RUMBLE FILTERS FOR HI-FI SYSTEMS

RADIO & TV NEWS

AUGUST
1957
35 CENTS

World's Leading Electronics Magazine

23 PAGES ON HI-FI

HIGH POWER VS LOW POWER AMPLIFIERS

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OPERATION JUPITER

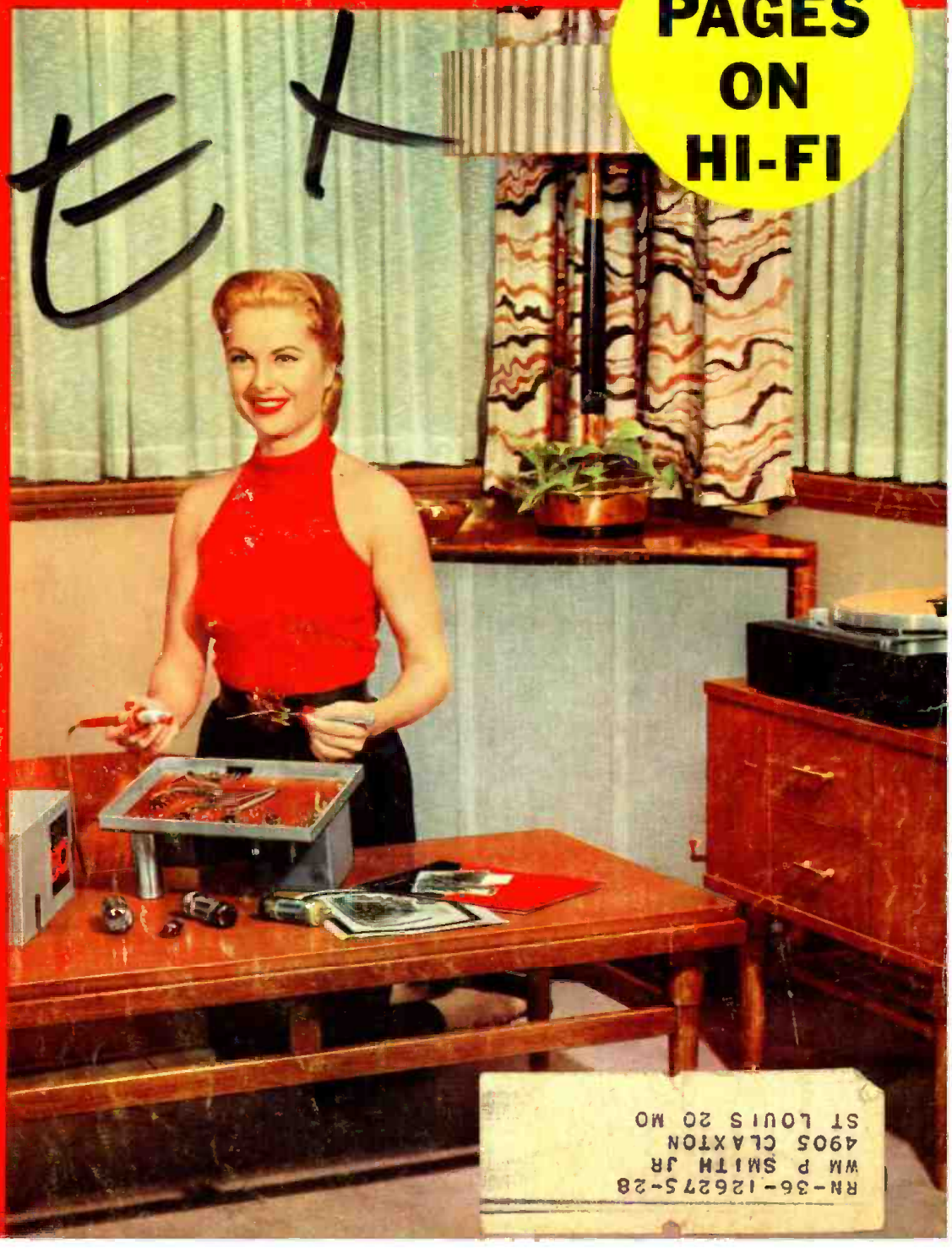
WOBBLED SCANNING WITH A NEW CRT

"ULTRAFLEX" SPEAKER ENCLOSURE

A NEW FM KIT FOR HI-FI

FRINGE-AREA FM RECEPTION

HI-FI FOR HYER➡
(See Page 92)



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The New G-E 1N1008 Brings You Just About as Close as You Can Come.

With the introduction of its new Type 1N1008 germanium TV rectifier, General Electric offers you a miniature 400ma device which can be used as a replacement for just about any make of selenium rectifier now found in television power supplies.
The 1N1008 is a 130V-400ma half-wave rectifier. Twin 1N1008's can be used in a voltage doubler circuit.

RATINGS AND SPECIFICATIONS

	Recommended Design Center	Absolute Maximum
RMS Input Voltage	117	130 volts
Peak Inverse Voltage	340	380 volts
D-C Output Current	200-400	400 ma
Rectifier Full Load Voltage Drop*	0.28	0.30 volts
Series Surge Resistor	4	4 (min) ohms
Ambient Operating Temperature	40	55°C
Operating Fin Temperature	50	65°C

**Full Cycle Average*

This represents General Electric's latest addition to its priced-right line of *snap-in* replacement TV rectifiers. Other easy-installation G-E TV rectifiers include the 1N1005 (250ma), 1N1007 (350ma), and 1N1013 (250ma). In most cases, the G-E snap-in design permits installation in the same chassis hole used for the selenium stud or bolt.

FREE...REPLACEMENT GUIDE

The General Electric Germanium TV Rectifier REPLACEMENT GUIDE tells you exactly which model fits your customer's set, and is the result of an analysis of all leading sets built since 1953. Only proved replacements are recommended. Get your copy, *free* . . . at your G-E tube distributor now. Or, write today to *General Electric Company, Semiconductor Products, Section S5887, Syracuse, New York.*

General Electric TV rectifiers are performance-tested by Howard W. Sams & Company, Inc. Check the low prices at your nearest G-E tube distributor. Just look for the new green & black cartons.

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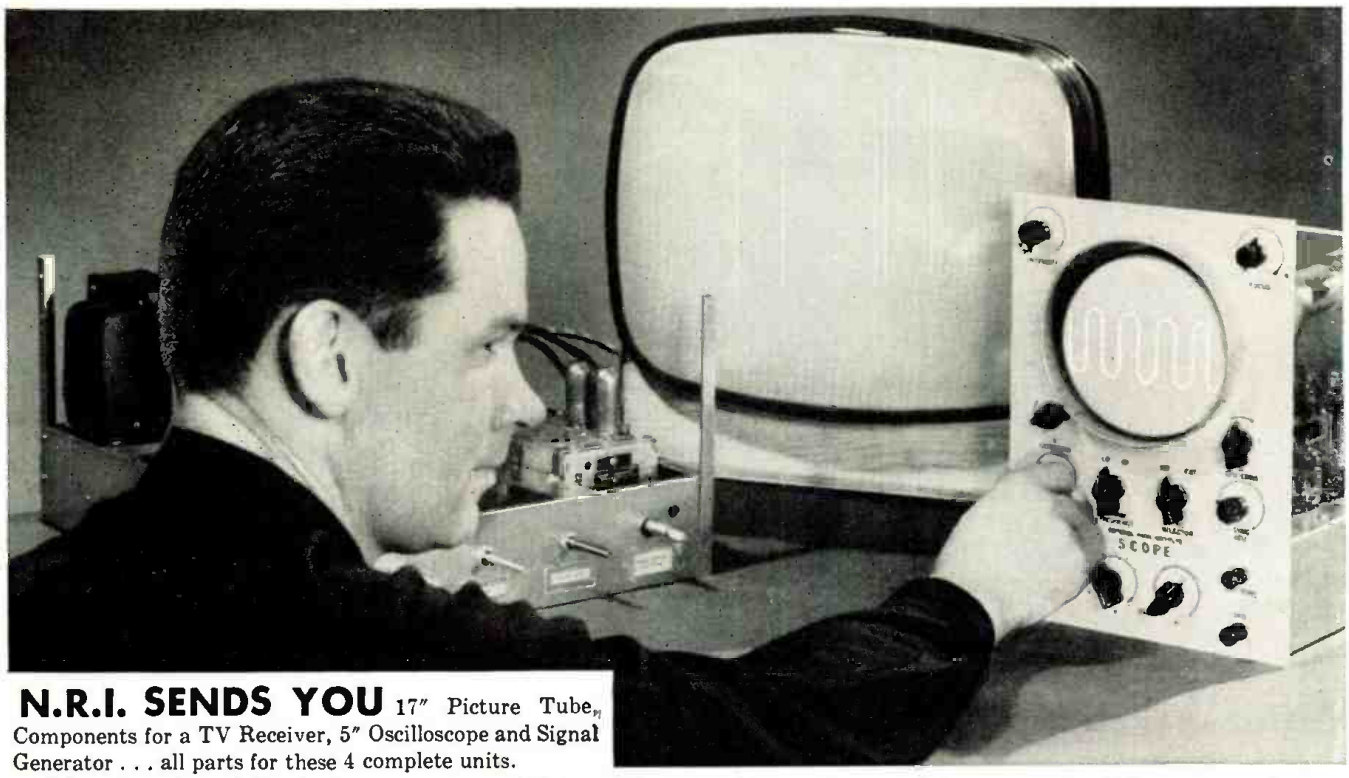
GENERAL ELECTRIC

NOW—A Faster Way to Reach the Top in TV SERVICING



N.R.I. SENDS YOU 17" Picture Tube, Components for a TV Receiver, 5" Oscilloscope and Signal Generator . . . all parts for these 4 complete units.

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The day you enroll, N.R.I. sends you special Color-TV books to speed your knowledge and understanding of this vast, growing phase of Television. Many full color pictures and diagrams help you recognize defects and help you learn how to correct them quickly and properly. To cash in on the coming Color TV boom, you'll need the kind of knowledge and experience this N.R.I. training gives.

This is 100% learn-by-doing, practical training. Here is a course for men who know basic theory, either from Radio or TV Servicing experience or planned training but realize the need for more knowledge to forge ahead. Here is what one graduate, G. G. Stethem of Belpre, Ohio, says, "I can not praise N.R.I.'s Professional TV Course highly enough. I have my own spare time shop and all the Radio-TV work I can handle."

Another graduate, Edward Ravitsky of Northumberland, Pa., says, "I have taken your course in Professional TV Servicing. It takes the kind of experience you offer to really learn." If you want to go places faster in TV Servicing, make your future more secure as the industry develops, we invite you to find out what you get, what you practice, what you learn from N.R.I.'s Course in Professional TV Servicing. Mail the coupon now. There is no obligation. NATIONAL RADIO INSTITUTE, Dept. 7HET, Washington 16, D. C.

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For the RECORD

HI-FI EQUIPMENT NEEDS SERVICE

ON OUR desk is an interesting survey of TV-electronic service shops, conducted by a well-known manufacturer of hi-fi and p.a. equipment who wished to determine the extent to which the service industry had penetrated the audio field, and also which magazines were preferred for service information on audio and related electronic products. We are as pleased with the high ratio of shops that *sell* audio products as we are by the fact that this publication headed the reader-preference list by a handsome margin.

In an earlier day, service outlets had little enough connection with the growing interest in high fidelity. Generally well built instruments did not require frequent, early repairs, and the interested fan learned enough to perform elementary checks and maintenance on his own. There was no problem in acquiring or using a stylus-pressure gauge; only a meter and slight skill were required for occasionally balancing out push-pull output tubes; and stroboscopic discs are often given away.

However, even the best designed equipment does not provide indefinite, trouble-free life, and the owner of audio equipment has been confronted, more recently, with the problem of where to go to get reliable handling of his valued gear. He does not have a wide choice of sources. To speak the plain truth, he has already learned that the man on whom he may justly rely for satisfactory repairs on his radio or TV set is not automatically prepared by this type of experience to work on audio equipment.

Where far-sighted service dealers have anticipated this problem, they have been able to carve out for themselves a sizable area of extra profit, not only in service income, but from reliable sales and installation. Also, those specialty shops that sell and service hi-fi only have come to the fore. These sources are able to demand and receive prices higher than the profitless, cut-price figures quoted by some of their competitors who offer nothing but the equipment. Obviously, the consumer is increasingly aware of the importance of a dependable source on which he can rely for advice and subsequent repairs.

Where does the service technician fall short? A working philosophy that has served him well for decades betrays him now. The technician is trained to "get the set working." If no sound comes out of a TV set, the repair may simply involve replacement of a dead output tube. The job ends right there; for no one imposes stringent requirements as to distortion, frequency response, and other such factors on this type of equipment. The technician must now be concerned with getting the set to work *right*. The discriminating man who pays a premium price for premium sound will not settle for less. He may point a guilty finger at an installation that is still "working," in the old sense, but justly complain that it has begun to sound mushy or no longer provides a sense of presence. You cannot tell him to let well enough alone.

To function in such situations, the service technician needs special knowledge in the subject, an understanding of the special type of customer with whom he must now deal, a new vocabulary, and equipment in addition to his conventional instruments, which he will also use.

Concerning the customer, something has already been said. He is not a crackpot; in fact, he generally has a more knowledgeable background than owners of more conventional equipment. He is entitled to sympathetic handling. On the other hand, he must also realize that the type of service he seeks, when he can get it, calls for a premium price. Give him what he wants and you will not find a better customer.

The language he speaks may sometimes be confusing. When the non-technical TV owner complains of "lines in the picture" over the telephone, the problem of deciding whether he means interference or loss of horizontal sync is nothing as compared to making sense of the hi-fi fan's complaints. The technician must learn to correlate such subjective evaluations as "the orchestra is blurred," "top piano notes fall apart," and "the violins sound steely" with objective factors like intermodulation distortion, limited frequency response or dynamic range, flutter, and overload.

To measure up, the technician must familiarize himself with existing equipment, what it can do, and its limitations. He must learn the difference between good and poor fidelity for himself. Without instruments, techniques, and records for assessing response, distortion, and other criteria, he is lost. Adequately prepared, he can do himself much good by providing a needed service for which the demand can only grow. . . . . W. S.

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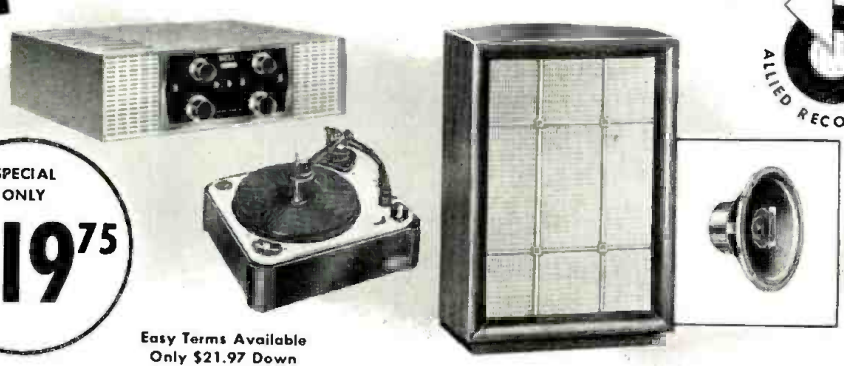

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94 PA 285. Net, F.O.B. Chicago, only $219.75

SAVE EVEN MORE—assemble your own speaker enclosure! System as above, but with E-V enclosure in unfinished kit form (KD-6 Kit). You save an additional $29.40 by doing the easy assembly yourself! Includes amplifier, changer and speaker as listed above. Shpg. wt., 90 lbs.

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The only pickup...

you can custom tailor to fulfill all requirements for optimum, unequalled play-back performance of every record in your collection

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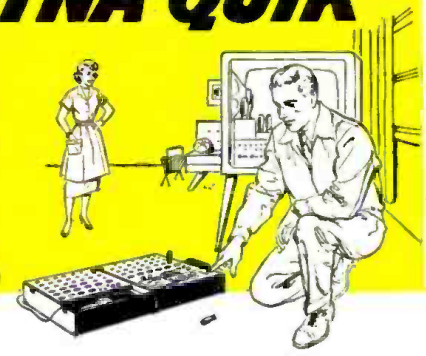

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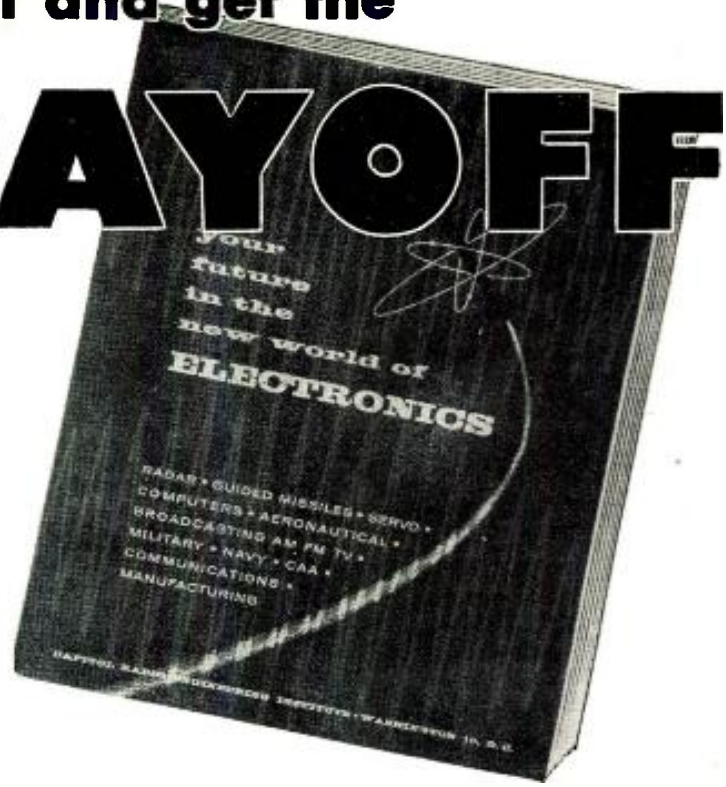

"You might like to know that since I have started this course, my company has given me a $32.00 a month raise. They seem to think anybody who has enough interest in their job to study at home is worth more money."

—Frank J. Mulvey, 910 124th St., S., Renton, Washington

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Here is just one of the many letters received from CREI students:

"In this time of less than two years, I have almost doubled my salary and have gone from wireman to engineering assistant and now to junior engineer. I have CREI to thank."—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

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Industry recognizes this, by choosing CREI to train their own technical staffs. Among them: United Air Lines, Canadian Broadcasting Corporation, Sears Roebuck & Co., Bendix Products Division, All American Cable and Radio, Inc.

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. . . as electronic engineering technicians. Employers contact us regularly for graduates to fill good jobs. Our placement bureau cannot keep up with the demands. Typical recent requests: "Two openings in our Field Service . . . aircraft electronics . . . starting salary is $380 and up . . ."—North American Aviation, Inc., Columbus, O. "Just about four months have passed since I made my first recruiting trip to CREI. As a result of that visit Messrs. Kohs, Plante and Wenger are now members of the Laboratories and Mr. Kresge soon will be . . . we have openings now and will have others . . ." Bell Telephone Laboratories, Murray Hill, N J.

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Spot Radio News

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By RADIO & TV NEWS
WASHINGTON EDITOR

THE SPECTACULAR ADVANCES made in electronics during recent years owe a significant part of their origin to the requirements of modern airborne weapon systems.

So declared Lieutenant General Thomas S. Power, commander of the Air Research and Development Command, recently, during a conference on aeronautical electronics in Dayton, Ohio.

The fantastic increases in speed, range, altitude, and all-weather capabilities of military aircraft, were noted as having created problems in the electronic art which continue to demand the best efforts of industry and the military services, alike.

Illustrating the growth scope of these problems, the air specialist said a modern fighter plane requires nearly 23,000 feet of electric wiring as compared with some 1500 feet in the average World War II fighter. Other examples cited were the 1500 electronic tubes required for a modern jet bomber, and the weight of its automatic all-weather bombing and navigation system—forty times as much as that of the 50-pound, manually operated, Norden bomb sight of World War II fame.

Requirements for the weapon systems of the future Air Force, manned as well as unmanned, will, it was emphasized, continue to impose increasing demands on the electronic field to provide operational solutions which will eliminate the need for dependence on human reaction. Also, electronics will have to provide the answers to the problems of global control of future weapons, as well as worldwide instantaneous warning and evaluation of an enemy threat in order to permit the most effective use of our retaliatory capability. Coupled with these requirements is the need to insure the utmost in performance and reliability. Too often, the ARDC spokesman said, our current solutions to new electronic problems result in stretching the performance of existing devices to the point where reliability and hours of operation cease to be realistic from either a logistical or operational standpoint.

ONE OF THE OBJECTIVES of psychological warfare is talking enemy troops into surrendering. A means of *talking* to ground forces from high altitudes, using magnetic tape playback, has been devised by industry under the supervision of ARDC.

After descending to 4000 feet, the magnetic equipment drives an amplifier producing a volume 250 times louder than that of the average home television receiver.

Nicknamed "talk down," the set fills a requirement for a means of *talking* to ground troops when weather conditions and ground fire prohibit the use of airborne verbal appeals delivered from low-flying aircraft.

The "talk-down" apparatus employs a barometric switch which opens a six and half-foot ribbon-type brake chute at about 12.000 feet, slowing the bomb-shaped device to a safe speed for the main parachute. When the barometric switch is activated, a timer starts functioning and, at 6500 feet, the tail separates from the main body, pulling out a 66-foot parachute. At 5000 feet, the "talk down" becomes stabilized and the nose separates from the main body, exposing the speaker. The set then operates for five minutes during descent from 4000 feet to the ground.

BY REFLECTING RADIO SIGNALS off meteor trails, a novel medium-range communications link has been established between Stanford Research Institute, Stanford, California, and Montana State College, Bozeman, Montana, a distance of 800 miles. Tests have been successful in voice as well as teletype communications.

Operating in the v.h.f. range, the two stations reflect radio signals off the meteor trails that occur about 60 miles above the earth's surface. The meteors create trails of ionized air that function like reflecting wire arrays.

The constant bombardment of the ionosphere by meteors enables the transmission of radio signals for distances as great as 1500 miles. Because of the small size of the meteors and the varying time intervals between their appearance, continuous transmission is not possible. Therefore, for maximum utilization of time, messages are transmitted at several times the standard teletype rate.

Systems Career: a laboratory for learning

. . . an exciting and rewarding career awaits the E.E. or Physics graduate who joins this highly respected Engineering team.

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The national respect which Hughes commands in the field of advanced electronics is in no small part due to the technical support provided by the Field Engineers. Other contributors to the success of the Field Service and Support Division are the Technical Manuals Engineer, Training School Engineers, Technical Liaison Engineers, and Field Modification Engineers.

This Hughes activity is a highly trained organization of expert engineers, giving support to the armed services and airframe manufacturers using the company's equipment. Locations are in Southern California, continental U.S., overseas. We invite you to join this team. For further information write us at the address below.

HUGHES

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Additional compensation plus complete travel and moving on assignments away from Culver City.

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The present link employs equipment similar to that used by the military and commercial world for short-range communications. However, by using signals reflected from meteor trails and equipment specially adapted for intermittent transmission, the unique Stanford-Bozeman system will enable long-range transmission of messages, and with lower powers than are now required for conventional high-frequency stations.

THE BUREAU OF STANDARDS has set up sixteen radio-noise recording stations throughout the world as part of the International Geophysical Year program. These stations will record radio signals generated by the more than 50,000 thunderstorms which occur daily on earth.

During the past year an atmospheric radio-noise recorder developed at NBS has been accepted internationally as appropriate for use in a world-wide measurement program. These receivers provide continuous recordings of the average power of the noise received on a standard antenna at eight discrete frequencies in the range from 15 kc. to 20 mc. In addition, some recorders have been modified to record the average noise voltage and the average of the logarithm of the noise voltage.

Some man-made radio noise will also be recorded and studied. However, most of the recording sites will be as far as possible from these sources of interference. For example, one station is installed at Marie Byrd Base in the antarctic, which is far removed from the radio noise of civilization and from the belt of high thunderstorm activity circling the equator. Information will be gathered at this base about the radio waves which travel long distances through the atmosphere.

The antarctic site is also an ideal place to study radio noise originating in the sun and the stars. Moreover, the station is inside the aural zone (the belt around the pole where the southern lights appear during magnetic storms) and thus will provide information on the effect this zone has on radio waves passing through it.

Stations planned for operation will include Marie Byrd Base, Antarctica; Maui, T. H.; Thule, Greenland; and Balboa, Canal Zone, in addition to the stations within the continental United States. Stations which will be operated by other governments, but equipped by the Bureau of Standards, will be located at Accra, Ghana, Africa; Cook, Australia; Johannesburg, Union of South Africa; Rabat, Morroco; San Jose dos Campos. Brazil; Singapore, Malaya; Stockholm, Sweden; and Tokyo, Japan. India will cooperate in the network by furnishing and operating two stations.

All data from the various stations will be forwarded to the Boulder Laboratories for analysis. The results of this study will not only provide valuable information about radio propagation and meteorology, but will also

The "GEM" of them all-- ROHN

TOWERS

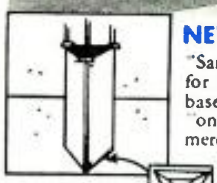
Rohn Towers are the only *complete line* of towers . . . from the No. 6 "all purpose" tower which is most suitable for TV installations, to the giant No. 40 communications tower. Hot-dipped galvanized finish is featured in the entire line.

No. 6 Tower is ideal for heights 50-120'. Features Magic Triangle construction that assures great strength, stability and durability. Stocking Rohn No. 6 Towers means you can fulfill practically all tower needs!

No. 40 Communications Tower for extreme heights and heavy duty work. Uses large 18" equilateral triangular design which allows heights up to 300 ft. or lesser heights where considerable strength is needed. Used widely for radio communication and micro wave throughout U. S. Sell this tower for these requirements existing in your locality.

Both the No. 6 and No. 40 Towers are in 10" sections and are easily installed without special equipment.

Also available: No. 30 Towers and a unique space-saver PACKAGED TOWER, the latter available in heights from 24' to 64'.



NEW BASE

"Same day" installation base available NOW for No. 6 and P. T. Tower! Use this unique base that permits "on the spot" erection and "on the ground" assembly. Towers are then merely "walked up" into position.

ROHN "superior design" LINE

Telescoping MASTS

Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. Quick installation . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives you a mast that won't pull apart with unequalled stability. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.

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5 "Superior Design" roof towers in heights from 2½' to 10'. Most all models are collapsible for easy shipping and storage. All models ideal answer for quick, inexpensive roof top installation. Get full information on this fine line of roof towers.

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establish an engineering basis for assigning frequencies to stations. For the commercial and military radio users who must know which frequencies are best for use at a given time and place, forecasts will be made of the amount of unwanted noise that will interfere with their communications. With other information provided by the Bureau, it will be possible to determine the minimum transmitter power that can be used to get information to the receiver, despite the competition from noise of natural origin.

A SIMPLE LAB INSTRUMENT to measure the current gain (or *beta*) of a variety of transistors has been developed by the Bureau of Standards in Washington. The tester can be used to measure the common-emitter short-circuit gain of *p-n-p* or *n-p-n* transistors at low audio frequency.

In operation, a transistor is plugged into the new tester and a dial is adjusted to a point where a tone is heard from a loudspeaker. The gain is then read from a calibrated dial.

The circuit used is similar in principle to the type used for measuring tube transconductance. In such a tube circuit, part of the plate voltage is fed back into the grid through resistor and transformer coupling to cause oscillation. Similarly, with the circuit for measuring transistor gain, the output is fed back into the input through a variable resistor and a transformer; when the resistor is properly adjusted, the circuit will begin to oscillate at an audio frequency.

The frequency at which oscillations will begin depends upon the characteristics of the transformer and the phase shift of the current gain. The current ratio of the usual audio transformer has a broad maximum centered at 1 or 2 kc., and if the phase shift of the transistor is sufficiently small, oscillation will begin at a frequency near this maximum. However, it has been found that the transistor gain required to produce oscillation for a given dial setting is not a particularly sensitive function of frequency. Thus, measurements which are accurate to within a few per-cent of the full scale can be expected with this novel tester.

A .15-OUNCE BATTERY, about the size of an ordinary-size flashlight cell, but with 63 times greater potential voltage and 10 times longer storage life, has been developed.

Described at a recent components symposium in Chicago, the battery was said to employ a solid electrolyte and be applicable where a deflection potential for cathode-ray devices is needed; the power package can also be used as a voltage source for dynodes of multiplier phototubes employed in conjunction with scintillation devices for radiation surveys.

At 70° F the battery is claimed to have a storage life of 20 years.

In the new battery, action takes place by the diffusion of positive silver ions through a solid electrolyte, which is silver-bromide; the net result of the chemical reaction is the displacement of electrons and the generation of additional electrolyte. In the reaction, the silver is used up and cupric bromide is directly converted to cuprous bromide.

A $2-MILLION CONTRACT for the development of a new radar set for air traffic control over a 100-mile area has been let by the Air Materiel Command.

A principal feature of the new equipment will be its ability to detect and track present and planned high-performance aircraft. It will be installed at Air Force bases for the surveillance of surrounding areas to pick up aircraft, allowing the ground controller to guide them rapidly and accurately over the landing strip.

When coupled to the ground-controlled approach radar, the air-traffic

(*Continued on page* 133)

NEW TELEVISION STATION GRANTS

An additional listing of new construction permits and changes that have been made in station call letters. List continued next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Pennsylvania	Lock Haven	.....	32	578-584	20
Wyoming	Sheridan	.....	9	186-192	3.08

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Arizona	Tucson	KOLD-TV (Formerly KOPO-TV)	13	210-216
Illinois	Pekin	WPKN	69	800-806
Massachusetts	Boston	WHDH-TV	5	76-82
Mississippi	Laurel	WTLM	7	174-180
Missouri	St. Louis	KMOX-TV	11	198-204
Oregon	Portland	KPTV (Formerly KLOR)	12	204-210
Texas	El Paso	KELP-TV (Formerly KILT)	13	210-216

* ERP = (effective radiated power, kw.)

Practical CBS Transistor Home-Study Course

Learn all about transistors by using them

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Let's face it. Transistors are here . . . now! Extra profits are waiting for service technicians who know all about them. Are *you* ready?

This new, profusely illustrated Transistor Home-Study Course, a CBS first, was written to make it easy for you to learn by using transistors. A residence course at home, it's fast and fascinating. What you learn you remember because you do it yourself . . . by making several practical transistor devices which you can keep and use. Course was written for CBS by A. C. W. Saunders. A well-known educator and author, he knows technicians and how to write for them.

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- Ten intensive lessons (with 3-ring binder) . . . up-to-date, complete
- Simplified basic theory . . . how transistors work
- Practical experiments and servicing techniques for:
  - *Amplifiers* . . . applications in all fundamental circuits
  - *Oscillators* . . . a-f, r-f, relaxation, multivibrator, special TV
  - *Rectifiers* . . . diode and transistor rectifiers and detectors
  - *Practical commercial applications* . . . immediate and future
- With free correction and consulting service . . . and up-to-date supplements for certified graduates

HOW TO GET IT?

See your CBS Tube distributor. He'll tell you how you can get the complete CBS Transistor Home-Study Course, PA-175, *free* with your purchases of CBS tubes: Each lesson with 100 tubes. Or full ten-lesson course with 750 tubes. Or complete course for $25.00. See him today!

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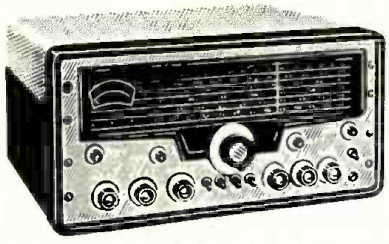
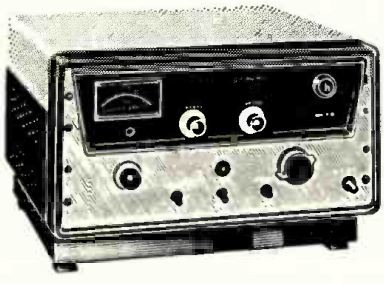


HALLICRAFTERS SX-101
RECEIVER. Net.....$395.00

HALLICRAFTERS HT-32
TRANSMITTER. Net.....$675.00



HALLICRAFTERS HT-33
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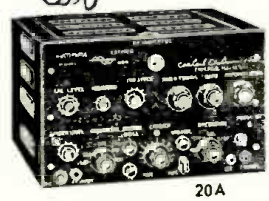
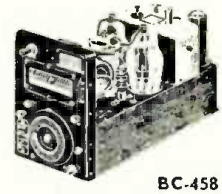
HEY! LOOK!

HOW ABOUT THIS?



20A



BC-458

BUY THIS PACKAGE DEAL AND GET A BRAND NEW BC-458 FOR ONLY 50¢

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Central Electronics 20A in kit form	$ 199.50
BC-458 conversion kit	15.00
Deluxe case and panel kit	10.00
BC-458 – BRAND NEW	.50
OUR SPECIAL PRICE	**$ 225.00**

PACKAGE NO. 2

Central Electronics 20A in wired form	$ 249.50
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Prentice Harrison, Lewes, Delaware	1st	27 weeks
W. E. Evey, Ottawa, Kansas	2nd	24 weeks
Raymond L. Gersig, Pittsburgh, Pa.	2nd	24 weeks
Francis W. Bartley, Danbury, Conn.	2nd	15 weeks

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

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Boyd Daugherty
105 Goodwin Ct., Apt. C
Falls Church, Va.

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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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- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
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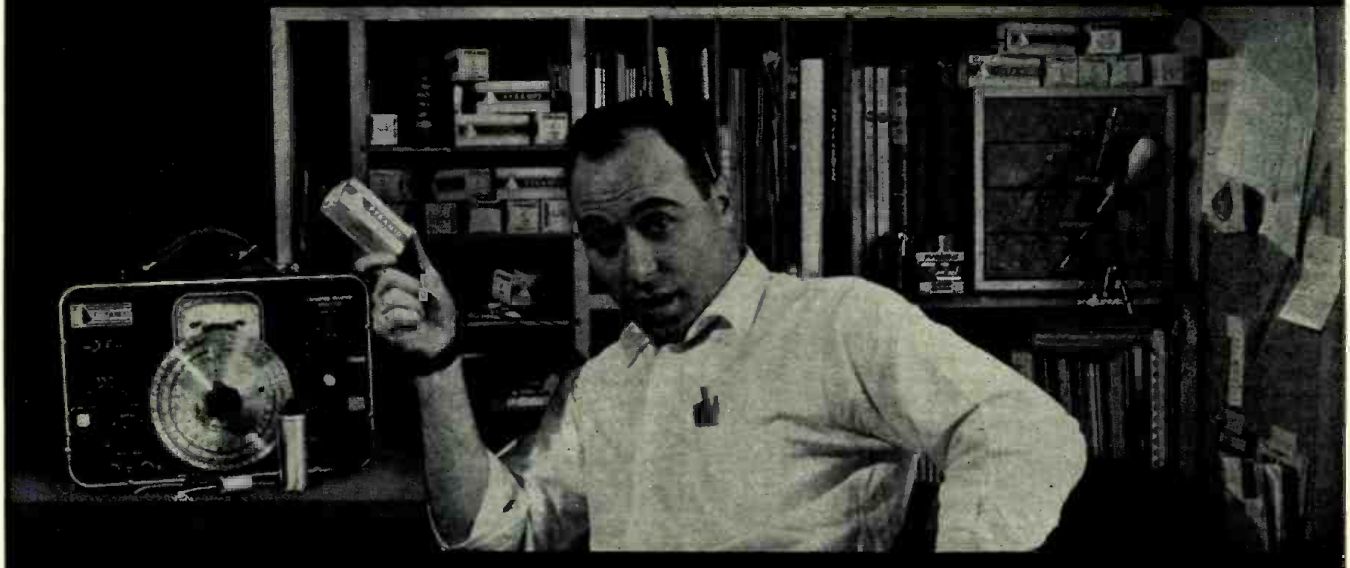

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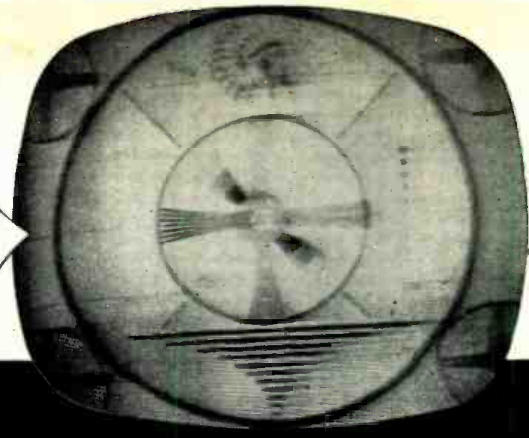
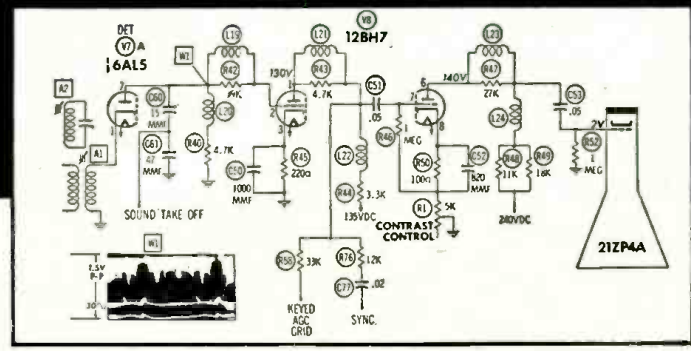
how long would it take you to solve this service problem?

SYMPTOM: Smeared Picture (showing black streaks trailing from blacks)



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



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

Let's take a look at this problem: A smeared picture such as illustrated above is caused by excessive low-frequency response coupled with poor high-frequency response. Look for the following possible causes:

1. Defective video amplifier, video output, or Picture tube
2. Low value of coupling capacitor C51 or C53
3. Low value of grid resistor R46 or R52
4. Open cathode bypass capacitor C50 or C52
5. Open series-peaking coil L23 or L21
6. High value of plate resistor R44, R48 or R49

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

Check the Video Detector (V7) and the Video Amplifier (V8). Just refer to the Tube Placement Chart (you'll find it in every PHOTOFACT TV Folder) for quick location of these tubes. Tubes okay?—then: Check the waveform at pin 7 of V7. The correct waveform is shown right on the PHOTOFACT Standard Notation Schematic. Waveform correct?—then: Check the voltages in the Video amplifier and Video output stages to determine which part is defective. The correct voltages appear right on the exclusive Standard Notation Schematic, along with resistances (shown in easy-to-read chart form). Exclusive PHOTOFACT chassis photos with "call-outs" keyed to the schematic help you locate the faulty parts in just minutes.

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.

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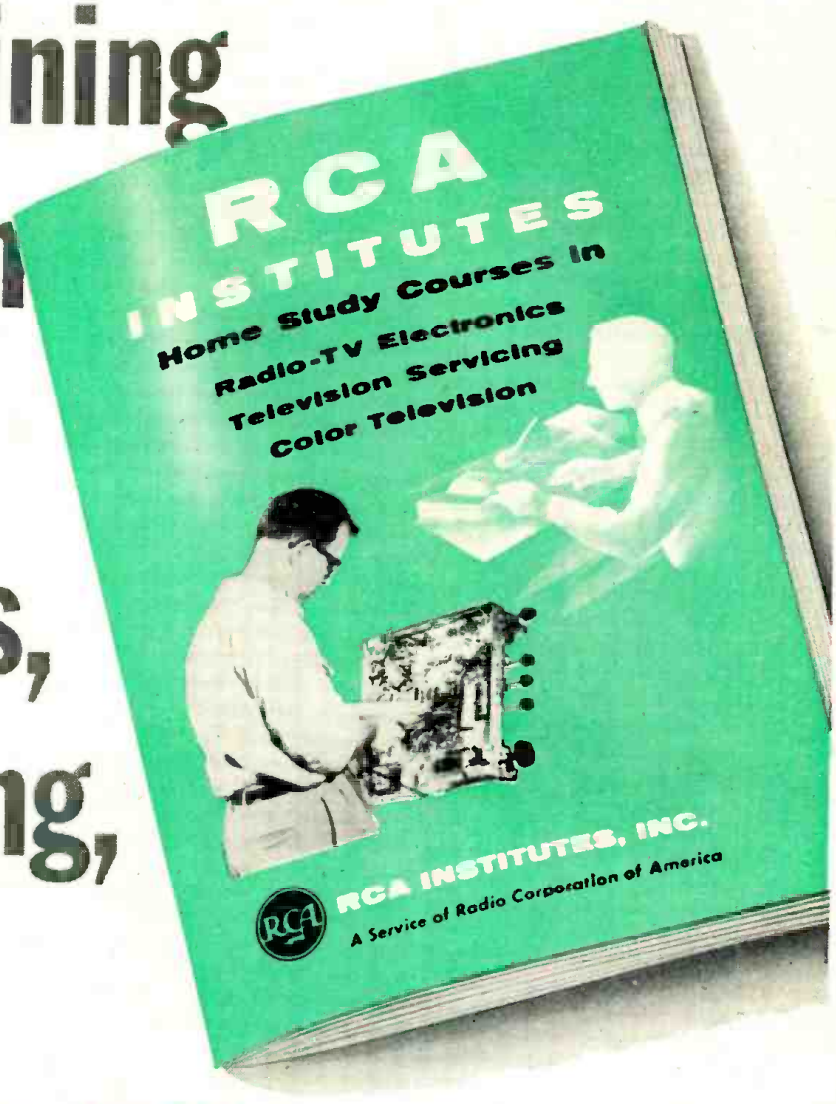

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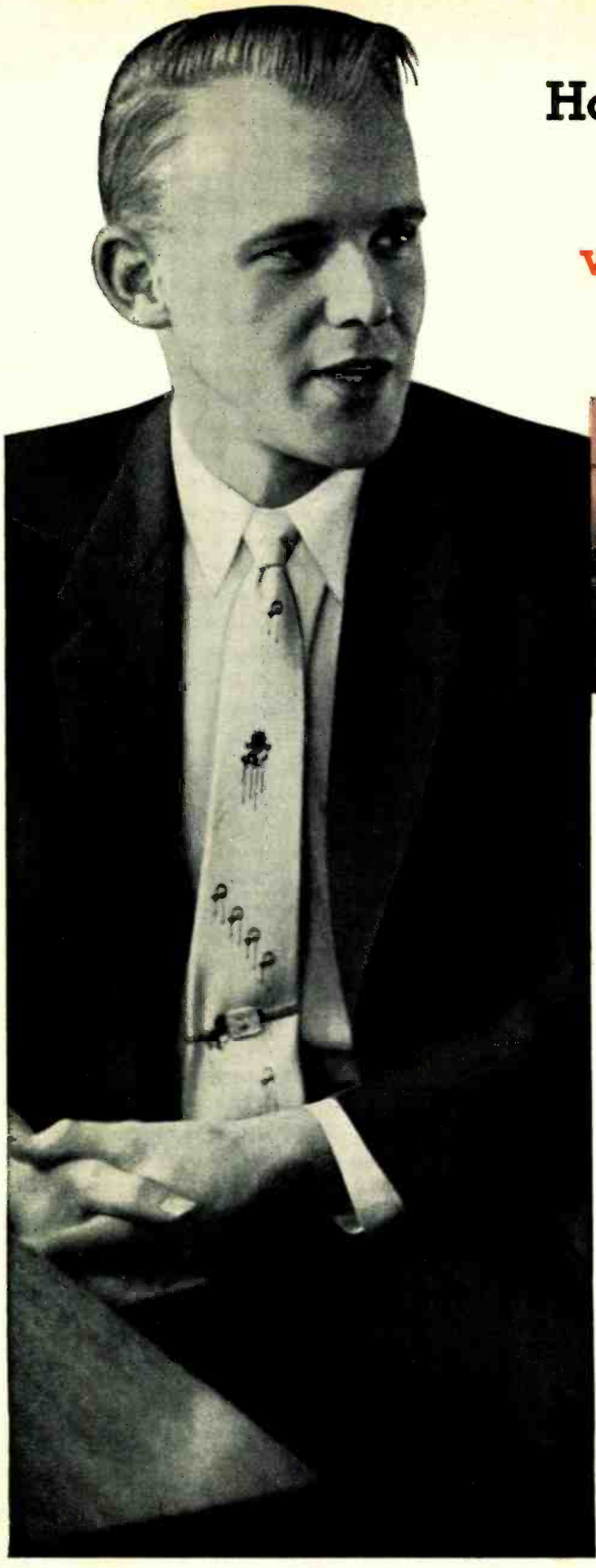

How far can you go in Electronics without a Degree?

Bernie Roth examines ribbon from printer during Field Engineering Laboratory period.

Without a formal degree, 24-year-old Bernie Roth is already established as a Computer Units Field Engineer—handling a key responsibility with IBM. At the McGuire Air Force Base, a directional control site for Project SAGE, Bernie is part of a team maintaining an entire electronic digital computer system. In this assignment, he must stay abreast of all the most advanced electronic concepts—developing his professional know-how every day. "That's what's different about IBM," Bernie says. "The graduate engineer has an advantage anywhere—but here at IBM the technician also can grow into managerial positions. IBM is one of the few organizations I know of that is willing to invest time and money in training the technical man—and then gauges his future ability strictly on performance."

IBM instituted its program for specialized technical training many years ago. The theory behind this built-in educational system asked the question: Why should the capable man be denied the opportunity simply because he lacks a formal degree? The wisdom and foresight of IBM's decision are reflected in the story of Bernie Roth—in the misgivings of his past—in the certainty of his future.

The Navy steers Bernie on the right course

When Bernie graduated from Flemington, N.J., High School in 1950, he received a general diploma—mathematics and science made up a small part of his curriculum. Enlisting in the Navy in 1951, Bernie proved his aptitude for technical work and was assigned to the electronics preparatory school in Jacksonville, Fla. Later, he attended the Class A Aviation Electronics School in Memphis, Tenn. . . . probably the most important phase of his naval training because it was in Memphis that he became convinced that a technical career was "Right up my alley." But an event that occurred during a furlough in the spring of 1955 put a brand-new light on Bernie's future.

Here, he scans the schematic of computer circuits.

Reports for training

Bernie smiled when he mentioned that his mother had a tendency to clip want ads. "It was just pot-luck that one of the ads she spotted was for IBM Kingston and Project SAGE." Soon afterwards, Bernie hopped a bus to Newark for an interview with the IBM representative. He took the required number of tests—talked over his hopes and ambitions, and "That's about all there was to it." In July, Bernie notified IBM that he was definitely available, and supplied the necessary references. Meanwhile, he made a study of IBM's history, its policies, its growth, and its future—all of which impressed him favorably. One day in September, Bernie received instructions to report to Kingston to begin training in the applications of electronic computers.

The material he studied at Kingston

"The Kingston program is a real experience, and quite an eye-opener in electronic techniques. First of all, I studied basic circuitry. Then, I actually learned a new way to think—the ability to comprehend the whole from the assorted parts. The student must know how to form logic blocks, and in time, he should be able to design his own circuits. All of this proved especially helpful once I got into the field. Later on, I studied the various input-output devices which are used as auxiliary units to the central computer. Finally, I analyzed the methods that supply the power for this electronic giant. Millions of watts are needed—a phenomenal amount. In general, I'd say that you couldn't find a better training ground for understanding the uses of electronic as well as electro-mechanical equipment."

Bernie checks a unit in one of the operating consoles.

How does Bernie feel about his current assignment?

"I'm responsible for the performance of the input-output devices—the auxiliaries that supply information to the central computer. The many Project SAGE outposts—picket ships, reconnaissance planes, Texas towers—flash their signals to the input devices which, in turn, correlate and compile the data. You might say the input devices prepare the food for digestion by the main electronic computer. This, incidentally, is one of the world's largest computers, which is built and tested at Kingston, then disassembled and shipped to a directional control site such as McGuire. Sometimes, I have the chance to assist in systems and displays. Now displays really fascinate me. There's a kind of television screen on which you can detect a plane, determine whether it's friendly or hostile, and where it's headed. My work is always different, never routine, and that's very important to me."

How does the future look to Bernie?

A happy and prosperous future is in the offing for Bernie Roth. Based on the records of his older associates, he's confident that in a short time he will qualify as a Systems Engineer, at the very least.* The next steps going up the ladder are Group Supervisor and then Group Manager. "The real satisfaction in working with IBM is the opportunity to understand more and more about electronic techniques. IBM is quick to recognize and reward improved ability through greater knowledge."

An outdoor man, Bernie takes full advantage of the New Jersey game preserve.

What about you?

Since Bernie Roth joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance, and IBM will invest thousands of dollars in the right men to insure its success.

If you have 2 years' technical schooling—or equivalent experience—IBM will train you for 6 months as a *Computer Units Field Engineer.*

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.*

After training, you will be assigned to an area of your choice. You receive *salary*, not wages, plus overtime pay. In addition, every channel of advancement in the entire company is open, and IBM is a leader in a field that is sky-rocketing in growth. And, of course, you receive the famous IBM company-paid benefits that set standards for industry today.

WHY NOT WRITE—today—to Nelson Heyer, Room 4308, IBM Corp., Kingston, N.Y.? You'll receive a prompt reply.

**Note: Since article was originally prepared, Bernie has been promoted to Computer Systems Engineer, and assigned to Santa Monica, Calif.*

IBM MILITARY PRODUCTS

DATA PROCESSING • ELECTRIC TYPEWRITERS
MILITARY PRODUCTS • TIME EQUIPMENT
SPECIAL ENGINEERING PRODUCTS

Within the Industry

RAYMOND E. WARD has been appointed sales manager for distributor accounts, *Shure Brothers, Inc.*, Evanston, Illinois.

He joined the organization in 1952 as a salesman in the distributor sales department, and since that time he has been calling on distributors throughout the country and analyzing products for that market.

In his new capacity, Mr. Ward will direct and work with the firm's sales representatives who are presently engaged in selling its components to authorized company distributors throughout the United States, Canada, and Alaska.

* * *

THE WEST COAST ELECTRONIC MANUFACTURERS ASSOCIATION has given 18 western universities major scholarship grants for deserving engineering students.

Funds for this annual scholarship program come from donations made by member companies of the electronics trade association.

Schools receiving scholarship grants for the 1957-58 school term are: Universities of Arizona, British Columbia, Idaho, San Francisco, Santa Clara, Southern California, Utah, and Washington. Also, University of California at Berkeley, UCLA, California Institute of Technology, California State Polytechnic College, Loyola University of Los Angeles, Oregon State College, San Diego State College, San Jose State College, Stanford University, and Utah State Agricultural College.

The purpose of these scholarships is to encourage and assist more young people in pursuing engineering careers in the electronic industry.

* * *

JOHN A. MIGUEL, JR. has been named vice-president in charge of export by the board of directors of *Zenith Radio Corporation*.

A graduate of Columbia University in New York City, he joined the export organization of *RCA* in 1929, remaining with them for twenty years. He has occupied executive positions in merchandising, sales, distribution, and plant management. He was also general manager of the subsidiary plant and general distributing company in Mexico and later became regional director of international activities for the Pacific and Far East area.

Mr. Miguel joined *Zenith* in 1949 as manager of the company's international division.

* * *

RETMA marketing data policy committee has reported a new record in dollar value of sales by electronics manufacturers during the fiscal year of 1956-57.

The report stated that the "dollar value of sales by the manufacturers is estimated to be nearly $5.7 billion vs $5.5 billion during 1955-56." And when distribution, service, installation, and broadcast revenue is added, "the total billing of the electronics industry is about $11 billion."

In addition, the association's international department has announced that exports of electronic equipment and parts rose nearly 24 per-cent over 1955, thus reversing a downward trend which had prevailed for the past few years. Reports covering the early part of this year (1957) indicate that this upward trend will continue.

* * *

HERMAN C. BLOOM has been appointed distributor sales manager of *International Rectifier Corporation*, El Segundo, California.

Mr. Bloom has been active in electronic distributor sales management for more than six years. In his new position he will coordinate and direct the activities of the distributor sales division, which supplies all types of rectifying devices, both for industrial and replacement applications, to electronic parts distributors throughout the United States.

* * *

ELECTRONIC PLASTICS, INC., a new company engaged in extruding high temperature plastic insulated wire and the custom molding of electronic component parts, has been formed. Sales offices for the new firm are located at 521 Fifth Avenue, New York 17, N. Y., and Warren L. Schnur has been elected president . . . Shareholders of **KAY LAB**, San Diego, Calif., have voted revision of the corporate structure, and a change in name. Approval has been granted for the sale of all assets to **COHU ELECTRONICS, INC.**, a Delaware corporation. In return, the California firm receives all the stock and assumes all the liabilities of the Delaware organization. In a second action, the shareholders approved dissolution of *Kay Lab* and the distribution to the shareholders of stock of *Cohu Electronics* in

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President, Sprayberry
Academy of Radio

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My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator. Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

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Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

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The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. *No salesman will call on you.* The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

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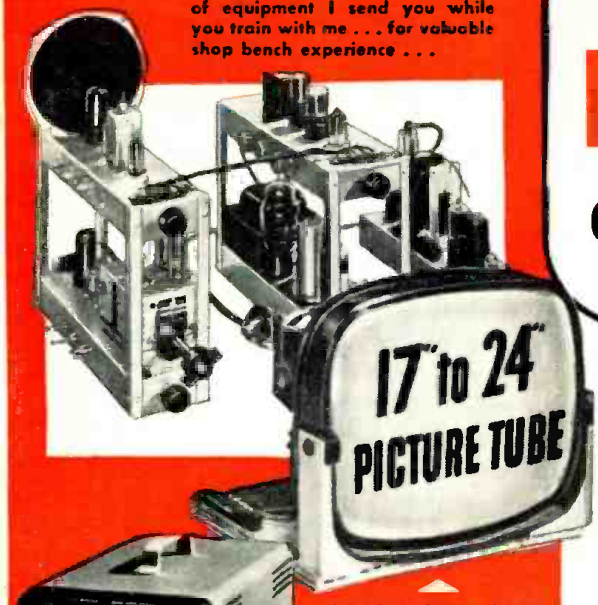
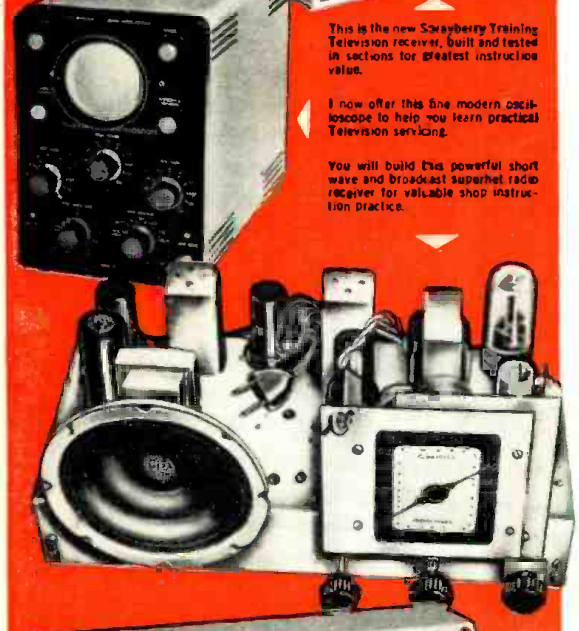


This is the new Sprayberry Training Television receiver, built and tested in sections for greatest instruction value.

I now offer this fine modern oscilloscope to help you learn practical Television servicing.

You will build this powerful short wave and broadcast superhet radio receiver for valuable shop instruction practice.



You build the new Sprayberry Tester... 18-range Volt-Ohm-Mil ammeter readings plus output meter and condenser and resistor substitution selector.

In addition to modern lesson training, I also give you plenty of home practice on actual Radio-Television equipment . . . you will build and use the units shown here plus many more. All this equipment is yours to keep...keep everything you need to set up your shop.

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Mail This Coupon For Free Facts and Sample Lesson

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Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that *no salesman will call upon me.* Include New Catalog and Sample Lesson FREE.

Name_____ Age____

Address_____

City_____ Zone____ State____

liquidation . . . **GREDAG, INCORPORATED,** a division of **ACHESON INDUSTRIES, INC.,** transferred its sales activities to **ACHESON COLLOIDS COMPANY,** an affiliate division . . . **BARLOWE TELEVISION** has changed its name to **BARLOWE ELECTRONICS** . . . A new electronics firm has been formed, to be known as **FISHER/BERKELEY,** and will be located in a 5000 square foot brick building at 4224 Holden St., Emeryville, Calif. Robert Fisher has been elected president of the new organization.

* * *

PAUL E. BRYANT has been named vice-president in charge of sales for the radio division of *Hoffman Electronics Corporation.*

A veteran of more than twenty years experience in radio and television sales, Mr. Bryant joined the organization in 1953 as general manager of the Los Angeles sales division. He subsequently served as general manager of all of the company's wholly owned distributing operations.

Prior to assuming his new position, he was general sales manager of the radio division.

* * *

L. M. HEINEMAN, president of *Permoflux Products Company,* has announced that all engineering, manufacturing, and sales offices are now concentrated in a new, modern, and enlarged plant in Glendale, California.

The firm, a division of *Linlar, Inc.,* now manufactures its products in the expanding electronics center of southern California, close to the industries requiring its specialized products.

Manufacturers and distributors are asked to direct their inquiries on the organization's products directly to the attention of the sales department, 4101 San Fernando Road, Glendale 4, California.

* * *

GENERAL PRECISION LABORATORY has opened a new 23,200 square foot environmental test building on its 69-acre property at Pleasantville, N. Y. . . . **LORAL ELECTRONICS CORP.** announces completion of its new $1.5 million plant building consisting of 100,000 square feet of single story floor space. The new building is located at 825 Bronx River Ave., Bronx, N. Y. . . . **RAM ELECTRONICS** expanded its engineering and production facilities and has moved to new and larger quarters at 600 Industrial Ave., Paramus, N.J. . . . **BLONDER-TONGUE LABS, INC.,** is now located in a new building, 9-25 Alling St., Newark 2, N. J. . . . **TECHALLOY COMPANY, INC,** is planning a $650,000 expansion program involving a new 24,000 square foot building . . . Construction of a $2,000,000 electronics facility for development of advanced radar instrumentation has begun at **SPERRY RAND CORP. . . . FEDERAL TELECOMMUNICATION LABORATORIES,** the

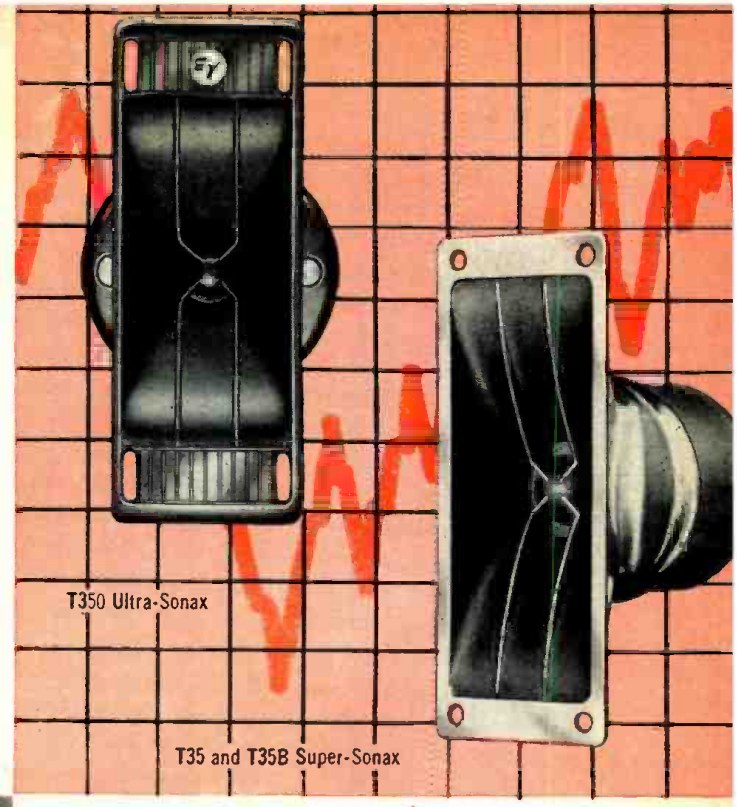
(*Continued on page* 108)

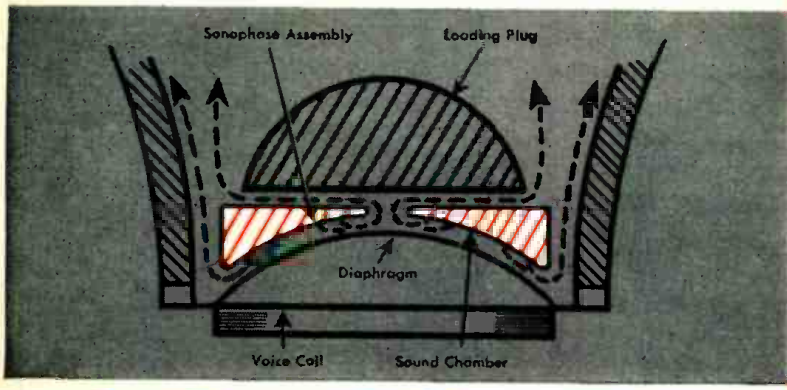
Electro-Voice®

NEW Ultra-Sonax and Super Sonax Very High Frequency Drivers, Diffraction Horns and Revolutionary E-V Sonophase Throat Design

No other manufacturer gives you very high frequency drivers combining all the customer benefits of these unique new Electro-Voice models. Today's folded horn and phase loaded speaker systems with their low first-octave response *require* flat, extended high range response beyond the very limit of audibility if essential musical balance is to be achieved. These very high frequency drivers, employing the time-tested diffraction principle and the new Avedon Sonophase throat design, overcome range and sensitivity limitations, function without distortion at the highest ranges.

All three models—T35, T35B and T350—have 180° dispersion patterns, program capacities of 50 watts, peak 100 watts, voice coils one inch in diameter and 16 ohms impedance. Chart shows other characteristics of each model.





Specifications	T35	T35B	T350
Frequency Response:	±2 db 2 kc—19 kc	±2 db 2 kc—18 kc	±2 db 2 kc—21 kc
RETMA Sensitivity Rating:	57 db	54 db	60 db
Magnet Weight:	7 oz.	4 oz.	1 lb.
Gauss	13,500	9,300	20,000
Size:			7½ in. long x
Horn:	5¼ in. long x 2 in. wide		2⅛ in. wide
Pot Diameter:	2¼ in. maximum		3½ in. maximum
Depth:	3¼ in. overall	3 in. overall	4½ in. overall
Shipping Weight:	3 lbs.	3½ lbs.	9½ lbs.
Net Price:	$35.00	$32.00	$60.00

And These are the Reasons Why

The Avedon Sonophase Throat Design

The unique throat design illustrated here overcomes a problem common in conventional high frequency drivers. This is diaphragm deformation at high frequencies, occurring at frequencies above 5 kilocycles. Piston action is destroyed, the phase is shifted and the result is destructive interference.

These Electro-Voice UHF drivers solve the diaphragm deformation problem with a longer sound path from the center of the diaphragm. This restores proper phase relationship. This is important above 12 kilocycles, where sound must be taken from the center of the diaphragm *and* from the outer edge simultaneously. The diagram shows E-V's Sonophase construction.

The Hoodwin Diffraction Horn

This is the Electro-Voice development which is used in all E-V horns to disperse sound *equally in all lateral directions* from a single point source. This is especially important in stereophonic reproduction to preserve the undistorted depth and width of the original sound. Diffraction horns insure balanced levels of both right and left stereo speakers. These drawings tell the diffraction horn story:

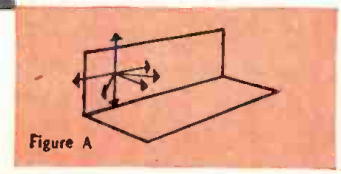
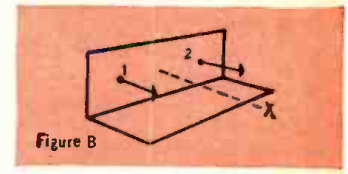
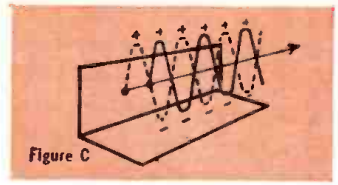


Figure A—This shows how sound disperses equally in all directions from a single point source.



In Figure B two sound sources are shown. On the axis, at point "x," double the sound power results as the resultant pressures are in phase.



But in Figure C, if the distance between the two sources is ½ wavelength or greater, the sound from the two sources will be considerably out of phase for points off the axis, resulting in decreased sound pressure.

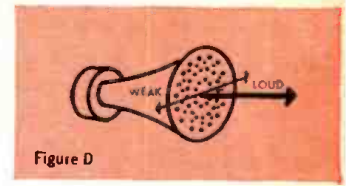


Figure D will show the deficiencies in horns of wide lateral dimensions compared to the wavelength being emitted. Any horn mouth can be considered as a group of small point sources of sound. They must beam the sound down the axis by their very nature.

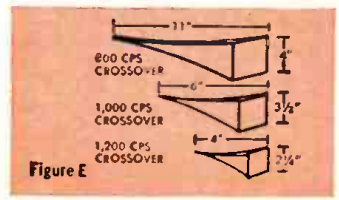


Figure E shows representative horns, illustrating that horns must have a certain length, as well as cross sectional area along this length and at the mouth to load the driver diaphragm down to the lowest frequencies to be reproduced. The lower we go, the longer must be the horn and the greater the mouth area.

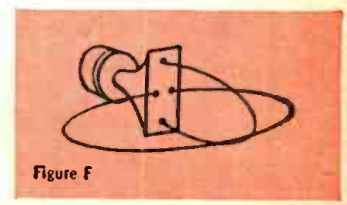


Figure F shows that narrowing the horizontal area and extending the vertical dimension of the horn mouth preserves the loading area necessary for good low end response, disperses the sound perfectly in the horizontal direction where it is so necessary, and keeps interfering reflections off the floor and ceiling.

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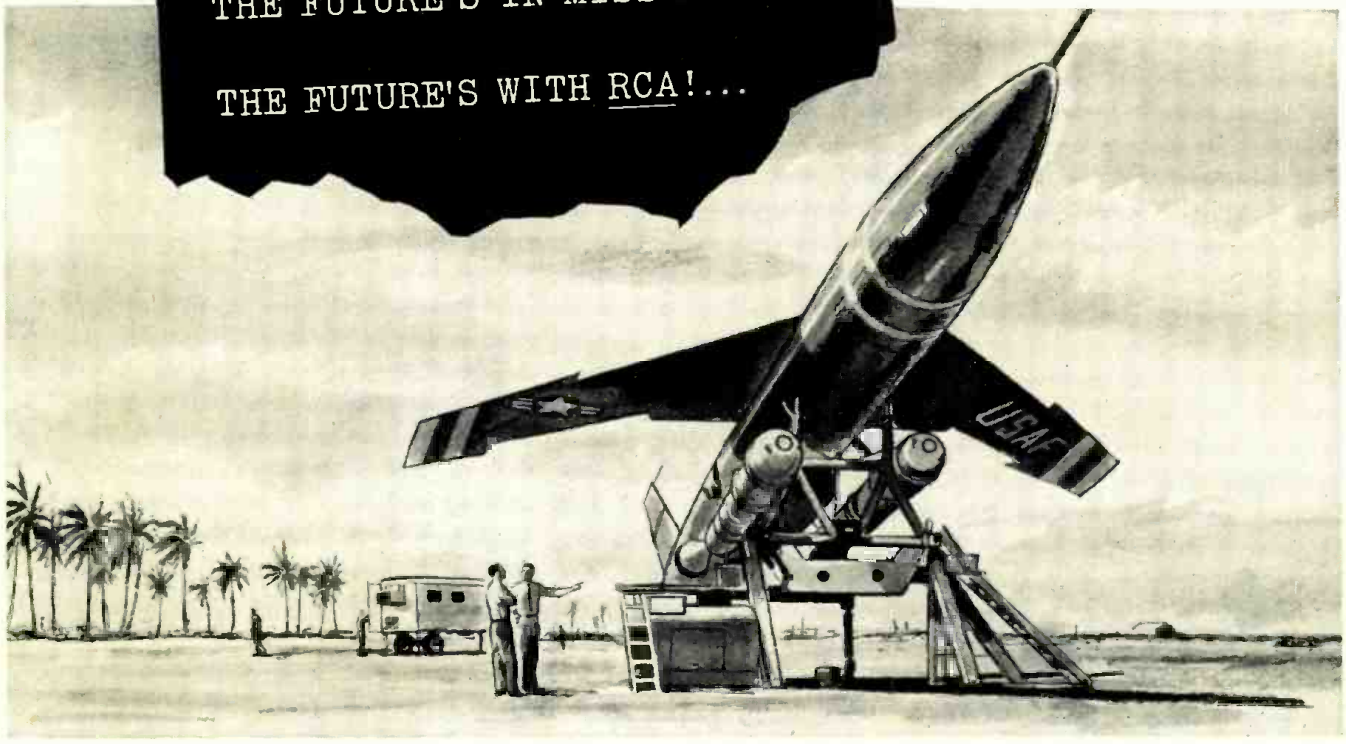

Missiles, the weapons technology of the future . . . delightful year 'round climate . . . combine these job factors in your career as an RCA electronic technician at Patrick Air Force Base on Florida's central east coast. At the Missile Test Project you'll help test most every type of missile being developed. You'll also contribute to the Vanguard Satellite's launching and tracking.

RCA is opening an unusually wide variety of positions for technicians on all levels. A basic knowledge of electronics will qualify you for many of them. Among facilities are the latest electronic and optical data acquisition and transmission systems. You'll enjoy RCA's complete benefit program . . . relocation assistance, too. And just imagine life in Florida's wonderful climate!

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Address U.S. Citizen Yes ☐ No ☐

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Earliest Date Available

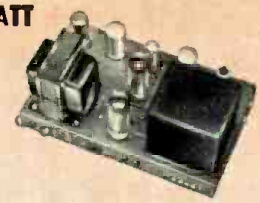
NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

with Preamplifier, Equalizer & Control Section

KIT $34.95 WIRED $57.95

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: 3¾" x 12" x 8¼". 13 lbs.

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.**

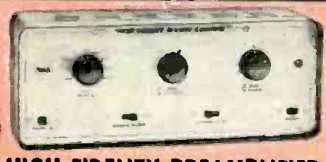
NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52

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

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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.**

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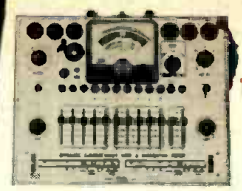

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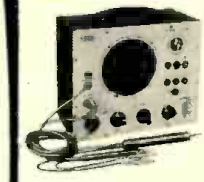

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Operation Jupiter

A CAP pilot uses his aircraft radio as a mobile control station, providing instructions to other CAP airplanes which are engaged in the air search and rescue mission.

By FRANK BURNHAM

Mobile radios in cars and planes, plus fixed stations at CAP headquarters, combine in daring flood rescue operation.

PELTING rain continued to come down as it had for more than 72 hours. Three days of downpour turned the brooks into creeks, the creeks into rivers, and the rivers into seas of raging destruction in western Virginia, southern West Virginia, and southeastern Kentucky. Rising water forced the Guyandot, Clinch, Kentucky, and Cumberland rivers out of their banks. And the rain kept up.

In a 15,000-square-mile area dominated by rugged hills, narrow valleys, and scores of soft coal mines the cry "flood" threw terror into the hearts of the mining folk. For the next five days they lived with terror. Death and destruction reigned in the shadow of the Clinch Mountains.

Almost immediately state and federal relief agencies swung into action. The American Red Cross marshalled its forces. The Federal Civil Defense Administration ordered its field office to give all possible support. Governor A. B. "Happy" Chandler of Kentucky and Governor Cecil H. Underwood of West Virginia asked President Eisenhower to declare the region an emergency area.

Even earlier, however, a relatively unknown and unrecognized group began emergency operations—operations which later were to prove vital to the over-all relief effort in "Operation Jupiter" as the flood mission was to be called.

This group was made up of civilian volunteers wearing the familiar blue uniform of the United States Air Force. Only the insignia was different. The volunteers were members of the Civil Air Patrol, official USAF auxiliary, and their part in "Operation Jupiter" was to be a big one.

Lt. Col. Huston H. Doyle, 43-year-old CAA chief airways operations specialist who commands the Civil Air Patrol's Kentucky Wing in his spare time, prepared a message to all CAP units in Kentucky. Especially to London and Hazard, in the path of the flood waters, he signalled:

"Request your squadron provide all possible assistance. . . ."

The rolling tide of disaster unleashed by the heavy rains moved faster than expected. As Doyle was preparing his message, *Middleground One Six*, communications station of the Hazard Squadron, came on the air with a desperate plea for help.

Lt. Bill Roll, 26-year-old Army veteran who wins the family bread as an LP gas serviceman, was at the microphone. The building at the Hazard airport which housed both the CAP headquarters and the State Police was already under water. Roll was operating from his home on high ground and on power supplied by a small, gasoline generator kept for emergencies. His message, which was picked up as far away as Atlanta, Ga., said:

"Hazard business district completely wiped out. Four feet of water in Peoples' Bank. Five million dollars damage. Several hundred people out of homes. Will be several days before contact possible by any other means than CAP radio net."

The message was signed by Dewey Daniels, Kentucky state Republican chairman. The Kentucky Wing immediately forwarded it to the office of Governor Chandler. Meanwhile CAP communicators Capt. J. R. Patterson and Lt. Peggy Wade, who had picked up the call in Atlanta, Ga., were also forwarding it to the Kentucky governor.

During the next four days *Middleground One Six* was the only contact with the stricken community. When Army engineer companies from Fort Knox broke through 48 hours after the first desperate message they found Roll still on the job.

Meanwhile in Louisville Colonel Doyle was busy arranging for a high-priority airlift of serum and vaccine to the flood area. CAP light planes, picking up the life-preserving fluid at Lexington and Louisville, transported it to London where a combined disaster operations headquarters had been set up. Here the precious vials were put on helicopters for the last leg of the journey into the area where nature had run wild.

The first two days of the emergency Colonel Doyle made his headquarters at the London, Ky., airport where CAP Maj. Roscoe Magee and the London squadron had been on duty since Lieutenant Roll's dramatic message went on the air. Through Lt. B. L. White, the squadron chaplain and a ham operator (W4UVH), the London CAP

CAP cadet ground rescue team boards Eighteenth Air Force "Vertol" (H-21) helicopter to answer a distress call broadcast by a Civil Air Patrol radio station during a recent flood disaster. This is a typical CAP function.

communicators maintained contact with Kentucky hams who also pitched in with an assist to their troubled state.

Going on the air at 1930 CST on January 29, *Middleground Eight,* the London Squadron headquarters station, stayed on the air continuously until 0245 CST February 2. At times atmospherics prevented direct contact with Hazard and a relay was set up with *Blue Chip One Three,* Tennessee Wing, and *Red Star Five,* Georgia Wing.

"Operation Jupiter" turned out to be one of the largest missions in the history of the CAP's Kentucky Wing. At its peak several hundred CAP civilian volunteers—each one taking time off from his job or business, mostly without pay—were manning the 18 fixed and mobile radio stations, the relief teams, and the aircraft. They weren't alone, however. In Virginia and West Virginia their counterparts were doing their share to stem the tide of death and destruction.

At almost the same time Bill Roll was telling of the plight of Hazard, the first word of immediate danger in Richlands, Va., was coming in from Senior Member Mack Blankenship (*Blue Flight Seven*) of Bandy, Va., six miles from Richlands in the heart of the soft coal fields. Relayed by other *Blue Flight* stations, it was received at Hampton by Capt. Mildred Hicks, attractive wife of CAP Maj. Douglas Hicks, Virginia Wing director of Communications. Mildred, who admits to some "30-odd" years, is an ardent CAP communicator and keeps *Blue Flight Three*—Virginia's alternate net control station—on the air when her husband is working at his full-time civilian job as an electronics engineer with the National Advisory Committee on Aeronautics at Langley Air Force Base.

The message which began "Operation Jupiter" for Virginia read:

"Richlands under water. Severe damage except in business district. Need blankets, food, and shelter."

Lt. Col. Alfred Nowitsky, deputy wing commander for Virginia, immediately ordered the entire statewide CAP organization on 24-hour alert.

In Richlands Maj. Grady Dalton, commander of the Richlands Squadron, who in private life is the vice-president and cashier of the Richlands National Bank, already had his unit at work aiding in the evacuation of citizens from flooded areas of the town. Two of Dalton's mobile cars were on the air maintaining contact with CAP stations outside the flooded region.

Another of the Richlands mobile cars, operated by Lt. Burkley Whited, was on its way from the Whited home in nearby Swords Creek. It was some time, however, before the 48-year-old carpenter reached Richlands. Whited got as far as Reven, Va., when he found his way blocked by flood waters. Turning back he found the flood had cut him off from behind. Some minutes later other CAP stations in the area heard Whited report:

"I've got a mile and a half of road and no place to go."

He spent the night on a low ridge between two roaring torrents of water relaying messages for other CAP stations that were maintaining the long vigil.

One of the first orders issued by Colonel Nowitsky was to the Tazewell Squadron—the CAP unit closest to Richlands. Immediately three mobile radio cars operated by Lt. Sam Evans (*Green Flight One Two Three*), Senior Member Aubrey McCracken, and Lt. Carless Chaffin were dispatched to the aid of beleaguered CAP forces in Richlands. Senior Member Walter Blank-

A radio-equipped CAP jeep and a radio-equipped ambulance aircraft work as a team evacuating simulated casualties from an atom-blasted house situated less than a mile from "Ground Zero" following a recent atomic test at Yucca Flat, Nevada.

enship (*Blue Flight Nine*) was assigned to coordinate the activities of the mobiles. During the periods he was to be off duty in his capacity as a Virginia State Trooper another CAP communicator, Lt. Luther Mercer, was to back Blankenship up.

None of the three mobiles was able to find a surface route open into the stricken community. After several tries it was decided that Chaffin and McCracken would return to their base of operations. Evans planned to continue his search for a way into Richlands.

Over the radio Evans told Blankenship he would stock his outboard motor boat with food and other supplies and would make another try. At home Mrs. Evans overheard the conversation on their monitor receiver. By the time he arrived at the house she had stripped the family pantry, loading every available item of food into the boat along with blankets and warm clothes. Stopping only for a word of thanks, Evans hitched the boat trailer to his mobile radio car and headed back toward the swollen Clinch River.

He might have a chance, he reasoned, to get through overland if he tried the many narrow, winding mountain roads in the area. Perhaps one of them would be open. Heading down Baptist Valley, he found the bridge under water. Another road, another, and still another was under water when he tried them. On his last try before taking to the boat he found an open road. Reporting to Grady Dalton in Richlands, Evans found it had taken him two hours to go 17 miles. He found also that the route he used became impassable almost immediately after he used it. It was two days before Chaffin, McCracken, and the Tazewell CAP land rescue teams got through to relieve him and Dalton's weary men.

Meanwhile Sam Evans' relief after 48 hours of duty in Richlands was short lived. Sam went home and dropped exhausted into bed. The next day he planned to return to his job as a telephone inspector for the Pocahontas Fuel Co. At Bluefield, W. Va., however, a chain reaction was beginning that was to demand more hard work and personal sacrifice from Evans.

Most of that night CAP Capt. Jim Cheek, a 32-year-old Army veteran, and his wife, Lt. Norma Jean Cheek, were busy moving emergency traffic. Their powerful *Lowland Four Four*, alternate net control for the West Virginia Wing, blankets most of western Virginia also with a strong signal. It proved a perfect relay station carrying traffic also for the Kentucky and Tennessee wings. Cheek is a salesman for the *Meyers Electronics Co.* of Bluefield and the next morning, leaving his wife to operate the station, he began a business trip to nearby Grundy, Va., just across the state line.

At Oakwood, Va., Cheek was turned back by State Police who said that the route was closed by flood waters.

A Cadet operates an SCR-511 "Pogo Stick" high-frequency transceiver, relaying instruction to CAP aircraft engaged in disaster relief training mission. Cadets at left operate a telephone switchboard tied into the local Civil Defense agency.

Checking the situation, Cheek found that there were apparently no open routes to Grundy. Returning to Bluefield, he went on the air with a report of the situation to *Blue Flight Three*.

Colonel Nowitsky, Virginia Wing mission commander, immediately checked with all state agencies in Richmond and found that there was no contact with Grundy nor had there been contact for more than 12 hours. In a matter of minutes Sam Evans was under orders to proceed toward Grundy keeping wing headquarters advised of his progress. The State Director of Civil Defense asked Evans for an evaluation of the situation if and when he got into the isolated community.

Lt. Chaffin (*Green Flight Four Five*) was sent to Short Gap, Va., a high point on the Buchanan County Line, to act as a relay. McCracken and Mercer were detailed to assist Evans and another relief mission was on. It took the mobile radio cars and the accompanying ground rescue team vehicles until 10 that night to get into Grundy and then only with the aid of heavy equipment of the State Highway Department. Evans reported immediately to the office of Mayor W. B. Raines and asked for an assessment of the situation. He then sent this message—the first contact between Grundy and the outside world in two days:

"One road now open one way. The one we used to come in on. Need cloth-

Civil Air Patrol communicators operate a high-frequency rig installed in a surplus Air Force bus which has been converted into a combination mobile communications station and a mobile operations headquarters for directing rescue work.

ing and bedding for 100 families. Water not contaminated. Power back on. Water dropped from 30 feet above normal to 10 feet above normal. Ten thousand miners out of work. Need Bailey bridges to mines. No loss of life. No other communications available."

When Cheek asked Evans if he could handle the situation in Grundy, the CAP citizen-turned-rescuer replied:

"Just tell my wife I'll be here until Sunday and that I'm all right."

Meanwhile West Virginia was having its own troubles with the Guyandot River in Logan County. CAP Maj. James Singleton is the coordinator for Civil Defense for the West Virginia Wing. He also is Logan County CD director.

"We have had experience with disaster in Logan County for a long time," he explains, "mine explosions, floods, complete disruptions of all types of communications caused by forest fires, and snow and ice storms which cut us off from the world completely.

"Because of the continual rainfall for a 72-hour period we—the CAP—dispatched a mobile radio car to the headwaters of the Guyandot. We checked rainfall and water level in the tributaries also. This was Monday. From past experience we determined that the river would begin approaching flood stage about 10:30 Tuesday morning. The Logan Squadron immediately made plans to meet the emergency.

"Communicators were alerted and were warned to have their mobiles moved to high ground out of danger from the water so that they would be usable if and when the flood struck. Four fixed stations and 14 mobiles went on the air.

"We sent CAP mobile cars through the probable high-water areas warning citizens to evacuate to high ground and assisting in evacuation wherever possible. Lt. Raymond Chapman (*Overland Two Six*) alerted this area—Champanville. Man, W. Va., was alerted *via* radio and CAP members there began warning the population."

Now the Red Cross, Civil Defense, State Police, and county law enforcement agencies took over the actual disaster assistance work while CAP stood by to provide emergency communication.

The work these civilian volunteers, like Singleton, performed in "Operation Jupiter" isn't new. The precedent was established in the early months of World War II when Nazi U-boats prowled our Atlantic and Gulf coasts sinking Allied shipping within sight of the shore. For several months tiny, light planes piloted by CAP's unpaid volunteers ranged out to sea spotting the submarines and reporting them by radio to the Army and Navy bombers which at that time were few and far between.

For its wartime work the Civil Air Patrol was chartered by a grateful Congress (Public Law 476, 79th Congress) to continue serving the people of the United States—this time as a non-profit corporation dedicated to furthering the principles of airpower and to using the airplane as an instrument of help and succor.

For the past six years these civilians have performed more than half of all the search hours recorded by all participating agencies in aerial search and rescue missions flown at the direction of the USAF.

In California's disastrous 1955 Christmas floods; in the wake of Hurricanes Hazel, Diane, and Connie; in the Michigan tornados; and in "Operation Jupiter" CAP's emergency communications capability was demonstrated.

At first communications in the Civil Air Patrol was a support function to the aircrews just as it was in the Air Force. Today, however, emergency communications is one of the CAP's assigned wartime missions and from all accounts it is a mission in which CAP excels.

Operating on both high and very-high frequencies loaned by the Air Force (Public Law 557, 80th Congress gave CAP auxiliary status), the Civil Air Patrol today has nearly 14,000 stations in the 48 states, the District of Columbia, the Commonwealth of Puerto Rico, and Alaska and Hawaii.

High-frequency stations include 2605 fixed, 4351 mobile, and 254 airborne. The v.h.f. facilities include 2510 fixed, 3926 mobile, and 438 airborne. Frequencies used by CAP include 2374, 4467.5, 4585, and 4507.5 kc. At present only one v.h.f. frequency—148.14 mc.—is authorized. Only A3 emission (voice) is permitted and all CAP transmitters must be crystal controlled. All CAP stations are FCC-licensed and all CAP operators must have at least a restricted radiotelephone operator's license.

At wing level (equal to the states and territories) 400 watts h.f. transmitter power output is permitted, 150 watts at group level, and 75 watts at squadron level. On v.h.f. 50 watts is permitted at all echelons. Mobile output is restricted to the power output of the respective headquarters.

CAP communicators employ a conglomeration of equipment. Some of it is surplus military equipment, mostly from World War II. The majority of it, however, is commercial equipment purchased and maintained at the expense of the individual member. "Globe Scout" and "Champion," *Heath, Johnson* "Viking," *Gonset,* and *Aerotron* are among the nameplates to be found in CAP communications rooms. There you find BC-669, ARC-5, ARC-4, BC-640, and SCR-522 equipment and perhaps even a few sets you never knew existed. The important thing is that when the chips are down the Civil Air Patrol always seems to turn in a whale of a job no matter what it has to work with or what price must be paid.

The value of their work in "Operation Jupiter" can best be told in the words of people who watched the CAP in action—people like Kentucky Governor A. B. "Happy" Chandler. In a telegram to Maj. Gen. Walter R. Agee, USAF, CAP National Commander, Governor Chandler said:

"Kentuckians are deeply grateful to the Civil Air Patrol for its assistance during the recent disastrous flood in eastern Kentucky. CAP members and their radio communications system performed nobly in helping protect lives and property. CAP radio at Hazard, using emergency generators when the city's power system failed, sent out first calls for help from the stricken community. Then Hazard radio working with CAP radio units in London, Middlesboro, and Louisville, dispatched messages which brought in food, clothing, and medicines. Throughout the flood crisis every Civil Air Patrol member involved performed magnificently and they have certainly earned our undying gratitude and esteem." —30—

Typical of the more than 5000 fixed stations used by the CAP is this installation being operated by CAP 2nd Lt. Kenneth Lofstedt, exec of the CAP Squadron 90.

STATION	FREQUENCY (Mc.)	RADIATED POWER (Kw.)	AVERAGE SIGNAL (A.G.C. Voltage)	USABLE SIGNAL TIME
KIRO-FM	100.7	4.5	2.5	80%
KISW-FM	99.9	2.1	.9	5%
KING-FM	98.1	15	7.1	100%
KTNT-FM	97.3	10	5.2	80%
KING-TV	Ch. 5	30 (audio)	12	100%

Table 1. Comparative data on reception at a point in Vancouver of four FM transmitters, each located well over a hundred miles away. As a criterion, data on the audio transmission from a TV station located in the same general area as the four FM transmitters is also included in the tabulated results.

Fringe-Area FM Reception

By **KENNETH BRAMHAM**

Establishing FM in a one-station area may depend on reaching out for added, distant transmissions.

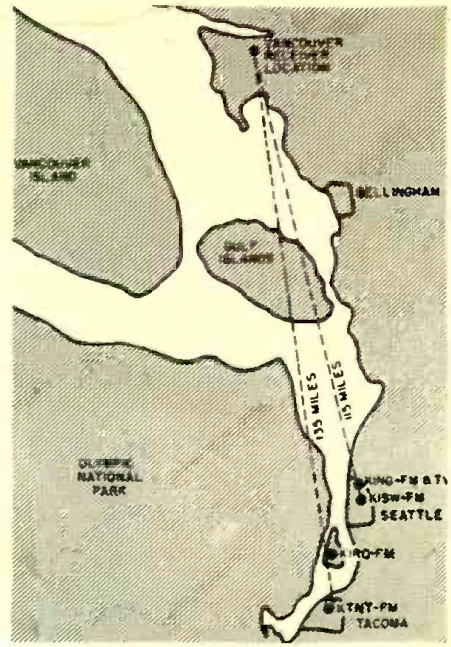

Fig. 1. This map of the western end of the U.S.-Canadian border shows the location of Vancouver relative to the four FM transmitters grouped together in the Seattle-Tacoma portion of Washington. Though the paths appear to be largely over water, much uneven island terrain occurs between the two areas involved.

IN MANY cases an FM broadcast station has its transmitting antenna located adjacent to or on the same tower with a television station which is being received successfully at distances of a hundred miles or more. Recent developments in TV antenna design and local information on television reception conditions will apply equally to the FM broadcast band (88 to 108 mc.) which is, of course, just above TV channel 6. There is therefore every reason for success in the reception of FM programs in fringe areas which are now enjoying good television reception. While FM radio has not achieved the popularity of television, there is a definite need for expanding the present accepted range of FM reception, using the experience gained in the television field.

Experiments carried out over a period of several months at Vancouver, Canada, have yielded good results in reception of FM programs transmitted from Seattle, Washington, a distance of 115 miles. (See Fig. 1.) While Vancouver does have one FM outlet (with excellent programming) to provide a reason for the existence of FM receivers in the area, there must be at least one alternate station. This was the reason for the attempt at fringe reception. During these tests, station KING-FM (Seattle) was monitored almost continuously and provided good quality audio, superior to closer AM reception better than 30% of the monitored time. A listenable signal of poorer quality was received 45% of the monitored time. Less than 25% of the time was the signal either unusable or not checked to determine if any improvement had taken place. The monitoring period was established as 9 a.m. to 8 p.m., and 11 p.m. to midnight, on the days included in the series of tests.

While these percentages are accurate over the period of the tests, they do not take into account the constant changes being made to equipment that brought about a steady improvement in listening quality of the received signal. For the final two months during which readings were taken, all equipment was fixed to provide a reliable series of results. The monitoring receiver was a modified *Hallicrafters* SX-62. A v.t.v.m. was used to measure a.g.c. voltage on this receiver to give a relative indication of signal strength.

EDITOR'S NOTE: *One of the factors that has impeded the growth of FM in outlying areas even where some local FM service is available, usually from a single station, is the fact that local listeners feel they do not have a sufficient choice of transmissions to warrant investment in receiving equipment. The author has therefore experimented, with gratifying results, in reaching out for distant transmissions, as described herein. Although his efforts were confined to a single area, what he learned will be useful in any area where a similar problem exists, both to the potential listeners and to the service technicians who can benefit from the business such an awakening in FM interest stimulates.*

The results of the tests are given in Table 1. It covers four FM transmitters in the Seattle-Tacoma area of Washington. For comparison, data is also presented on the audio portion of the transmission for KING-TV in Seattle.

As one purpose of the tests was to establish that specially designed FM antennas are *not* essential where a TV installation is already in use, only all-channel type v.h.f. TV antennas were used. The fact that no high-gain FM-band antenna was available locally also had some bearing on the matter. Of the various types used, it was found that any all-channel antenna which performed well on Seattle TV station KOMO (channel 4) and KING (channel 5) would also perform well on the FM band. The *Channel Master Corp.* seven-element "Travelling Wave" antenna is at present in use and is producing excellent results, being "flat" from 40 to 108 mc. (the upper limit of the FM band). Other types tested were designed to provide reception over separate high and low TV bands, and thus have a tendency to "dip" in the intermediate portion of the v.h.f. band, which includes the FM band. It is possible to compensate for this loss by stacking antennas if a stacking harness or bars of approximately 54 inches are used. This may be done without seriously affecting the TV high-band reception which is often the higher-gain portion of antenna bandwidth.

Antenna installation for FM use does present one problem which is not as easily overcome as in TV work, that of correct orientation. While ghosting is easily seen on a TV screen, it is not so easy to distinguish by ear and can be mistaken for lack of signal strength and insufficient limiting. Field-strength measurements are little help under these conditions, but it has been found satisfactory to orient on a TV station near the desired FM station in the normal way.

Although signal "boosters" have lost some favor in the TV field since the advent of the cascode tuner, some form of preamplification can be used in

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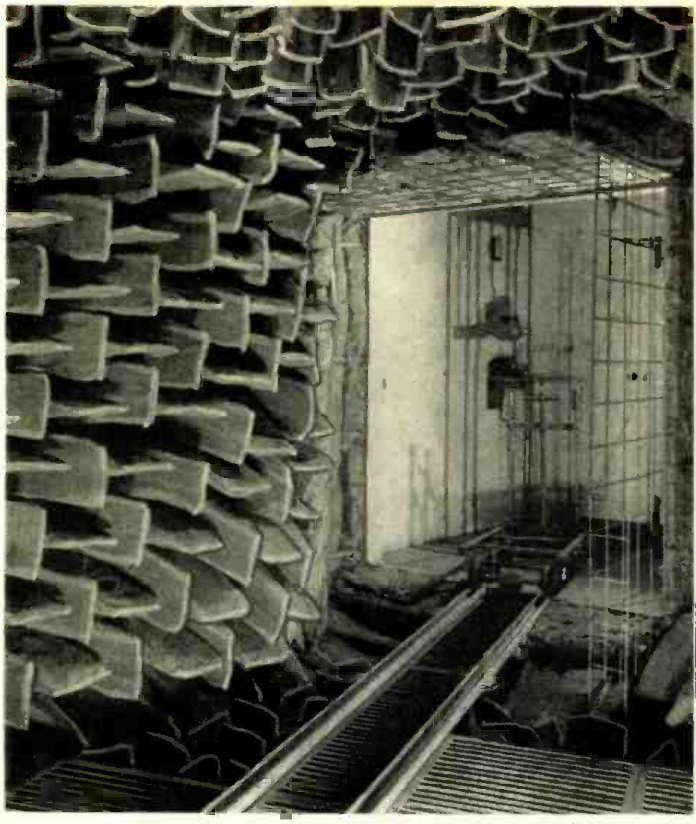
All About Audio and Hi-Fi



←Fig. 11. British Broadcasting Corp. anechoic room showing removable floor.

Testing Loudspeakers

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

Part 4. Listening tests and acoustic response curves, with method of using live room for useful measurements.

IN THE previous articles of this series we have examined the problems of reproduction of sound as affected by the human ear and listening rooms. In other words, we have been dealing with sound waves after they have left the loudspeaker. We now come to the subject of this article which is the transducers themselves.

There are many ways of testing loudspeakers, but unfortunately there is no single test which will give us all the answers. By comparison, testing an amplifier is child's play; pickups are about half way between the two in elusiveness.

Useful speaker tests should include the following: objective listening, response curves, impedance curves, transient response and resonances, directional effects, power handling capacity, and efficiency. All of these qualities are seriously affected by the method of mounting the speaker, a problem which will merit at least a complete article in itself. But let us deal with the questions in order.

Objective Listening

It is most important to remember that our raw material is far from perfect: with both radio and records we have to take what we can get. The idea that records are turned out to a specified characteristic and can be played back perfectly by using an inverse of the characteristic always strikes me as fantastic—rather like believing in astrology, fortune-telling, or fairies. At the recent Audio Fair in London I heard more than one demonstrator say: "This record is AES. I am therefore playing it with AES correction and no further use of tone controls." This he would proceed to do with a virtuous air, no matter how awful the results. I can see no sense in altruism of this sort. The only way to play records is to adjust the controls to suit the speaker, the room and number of people in it, and the condition of the record.

Now that the same original recording is often available to the general public in different forms, variations in "characteristics" can easily be found by comparing the finished articles. The available forms include the 33⅓ and 45 rpm discs and 7½ ips monaural and stereo tapes.

It is not at all strange that variations should crop up (it would be a miracle if they did not), but they are, in some cases, so great that it is difficult to believe that the same original material was involved. If the bass on a record has been attenuated by narrow groove spacing in order to get a complete movement on one side of the disc, the remedy is to apply some bass boost to the replay and forget all about the supposed recording characteristics.

Although we have used disc recordings to illustrate the point, our experience is that tapes display even wider variations, and top cut to avoid hiss is often necessary. In fact, there is ample evidence to show that the loudspeaker is still not the only imperfect link in a modern reproducing chain.

I think it was Robert Browning who wrote, "What's come to perfection perishes." (Actually, I know it was Browning because I have been thumbing through my Anthology again.) If the words are true, it is to be hoped that we are still a long way from perfection in the art of sound reproduction.

Similar reservations apply to program material from FM radio, which at its best provides the finest quality of reproduced music available in England today; but if you use a tuner preset to the three available transmissions ("Home," "Light," and "Third" programs) and switch from one to the other, the variations in frequency range and tonal quality are enormous, and the use of wide-range hi-fi equipment becomes impossible without adequate means of tone control. My experience is that when the quality on one program is excellent, the other two are usually pretty grim.

Response Curves

The longer I test and listen to loudspeakers, the less importance do I attach to the response curve as the final arbiter of performance. I suppose the reason is that we do not listen to music with a slide rule. For instance, you cannot put a speaker in a box or on the end of a horn without making it sound as though it is in a box or on a horn. You can "tune" the box (reflex enclosure or Helmholtz resonator to the expert): you can line it and fill it with soft absorbents until theoretical perfection is attained, but you still end up with a speaker in a box and no response curve will show the effect. Of

course, the bigger the box, the less "boxy" the results. Fortunately, after a short period of listening the ear becomes punch drunk and no longer notices coloration: hence the ubiquitous radio receiver and radio-phonograph combination.

Incidentally, Mr. P. J. Walker had a similar experience when working on the design of full-range electrostatic speakers. He told me that he could easily increase the output at low frequencies by adopting some form of resonant enclosure of moderate size, but once this was done his new speaker sounded exactly like much cheaper moving coils and there was no point in proceeding.

I submitted the foregoing comments to Mr. Walker for his approval, and he added the following very interesting note:

"I did explore horns, vented enclosures, and completely sealed enclosures. They all introduced coloration except one, and that was a long and rigid tube built of brick with progressive Fiberglas damping. This was very good but not very practical."

As I have advocated bricks for many years as the cheapest and most effective way of avoiding panel resonance, I was interested to have this confirmation of their sterling qualities.

However, Mr. Walker wisely decided to increase the size of his speaker and retain its character, which would not show on a response curve.

There are many different ways of mounting and loading a loudspeaker—often with murderous results—and arguments about their merits and shortcomings have gone on for so long that the newcomer to hi-fi must find the outlook rather bewildering. In fact, discussion has been just about as endless and indeterminate in this country as on the subject of capital punishment. I think the following comment by the Archbishop of Canterbury would apply in both cases:

"This long and distressing controversy . . . (over capital punishment) is very unfair to anyone meditating murder."

No doubt the situation will eventually be resolved by a general decision to look on the speaker and its mounting as one item instead of two, as is presently the case.

In spite of limitations, response measurement still remains an important aspect of speaker tests and requires conditions approaching those of a free (acoustic) field. These conditions are usually obtained either by operating out of doors, with the loudspeaker hoisted clear of the ground, well away from buildings and other reflecting surfaces, or by the use of anechoic chambers.

The first method approaches the theoretical ideal but is fraught with practical difficulties due to the vagaries of the weather, wind, and ambient noises. In Great Britain the weather is capricious, and suitable dry spells with little or no wind rarely coincide with periods of technical activity. On the other hand, anechoic chambers are very costly to construct. With Fiberglas wedges at £1 each, a room of reasonable size may cost upwards of £5000. The outlay of capital and use of valuable floor space can hardly be justified for occasional use. Furthermore, the average, medium sized anechoic chamber does not provide free-field conditions at frequencies below 100/150 cps, and measurements at very low frequency therefore require experienced interpretation.

Such limitations would hardly apply to the free-field room, described in Olson's "Elements of Acoustical Engineering," which is 32 feet x 20 feet x 20 feet *after* treatment (some room!) and I noticed during a visit to *Bell Telephone Laboratories* in 1955 that they

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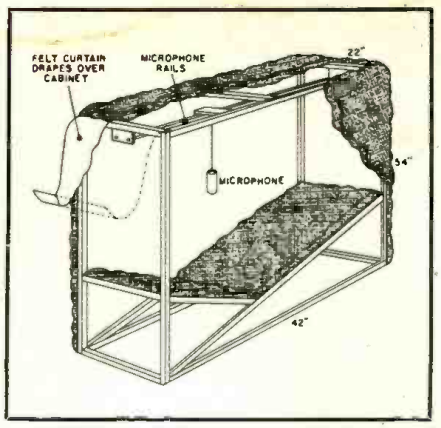


Fig. 12. Details on construction of absorbent enclosure used for the measurement of loudspeaker response in live rooms.

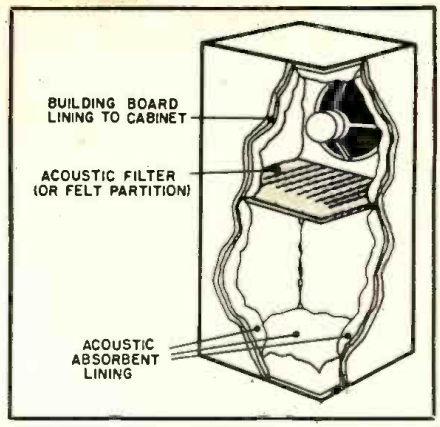


Fig. 13. Five cubic foot enclosed cabinet used for speaker mounting for response measurements with Fig. 12 enclosure.

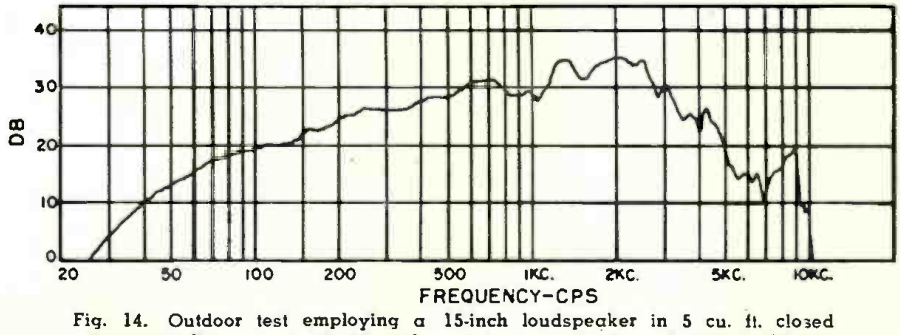


Fig. 14. Outdoor test employing a 15-inch loudspeaker in 5 cu. ft. closed cabinet standing on ground. Microphone 1 foot on axis. Input 1 watt at 400 cps.

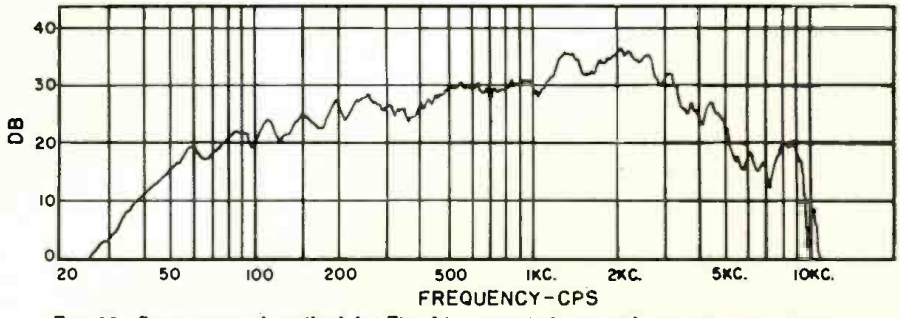
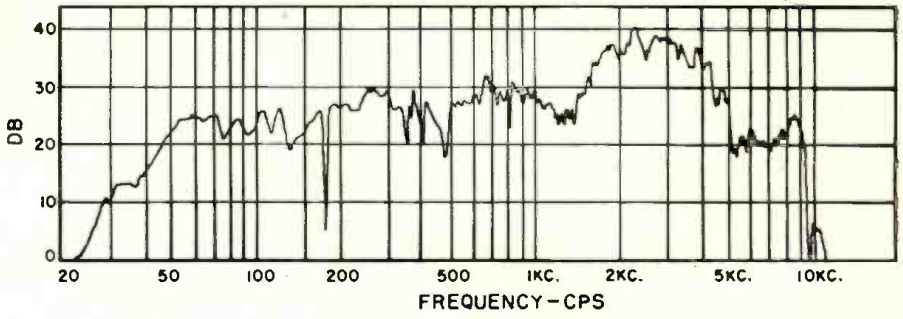
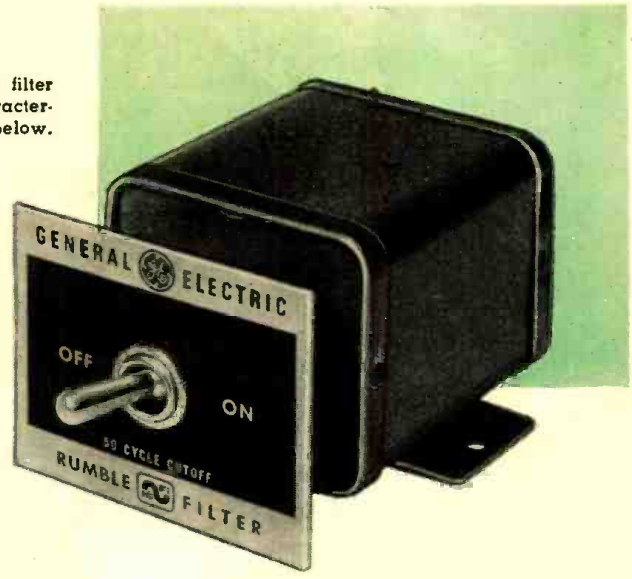


Fig. 15. Same setup described for Fig. 14 except indoors with absorbent enclosure.

Fig. 16. Indoor curve of 15-inch speaker mounted in 9 cu. ft. brick corner reflex enclosure. Microphone is 1 foot on axis in absorbent enclosure. Input as above.



Rumble Filters



The A1-903 rumble filter whose circuit and characteristics are described below.

ADELORE F. PETRIE
Special Products Engineering
General Electric Company

Causes and cures for rumble, including design of simple but effective LRC filter with 50-cps cut-off.

THE presence of rumble in a high-fidelity system is not always apparent. By careful inspection, however, the symptoms of rumble can be recognized. Sometimes rumble shows up as a noise similar to a car driving over a bumpy road. This manifestation, however, is the exception, not the usual case. More often it shows up as intermodulation distortion—a sort of garbling of the sound when the bass control is turned up at reasonably high listening levels.

A simple check for rumble is to hang a piece of facial tissue in front of the loudspeaker opening, or the port of the loudspeaker enclosure if you have a reflex type enclosure, and watch the movements of the tissue while playing a typical record from your music library at fairly high volume levels. If your system has rumble, you will note rather large movements of the piece of tissue which bear no direct relation to the music being played. If a proper rumble filter is now switched into the system, you will hear no degradation in the sound, but will notice a complete elimination of the haphazard vibrations of the tissue. (If the rumble were strong enough to cause distortion, this too will be eliminated.) The haphazard motions of the tissue indicate that the system is not capable of using its full power to reproduce the desired music, since much of the power is being wasted in attempting to reproduce unwanted rumble transients.

Rumble is by no means limited to poor systems. In fact, it often becomes more of a problem as the quality of the reproducing system is improved.

Causes

There are four major causes of rumble:

1. *Records:* There is some low-frequency noise on all records. This is due to variations in material and imperfections in pressing the record. On top of this, only too many records actually have rumble recorded on them through mike vibrations, breath blasts, and vibrations in the recording lathe and turntable.

2. *Turntables:* Rumble can come from the reproducing turntable due to an unbalanced rotor in the motor, imperfections in the idler, or poor bearings on the turntable itself. This problem is minimized with more expensive equipment.

3. *Tone Arm, Stylus Resonance:* This resonance usually occurs between 10 and 50 cps and may amplify rumble occurring at that frequency. This, again, is less troublesome with more expensive tone arms.

4. *Mechanical Vibrations:* This includes all vibrations transmitted to the record playing equipment from external sources. Remember, the modulation on the record is on the order of one thousandth of an inch; and that such things as walking across the floor, or a truck driving by outside, can easily cause vibrations of this magnitude at the record player. This becomes more of a problem with more expensive equipment, due to better low-frequency reproduction.

Why do low-frequency vibrations present a problem? Let us investigate the power handling ability of the reproducing system at the lower frequencies.

1. *The Loudspeaker System:* A typical high-quality loudspeaker system is capable of handling 13 volts input at 50 cycles-per-second at a given level of distortion, yet will handle only 1.5 volts at 30 cycles-per-second at the same level of distortion. It is obvious that, with this system, rumble transients below 50 cps must be severely attenuated to prevent overloading of the loudspeaker system.

2. *Power Amplifier:* A typical high-quality power amplifier is capable of delivering 20 watts at 30 cycles and only 1 watt at 8 cycles although the frequency response is still flat down to 10 cps. Again it is necessary to eliminate low-frequency rumble to prevent overloading the amplifier.

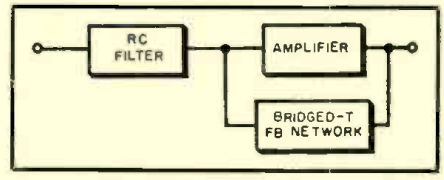


Fig. 1. Block diagram of sharp cut-off filter using a feedback-type amplifier.

What does all of this mean? It means that, no matter how good the reproducing system, at some frequency between 50 and 30 cps, the signal voltages coming from the phonograph pickup will be less than the noise (rumble) voltages during 99.9% of the playing time. Also, at some frequency between 50 and 30 cps, the amplifier and/or loudspeaker system will drastically lose power handling ability.

The problem is to eliminate the rum-

Fig. 2. A one-stage RC filter network. The dashed line indicates the effect of adding feedback arrangement shown in Fig. 1.

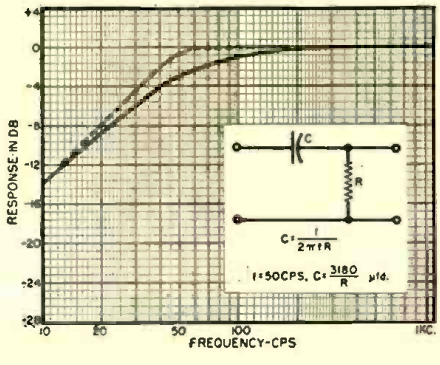
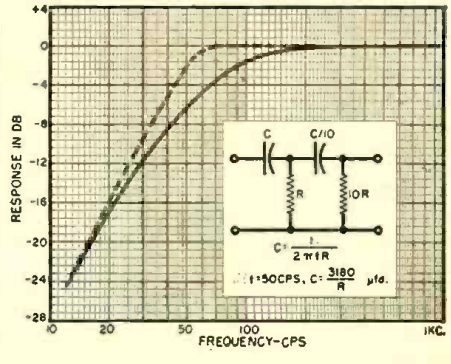


Fig. 3. Note the greater attenuation rate of a two-stage network. Again the dashed line shows the effect of feedback amplifier.



The A1-901 record filter includes a rumble filter of the LRC type. A choice of several low-frequency cut-offs is provided by switching in various values of R and C.

For Hi-Fi Systems

ble without depreciating the useful low-frequency response of the system. There are many approaches that can be used to eliminate rumble. The best way, of course, is to eliminate the rumble at the source. Some of the causes, however, are beyond the control of the user.

Solutions

The simplest rumble filter to construct is an *RC* filter. The schematic of a 50-cycle filter of this type with its response is shown in Fig. 2 (solid line). Note that the drop-off is quite gradual (6 db/octave) and that the "knee" is not very sharp. This filter would attenuate the low frequencies too much and not attenuate the rumble enough.

Adding a second stage to the *RC* filter (see Fig. 3, solid line) makes the slope of the drop-off sufficiently steep (12 db/octave), but produces even greater attenuation of the desired low frequencies above 50 cps.

What is needed is a way of sharpening up the "knee" of the curve so that there is less attenuation of the desired frequencies above 50 cps. One way to do this is to add a feedback amplifier with a bridged-T or parallel-T null network in the feedback path (see Fig. 1). This type of amplifier produces a rise in response at the null frequency of the T-network. If the rise in response is made to correspond to the cut-off frequency of the *RC* filter, it can be used to sharpen up the "knee" of the curve as shown by the dashed lines in Figs. 2 and 3. This combination makes a filter which has the desired characteristics; however, it is much too complicated and expensive to be really practical in many cases.

As it turns out, there is another way of obtaining this same type of response. This is by using an *LRC* filter (see Fig. 4). This filter produces the desired slope for attenuation of the rumble and, at the same time, permits adjustment of the sharpness of the "knee" of the curve by adjusting the resistance *R* as shown by the dashed line. The "knee" can even be adjusted to produce a rise in response at the cut-off frequency. This circuit has the disadvantage that the inductance, *L*, must have special characteristics, as follows: 1. it must have a high "*Q*" at low frequencies and 2. it must be well shielded from any hum fields that may be present.

Fig. 4. One-stage LRC rumble filter. Dashed line indicates the effect of decreasing the value of the resistor R.

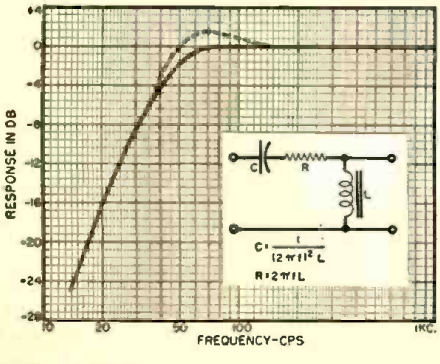
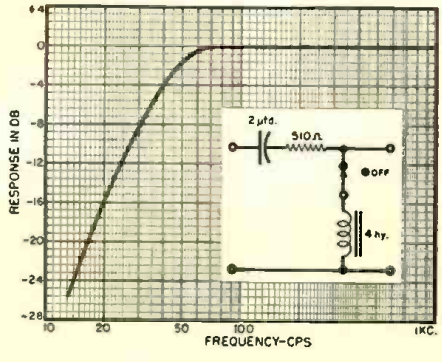


Fig. 5. The actual response curve and schematic diagram of the General Electric type A1-903 rumble filter are shown here.



A Practical Approach

The idea of a simple *LRC* rumble filter has plagued engineers for some time. Finally, a combination of elements has been found that makes this type of filter practical. The heart of this filter is a special, small, well-shielded inductor. Excellent hum shielding has been obtained, permitting use of the rumble filter between the pickup and the rest of the system; thus, rumble is eliminated before it can affect even the input stage of the amplifier. At this point in the system, the driving and load impedance are known and, therefore, it is possible to design the filter for optimum performance without affecting the rest of the system. The schematic and response curve of a production unit (*General Electric* A1-903 rumble filter) are shown in Fig. 5. Note the values of components used.

Other commercial units which use this filter are the *General Electric* A1-901 record filter and A1-320 "convertible" amplifier.

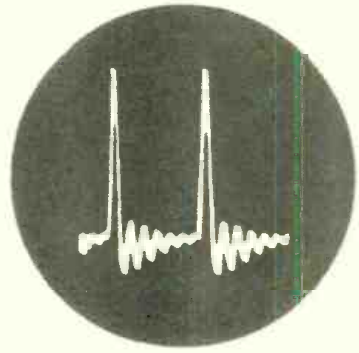
The A1-320 amplifier, the A1-903 rumble filter, and the "lo cut-off" section of the A1-901 record filter, although designed primarily for use with the standard *G-E* variable reluctance cartridge, will operate satisfactorily with any magnetic cartridge which has similar characteristics (d.c. resistance —340 ohms. inductance at 1 kc.—520 millihenrys). The "compensator" and "hi cut-off" sections, however, function properly only with magnetic pickups whose characteristics are practically identical to the standard variable reluctance unit.

A word of caution. Many commercial units which incorporate a "rumble filter" have but a simple *RC* filter such as that shown in Fig. 2. The low-frequency reproduction is quite noticeably depreciated when this type of filter is used. It is suggested that the prospective user check the response curves or the schematic diagram of the filter to determine whether the unit has the desirable sharp cut-off, such as that shown in Fig. 4, or the less desirable gradual cut-off, as shown in Figs. 2 and 3.

Since rumble is present, to some degree, in all high-fidelity systems not incorporating a rumble filter, and may even become more of a problem as the quality of the system is improved, a sharp cut-off low frequency filter is the most satisfactory solution.

The fact that a simple, practical filter has been designed and is available in several commercial units should be the answer to this audiophile problem. —30—

Overworked Horizontal Amplifiers



By
GEORGE D. PHILPOTT

Do you run high on "defective" horizontal output tubes? Perhaps something else needs checking.

REPLACEMENT of horizontal-amplifier tubes in television receivers, without a prior check of all circuit-related components to make sure that the tube failure was not actually induced by another defect, can be an expensive habit. Many unprofitable callbacks result from this "I'll-take-a-chance" method of operation.

Too often the callback results in an exact repeat performance. Consequently, a seemingly endless stream of so-called "defective new tubes" continues to roll back to parts distributors throughout the country. The tube jobbers scratch their heads and the tube engineers shake theirs. The "returns" are discouraging and the results obvious. Prices on horizontal-amplifier tubes remain high—customer morale remains low.

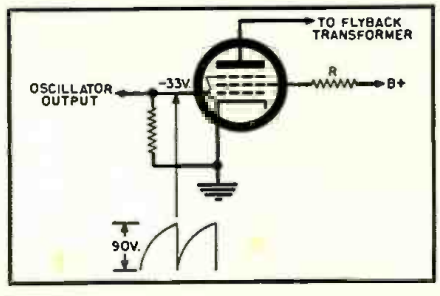
Someone sooner or later must spend lost time and money to fix the receiver. If you double-check a few key points, you can avoid being that someone; so let's review a few facts about horizontal circuits to see whether we can't come up with enough information to make the *next* horizontal job a profitable one.

Role of the Oscillator

To begin with, the horizontal oscillator is designed to supply signal-locked pulses to the control grid of the horizontal amplifier at a given frequency and amplitude, as shown in Fig. 1. The negative-going portion of these pulses serves to keep the amplifier's grid cut off during a substantial portion of each cycle and to develop the substantial negative bias at this point. The values shown are not necessarily universal, but they give an idea of what happens at this point. Since the output stage is designed with this action in mind, most failures in the oscillator result in removal or reduction of this negative grid voltage. An overload then occurs in the horizontal-amplifier stage, and either the time lag fuse kicks out or the tube itself overheats and becomes gassy. The reason for this is quite obvious when we consider what happens to the plate current of, for example, an amplifier in the 6BQ6G class when grid excitation fails.

Normal operating plate current for a 6BQ6G, properly supplied with enough grid drive, is about 80-90 ma., at 500 volts d.c. (plus 4.5 kv. peak-positive pulsed d.c.). Without grid bias or "horizontal drive" from the oscillator stage, plate current jumps quickly to *300 ma.!* This high current is drawn through the plate winding of the flyback transformer and all component resistors in the line back to the low-voltage rectifier. Now, we find it easy to understand why the *proper* fuse in a horizontal plate-supply line is important. But hold it! Not always do we find a fuse in this circuit. And, more times than not, a set owner has replaced this fuse with one out of the glove compartment of his car; originally intended, of course, for the headlight circuit in the vehicle.

Fig. 1. Oscillator output keeps the output-stage grid properly negative.



Due to the fact that horizontal-output tubes operate close to the maximum load level in many receivers, it is to be expected that any unusually high plate current can cause the tube to overheat and be permanently damaged.

Screen Grid Troubles

For the sake of simplicity, let's consider a real troublemaker found in an average horizontal-amplifier circuit, the screen-grid dropping resistor, shown as *R* in Fig. 1. Should this unit be of the metalized-carbon variety—look out! You may have a hot one that is not so hot. Let's place ourselves in a familiar situation and consider a service call involving a receiver we shall call the "Blur-Vision." The customer phones and we arrive at the scene.

A hasty examination indicates that the trouble is in the horizontal circuits; we have no raster but there is plenty of sound. We remove the back. Ah! The horizontal oscillator is cold as the doorknob on an igloo. In goes a new 6SN7GTA. Turning the set on, we take a few drags on a cigarette and wait for the inevitable sight and sound of a picture. But it is not that easy

(*Continued on page* 112)

Sine-Wave Clipper

By
RUSSELL D. SHATTUCK

This single-tube subchassis will yield good square waves for bench tests when fed by a standard sine-wave generator.

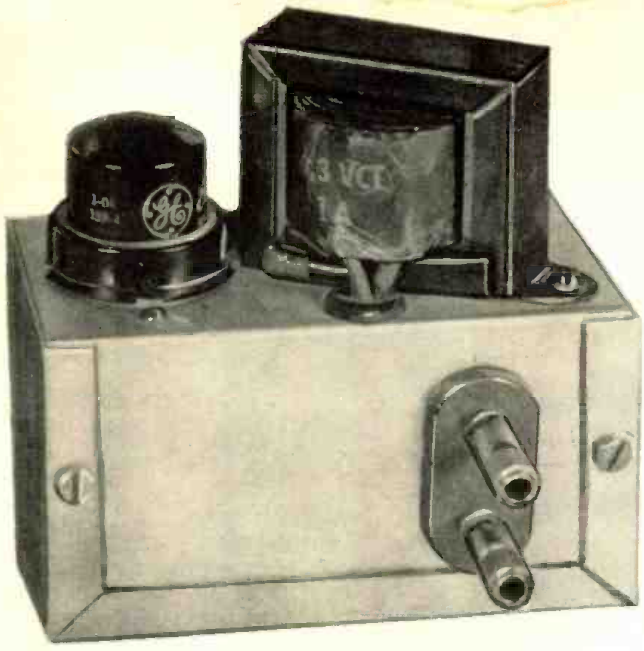


Fig. 1. The completed sine-wave clipper.

FREQUENTLY, in audio and other service work it is useful to employ square waves to test some piece of equipment. The value of such a method lies in its convenience and the rapid indication of results it provides. Any test technique is good only if it is quicker than another laborious point-by-point method, especially if one includes the time necessary to prepare for the test as well as that needed to complete the test and then to interpret the results.

The unit described here satisfies the first requirement noted by allowing you to prepare for the test with a minimum of time. It requires about two hours to assemble this "wave squarer." Fig. 1 shows the unit ready for use with a sine-wave signal source. This particular one was built with a pair of banana plugs which mate with the terminals on the oscillator, but some more universal arrangement could be used.

The clipper schematic is in Fig. 2. No internal views are shown since the only requirement for good performance seems to be compactness. A 2" x 2" x 4" aluminum box has plenty of room to spare.

The operation is based on a simple arrangement of a pair of biased diodes. The input, which should be about 10 volts, can pass its positive half-cycle through the first diode unaltered. The negative half-cycle will pass until it reaches a value equal to the effective bias. At that time the diode no longer conducts, and the signal level applied to the second diode remains constant during that portion of the negative half-cycle. The clipped wave is then applied to the second diode, which can conduct only as long as the positive half-cycle is less than the value of the effective bias on that stage. The already clipped negative portion of the pulse from the first stage is conducted through the second diode with no difficulty, since the polarities are correct, and a square wave appears at the output terminals.

EDITOR'S NOTE: *This is not the first clipper to be used with a conventional sine-wave generator for producing square waves that has ever appeared in this publication, nor is the unit described spectacularly different from many others. Why, then, take another trip over a well travelled path? Simply because the article goes beyond the usual construction piece. The author does not stop at an arbitrary statement covering his particular unit; he gives some thought to possible variations and the effects they will have. We feel that this will be particularly useful to readers who wish to build similar units that may be intended for applications other than those the author has found most adaptable to his own technique, and that they will want to know what effect variations can have on such factors as rise time and approach to true squareness, which may vary in importance from one person to another.*

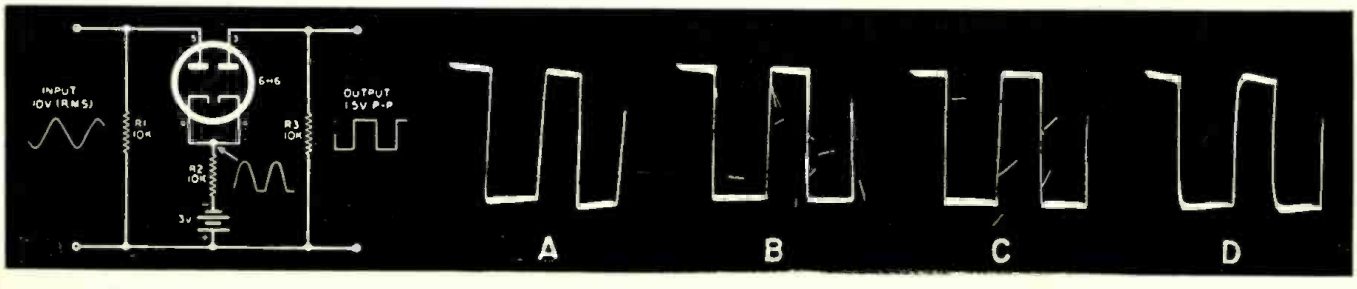
The performance of this clipper is shown in the photos of Fig. 2. The rise time of the wave is, of course, limited to the rise time of that portion of the sine wave which is passed by the clipper. This means that, to obtain a fast rise time with a clipper, it is necessary to apply a signal of relatively high amplitude. This insures that the rise of the output signal takes place during a small per-cent of the rise of the total signal applied to the input. This clipper will actually clip any signal from about 2.5 volts r.m.s. to the limit of the components, which is about 100 volts r.m.s.

The output voltage from this circuit is approximately one half of the battery voltage, since it is taken from a divider consisting of the battery, resistors R_2 and R_3, and the diode. The voltage divider could be adjusted to provide some more convenient voltage level, such as two volts for scope calibration, if desired.

In the matter of range, excellent square waves can be obtained from well below 100 cps to well above 1000 cps. A square wave of no more than 2000 cps would be needed to test the top frequencies to be handled by an audio amplifier, which range around 20,000 cps, or 10 times 2000 (see "Practical Techniques of Square-Wave Test-

(*Continued on page* 103)

Fig. 2. A dual-diode, three resistors, a 3-volt battery and a heater transformer are the only parts needed for the clipper. The clipper's square-wave output waveforms are shown from A to D at 35, 100, 1000, and 10,000 cycles per second.



A New For

Considering cost, this new Allied tuner is a good buy. Printed wiring simplifies the construction.

WE HAVE all witnessed, during the past ten years, the remarkable growth in the size and number of kit manufacturers. Starting with test equipment of all types, this industry soon expanded to embrace the high-fidelity field. Audio amplifiers, preamplifiers, and speaker systems of various types have been with us for some time in kit form but only recently have these manufacturers included the development and marketing of FM kits.

One of the most recently announced FM kits is the stock # 83YX751 developed by *Allied Radio Corp.* It is an extremely well engineered unit designed to cover the FM band from 88 to 108 mc. It features modern design, flywheel tuning, pre-aligned i.f. transformers, pre-adjusted r.f. coils, and cathode follower output. Circuit-wise, it incorporates a.v.c., a.f.c. (with disabling circuit), cascode broadband r.f. amplifier, and is advertised as providing a sensitivity of 10 microvolts for 20 db of quieting across the entire band. (We actually found it to have much better sensitivity than this; see our test figures later in the article.) It also includes a special drift-compensated local oscillator that provides stable operation even with a 20 volt line voltage variation.

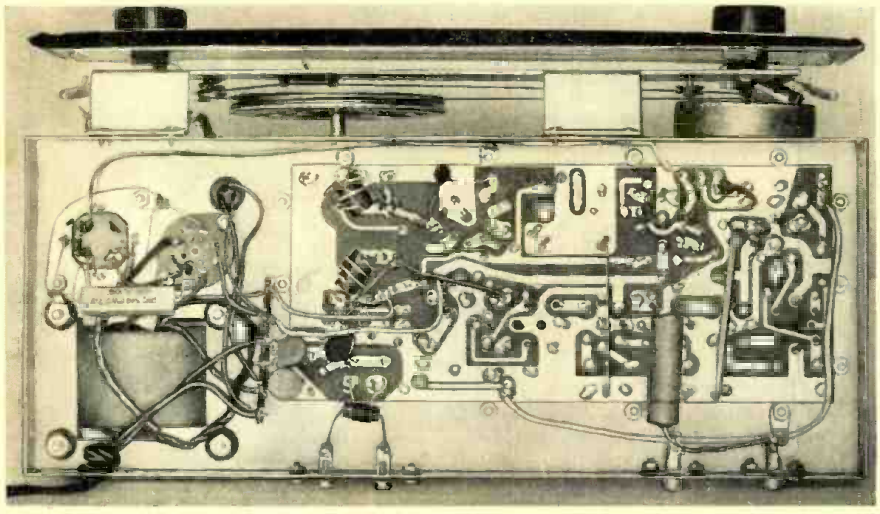
The design is based on the use of seven tubes: 6BQ7A as an r.f. amplifier; 6BA7 as a mixer; 12AT7/ECC81 as a local oscillator and a.f.c.; two 6AU6 i.f. amplifiers; 12AU7/ECC82 as an audio amplifier and cathode follower output; 6AL5 as a ratio detector; and a 6X4 power rectifier.

One of the most important features of this new FM tuner is a printed circuit board which takes up about two-thirds of the chassis area. It practically eliminates possible wiring errors and will definitely reduce to a minimum the problem of lead dressing at high frequencies. Obviously stray capacities and lead inductances will not vary and thus the manufacturer can pre-align the i.f. circuits and adjust the r.f. coils to an extremely close tolerance, simplifying final alignment. One of the greatest problems for the uninitiated in constructing an FM tuner is the final adjustment of all coils and trimmers which is necessary if optimum performance is desired. Although the coils are closely pre-aligned and good results are obtained on local stations without further alignment, an AM signal generator and meter may be employed for better alignment. A scope and FM sweep generator would result in a still better adjustment, especially in the shaping of the detector response curve.

The printed circuit board simplifies the construction by the home builder. No longer is it necessary for him to wrap leads around tie points—all that is required is to simply bend the leads of the components and they can then be slipped into pre-positioned holes on the board itself. A touch of the iron and solder completes the circuit. All in all, it makes for a far more simple assembly and the design is such that anyone who has the ability to solder should be able to put this unit together without any difficulty.

This new tuner is simple to hook up and operate. Since it does not include its own audio amplifier, it will be necessary to use a separate power amplifier. The output voltage of the tuner is taken from a cathode follower whose output impedance is 3000 ohms, and since the output voltage is relatively high, almost any power amplifier will suffice. The amplifier should, of course, have a set of controls—at least a volume control and phono-tuner switch. The antenna input impedance, of course, is a standard 300 ohms. There are two operating controls. One is a tuning knob and the other a 3-position function switch (on-off, FM, and FM-a.f.c.). In tuning, the station should be tuned in without the a.f.c. in the circuit. After the tuning adjustment is made as closely as possible, the a.f.c. circuit should be switched in. For distant reception, the a.f.c. circuit should not be used.

The under-chassis view shows neatness of assembly as a result of printed wiring.



Performance

For those who are interested in evaluating performance characteristics, refer directly to the table on the next page. The specifications shown are those published and quoted by the manufacturer. The question that always comes to mind is just how conservative are the published figures. To check this point, a sample tuner was built and sent to an independent laboratory for a performance check. After accurate alignment and tracking by a qualified electronic technician, using

FM Kit Hi-Fi

laboratory-type test equipment, most of the performance characteristics proved better than those published by the manufacturer. The results are as follows:

Ratio detector peak-to-peak separation was 400 kc., with a linear area of 215 kc.

I. F. bandwidth was 210 kc. at 3 db down, and 295 kc. at 6 db (50%) down.

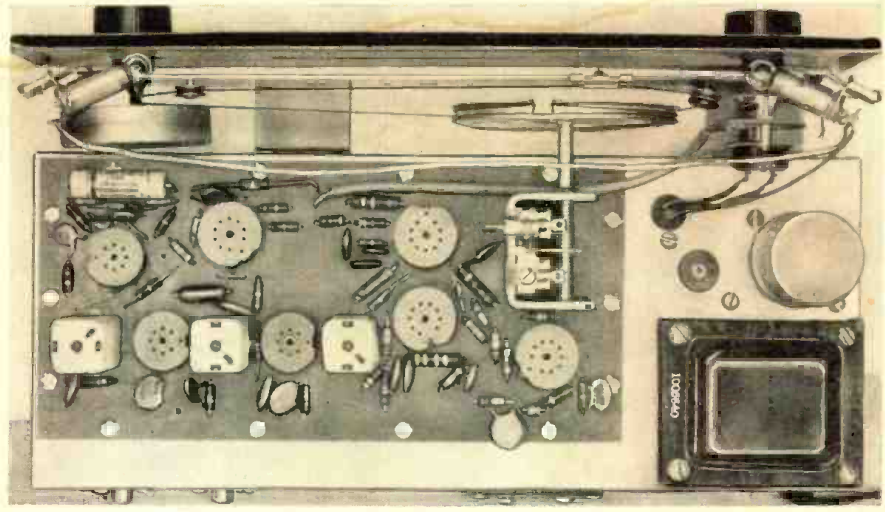
Sensitivity was 4-6 microvolts for 20 db quieting across the entire tuning range.

Image rejection was 46 db, with no other spurious responses up to —50 db.

Output voltage was 3.5 v. at 100 μv. input, 30% modulation; 5.3 v. at 1000 μv.; 7.8 v. at 100,000 μv. input.

Audio frequency response taken through the entire tuner at a 100 μv. input signal was within +0, —3 db of the standard FM de-emphasis curve from 50 cps to 15 kc. (Measurements were not taken outside this frequency range.)

Hum level was below —60 db at an input signal of 100 μv.; AM rejection factor was 18 to 1.



Top view of FM tuner showing the relative position of the printed circuit board.

PERFORMANCE SPECIFICATIONS

Ratio Detector Peak-to-Peak Separation	320 kc.
I.F. Bandwidth	200 kc. at 50% on curve
Sensitivity	10 microvolts for 20 db quieting across tuning range
Image Rejection	40 db with a 10 μv. signal
Output Voltage	1 v. at 100 μv. input 30% modulation; 2 v. at 1000 μv.; 3.5 v. at 1000,000 μv.
Distortion	0.6% with 1000 μv. signal; 30% modulated 20 cycles to 20 kc.
Audio Frequency Response	20 cycles to 20 kc. ±½ db
Hum Level	—45 db; AM Rejection Factor, 10 to 1; Intermediate Frequency, 10.7 mc.

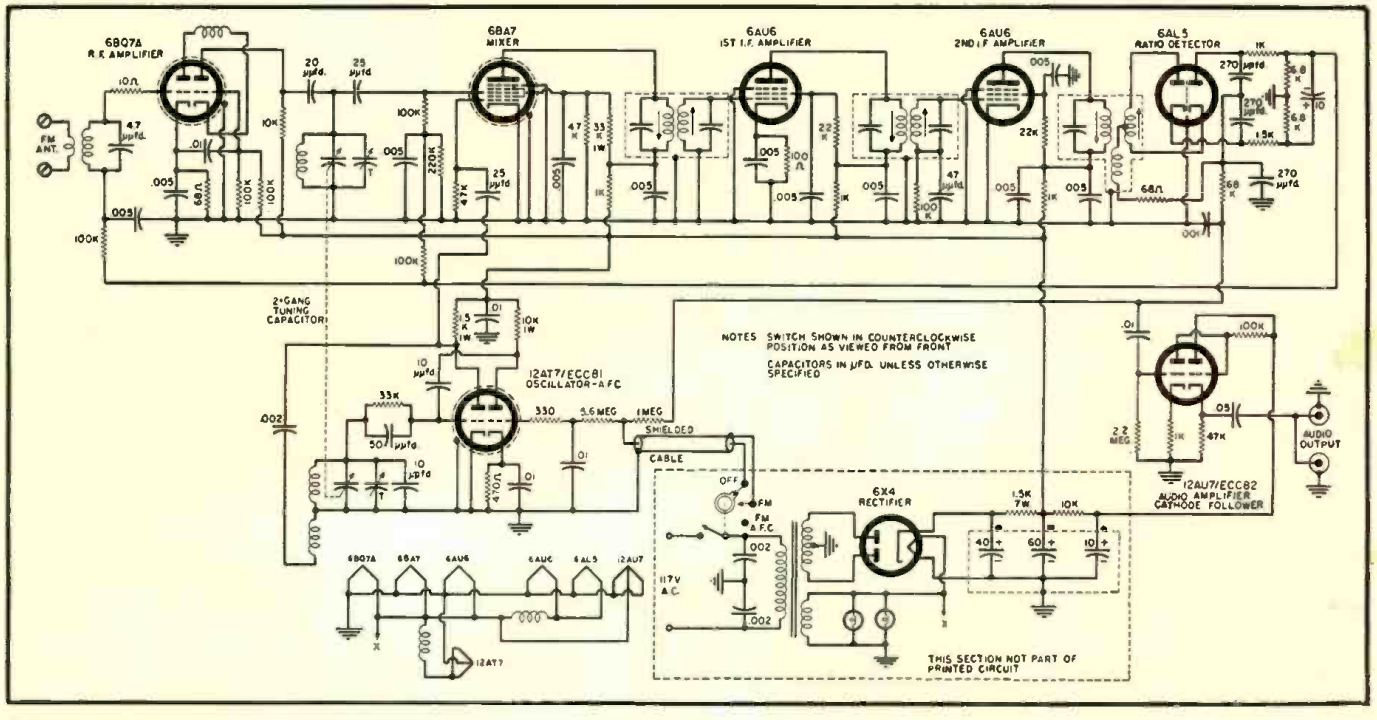
Published performance characteristics of new kit as supplied by the manufacturer.

Drift without a.f.c. was 0.2 mc. in 30 minutes from a cold start, while with a.f.c. there was no measurable drift. The a.f.c. pull-in range at 100 mc. was from 99 to 102 mc.

It is interesting to note that the audio frequency response was the only specification that failed to meet the manufacturer's figure. Since the published figures did not specify exactly how this characteristic was taken, we had to use our own judgment in making the test. We noted that the audio frequency response varied with the signal input. This, of course, is not unusual. Actually, with a 10 microvolt signal input the audio frequency response curve was within +4 —0 db of the standard FM de-emphasis curve. From this we would gather that at some value of signal input between 10 microvolts and 100 microvolts the audio response curve would come out relatively flat over the range measured; that is, from 50 cps to 15 kc.

(*Continued on page* 151)

The circuit is straightforward and includes a.f.c. and a.v.c. All major wiring is done on a printed circuit board.



By BERT WHYTE

INASMUCH as my "spies" in England have not been able to ferret out all the secrets of the new monogroove stereophonic discs introduced by the *Sugden Company* at the London Audio Fair, at least in time for this issue, we shall have to defer the matter. Which, in its way, may be just as well because the record companies are absolutely inundating the critics with new recordings. It seems incredible that the market could possibly absorb all this new material but, as I reported a while back, the hi-fi and music market is ever broadening and the saturation point still seems a long way in the future. Naturally this tremendous burgeoning market brings with it all the problems we have discussed before, such as duplication of repertoire, etc. This is something that requires investigation anew and a general updating, but please . . . not now, chum . . . we've just *got* to dig into this record pile!

HINDEMITH
MATHIS DER MALER
TOCH
SYMPHONY #3
Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol P8364. RIAA curve. Price $3.98.

This is the most massively proportioned, big sounding "Mathis" yet recorded. Steinberg has an affinity for this type of repertoire and, in his hands, the score unfolds in ordered progression . . . every note meaningful, every facet burnished . . . yet he paints in bold strokes and throughout the work emphasizes its lyric beauty, its drama, and passion. A superb "Mathis," definitely the best-sounding of the existing versions, it is largely a matter of taste whether you prefer this performance or that of Hindemith himself, or the old but excellent Cantelli reading.

The Toch 3rd symphony is here recorded for the first time and affords us an opportunity of hearing the work that won the 1956 Pulitzer Prize for music. In three movements this is a powerful score, modern in concept yet free from many of the contemporary cliches that are the Achilles heel of so many new works. Toch has always been an avid tonal experimentalist and much addicted to intricate and unusual percussion scoring. In the 2nd and 3rd movements he gives a pretty free rein to his ideas with some rather dazzling results. In addition to the usual percussion armamentarium he has added what he calls a "hisser" . . . a tank of compressed air with a valve to regulate the flow and thus the "sound," and a vibraphone as a substitute for the archaic glass harmonica and glass balls.

The sound throughout both scores is bright and clean and hi-fi fans will delight in the tumultuous finale of the Toch symphony, where the orchestra is in full cry, augmented percussion going full blast and, as a great counterpoint to it all, the stentorian voice of a pipe organ! An interesting score, this Toch 3rd symphony and worth a hearing even if you're not a "modernist."

BERLIOZ
HAROLD IN ITALY
Heinz Kirchner, violist, with Berlin Philharmonic Orchestra conducted by Igor Markevitch. Decca DL9841. RIAA curve. Price $3.98.

The Beecham-Primrose reading of this work has long reigned as the preferred version, but now must look to its laurels. This is not necessarily a "better" performance, but rather a different kind of performance equally logical and acceptable. Markevitch takes a more lyrical approach to the score than Beecham does and many will find this more palatable. On the other hand, Markevitch can't match Sir Tommy's fire and flint in the "Orgy of the Brigands" section. I found Kirchner's viola performance of a softer, more romantic hue than Primrose, but lacking some of his assurance.

Soundwise this is the big, full, richly resonant type favored by *Deutsche Grammophon*, with all elements cleanly reproduced.

BRAHMS
SYMPHONY #3 IN F MAJOR
Berlin Philharmonic Orchestra conducted by Eugen Jochum.
TRAGIC OVERTURE
Berlin Philharmonic Orchestra conducted by Fritz Lehmann. Decca DL-9899. RIAA curve. Price $3.98.

In spite of some very formidable competition this must be reckoned as one of the best Brahms 3rd's available. Jochum takes a broad view of the work, utilizing rather leisurely tempi and preferring to build his tensions slowly. This is a dangerous game, to be played only by experts, lest the performance turn into a stodgy bore. Jochum knows his way past the pitfalls and in taking this approach he imbues the score with a lovely warmth of expression, bolstered with a sturdy songfulness that underscores the essential beauty of the work. The Berlin Philharmonic plays with great elan and precision under the urgings of Jochum and if it's a really German performance you want, redolent with "Gemutlichkeit," this can stand along with the famous Bruno Walter reading as a model of its kind.

The "Tragic Overture" receives a good, competent, but not overly-inspired, reading under Lehmann. The sound in both works is typical *Deutsche Grammophon* . . . very full-bodied, no striving for effects, clean-lined and with an acoustic perspective that affords a "naturalness" that is quite attractive.

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.

BORODIN
POLOVETSIAN DANCES
RIMSKY-KORSAKOV
LE COQ D'OR SUITE
London Symphony Orchestra and chorus conducted by Antal Dorati. Mercury MG50122. RIAA curve. Price $3.98.

When *Mercury* sent its famous recording truck to England last year Antal Dorati was on hand to conduct the London Symphony in some of his specialties. This recording is one of the first fruits of that visit and a mighty succulent fruit indeed! This can easily qualify as another *Mercury* "super-recording," that rarified group of the "Olympian Series" wherein the recorded sound represents the highest pinnacle of technical excellence in the art and science of recording.

If the "Polovetsian Dances" are great, the "Coq D'Or" is overwhelming. In both scores Antal Dorati displays his conductorial virtuosity with exciting readings which broach no competition from anyone. His readings have fire and dash and drive . . . and they also exploit the Oriental color, the sensuous beauty, the mysticism of these exotic scores. The "Polovetsian Dances" are heard here in the version employing a chorus and this contributes mightily, both to the beauty of the work and to its savage whirling excitement. In matters of sound, the "Dances" are notable for the huge smash of tympani and bass drum and the tremendous dynamic interplay between chorus and orchestra.

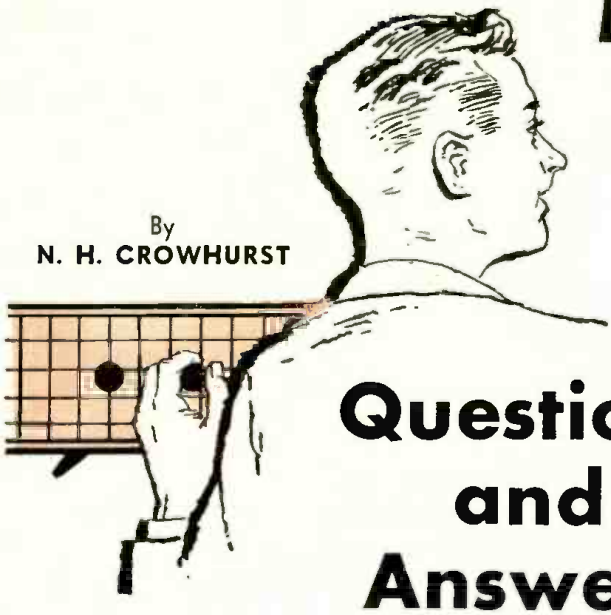
The sound in "Coq D'Or" is simply fantastic! Throughout the recording string sound is smooth and edgeless, trumpet and trombone have a bright, brazen blare, the facile woodwind rich in intonation. Percussion verges on the incredible . . . from the most clangorous clash of cymbal to the clean thundering impact of the tympani. There is an absolute monster of a bass drum employed in the "King Dodon on the Battlefield" section which gives forth with one of the most almighty WHUMPS ever heard from a record. On a good big speaker this drum will move enough air to snuff a candle, to say nothing of the sock in the tummy you'll feel if you stand in front of the speaker! Dynamic range near the finale is in the extreme and a more awesome outpouring of sound would be hard to find. One of the great recordings of this year, which should be on the list of every sound fancier.

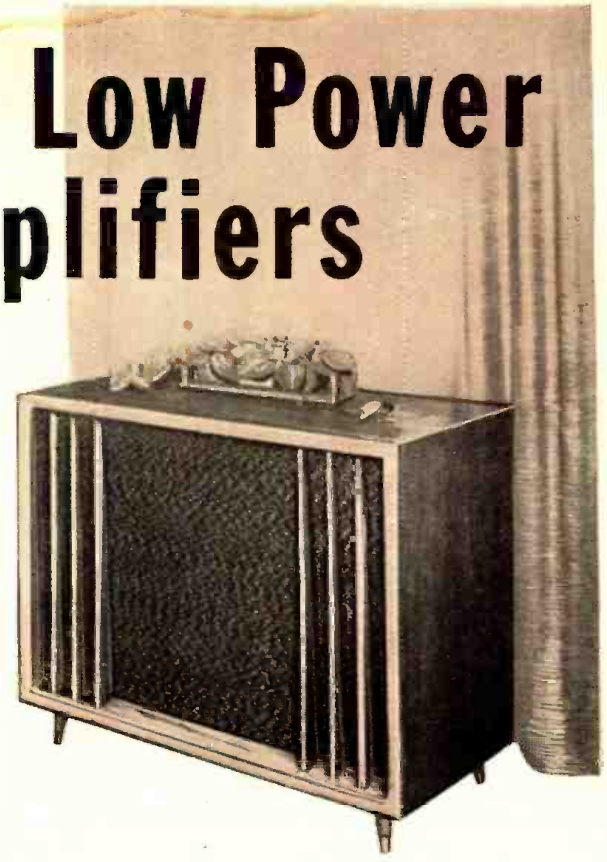
SAINT SAENS
SYMPHONY #3 IN C MINOR
Hans Eibner, organist, with Vienna Philharmusica Orchestra conducted by Hans Swarowsky. Urania UX-105. RIAA curve. Price $3.98.

This is another fine recording from the newly re-vitalized *Urania* label. From the number of new recordings of it, the Saint Saens 3rd symphony must be steadily growing in popularity. This version is excellently performed by Hans Swarowsky, although with considerably less polish than Cluytens' reading on *Angel*. However, Swarowsky manages to imbue the work with a kind of taut excitement that has its own particular attractions.

One of the most notable features of this version is the splendid sound. Outside of a little wiriness in the strings, this was very clean, with wide dynamic range, excellent transient response. The organ part here sounds much better than in any version since the old Munch/*Columbia*. The nice solid pedal is probably due to the fact that the organ of the Grosser Musikvereinssaal was used and it was there in those wonderfully felicitous acoustics that this recording was made. This record is worth owning for the marvelous sound textures afforded by the acoustics. A stereophonic tape of this performance is supposed to be available and that should be a humdinger! (*Continued on page* 137)

High Power vs Low Power Amplifiers





By
N. H. CROWHURST

Questions and Answers

An excellent article that should go a long way in settling the power argument for some time to come.

AMONG high-fidelity people, whether by that term you imply the manufacturer or the user of the equipment, there are two very definite schools of thought, as soon as the question of power output from an amplifier is raised. One says the trend toward big, powerful amplifiers (30, 50, or 100 watts) is quite unnecessary, all you need for the average living room is, at the most, 2 watts, with maybe some "headroom," so perhaps you should get an amplifier with a 10 to 15 watt rating.

The other school says you don't have sufficient headroom to handle transients and special effects in the musical program unless you do go to high power amplifiers, rated at 30, 50, or 100 watts (the higher the better). There are very definitely two points of view here, but each protagonist presents his own viewpoint as if it were the only one.

One writer will tell the reader he really doesn't need an amplifier with 30 watts output, let alone *more* than that, while another writer comes along and tells the reader that any amplifier with less than a 30-watt output is totally inadequate. This leaves the unfortunate layman (Mr. Average American) in a state of confusion.

A simple way to tackle this problem seems to be to deal with the most basic questions from which it derives, so each reader can judge for himself.

Question 1: Why do some recommend high power, say 50 to 100 watts, when an amplifier with 10 to 15 watts sounds quite good?

Let's simplify the issue a little by just taking the two extreme wattages. The contrast for ratings in between this will be that much less. Take an amplifier of 10 watts as compared with an amplifier of 100 watts. To the newcomer, this gives the impression that the 100-watt amplifier should sound 10 times as loud as the 10-watt amplifier. Unfortunately this is not true, due to a law, considered elementary by physiologists, called Fechner's Law.

This says that the sensation of loudness, like any other human sensation, is dependent upon the logarithm of the intensity of stimulus. Simply stated, the change in *sensation* of loudness is proportional to intensity *ratio,* not intensity *difference,* or the ratio between one power and another. As the human loudness sensation, at 1000 cycles at any rate, extends over a power ratio of 1,000,000,000,000 to 1, this means a ratio of 10 to 1 is just 1/12th the loudness "difference" between being just audible and the maximum intensity audible as sound. (Fig. 1.)

Expressed this way, even a 10 to 1 ratio, from 10 watts up to 100 watts, represents not a very big change in loudness. A change from 25 to 50 watts becomes only just perceptible—it is 3 db, and a change from 10 watts to 100 watts is only very little more than 3 times as much "difference" in loudness sensation—10 db, although one is a step-up of 2 to 1 in power, while the other is 10 to 1. This should help to set the stage for what follows and explains why the loudness sensations created by amplifiers at different power ratings are not as different as might be expected just by considering the power rating. A 50-watt amplifier gives 5 times as much power as a 10-watt amplifier, but this is only 7 db.

Larger power *can* be a disadvantage, unless the amplifier has a lower hum level. If the hum level is the same in each case, the hum from a 100-watt amplifier will be 10 db higher than that from a 10-watt amplifier. And loudness sensation at 60 or 120 cycles, the hum frequencies, is about three times as sensitive, so 10 db here is equivalent to 30 db at 1000 cycles. It can be the difference between an inaudible hum and one that is quite annoying during quiet passages.

Question 2: How is it that some 15-watt amplifiers sound louder and cleaner than some 50-watt amplifiers?

The hum question, just mentioned, can be a factor. There are others, but without getting involved in amplifier design and performance characteristics in detail, this depends on what is termed the "overload characteristic" of the amplifier.

Many amplifiers, rated to give 50-watt output, certainly do give 50 watts output. But try to make them give 51 watts and you might as well strive for the moon! It is not just that they refuse to give more than the 50 watts, but when the input is increased beyond that required to give 50 watts, the waveform becomes completely dis-

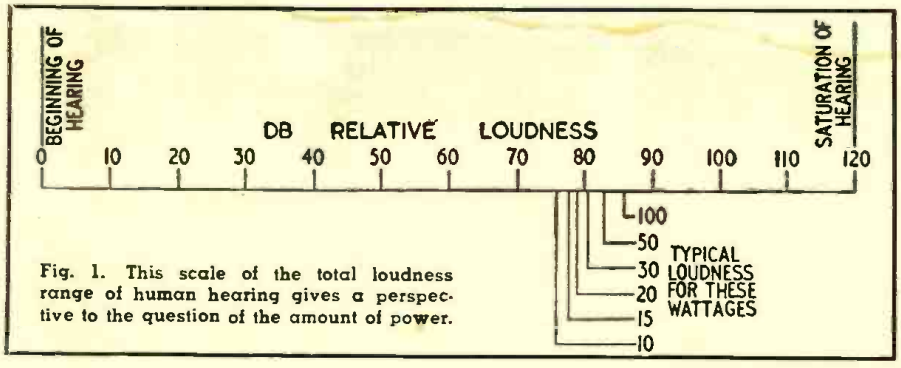


Fig. 1. This scale of the total loudness range of human hearing gives a perspective to the question of the amount of power.

torted. It is suddenly extremely evident to the listener that the amplifier has reached "the top."

On the other hand, many 15-watt amplifiers use quite a different kind of circuit. They may not give too much more than 15 watts before running into distortion troubles. They may become considerably distorted if you try to push 20 watts out of them. But the difference is that you can push in perhaps twice as much input and get a *reasonably* distorted output of 20 watts. (Fig. 2.)

If you push twice the voltage into a 15-watt amplifier, this would give 60 watts *if the amplifier continued amplifying more without distortion.*

Instead, you get 20 watts of tolerably distorted output. But, because you turned the voltage up this much, all of the lower level parts of the program sound like a 60-watt amplifier, and the peaks which should have 60 watts available to amplify them *without distortion* come out at about 20 watts without too serious distortion.

On the other hand, putting the same input into the 50-watt amplifier goes over the 50-watt level and produces *extreme* distortion, so you have to turn the input down to make quite sure the peaks *never* go beyond the 50-watt point. Program material that uses an average power of 5-15 watts with peaks running to 60 watts, will have *occasional* peaks running to 120 watts or more. The so-called 50-watt amplifier may need to be turned down to an average of only 2-6 watts to compare favorably with the 15 watter.

Question 3: Does the kind of loudspeaker you use have anything to do with the power needed from the amplifier?

It certainly does, and this is a point often overlooked in discussing the subject. A high-efficiency loudspeaker, of a type used in home high-fidelity systems, will have an efficiency of not more than 20%. This efficiency would mean an output of 50 watts will give not more than 10 watts actual acoustic power. More often the efficiency will be not more than 10%.

But even with this much efficiency, about 2 watts of electrical output will give you all you need in the living room for the sound to become almost deafening at loud passages. It is quite true as claimed by the "low-power" people, that the actual sound energy you need in the living room is only a matter of hundreds of milliwatts at the peak.

But some loudspeakers, instead of running in the region of 10% efficiency, which is still relatively high for a loudspeaker, only achieve 1 or 2% efficiency. Take a 2% efficient speaker in comparison with a 10% efficient speaker. Obviously, a 10-watt amplifier with a 10% efficient speaker will produce the same acoustic output into the room as will a 50-watt amplifier with a 2% efficient speaker. Both will give a maximum of just 1 watt into the room.

Question 4: Is the use of electronic dividing networks of any advantage in making do with less power?

The whole problem in power rating on amplifiers is one of providing for *peaks*. The average power is quite a small fraction, probably not more than 1/10th, of the peak power necessary to handle the composite audio waveform adequately.

Consider an idealized case, in which the audio composite consists of a single sine-wave frequency in each of the frequency ranges handled by a three-way loudspeaker system. (Fig. 3.) The highest frequency can be considered as riding on the medium frequency, and then this composite can be considered as riding on the lowest frequency. Assume, for simplicity, that each of these waveforms has a peak amplitude of 10 volts across an impedance of 10 ohms, representing a *peak* power of 10 watts or an *average* power of 5 watts.

Table 1. Maximum watts needed. Powers are those normally used as "average" ratings.

ROOM CLASSIFICATION	A		B		C	
PROGRAM CLASSIFICATION	1	2	1	2	1	2
High-Efficiency Speaker (15%)	.25	1	1.25	5	6	25
Medium-Efficiency Speaker (5%)	.75	3	4	15	18	75
Low-Efficiency Speaker (1.5%)	2.5	10	12	50	60	250

Then the total peak voltage will be 3 times 10, or 30 volts, representing a peak power of 90 watts, or an average power of 45 watts. This is what the amplifier rating would have to be to handle the composite signal. And yet the actual total power is only the sum of the three average powers, $5 + 5 + 5 = 15$ watts. So, for this idealized example, we need an amplifier with a *rating* of 45 watts, which means it will handle 90 watts peak, to satisfactorily accommodate the three 5-watt sine waves one on top of the other.

If we separate these three sine waves with an electronic dividing network, before we get to the power stage, so they are handled by separate power amplifiers, each amplifier will only need to handle its own 5 watts individually. This is the kind of argument put forward to show the advantage of an electronic dividing network. Of course, it will also reduce the possibility of intermodulation in the amplifiers and provides other advantageous features, but here we are discussing its possible advantage in making do with less total power.

What the argument just presented does not say is, how you would like a program consisting of just one sine wave in each of the frequency bands handled by your three-way system? It certainly would not sound much like music.

Typical musical programs will normally consist of: a single frequency, maybe with some harmonics, in the woofer range; a composite of several tones in the mid-frequency range, representing chords or the harmony of the music; while the tweeter or high-frequency range will only be carrying a comparatively small amount of power—just a few milliwatts—to give "definition" to the low- and mid-range material.

The biggest amount of power is probably required in the low and middle ranges. So from the standpoint of power division we can consider the problem as being essentially a two-way system. Sometimes there may be no low-frequency component but then the bulk of the power will be presented in the mid-range. This often occurs in musical programs. On the other hand, when there is a predominant low-frequency component, such as when a pleasant string bass "foundation" predominates, the other instruments are usually considerably quieter or at least do not require maximum power.

If you use your system exclusively for reproducing a string quartet, you probably could save on the total power required by using an electronic dividing network system. But if you play a more varied kind of composite material, then this advantage for using it seems to disappear, because on some occasions you will need to present the total power of the system through the mid-range channel. You will probably finish up needing an amplifier, for *both* the low- and mid-range channels, as big as a single amplifier would be to handle the full range.

The high-frequency channel, it is true, can use considerably less power, but there is little possibility of achieving any worthwhile power economy by using electronic dividing networks here.

This does not argue, of course, against their use for reducing possible intermodulation distortion and providing other features that do not come within the scope of this article.

Question 5: Must the amplifier and loudspeaker power ratings be matched? For example, must I use a 30-watt amplifier with a 30-watt loudspeaker?

This question, with variations, often crops up. It is surprising how often someone wants to know why the 30-watt loudspeaker doesn't sound louder than the 10-watt loudspeaker, when both are operated from a 5-watt amplifier, although the latter piece of information is *not* usually volunteered, because it "seemed irrelevant." *The wattage rating of a loudspeaker is not an indication of how loud it will sound, but of how much power can be put into it.*

It does not mean the loudspeaker with the bigger rating will sound any louder if only 2 or 5 watts are actually delivered to it by the amplifier. This is dependent, not upon the *power rating* of the loudspeaker, but on its *efficiency*. If one loudspeaker has an efficiency of 2% and another of 10%, then the 10% loudspeaker will sound louder than the 2% one, *with the same power delivered to it.*

To answer the question directly, the only possible reason why amplifier and loudspeaker power ratings should be matched is to insure the loudspeaker is not damaged by being overworked. For example, a 50-watt amplifier fed into a 10-watt loudspeaker could burn out the voice coil or cause other damage to the loudspeaker. On the other hand, a 10-watt amplifier, worked into a 30-watt loudspeaker, will never cause any damage, because the loudspeaker can never get enough power to fully drive it.

Question 6: Is there any connection between the efficiency and power rating of a loudspeaker?

Only that you need to take both these properties into account to determine how loud the loudspeaker can go. For example, a 30-watt loudspeaker with 5% efficiency will accept 30 electrical watts from the amplifier before causing any serious damage to itself. The fact that it is 5% efficient means that 1/20th *of the 30 watts* or whatever power it actually gets from the amplifier is delivered to the room as acoustic energy (a maximum of about 1.5 watts). This should be more than loud enough for any living room, but to get the 1.5 watts *you will need a 30-watt amplifier.*

On the other hand, a 20-watt loudspeaker may have an efficiency of 15%. This means the loudspeaker will accept 20 electrical watts and, being 15% efficient, will convert these into 3 acoustic watts. Although the power rating of the loudspeaker is lower than the other one it will give a bigger acoustic output into the room from a smaller amplifier (needing only a 20-watt amplifier in place of the previous 30-watt unit).

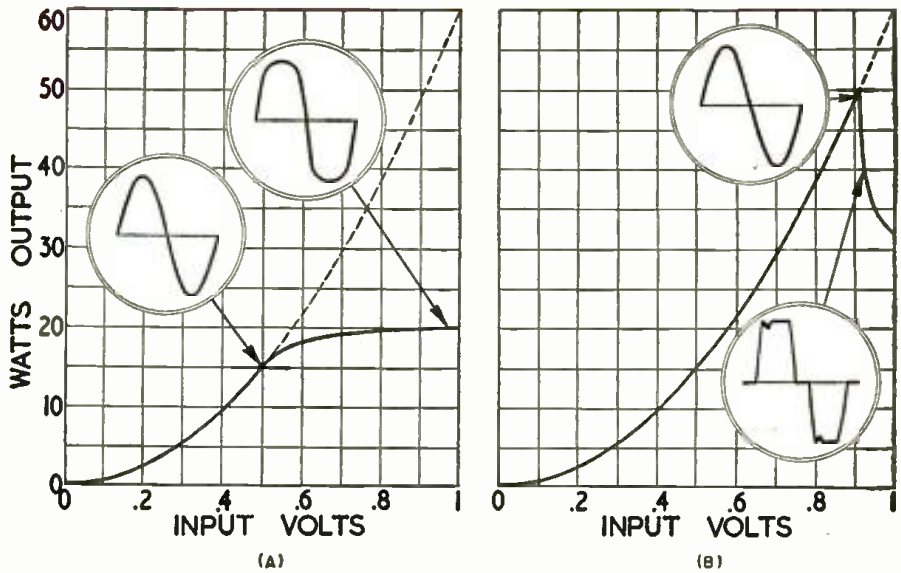


Fig. 2. The power output characteristics of a 15-watt amplifier (A) and a 50-watt amplifier (B) to show reason for difference sometimes noticed. The waveforms inset show output quality up to maximum output and beyond it, in each case.

This says that, in considering the power needed for a system, you need to take into account not only the power rating, but also the efficiency of a loudspeaker. Beyond this there is no connection between the two. If a loudspeaker has a higher power rating it is not an indication, automatically, that it is either less or more efficient.

Some high power compression driver type units, for outdoor use broadcasting from aircraft and similar application, have been built with an efficiency of 50% and a power rating in the region of 150 watts. This means they are capable of delivering some 75 acoustic watts into the air. Of course, they need it to overcome the background noise of aircraft motors. But for high-fidelity use, you could never live in the same room with a loudspeaker like that! This fact is only quoted to illustrate the lack of basic relationship between the efficiency and power rating of a loudspeaker.

Question 7: Can you give me some idea how much power I shall need for my system?

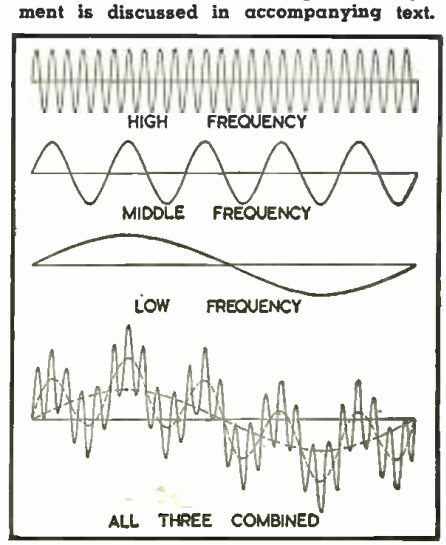
As the foregoing questions have shown, this depends on a number of factors. To try and be specific, we will give a comparative table that shows a range of maximum power required for various typical conditions. Note that Table 1 gives figures ranging from a quarter of a watt to 250 watts, which covers the entire range recommended by both the high-power and the low-power advocates.

Three typical room classifications are listed: *A* is a typical room with tiled floor, smooth walls, and furnishings without much, if any, upholstery —a modern American recreation room —with quiet background, not too near a railroad track; *B* is an average room, with carpet on the floor (not necessarily wall-to-wall), well-draped or open windows, possibly some drapes at entrance to another room, and some upholstered furniture; *C* is a well damped room of considerable size, with wall-to-wall carpeting, plenty of heavy drapes, on walls as well as at windows, and a quantity of well upholstered furniture—a real "plush" suite. Ambient noise from the neighborhood will make some difference here, as well as the size of the room and the number of listeners.

Program classification takes into account two extremes, which might be described as "highbrow" and "lowbrow"! Under these columns the figures are based on the relative peak power rating needed to give a similar impression of peak loudness with the two types. Column 1 is for jazz music, or any variety where the general level remains fairly constant, or compression is used in recording. Column

(*Continued on page* 150)

Fig. 3. The waveforms shown here illustrate the argument that the use of an electronic dividing network saves on the total power rating required. Validity of this argument is discussed in accompanying text.



Wobbled Scanning with a New CRT

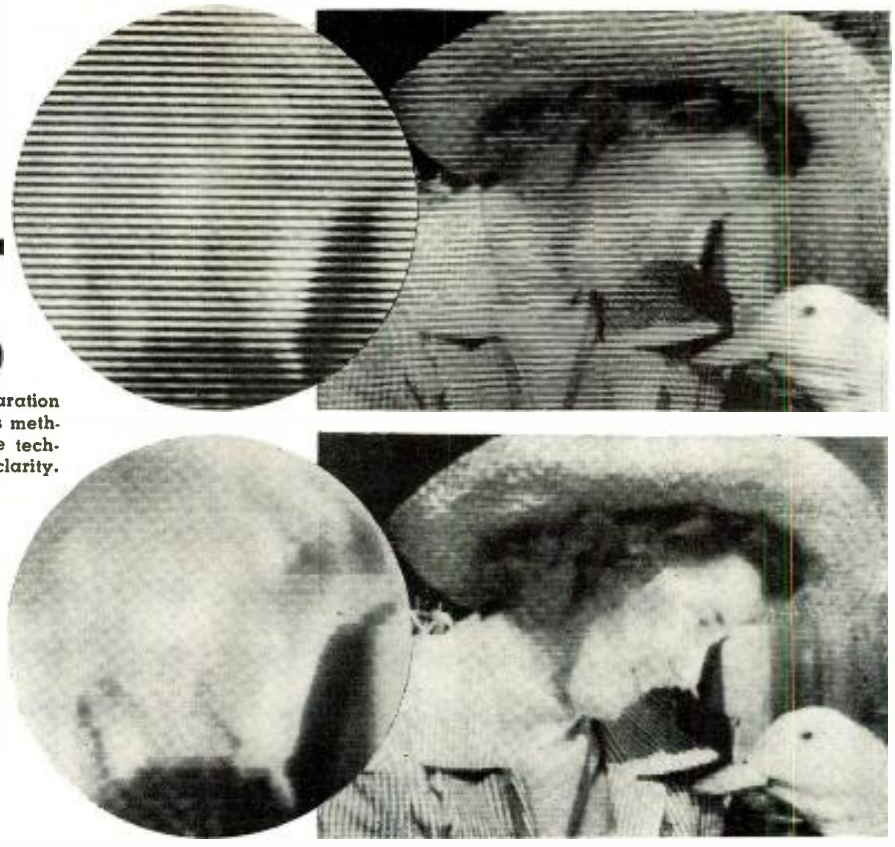


Fig. 1. The scanning-line separation noticeable with conventional focus methods (top) is obscured with wobble techniques (bottom) with no loss of clarity.

A split-grid gun simplifies wobbling techniques, yields clear pictures on a larger picture tube.

WE HAVE all come to accept the old saw that you can't get any more out of anything than has been put into it. Probing minds, however, have always had a disconcerting way of taking apart traditional concepts. Such minds in the *Westinghouse Electric Corp.* have come up with a way of geting more apparent clarity out of the television picture than is inherent in the transmitted TV signal. Actually, they do put something in to get this new advantage out—but the addition is to the receiver, not to the signal.

To appreciate the new technique, some review of background material is helpful. In this country, the chief limitation to picture definition is inherent in the 4-mc. maximum bandwidth and the 525-line scanning structure associated with FCC standards. Beyond a certain image size, horizontal detail will begin to blur and the scanning lines will begin to separate, instead of blending together visually, to the point that the picture loses intelligibility at normal viewing distances. In effect, this sets a limit on the size of the CRT that can win acceptance in home instruments.

Since television's earliest days, the horizontal scanning lines have been something of a problem. Ten years ago, it was the practice with some viewers to misadjust the focus control deliberately. The resultant increase in size of the spot made by the electron beam on the screen then blended the scanning lines together, making them indistinguishable. However, this approach also blurred the beam in the horizontal direction, giving the picture a smeared quality instead of the crispness we now associate with a well-focused image.

Nowadays, most viewers accept the practice of adjusting for sharpest focus (fine, separate scanning lines) and then sitting far enough back from the picture tube so that the lines are not individually distinguishable. The bigger the image, the farther back the viewers have to move—but they can move no farther than the wall of the room.

If we could somehow blend the scanning lines together without sacrificing sharpness, that is, if we could increase the size of the picture without having the viewer move still farther back—we could find acceptance for larger picture tubes. This may be done by spreading out the spot size *in the vertical direction only* to fill in the conspicuous black areas between raster lines. Retaining the narrow spot *width* at the same time would avoid the sacrifice of any inherent detail. Accomplishing this general purpose by spot wobbling techniques has been known for years in the laboratory and is in actual use in some parts of the world.

Many countries in Europe have adopted TV transmission standards involving fewer lines in the raster than we use, with the result that the separation problem in respect to these lines is considerable when the attempt is made to use the 21-inch picture tubes that have become accepted here. Wobbler circuits are used in some foreign receivers to overcome this problem. In essence, the wobbler is an oscillator whose output is used to deflect the scan lines so that, instead of tracing straight across the tube, these lines wriggle up and down in a sine-wave path. If a high wobbling frequency is used, the individual oscillations crowd together so that, instead of discrete cycles of oscillation, we get the impression of a thicker line. The effect on the picture can be noted by comparing the photos of Fig. 1, taken of the same scene viewed on a CRT screen, with and without wobbling.

Traditional means for obtaining spot wobble have involved considerable increase in the cost of the receiver, including the expense of an added winding around the neck of the picture tube, to which the wobble signal is applied. Also, there has been the problem of self-generated interference radiating from this coil. To overcome these drawbacks, *Westinghouse* engineers started out with the conventional low-voltage, electrostatic-focus picture tube, of which the 21AUP4 is an example. Francis T. Thompson, of the manufacturer's research laboratories, suggested the use of a split focus grid as a simple method of setting up wobbling. The modified gun structure, developed by Eros Atti and J. A. Hall of the manufacturer's tube division, is shown in Fig. 2. As this exploded view shows, the cylindrical focus electrode has been split in two.

In other respects, the gun structure is conventional. Separate leads are brought out from each half of the split

electrode through the base of the CRT for application of the wobble signal. Acting as a single unit, the two halves of the focus electrode continue to control focus in the conventional way. Acting separately, they form a push-pull pair to which the additional wobble signal is applied to swing the beam rapidly up and down.

The simple oscillator circuit of Fig. 3 was used to provide the wobble signal. While exact frequency is not critical, the circuit shown provided output at about 25 mc. Since this is more than 1500 times the scan frequency for each raster line, individual wobble cycles were not visible on the screen. The coil in the tank circuit was wound on a form ¾-inch in diameter. Eleven turns of closewound #17 wire were used, with a center tap for introduction of the normal focus voltage. Value of the potentiometer in the plate circuit is not given because it will vary depending on the value of available "B+." Plate power for the desired signal amplitude should be approximately 80 volts d.c. at 2 milliamperes. A nonlinear control, with resistance increasing rapidly as the adjustment is made away from the d.c. source, will afford the most convenient manipulation. If the "B+" source from which the plate voltage is derived is at about 130 volts d.c., the control should be about 500,000 ohms in total resistance. In a nonlinear pot, 50,000 ohms, which should be the approximate value needed to provide the desired 80 volts, will then occur in the vicinity of the center position.

In laboratory experiments with the split-grid tube, the receiver was adjusted as follows to demonstrate the effectiveness of the circuit: the wobble amplitude adjustment was turned off so that the picture tube could be operated just like a conventional CRT. Receiver focus was then adjusted for minimum spot size and sharpest definition. The resultant image is shown in the top portion of Fig. 1. The wobble amplitude control was then rotated until adjacent scanning lines were just touching each other. The image then obtained is shown in the lower portion of Fig. 1.

If the reader moves far enough back from Fig. 1, he will reach a point where the scanning lines cannot be distinguished in either portion of the figure, and both images appear pretty much alike. As he moves in toward the page, the lines in the top portion begin to separate, but the image in the bottom portion maintains its integrity, with the line structure remaining indistinguishable, over a considerable distance.

Aside from manipulation of the wobble adjustment, no other controls were touched between the taking of the first photograph and the second. Contrast and brightness controls remained the same.

The split-grid wobble deflection method has several advantages over the system used in Europe, notably in Great Britain, where an auxiliary coil has to be wound around the neck of the picture tube. The combination of the oscillator with the split grid results in a high "*Q*" which minimizes the need for driving power and reduces oscillator harmonics. Such harmonics may cause interference patterns on some channels. Experimental evidence indicates that interference is not a serious problem when the split-grid method is used. Also, high wobble frequencies are relatively easy to obtain because of the low capacitance between the two portions of the split grid and the fact that it thus does not do much to bring down the resonance of the oscillator tank circuit. As already noted, if the wobble frequency is too low, the scanning lines will detract from the desired effect by permitting the individual cycles of oscillation to become visible. In addition, the cost of splitting the grid is small, in terms of production, as compared to the cost of using auxiliary deflection coils. The wobble oscillator will be necessary in either case, but the drive requirement in the split-grid method is sufficiently lower so that some probable cost reduction in this circuit may also be realized.

When the split-grid tube becomes available, existing receivers can be adapted to the new technique quite simply. The experimental wobbler circuit was built on a plug-in subchassis, shown in Fig. 4, that was inserted between the base of the CRT and the existing picture-tube socket. Filament and "B+" voltages for the oscillator are available at the latter socket. This construction minimizes radiation by keeping r.f. leads short.

Production of split-grid picture tubes has not yet reached the commercial stage. One obstacle is the present association in the viewer's mind between clearly visible scanning lines and optimum focus. A logical choice for its earliest use would seem to be sets with extra-large screen sizes for use in places of public assembly. If the system wins acceptance in this direction, it may well pave the way to home receivers with larger picture tubes than the ones currently accepted as providing images of quality from the normally observed living-room viewing distances. —30—

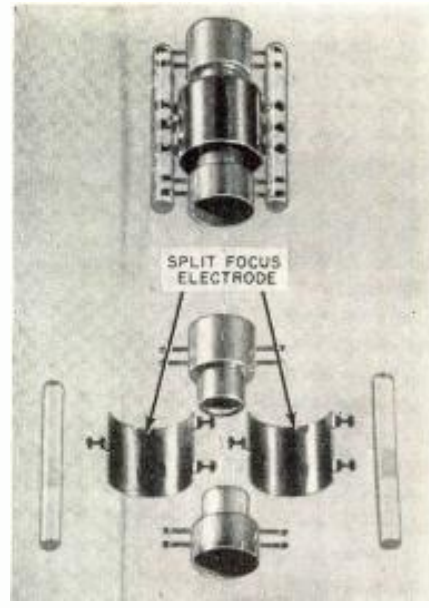


Fig. 2. Exploded view of gun structure for conventional low-voltage electrostatic-focus picture tube, except that the focus electrode has been split into two parts, as shown, for the addition of an r.f. signal to produce scan wobbling.

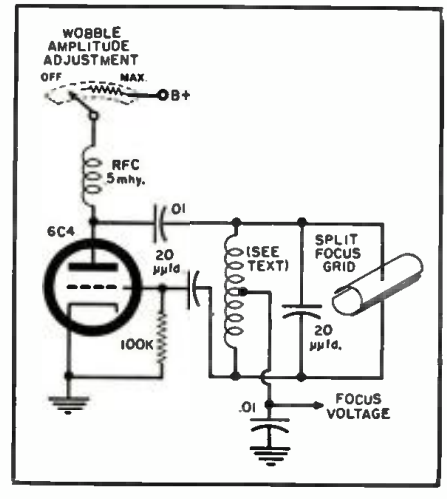
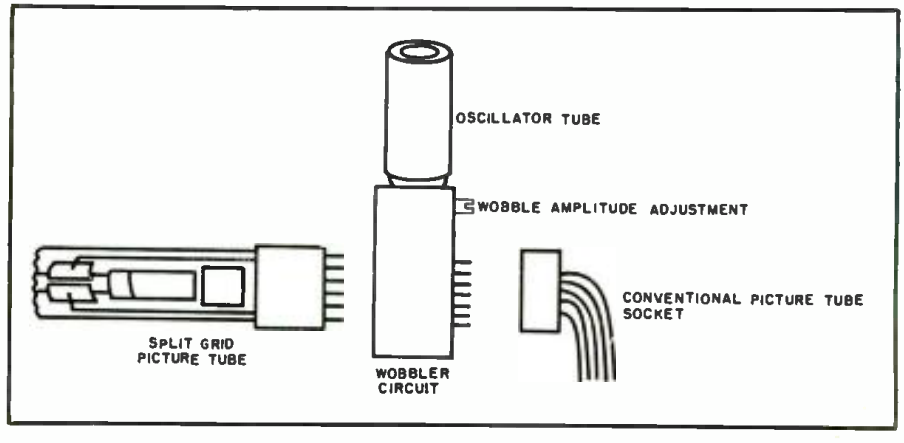


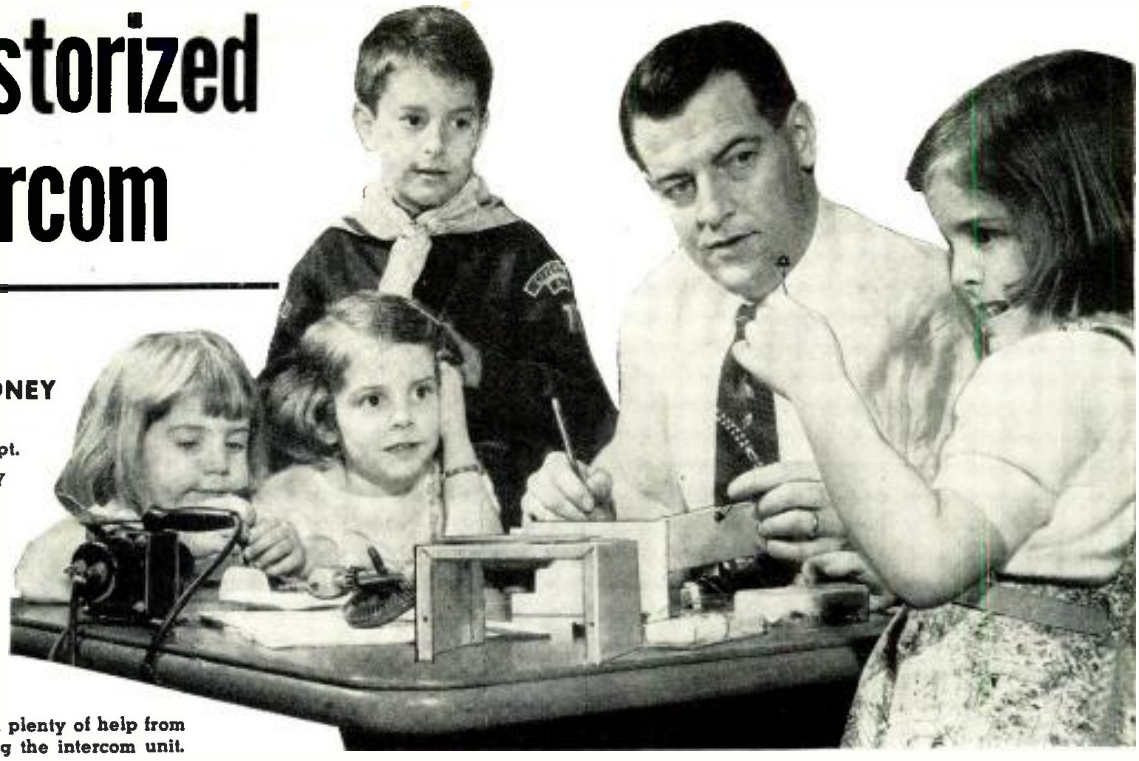
Fig. 3. This single-stage wobbling oscillator, operating in the vicinity of 25 mc., uses one resistor, one resistive control, four capacitors, one standard choke, and one easily hand-wound coil on a plug-in subchassis.

Fig. 4. The complete wobble oscillator circuit can be built on a plug-in subchassis to fit between the CRT and its socket. The socket provides voltages.



Transistorized Intercom

By **WILLIAM J. MALONEY**
Transistor Engineering
Semiconductor Products Dept.
General Electric Company



Author Maloney had plenty of help from his family in building the intercom unit.

Simple but sensitive unit using four inexpensive transistors will find many uses around the home.

THE intercom is a very useful electronic gadget. Today, in its commercial form, it saves considerable time by keeping offices, laboratories, shipping docks, and the like in constant communication with control offices. It is also used in many homes for the same reason but its use here has been restricted due to cost and the relative complexity of building even a simple one. Sixty-cycle hum is a very perplexing problem in any but the most carefully designed units.

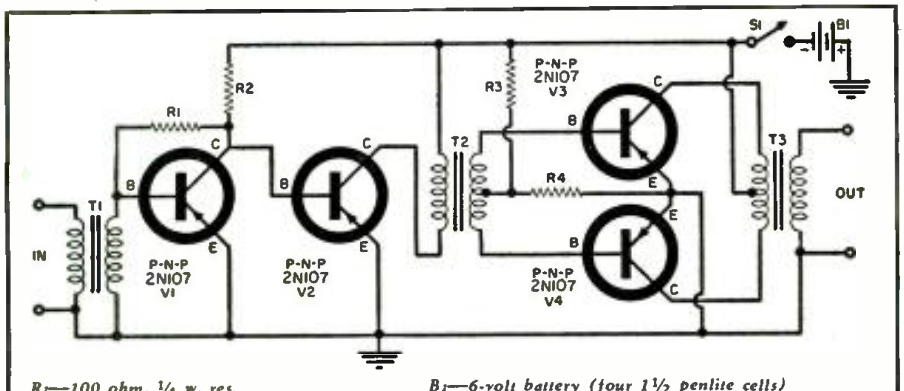
With the advent of transistors, many of the more serious problems are minimized. Transistors give high gain at low voltage and low current. Furthermore, due to their low impedance input, hum pickup is reduced. It is possible to build a low power intercom suitable for home use whose power consumption is low enough to make a battery supply feasible. This further eliminates the hum problem. Along with these obvious advantages goes compact size, relatively simple circuitry, and low power requirements.

The intercom described here is a simple two-station one, although it can be expanded into larger systems. If it is expanded, it should be remembered that the power requirements will be increased.

The output stage (Fig. 1) is a conventional push-pull system, utilizing two *p-n-p* (*G-E* 2N107) transistors. The biasing is arranged so that the d.c. current is low. It should be noted that the biasing circuit, R_3 and R_4, is relatively high in resistance for two reasons: (1) It should not draw excessive bleeder current thereby increasing the power drain, and (2) it should be high enough so that it does not affect the input impedance.

The output transformer (T_3) uses a 2000-ohm center-tap to the 3.2-ohm voice coil. This means each transistor is working into an output load which is somewhat low. Ideally, the transistors should be matched to each other, but a certain amount of mismatch is tolerable. *Beta* on the two transistors should be as close as possible. The difference in the d.c. current between the two will determine the amount of d.c. current in the transformer. This is important in most applications of this type since miniaturization of the transformer requires very low d.c. quiescent current. T_2 is a 20,000 ohm to 2000-ohm center-tapped unit. The input stage operates at a fairly low voltage level with the base and collector at nearly the same potential. Although the quiescent d.c. through the input stage will be relatively high, the resultant operation will give high sensitivity, good gain, and low noise operation. Since the driver is direct-coupled to the collector of the input stage, its bias will be determined by the input stage. For this reason, a relatively low collector load resistor is used to make changes in I_{co} less significant in the circuit operation. It will be noted that an change in I_{co} or βI_{co} will result in a shift in bias on the second stage. R_1 is used to bias the input base to a potential near that of the collector. It gives a considerable amount of feedback which results in very stable operation. At high signal levels, where there is a tendency to overdrive, the large amount of feedback is very desirable. T_1, the input transformer, is the same as the output transformer

Fig. 1. Complete schematic diagram and parts list for the intercom amplifier.



R_1—100 ohm, ¼ w. res.
R_2—15,000 ohm, ¼ w. res.
R_3—43,000 ohm, ¼ w. res.
R_4—1 megohm, ¼ w. res.
S_1—S.p.d.t. slide switch (Carling S60A)
B_1—6-volt battery (four 1½ penlite cells)
T_1, T_3—Transistor output trans. (Argonne AR-135)
T_2—Transistor driver trans. (Argonne AR-103)
V_1, V_2, V_3, V_4—"p-n-p" transistor (General Electric 2N107)

but the center-tap is not employed.

The design presented has been optimized for a minimum of parts and simplicity in general. It is recognized that it may be difficult to get consistent operation from all transistors of this type. However, if the appropriate resistors are adjusted for proper bias currents, the resultant operation is quite satisfactory. Therefore, in general, R_3 should be adjusted so that the current through each output transistor is 1.0 ma. Be careful to measure the current through *each* transistor and not the combined current of the two. To do this, it will be necessary to open the lead at each collector. Furthermore, the current through the two output transistors should be within 10 per-cent of each other. R_2 and R_1 will affect the current through both V_1 and V_2. R_1 should be kept small so that the voltage between collector and base on V_1 is kept low. This will affect the noise level of the output considerably, therefore, it is better to adjust R_2 first to get the collector current through V_2 to 0.5 ma. Then the collector current through V_1 should be 1.0 ma. Furthermore, since the design has been kept simple, the bandpass is only sufficient for voice frequencies, approximately 300 to 4000 cycles.

A remote speaker, of the type used in mobile communications, houses the unit (Fig. 3). Its small size and compactness were ideal and there is sufficient room inside to house the necessary components. A *General Electric* type 4EZ-1A1 speaker and enclosure was used and its dimensions are 4½" square by 2¼" thick. It uses a 3.2-ohm, 3-inch speaker. It is possible to build a small housing similar to the one shown out of aluminum or even wood. The model in the photo comes with a bracket for wall mounting.

The amplifier circuit with all its components is mounted on a phenolic board 1⅝" x 4" x ⅛". Ten terminals are spaced evenly along each side. This board is big enough to mount all the components conveniently. See Fig. 2. Care must be taken in soldering the transistor leads, since excessive heat can harm the units. The transformers can be attached to the back of the board with the leads brought up to the proper terminals.

A push-to-talk switch was made from two miniature "switchettes." A small groove was filed in the bottom of one switch until the plunger is exposed. Then the push-button on the second switch is filed so that it just fits into the groove of the first one. See Fig. 5. Thus, when the two are clamped together, pressure on the one switch-button actuates both switches. A small slide-switch (single-pole, double-throw) is used as the power switch.

As noted in Fig. 6 the batteries are formed into a square by strapping four small penlite cells together with tape, and using cardboard to act as a further insulator and "cushion." The proper amount of ordinary cardboard makes the battery pack fit snugly into a space above the speaker. The amplifier board, when covered with cardboard to cushion it and insulate all terminals, also fits neatly in a space below the speaker. The two switches are mounted on the side.

This unit has been used by the author for several practical purposes. It was originally built and used to monitor a sick child both day and night. Arranged properly, the slightest call in the night can be distinctly heard in any other part of the house. It works very well between the living room and a basement laundry so that a mother can do her wash and, at the same time, keep "tuned in" on the doorbell, phone, and children's arguments. When dad started fixing over the attic room, he kept in close contact with the household by means of the intercom. Of course, it can also be used to interrogate front door callers without exposing oneself. It is so sensitive that, placed on the back porch, it will pick up all the noises and conversations normally heard and can be used to keep track of the children at any age.

Finally, it can "baby sit" when going next door to play cards. A wire stretched across the lawn and into the kitchen window obviates running home every few minutes to check. —30—

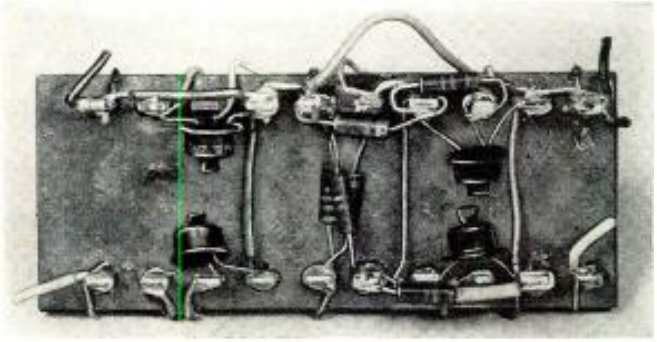


Fig. 2. Top view of the amplifier chassis. All components are visible except transformers which are on the reverse side.

Fig. 3. Front view of speaker housing used for intercom amplifier, including all batteries and switches.

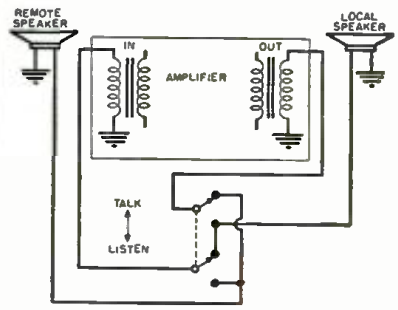


Fig. 4. Diagram showing the switching circuit employed for the transistorized intercom unit. Both the remote and local speakers are conventional 3.2-ohm, 3-inch units which are switched from output to input circuit with d.p.d.t. switch.

Fig. 5. This view shows all components in place and case ready to be closed. Cardboard packing insulates terminals from case.

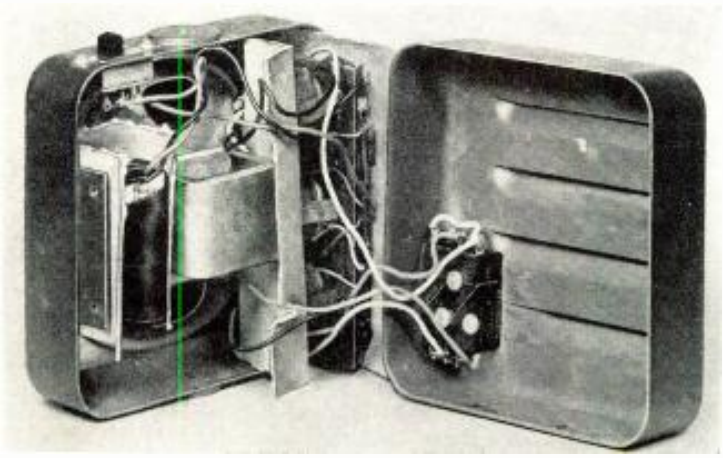
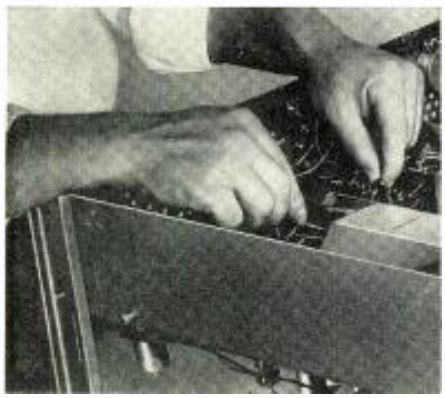


Fig. 6. Here is a partially disassembled view of complete unit.

Professional Standards for Technicians



By **WILLIAM LEONARD**

Many seek alternatives to government licensing.

THE PHRASE *professional recognition* has been widely used by service associations without considering how it may be interpreted by the average person. The result is that many full-time service technicians are considered professionals by their customers, but not in a complimentary sense.

A widely accepted application of the term *professional* is defined by dictionaries as "Engaging for livelihood or gain in an activity pursued, usually or often, for noncommercial satisfactions by amateurs, as a *professional* golfer." Under this interpretation, any man who earns his livelihood in servicing electronic products would be classed as a professional without regard to his proficiency as a technician. Hobbyists and part-timers who do service work for the pleasure they get from curing troubles in electronic devices would be classified as amateur technicians.

What service associations mean to imply is that electronic service should be recognized as a professional activity. Turning again to the dictionary, we find this description of work associated with a recognized profession, "Characteristic of or conforming to the *standards* of a profession." In this interpretation it is the conformance to recognized standards that determines a man's professional status.

A critical analysis of all of the licensing measures that have been proposed to regulate the handling of consumer service on electronic products reveals that the factor of technical proficiency is used as a screen in the hope of legally regulating the moral and ethical practices of a service shop as a business is so closely intertwined with the technical proficiency in performing service that the weaknesses of the former can easily be blamed on the latter.

The bulk of the consumer complaints about TV service have not been caused by poor or inefficient technical service. They are the result of larcenous practices that have bilked the public for unneeded parts, tubes, and service.

In turning to municipal councils and state legislatures for licensing at this time, service dealers are trying to unload on an unqualified third party a responsibility that is a primary obligation of the service industry itself if it ever hopes to achieve the status of a profession. This responsibility is the development of professional standards for electronic service technicians by which relative technical proficiency can be appraised accurately.

It is axiomatic that the public can never be brought to respect an industry whose members have no respect for each other. Some of the industry's finest technicians have been pilloried before set owners by unethical competitors because they make honest charges for their time, knowledge, and skills.

In the complex maze of electronic products and circuitry applications, what published standards are available to gauge whether a man is a good, fair, or poor technician? If the industry itself has been unable to establish standards of performance, what are the chances that this can be done equitably by politically appointed committees?

In order to earn recognition as a professional activity, the service industry must develop and win national recognition for a system of standards by which the technical proficiency of its members can be rated. If this is left to politically appointed license committees, or manufacturers, or distributors, the service activity will become captive to the outside force that institutes and controls its standards.

One of the big problems of organized service at this time is that not all of the most vocal advocates for licensing are motivated only by a desire to raise the over-all technical and business level of service. Some are hoping also to create good jobs for themselves so they can quit the service business to tell others how they should operate.

Many service dealers have long been aware of the industry's responsibility to put a firm foundation under electronic service by developing standards and a system for technician accreditation. A group of prominent service dealers on the eastern seaboard have been getting together frequently in unpublicized meetings to discuss plans for setting up standards and methods for accreditation of technicians who meet those standards. Several of these men who once were staunch advocates of political licensing now feel that it would be unwise to put control of service in the hands of political bureaus.

Another group of service dealers who have been in the vanguard in this trend of thinking are the members of the Minnesota Television Service Engineers, Inc. Working with the Apprenticeship Council of the Industrial Commission of Minnesota and the Bureau of Apprenticeship of the U. S. Department of Labor, the MINTSE organization has been developing technical standards for service activity over a number of years.

The first section of the standards developed by MINTSE was released recently. This section covers the standards approved for radio and television apprentices. In a letter to manufacturers which accompanied copies of these standards, John W. Hemak, president of MINTSE, said:

"No industry, trade, institution, etc., can keep advancing without a solid foundation. So, without putting skids on progress, and exploring the possibilities for developing a foundation, the Apprenticeship Program is being put into effect (in Minnesota) for the first broad, legal, progressive recognition of an industry.

"This program is not a 'cure-all' but definitely a 'common denominator' on which a meeting ground can be found for further progress and raising the level of the whole industry, ethically, institutionally, and financially.

"Uncomplimentary, erroneous, or derogatory information need not reach the public with the industry united to offer the consumer the best possible value in the home."

The MINTSE program of standards provides for progressive advancement from apprentice to serviceman to technician. The apprenticeship period embraces about four thousand hours of training in various categories of service work associated with radio, television, phonograph, sound and electronic products, public relations, and miscellaneous electronic devices.

In addition to its work in connection with the development of technical standards for the service industry, the Minnesota Television Service Engineers have cooperated with the Center for Continuation Study at the University of Minnesota in presenting an annual 3-day Institute for Television Service Engineers and Managers.

Subjects covered in the 1957 Institute included: Customer Relations; Employer-Employee Relations in Small Businesses; Budgeting; Accounts Receivable, Rights, and Collections; Safety; Liabilities in Television Servicing; Business Practices; and Business Insurance.

MINTSE has made its standards available to the industry for study and possible adoption in other states. —30—

Practical Color TV For The Technician

By
KEN KLEIDON
National Color TV Mgr.,
Hycon Electronics, Inc.

Part 1. First in a series that will concentrate on the information most useful in servicing color sets.

SHORTLY after the NTSC transmission standards for color were approved by the FCC, many articles were published expounding the theoretical aspects of the new color specifications. Articles also appeared covering the different color-picture tubes and circuits required for the reception of the color signal. Commercial receivers progressed from the 15-inch, three-gun tube to the 19-inch, then to the 21-inch, and now 22-inch rectangular three-gun tubes are available. During this period, the TV manufacturers have been striving to simplify circuitry and reduce manufacturing costs. As a result, color-receiver circuitry has changed drastically.

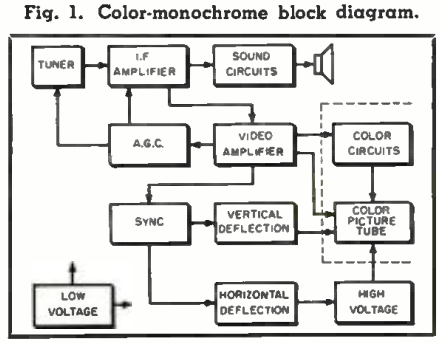
Between circuit evolution and the multiplicity of articles, some confusion inevitably results for service technicians who have attempted to keep abreast of the latest developments in this new field. The sheer bulk of available color information presents a definite problem. Since much of the color reference material is repetitious, the technician has the task of deciphering and separating the useful or practical information from that which is unimportant to him. The purpose of this article and those which will follow is to present useful and practical subject matter that will be of a definite value in servicing. Color television will be approached from a service standpoint and analyzed with a practical rather than a theoretical point of view.

As is the case with the theoretical aspects of monochrome television, knowing the intricate details of the color picture tube or the transmitted color signal is not an absolute necessity in servicing color receivers. An understanding of the basic function and operation is more important. Every service technician is well aware that the monochrome sound carrier is frequency-modulated and that the horizontal scanning rate is 15,750 cps. However, questions like the following may be difficult for some to answer: 1. Why was the sound carrier frequency-modulated rather than amplitude-modulated? 2. Why was the exact frequency of 15,750 cps chosen for the horizontal scanning rate?

Knowing the answers to these questions is neither important nor necessary to service monochrome receivers. The same often applies to understanding the operational characteristics of the new color circuitry or the theory of the transmitted color signal. It is not, therefore, important to know why the luminance and chrominance signals are frequency-interleaved or why the frequency of 3.579545 mc. was chosen for the color burst signal or color subcarrier signal.

To illustrate with a similar situation in the monochrome receiver, the operation of the FM detector stage is quite complicated. This circuit performs the function of limiting, FM detection, and amplification, often with only one tube. To cover the operation of this circuit exhaustively would require a number of pages of this magazine. However, all that is actually necessary to service this section of a receiver is to understand the circuit's basic function, which is to accept the 4.5-mc. signal containing the sound information, detect the frequency-modulated signal, and then amplify the sound signal. The technician is familiar with the signal applied to the stage and the signal which should be obtained in the output. When trouble occurs, he follows established service techniques and practices to locate it. This same analogy can also be applied to color and will prove to be a practical approach. Analyzing color from a basic service standpoint will reveal the important requirements necessary for servicing.

Fig. 1. Color-monochrome block diagram.



One requirement for a color receiver is that it be capable of receiving a monochrome transmission and reproducing a picture in black-and-white. This is necessary due to the fact that the NTSC standards for color are compatible. Therefore, a color receiver is identical to a monochrome receiver in that it can reproduce television pictures in black-and-white. However, it is considerably different in that it can also reproduce in full color. Because of this requirement, the design of a color receiver must closely parallel

(*Continued on page* 141)

Views of the "Californian, Jr." showing the attractive "wrap-around" grille cloth styling. Rear view with back removed shows the tunnel plate which forms the ducted port.

By **MILTON S. SNITZER**
Technical Editor,
RADIO & TV NEWS

"Ultraflex" Speaker Enclosure

Construction and performance of Argos-built and Jensen-designed small ducted-port reflex enclosure.

IF YOU are looking for a compact, attractively styled, and well-designed enclosure for your 8- or 12-inch loudspeaker, the "Californian, Jr" is for you. Pre-built or available in kit form, this *Argos Products Co.* enclosure (Model DSE-2) is a *Jensen*-designed "Ultraflex," a special type of ducted-port reflex unit. A pair of these enclosures may be used for an inexpensive stereo system.

The actual volume of the "Californian, Jr," is only 2.5 cubic feet. In order that it may resonate at a fairly low frequency of 55 to 65 cps and so be suitable for use with speakers having this order of cone resonance, several expedients are followed. First, a fairly small port area of 24 square inches is used. This lowers the resonant frequency of the enclosure. However, this usually results in a reduction of bass radiation from the port compared to that obtainable from a larger port-larger volume combination. Second, a 9-inch tunnel plate is installed just above the port in such a way that a duct, extending the entire width of the cabinet, is formed.

Effect of Duct

In order to see just how effective the duct is, we conducted a number of impedance measurements shown in Figs. 1 and 2. These measurements are actually voltage readings taken directly across the speaker voice coil. But since the speaker was isolated from the audio oscillator feeding it by means of a large resistor, the oscillator was, in effect, converted into a constant-current source. Then, as the speaker impedance rises and falls while the current remains steady, the voltage across the voice coil also rises and falls in direct proportion to the impedance. Hence, although the curves are voltage curves, they are directly proportional to the speaker impedance.

First, a fairly low-priced 8-inch coax speaker (*Jensen* K-80) was used. The free-air cone resonance of the particular speaker checked was found to be close to 65 cps (curve 1, Fig. 1). Next the speaker was mounted in the enclosure but the tunnel plate forming the duct was not yet installed. Without the duct the typical double-peaked curve was produced with the peaks straddling the single free-air resonance peak of the speaker alone. Upon examination, though, it can be seen

(*Continued on page* 93)

Fig. 1. Impedance curves obtained with 8-inch loudspeaker unit.

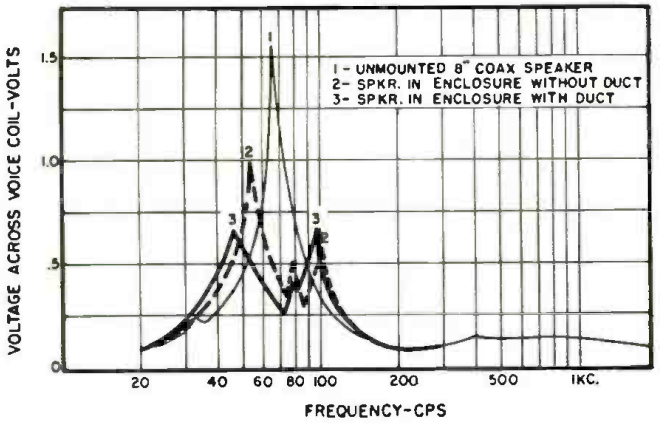


Fig. 2. Impedance curves obtained with 12-inch loudspeaker unit.

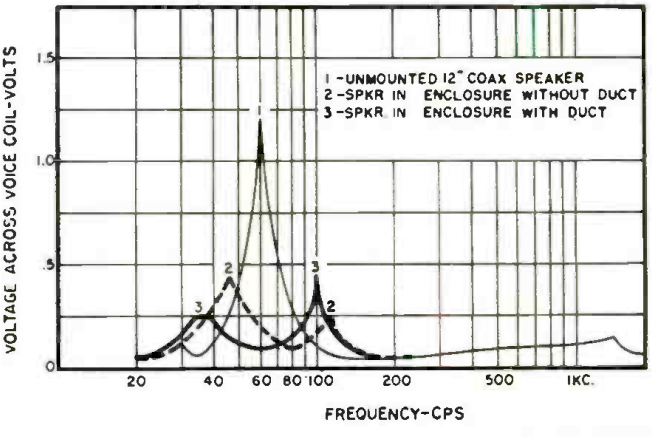
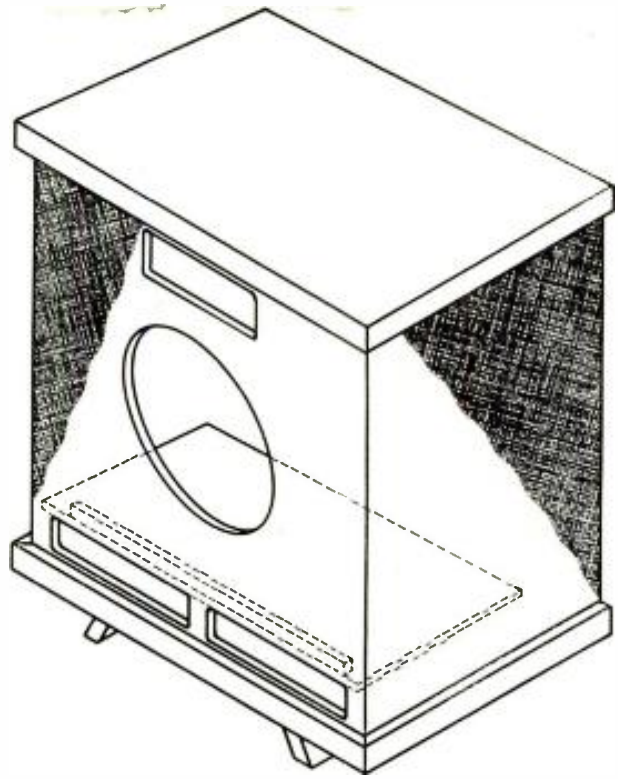
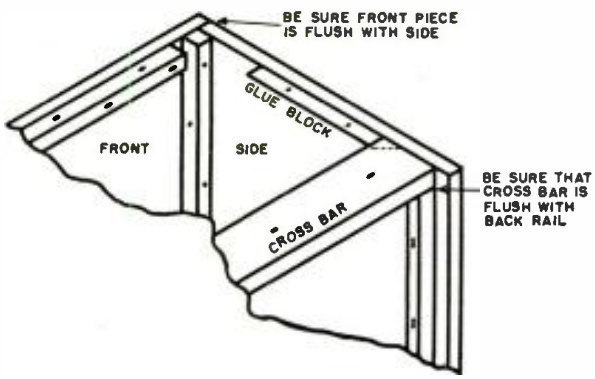


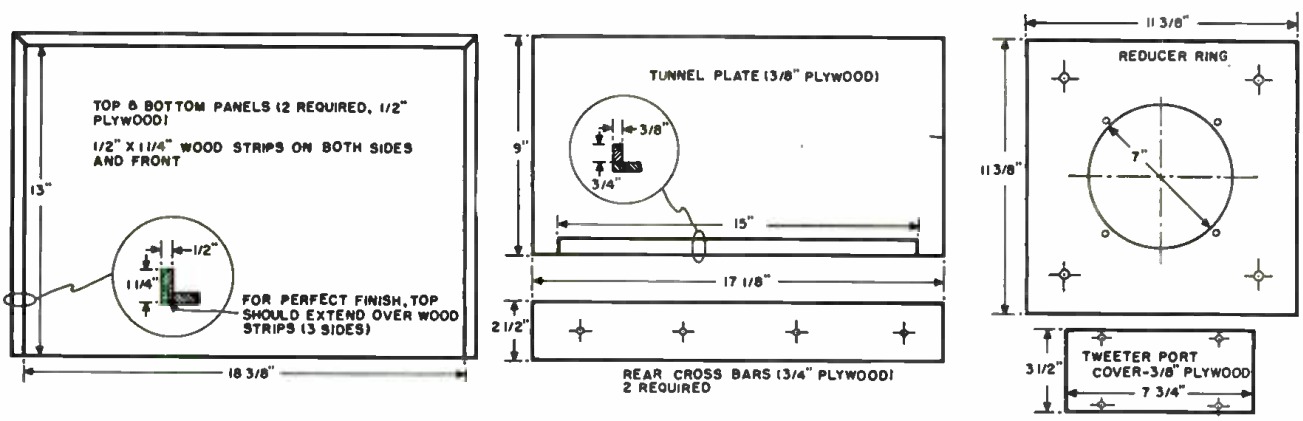
Fig. 3. Constructional diagrams for the Argos "Californian, Jr." Enclosure is a ducted-port reflex type which will accommodate a 12-inch speaker and a separate tweeter, if required. An 8-inch speaker may be used in place of the 12 by means of reducer ring shown below. Tunnel plate forms the ducted port required.

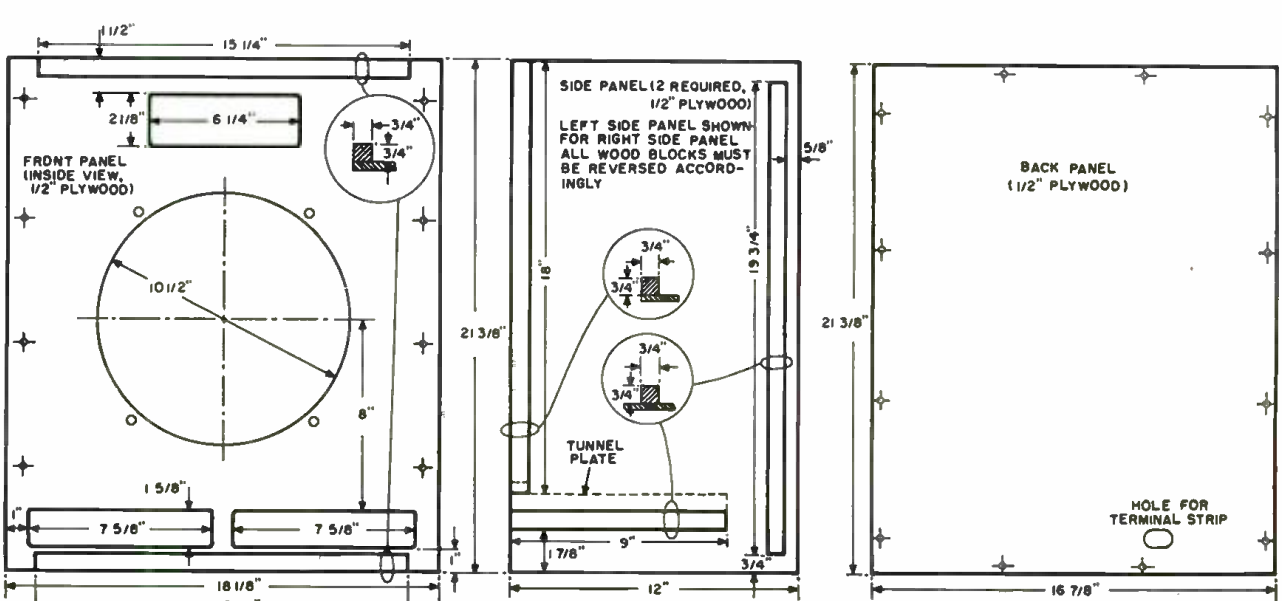


NOTES:

1. Mount sound absorbing material on inner surfaces of back, top and one side.
2. Glue and screw all joints except back which is only screwed on; use glue blocks as required.
3. Paint front and side surfaces black as these are to be covered with grille cloth.
4. Cover tweeter port if not used.
5. Feet or casters are added as desired.







Delco's All-Transistor Auto Radio

Dashboard of Cadillac's "Eldorado Brougham" (top) showing the new receiver. General Motors' special, limited-production five-passenger automobile is shown below.

Thirteen transistors make this design landmark a superior instrument for a limited-production car.

WHAT KIND of radio belongs inside an automobile that incorporates many engineering firsts, in addition to such luxuries and conveniences as interior carpeting, gold-finished drinking cups, and a built-in vanity including a perfume atomizer filled with "Arpege"? The car is the super-deluxe, limited-production "Eldorado Brougham," being produced by the *Cadillac* division of *General Motors*. Unable to find an auto radio of current design sufficiently distinctive for use in this "car of the future," *GM's Delco Radio* division has come up with an auto receiver of the future as impressive, in its own field, as the vehicle in which it makes its debut.

Thirteen transistors and four crystal diodes are used in Model 7268085, shown in Fig. 1. The completely tubeless set, as depicted, uses a separate audio-output subchassis. A superficial check of the unit reveals nothing out of the ordinary: the housing, although handsomely styled, is conventional; features and provisions—including tone control, variable rear- and front-seat speaker selection, push-button station selection combined with automatic search tuning, and a sensitivity control—have been incorporated in top-quality auto radios before this.

Awareness of the radio's distinctiveness comes with an examination of its specifications and of the generous design evident from the schematic of Fig. 2. Beginning with the receiver's input characteristics, *Delco* engineers rate the unit as having a sensitivity of one to three microvolts. There is always some question as to just what a sensitivity figure of this kind means in terms of AM reception, but the available data further specifies that one microvolt of signal at the antenna will produce one watt of audio power output, which is usually quite adequate for the interior of any car.

In terms of maximum power output, the push-pull transistor stage can deliver up to 10 watts. As far as the transistors themselves are concerned, response up to about 18,000 cps is available. Actual response is limited to less than this by the speaker used and by AM bandwidth considerations. Although it looks like the conventional 6"x9" oval speaker, the transducer used is rated as having response from 60 to 9000 cps—more than sufficient for the response inherent in conventional AM broadcasts. A quality detector circuit preserves whatever fidelity is inherent within AM frequency-response limits. The intermediate frequency chosen for the design is 262 kc.

Some of the features cited begin to suggest answers to one of the first questions likely to come to mind: "What in the world are they doing with thirteen transistors? How can considerations of good design justify that substantial number when the finest available transistorized portable radios use no more than seven or eight?" Fig. 2 shows that one transistor is used as the r.f. amplifier, another as the mixer, and still another as the local oscillator. To this point already we find a configuration involving three transistors, for superior performance, where conventional circuits use one (converter only) or at most two (r.f. amplifier and converter).

Not content with these measures, the designers, moving over to the i.f. strip, have gone all out for the most selectivity and sensitivity they can get. No less than three i.f. amplifiers are used, making a total of six transistors to this point in the signal chain, where previous all-transistor receivers generally use three.

A diode detector, when shunted

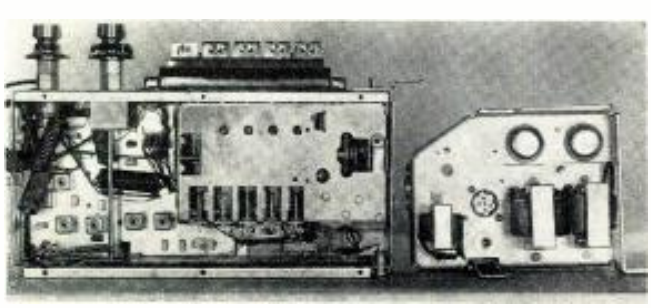


Fig. 1. Top view of Model 7268085. The separate push-pull audio-output subchassis is to the right of the main chassis, which includes r.f., i.f., detector, and automatic station-seeking circuitry.

across a final i.f. stage in conventional fashion, is a low-impedance device that damps the i.f. stage considerably, thus reducing the gain that is realized from the i.f. strip. In its place, the "Brougham" radio uses another transistor as an infinite-impedance detector. In addition to permitting the third i.f. to operate with no significant loading, this type of circuit provides other advantages. Distortion in diode detectors, for example, is often at the mercy of variations in depth of modulation or of r.f. signal amplitude. Sensitivity to such variables is less in the infinite-impedance detector, making for better audio quality.

Where economy is the over-riding factor, the type of circuit just discussed is not considered, not only because it involves additional circuit elements in itself, but because it does not provide a simple method of deriving an a.v.c. or a.g.c. voltage. This type of control, taken for granted nowadays, must either be abandoned or provided for with still more circuit additions. With quality performance as the determining factor, *Delco* engineers have not hesitated to call for still another transistor, and an added crystal diode, to boot. Part No. 175, the crystal diode, is a separate a.g.c. detector. Associated with it is the eighth transistor used in the set, an a.g.c. amplifier, to afford really tight control over changes in signal level. A diode in the a.g.c. line going to the r.f. amplifier provides some delay to this stage with respect to the a.g.c. signal applied to the i.f. strip, thus permitting optimum operation in the front end of the receiver.

Although it has some interesting particulars, the three-transistor audio portion of the set is not an unusual configuration in general: a single transistor acts as the audio driver, through a transformer, for the push-pull two-transistor output stage. This accounts for eleven of the transistors. Only two remain unaccounted for. These are simply replacements for the tubes one usually finds fulfilling the functions of trigger amplifier and relay control in other receivers using automatic signal-seeking systems.

A close look at the audio portion of the set shows some interesting details, included in the interests of maintaining quality performance. Part No. 131, a service adjustment for establishing optimum bias for the output stage, is not an innovation: a similar control may be found in the audio-output stages of other hybrid transistor radios designed for use in vehicles. In this design, it is implemented by Part No. 127, a thermistor. The thermistor is a resistor whose value varies depending on its ambient temperature. As used here, it is a regulator or auxiliary bias adjustment. As the stage heats, its operating characteristics change. The thermistor compensates for these changes, thus maintaining a constant operating point for the 2N278 transistors in the output stage, and assuring continued good performance from this circuit despite temperature changes.

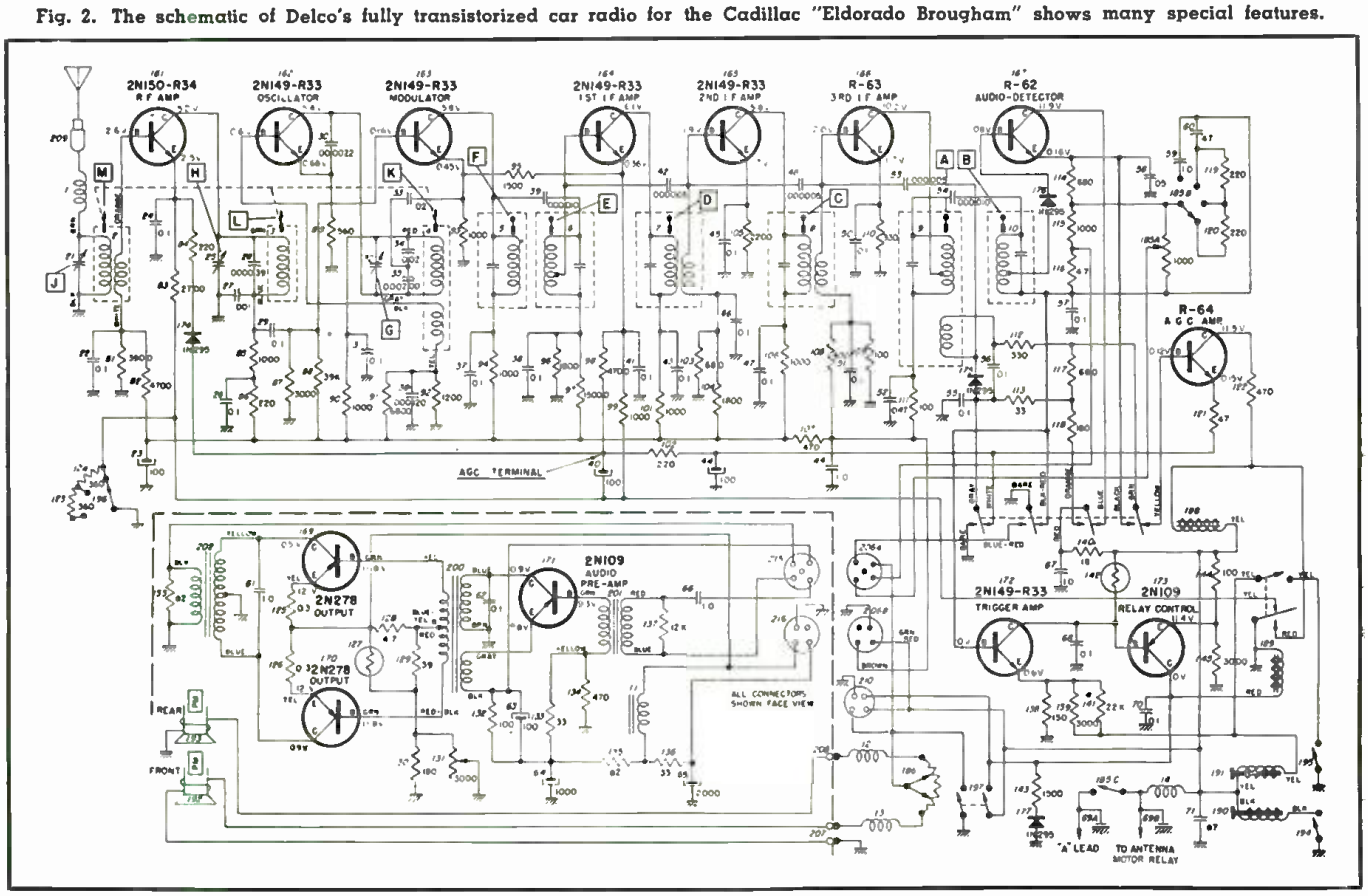
A glance at the interstage coupling transformer (Part No. 200), between the audio driver and the push-pull output stage, reveals a third winding where two would seem to do the job. This added emitter winding to the 2N109 audio preamplifier stage actually provides negative feedback to cancel distortion.

In production right now, enough units of the thirteen-transistor radio have been made for the engineers, as is their wont, to come up with their first design change in the unending search for something just a bit better. As shown, the audio-output circuit operates class *AB*. Minor component changes in the output circuit during later production have resulted in class *A* operation.

Of practical interest is the fact that the receiver (class AB version) drains only 6/10ths of an ampere from the auto battery. This means the radio could be run uninterruptedly for several days while the car is not in use without running down the battery. Even at that, more than 50 per-cent of the current drawn is consumed by the two pilot lamps! If these two are disabled, the radio can run on the storage battery for weeks.

Included as regular equipment in the "Eldorado Brougham," the price of the radio would doubtless be prohibitive if it were available separately. However, that is neither a new nor an unexpected situation with respect to pioneering developments in general. The important thing is that we have our first all-transistor, quality auto receiver. With the barrier broken, this forerunner is not likely to be the last of its kind. -30-

Fig. 2. The schematic of Delco's fully transistorized car radio for the Cadillac "Eldorado Brougham" shows many special features.



By JOHN T. FRYE

PUT IT ALL BACK!

MAC came back to work after a two-week Florida vacation with a tan so deep it virtually radiated. During his absence, the service shop had been operated by Barney, his understudy, with the able assistance of Miss Perkins, the office force. Let it be added to the credit of the latter that when the occasion demanded Amanda could hold the end of a dial cord while it was being tied with the best of them.

"Glad to see you back, Boss!" Barney greeted with obvious sincerity. "How was the vacation?"

"Couldn't have been better," Mac replied as he shrugged his way into his shop coat. "Weather was ideal; fish were starving; car never missed a beat; and the motels had plenty of 'vacancy' signs."

"Who could ask for more? I suppose you never gave radio or television a passing thought while you were gone."

"Well, now, I wouldn't say that. After all, you can't shift a technician's brain into neutral that easy. As I think I mentioned to you before, I'm always astonished at the things they do with pipe masts for TV antennas in parts of the South, especially down in the mountain valleys. There are large sections down there where it seems to me a tower salesman would starve to death. Those folks seem to think nothing at all of running a small pipe up in the air some sixty or seventy feet and sticking a rotor and husky TV antenna on top it. They keep it up, of course, with good guying. They use lots of guy wires spaced to do the most good.

"But two things keep worrying me: first, how do they get that wobbly pipe up in the air in the beginning; secondly, what do they do when they want to replace an antenna feedline or make a repair to the rotor? I've been told the fellows actually climb those masts, but I'd have to see it to believe it."

"That makes two of us. Did you see anything else interesting?"

"Sure. I never fail to notice a number of odd-ball antennas on a trip like that. These are home-brew jobs dreamed up by rugged individualists who stubbornly refuse to concede that antenna manufacturers know all there is to know about television antennas. These fellows, unhampered by any knowledge of antenna theory, try anything and everything in the hope of somehow stumbling on a miracle-working arrangement. They believe in their contraptions, too. For example, I met one character who gravely insisted that a burned-out 500-watt lamp bulb would out-perform any antenna you could buy, especially on the high channels!

"While I can't accept all the claims these fellows make for their brain children, I always have a sneaking respect for their spirit. Every one of those weird antennas standing in a yard is a sort of totem pole proclaiming that the man who set it up is an independent thinker and has the courage to try out his ideas. And I've been in this electronics game too long to say flatly none of them will ever come up with something workable. Too many discoveries have been made by men untrained in the field of their discovery for that. These men succeeded because they plunged ahead in their ignorance and blundered into blind pockets of knowledge hidden from men in the field by unrealized prejudices, paradoxical difficulties, etc.

"But probably the strongest impression I got on this trip is that independent technicians are doing all right for themselves. Their little shops are seen everywhere: in the middle of the cities, in residential shopping centers, and quite frequently right out in the open country. The great majority of these shops are clean, modern, inviting-looking places. The trucks parked in front of them are usually recent models, well-painted, and proudly advertising the business of the owner. I came home with the deep conviction that independent radio and TV servicing is a vigorous, hardy, rapidly growing affair. But that's enough about me and my vacation. How did you and Amanda make out while I was away?"

"Fine! As you can see, we're all caught up."

Mac looked at the bench cluttered with tools and casually picked up some chassis screws and back-cover clips.

"Where did these come from?" he asked.

"Oh, they're just a few little things that didn't get replaced in the shuffle. You know how it is: why use four chassis bolts when two will keep the chassis in place until the cows come home?"

Mac heaved a sigh and then said patiently: "Barney, I hate to start criticizing you as soon as I get back, but this is something we have gone over before. I want every single screw, bolt, nut, and cover-clip put back in place on every piece of equipment we service—not just most of the time, but *every* time!"

"I still don't see the sense of it," Barney muttered.

"I know you don't; so let me give you a couple of examples: About a year ago a woman brought in a large transformer-type table model radio that her son on the West Coast had sent her by a friend who was driving a pickup truck through. The radio had been well packed by her son, but when she started to open it she heard something rattle. She decided to bring it down and have me look it over before plugging it in.

"Well, when I took that set out of the cabinet, it was the darndest looking thing you ever saw. The power transformer had been replaced at one time, and the fellow doing the work only used two bolts to anchor the new transformer to the chassis. What's more, he surely did not tighten the nuts down very well, for they had worked loose and finally come clear off. That left the transformer free to lunge around with each bump and jar of the road, and it had literally beat that radio to pieces. Tubes were shattered; the tuning capacitor was a mass of twisted, battered plates; i.f. cans were torn loose from the chassis; and even the speaker frame was bent out of shape. The set—and it had been an expensive one—was nothing but junk, all because the technician was too lazy or in too big a hurry to put in two more bolts and tighten down the nuts as he should."

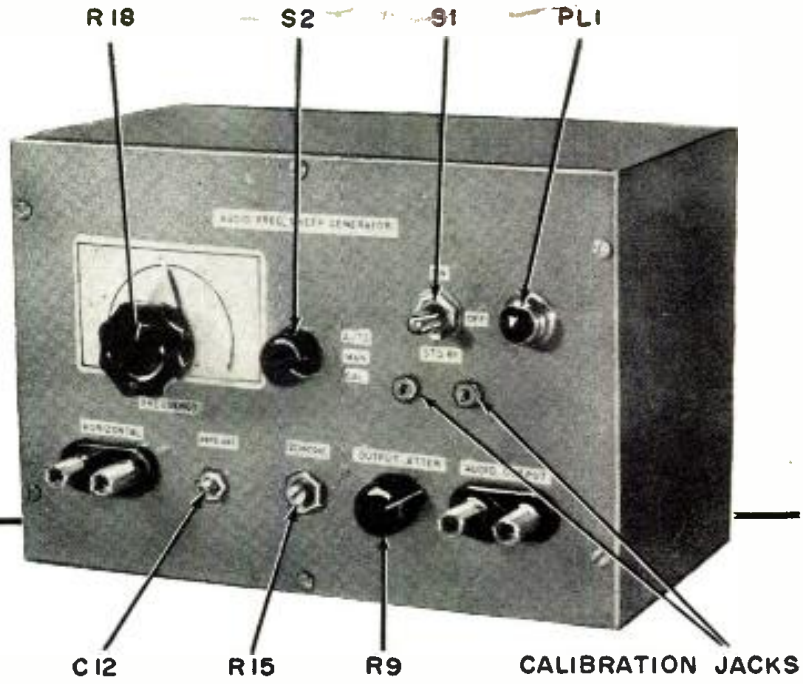
"Yeah, but that was an unusual case. How did the technician know the owner of the set was going to send it across the country in a rough-riding truck? Ninety-nine times out of a hundred those missing two bolts would have caused no trouble."

"True, but the technician had no right to assume the receiver would be accorded ideal treatment. The manufacturer made no such assumption when he specified four bolts for holding the original transformer. But let me give you another more recent example of the need for replacing all hardware:

"Just before I left on vacation a

(*Continued on page* 150)

Audio Frequency Sweep Generator



Front panel view of audio sweep generator showing location of operating controls.

By **RICHARD GRAHAM**

Sweeps from 0 to 20,000 cps. Useful in producing display of audio frequency response on scope screen.

THERE'S a saying to the effect that one picture is worth a thousand words. This is particularly true in the use of sweep generators where perhaps a multiplicity of adjustments must be performed to obtain a desired sweep pattern on the scope. A frequency response display on an oscilloscope instantly shows the response of an amplifier and the effect of any adjustment. To take this same data point-by-point with a signal generator would certainly take a considerably longer time.

The sweep generator and its associated techniques of alignment are considered standard operating procedure in r.f. alignment, but it has not been too widely used in the audio field. One can quickly realize the time-saving features of an audio sweep generator in checking out preamplifier phono compensation, tone control networks, loudness controls, amplifier response, speaker crossover networks, and the like. This time-saving feature is more important when time is money as in servicing hi-fi components. The audio sweeping technique is also a big customer confidence builder in servicing, for it instantly and graphically illustrates the frequency response of the customer's equipment in terms he can understand.

The device to be described is an audio frequency sweep generator covering from 30 to 20,000 cycles in one sweep, with an output of .5 volt from a cathode follower. The output is within ±1 db of 1 kc. throughout the range.

The audio frequency sweep generator is quite simple considering the job it does. It consists of five tubes, one of which is a voltage regulator. Basically the device beats two high-frequency oscillators together to produce an audio tone. One oscillator is fixed, the other is controlled by a reactance tube which is fed a 3 cps saw-tooth. Thus the frequency of the reactance-tube-controlled oscillator can be varied from a zero beat through the audio range to 20 kc., three times a second. The resultant variable audio frequency beat note is amplified and fed to the output jacks.

The 3 cps sweep rate is necessary in order that the lower audio frequencies in the vicinity of 30 cycles can be observed. This sweep rate is fast enough so that even the persistence of the ordinary scope tube will serve adequately.

The variable-frequency oscillator is formed by one-half of a 12AT7. This is a standard Hartley oscillator operating at 6.6 mc. The exact frequency is not too important as long as it is capable of zero beating with the fixed crystal oscillator. The oscillator coil L_8 is a slug-tuned affair and the resonant frequency is variable over a range of 2 mc. A small variable trimmer, C_{12}, is connected across the oscillator tank, L_8 and C_{18}. This capacitor is mounted on the front panel to provide a convenient means of zero beating the two oscillators together for calibrating.

The frequency of the variable oscillator is adjusted by means of a reactance tube, which is formed by the second half of the 12AT7. The resistor, R_{13}, is in series with the grid-cathode capacitance of the reactance tube. This RC is across the oscillator tank coil L_8 and capacitor C_{18}. Now since the resistance of R_{13} is considerably larger than the reactance of the grid-cathode capacitance at 6 mc., the current flowing through the RC circuit is substantially resistive. But since in a capacitor the voltage lags the current by 90°, the voltage across the grid-cathode capacitance of the reactance tube will lag the voltage across the RC circuit by almost 90°. In a vacuum tube the a.c. grid voltage will be 180° out-of-phase with the a.c. plate voltage. This, then, means that the r.f. voltage at the plate of the reactance tube is leading the r.f. voltage across L_8, C_{18} by 90°. This means that as far as the oscillator is concerned, the reactance tube acts like an inductance placed in parallel with L_8. This would raise the frequency of the oscillator. The degree to which the reactance tube acts like an inductance is determined by the signal fed into the grid of the reactance tube through the isolating choke L_4. The signal which is fed into this grid is determined by the rotary switch S_2 which applies the 3 cps saw-tooth; a fixed d.c. voltage determined by the setting of R_{17} and R_{18}; or ground.

The saw-tooth is generated by a simple neon lamp relaxation oscillator, consisting of a one-megohm resistor R_{16}, a .5 μfd. capacitor C_{17}, and an NE48 neon lamp PL_2. The capacitor C_{17} charges up through R_{16} until it reaches the firing voltage of the neon lamp, which is around 65 volts. The capacitor C_{17} then discharges through the neon lamp and the cycle starts over again. The charging and discharging of C_{17} results in a saw-tooth waveshape across C_{17}. This saw-tooth is fed directly to the oscilloscope horizontal amplifiers since most oscilloscopes do not have a sweep frequency as low as 3 cps.

This saw-tooth must also be fed into the reactance tube grid. However, R_{15} serves as a voltage divider to reduce the peak of the saw-tooth fed into the reactance tube to approximately two volts. This pot is located on the front

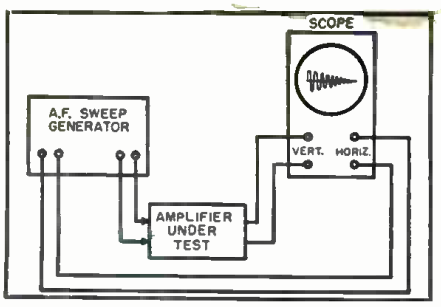


Fig. 1. Setup of the a.f. sweep generator when used for testing an amplifier.

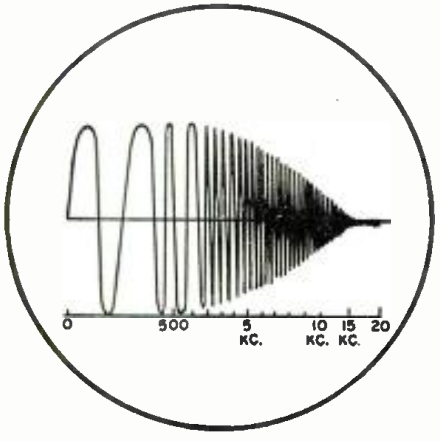


Fig. 2. Response of fairly limited band audio amplifier as seen on scope screen.

panel since the peak voltage of the saw-tooth determines the highest audio sweep frequency out of the generator. The calibration procedure for R_{15} will be described later.

The manual position of S_2 marked "Man." selects a fixed voltage as determined by the settings of R_{17} and R_{18}. R_{18} is the pot calibrated in frequency on the front panel. R_{17} is used to set the maximum d.c. voltage applied to R_{18}, thus setting the top frequency to which R_{18} can be set. The general purpose of the manual position of the audio sweep generator is to enable the device to be used as a standard fixed frequency audio oscillator. This is useful in investigating small portions of the audio spectrum in detail in the conventional way using a v.t.v.m. to determine the exact response.

The "Cal." position of S_2 simply grounds the grid of the reactance tube. This enables the user to zero beat the two oscillators for calibration purposes.

The fixed oscillator is formed by part of a 6BA7 mixer tube. The oscillator circuit is of the modified Pierce type and is crystal controlled. Crystal control was chosen in preference to another *LC* type of oscillator because of stability and frequency pulling problems that developed. Trying to keep two *LC* oscillators zero beat for any length of time becomes a major design problem. Since odd frequency quartz crystals are available surplus at such reasonable figures (this one cost 49¢), it became obvious that crystal control was the thing to use for the fixed oscillator. C_1 is a feedback capacitor and should be close to the value specified.

The variable frequency oscillator (V_3) is coupled into grid 3 of V_1 through a capacitor formed by a 3 inch piece of wire laying along the chassis in the direction of (V_3). This very loose coupling is all that is necessary.

Making the coupling any tighter than this can cause oscillator pulling. This effect is the result of the crystal oscillator "locking" the frequency of the variable frequency oscillator so that it will suddenly jump out of zero beat when rotating the trimmer (C_{12}) through zero beat. The result when using the audio sweep generator in the "Auto." position of S_2 is that all the frequencies below two or three hundred cycles can be lost.

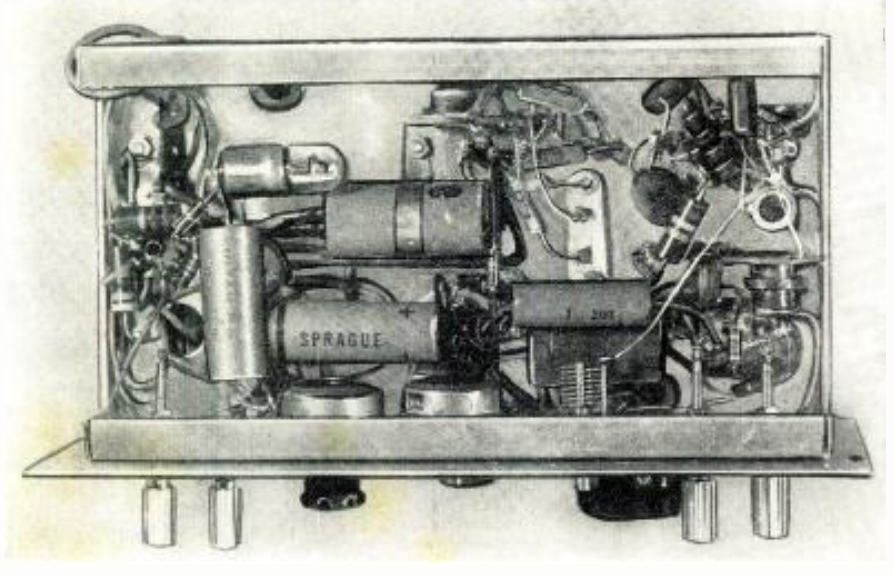
However loosening the coupling into grid 3 of the 6BA7 (V_1) also results in less output, so the amount of coupling permitted can be quickly determined by using a longer coupling wire on the grid of (V_1) and rotating C_{12} and noting the locking effect. The wire can be then shortened until the effect is negligible.

The two mixed signals in the plate circuit also produce the sum frequency. Thus four frequencies are present in the plate circuit of the 6BA7, *i.e.*, the fixed oscillator frequency, the variable oscillator frequency, the sum of these two frequencies, and the difference between them. The great frequency difference between the audio difference frequency and the remaining three frequencies makes it easy to filter out these frequencies. A 500 $\mu\mu$fd. capacitor (C_2) from the plate of V_1 to ground removes the unwanted frequencies. The audio signal is then amplified by a straightforward 6C4 voltage amplifier. The audio signal is then fed into a 6CL6 cathode follower which provides a low impedance output. This low impedance is useful in preventing hum pickup when using the device. Because of the low impedance, a large value coupling capacitor (C_7) is necessary to couple out the cathode follower to R_9.

The power supply is a transformer fed, selenium half-wave rectifier supply. An 0B2 regulator supplies a constant 105 volts d.c. for the two oscillators, reactance tube and neon tube oscillator.

The unit was constructed on a 4½"x 8"x1½" chassis (*ICA* number 29000) and housed in an aluminum utility cabinet 5"x6"x9", such as *Bud* AU1040-HG. Wiring is straightforward but some precautions are necessary when wiring the two oscillators to prevent oscillator lock-in described previously. Keep the wiring of the filament and "B plus" leads to the two oscillators on opposite sides of the chassis and connect bypass capacitors (C_5, C_{10}, C_{15}) direct to the nearest ground. In general, keep all the leads associated with the two oscillators short. One should also keep shields on the tubes. If these precautions are observed, no particular trouble should be encountered in the proper operation of the audio sweep generator.

Under-chassis view of sweep generator showing the location of the components used.



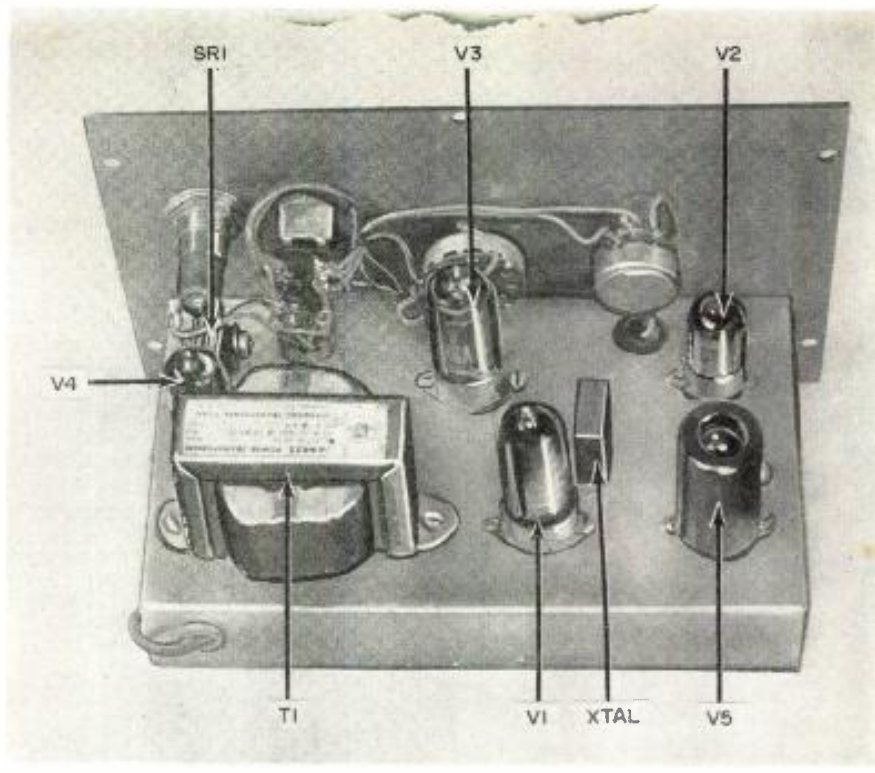
The next step is to calibrate the unit. The first step in the initial calibration is to zero beat the two oscillators. This is done by setting S_2 to the "calibrate" position. Set trimmer C_{12} to its mid-capacity position. Now adjust the oscillator inductance L_3 to zero beat. This can be done by hooking an audio amplifier or a set of headphones to the audio output jacks on the front panel of the generator and adjusting L_3 until no audio beat is heard. The two oscillators are zero beat if, by tuning off to either side, an audio tone of increasing frequency is heard. Now switch S_2 to the "Auto." position. An audio tone increasing from zero to some higher frequency will be heard occurring at a 3 cps rate. The top frequency of the audio sweep is set by R_{15}.

If one is not interested in exact calibration, R_{15} can be set so that the audio tone increases through the audio

range to beyond audibility. However if one is interested in a more exact calibration of the top frequencies as well as the frequencies in between, the following procedure can be used. The first step would be to calibrate the audio tone out of the audio output jacks when S_2 is in the "Man." position. This is done by first setting R_{18} to maximum voltage position. Place a v.t.v.m. on the "Cal." jacks in the front panel. Adjust R_{17} so that the audio tone out of the audio output jack is 20 kc. This can be done by means of Lissajous figures that may be derived with the assistance of another audio oscillator. This procedure won't be described in detail since most general radio texts cover frequency measurement by means of Lissajous patterns. Other positions of R_{18} can be calibrated in frequency at the same time. The d.c. voltages corresponding to these frequencies should be noted on the v.t.v.m. connected to the "Cal." jacks.

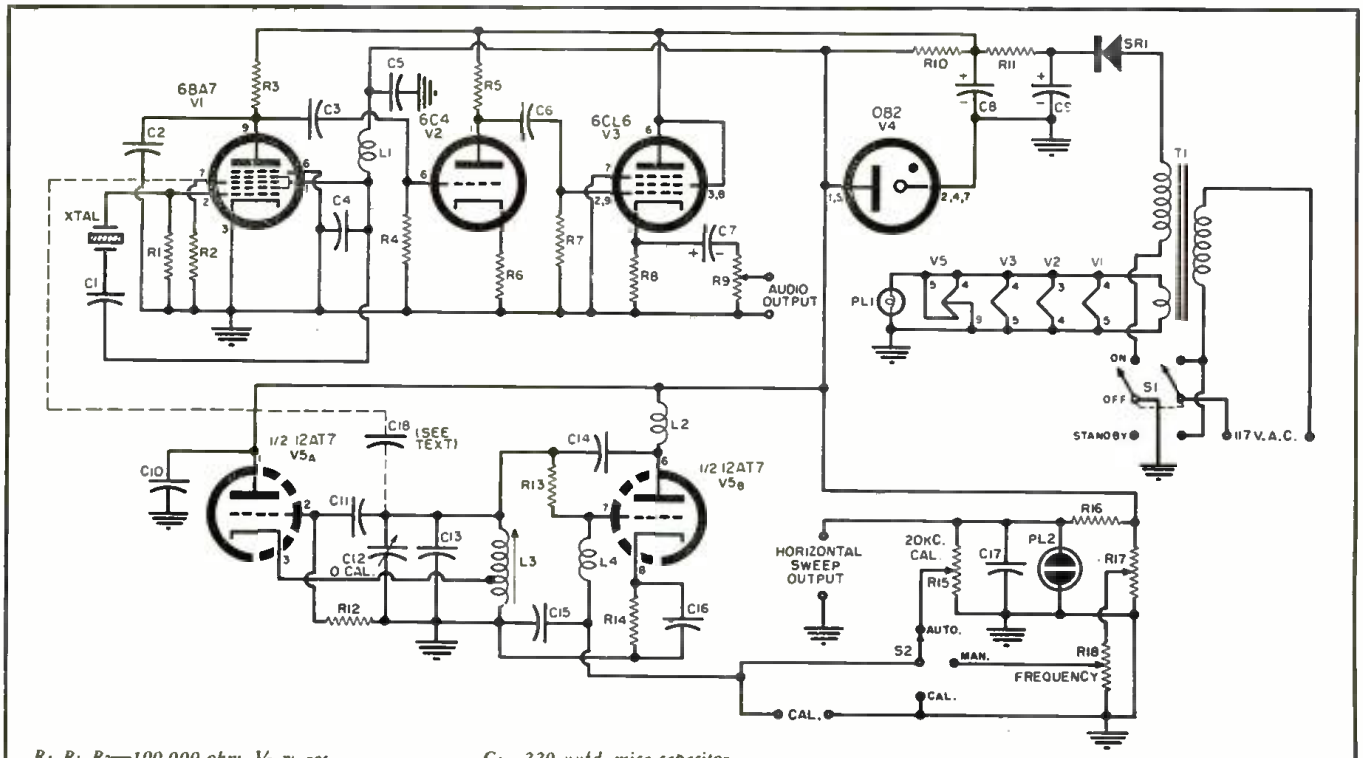
When the generator is putting out a steady 20 kc. audio tone, the v.t.v.m. reading is noted. This voltage is that applied to the reactance tube grid. Now, knowing this voltage for 20 kc., one can calibrate the saw-tooth voltage being applied to the reactance

(*Continued on page* 140)



Top-chassis view of the audio sweep generator. The crystal is mounted adjacent to V_1, the fixed oscillator. V_5, the variable oscillator—reactance tube is shielded.

Fig. 3. Complete schematic diagram of the audio frequency sweep generator. Neon tube oscillator is used for the sweep.



R_1, R_4, R_7—100,000 ohms, ½ w. res.
R_2, R_3, R_{12}—22,000 ohm, ½ w. res.
R_3, R_{13}—47,000 ohm, ½ w. res.
R_6—1000 ohm, ½ w. res.
R_8—100 ohm, ½ w. res.
R_9—1000 ohm pot
R_{10}—1000 ohm, 2 w. res.
R_{11}—150 ohm, 1 w. res.
R_{14}—180 ohm, ½ w. res.
R_{15}—5 megohm pot
R_{16}—1 megohm, ½ w. res.
R_{17}, R_{18}—1 megohm pot
C_1, C_{11}, C_{14}—.001 µfd. ceramic capacitor
C_2—500 µµfd. ceramic capacitor
C_3, C_6—.1 µfd., 400 v. capacitor
C_5—220 µµfd. mica capacitor
C_8, C_{10}, C_{15}, C_{16}—.01 µfd. ceramic capacitor
C_7—50 µfd., 50 v. elec. capacitor
C_8, C_9—40/40 µfd., 150 v. elec. capacitor
C_{12}—3-11 µµfd. trimmer capacitor
C_{13}—100 µµfd. mica capacitor
C_{17}—.5 µfd., 400 v. capacitor
L_1, L_2, L_4—2.5 mhy. choke
L_3—26 t. #30 d.s.c., closespaced, wound on ⅜" dia. slug from a CTC Type LS-5 or equiv., tap at 10 t.
S_1—D.p.d.t. toggle switch with center "off" position (a two-pole, 3-pos. rotary switch may be substituted)
S_2—S.p.3-pos. rotary switch
PL1—6.3 volt pilot light
PL2—NE48 neon lamp
T1—Power trans. 125 volt half-wave secondary @ 50 ma.; 6.3 v. @ 2 amps (Stancor PA8421)
SR1—65 ma. selenium rectifier
Xtal.—Any available or surplus crystal in the vicinity of 6.5 mc. (6.673 used in unit described)
V_1—6BA7tube
V_2—6C4 tube
V_3—6CL6 tube
V_4—0B2 tube
V_5—12AT7 tube

Design Features of Packard-Bell Color Sets

By **WALTER H. BUCHSBAUM**
Television Consultant, RADIO & TV NEWS

Fig. 1. Although shown with legs, Model 21CT-1 is a basic table color receiver.

Stabilized i.f. stages and innovations in color sync and luminance circuits are notable features.

THE PACKARD-BELL Model 21CT-1, shown in Fig. 1, and Model 21CC-1 both use the 98C-1 chassis and are, therefore, identical in all technical respects. The one exception is that the latter model is a full console with two 6" x 9" speakers. Important features of the chassis, circuitry, and adjustment will be described in this article.

The *Packard-Bell* color sets use a single-pan horizontal chassis on which six sub-assemblies are mounted. Five sub-assemblies are printed-wiring boards, while the sixth uses conventional wiring and contains the color-demodulator and color-sync section. One printed-wiring board contains the horizontal-oscillator tube and synchroguide circuit, while another board has two tubes operating as vertical oscillator-output and sync-separator section. The video stages and noise inverter comprise a third sub-assembly. Three stages of i.f. and the two diode detectors are mounted on the fourth printed-wiring board. Five tubes performing the a.g.c., sync, and sound functions make up the fifth and largest printed-circuit assembly.

This color set has 29 receiving tubes plus the 21AXP22 round, shadow-mask, color picture tube. There are no selenium rectifiers, but three crystal diodes and one oscillator crystal are used. The tuner, mounted separately in one corner of the cabinet, is the *Standard Coil* "Neutrode," which has quite good noise and gain characteristics. It is a turret tuner intended primarily for v.h.f. reception, but coil strips can be added to receive any desired u.h.f. channels, as with other tuners of this make.

Installation and Adjustment

As with all color receivers, it is necessary to use a good antenna, usually an outdoor type, which provides ghost-free reception. The problem of selecting an antenna suitable for color TV has been discussed in these pages before, and the *Packard-Bell* receiver is as subject to antenna limitations as any other set. Similarly, the problem of color purity and the effects of magnetization have been described in recent articles on *Motorola* and other color sets.

In determining the location of the receiver in the customer's home, several important factors should be considered. In addition to the usual monochrome requirements of accessible a.c. power and antenna lead-in, it is also important to provide adequate ventilation. This only means that the set should not be placed flush against the wall or against some heavy drapes which prevent the warm air from the chassis from escaping through the rear ventilating holes. The color set should also be located away from large metal objects such as radiators. Another factor to remember in any installation is that final purity and convergence adjustments should be made right at the permanent location and, if the set has to be moved, it should be returned to its original spot before purity is adjusted again.

In addition to the controls normally found on monochrome receivers, there are two color controls, hue and chroma gain, available for consumer operation. Service adjustments are accessible only when the rear cover and the front subpanel are removed. To obtain access to some of the front service adjustments, the knobs of some of the consumer-available controls must be removed. Although these single knobs give the appearance of single controls, each conceals an inner concentric adjustment that is accessible only after the knob is taken off. Thus the noise-threshold adjustment is hidden inside the tone control and the contrast control conceals the a.g.c. threshold setting. Mounted on the front panel are the convergence controls, gray-background controls, and screen controls. This location facilitates adjustment, since availability from the front permits the technician to observe the picture-tube screen at the same time without awkwardness.

The rear of the chassis, shown in Fig. 2, contains the two centering controls, the width switch, and the focus control. The matrix balance, killer threshold, and automatic color level adjustments are also located here. Tunable coils, such as the i.f. and color

sync, are all accessible from the top or bottom of the chassis.

Note the terminal strip visible in Fig. 2, containing important test points. Additional test points are located on each of the printed-circuit assemblies, and the various plugs also can be used for troubleshooting. The tuner, for example, is connected to the main chassis by two cables. One carries the filament, "B+", and a.g.c. voltages, while a coaxial connector is used for the i.f. signal. Separate plugs and cables are also used for the yoke, convergence assembly, and CRT socket.

Four fuses are used, two of them located at the top of the chassis next to the horizontal-oscillator assembly. A 2-ampere fuse protects the 300-volt "B+" line and a separate ¾-ampere fuse is in series with the 380-volt bus. A loop of #22 wire is used as fuse for the 6.3-volt filaments and a 0.3-ampere fuse is in series with the cathode of the horizontal-output amplifier.

Circuit Features

The three i.f. stages are unique only in that the tuning capacitors are the type having a negative-temperature coefficient. This is done to maintain accurate alignment over a wide range of temperatures; in other words, the bandpass will be essentially the same right after warm-up and after hours of operation. When repairing any of the tuned circuits in the *Packard-Bell* sets, it is therefore important to use the correct replacement capacitor, not only as concerns capacity but also temperature coefficient.

While some previously described color sets use a bridge-T sound rejection filter with an adjustable resistor in the first i.f. stages, this receiver has a sound rejection potentiometer in the video-detector transformer network. Another innovation is the separate a.g.c. bias supplied to the tuner. This is part of the keyed a.g.c. system, but has "B+" added to provide delay on weak signals. Conventional keyed a.g.c. is supplied to the i.f. stages.

The luminance or main video channel uses the so-called bootstrap circuit to feed the second video amplifier. A combination of cathode and plate coupling is utilized to operate the now familiar noise gating circuit. The cathode drives the 2nd video amplifier while the plate output goes to the color sub-assembly. As in most other sets, the brightness or monochrome signal is applied to the three picture-tube cathodes. In this color set, however, the cathodes are not connected together but rather form part of a voltage-divider network, as shown in Fig. 3. This network supplies 100% of the signal to the red electron gun, 80% to the green, and 60% to the blue. By establishing this distribution at the cathode, the gray adjustment of the monochrome picture is made less critical. Note that the vertical blanking pulse is added at the top of the divider. The horizontal blanking pulse is added to the three grids through a separate blanking amplifier. This arrangement is not shown.

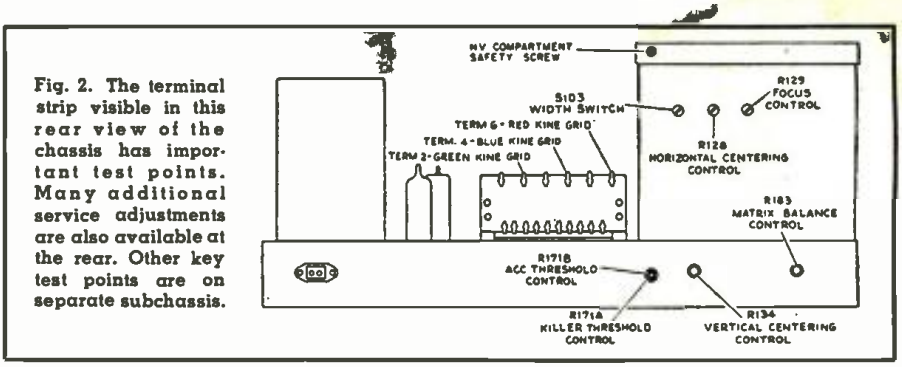


Fig. 2. The terminal strip visible in this rear view of the chassis has important test points. Many additional service adjustments are also available at the rear. Other key test points are on separate subchassis.

The color section has two stages of bandpass amplification and uses 6BY6 pentagrid tubes as synchronous color demodulators. In this system, the chroma signal is applied to the #1 grid and the color sync signal to the #3 grid. At the plate, the demodulated color video signal is then developed. The output of the two demodulators is matrixed to three amplifiers providing the red, green, and blue color-difference signals. One novel control is the matrix balance potentiometer, which connects both demodulator cathodes to ground and thereby establishes amplitude balance between the tubes.

The color sync circuit is novel in several respects. At first glance, the circuit in Fig. 4 may appear to be a simple crystal-controlled 3.58-mc. oscillator. Most previously described oscillators have been preceded by a reactance control tube which, in turn, was controlled by a phase detector. In the *G-E* set, the crystal was made to oscillate or "ring" directly, and its output was then amplified and limited. Fig. 4 contains no limiting amplifiers, nor does it appear that the crystal ringing system is used. Actually the operation of this stage is based on the coincidence of the color burst with the natural crystal-controlled oscillations. The oscillatory network consists of T_2, L_1, and their associated capacitors. In this system the crystal acts as series-resonant circuit.

The flyback pulses on the control and screen grids of the burst amplifier will permit the tube to conduct during that period, but it is cut off during the rest of the horizontal sweep.

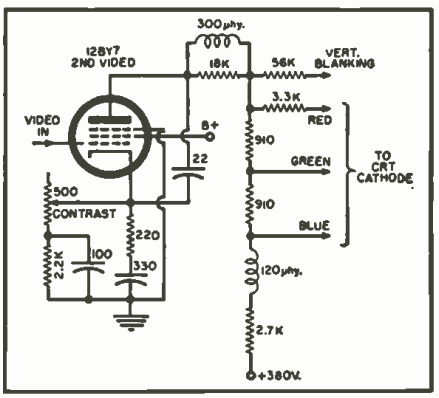


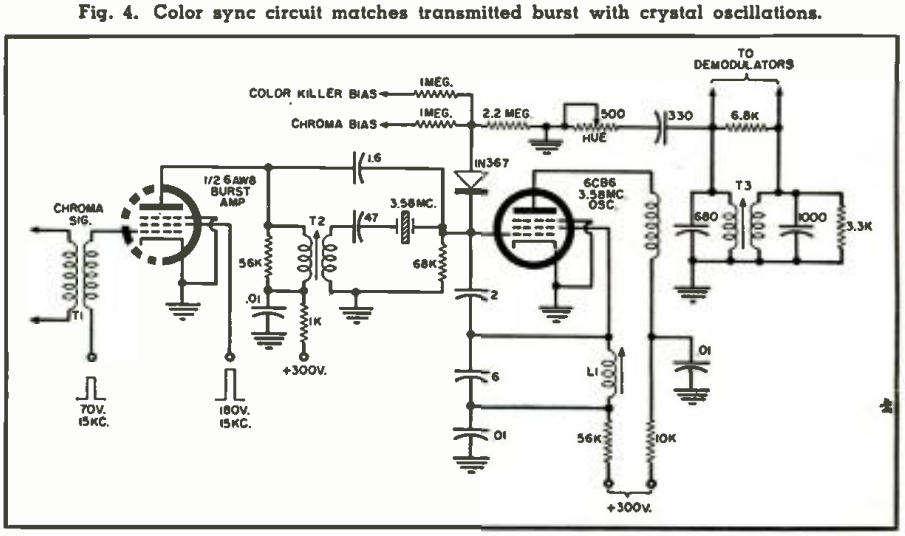
Fig. 3. A divider feeds CRT cathodes.

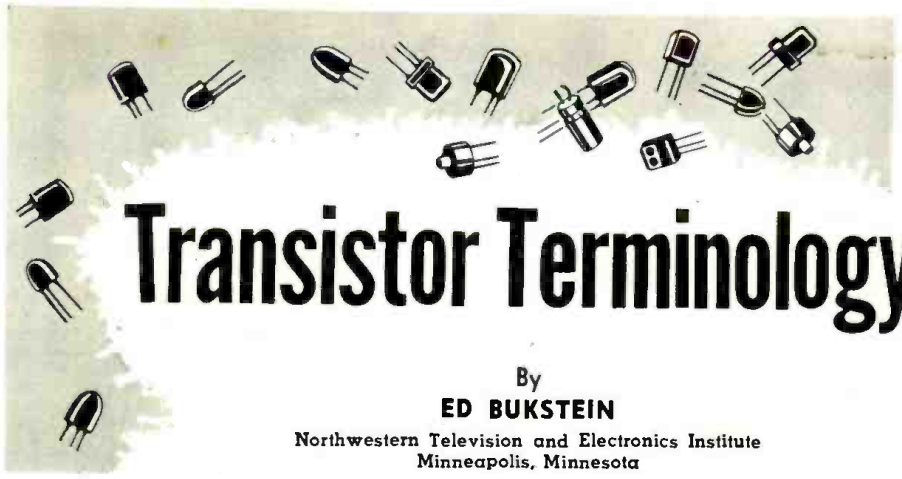
When a color signal is received, the color burst is passed through the burst amplifier and applied to the injection-type crystal oscillator. The output of the oscillator is distributed, through the winding of T_2, to the #3 grids of the two demodulators. By changing the resistance in series with a capacitor, the relative phase of one of the sync signals is varied. Hue control is thus achieved.

Diode 1N367 rectifies part of the oscillations on the grid of the 3.58-mc. oscillator and develops a bias which is used to cut off the color killer and to control the chroma amplifier gain. If this bias is not present, the color killer tube will conduct and develop cut-off bias, which controls the #1 grids of the demodulators. It would appear that the color sync circuit of the *Pack-*

(*Continued on page* 106)

Fig. 4. Color sync circuit matches transmitted burst with crystal oscillations.





Transistor Terminology

By
ED BUKSTEIN
Northwestern Television and Electronics Institute
Minneapolis, Minnesota

For a true understanding of semiconductors, you must be able "to speak the language". Here is how.

THE transistor has now ceased to be an experimental device and has become, instead, a commercial reality. The technician who fails to recognize this fact and does not prepare himself accordingly, faces a future as limited as that of an automobile mechanic who does not acquaint himself with automatic transmissions. In his attempts to *read up* on transistors, the technician too often finds himself engulfed in a fog of unfamiliar terminology. Such terms as injected carriers, intrinsic semiconductor, trivalent impurity, etc. are from the vocabulary of the semiconductor physicist and to the average technician are as meaningless as Sanskrit. It is the purpose of this article to define, in terms familiar to the technician, the terminology of transistor physics.

In some substances, the atoms are arranged in neat, orderly geometric patterns, like oranges in a newly packed crate. These are known as *crystalline* substances in order to distinguish them from materials in which the atoms, like grains of sand on a beach, have no regular pattern of arrangement. Because of the geometric orientation of their atoms, crystalline substances have characteristic shapes. A familiar example is the six-sided rod of quartz in its natural state.

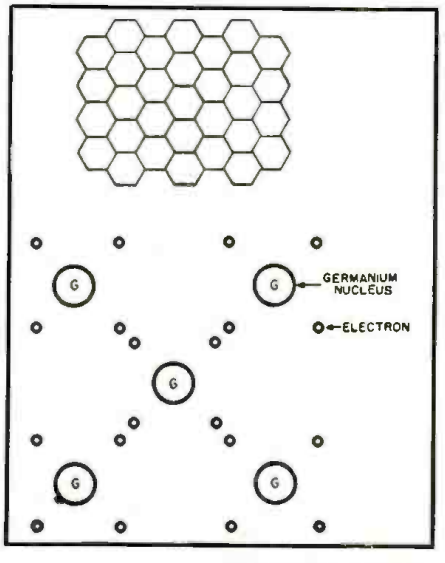
Germanium is a crystalline substance whose electrical resistance is too great to permit its use as a conductor and too low to be used as an insulator. For this reason, germanium is classified as a *semiconductor*. In each atom of germanium, 32 electrons revolve around the nucleus. These planet-like electrons are located in four orbits or rings. The outer orbit, known as the valence ring, contains four of the electrons. In a germanium crystal, the four valence ring electrons of each atom are associated with the valence ring electrons of adjacent atoms. These associations or partnerships of outer orbit electrons are known as *valence bonds* or *covalent bonds*. To illustrate the concept of valence bonds with a purely mechanical analogy, consider a floor made up of hexagonal tiles as shown in Fig. 1. It is apparent that tiles of this particular shape will fit together perfectly, and that each tile is associated with six adjacent tiles. An analogous relationship exists in the atomic structure of a germanium crystal. As shown in Fig. 1, each outer orbit electron is associated with an outer orbit electron of an adjacent atom. Since no outer orbit electron is without a mate, the atoms (like the tiles) fit together perfectly. The chemist describes this situation by saying that all of the valence bonds are satisfied. As is common practice, only the outer orbit or valence electrons are shown in the drawing of Fig. 1 shown below.

Consider now the consequence of replacing one of the tiles of Fig. 1 with a tile having a different number of sides. It is immediately apparent that such a tile will not fit. Either it will overlap adjacent tiles or will leave empty spaces. These structural defects have analogies in the transistor. If one of the atoms of Fig. 1 is replaced with an atom having either too many or too few outer orbit electrons, this *impurity* atom will not properly fit into the structure of the crystal. Either there will be an overlap (extra electron) or an empty spot (hole) in the structure, depending upon the number of valence electrons in the impurity atom. Under these conditions, all of the outer orbit electrons do not have mates. In the language of the chemist, all of the valence bonds are not satisfied. In transistor physics, such structural imperfections are known as lattice defects and are intentionally created by introducing impurity atoms into the semiconductor material. By definition, an impurity atom is one having either more or less valence electrons than the atoms of the semiconductor to which it is added.

When the chemical impurity added to a semiconductor material has fewer valence electrons than the atoms of the semiconductor, the impurity is known as an *acceptor*. For example, boron is an acceptor when added to germanium because it has only three outer orbit electrons as compared to four for germanium. As a consequence, each boron atom will rob or accept a valence electron from an atom of germanium. The site formerly occupied by the *stolen* electron is known as a hole. Because it is the consequence of a missing electron, the hole possesses the properties of a positively charged particle. This condition is shown schematically in Fig. 2. Since its atoms contain three valence electrons, boron is known as a *trivalent* impurity. Indium, gallium, and aluminum are also trivalent and therefore are acceptors with respect to germanium. Germanium to which acceptor impurities have been added is characterized by an abundance of holes and is therefore known as positive or *p*-type germanium.

When the chemical impurity added to the semiconductor material has more valence electrons than the atoms of the semiconductor, the impurity is known as a *donor*. For example, arsenic is a donor when added to germanium because it has five outer orbit electrons as compared to four for germanium. As a result, each arsenic atom provides one extra electron which is not in valence bond and therefore free to act as a current carrier. This condition is shown schematically in Fig. 2. Since its atoms contain five valence electrons, arsenic is known as a *pentavalent* impurity. Germanium, to which donor impurities have been added, is characterized by an abundance of electrons and is therefore known as negative or *n*-type germanium.

Fig. 1. Hexagonal tiles fit together perfectly. Each tile is associated with six adjacent tiles. Atoms of germanium fit together perfectly. The four outer orbit electrons of each atom are associated with outer orbit electrons of adjacent atoms. Such associations are called "valence" bonds.



Since its atoms contain four valence electrons, germanium is known as a *tetravalent* element. When the germanium is pure or when it contains equal amounts of donor and acceptor impurities, it is referred to as *intrinsic* germanium.

A junction diode is made up of *n*-type and *p*-type germanium as shown in Fig. 3. When the negative terminal of a battery is connected to the *n*-type (electron-rich) layer of the junction, and the positive terminal is connected to the *p*-type (hole-rich) layer, the diode is biased in the *forward* direction. Under these conditions, the electrons in the *n*-type layer are repelled by the negative terminal of the battery and move toward the junction. At the same time, the holes in the *p*-type layer are repelled by the positive terminal of the battery and also move toward the junction. At the junction, the electrons and the holes effectively neutralize each other and permit current flow. This represents the low resistance direction of the junction diode. When the polarity of the battery is reversed, the electrons in the *n*-type layer and the holes in the *p*-type layer move away from the junction. Very little current can now flow across the junction because there are few current carriers in this region. This is referred to as *reverse* bias and represents the high resistance direction of the junction diode.

The junction transistor consists of two back-to-back junction diodes with the center layer (known as the base) participating in both junctions. The input junction (emitter and base) is biased in the forward direction, and the output junction (collector and base) is biased in the reverse direction. The transistor shown in Fig. 3C consists of a layer of *p*-type germanium between two layers of *n*-type germanium. This is known as an *n*-*p*-*n* transistor. An opposite arrangement is used in the *p*-*n*-*p* transistor and the battery polarities must be opposite those shown in Fig. 3C.

In some respects, the emitter of a transistor is comparable to the cathode of a vacuum tube since both emit or inject the current carriers. In the transistor, the injected carriers may be either electrons or holes. In the operation of an *n*-*p*-*n* transistor, a negative potential is applied to the emitter and electrons are repelled from emitter to base. The emitter has thus *injected* carriers into the base region. The emitter of a *p*-*n*-*p* transistor is made positive with respect to base. Each electron attracted towards the positive terminal of the battery leaves a hole at its former location. The hole then captures an electron from an adjacent atom, creating another hole farther back toward the base. In effect, the emitter has injected holes into the base region.

The collector-base junction is biased in the reverse direction and the current flow is therefore relatively small. This current, however, is increased by the presence of the additional carriers injected by the emitter. When an input signal is applied to the transistor, it varies the number of carriers injected into the base region and therefore varies the collector current. The ratio of the change of collector current to the change of emitter current (with collector voltage held constant) is known as the *alpha* of the transistor. Since it specifies the ratio of the output to input current, *alpha* is the current gain of the transistor. *Alpha* is defined with respect to the common base circuit, a configuration in which the base is common to both the input and the output circuit. The *alpha* of a junction transistor is less than unity because some of the carriers injected by the emitter are neutralized in the base region and therefore do not reach the collector. For example, some of the electrons injected by the emitter of an *n*-*p*-*n* transistor are neutralized in the hole-rich base region. In the *p*-*n*-*p* transistor, the injected carriers are holes, and some of them are neutralized in the electron-rich base. It is for this reason that the output current is less than the input current. The *alpha* of junction transistors commercially available is in the range of 0.80 to 0.99. The higher values of *alpha* (approaching unity) are obtained when the base layer of the transistor is made very thin. The injected carriers then pass through the base in less time and fewer of them are neutralized.

Because the *alpha* of a transistor is less than one does not mean that it is incapable of producing voltage gain. The feature of the transistor that makes voltage gain possible is the high output resistance as compared to the input resistance. Even though the output current is slightly less than the input current, it flows through a higher value of resistance and therefore produces a signal voltage of greater magnitude than that of the input signal. For the same reason, the transistor is capable of power gain.

When a transistor is connected in a common emitter circuit, the input signal is applied to the base and the output is taken from the collector. With this configuration, a current gain greater than unity can be achieved. This base-to-collector current gain is known as *beta*, and values of 30 to 40 are common for commercially available transistors. The *beta* of a transistor is related to its *alpha* as follows: $beta = alpha/(1 - alpha)$. From this relationship, it is apparent that the *beta* of a transistor becomes greater as its *alpha* approaches unity.

The vacuum tube is a voltage-operated device and bias voltage is used to establish the desired operating point. The input signal then swings the grid around this operating point. The transistor, however, is a current-operated device. A steady d. c. bias current is used to establish the initial condition and the input signal then swings this current around the operating point. In the common emitter circuit, the input signal is applied to the base of the transistor. The steady bias current, upon which the signal current is superimposed, is known as the base bias current. In the common emitter circuit shown in Fig. 4A, battery B_1 supplies the base bias current, and battery B_2 is used to bias the collector circuit. Fig. 4B is a circuit arrangement which uses a single battery for biasing both input and output circuits. Resistor R determines the magnitude of the base bias cur-

(*Continued on page* 105)

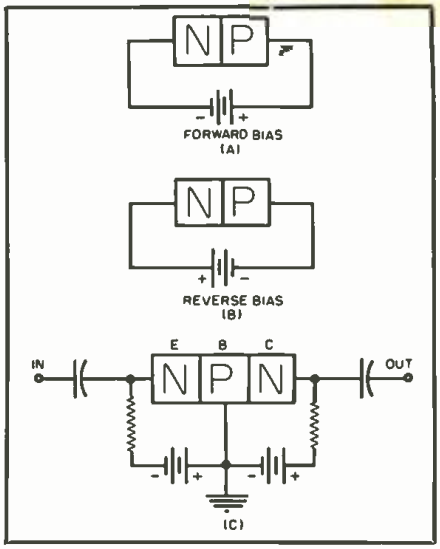
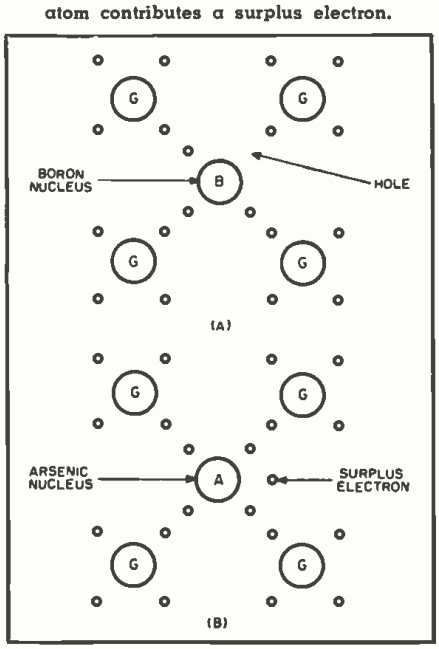
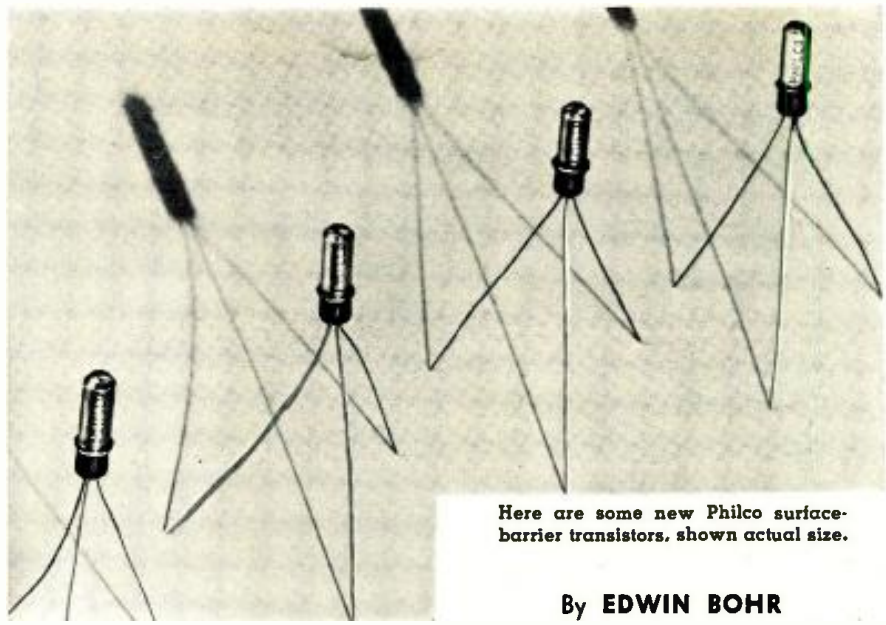


Fig. 3. The base-collector junction of the transistor is biased in the reverse direction, but current flow is increased by the presence of carriers injected by emitter. Input current therefore controls output current.

Fig. 2. Since boron has only three valence electrons, one of the valence bonds is left unsatisfied when an atom of boron is added to germanium. The "missing" electron creates a hole in the crystal structure. When arsenic is added to germanium, each atom contributes a surplus electron.



Amazing Surface Barrier Transistor



Here are some new Philco surface-barrier transistors, shown actual size.

By **EDWIN BOHR**

Recent availability of SB transistors now makes it important to learn something about these new types.

YEARS ago, when junction transistors were just beginning to nudge the one-megacycle limit of useful operation, surface-barrier transistors were percolating away at 30 mc. and higher. And, to top it all, they were doing this with absurdly small values of collector voltage and current—small even by ordinary transistor standards. Today, the surface-barrier transistor, in its particular field of application, still remains without peer.

Yet, in the popular technical magazines, this surface-barrier transistor has received hardly more than a casual mention. The reason for this is simple. The SB transistor has not been an "available" transistor. Surface-barrier transistors have been with us for a long time, but only on an engineering sample basis; and their development and potentialities largely have hidden in the laboratory and between the pages of learned journals.

This situation has been given a complete about face. Anyone with a few dollars in his pocket can now buy a surface-barrier transistor. In fact, he can choose from several types. Some units have cut-off frequencies as high as 60 mc.

Surface-barrier transistors are beginning to appear in personal receivers and automobile radios. At least one piece of ham gear has appeared using this fabulous transistor. Military equipment, too, now employs the SB transistor, dispelling early rumors that this unit was undesirably fragile and delicate. The current availability of this component will undoubtedly kindle a wildfire of interest in surface-barrier transistor applications and circuitry.

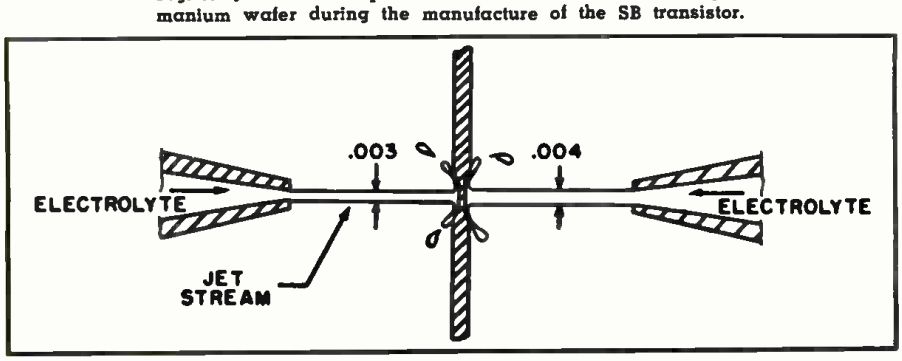
In this article we will hit the high spots of the SBT, its theory, history of development, and present some practical applications and circuits. Some of the things the SBT can do really make a person's mouth hang open. As an enticement to read further, we will tell you in advance that one of the circuits is a scale-of-two counter containing only four components—two SBT's and two resistors! If the SBT is unique, which it is, some of its circuits are even more unique.

The Name

By now, the curious reader has undoubtedly wondered how the name "surface-barrier transistor" is derived. Briefly, we can hint at an answer to this question by indicating that the ordinary diffused junction transistor contains *two* forms of semiconducting material. In contrast, the SBT contains only *one* form. Available diffused junction transistors are either *p-n-p* or *n-p-n* types. Available SBT's are simply *n*-type transistors. The emitter and collector of the SBT both are formed by *plating* to the *surface* of germanium, forming a *surface-barrier* rectifying interface.

Momentarily, we are dropping the theory right here. An understanding of semiconductor physics is, of course, anything but easy and necessitates a broad knowledge in many direct and accessory fields. After all, to run, one must first learn to crawl and then to walk. We, alas, can't do it all in fifteen hundred words. However, we can still give the reader plenty of good functional "walking" information. Don't worry, we will be back to the theory in a few paragraphs.

Fig. 1. Jets of electrolyte stream from nozzles toward the germanium wafer during the manufacture of the SB transistor.



History

The SBT is a development of the *Philco Corporation* and, at present, they and *Sprague Electric Co.* are the only manufacturers. Just as the transistor was an outgrowth of research into the field of solids, the SBT was the result of further *Philco* research into changes in the properties of germanium just beneath the crystal's surface.

Atoms of germanium behave very differently at the surface of a crystal from the way they do in the interior. The changed behavior extends from the surface into the crystal for a depth of about one ten-thousandth of an inch, forming a so-called surface barrier. Scientists found the SB effect can be utilized to form a *useful* amplifying semiconductor device *if* several special conditions can be met.

First, electrodes must be attached to the germanium in a way that will produce a minimum distance between the collector and emitter. This dis-

tance between collector and emitter must be the same order of thickness as the surface barrier. Second, the germanium must be completely free from contamination or physical strain.

These are problems of the highest degree. Nevertheless, by the magic of modern technology, they have been solved. In fact, the spacing between emitter and collector in the SBT has actually been reduced to a few thousandths of a millimeter and with tolerances of a millionth of an inch. This small miracle is accomplished by a clever process called "electrolytic machining."

Electrolytic Machining

To begin the manufacture of SBT's, blanks of single-crystal *n*-type germanium are cut and etched to a thickness of 0.003 inch. The blank is next placed between two tiny glass nozzles, mounted on a common axis. Jets of electrolyte stream from the nozzles toward the germanium wafer. An electric current passes through this stream of electrolyte, removing the germanium under the point of impact, an action that is the reverse of electroplating. Fig. 1 shows this arrangement clearly.

As the electrolytic machining proceeds, the emitter and collector surface barriers begin to approach each other, the current density reduces, thus slowing down the etching for vernier control of the process. This reverse-plating, or etch process, has now caused two pits to form in the germanium blank. The remaining thickness of germanium between the pits can be controlled to ± 5%. Ninety to 120 seconds are required for this etch.

By instantaneous reversal of current through the electrolyte, the drilling process is stopped and indium emitter and collector electrodes are plated to the surfaces of the cavities. All of this is done without interrupting the stream of electrolyte. Indium, incidentally, is the same metal used to form the *p*-type germanium in *p-n-p* junction transistors.

In the finished transistor the collector is twice as large in diameter as the emitter. Hairlike leads are attached to the indium electrodes and the transistor is ready for hermetic sealing into a small cylindrical case.

Performance

Cut-off frequencies for all transistors are given in terms of a grounded-base circuit. For grounded-emitter and grounded-collector service, the high-frequency performance begins to roll off at a frequency approximately equal to the grounded-base cut-off frequency divided by the *beta* gain of the transistor.

Applying this rule, we see that a conventional diffused junction transistor, with a 20 mc. cut-off and a *beta* of 60 performancewise, begins to deteriorate at one-third of a megacycle. In contrast, the SBT may have a cut-off frequency of 60 mc. and a *beta* of 10. This means the SBT gain is smooth up to six megacycles. Tests made with the SBT show that it gives unprecedented performance as a superhet mixer. Too, it has the largest bandwidth-gain product of any available transistor, making it really practical for wide-band video and i.f. amplifier applications.

To top it all, the SBT does this at collector voltages and power levels remarkably lower than those of conventional transistors. A 30 mc. SBT oscillator, for example, can easily operate at a collector potential of 3 volts and a current of 0.5 milliamp! A portable receiver using the SBT's will operate from a small three-volt battery. Using conventional transistors, about nine volts are usually considered to be necessary.

Characteristics

Table 1 provides the more important features on available *Philco* units. Of these, the SB-100 was the first commercially available SBT. This SB-100 and the L-5108 are generally the most useful for high-frequency and amateur-band applications. The L-5116 will oscillate to 90 mc.

Three SBT's, the AO-1, L-5113-L, and L-5114-L, are types made available for particular customer requirements. The AO-1 is an inexpensive SBT and its user can probably expect widely varying characteristics. Service technicians will find the L-5113-L and L-5114-L used in battery sets. The L-5113-L is used for converter and second detector service and the L-5114-L for i.f. applications.

Types 2N128 and 2N129 are military-version SBT's. Undoubtedly, personnel in the armed services will be seeing plenty of these transistors in FM receivers.

Another SBT, the 2N240, is available for computer and high-speed switching circuits. This type has controlled saturation characteristics, fitting it for numerous ultra-simple di-

(*Continued on page* 122)

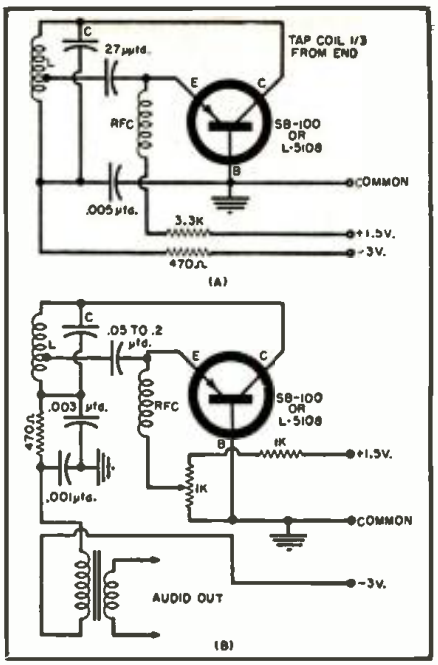


Fig. 2. (A) Osc. and (B) superregen circuit.

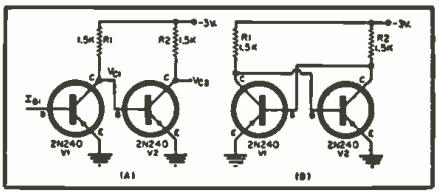


Fig. 3. (A) D.c. amp. (B) Bi-stable circuit.

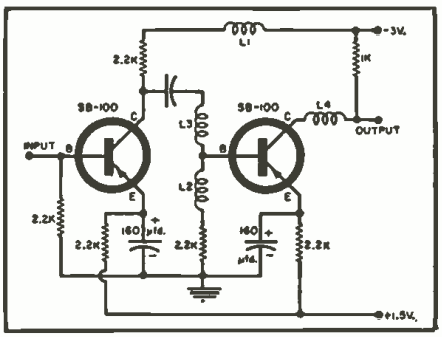


Fig. 4. Wide-band video frequency amplifier.

Table 1. Types and characteristics of typical Philco SB transistors.

TYPE	APPLICATION	CUT-OFF (mc.)	MINIMUM α/β	COLL. POWER DISS. (mw.)	DC. COLL. VOLTS	MAX. D.C. COLL. MA.
AO-1*	r.f.-osc.-i.f.	40	not specified	10	−4.5	−5
L-5108	osc.-amp.	60† 70††	10†	10	−4.5 V_{ce}**	−5
L-5113-L*	b.c. receiver conv., 2nd det.	....	....	....	....	....
L-5114-L*	b.c. receiver i.f.	....	....	....	....	....
L-5116	mixer osc. amp.	90††	.9††	10	−7 V_{ce}** −4.5 V_{cb}**	−3
2N128	osc., osc.-mixer, conv., detector, video amp.—MILITARY	65††	.95	30	−4.5 V_{ce}** −10 V_{cb}**	−5
2N129	r.f., i.f., video—MILITARY	60††	.92	30	−4.5 V_{ce}** −10 V_{cb}**	−5
2N240	computer switching circuits, direct-coupled amp.	30†	....	10	−6 V_{ce}**	−15
SB-100	video, switching, r.f., i.f., mixer	45††	20††	10	−4.5 V_{ce}**	−5

* Customer type, see text: †† typical: † minimum: ** absolute maximum: V_{ce} = collector voltage, grounded emitter: V_{cb} = collector voltage, grounded base.

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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.

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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.

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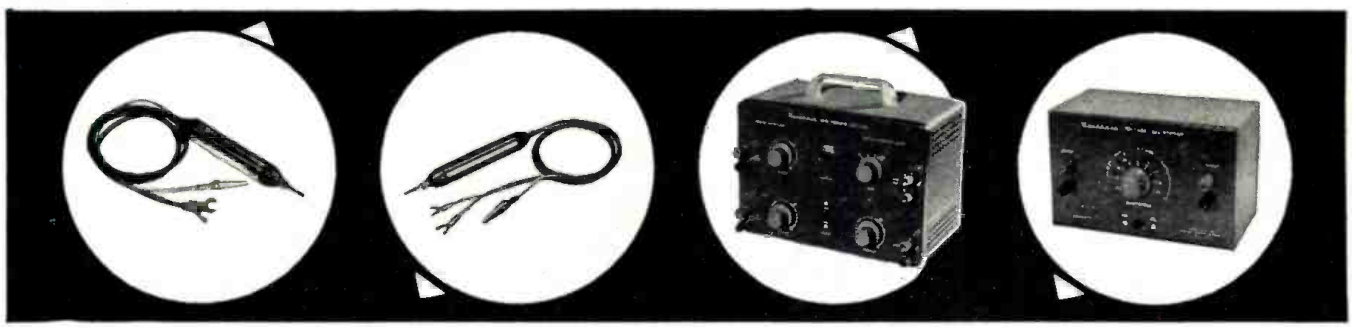

HEATHKIT SCOPE DEMODULATOR PROBE KIT

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.

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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

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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.

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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.

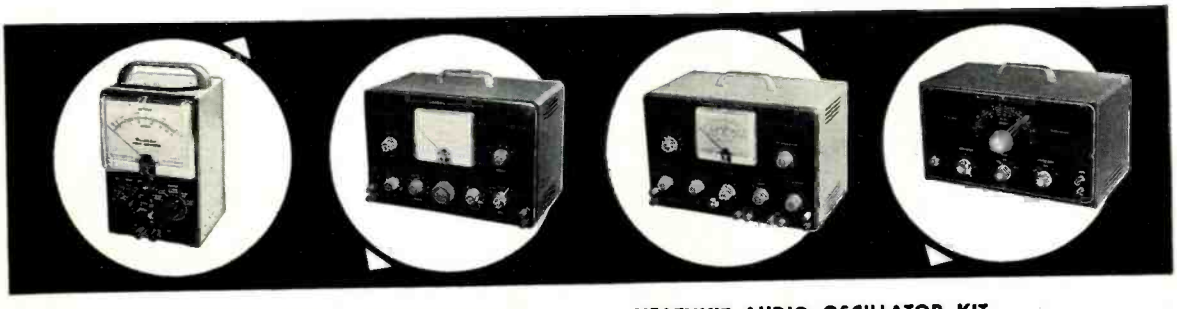
HEATHKIT AUDIO ANALYZER KIT

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

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

Audio Generator Kit

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.

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.

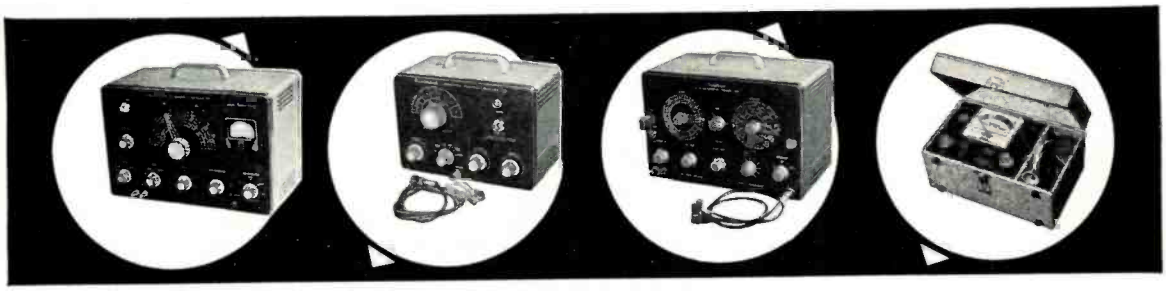
HEATHKIT TV ALIGNMENT GENERATOR KIT

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.

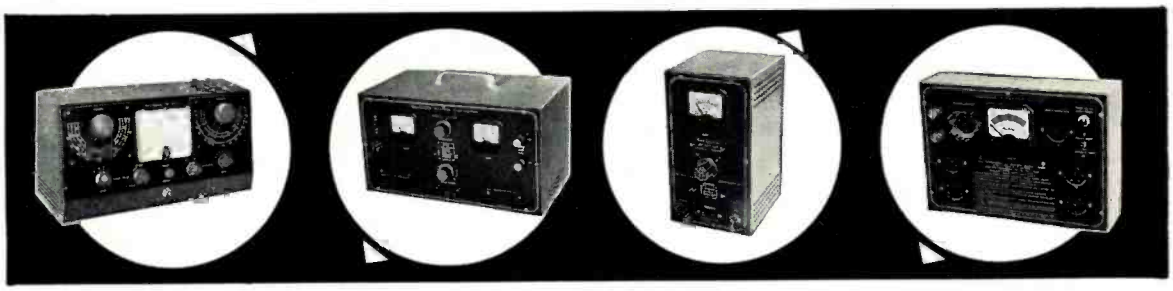
HEATHKIT ISOLATION TRANSFORMER KIT

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.

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

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

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.

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.

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

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.*

MODEL DX-35

$56.95 Shpg. Wt. 24 Lbs.

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.

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.

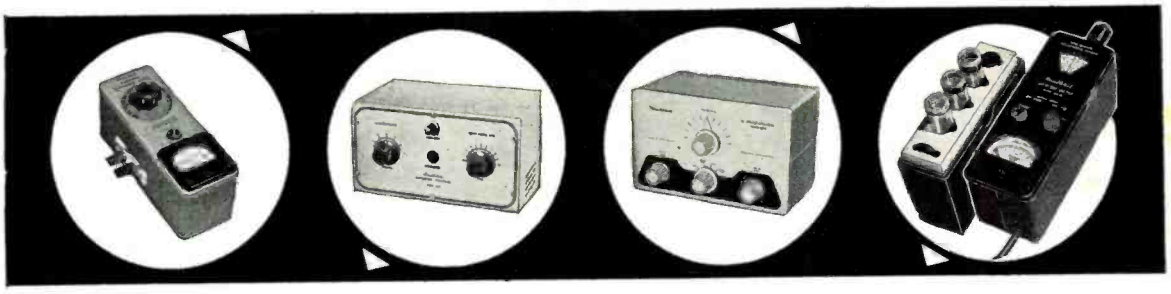
HEATHKIT "Q" MULTIPLIER KIT

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.

HEATH COMPANY
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BENTON HARBOR 15, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

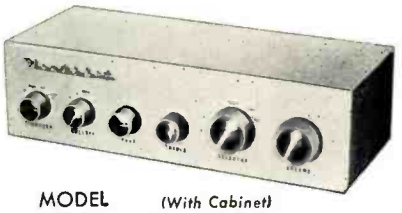
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. 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 IM 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 IM 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

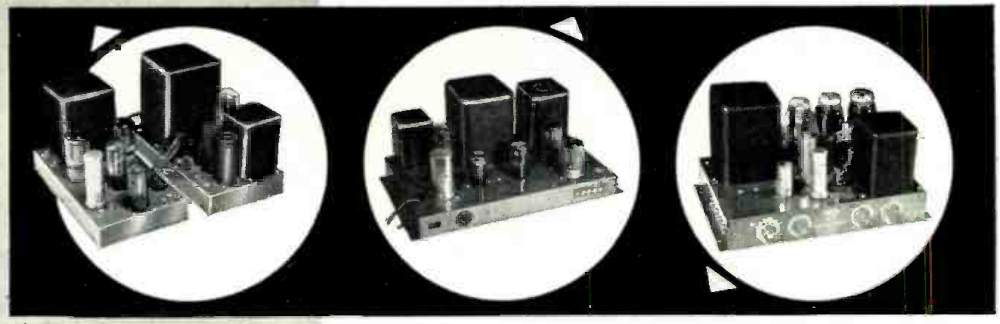
MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only..... $69.50

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 response 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
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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.

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Please ship C.O.D. ( ) postage enclosed for_____pounds.

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- ☐ Best Way

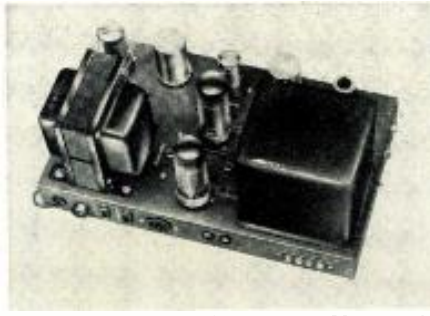
QUANTITY	ITEM	MODEL NO.	PRICE

Hi-Fi-Audio Product Review

EICO 50-WATT AMPLIFIER

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., has released a 50-watt "Ultra-Linear" type power amplifier which is available in both kit and wired form.

The HF-50 incorporates all of the



circuit features of the HF-60 but is rated at 50 rather than 60 watts. It uses a *Chicago* output transformer which employs grain-oriented steel, extensively interleaved windings, and fully potted seamless steel case. Taps for 4-, 8-, and 16-ohm speakers are provided.

Sinusoidal frequency response is ±.5 db from 6 to 60,000 cps at 1 watt and ±.1 db from 15 to 30,000 cps at any level from 1 milliwatt to rated power without peaking or raggedness. IM distortion is below 1% at 50 watts and ½% at 45 watts. Hum is 90 db below rated output.

Further details on this and other audio items in the company's line are available from the manufacturer.

4-SPEED MANUAL PLAYER

Garrard Sales Corp., 80 Shore Road, Port Washington, N. Y., is now offering the Model T Mk II "Crest," a four-

speed, single-record player featuring unusual operating simplicity and durability and compact size.

The new unit has a four-pole shaded induction surge motor which is guaranteed not to produce hum even when used with sensitive pickups. A dynamically balanced rotor insures true speed while the live rubber motor mounts isolate and damp the motor to eliminate rumble.

All four speeds operate directly off the motor on a single turret, eliminating vibration and insuring even speed without the use of belts, etc. The turntable is of heavy steel and flywheel action compensates for any voltage variation in the drive motor.

The unit measures 14¾" long and 12½" deep. The mechanism extends 3" above the motor board and 2⅛" below. Dept. K-23 of the company will supply full specifications on this player upon request.

RONETTE HI-FI CARTRIDGE

Ronette Acoustical Corporation of Lynbrook, N. Y., is now offering a new wide-range hi-fi cartridge that requires no preamp.

The TX-88 "Superfluid" cartridge design permits quick and positive styli replacement without the use of tools.

Response is claimed to be ± 1 db from 30 to 24,000 cps, IM distortion is negligible. The output is .4 volt as measured on *Columbia* test record RD103. The stylus assembly is color dot coded for easy identification.

SONOTONE AMPLIFIER

Sonotone Corporation of Elmsford, N. Y., is now marketing a 15-watt power amplifier which has been priced in the 10-watt class.

The HFA-150 features d.c. filament supply and individual pre-set level controls in addition to other refinements usually found only in higher priced amplifiers. Six inputs provide connections for both magnetic and ceramic phono cartridges, tape recorder, AM, FM, or AM-FM tuners, and additional equipment such as TV sound.

The chassis measures 3" high by 12" wide by 7" deep. An optional cover (AC-150) is available in a choice of colors.

RCA SPEAKER ENCLOSURE

The Components Division of *Radio Corporation of America*, Camden, N. J., has developed a custom convertible enclosure for 12" speakers that is de-

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.

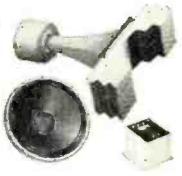
MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, 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 adoress of Authorized JBL Signature Audio Specialist in my community

TECHNICAL BULLETINS ON:

☐ D130 ☐ D123 ☐ D208 ☐ 175DLH ☐ 075 ☐ 130A ☐ 150-4C

Name_____

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signed to meet the needs of audiophiles and operators of restaurants, etc.

The enclosure is constructed of solid Honduras mahogany and is available in either cherry or blonde finish. The unit can be used as a bass reflex, in-

finite baffle, or corner driver type of housing. When sitting on its legs, it acts as a bass reflex with tuning carried out by varying the length of the legs. When resting flush on the floor, it is an infinite baffle. In the corner of a room, a bottom port acts as a diffraction filter to feed extreme low frequencies into the corner apex.

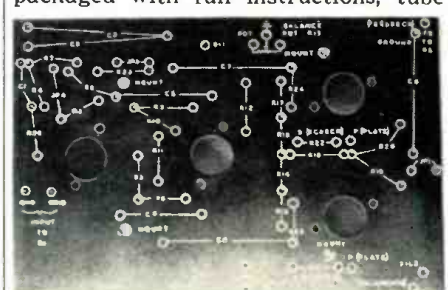
PRINTED CIRCUITS FOR HI-FI

Danco Manufacturing Co., P. O. Box 533, Van Nuys, Calif. is now manufacturing and distributing a series of printed circuit boards, primarily for use in the construction of audio amplifiers and preamps.

Boards for constructing a preamp include a preamp-equalizer section, an input selector-tone control stage, and a gain compensator-output stage. The various boards are available separately as the Models 21, 31, and 41 respectively.

Model 14 is a basic amplifier model which may be connected as a conventional Williamson-type circuit, providing 10 watts output, or "Ultra-Linear" type circuit, providing 20 watts output.

All of these printed circuit boards are packaged with full instructions, tube



sockets, and parts lists. The company will supply data sheets on its line upon request.

"TRUSONIC" 8-INCH SPEAKER

Stephens Trusonic Inc., 8538 Warner Drive, Culver City, Calif. is now offering a new full-range speaker, the 8-inch 80FR.

Among the unique features of this speaker is the new "Truflex" compliance which makes use of a plastic-impregnated fabric which holds the cone to the frame and provides strength, flexibility, and durability. The internal air damping system introduces a controlled cushioning which assures no break-up at extremely high levels. There is a ring magnet for maximum efficiency in driving the new low-mass edge-wound aluminum voice coil assembly.

Frequency response is 40 to 15,000 cps, free air resonance is 50 cps. The speaker will handle 20 watts continuously and 50 watts on peaks. Impedance is 16 ohms and the unit measures 8¼"x4¼". Its shipping weight is 6½ pounds. A data sheet on the 80FR is available from the manufacturer.

HIGH-STYLED COMPONENTS

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio, has recently introduced a new line of audio components which has been redesigned and restyled to provide a "sleek, slim silhouette."

The new components are little more than four inches high. The recessed base gives the appearance of a long, low look. Three amplifier models are included in the new line. The Model 2315 is a 12-watt unit, the Model 2325 is rated at 20 watts, while the 50-watt unit has been designated as the Model 2360. All of the units feature a three-position speaker switch, built-in preamp, rumble and scratch filters, con-

tinuously variable loudness control, and an 8-position selector-equalizer switch with separate phono and tape input.

Product literature on any or all of the amplifiers in the new line is available from the manufacturer.

ACROSOUND KIT

Acro Products Company, 369 Shurs Lane, Philadelphia 28, Pa. has announced the initial production of a new "Ultra-Linear" amplifier kit which is slated for September delivery.

This 60-watt unit combines the qualities of "Ultra-Linear" circuitry with new feedback circuit design to provide exceptionally good stability. The circuit also incorporates an effective damping control which is adjustable over a range of damping factors between .5 and 10 for optimum speaker match. The control does not affect volume nor increase distortion and is not frequency discriminating.

The tube line-up includes a 12AX7, a 12AU7, a GZ34, and two EL34's. The output transformer is the new *Acrosound* TO-600 unit which combines extremely low leakage reactance between windings with a novel feedback winding, providing a degree of feed-

back relatively unaffected by the reflected impedance of the speaker system.

Frequency response is 1 db at 1 watt from 5 to 100,000 cps and at 60 watts is 1 db from 18 to 30,000 cps. Har-

monic distortion is less than 1% at any frequency between 20 and 20,000 cps at power output within 1 db of 60 watts.

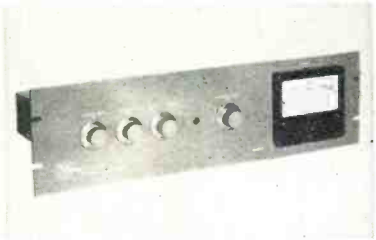
Available in either kit or factory wired form, the amplifier measures 7"x15⅛"x8" with a dark brown chassis and cover and light brown transformer cans. A data sheet on this new amplifier will be forwarded on request.

TRANSPORTS AND PREAMPS

Viking of Minneapolis, 9600 Aldrich Ave., South, Minneapolis 20, Minn. is now offering its line of tape transports and recording preamplifiers in rack-mounted form for professional and industrial applications.

The transport is floated on rubber shock mounts in a standard 10½"x19" relay rack panel. All of the company's standard head configurations are available in the rack mounting style. Of principal interest to industrial, laboratory, and commercial users, will be the 75P (half-track playback only), the 75R (half-track erase-record), and the 75RM (half-track erase-record, monitor).

The company's RP61 recording and playback preamplifier is similarly available in a rack mounting style.



The unit features a vu meter instead of the standard eye indicator and is designated as the RP61VU.

Write the manufacturer direct for full details and prices.

LOW-PRINT TAPE

Audio Devices, Inc., 444 Madison Ave., New York, N. Y. is now in production on a new magnetic tape, in which layer-to-layer magnetic print-through has been reduced so low as to cause no harmful effects over very long periods of storage.

Designated as the "Master Audio-

tape," the new product has been under trial for more than a year by phonograph record and recorded tape manufacturers, custom studios, and other professional users. The reduction in print-through on this new tape, amounting to 8 db as compared with present standard thickness tape, has been achieved without any change in the other characteristics such as frequency range, signal-to-noise ratio, etc. It is thus completely interchangeable on recording machines with standard tapes.

ESL "DUST BUG"

Electro-Sonic Laboratories, Inc., 35-54 Thirty-sixth St., Long Island City, 6, N. Y. has recently released an ingenious device for removing the static and dirt from phonograph record grooves.

Known as the "Dust Bug," the unit was developed by Cecil E. Watts, an English recording engineer. The device itself consists of a separate arm which terminates in a small brush of nylon bristles, each of which is pointed so that the bottom of the groove may be thoroughly explored. The bristles also serve to track the arm across the record. A cylindrical plush pad (the

"bug") is situated immediately behind the brush and collects the loosened particles.

The device is placed at the beginning of the record just before the pickup is lowered and cleans the record as it is played. A wipe with the dispenser cork of the cleaning fluid bottle cleans and charges the pad with the correct amount of fluid required to dissipate any electrostatic charge induced by the friction of the reproducing stylus or by previous polishing.

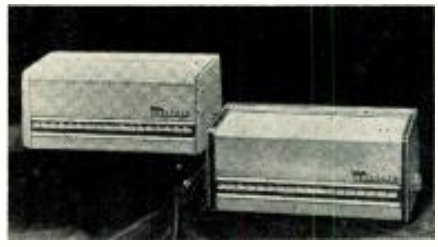
The mounting arm, brush, "bug," fluid, and applicator are all included in a single "package." Write the U.S. distributor for any additional information that is required.

HIGH-POWER INTERCOM

Webster Electric Company of Racine, Wisconsin is offering a high-power intercom unit especially for offices, plants, schools, institutions, or homes.

Incorporating printed circuits, two or three transistors (depending on model), and one or two germanium diodes, the new line is being marketed as the "Teletalk."

Choice of either of two duo-tone cabinet styles, natural walnut with a gold grille or driftwood silver with a rose gold grille, is offered in both the custom (#2100) and executive (#3100) series. A feather-touch "talk-listen" control bar and station switches of clear plastic are aligned in either a single bank or a double bank to maintain the streamlined styling. Capacities range from 6 to 24 stations without annunciators and from 6 to 12



with annunciators. Larger capacities are available on special order to the manufacturer.

For details on the entire line and complete electrical specifications, write the manufacturer direct.

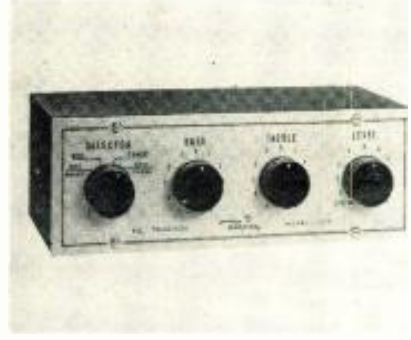
TRANSISTOR EQUALIZER-PREAMP

The *Regency Division* of *I.D.E.A., Inc.*, 7900 Pendleton Pike, Indianapolis 26, Ind. has recently introduced a new, all-transistor preamp-equalizer, the Model HFT-1.

Measuring only 7½"x2½"x3⅞", the unit is housed in a black-finished cabinet with gold anodized control panel. The all-transistor operation eliminates hum and microphonic problems and IM distortion is less than .5% at normal operating level.

Controls include four positions: input selector switch, bass equalizer, treble equalizer, and level control with switch. With equalizer controls in the flat position and the selector switch on "magnetic phono," response follows the RIAA curve. Control adjustments to conform to other recording curves are covered in the instruction manual that accompanies the new transistorized unit.

The preamp-equalizer is available in kit form as the Model HFT-1K while



the completely wired and tested version is designated as the Model HFT-1A.

"STUDIO DYNETIC" TONE ARM

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. recently released a new 1-gram tone arm and cartridge assembly, known as the "Studio Dynetic."

Employing a stationary coil with a moving magnet in the cartridge, the tone arm is so carefully counterweighted that it applies a tracking force of only one gram to the record surface.

Jeweled bearings combine rugged-

ness with delicate balance. A control button is provided for lifting the tone arm from the record to move it to any desired point, where it will set down when the button is released.

The straight, tapered tone arm is 15" long and 11" from pivot to stylus. Both

horizontal and vertical suspensions have jeweled bearings. The arm may be used with any conventional turntable. Damping is achieved by floating the arm counterweight on a leaf-spring embedded in a viscous elastomer.

AUDIO CATALOGUES

L.E.E. SPEAKER SYSTEMS

L. E. E. Incorporated, 625 New York Ave., N. W., Washington 1, D.C. is offering a 6-page data sheet on its line of high-fidelity loudspeaker systems.

Pictured and described in detail are the "Catenoid," "Trio," "Chorale II," "Fantasia," and "Musette" systems. The size and specifications on available units range from a minature bookshelf system which covers 70 to 15,000 cps to the elaborate three-way "Catenoid" which has a response from 30 to beyond 22,000 cps and crossovers at 300 and 5000 cps.

Copies of this data sheet are available without charge upon written request.

ARGOS KIT CATALOGUE

Argos Products Company, 310 Main St., Genoa, Illinois has issued a compact, 4-page catalogue covering its complete line.

Included are details on the "Californian" speaker enclosures in kit and assembled form, two lines of wall and corner baffles, and a series of tube caddies. Each item is pictured and a fairly complete description given. Copies of this catalogue are available without charge from the manufacturer. Please write direct, requesting the publication "Craftsmanship in Cabinets."

NEEDLE CHART

Recoton Corporation, 52-35 Barnett Ave., Long Island City 4, N. Y. has announced publication of its new "Replacement Needle Cross-Reference Chart."

This latest addition to the company's line of jobber and dealer aids is up-to-the-minute and designed to be of maximum help to the user. The six-page chart which is folded and punched to fit a standard ring binder, lists cartridge makers and model numbers, provides a picture of the needle, lists the *Recoton* catalogue number, price, and covers the model numbers of competitive manufacturers. The listing is alphabetical to facilitate spotting the correct replacement. —30—

COVER STORY

Hi-Fi For Hyer

Film star finds assembling her own hi-fi system relaxing after her arduous movie-making chores.

THE current availability of a wide variety of excellently engineered assemble-it-yourself kits has lured individuals without one scrap of technical "know-how" into trying their hands at putting at least part of their hi-fi systems together.

Miss Martha Hyer, whose next starring vehicle is Universal-International's "My Man Godfrey," is not one whit intimidated by the thought of assembling her own amplifier for her home music installation. Taking advantage of the fact that the "PERI-50" amplifier kit incorporates etched circuitry and many other aids to easy and trouble-free assembly, Miss Hyer finds that "do-it-yourself" hi-fi is fun. When the amplifier is finished, her home music system will be complete since she has already purchased the required preamp (not shown) which will be hooked up with the Metzner "Starlight" turntable to drive the James B. Lansing "Harlan" speaker system.

The "PERI-50" Amplifier Kit

The amplifier Miss Hyer is assembling is rated at 50 watts continuous and 100 watts peak. It provides a frequency response ±.5 db from 6 to 60,000 cps and ±.1 db from 20 to 35,000 cps. The kit, which uses a deep-etched photoelectronic circuit board, can be assembled in ninety minutes without any special tools or equipment, according to Printed Electronic Research, Inc. of North Hollywood, Calif., the manufacturer. The kit comes complete with the required soldering iron to make the job even easier.

Design-wise, the "PERI-50" is based on the well-known Mullard circuit and in many respects might seem to be similar to the "Dynakit" manufactured by Dyna Company. This is not the case despite the fact that the output transformer used in both amplifiers is the Dynaco A-430. There are several significant points of difference in the two units.

"Starlight" Turntable

The turntable Miss Hyer selected for her system is the "Starlight" made by Metzner Engineering Corp. of Hollywood. The specially designed, four-pole motor and center drive mechanism gives the unit its speed stability while providing the desirable variable speed range. A built-in stroboscope permits exact settings of 16⅔, 33⅓, 45, and 78 rpm and continuously variable control from 16 to 83 rpm. The 12" precision-machined turntable has a built-in, self-retracting 45 rpm hub so that any record can be played without searching for accessory spindles, etc. The non-slip cork pad, which is used instead of a flocked turntable, protects valuable discs from scratches and lint accumulation.

The transcription arm features an exclusive "double-wrist" action while the counter-balanced head insures minimum mass for good tracking and reduced record wear. Any standard cartridge will fit in the arm.

Speaker System

The final link in the reproducing chain is the James B. Lansing multiple/corner-reflex enclosure, the "Harlan C39."

A handsome enclosure of modern design, the Model C39 is spacious enough to house up to four 12" speakers. The cabinet will fit snugly into any corner, a feature most women appreciate for its unobtrusiveness and utilization of what often proves to be waste space in the living room. Like most audiophiles, Miss Hyer enjoys all kinds of music ranging from the latest pop tunes, calypso, through light classics, to the deep symphonic works. With the sound system she has carefully selected, all of the discs in her record library receive realistic reproduction. The frequencies that are cut into the disc are available at the speaker, unchanged and undistorted—the way it should be. —30—

(Ektachrome by Peter J. Samerjan)

"Ultraflex" Enclosure

(*Continued from page 58*)

(curve 2, Fig. 1) that the two peaks do not straddle the single peak evenly. What is more, the low-frequency peak is just about twice as high as the high-frequency peak and about two-thirds the amplitude of curve 1. This is characteristic of a reflex enclosure that is tuned *too high*. With the tunnel plate installed, note how the picture changes (curve 3, Fig. 1). Both peaks straddle the speaker resonance peak evenly and are of exactly equal amplitude. This indicates a properly matched condition that is the goal in the design of a reflex enclosure.

A moderately priced 12-inch coax speaker (*Jensen* H-222) was tried next. The speaker on hand was found to have a free-air cone resonance of 60 cps. as shown in curve 1, Fig. 2. With this speaker mounted in the enclosure from which the tunnel plate had been removed, the impedance curve shown as curve 2 results. The lack of symmetry about 60 cps and the greater amplitude of the lower frequency peak again indicated that the enclosure was tuned too high. Finally, the tunnel plate was permanently installed and the resultant curve (curve 3, Fig. 2) occurred. Both peaks have moved lower in frequency so that they now seem to straddle the speaker's resonant frequency quite well. The amplitude of the low-frequency peak has been reduced, but the high-frequency peak has become larger. Even with this increased height, note that the amplitude is only one-third the height of the free-air resonance curve. Curve 3 is usually produced in a reflex cabinet that is tuned too low in frequency; however, in such cases the two peaks do not straddle the single peak of the speaker alone as well as appear to be the case here.

From the foregoing it would appear that if the tunnel plate were not made quite so long, it would be possible to equalize exactly the amplitudes of the two peaks. In an effort to smooth out curve 3, a single, 1-inch thickness of Fiberglas was stretched temporarily across the port. This resulted in a reduction by one-third of both impedance peaks. The Fiberglas was not left in place as it was felt that this would impair the low-frequency output from the small port.

In studying the curves shown in Figs. 1 and 2, it appears that the enclosure would be a good match for any 8- or 12-inch loudspeaker having a cone resonance in the order of 60 to 65 cps.

Performance

Acoustic measurements were taken in an anechoic room with the 12-inch speaker installed in the enclosure. The output was found to be fairly smooth down to about 85 cps, below which the response fell off at a rate of about 12 db per octave. Measurements in a live

room showed somewhat greater bass response.

When subjected to listening tests using a good quality 12-inch coax speaker, we found no evidence of boominess. What is more, there was no evidence of cabinet rattles or buzzes even at high volume levels. Of course, it is possible to get more bass response from larger enclosures, but the output of a good speaker in this enclosure was pleasantly balanced.

Construction

Complete details concerning the construction of the speaker cabinet are shown in Fig. 3. Dimensions are given for all parts with the exception of the legs, which naturally do not affect the acoustic design, and for the glue blocks, which should be used where the sides meet the top and bottom. Not required when the enclosure is constructed at home are the triangular corner blocks that may be seen in the photograph of the inside of the unit. These are used in the factory-built version to prevent damage during shipping.

As the first step in the construction of the cabinet the wood strips, blocks, and rails should be glued to the top and bottom panels, the tunnel plate, the front panel, and the side panels as shown. This step is already done if the kit is obtained. Next the sides are glued and screwed to the front panel. The two rear cross bars are then added and the frame is now ready to be squared. When you are sure that the frame is perfectly square and true, you are ready to tighten securely all the bolts.

Next, fin-shanked or T-bolts are installed for the speaker. If an 8-inch speaker is to be used, the reducer ring is installed. Then acoustic grille cloth is tacked to the rear edge of one of the sides; it is then stretched tightly over this side, over the front, and over the other side, where it is tacked to the back edge. The top and bottom panels and the tunnel plate are then glued and screwed into place. Finally the feet are installed, soundproofing material is tacked to the inside surfaces, and the speaker is bolted into place. Speaker leads are connected to a terminal strip in the back panel, which can now be screwed tightly into place.

Since the entire front and both sides of the enclosure are completely covered with grille cloth, it is only necessary to finish the top surface and its edges, the edges of the bottom panel, and the legs. In the case of the kit or pre-built unit, this has already been done by the manufacturer. The finish supplied, either in blonde or mahogany, is a hard plastic, wood-grained material, which resists stains, burns, and scratches.

We were particularly pleased with the simplicity with which the kit could be assembled and with the professionally finished and attractive appearance of the enclosure that was apparent just as soon as the last screw holding the back on was tightened. —30—

have *two* anechoic chambers—one large and one small.

I do not know how many of these rooms have been built here in England, but I have visited half a dozen as follows: *BBC, G.E.C.,* G.P.O., *Goodmans, Hawley Products,* and *Plessey;* and Mr. Cooke has had a look (forgive the rhyme!) at the National Physical Laboratory and the *Philips* installations.

The *BBC* room at its research department in Kingswood Warren, Surrey, is interesting on account of the loose grid floor which can be removed for very precise work. A view taken from the inside, looking towards the entrance, is shown in Fig. 11. (I have no precise information on what happens if you enter the dead room after the ironwork has been removed, except that shouts for help are inaudible.)

The walls, floor, and ceiling are lined with Fiberglas wedges 40 inches long and the useful room space measures 15 feet x 10 feet, 8 inches x 7 feet, 4 inches. This gives near-perfect free-field conditions down to 150 cps, but useful measurements can be made at much lower frequencies. A rubber-tired trolley for moving heavy enclosures can be seen in the doorway. When work is in progress the entrance is closed by a heavy door also fitted with the Fiberglas absorbent wedges.

Live Room Tests

To avoid the difficulties of open-air working and the high cost of building anechoic rooms, attempts have been made to carry out measurements in live rooms, the effects of standing waves being minimized by placing the microphone only a foot or so from the loudspeaker and by screening off the space around them with sheets of sound absorbent having an appropriate flow resistance. Mr. D. E. L. Shorter of the *BBC* showed us some response curves taken in this way. The speaker, which had an unvented cabinet, was mounted as far as possible from all obstacles. Using a velocity microphone to minimize room effects, the curve obtained was within 2 db of the corresponding curve taken in the dead room. The close microphone position introduces a spurious bass rise (which can be allowed for), together with some other errors at frequencies where the cone breaks up. However, these errors are nearly constant for a given type of speaker so that the method can be useful for production checking.

We find that we can get a lot of reliable information from curves taken in the absorbent enclosure illustrated in Fig. 12, which consists of a light wooden framework covered with sound absorbent material, with extra oblique layers of the same material above the floor. The frame is built of solid wood (2" x 2") covered by double layers of resin-bonded Fiberglas each 1" thick.

It is large enough to permit measurements with loudspeaker/microphone spacings up to one meter (39.37 inches) and 30 degrees off axis in a vertical direction at that distance.

In a live room, sound from the loudspeaker reaches the microphone both directly and after reflection from the room boundaries. The purpose of the screen is to increase the ratio of direct to reflected sound. Obviously, sound waves reach the microphone directly without attenuation, but reflected sound is attenuated during its passage through the absorbent screens. Because of the close proximity of the floor it is advisable to use several layers of absorbent material on the bottom of the screen.

A further improvement in the ratio of direct to reflected sound can be achieved by using a directional microphone with its axis adjusted to discriminate in favor of direct radiation.

There is no advantage in using a cardioid microphone as compared with a figure-eight type, because both have approximately the same ratio of direct/reflected pickup. The velocity type microphone has two thin lobes (front and back) whereas the cardioid has one fat frontal lobe, which in some cases can be a disadvantage because it picks up more floor reflections.

A suitable microphone is the *Standard Telephones and Cables* ribbon type 4038A, which has a uniform response from 40 to 12,000 cps to sound at normal incidence to the ribbon. Satisfactory direct/reflected sound pickup can be achieved by keeping the loudspeaker/microphone distance as low as one foot, for measurements up to about 2000 cps. Above this frequency such a small distance gives erroneous results because of the reflection effects taking place at the surface of the cone, and it is advisable to increase the microphone spacing to some 3 feet. Fortunately, we are able to do this without introducing serious irregularities in the response reading, because the absorption coefficient of the Fiberglas screen increases rapidly with frequency. Where measurements are required at frequencies higher than 12,000 cps, we use a miniature Rochelle Salt sound cell microphone, or a miniature Rochelle Salt "X"-cut expander block. Both these instruments are small enough to have negligible diffraction effects up to about 20,000 cps, and both respond to much higher frequencies.

The loudspeaker under test may be mounted in the wall of the room—a perfect and simple infinite baffle—or it can be placed in a totally enclosed cabinet similar to the one illustrated in Fig. 13. This has a volume of 5 cubic feet, is rigidly braced and lined with building board to prevent panel resonance, and acoustically treated to avoid standing waves. The absorbent enclosure of Fig. 12 can, of course, be placed in front of a loudspeaker already mounted in a corner cabinet or horn.

The response curves of Figs. 14 and 15 show the results obtained. A 15"

foam-surround speaker was mounted in the 5-cubic foot enclosure and curves were taken in the open air (free-field) and in the lab (with absorbent enclosure). Incidentally, this 15" unit is normally recommended for use up to 1000 cps only, because of the rise in output in the 1000 to 5000 cps region.

It will be observed that the irregularities introduced by the room are about ±2 db up to 1000 cps and less than ±1 db above that frequency.

The severe low-frequency roll-off below 100 cps is due to the closed box which is small for a 15" speaker. Fig. 16 shows the output from the same unit mounted in a 9-cubic foot corner reflex enclosure built of bricks and mortar; at 50 cps the output is some 8 db higher.

It will be appreciated that this indoor method of taking curves with the microphone fairly close to the speaker makes it impossible to include the low-frequency output from the vent of a reflex enclosure in the main response curve. The vent of this 9-cubic foot enclosure resonates at around 35 cps and greatly enhances the output in the region below 50 cps.

(To be continued)

UNIQUE FEEDBACK CIRCUIT

By PROF. A. V. J. MARTIN

THE feedback circuit shown in the accompanying diagram is used in some French "Arco" radio receivers. It provides a relative bass and treble boost by giving a higher feedback ratio for medium frequencies.

The interesting components are labelled R_1, R_2, C_1, C_2. The feedback chain is connected between the plates of the preamplifier and the power amplifier.

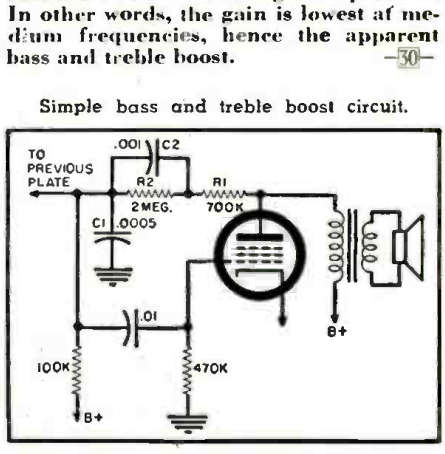
At low frequencies, the effect of C_1 and C_2 is negligible and there is a little negative feedback, on the order of 3% at 100 cps.

At medium frequencies, that is, around 800 cps, the shunt effect of C_1 is still negligible, but the shunt effect of C_2 is important, because it shunts a high-value resistor and partially short-circuits it. The feedback ratio then reaches nearly 10%.

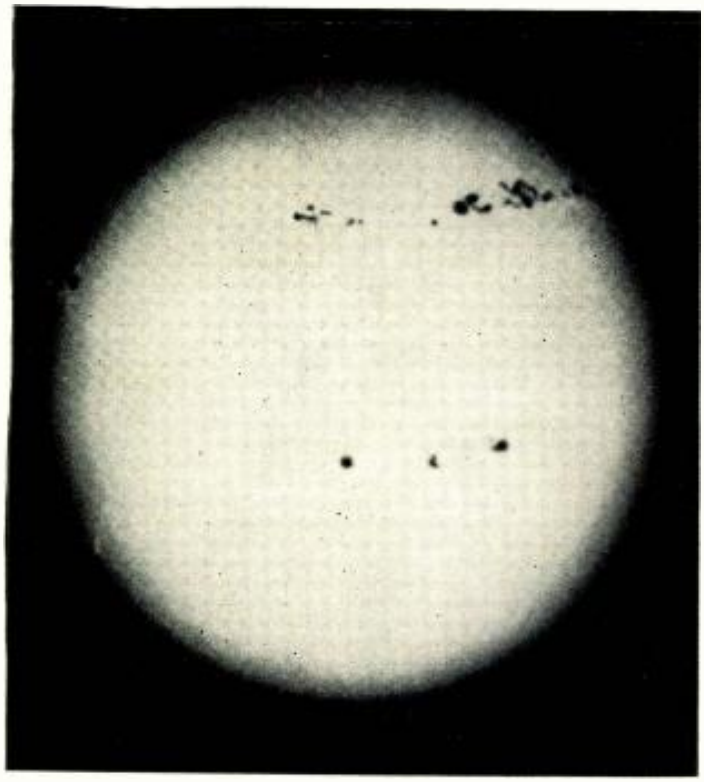
At high frequencies, the shunt effect of C_2 is still there, but C_1 comes into play as well, to shunt to ground part of the feedback voltage. This reduces the feedback ratio to 3% approximately at 10,000 cps.

The total effect is then a 10% feedback at medium frequencies and a 3% feedback at low and high frequencies. In other words, the gain is lowest at medium frequencies, hence the apparent bass and treble boost. —30—

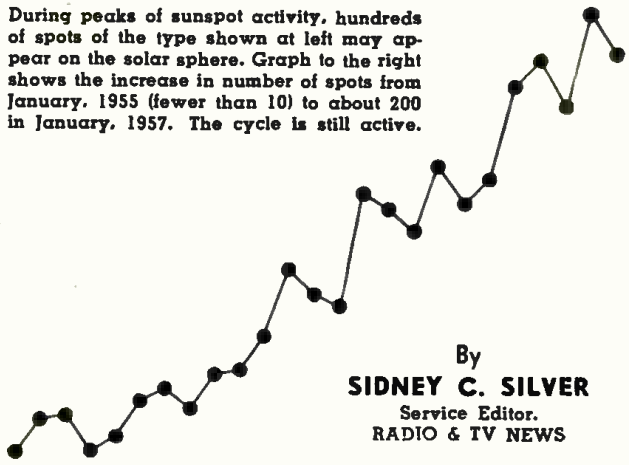
Simple bass and treble boost circuit.



Sunspots Mar TV Reception



During peaks of sunspot activity, hundreds of spots of the type shown at left may appear on the solar sphere. Graph to the right shows the increase in number of spots from January, 1955 (fewer than 10) to about 200 in January, 1957. The cycle is still active.



By
SIDNEY C. SILVER
Service Editor,
RADIO & TV NEWS

Strange DX signals suddenly appear, taking over TV screens, plaguing set owners and technicians.

A VIEWER who lives about 50 miles from the metropolitan area in which his favorite TV stations are located, and who normally gets pretty good reception, is reclining in his living-room chair one afternoon, completely relaxed, enjoying his favorite program on, say, channel 4. He becomes aware of fine horizontal lines faintly visible across the picture. Since he has been enjoying reception on this channel for a number of years with the same receiver and the same antenna, this entirely new phenomenon puzzles him somewhat, but it is not sufficiently prominent to be really annoying: he remains in his chair in the hope that the symptom will go away of itself.

As he watches, the lines become somewhat heavier and eventually mar his enjoyment. A somewhat darker vertical bar is now noticeable, swinging back and forth across the screen. Now he can barely make out his program at all; the lines are practically dominating the screen. Then the picture goes completely out of sync. Although he is bewildered, many a technician would state at this point confidently—and correctly, to a degree—that a serious case of adjacent- or co-channel interference is causing all the fuss.

The harried viewer has left his chair and is heading toward the set to apply the only remedial technique he knows. He is preparing to twist every knob with which the receiver manufacturer has supplied him in an attempt to exorcise the crazy quilt on the screen. Before he can do this the receiver, as though acting in self defense, suddenly permits an intelligible picture to fill the screen again. As our viewer gets ready to relax again, he realizes that the characters on the screen are completely unfamiliar. The show itself is completely unfamiliar. It has nothing to do with the program he was watching a short while ago and which should still be on the air. While he is trying to make some sense of this odd development, the program ends and a station break comes along. A completely unheard-of station with call letters he never knew existed identifies itself as "his" channel 4. Its location is given as some metropolis in another part of the country, hundreds of miles away.

Before reaching into his pocket for a tranquillizing pill, the victim just barely manages to reach the telephone and pour out a garbled account of what has happened to his incredulous service technician. While awaiting the technician's arrival, he stalks to his window and stares out, puzzled, at his antenna, which is just visible in one corner of his field of vision. He has to squint uncomfortably because he is partially blinded by the bright light beyond his antenna on this fine, clear day. The light comes from the sun, the unperturbed culprit in our little drama.

Admittedly, the account just given of interference resulting from so-called sunspot activity is of a severe case; but it is based on an authenticated experience. Nor will it be the last of its kind before we have drifted past the current sunspot cycle maximum. Often, the effect does not become as severe as in the unfortunate drama we have just presented; that is, the interfering, distant transmission working on the same frequency does not always become strong enough to ride over the desired local program. In these less startling cases, the symptom will take the form only of enough co-channel interference to ruin the program being viewed or to mar it considerably, usually by introducing instability or complete loss of sync, as well as by making a hash of picture content.

Uppermost in the minds of affected technicians and set owners will be the question, "What can we do about it?" Before we can start to supply answers—and there aren't many—we have to have some picture of what is going on.

As we rise above the earth, penetrating its surrounding atmosphere, we reach a region beginning about 50 or 60 miles up known as the ionosphere. This consists of several layers in which free ions and electrons occur with far greater frequency than they do in the more immediate atmosphere that hugs the earth intimately. The highest of these layers is about 200 miles straight up—quite a trip on the elevator.

With all the free electrons and ionized particles in the upper layers of the atmosphere, this ionospheric region is essentially a different medium from the atmosphere we find immediately around us. It is, in effect, a denser or less transparent medium, just as water or glass, although still transparent, are denser media than air.

When a pencil is put in a glass of water, it appears to be bent to the viewer standing away from the glass. What has happened is this: the normally straight-beamed light rays (very super-high-frequency radiation) from that

part of the pencil which has been submerged, in travelling to our eyes, have been bent in going through the water and glass, because they have been slowed up by the denser medium. In like manner, radio signals are bent or refracted as they pass through—or try to pass through—a "thicker" medium, like the ionosphere.

This phenomenon gives us our long-range or DX short-wave transmission. As shown in Fig. 1, ordinary radio waves, essentially unbent, travel line-of-sight and cannot be picked up by receivers beyond the horizon. Other waves are refracted so severely that they finally reflect downward and return to the earth at some distant point beyond the horizon (receiver 2).

The higher the frequency of either sound or electromagnetic waves, the more resistant they are to refraction and reflection. The bass end of the audio range, for example, seems to spread around the room from a loudspeaker. The treble end of the range is more narrowly beamed in front of the speaker and is not heard as clearly off the speaker axis. With electromagnetic waves, the signals can bounce around the world, between ionosphere and earth in the short-wave bands; however, when we go up in frequency into the TV bands, the signals tend to resist the bending effect of the ionosphere and transmissions manage to fight their way through this medium without being hurled back to earth. Thus, we ordinarily think of TV reception as not being practical beyond the horizon from the transmission point.

The highest frequency that can be bounced back to earth depends on the degree of ionization in the upper layers. This m.u.f. (maximum usable frequency) seldom moves up as high as the TV frequencies under ordinary conditions. However, along comes our sun to shed a new, if somewhat confusing, light on the situation.

Alone in space, millions of miles from its nearest neighbor, the solar orb gets bored now and then—about every eleven years or so—and begins to amuse itself with what we have come to know as sunspot activity. There is much speculation and less actual knowledge about the whys and wherefores of this sunspot cycle. As to effects, however, we do know that, during the period when the sun is riding the peak of a sunspot cycle, disturbances also occur in the ionosphere. Along with marked changes in the degree of ionization, the m.u.f. soars upward, and may get well into the lower v.h.f. band. When it does, TV transmissions at or below the m.u.f. can be thrown back to earth hundreds and even more than a thousand miles from the point of origin. The lensing action of the ionosphere may concentrate the refracted energy sent back down into the distant area to the degree that the returned signal will be strong enough to force its way over local transmissions on the same channel, and take over the screen completely.

We are going through a period of heavy sunspot activity right now, and this condition is likely to persist for half a year, or for more than a year; it is never easy to predict its exact termination. This type of disturbance is a new problem in the TV era: during the last sunspot peak, which occurred in 1947, there were neither enough receivers nor enough operating stations in the country to create much difficulty.

Although the disturbing effects already described may occur anywhere, areas of primary reception will be less susceptible than others. The particular instance with which this article begins occurred in a near-fringe sector about 50 or 60 miles west of an eastern metropolis. Since the locality is on high ground, many favored set owners are able to get acceptable reception from the big city with nothing more than indoor rabbit ears. The indoor antenna was beamed east, of course, but antennas of this type are equally sensitive in the opposite direction. The interfering station was identified as one from the midwest.

Most reports of DX TV reception at this time come from fringe areas, where the inherently weaker signals available locally can put up less of a battle against intruders. Nevertheless, the author, who resides in a near suburb of New York City where there is signal strength to throw away, has suffered some mild, occasional co-channel effects—horizontal lines, windshield-wiper effect, infrequent sync instability—on channel 2. This has occurred three or four times over the last half year, and has lasted for two or three hours on each occasion.

To the DX fan, these random pickups are gifts from heaven—or from the sky, in any case—especially when they fall on channels that are normally vacant in the local area. To most viewers, these invading signals are unwelcome obstacles to TV enjoyment, and these people can't understand what is wrong with the idiotic technician who shrugs his shoulders helplessly when he is asked to "fix the set."

The situation is a tough one, because a sure, universal cure does not exist. In areas where the victim has been getting by with an antenna that is largely nondirectional, a narrowly beamed unit, aimed in the direction from which transmission is desired, will cut down hobo signals that drop in uninvited from random angles. However, the refracted intelligence may also swoop down from the angle of optimum orientation. Even in these cases, the fact that normal TV transmissions travel in the horizontal direction gives us something to work on. The angle of incidence of radiation bounced back from the ionosphere will be oblique (see Fig. 1). There are many good antennas that not only discriminate against signals arriving at the rear and sides, but also reject signals that do not come in horizontally. A check of the vertical radiation patterns supplied by most manufacturers of good antennas will be useful in making a choice.

Recommending the expense of a new antenna installation to a victim of the sun is a delicate problem, at best. There is no assurance as to how effective it will be, and the unpredictable sunspot cycle may come to an end before the cost of a new antenna can be justified in terms of whatever relief it will provide from the difficulty. The technician would do just as well to use the opportunity for stressing the need for a better, newer antenna on general principles, with possible reduction of sunspot interference as an added inducement. Overstressing the possible protection against interference from DX TV transmissions, even where this symptom has been a fairly regular nuisance, leaves the technician open to recrimination by the set owner where the results will not justify the expenditure involved. Few technicians will want to take such a risk.

In any case—and especially in those where the condition exists despite a good antenna installation—an important public-relations problem confronts the TV service worker. Unless it is properly handled, he may suffer loss of confidence with some customers. His best bet is to make a rough sketch like the one shown in Fig. 1 and try to explain what is going on. The simplified explanation given here has been tried out on several nontechnical people with good success. The technician is less likely to be looked upon as an idiot if he can do this successfully; he is also giving his customer an honest picture of the situation and expectations. In effect, the customer, not the technician, is responsible for the decision as to whether a gamble on a new antenna should be taken. Besides, while the explanation is being given, the symptoms may very well disappear altogether. —30—

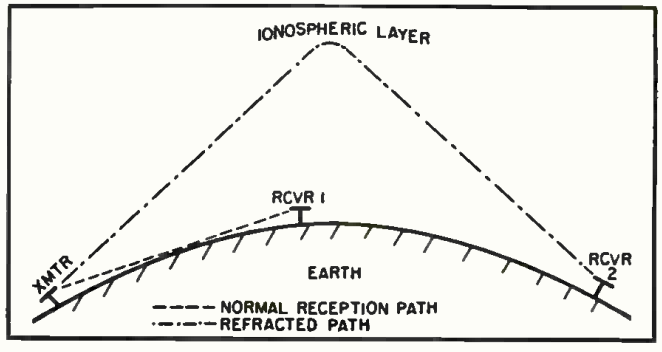
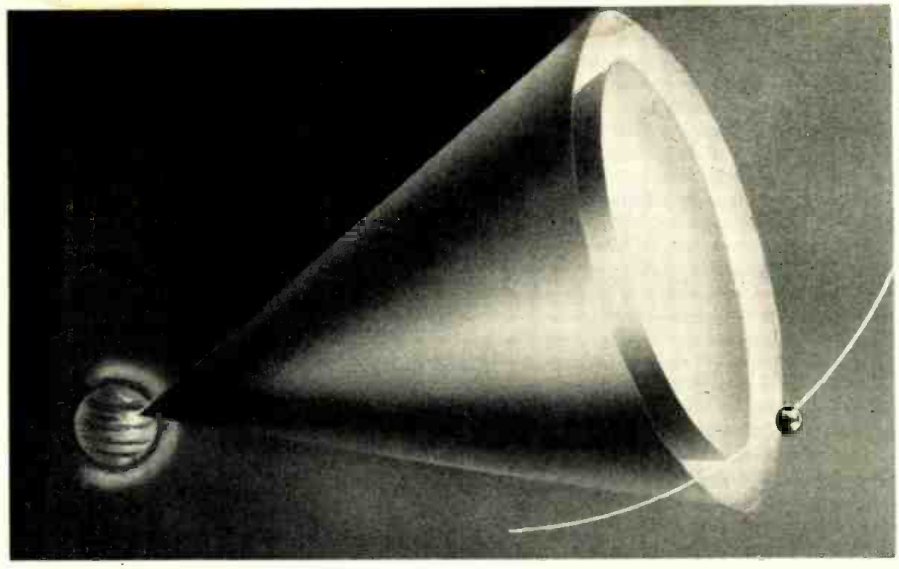


Fig. 1. Normally propagated TV transmissions travel in straight lines, and cannot be picked up beyond the horizon. When the sun acts up, they may bounce for great distance.



The reception cones of Jupiter's radio emissions as limited by Jupiter's ionosphere.

Signals From Jupiter Studied by N.B.S.

Distant planet emits pulse-type radiation that appears to indicate the presence of a surrounding ionosphere.

FOR about two years astrophysicist Roger Gallet at the Boulder Laboratories of the National Bureau of Standards has been studying radio signals of tremendous power from Jupiter. Gallet's work rules out thunderstorms as the possible source since lightning discharges, unlike the signals being received from the planet, broadcast on all frequencies at the same time and have other different characteristics.

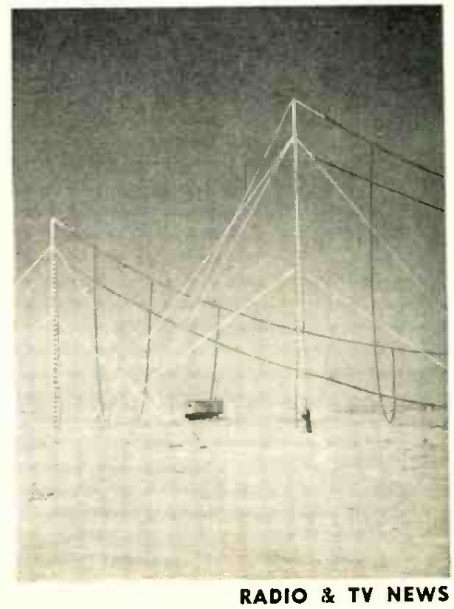
The actual signals consist of 2-second pulses having 100 thousand times more energy than that contained in a strong local lightning discharge, and 30-millisecond pulses of infrequent repetition. Concerning the origin of the signals, it is suggested that they may have a shock-wave origin possibly from geyser-like phenomena or volcanic activity, although different from any such activity we know on earth, because the material constituting Jupiter is different from Earth.

Perhaps the most important evidence on Jupiter that has been collected is that which seems to prove that the huge planet has a strongly ionized upper atmosphere—an ionosphere—similar to our own. And just like our ionosphere its electronic density varies in relation to the amount of ultraviolet radiation given off by the sun. Emissions, recorded at a specific frequency, come through a cone of transmission radiating from the source. This seems to indicate that the radio waves within the cone are penetrating Jupiter's ionosphere, but the oblique waves outside the cone are being reflected back to Jupiter by its ionosphere.

It has also been found that the cone is larger for 20 than for 18 megacycles. These are the two frequencies on which the observations are conducted.

Interestingly enough, this radio astronomy work must be done only at night when our ionosphere is less ionized and the Jupiter waves can come through. —30—

These antennas direct radio signals originating 500 million miles away from earth to recording equipment located in the trailer.



Fringe-Area FM Reception

(*Continued from page 39*)

fringe-area FM reception to good advantage, acceptable noise level being much higher than in TV work. As no FM band preamplifiers were available locally in commercial form, various makes and types of v.h.f. TV preamplifiers were re-aligned and used with success. Cascode amplifiers were built and tried, but were found to have little advantage over the straight triode or pentode circuits when used with a receiver having good AM rejection characteristics. As the gain of a cascode circuit may be approximately that of a single triode, it was found better to re-align available triode or pentode equipment, often spending considerable time in the process, rather than use the bulkier "home made" variety. It was also found to be economical to purchase new equipment which had been rendered virtually obsolete in this area when the Seattle TV stations increased their radiated power a few years ago. The wide-band type preamplifier was found to be more satisfactory than the manually tuned variety, since the former was relatively easy to align with sweep generator and scope to cover the FM band with the additional advantage that, once installed, it could be forgotten.

In the case of a permanent installation (not the experimental type), a mast mounted preamplifier would be better, but should be checked for alignment and gain before installation.

The *Hallicrafters* Model SX-62 receiver used during the final part of these tests had previously been modified for use as an AM-FM tuner in conjunction with a separate audio amplifier and was again modified to provide higher gain and improved limiting. In its final form a 6AH6 tube was used instead of the original 6AG5 second r.f. amplifier, a 6SG7 replaced the 6SK7 first i.f., and FM detection was accomplished with a ratio detector circuit instead of the original discriminator. A test point was provided above the chassis so that the a.g.c. voltage could be measured as an indication of signal strength.

The results of these tests, already noted, give an indication of what can be expected of FM reception compared with TV reception. It is interesting to note that received signal strength varies directly with transmitted power without regard to varying antenna height. This is explained by the fact that, for line-of-sight reception at this distance, variations of 10 or 20 feet in receiving-antenna height and of 100 or 200 feet in transmitting-antenna height would be completely ineffective except in the case of local minor obstructions.

The modified *Hallicrafters* receiver is not the type of equipment found in the average hi-fi installation, but comparisons with more usual FM tuners show them to be adequate for this type of reception. —30—

New Tube Tester Data

Owners of EMC tube testers will want to keep this supplementary data handy at all times.

EMC MODELS 200, 201, and 206

Tube Type	Fil.	S	G	P	Bias	Sensitivity	Average Gm	Remarks
3A3	3.3	2	.....	10	.....	48	.....	cold K—glows at 3, 7, 8
s)3DT6	3.3	3	1	5-6	9	14	3500	
5AS4	5	2	.....	4	.....	22	.....	rect.
5AS4	5	2	.....	6	.....	19	.....	rect.
6BK4	6.3	2	.....	5-10	.....	95	.....	rect.
s)6BU8	6.3	4	7	2-3	10	15	3000	
s)6BU8	6.3	4	7	8-2	10	15	3000	
s)6BV8	6.3	4	2	3	12	11	4500	
s)6BV8	6.3	4	.....	6	.....	50	.....	diode
s)6BV8	6.3	4	.....	9	.....	50	.....	diode
s)6BZ8	6.3	4	2	1	20	20	2500	
s)6BZ8	6.3	4	7	6	20	20	2500	
6CB5	6.3	2	4-5	1-8-10	80	17	2800	glows at 1,3,4,5,6, 7,8
s)6CE5	6.3	3	1	5-6	9	13	4200	
s)6CG8	6.3	4	1	2	12	15	3300	
s)6CG8	6.3	4	9	6-7	8	14	3500	
s)6CM7	6.3	4	7	6	14	20	2400	
s)6CM7	6.3	4	8	1	15	13	4000	
6DQ6	6.3	2	4-5	10	5	20	2400	
s)6DT6	6.3	3	1	5-6	9	14	3500	
s)10C8	12.6	4	2	1	7	13	3800	
s)10C8	12.6	4	8	6-7	12	11	4800	
s)12AB5	12.6	4	3-6	1-8-9	30	15	3000	glows at 1,3,5,6,8
s)12AD6	12.6	3	1	6-7	41	26	1800	
s)12AE6	12.6	3	1-5-6	7	15	30	1500	
s)12AF6	12.6	3	1	2-5-6	32	18	2800	
s)12AJ6	12.6	3	1-5-6	7	5	15	3000	
s)12BL6	12.6	3	1	2-5-6	30	13	4000	
s)12BV7	6.3	6	2	7-8	15	10	5400	glows at 3,4.5,9
s)12C5	12.6	3	2-5	6-7	40	13	4200	glows at 2,4.5
s)12CR6	12.6	3	2-6-7	5	0	28	1600	
s)12CT8	12.6	4	2	1	8	14	3200	
s)12CT8	12.6	4	8	6-7	10	9	6000	
s)12CU5	12.6	3	2-5	6-7	45	18	2800	glows at 2,4,5
s)12K5	12.6	3	5-6	2-7	9	13	4100	glows at 4.5.6
s)17H3	25	4	.....	3-8	.....	16	.....	rect. glows at 3,5,8
18A5	25	2	1	5	0	10	5500	
s)6386	6.3	9	3	4	19	11	4500	
s)6386	6.3	9	7	6	19	11	4500	
s)6829	6.3	9	2	1	10	12	4100	glows at 4,5
s)6829	6.3	9	7	6	10	12	4100	

Sine-Wave Clipper

(*Continued from page 45*)

ing," in the July issue of this publication). Going below 100 cps, Fig. 2 shows that output from the squarer at 35 cps is also of good quality and certainly useful where its initial shape is known before it is applied to a circuit for test purposes. At higher frequencies, departure from squareness is not uncommon even in elaborate square-wave generators. Despite some rounding and slight deterioration in response, the 10,000-cps square-wave output is still good.

The quality of output desired and the range of frequencies over which it is desired that the output continue to be usable will depend on the applications for which the particular clipper will be used in square-wave testing. Several variations in the circuit are possible, and ultimate use will determine which of these will be preferred. An obvious change is the substitution of a pair of crystal diodes for the 6H6, which will eliminate the need for a heater transformer and thus permit a great reduction in the final size of the package. However, the ratio between forward and reverse resistance in crystal diodes is not as good as it is with a vacuum-tube diode, and the square waves tend to become somewhat round-shouldered, increasing the difficulty of interpretation. Depending on the individual use to which the accessory will be put and the preferences of the operator, this sacrifice may be worth the elimination of an extra component.

Another variation is to use a 117-volt dual-diode, such as the 117Z6, which eliminates the transformer since its filament can be placed directly across a house-current line. Such a measure is bound to increase 60-cycle hum when operated from an a.c. line, however. Some users may find this added hum tolerable in certain applications, but most will prefer to avoid it by retaining the transformer.

In still another variation, where the step-down heater transformer is used, the battery can be eliminated by obtaining bias from the heater supply, using a crystal diode rectifier and subminiature capacitors for filtering. However, this method is far more costly than that of using dry cells, as suggested. The unit as described here is more than a year old and still has the original dry cells. Even if the 6H6 is left energized continuously, the load is only .0003 ampere, and the cells should last several hundred hours. In addition to the cost saving, the dry cells render the clipped voltage waveform practically independent of line voltage changes.

Experience with the accessory clipper, built as described here, indicates that its performance is as reliable as one could wish. The versatility of application, limited only by the user's ingenuity, increases with use. —30—

Scatter System to Link NATO Nations

One of the most modern and extensive military radio communications systems in the world will combine over-horizon forward scatter and line-of-sight links.

SUPREME Headquarters Allied Powers Europe recently issued a letter of intent for the engineering and installation of one of the most modern and extensive military communications systems in the world. This new network will combine over-the-horizon tropospheric forward scatter and line-of-sight radio relay links to further integrate, from a communications viewpoint, certain international and national military agencies and installations. These extend from Eastern Turkey around the broad crescent throughout NATO Europe to the far reaches of Northern Norway.

The companies involved are *International Standard Electric Corp.*, the overseas management subsidiary of *International Telephone and Telegraph Corp.* and *Hycon Eastern, Inc.*, Cambridge, Mass. The combined estimated contract cost is $9 million.

The main center of this gigantic undertaking will be established in Paris. Planning, engineering, and general supervision will, in the larger part, be conducted from there. In addition, there will be field teams for testing, exploration, installation, and supervision which will be deployed in the many NATO European countries where the forward scatter and radio relay station sites are projected.

The system design will employ the most modern techniques known. Consideration is given to very high circuit reliability and to physical and electronic security in order to provide the greatest dependability.

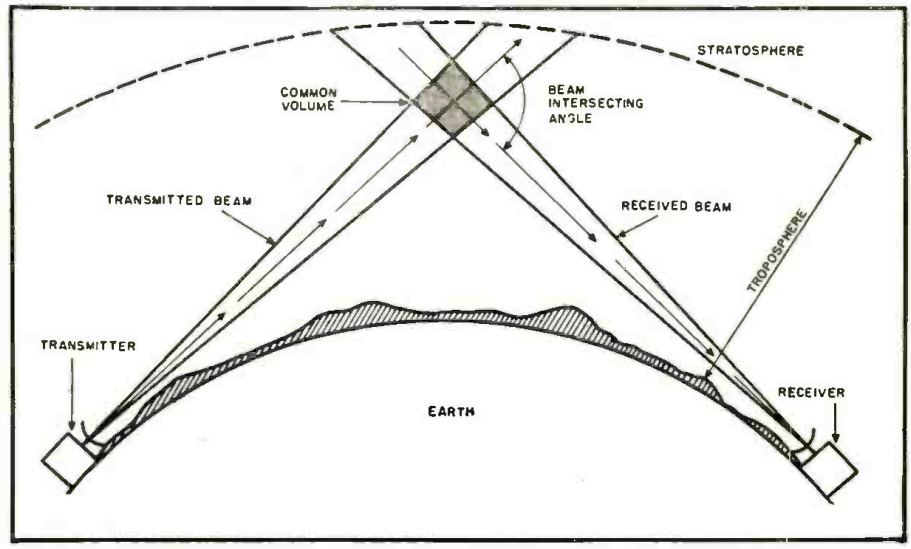
In scatter propagation, there is a very large amount of radio energy thrown out into space in the hope that some of the energy will get scattered around by dust, raindrops, and normal discontinuities in the layers of air around the earth's surface. The small amount of energy which does get bounced back in the right direction is then detected, using specially designed, very sensitive radio receivers.

In the scatter process, much energy is lost, since the radio waves are indeed scattered in every direction. But the percentage of energy which does get back to earth contains all the information necessary to communicate reliably.

Ordinary radar waves and other very high frequency radiations travel through space in straight lines. But as the accompanying illustration shows, two straight lines, properly oriented, can make an angle around a curved surface. It is in this manner that forward scatter propagation "bends" around the earth's surface and covers much greater distances than in conventional line-of-sight transmission.

In the entire operation there will be wide employment of technical personnel from the NATO countries, and the procurement to the maximum extent of equipment on an international competitive bidding basis. The project will be both complex and challenging. —30—

Diagram showing the path geometry of a tropospheric forward scatter circuit.



Transistor Terminology

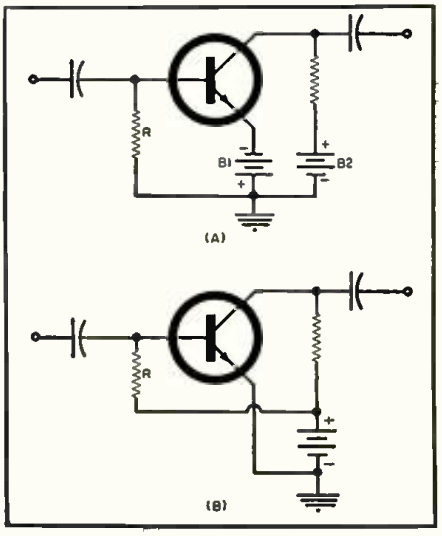
(*Continued from page 69*)

rent and therefore establishes the operating point.

The collector of a transistor is biased in the reverse (high-resistance) direction. Consequently, current in the collector circuit is relatively small. This current, however, is increased by the presence of injected carriers and therefore varies in accordance with the variations of input signal. Even with the input current reduced to zero, some small amount of current will flow in the collector circuit. This is known as *collector current cut-off*. It is not a true cut-off condition such as can be obtained in a vacuum tube because the collector draws some current even with reverse bias and with no injected carriers. The current, however, is sufficiently small to justify the use of the term cut-off.

The amount of power that can be dissipated in the collector of a transistor is limited by the possibility of damage or serious change of characteristics as a result of overheating. Except for specially designed power transistors, collector dissipation is usually in the range of 50 to 150 milliwatts. Numerically, collector dissipation is equal to the product of collector current and collector voltage. The transistor must be so operated that this product does not exceed the maximum dissipation rating. For example, if the maximum collector dissipation of a transistor is 100 milliwatts and the collector voltage is 25, the collector current must not exceed 4 ma. If the collector voltage is reduced to 20 volts, the permissible collector current will be 5 ma. Naturally, the operating range of the transistor should be so limited that at no point will the rated maximums of collector voltage and collector current be exceeded. -30-

Fig. 4. Resistor R determines the magnitude of the d.c. bias current. The input signal swings this current around the operating point, causing related variations in output current.



Packard-Bell Color Sets

(*Continued from page 67*)

ard-Bell sets requires very exact alignment and that all controls must be set just right. The automatic pull-in range of this system is more limited than those in receivers which use a phase detector and reactance tube.

The horizontal and vertical sweep sections are conventional except for the fact that the horizontal-flyback and vertical-output transformers have bifilar windings. These provide d.c. isolation to facilitate the application of a centering current. Most other receivers use elaborate filter and isolation networks for this purpose.

The high-voltage section differs from most previously discussed sets in that there is no apparent h.v. filter capacitor. Actually the plastic insulating jacket which fits around the metal envelope of the picture tube also serves as filter capacitor. The inside and outside of this jacket have conductive coatings that form a 2000-$\mu\mu$fd. capacitor. It is important that the inside, which contains the h.v. connector, make good contact with the tube metal, while the outside must be grounded securely in several places. To protect the electron-gun structure in the event of h.v. arcing, a 50,000-ohm film resistor is painted on the inside of the tube neck. The focus potential is also protected against excessive voltages. An arc gap made up of a grounded lug bent close to the focus terminal will arc over when the voltage reaches about 12 kv.

The power supply in this color set uses a transformer and two 5U4 rectifiers followed by a two section *pi*-filter, which keeps 120-cycle hum to a minimum. Most other receivers use permanent magnets for d.c. convergence, while in the *Packard-Bell* sets all convergence controls are on the front panel and not at the neck of the picture tube. Convergence circuits are of the well-known tubeless type, but it is interesting to note that the d.c. power for these networks is obtained from the cathode of the horizontal-output tube. This tube usually passes well over 100 ma. and has a small cathode resistor. Here this power is not wasted, but operates the d.c. convergence controls. —30—

U.H.F. HINTS

By H. R. HOLTZ

IF YOU are a technician cutting your u.h.f. teeth in a new u.h.f. area, perhaps we can save you some headaches. Here are a few things we have learned about u.h.f.

With respect to the question of u.h.f. strips, we have found that u.h.f. converter conversion strips for turret tuners will work satisfactorily under conditions of high signal strength and/or hot front ends using 6BZ7 or equivalent r.f. stages. Remember, these strips are oscillator-mixer units and do not have a u.h.f. r.f. stage. If you are in doubt, use a two- or three-tube converter having a good r.f. stage. You may also have to stack a pair of antennas. Even 500 kw. of u.h.f. at 10 miles distance from the tower may require a stacked antenna and a good stage of r.f. before being double-superheterodyned.

Don't fall in love with one type of antenna. Here in the Miami area, the all-channel double-V is popular. It pulls in 4, 17, and 23 pretty well. Since all three towers are close to each other, hence, pretty well in one direction from most locations, stacked u.h.f. yagis work beautifully on the two u.h.f. channels. In one area, in direct line-of-sight of these two towers, yagis have been pretty satisfactory. However, at close range the towers are not always in line, and yagis are then too directional. A mere couple of degrees of rotation can mean the difference between a good picture and a blizzard. A broadband job, such as the V, is much less troublesome.

In many cases, after installing a good, stacked antenna and a good converter, dressing lead-in carefully with no sharp turns and preparing a drip loop, we were still snowed out. A case of i.f. misalignment proved to be the trouble here. Some of these sets were virtually factory-new. Check all other possibilities first but don't overlook the i.f.'s!

In one case, we were about to haul the set back to the shop for i.f. alignment when the technician on the roof noticed that one stand-off had pulled out of a rotten piece of wood trim on the roof and the lead-in was lying across the concrete roof of the porch. When he picked up the lead-in to replace the stand-off, the other man, at the set, shouted excitedly into the 2-way phone system. The snow had miraculously cleared up.

Cut lead-in as short as possible. Position antenna for shortest possible run. Make round, gradual bends, never sharp corners. Use a drip loop just before entrance. Do not leave coils of lead-in lying behind the set. Dress lead away from flashing, spouts, and other metal surfaces.

The 6T4 and 6AF4 are the most widely used local oscillators in u.h.f. They are as troublesome as 6BQ7's. Trust them not! They are always suspected, even for snow, but especially for intermittent operation. Most converters use a crystal mixer, generally a 1N82. These have, so far, given us little trouble.

Sometimes, snow on u.h.f., when using a converter, may be caused by the receiver's r.f. amplifier, especially if it is a 6BQ7 or similar tube, even though v.h.f. is being received free of snow. We have also had cases where the v.h.f. oscillator (a 6J6 in a Stromberg-Carlson is one case we particularly recall) was working properly on the local v.h.f. channel but wouldn't give us satisfactory performance on channels 5 or 6, the channels to which the set must be tuned to receive signals from most commercial u.h.f. converters.

To sum up: use a converter with r.f. stage and a stacked antenna. Dress lead-in carefully and as short as possible. In case of snow, check r.f. amplifiers and local oscillators in both converter (or u.h.f. tuner) and v.h.f. tuner. Orient antenna carefully and re-check lead-in dress. As a last resort, check i.f. alignment. —30—

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				3	4	5
						12
						19
						26

CALENDAR of EVENTS

AUGUST 2, 3, 4

Fifth Annual Clinic and Fair. Sponsored by Texas Electronics Association, Inc. Texas Hotel and Hall of Exhibits, Fort Worth, Texas. Leonard R. Smith, 1105 May St., Fort Worth 4, is Clinic Chairman. See page 148 of this issue for details on this event.

AUGUST 20, 21, 22, 23

Western Electronic Show and Convention (WESCON). Sponsored by the San Francisco and Los Angeles Sections of the IRE and the West Coast Electronic Manufacturers Association. Cow Palace, San Francisco. Show offices at 342 N. La Brea Ave., Los Angeles 36, Calif.

AUGUST 22-SEPTEMBER 5

International Scientific Radio Union. Sponsored by Boulder Laboratories of NBS, University of Colorado, the High Altitude Observatory, and the City of Boulder. Kenneth A. Norton, chief of NBS radio propagation engineering division, Boulder, is in charge of local arrangements.

AUGUST 30, 31, SEPTEMBER 1

Ninth National Convention of the American Radio Relay League. Sponsored by the Chicago Area Radio Club Council, Inc. Palmer House, Chicago. Registrations should be addressed to Treasurer, Chicago Area Radio Club Council, P.O. Box 6797, Chicago, Ill. Advance registration fee, including banquet is $10.50, on arrival $12.50.

AUGUST 31

First National Dinner. Sponsored by Single Side Banders. Palmer House, Chicago in connection with ARRL Convention. Reservations should be sent to W. L. Runzel, Jr., W9OGA, chairman of the dinner, 4727 Montrose Ave., Chicago 41, Ill. Other details on page 109 of this issue.

SEPTEMBER 4, 5, 6

Second Special Technical Conference and Exhibit on Magnetic Amplifiers. Sponsored by the AIEE Committee on Magnetic Amplifiers and the IRE Professional Group on Industrial Electronics. Hotel Penn Sheraton, Pittsburgh, Pa. Complete details from Mr. D. Feldman, Bell Telephone Laboratories, Whippany, New Jersey.

For information on scheduled Service Association Meetings, see "Service Industry News," page 148.

Within the Industry

(*Continued from page 30*)

Palo Alto branch of the Nutley, N.J. subsidiary of **IT&T,** has moved into a new 6000 square foot research and development headquarters at 937 Commercial St., Palo Alto, Calif. . . . Salt Lake City has been chosen as the site for **LITTON INDUSTRIES'** eleventh plant. A building covering 60,000 square feet and employing about 600 people is planned . . . Construction of additional production space is announced by **CLAROSTAT MFG. CO., INC.** The new construction consists of a wing added onto the present five-story building . . . **H. H. SCOTT, INC.** is building a new 32,000 square foot plant at Maynard, Mass. . . . **MARANTZ COMPANY** is now located at 25-14 Broadway, Long Island City 6, N. Y. . . . **TEXAS INSTRUMENTS INC.** has opened a new semiconductor-components division marketing division in the Wilson Building, Room 701, Broadway and Cooper Streets, Camden 2, N. J.

* * *

GEORGE E. HALLET, controller of *Tung-Sol Electric, Inc.,* has been elected a vice-president of the Controllers Institute of America, effective September 1.

A member of the Institute since 1945, Mr. Hallett became a national director a year ago. He has been chairman of the group's national admissions committee, and the ethics and eligibility standards committee.

Established in 1951, the Institute is a non-profit management organization of controllers and finance officers in all lines of business.

* * *

DR. J. C. R. LICKLIDER, associate professor of psychology in the department of economics at MIT, and a member of the firm of *Bolt, Beranek and Newman,* has been named president-elect of the Acoustical Society of America.

At the same time, announcement was made of the selection of Dr. R. Bruce Lindsay as Editor-in-Chief of the Society's publications.

William A. Jack was elected vice-president, and Wallace Waterfall and Herbert A. Erf were re-elected secretary and treasurer, respectively.

* * *

ROBERT BEEBE is now the head of sales for the *Ward Products* line of mobile communication equipment. The firm is a division of *Gabriel Company* . . . **JAMES P. KLEEMAN** has been appointed supervisor of customer services for *Kaar Engineering Corp.* . . . *Ford Instrument Co.,* division of *Sperry Rand Corp.,* has announced the appointment of **EDWARD C. WAGNER** to the new post of assistant to the vice-president for engineering . . . **STANLEY J. KOCH** and **MAJOR GENERAL RAYMOND C. MAUDE** (USAF, Ret.) have been elected vice-presidents of *Allen B. Du Mont Laboratories, Inc.* . . . **W. E. BOSS** has been appointed director, color television coordination, *RCA* . . . *International Resistance Company* has appointed **GREGORY PETERS** to the post of controller of the firm's subsidiary, *Circuit Instruments Inc.* . . . **NORMAN NISENOFF** and **DR. JAMES E. MEINHARD** are now senior research engineers in the electronics division of the *National Cash Register Company* . . . **J. W. "BIM" FARROW** has joined *Ampex Audio, Inc.* as director of marketing . . . **HIRAM PRINCE** and **CHARLES WEIGAND** have been appointed sales manager and chief engineer, respectively, of *Permo, Inc.* . . . *RCA* has advanced **RICHARD H. BAKER** to the newly created position of administrator, value engineering, defense electronic products . . . *Loral Electronics Corp.* announces the election of the following additional officers: **GERSON LEWIS,** vice-president; **THOMAS J. McLAUGHLIN,** vice-president; **A. GERALD MERLIN,** vice-president; **SHELDON SIMON,** vice-president; and **ARTHUR KOTEEN,** assistant treasurer . . . **ROBERT A. LEBOWITZ** has been appointed assistant to the manager of manufacturing at *Polytechnic Research & Development Co., Inc.* . . . **DR. WERNER F. AUERBACHER** has been named divisional vice-president for engineering and manufacturing of the *Emerson Radio & Phonograph Corp.,* government electronics division . . . **WALTER H. SIEGER** has been elected president of *Revere Corp. of America,* subsidiary of *Neptune Meter Co.* . . . **ANTHONY DEL DUCA** has been named chief electronics engineer for the process instruments division of *Beckman Instruments, Inc.* . . . **DR. G. RUSSELL TATUM,** division general manager, and **DR. WILLIAM A. BAIN, JR.,** director of the firm's West Orange laboratory, have been elected president and vice-president, respectively, of *Vitro Laboratories,* a division of *Vitro Corporation of America* . . . **W. HAYES CLARKE** has been named national accounts sales manager for the receiving tube department of *General Electric Company* . . . **FRANCIS W. CROTTY** has been named vice-president in charge of patents by the board of directors of *Zenith Radio Corp.* . . . **CLARENCE M. LEEDS** has been elected vice-president for manufacturing of *Simplex Equipment Corp.,* a subsidiary of *General Precision Equipment Corp.* . . . *Prodelin, Inc.* has appointed **GEORGE A. LAKIN** to its technical service engineering staff . . . **DR. ROBERT F. REA** has been appointed director of engineering at *Diamonite Products Manufacturing Co.,* a division of the *United States Ceramic Tile Co.*

* * *

RICHARD T. DENTON, a University of Michigan student, has been awarded the first National Electronics Conference fellowship in electronics.

The winner, chosen in national competition, will receive a $2500 fellowship for a year of graduate study at any of eight colleges and universities participating in the conference.

The sponsoring group includes the

American Institute of Electrical Engineers, and Institute of Radio Engineers. The Radio-Electronics-Television Manufacturers Association and Society of Motion Picture and Television Engineers are participating members.

* * *

MAX F. BALCOM, director and consultant, *Sylvania Electric Products Inc.,* has received the 1957 RETMA "Medal of Honor," the electronics industry's highest award for outstanding service.

In presenting the award, the association's president, W. R. G. Baker, vice-president, *General Electric Company,* expressed the feeling that the awards committee could not have selected anyone to receive the medal who is held in greater esteem by his colleagues than the winner.

* * *

JOHN BENTIA, president of *The Alliance Manufacturing Company,* Alliance, Ohio, has been presented with the Horatio Alger Award of American Schools and Colleges Association.

The award, established in 1947 by the association, was aimed at combating the trend among young people towards the belief that equal opportunity was a thing of the past.

Mr. Bentia sold newspapers as a boy and started with the company as a stockboy. Sixteen years later, he became president of the firm. At 39, he is the youngest executive ever to win this award. -30-

SINGLE-SIDE BANDERS MEET

THE first annual dinner of the Single Side Banders will be held during the ARRL National Convention at the Palmer House, Chicago, Saturday, August 31st.

Tickets are $7.50 and reservations should be made with W. L. Runzel, Jr., 4727 Montrose Ave., Chicago 41, Ill.

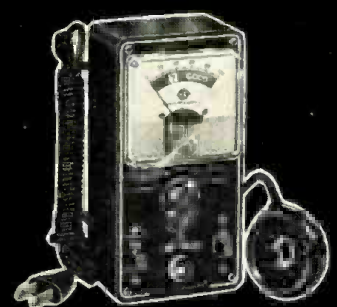
-30-

Revolutionary RCA-developed instrumentation radar system, which for first time makes possible direct calibration and immediate evaluation of the performance and behavior pattern of free-space moving targets, was shipped recently to the Grand Bahamas Island for use in tracking the "Vanguard" rocket used for launching the earth satellite.

MODEL TD-55
Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.

MODEL TW-11
Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

MODEL TV-12
Terms: $22.50 after 10 day trial then $10.00 per month for 5 months.



MODEL TV-40
Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER

NO C.O.D.

Superior's New Model TD-55
EMISSION TYPE

TUBE TESTER

FOR { The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum.

Checks for shorts and leakages between all elements
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

Elemental switches are numbered in strict accordance with R.M.A. Specifications.
The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case..... **$26.95 NET**

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, 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. **All elements are numbered according to pin-number in the RMA base numbering system.**
- Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. **Thus it is impossible to damage a tube by inserting it in the wrong socket.**
- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

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

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet... **$47.50 NET**

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

★ **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%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

EXTRA FEATURE:
Model TV-12 Also Tests 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.

Housed in hand-rubbed oak cabinet... **$72.50 NET**

Superior's New Model TV-40

PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton! !

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only..... **$15.85 NET**

USE APPROVAL FORM ON NEXT PAGE

We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

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

TRY FOR 10 DAYS

before **you buy!**

then **if satisfactory pay in easy, interest free, monthly payments. See coupon below.**

Superior's New Model 770-A

POCKET-SIZED VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA

Occupies exactly the same space used by the older standard 2½" Meters, yet provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type.

• Housed in round-cornered, molded case. Beautiful black etched panel.
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, +34db to +58 db.
Complete with test leads..... **$15.85 NET**

Superior's New Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER *PLUS* Capacity, Reactance, Inductance and Decibel Measurements

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 • **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 to 7,000 Henries • **DECIBELS:** −6 to +18, +14 to +38, +34 to +58.
Complete with test leads..... **$28.40 NET**

Superior's New Model **76**

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

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 Microforads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

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

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

✓ **TV ANTENNA TESTER SECTION**
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in ony TV antenno and measures the location of the break in feet from the set terminals.
Complete with R.F. and A.F. probes and test leads..... **$26.95 NET**

Superior's New Model TV-50

GENOMETER

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**

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundomentals and from 60 Megacycles to 180 Megocycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: 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.)

BAR GENERATOR: Pattern consists of 4 to 16 horizontol bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontol and vertical lines interlaced to provide a stable cross-hatch effect.
Complete with shielded leads..... **$47.50 NET**

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-366, 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 .....

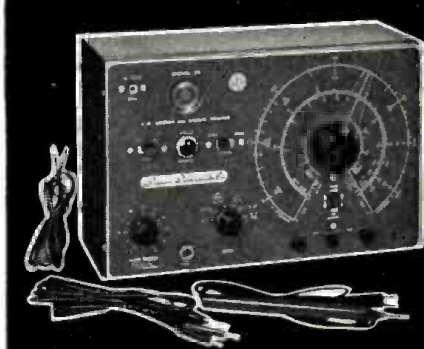
City .....Zone.....State.....

All prices net, F.O.B., N. Y. C.

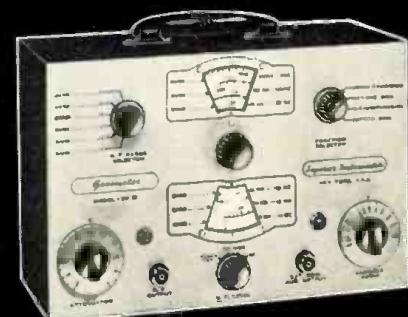
- ☐ Model TW-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 76.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TD-55.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-50.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-40.....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 $3.50 monthly for 6 months.
- ☐ Model 770-A.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-12.....Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

MODEL 770-A
Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

MODEL 670-A
Terms: $7.40 after 10 day trial then $3.50 per month for 6 months.



MODEL 76
Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.



MODEL TV-50
Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

Overworked Tubes

(*Continued from page 44*)

this time; the horizontal amplifier is turning blue inside. Quickly we pull the cord. We reach and—oh, those poor fingers—the tube is hot enough to melt! Very mindfully now, we install a new 6BQ6G, take time to resolder the plate-clip wire, push in the safety plug, and again we're in business.

This time the "Blur-Vision" whistles to life: the picture flops and then falls in sync. We're in luck. We button up the back and reach for the little book that pays the rent. TV repair work is a cinch. Back at the shop, a call is waiting. Our girl hands us a slip of paper with an address on it that makes our eyes pop. We just left the place!

"All Mrs. Gruff said was to come right back out. The TV is doing the same thing; she can hear the voices but no picture," says our office girl.

On the bench, a close inspection of the receiver's horizontal section tells the story: As could be expected, we now have one more "defective new tube" to get rid of as our conscience dictates. The real troublemaker is a screen-grid dropping resistor, baked down from a correct 8500 ohms to a lazy 1500 ohms. Our original chain of events went something like this:

The horizontal oscillator conked out because of filament failure in the 6SN7GT. The receiver cooked along for about an hour before anyone noticed that "John's Other Horse" no longer filled the screen. By then it was too late to do anything about the gassy horizontal-amplifier tube, which was now also making things happen beneath the chassis. The screen grid of the horizontal amplifier had become red-hot and began to emit electrons. The higher-potential plate collected and returned these electrons through the screen-grid circuit, doubling the load here. The five-watt metalized resistor responded by puffing out its sides slightly and changing down in resistance value from the correct 8500 ohms to a rough 1500 ohms. When this happened, the screen voltage jumped from a normal 140 volts d.c. to nearly 300 volts. The plate turned cherry-red and blossomed like a tomato. Wax began to drip from the windings of the flyback transformer. Several other heavy-duty resistors along the "B+" line became overheated and changed electrical characteristics. (Still no action by the wrong-value fuse.) At some point during this smoldering period. the customer finally realized the fact that there was no picture and turned the set off. Shortly afterwards, we were called to go to the scene and correct the trouble. Three trips' worth!

All that need be said on this subject is this: had we been more observant on the first trip out there would have been no other trips to make on a recall basis. A preliminary examination of the voltages on the horizontal amplifier, using adapters, would have saved a tube, a trip, and the difference between making money on the call and losing money. Remember, screen voltages on all types of horizontal-amplifier tubes commonly in use today seldom run higher than 150 volts d.c. Readings of 250 to 300 volts on the screen will run screen current out of sight, as far as normal screen-grid currents go. No standard replacement tube will hold up for any length of time under these abnormal operating conditions.

Low-Drive Symptoms

Lack of enough horizontal drive on the control grid of the horizontal amplifier may show up in several different ways. Usually there is insufficient width, low brightness in some sets, poor focus and distinct blooming when the brightness control is advanced. Some receivers "black out" when the brightness control is turned to an advanced position. (A word of caution here: brightness, focus, and blooming conditions may also be traced to the high-voltage rectifier tube. Don't forget to test this one.)

A crowded raster, insufficient width, or a white, vertical line down through the picture usually indicate misadjustment of the horizontal-drive control. In some receivers, this control is of the variable-potentiometer variety, part of the plate-load circuit of the horizontal oscillator. Usually, though, it is a trimmer capacitor either in series with the grid-drive circuit from the horizontal oscillator, or from control grid to ground of the amplifier stage. A v.t.v.m. connected across the grid-bias resistor of the horizontal amplifier is useful in adjusting the horizontal-drive control. The meter should be set on the negative d.c. 50-volt scale, and the control should be adjusted until the correct grid bias is obtained on the horizontal amplifier grid. Service data for the set will give this value for the stage in question. If such data is not available, a tube manual can be used as a guide. Improper adjustment of the drive control will shorten the life of the horizontal amplifier and component parts in the circuit just as much as trouble in the horizontal-oscillator stage. Positive adjustment here is a must.

To be on the safe side, it is a good policy to replace the screen-grid dropping resistor, screen bypass capacitor, cathode bypass capacitor, and any other related part in the amplifier circuit which shows the slightest deterioration. The cost is nominal compared to that of making a callback to the customer's home or to making those vague explanations and getting the questioning look in the tube distributor's eye when you walk in with another sack of "defective new tubes" and begin to hint around for his sympathy. He might say, without thinking, "Say, Joe, you ever think of buying some fuses?" —30—

STANDARD LINE

MANUFACTURERS ORDERS INVITED

EXPORT ORDERS INVITED

FEATURING FAMOUS FACTORY

TUBES

- INDIVIDUALLY BOXED!
- GUARANTEED ONE YEAR!
- FACTORY BOXED • FACTORY IRREGULARS
- NEW JAN SURPLUS • EQUIPMENT TUBES

ALWAYS 1000 TYPES IN STOCK

FREE POSTAGE! On All Orders Shipped In U.S.A., Territories and A.P.O.'s. Send 25c for handling on orders under $5.00. Please send approx. postage on Canadian and foreign orders. Excess will be refunded.

Below Is A Partial List—Send For FREE Complete List and Order Form

QZ4 .42	5AT8 .79	6BK7 .75	7A4 .46	12J5 .39
1A7GT .42	5J6 .79	6BL7GT .74	7A5 .52	12L6 .59
1B3GT .66	5T8 .79	6BN6 .57	7A6 .44	12SA7 .47
1C5GT .40	5U4G .48	6BQ6GT .79	7A7 .44	12SG7 .54
1C6 .25	5U8 .79	6BQ7 .75	7A8 .44	12SJ7 .44
1C7G .25	5V4G .57	6BY5G .57	7AU7 .69	12SK7 .47
1D5GP .42	5V6GT .49	6BZ7 .75	7B4 .43	12SL7GT .59
1H4G .45	5X8 .79	6C4 .36	7B5 .40	12SN7GT .56
1J6GT .46	5Y3 .38	6CB6 .50	7B6 .41	12SQ7 .39
1L4 .45	5Y4G .42	6CO6G 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
3S4 .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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2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
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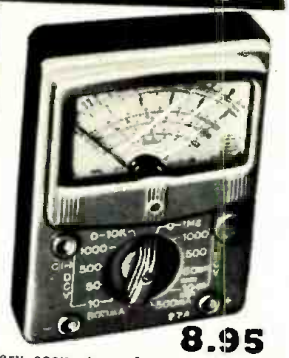

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FULL SCALE RANGES

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

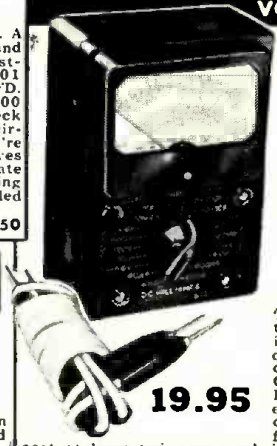
34.50

- 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



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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 henrys —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

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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

Lafayette Import Special! TRANSCRIPTION TYPE MANUAL PLAYER

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM

Complete Turntable and Tone Arm Assembly at the lowest price Ever for Such High Quality

24.50 Less Base

with TWO PLUG-IN HEADS

Here is a new manual player for the audiophile who wants noiseless, "wow-free" and rumble-free reproduction of recorded music at nominal cost. All the important features of professional transcription players have been incorporated in this precision turntable. The lightweight pickup arm is an integral part of the mounting plate and requires no installation. Player is equipped with a heavy duty, 4-pole, 3-speed motor for 78, 45 and 33⅓ RPM records. An exclusive magnetic brake controlled by knob on the base plate, permits instantaneous fine adjustment of each speed. Stroboscope disc included with unit, checks speeds. Extremely smooth and quiet operation. No hum even with the most sensitive cartridges. Speed selector safety switch protects mechanism by making it necessary to pass through an OFF position when switching from one speed to another.

10" diameter, heavy turntable is supplied with a rubber traction mat for positive grip of record. Stylus pressure adjustment can be made easily and quickly with the conveniently located adjusting screw on the underside of the tone arm. Mounting plate is also equipped with pickup rest and ON-OFF switch. Dimensions of mounting plate: 12-15/16" left to right, and 10⅞" front to rear. Requires 2¾" clearance below motor board and 3" above. Supplied with AC line cord, two plug-in heads, output cable for connection to amplifier and 45 RPM adapter. For 105-120 volts, 60 cycle AC. Shpg. wt., 12 lbs. Less cartridge. (NOTE: For protection in shipping, tone arm is separate. Just fasten to mounting plate.)

PK-160 Manual Player ..... Net 24.50

PK-164. Same as above except equipped with genuine GE triple-play magnetic cartridge and dual diamond-sapphire styli ..... Net 36.50

Wood base, cut out for PK-160 Manual Player. Top quality veneer attractively finished in mahogany or blonde (Specify).

PK-162. Shpg. wt., 5 lbs. ..... Net 3.95

Unfinished mounting board only, cut out for PK-160 player. Strong, durable ⅝" gumwood, ready for stain or paint.

PK-163. Shpg. wt., 1 lb. ..... Net .95

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PK-300 TURNTABLE, PK-90 TONE ARM AND G.E. CARTRIDGE WITH GENUINE DIAMOND AND SAPPHIRE STYLI.

72.50

PK-300

ILLUMINATED BUILT-IN STROBOSCOPE & VIEWER

COMBINATION DEAL

PK-90

LATEST IMPROVED MODEL PK-300 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-300 ..... 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 reasonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 12" 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-300 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**

NEW! IMPORTED 12" HI-FI COAX. SPEAKER

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
- COMPLETE WITH LEVEL CONTROL
- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

Reg. Price 44.50 Net **29.50**

A Lafayette exclusive import and exceptional value. Consists of a 12" woofer, coaxially mounted 2½" tweeter and a built-in crossover network. The specially processed fibre cone has a sheepskin edge to suppress unwanted nodal vibrations and insure beautiful tone quality. Highly efficient TSK-5 magnets. Level control provides variation to 6 db cut. Maximum input 20 watts. Impedance 8 ohms. Rugged all-metal frame. If made in this country, would cost at least $49.50. Shpg. wt., 11 lbs.

SK-58 ..... Net **29.50**

LAFAYETTE HI-FI LP TEST RECORD

Ideal for audiophile who is building a bass reflex speaker enclosure, or wants to check the components already in use. Two-side, 12" LP record covers cartridge and stylus test, turntable rumble test, average and minimum recording levels, stylus and tone arm resonance check, equalization checks, sound effects, tuning bass reflex enclosures, and a group of delightful music box selections. Specially recorded with painstaking care at 33⅓ RPM, and master cut on a mechanism that produces the quietest grooves in the industry. Complete with instructions for use and colorful protective envelope. Shpg. wt., 1 lb.

PR-10. Hi-Fi Test Record ..... Net **2.25**

New! LAFAYETTE MASTER AUDIO CONTROL CENTER WITH BINAURAL CHANNEL AND DUAL VOLUME CONTROL

$39.50 IN KIT FORM KT-300

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YEARS AHEAD OF EVERY OTHER PREAMPLIFIER CONTROL UNIT

The Lafayette Master Audio Control Center is not only the finest high fidelity preamplifier, characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound.

FEATURES

- Incorporates an extra channel and dual volume control for binaural reproduction.
- DC on all tube filaments for minimum hum, and negative feedback in every stage.
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- Dual cathode follower output stages.
- High gain for low level pickups.
- Separate turnover and roll-off controls —24 positions of equalization.
- Printed circuit construction.
- Tasteful styling, brilliantly executed.
- Designed for ease of installation and operation.

SPECIFICATIONS

INPUTS: 7 inputs accommodate every type of phono, tuner and tape. **CONTROLS:** 9 front and 2 rear panel controls make for utmost versatility. **FREQUENCY RESPONSE:** Uniformly flat frequency response over the entire audible spectrum. **TAPE EQUALIZATION:** Tape head playback equalization both **NARTB** and adjustable. **SENSITIVITY-GAIN:** 34db on magnetic input (2mv input produces 1V output); 14db on radio tape and auxiliary inputs (0.2V produces 1V output). **HUM & NOISE:** 80db below 3V output at full gain on radio, tape and auxiliary inputs; better than 60db below effective program level at full gain with 10mv input. **TUBES:** 3 premium type ECC83 tubes plus 2 selenium rectifiers. **POWER SOURCE:** 105-125V 50-60 cycles AC. **SIZE:** 12¾" L x 3¾" H x 9⅛" D from front panel to rear jacks—knobs project 1". Shpg. wt., 10½ lbs.

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Mobile High Fidelity

By
A. W. WADDILL, JR.

Over-all view of author's mobile hi-fi.

How audiophiles can enjoy AM-FM programs, tape and disc recordings while "taking the air" in the family auto.

EACH year an increasing number of people are enjoying music in their homes through the medium of high-fidelity reproducing systems. The system to be described is similar to these, but is designed for mobile use either in an automobile or in a small pleasure boat.

A mobile system, like any other high-fidelity system of the more conventional type, involves three basic components: an input source, an amplifier, and a speaker. In a mobile system, the input source may consist of either phonograph, tape, AM tuner, FM tuner, microphone, or any combination of these components. Television has been excluded deliberately in the interest of highway and waterway safety.

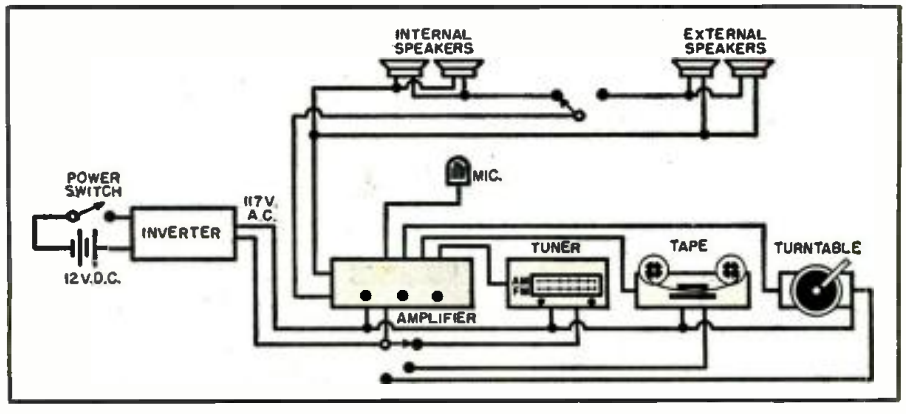
The amplifier may be any low-power unit, preferably with a built-in preamplifier. The speakers are divided into two groups: internal and external. The internal speaker system may be one or several of the small extended-range high-fidelity units. The external speakers may be any small trumpet-type, outdoor speakers which are mounted under the hood of the automobile.

Power is supplied to the equipment by one of two methods. The equipment may be re-wired to the available voltage or a 117-volt inverter (vibrator type) or converter (rotary type) of sufficient wattage may be used. The author employs the latter method in his particular installation.

The FM tuner and microphone shown in the photograph are two of the inputs used in the author's system. The other two inputs are a phono turntable and a tape recorder—both of which are located in the trunk of the car. The turntable is reserved for stationary use, while the other gear is designed to operate while the car is in motion. The three knobs visible on the dashboard are a power switch, remote volume control, and the "internal-external" speaker switch. The 10-watt amplifier-preamp is located under the driver's seat.

Two extended-range 8" speakers and a high-frequency unit supply the sound inside the car and are mounted in the space behind the rear seat. Most cars provide one opening pre-cut for installation of a rear-seat speaker. Additional openings may be made to accommodate the remaining speakers. An additional opening should be made to allow passage for the air which is compressed by the sudden closing of the trunk lid. If this precaution is not

How the mobile high-fidelity system is interconnected with car's power supply.



taken, a ripped speaker cone may result. The entire area may then be covered with plastic speaker cloth or woven Fiberglas, if individual speaker covers are not desired. The two external speakers are mounted under the front grille.

A system of this type not only provides FM or tape-recorded music while driving the car, but it allows any of the inputs to be used and played through the external speakers, making it ideal for outdoor work, such as picnics and dances. In many cities a license is required if the external speakers are to be used "sound-truck" fashion, so check this point before you "sound off." The cost of a mobile sound system varies, of course, depending on the quality of the individual components and the number of devices.

If a 117-volt converter or inverter is to be used, one of the sine-regulated types is preferable. A unit not of this type may vary from 50 to 70 cps, while the frequency regulated type will be within ± 1% of 60 cps. Regulated and non-regulated types are available in both the vibrator (inverter) and rotary (converter) types of power supply. Sufficient wattage to power the amplifier and the largest input is all that is required of the unit selected, since only one input is used at a time. A switching system similar to the one shown in the diagram will allow a converter or inverter of less capacity to be used than the sum of the wattages of the equipment.

In the author's system the amplifier requires 55 watts, the tuner 50 watts, the phono turntable 20 watts, and the tape recorder 60 watts. Therefore, a 125-watt, 117-volt unit of the sine-regulated type was selected. A device of this size draws very little current from the battery. Some provision should be made, however, to increase the car's idling speed if the system is to be used while the car is stationary. If it is desired to record directly from the tuner to tape while driving, the minimum wattage of the converter or inverter should be sufficient to power the amplifier, tuner, and the tape recorder simultaneously.

A standard automobile antenna may be used for the AM section of the tuner and a piece of wire about five feet long is sufficient for the FM section. If better FM reception is desired, especially of stations at a distance, a separate antenna should be used for this section of the tuner.

The FM tuner shown in the photograph is mounted under the dashboard with hardware C-clamps. This method has proved successful with most units provided a piece of sponge rubber is used to separate tuner and dash.

Although there was a moderate amount of work involved in getting this mobile set-up arranged and in operation, the pleasure the author, his family, and friends have derived made the job a "labor of love." We can now cruise along secure in the knowledge that we are not missing one of our favorite musical programs. —30—

"TRANSISTOR CIRCUITS AND APPLICATIONS" edited by John M. Carroll. Published by *McGraw-Hill Book Company,* New York. 285 pages. Price $7.50.

This volume is a compilation of articles which have appeared in *Electronics* magazine and have been selected with an eye to providing a complete picture of the development and present status of the transistor art.

Intended as a source book for circuit designers, this volume provides detailed information on the application of transistors to military, industrial, and home entertainment equipment. It covers typical transistor operating characteristics, important circuit parameters, transistor types, problems of temperature and gain stabilization, plus a number of typical transistor circuits, including the newest developments in transistor radios. Operating characteristics of over 200 commercially available transistors are included.

This fact-packed and valuable manual will find a wide audience among engineers, students, and experimenters interested in the applications of this versatile component.

* * *

"SMALL APPLIANCE SERVICING" by P. T. Brockwell, Jr. Published by *McGraw-Hill Book Company,* New York. 176 pages. Price $4.50.

Radio and television technicians who are looking to small appliance servicing as a means of increasing shop revenue and keeping busy will find this volume informative and useful.

Based on the author's own experience in the field, this book offers basic data on operating principles, testing and servicing techniques, and hints and tips for speeding the repair jobs. The appliances covered include irons, toasters, mixers, roasters, coffee makers, waffle and sandwich grilles, and rotisseries. The details provided can be applied to any make or model.

Chapters on starting an appliance servicing business and making it pay are also included with emphasis placed on business ethics that build customer good-will and keep the shop in the black.

* * *

"AN INTRODUCTION TO SEMICONDUCTORS" by W. Crawford Dunlap, Jr. Published by *John Wiley & Sons, Inc.,* New York. 407 pages. Price $11.95.

No one, whether actively engaged in the field or not, can fail to be aware of the tremendous impact of semiconductors on the entire electronic industry. In order to meet the informational needs of a diversified audience, the author has prepared this single volume covering as complete a picture of the subject as possible.

The text includes basic concepts, properties of materials, methods of measurement, and applications. That the author has managed to do this without resorting to involved mathematics or highly technical excursions is somewhat of a *tour-de-force.* As a consultant on semiconductors to the Electronics Laboratory of *General Electric Company,* Dr. Dunlap is in an enviable position to know the entire field. That he has shared this knowledge in the most usable form is a boon to the industry.

* * *

"PROCEEDINGS OF THE RETMA SYMPOSIUM ON APPLIED RELIABILITY". Published by *Engineering Publishers,* GPO Box 1151, New York 1. 105 pages plus 46 page supplement. $5.00. Paper bound.

This volume represents a compilation of the papers presented at the Symposium on Applied Reliability held in Los Angeles in December 1956, and sponsored by the Engineering Department of the RETMA.

The papers are presented in their entirety and, in addition, the publishers have included a supplement entitled "A General Guide for Technical Reporting of Electronic Systems Reliability Measurements." This guide was prepared by members of the RETMA's Electronic Applications Committee on Reliability.

* * *

"TRANSISTORS, CIRCUITS AND SERVICING" by B. R. Bettridge. Published by *Trader Publishing Co. Ltd.*. Dorset House, Stamford St., London S.E. 1. 23 pages. Price 2s/8d by mail. Paper bound.

This book has been written primarily for the service technician as it explains in simple practical terms how transistors work, how they are used in radio circuits, and the best methods to use when servicing equipment incorporating such components.

The treatment is non-mathematical and covers the nature of transistors, common base and common emitter operation, low-frequency amplifier circuits, a complete transistor receiver, and provides general servicing notes. The author is a member of the valve and electronics department of *G.E.C.* and a recognized authority on the use of transistors in domestic electronic equipment.

* * *

"SCIENTIFIC GERMAN" by George E. Condoyannis. Published by *John Wiley & Sons, Inc.* New York. 164 pages. Price $2.50. Spiral bound.

This is the second volume offered by this publisher which has been especially designed for the scientist or engineer whose work requires a reading knowledge of a foreign language.

Like the previous text, "Scientific French," the presentation is aimed at the beginner with no prior knowledge of German. Used in conjunction with a good German dictionary, the user

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The Xmitter Dynamotor has input of 27.5 V DC @ 7.4 A; output: 425 V DC @ .320 A, with Filter Base. Brand New.
Complete Assembly,
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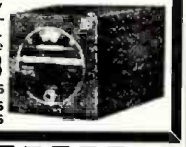

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DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
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DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A		7.95
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PE-86	28V 1.25A	250V .050A	2.95	5.24

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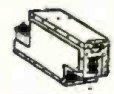
Willard 6-Volt Midget Storage Battery
3 Amp. Hour. BRAND NEW. 3⅜" x 1-13/16" x 2⅜". Uses Standard Electrolyte ..... Only $2.22



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BC-455	Receiver 6-9 Mc	5.25	7.95 9.95
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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

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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.
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FREE! Schematic Diagram included FREE with each piece of equipment shown on this page. Schematics for any of these units also available separately at 50c each.

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BRAND NEW — A Terrific Value! Tuning Range 234 to 258 Mc. Tubes: 7-9001. 3-6AK5, 1-12A6. Schematic included. Only a few at this low price! Complete $8.88
With 28 V 1.6A Dynamotor, complete $12.98
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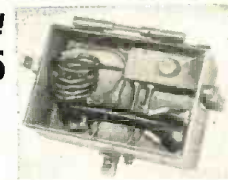

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OUR PRICE $12.95
BRAND NEW
In Original Packing

Here's what you get: H-22/U Handset with 5' Kinkless cord, equipped with "talk-listen" butterfly switch, PL-68 plug and PJ-055B plug; 14' flexible plated steel conduit, ¾" diam.; All-steel control box with switches, binding posts, pilot indicator; 3-lb. box of costly hardware; many necessaries and spares, including: 4 indicator lamps, 2-oz sealing compound, toggle switches, gaskets, large roll friction tape, complete technical manual—and it's all yours, for only $12.95.

RADIO RECEIVER NAVY TYPE RAY-3

Made by Doolittle Radio, this dandy receiver is a terrific buy at our low price.
Model AN-PR7NA is for 28V DC operation.
Model AN-PR6N is for 14V DC operation.
These receivers are supplied complete with built-in dynamotor, 11 tubes, Weston output meter on front panel, as well as coax antenna and output connection, phono jack, on-off switch.
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With MANUAL for Easy Conversion to CITIZENS' BAND!

BRAND NEW

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BC-221 FREQ. METER $129.50

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Aluminum Case for BC-221 or TS-184 Freq. Meters. Shock Mounted. BRAND NEW $3.99
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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 $3.95

HI-LO IMPEDANCE MATCHING TRANSFORMER for headphones, 600 ohms to 8000 ohms. With plug and jack. BRAND NEW 97c

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	Army and Navy Lip Mike		1.33
RS-38	Navy Type	2.45	4.95
T-24	Carbon Mike		5.95
TS-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

should be able to deal with simplified scientific and technical reading matter from the very beginning.

The author, who taught courses in both German and French at Massachusetts Institute of Technology, has drawn heavily on his experience in teaching these subjects to embryo engineers. As a result, the material presented is both practical and completely usable.

* * *

"DAVE RICE'S OFFICIAL PRICING DIGEST" by Dave Rice. Published by *Electronic Publishing Co., Inc.*, Chicago. 248 pages. Price $2.50. Vol. 2, No. 2. Paper bound.

In this new "Spring-Summer" edition the publishers have provided a guide to TV-radio servicing charges, showing national and regional average charges. Compiled in cooperation with leading service organizations and independent service companies throughout the country, this new feature has been added in response to a good deal of user demand.

In addition to this information, the digest contains suggested list or resale prices on over 65,000 items, with over one-third of the prices listed revised since the publication of the previous edition. Several thousand new items have been included as well.

* * *

"TV PICTURE-TUBE CHASSIS GUIDE" compiled by Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 63 pages. Price $1.35. Paper bound.

This compact handbook is designed for practicing technicians and parts distributors. It lists the picture tubes used in all television receivers made since 1946. The listings are by manufacturer's chassis number where possible and by model number in other cases. Both private brand and tradename sets are included and the picture tube is listed immediately following the model or chassis number. The sets are listed alphabetically by manufacturer and numerically by chassis number for most expeditious usage by the technician.

The practicing technician will find this guide a time and trouble saver *par excellence!*

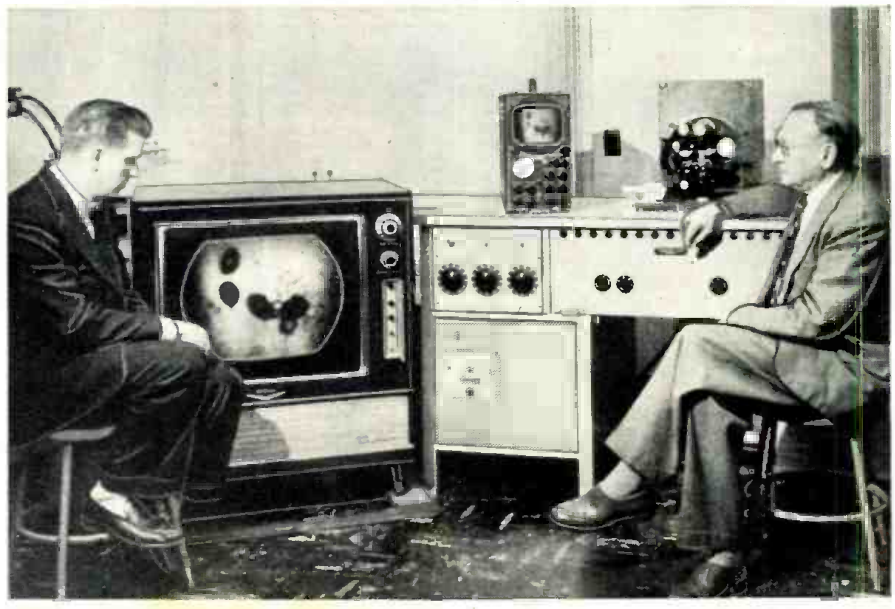
* * *

"GETTING STARTED IN AMATEUR RADIO" by Julius Berens, W2PIK. Published by *John F. Rider Publisher, Inc.*, New York. 132 pages. Price $2.40. Paper bound.

This is a clear and concise presentation of all the basic material needed by the would-be amateur in preparing for his FCC license exams. An introductory chapter briefly traces the beginnings of ham radio and outlines the various classes of licenses, license requirements, duration of the ticket, and whether or not it is renewable and under what conditions.

The author then covers the code and the key, radio theory required for Novice class license exams, study questions and sample Novice exams, radio theory required for General class licenses and study questions and sample exams for this class license. A separate chapter deals with pertinent FCC regulations and carries a listing of field engineering offices. —30—

A new ultraviolet color-translating television microscope has been developed at the Rockefeller Institute which will enable scientists to study better the function, structure, and chemistry of living cells. In visible-light microscopy the structure of cells is made visible by means of a stain, which may alter the natural state of the cells, sometimes killing them. When using an electron microscope, the cells may be destroyed by the streams of electrons. In the system shown below however, ultraviolet light is used which is then immediately translated in colors by means of a modified color-TV receiver. The cells are, in effect, stained electronically. The system has been developed by Dr. Vladimir K. Zworykin (right), Rockefeller Institute affiliate and honorary vice-president of RCA, and Mr. F. L. Hatke (left). Special camera tubes, highly sensitive to ultraviolet, are employed.



Parasitics in Vertical Output

By **JAMES A. McROBERTS**

Triode-connected pentode stage may be source of pix or sound interference.

PARASITIC oscillation originating in the vertical output tube can cause interference in the television picture or sound on high-band channels. A particular receiver on which this occurs is the *RCA* 21D326, but any type in which the vertical-output tube is a triode-connected pentode may give offense in this regard.

The cure is simple once the trouble has been pinned down: one has only to install an anti-parasitic resistor whose value is somewhere between 47 and 100 ohms between the screen grid and the plate of the triode-connected pentode that is causing the trouble. Be sure to use a 1-watt resistor.

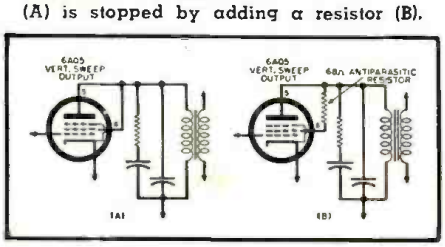
When the interference manifests itself in the sound, it will be akin to other forms of 60-cps interference, although there is a difference in quality that may be perceived with careful listening. It seems to be richer in overtones or harmonics than other forms of 60-cps noise. In any case, it will be possible to vary the tone by manipulation of the vertical-hold control.

Where the interference is present in the picture, the symptom may vary anywhere from a single bar to many bars to very fine variations similar in appearance to 4.5-mc. grain, such as is usually associated with a misadjusted sound trap.

Also symptomatic in tracing down the fault is the fact that the frequency of oscillation—and hence the immediate symptom—may be changed by movement of the screen or plate leads of the vertical-output tube, or by motion of the hand or some conductor in the immediate vicinity of the output tube or its leads.

Since the trouble arises because the parasitic oscillation feeds back to the signal circuits, an alternative way of tracking it down is to dress the antenna leads temporarily near the output tube to see whether this does increase the intensity of the symptom as it is seen or heard. —30—

Oscillation in triode-connected pentode (A) is stopped by adding a resistor (B).



Surface Barrier Transistor

(*Continued from page 71*)

rect-coupled "on-off" amplifier circuits. The meaning of "saturation characteristic" will be explained later in the article.

Circuits

Surface-barrier transistor circuits are similar in most respects to those of the *p-n-p* diffused-junction transistor. The electrode voltages and bias currents have the same polarity. In the case of high-frequency operation there is really no significant difference between schematics for SB and *p-n-p* transistors. For computer applications, the differences are really quite startling.

Figs. 2A and 2B give surface-barrier circuits for operation at 20 mc. and higher with suitable tuned circuits. For 30 mc. C may be approximately 100 $\mu\mu$fd. and L 6 turns spaced to ½ inch on a ⅜-inch coil form. The 470-ohm resistors are insurance against excessive collector current.

A direct-coupled amplifier and bistable circuit using the 2N240 are shown in Figs. 3A and 3B. When you look at these circuits they appear to be printer's errors or textbook-type simplified diagrams. But they aren't. These are good workable circuits. Let's look at Fig. 3A and see how it operates.

As you may remember, the 2N240 has a controlled saturation characteristic, by this we mean the voltage from collector to base, when the transistor is passing the maximum collector current permitted by the collector resistor and the available collector supply voltage. In other words, the voltage from collector to ground, when the collector current has reached saturation, is called saturation voltage.

For the 2N240, the collector-to-emitter voltage with a saturation current of 2 ma. is −0.07 volt and −0.1 volt for a saturation current of 8 ma. Further characteristics of the 2N240 state that an input signal of −0.1 volt from base to emitter will cause only −150 microamps of collector current.

Now if we apply an input base current I_{b1} of −0.3 ma. to V_1, the collector voltage V_{c1} will drop to −0.07 volt which is direct-coupled to V_2. This is not enough voltage to make V_2 conduct so that V_{c2}, the output voltage, is practically equal to the supply voltage. However, if we decrease the input current, V_{c1} will increase, driving V_2 into saturation.

If we now connect the output lead to the input, the direct-coupled bistable circuit of Fig. 3B results. With the addition of proper steering and control circuits, this type of counter is capable of operating at frequencies higher than the best vacuum-tube counters. The power dissipation and space requirements for this computer circuit are extremely small.

The SB transistor is a hot-performing video amplifier. Using simple audio-amplifier-type *RC* coupling, a two-stage SBT amplifier will have adequate response out past 3 mc. Employing peaking coils, the circuit of Fig. 4 has a 9 mc. bandwidth and 28 db gain. Removing the coils, the bandwidth is still sufficient for good video response.

Surface-barrier video amplifiers are non-microphonic. We have replaced industrial-TV video preamps with three-stage SBT preamps, eliminating all but trivial remaining microphonics in the vidicon.

Entertainment radios, both portable and automobile, use the SBT, with circuits almost identical to diffused-junction transistor sets.

Sometimes there is a protective circuit to prevent burnout of the converter or input r.f. stage caused by too-large signal from signal generators, etc. This is necessary because the emitter and collector connection wires inside the transistor are almost microscopic and the thin base section is easily ruptured. Consequently, the SBT is faster than the fastest fuse —and far more expensive.

Philco recommends gun-type soldering irons or conventional irons with isolation transformers for bench work. Otherwise, possible leakage currents from the iron and any other test instrument connected to the chassis may damage the transistors.

Conclusion

The surface-barrier transistor, its performance, and fabrication, are nothing short of a modern technological *tour-de-force*. Yet, it does not stop here. Already surface-barrier transistors, using the diffusion process (SBDT units) are able to operate at tremendously higher frequencies than the present units. Some applications, in fact, are spectacular enough to be classed as closely guarded military secrets.

Surface-barrier transistors, however, do not replace diffused-junction transistors. They simply give the transistor circuit engineer new inspiration and unprecedented performance in several special applications.

How far the SBT invades the entertainment market depends, among other things, upon the number of SBT suppliers. Today, *Philco* and *Sprague* are the only makers. Firms generally will not use a transistor unless there are several sources acting as alternate lifelines in the event of strikes, material shortages, catastrophe, etc. This lack of suppliers until now has held back transistorized power amplifiers for automobile sets and it will have the same effect on SBT radios.

Meanwhile, practical transistorization has been pushed past the ten-meter band by SBT's. Next, the twelve TV channels will fall before the transistor. Any one want to service this transistorized TV booster? Don't laugh, it isn't too far off. —30—

"HOT" SUMMER BARGAINS

RCA-VICTOR 45 RPM PLAYER
Famous Slide-O-Matic + 6 Best Selling Records

Concord Radio Offers the Finest!
RCA-Victor Slide-O-Matic 45 RPM Player-Record Combination!
Player PLUS 6 Top Seller 45 RPM Records.
Brand New in Factory Sealed Cartons!
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Save Over 60% Off NET prices! Reg. Combination.

Value $21.00

Concord's Combination Price
$7.99

- Fully Automatic Start and STOP!
- Famous Recordings by London, Columbia, MGM, Mercury etc.
- Complete with Standard Phono plug.
- Plugs Into Any Amplifier, Radio or TV Set Equipped with Phono Jack.
- Compact Hi-Impact Cabinet in Handsome Ebony.
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- Unique Design Protects Entire Mechanism.
- Size: Only 3¾" x 10½" x 7½".
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FREE B/C FLASH

With Carrying Case

the NEW SUPER BALDINA CAMERA OUTFIT WITH FAST F2.8 LENS

This popular priced camera has everything you want. Check the fine features. Made in West Germany by camera experts. Hurry, while our limited quantity lasts!

- F2.8 Color Corrected Lens
- Speeds from 1 Sec. to 1/300 Sec.
- MX Synch. for all Flash-bulbs and Strobes
- Cpld RF Combined with Single Window Viewfinder
- Built-in Self-Timer
- Rapid Advance, Single Stroke Lever
- All Metal Body. Weighs Only 18 ozs.
- B/C Flashgun
- Genuine Leather Eveready Case.

$44.50 ea. Complete With Panhead

Shpg. Wgt. 4 Lbs.
STOCK No. BALD-35-RN8

NORMAL PRICE $69.95 Complete with Case and Flash.

FAMOUS MAKE EXTENDING
ALUMINUM TRIPOD

Reg. $24.40

$10.95 Complete with Panhead

STOCK No. TRI-AL-8RN

BRAND NEW EXPOSURE METER MODEL PR-1

G. E.

Free Case

$18.95 CONCORD SPECIAL REG. PRICE $32.50

STOCK No. GE-XP-RN8

- lens stops from f:1 to f:128
- ASA Index numbers from .2 to 1600
- Dial is marked for shutter speeds
- from 1/3000th to 120 seconds

FREE LEATHER CASE Worth $2.50

Free! 23 Carat Gold Signature Kit

CROSLEY

Book Radio Famous Transistor

$19.95

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). **$19.95**

Stock No. BUK-RAD-RN-8, Shipping Wgt. 3 Lbs.
Batteries for above—No. 415, $1.75 (B). No. E233, $1.68 (A).

---

4 TUBE PERSONAL PORTABLE RADIO

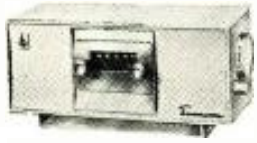
$13.95 LESS BATTERIES

Imported to save you money.

- FULL 4 TUBE SUPER-HET CIRCUIT (1—1R5, 1—1T4, 1—1U5, 1—3S4).
- FULL BROADCAST COVERAGE—532Kc.—1640Kc.
- 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.
STOCK NO. 5 STAR RN-8
SHIPPING WGT. 2 LBS

EMERSON-BRACH RADIO-ROTATOR



Brach Rotator Alone $9.95

COMBINES 5 TUBE EMERSON RADIO PLUS HEAVY DUTY BRACH ROTATOR AND DIRECTION CONTROL

Radio
- IMPROVED SUPERHETERODYNE CIRCUIT
- 115 Volts, 60 Cycles AC
- SEALED DYNAMIC SPEAKER WITH ALNICO PERMANENT MAGNET
- ENCLOSED FERRILOOP ANTENNA
- INVERSE FEED-BACK CIRCUIT

Rotator
- FLEXIBLE WORM DRIVE
- BUILT-IN THRUST BALL BEARING
- BUILT-IN GUY RINGS—WITH ATTACHED GUY WIRE THIMBLES
- 150 LBS. DIRECT AXIAL LOAD
- HIGH STARTING TORQUE MOTOR 365°
- AUTOMATIC BRAKE ACTION

4 WIRE CABLE FOR ABOVE 3½¢ Per Ft.

$37.50

Concord's Sensational Price
REG. ADVERTISED PRICE $79.99
STOCK No. EM-BRAK-RN8
Shipping Wgt. 20 Lbs.

SOLAR RADIO

$10.95

WORTH $14.95

VEST POCKET SIZE

- No batteries required
- Ideal portable radio for sportsmen, etc.
- Size: Only ¾" x 2" x 3" ½ the size of cigarette pack!
- Fully guaranteed for one year

A miracle of the age, this radio operates from any light source including sunlight, artificial light, etc. Complete with miniature earphone, lipstick antenna, transistor circuitry. Entire AM broadcast band.

STOCK No. SOL-RAD-RN-8
Wgt. 1 Lb.

CRYSTAL OR MAGN. MINIATURE EARPHONE HI IMP.

Your Choice **$1.95** each

Molded plastic shell, miniature type, fits comfortably into the ear. Equipped with 5-ft. plastic covered cord. High impedance, ideal for many applications.

Stock No. 743-C6—magnetic. RN-8
Stock No. 748-C6—Crystal. RN-8
Shipping Wgt. 4 ozs.

FAMOUS DE WALD "5 IN ONE" 5 TRANSISTOR PORTABLE RADIO

- Full 5 transistor circuitry
- Becomes a hearing aid with the flip of a switch
- Easily used as a communicator by adding remote speaker
- Use for private listening with earphone (not included in price)
- Use as amplifier by plugging in additional speaker
- Texon carrying case is scuff-proof
- Single battery lasts almost 6 months

Earphone for above $4.95
Additional Speaker for above $5.95
Complete with CABINET and plug.
STOCK No. 5 IN ONE-RN8

CONCORD'S LOW PRICE **$39.50**

Eveready No. 2 4 6 Battery for above $1.30

Shipping Wgt. 2 Lbs.

HI-FI SPEAKER SYSTEM

UTAH DIAMOND GEM 8" HI-FI Fundamental Spkr.

29.59

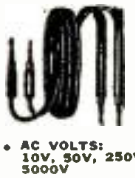
UTAH HI-FI 5" TWEETER WITH BUILT IN CROSSOVER. Gives the typical presence and performance of the true 2 way system. Capable of adequate bass response even at low level. Cabinet finished in rich mahogany or blond mar-proof plastic spray, or straight grained unfinished wood. Specify. SIZE: W. 23½" x H. 11" x D. 11".

"THE SPACE-SAVER"
Concord has combined "Utah Speakers" with the "RJ" type enclosure to give you the ultimate in a compact wide range sound reproducer.

- Utah Diamond Gem 8" hi-fi fundamental speaker
- Utah hi-fi 5" tweeter with built in crossover
- RJ type bookshelf enclosure "RJ" TYPE BOOK SHELF ENCL. No. BFL19-RN-8

STOCK No. COMBO-RN-8
Shipping Wgt. 15 Lbs.

"CUSTOM" MULTI-METER Model L-7F



CONCORD'S PRICE **$16.95**

These multimeter designed for radio & TV service, so handy, so cheap priced!!

SOLD NAT'LLY FOR $29.95

- AC VOLTS: 10V, 50V, 250V, 500V, 1000V, 5000V
- DC VOLTS: 10V, 50V, 250V, 500V, 1000V, 5000V
  DC current: 1mA, 500mA
- OHMS: 0 1k, 0 10k, 0 100k, 0 1M
- Decibels: —20 +5db (Odb. 0.775V, 600)
- Dimension: 4⅜" x 7" x 3¼"

FREE TESTPRODS AND BATTERY

STOCK No. L-7F-RN-8
Ship. Wgt. 3 Lbs.

UTILITY MT-90 VOLT-OHM-MICROAMMETER

Designed for radio testing. 330ohms per volt AC & DC.

- AC Volts: 6, 12, 60, 300, 1200V
- DC Volts: 6, 12, 60, 300, 1200V
- DC MILLIAMPERES, 300 A, 3mA, 300mA
- OHMS: 0 1Meg 0 10k By 3V internal Bat'ry
- Decibels: —20 +36db (Odb. 0.775V, 600)

$9.95

FREE TESTPRODS AND BATTERY

STOCK No. MT-90-RN-8 Ship. Wgt. 1 Lb.

"POCKET" V.O.M. MP-6

Fits in your shirt pocket!

WORLD'S SMALLEST TESTER!! FOR APPLIANCE REPAIR, RADIO, TV SERVICE.

- AC & DC: 10V, 50V, 250V, 500V, 1000V (1000V/)
- DC current: 1mA, 100mA, 500mA
- OHMS: 0 100k (By 1.5V internal Battery)
- Dimension: 2½" x 3¾" x 1½"

CONCORD'S PRICE Reg. Pr. $12.95 **$8.95** EACH

Plastic case & panel, Various colors

Your 1957 Catalog Is Ready . . . Write for Free Copy

CONCORD RADIO CORP.
45 Warren St., N. Y. 7, Dept. RN-8

RUSH THE FOLLOWING ITEMS:

1—..... 3—.....
2—..... 4—Free Catalog

☐ I am enclosing $..... ☐ Send C.O.D. I enclose 20% deposit

NAME .....

ADDRESS .....

NEW RETMA "FACT BOOK"

The third edition of the RETMA's "Electronics Industry Fact Book" is now available for distribution.

According to the publication, the electronics industry established a new record during 1956 with factory sales of radios, television, phonographs, military and industrial equipment, and components reaching $5.9 billion.

When distribution, servicing, and broadcasting revenues are added, the industry value totals $11.6 billion—twice the value of the billings in 1950 but only half that anticipated by 1965.

The booklet contains a detailed and comprehensive statistical analysis of the size and composition of the radio, television, and electronics industry, including production and sales figures; TV picture and receiving tube statistics; and special chapters devoted to military and industrial electronics, tubes and parts, and export data on the industry.

Copies of the "Fact Book" are available to non-RETMA members and the general public for 50 cents a copy. Write the headquarters of the association at 1721 DeSales St., N. W., Washington 6, D. C.

CONTROL TRANSFORMERS

Hindle Transformer Company Inc., Woods Church Road, Flemington, N. J., has just issued a four-page data sheet covering its line of control transformers.

Catalogue 956 contains application data and mechanical and electrical specifications on the line. Line drawings illustrate the case styles available. Copies of the new publication are available without charge upon written request made direct to the manufacturer.

NEW RETMA LAB MANUAL

The Service Committee of RETMA has announced that the fourth volume in its series of pre-employment laboratory manuals, used in the vocational training program, will be available early in September to assist trade and vocational school instructors and administrators in planning curricula.

Entitled "Basic Television and Television-Receiver Servicing," the publication will include both laboratory manuals and a related instructor's guide. Earlier volumes covering basic electricity, basic electronics, and basic radio and radio-receiver servicing have been and are being used in industry-sponsored courses and regular school programs. An advanced, up-grading refresher course for practicing TV technicians will be offered shortly as "Advanced Television Servicing Techniques."

McGraw-Hill Book Company of New York is the publisher and distributor of the fourth volume. Details on the course may be obtained from the RETMA Service Committee, 1721 De Sales St., N. W., Washington 6, D. C.

SPECIAL TRANSFORMERS

Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass., has issued a four-page brochure describing its line of military and special commercial transformers.

The components described are made to customer specifications and include high-power pulse, hermetically sealed military and open type military, subminiature binary, and toroid types. The facilities of the company are also described.

ELECTRONIC COMPONENTS

Richards Electrocraft, Inc., 3739 N. Kedzie Ave., Chicago 18, Ill., has released an 8-page bulletin covering its line of electronic components.

Complete information is given on the company's products including plugs, jacks, connectors, adapters, and push-button switches in both standard and miniature sizes.

Parts are completely illustrated, drawings show construction details, and tables list the sizes and types available. Write the company direct for a copy of this publication.

CUSTOM-MOLDED PLASTICS

A new booklet entitled "Custom Molded Plastics for Industry" is now available from *Sylvania Electric Products Inc.*, Warren, Pa.

The 12-page booklet includes illustrated sections on molding facilities, finishing and assembly of components, research and development, and quality control. Chapters on injection molding, compression molding, and transfer molding list examples of automatic equipment used in molding of thermoplastic and thermosetting materials.

PRECISION WIRE-WOUNDS

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa., is currently distributing copies of its Bulletin D-1b containing comprehensive data on the construction, types, winding technique, winding forms, impregnation, terminals, and characteristics of its line of precision wire-wound resistors.

The four-page bulletin includes detailed charts and graphs.

HEATHKIT FLYER

Heath Company of Benton Harbor, Mich., has issued a compact flyer and order form which is now available on request.

In addition to listing the many standard and popular kits in its line, the catalogue provides details on the company's new ignition analyzer kit (Model IA-1), its recently introduced Model W-6M 70-watt audio amplifier, an "in-circuit" capacitester (CT-1),

and a low-ripple battery eliminator kit (BE-5) for operating transistor circuits.

Write the company direct for a copy of this new publication.

SHOP EQUIPMENT

Precision Equipment Co., 4405A Ravenswood Ave., Chicago 40, has just issued a 24-page catalogue covering an extensive line of office and shop gear.

Pictured and described are racks, bins, work stools, shelving, files, metal desks, dollies and other essential equipment. The catalogue is free.

PDC METER DATA

Precise Development Corp. of Oceanside, N. Y. has issued a four-page data sheet covering its new meter design and merchandising program in some detail.

The basic design back of the new scheme is to provide the dealer with a "package" from which he can assemble, on the spot, the exact meter the customer requests. The kit includes plastic-cased meter movements, related scale faces, companion resistors, and a meter range chart. The entire operation takes less than a minute.

The entire plan is outlined in this brochure along with a chart of specifications and ranges for the basic meter package. Write the company direct for a copy of this publication.

RCA'S TRANSISTOR BOOKLET

The Semiconductor Division of *Radio Corporation of America* has just published a 24-page booklet entitled "*RCA* Transistors and Semiconductor Diodes."

The booklet contains a general explanation of transistor theory and operation with a special section devoted to a discussion of the firm's "drift-type" transistors. Complete characteristic data on the 18 transistors and four semiconductor diodes made by the company are supplemented by equivalent circuits and dimensional outlines.

An interchangeability directory is of special value to the designer, experimenter, and service technician. Copies of the booklet are available from the company's distributors or by sending 25 cents for each copy to *RCA* Commercial Engineering, 415 S. Fifth St., Harrison, N. J.

GENERAL RADIO "VARIACS"

A four-page data sheet which describes the firm's Type W5L and W50 "Variacs" has been released by *General Radio Company*, 275 Massachusetts Ave., Cambridge 39, Mass.

Issued as a supplement to "Variac" Bulletin O, the data sheet illustrates and describes these two new units in detail. Physical size, mounting dimensions, and complete electrical specifications have been included, along with pertinent application data.

BATTERY CONNECTOR CATALOGUE

Cannon Electric Company, 3208 Humboldt St., Los Angeles 31, Calif. is now offering copies of its new 32-page

catalogue which carries information on battery connectors, power connectors, and heavy-duty connectors for industry and allied applications.

The connectors are illustrated and described with dimensional details and full specifications given on each unit in the line. The catalogue will be sent without charge to those making their requests direct to the manufacturer. Please specify Catalogue GB6.

CAPACITOR DATA

Erie Resistor Corporation, Erie, Pa. is now offering a convenient reference chart which gives data on capacitors in quickly available form.

The plastic card is 7⅝" x 4⅛" and shows dielectric qualities and temperature coefficients of the company's tubular and disc "Ceramicons" as well as maximum available nominal capacities in micromicrofarads.

The reverse side gives dimensions of the firm's "Ceramicons" and "PAC's." The Electronic Division of the company will supply a free copy on request.

DELCO PARTS CATALOGUE

The *United Motors Service Division* of *General Motors*, Detroit 2, Michigan has just issued a new 60-page catalogue covering the entire *Delco* line of electronic parts.

The colorful orange and blue catalogue lists the company's tubes, vibrators, auto antennas, speakers, auto radio components, and all parts for the "Autronic eye" automatic headlamp control. All parts are alphabetically listed by make of car and indexed for quick reference by distributors, dealers, and service technicians.

The catalogue is illustrated with more than 300 photos and diagrams.

"POWERSTAT" TRANSFORMERS

The Superior Electric Company of Bristol, Conn. has issued a 28-page catalogue covering its line of variable transformers for high-frequency applications.

Included in Bulletin P257H are full details on "Powerstats" in the HM, HL, and JS series, single- and three-phase units, manual- and motor-driven, open- and closed-construction, round- or square-frame, in various combinations of features.

Information on how to order, ratings, and a listing of other products are also included. Write the company direct for a copy of this publication.

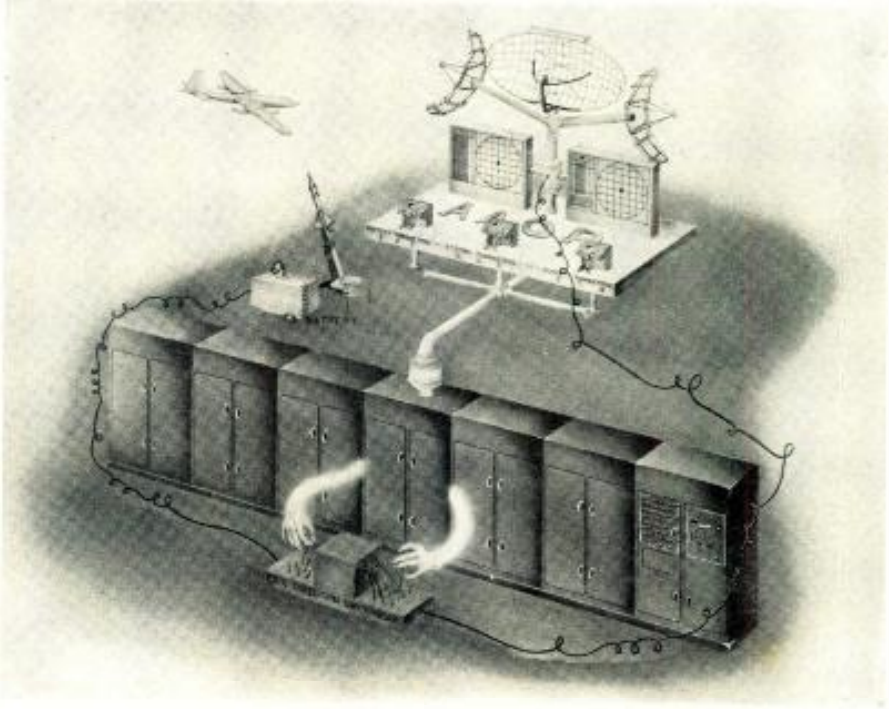
B-T GENERAL CATALOGUE

Blonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N. J. has issued a new catalogue covering its complete line of TV products.

Among the new items are crystal-controlled v.h.f. and u.h.f. converters and a series of all-channel indoor cable tap-offs. Illustrations, descriptions, and trade prices are included for each model.

Copies of the catalogue, as well as technical bulletins on the converters and tap-offs, are available from the company's sales department. —30—

This artist's conception illustrates how the Multi-weapon Automatic Target and Battery Evaluator (MATABE), developed by the Burroughs Research Center, Paoli, Pa., fits into the nation's air defense system. Receiving information from a radar station, the equipment is capable of performing 136,000 mathematical steps in less than a second to help anti-aircraft batteries destroy approaching enemy planes. The equipment was built for the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J. The hands indicate information being relayed from the machine to the battery which, in turn, operates to direct fire on approaching planes.



SSB Broadcasts Promise Hi-Fi

AM broadcast station is trying out new compatible single-sideband system.

WITH permission from the FCC, 50,000-watt AM broadcast station WMGM (1050 kc.) in New York City is testing and introducing for the first time in the U. S. a new system of broadcasting which makes possible improved fidelity with average-priced broadcast receivers. The system is a special type of single-sideband operation in which the carrier is not suppressed. As a result no modification of the receiver is required in order to receive the signals.

The system has been in use between the hours of 4:30 and 6 a.m. EDST Mondays through Fridays. All tests are carried out under the temporary experimental call letters KE2XUT.

The new system is the development of the *Kahn Research Laboratories,* Freeport, L. I. In addition to its use in this country, the system is also being used by the "Voice of America" at its megawatt station in Munich, Germany. An adapter is required at the transmitting station in order to employ this particular method of modulation.

A major problem in the design has been to devise a method that would permit the carrier to be transmitted (required for compatibility) and still not produce the high distortion that would ordinarily result when this is attempted. A major function of the transmitter adapter is to remove such distortion.

According to Mr. Leonard R. Kahn, president of the laboratories, the system provides higher fidelity sound in comparison with standard AM transmission because the entire passband of the receiver can be used for the sidebands rather than just half the passband. For example, with a receiver passband of 6 kc. and a double sideband signal, sideband components up to only 3 kc. would be passed. With the single-sideband technique, however, sidebands up to 6 kc. would pass. Or if the signal fidelity is held constant, the technique would provide an effective two-to-one power gain.

Realignment of the receiver is not necessary when this method is used. It is only necessary to tune normally for best signal response and the transmitted signal will fall at the proper place in the receiver's passband.

Even more important is the fact that adjacent and co-channel interference is said to be reduced and that selective fading distortion is cut down when this method is employed. —30—

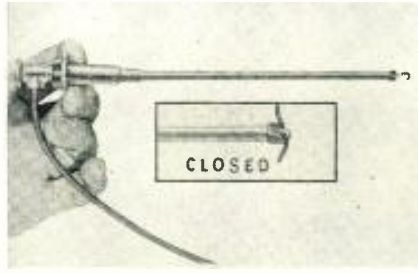
What's New in Radio

HANDY "GRIPROBE"

Standard Electronics, Inc., 5523 Satsuma Ave., Burbank, Calif. is now marketing a new test probe of durable plastic which has been designated as the "Griprobe."

Precision engineered to grip-hold terminals, tube sockets, lugs, wires, etc., the instrument thus frees the hands of the operator to work with other tools or test equipment. The unique feature of this instrument is its interior spring mechanism. By a simple press of the thumb, the hook-shaped metal probe opens; by removing the thumb, it closes in a self-lock grip.

Designed for use by radio and TV technicians, lab workers, experimenters, and operators engaged in the manufacture or testing of missiles, rockets, test equipment, radio, TV, and electronic components, the instrument is said to speed up troubleshooting procedures by from 10 to 30 percent.



TRANSISTOR TRANSFORMERS

Crest Transformer Corp., 1834 W. North Ave., Chicago, Ill., has released a complete line of U.S.A.-made transistor transformers, which will be offered as stock items.

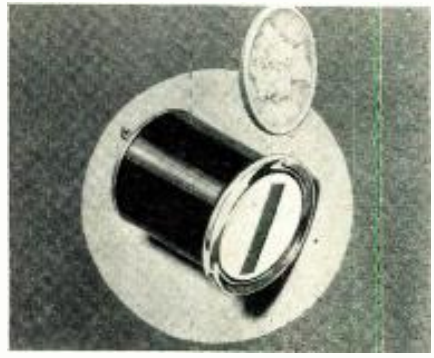
All of the transformers in this new line are cored with 48% nickel-silicon steel, wound on nylon bobbins, made with Formvar wire, and boxed in translucent plastic housings. They are available in two core sizes and fall into categories which will find universal application in laboratories, industries, ham installations, and the home workshop.

A comprehensive, easy-to-read catalogue sheet carrying complete electrical specifications is available from the manufacturer on request.

CONELRAD INDICATOR

Electro Mechanical Instrument Co. of Perkasie, Penna. has devised a new monitor system that can be adapted to any home or automobile radio to detect when a Conelrad alert is on the air.

The system employs a special flag indicator meter which is connected in series with the screen-grid circuit of



an a.v.c.-controlled i.f. tube. A 400-ohm resistor is connected in parallel with the indicator. When the station to which the receiver is tuned goes off the air, the a.v.c. bias voltage disappears and the screen current rises and actuates the indicator.

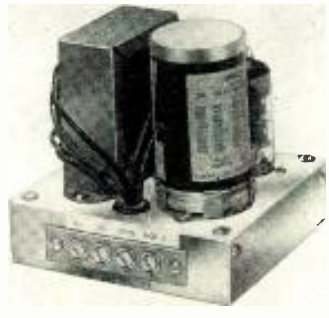
The unit is available either directly from the manufacturer or through many jobbers and parts dealers.

VIBRATOR POWER SUPPLY KITS

Heath Company, Benton Harbor, Mich. has added two vibrator power supply units to its line of electronic kits.

Suitable for operating all kinds of electronic equipment away from power lines, the supply will provide high-voltage "B+" for most communication receivers, small p.a. systems, or even a miniature transmitter. The unit may be used in boats, cars, light aircraft, or in field applications. Each unit provides 260 volts d.c. output at up to 60 ma.

The kit comes complete with a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. The Model VP-1-6 operates from a 6-volt storage battery or bat-



tery eliminator while the Model VP-1-12 is designed for 12-volt systems.

More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage.

ATR TUBE PROTECTOR

American Television & Radio Co., 300 E. 4th Street, St. Paul, Minn. has just introduced an electronic tube protector which is designed to be used in TV or hi-fi sets, amplifiers, and similar electronic equipment.

Available in two models, the Type 250 and the Type 300, the former is housed in a golden brown hammerloid metal container and plugs directly into the wall socket. The second unit is also housed in a golden brown hammerloid steel case but has rubber mounting feet. It is equipped with a cord set to plug into wall socket thus providing flexibility in position.

Both units utilize a thermal cushion-action principle which also protects all other components by eliminating initial damaging surge currents. These protectors can be used with electronic equipment having input wattages from 100 to 300 watts.

Complete descriptive literature is available on request.

TV SWEEP AND MARKER

The Hickok Electrical Instrument Co., 10524 Dupont Ave., Cleveland 8,

Ohio has introduced a new single-unit v.h.f.-u.h.f. sweep-marker-alignment generator, the Model 615.

Engineered to provide all of the necessary features and ranges required for visual alignment of modern TV sets, the circuit incorporates all-electronic sweep with no moving parts to wear out or become inoperative. Amplitude modulation is said to be less than .1 db per mc. which results in true and undistorted curves when viewed on a scope. Marker frequency accuracy is less than .5% at any setting with excellent attenuation. New knife-edge non-parallax pointers practically eliminate reading errors.

For complete specifications on this unit, write the manufacturer direct.

REGENCY FM "TELEVERTER"

The *Regency Division of I.D.E.A., Inc.*, 7900 Pendleton Pike, Indianapolis 26, Ind. is now marketing an economical FM converter which will allow any TV set to be used as an FM receiver.

Designed to operate with intercarrier TV sets, the FM "TeleVerter" does not require any connections to the TV set other than to the antenna terminals. It is all-transistorized and current drain is so low that the three penlite cells used as the power source have a life expectancy approaching shelf life. After installation, normal

operation of the TV set is accomplished merely by turning the converter off.

The unit is housed in a plastic cabinet measuring 4½"x6"x4½". The company will supply additional details on request.

SERVICE REFRIGERANT

Arco Electronics, Inc., 111 S. Vermont Ave., Los Angeles 4, Calif. has released a new liquid refrigerant on which they have spent two years of research and development.

Tradenamed "Jiffy Zero," the new product is designed to speed up electronic servicing by employing a spray of frost to locate faulty components.

Sprayed on transistors, capacitors, i.f. cans, etc., the refrigerant instantly isolates intermittent thermal defects because the quick-freeze momentarily restores heat-damaged components to life. This "on-off" action points a finger at the faulty component which must be replaced.

The liquid is non-corrosive, non-toxic, non-inflammable, and non-conductive. It can reduce the temperature of electro-mechanical parts to —20 degrees F in a matter of seconds, It can also be used to shrink-fit parts such as screws, rivets, etc.

For further information contact local distributors or the manufacturer direct.

REFLEX TRANSISTOR SET

J. W. Miller Company, 5917 S. Main St., Los Angeles 3, Calif. has developed an all-transistor super-reflex receiver

kit which is being marketed as the "555 Transistall."

The kit features printed circuit con-

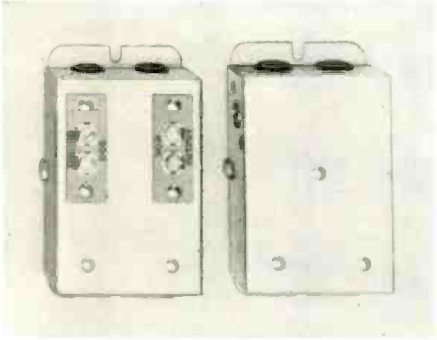
struction, a superhet circuit, "reflexed" amplifier stage, three transistors, two crystal diodes, a.g.c., good sensitivity and selectivity, vernier tuning, an internal ferrite antenna, self-contained speaker, all housed in a Bakelite cabinet accented by a gold colored front panel. The set, which measures 4"x7"x 3½" is available in ebony, ivory, pearl gray, powder blue, and Chinese red. It is powered by a miniature 9-volt battery which will operate the receiver for about 300 hours before replacement.

The kit is supplied complete with detailed step-by-step assembly instructions, schematic diagram, alignment instructions, and pictorial diagrams. The use of printed circuitry and the fact that all coils and transformers are factory adjusted makes assembly and alignment easy for the average hobbyist.

MASTER TV "TAP-OFFS"

Bonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N. J. has added a completely new series of single and double TV outlet boxes to its line of video accessories.

All models feature 17 db isolation plus effective strain relief for RG11/U or RG59/U cable. The 75-ohm outlets are designated T01-75 for one receiver



and T02-75 for two receivers. Each unit covers the full frequency range from 0 to 900 mc. with only ½ db insertion loss. Plugs are furnished for easy connection and disconnection.

The 300-ohm versions are matched internally to the distribution cables. The single outlet T01-300 covers v.h.f., FM, and u.h.f. with only ½ db insertion loss. The two-outlet model covers v.h.f. and FM with a 1 db total line loss. Spade lugs are used for making connections. Write the company for further details.

RCA GENERATORS

The Components Division of *Radio Corporation of America* has introduced two new generators for television service work—a crystal-calibrated marker generator (WR-99A) and a TV-FM sweep generator (WR-69A).

The marker generator is actually a three-in-one unit including a marker generator producing crystal-controlled signals for marking response curves; a transmitter for rebroadcast from one TV channel to another; and a heterodyne frequency meter for calibrating other generators and circuits. It

features a slide-rule dial scale, with each band switched into view automatically as the range is changed. Its eight individually aligned bands cover 19 to 260 mc. with 242 crystal-controlled calibration points at 1 mc. intervals.

The TV-FM sweep generator provides sweep signals for aligning broad circuits such as FM, TV, i.f. and video amplifiers from 50 kc. to 220 mc. Its video sweep, in addition to r.f. sweeps, is an essential feature necessary for aligning chromatic sections of color TV sets.

TRANSISTORIZED V.T.V.M.-V.O.M.

Transvision, Inc. of New Rochelle, N. Y. is now offering a transistorized v.t.v.m.-v.o.m. in kit form.

As two of the test instruments most frequently used by technicians, they have been combined in a single test unit which is versatile and convenient to handle. Component parts in the kit have tolerances of ±1% to insure accuracy of the instrument readings of the assembled unit.

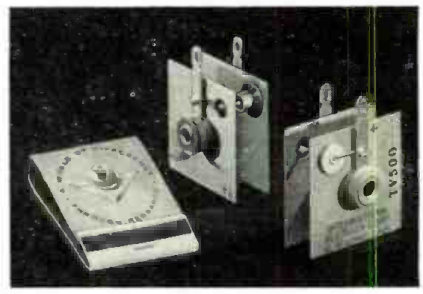
The kit itself is easy to wire. It is divided into three stages which may be purchased separately on the "pay-as-you-wire" plan. The instrument is also available completely assembled and tested.

Further information may be obtained or orders placed by writing direct to the factory.

SILICON TV RECTIFIERS

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, Calif. has introduced a new silicon TV rectifier as a direct and universal replacement unit for all existing selenium stacks up to 500 ma.

Featuring eyelet construction, this unit eliminates the need for special sockets, drilling, or conversion kits. Known as the "Unistac TV500," this rectifier employs a silicon diode mounted on a finned heat exchanger for optimum convection cooling and is especially suited to the elevated operating temperatures inherent in most TV sets.



In a half-wave circuit it will deliver 500 ma. and 130 volts d.c. with an input voltage of 117 volts r.m.s. Two units in a half-wave voltage doubler circuit will deliver 500 ma. and 240 volts d.c. under the same input conditions. —30—

ARIZONA HAMFEST

THIS year's Southern Arizona Hamfest has been scheduled for Labor Day weekend, August 31st through September 2nd at Fort Huachuca, Arizona.

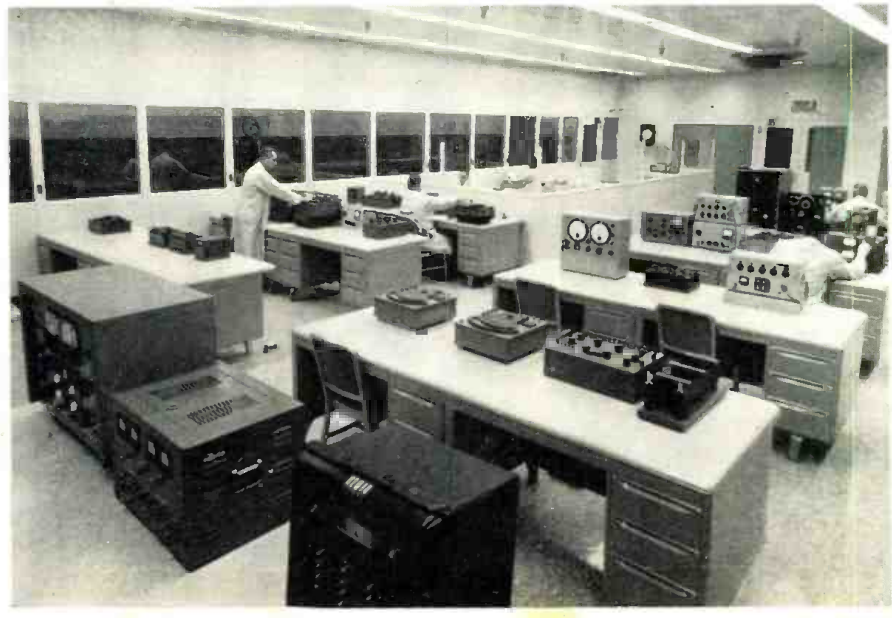
The Huachuca Amateur Radio Club will play host to this year's meet and have planned a well-rounded program of activities for the whole family.

The Picnic Area of scenic Garden Canyon has been reserved for the hamfest and camping facilities and power will be available.

Tickets are $1.00 before August 24th and $1.50 after that date. "Harmonics" under 12 will be admitted free.

Reservations should be mailed to Secretary, Huachuca Amateur Radio Club, P.O. Box 902, Fort Huachuca, Ariz. —30—

Over-all view of the electrical section of the IT&T Standards Laboratory, Clifton, N. J., showing equipment which can make a wide range of electrical measurements with the highest possible degree of precision. This new facility is one of the best equipped privately owned installations of its kind in the world, and it is expected to supplement and extend the services of the National Bureau of Standards.



Spot Radio News

(*Continued from page 18*)

control radar will make a major improvement in blind approach and landings, a primary requirement for all-weather bombers, fighters, and interceptors, as well as civilian aircraft.

WITH PAY-SEE TV to worry about, 890-mc. problems raging at lengthy hearings, and Congress demanding immediate action on the allocation problem, particularly insofar as the u.h.f. channels are concerned, the Commission's offices were buzzing with conferences, as this column was being prepared. But, there was little activity on TV grants as the table on page 18 of this issue reveals.

Both industry and the FCC were stalled as to a direction to take on the low- or high-band stations. And at the present writing, it appears as if the confused state of affairs will obtain for many months. It is hoped that the TASO study report will provide the Commission with a concrete plan that will resolve the allocation muddle.

NOW A TRANSISTORIZED ELECTRONIC computer is available to count and classify the time of flight of neutrons from a nuclear reactor, accomplishing in an hour what it previously would have taken a man a month to do.

The device, only 8 inches high, 19 inches long, and 13 inches deep, compared to earlier analyzer equipment which took up at least ten times that amount of space, uses 293 transistors in place of as many tubes, along with more compact circuitry through the use of printed circuits.

In addition, the new analyzer uses only eight watts of power, compared to two kilowatts needed to operate the earlier tube-equipped instrument.

VERY-HIGH-FREQUENCY SIGNALS are now being used for the automatic control of two of Nova Scotia's nine hydroelectric generating plants.

The use of a mobile voice communications band was selected for this purpose, because it was found that power line carrier was impractical and microwave was also uneconomical when only a small number of channels are required.

A high-gain antenna system is used in conjunction with standard FM transmitters and receivers to provide the supervisory service, which at present obtains at the hydro plants at Nictaux and Paradise in the Nova Scotia (Canada) area.

The novel feature of this installation is the integration of radio equipment of stock design with supervisory equipment; a striking example of the broad possibilities of electronics in the control of power distribution, which but a short while ago was merely in the idea stage. . . . . L. W.

Sound on Tape

By BERT WHYTE

I HAD hoped to bring you the first part of the series on stereophonic perception this month, but getting some of the data is like pulling teeth, so if you'll forgive me, I'll have to postpone it. I'm almost certain I can have the first part at least, latched up in time for next month's column. In the meanwhile, it may be a blessing in disguise because I've begun to get plenty of tapes and I want to report on as many as space will permit.

STRAUSS, RICHARD
DEATH AND TRANSFIGURATION
Vienna Philharmonic Orchestra conducted by Fritz Reiner. Victor CCS28, stacked stereo, 7" reel, 7½ ips. NARTB tape curve. Price $10.95.

This can only be described as an awesome musical experience. Anyone who can listen to this tape over the proper equipment and still declare that they don't like stereo, surely must have a tin ear or perhaps it is just . . . sour grapes! For this represents just about the quintessence of stereo experience, at least as far as the commercial two-channel variety is concerned. It has the tremendous weight and sonic impact of the massive Strauss orchestra, yet there is that almost eerie sense of spaciousness that is peculiar to good stereophonic reproduction. Thus, despite the imposing power, there remains the ability to separate and discriminate the instruments in the orchestra. This affords the dual benefits of crisp orchestral definition and the ability to perceive the sensation of direction in the complex interweaving of sounds among the various orchestral choirs. All these sensations add up to that elusive thing called "presence," and this tape has it in abundance.

As I noted in the disc review of this work, this is one of Reiner's major achievements and a stunning performance. It is impossible to convey to you in words what you must hear for yourself, as far as the difference between disc and stereo tape is concerned. The performance is the same, of course, but there is so much more to hear in the stereo tape, so many little subtleties and nuances now revealed, so many little fillips of orchestration not apparent in the disc.

In terms of sheer sound there are significant differences, one of the most obvious being the quality and projection of the contrabassi. They are used quite extensively throughout the score and what a joy it is to hear them reproduced so cleanly, so articulately, even though they are throbbing with a massive sonority beyond anything ever experienced on a disc.

The *Victor* engineers have taken advantage of the superb acoustics of the Viennese hall and the over-all sound is a happy blend of judicious reverberation and orchestral clarity. Wide in frequency response and dynamics, this is a tape which should be played through a big hi-fi rig at a good room-filling level, if one would properly savor its sonic delights. My only quibble is the old bug-a-boo of signal-to-noise ratio, as tape hiss was discernible and occasionally there would be the intrusion of the "pop-pop-pop" of low-frequency d.c. module noise. But don't let this deter you . . . this is a real thriller!

STRAUSS, RICHARD
TILL EULENSPIEGEL
Vienna Philharmonie Orchestra conducted by Fritz Reiner. Victor ACS27, stacked stereo, 7" reel, 7½ ips. NARTB tape curve. Price $6.95.

This is more of the same quality found in "Death and Transfiguration," and with the popularity of the work and the comparatively low price, should be one of the best sellers in stereo. "Till Eulenspiegel" is one of Strauss' most colorful scores and, as you might imagine, in its stereo format is productive of some fantastic sound. The precision of the strings of the Vienna group will make you gasp, as will the soaring french horns and the sweetness of the famed Vienna woodwind, as Reiner guides them in this fine performance. In the tragi-comic "hanging scene," you will hear the most hugely brazen blare of trombones ever captured on a recording, as the trap is sprung. Boy, through almost any system this is impressive, but if you own a king-size rig this is a real gut-rumbler!

My only reservations here are that I think a somewhat closer-up recording perspective would have afforded a shade more definition and it seemed to me that the dynamic range should have been a little wider in compass. As it is, it's a striking demonstration of the musical enhancement afforded by stereo. I'm just the kind of guy who likes lemon juice on his caviar!

ORGAN CONCERT
Austin Lovelace, organist. Concertapes stereo 24-3, 7" reel, 7½ ips. NARTB tape curve. Price $11.95.

This is one of the most grandiose-sounding organ stereo tapes, I've yet encountered. It affords an interesting contrast to the Carl Weinrich series on *Sonotape,* especially in the sound of the Bach works. Weinrich performed on a brilliant-voiced baroque-type instrument, while in this recording Dr. Lovelace uses an *Austin* organ. entirely rebuilt to modern principles in 1954. This is a large high pressure organ with 4 manuals and nearly 5000 pipes. In 75 ranks and 85 stops, they encompass almost the entire frequency range of the organ . . . from the mighty thunder of 32-foot contrabourdon to the stratospheric 1-foot sifflote. As with most modern organs, this has a heavier, much more powerfully rich

and sonorous sound than the baroque types. Some purists may object that Bach and the other early composers for organ represented on this tape, Pachelbel and Flor Peeters, should only be heard on baroque instruments. This may be a legitimate viewpoint, but only the most hide-bound pedant would deny that when performed on one of the large modern organs, these works assume a majesty and a grandeur of sound that is altogether thrilling.

Dr. Lovelace is a splendidly accomplished organist with a fine sense of taste and balance in his choices of registration and he performs his varied program with considerable verve and polish. He is heard in the magnificent "A Minor Prelude and Fugue" of Bach and in two well-known Bach "Chorales"; Pachelbel's, "Von Himmel Hoch"; Peeters's, "Aria for Organ"; two "modern" works by late 19th-century composer Hermann Schroeder; and the brilliant "Grand Jeu et Duo," of Claude D'Aquin. The organ sound is very clean despite its power and reverberation characteristics of the hall, abetted by the carefully tailored tempi chosen by Dr. Lovelace, allow for desired spaciousness without loss of detail.

The organ sound is projected well forward which brings in the slight penalty of some blower noise, but outside of this the tape is remarkably quiet. Directional effects were not as pronounced in this tape as in some other organ stereo, probably due to the disposition of the pipes. *Piece de resistance* for the sound enthusiast is the tremendous thundering pedal. There are scads of 25- to 60-cycle material throughout this tape, a fact which became very apparent when my big *Bozak* speaker began to shake the walls of my house! If you are an organ enthusiast, don't fail to hear this outstanding tape.

THE BIG SOUND ON BROADWAY

Ray Bohr, organist. Victor monaural BP-55, 7" reel, 7½ ips. NARTB tape curve. Price $8.95.

This is one of the best recorded and best performed miscellany of pop tunes played on a big pipe organ that I've run across. Bohr is a man obviously in love with his work and his playing is at all times a marvel of polish and precision. In stylish, tasteful arrangements, Bohr plays tunes derived from Broadway hit shows such as "So in Love," "Whatever Lola Wants, "You'll Never Walk Alone," "I Whistle a Happy Tune," "The Rain in Spain," "I Could Have Danced All Night" and others. The organ is a real rip-snorter with all the trappings dear to the heart of the theater organ fans. Bohr constantly favors a huge blary trumpet and trombone stop which really hits you through a big speaker. The engineers have afforded a very big, clean sound, with live acoustics and bright close-up detail. This is one of the quietest commercial monaural tapes yet and it's a pleasure to know that the only hiss one can hear is blower noise from the organ.

COLE PORTER AND ME

Eddie Cano and his Sextet. Victor monaural BP-50, 7" reel, 7½ ips. NARTB curve. Price $8.95.

This is a most unusual type of pop music, a sort of odd but highly listenable amalgam of jazz with a Latin beat. Cano is a very facile pianist who formed a sextet comprised of men who were top performers in both the jazz and Latin areas of music. Then he and his men turned themselves loose on six Cano originals and six of Cole Porter's best, including such numbers as "Love For Sale," "What is This Thing Called Love," and "I Get a Kick Out of You," among others.

There is no attempt to synthesize both jazz and Latin elements into some hybrid monster. Rather Cano lets each speak for itself, and in spite of some complex interweavings of both elements each does retain its individuality. Soundwise this is really superb . . . a very loud, very brassy type, with all the familiar acoutrements of the Latin rhythm section, clinking and clanging at a great rate. Good wide frequency and dynamic range here and again a close-up perspective which highlights every instrument. As in the organ tape, signal-to-noise ratio was very impressive as the orchestra performed against a background of velvety silence. —30—

Operation of the new Signal Corps field facsimile set through jeep-mounted gear.

New Army Facsimile Set and Sun-Powered Helmet Radio

Portable radio facsimile system and sun-run helmet set shown by Signal Corps.

TWO new electronic developments have recently been shown by the U. S. Army Signal Engineering Laboratories, Ft. Monmouth, N. J. One of these is a new highly portable facsimile set that can put a finished photo in the hands of a person miles away—five minutes after the photographer clicks the shutter.

The new facsimile equipment fits easily into the back of a radio-equipped jeep or car and can send a picture to its companion receiver 40 miles away. The set can also send a photo thousands of miles, over standard telephoto lines or around the world, by long-range radio circuits. The new facsimile, the fastest in the world, combines high-speed Army picture-sending techniques with a "Polaroid" film that produces a finished print a minute after exposure. No darkrooms or messengers are needed for the unit which was built by the *Times Facsimile Corp.*, New York, N. Y.

In the case of the helmet radio, experiments have been conducted in which exposure to sunlight is all that would be needed to operate both transmitter and receiver for as long as a year. Long, narrow clusters of tiny solar cells are placed on either side of the crown of the helmet. These silicon wafers power the radio for normal daylight operation. They also charge four small nickel-cadmium storage batteries to supply peak current in daytime and to operate the set at night. Use of the solar cells in combination with rechargeable nickel-cadmium batteries would provide power for possibly a year or more. With the dry cells now used in the helmet radio, battery life is less than a day if used continuously. A transistorized power converter is used to raise the 4.5-volt output of the solar-nickel-cadmium battery combination to the 50 volts required for proper operation. The sun-battery version of the helmet radio is as light as the dry-battery version, which weighs less than a pound.

Similar power is being considered for other light field radios. —30—

Tiny silicon wafers, or solar batteries, power this helmet radio in the field.

Certified Record Revue

(*Continued from page 48*)

VISTAS D'ESPANA
Laurindo Almeida, guitarist. Capitol 8367. RIAA curve. Price $3.98.

The wonderful guitar of Almeida is heard on this disc in a potpourri of Spanish works, most of which are fairly familiar. Albeniz is the composer represented on side one with his famous "Malaguena" and three other numbers; Turinais the composer on the flip side with his "Sevillana" and other numbers. All are quite idiomatic of course and Almeida has ample opportunity to display his fabulous dexterity and his feeling for these works.

Soundwise this is a guitar clean and pristine of tone, with a rich full bass and the high strings sharp and incisive. It is fascinating to hear Almeida play, as the recording has such clarity that one can hear the mechanics of the playing . . . all the finger noises and tick of the nails and the rapid sliding up and down the strings. On a good hi-fi system, a guitar recording of this quality is almost a literal re-creation of the instrument in your living room and a startling demonstration to use on the uninitiated.

TCHAIKOVSKY
SYMPHONY #6 (PATHETIQUE)
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL-1633. RIAA curve. Price $3.98.

One might rightfully feel that this type of repertoire is not the best for Ernest Ansermet. Yet, surprisingly, on this disc he gives a fine account of himself in an exemplary reading, that finds him among the top runners. True, Ansermet does not have the profundity of a Furtwangler nor the drive of Toscanini, but neither does he have some of the annoying mannerisms displayed by other conductors of this work. Ansermet plays everything fairly straight, essays a moderate pace and contributes one of the best march-scherzos on record.

As far as sound is concerned, this is about the tops, with only the Kubelik/*Mercury* as any real competition. Luscious string tone here, fine rousing brass, very smooth woodwind and percussion of notable impact and accuracy. Wrap it all up in some of *London's* most pervasive acoustics and this should find plenty of buyers.

WAGNER
PRELUDE AND GOOD FRIDAY SPELL
SIEGFRIED IDYLL
DIE MEISTERSINGER (PRELUDE)
Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol P8368. RIAA curve. Price $3.98.

Steinberg gives a good account of himself with these works especially in the "Parsifal" music. Superb playing from the Pittsburgh Orchestra and all is heard with a rich glowing sound aided by the dead quiet *Capitol* surfaces. Recommended.

BACH AND HANDEL RECITAL
Kirsten Flagstad, soprano, with London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL1641. RIAA curve. Price $3.98.

This is a wonderful recording and a pleasant surprise since very few people have ever associated Kirsten Flagstad with the works of Bach or Handel. Yet here she is in glorious voice singing such items as "Sheep May Safely Graze," "Jesu, Joy of Man's Desiring," "He Shall Feed His Flock," and "I Know That My Redeemer Liveth," among others. One would expect professional poise and a reasonable job on almost any kind of repertoire from a

singer the calibre of Madame Flagstad. Quite unexpected was the ease and polish with which she sang these, to her, unfamiliar works, imbuing them with the beauty of her great voice. Ably accompanied by Sir Adrian Boult and The London Philharmonic, this disc is an unqualified triumph. The *London* sound is superb, affording us a clean sonic picture of all participants.

BRAHMS
SYMPHONY #1
Symphony of the Air conducted by Igor Markevitch. Decca DL9907. RIAA curve. Price $3.98.

A disappointment and a great shame. Markevitch gives a remarkable performance, surely ranking with the best available on recordings and the Symphony of the Air sounds like the solid magnificent ensemble it was in the hey-dey of the Maestro. All is for naught because of the sound quality. This was made in this country, reportedly in Manhattan Center, New York. I can't imagine what happened, but in the finished product, the strings are impossibly shrill and at the same time the bass is so heavily accented that it has literally no definition. All the enthusiasm in the world for the performance and playing, can't erase the deficiences of the sound.

BLOCH
SUITE FOR VIOLA
SUITE HEBRAIQUE
MEDITATION AND PROCESSIONAL
William Primrose, violist, and David Stimer, pianist. Capitol P8355. RIAA curve. Price $3.98.

This recording marks the debut of William Primrose on the *Capitol* label and he has chosen the fantastic Bloch, "Suite for Viola" as his starting point and the other two Bloch works as the balance of his program. The "Suite for Viola" is a tremendously complex score, probably the most exacting piece in the entire viola literature. Primrose sweeps through this fascinating score with characteristic ease and the other works hold no terror for him. Primrose is, as always, fabulously dexterous and productive of that darkly rich, meltingly beautiful tone. The *Capitol* sound of viola and the piano accompaniment is clean and wide range and again, as nearly always, the surfaces are beautifully quiet.

LISZT
PIANO CONCERTO #1
GRIEG
PIANO CONCERTO IN A MINOR
Richard Farrell, pianist, with Halle Orchestra conducted by George Weldon. Mercury MG50126. RIAA curve. Price $3.98.

Mercury has built up an enviable reputation with its symphonic recordings. Many people, however, have lamented the fact that they have never applied the "Olympian Technique" to the field of concerto recording. That was true up until last year in England when they finally entered the concerto sweepstakes with this recording of these two well-ridden warhorses.

The brilliant young Australian pianist Richard Farrell, was elected to perform the works. And now we have this disc for the evidence of our ears. As most readers probably know, the "Olympian Technique" is based on the use of single *Telefunken* microphone suspended a certain distance above and in front of the performing group. It has worked superbly in symphonies, but as applied to a concerto it was flying in the face of all recording convention, which dictated that two or more mikes were necessary in concerto pickups.

Well, what magic formula the *Mercury* engineers use I don't know, but in this recording they stuck by their guns and used but a single *Telefunken* mike and have come up with a beautifully balanced concerto. The recording favors neither the orchestra nor the piano. The sound is superb with a very crisp, clean piano heard against the equally clean orchestra. Piano transients are ultra-sharp and undistorted, dynamic range is far wider than that found in piano concertos recorded in the usual fashion. About the only thing one might quibble about, is that in some very hard-played percussive passages, some hammer action noise could be heard.

As to the performance, Mr. Farrell turns out to be a pianist in the romantic tradition. His tempi are slower than most of his slick contemporaries, his phrasing well-turned, deliberate. He has a robust tone, facile technique, warmth, and expression. A well-equipped young man who will bear watching, he is as yet, however, no match for a Rubenstein. All things considered, he handles things well enough so that those who prefer this recording for sound alone, will not have to apologize for the performance.

HAYDN
SYMPHONY #100 (MILITARY)
SYMPHONY #101 (CLOCK)
Vienna State Opera Orchestra conducted by Mogens Woldike. Vanguard VRS492. RIAA curve. Price $3.98.

You can't miss on a combination like this . . . Haydn scholar and brilliant conductor Woldike, the superb orchestra of the Volksoper, and *Vanguard's* most estimable hi-fi sound! Woldike's handling of these two well-known Haydn scores is nothing short of masterful. His tempi are authentic and reasonable, his phrasing and dynamics not grossly exaggerated as in several other recordings one could name, and, above all, in refutation of his background, Woldike is never the pedant and the scores remain pliable and interesting.

The famous drum and the snares and cymbal of the "Military" symphony are surely present and cleanly articulate, but they are not played *forte* and remain well-mannered, at the proper level in the score. Gorgeous string tone here and woodwind of outstanding realism. All other elements are cleanly reproduced, and as a final touch we add spacious acoustics to contribute a compelling sense of "liveness" to a delightful recording.

STRAUSS, RICHARD
LE BOURGEOIS GENTILHOMME
Berlin Philharmonic Orchestra conducted by Ferdinand Leitner. Decca DL-9903. RIAA curve. Price $3.98.

This is one of Strauss' most hard-to-digest works, but after several hearings, it sorts itself out and one realizes this has many interesting and delightful moments. The reading by the late Clemens Krauss has always been highly regarded and at one time Reiner was considered quite a protagonist of this score. For the historical minded, there is a dismal-sounding recording conducted by Strauss himself.

I can find little to quibble about in this venture by Leitner. He indulges in no idiosyncrasies, takes no liberties and, in general, turns in a first-rate performance. Soundwise this has an edge over all its competitors, especially in terms of string tone, with a special nod towards the beautiful cello section of the Berliners. In short, this is an eminently acceptable recording.

KATHLEEN FERRIER MEMORIAL ALBUM
London LL1529. RIAA curve. Price $3.98.

Kathleen Ferrier died of leukemia in 1953, at the height of her career. But her tragic death has not stilled forever that glorious voice . . . we have the legacy of her recordings to enjoy and enjoy again. This is a

collection of songs she made famous in her lifetime . . . Schubert and Schumann lieder; "Art Thou Troubled" from Handel's "Rodelinda"; "What Is Life" from Gluck's "Orfeo ed Euridice"; Handel's "Largo" and "O Rest in the Lord" from Mendelssohn's "Elijah." These works were recorded over a period of years . . . in some the sound seemed dated, there is even an annoying hum in one section. Most, however, are fairly good recordings which are sufficient for us to savor the warm humanness, the deep-felt expression, the sheer tonal beauty of this magnificent voice.

If you have never known the lovely voice of Kathleen Ferrier, you should try this album. For Ferrier fans, no further comment should be necessary.

Jazz Corner

TED HEATH AT CARNEGIE HALL
Ted Heath and his orchestra. London LL1566. RIAA curve. Price $3.98.

Ted Heath admirers who attended the Carnegie Hall concert can relive that night with this album, complete even unto clapping, yells, and whistles. All others will get a kick out of the terrific show Heath puts on. Some numbers are American classics like "Perdido," "Autumn in New York," and "Lullaby in Rhythm," others are Heath originals or of British derivation. This is a hard swingin' group, no doubt of that, and they play with great style and verve. Soundwise this is quite good, with bright punchy brass, heavy, accurate, well-accented percussion, and the ubiquitous saxes straddling the tonal spectrum.

NEW YORK JAZZ QUARTET GOES NATIVE
Herbie Mann, flute; Mat Mathews, accordion; Joe Puma, guitar; Whitey Mitchell, bass. Elektra EKL-118. RIAA curve. Price $3.98.

Elektra is turning out some sensationally hi-fi recordings these days, still staying for the most part with small combos or individuals. The New York Jazz Quartet is a typical group . . . four highly talented lads addicted to a sort of "cool," "progressive" type of jazz of the style generally favored at spots like the famous, "Embers." On this disc they have temporarily forsaken the "cool school" for an interesting experiment in trying to fuse jazz elements with Latin and Afro-Cuban material.

In this endeavor they were assisted by drummers, Manuel Ramos and Teiji Ito. Spread over eleven numbers on two sides the results were highly interesting and, if hard to understand as a musical form, why just skip it and enjoy the terrific hi-fi sound! Actually the boys succeeded rather well and the fusion of jazz and Latin music is not as radical as it might first appear. Recording is close-up highly detailed type, wrapped in spacious acoustics for liveness. Every instrument is sharply articulate, wide in frequency response, and there was no apparent transient distortion. Try this for something different.

MAX ROACH PLUS FOUR
EmArcy MG36098. RIAA curve. Price $3.98.

Max Roach, the sensational drummer man of the Brown-Roach combo, sustained a terrible loss in 1956 when his partner and friend, Clifford Brown, was killed in an automobile accident. Killed in the same wreck was another friend and pianist of the group, Richard Powell. After the initial shock wore off, Max set about finding the proper kind of musicians to rebuild his combo. He eventually settled on Kenny Dorham for trumpet and Ray Bryant for piano and called his new group "Max Roach plus Four."

This is the first recording of this new outfit and their debut can only be described as sen-

sational. This is jazz of the rock-'em, sock-'em school. A frantic hard drivin' bunch who blow up more sound than some bigger orchestras. Most of the Four take their solos with Max taking his breaks and backing up the others at all times with his tremendous beat. In three standards and three originals, these boys really blow up a storm. In one of the originals, "Dr. Free-Zee," Max does a two-track stunt with drums and tympani which is wildly exciting. Big bonus throughout this record is the amazing sound. This is the most incredibly "live" jazz sound I've heard in a long time. The recording is ultra-close, ultra-detailed, and since a group this small could conceivably be playing in your living room . . . playing this back at the approximate levels that would obtain if they were in person is uncanny in its realism. —30—

Audio Sweep Generator

(*Continued from page* 65)

tube grid in terms of frequency. This is done as follows. Set switch S_2 to the "Auto." position. Now connect an oscilloscope (the vertical deflection of which has been previously voltage calibrated) across the "Cal." jacks on the front panel. Adjust R_{15} to produce a peak voltage on the scope equal to the v.t.v.m. reading taken previously at 20 kc. This means that the audio sweep is now going from zero to 20 kc. If the intermediate settings of R_{18} are calibrated in frequency and the voltages at the "Cal." jacks known for each frequency setting of R_{18}, then these voltages corresponding to a specific frequency can be picked off the saw-tooth wave displayed on the scope. These frequencies can then be permanently marked on a lucite screen which can be fitted over the face of the scope whenever the audio frequency sweep generator is used. Of course the calibration process isn't too easy, but once it is set up recalibration of the zero and 20 kc. points can be accomplished quite easily. During use, an occasional resetting of the zero beat by means of trimmer C_{12} may be necessary to insure the continued accuracy of readings.

The equipment is now calibrated and ready for use. Fig. 1 shows the set up when testing an amplifier. The response of the amplifier will be displayed on the scope. Fig. 2 shows a typical pattern produced by a fairly limited band audio amplifier. —30—

"SURGISTOR" PROLONGS TUBE LIFE

SINCE the resistance of tube heaters is normally much lower when cold than when hot, the inrushing surge of current that occurs when any tube-operated equipment is first turned on is quite heavy. Flaking of the cathode material, heater-cathode shorts, and early decline of mutual conductance are some defects encouraged by this condition. There is also evidence that components other than tubes, such as electrolytic capacitors and dry-disc rectifiers, suffer from this surge.

Since TV receivers, radios, hi-fi equipment, and other electronic devices found in the home are cycled on and off frequently, these surges become an important factor in the reliability of such instruments: about 80 per-cent of all service calls are handled by tube replacement alone.

Effective, automatic reduction of the punishing inrush current is provided by the "Surgistor," a simple device marketed by Wuerth Tube-Saver Corp. The compact unit, shown in Fig. 1, is permanently connected in scries with one side of the power line, and may be concealed behind the receiver or other device. It contains a resistive element sealed in a small rectangular case. A bracket at one end supports the stationary contact of a thermal relay. The bracket at the other end supports the bi-metal blade and moving contact of the relay so that, when the relay is closed, the resistor is shorted out.

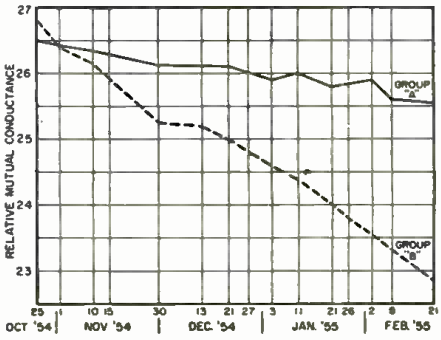
With the "Surgistor" wired in place and the equipment turned on, the fixed resistance limits the initial surge to the set severely, usually to about 25 per-cent of normal line voltage.

As tube filaments heat their resistance increases, and about 60 per-cent of line voltage is going to the set in a few seconds. About the time (approximately 10 seconds) that heater resistances have stabilized, the heat generated by the resistor closes the relay. This shunts out the resistor and places full line voltage on the equipment. Although the resistor then cools, the heat of full line-current flow through the bi-metal blade keeps the contacts closed. When the equipment is turned off, the resultant cooling of the contacts opens the relay, which is then ready to go back to work next time the device is turned on.

Tests by apparatus manufacturers, testing agencies, and the Armed Forces indicate substantial increases in tube life when the "Surgistor" is used. In a check of mutual conductance alone, two similar groups of tubes were operated in equipment with and without the "Surgistor" over a period of four months. Tubes in group "A" of Fig. 2 were protected by a "Surgistor." Mutual conductance of the tubes in group "B," unprotected, fell off three times as fast.

Fig. 1. A surge-limiting resistor combined with a time-delay thermal relay.

Fig. 2. Tubes in group A. protected by the "Surgistor," maintained efficiency.



Practical Color TV

(*Continued from page 57*)

that of a monochrome receiver for those circuits which will handle the monochrome signal. Following this reasoning, a color receiver, irrespective of make or model, can be looked upon as a monochrome receiver with a different type of picture tube and the additional circuitry needed for the reproduction of color. This is illustrated in Fig. 1.

The block diagram shows a basic color receiver, with each block representing a section or group of circuits which function in a prescribed manner and contribute in a definite way to the image appearing on the face of the picture tube or sound produced by the speaker. Notice that the blocks located to the left of the dotted line are the same type of circuits found in a monochrome receiver. If the block labeled "color circuits" were removed and the word "color" were deleted from the picture-tube block, a typical monochrome receiver block diagram would remain. A monochrome signal will be handled by the color receiver in essentially the same manner as does a monochrome receiver. The color circuits, during a monochrome transmission, will not be operative and the color picture tube will reproduce a black-and-white picture.

Irrespective of the new circuits which may be employed in a color receiver, they will still make use of vacuum tubes, resistors, capacitors, coils, transformers, and the like. For this reason, the same servicing techniques and practices now followed for monochrome receivers can also be applied to color servicing. The experience gained through servicing monochrome receivers will be of definite value in color. If the service technician is familiar with monochrome circuitry, he has more than half the battle won.

A color receiver is made up of approximately 50% monochrome circuits, 30% monochrome circuits with slight modification, and only 20% new circuits. The 30% monochrome circuits with slight modification differ only in application and not in function or operation. As an example, the high-voltage circuit in one color set delivers 25 kv. at a current drain of approximately 800 microamperes. This, plus other requirements, necessitates heavier components, new tube types, and a schematic diagram which may seem to be different. However, upon close examination, it will be obvious that this circuit operates much the same as monochrome high-voltage circuits and that it can be serviced by using the same procedures and techniques. Thus, only 20% of the circuits in a color receiver will be unfamiliar to the service technician.

There are only four major differences between a color and monochrome receiver as far as the service technician is concerned. Two of the

four are illustrated in Fig. 1, the color picture tube and the additional circuitry for the reception of color.

The picture tube is, in many ways, the heart of the entire receiver. This tube performs the final act in the reproduction of the televised scene as it converts the electrical signal impulses into the color light variations. Understanding the color picture tube's function and operation is important.

The color circuits are also new and different, as they function to process the new color portion of the transmitted signal. Understanding the function and operation of these new circuits is a prime requisite for signal tracing or analyzing circuit failures when troubleshooting.

The other two major differences between a color and a monochrome receiver are concerned with the nature of the color signal transmitted by the station and the new service techniques that will be required.

Color techniques involve more than just the servicing procedures necessary with the new type of picture tube and color circuitry. Also involved are new types of test equipment needed for such troubleshooting.

If the technician understands the operation of the circuits in a monochrome receiver, the functioning of the monochrome picture tube, the fundamentals of the transmitted monochrome signal, and can adequately service monochrome receivers, all that will be required to place him in a position to service color receivers is that he become familiar with the four areas outlined. These areas will be explored in subsequent articles.

(To be continued)

TRANSISTOR AUTO-SET HINTS

By A. VON ZOOK

THESE suggestions were specifically worked out for Philco auto radios like models C-5705, C-5707, C-5709, and P-5703, found in 1957 Chrysler and Plymouth cars. However, they will be equally useful on the number of other transistorized auto radios with similar circuits.

A bias pot that will require adjustment from time to time is found on these receivers. When making this adjustment, use a fiber tool rather than a metallic one. The latter may short the transistor to ground, destroying an otherwise good unit.

The transistor is mounted on a separate plate or heat sink, insulated from the chassis, and the collector connection is common to the heat sink. Shorting to the chassis from this point will thus result in a no-output symptom and ruin the transistor. Never connect the "A" battery return to this plate or you'll be in serious trouble.

When installing a new transistor, make sure it contacts the flat surface of the sink firmly, or heat dissipation will be poor. Never operate these sets without a speaker or equivalent load, for this too may end the transistor's life. Even an open bias pot can bring early death. If a new transistor is installed, adjust the pot to read .75 volt (or other value specified in other sets) with d.c. meter between heat sink and chassis. —30—

TELEVISION IN THE U.S.S.R.

By PROF. A. V. J. MARTIN

TODAY there are thirteen television transmitters in operation in the U.S.S.R. with only three of them transmitting daily programs—the stations in Moscow, Leningrad, and Kiev.

According to Russian information sources, there are approximately ten million viewers for the programs of all thirteen stations.

Projected construction visualizes some 75 transmitters on the air by 1960, mainly in the principal industrial towns. The estimated audience is set at 25 million. The total population of the U.S.S.R. is roughly 200 million. To link these transmitters, 10,000 kilometers (6000 miles) of coax will have to be installed.

The exact number of TV receivers is not known but is estimated at 2 million. Each receiver is watched by a number of persons and some sets belong to cities.

By American standards, screen sizes are small—most sets having 7-inch picture tubes. —30—

Sales Aids

TRAVEL THEME IN PROMOTION

RCA Victor Radio and *"Victrola"* Div. announces that this year's record projected travel figures are a prime influence in its promotional and merchandising plans for the 1957 portable radio peak sales season.

Portable dealer aids carrying out the travel theme include six 4-color travel posters which feature photographs of world famous landmarks. Each 22" x 34" poster carries copy on a different portable or transistor radio manufactured by the company. Six die-cut cards in the form of pixies fit snugly over portable sets, each pointing out a sales feature of the radio.

The in-store materials are rounded out with a door-hanger with printed messages on both sides, window streamers, and counter booklets.

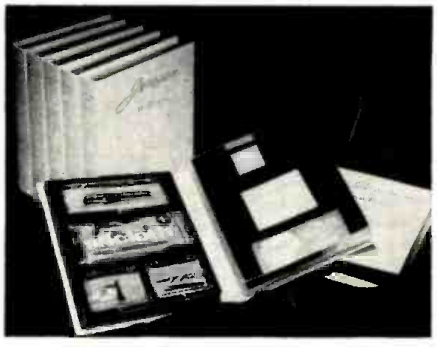
* * *

THE JENSEN "HI-FI-ER"

Jensen Industries, Inc., is building brand new "profits-for-dealers" into its latest merchandiser.

This attractive diamond needle kit comes in a book-shaped package and contains a "full complement of essential components," including the needle.

The company's "Hi-Fi-Er" consists of the following products: diamond needle; a 50 power microscope for checking the needle in the cartridge; the firm's "Silcloth" for de-staticizing



records; record sweep to clean record grooves while playing; set of needle and cartridge installation tools; and an informative booklet on record and needle care.

* * *

NEW FLOOR MERCHANDISER

The special products division of *Stromberg-Carlson*, division of *General Dynamics Corp.*, announces a new floor merchandiser. Model DA-32, for point-of-sale display of its line of commercial audio equipment.

The unit provides a maximum of display for amplifiers, speakers, microphones, speaker housings, and accessories, and measures 5'5" high, 4' wide, and 18" deep. The over-all coloring of the merchandiser is green and white,

and the shelving is finished in a scratch-resistant enamel. The unit is shipped knocked down, and it can be assembled quite easily.

* * *

RADIO BATTERY DISPLAY

A new radio battery merchandiser is being offered by the *Ray-O-Vac Co.*

The RB-1 is a compact, all-metal unit and solves the problem of display

space at the retail level. It ships flat but requires only a few seconds to set up.

This display makes a distinctive floor stand. Without the legs, it can be set on a counter or hung on the wall.

The unit is available to all of the firm's radio battery dealers.

* * *

AUTO AERIAL COUNTER STAND

A new colorful counter stand for *United Motors System Delco* auto aer-

ials is now being featured by the company's electronic parts distributors.

The stand, which features a mount to display the aerial and a handy "pocket" for carrying descriptive literature, is made from heavy durable cardboard. It is easy to assemble and carries the company's orange and blue colors.

* * *

GRILLE CLOTH DISPLAY

Newcastle Fabric Corp., manufacturer of "Acoustone" grille cloth, has announced that its new "Picture Gallery" pattern selector will be available from its representatives.

The selector features six patterns per page, with each design having its own wood-tone frame around it. With 36 individual patterns being so displayed and carried in stock, it is expected that an increased volume of business can be built by the distributor who is going after industrial orders as well as the small custom builder's account.

* * *

NEW DISPLAY BOXES

Rye Sound Corp. has announced that all shipments of its earsets will now be made in attractive, colorful point-

of-sale display boxes. Each of the boxes, measuring approximately 7"x 3"x2" will hold six individually packaged earsets.

The boxes are brightly colored in yellow and black. One style box will be used for earsets for transistor radios and television sets and a different box is planned for the company's line of earsets for dictating machines and other electronic uses.

* * *

RECEIVING TUBE AIDS

RCA has made available to all of its distributors a new package to aid in the sale of receiving tubes for color television.

In addition to a modern display panel, which is being shipped to the distributors, the firm will also send out promotion flyers which can be used for mailing to service dealer customers and for in-store giveaways, marking pencils for "bonus" use, distributor imprint stickers, a dealer indoor sign which provides a point-of-sale sign to advertise color TV servicing, plastic price list holders which help to keep the price list clean and handy for ready reference, receiving tube purchase contracts, color tube envelope stuffers which help to sell the importance of color TV in the growth of the servicing industry, and a tube shelf strip book which contains self-adhering strips of industry type numbers useful in keeping the tube supply in order.

Complete information on these items is contained in an attractively packaged kit which is being sent to all distributors.

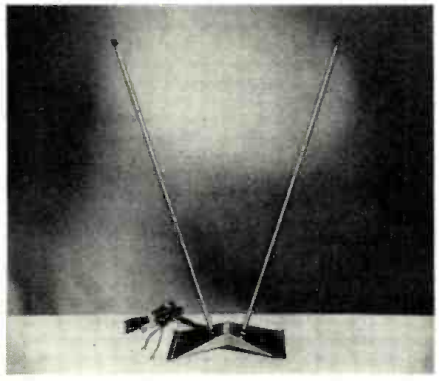
With the exception of the display panel, which is provided free of cost, there is a small charge for most of the other items. —30—

Antenna News

STYLED INDOOR ANTENNA

Trio Mfg. Co., Griggsville, Ill., has restyled the conventional indoor dipole and added mechanical features to improve durability and operation.

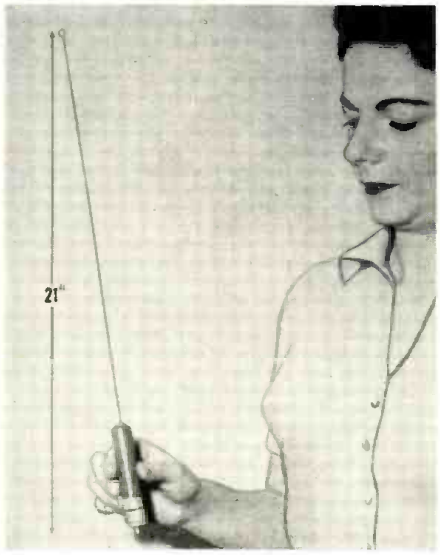
The "Silver V" uses spring tension in the telescoping sections of the aluminum tubing to hold the elements se-



curely in place after they have been adjusted. This avoids the collapse of the tubing when elements become loose and, by maintaining good contact, prevents picture flicker. Ball sockets permit the elements to be positioned flexibly, but spring loading on these sockets also gives positive hold on position. The low-silhouette base is finished in bronze.

LOADED MOBILE WHIP

Tele-Beam Industries of Napa, Calif., announces a 25-50 mc. loaded type of whip antenna for mobile radio communications that is not much longer



than those used in 152-174 mc. systems.

The new units are about one-third the length of conventional whips. The size makes them ideal for roof mounting on vehicles instead of mounting

on bumpers or cowls for overhead-clearance purposes.

The line includes various types, each designed for operation over a 4-mc. segment of the band. All terminate in PL-259 coaxial connectors. A typical example (38 to 42 mc.) is 24 inches long including the insulated loading coil.

NEW COMMUNICATIONS LINE

Ward Products Division of the *Gabriel Co.*, Cleveland, Ohio, announces a new line of mobile communications products, an expanded national network of warehouses, and new manufacturing facilities.

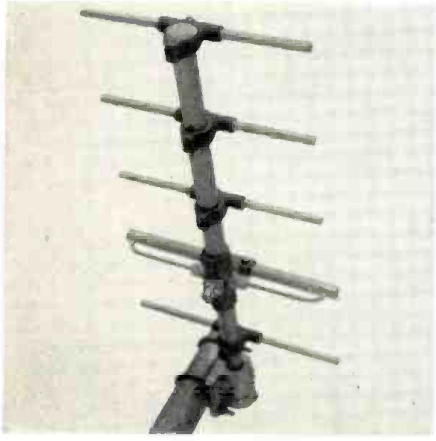
The communications line will include antennas for industrial and ham use, as well as those for private short-wave use, a relatively untapped market.

A new large-capacity plant in Amsterdam, N. Y., provides for rapid fabrication, assembly, and shipping. It will expedite service to customers in the East.

COMMUNICATION YAGI

Scala Radio Co., San Francisco, Calif. is producing Model CA-450, a yagi type for communications applications at 450 mc.

To withstand extreme weather con-



ditions, elements are made of solid aluminum rods, 7/16 in. in diameter, except for the driven element, which is made of ¾-in. tubing. Aluminum castings mount elements to the boom. The *T*-match on the dipole is fed by an insulated balun inside the boom, potted under pressure to insure moisture resistance. *N*-type connectors and two *U*-bolts to accommodate standard masts are provided, with others available on special order. Fittings are plated or anodized to pass salt-spray tests.

AIR FORCE AWARDS

Channel Master Corp., Ellenville, N. Y., has instituted a program to award recognition plaques for outstanding service to Ground Observer Corps posts, in association with the U. S. Air Force. The quarterly selections will include one post from each of the seven air divisions that comprise the Eastern Air Defense Force. Awards will be bestowed on the basis of high operational efficiency. —30—

Service Industry News

THE FIFTH annual service clinic and fair sponsored by the Texas Electronic Association will lead off a series of major events sponsored by service associations that will extend through the fall and winter months.

The 1957 TEA clinic and fair is scheduled to be held at the Texas Hotel in Fort Worth, Texas, on Friday, Saturday, and Sunday, August 2, 3, and 4. With the experience from four previous clinics to guide them, TEA officials are planning a show they expect will attract more than one thousand service dealers and technicians from the Lone Star and adjoining states.

Departing from the former plan of depending upon parts jobbers to distribute announcements to their service customers, invitations in the form of a printed program of events will be mailed to more than 3500 service dealers in Texas, Louisiana, Arkansas, Oklahoma, and New Mexico. This direct approach will put advance information about the clinic in the hands of more service technicians than the promotion of any previous show.

The clinic and fair was instituted by the Texas Electronic Association as a convenient means for giving service dealers and technicians a maximum amount of product and technical information in a short period of time. Manufacturers and distributors utilize their booth space to display the latest products and equipment with experts on hand to answer questions. The fast-moving clinic program features some of the industry's outstanding authorities on technical and business subjects.

W. J. (Bill) Inman, prominent Dallas service dealer, is president of the Texas Electronic Association, which is a state-wide organization made up of fourteen local service associations. Leonard R. (Len) Smith, of Fort Worth, who headed the organization five years ago when the first clinic was held, is handling the job of chairman.

While TEA is putting the final touches on its 1957 show, the Radio Television Guild of Long Island is getting ready to launch the promotion of its second annual Electronics Fair. To provide more convenient accessibility than last year's show, the Guild is planning to hold its 1957 Fair at the Hempstead Armory in Hempstead. Bob Barasch, Murray Barlowe, and Ralph Milne make up the committee appointed by the Guild to initiate plans for this year's big event.

What's An Association?

Like a lot of other service dealers Jack Wheaton, secretary of the Empire State Federation of Electronic and Television Service Associations (as names go, a bit of a mouthful in itself,) has been pondering the confusing variety of names that are used by local associations of service dealers and technicians. He concluded from an analysis of the 237 organizations listed on the national roster of currently active associations, that service associations fall into two major categories: service dealer organizations (business memberships) and technician associations (individual memberships.)

According to Mr. Wheaton's summary of association types, 140 are basically organizations of service dealers with memberships vested in the service businesses that make them up and 97 are organizations of technicians with memberships on an individual basis.

Writing in a recent issue of the *"Guild News"* under the title "What's In A Name?" Mr. Wheaton observed that in "Looking ahead, the use of Radio and Television (to identify an association) is fast becoming limited; opportunities are being presented daily for expansion of Service . . . into the Electronic field."

"Looking into the future," he said. "Electronic Service Association seems to be the simplest, with perhaps an indicated preference for inclusion of the word Technician, as Electronic Service Technicians' Association. One group has already picked the name Better Electronic Service Technicians, BEST. Since a good part of the difficulty in getting groups together (in regional and national associations) is the concerted endeavor to retain a name which has been developed over the years by the individual group, and since the best tool for independent service to use is a common name that will soon become familiar to the consumer as being representative of ethical, responsible, and personal service for electronic apparatus, it would be well for all associations to give a little thought to determining where their preference lies, and come up with some suggestions with a view to finding a name everyone can subscribe to. Certainly it is clear that there is no one name, or no one format in existence which can be accepted by even a majority of the more than 200 service associations in the United States. To provide a basis for the best possible relations with our distributors, our parts manufacturers, and most important of all, our customers, that fault must be corrected."

The subject of a single name or designation to identify all affiliates of

NATESA was one of the major points of discussion at that organization's spring convention in New Orleans. The delegates expressed a strong preference for TESA in place of NATESA. They approved a resolution to urge all NATESA affiliates to change their organization names to the Television Electronic Service Association of their own city so the name TESA will be universally used by all affiliated associations within a two-year period.

The trend toward simplification of association names has been moving forward at a quickening pace for several years. Forerunner in this process of name simplification was the adoption of the simple, easy-to-remember name—Texas Electronic Association (TEA)—when that state-wide organization was formed six years ago by four local Texas associations.

Associations in the Hoosier state followed the pattern of simplicity in naming their state-wide association the Indiana Electronic Service Association (IESA.) And another reflection of the same trend was the selection of the name California State Electronic Association (CSEA) when that statewide organization was formed last year.

Dealers or Technicians?

While the trend toward simplifying association names picks up speed, the problem of satisfying service dealers' and technicians' interests in a single association still beggars solution. The most successful associations to date have been those that are primarily organizations of service dealers. While the majority of service dealers like to maintain their status as "technicians," economic necessity has made it imperative to be realistic about their service work as a business enterprise.

Efforts to accommodate service dealers and technicians in a single association usually founder when an attempt is made to set up a realistic dues structure. The dealers know from practical business experience that an association cannot function effectively without a substantial dues structure to finance advertising and public relations programs on behalf of its members. While they constantly strive to improve their technical performance, dealers know that effective promotions and publicity are the only tools that will sell the public and keep it sold on patronizing independent service shops.

On the other hand, a technician's interest in the association may be merely to broaden his personal knowledge of electronic circuitry and servicing procedures. He may feel that the main purpose of the association should be to work with manufacturers and jobbers to get good technical lectures scheduled at regular intervals. He is inclined to feel that, since manufacturers and jobbers will pick up the tabs for these technical meetings, the association dues structure can be low. Where dealers may see the wisdom of paying as much as twenty-five dollars per month dues to their association to

finance local advertising on behalf of the membership, the average technician has a ceiling of about a dollar per month in what he is willing to pay into an association as dues.

Some of the service-dealer associations recognize that continued technical training for association members and their employees is an association obligation. They set aside regular meeting dates for pre-planned programs to sponsor the best technical lectures available to them.

The current trend among dealer associations is to encourage the formation of technicians' associations to cooperate with, but to function separately from, the dealer organization. Officers of the technicians' group are elected by the technician members and the organization sets up its own dues structure. The dealers' organization assists in getting the best technical lectures available for the technicians' association.

Since many service dealers feel that the working technician has become the "forgotten man" in electronic service, ways and means for giving technicians recognition on the basis of their training, experience, and abilities will be explored by many organizations throughout the nation during the present association year. —30—

High Power vs Low Power

(*Continued from page 51*)

2 is for a recording possessing wide dynamic range, high quality orchestral material.

Three rows of figures are given for different average efficiencies of loudspeaker. The percentages given are average, as no loudspeaker has constant efficiency at all frequencies. As few loudspeakers come with an efficiency rating, this does not help too much, except to give some idea of range, and we hope, some idea where to expect yours to come.

The table is based on approximately equal loudness impression under the different circumstances described. This cannot take into account the difference in loudness at which different people like to listen, and we would rather stay out of that, because differences of opinion are apt to exist on whether a person's choice of level is loud or quiet!

From the answers to these questions. I hope you will be able to decide how many watts you need, approximately at least. It is evident there is no simple rule on the matter. It depends on many things: the efficiency and power handling capacity of your loudspeaker system; the kind of system; how big is your living room and how loud you like your music; what kind of program material you like; how "fussy" you are about minimizing distortion; and how the particular amplifier you choose, to get however many watts you decide on, happens to overload. —30—

Mac's Service Shop

(*Continued from page 62*)

brand-new table model radio came in with an intermittent condition. It would start out all right, but after it played about a half hour the volume would drop and a loud hum would appear. This condition could be made to go and come simply by pushing on the volume control shaft.

"It was a printed-circuit chassis. The volume control was mounted on a stiff bracket rigidly mounted on one corner of the printed-circuit board. When the board was in place in the cabinet, a screw was supposed to hold this bracket firmly against the front of the cabinet and so prevent pressure exerted on the volume control shaft from being transmitted through the bracket to flex the printed-circuit board.

"Well, some joker had left that screw out. As a result, every time someone pushed or pulled on the volume control knob he pried back and forth on the corner of the circuit board. Eventually this flexing broke some of the conducting lines on the board. When the set was cold, the broken edges would maintain contact; but when heat produced a little expansion, the contacts would open up. The worse part was that not just one of the lines had been cracked; there were three of them!

"I sweated blood over that little set and had the chassis in and out of the cabinet like a cuckoo-clock bird signalling twelve o'clock before I finally detected and repaired all the breaks. Tracing down that kind of trouble in a printed circuit can be a real time-consuming job. You can't see the breaks; you have to flex the board a bit to make the condition come and go; and if you get too enthusiastic about this flexing process, you are likely to end up with some new breaks not present to start with. By the time I finished, I loathed the man who had left out that screw with a deep and cordial hatred."

"You're beginning to make your point," Barney conceded grudgingly.

"Then let me tell you the clincher. Before you started to work for me—if you will pardon the expression!—we had a technician in this town who consistently left out chassis bolts, threw away cover screws and clips, and never tightened speaker nuts with anything but his fingers. He was so bad about this that it became sort of a joke with the rest of us. When we got in a set with most of the hardware missing or loose, we'd say, 'Screwloose has had hold of this one.' This name stuck, and we never called him anything else but 'Screwloose' among ourselves. Now you wouldn't want the fellows to tag you with a name such as that, would you?"

"I can think of other names I'd like better. What happened to him, anyway?"

"That's the irony of the whole thing. He quit the service game, which was a blessing all around, and took a job on a factory assembly line. All he does all day long—or so the story goes—is start twenty-six bolts around the edge of a gear-case. The next operator drives these home with an automatic screwdriver. They claim he is the best screw-starter they ever had!"

Barney shot a searching, suspicious look at his employer, but the bland smile on the face of the latter told him nothing. —30—

FM Tuner Kit

(*Continued from page 47*)

The instruction booklet for this tuner recommends a meter alignment procedure using on-the-air stations for medium signal areas if you feel that alignment is necessary. Signal generator alignment is recommended for fringe reception. If the constructor does not have the equipment required, or hesitates to do the aligning himself, most TV and radio service shops will be able to make these adjustments for a nominal charge.

If one were to consider the cost, this particular unit is certainly a good buy. We do not want to imply that it will out-perform or equal the performance of much higher-priced commercially available tuners on the market today. These units may have better mechanical design and include many additional features such as a squelch circuit, limiters, Foster-Seeley discriminator circuits, special broad-band tuned circuits, etc. They may have better a.v.c. and a.f.c. action, better sensitivity, and longer trouble-free service life. But all in all, considering the price of $37.75, this unit gives remarkable performance. —30—

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126	Burroughs Research Center
132	I. T. & T. Corp.

ERRATA

In the article "Negative Feedback Transistor Amplifiers" (May 1957 issue), there was an error in the schematic of Fig. 18. The collector and emitter leads of the lower transistor were inadvertently transposed. Also the commercial equivalent numbers for T_1 and T_2 (Fig. 23) are the Argonne #173 (#500) and #176 (#501).

* * *

In the parts list for "Multiband FM Receiver," page 68, June issue, the specifications for coils L_1 and L_2 are interchanged.

* * *

A component was omitted from the schematic for "A Transistorized Marine Direction Finder," page 43 of the June issue. A 6800-ohm resistor should be connected between the base and ground of V_4.

INDEX OF Advertisers

AUGUST, 1957

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

Classified

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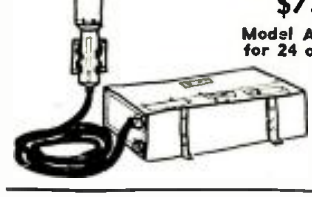

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1A7	.52	6AH4	.85	6R7	.85	12BZ7	.95
1AD4	1.20	6AH6	.85	6R7GT	.68	12C8	.69
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1AX2	.95	6AK5	.69	658GT	1.05	12H6	.59
1B3GT	.79	6AK6	.75	6SA7	.79	12J5GT	.65
1C5GT	.52	6AL5	.58	6SA7GT	.79	12K7GT	.85
1G4	.65	6AL7	.95	6SB7Y	.87	12K8	.69
1G6GT	.49	6AM4	1.50	6SC7	.72	12Q7GT	.75
1H5GT	.58	6AM8	1.10	6SF5	.72	125A7	.69
1J6GT	.69	6AN4	1.50	6SF5GT	.69	125A7GT	.69
1L4	.74	6AN5	2.75	6SF7	.92	12SC7	.75
1L6	.79	6AN8	1.15	6SG7	.65	12SG7	.79
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1LC5	.79	6AR5	.70	6SJ7GT	.59	12SL7	.85
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1LG5	.85	6AS7G	2.35	6SN7GT	.75	12V6GT	.73
1LH4	.85	6AS8	1.15	6SQ7	.59	12W6GT	.87
1LN5	.79	6AT6	.52	6SQ7GT	.59	14A4	.95
1N5GT	.59	6AT8	1.05	6SR7	.55	14A5	1.30
1Q5GT	.95	6AU4	1.05	6SS7	.75	14A7	.75
1R4	.65	6AU5	1.10	6ST7	.95	14AF7	.95
1R5	.65	6AU6	.65	6T8	.95	14B6	.69
1S4	.65	6BA7	.85	6U5	.85	14C7	.95
1S5	.65	6AV5	1.20	6U8	.95	14E6	1.05
1T4	.65	6AV6	.53	6V3	1.25	14E7	1.15
1T5	.69	6AX4	.79	6V6	1.10	14F7	.85
1U4	.67	6AX5	.69	6V6GT	.59	14F8	1.10
1U5	.59	6B4G	.95	6W4GT	.65	14H7	.85
1V	.65	6B8	.67	6W6GT	.79	14N7	.85
1V2	.59	6BA6	.63	6X4	.48	14Q7	.85
1V6	1.49	6BA7	.85	6X5GT	.49	14R7	1.20
1X2A	.85	6BC4	1.50	6X8	.95	14S7	1.10
2A3	.95	6BC5	.68	6Y6G	.89	14W7	1.25
2A6	.59	6BC7	1.20	7A4	.79	19BG6G	1.89
2X2	.49	6BD5	1.35	7A5	.69	19T8	.95
2X2A	1.35	6BD6	.73	7A6	.78	25AV5	1.25
3A3	1.08	6BE6	.65	7A7	.75	25AX4	1.05
3A4	.50	6BF5	.82	7A8	.75	25BK5	.95
3A5	.64	6BF6	.68	7AD7	1.65	25BQ6GT	1.25
3AL5	.65	6BG6G	1.75	7AF7	.89	25CD6G	1.75
3AU6	.70	6BH6	.79	7AG7	.95	25CU6	1.30
3AV6	.60	6BJ6	.69	7AH7	.95	25L6GT	.65
3B4	2.95	6BK5	.95	7B4	.75	25W4GT	.72
3B7	.39	6BK7	1.05	7B5	.65	25Z5	.75
3BC5	.80	6BL7	1.05	7B6	.75	25Z6	.62
3BN6	1.05	6BN6	1.10	7B7	.75	30	.65
3BY6	.75	6BQ6GT	1.15	7B8	.85	32L7	.85
3CB6	.80	6BQ7A	1.15	7C5	.75	35A5	.69
3CF6	.85	6BX7	1.20	7C6	.75	35B5	.68
3D6	.39	6BY5G	1.25	7C7	.79	35C5	.68
3LF4	.85	6BZ7	1.20	7E7	1.15	35L6	.65
3Q4	.65	6C4	.38	7F7	.85	35W4	.44
3Q5	.75	6C5	.48	7F8	1.10	35Y4	.65
354	.65	6C5GT	.46	7G7	1.10	35Z3	.65
3V4	.69	6C6	.49	7H7	.79	35Z5	.59
4BQ7A	1.30	6C8G	.85	7J7	1.25	41	.75
4BZ7	1.35	6CB5	4.40	7K7	1.15	42	.69
5AM8	1.05	6CB6	.68	7L7	1.10	43	.79
5AN8	1.10	6CD6G	1.75	7N7	.85	50A5	.68
5AQ5	.75	6CF6	.90	7Q7	.95	50B5	.68
5AS8	1.10	6CG7	.85	7R7	.95	50C5	.68
5AT8	1.10	6CL6	1.10	7V7	.95	50L6	.62
5AV8	1.15	6CM6	.85	7W7	.95	50X6	.85
5AW4	1.10	6CS6	.75	7X7	.90	50Y6	.78
5AZ4	.60	6CU6	1.30	7Y4	.65	50Y7	.78
5J6	.90	6D6	.59	7Z4	.65	53	1.25
5R4GY	1.45	6DC6	.95	12A4	.85	70L7	1.15
5T4	.90	6E5	.75	12A6	.57	75	.65
5U4G	.58	6F5	.59	12A8GT	.79	77	.47
5U8	1.10	6F6	.85	12AH7GT	1.05	78	.57
5V4G	.88	6F6GT	.69	12AL5	.65	80	.59
5V6GT	.70	6F7	.85	12AQ5	.70	81	1.85
5W4GT	.65	6F8G	.72	12AT6	.48	83	1.19
5X4G	.75	6G6G	.72	12AT7	.92	83V	.95
5X8	1.05	6H6	.59	12AU6	.62	84/6Z4	.49
5Y3GT	.49	6H6G7	.49	12AU7	.75	117L/M7	2.45
5Y4G	.65	6J4	2.55	12AV6	.52	117N/P7	2.45
5Z3	.69	6J5	.48	12AV7	.95	117Z3	.68
5Z4	.89	6J5GT	.47	12AW6	.95	117Z4	1.05
6A3	.95	6J6	.68	12AX4	.85	117Z6	.95
6A6	.82	6J7	.82	12AX7	.78		
6A7	.89	6J7GT	.65	12AY7	1.15		
6A8	1.05	6K6GT	.65	12AZ7	.85		
6ABGT	.95	6K7	.74	12B4	.85		
6AB4	.59	6K7GT	.59	12BA6	.60		
6AB7	.95	6K8	1.10	12BA7	.89		
6AC5	1.05	6K8GT	.95	12BD6	.70		
6AC7	.85	6L6	1.69	12BE6	.65		

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0B3/VR90	.73	5JP5	9.95
0C3/VR105	.68	5LP1	7.40
0D3/VR150	.68	5NP1	4.95
1B22	1.25	6AC7W	1.45
1B23	2.68	6AK5W	1.45
1B24	4.85	6AL5W	.95
1B27	12.95	6AQ5W	1.70
1B35	3.45	6AS6W	2.69
1B38	33.50	6BF7W	3.45
1B40	3.45	6C4W	6.75
1B41	14.95	6C21	14.95
1C21	1.89	6F4	2.65
1N21	.39	6J4WA	4.45
1N21B	1.45	6J5WGT	3.90
1N23	.68	6J6W	2.20
1N23B	1.40	6J6WA	3.90
1N34	.42	6K4	2.20
1N34A	.48	6SN7WGT	1.85
1P21	29.50	6X4W	1.20
1P22	13.25	6X5W	1.35
1P23	1.85	7BP7	4.45
1P24	1.45	12DP7	14.95
1P25	64.50	15E	1.45
1P28	8.95	15R	.49
1P30	1.95	28D7	.95
1P32	.95	100TH	6.25
1P39	1.45	100TL	8.25
1P40	1.25	211	.45
1P41	2.45	249B	2.95
1P42	2.35	249C	1.95
2AP1	4.95	250TH	18.95
2B22	1.95	250TL	14.75
2C21	.39	262B	4.95
2C34	.25	274A	3.45
2C36	21.50	274B	.85
2C39A	10.95	304TH	12.95
2C40	9.45	304TL	12.95
2C43	10.25	307A	1.10
2C51	2.95	350A	2.65
2C53	10.75	350B	2.35
2D21	.65	371B	.85
2D21W	1.95	393A	4.50
2E22	3.15	WL417A	2.95
2E24	2.40	417A/5842	
2E26	3.25		14.95
2E30	1.55	434A	2.95
2G21	2.45	450TH	47.50
2J31	14.00	450TL	35.00
2J32	12.50	575A	12.50
2J33	14.00	705A	.68
2J34	14.00	707A	4.95
2J36	14.95	707B	3.95
2J51	97.50	715B	2.95
2J55	59.50	715C	10.95
2J61	12.95	717A	.35
2J62	12.95	721A	.65
2K23	15.25	723A/B	8.45
2K25	11.95	725A	2.95
2K28	27.50	726A	4.95
2K33A	56.95	726B	32.50
3AP1	2.90	726C	32.50
3B24	1.50	750TL	65.00
3B24W	4.95	801A	.38
3B25	4.95	802	2.45
3B26	7.45	803	1.40
3B27	3.45	804	8.85
3B29	5.95	805	3.95
3BP1	2.45	806	4.85
3C22	59.50	807	1.18
3C23	3.45	808	1.25
3C24	1.48	809	2.20
3C45	5.95	810	10.50
3D21A	2.95	811	2.75
3DP1	3.25	811A	3.25
3E29	9.00	812	2.75
4-65A	16.95	812A	3.25
4-125A	24.95	813	9.95
4-250A	36.50	814	1.95
4C27	8.95	815	1.95
4C28	17.45	816	1.15
4C35	13.45	826	.65
4E27	8.50	828	7.42
4X150A	22.45	829B	7.95
4X150G	31.95	830B	.65
5BP1	2.35	832	5.75
5BP4	1.95	832A	7.95
5C22	27.50	833A	42.50
5CP1	1.95	836	1.45
5CP1A	8.45	837	1.25
5CP7	7.95	838	.69
5D21	7.45	845	4.85
5FP7	1.20	851	8.95
5J29	29.50	860	2.75
5J30	17.25	861	12.95
5J33	6.95	866A	1.15
5JP1	12.45	872A	1.25

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878	.48	5692	5.10	6101	1.45
884	.95	5693	4.65	6113	1.25
885	.95	5696	.90	6146	4.75
902	2.45	5702	1.95	6161	69.50
918	1.65	5703	.95	6187	3.95
923	1.25	5704	1.85	6189	2.25
925	1.50	5718	2.75	6263	11.45
927	.95	5718A	4.75	6264	11.45
930	1.19	5719	2.15	6539	2.95
931A	2.95	5725	1.45	8005	4.75
954	.25	5726	.60	8008	3.95
955	.35	5727	1.25	8012	.98
956	.35	5732	2.95	8013	2.65
957	.35	5744	1.75	8013A	3.75
958A	.35	5751	1.45	8014	67.50
959	1.32	5762	99.50	8020	1.25
991	.29	5763	1.25	8025	1.45
1603	2.95	5783	4.45	9001	.82
1616	.50	5787CK	4.05	9002	.60
1619	.30	5794	5.95	9003	1.20
1622	1.45	5812	2.70	9004	.35
1624	.95	5814	.95	9005	1.39
1625	.29	5819	32.50	9006	.25
1626	.19	5820	495.00	C1JA	10.95
1633	.85	5823	1.35	C6J	7.95
1635	1.48	5829	1.35	CK1005	.32
1641	1.35	5840	4.40	CK1006	3.45
1654	1.75	5841	7.40	CK1007	.65
2050	1.25	5844	.95	CK1038	4.70
2051	.65	5851	3.45	CK1039	4.70
5516	6.45	5876	12.50	F123A	2.75
5517	1.65	5879	1.25	F127A	22.50
5634	6.95	5881	2.95	F128A	14.95
5636	2.90	5886	3.25	FG17	4.95
5637	4.95	5894	15.95	FG27A	10.90
5638	7.45	5896	4.45	FG32	3.95
5639	8.95	5899	3.95	FG95	17.50
5641	5.95	5902	5.95	FG105	12.95
5642	.95	5905	8.75	FG172	17.95
5643	5.95	5906	14.95	HF100	6.95
5647	3.95	5908	7.85	HF200	9.95
5651	1.35	5932	3.95	HF300	17.50
5654	1.25	5933	2.25	WL616	47.50
5656	7.90	5963	5.45	RK65	7.50
5670	1.10	6021	4.45	RK72	.50
5675	10.95	6080WA	7.95	RX21	5.50
5676	1.25	6096	1.45	TZ40	4.95
5678	1.25	6097	1.45		
5686	1.95	6098	1.85		

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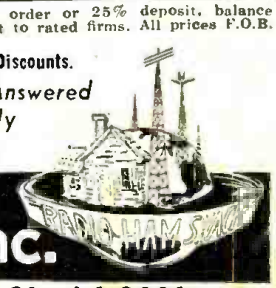

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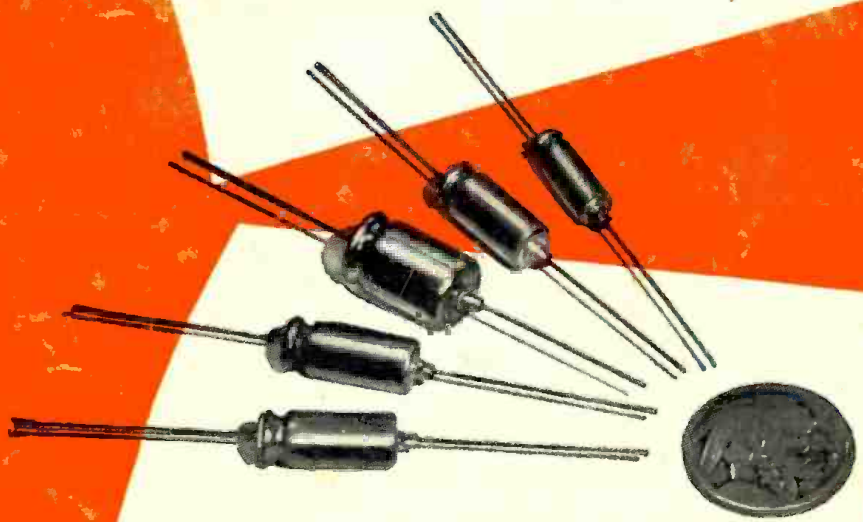

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