtained by instruments in the sphere. For the IGY satellite, this radio telemetering will be accomplished by means of the Minitrack transmitter. The data obtained by the various sensing elements will be coded by a suitable premodulator into a waveform suitable for modulating the Minitrack carrier, and then impressed on the tracking signal. The percentage modulation of the carrier will be limited so as to maintain the integrity of the tracking during the telemetering operations. In some cases the telemetering may be carried on continuously along with the tracking. In others, a command signal from the ground may be used to turn on the satellite-borne scientific instruments for a limited time, simultaneously switching from the low-powered tracking oscillator to a higher powered tracking-telemetering oscillator.

The premodulator to be used should be designed as a more or less integral part of the experiment to be performed in order to save space and weight. The particular approach to be used will be dictated by the experimental requirements. The University of Iowa has, for example, designed a lightweight magnetic tape recorder into an experimental setup for cosmic ray observations from a satellite. Using this, data can be stored throughout the entire satellite orbit and then read out as the satellite passes over an observing station. The

Naval Research Laboratory has designed an extremely lightweight unit using magnetic cores and transistors. This premodulator provides 48 channels of information, comprising a total bandwidth of 10 kc., handles a wide variety of inputs, and with batteries for 3 weeks of operation weighs only a little over half a pound.

Possible Satellite Instruments: For the IGY satellites, there are numerous experiments of genuine interest and importance. Only those, however, that can be performed with equipment weighing no more than a few pounds can be carried out. With this stringent weight requirement in mind, let us then consider existing instrumentation that might form the basis for an IGY satellite experiment.

Temperatures on the surface of the satellite or in its interior might be measured with thermistors or similar gauges. These together with the necessary circuitry are extremely light, totaling only ounces. Likewise there are very light hot wire, ionization, and mechanical pressure gauges that could be used to measure pressures within certain regions in the satellite. This could be a means of checking on whether or not the satellite experiences a serious puncture by a meteor.

There are lightweight microphones, which together with their circuitry weigh on the order of an ounce. These could be used to listen for the impact of meteors against the satellite surface.

Very thin metallic coatings could be used as resistance elements in an electrical circuit and placed on the outer surface of the satellite. If these were to wear away because of encounters with particles in space, their resistance would increase. By measuring the change in resistance the rate of erosion could be determined.

Very lightweight geiger counter circuits can be made for the observation of cosmic rays. Such counters and ionization chambers, seem to be a natural choice for measuring these extremely high energy particles.

Photon counters and ionization chambers can also be used for observing the sun's radiation. For example, a satellite installation has been developed at the Naval Research Laboratory for monitoring the sun in the Lyman-*alpha* region of the spectrum. This equipment uses an ionization chamber for the primary measurement and a solar cell for aspect determination. With the power supply for two weeks of operation it weighs only a couple of pounds.

Packard, of the *Varian Associates*, has studied the problem of constructing a nuclear resonance magnetometer for use in a satellite. He has concluded that such an installation can be made weighing a total of four pounds, including the power supply for about three weeks of operation. In this type of magnetometer, a proton rich substance, like water, is placed inside a coil of wire. The coil is energized for a short time with a

strong current, causing the magnetic moments of the protons to align themselves with the coil field. The coil is then de-energized, after which the protons begin to precess around the direction of the earth's magnetic field. The precession gives rises to an alternating e.m.f. in the coil containing the water, which signal can be amplified and recorded. It so happens that the frequency of this signal depends on the strength of the earth's magnetic field, but not on its direction. By suitable calibration, then, the device can be used to determine the strength of the magnetic field in which it is embedded. The weights quoted by Packard make it practical to consider this instrument for use in an IGY satellite.

Photocells can be built into a sufficiently lightweight installation for satellite use. Such an installation might be used for measuring the albedo of the earth, or to look for cloud cover on the earth.

The radio transmitter may be looked upon as a means of obtaining scientific data. The Minitrack signal at 108 mc. will be affected by the ionosphere. The frequency was chosen so that this effect will be too slight to affect the tracking seriously. It will however, be detectable, and should furnish a measure of the total ionization in the ionosphere.

Finally, solar cells can eventually be used in power supplies for artificial satellite experiments. The Signal Corps Engineering Laboratories at Ft. Monmouth, New Jersey, have already worked up a solar supply that comes within the weight limitations of the IGY satellites. This device will undergo a series of tests in the near future. It may be that the necessary engineering can be accomplished soon enough to work such a solar power supply into some of the IGY satellites. If so, the total period of operation may be extended from the weeks expected with conventional batteries to an appreciable fraction of a year.

The reader who wishes to pursue these thoughts further may be interested in consulting a new book: "The Scientific Uses of Earth Satellites," edited by James A. Van Allen, and published by the University of Michigan Press. The book contains papers presented at a symposium held at the University of Michigan during January, 1956. -30-

HI-PLAINS HAMFEST

THE Hi-Plains Amateur Radio Club is holding its eighth annual hamfest in Plains, Kans., Sunday, May 19th.

Prizes will be awarded with only visitors eligible for the drawing. Registration is $1.00 per person—and non-hams are cordially invited. Coffee and iced tea will be supplied but attendees are each asked to bring a dish to pass and his own table service.

All hams are asked to bring along one of their QSL cards for display. Write Zelma Cook, WØNIQ, Plains, Kans. for more information. -30-

New Tube Tester Data

Owners of Simpson tube checkers: Keep up-to-date with this listing of the most recent tube types.

SIMPSON MODEL 1000

Tube	Fil.	Bias	Range	Toggles	Push Buttons Shorts	Push Buttons Value
2B3	1.75	0	76	510-000-050-202	J	J
3C2	2.8	0	62	010-055-050-202	J	J
3CE5	2.8	10	50	401-032-500-012	BF	E
3DT6	2.8	60	90	401-022-000-023	BF	E
4BC5	5	15	37	401-032-500-012	BF	E
4BN6	5	7	59	041-020-200-013	ABEG	G
4BS8-TRI-1	5	10	13	200-102-400-012	ACFH	F
4BS8-TRI-2	5	10	13	240-102-000-012		A
4BU8-SEC-1	5	40	31	020-100-430-023	ACGH	H
4BU8-SEC-2	5	40	31	023-100-400-023		C
4CB6	5	7	25	401-032-000-012	BEF	E
5BR8-TRI	5	20	75	420-100-000-001	ACGI	B
5BR8-PEN	5	7	65	000-103-204-002		F
5BT8-PEN	5	12	33	550-103-240-012	CGI	F
5BT8-DIO-1	5	7	0	550-103-240-005		A
5BT8-DIO-2	5	7	0	550-103-240-005		B
5BZ7-TRI-1	6.3	7	23	240-102-400-002	ACFH	F
5BZ7-TRI-2	6.3	7	23	240-102-400-002		A
5CG8-TRI	5	25	10	420-103-250-012	ACG	B
5CG8-PEN	5	25	25	020-103-254-012		F
6BN8-TRI	6.3	7	90	500-105-240-012	AFH	G
6BN8-DIO-1	6.3	7	95	500-105-240-015		F
6BN8-DIO-2	6.3	7	95	500-105-240-015		A
6BR8-TRI	6.3	20	80	420-100-000-001	ACGI	B
6BR8-PEN	6.3	7	62	000-103-204-002		F
6BS8-TRI-1	6.3	12	10	200-102-400-012	ACFH	F
6BS8-TRI-2	6.3	12	10	240-102-000-012		A
6BT8-PEN	6.3	12	30	550-103-240-012	CGI	F
6BT8-DIO-1	6.3	7	0	550-103-240-005		A
6BT8-DIO-2	6.3	7	0	550-103-240-005		B
6CE5	6.3	10	37	401-032-500-012	BF	E
6CG8-TRI	6.3	25	21	420-103-250-012	ACG	B
6CG8-PEN	6.3	25	40	020-103-254-012		F
6CH7-TRI-1	6.3	7	42	240-102-405-012	BCGH	F
6CH7-TRI-2	6.3	7	42	240-102-405-012		A
6CL5	6.3	7	49	210-455-050-210	AD	J
6CU5	6.3	7	96	041-052-200-000	BF	G
6DC6	6.3	18	27	401-032-000-012	BFG	E
6DT6	6.3	40	83	401-022-000-023	BF	E
6205	6.3	7	30	401-020-250-012	ABEG	E
8BH8-PEN	10	12	87	000-100-422-001	ABFH	I
8BH8-TRI	10	7	93	042-100-000-001		C
8CG7-TRI-1	10	45	17	240-102-400-012	ABCGH	F
8CG7-TRI-2	10	45	17	240-102-400-012		A
8CM7-TRI-1	10	7	68	200-102-440-012	CGHI	F
8CM7-TRI-2	10	47	80	200-102-440-011		A
8CN7-TRI	10	7	86	550-100-425-013	CFG	H
8CN7-DIO-1	10	7	100	550-100-425-015		B
8CN7-DIO-2	10	7	100	550-100-425-015		A
9AU7-TRI-1	10	40	23	340-103-405-022	ACFH	F
9AU7-TRI-2	10	40	23	340-103-405-022		A
12AD7-TRI-1	12.6	7	35	340-103-405-013	ACFH	F
12AD7-TRI-2	12.6	7	35	340-103-405-013		A
12AF6	12.6	7	85	401-022-000-033	AG	E
12AQ5	12.6	67	97	401-032-500-000	BF	E
12BW4-DIO-1	12.6	0	83	350-010-300-000	AGI	G
12BW4-DIO-2	12.6	0	83	350-010-300-000		A
12CN5	12.6	7	65	041-052-200-032	AF	G
12CU5	12.6	7	96	041-052-200-000	BF	G
12D4	12.6	0	70	550-020-100-000	C	E
17AX4	19	0	75	000-020-100-000	C	E

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					4	5
						12
						19
						26

CALENDAR of EVENTS

APRIL 28-MAY 3

81st SMPTE Convention. Sponsored by Society of Motion Picture & Television Engineers. Shoreham Hotel, Washington, D. C. Details from the Society at 55 W. 42nd St., New York 36, New York.

MAY 5-11

National Radio Week. Sponsored by RETMA, NARTB, NARDA, and the Radio Advertising Bureau. All media will be used to promote radio listening and sale of receivers.

MAY 9, 10

Annual Meeing of IRE Professional Group on Microwave Theory and Technique. Sponsored by the Institute of Radio Engineers, Western Union Auditorium, New York City. Subject of conference is "Microwave Ferrites and Related Devices and Their Applications." Further information from IRE headquarters, 1 E. 79th St., New York 21, N. Y.

Conference on Managerial Controls. Sponsored by Illinois Institute of Technology. Institute Campus, Chicago. Details from Conference Secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

MAY 12-16

111th Meeting of the Electrochemical Society, Inc. Hotel Statler, Washington, D. C. Six divisions of Society will hold sessions. Write Association at 216 W. 102 St., New York 25, N. Y., for program details.

MAY 14-16

Industrial Nuclear Technology Conference. Sponsored by Armour Research Foundation and Nucleonics Magazine. Museum of Science and Industry, Chicago. Address inquiries to Conference Secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

MAY 15-17

Annual Convention of the Radio-Electronics-Television Manufacturers Association. Sheraton Hotel, Chicago. Details from RETMA at 1721 De Sales St., N.W., Washington, D. C.

MAY 20-23

Electronics Parts Distributors Show. Sponsored by RETMA; Sales Managers Club, Eastern Group; EP & EM; and WCEMA. Conrad Hilton Hotel, Chicago. Closed show, see details page 132 of this issue.

MAY 22-25

URSI Spring Meeting. Sponsored by IRE Professional Groups on Antennas and Propagation and on Microwave Theory and Techniques. Hotel Willard, Washington, D. C.

What's New in Radio

LOW-COST TRANSISTOR CHECKER

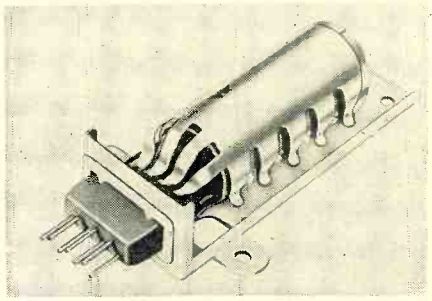
Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y., is currently offering a new low-cost transistor checker which is designed to be used with v.o.m. meter scales in various ranges to provide maximum flexibility and efficiency.

The "Transistor-Check" is a compact and durable instrument which tests all transistors in or out of the set for current gain, leakage, open, or shorts. The unit also checks crystal diodes for front-to-back current.

The unit comes with test leads that enable the technician to leave transistors in the circuit while checking. Battery life is expected to approximate shelf life. A detailed manual on transistor theory and testing is included with each instrument.

TUBE SHIELD MOUNT

International Electronic Research Corporation, 145 W. Magnolia Blvd., Burbank, Calif., has developed a new subminiature tube shield mount of right-angle design which includes an integral socket for 3-, 4-, 5-, 6-, and 7-pin flat press subminiature tubes. The new design gives engineers a compact, easy-to-install heat dissipating clamping mount that is ideal for use in confined spaces while permitting ready access for service or tube replacement.



The right angle configuration provides tube retention through the patented metal-to-glass contact method on the bulb along with the precision fit of the socket. Increased tube life

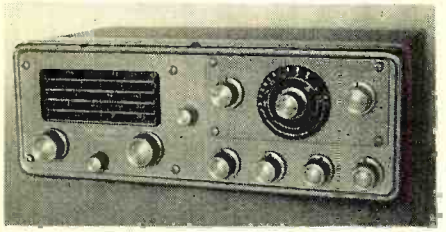
and reliability through a combination of reduced bulb temperature, maximum tube retention under severe shock and vibration, and good electrostatic shielding is assured.

Write the manufacturer direct for full details on available finishes and prices.

NEW HAM RECEIVER

Morrow Radio Mfg. Co., 2794 Market St., Salem, Ore., has developed a new amateur communications receiver which has been tradenamed "Falcon."

Featuring 1 microvolt sensitivity for a 14 db signal-to-noise ratio on 10 meters, the receiver has a selectable bandpass of 2.8 kc. and 9.2 kc. at 6 db down, and excellent stability even with wide fluctuations of temperature and voltage. The frequency coverage is 3.5 to 4 mc., 7 to 7.3 mc., 14 to 14.35 mc.,



21 to 21.45 mc., and 28 to 29.7 mc. in five bands. It features double-conversion superhet circuit.

The receiver is a companion unit to the company's MB-560-A transmitter. Descriptive literature on the receiver and/or transmitter is available from the manufacturer.

"STUBBY" SCREWDRIVERS

Xcelite, Incorporated, of Orchard Park, N. Y., is now offering its stubby-size "combination-detachable" screwdriver with four quick-change points in a durable transparent plastic kit with snap-fastener top.

Called the SK-20 kit, it fits into the hip pocket, tool box, glove compartment, or motorboat kit. The screwdriver blades are double ended, one with 3/16" regular and No. 1 Phillips, the other 1/4" regular and No. 2 Phillips. Each blade has a press-fitted hex sleeve in the center to fit a 7/16" spring-loaded hex bushing imbedded in the handle for snug holding and easy release for quick reversal or switching of blades.

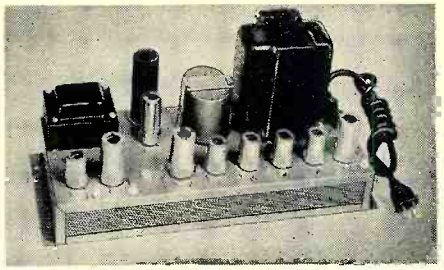
The new SK-20 is a companion item to the company's recently announced CK-20, a clear plastic zipper kit with corresponding handle and blades in regular length.

R.F. AMPLIFIER

Westbury Electronics, Inc., Westbury, N. Y., has developed a new broadband r.f. amplifier especially for community, industrial, apartment house, and hotel TV applications.

The Model ABB-1 covers channels 2 through 6 and is designed for continuous commercial service. It features a simplified tilt control system which permits equalization of cable characteristics over the entire passband. High signal-to-noise ratio is provided by a

cascode input circuit matched to 75 ohms for no reflections. Gain is 45 db mid-band with a factory aligned 8 db slope. A matched 75-ohm output provides .3 volt per channel or 2 volts



composite undistorted output. The output signal level is held to 1.5 db for a 10 db input swing by the a.g.c. circuit.

The output level control permits adjustment of gain while maintaining slope linearity to ±.5 db over the passband. A constant voltage power transformer provides filament and plate regulation to 2%. Non-critical circuits insure good stability.

TV TRANSMITTER MONITOR

General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass., has developed a TV transmitter monitor, the Type 1184-A.

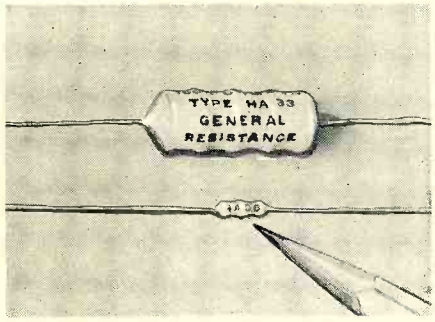
The unit is more than a monitor because it provides many operational tests that will speed and improve adjustment and maintenance in both aural and visual transmitter circuits.

TV visual transmitter and intercarrier frequencies can be monitored with this unit. In addition, a complete intercarrier sound-detection system has been included within the monitor. In addition to provisions for the measurement of residual AM noise on the aural transmitter, circuits for the direct measurement of the residual FM noise on the visual transmitter carrier are also provided.

Every operation in the installation, use, and maintenance of this new monitor can be handled from the front. The instrument comes with an individually adjusted master quartz crystal.

ENCAPSULATED WIREWOUNDS

General Resistance, Inc., 577 E. 156th St., New York 55, N. Y., is now



offering a series of microminiature encapsulated wirewound resistors which meet MIL R 93A specifications for environmental conditions.

The HAOO is 3/32" in diameter by 5/16" in length. The series is available in the resistance range of .1 ohm to 25,000 ohms. Standard tolerance is

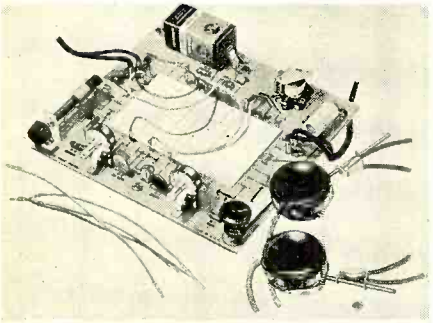
±1% (with tolerances as low as .1% available on special order). Wattage rating is 1/10 watt full load at 85 degrees C.

Write Dept. 35 of the company for full details on these new units.

10-CIRCUIT LAB KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., has just released a new 10-circuit transistor lab kit under its "Knight" label.

Low in price and easy to assemble, the new kit offers many features of special interest to beginners and experimenters. Supplied complete, the kit includes two transistors, all parts, and plug-in leads for building any one of ten different electronic circuits that



really work. The plug-in leads permit changing from one circuit to the next in minutes, without any need for resoldering once the basic parts have been fixed in place.

The circuits included are a two-stage AM radio, photoelectronic relay, wireless broadcaster, code practice oscillator, electronic switch, two-stage audio amplifier, capacity-operated relay, electronic timer, voice-operated relay, and electronic flasher. Circuits are quickly and easily changed by merely inserting special "plug-in" leads into jacks, which are already mounted on the printed circuit board.

MERIT REPLACEMENT YOKES

Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago 40, Ill., has added five replacement yokes for the latest *General Electric* chassis to its line. These units cover replacements in more than 150 of the set maker's models and chassis.

The new units, currently available at parts jobbers throughout the country, include the MDF-83 (for RLD-013), MDF-84 (for RLD-025), MDF-85 (for RLD-041 and 045), MDF-86 (for RLD-042), and MDF-87 (for RLD-052-067).

"BUTTON-LESS" VIBRATOR

A completely new kind of vibrator construction is being featured by *P. R. Mallory & Co. Inc.,* P. O. Box 1558, Indianapolis 6, Ind., in its Series 1600 just released.

The new design eliminates the usual button contacts with the vibrating reed and side arms, made of special contact alloy, acting as the contacting elements. The new design affords far greater contact area than previously possible. Vibrator life is said to be increased by 50 to 100 per-cent. Stick-

ing of contacts is eliminated and wear is distributed over a larger surface. The new design permits use of fully automatic production methods that assure high uniformity of characteristics. Mechanical hum is held to new low level, due to the lighter vibrating mass and the company's noise-reducing refinements.

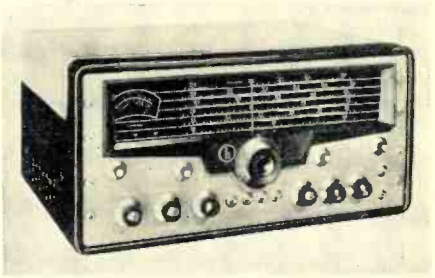
For technical data and prices, write the company's Distributor Division.

NEW SSB RECEIVER

The Hallicrafters Company, 4401 West Fifth Ave., Chicago 24, Ill., has announced the production of a new stable SSB receiver, the Model SX-101.

Possessing one of the heaviest chassis in the industry, the new unit incorporates the company's exclusive upper and lower sideband selection feature.

The circuit itself consists of thirteen tubes plus voltage regulator and rectifier and covers the 160, 80, 40, 20, 15, and 11-10 meter bands. By special positioning of the bandswitch, reception of the WWV 10 mc. standard frequency transmissions is possible. This makes possible a precise and highly accurate adjustment of the built-in 100 kc. quartz crystal calibrator. Another feature is



the a.v.c. system which will operate effectively for single sideband as well as c.w.

Complete technical specifications on the SX-101 will be supplied by the company upon written request.

"ADJUSTA-VUE"

Advance Electronics Co., 8510 North End Ave., Oak Park 37, Mich., has developed a unique portable mirror which is designed especially for TV service technicians.

Tradenamed the "Adjusta-Vue," the unit consists of a fully adjustable mirror in a self-contained carrying case. When in use the two covers that form the carrying case open and convert into base and stand to support the mirror and frame. The glass can then be swiveled or tilted into any position required for a sharp,undistorted reflection of the entire screen.

For service technicians who make home calls, four specially designed brackets are available so that the "Adjusta-Vue" can be mounted on the side of the tube caddy, for easy portability.

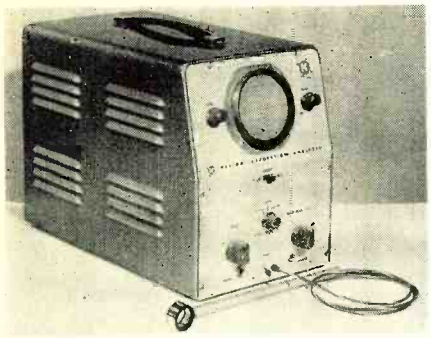
A data sheet describing this new servicing aid is available on request from the manufacturer.

TV CIRCUIT ANALYZER

Kingston Electronic Corporation, 17 Tudor Street, Cambridge 39, Mass., has developed a unique waveform-type tel-

evision test instrument and trouble tracer which is being marketed as the "Absorption Analyzer."

The ring-type probe, designed to slip over any tube, makes every tube a test



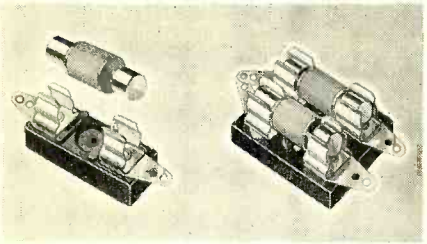
point, permitting service technicians to trace and isolate the trouble without removing the chassis from the cabinet and with no physical connection to the circuitry.

The instrument follows composite video from the antenna to the CRT, traces sound from the i.f.'s to the speaker, and displays sweep and sync information through progressive stages. Defective circuits are isolated by means of the waveforms which are displayed at each stage. Because no physical connection is necessary, minimum loading effects are produced. Designed specifically for TV servicing, the instrument has been made light, simple to operate, and completely portable.

POLARIZED MOUNTING BLOCKS

Bussmann Mfg. Co., a division of *McGraw-Edison Co.*, University at Jefferson, St. Louis 7, Mo., is now offering a new type of mounting block for silicon rectifiers in either single- or double-pole versions.

Proper polarization is assured because the rectifier can be inserted in only one way. A stop on one clip is so positioned that it engages the slot on the positive pole of the rectifier. The negative pole of the rectifier is not



slotted and so cannot be inserted in the clip with the stop. The other clip does not have a stop so takes the negative pole of the rectifier.

WIRE-WRAPPING TOOLS

Tools designed to speed electrical connections in radio, TV, and other electrical, electronic, and electromechanical assemblies have been announced by *Ingersoll-Rand*, 11 Broadway, New York, N. Y.

The wire wrapper is a hand-held tool, powered either by air or electricity. In use, the skinned wire is inserted in the loading groove, which can be set in six different positions to

make wire insertion easy from any angle. Proper alignment of the groove is assured by a spindle homing cam which provides positive location of the loading groove after each wind. A notch in the winding bit anchors the wire, then the bit is placed over the terminal lug. The wire-to-terminal connection is made by pressing the trigger which "shoots" the connecting wire around the terminal piece about six times per second under high tension. The result is a tightly wound spiral that forms a firm joint which withstands corrosion and vibration.

PORTABLE HAM RECEIVER

National Company of Malden, Mass., has developed a versatile receiver that may be used as a three-way portable; SWL, ham, or marine receiver.

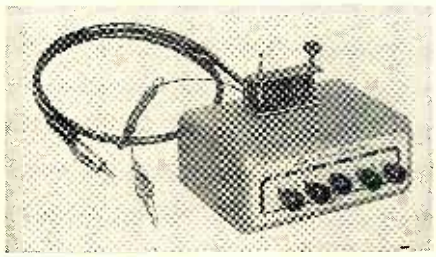
The Model NC-66 offers 115 volt, a.c.-d.c. or battery operation, five band cov-

erage from 150 kc. to 23 mc., electrical bandspread with logging scale, and a fixed tuned c.w. oscillator. It also has a "full-vue" slide-rule dial, 5" PM speaker, phone jack, and two built-in antennas (ferrite loop for d.f. and b.c. bands and a whip for short-wave reception). For boat owners a special marine band from 150 kc. to 400 kc., covering the direction-finding frequencies, is included.

The entire unit is housed in a sturdy two-tone metal cabinet with chrome trim and a carrying handle. It measures 12 5/16" wide, 9 11/16" high, and 10" deep. It weighs 16 pounds, less battery.

SHORT-WAVE CONVERTER

Gonset, 801 S. Main St., Burbank, Calif., is now offering a short-wave converter which is designed to operate



with any standard American-made, 12-volt auto radio which has a manual tuning knob.

The simple, do-it-yourself installation may be accomplished in minutes. The converter, which measures only 2¼" high, 5¼" wide, and 4½" deep, is secured in position by thumb screws on a mounting bracket. Fitting, drilling, or soldering is unnecessary.

The auto radio need not be removed from its housing since internal connections or alterations are not required. A converter patch cable is plugged into the antenna receptacle on the auto set and the flexible lead is clipped to the 12-volt accessory terminal under the dash. All plugs, cords, cables are supplied with the converter.

The converter covers the 49, 39, 19, and 13 meter bands. Bands are selected by push-buttons on the converter with the actual tuning being done with the auto radio dial. Performance of the broadcast receiver is not impaired.

VOLUME CONTROL FOR TRANSISTORS

A printed-circuit type volume control, with a special low-end resistance taper designed for use with transistors has been developed by *P. R. Mallory & Co. Inc.*, 3029 E. Washington St., Indianapolis 6, Ind.

The zero rotation resistance of the new control is extremely low, to provide satisfactory minimum volume level in low-impedance circuits. In addition, the low-end taper gives gradual resistance rise from the zero point over the first 20 to 30 degrees of shaft rotation, thus providing smooth control throughout the entire volume range.

The new taper is available on controls of several styles, designed for mounting vertical to or horizontal to the printed circuit panel. Each sample control is supplied with an overall resistance-rotation curve, plus a new "low-end" curve showing detailed characteristics through the minimum volume range.

Complete specifications will be supplied by the manufacturer upon written request.

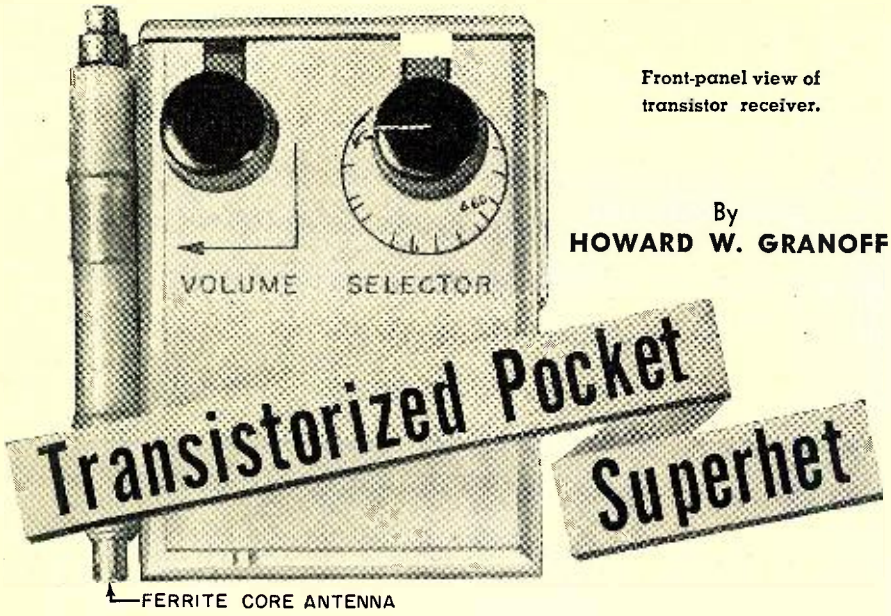
SPRAYER FOR TV-RADIO WORK

DeVilbiss Company of Somerset, Pa., has developed a special atomizer which is designed to spray a cleaning solution on dirty or corroded electrical contact points in television tuners and eliminate the costly and tedious job of disassembly to replace the tuner.

Designed especially for this application, the instrument has a 5⅜" spray tube which pinpoints the spray of the solution on the troublesome areas. It

avoids waste and provides greater reach and finer spray. The unit is designed for one-hand operation and compactness, making it easy to carry in the tool kit.

Radio, TV, and electronic parts jobbers are handling this new item. –30–



Front-panel view of transistor receiver.

Transistorized Pocket Superhet

By **HOWARD W. GRANOFF**

Sensitive pocket superhet receiver is built in cigarette case. Will drive external speaker.

TRANSISTOR articles for the past two years have dealt with all types of circuits. Of these, the radio receiving circuits have probably emerged as the most popular. At first, receivers utilizing crystal detectors followed by a stage of transistor amplification appeared. These were later followed by the more efficient regenerative type circuit which, in turn, has now given way to the more reliable superhet circuit.

Some of the more recent articles have dealt with "pocket superhets." A number of these sets were constructed and found to operate satisfactorily; however, it was felt that a major improvement could be made as far as the size of the package was concerned. With this idea in mind the task of designing and building a unit more in accordance with the idea of total miniaturization was attempted.

The receiver described is entirely self contained and is housed in a cigarette guard case which may be purchased in any cigar or stationery store for a few cents. The dimensions of the case used for this particular set are 2 5/16" x 1 1/16" x 3 1/8".

The power required is derived from a *Mallory* mercury cell, Type TR-145R or equivalent, which has a potential of 7.5 volts and a capacity of 350 milliampere/hours.

Six volts, however, is more than ample and as space was a problem, the outer cardboard cover of the battery was removed and one section discarded. Each of these sections has a potential of about 1.5 volts. The remainder of the battery is secured with *Scotch* tape as shown in one of the photos. Since the receiver requires about 4 or 5 ma. at six volts, the life of the battery, if used continuously, would be about seventy hours. However, as the voltage is reduced the current does not fall off proportionally, but rather logarithmically, which would indicate a much longer battery life at a lower voltage. Actually this receiver operated quite satisfactorily at a voltage as low as two volts.

Although only one i.f. stage is used, the receiver has excellent sensitivity, selectivity, and power when operating with no other pickup other than its ferrite core antenna. In the metropolitan New York area a total of 17 stations was heard. All stations were sharply separated and clearly received with more than ample earphone volume available for the majority of the signals picked up. In fact, it was found that when the output of the receiver was coupled to a ten-inch PM speaker through a suitable output transformer, the resulting fidelity and volume level was exceedingly good. Out of the metropolitan area the receiver performance fell off somewhat but still provided ample earphone volume when tuned to any of the major stations. The weaker signals could be brought in satisfactorily by connecting a short length of wire, approximately one to two feet long, to the antenna terminal of the tuning capacitor.

Weighing not much more than a package of cigarettes, the set can be carried in one's pocket while inconspicuously enjoying his favorite program.

All components are mounted on a *Bakelite* mounting board measuring 2¼ x 3 inches. Referring to the photos, it can be seen that all major components are mounted on one side while the wiring occupies the other side. All wiring is secured to the board by means of eyelets which are placed in drilled holes and then peened over.

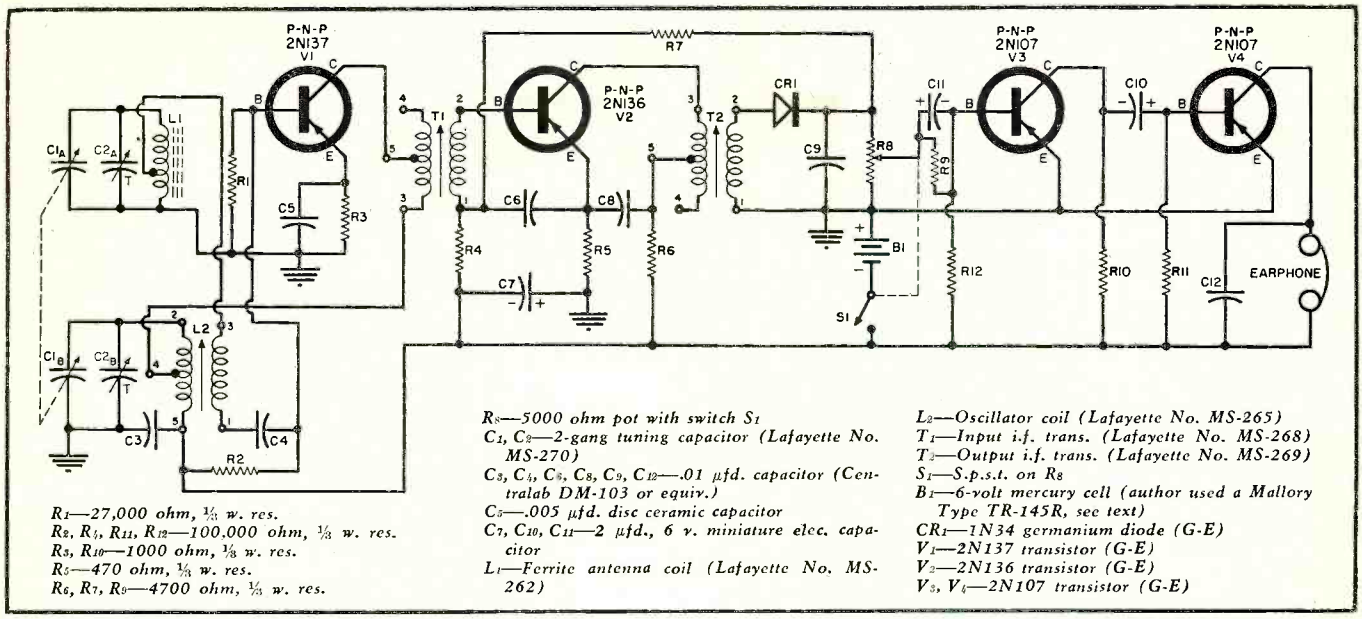
The i.f. transformers have primary impedances of 25,000 ohms; however, to insure proper matching, the first stage i.f. transformer has a secondary impedance of 600 ohms. The second stage i.f. transformer has a secondary impedance of 1000 ohms. Both units measure one-half inch square by three-quarters of an inch in height and are secured to the mounting board by *Duco* cement. The terminals of each of the two i.f. transformers were trimmed down so as to conserve as much space as possible.

The oscillator coil (*Lafayette* Part No. MS-265) is tuned over the broadcast band of 540 to 1650 kc. by means of a two-gang tuning capacitor (*Lafayette* Part No. MS-270) having an oscillator section of 10 to 100 μμfd. and an r.f. section of 10 to 208 μμfd. The unit measures 1 1/16 inches square and is secured to the mounting board by the two screws which engage in two tapped holes on either side of the shaft. Directly adjacent to the tuning capacitor, as shown in the photo, the oscillator coil is mounted by installing the small diameter end of the unit in a snugly fitting hole 0.175 inch in diameter and made with a No. 16 drill. The coil is then secured in place with *Duco* cement. The arrangement, as shown in the photos, allows for a neat layout of parts and the shortest possible wiring keeps parasitic oscillation to an absolute minimum.

The ferrite core antenna (*Lafayette* Part No. MS-262) is a high "*Q*" radio-frequency transformer consisting of 126 turns tapped 4 turns from one end. The coil is closewound with No. 28 cotton covered wire on a ferrite rod 3½ inches in length and ¼ inch in diameter. When measured on a "*Q*"-meter, the coil yielded a "*Q*" of 75. At a later date the "*Q*" of the same coil measured 90. Upon investigation it was found that the cotton covering on the wire soaked up more humidity on some days than on others. The remedy was to bake the antenna under an infrared lamp for about 30 minutes and then dip it in a bath of molten wax. Immediately after withdrawal from the wax bath the coil was violently twirled, by means of the "dipping string," until all the excess wax was driven off by centrifugal force. This operation removes all the moisture and thoroughly dries out the cotton covering on the wire. The wax forms a seal to prevent any future moisture contamination. After being treated, the coil showed a "*Q*" reading of 100.

The antenna coil is used in the antenna circuit of the set and is tuned over the broadcast band by the 10 to 208 μμfd. section of the tuning capacitor. Unfortunately, the antenna coil was too long to be installed inside the case, therefore, it was mounted on the side of the case as shown in one of the photos. It might be thought that trimming the ferrite rod would be a solution but this would change the characteristics of the antenna, which might result in inferior operation.

The circuit consists of an oscillator, mixer stage, i.f. amplifier, detector stage, and two *RC*-coupled audio amplifier stages. In the oscillator and



R1—27,000 ohm, ½ w. res.
R2, R4, R11, R12—100,000 ohm, ⅛ w. res.
R3, R10—1000 ohm, ⅛ w. res.
R5—470 ohm, ⅛ w. res.
R6, R7, R9—4700 ohm, ½ w. res.
R8—5000 ohm pot with switch S1
C1, C2—2-gang tuning capacitor (Lafayette No. MS-270)
C3, C4, C6, C8, C9, C12—.01 μfd. capacitor (Centralab DM-103 or equiv.)
C5—.005 μfd. disc ceramic capacitor
C7, C10, C11—2 μfd., 6 v. miniature elec. capacitor
L1—Ferrite antenna coil (Lafayette No. MS-262)
L2—Oscillator coil (Lafayette No. MS-265)
T1—Input i.f. trans. (Lafayette No. MS-268)
T2—Output i.f. trans. (Lafayette No. MS-269)
S1—S.p.s.t. on R8
B1—6-volt mercury cell (author used a Mallory Type TR-145R, see text)
CR1—1N34 germanium diode (G-E)
V1—2N137 transistor (G-E)
V2—2N136 transistor (G-E)
V3, V4—2N107 transistor (G-E)

Complete schematic diagram of sensitive, transistorized pocket superhet receiver. Four readily available transistors are used.

mixer stage a 2N137 is employed. Although more costly than the 2N136 which was originally tried, the 2N137 displayed a marked increase in gain. The i.f. stage uses a 2N136 and for the same reasons replaces a 2N135 which was originally tried. Detection is accomplished by a 1N34 crystal diode. Two inexpensive 2N107 transistors are used in the first and second audio stages. Actually one stage of audio was originally used and worked quite well; however, to get that extra power to bring in the weaker stations, a second stage was added at a cost of an extra milliampere of drain from the battery. The additional gain thus obtained gives the set that extra "zip" and allows reception of the weaker stations with "easy listening" volume.

The earphone used is a model 4680, manufactured by *Telex,* and has a d.c. resistance of 2000 ohms. The unit is connected to the collector of the second audio stage through a miniature type jack (*Lafayette* Part No. MS-282 or equivalent).

In aligning the set, standard alignment procedure is as follows: The i.f. transformers are tuned to 455 kilocycles by means of a single adjustment through a hole in the bottom of the transformer. The slugs in the cores of these transformers are made of powdered iron which is rather soft, therefore, care must be taken not to damage the slots while aligning the transformers. In addition, a non-metallic alignment tool should be used in order to prevent the detuning which would occur, thereby resulting in misalignment. Good bandtracking is accomplished by setting the low end of the band at 600 kilocycles by means of the slug adjustment in the oscillator coil. The high end of the band is set at 1500 kilocycles by the oscillator trimmer and r.f. trimmer adjustments located on the back of the tuning capacitor. When the alignment is complete, the set should be tuned to 1000 kilocycles and checked for over-all gain. This is accomplished by applying a 1000 kilocycle, 16 microvolt signal, 30% modulated with a 400 cycle tone, between the r.f. section of the tuning capacitor and ground which should result in a reading of approximately 0.024 volt (volume control in full clockwise position, over-all gain 65 db) on the proper scale of a sensitive a.c. vacuum-tube voltmeter placed across the earphone. In this gain check a *McMurdo Silver* signal generator, Model 906, was used; however, any equivalent instrument having a calibrated output may be used. The v.t.v.m. used was the *Heath* Model AV-2.

Connection to the battery is accomplished by soldering the power leads, taking care to observe correct polarity, from the set to the ends of the battery. Failure to comply with correct polarity connections may result in permanent damage to the transistors. The battery is then secured in place by means of *Scotch* tape as shown in the photo.

It is the opinion of the writer that this receiver has been reduced to the simplest form of a superheterodyne transistor radio, and with a few hours plus a little effort, the results will be most rewarding—a small price to pay for so much in such a little package.

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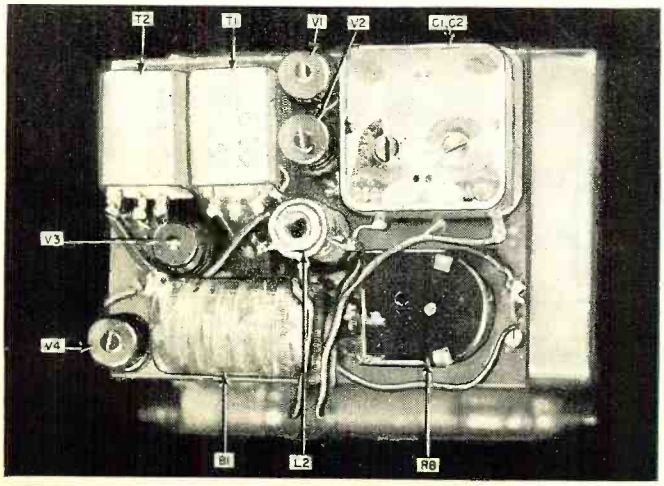
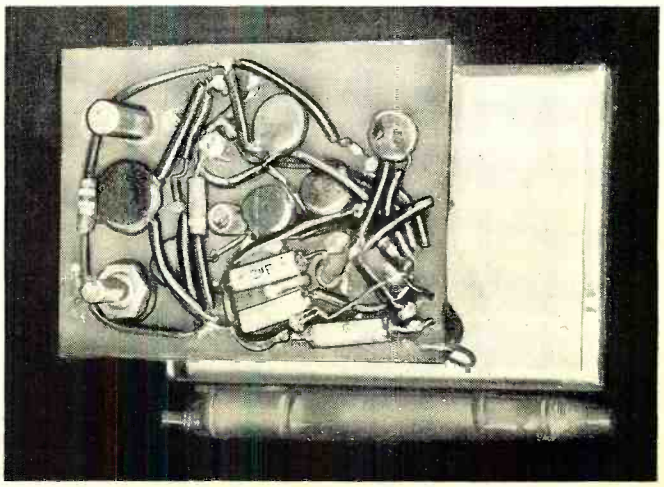
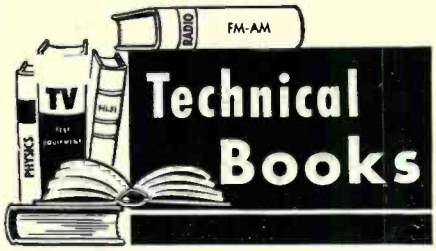
Small Bakelite mounting board supports all the components.



Reverse side of mounting board showing smaller components.





"FREQUENCY-MODULATED RADIO" by K. R. Sturley. Published by *The Macmillan Company,* New York. 118 pages. Price $3.00.

This is another in this publisher's current series of books covering training material for engineers of the *British Broadcasting Corporation.* This volume comprises an introduction to the theory, design, construction, and servicing of v.h.f. FM receivers.

Although two brief chapters are devoted to a discussion of FM transmissions, the bulk of the material deals with FM receivers and combination AM-FM sets. The chapter on tests on FM receivers is written at a level that the set owner can understand in case he wishes to try his hand at aligning his own set or making minor repairs.

The equipment discussed and used for illustrative purposes is British built but the principles involved apply equally as well to U. S. sets.

* * *

"MATHEMATICS AND COMPUTERS" by George R. Stibitz & Jules A. Larrivee. Published by *McGraw-Hill Book Company, Inc.,* New York. 208 pages. Price $5.00.

This book is, in effect, a survey of the applied mathematician's job in the world of science, engineering, and business. The problems he studies, the methods he uses, and the computing devices at his service are all covered in this interesting and illuminating text.

The various computing devices, both digital and non-digital, now in use are described along with typical applications for such devices in technology and business.

Both technical and lay persons should enjoy this intimate "look over the shoulder" at another man's job.

* * *

"REPAIRING TELEVISION RECEIVERS" by Cyrus Glickstein. Published by *John F. Rider Publisher, Inc.,* New York. 197 pages. Price $4.40. Paper bound.

This is a "how-to-do-it" book in the best sense of the phrase. The author has stressed the practical aspects of troubleshooting and repair with the result that those who follow his suggestions will save time and make money.

The correct procedures have been set up on a step-by-step basis and move logically through the receiver circuits until the fault is localized. Four chapters dealing with typical receiver troubles are especially valuable as time savers. A final chapter dealing with "timewasters" in servicing is an eye-opener which even experienced technicians will find instructive.

As a compact one-volume text, this book should find a wide audience.

* * *

"MOST-OFTEN-NEEDED 1957 RADIO DIAGRAMS AND SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications,* Highland Park, Ill. 192 pages. Price $2.50. Paper bound.

This is Volume 17 in this publisher's series of diagrams covering radio receivers, radio-phonos, portables, etc., in the 1957 lines of some 35 manufacturers.

As with the earlier books, each receiver is pictured, described, schematic diagram provided, parts list given, and special servicing and troubleshooting hints discussed. Where the receiver uses a dial cord, details for restringing are given. Service technicians who have come to depend on this publisher's manuals will welcome this new addition.

* * *

"RESONANT CIRCUITS" edited by Alexander Schure. Published by *John F. Rider Publisher, Inc.,* New York. 64 pages. Price $1.25. Paper bound.

This 16th volume in the "Electronic Technology Series" covers resistors, capacitors, and inductors used in various series, parallel, or series-parallel resonant combinations in electronic circuits.

Because of the subject matter, the treatment is, of necessity, mathematical, but engineering students as well as electronic technicians with some formal training in electronic theory should have no difficulty in deriving much useful information from this textbook.

* * *

"PRACTICAL RADIO AND ELECTRONICS COURSE" compiled by M. N. Beitman. Published by *Supreme Publications,* Highland Park, Ill. 268 pages. Price $3.95. Paper bound. Companion "answer" book. 25 cents.

The publisher has taken its three earlier "home-study" volumes, revised them, brought them up to date, and is now offering them in single-volume form for the convenience of the student. There are 35 lessons in all, with test questions appended to each lesson.

A companion "answer" book is available as a separate publication and can be ordered at the time the course is purchased or requested later after the student has completed his lessons.

The text material is well and lavishly illustrated with photographs, line drawings, and diagrams. A large tube characteristics chart section makes this volume self-contained. A good book for the beginner.

* * *

"L-C OSCILLATORS" edited by Alexander Schure. Published by *John F. Rider Publisher, Inc.,* New York. 64 pages. Price $1.25. Paper bound.

This is the 13th volume in this publisher's "Electronic Technology Series" and covers *LC* oscillator elements, energy conversion, frequency range and stability, power considerations, oscil-

lator efficiency, harmonic generation, series and parallel resonance, and critical damping.

Since *LC* oscillators are being widely used in various radio communications systems and in a number of industrial control and manufacturing devices, more and more engineers and technicians are encountering this circuitry in their day-to-day jobs. This little volume should be a decided help in understanding the basics.

* * *

"THE J_ω—OR SYMBOLIC METHOD" by Dr. Harry Stockman. Published by *SER Co.*, 543 Lexington St., Waltham, Mass. 312 pages. Price $3.50. Paper bound.

A survey of the symbolic method of handling electronic engineering calculations and its association with the integro-differential equation, the D-operator, the Laplace transform, and other methods. Solved problems are included along with an extensive bibliography.

* * *

"TRANSISTOR ENGINEERING REFERENCE HANDBOOK" by H. E. Marrows. Published by *John F. Rider Publisher, Inc.,* New York. 288 pages. Price $9.95.

This volume represents a *tour-de-force* of some magnitude since it includes a large body of technical data which heretofore has been widely scattered and often unavailable.

The text is divided into five major sections covering a general survey of transistors; reference data on commercial units; reference data on commercial transistor components and test sets; reference data on commercial applications of transistors; and a directory of manufacturers.

This book covers some 200 different types of transistors, components designed especially for transistorized equipment (including capacitors, cells and batteries, thermistors, etc.), and other pertinent data which the design engineer must have at his fingertips.

Those whose work is concerned with the application of transistors will find their money well spent on this reference manual.

* * *

"THE RADIO AMATEUR'S HANDBOOK" compiled by ARRL Staff. Published by the *American Radio Relay League,* West Hartford, Conn. 576 pages plus catalogue and tube data sections. Price $3.50. Paper bound. 34th Edition.

There have been a number of important revisions and additions to this year's "Handbook," notably the sections on semiconductor theory, vacuum tube technical data, high-powered amplifiers and beam antennas for v.h.f., simple and complex receivers and transmitters for Novices and experienced hams.

As a construction manual, reference work, and training text for classroom or home study, this book is tops. There are over 1350 illustrations including 502 tube-base diagrams, and as a compact, handy one-volume reference "library" this is one book that would be hard to beat.

Despite the "Amateur" in the title, a lot of the material in this volume is of use to all radiomen.

* * *

"HANDBOOK OF SOUND REPRODUCTION" by Edgar M. Villchur. Published by *Radio Magazines, Inc.,* P. O. Box 629, Mineola, N. Y. 213 pages. Price $6.50.

This text is based on a series of magazine articles covering the more technical aspects of high fidelity. Although the treatment makes no concessions to the novice, the subject matter is presented in such a way that the intelligent layman should have no difficulty in coping with the material.

The author covers his subject in eighteen chapters dealing with the sound wave, the quality of sound, the life cycle of sound energy, oscillatory systems, musical instruments and the human voice, the perception of sound, the history of the phonograph, fidelity in sound reproduction, recording on discs, loudspeakers, baffles and enclosures, the power amplifier, voltage amplifiers and phase splitters, tone control and equalization, power supplies, hum, and noise, pickups and tone arms, assembling the system, and testing and measurement. The text is well illustrated and numerous references are appended for further study, if desired.

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Sales Aids

RESISTOR KIT AND RACK

G-C Electronics Mfg. Co., Rockford, Ill., is offering a handsome all-metal bench or wall rack, at no extra charge, with its "starter" assortment of resistors. This kit includes 30 boxes of the most used ½, 1, and 2 watt units.

According to the company, this kit was developed in answer to many requests for a "package deal" that would help obtain an assortment of resistors with a high turn-over potential.

Containing the same resistors used for original equipment assembly, the hinged cover plastic boxes have made it easy to determine resistor values by a novel method of color-coding and labeling, while giving the resistors and their leads full protection against any damage or careless handling.

This kit is now available through leading electronics distributors. Further information may be obtained from the company at 400 South Wyman Street.

* * *

ZENITH GIFT PACKAGE

A red ribbon, printed on a clear acetate cover, gives a flourish to the new *Zenith* gift package for its "Royal 500" 7-transistor pocket radio.

The company's crest, logo, and product identification appear in white and black on the ribbon. Metallic tweed pattern in gold and black on the tray affords a rich background for displaying the radio, carrying case, and ear attachments for personal listening. Decorative design, and further product identity are printed on the sides of the base piece, with red and gold on white.

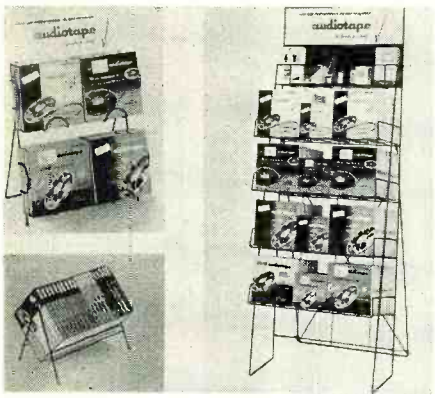
The product is shipped in a new

corrugated container. Slotted flaps interlock to suspend the radio, giving clearance from the carton in all directions. Gray linen-weave pattern and yellow and black printing provide attractiveness and identification.

* * *

"AUDIOTAPE" RACKS

Audio Devices, Inc., manufacturer of "Audiotape", is offering a line of merchandising aids to dealers and distrib-



utors of sound recording tape. Included in the program are two display racks, and a tape storage rack for consumers.

The merchandising racks include one floor model and one counter type. The counter rack is a compact, two-shelf unit, only 19 inches tall, and 15 inches wide. It holds 20 seven-inch reels of tape. The floor display has four shelves for tape, with a total capacity of 120 seven-inch reels, and 60 five-inch reels.

Both of the store display racks are constructed of light, sturdy, wrought-iron wire.

The racks are available to the trade without charge, and details are available from the company's representatives, or from the firm's headquarters, 444 Madison Avenue, New York, N. Y.

* * *

ANTENNA DISPLAY

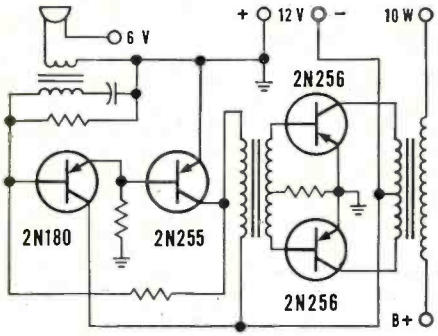
The display shown below—complete with a free "Color'ceptor" antenna, and striking promotion material—is

being furnished by the *Winegard Company*, Burlington, Iowa.

This display is being provided to qualified jobbers and dealers participating in a new antenna promotion recently launched by the firm.

Early reports from the field indicate that this merchandising approach to selling antennas has been highly successful in stimulating sales. Many jobbers and dealers have already doubled or tripled the number of antennas originally ordered. —30—

Transistorized Modulator



Now radio amateurs and experimenters can build a mobile transistorized modulator. Simple circuit features: pre-driver, driver, and final amplifier with low-cost CBS 2N255 and 2N256 power transistors . . . 10 watts output (modulates 2E26) . . . instant-heating . . . low drain . . . for use with transmitter or sound system.

CBS alloy-junction, germanium power transistors 2N255 (6-volt) and 2N256 (12-volt) are useful also in many other economical amplifiers . . . fixed or mobile. Let the second edition of CBS Power Transistor Applications, Bulletin PA-16, help you put them to work. Free, it gives complete data and seven detailed circuits, including the mobile modulator. Pick it up along with your 2N255 and 2N256 transistors at your CBS Tube distributor's.

CBS-HYTRON

Semiconductor Operations, Lowell, Mass.
A Division of
Columbia Broadcasting System, Inc.

1957 Parts Show Program

THE 1957 Electronic Parts Distributors Show will be held May 20th through 23rd at Chicago's Conrad Hilton Hotel. Sponsored by the Radio-Electronic-Television Manufacturers Assn.; the Sales Managers Club, Eastern Group; the Association of Electronic Parts & Equipment Manufacturers; and the West Coast Electronic Manufacturers Association, this year's event, like those of the past few years, will be a "closed" show with membership in one or more of these associations prerequisite to eligibility to exhibit.

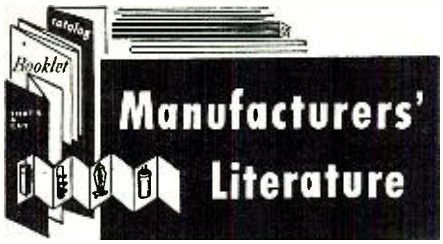
Exhibits have been divided into categories and manufacturers have been assigned space in either the special "Sound Demonstration" area on the fifth and sixth floors of the hotel or the "Parts and Equipment" area. No audible demonstrations will be permitted in the latter section.

Admission to the show is by badge only. Free badges were issued on an advance and by-mail basis earlier this year. Persons who have not preregistered must clear the credentials panel at the show and pay a registration fee to get a badge. They are then accorded only limited access to the exhibits. Distributors planning to attend the show must either be a member of NEDA or prove that they buy from at least 5% of the exhibitors who manufacture products other than sound equipment. Commercial sound badges are issued to commercial sound contractors who buy from at least four different exhibitors of sound equipment. Hi-Fi badges are issued to persons associated with dealers who buy from at least six different exhibitors.

Among the Show-wide activities planned for visitors is a "Gala Night Out" dinner on May 20th to be held at the hotel. V. M. Zachariah of *Zach Radio Supply Co.*, San Francisco, is chairman of the entertainment committee. He promises an interesting "menu" of stars, stunts, surprises, as well as top-notch professional entertainment.

Women guests and those who accompany their husbands to the Show will find a variety of activities planned for their entertainment. Sightseeing trips, matinee theater parties, shopping tours, free tickets to radio and TV broadcasts will be available. The traditional hospitality suites of former years have been renamed "The Teahouse of the May Show" and light refreshments and other amenities will be available daily.

As in the past, "The Representatives" will again handle the Show's message and directory service. Closed circuit TV will be used for paging and announcement services as was the case last year. This service proved to be both useful and attention-getting and is repeated by demand. —30—



MANUFACTURING FACILITIES

Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass. has issued a 12-page brochure which describes its facilities in some detail.

The company makes electronic test equipment components for the electronic industry, custom builds complex electronic devices, and engages in electronic research and development.

The two-color booklet describes and illustrates these facilities.

NEW RETMA STANDARDS

The Engineering Department of RETMA, 650 Salmon Tower, 11 W. 42nd St., New York 36, N. Y. has announced the release of four new standards.

Standard RS-159 covers chassis pick-up of vehicular receivers and is priced at 25 cents. No. RS-177 is entitled "Vibrator Power Transformers" available at 30 cents a copy. RS-178 covers the solderability test standard and sells for 25 cents while RS-179 is a classification of tube testers, priced at 25 cents.

Any or all of these standards may be ordered direct from the association. Payment should accompany orders.

RESISTANCE BRIDGES

Shallcross Manufacturing Co., Collingdale, Pa. has described seven bridges, covering d.c. resistance measurements from 1 μohm to 1 million megohms to tolerances as close as $\pm$ .02%, in its new Bulletin L-19B.

Types illustrated range from general-purpose Wheatstone bridges for laboratory and field use and Kelvin-Wheatstone and Megohm-Wheatstone bridges for precise measurements of extremely low or extremely high resistances to special-purpose Per-cent-Limit bridges that make resistance measurements within preset tolerances on a "go-no-go" production line basis.

TRANSISTOR DATA SERVICE

Service Instruments Corp., 171 Official Road, Addison, Ill. has inaugurated a new system of distribution on its transistor set-up charts and booklets.

Because the transistor field is changing so rapidly and to avoid delay between factory, distributor, and service technician, a user can now register for up to six mailings a year for $1.00. The money collected will go into a non-profit fund for this purpose alone.

The information released will include new set-up information on transistors and the latest information on testing of new crystal diodes, selenium rectifiers, and silicon rectifiers.

This service is available on letter-

head request plus $1.00 which covers service for one year from the date of the letter.

TEST INSTRUMENTS

The *Shasta Division* of *Beckman Instruments, Inc.,* P.O. Box 296, Station A, Richmond, Calif. has announced the availability of a new 4-page, 2-color catalogue which describes its line of electronic test instruments.

Details on expanded scale voltmeters, frequency meters, synchro testers, v.t.v.m.'s, oscillators, resistance bridges, power supplies, wide-band amplifiers, a WWV receiver, and a decade inductor are included in the bulletin.

CONVERSION FACTOR CHART

Precision Equipment Co., 3716 N. Milwaukee Ave., Chicago 41, Ill. is offering a handy reference table for engineers, in wall chart form, as a service to the industry.

Included are common conversions such as inches to centimeters or watts to horsepower, as well as many conversions that are difficult to locate in reference manuals.

HARVEY RADIO CATALOGUE

Harvey Radio Company, Inc., 103 W. 43rd St., New York, N. Y. has released a 284-page catalogue covering a wide variety of radio, electrical, and electronic components.

The most complete catalogue ever issued by this distributor, the new publication also includes a 64-page high fidelity equipment section. Write the firm direct for a copy.

HICKOK'S V.O.M.

Complete details on its new portable electronic voltohmmeter are included in Form 415 being offered without charge by *The Hickok Electrical Instrument Company,* 10524 Dupont Ave., Cleveland 8, Ohio.

The data sheet describes this small portable unit in detail and explains how the single-unit, multi-function range selector is color coded to facilitate use and speed selection. The instrument itself needs no batteries, even for the ohmmeter section. It comes complete with leads, single unit a.c.-d.c. probe, instruction book, and guarantee.

RECTIFIER REPLACEMENTS

The Components Division of *Federal Telephone and Radio Company,* 100 Kingsland Road, Clifton, N. J. has issued a 52-page replacement guide containing detailed information on selenium rectifier replacement for servicing literally hundreds of different TV and radio receiver chassis and a variety of electronic products.

The guide, a bound, standard-punched 8½" x 11" brochure, is priced at $1.25 and is available through local distributors or from the manufacturer. In addition to replacement information, the guide also contains trouble-shooting, servicing, and testing information on selenium rectifiers, presents fundamental circuits using such components, and provides dimensional information on the rectifiers in tabular and diagrammatic form. Other sections present electrical characteristics of the rectifiers, with photos, and a cross reference table for replacement of rectifiers of other manufacturers.

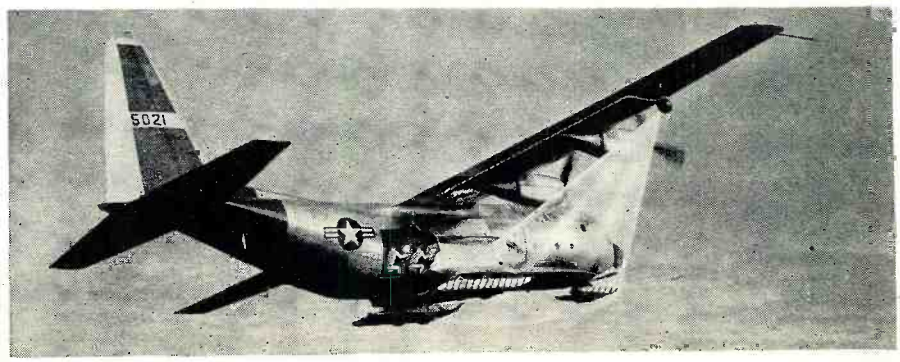
FREED COMPONENTS

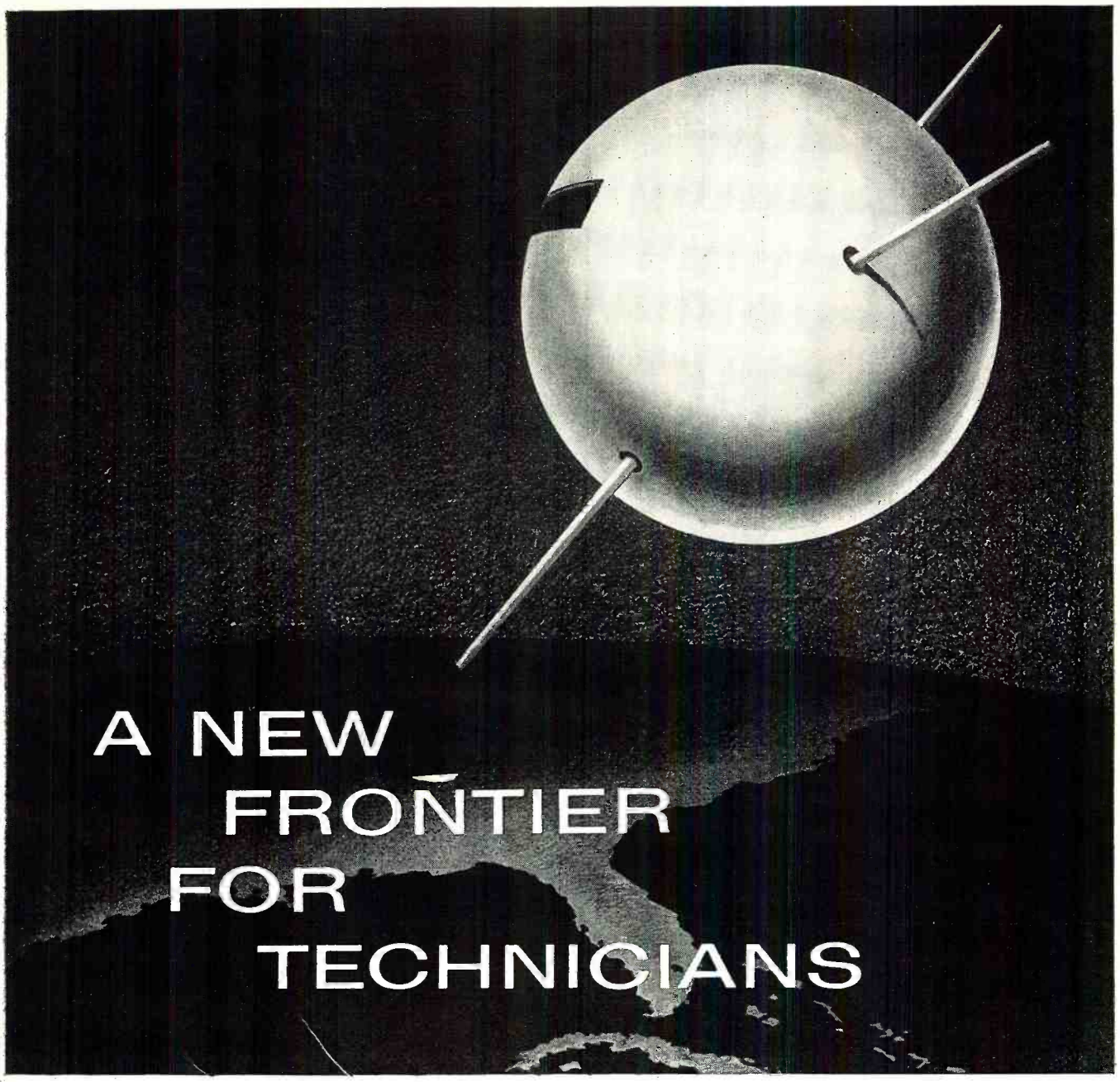
The newest line of electronic components manufactured by *Freed Transformer Co., Inc.,* 1773P Weirfield St., Brooklyn 27, N. Y. is featured in the 48-page catalogue just released by the firm.

Audio, power, and pulse transformers, filters and discriminators, toroids, magnetic amplifiers, and ultrasonic components are pictured and described in detail. Some 128 graphs show the performance of many of these units. Complete data on transformers for military and commercial applications is also included. They are available in open, hermetically sealed, or encapsulated forms.

When writing for a copy of this catalogue, please specify No. 571. —30—

Flight testing of the world's largest ski-equipped airplane and the first propjet ever fitted with skis, Lockheed's C-130 Hercules is observed by an automatic television camera under the right outer wing. Details of the flying TV station are shown on this aerial picture of the 62-ton Air Force combat transport during a recent test flight. The TV camera, equipped with a wide-angle lens, is suspended in a two-foot diameter Fiberglas pod under the wing. Focus is fixed on the 19½-foot main skis and the smaller nose skis, which are painted with candy-cane stripes for better visibility. A coax cable runs under the trailing edge of the wing, through the wing center section, and into the cabin. Flight test engineers inside the compartment watch the behavior of the boat-like skis at various speeds and at various attitudes during the testing flights, using a 10-inch monitor screen in front of them.





RCA offers an opportunity for you to apply your technical skill to its Missile Test Project at Patrick Air Force Base, Florida—"Launching Site of the Satellite."

Here at the world's longest missile testing range, extending from Florida far across the South Atlantic, you can enjoy improved status with the recognized leader in Electronics. Unprecedented growth opportunities are offered in various phases of data acquisition, transmission and processing, including Radar—Communications—Optics—Computers—Timing—Telemetry.

At RCA's Missile Test Project you will enjoy technical advancement combined with famous Florida living. Your family will appreciate the ideal climate—allowing year 'round outdoor activities—and pleasant social surroundings.

Immediate assignments are available in Florida, the Bahama Islands, and aboard tracking ships in the South Atlantic. Attractive home leave policy and salary differential make the Bahama Islands and tracking ship assignments especially attractive for single men.

Let the Missile Test Project become *your* symbol of the future. Join in our assault on the frontier of space!

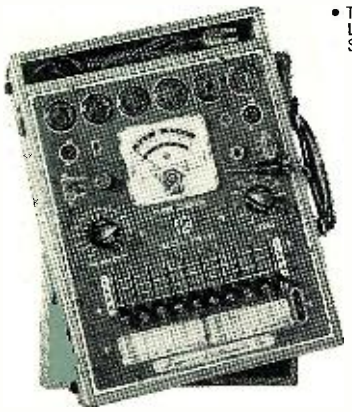
For complete information about this new and challenging field, write to:

Personnel Manager, Dept. N-16E
RCA Service Company, Inc.
Missile Test Project
P.O. Box 1226
Melbourne, Florida

RCA® **RADIO CORPORATION of AMERICA**

Superior's new Model TW-11 **STANDARD PROFESSIONAL**

TUBE TESTER



- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any 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. All tube listings printed in large easy-to-read type.

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

EXTRAORDINARY FEATURE — SEPARATE SCALE FOR LOW-CURRENT TUBES — Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$26.95 NET

Superior's New Model TV-12 **TRANS-CONDUCTANCE**

UBE ES ER

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

ALSO TESTS TRANSISTORS!

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Model TV-12 housed in handsome rugged portable cabinet sells for only **$72.50 NET**

Superior's New Model 770-A

The FIRST POCKET-SIZED

VOLT-OHM MILLIAMMETER

USING THE NEW *"FULL-VIEW"* METER. *71% MORE SCALE AREA!!*

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

SPECIFICATIONS

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/-1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** −6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

Compact — 3⅛" x 5⅞" x 2¼"

The Model 770-A comes complete with self-contained batteries, test leads and all operating instructions.

$15.85 NET

Superior's New Model 670-A

SUPER METER

A Combination VOLT-OHM MILLIAMMETER *PLUS* Capacity, Reactance, Inductance and Decibel Measurements.

ADDED FEATURE:
Built in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

SPECIFICATIONS

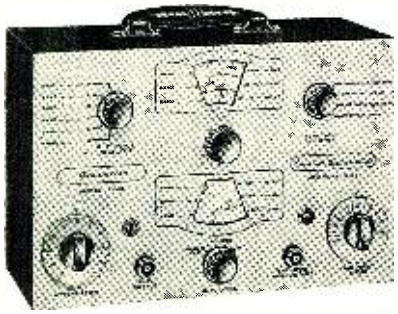
D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 Henries to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's New Model TV-50

GENOMETER



A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio • F. M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

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

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

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

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

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

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

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

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.
Only ..... **$47.50 NET**

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

Superior's New Model 76

IT'S A CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms

IT'S A SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

Specifications

√CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the *power factor* of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

√RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

√SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

√TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2′ to 200′ for 72 ohm coax and 2′ to 250′ for 300 ohm ribbon.

Model 76 comes complete with all accessories, including R.F. and A.F. Probes; Test Leads and operating Instructions. Nothing else to buy. Only **$26.95 NET**

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-345, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....
Address .....
City .....Zone.....State.....

All prices net, F.O.B., N. Y. C.

- ☐ Model TW-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 76 . . . Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-12.....Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ Model TV-50.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 770-A.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model 670-A . . . Total Price $28.40 $7.40 within 10 days. Balance $5.50 monthly for 6 months.

Improving V. T. V. M. Linearity

By **ARTHUR H. SCHMIDT**

A simple network shunted across the meter movement improves the over-all accuracy of scale readings.

IN MANY audio voltmeters, such as the *Heathkit* AV-2, the crystal diodes that feed the indicating meter are not quite linear. The result is that the meter may read low when the pointer is on the lower part of the scale. This also causes apparent error when the meter is switched from one range to another. For example, suppose we adjust the sensitivity so the meter reads exactly full scale on the 1-volt range, with an input of 1 volt. Leaving the signal input the same, switch the meter to the 3-volt scale. Now the meter will read about .93 volts or 7 per-cent too low.

A very simple compensating circuit will improve this condition considerably. It consists of an additional crystal diode and a resistor in series, connected across the meter terminals as shown in Fig. 1. The two components, W, the added diode, and the resistor, R, are indicated by the heavy lines in the drawing.

When the meter current is near full scale, the crystal diode conducts more than when the current is near zero. We thus have a nonlinear shunt. Be sure that the cathode of the diode is poled toward the minus meter terminal. About any germanium diode will work in this application. A 1N34 or 1N51 would be suitable. The correct resistor value is somewhere between 6800 and 10,000 ohms. A good way to determine the correct value is to perform the scale-switching test already mentioned and to pick the resistance which will correct the readings. This resistance is not critical. This modification will reduce the full-scale sensitivity by about 6 to 8 per-cent on all meter ranges, so the sensitivity adjustment will have to be reset.

Fig. 2 shows a simple linearity tester that will check any v.t.v.m. The "tester" consists of a group of precision resistors wired around a rotary switch to form an accurate voltage divider. To use the "tester," connect it between an audio oscillator and the audio voltmeter or v.t.v.m. Next set the rotary switch of the tester to the "100%" position and adjust the oscillator output so the meter reads exactly full scale. Then reduce the divider setting in steps—to "80%", "60%", and so on down to see if the meter readings continue to agree.

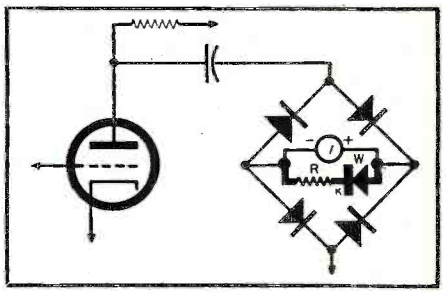


Fig. 1. A resistor and crystal diode (shown in heavy lines) wired across the movement minimize errors in readings.

This will work on the regular "Voltohmyst" type of v.t.v.m., too, provided the a.c. ranges have an input impedance of 1 megohm or more. It will also check the d.c. linearity if a battery and pot are used for the signal source instead of an oscillator. It will not work on a multimeter because the current drawn by the meter loads

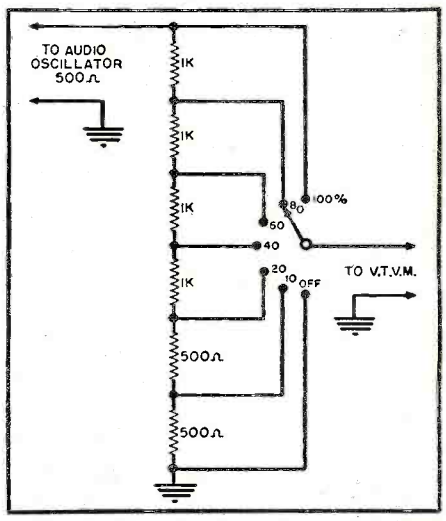


Fig. 2. This simple switched divider network, together with an audio generator, facilitates check of a.c. readings.

Table 1. Accuracy of low-scale readings are most improved after compensation.

INPUT (% OF FULL SCALE)	BEFORE COMPENSATION METER READING	% ERROR	AFTER COMPENSATION METER READING	% ERROR
100	100	0	100	0
80	80	0	80.5	+.6
60	60	0	60.5	+.8
40	39	—2.5	40	0
20	18	—10	19	—5
10	8	—20	9	—10

down the voltage divider, thus upsetting the accuracy.

Table 1 shows the result of applying this compensation procedure to a conventional audio voltmeter. Note that, prior to compensation, the instrument was "on the nose" at the higher portion of the scale. This tends to be the case with most meters of this type and is part of the reason for describing the meter's performance, when specifications are given, in terms of error from full-scale reading.

With the special shunt in the circuit there is slight loss of accuracy at upper scale, but drastic reduction of error over-all, with the maximum error being cut in half.

This same type of inaccuracy—and the same cure—apply to any instrument of this type which uses an amplifier, a bridge-type crystal rectifier, and an indicating meter which has a linear microampere scale. —30—

BAD INTERLACE

By JAMES A. McROBERTS

"TWINNING" of horizontal lines due to impaired interlace was the complaint on the Motorola TS23 chassis.

The bridging of capacitors in the vertical pulse-forming circuit revealed that the capacitor C_{47} (5000 $\mu\mu$fd.) had decreased in value to approximately 1200 $\mu\mu$fd.

This decrease in the capacitor value also decreased the integrating ability of the network so that the interlace was impaired. —30—

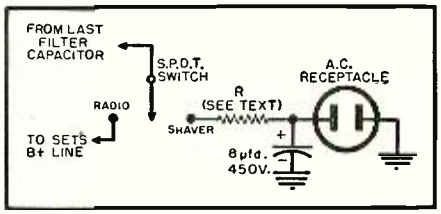
USING SHAVER IN AUTO

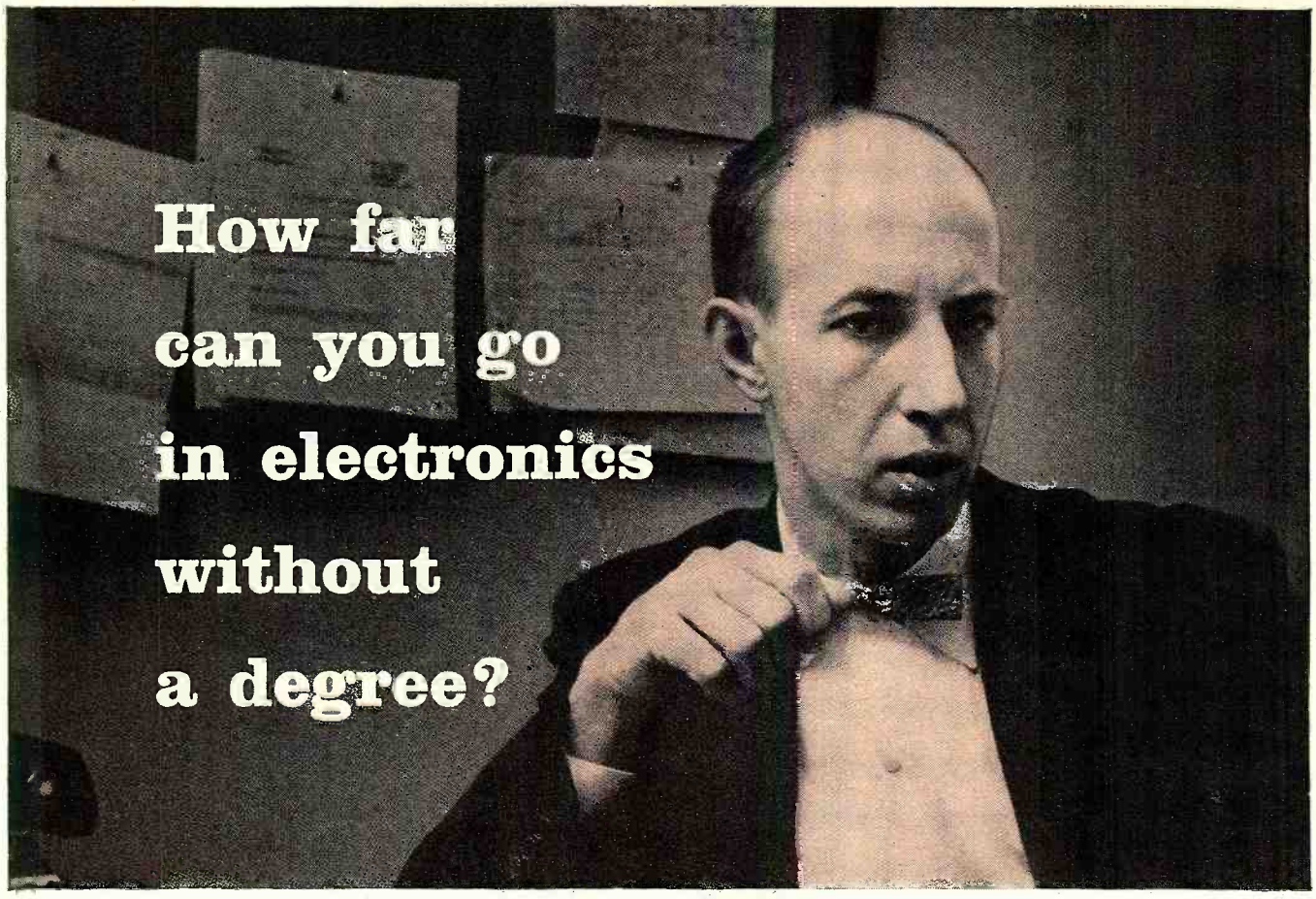
By CHARLES ERWIN COHN

MANY people at the present time find it convenient to operate an electric shaver in their cars. The necessary power can be drawn from the car radio, as shown in the diagram below. To do this, mount an s.p.d.t. toggle switch and an a.c. chassis receptacle on the car radio cabinet. Break the set's "B+" line after the last filter capacitor and wire in the toggle switch as shown. The resistor R should be proportioned to give about 150 volts d.c. at the socket with the shaver running.

The current drain of smaller shavers such as the Schick is around 80 ma., while larger models such as the Remington 60 draw as much as 150 ma. Although these currents exceed the nominal ratings of most car-radio power supplies, their effects are evidenced more in reduced voltage output than in actual damage to parts. For this reason, the proper value and wattage rating for R must be found experimentally. The toggle switch eases the load on the supply by cutting off the radio circuits while the shaver is running. —30—

Adapter enables electric shaver to be operated from car radio power supply.





Bill Miles talks frankly about the technicians' biggest problem

2 years ago, degreeless Bill Miles had reached a blind alley in his career. Yet today, with IBM, he's actually supervising engineers in America's biggest electronics project. Here's how this technician broke through the "education barrier."

"*Training* and *local assignments*," recalls Bill Miles, "were what caught my eye when I saw an IBM ad in 1955. So I investigated. Now here I am with an advanced electronics education under my belt—and responsibility as a Group Supervisor in Project Sage. I work on the world's largest and most advanced computer. I live in my home town. And my future in the company is what I make it. Yet only 2 years ago, I thought I'd gone as far as a technician ever could!"

Becomes radar technician

Bill's background is typical of thousands of capable, ambitious technicians who never acquired a formal engineering degree. His interest in electronics, aroused in Camden, New Jersey, high school, was nourished by a 3-year stint as Aviation Radar Technician in the Navy's "Black Cat" air-sea rescue squadron.

Takes night courses

Discharged in 1946, Bill married a girl he'd known in high school. During the next 9 years, Bill was teacher in a radio-TV institute, TV service man, TV company technician, and chief supervisory TV technician. All the while he pursued an engineering education at night. But growing family responsibilities made it more and more difficult.

Finds doors barred

However, feeling he was equipped for greater responsibility, Bill, now 30, investigated several companies but found that, while they liked his abilities, his lack of degree barred the door to any significant future advancement.

Enters IBM school

In May 1955, when he moved his family to Kingston, New York, and started at IBM, Bill wasn't quite sure what to expect. The 9-month training course—valued at many thousands of dollars per man—had been the big magnet for him. He hoped the future would match his expectations.

Meets head of school

"Sixty of us started school at IBM, attending class 8 hours a day. The course consisted of about 20 subjects, mostly dealing with computer circuits and units, and maintenance techniques. The teaching was adult, superb. After the first 20 weeks, we received a living expense allowance, over and above salary. We kept our own grades, and every 6 weeks when we reviewed them with the instructors, *they* asked *us* for ways to improve the course. I expected a casual 'hello' when I met the Division Manager of Education, but he talked to me for an hour about myself and my interests. The real concern IBM has for you as an individual, both before and after they hire you, is undoubtedly one reason why we all began to take a lot of pride in this outfit."

Joins home-town computer site

Bill had joined IBM as a Field Systems Engineer. After graduation, when 10 of his classmates were immediately promoted to specialized assignments, Bill was assigned to a computer site near his home in Mt. Holly, New Jersey, with IBM paying his moving expenses. For the first two months he helped install the SAGE computer, an important link in America's air defense. Ultimately, such computers will ring America's entire air defense perimeter. Looking back, Bill notes, "I'll admit the work was laborious and difficult, but still I have a sense of great accomplishment. Together we all helped create something of value from almost nothing."

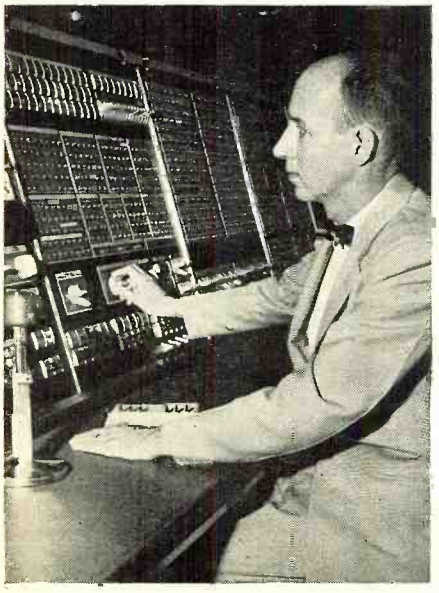
World's largest computer

"The computer is probably the largest one in the world, with over a million components. Flattened out, it would probably fill a ball field. The computer analyzes radar data on every object in the sky. Then it checks each object against available traffic information and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against what it thinks is a 'baddie.' Only airmen can make that decision."

Bill gets electronic computer education at IBM Kingston

Supervises fifteen

Recently promoted to Group Supervisor, Bill now directs an entire shift of 15 men, reporting to a Group Manager. His job: to maintain the computer in combat readiness. "I have to be familiar with the entire system. I rely on two types of specialists to help me: computer units men who are specialists in certain areas; systems engineers for the over-all computer."



Miles does diagnostic programming on the Operating Console of the Sage Computer

Miles nails down problem with Site Manager R. Schimmel

Buys house, car

Bill has bought a 7-room house in Mt. Holly. When not busy with his son and twin daughters, he likes to bowl. He drives a new automobile. He's enjoying the good life, and expects it to get even better. His employee benefits alone represent a cash value of many hundred dollars a year. He expects the IBM-sponsored General Education Program will prepare him for higher management responsibilities. Later, Bill's manager said, "He's currently assuming the responsibilities of an electrical engineer."

But the question remains: Is Bill really an engineer?

The "professional" engineer

"No, I certainly don't consider myself a 'professional' engineer, qualified to design machines, for instance. But the point is, I'm doing work ordinarily done by engineers . . . work usually denied to men without a degree."

IBM upgrades technicians

Could he do this elsewhere? "Of all the companies I know, IBM appears to be one of the few upgrading the technician to the level of engineering responsibility. Fortunately for me, IBM had the imagination to get men without degrees and encourage them to rise in responsibility and income to the level of their native talents . . . not what their formal education dictates."

"Student" Bill Miles diagrams computer circuit

Both titles gain

Is this a sign that the educational system is wrong? "Not at all," answers Bill Miles. "A Doctor's, a Master's, a B.S. degree stand for something and always will. But if a technician can perform many jobs that traditionally belong to the engineer, they both stand to gain. The technician, because he gets much of the engineer's salary, satisfaction and recognition; the engineer, because he is free to do work which *only* a man with his formal training can do. When everybody wins, and nobody loses, it's the sign of a good thing."

Since Bill Miles joined IBM, opportunities in the Project Sage program, destined for long-range national importance, have grown more promising than ever. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, as a Computer *Systems Engineer*. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training, as a Computer *Units Field Engineer*, with opportunity to assume full engineering responsibility. Assignment in area of your choice. Every channel of advancement in entire company open—and IBM is leader in a field that's sky-rocketing in growth. All the customary benefits and more. WRITE to Nelson O. Heyer, Room No. 4305, IBM, Kingston, New York. You'll receive a prompt reply.

Home-town assignment pleased Miles' wife, son, twin girls

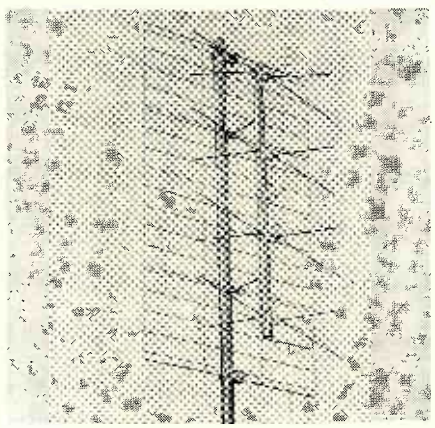
Antenna News

BACK-OF-SET ANTENNA

JFD Electronics, Inc., 6101 16th Ave., Brooklyn, N. Y., has designed an indoor antenna that can work efficiently while almost completely out of sight. The "Magic Genie" mounts in back of the set with only its 3-inch high, 12-position selector knob protruding above the receiver, when the dipole elements are fully collapsed into the body. In this position, the elements, although they point downward, are still operative. A coiled impedance - matching stub, which is in the form of a printed circuit, is also concealed in the case behind the set. The selector chooses different resonance combinations for optimum matching on various channels. The elements, when fully extended, may be oriented in any direction, as they are mounted on swivel ball joints. The antenna is available in a housing of honey blonde, Indian ebony, swirl mahogany, or cherry red.

U.H.F. TRANSLATOR ANTENNA

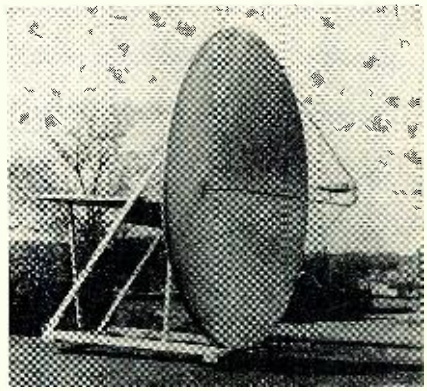
Clear Beam Antenna Corp., Canoga Park, Calif., is offering an antenna especially designed for reception of translator channels. The "Kat's Whisker," Model KW4S, provides peak performance up to 18 db on channels 70 through 83. The broad vertical capture area cuts installation time by reducing the need for pin-point probing.



The 4-bay, vertical arrangement also assures proper placement regardless of shifts in wavefront layer caused by atmospheric or weather conditions. The screen reflector reduces ghosting and improves the front-to-back ratio; it is made of cadmium-plated spot-welded steel rod. The unit is shipped fully assembled.

MICROWAVE ANTENNA

Diamond Antenna and Microwave Corp., 7 North Ave., Wakefield, Mass., is manufacturing a high-gain, broadband, variable-polarization antenna for use at microwave frequencies. It uses a close-tolerance, aluminum, parabolic reflector, 6 feet in diameter, and a "question-mark" rectangular wave-guide feed with a weatherized conical horn. A remotely controlled ferrite transducer located between the feed and the horn is used to rotate the plane of polarization of the transmitted wave. Operating frequency is 16,000 mc., and gain is greater than 45 db. The antenna also features extremely narrow bandwidth and low standing-wave ratio.

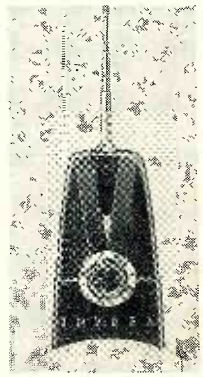


"EARS" FOR EARTH SATELLITE

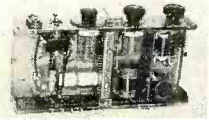
Technical Appliance Corp., Sherburne, N. Y., is now in the process of manufacturing and delivering 74 "Minitrack" antennas to the Office of Naval Research. The design is to be used in "Operation Vanguard" to track the course of earth satellites. Used in arrays of eight, each of these units is only 3 feet tall. Installations will be in this country and in other parts of the world.

ONE-ELEMENT INDOOR ANTENNA

Snyder Manufacturing Co., Philadelphia, Penna., has announced the "Imperial Directronic 10-D," a decorative antenna with heavy base for use on top of the TV receiver. It features a single 4-section extendable staff, finished in gold tone, and a 12-position selector switch for matching to different channels. The swivel-mounted staff can be tilted and rotated in any direction. The antenna is available in a choice of three colors for the base: walnut, blonde, and ebony. All feature gold trim. A 10-day money-back guarantee is being backed up by *Lloyds of London.* —30—



25—40 Watt Transmitter FOUNDATION UNIT



Plug-In Oscillator Unit as used in BC-610 Transmitter. Ideally suited for Trans. Foundation. Contains variable Cond., 1/140 MMFD. 2/100 MMFD. Fixed Cond., Coils, Crystal Holder, Switch, Knob, etc. TU-48 2.5—3.2 MC; TU-49 3.2—4 MC. Circuit Diagram included on each Unit.
PRICES: Two for $5.00.....EACH: **$2.95**

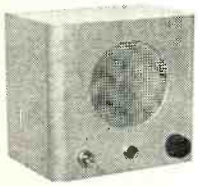
DYNAMOTORS & GENERATORS:

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW:
12 VDC	220	80	DM-34	$2.95	$ 4.95
12	225	100	D-402	5.95	8.95
12	625	225	DM-35	9.95	
12	230	90	PE-133	4.95	6.95
12	540	450	DA-12		14.95
12	230	100	DA-14		8.95
14	220	70	DM-24	4.95	7.95
14	1030	260			
	515	215	DM-42	4.95	9.95
14	425	163	WE-377	5.95	
14 VDC	330	150	BD-87	3.95	5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	
14	230	90	DM-21	6.95	
24	250	60	DM-32	2.95	5.95
12	250	60	12V/DM-32		4.95
24	250	60	PE-86		8.95
28	1000	350	PE-73	8.95	

12 to 24 VDC PM Dynamotor—Supplies 24 VDC 2 A. from 12 VDC, also 500 V 50 MA. @ 6 VDC will supply 12 VDC & 250 V 50 MA.
#0515.....New: **$4.95**

100—156 MC TRANSMITTER & RECEIVER—SCR-522 TRANS. &

RECEIVER: 100—156 MC, 4 Channel, Crystal Control, AM Voice Operation. 18 Tubes—Trans.: 2/832, 3/12A6, 1/6SS7, 1/6G6—Rec.: 1/9002, 1/9003, 3/12A6, 2/12AH7, 1/12C6, 1/12H6, & 3/12SG7. Complete with Tubes, Schematic, and Conversion Info. for amateur use—Good Cond. **$34.95**
REC.—Chassis Only, w/Tubes $19.95 without.....$9.95
TRANS.—Chas. Only, w/Tubes $22.50 without....$9.95
SCHEMATIC and Conversion Info. Only.....$2.50



POWER SUPPLY 110 V. For Army/Navy COMM. RECEIVERS

Eliminates set conversion. For use w/BC-453-454-455-946 or any sets requiring 24 V. @ 1 A. & 250 V. @ 50 MA. Ready to use: has 4" speaker, volume control, CW and on-off switches. Complete with cord and plug f/rec.
Price....NEW: **$18.95**

TA-12B BENDIX TRANSMITTER

Frequency 300-600 KC and 3000 to 7000 CW & MCW 100 Watt. Four separate oscillators easily converted to cover 20-40-80 Meters by using crystal for 10 Meter Band. Selector channel switch changes ECO, IPA, and Output Tanks at one time. All controls mounted on front panel. Uses 3/807, 4/12SK7; also has output Meter. Size: 15⅛" x 10¼" x 6¾". Complete with Tubes, Plug and Cable...Used: **$32.95**
For Conversion—See Surplus Manual #2—Price: $2.50

RA-10 BENDIX RECEIVER

150-1100 KC and 2-10 MC. Excellent for range and marine use. 7 Tubes: 3/6SK7. 1/6K7, 1/6C5, 1/6K6G, 1/6K8. Complete with Dynamotor. MR-9 Control Box, Plugs, Remote Tuning shaft. Size: 10" x 8½" x 17".
RA-10 DA—24 Volt 150-1100 KC & 2-10 MC. Used $34.95
RA-10 CA—12 Volt 150-1100 KC & 2-10 MC. U: $39.95
RA-10 FA—24 Volt 150-400 KC & 2-10 MC. U: 29.95
Surplus Conversion Manual—#1 or #2....Ea.: 2.50
For List of contents in each Manual, send 3c stamp.

SCR-625 Army MINE DETECTOR

• For Prospectors, Miners, Oil Companies, Plumbers, etc. An ideal portable unit for locating all types of buried metal objects up to 24" or more, depending on size and ground condition. Detection by means of a tone. Packed in a chest. Operating weight approx. 15 lb. Shipping wt. approx. 40 lbs.
Complete with batteries..... **$39.95**

COAXIAL CABLE & CONNECTORS

CD-1071 CORD—With PL-259 Plugs each end. 50 ohm coax 2 Ft. long. Prices: 59¢ Each—Or in Lots of 10 @ 50¢ Ea.
PL-259—Plug. Ea. End & 32"—RG-54/U—58 ohm.50¢
SO-239 Chassis Conn. f/PL-259 (Removed)..3 for $1.00
UG-21/U—Plug ea. end & 32"—RG-11/U—75 ohm.50¢
UG-22/U—With 4" Coaxial Cable.....50¢

WRITE US YOUR REQUIREMENTS:
Whatever your needs in Generators, Blowers, Inverters, Motors, etc.—write us. Chances are we have it!

RT-19/ARC-4 REC.-TRANS.

144 to 148 MC RECEIVER-TRANSMITTER—Easily converted to 2 meters. Uses 2/6AC7, 3/12SJ7, 2/12SQ7, 2/12A6, 4/6N7, 2/6V6, 2/1614, 1/832, & 2/6L6 tubes. Conversion does not require all the tubes to be used. Power required 350 VDC & 12 VDC. Price—Less tubes and Dynamotor—with Schematic and conversion information **$12.95**

SELSYNS—115 V 60 CYCLE

115 Volts 60 cycle Synchronous TRANS. Can be used to turn small Bean Antenna and as Indicator. Size: 5" x 3½"—#C-78414. (Removed from New Equipment).....PAIR **$7.95**

ANTENNA EQUIPMENT

MAST BASES—INSULATED

MP-22 BASE — (Illustrated) Ins. spring action; direction of bracket can be raised or lowered easily. Wt. 9 lbs. **$2.95**
MP-22A—Same as above, except takes smaller MS-51 section **$2.95**
MP-33—Insulated type w/heavy coil spring and 5" dia. Ins. Requires 2" hole for mounting Wt. 8½ lbs. **$5.95**
MP-37—Heavy coil spring with 8" Ins. 2" mounting hole req. Wt. 10½ lbs. **$5.95**
MP-48—Insulated type with heavy coil spring. Needs 1¾" mtg. hole. Wt. 11¾ lbs..... **$4.95**

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, copper coated painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section.....@ 50¢ Each
Larger Diameter Section: MS-54.....75c
WHIP ANTENNAS—5 Ft. w/Rigid Base $1.50—6 Ft. No Base $1.50—10 Ft. Throw Out $1.50—94" Telescoping $1.00—18 Ft. 3 Sections, Telescoping $5.95—20" Telescoping (Chrome) 50c.

100 Watt BC-375 TRANSMITTER

BC-375 100 Watt TRANSMITTER—Voice CW—Freq. 200—500 KC., 1500—12500 KC. by use of Plug in Tuning Units. Uses 1/10y & 4/VT-4C Tubes. Size: 23" L. x 21" H. x 8" W. Complete with Tubes, less Tuning Units.....USED: **$29.95**

TUNING UNITS For BC-375 & BC-191:

	NEW:	USED:
TU-5: 1.5 to 3 MC.	$4.95	$3.95
TU-6: 3 to 4.5 MC.		3.95
TU-7: 4.5 to 6.2 MC.	3.95	2.95
TU-8: 6.2 to 7.7 MC.	3.95	2.95
TU-9: 7.7 to 10 MC.	3.95	2.95
TU-10: 10 to 12.5 MC.	3.95	2.95
TU-26: 200—500 KC.	3.95	2.95
BC-306: Antenna Tuner	3.95	2.95
CABLES: PL-64-61 or 59 Each End.....Each:		2.75

ANTENNA MATCHER—

Variable Inductance Tuner, 100 Watt Cap— From BC-375—No Dial.....USED: **$5.95**

METERS:

DC AMMETER HOYT—

In portable metal case, with Test Leads, 4½", Fan Mirrored Scale 0-15 ADC... **$3.95**
DB METER—10 to Plus 6—Westinghouse 3", NC-35 Imp. 600 ohms @ 1000 cycle.... **$4.95**
0-3 RF AMMETER IS-128: 2½" Rd.....NEW: 2.95
0-8 Amp RF w/Thermocouple IS-89; 2½" Rd... 4.95
0-15 AC-DC—2½" Rd.; IS-122..... 4.95
0-500 MA DC—2½" Rd.; IS-22..... 4.95

TELEPHONE CONTROL EQUIPMENT

CONTROL UNIT RM-53—Used to operate radio equipment and provide remote control and intercom. of such equipment by use of the RM-52 Unit listed below. Up to ½ mile, uses 2 flashlight batt. Internal transformer has High-Low impedance Sw. and Sidetone. Also Mic. & Phone Jack & PL-55 & PL-68 Plugs.
USED: **$3.95** NEW: **$5.95**
REMOTE CONTROL RM-52—Can be used with RM-53 or used as a separate telephone system. Up to ½ mile. Uses 4 flashlight batt. Also can be used as a direct remote control for radio equipment. Provides bias for Mic. & Sidetone to headset. High or Low Imp. Also Mic. & Phone Jacks.
USED: **$2.95** NEW: **$4.95**
TS-13 HANDSET for RM-53 or RM-52....Used: $3.95

EE-8 FIELD TELEPHONE

Ideal for private telephone system for two or more phones, up to 17 miles. Hand ringer, generator with handset, carrying case. Uses 2 flashlight batteries. **$14.95**
USED—Checked .....
WIRE—Weatherproof Twisted Pair: 500 ft. $4.75—1350 ft. $10.00—2500 ft. $19.95. Per Foot at 1½¢.
COMBAT WIRE—Rubber covered W-130..$.01 per Ft.

FM RECEIVER—30 to 50 MC

• Government Surplus RECEIVER, converted to receive 30 to 50 MC FM. Continuous tuning and Push Button tuning on 10 Pre-set channels. With 10 Tubes, Speaker, Phone Jacks, Squelch Circuit, etc. Size: 11½" H x 6¾" W x 12½" D. Power required 220 VDC 80 MA and 12 or 24 VDC. Stock No. 3050. Used—Checked. **$34.95**
DYNAMOTOR—12 V for above: New: $4.95—Used: $2.95
AC POWER SUPPLY for the above.....$19.95

TRANSFORMERS and CHOKES

115 V. 60 CYCLE PRI. TRANS.:

600 VCT/100 MA—6.3 V/5 A.; 5 V/3 A. $4.95
240 VCT/35 MA—24 V/.9A; 6.3 V/.6 A; 6.3 V/.3 A 1.75
1500 VCT/260 MA—6.5 V/3 A.—6.5 V/5 A.—5 V/4.5 A. 9.95
700 VCT/150 MA—5 V/3 A.; 6.3 V/4.5 A. CSD.. 3.95
1890 V/12.6 MA—Tapped 2.5 V 2 A. 5.95
1100 V/80 MA—7.5 VCT/3.25 A. 5.95
662 VCT/110 MA—6.3 V/2 A—5V/2 A. 3.95
16 Volt 35 Amp. 115/230....$14.95; 24V—1 Amp 1.50
9 Volt CT—35 Amp.—Tapped 4.5 V. 7.95
12 Volt—Two separate windings—4 amp each.... 5.95
5 V/2 A.; 5 V/2 A.; 5 V/2 A.; 5 V/6 A. 2.95
312 VCT/70 MA.; 6.3 V/2.1 A & 5 V/3 A. 1.75
600-0-600 VAC—200 MA. 12.5 V. 2 A.; 12.5 V. @ 2 A.; 5 V. @ 3 A.—#H-108—Price..... 8.95
250-0-250 VAC—50 MA, 24 V. 1 A.; and 6.3 V. 1 A.—#H-109—Price 4.95

Choke—12.5 Hy/100 MA.....$1.95
Choke—8 Hy/150 MA—200 Ohm—Open Frame.... 1.25
Choke—5 Hy/150 MA—85 Ohm..... 1.50
Choke—10 Hy/250 MA—2⅜" x 2" x 3" Potted.... 4.95
Choke—5 Hy/400 MA—4½" x 4" x 5⅝"..... 4.95

COMMAND EQUIPMENT

	USED:	NEW:
550 to 1500 REC., Navy	$14.95	$19.95
1.5 to 3 MC. REC., Navy	7.95	
3 to 6 MC. REC.—BC-454	7.95	
6 to 9 MC. REC.—BC-455	7.95	
2.1 to 3 MC. TRANS., Navy	7.95	9.95
3 to 4 MC. TRANS., Navy	5.95	
4 to 5.3 MC. TRANS.—BC-457	4.95	
5.3 to 7 MC. TRANS.—BC-458	4.95	
7 to 9 MC. TRANS.—Navy		7.95
100 to 156 MC. TRANS.—T-23	14.95	

MICROPHONES & HEADSETS

F-1 BUTTON CARBON MIC.—(Pictured at left) High Gain—Can be used on desk, car, hand, or strapped to chest. Complete with on-off Mom. Switch .....NEW: **$1.95**
RS-38 CARBON MIC. with PL-68 Plug .....U: $2.50
T-17 Microphone .....U: $4.50
HS-30 HEADSET—Hearing Aid Type .....U: $1.50
TS-9 HANDSET—Push to talk Sw. No plugs. U: $2.95—N: $4.95
TS-13 HANDSET—Push to talk Sw. w/PL-68 & PL-55. U: $3.95—N: $5.95

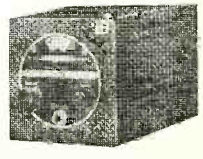
PE-110 AC POWER SUPPLY

115 Volt 60 cycle Power Supply for BC-669 Rec.-Trans. Complete with Tubes, 25 ft. AC Power Cord, Spare Tubes, Vibrator, Capacitor, Fuses. Housed in wood chest. Brand New..... **$59.50**
PE-110—USED, Not in Chest..... **$34.50**
CD-515 CORD for BC-669.....$2.75
RM-21 CONTROL BOX for BC-669..... 4.95

BC-1158 TRANS. & MODULATOR:

Frequency coverage 53.3 to 95 MC. 50 Watt. RF Doubler, Amplifier and Modulator Sections, using 4/815 and 10/12SN7 Tubes. Can be converted to 2-6-10- or 20 Meters. Complete with Tubes, Meter, Blower, etc. .....NEW: **$39.95** Used: **$29.95**

NOW—OPERATE BEACON RECEIVER FROM 12 VOLT



BC-1206CM BEACON RECEIVER: 200-400 KC. 5 Tubes, 135 KC IF, operates from 24 VDC— **$9.95**
New .....
Used $5.95
For 12 Volt operation, use this PM DYNAMOTOR—12 VDC input, output 24 VDC. Size: 2½" x 4" x 7" Dyn. ....Only **$4.95**
AC POWER SUPPLY—To operate BC-1206 from 110 Volt 60 cycle. Complete with Speaker, etc., in same type cabinet as illustrated at top of this column—Price **$18.95**

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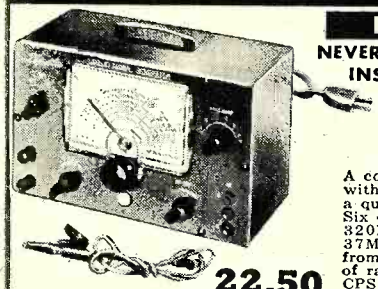
LAFAYETTE SENSATIONAL VALUES! IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!

LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY



22.50

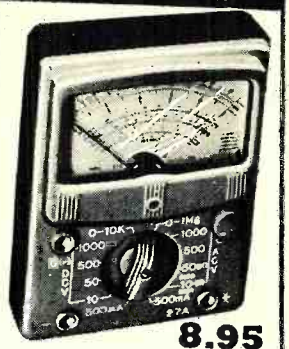
A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR **22.50**

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH



8.95

FULL SCALE RANGES

DC Volts: 0-10; 0-50; 0-500; 0-1000 Volts — *AC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:* 500 ua and 500 ma — *Resistance:* 0-10K; 0-1 Meg — *Decibels:* —20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:* 250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:* 0-10; 0-50; 0-500; 0-1000 volts

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete **8.95**

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

34.50

- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001 -.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¼"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET **34.50**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER

19.95

LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — A.C. VOLTS: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — RESISTANCE: 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—D.C. CURRENT: 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — DECIBEL: —20 to +17 db (0 db—0.774V) — CAPACITY: .0001-.01; .005-.15 mfd — INDUCTANCE: 20-2000 millihenry —OUTPUT RANGES: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each **19.95**
In lots of 3, Each **19.25**

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

21.50

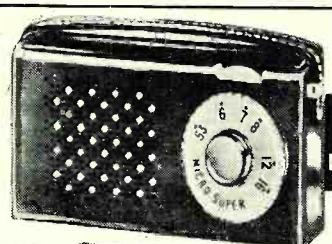
COMPLETELY WIRED AND TESTED

- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET **21.50**

BUILD A 6 TRANSISTOR SUPERHET RECEIVER



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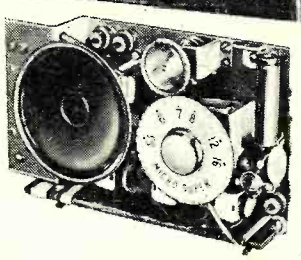

33.50

Superb Performance! Incomparable Value!

Transistor-wise Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. An outstanding achievement of constant research and design, this kit represents the optimum in sensitivity, selectivity and stability. You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit, using 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode, features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2¾" speaker for exemplary reproduction, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 6" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case ..... Net **33.50**

MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119. 6" x 3½" x 1½". Shpg. wt., 1 lb. ..... Net **2.95**

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PK-100A TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100-A ..... Net **49.50**

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2½ lbs.

PK-90 ..... Net **15.95**

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output; **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V, 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 kit, less cage ..... Net **34.95**

ML-100—Metal cage for above, shpg. wt., 3 lbs. ..... Net **5.00**

3 WAY HI-FI SPEAKER SYSTEM

- 15" Woofer with 31.5 oz Magnet
- 8" Mid-range speaker
- Acoustical Lens Tweeter
- 3-Way Crossover Network

A complete 3-way system capable of performance heretofore found only in systems at many times this price. The components were specially selected by Lafayette sound engineers to offer the maximum in audio fidelity at the lowest price possible. Includes continuously variable presence and brilliance controls. Offers superb reproduction across the entire audio spectrum. Shpg. wt., 25 lbs.

SY93 ..... Net **55.50**

HW-7 Hi-Fi Tweeter w/Acoustic Lens **14.95**
LN-3 3-way Crossover Network with Controls **14.95**
LN-2 2-Way Crossover Network with Control **8.75**

LAFAYETTE MATCHED HIGH FIDELITY PHONO SYSTEM

Nothing Finer At This Price

NEVER—in the annals of **HIGH-FIDELITY** has a phono system of this quality—at this price—been offered. A Lafayette "best buy" system designed around the new Lafayette **LA-59** amplifier. The performance of this Phono system surpasses the most critical requirements of music lovers. Twenty-four combinations of record equalization provide an almost endless variety of tone compensation to match varying recording characteristics. This system includes the famous **Garrard RC-121 "Renown" 4 speed automatic and manual record changer, LAFAYETTE LA-59 18 watt amplifier** with features found only in the most expensive amplifiers. G.E. triple-play—turnover cartridges with **genuine G.E. DIAMOND SAPPHIRE STYLI,** AND **LAFAYETTE SK-58 12" coaxial HI-FI speaker.** All units are supplied with plugs, jacks and prepared color-coded interconnecting cables for quick easy installation. For 110-125 volt, 60 cycle AC. Shpg. wt. 50 lbs

HF-154—Complete Phono System ..... Net **119.50**

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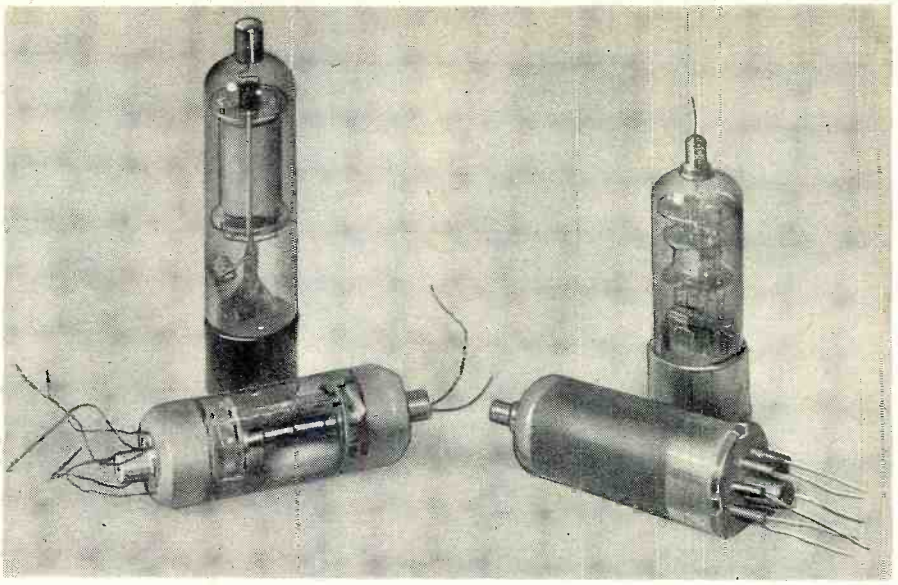


Final designs and early models (rear) of the 175HQ (left) used in the long Newfoundland-Scotland section and the 6P12 used in the Nova Scotia-Newfoundland section.

20-Year Tubes For Transatlantic Cable

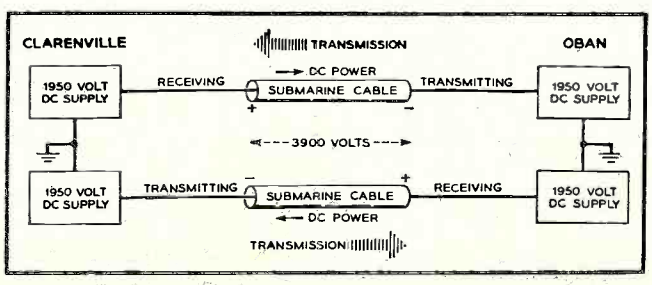
Must operate reliably and unattended on ocean floor.

THE NEW transatlantic telephone cable system depends on the use of hundreds of specially designed very long life vacuum tubes housed in built-in repeaters in the cables lying on the ocean bottom. Repeaters are installed at intervals of about 40 miles in each of the pair of 2000-nautical-mile-long deep-sea cables between Newfoundland and Scotland. Each of the 102 repeaters is a 3-tube circuit used to overcome the attenuation of the cable and to equalize its nonlinear frequency response.

Two main types of tubes are in operation. One, the 6P12, was developed by the British Post Office for use in the shallow-water portion of the system between Newfoundland and Nova Scotia. The other, the 175HQ, was developed at *Bell Telephone Laboratories*, for use in the deep-sea portion of the system between Newfoundland and Scotland.

The deep-sea tube was designed to function at the lowest practical operating cathode temperature. The plate and screen voltages were reduced to the lowest values consistent with good circuit performance. In addition, electrode spacings were made large. The heaters of the tubes, requiring 225 ma. d.c., are connected in series while the plate and screen voltages for any one repeater are obtained from the voltage drop (about 55 volts) across the heaters in that particular repeater. Hence, the power supply problem is one of feeding a steady current of 225 ma. into the cable. The tube heaters for each cable require roughly 2800 volts, and the drop in the cable itself brings the needed voltage to 3900 volts d.c. To minimize dielectric stresses, a double-ended series-aiding power feed is used as shown below.

Tubes essentially like those used have been on life test for about 17 years with no failure and there is reasonable probability that these tubes will operate without failure for at least 20 years. —30—



Block diagram showing voltage requirements for the Clarenville, Newfoundland and the Oban, Scotland terminals of new transatlantic telephone cable.

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1J6GT .46	5Y3 .38	6CB6 .50	7B6 .41	12SQ7 .39			
1L4 .45	5Y4G .42	6CD6G 1.17	7B7 .42	12V6GT .44			
1L6 .54	5Z3 .44	6CU6 .79	7B8 .46	12W6 .59			
1LA4 .55	6A7 .56	6D6 .47	7C4 .40	12X4 .36			
1LA6 .46	6A8 .46	6E5 .43	7C5 .41	14A7 .44			
1LB4 .58	6AB4 .44	6F5 .36	7C6 .42	14B6 .44			
1LC5 .48	6AC7 .66	6F6 .37	7C7 .44	14Q7 .44			
1LC6 .46	6AF4 .75	6H6 .37	7E5 .44	19T8 .69			
1LD5 .56	6AG5 .49	6J4 1.59	7E6 .44	19BG6G 1.17			
1LE3 .56	6AG7 .68	6J5 .38	7E7 .48	25BQ6GT .84			
1LH4 .63	6AH4G2 .69	6J6 .48	7F7 .58	25CA5 .79			
1LN5 .46	6AH6 .70	6K6GT .38	7F8 .65	25CD6 1.29			
1N5GT .49	6AK5 .53	6K7 .38	7G7 .74	25CU6 .99			
1R5 .50	6AL5 .41	6L6 .67	7N7 .57	25L6GT .46			
1S5 .45	6AM8 .79	6N7 .59	7Q7 .58	25W4GT .42			
1T4 .50	6AN8 .79	6Q7 .39	7X7 .64	25Z6 .36			
1U4 .46	6AQ5 .45	6S4 .39	7Y4 .34	27 .24			
1U5 .45	6AS5 .47	6S8GT .70	7Z4 .39	35B5 .47			
1V2 .70	6AS7G 2.25	6SA7 .47	12A4 .59	35C5 .47			
1X2 .66	6AT6 .38	6SB7Y .75	12A6 .40	35L6GT .46			
2A3 .49	6AT8 .79	6SC7 .47	12AB5 .59	35W4 .38			
2A7 .54	6AU4GT .64	6SG7 .40	12AQ5 .49	35Y4 .38			
2D21 .95	6AU5GT .60	6SH7 .42	12AT6 .40	35Z3 .40			
3A4 .50	6AU6 .42	6SJ7 .42	12AT7 .65	35Z5GT .38			
3A5 .50	6AU8 .79	6SK7 .49	12AU6 .42	39/44 .25			
3AL5 .52	6AV5GT .64	6SL7GT .56	12AU7 .58	50A5 .47			
3AU6 .52	6AV6 .38	6SN7GT .56	12AV6 .41	50B5 .47			
3BZ6 .57	6AW8 .89	6SQ7 .40	12AV7 .66	50C5 .47			
3BC5 .57	6AX4GT .65	6SS7 .40	12AX4GT .64	50L6GT .44			
3BN6 .57	6AX5GT .56	6T4 .85	12AX7 .62	80 .39			
3CB6 .57	6BA6 .46	6T8 .67	12AZ7 .62	84/6Z4 .45			
3Q4 .55	6BC5 .49	6U5 .54	12B4 .67	117L7GT 1.25			
3Q5GT .56	6BC8 .89	6U8 .79	12BA6 .45	117N7GT 1.25			
354 .46	6BD5GT .52	6V3 .79	12BA7 .59	117P7GT 1.25			
3V4 .55	6BE6 .45	6V6GT .45	12BE6 .45	117Z3 .36			
4BQ7 .75	6BF5 .39	6W4GT .39	12BH7 .59	117Z6GT .61			
4BZ7 .75	6BG6G 1.17	6W6GT .52	12BY7 .63				
5AM8 .79	6BH6 .50	6X4 .38	12CA5 .59				
5AN8 .79	6BJ6 .46	6X5 .38	12CU6 .79				
5A95 .49	6BK5 .67	6X8 .74	12DQ6 .79				

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New G-E Color Circuits

(Continued from page 67)

for the entire color-sync restoration. Since, during monochrome telecasts, no color-sync burst is available to excite the crystal, there can be no 3.58-mc. signal and therefore no output of the color demodulators. This means that a color-killer circuit is not necessary. Further, there can be no oscillator drift, no defective reactance tubes, and no unbalanced phase detector. These and other ills to which conventional color-sync circuits are subject have thus been eliminated. By simple adjustment of the few tuned circuits, many color-sync difficulties are avoided.

Color Demodulator

Like most color sets, the *G-E* receivers use color-difference decoding rather than the *"I"* and *"Q"* system; but, unlike other sets, the new *G-E* circuit uses a dual-diode as demodulator, followed by a triode amplifier. The 6BV8 shown in Fig. 5 contains two diodes and a triode in one envelope, and two of these tube sections perform the red- and blue-difference decoding. The third (triode) section is used to matrix the green-difference signal from the other two.

The simplified circuit diagram of Fig. 5 shows that the color-sync signal is applied across a center-tapped, tuned circuit, and then to one cathode and one plate respectively of the dual diode. The opposite plate and cathode are connected together and driven by the 3.58-mc. color subcarrier and its sidebands. A low-level *R-Y* video signal is obtained at the center of the load circuit as shown. This circuit is first adjusted to obtain the correct *R-Y* signal by setting the *R-Y* balance control, R_3. Then the *R-Y* gain control, R_5, is set to produce correct *R-Y* amplitude at the plate of the triode section. The red-grid control determines the d.c. bias on the red grid of the color-picture tube, and therefore sets the level about which that electron gun will operate. Detailed adjustment of these three controls requires the use of a color-bar generator and carefully measured video amplitudes. The chroma gain control, R_1, at the front of the receiver, determines the driving voltage to both the red and blue decoders. It is used to set the over-all chroma amplitude.

For the service technician, the color-demodulator circuit presents more work than the high- or medium-level triode demodulators featured in other sets, but ample test points and detailed instructions are available to help in this procedure. Ordinarily, these controls will only require adjustments after major repairs have been made in the color-demodulator section.

Other Circuit Features

Although used in some recent monochrome receivers, the dual-selenium rectifier circuit found in the horizontal phase detector of the *G-E* color sets

represents its first application in a color circuit. Together with the selenium diodes, the horizontal oscillator uses a pentode reactance tube controlling a triode oscillator and another triode discharge tube. The flyback and h.v. circuit does not contain any unusual features except for a dual-potentiometer focus control and the corona-discharge type of h.v. regulator already mentioned.

One other circuit which may be unfamiliar to some is the vertical oscillator. Here only a simple integrating network is required to synchronize the blocking oscillator. This latter circuit uses a tapped coil which is connected between grid and cathode in the manner of a cathode-coupled Hartley oscillator. Sync pulses are applied to the cathode. To obtain a saw-tooth driving signal for the output tube, a special discharge network is inserted at the plate of the vertical oscillator triode.

The *G-E* color sets use a three-stage i.f. strip, intercarrier sound, and the by-now-familiar convergence system. All circuits other than the power, vertical, and horizontal sweeps and h.v. supply are contained on a printed-wiring board. Available on this board are a total of twelve separate test points, numbered and indentifiable from the circuit diagram. To the service technician the *G-E* color sets will mean more opportunities for color installation and service work on a receiver that has some interesting and challenging differences as compared to other color sets. Technical data and servicing material are available from the *G-E* service department. —30—

SIGNAL CORPS' JOBS OPEN

THE Signal Corps, Department of the Army, has recently released a listing covering a variety of interesting and challenging overseas assignments for those with radio, electronic, and electrical training.

Among the vacancies for which applicants are to be interviewed are: Electronic engineer (Grade GS-855-11) in Verdun, France at $6390 plus allowances; supervisory electronic engineer for wire communications (Grade GS-855-12) in Japan at $7570 plus quarters allowances; equipment specialist with 7 years' experience in the maintenance and operation of radio, radar, electronic instruments, photographic equipment (Grade GS-1670-12) in Japan at $7570 plus quarters allowances; supervisory electronic engineer for radio (Grade GS-855-9) in Japan at $5440 with quarters allowances; equipment specialist on signal items (Grade GS-1670-9) in Korea at $5440 plus overseas differential and quarters allowances; etc. Posts in France, Alaska, Japan, Korea, and Okinawa as well as a few stateside jobs are included in this new call.

For further information on any of the openings, plus all details on experience required and duties, contact the Office of the Chief Signal Officer, Civilian Personnel Branch, Room 2C200, The Pentagon, Washington 25, D. C. Information is available by phone by calling Albert G. Crosetto, Liberty 5-6700, Extension 52525 or Code 131, Extension 52525 in Washington. —30—

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20-WATT AMPLIFIER $24.95

Model HF-21

$24.95

Push-Pull 6L6 Output Tubes
Response 30-15,000 cps
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V. R. Phono

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20-watts power output. Use with any 8-ohm speaker. Chassis size 7¾" x 10½" x 7⅛" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use High Fidelity amplifier at less than the cost of a kit. Ship. wt. 19 lbs. Model HF-21, 20-watt Hi-Fi amplifier. Sale price $24.95.

12" COAXIAL PM SPEAKER RESPONSE 25-17,000 CPS

$9.95

Model 12X3Y, new 1957 12" Coaxial PM Speaker, has high efficiency 12" woofer with Alnico V magnet and coaxially suspended 3½" Alnico V tweeter. Built-in crossover with variable brilliance control on an 18" lead for remote control of the tweeter volume. 10-watts, response 25 to 17,000 cps. Ship. wt. 7 lbs. Stock No. 12X3Y, 12" coaxial PM Speaker. Sale Price $9.95.

TREMENDOUS McGEE VALUE
NEW 1957 HI-FI SPEAKER SYSTEMS
ON BAFFLE BOARDS

Model B-125-X, high fidelity 20-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" Jensen woofer, 2—4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in LC crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-125-X, 5-way, 20-watt Hi-Fi speaker system. AUDIOPHILE VALUE $30.00. SALE PRICE $18.95.

SALE PRICE $18.95

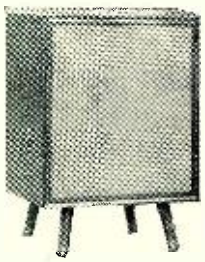
Model B-347, high fidelity 30-watt, 5-way speaker system, mounted on an 30" x 24" baffle board. Has 15" UTAH 21½-oz. woofer, 2-new high fidelity extended range 6 x 9" speakers, plus 2-5" tweeters; all with Alnico V magnets. Built-in LC crossover network with variable brilliance and presence controls. Ship. wt. 22 lbs. Stock No. B-347, 5-way, 30-watt Hi-Fi speaker system. AUDIOPHILE VALUE $59.95. SALE PRICE $39.95.

SALE PRICE $39.95

Mount these Hi-Fi speaker systems in your own cabinet or use for custom installation. Ideal for use with any radio or amplifier. Completely wired, with only 2-wires to connect to any 8-ohm output (Take 10% discount if ordered with any radio or amplifier listed hereon.) Grill cloth, 75¢ extra.

3 - 1957 MODEL Hi-Fi SPEAKERS

- COMPLETE SYSTEMS WITH 4 SPEAKERS
- ACOUSTICALLY LINED ENCLOSURES



The new 1957 Hollywood, 4 speaker high fidelity speaker systems are expressly designed to give realistic reproduction from your Hi-Fi amplifier or FM-AM radio. Juke box bass response with brilliant, middle and high range response. All 3 models have genuine L-C crossover networks and variable brilliance controls. Only 2 wires to connect to the 4 or 8 ohm tap on your Hi-Fi amplifier. A fine speaker system to use with our Imperial 20, 30 and 34 high fidelity amplifiers, and all FM-AM chassis in our Radio & TV News offerings. Adjusting the twin tone controls on our Imperial amplifiers along with the brilliance control on the Hollywood speaker systems you can have fidelity of your own personal taste. All 3 Hollywood models are housed in the same fine cabinet. Choice of either Mahogany, Walnut or Maple finishes. Baffles are fully enclosed and acoustically lined. Small enough in size for the average room, yet large enough for proper baffling. 35" high, 19" front to back, 25" wide. Specify cabinet finish when ordering, otherwise we will ship mahogany finish. Take $3.00 discount when you order with any of the Imperial amplifiers or Espey FM-AM chassis offered in this 3 page ad.

Model H-4H, Hollywood 4 speaker high fidelity speaker system. 20 watts, response 20 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features a 12" General Electric 6.8 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance L-C crossover network. Model H-4H, Ship. wt. 55 lbs. Price $39.95. $39.95

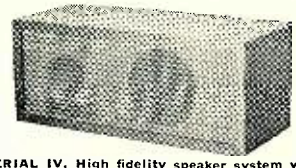
Model Y-4Y, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 20 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features 12" General Electric 14 oz. Alnico V magnet, aluminum voice coil woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance L-C crossover network. Model Y-4Y, Ship. wt. 55 lbs. Sale price, $44.95. $44.95

Model Z-4Z, Hollywood 4 speaker, high fidelity speaker system. 25 watts, response from 18 to 17,500 cps. Choice of Mahogany, Walnut or Maple finish enclosure. Features a 15", 21½ oz. Alnico V Utah heavy duty woofer, plus 6" mid-range and 2-5" tweeters. Built-in variable brilliance, L-C crossover network. Model Z-4Z, Ship. wt. 57 lbs. Sale price, $49.95. $49.95

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker

$19.95



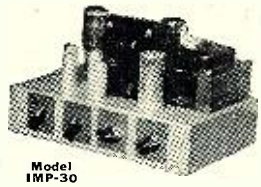
3-Way Imperial VI with 12" G.E. Speaker

$29.95

New 1957 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 or 9770 Norelco 8" extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvilinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Ship. wt. 14 lbs. Model IV Imperial $19.95.

1957 Model Imperial VI, 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers: A 12" G.E. Model 1203 with 9 oz. Alnico V magnet, plus 5¼" PM for middle range and 3" tweeter. Simple to connect to any high fidelity amplifier. (8 ohms impedance). Ship. wt. 25 lbs. Stock No. IMP-VI, Sale price, $29.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

IMPERIAL 30-WATT AMPLIFIER $29.95
NEW 1957 MODEL



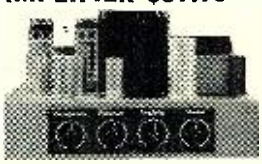
Model IMP-30

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-14Y, 12" Coax Speaker .$39.95
With P15-CR, 15" Coax Speaker..$49.95
With Imperial IV Speaker System.$46.95
With Imperial VI.....$55.95 With HF-33GE $76.95

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12¼" x 7¾" x 7¼" high. Complete with tubes: 6AR6, 12AU7, 6C4, 12AU7, 2—6L6GA, plus 5U4G rectifier. Stock No. IMP-30, 30 watt Imperial High-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs.. Sale price only $29.95.

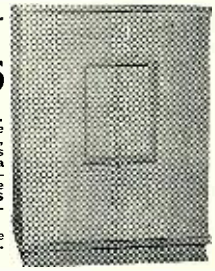
NEW IMPERIAL 24 WATT AMPLIFIER $39.95
PUSH-PULL EL-34 ENGLISH MADE MULLARD OUTPUT TUBES
WILLIAMSON TYPE CIRCUIT
RESPONSE 15-20,000 CPS



With CU-14Y, 12" Coax Speaker..$49.95
With P15-CR, 15" Coax Speaker..$59.95
With Imperial IV Speaker System.$56.95
With SP12125CR..$65.95. With HF-33GE..$86.95. Model IMP-34X

New, 1957 model Imperial 34X, 24 watt high fidelity amplifier for the audio enthusiast who wants McGee's finest amplifier. This amplifier features push-pull Telefunken or EL-34 English made Mullard output tubes in a Williamson circuit. Heavy duty 6 lb. specially wound Williamson type ultra-linear output transformer in potted case has a response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. Amplifier has input for crystal pickup and built-in pre-amplifier for the popular General Electric and Goldring variable reluctance cartridges; as well as input for crystal or high impedance dynamic microphones. 4 controls are microphone gain, phono gain and separate variable treble and base boost tone control with off-on switch. Chassis size: 12¼" x 7¾" x 7¼" high. Complete with 7 tubes and diagram. Model IMP-34X, 24 watt high fidelity amplifier, ideal for use with any of our high fidelity coaxial or multiple speaker systems. Ship. wt. 26 lbs. Sale price, $39.95.

NEW 1957 MODEL 8-WAY SPEAKER SYSTEM BLOND OAK CAB. $69.95



New 1957 model, 8-way Hi-Fi console speaker system. Features a beautiful full door blond oak speaker enclosure that would cost $100 to duplicate; 43" high, 31" wide and 23" deep. A cluster of eight PM speakers matched to an L-C type crossover network give a cone area equal to almost half of the baffle board. Included are 2—10", 2—7½", 2—5½" 2—4" speakers. System will take 30 watts of audio. Frequency response, 20 to 17,500 CPS Juke box quality when connected to any good Hi-Fi amplifier. Only 2 wires to connect to 8 ohm output.

Stock No. AHK-8, 8-way system. Ship. wt. 120 lbs. Sale price, $69.95. Order with our IMP-30 or IMP-34X amplifier and take $5.00 discount.

McGEE OFFERS DIAMOND NEEDLES $25.00 to $27.50 LIST VALUE $9.95

McGee offers $25.00 and $27.50 list value Diamond phono needles for only $9.95. Made by a nationally known phono needle manufacturer and guaranteed 1st quality, free of any defects.

Stock No.	Speed (RPM)	Cartridge Maker	Cartridge Type No.	List Price	Sale Price
MA-21D	33-45	Astatic	QT-33, CAC, CQM, LQD, QT, CQ Series	$25.00	$ 9.95
MA-61D	33-45	Astatic	AC, ACD, Series, 10L3, 11L3	25.00	9.95
MATO-55DS	33-45-78	Astatic	GD-J, 55J, 55TM	30.00	10.95
MGE-61D	33-45	Gen'l Elec.	RPX-041A, RPX-050A, RPX-061A, RPX,052A RPX-053A	27.50	9.95
MGE-713DS	33-45-78	Gen'l Elec.	RPX-050A, RPX-052A	31.00	10.95
MGL-11D	33-45	Goldring	500, 546	25.00	9.95
MRC-11D	45	RCA	74077	25.00	9.95
MRC-31D	33-45	RCA	77779, 75475, 70332, 38453, 38598, 39550.	25.00	9.95
MP-41D	33-45	Shure	W22A, W22AB, P72 P72AF, P72V, P76, P77, Admiral 409A-11.	25.00	9.95
MSA-113DS	33-45-78	Sonotone	W9980, 512E	30.00	10.95

Note: Stock numbers ending in "D" indicate 1 mil diamond stylus. Numbers ending "DS" indicate 1 mil diamond and 3 mil sapphire. Other diamond needles are available. Write for price.

LITTLE GIANT HI-FI PM SPEAKERS $4.49

Hi-Fi 8"

McGee offers its new 1957 models of little giant Hi-Fi PM speakers. List values of up to $15.00 at only $4.49; two for $8.25. Order either 8" or oval 6x9 sizes. Features heavy 3.2 oz. alnico V. magnets and 8 ohm voice coils. New Hi-Fi cone features center horn feature to extend the high frequency range. Rated 6 watts at from 35 to 15000 cps.

8 inch size stock CL-81. Net $4.49; 2 for $8.25.

6x9 oval size stock No. CL-69. Net $4.49; 2 for $8.25.

Hi-Fi 6x9"

WRITE FOR McGEE'S 88-PAGE 1957 CATALOG

GENERAL PURPOSE AUTO-RADIO

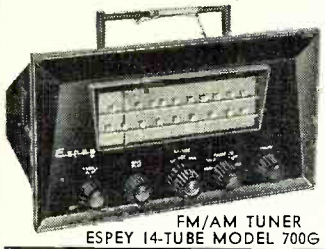
SALE PRICE $17.95

Over $49.95 List Value Radio, Nash model NH3C for Nash Rambler, manufactured by Motorola. Works on 6-volt storage battery, custom built Superheterodyne receiver, rating 4.3 Amp., 6.3 volts D.C., broadcast range 540-1600KC, five tubes: 1 each 6BE6 Conv., 6BA6 Det. AVC-AF amplifier, 6A55 audio output and 6X4 rectifier with a 4x6" PM 3-ohm speaker. With some ingenuity, this set can be adapted to many other types of installation where a 6.3 VDC is available. Overall size: 10½" long, 5¼" high, 4½" deep (5" with knobs). Knobs: 8½" centers. Ship. wt. 10 lbs. Stock No. NH3C, Sale price, $17.95 each or two for $34.00.

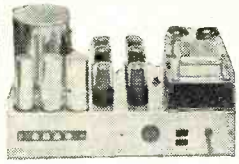
22 TUBE ESPEY FM-AM HI-FI TUNER-AMPLIFIER

SALE PRICE $119.90

A REGULAR $199.50 NET VALUE COMBINATION FOR $119.90



FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



ESPEY 24 WATT
MODEL 501G AMPLIFIER

MODEL 700G FM-AM TUNER ONLY— SALE PRICE **$79.95**

MODEL 501G AMPLIFIER $49.95 SEPARATE **$39.95** If Ordered with Tuner

ESPEY DEAL—1A

Espey 700G-501G tuner with 24 watt amplifier plus VM-956 GE 3 speed VM on metal base—1 Mill Diamond Needle $10.00 extra. Net **$144.95**

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net **$164.95**

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net **$194.95**

SPE MENDED

Order any of the following speakers with your Espey tuner and amplifier:
12" coaxial PM, CU-14Y—$10.00 extra
15" coaxial PM, P15-CR—$20.00 extra
Imperial IV system—$15.00.
Imperial VI system—$25.00.
Norelco 9762—12" regularly $59.50 at $30.00 extra.
EV84—15W system—$150.00 extra.

McGee offers you both the regular $119.50, 14 tube Deluxe FM-AM tuner and the $79.50 value 8 tube audio amplifier for the special sale price of only $119.90. The Model 700G Espey tuner has its own built in power supply. Performance features are: Sensitivity 3mv on AM, 5 mv on FM for 30 db quieting. AM selectivity 10kc at 6 db. FM 240kc at 6db. Audio response flat from 20 cps to 20,000 cps., with less than ¼ percent distortion with one volt audio output. Chassis is 14" long, 8½" high and 10" deep. Features a one-piece molded, gold color plastic front which makes a custom installation both extremely attractive and easy at the same time. Full tuned RF stages-AFC on FM with defeating switch for easy FM tuning. Built-in preamplifier for GE or other popular variable reluctance cartridges. Three position equalizer switch for LP, AES or European records. Separate bass and treble tone controls with 23db boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Has built-in ferrite loop antenna for AM broadcast band and 300 ohm input for FM band. This fine quality FM-AM tuner is second to none. It has all of the features that you might expect of a tuner that would cost as much as $200. All of the controls are on the front panel. This is a most desirable feature when the tuner is used in conjunction with a good audio amplifier, such as the 501G which was designed with no tone control or preamplifier circuits.
The Model 501G, 8 tube ultra linear high fidelity, 24 watt audio amplifier is made to match the 700G tuner. This amplifier is offered separately at the special sale price of $49.95, but costs you only $39.95 when purchased with the 700G Espey tuner. This amplifier features less than ½ percent distortion with high fidelity response from 10 cps to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size, 12"x5"x8". Output tubes; 4—6V6GT in push-pull Williamson circuit. 6SN7GT phase inverter and 2—5V4G rectifiers. Has an 8 pound potted case output transformer with specially made grain-oriented iron core. Output impedance taps of 4, 8 and 16 ohms. This output transformer alone is a $20.00 value.
Buy just the 700G FM-AM tuner at the special sale price of $79.95, or buy both the 700G tuner and the matching 501G amplifier for $119.90. Model 501G amplifier sale price, $49.95 when purchased separately. Tuner shipping weight 20 lbs. Amplifier shipping wt., 22 lbs. See the special deals of the 700G-501G tuner-amplifier combination with record changer and GE cartridges for extra money saving values. Also, special discount on speakers and speaker systems when ordered with your Espey tuner and amplifier.

VM HI-FI CHANGER. SALE PRICE $29.95

LESS BASE LESS CART.

$45.90 WITH GE RPX-052A

4 Speed Monarch SALE PRICE **$27.95** with 222 Ronette Ceramic Cart. Diamond 1 Mil Stylus $10.00 Extra

VM-936HF $32.95

COLLARO 456 - $34.50

MONARCH UA8H $27.95

New offering of VM Hi-Fidelity, 3 speed record changer with or without metal base. A large special purchase makes this low sale price possible. Reg. net on VM-935 less cartridge was $38.97. Reg. net on VM-936 less cartridge was $45.47. The VM-935-936 Hi-Fi Series changers are equipped with two plug-in tone arm heads which will hold popular G.E. or Pickering single or dual play cartridges. Both have 4-pole motors for constant speed, hum free operation with a VR cartridge. Plays all 3 speeds and all 3 sizes. Will inter-mix 10" and 12" records of same speed. Shuts off after last record plays. Muting switch silences pickup during change cycle. Furnished with large 45 RPM spindle. Chassis size 13½ x 13¼ x 8½" high, 4½" above plate. Ship. wt. 12 lbs., with base, 18 lbs.
VM-935HF, 3 speed Hi-Fi changer, less cartridge and base, only $29.95.
VM-935HF-GE with G.E. RPX-050A VR cartridge, $35.90.
VM-935HF-GED with "Golden Treasure" RPX-052A VR cartridge; 1 mil diamond and 3 mil sapphire stylii, only $45.90.
VM-936HF, 3 speed Hi-Fi changer with metal base, less cartridge, Sale price, $32.95.
VM-936HF-GE with G.E. RPX-050A VR cartridge, $38.90.
VM-936HF-GED with G.E. RPX-052A "Golden Treasure" cartridge; 1 mil diamond, 3 mil sapphire stylii, only $48.90.

4-SPEED COLLARO

Latest 1957 Model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $46.95. Large spindle $3.30 extra.

New Model UA8, Monarch 4 speed imported High Fidelity record changer. Features a high fidelity 4 pole motor, 9" turntable with molded rubber pallet. Counter-balanced tone arm will accept any of the popular Hi-Fi cartridges. Plays all 4 speeds and all 3 sizes. Intermixes 10" and 12" records of the same speed and shuts off after last record plays. Base size, 10⅞" x 12¾". Ship. wt. 15 lbs. Large spindle for 45 RPM records, $1.88 extra.
Model UA8-H with ±222 Ronette Hi-Fi flipover ceramic cartridge, $27.95.
Model UA8-HD, same as above but with 1 mil diamond stylus, $37.95.
Model UA8-U with ±500 Goldring variable reluctance cartridge, $29.95,
Model UA8-UD, same as above but with 1 mil diamond stylus, $39.95.

GOLDRING V. R. CARTRIDGE

WITH 2 SAPPHIRE STYLII $5.95
WITH 1 MIL DIAMOND, 3 MIL SAPH. $13.95

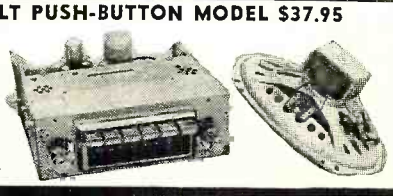
McGee offers the internationally famous Goldring variable reluctance phono cartridge, made in England and sold throughout the world to those who want the finest and most accurate music reproduction from 33⅓, 45 and 78 RPM high fidelity phono records. (Input gain and compensation similar to G.E. v.r. cartridge required.) Furnished as standard equipment with sapphire 1 and 3 mil stylii. A regular $9.90 net item on sale at McGee for $5.95. For $13.95 with a diamond 1 mil stylus. These are the latest production, individually cartoned turnover cartridge with mounting bracket. Fits tone arms on most changers. Made for and bearing the famous Wilcox-Gay Recordio name.
No. 546 Goldring V.R. (Wilcox-Gay) cartridge, Net $5.95. No. D546-DS, Goldring V.R. (Wilcox-Gay) cartridge with diamond 1 mil stylus, $13.95. 1 mil diamond stylus for Goldring V.R. cartridge, purchased separately, $9.95.

SAVE ON NORELCO SPEAKERS AT McGEE

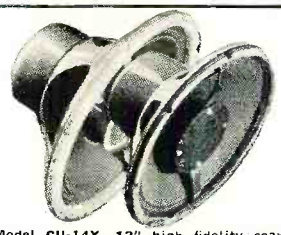
World Famous Hi-Fi	Imported From Holland
12" Model 9762 reg. $59.97	Sale Price $39.95
12" Model 9760 reg. $32.97	Sale Price $19.95
8" Model 9750 reg. $22.17	Sale Price $15.95
8" Model 9770 reg. $ 9.90	Sale Price $ 7.95

NORELCO Model 9762—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice Coil imp. 8 ohms—new Alnico VI magnet gives 11,000 gauss. Regular $59.97 net, on sale at McGEE for only $39.95.
NORELCO Model 9760—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice coil imp. 8 ohms—new Alnico VI magnet gives 8,000 gauss. Regular $32.97 net, on sale at McGEE for only $19.95.
NORELCO Model 9750—8" wide range Hi-Fi PM speaker, res. 50 to 20,000 cps at 10-watts. Voice coil 6 ohms—New Alnico VI magnet gives 13,500 gauss. Regular $22.17 net, on sale at McGEE for only $15.95; or 2 for $30.00.
NORELCO Model 9770—8" wide range Hi-Fi PM speaker, res. 75 to 19,000 cps. New Alnico VI magnet gives 11,000 gauss. Reg. $9.90 net, on sale at McGEE for only $7.95; or 2 for $15.00.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $37.95



New model SH-78555-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ5 high-powered audio. Stock No. SH78-555-X with 6x9 speaker—$37.95. With 2—5x7 speakers—$39.95; with 1—5x7 speaker $37.95. Specify speaker size wanted. Three-section top cowl mounting antenna —$2.29 extra.



McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

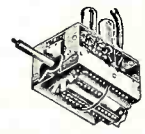
$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.
McGee's new 15" Junior coaxial PM speaker, 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker. Sale price, $16.95.

FAMOUS STANDARD COIL CASCODE TUNERS

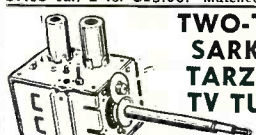
SALE PRICE **$12.95** 2 FOR $25.00



TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than a 6 pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 27/8" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.
Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59c a pair.

STANDARD COIL PENTODE TUNERS $7.95

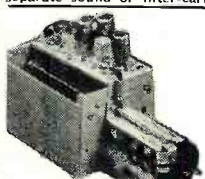
SC-948, Standard Coil, 21 mc Pentode tuner with 6BC5 or 6AG5 and 6J6 tubes. Popular 12 channel, 2 thru 13, used in millions of TV sets. Why spend time repairing an old tuner when it may be easier to just replace it. Shaft can be cut to desired length. Available with 27/8", 3", 4¼" or 4½" shaft. Specify length of shaft. Sale price, $7.95 ea., 2 for $15.00. Matched knob set 59c extra.



TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

21MC OR 41MC $7.95

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel TV tuner for 21mc. Used in CBS, Arvin, Crosley, etc. Ideal for general replacement. 3⅛" shaft. With tubes, $7.95 each, 2 for $15.00.
No. TT-2C, 2 tube Sarkes-Tarzian 41 mc Cascode tuner with tubes, 4½" shaft. Smallest cascode tuner made. Popular in many sets. $7.95 each, 2 for $15.00.
Either of the above tuners with 9" shaft, $1.00 extra.
Type 3, 3 tube 21 mc Sarkes Tarzian tuner with tubes. Rotary switch type complete with 6C4, 6BH6 and 6AG5 tubes. Regular cost is several times our new low price of only $4.95. Wired, ready to hook-up to video and sound I.F. strip. Use with either separate sound or inter-carrier. Built-in fine tuning. 2⅞" shaft. Net, $4.95.



RCA KRK-12 TV TUNER Brand New—with Tubes

SALE PRICE **$6.95** 2 for $13.00

RCA Model KRK-12, UHF-VHF TV tuner with tubes: 2—6BQ7A, 6AF4 and 6S4. A complete tuner with all 12 VHF strips, but with blank strips in the UHF positions. This tuner fits many RCA sets using 40 megacycle I.F's. 27D382 also KCS-66, etc. Original tuner list was about $50.00. We offer them new at about the value of the tubes. Ship. wt. 10 lbs. McGee's sale price, $6.95 each, 2 for $13.00.

MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE SALE PRICE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

Service Industry News

INFORMAL meetings held recently between executives of the National Electronic Distributors Association and representatives of the electronic service industry indicate that cooperative programs for the mutual benefit of both segments of the industry will soon be started.

The move to find a satisfactory pattern for cooperation between electronic parts distributors and service associations was initiated last year with the formation of the Eastern States Regional Conference of Service Associations. Spurred by invitations from Frank Silverman, president of the Television Service Association of Connecticut, and Dave Krantz, on behalf of the Federation of Television-Radio Service Associations of Pennsylvania, delegates from service associations located in the seven northeastern states met in Bridgeport, Conn., and formed the Eastern States District Conference of Service Associations. Included in its membership are associations affiliated with NATESA, NETSDA, AEC, and several nationally unaffiliated associations. This regional unity provided the Conference with an excellent cross-section of service-industry thinking.

At its Bridgeport meeting, the Conference adopted a dual ten-point program for improving distributor-service relations. The purpose of this program was to provide a definite pattern in the discussions of factional differences with representatives of the parts distributing industry.

Recently, key officials of NEDA met with eastern-states TV service leaders for the purpose of exchanging ideas, looking toward the improvement of industry relations for mutual benefit.

Harry Esdale, eastern representative of NEDA, described the conference as the beginning of a series which would ultimately bring his group into contact with most of the TV service leaders in the country. NEDA representatives who attended the conference, in addition to Esdale, were Aaron Lippman, chairman emeritus of NEDA, Morris Green, chairman of NEDA's educational committee, and Joseph DeMambro, president of the distributors' organization.

Service leaders, all from the eastern states and functioning under the temporary designation of the Eastern States District Conference, were Frank Silverman, president of TELSA of Connecticut; Alfred Feisal, president of RTTG of Massachusetts; Gilbert Clark, vice-president of RTTG of Boston; David Krantz, vice-chairman FTRSA of Pennsylvania; Jack Wheaton, secretary of ESFETA of New

Loran APN/4 Oscilloscope

Easily converted for use on radio-TV Service Bench!

BRAND NEW
Completely Assembled

Supplied with 5" Scope type 5CP1 and RCA 100 Kc. Crystal Unit **$14.95**

I-95-M FIELD STRENGTH METER

Tunes 100 to 155 Mc. Made for Signal Corps. Like New **$34.50**

MN26Y BENDIX DIRECTION FINDER

150-325 Kc; 325-695 Kc; 3.4-7 Mc. Complete with tubes, motor. **$26.95**
BRAND NEW .....
Used, like new, incl. tubes and dynamotor.. **$18.95**

BENDIX DIRECTION FINDER

12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands, 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:

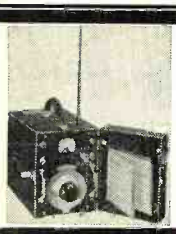
MN-26-C Receiver, used, with 12 tubes	**$16.50**
MN-26-C With 12 Tubes, BRAND NEW	$24.95
MN-20-E Rotatable Loop	4.25
MN-52 Azimuth Control Box	2.95

All necessary accessories for above in stock.

TS-16/APN TEST SET. BRAND NEW, complete with all cables **$12.95**

JUST ARRIVED!

MODEL OAO-2 NAVAL RADIO TEST EQUIPMENT FREQUENCY METER. 110 V 60 cycles AC. 105 to 127 Mc. Mfd by LIEBEL-FLARSHEIM CO. BRAND NEW, Export Packed **$44.50**



BC-906 FREQ. METER—SPECIAL!

Cavity type, 145 to 235 Mc. BRAND NEW in original factory packing, complete with antenna. Manual included.
OUR LOW PRICE **$8.88**

BC-221 FREQ. METER **$129.50**

BC-221 FREQ. METER CASE

Aluminum Case for BC-221 or TS-164 Freq. Meters. Shock Mounted. BRAND NEW..... **$3.99**
(add 50¢ for packing)
Original 1000 Kc Crystal for BC-221. BRAND NEW $8.45

TG-5-B TELEGRAPH SET

Made for USA Army Signal Corps. A dandy little field set for 2-way communication. Sturdy metal container, 6¾"x 4⅞"x4". with hinged covers, complete with telegraph key and headset. BRAND NEW, in carrying case with shoulder strap **$9.95**
Used, exc. Cond. $7.95
TG-10 KEYER. Complete with all Tubes.. **$21.95**
110 V. 60 cy. .....

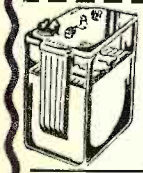
BRAND NEW SELSYNS

Operates from 57½ volts, 400 cycles. New tested. Conversion diagram for 110 volts AC included.
2J1G1 Selsyn Control Transformer. **$2.95**
2J1H1 Selsyn Differential Generator.....Each
Caps for Above.....50¢

DYNAMOTOR VALUES!

Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	2.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24

PE-103 6/12V Input, 500V @ 160 Ma output. With cables and plugs, excellent, like new..... **$24.50**



2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery $2.45
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW!
Combination Price.... $4.99

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte .....Only **$2.22**

ASB-5 RECEIVER FOR 420 Mc BAND!

As featured in "CQ" for October 1956. Easily converted, makes a marvelous receiver for 420 Mc band, with RF amplifier! Supplied complete with all tubes. **$14.95**
OUR LOW PRICE.....
Tuning Knob for ASB-5 Receiver.....$1.29
ASB-5 INDICATOR $16.95

Ham Special! Famous BC-645 XMITTER-RECEIVER

BRAND NEW

With MANUAL for Easy Conversion to CITIZENS' BAND!

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** **$29.50**
Shpg. wt. 25 lbs.....

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) .....only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645....$2.45
Complete set of 10 Plugs for BC-645 ..... **$5.50**
CONTROL BOX for above.....$2.25
SHOCK MOUNT for above..... 1.25
CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **$2.50**

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, complete with all components. 100-156 Mc, 4 channels. Xtal-controlled, Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes. **$33.33**
COMBINATION.....Special

Receiver Only, with all tubes...$19.50
Transmitter Only, with all tubes. $22.25

ARC-5/T-23 TRANSMITTER

100-156 Mc Includes 2-832A, 2-1625 Tubes. BRAND NEW **$19.95**

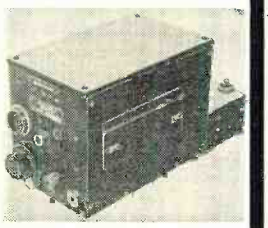
SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. BRAND NEW, less tubes.....$7.95 Excellent Used, less tubes.....$5.95

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**

Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal..... **$12.45**

AN/ARR-2 RECEIVER



BRAND NEW — A Terrific Value! Tuning Range 234 to 258 Mc. Tubes: 7-9001, 3-6AK5, 1-12A6. Only a few at this low price! **Complete $8.88**
With 28 V 1.6A Dynamotor, complete **$12.98**
110 VOLT AC POWER SUPPLY KIT for above.....$7.95

NAVY RECEIVER TYPE ARB

Four Band. 195 to 9050 kc. Low Freq., Ship, Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V, or 6 V. Schematic Included. Excellent Condition. Overall: 8¼" x 7¼" x 15¼". Wt. 30 lbs.
COMPLETE WITH ALL TUBES, Special..... **$21.50**

LORAN APN-4

FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE**..... **$129.50**

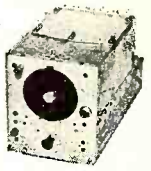
SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized)..... **$29.50**

WRITE FOR FREE CATALOG!

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All shipments F.O.B. Our Warehouse N.Y.C.

G & G Radio Supply Co.
Telephone: CO 7-4605
51 Vesey St., New York 7, N. Y.

R24-ARC/5 NAVY TYPE (Similar to BC-946) BROADCAST RECEIVER



520 to 1500 Kc. 6 tubes: 3—12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 or 32 Volt. 2—IF stages, 3-gang tuning cond. Complete with all tubes, in original sealed carton. **$19.95**
BRAND NEW...
BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW **$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. BRAND NEW **$11.95**
ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.88**

110 VOLT AC POWER SUPPLY KIT

For All 274-N and ARC-5 Receivers

Can be assembled quickly and easily, on predrilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. Complete kit of parts with metal case, instructions. **$7.95**
SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. **Only**..... **49c**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Excellent Used	Brand Used	Brand NEW
BC-453	Receiver 190-550 KC...	$9.95	$11.95	$14.95
BC-454	Receiver 3-6 Mc.....	7.19	8.29	11.95
BC-455	Receiver 6-9 Mc.....	5.25	7.95	9.95
BC-456	Modulator	2.24	2.75	4.24
BC-450	3-Receiver Control Box ...		1.49	1.95
BC-451	Transmitter Control Box ...		1.25	1.49
BC-696	Xmtr 3-4-Mc (like new) ...		6.95	8.88

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. BRAND NEW.. **$8.88**
Brand New, less tubes..$5.95
USED, with tubes.....$5.95
USED, less tubes..... 2.95

BRAND NEW SPECIAL PURPOSE TUBES

in Original Individual Packing
JAN CRP-730A MAGNETRON. Raytheon.....$3.45

Type	Each	Lots of 12	Lots of 100
6J6W	$.45	$5.15	$41.00
1625	.26	2.75	21.50
1626	.16	1.75	13.50
1629	.27	3.05	23.95
826	.44	4.95	39.50
2J724B	.35	3.95	29.50
VR105	.79	8.88	70.00
VR150	.79	8.88	70.00
8002R	5.95	...	....
RK65	7.25	...	....

NEW! Cathode Ray Tubes NEW!

3CP1	$1.18	5BP4	$2.22
3FP7	1.18	5CP1	2.45
5BP1	2.22	5FP7	1.44
		9LP7	1.88

BUBBLE SEXTANT

Made for U. S. Armed Forces by AGFA ANSCO. Actually worth $150 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case. Only..... **$9.95**

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only..... **$2.95**

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special..... **$2.95**

DYNAMIC Headphone with Dynamic Mike. **BRAND NEW**..... **$3.95**

HI-FI DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW** **$5.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike.....$5.45		$7.95
T-30	Carbon Throat Mike...	.33	.69
T-45	Navy Lip Mike.....		.99
RS-38	Navy Type	2.45	4.95
T-24	Carbon Mike		3.95
T5-9	Handset		4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance.....$2.25		$4.35
HS-33	Low Impedance	1.99	4.65
HS-30	Low Imp. (featherwt.).	1.49	2.25
H-16/U	High Imp. (2 units)...	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack.....		.99

BC-442 ANTENNA RELAY

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator, 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW..... **$2.24**

York; and Paul V. Forte of *Tower Associates,* Philadelphia.

Although the conversations were general in nature and ranged over a variety of subjects, both groups felt that much had been accomplished. Since no conclusions were reached at this time, it was decided that other meetings including more representatives from service should be held. Frank Silverman of the Connecticut group assumed the post of chairman of the conference and was asked to coordinate the details of the next meeting.

Plans for the next meeting anticipated the participation of several independent manufacturers, as well as service leaders from other sections of the country.

Three Technical Fairs

The Texas Electronics Association, Inc., recently announced that its Fifth Annual Electronics Fair and Clinic will be held in Fort Worth, Texas, on August 2, 3, and 4, 1957, at the Texas Hotel. Leonard R. Smith of Fort Worth is clinic chairman this year.

Two regional service fairs were held during the month of April. In Indianapolis, the Indiana State Electronic Association held its first Mid-West Electronic Service Fair. Host organization for the three-day event was the Indianapolis Television Technicians Association. Robert M. Sickels, president of both ITTA and IESA, was chairman of the fair committee.

The Council of Radio and Television Service Associations of Delaware Valley sponsored an Electronic Service Industry Telerama at the Ritz-Carlton Hotel in Atlantic City. This three-day event included a well-rounded series of lectures and demonstrations as well as exhibits of the latest products and service equipment. H. Harrison Neel, co-chairman of the Council, coordinated the event.

The Licensing Front

A service licensing bill proposed for the community of Long Beach, N. Y., was recently tabled temporarily by the City Council pending action by the New York State Legislature on a similar bill which it was considering. The Radio Television Guild of Long Island, which has endorsed licensing on a state-wide basis and is supporting the licensing measure currently before the State Legislature, had also endorsed the proposed Long Beach ordinance, with reservations.

A proposed TV Service Ordinance for the City and County of San Francisco, Calif., was recently placed before the San Francisco Board of Supervisors. The ordinance, which covers only the installation and servicing of TV receivers, would require the licensing of businesses as well as technicians engaged in the activity. It would provide for three categories of effort: Television Service Dealers; Certified Television Technicians; and Apprentice Television Technicians.

Trade-Mark of Service

Edward O. Roehr, president of *Spee D. Servus, Inc.,* recently announced that the association now has approved members in all 48 states as well as Hawaii and Canada. The *Spee D. Servus* organization is a non-profit corporation whose purpose is to publicize and promote its unique name and emblem as a trademark for qualified independent service shops. Its national promotion program is designed to create the same confidence and respect for its member shops as that enjoyed by the brand-name set manufacturers.

Head of the *Ed Roehr Radio Co.,* in St. Louis, Mr. Roehr uses the distinctive name and emblem in connection with all of his advertising and promotion. He claims the cumulative advantage of the *Spee D. Servus* name and emblem used by thousands of shops in all parts of the country will be tremendous. Each member, he says, will automatically gain prestige and distinction from the advertising done by all of his fellow members in the organization.

Technicians and Business

Karl Heinzman, president of the Television Service Association of Michigan, recently spoke at a monthly meeting of the fast-growing Electronic Service Dealers Asso-

ciation of Western Pennsylvania in Pittsburgh, Penna.

The TSA president told his audience of service dealers: "We live in a day and age where we no longer swap a bushel of potatoes to shoe a horse. We live with big business, therefore we must set up our own standards. We cannot do it alone.

"Your Pittsburgh association has accomplished almost as much in four months as it took TSA of Michigan six years to do. In regard to membership, you are all both technicians and businessmen. You must help one another; visit with one another. In this manner, your membership will grow.

"We live in a complex society and we must recognize certain forces that seek to dominate us and our businesses. If we protest on the one hand, then we must be strong enough to enforce it on the other hand with collective action.

"The morning I arrived in Pittsburgh, I took a trip around your city and found evidence of what you had mentioned—that some of your distributors are not really distributors but glorified retailers. That is something that certainly needs correcting. I have information that one of those people is shortly to become a retailer in fact. No manufacturer should sell to them at distributor prices when they compete with you for retail business."

ESFETA: Captive Service

At its February meeting, ESFETA delegates adopted two resolutions dealing with competition from captive service. In the first, ESFETA went on record commending the *P. R. Mallory Co., Sprague Products Co., Tung-Sol Electric Inc., Raytheon Manufacturing Co., Sylvania Electric Products Inc.*, and *CBS-Hytron* for the support they have given independent service in the controversy over captive service. In the second, ESFETA went on record to the effect that it does not condone competition at the factory level.

Head of New Group

Harry M. Andrew of Delaware Water Gap, Penna., was unanimously elected to serve as president of the Pocono Electronic Service Association, recently formed by a group of radio and TV service dealers in Pennsylvania's Pocono mountain region. Augie Lockwith, of East Stroudsburg, was elected to serve as secretary.

PRSMA Officers

The Philadelphia Radio Service Men's Association announced the slate of new officials elected to serve for the current year. Re-elected to the office of president was William L. Poole. The new vice-president is Fred Cohen. Other officers include A. P. Greben, recording secretary; William P. Humes, treasurer; and Leonard Shaw, corresponding secretary. Re-elected to the board were William Royal and Richard G. Devaney. Others now on the board are John Brozenske, Samuel M. Brenner, and William Abbott. —30—

Challenge to Civilian Inventors

Inventors Council issues call to "free-lancers" to help solve nine problems baffling armed services.

THE National Inventors Council of the U.S. Department of Commerce has issued a call to all freelance inventors to try their hand at tackling nine "blue sky" problems confronting the armed services.

The problems have been described as "blue sky" since the council feels that it will take imaginative, sky-is-the-limit thinking to solve them. According to John C. Green, director of the Office of Technical Services and the Council's executive director, "The man who cracks one of these puzzles won't be bound by traditional barriers between sciences. He may have to be the modern equivalent of an Edison or Marconi—or even a Houdini".

The Council is the official clearing-house for all inventions of potential value to the government.

The nine new problems which civilians are being asked to tackle include:

1. Non-magnetic compass: This must be a device small enough to be carried by a man on foot. It will be used to determine true north, independent of the earth's magnetic field. Better still, it should enable a man to determine his position accurately.

2. Explosive mine detector: A method for locating explosives buried at shallow depths below the earth's surface. Present detectors locate the explosive's container or signal the presence of a hole in the ground.

3. Method for converting light into electrical energy: An invention which will convert a small amount of light into enough electricity to operate electrical equipment. Far greater power output is needed than has yet been supplied by solar batteries.

4. Snow track eraser: A practical means of destroying the tell-tale tracks of men or vehicles across snow fields. Object is to restore original contour of snow field to avoid air detection.

5. Destructive wave or ray: Equipment of usable size capable of producing death rays effective at 500 yards without excessive power input. Investigations so far indicate that a completely new approach is needed.

6. Universal track: A new method of traction for land vehicles for use on all types of terrain. Present steel tank tracks wreck paved roads.

7. Radical method for unloading ships: New means of quickly discharging large quantities of military supplies from commercial or military vessels, either over the beach or at dockside.

8. Vehicle blackout devices: Inventions to mask the light, noise, and radiation from combat vehicles operated under cover of darkness.

9. New type of communication: An ingenious new method of transmitting intelligence, non-detectable except by the desired receiver. The military is seeking a new principle which does not use electrical impulses, electro-magnetic waves, or sound waves.

There is the challenge. Any practical ideas on any of these problems will be welcomed by the Council. Send "solution" to the NIC, U.S. Department of Commerce, Washington 25, D.C. —30—

A Portable 110° TV Set

(*Continued from page 64*)

on the floor of the cabinet. These supports can be seen in Figs. 1 and 2.

Note has already been taken of the manner in which troubleshooting can be facilitated on the automated board: if light is allowed to shine through the board from the printed-wiring side and the board is viewed from the component side, tracing out circuit connections is made quite easy.

Future Possibilities

The receiver under discussion is, without question, a definite step forward in the unending search to find ways of decreasing receiver size in relation to picture size. Since the 110-degree tube is now a reality, why not develop, say, a 130-degree tube? To answer the question indirectly, it may be pointed out that, as the deflection angle increases beyond the present point, the rate at which other problems are aggravated is accelerated. For example, if the deflection angle were to be increased to 180 degrees with the present method of scanning, an infinite amount of power would be needed to deflect the beam and the yoke would have to be positioned on the screen of the cathode-ray tube! A new way of scanning would have to be found before such a flat-plate tube would be practical.

Also note that, with the exception of weight reduction, such a flat tube would not offer any great advantages for use in a portable receiver unless there were further improvements in the field of component miniaturization. Relatively small increases in the deflection angle would present problems that engineers would doubtless be able to overcome, since these problems are basically similar to those encountered as the deflection angle has been increased. However, economic difficulties become important as associated components used with the tube and in the set must be redesigned.

Other approaches to reducing the size of the picture tube include elimination of the ion trap, which would take about one inch off the neck of the tube. This is made possible by the aluminum coating on the rear surface of the screen material, which can prevent ions from damaging the screen. However, other harmful effects of "free" ions in the tube are possible. These ions may poison the cathode, with detrimental effects on emission. More careful life testing must be carried out to explore such possibilities.

Of course, there are other interesting possibilities for future size reductions. Perhaps the yoke can be built into the tube envelope, thus bringing it closer to the electron beam and increasing its sensitivity. It may also be possible to mount the electrode assembly at some angle to the screen other than the now accepted one of 90 degrees. These possibilities are for the future. —30—

CONCORD'S SUMMER SPECIALS

FAMOUS MAKE TV PICTURE TUBE TESTER and REACTIVATOR

Concord's Closeout Price
Made to sell nationally for $54.90
Stock No. BB701-RN-5
Shipping Wgt. 5 lbs.
*With Famous Simpson 4½" 0-100 Microampere Meter

1. Completely tests the operating conditions of the picture tube, for quick and easy location of troubles or defects. Provides large meter indication of whether tube is GOOD or BAD, quantitative readings of leakage and voltages.
2. Provides reactivation of worn out TV picture tubes.
3. Indicates and identifies troubles in the TV receiver, includes contrast and brightness controls, plate screen and bias voltage, video output, etc. Includes an accurate 600 volts d-c range for checking receiver plate, bias and screen voltages. 30KV or 60 KV.

$23.50 EACH

VERSATILE BIAS VOLTAGE SUPPLY

Stock No. Bias-V N-6
Shpg. Wgt. 2 lbs.

Any Bias Voltage From 0 to 30 Volts From a Permanent Source. Why Buy Bias Batteries Which Wear Out, Can't Be Adjusted & Whose Voltage Is Not Constant? RATINGS INPUT: 110 V. AC OUTPUT as follows: Chassis (clips): 0-30V. Pos. Output Lead: 0-30C. Negative "Voltage Set" adjusted to any value up to 30 volts as indicated by Dial Pointer on Panel Calibration. Get exact specified substitute bias voltage for trouble-shooting AVC circuits in radios, troubleshooting AFC circuits in TV sets, visual sweep alignment of TV and other receivers, industrial equipment checking, troubleshooting and adjustment of A-F and R-F amplifiers. Reg. Price $14.95.

$7.45 EACH

PROBE 0-60 KV RANGE

UNIVERSAL HIGH VOLTAGE PROBE

$7.75 each

Stock No. PROBE-RN-5
Shpg. Wgt. 3 lbs.

Up to 0 to 60 KV on any meter with no extras to buy. High accuracy with safety for experimental and development work, industrial high voltage supplies, black and white TV receivers, color TV receivers.

PRICE—Complete with four universally matched precision High Voltage Resistors and full instructions, only.

$6.45 each

Stock No. PROBE-RN-5
Same as above in Kit Form.

ALLIANCE TRICEPTOR ALL CHANNEL ANTENNA

PRICE CUT

Covers Channels 2-13

Reg. Price $16.95 LOTS OF 3 **$6.50 each**

- A Real DX Antenna
- All Aluminum Construction **$6.95 each**
- Designed for Minimum Wind Resistance
- Can Be Stacked for Additional Signal Pickup
- Elements Snap Into Position In One Motion
- Antenna Is Packed In Heavy Carton To Prevent Damage
- Full Instruction Sheet Is Included with Each Unit

MODEL TC-1
Stock No. TC-1-RN-5
Shipping Wgt.: 2 lbs.

PHILCO Reversible Motor (Remote Control)

$1.39 Net **$5 Lots of 4 Net**

Philco Remote-Control Reversible, 24-30V., 60 cycle AC. Exact replacement for Philco Antenna Rotator motor Part No. 35-1465. Reversible in either direction. Has pulley for driving dial cable, or figure out your own application. Use for remote control in radios, TV, model railroads, what-have-you. Size 1¾" square. 4 pole motor with oilite bearings. Shaft of very hard tungsten steel ⅛" diameter. Pulley ¼" dia. with ⅜" flange. They'll go fast, so buy 4 for $5; and save a half-dollar.
Stock No. RN-5-P35-1465—Shpg. Wgt. 2 lbs. . . Net $1.39
Lots of 4—List $15.50 each . . . . . Net $5.00

PHONO SLIDES!

$1.15 PAIR

3 pr. $3.00

- Heavy Duty Type. Extends to 22".
- Capacity 52 Lbs.
- Heavy Enameled.

Just the fine units for mounting record changers into your custom cabinets, or extension drawers in tool or work benches, in closets, etc.
Stock No. PH-SL-C-RN-5 Shipping Wgt. 4 lbs.

TUBE COOLING MOTOR AND FAN

110 V. 60 cycles. RPM equals 2000. For cooling xmitting tubes as 813, 304th, etc.
Stock No. MF-600-C6.

$1.89

HAYDON 1 RPM TIMING MOTORS

LIMITED QUANTITY

$1.39 EACH

Haydon Model 1600A — Designed primarily for applications requiring a constant speed at a given frequency. Turns at 1 rpm. Operates on 110 V. 25-cycle A.C.
Stock #RN-5-H160-25

SARKES TARZIAN 21 MC UHF Tuner

Lots of 3 **$6.95 each**

SARKES Tarzian turned these out by the thousands for almost every type of TV set now in use. Replaces many models. Covers all 13 VHF channels. With tubes ready to install.
Stock No. RN-5-ST21—Shpg. Wgt. 5 lbs.

21 MC. STANDARD PENTODE TUNER

Standard Shaft

It took unlimited buying power plus a lucky "deal" to get these tuners for you at our famous price. Used in millions of receivers you will find these units are no "dust collectors." Complete with tubes (6BC5 and 6J6) they cover channels 2—13. For 300 ohm input. Buy a good supply while these quantities last.

Stock #21ST-TUN-RN-5
Shipping Weight: 4 Lbs.

$11.99 EACH
Lots of 3 $13.00 ea.

STANDARD CASCODE TUNERS

Latest Standard Coil Cascode Tuner at a clear $10.00 saving to you . . . The Standard Coil Cascode Tuner will give up to 50% improvement in gain, provide stronger, sharper pictures. Interchangeable Standard Coil UHF strips. Has 300 ohm input and easily accessible individual channel oscillator adjustment screw. Size: 4⅝" x 6¼".
Stock No. RN-5-SCTV2
Shipping Wgt. 4 lbs.
Stock No. RN-5-SC-104
Shipping Wgt. 4 lbs.

Lots of 10 **$13.99 each**

Same as Above But for 41 MC. Complete With Tubes, 6J6 (or 6U8) and 6BZ7 (or 6BQ7) . . . . . Each $14.50

POWER TRANSFORMER

INPUT: 117v. 60 cycle a.c.
OUTPUT: 185v. 90Ma. c.t.
SIZE: 2¾" H. x 2½" W. M.C. 2⅞".

$2.50 EA.

USES: Power supplies using selenium rectifiers. As in miniature equipment where space is a problem.
Stock No. PT-656-RN-5—Shipping Wgt. 2 lbs.

6.3 VIBRATOR TRANSFORMER

Made by Mallory. Original part No. 6A325A. Perfect for mobile amateur . . . This unit is a real buy. Input . . . 6.3 volts. Output . . . 300 volts center tapped at 50 ma. Concord had to really extend themselves to get this once in a lifetime buy for their ham trade. Used to power surplus mobile units . . . operating ham equipment . . . ideal for experimenters. Size: 3⅞" x 3¾" x 2⅝". Mntg Cntrs: 3¼ x 1⅝.
Stock No. VIBTR2-RN-5.
Shipping Wgt. 5 lbs.

REG. $6.95 CONCORD'S PRICE **$1.49 EA.**
Lots of 5 $1.69 ea.

6.3 V. FILAMENT TRANSFORMER

Concord's Price **$2.95**

INPUT: 110-120V. 25/60 Cycles
OUTPUT: 6.3V. @ 6 Amps. 6.3V. @ 4 Amps.
SIZE: 4¾" x 4½" x 4⅝".

Just the right unit for use with transmitters, surplus equipment (where 12V. is necessary), test equipment, etc. Fully cased. High insulation V. breakdown.

Stock No. FETIM-RN-5
Shipping Wgt. 6 lbs.

ELECTRIC SPRAY GUN JIFFY SPRAY

$6.95

Reg. $10.95

Sprays paints, lacquers, enamels, varnishes, chemicals, insecticides, oils, deodorants, etc. No Compressor required. Complete with 16½ oz. jar, 8 ft. Line cord, Two Nozzle tips. 110-120 V. 60 cyc. AC. Shpg. Wgt. 5 lbs.

Stock No. JIF-1 SM-RN-S

'Quick-Hot' 200-watt Solder Gun

Free—1 Lb. Solder

No. 288—Reg. $9.95
COMBINATION SALE
1 LB. OF FINEST SOLDER FREE with each gun

Built-in spotlight. Special long-nose tip melts solder in 4 seconds. For 105-125 Volts, 60 cycles AC. Shpg. Wgt. 3 lbs.
Stock No. WEN-RN-5 . . . . . **$7.35**

Complete Standard Coil UHF-VHF Tuner

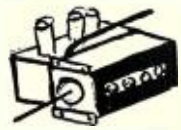
reg. $34.95

Concord's Price **$17.95 ea.**

Covers Channels 2 thru 83

Genuine Standard coil UHF-VHF front end all in one factory built one-piece tuner. Popular 41 mc type as employed in all recent models of TV sets. Our low price includes 3 tubes, 1 each 6BZ7, 6U8 and 6AF4. Fully shielded to assure low oscillator radiation. No more when these are gone.

MALLORY INDUCTUNERS UHF



Complete with 3 tubes **$3.99 EACH**
3 for $9.00

Complete with 3 tubes, 2-6AB4's; 1-6CB6. Can be used as regular replacement. Makes a good fundamental unit for a UHF Converter. Long shaft can be trimmed to required size. Frequency covered 470 mc. to 890 mc. Tubes almost cost more.
Stock No. M-106-RN-5—Shipping Wgt. 2½ lbs.

MALLORY 3 GANG UHF INDUCTUNERS

Lots of 5 $7.50
Singly **$1.69**

Same as above except for use in circuits requiring 82 mc. I.F. Your choice. Please specify.
Stock No. M-102-RN-5
Shipping Wgt. 2 lbs.

Frequency coverage is 470 mc. to 890 mc. For use with 42 mc. I.F. used for converters, tuners and experimental use.
Stock No. M-101-86
Shipping Wgt. 2 lbs.

UTAH DIAMOND GEM 8" HI-FI SPEAKER

Reg. Price $12.50

Lots of 3 Each . . . . **$4.79** Singly Each . **$4.95**

"Where Hi-Fi Is Desired and Space Is at a Minimum"

FEATURES: Built-in treble unit with latest cone hi-freq. disperser.
Built solely for Hi-Fi sound reproduction, the Utah Diamond Gem Speaker consists of an extended range 8" speaker with a concentric miniature cone treble reproducer. Handles 8-10 watts with ease. Response is 40-13,000 cps. V.C. is 8 ohms. Heavy Alnico V Magnet. The perfect Hi-Fi replacement for your console Radio, TV or Hi-Fi system.
Stock #UT-8-H-RN-5. Shipping Wgt. 6 lbs.

REPLACEMENT FLYBACK TRANSFORMERS

$2.29 each 3 for $6.00

Ram. Equiv.: X-109
Merit Equiv.: H-210
For all picture tubes 10" x 21".
Delivers: 12 to 13.5 KV.
For 66 to 70 degree deflection systems.
Used with conventional tube line up (6BG6, 1X2, 6W4).
Mounting centers: 2-9/16".
Height: 4-11/16".
Shipping Wgt. 2 lbs.
Stock No. 19817-3-RN-5

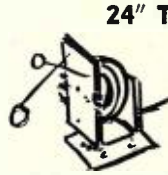
THORDARSON Flyback Transformers

Lots of 3 **$1.95 EACH**

Shipping Wgt. 2 lbs.
Stock No. RN-5-12E-27097

Delivers 12.5 to 13.5 KV
Deflection angle of 66 to 70 degrees.
Used with conventional tubes (25BQ6, 1X2B, 25AX4)
Mounting centers: 2 inches.
Height: 3¾ inches.
Brand new replacement stock model FLY-80, Ram equiv. X-126. Exact replacement for Belmont, Raytheon 12E-23939, 12E-24612, Bendix 265106-1, Airline, Coronado, Firestone and Truetone.

24" TUBE FLYBACK



Concord's Serviceman's Price **$2.29 EACH**

3 for $6.00

Merit Equiv.: HV-07.
Delivers up to 13 KV.
Used with conventional tubes (6CD6, 183GT, 6W4).
Mounting Type "C".
B plus supply: 350 Volts
Ram Equiv.: X-049.
Boost: 510 Volts.
Stock No. FLY-9251-RN-5.
Shipping Wgt. 2 lbs.
Regularly Sold for $10.50.

POPULAR REPLACEMENT FLYBACK TRANSFORMERS

Lots of 3 **$2.00 EACH**

Stock No. FL-048-RN-5
Shipping Wgt. 4 lbs.

Brand New: Replaces RCA-225T1, Farnsworth, Silverton, Olympic, Thordarson Equiv.-FLY-12T. Merit Equiv.-HV-048, Stromberg-Carlson. No. 161048. Delivers 15KV Deflection angle 70 degrees B plus supply 300 Volts. Boost—500 Volts.
Mounting Centers 1¼" x 2".
Height: 3⅝".

CONCORD RADIO • 45 Warren Street, N.Y. 7, N.Y.

$135 DELCO SELECT-O-MATIC RADIO

• 9 TUBES • 12 VOLT • 6 VOLT CONCORD SPECIAL

General Motors Finest Radio

• Ideal for Cars, Boats, Trucks, Tractors, Farms, Summer Camps • Push-Pull 6V6 Output! • 9 Tube Circuit • Extended Range 6" x 9" PM Speaker • Covers Full B'cast Range • Volume, Tone and Sensitivity Controls • Signal Seeker Tuning and • Manual Tuning TOO!

Stock No. DEL 9-612 RN47.

$34.95

For 12 Volt Operation Use Concord Vol-ta-Drop. Price $3.95 extra

8-TUBE *DELCO* PUSH BUTTON AUTO RADIO

Reg. $125

Has 5 Push-Buttons in addition to manual tuning control. Tube line-up includes 2—6SK7, 2—6V6G, 1—6SQ7, 1—6SA7 and 1—0Z4. Wide range tone control. Size 9".

Complete with owners' installation manual, all necessary hardware, brackets and knobs.

With tubes, less escutcheon. Shpg. Wgt. 19 lbs. Stock No. P8TP-RN-5.

For 6 or 12 Volt Operation Same as Above

$29.95

CROSLEY Famous Transistor Book Radio

$24.95

Concord's Buyers this hot item and your price is amazingly low! You will thrill at the fine tone of this radio. The handsome binding in genuine leather is made in a book form. A special automatic switch starts radio when cover is raised. Small enough to keep in your pocket.

Sold Nationally for $54.50. CONCORD'S LOW, LOW PRICE (Less Batteries) $24.95

Stock No. BUK-RAD-RN-5, Shipping Wgt. 3 lbs. Lots of 3, $28.50 each

Batteries for above—No. 415, $1.75 (B). No. E233, $1.68 (A).

RPX-050

TRIPLE-PLAY version of GE's Variable Reluctance Cartridges. All standard, and microgroove records played with just one cartridge. Wide range performance to 15,000 cycles only 6 to 8 grams pressure. With .001" and .003" replaceable Sapphire stylii. Uses preamp.

$6.35 Reg. $8.37

Stock No. RPX-050-RN-5. Shpg. Wgt. 8 ozs.

50% CONCORD 50% Off CAMERA DIVISION Off

FAMOUS GERMAN IMPORT

ILOCA II STEREO

F3.5 ctd matched lenses. FLASH SNYC • B&W or COLOR. Stock No. CAM-ILS-RN47.

NEW **$46.95** List $99.50

NEW

BOLSEY B-2 KIT

ONLY **$39.95**

F2.8, Case & Flash. Sells Reg. $66.50. Stock No. CAM-B2-RN47.

WE BUY, SELL, TRADE CAMERAS PROJECTORS • ENLARGERS

Write for our prices before you buy or sell

ISOPHON ELECTROSTATIC TWEETERS

Built-in baffles offer pure sound reproduction. Two types ST H B 1 round, and ST H 5/16 rectangular handle all mounting needs.

Size: ST H B 7 round—Diam. 2.76", Wgt. 2 oz. ST H B 5/16 rect.—Diam. 1.97x30", Wgt. 4 oz.

Stock No. STHB516 RN-5. Shipping Wgt. 1 lb. ..... each **$3.95**

Features:
- 30 Effect
- Full Range Reproduction
- 7000 to 20,000 cps.
- Compact Space Saving Design
- Remarkable Brilliance of Sound

Stock No. STH B7-RN-5..... Each **$2.95**

Reg. $18.00

UTAH 5" TWEETER

Response Beyond Audibility • Built-in Crossover Network • 6 db. Per Octave Attentuation • 3.16 oz. Alnico V Magnet • Binding Posts • 8 Ohm Voice Coil Impedance • Faithful Reproduction of All High Frequencies.

Tweeter C6. Shpg. Wgt. 2 lbs. Singly $6.45 ea. Lots of 3 Each **$5.97**

RECOTON GOLDRING 500 - MAGNETIC FLIP-OVER CARTRIDGE!

$5.95 ea.

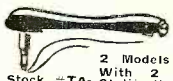
Unique circuit features push-pull coils for minimizing hum (inductive) often caused by changer motors. Universal design, standard ½" mounting hole. Requires pre-amp. Freq. response 20-16,000 cps. Needle pressure 3 to 7 grams.

RECOTON with 2 Sapphire Needles. Stock #RECOTON-586 RN-5, Ship. Wgt. 6 ozs. Price ..... $5.95 ea.

RECOTON with Diamond LP & Sapphire 3 Mil Needles. Stock #RECOTON-500-D RN-5 Ship. Wgt. 6 ozs. Price..$15.95 ea.

HI-FI TONE ARMS

DE-LUXE FLIP OVER MODEL

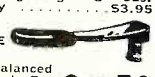


2 Models for All Needs With 2 Precious Metal Stylii. Uses 3 Mil and 1 Mil Needles. Output Is 3 Volts. Responsce Is Better Than 50-7000 cps. Spring Counter Balanced Arm Replaces Earlier Models. Shipping Wgt. 8 Ozs.

Stock #TA-703-RN-S Lots of 3 **$3.69** Ea.

Singly $3.95

UNIVERSAL TYPE



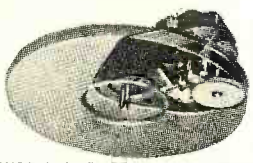
Spring Counter Balanced Arm. 3 Volts Output. Responsce Better Than 50-5500 cps. Uses Low Pressure Cartridge. Less Needle. Ship. Wgt. 8 Ozs.

CONCORD'S PRICE .....

Stock #TA-101-RN-5 **$2.79** Ea.

$2.95 Singly—Lots of 3

4-SPEED PHONO-MOTOR



CONCORD is first with this latest addition. The new 16⅔ speed offers the listener the finest pleasure—Talking Books. Ideal for the invalid, children, students, and blind people, every type of reading by listening is available. For operation on 110-120 V. 60 Cycle A.C. 3-Speed Same As Above. Shipping Wgt. 6 Lbs. Reg. $12.75. $4.95 Ea. Lots of 3..... **$13.00**

Stock #3-PHMI-RN-5. Stock #4SP-PM-RN-5 Shipping Wgt. 6 Lbs. **$6.95 ea.**

A $149.50 Tape Recorder And Record Player

At the Low Price of

These Will Sell Fast. Get Your Order In At Once! **$48.88 each**

- Fine 3¾ IPS Tape Recorder
- Built-in 5 Watt AC Amplifier
- Wide Range Tone Control
- Fine 78 RPM Player Incorporated, With Custom Tone Arm
- Input For External Speaker
- Wide Response Crystal Microphone
- Neon Bulb For Recording Level
- Custom Luggage Case

Stock #Wil-Gay-U-RN-5 Shipping Wgt. 31 Lbs.

RECORD CHANGERS

MARKEL

Plays BOTH sides of 78 RPM Records automatically, in sequence. Separate Hi-Fidelity arm for 33 RPM records. Finest dual-styli obtainable. Weighted turntable. Motor is finest of its type. Push button selection.

MODEL 72 Record Changer

Reg. Cost 125.50. Almost 70% Off. CONCORD'S WHOLESALE PRICE ..... **$29.95** Each

Stock #MAR-RN-5.

NEW 4-speed

16⅔ | 45
33⅓ | 78

Automatic Record Changer with Famous Hi-Fi Cartridge

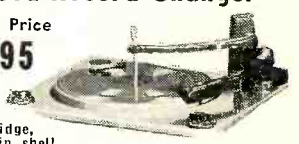
NEW EXCLUSIVE 4-SPEED RECORD CHANGER. Plays 33⅓, 45 and 78 plus the new 16⅔ RPM "talking book" speeds. Has new patented constant speed turntable drive. Rumble-free performance, gives twice the life, half the wear. Spindle gently lowers precious records on air cushion to turntable. Will play for hours without interruption.

$26.95 each

Stock #WEB-RN-5 Wgt. 14 lbs. 45 rpm spindle Wt. 2 lbs. Stock #A45-3-RN-5 .....$1.98

New 1957 COLLARO RC 456 4-Speed Record Changer

Concord's Price **$28.95**



less cartridge, with plug in shell

with flip-over cartridge **$31.95**

FINEST ENGLISH CHANGER!

- Rugged rumble-free 4 pole motor.
- Weighted, balanced turntable.
- Switches off automatically, rejects instantaneously.
- Full Manual or Automatic operation.
- Intermixes all size records.
- Automatic Idler Disengagement.
- Size: 12" x 13½", Requires 5⅛" above and 2⅝" clearance below.

Stock No. RC-456-RN-5.

CONCORD'S LUCKY BUY SAVES YOU $$$$$$$$$$

Finest Quality 4 Tube Personal Portable Radio

Fully Warranteed!!

Imported to save you money, Concord bought a carload and passes savings along to you. Double check the quality features and you'll hurry to buy several.

- Full 4 Tube Super-Het Circuit (1—1R5, 1—1T4, 1—1U5, 1—3S4).
- Full Broadcast Coverage—532 Kc.—1640 Kc.
- Quality 2½" PM Speaker.
- "Hi-Impact" Plastic Case for Added Safety.
- Uses Long Life Batteries for Economical Operation.
- Retracting Handle for Portable Use.
- Your Choice of Colors at No Added Cost—Ebony, Maroon, Ivory.
- One Piece Chassis, Easily Removed.
- Highly Sensitive Bar Type Antenna.
- Personal Size: 6¾" x 4" x 1½".

Weight with Batteries Only 1.7 Lb.

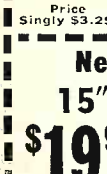
Sold Nationally for.....$21.95

CONCORD'S CLOSEOUT PRICE **$13.95** (less batteries)

BATTERIES FOR ABOVE—one each—EVEREADY 935.....09 each; 415....1.75 each

Stock #5 Star RN-5, Shipping Wgt. 2 Lbs.

CRYSTAL MIKES ! ! !



MODEL 101-RN-5 Die cast case, baked on gray enamel finish. 6 foot shielded cable, stand adaptor. Response better than 60-7000 CPS. Output level 49 db. Shipping wt. 1 lb. Reg. Price $9.95. Concord's Closeout Price Singly $3.25 Lots of 3 Each **$3.69**

MODEL 102-RN-5 Handy durable plastic case tan finish. 5 feet of shielded cable. Response is 60-8500 CPS. Output level 45 db. Shipping Wgt. 1 lb. Reg. Price $8.95. Concord's Famous Price, Each Singly $3.95 Lots of 3 Each **$2.95**

New 1957 Coaxial Speakers

15" $19.95 Worth $45.00

12" $10.66

8" $8.45

• Don't Lose the Beauty of Low Response • Our Price is Less Than You Would Pay for a Smaller, Inferior Unit • One Piece Molded Cone • Built-in Cross Over Network • Massive Alnico No. 5 Magnet Weighs Almost 1 Lb. • Modern Design in the 15" Woofer • 4" Tweeter Delivers Brilliant Highs • Handles 25 Watts with Ease • Frequency Response 30 to 16,000 cps. • Voice Coil Impedance 8 OHMS.

Stock No. CXS-15A-RN5. Shpg. wt. 12 lbs.

Your 1957 Catalog Is Ready . . . Write for Free Copy

CONCORD RADIO CORP.

45 Warren St., N. Y. 7, Dept. RN-5

RUSH THE FOLLOWING ITEMS:

1—..... 3—.....

2—..... 4—FREE CATALOG

☐ I AM ENCLOSING $.....

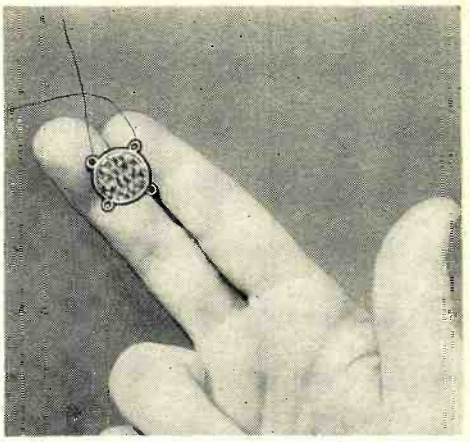
☐ SEND C.O.D. I ENCLOSE 20% DEPOSIT

NAME .....

ADDRESS .....

Miniature Atomic-Powered Battery

Delivers continuous power for at least five years.



Man's fingers loom large holding tiny battery which in its shielded form shown above is no bigger than a cuff link.

ATOMIC energy has come a giant stride closer to casual use by the man on the street with the recent announcement of a tiny nuclear-powered battery that will deliver useful electrical current for at least five years.

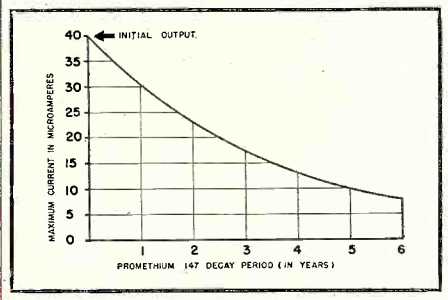
It is the first such device to harness radioactive materials in a way that makes them safe for extensive personal use without special precautions, say inventors of the cell. Although not yet available commercially, the long-life battery will eventually be used in such products as electrically operated wrist watches, hearing aids, miniature portable radios, and civil-defense warning receivers for the home that can operate around the clock for years.

The atom cell, developed by *Elgin National Watch Co.* in conjunction with *Walter Kidde Nuclear Labs. Inc.*, Garden City, N. Y., operates for a period of time that is determined by the rate at which the radioactive promethium 147 disintegrates. This presently scarce isotope, which was reclaimed from the atomic bomb "ash heap," is now believed to have a half-life of about 2½ years. Present high cost of promethium 147 will delay commercial availability of the atomic cell, although extensive expansion of production facilities by the A.E.C. has already started.

The two-stage process of producing electrical energy within the cell involves a tiny amount of phosphor, or crystalline substance that converts into light energy the *beta* energy particles emitted by the radioactive isotope. A silicon diode, which actually operates as a photocell, then changes this light into usable electrical current.

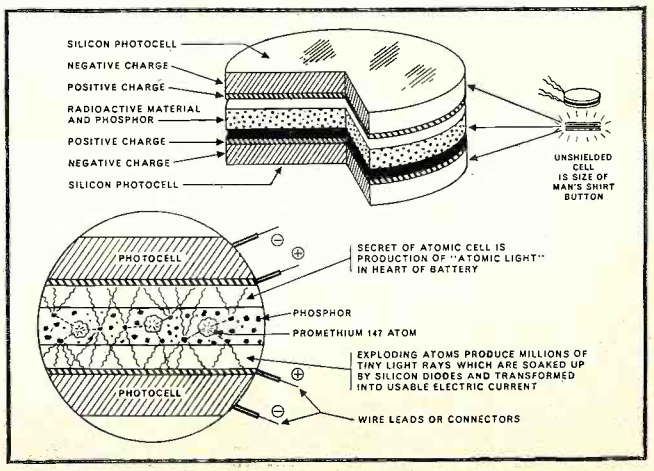
The *Elgin-Kidde* cell uses a transparent container of radiation-resistant plastic to seal the light source, which gives off red and infrared radiation. Photocells, of a modified solar type, may be connected in various ways to produce output voltages from ¼ to 1 volt, with an output power of 20μw. when new, falling to 5 μw. after 5 years. The present cell is housed in a compact metal protective shielding.

Laboratory samples to date have delivered 20 μa. of current. According to present target specifications, a cell will be made to deliver 40 μa. of current by the use of larger amounts of the radioactive material. —30—



Life performance, showing maximum currents delivered over long period of time.

Beta radiation converted to light acts on photocells and produces electricity.



"Super-DX" Converter

(*Continued from page 53*)

be completed before the plate is fastened to the side rails. The two peaking trimmers are mounted on the end rail section, as shown in the photographs. After the converter is completed, the bottom plate is secured by means of the sheet metal screws, supplied by the manufacturer, thus completely shielding the r.f. circuitry.

The assembly and wiring are not difficult but care must be exercised to keep the r.f. leads short and direct. The r.f. bypass capacitors are mounted between the 6BQ7A socket terminals and ground. The capacitor leads must be kept as short as possible. All bypass units are disc ceramic types. The usual precautions with regards to bypassing to suppress parasitic oscillations also apply.

Complete data on the output coils and the tuned interstage transformer is included in Fig. 1.

To adjust the converter, remove the 6BQ7A from its socket and apply heater and plate voltage to the 6J6 oscillator and mixer. The 6J6 plate voltages should not exceed 100 volts. Tune the communications receiver to 24.75 mc. and plug in the 8.25 mc. crystal. The oscillator signal, when tuned in on the receiver, should be very strong and may drive the "S" meter completely off-scale. For adjustment purposes, the carrier level from the oscillator signal should be about "S-9" but not full scale. Adjust the oscillator coil slug for maximum output at 24.75 mc.

Now tune the receiver to 16.5 mc. The second harmonic of the crystal may be heard but should be very weak as compared to the level of the third harmonic on 24.75 mc. If the 16.5 mc. harmonic is the strongest, remove three or four turns from the oscillator coil and re-adjust for maximum output on 24.75 mc. If the coil resonates at 24.75 mc., the 16.5 mc. signal should be at least 50 to 60 db lower in amplitude than that of the third harmonic. There should be a sharp increase in output from the oscillator as the slug is tuned through resonance. However, the crystal will generally oscillate even though the coil is detuned.

Now replace the 6BQ7A and apply plate voltage to both tubes. Terminate the antenna input jack with a non-inductive 50-ohm resistor. Connect the converter output to the receiver antenna and ground terminals. Tune the receiver to about 3.5 mc.

A low-level test signal, such as that supplied by the transmitter crystal oscillator or a v.f.o. operating on the 15-meter band, will be useful for adjustment purposes. Tune the receiver dial for maximum signal indication. Peak the mixer plate trimmer for maximum signal. The mixer grid circuit trimmer will tune broadly but should be peaked with the test signal adjusted to approximately 21.25 mc. Set the front panel r.f. trimmers at half scale. Ad-

just the 6BQ7A plate trimmer for maximum signal at 21.25 mc.

Adjust the slug of the r.f. amplifier grid coil for maximum indication. If the 6BQ7A circuit oscillates, rotate the r.f. plate and grid trimmers back and forth across resonance and adjust the small ceramic neutralizing trimmer *very carefully* until the circuit is stable. When the r.f. stage is properly neutralized, there should be no oscillation when any or all of the tuned circuits are peaked. To adjust for best noise figure, remove the test signal and carefully peak each circuit for maximum noise. Adjust the neutralizing capacitor for minimum noise. When properly adjusted and neutralized, the noise indication on the receiver "S" meter should not be over "S-1" or "S-2" with the converter input jack terminated in 50 ohms. If the noise reading is higher than this figure, it indicates regeneration in the r.f. stage. Increase the values of the r.f. bypass capacitors to .02 μfd. or add a small metal plate between the 6BQ7A grid and plate circuits to obtain better isolation. This additional shielding was not required in the original model. The metal shield plate shown in the photographs is to prevent pickup of strong signals in the 3.75-3.3 mc. region by the mixer plate coil.

To match the transmission line to the converter input, remove the terminating resistor and connect the coaxial line from the antenna to the input jack. Leave the r.f. amplifier grid trimmer at about half scale. Tune in a steady 15-meter signal and alternately adjust C_2 and L_1, for the highest "S" meter reading. In the original unit, the best match was obtained when the total capacitance across the input terminal was about 150 $\mu\mu$fd. The exact value will be determined by the standing-wave ratio of the coaxial line.

The adjustment of the input capacitor will affect the neutralization slightly. After the matching is completed, the neutralizing capacitor should be carefully re-adjusted as outlined previously.

The heater and plate voltages for the converter may be obtained from the receiver power supply or from a separate source. Use the lowest value of plate voltage which will give good results. In the converter shown, the 6J6 mixer and oscillator plate voltage is about 75 volts; the plate voltage on the 6BQ7A output section is about 180. The over-all gain from the converter, as compared to the receiver operating directly on 15 meters, is approximately 35 db.

Using the HRO-7 and converter combination, as shown in the photograph, thirty-seven countries have been worked over a period of several weekends. Many of these countries, in all parts of the world, had never been heard previously on either the receiver alone or when using a broadband converter. A number of these converters have been built by overseas armed forces personnel for use with the older military receivers. —30—

Mac's Service Shop

(*Continued from page 70*)

those old-timers that use a large triangular-shaped piece of cardboard covered with metal foil to ground the outer coating of the picture tube. The foil is supposed to be held against the outside of the tube with springs, but the stuff on which the foil is fastened had warped allowing the foil to pull away from contact with the tube.

"At just certain conditions of temperature, etc., this foil started to vibrate at a low frequency that gave forth a sound exactly like 120-cycle hum coming out of a speaker. I'm still not sure why the foil vibrated like this. Maybe an electrostatic charge was induced in it that pulled it down against the tube coating. When the coating was touched, the charge was lost and the foil sprang back, only to have another attracting charge induced in it that forced it to repeat the cycle."

"It's hard to be sure about something such as that, but your explanation sounds logical," Mac agreed.

"Curing the trouble was simple, of course," Barney concluded. "I just rearranged the springs so that the foil was held firmly in contact with the tube, and the hum was gone—this time, I know, for good. But if I live to be a hundred, I know I'll never forget that feeling of absolute bewilderment that swept over me when even disconnecting the speaker did not stop the hum I thought was coming from the speaker."

Mac chuckled heartily as he said, "I can't help but laugh at how you must have felt, but in all honesty I don't think you need be too rough on yourself for not spotting the difficulty.

"It's the sort of thing you will not find in your book under 'causes of hum.' There is no reason why it should be there any more than there is reason for the knowledge of this freak possibility being tucked away in your mind. However, I feel that buried deep down in this experience is a sort of lesson. I'm not sure if I can put it into words or not, but I'll try:

"In doing service work, it is of the essence that you be logical and methodical just as long as possible. We have often talked about how much time and effort you can waste by being haphazard in your troubleshooting. The most likely causes of a particular trouble should be checked first; then the next most likely, and so on. But finally there comes a time when you have checked and double-checked every logical cause of the trouble without getting results. Then is the time to cut yourself loose from logic and method and start making tests and probing circuits that common sense tells you could not possibly be the cause of the trouble. That's what you did subconsciously when you disconnected the lead from the speaker."

"I suppose the tricky part is knowing just when to abandon logic," Barney observed.

"That's right. It should be a last

resort, not a form of first aid. The poorly trained technician is likely to run out of 'logical' tests much sooner than the technician with a good grasp of theory backed up by lots of experience. That is where a book such as the one in your lap comes in handy. It insures that no logical cause of the trouble is overlooked.

"But there are still times when the best of technicians, armed with all his knowledge and his experience and his books, comes upon a real 'dog.' And when I say 'dog' I am not referring to those small puppies that only look like dogs to inexperienced technicians. When you meet up with one of these, then is the time to go bravely beyond logic in your thinking and testing, while you maintain every sense keenly alert for the smallest clue.

"Eventually you will whip the trouble. Then others will say you 'stumbled' on to the cause, but you will know you solved it by stubbornly refusing to give up simply because the difficulty did not yield to routine service techniques." —30—

Tube Tester Modernization

(*Continued from page* 65)

ism was felt to be the most logical means of eliminating thumb calluses and slow operation.

For this feature, the following items, shown in Fig. 4, are required: An Allen socket-head cap screw, a round washer, a couple of machine screws with matching nuts and lock washers, and a hand crank. The Allen socket-head cap screw used had a ⅜" shank and a 5/16" hexagon socket in the head. The shank immediately below the head was not threaded. The washer was 1⅛" outer diameter, ⅜" diameter hole, and 1/16" thick. The cap screw head was sawed off 1/16" down the shank—the remaining portion of the shank being the same length as the thickness of the washer used.

The 1/16" shank remaining was then pressed into the hole of the washer between the jaws of a vise. A series of chisel marks was made across the edges where the shank and the washer met, to further strengthen the bond. Two small holes were then drilled through the washer 180 degrees apart. The washer and cap screw head assembly was then clamped dead center on the face of the thumb wheel, and holes were drilled through the composition wheel so as to be perfectly aligned with the holes through the washer.

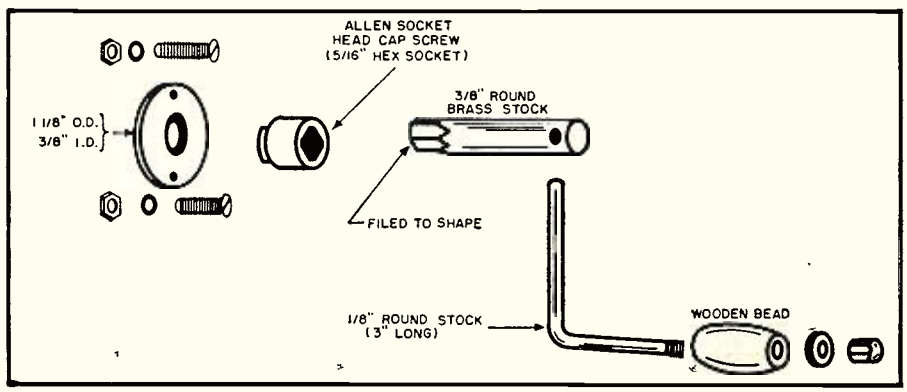
The socket assembly was then fastened to the thumb wheel with the two machine screws, lock washers, and nuts. It was not necessary to remove the composition thumb wheel from the roller chart mechanism to perform this operation, although the entire roller chart assembly was detached from the tester chassis.

With the roller chart assembly replaced and the tester chassis back in its case, the exact spot to drill a hole in the side of the case for the crank to go through was determined. A carpenter's square was used to do this. A ⅜" diameter hole was drilled through the side of the case, with care being used to hold the drill at right angles to the side of the case. All that remained now was to fashion a crank that would engage the 5/16" hexagon socket and utilize the ⅜" round opening in the side of the case as a bearing to reduce any side thrust when operating the crank.

A 2-inch length of ⅜" round brass stock, with one end filed down to a 5/16" hexagon shape and the other end drilled crosswise to accommodate a length of ⅛" diameter round brass stock (jammed fit) was made up. A 3-inch piece of this ⅛" diameter stock was bent to form a right angle, with one leg being 1¾" long and the other 1¼". The longer leg was pressed into the hole in the ⅜" round stock, and a wooden bead was slipped over the short leg. The end of this short leg was then threaded and a washer and nut affixed to it.

Figs. 1 and 3 show the tube tester adapted to test noval tubes and fitted with the removable hand crank. Successful operation of the crank depends, to a large extent, upon the care exercised in positioning the socket assembly to the center of the thumb-wheel face. No less important is the alignment of the crank shaft with the shaft to which the thumb wheel itself is attached. The roll chart assembly itself should be lubricated sparingly at all points of friction. —30—

Fig. 4. How the parts of the crank fit together and join the thumb wheel.



Ultrasonic Generator

(*Continued from page 45*)

strument may be used to determine the maximum frequency which a patient can hear. Because of directional effect, it can also be used to determine which ear has the maximum sensitivity to high-pitched sounds. In research work, it might be used to determine the mental and physical reactions of patients to various high-frequency sounds.

Biology: In this field, the device should find wide application in studying the hearing range of animals or insects, as well as the effects of high-pitched sonic and ultrasonic energy on plants and animals. The reaction of bacteria or other microscopic life to the presence, or absence, of ultrasonic energy could offer a field of research.

Schools: Students and teachers should find that many of the possible applications of the instrument to specialized fields, such as medicine and biology, will also apply to the study of those fields. In addition, the device could be used in the physics laboratory to study, and to demonstrate, many of the basic laws covering sound propagation. At high frequencies, reflection, absorption, refraction, and resonance are all relatively easy to demonstrate, for the physical size of the "props" needed are small enough to be manageable in the average class room or school laboratory.

One of the most interesting experiments involving high-frequency sound energy is the classical "wine-glass" demonstration. A small wine glass is shattered by sound energy alone. Although this one has "whiskers," it never fails to mystify onlookers.

To perform this experiment, a very small wine glass is needed. The glass must be thin, and highly stressed. The glass is placed in front of the instrument and the output frequency gradually increased. As the natural resonant frequency of the wine glass is approached, the glass starts to vibrate in sympathy, building up to an extreme pitch, and finally shattering. *Not all glasses will give satisfactory results in this experiment, however, for success depends more on the characteristics of the glass than on the source of high-frequency sound energy.* In the "classical" version of the experiment, a vibrating violin string served as a source of sound energy.

As the worker gains added experience working with this transistorized ultrasonic generator, he will discover more and more applications for the instrument. One caution must be exercised in its use, however. Some individuals are more susceptible to high-frequency sound than others. Such individuals, if exposed to a high level of ultrasonic energy for an extended period of time, may suffer headaches.

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1. Louis, E. G.: "p-n-p—n-p-n Oscillators" RADIO & TELEVISION NEWS, *July 1956*
2. Garner, L. E.: "Transistor Circuit Handbook," Coyne

—30—

Within the Industry

(*Continued from page 30*)

of working area to the present division plant and corporate headquarters at Fullerton, Calif. . . . **HI-LO TV ANTENNA CORPORATION** has moved to new quarters at 1122-26 Newport Avenue, Chicago 13, Ill. . . . A 150,000 square foot addition to the firm's electronics plant at Harvard, Ill. is planned by **ADMIRAL CORPORATION.** The completed plant will have a production capacity of 6000 TV receivers, and 1000 high-fidelity phonographs daily . . . **BERKELEY DIVISION** of **BECKMAN INSTRUMENTS, INC.** is planning a $1,500,000 expansion program. Groundbreaking for the first unit of the project is scheduled shortly on a recently acquired six-acre site in Richmond, Calif. . . . **EPSCO, INCORPORATED** has announced the expansion of its engineering and manufacturing facilities with the addition of 20,000 square feet of floor space to its present 30,000 . . . **WESTINGHOUSE ELECTRIC CORPORATION** has broken ground for a new distribution transformer plant in Athens, Ga. The new plant will be located on a 238-acre site and will have about 750,000 square feet of floor space.

* * *

ED KINNEY has joined the audio and Recordata divisions of *American Electronics, Inc.* as chief engineer.

His previous experience includes work as project engineer on the first instrumentation recorder built in this country and chief development engineer on the first commercially successful instrumentation video recorder. He has also worked in the fields of transmitter installation and the development of electronic test equipment.

One of Mr. Kinney's first programs in his new position will be the expansion of the engineering staff to meet the demands of the growing line of products manufactured by the division.

* * *

ALBERT GOLDSTEIN has been named assistant sales manager of *Radio Merchandise Sales, Inc.* . . . *Allied Radio Corporation* has announced the election of three vice-presidents. They are: **ARTHUR E. DAVIS, ALFRED W. PRESKILL,** and **ALEX BRODSKY** . . . *Merit Coil & Transformer Corp.* announces the election of **GAIL S. CARTER** to the board of directors and his appointment as assistant to the president of the company . . . **DAVID M. GASKILL** has been appointed manager of industrial equipment sales for *Brush Electronics Company* . . . **MALCOLM ROSS** has been elected president of *General Transistor Western Corp.,* a subsidiary of *General Transistor Corp.* . . . **PAUL M. SAINT-AMOUR,** and **DONALD R. SINCLAIR** have joined the staff of *Keithley Instruments, Inc.* as sales engineer and works manager respectively . . . **E. V.**

SPACE has been named to the newly created position of manager, equipment and production development, *RCA* semiconductor division . . . *Radio Receptor Co., Inc.* has appointed **ALVIN HOLMES** assistant credit manager . . . **CRAIG C. BRITTON** has been named to the managerial group of *Arvin Industries, Inc.* . . . **WILLIAM L. GARFINKLE** has joined *Arrow Electronics Inc.* as an industrial sales engineer . . . **FRANCIS E. ABT** will fill the post of sales coordinator for *Du Mont* television receivers, high-fidelity phonographs, and radios . . . *Electro-Voice, Inc.* has appointed **OTTO C. DEUTSCH** as a factory sales engineer . . . **WILLIAM B. VALENTINE** has been appointed broadcast representative for New Jersey, New York, Ohio, and the New England states for *Collins Radio Company.* **JOHN M. HAERLE** has been named broadcast sales manager . . . The appointment of **TOM BROWN** as sales manager of the distributor division for *Oxford* speakers, *Oxford Components, Inc.* has been announced by the parent organization, *Oxford Electric Corp.* . . . **G. J. FEDER** has been named manufacturing manager, *RCA* semiconductor division . . . *Datamatic Corporation* has announced the appointment of **LAWRENCE W. KELBLEY** as director of manufacturing . . . **WALTER W. SLOCUM** has been elected executive vice-president of *Weston Electrical Instrument Corp.* . . . **WILLIAM H. MOORE** has been appointed a vice-president of *Packard-Bell Electronics Corp.* . . . *DeJur Amsco Corp.* has appointed **ERNEST W. GROSS** general sales manager . . . **WILLIAM E. WHITTAKER** has been named service manager for the receiver division of *Allen B. Du Mont Laboratories, Inc.* . . . **CHARLES R. OCHS** has been appointed administrator, advertising and sales promotion, *RCA* components division . . . **CHARLES W. SHAW**, assistant to the vice-president, marketing, *Sylvania Electric Products Inc.*, has retired after 26 years with the company . . . **MILAN E. ROBICH** has been appointed assistant sales manager of *Sealectro Corp.* . . . **W. J. HALLIGAN, SR.**, president and board chairman of the *Hallicrafters Co.*, has been elected to the board of directors of the Veteran Wireless Operators Association . . . **RUSSELL A. SCHLEGEL** has been named general sales manager, and **JOHN R. HEMION** assistant to the general sales manager of *Weston Electrical Instrument Corp.*, a subsidiary of *Daystrom, Inc.* . . . **MICHAEL E. KELLY** has been appointed Chicago branch manager for *Sylvania Sales Corp.*, operators of factory branches for the radio and TV division of *Sylvania Electric Products Inc.* . . . **O. LEE BALLENGEE, JR.** has been named *CBS-Hytron* regional equipment sales manager, Midwest division . . . **ABEL DeHAAN, JR.** has been promoted to the position of director of the Western division, *Tracerlab, Inc.* . . . **JOSEPH J. SULLIVAN** has been named manager of the hearing aid division of *Zenith Radio Corp.* . . . The election of **A. E. BYERS** as president, and **DR. B. W. ST. CLAIR** as vice-president has been announced by *Waveforms, Inc.*

. . . *Granger Associates* has appointed **DR. WILLIAM E. AYER** as vice-president and director of engineering, and **HUGH D. KENNEDY** as production manager . . . **LINDSAY L. LENHART** has been appointed a sales engineer for *Potter & Brumfield, Inc. . . . International Resistance Co.* has appointed **ROBERT L. COLFAX** sales manager of its *Hycor Division.*

* * *

RETMA is again offering its special seminar for all teachers of television courses. Co-sponsored by the N. Y. State Educational Dept., University of the State of New York, and New York Trade School, the course will be held at the latter school, 304 E. 67th St., New York City, from July 8 to 26. Tuition for the three-week, three-credit, 90-hour class is $37.50 for out-of-staters and $30 for N. Y. state residents.

Applications and tuition fees should be forwarded to Donald H. Stover, RETMA Service Coordinator, 1721 De Sales St., N. W., Washington 6, D. C.

* * *

HOUSTON TECHNICAL LABORATORIES has changed its name to **TEXAS INSTRUMENTS INCORPORATED,** Industrial Instrumentation Division . . . **BECKMAN INSTRUMENTS, INC.,** and **STATHAM LABORATORIES, INC.** have agreed to merge the two firms, subject to the completion of legal details and the approval of shareholders. The transaction will involve a stock exchange of up to 400,000 shares of **BECKMAN** for all of the **STATHAM** interests . . . **GENERAL PRECISION EQUIPMENT CORPORATION** has announced that **SIMPLEX EQUIPMENT CORPORATION** has been made a subsidiary of **GENERAL PRECISION LABORATORY . . . AHRENDT INSTRUMENT COMPANY** has changed its name to **LITTON INDUSTRIES OF MARYLAND, INC.** This organization is a subsidiary of **LITTON INDUSTRIES, INC. . . . SIMPSON ELECTRIC COMPANY** announced the acquisition by the parent company **(AMERICAN GAGE & MACHINE CO.)** of **STANDARD TRANSFORMER COMPANY . . . GENERAL TRANSISTOR CORP.** announced the acquisition of an 80% interest in **MAGNE-HEAD ELECTRONICS COMPANY,** which will operate as **GENERAL TRANSISTOR WESTERN CORPORATION . . . P. R. MALLORY & CO. INC.** announces the unification of its battery activities into a single operation, **THE MALLORY BATTERY COMPANY.** This company is a division of the parent organization. —30—

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