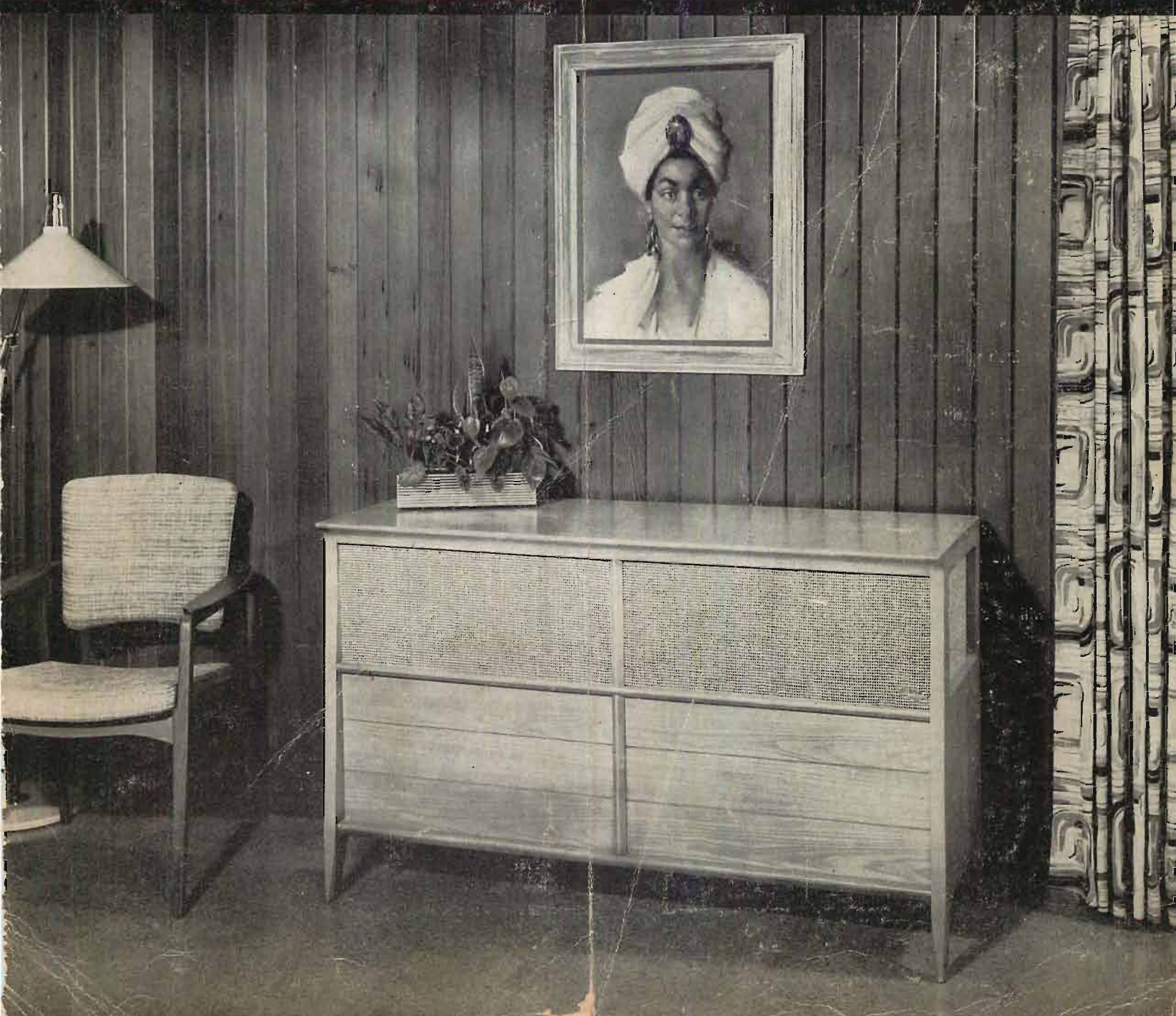


AUDIO

OCTOBER, 1958
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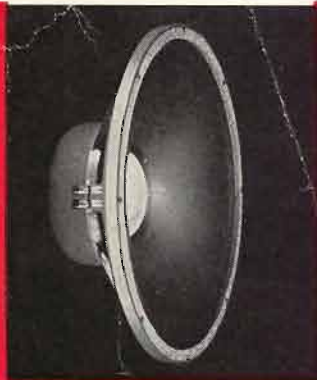


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COVER PHOTO—Jensen DS-100 Dual Stereo loudspeaker system. Turn to page 4 for full description.

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary, Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S. Possessions, Canada and Mexico, \$4.00 for one year, \$7.00 for two years, all other countries, \$5.00 per year. Single copies 50¢. Printed in U.S.A. at Lancaster, Pa. All rights reserved. Entire contents copyrighted 1958 by Radio Magazines, Inc. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

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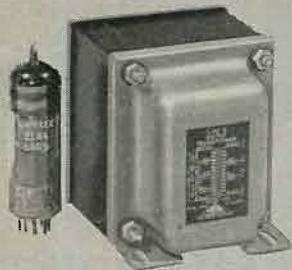
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AUDIOCLINIC??

JOSEPH GIOVANELLI*

Transformer Impedance

Q. I was recently given what seems to be a fine output transformer, but I don't know its impedance. The wires are divided into two groups, the first of which contains those colored red, blue, and reddish yellow, while the second contains those colored black, brown, orange, and yellow. The first group is evidently the primary, and the second, the secondary, but how will I proceed from here? Al Kerper, Brooklyn, N. Y.

A. My first recommendation would be to locate the model number and the name of the manufacturer of the transformer, and then consult his catalogue for the desired information. If, for any reason, you are unable to follow this course, proceed as follows:

Assume first that you have correctly identified the groups of wires. Red goes to one plate, blue to the other, and reddish yellow to B plus. (proper phasing of the primary leads can be found only by trial & error. If the phase is reversed, the amplifier will oscillate. Black is probably the common on the secondary winding. It is probable that the brown is the 4-ohm tap, orange the 8-ohm tap, and yellow the 16-ohm tap. However, to be certain, measure the resistance of each lead with respect to black, or common, arrange the leads in order of ascending resistance values, and they will be in order of ascending impedance values, although the resistances do not equal the impedances. You will find that the lowest resistance you will come across will be less than one ohm, whereas the impedance represented by this resistance is 4 ohms.

You now have the probable impedances of the secondary and next you must find the impedance of the primary. This is done by connecting a resistor of appropriate value across the secondary, feeding in a signal from an audio oscillator at a given voltage, and then noting the voltage appearing across the primary. The square of the voltage ratio between the signal fed in and the voltage appearing across the primary gives the impedance ratio of the two windings.

Illustration: Start with the 8-ohm tap. Connect an 8-ohm resistor from this tap to common. Connect your audio generator across this resistor and feed the secondary with 1 volt of signal of approximately 400 cps. Measure the voltage appearing between the red and blue leads (primary). Be sure to use a fairly sensitive a.c. voltmeter for this purpose, so as not to load down the primary circuit. Let us assume that you get a reading of 30 volts. Since the ratio of the voltage fed in to that appearing across the primary is 30:1, the turns ratio is also 30:1. The impedance ratio is equal to the square of the turns ratio, so we find that the impedance of the primary is 30², or 900 times that of the secondary. Since the impedance of the

secondary is 8 ohms, the primary impedance must be 7200 ohms. This primary impedance is correct only when the secondary is terminated in an 8-ohm load. Within limits, the transformer can be used to match a range of impedances. The only thing which is really constant is the turns ratio. Do not confuse the impedance of the transformer with that of the internal impedance of the amplifier. This latter is a function of the amount of negative feedback applied. A discussion of internal impedance can be found in an earlier AUDIOCLINIC.

Frequency Response

Q. Is it possible to sweep a high fidelity preamplifier or amplifier and observe the over-all response curve as is done in video alignment? If so, how? Also, how can I determine the frequency response of a loudspeaker? Robert A. Poltzer, Chicago, Ill.

A. Yes, methods for rapidly sweeping the audio spectrum are often employed. The audio generator is made to sweep the spectrum and is, of course, fed into the device to be checked out. The output of the device is connected to a scope for direct display, or to an assembly which moves a pen over a moving drum in accordance with the dips and rises in response. By this means, a permanent graph of the response of the equipment is obtained.

Measuring the response of a loudspeaker is quite complicated because of at least three variables which you will encounter besides that of the speaker itself. Were it not for these, the method would be quite simple. Feed a series of audio-frequency tones into the speaker. Place a microphone near the speaker to pick up these tones. The output of the microphone feeds the measuring device.

The first question which arises is: how flat is the response of the microphone? In order to be sure, you have two courses open to you. One is to use a calibrated microphone, especially designed for this type of work. The second is to send your own microphone to the Bureau of Standards to be calibrated. Then, superimpose the graph of the microphone's response over that of the plotted response of the speaker in order to obtain the speaker's true response.

Another problem is that of the room in which the measurements are made. Any resonances, antiresonances or reflections present within the room will greatly influence the response curve. It is necessary to make these measurements in a room designed especially for such work. Such a room is known as a space room, or anechoic chamber, because of its complete freedom from reverberations. Most of us do not have such rooms available, but we can approximate the conditions found in them very closely by making the measurements out-of-doors. A rooftop is a good spot, but it may be resonant at several frequencies, and the effect of this will to

* 3420 Newkirk Ave., Brooklyn 3, N. Y.

THE Garrard PAGE

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be given erroneous response readings. An unpaved area considerably removed from buildings or trees is probably the best location, but here you can run into the danger that ambient noise may be picked up by the microphone.

The last variable which may be encountered is that of the angle at which the soundwaves strike the diaphragm. It is undesirable to measure the frequency dispersion of the unit, rather than its frequency response.

Tuner Problems

Q. 1. The AM section of my tuner produces more hum and background noise than the FM. I have heard other tuners in which the AM section is quiet. 2. When I connect the FM section of the tuner to my double conical TV antenna, I receive the same station at many places on the dial. What is causing these two conditions and what can I do about it? Robert McDonald, Oakland, Calif.

A. 1. The hum which is present in the AM section of your tuner can be caused by several things: perhaps the AM section is not well filtered, leading to the supposition that perhaps one of the filter capacitors has become defective. There may be a leak between the heater and cathode of one of the tubes. It may be generated as a result of poor grounding or oxidized house wiring. If this latter is the case, I don't believe there is much you can do, especially if you are an apartment dweller as I am. There is also the possibility that the hum is caused by something on the line to which the tuner is connected. I have an AC-DC dictating machine which, when turned on, introduces hum into every AM receiver in the house. Hum arising from these last two sources can sometimes be minimized by the use of an outside antenna. It need not be elaborate. Make it about 20 feet long and keep it well insulated from surrounding objects. The lead-in wire from the antenna should be of coaxial cable, so that the lead-in cannot pick up any interference. Naturally, the shield of the cable should be returned to a good ground, as should your tuner chassis.

(Continued on page 104)

THE COVER PHOTO



The Jensen DS-100 Dual Stereo loudspeaker system on the cover represents a radical departure in stereo speaker system design. It consists of two complete three-way speaker systems in a single cabinet. All directional elements (the mid- and high-frequency units covering the range above 600 cps) are located on two Stereo Directors, shown above. These assemblies are swivel mounted so that the user can aim the direct sound at any desired angle with the cabinet flat against the wall. Two super-low-resonance woofers in duct-loaded acoustic enclosures are aimed at the floor for added loading.

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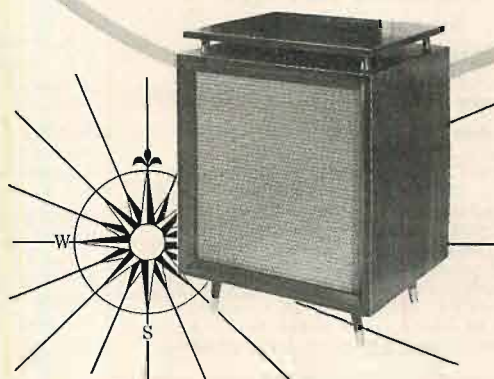
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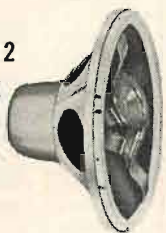
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LETTERS

FM Detector Information

SIR:

I am sure others beside myself have missed the AUDIO PATENTS column by Richard Dorf, since they were always interesting and informative, whether pertinent or not to the enjoyment of good quality sound and/or music.

Also, would it be possible soon to have an article on wide-band, low-distortion FM detectors, with particular reference to the "counter" type and the wide-band ratio detector as used by H. H. Scott. I suppose it would also be necessary to include something about the mechanics of wide-band i.f. circuits as used with these detectors. I seem to have missed all references to these in the literature except a few glib explanations.

WM. LEWIS,
2026 Bedford St.,
Los Angeles 34, Calif.

(Two excellent papers on FM detectors and i.f. amplifiers were published by the Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Mass., and may possibly be obtainable from them. These papers are: "Interference in frequency-modulation reception," by J. Granlund, Technical Report No. 42, Jan. 20, 1949; and "A receiver design for rejecting interference," by Roy A. Paananen, Technical Report No. 245, Sept. 22, 1952. Both are quite technical, and hardly suited to magazine reprinting, although simplified versions would be useful to most readers. We shall endeavor to cover the subject in the near future, however, as well as to get Mr. Dorf back. Ed.)

Stereo-Mono

SIR:

I have been interested and somewhat amused by the discussion about the proper nomenclature of non-stereophonic or usual method of sound reproduction.

Actually, neither of the two accepted methods is truly stereophonic. The single source method—our present "monaural" or "monophonic" system—presents the sound to the listener as if he were seated behind a window (to borrow a very apt description I once read in AUDIO). This sound has musical dimensions—frequency and amplitude—but it has no spatial dimension; it represents a single point. Whether the listener uses both ears or only one, it still is a point source to him.

The method we call "stereophonic," using two loudspeakers with each receiving signals from its own microphone and each separated from the other, does have space dimension. A listener is able now to perceive the direction of the sound but not the precise location of the source. This is not true stereo, nor does it require two ears. A person who is deaf in one ear can easily identify the direction from which a sound is coming in the same way a one-eyed person can point out an object but cannot accurately judge its distance. Certainly this isn't true depth perception. It is more like a photograph or a 2D motion picture.

The third method is the most perfect of all. It consists of placing two microphones alongside a dummy head at the location of the ears and carrying the sound picked up by each of these microphones to separate earphones, one on each ear of the listener. Now the listener is actually able to perceive depth. Each of his ears receives only the information which it would receive were he at the location of the microphone. With this method, the sound can circulate

around the listener, or can move nearer to or farther from him and he can still tell where the source is. This requires two ears, is the equivalent of visual stereo, and can properly be called stereophonic or binaural.

To get back to nomenclature, we are calling spatial sound reproduction "stereophonic" and even, at times, "binaural," neither of which is correct. People know what is meant, however, and the term will stay with us. Why not, then continue to call single-source reproduction "monaural," as long as everyone knows what is meant. We still call rubber "rubber" after one of its very minor uses.

JOEL C. HERTSCHE, JR.,
2105 N.E. Klickitat St.,
Portland 12, Oregon.

(In conversation, the terms already have degenerated to "stereo" and "mono"—thus effectively dodging the issue, or at least avoiding it. However, Dr. Olson's article in the September issue seems to offer already accepted definitions for the various terms, and during the past month the Institute of High Fidelity Manufacturers has accepted "monophonic" as the correct term for what we used to call "monaural"—or single-channel—reproduction. We think "monophonic" will win out in the long run. Ed.)

General Comments

SIR:

The AUDIOCLINIC article on negative feedback will possibly mislead many of your readers, as nowhere is it pointed out that the negative feedback in Figs. 1, 2, and 3 is a function of the internal impedance of the driving source connected to the input. A low-impedance source (such as a cathode follower) will allow very little feedback, and a zero-impedance source will allow none whatever.

Mr. Canby says ". . . there just ain't any two amplifiers alike. Not even two of a kind—though in theory they should be identical. . . . as soon as two of them are teamed together, all sorts of troubles and confusions pop up to prevent a smooth, balanced equality in the two sound tracks." What does Mr. Canby think a dual-channel stereo amplifier consists of, if not two of a kind? and why should these two of a kind be any more identical than any other two of a kind that do not happen to be on the same chassis? I doubt that manufacturers of stereo amplifiers do any selective matching of components to assure that both channels have exactly the same shape response curve and other features. I even doubt that the specs on part values are any tighter than those used for monophonic amplifiers.

WILLIAM C. HOLM,
919C Birch Road,
East Lansing, Mich.

(Interesting last paragraph, isn't it? We imagine Mr. Canby was referring to interconnection problems. Ed.)

Record, Anybody?

SIR:

I am trying to locate someone who owns a Russian record (Label MWL) of Arensky's Violin Concerto. I am collecting recorded violin concerti (have 164 already) and wish to add this one. I am willing to buy the record, rent it for taping, or buy a tape copy of same.

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Beautifully designed, this stereo equipment cabinet has ample room provided for an AM-FM tuner—tape deck—preamplifier—amplifiers—record changer—record storage and speakers. Constructed of $\frac{3}{4}$ " solid-core Philippine mahogany or select birch plywood, beautifully grained. Top has shaped edge and sliding top panel. Sliding doors for front access. Mounting panels are supplied cut to fit Heathkit units with extra blank panels for mounting your own equipment. Easy-to-assemble, all parts are pre-cut and pre-drilled. Includes all hardware, glue, legs, etc. and detailed instruction manual. Speaker wings and center unit can be purchased separately if desired. Overall dimensions with wings 82" W. x 37" H. x 20" D. Send for-free details.



DELUXE AM-FM TUNER KIT

HEATHKIT
MODEL PT-1 **\$89⁹⁵**

Here is a deluxe combination AM-FM tuner with all the advanced design features required by the critical listener. Ideal for stereo applications since AM and FM circuits are separate and individually tuned. The 16-tube tuner uses three circuit boards for easy assembly. Prewired and prealigned FM front end. AFC with on/off switch—flywheel tuning and tuning meter.



STEREO PRE- AMPLIFIER KIT

HEATHKIT
MODEL SP-2 **\$56⁹⁵**

This unique two-channel control center provides all controls necessary in stereo applications. Building block design lets you buy basic single channel now and add second snap-in channel later for stereo without rewiring. 12 inputs each with level control—NARTB tape equalization—6 dual concentric controls including loudness controls—built-in power supply.



55 WATT HI-FI AMPLIFIER KIT

HEATHKIT
MODEL W-7M **\$54⁹⁵**

First time ever offered—a 55-watt basic hi-fi amplifier for \$1 per watt. Features EL-34 push-pull output tubes. Frequency response 20 CPS to 20 KC with less than 2% harmonic distortion at full output throughout this range. Input level control and "on-off" switch provided on front panel. Unity or maximum damping factors for all 4, 8 or 16 ohm speakers.



12 WATT HI-FI AMPLIFIER KIT

HEATHKIT
MODEL UA-1 **\$21⁹⁵**

Ideal for stereo applications, this 12-watt power package represents an outstanding dollar value. Uses 6BQ5/EL84 push-pull output tubes. Less than 2% total harmonic distortion throughout the entire audio range (20 to 20,000 CPS) at full 12-watt output. Designed for use with preamplifier models WA-P2 or SP-1. Taps for 4, 8 and 16 ohm speakers.

For complete information on above kits—Send for FREE FLYER.

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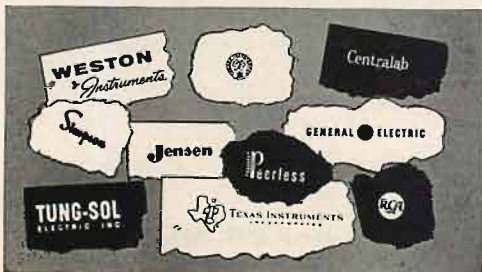
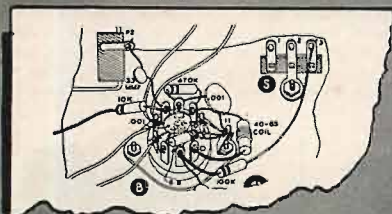
high quality

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- ✓ Install a .001 μ fd disc condenser from socket B7 (NS) to ground lug B11 (NS). Cut the leads so that they are just long enough to reach and dress the condenser close to chassis, over the wires already present.
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Read the step . . . perform the operation . . . and check it off—it's just that simple! These plainly-worded, easy-to-follow steps cover every assembly operation.

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Detailed pictorial diagrams in your Heathkit construction manual show where each and every wire and part is to be placed.

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Kit construction is not only fun—but it is educational too! You learn about radio, electronic parts and circuits as you build your own equipment.

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HEATHKIT

bookshelf 12-watt amplifier kit

MODEL EA-2

NEW

\$28⁹⁵

There are many reasons why this attractive amplifier is a tremendous dollar value. You get many extras not expected at this price level. Rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern" styling, making it suitable for use in the open, on a bookcase, or end table. Look at the features offered by the model EA-2: full range frequency response (20—20,000 CPS \pm 1 db) with less than 1% distortion over this range at full 12 watt output—its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special hum control—and it's easy-to-build. Complete instructions and pictorial diagrams show where every part goes. Cabinet shell has smooth leather texture in black with inlaid gold design. Front panel features brushed gold trim and buff knobs with gold inserts. For a real sound thrill the EA-2 will more than meet your expectations. Shpg. Wt. 15 lbs.

TIME PAYMENTS AVAILABLE ON ALL HEATHKITS WRITE FOR FULL DETAILS



chairside enclosure kit

NEW

This beautiful equipment enclosure will make your hi-fi system as attractive as any factory-built professionally-finished unit. Smartly designed for maximum flexibility and compactness consistent with attractive appearance, this enclosure is intended to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the majority of record changers, which will fit in the space provided. Adequate space is also provided for any of the Heathkit amplifiers designed to operate with the WA-P2. During construction the tilt-out shelf and lift-top lid can be installed on either right or left side as desired. Cabinet is constructed of sturdy, veneer-surfaced furniture-grade plywood $\frac{1}{2}$ " and $\frac{3}{4}$ " thick. All parts are precut and predrilled for easy assembly. Contemporary available in birch or mahogany, traditional in mahogany only. Beautiful hardware supplied to match each style. Dimensions are 18" W x 24" H x 35 $\frac{1}{2}$ " D. Shpg. Wt. 46 lbs.

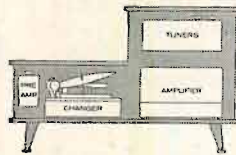


CE-1C Mahogany
CE-1CB Birch



CE-1T Mahogany

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Be sure to specify model you prefer

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HEATHKIT

high fidelity FM tuner kit

For noise and static free sound reception, this FM tuner is your least expensive source of high fidelity material. Efficient circuit design features stabilized oscillator circuit to eliminate drift after warm-up and broadband IF circuits assure full fidelity with high sensitivity. All tunable components are prealigned so it is ready for operation as soon as construction is completed. The edge-illuminated slide rule dial is clearly numbered for easy tuning. Covers complete FM band from 88 to 108 mc. Shpg. Wt. 8 lbs.

MODEL FM-3A \$26.95 (with cabinet)



HEATHKIT

broadband AM tuner kit

This tuner differs from an ordinary AM radio in that it has been designed especially for high fidelity. A special detector is incorporated and the IF circuits are "broadbanded" for low signal distortion. Sensitivity and selectivity are excellent and quiet performance is assured by a high signal-to-noise ratio. All tunable components are prealigned before shipment. Incorporates automatic volume control, two outputs, and two antenna inputs. An edge-lighted glass slide rule dial allows easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

MODEL BC-1A \$26.95 (with cabinet)



HEATHKIT

master control preamplifier kit

Designed as the "master control" for use with any of the Heathkit Williamson-type amplifiers, the WA-P2 provides the necessary compensation, tone, and volume controls to properly amplify and condition a signal before sending it to the amplifier. Extended frequency response of $\pm 1\frac{1}{2}$ db from 15 to 35,000 CPS will do full justice to the finest program material. Features equalization for LP, RIAA, AES, and early 78 records. Five switch-selected inputs with separate level controls. Separate bass and treble controls, and volume control on front panel. Very attractively styled, and an exceptional dollar value. Shpg. Wt. 7 lbs.

MODEL WA-P2 \$19.75 (with cabinet)

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HEATHKIT 25-WATT

MODEL W-5M

\$59⁷⁵



HEATHKIT 70-WATT

MODEL W-6M

\$109⁹⁵

high fidelity amplifier kits

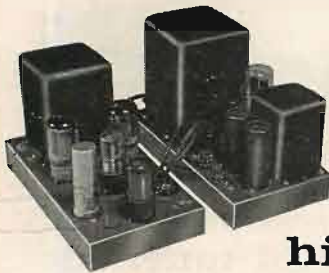
To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding high fidelity amplifiers available today. The high peak-power handling capabilities of the W-5M guarantee you faithful reproduction with any high fidelity system. The W-5M is a **must** if you desire quality plus economy! Note: Heathkit WA-P2 preamplifier recommended. Shpg. Wt. 31 lbs.

For an amplifier of increased power to keep pace with the growing capacities of your high fidelity system, Heath provides you with the Heathkit W-6M. Recognizing that as loud speaker systems improve and versatility in recordings approach a dynamic range close to the concert hall itself, Heath brings to you an amplifier capable of supplying plenty of reserve power without distortion. If you are looking for a high powered amplifier of outstanding quality, yet at a price well within your reach, the W-6M is for you! Note: Heathkit model WA-P2 preamplifier recommended. Shpg. Wt. 52 lbs.

HEATHKIT DUAL-CHASSIS

MODEL W3-AM

\$49⁷⁵



HEATHKIT SINGLE-CHASSIS

MODEL W4-AM

\$39⁷⁵



high fidelity amplifier kits

One of the greatest developments in modern hi-fi reproduction was the advent of the Williamson amplifier circuit. Now Heath offers you a 20-watt amplifier incorporating all of the advantages of Williamson circuit simplicity with a quality of performance considered by many to surpass the original Williamson. Affording you flexibility in custom installations, the W3-AM power supply and amplifier stages are on separate chassis allowing them to be mounted side by side or one above the other as you desire. Here is a low cost amplifier of ideal versatility. Shpg. Wt. 29 lbs..

In his search for the "perfect" amplifier, Williamson brought to the world a now-famous circuit which, after eight years, still accounts for by far the largest percentage of power amplifiers in use today. Heath brings to you in the W4-AM a 20-watt amplifier incorporating all the improvements resulting from this unequalled background. Thousands of satisfied users of the Heathkit Williamson-type amplifiers are amazed by its outstanding performance. For many pleasure-filled hours of listening enjoyment this Heathkit is hard to beat. Shpg. Wt. 28 lbs.



HEATHKIT

high fidelity amplifier kit

MODEL A-9C **\$35⁵⁰**

For maximum performance and versatility at the lowest possible cost the Heathkit model A-9C 20-watt audio amplifier offers you a tremendous hi-fi value. Whether for your home installation or public address requirements this power-packed kit answers every need and contains many features unusual in instruments of this price range. The preamplifier, main amplifier and power supply are all on one chassis providing a very compact and economical package. A very inexpensive way to start you on the road to true hi-fi enjoyment. Shpg. Wt. 23 lbs.



HEATHKIT

electronic crossover kit

MODEL XO-1 **\$18⁹⁵**

One of the most exciting improvements you can make in your hi-fi system is the addition of this Heathkit Crossover model XO-1. This unique kit separates high and low frequencies and feeds them through two amplifiers into separate speakers. Because of its location ahead of the main amplifiers, IM distortion and matching problems are virtually eliminated. Crossover frequencies for each channel are 100, 200, 400, 700, 1200, 2000 and 3500 CPS. Amazing versatility at a moderate cost. Note: Not for use with Heathkit Legato Speaker System. Shpg. Wt. 6 lbs.

NEW LOW PRICE!



"LEGATO"

high fidelity speaker system kit

Wrap yourself in a blanket of high fidelity music in its true form. Thrill to sparkling treble tones, rich, resonant bass chords or the spine-tingling clash of percussion instruments in this masterpiece of sound reproduction. In the creation of the Legato no stone has been left unturned to bring you near-perfection in performance and sheer beauty of style. The secret of the Legato's phenomenal success is its unique balance of sound. The careful phasing of high and low frequency drivers takes you on a melodic toboggan ride from the heights of 20,000 CPS into the low 20's without the slightest bump or fade along the way. The elegant simplicity of style will complement your furnishings in any part of the home. No electronic know-how, no woodworking experience required for construction. Just follow clearly illustrated step-by-step instructions. We are proud to present the Legato—we know you will be proud to own it! Shpg. Wt. 195 lbs.



MODEL HH-1-C
(imported white birch)
MODEL HH-1-CM
(African mahogany)
\$299⁹⁵ each



**HEATHKIT
BASIC RANGE**



**HEATHKIT
RANGE EXTENDING**

high fidelity speaker system kits

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SS-2

A truly outstanding performer for its size, the Heathkit model SS-2 provides you with an excellent basic high fidelity speaker system. The use of an 8" mid-range woofer and a high frequency speaker with flared horn enclosed in an especially designed cabinet allows you to enjoy a quality instrument at a very low cost. Can be used with the Heathkit "range extending" (SS-1B) speaker system. Easily assembled cabinet is made of veneer-surfaced furniture-grade 1/2" plywood. Impedance 16 ohms. Shpg. Wt. 25 lbs.

Designed to supply very high and very low frequencies to fill out the response of the basic (SS-1) speaker, this speaker system extends the range of your listening pleasure to practically the entire range of the audio scale. Giving the appearance of a single piece of furniture the two speakers together provide a superbly integrated four speaker system. Impedance 16 ohms. Shpg. Wt. 80 lbs.

MODEL **\$99⁹⁵**
SS-1B

Free Catalog!

Don't deprive yourself of the thrill of high fidelity or the pleasure of building your own equipment any longer. Our free catalog lists our entire line of kits with complete schematics and specifications. Send for it today!



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THE HOW AND WHY OF HIGH FIDELITY, by Milton Sleeper, explains what high fidelity is, and how you can select and plan your own system. This liberally-illustrated, 48-page book tells you the HI-FI story without fancy technical jargon or high-sounding terminology. **25c**

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Sound Talk



by John K. Hilliard

Director of Advanced Engineering

LOUDSPEAKER EFFICIENCY

Loudspeaker efficiency is an important design factor that is often overlooked or misunderstood by those who enjoy high fidelity. It is only logical to assume that any device should be engineered to be as efficient as possible whether it is an auto engine, an amplifier or a loudspeaker.

Speakers which have very low efficiency were not designed with that feature in mind. Rather this low efficiency is a by-product of one of the simpler and less expensive engineering methods used to achieve bass response and low distortion.

Such designs, in an effort to achieve greater bass and low distortion, utilize a heavy cone which has inherently low resonance. This heavier mass provides greater bass but carries with it the high price of poor transient response, loss of mid and high-range efficiency and smoothness, and heavier amplifier requirements.

Many speakers following this design approach require as much as 16 times the amplifier power to obtain the same listening levels as more efficient units. Ten watts versus 160 watts seems like an extreme design compromise. Few, if any, of the stereo amplifiers will provide sufficient power for full dynamic range at normal listening levels with such low efficiency speakers.

With a more carefully integrated design approach, and the acoustical laboratories necessary to truly evaluate results, it is not necessary to make this compromise to achieve bass. A properly designed magnetic structure will provide a strong flux throughout a long air gap. Cones, with their compliance and voice-coil designed for long linear excursion throughout the audio range, will operate in this high flux with great efficiency. Such a design has low distortion and good bass without any compromise in efficiency or transient response.

All ALTEC speakers are the result of such integrated design principles. Their bass reproduction is in proper balance with the rest of the audio spectrum. Their distortion and transient response have received careful attention. Their efficiency is as high as present engineering art permits.

It should be remembered that a good loudspeaker design need not sacrifice a part of the whole performance in order to provide a single outstanding feature.

Listen critically at all levels of loudness. You will readily distinguish the superiority of ALTEC loudspeakers.

Write for free catalogue: ALTEC LANSING CORPORATION, Dept. 10A-B, 1515 S. Manchester Avenue, Anaheim, Calif., 161 Sixth Avenue, New York 13, N. Y. 12-39

BOOK REVIEW

Music and Western Man, edited by Peter Garvie (Philosophical Library, 328 pp., \$7.50).

In 1955 the Canadian Broadcasting Corporation organized a series of fifty weekly one-hour programs designed to trace the development of Western music by means of commentary and recorded illustrations. Twenty-one critics, musicologists, composers and musicians took part in the symposium, which covered more than twenty centuries of music. When listeners began to write in, asking for copies of the scripts and information regarding the discs played, C.B.C. producer Peter Garvie was convinced that his series had the makings of a fine book. Accordingly, he edited the entire set of lectures and arranged for their publication.

In terms of scholarship and musical authority, the list of contributors to this new survey of music history is impressive: Paul Henry Lang, Karl Geiringer, Denis Stevens, Gustave Reese, Willi Apel, and the other 16 writers are names any anthologist would be proud of. The book is carefully edited, includes an index, and notes related books and records. Yet, despite the quality of its parts, **Music and Western Man**, as a whole, falls short of the mark.

In the book's Preface, Mr. Garvie writes that his aim was "to provide a history of music in western civilization and to explore western civilization through one of its aspects." A tall order, indeed. Even the best-intentioned editor must realize that, with several contributors to contend with, he cannot hope for a perfectly uniform approach. **Music and Western Man** proves no exception to this rule. In some chapters, the historical perspective is treated in detail, but it is only touched upon in others. The writing, too, varies from one author to the next, ranging from dry to colorful, academic to informal.

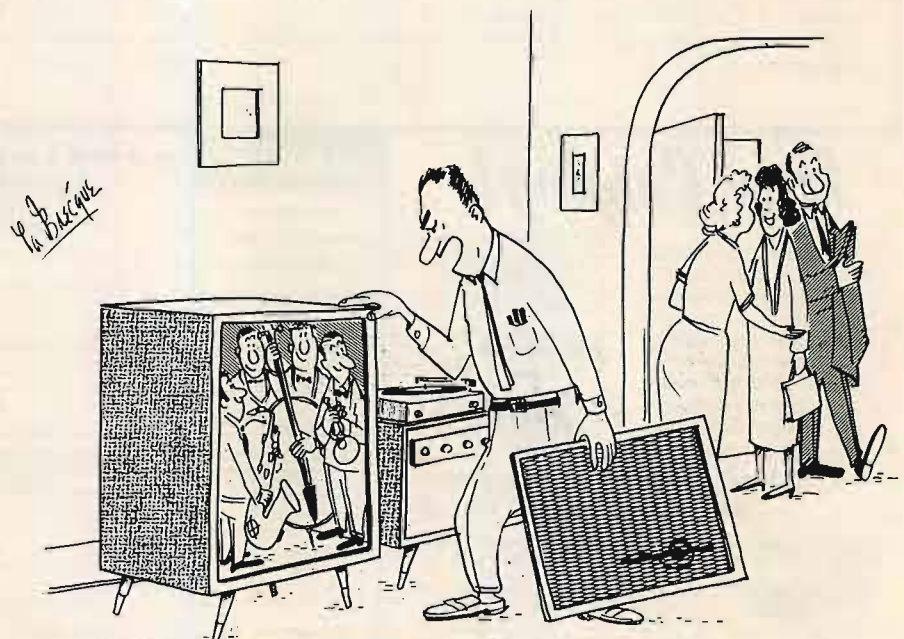
Perhaps the book's chief shortcoming is that it was originally conceived for the

ear rather than for the eye. Within the framework of a radio broadcast, the commentator cannot examine his subject as thoroughly as on the printed page. The clock becomes his master, and the pacing of the script an all-important consideration. During the course of the programs, records are played to illuminate the commentary, thus adding the depth of understanding that words alone cannot supply. In his chapter on the medieval *trouvères*, Denis Stevens describes a song for soloist and chorus by Guillaume d'Amiens: "A young swain is making amorous advances to an attractive brunette who is trying to keep her mind on the cows she is supposed to be looking after. The chorus chimes in after every verse: 'Keep a lookout! Is anyone watching? If anyone's watching us, give me a shout!'" At that point, the record is played, and the listener properly enlightened.

But what is the reader to do about the hundreds of similar recorded examples sprinkled throughout the book? Unless he already has a superb record collection (highly unlikely in view of the fact that this book is designed for the music lover whose musical knowledge and experience is limited), or has access to an unusually large record library, he will be hard put to find all the records listed in the book. For one thing, some of them were privately recorded especially for the broadcasts. Others are discontinued 78-rpm. records, and many of the LP discs are parts of multi-record albums, such as the *History of Music in Sound* (RCA Victor).

To be successful, an enterprise of this nature requires the collaboration of a book publisher and a record company. In this way, all musical examples will have been recorded by one company, and will be as accessible to the music lover as the text itself. As a series of radio programs, **Music and Western Man** seems a praiseworthy idea, but a great deal is lost in the "translation."

—Harold Lawrence



"The minute he says his sounds more realistic, you know what to do."

SOUND AS NATURAL AS

the Roar of the Surf



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Edward Tatnall Canby

1. THE GREAT IMPROVEMENT

I'm feeling much better this month about stereo—as I knew I would, given a little time.

Last month's somewhat dismal effusion was, I felt, a necessary expression of a state of mind through which most of us who listen to stereo have already gone, or will have to pass, in these early days of a new era. If the facts were few and the constructive tips practically nil last month, the confusion and the indecision were genuine.

I asked the editor how he had reacted to what I wrote and he opined, somewhat glumly, that well, he supposed it had to be said. It did.

But now the skies are clearing. The blue is just over yonder. I am now enjoying almost every stereo disc worth enjoying. I can, at last, write record reviews of the stereo discs in no more than twice the time it takes to review a comparable mono disc. Only occasionally, now, do I start a new stereo record and find myself three or four hours later still stuck with it, fiddling with equipment, speaker placement, phasing, balance, distortion (in the record? or somewhere else?) and so on.

I'm beginning, finally, to be able to judge a stereo disc for itself without having to go through endless comparisons, backtrackings, changes of feeling, doubts, unpleasantnesses. And best of all, I'm beginning to be amazed at the high quality of the latest batch of stereos that have come in. Also, retroactively, the fine quality of some of the earlier ones. One must constantly re-assess, re-judge, re-listen, in this formative period of what is in part a new phonograph art. It takes work and it takes time.

It'll accordingly pass on to you my present thinking, on a more positive and definite plane than last month's. It'll change further, of course, as will yours, while the discs come in and the new stereo playing equipment burgeons.

Level

As evidence piles up, there are several rather clear-cut areas where you may expect a bit of trouble in stereo disc. Maybe "trouble" isn't the right word, for I mean in some cases a positive annoyance like distortion and in others a negative lack, like missing bass.

First, there is the matter of recorded level. It varies presently from one record to another in rather drastic degree, as noted in the RECORD REVUE. Some stereo discs are cut really high-level, others seem remarkably low. Perhaps, to tell the truth, the difference is really not much greater than in the past with mono disc. But if so, it is far more touchy in the stereo situation.

Cutting level is, of course, the sum result

of a whole batch of crucial factors and represents a sort of final balance, for the moment, as chosen for a particular set of circumstances. Judgments differ, circumstances differ, compromises that may be made are many. The choice may be—low-level.

Low-level stereo disc is dangerous right now, as mentioned in one of my record reviews, because we have prevalent troubles with hum and rumble. Jack up the playback volume and up comes whatever rumble and/or hum is present in the system. Good equipment, as mentioned last month, ideally has no audible hum and virtually no rumble, but in practice the hum creeps in a lot more than twice as easily when two circuits must work together. And the rumble problem is greatly increased by the two-way stretch, the vertical rumble element added to the lateral plus all the rumble-angles in between.

The decisions in stereo cutting are painful ones in this respect. Natch—a high level is desirable for best reproduction in relation to hum and rumble. But a low level is equally desirable, from a different point of view, to allow longer playing time and relatively low distortion.

Length of Play

It is interesting to note that a number of companies have deliberately tied themselves to stereo-mono disc equality by assigning the same catalogue numbers and titles—and even the same cover—to their stereo and mono releases. This is a brave move, since it states in effect that stereo can be cut equally with mono, at as great a playing time and with top matching stereo quality, that the sacrifices, if any, are tolerable, even now. But the engineers of these committed companies must have had many nightmares these last months trying to put this principle into practice!

Other companies, more cautious, are initiating separate stereo catalogues with separate record numbers (and even separate labels occasionally), thereby reserving the unspoken right to put less music on the stereo disc, if and when advisable. As usual, Columbia and RCA are on opposite sides in this respect, Columbia being the cautious one.

The plain fact is that the necessary compromises right now are distinctly less favorable for stereo than for mono wherever the compromise is crucial. Something has to be done, somewhere. The first thing to give, in this judiciously necessary compromise, is the length of play. You'll find that a good many of your stereo discs are therefore on the short side, some of them definitely skimpy. At a wild guess, I'd say that the average stereo disc so far is about ten per cent shorter than the equivalent in standard mono LP. New titles, new numbers, new covers, disguise this factor; but it is there and is surely legitimate. Shorter play is clearly the most direct road

towards top stereo sound. The playing time can be again increased (as it was in standard LP) as improvements make it possible.

So don't be a bit surprised if the stereo disc version of a particular recording turns out to have an item or two less on it than the same record in mono form. It could even happen in the case of RCA. Note that the stereo *tape* version of RCA's "Hi-Fi Fiedler" contained only half of the original LP content (the rest came out on a separate tape) though the same title and the same cover picture are used for both the long LP and the shorter tape.

Don't forget that there are many recordings that are just naturally brief enough to be cut in both mono and stereo without compromise. Plenty of room. It's the lengthy material that makes trouble, the long Beethoven works, for instance. They cannot be shortened by a single note and often the original mono version is already crammed in pretty tightly. To get these items onto stereo disc requires some further compromise and/or risk of distortion. It appears usually in a lowered volume level, as in the Vanguard Beethoven series and in some of the Capitol-Angel discs of a similar persuasion. (See the Beethoven Seventh Symphony, in the RECORD REVUE.) But the compromise may also turn up in other ways—or show up in distortion when the calculations have been too close, especially in the crucial inner grooves. (See Mercury's Gershwin disc, also reviewed this month.)

Less Bass?

Bass is the next-easiest way out. Most sound energy is in the bass; reduce your bass and you can raise the over-all level, lengthen the playing time, reduce all sorts of mechanical troubles in the playing motions. Standard RIAA equalization theoretically is able to take care of this factor, for stereo grooving as it has for standard; the curves are the same. In the end, we can assume that this is the fact; for the time being and in present practice, bass isn't that easy to manage. It's my impression that a lot of stereo discs now coming out have been quietly reduced in bass, in order to make other problems collectively manageable.

I've just played one such disc. It has a gorgeous sound, seems to be plenty loud in the over-all, is beautifully miked and is cut as clean as a whistle. But I can't hear the bass. I didn't notice it for a while; you don't, if the music is good and the sound too. (And it still might be merely that the bass instruments were miked further away and so less loud.) Nevertheless, my sense tells me that there is reduced bass here. Boosting it helps the musical effect, but brings in too much rumble for comfort. The impression made by this particular disc fits in with other experiences.

I've already been making random AB comparisons, when time has allowed, directly between the mono and the stereo versions of the various recordings. I get both in some cases. And I have found that quite often (a) the mono level is higher and (b) the mono bass range is noticeably fuller, deeper in sound than the stereo.

How about the pickup? At first, the differences in bass content between stereo and mono discs may be confused by noticeable differences in the two types of playing cartridge. It is a phenomenon to me so far unexplained that most stereo cartridges seem to reproduce a weaker bass than their mono equivalents. Is the lack of reproduced bass perhaps here in the cartridge, not in the stereo disc? No. Try one car-

(Continued on page 94)

**STEREO
STEREO
AND
MONAURAL**

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FM Tuner HFT90



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HF81



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EDITOR'S REVIEW

THE HI-FI SEASON

BY THE TIME this issue is in the hands of readers, the 1958 Hi-Fi season will be well under way. The Chicago show will be a thing of the past, as will the Rigo shows in Albany, Syracuse, and Rochester, and the IHFM High Fidelity Show in New York will be in progress. Each year it seems as though there is greater public interest in our industry, and more and more "hi-fi" phonographs and radio-phonograph combinations are being sold to those who have heard the magic words and thus entered into the ranks of the thousands who find much real enjoyment in good reproduction of music.

Even the radio networks are beginning to take notice of the growing interest in good music, and some are already feeling their way into the intricacies of stereo. We do not have the slightest doubt that some form of stereo broadcasting will be agreed upon and become common within the next twelve months. For the sake of good quality and the minimum use of air space, we hope the method will be FM and multiplex, and if there is enough public interest it is possible that the FCC will rule in its favor.

While we are wholeheartedly in favor of the sum-and-difference method of stereo broadcasting as proposed by Murray G. Crosby—and currently undergoing engineering tests at New York's WBAI, we think that some modifications of his proposal might be more readily acceptable to the background-multiplex people, who have investments in equipment and who are engaged in businesses which have been made possible by FCC regulations. The presence of wide-band multiplex adapters in the hands of the public would certainly lower the value of the background music services even though "pirating" of the programs is illegal. There are always some who risk the illegality for the sake of a few dollars.

One of the problems of multiplexing is the crosstalk between main and sub-carrier channels, and the closer the channels are the more crosstalk there is likely to be. The use of a 50-kc subcarrier for stereo broadcasting, allowing for a 25-kc swing, covers both presently used multiplex bands, and consequently the background stations can be heard on an adapter of the Crosby type. The wide swing of the Crosby carrier undoubtedly gives a better signal-to-noise ratio, but present background stations are doing quite well with respect to noise with considerably less swing.

We think that if the stereo subcarrier were to be set at 35 kc, for example, a swing of ± 15 kc would thus range from 20 to 50 kc. Allowing for a 5-kc clearance band, the background subcarrier could be set at 67 kc and allow a swing of ± 12 kc—which, we are told, is adequate, and many are swinging in the range of 6 to 8 kc. Then all background multiplex stations might readily use 67 kc, which many are already using, and adapters or receiver-adapters for the public could be made so as not to receive the 67-kc

subcarrier. This would permit the continuance of the multiplex background services, which undoubtedly fill a definite need at present, and would still provide for a stereo-multiplex service, which would then function as a sum-and-difference method. The increased crosstalk between the lower stereo sub-channel and the main channel might be increased somewhat, but we do not believe that this would be detrimental to the stereo effect. Channel separation on stereo pickups is seldom more than 20 db, and this seems to be thoroughly adequate; we are told that 30–35 db can be obtained fairly easily, even with the 32.5-kc subcarrier now in use by some stations.

We are of the opinion that this distribution of the subcarriers would serve both stereo and background interests in a thoroughly satisfactory manner. The use of the entire subcarrier spectrum for point-to-point services does not serve the general public particularly, but we do not think that the broadcasters should displace the background operators from their established businesses, certainly not without due remuneration. It should be possible for the two services to co-exist without any degradation of either one.

MONTEREY JAZZ FESTIVAL

There was a time when a jam session consisted of a few musicians and perhaps twice as many jazz buffs in a smoke-filled room some evening. But in the past few years these sessions have grown into festivals, lasting several days and attended by thousands. The session in Monterey, California, which is to be held early this month, has really become "big business" requiring a \$35,000 installation of sound reinforcement and recording equipment, with some 525 watts of power being available to drive the five complete speaker systems consisting of 22 separate speaker units. The entire installation will be handled by Ampex—which is almost close enough to run back to from Monterey to get a forgotten cable or microphone.

In any case, full information about the installation is too long for this column, but we have been promised pictures and a complete description for next month. We believe it will be interesting.

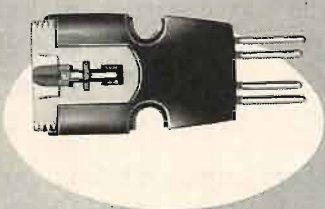
ERRATA, AGAIN

The photo of Harman-Kardon's FA-10 tuner-amplifier which appeared on page 44 of the September issue was incorrectly labeled the F-10. The tuner, of course, has only two controls, and is somewhat smaller in size.

E. B. Harrison, of Altec's Peerless transformer division, calls our attention to an error in the number of the transformer used in the Isodyne amplifier described in the August issue—it should be S-258-Q instead of S-268-Q as shown on the schematic. He's right, of course, since the latter is a discontinued item.

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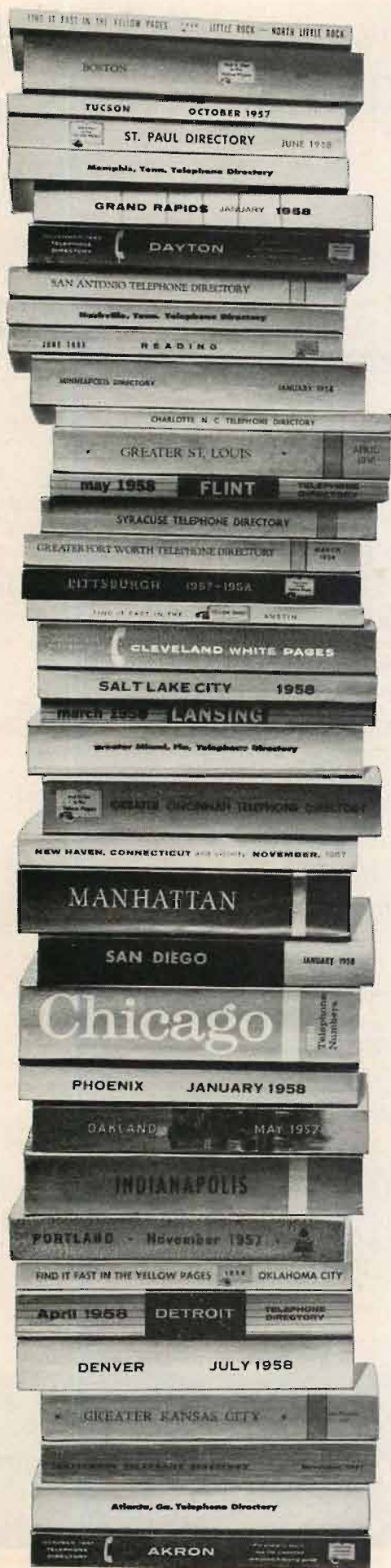
PHOTOGRAPHED BY MORT WELDON



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1 in 35,000,000

How the telephone switching system sorts numbers in seconds

When you dial out of town, the telephone switching system performs an amazing feat. It sorts out the one other number in 35 million you want, and connects you to it in seconds. The other telephone may be thousands of miles away.

Bell Laboratories engineers endowed this great switching network with almost superhuman capabilities. As you dial, the machine listens, remembers, figures out the best route, makes connections, alerts, reports, even corrects itself. If it detects trouble on the way, it files a report, then chooses other circuits and goes on to complete your call. All you are aware of is the end product—the completed call.

Yet at Bell Telephone Laboratories, switching engineers see the present system as only a beginning. Ahead they see—and are developing—new systems vastly more flexible and capable than today's. Nowhere in telephone technology is the challenge greater. Nowhere are dreams coming true faster.



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These Bell Telephone System directories list some of the 35,000,000 telephones now linked by the Direct Distance Dialing system developed at Bell Laboratories. In seconds, this unique machine sorts out and connects you with precisely the number you want.

A Two-Way Stereophonic Amplifier

B. B. BAUER,* J. HOLLYWOOD,* and G. MAERKLE*

With this ingenious circuit, stereophonic phono systems may be reduced in number of tubes required and consequent cost while maintaining low distortion and simple amplifier design for medium-power installations.

NOT THE LEAST of the problems of stereophonic reproduction is that of space and cost. The necessity of providing two separate reproducing channels doubles everything with the exception of the pickup stylus. It is evident that if stereophony is to be enjoyed by a wide segment of population, new engineering approaches must be found for minimizing the bulk and cost of stereophonic equipment without sacrificing quality. The amplifier described in this article helps to solve this problem.

The new amplifier is called a "two-way amplifier" because it uses a single push-pull stage to amplify two independent signals. Its total power output is equivalent to that of a single push-pull amplifier using the same tube complement. The separation between the two channels on the average is better than 25 db. The cost is only a little more than that of a single push-pull amplifier and considerably less than that of two separate push-pull amplifiers of similar total performance.

To understand the principles upon which the new amplifier is based, reference is made to Fig. 1, which illustrates

* CBS Laboratories, 227 High Ridge Road, Stamford, Connecticut.

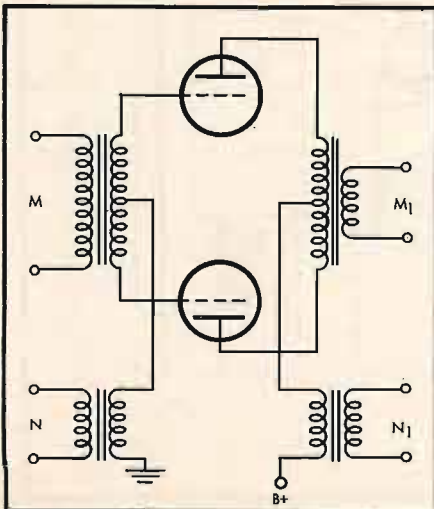


Fig. 1. Amplification of two signals with a push-pull stage.

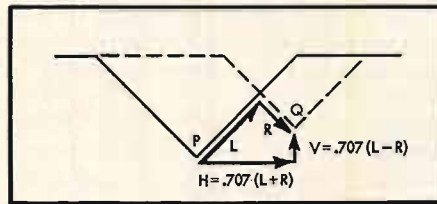


Fig. 2. Equivalence of 45/45 L and R modulation and H and V Sum-and-Difference modulation.

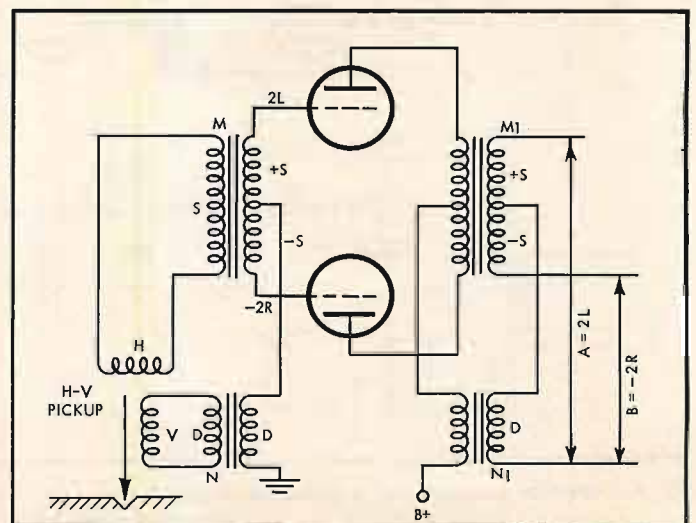
a push-pull output stage operating in class A or AB. This stage differs from a conventional transformer-coupled push-pull stage in having two instead of one input and output transformers. A signal applied to the winding M only will drive the two grids in opposition, so that the stage will perform in a conventional push-pull fashion, i.e. an output signal will appear at the winding M_1 , and since the incremental plate currents will be oppositely directed there will be no output at N_1 . A signal applied to the winding N only will drive both grids equally and the incremental plate current will be in the same direction resulting in parallel operation, i.e. there will be output at N_1 , but not at M_1 . Such a push-pull stage will amplify two independent signals with little interaction, and it could conceivably be used to am-

plify the left (L) and the right (R) stereophonic signals independently of each other. Its operation, however, would not be entirely satisfactory. One of the obvious faults, for example, is that the two channels are not identical. The push-pull channel will have a greater power handling capacity than the parallel channel for given frequency response and distortion, and in stereophonic work it is best to provide channels of equal capacity for both signals.

Improved Circuit Arrangement

An improved circuit can be provided by considering an additional principle. In Fig. 2 is shown a stereophonic groove in cross-sectional view. Let us assume that in the process of modulation the apex of the groove is driven from the point P to the point Q . This comes about because of two stereophonic 45/45-deg. signals L and R . We notice at this point that *precisely* the same result would have been accomplished by a horizontal modulation $H = .707(L + R)$, and a vertical modulation $V = .707(L - R)$. Therefore, except for the factor .707, a 45/45 modulation is equal to a horizontal-vertical modulation in which the sum signal $S = L + R$ is recorded horizontally and

Fig. 3. Reproduction of Left and Right channels played as S and D signals with a Horizontal-Vertical pickup.



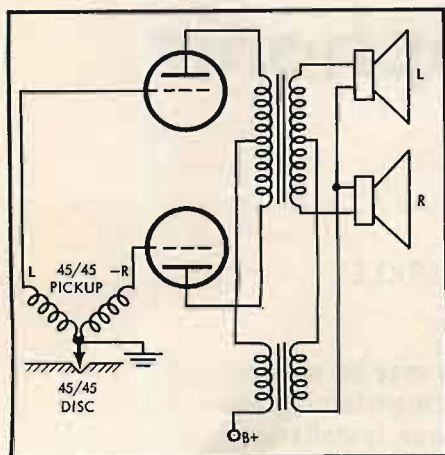


Fig. 4. The use of the Two-Way amplifier with a 45/45 pickup.

the difference signal $D = L - R$ is recorded vertically. This is an important identity which should be kept in mind: The two systems are really one and the same but are merely expressed by a different set of equations. It has been observed that the sum signal S is apt to carry the bulk of the power while the difference signal D principally conveys the stereophonic information.

Let us now consider one way of combining these principles to achieve the reproduction of a 45/45 record with the single push-pull stage. The record may be reproduced with a horizontal-vertical pickup connected as shown in Fig. 3.

The horizontal section reproduces the sum signal $S = L + R$ and its output is applied to the input winding M which will actuate the stage in accordance with its maximum power handling capability. The vertical section reproduces the difference signal $D = L - R$ and its output is connected to the winding N . The winding M_1 is now center-tapped and provided with sufficient turns to generate two signals $+S$ and $-S$. One side of N_1 is connected to this center tap. The voltages between the other side of N_1 and the two free ends of M_1 now may be calculated as follows:

$$A = D + S = (L - R) + (L + R) = 2L$$

$$B = D - S = (L - R) - (L + R) = -2R$$

Thus we see that a horizontal-vertical pickup combined with the special push-pull stage and matrixing output transformers will produce two independent L and R signals from a 45/45 disc. These two signals may be applied to the stereophonic loudspeakers in the usual manner; noting however that the phase of one of them is reversed, but this can be readily corrected by reversing one pair of leads. The performance of this unit will be indistinguishable from that of two independent amplifiers and loudspeakers driven with a 45/45 pickup.

Use with 45/45 Pickup

The final question now can be answered: How to use this stage with a

45/45 pickup? Consider the potentials at the grids of the tubes. Referring again to Fig. 3, the upper grid has a potential $(L - R) + (L + R) = 2L$ and the lower grid has the potential $(L - R) - (L + R) = -2R$. Therefore, the potentials at the two grids are equal and opposite to those supplied by a conventional 45/45 pickup. Some stereophonic pickups have four terminals and they will be directly usable with the two-way amplifier by suitable connection. Other pickups are purposely provided with terminals of opposite polarity. Such an arrangement is shown in Fig. 4.

It should be noted that by reversing the phase of one of the stereophonic signals, the single stage will continue to handle a virtual sum signal in push-pull and a virtual difference signal in parallel, and this will utilize its capabilities most effectively. One of the loudspeakers is also reversed in phase as previously mentioned to preserve the proper phasing of the sound from both channels.

Advantages

The two-way amplifier has several advantages over two equivalent single-ended amplifiers. A good single-ended stage is difficult to design because of the saturation of the output transformer iron. In the two-way amplifier the push-pull transformer is not subject to saturation. This transformer carries the sum

(Continued on page 92)

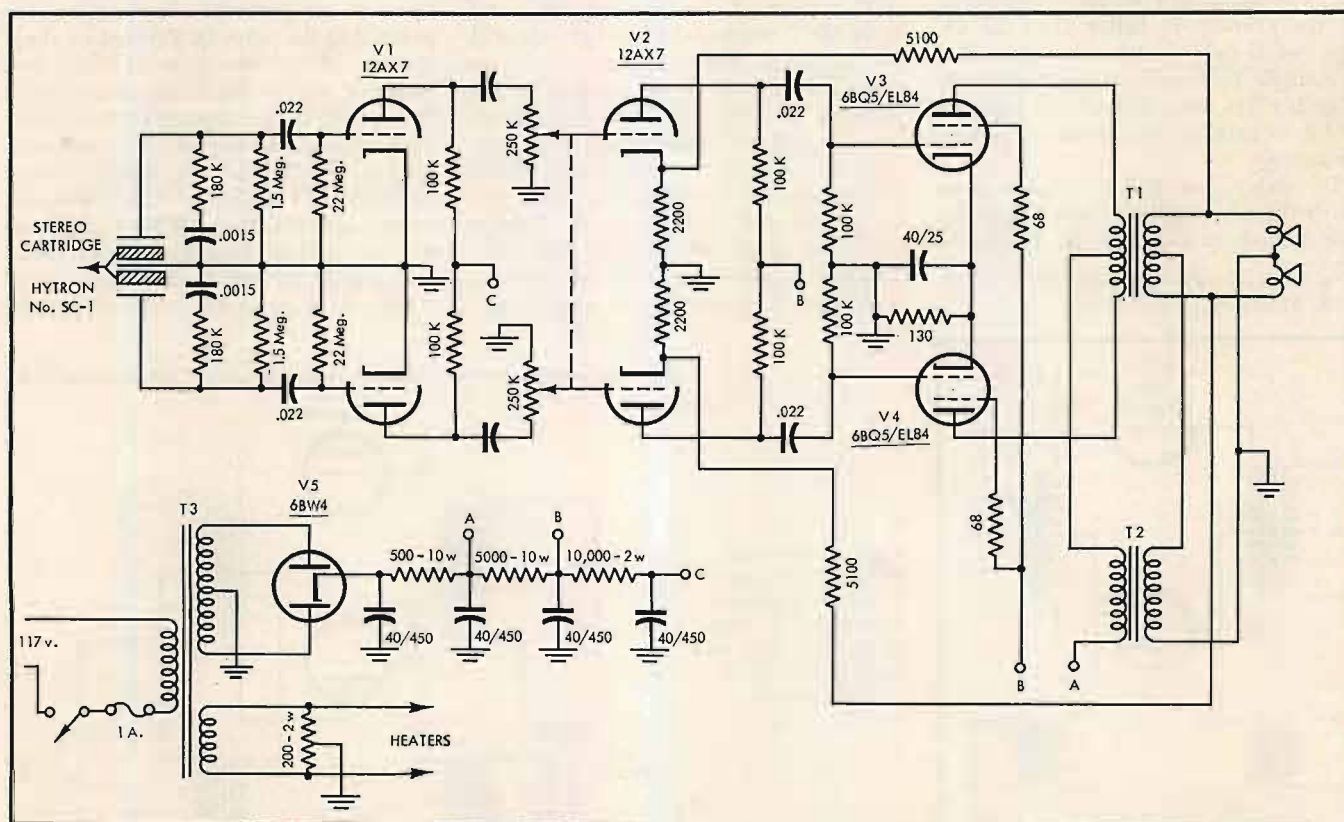


Fig. 5. Complete schematic of a practical amplifier using the Two-Way principle to provide a total of 10 watts of power at less than 1 per cent harmonic distortion.

The Two Approaches

To build in or not to build in—that is the question. And here are two examples which have been created by or for their owners and which satisfy their individual tastes in decor.

AS LONG AS PEOPLE DIFFER in tastes, there will be differences in the insides of their homes. Some enjoy the built-in installation with its many advantages, while others prefer conventional furniture with *its* many advantages. Living habits certainly differ from house to house, and the requirements seem to differ just as widely.

An exponent of the "furniture" school, Robert L. Cantillo, of 2726 Valentine Avenue, Bronx, N. Y., remodeled an old buffet considerably, hinging its top, and replacing the legs with more modern ones, and installed a complete system in the result. The photo at the right shows the finished unit, which houses a Concertone 1401 tape recorder, Weathers turntable and pickup, Glaser-Steers changer, Radio Craftsmen AM-FM tuner, and an EICO preamplifier, together with a 30-watt McIntosh amplifier. When not in use, the controls are hidden behind two panels which are covered by the same type of grille cloth as that at the top.

The built-in approach is shown below—an installation planned for a family in Tucson, Arizona. In this photo, sent us by Louise Price Bell of that city, all the necessary equipment is accommodated in a one-wall music center. The TV set is at the right height for viewing from twin couches in the corner opposite, the record player is in its own little niche, with the preamp controls above the TV set, speaker switches for the entire house under the player compartment, and the AM-FM tuner below. Musical instruments are stored behind closed doors, kept free from dust, and records are on conveniently sloped shelves at the left.



Standing Waves—An Audio Booby Trap

WILLIAM D. BELL*

The acoustics of the listening room have always been considered important, but the analysis and cure have not often been discussed. The author describes one type of trouble and tells how to correct for it.

NOT LONG AGO I witnessed an impressive static rocket-engine test. The test stand was nestled in a ring of hills in a remote, isolated spot. When the engine was fired, it shot a column of fire, smoke, and steam blistering down a canyon, and the tremendous energy shook the very ground of the distant hill where I stood. Sound levels? 180 db and more at the engine—enough to burst your eardrums, or worse, if you were close. As I watched this awesome demonstration, the terrifying sound level rose higher and higher and then abruptly weakened, suddenly reversed itself and grew stronger again. The wavering sound effect continued. Later, I asked one of the test engineers how they controlled the rocket engine to make it change its power setting. The engineer laughed. "What you were hearing," he said, "wasn't a change in the sound of the engine; it was just *standing waves* in the valley."

This rocket-engine demonstration was probably as impressive a display of standing waves as anyone could ever hope to hear. The same phenomena can make a perfect hi-fi rig sound mediocre. What are standing waves? How do you know if they exist? And what can you do about them?

Take the case of Ed Goldenears.¹ Ed built his own amplifier and preamplifier. He designed his speaker box and had it made by a first-class cabinetmaker. He put a great deal of care and expense into the selection of all components of the system. When he was done, his wife said, "It sounds wonderful!" All of his neighbors and friends agreed. Ed, being a genuine golden-ear, said, "It just doesn't sound right!" He had listened to reproduced sound in some of the best recording studios in Hollywood and he knew just how good reproduced music could sound.

Our friend Goldenears diligently checked his system; he ran frequency tests, power-level tests, distortion tests, and speaker-box tests. So far as he could

tell, he had an exceptionally fine system. But it just didn't sound right!

Remembering the long-standing argument between the triode purists and the pentode advocates, he revamped the output stage of his amplifier. Triodes were substituted for the pentodes formerly used. Again he ran extensive listening tests. He played the same passages over and over, at low level, MEDIUM level, and HIGH level. Over and over and over. This sort of thing almost drove Mrs. Goldenears, who didn't have golden ears, crazy. Fortunately, she didn't know that worse was yet to come.

So far as Ed could tell, the change in tube types made no difference—it still just didn't sound right. The next step was to change output transformers and try the Ultra-Linear circuit. This didn't help, either.

Ed was both diligent and persistent. He took his expensive speakers out of the cabinet and took them to the manufacturer. "They're no good," he stated, belligerently. The manufacturer ran frequency-response tests on the speakers and compared them with new speakers coming off the line. Ed's speakers were excellent. Their self-resonance was way down where it should be. Nevertheless, he had the manufacturer remagnetize the permanent magnets, just to make sure nothing was wrong. Remounted, the speakers still didn't sound right.

A speaker box plays a large part in any high-fidelity system. It was natural that Ed next directed his attention to his lovely mahogany bass-reflex speaker enclosure with its twenty coats of hand-rubbed lacquer. He placed a resistor in series with the lead to the speakers, used an oscillator to feed his amplifier, and by measuring the voltage across the series resistance, located the resonant peaks of both the box and the speaker. He saved out the bass-reflex ports in the speaker box to make them larger. He covered the holes to make the ports smaller. He increased the internal bracing of the box for better rigidity. He converted the bass reflex to an in-

finite baffle. He converted the infinite baffle to an exponential horn.

For every change made in the speaker box, a complete set of response curves was taken. Our friend Goldenears was nothing if not a perfectionist. Moreover, he was not going to be misled by taking too wide spacing in his frequencies and thus miss pertinent information. The sine-wave oscillator alternately made the big woofer boom, shaking the pictures on the walls, and then shrieking until Ed's wife held her ears. And so Ed, testing and checking, went on—day after week after month. Two years elapsed. The system still just didn't sound quite right! Ed was aging rapidly, and his wife was getting old twice as fast.

One weary night, Ed was for the umpteenth time running response curves on the system. The familiar bedlam of groans, moans, and shrieks began to issue from the powerful speakers. Ed's wife stood in the doorway, her lips moving as she pantomimed an ultimatum which neither she nor her husband could hear. The door slammed behind her, and Ed was alone for another night of research into the mysteries of High Fidelity.

Standing Waves Discovered

About half an hour later, a strange thing occurred. Ed Goldenears was crossing the room, intending to change the setting of the oscillator. Halfway across he suddenly stopped with a shocked, surprised look upon his face. In the spot where he was standing he could hear absolutely no sound! Hurriedly, he backed across the room and slowly, inch by inch, worked his way forward again. This time he hadn't found a dead spot. He slapped the side of his foggy head the better to clear his ears and tried it again. This time he found the dead spot again. Standing stiffly in the mysterious spot, he slowly rotated his head from side to side. He found that he could make the sound come and go by the position of his head. Exploring further, he found that there were spots in the living room where the sound was much

* Route 2, Box 923, Tucson, Arizona.

¹ Not his real name.

louder than it was in other locations. He tried shifting the frequency of the signal generator from 190 cps. A change of just a few cycles in either direction, and the phenomenon he had discovered disappeared. However, every time the oscillator stood at 190 cps, he could find spots of sharp silence and other locations of shockingly loud sound. Edward Goldenears had discovered standing waves—and the source of all his troubles!

The quality of sound reproduction depends not only upon turntables, preamplifiers, amplifiers, and speakers, but upon the acoustical environment of the hi-fi rig. In words of one syllable, the calibre of sound reproduction depends also upon the room in which the equipment is located.

This is why a hi-fi system that sounded wonderful at the dealer's may sound only mediocre in your own home. Or vice versa!

We are all familiar with reverberation, which we recognize as the "liveness" or "deadness" of a room. When we visit an empty house, our footsteps are loud as we walk across the bare floor, and speech is often muffled and garbled. This is because there is nothing in the house to damp the sound—no rugs, no draperies, no furniture. Instead, the hard surface of plaster wall and hardwood floors cause the sound to bounce in multiple, continuous reflections. Such empty rooms have very long reverberation time constants.

At the other extreme are the acoustical "dead" rooms that have been built for making accurate sound measurements in an area free of reflections. Stand quietly for a moment in such a completely dead test area. You are soon conscious of a feeling of pressure in your head; your breathing is abnormally loud, and the pounding under your shirt sounds like Poe's *Telltale Heart*.

Sound waves follow the same laws of reflection as light waves. Under normal circumstances, a sound bounces around randomly within a room and is rather quickly absorbed by damping materials in the room. There remain the special circumstances that create standing waves. This occurs in small rooms with parallel reflecting surfaces. Unfortunately, this is a perfect description of the rooms in which we live and play our high-fidelity systems. We have ceilings exactly parallel to the floor, at least in most houses. The four parallel walls of each room are hard, reflecting plaster or glass.

Causes

What causes the standing wave? To answer this question, we must first remember the nature of sound. Sound travels in waves from either the source of the sound or from a reflection. A

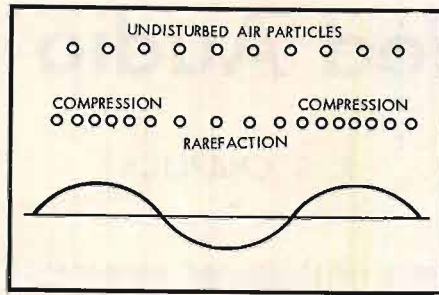


Fig. 1. Particle distribution along a sound wave.

sound wave exists as a compressional wave motion in an elastic medium, the air. *Figure 1* illustrates how a simple sine wave consists of a series of successive areas of compression and rarefaction. When a reflected wave exactly matches compression with a rarefaction area of the original sound, cancellation occurs. When the reflected signal is in the same phase as the original, the sound waves reinforce themselves, and as they reflect back and forth the amplitude of the sound increases. These are standing waves! Sound reinforcing at such critical frequencies can amount to 20 to 25 db or more! Thus, the standing-wave frequency may actually be heard ten to twenty times as loud as other frequencies. The whole room resonates at some critical frequency, just as a bass-reflex speaker box resonates to reinforce the low-frequency range.

Understanding a little about standing waves, it is obvious why Ed Goldenears' hi-fi system didn't sound right to him. All of the effort of producing a really superior reproducing system is aimed at securing linear reproduction—all frequencies are reproduced at the same sound level. And yet, in Ed's case, one frequency—190 cps—was amplified twenty times louder than any other frequency—*amplified by the room itself!*

Typically, serious reinforcement of a critical frequency will occur when the wave length of the sound is twice the height of the ceiling. Standing waves

can also occur at a harmonic of the fundamental. In one case of a living room that was carefully measured, the fundamental frequency of standing waves was related to the height of floor to ceiling and the fourth harmonic of that fundamental to the wall-to-wall dimensions within the room.

How can you tell if there are standing waves in your hi-fi area?

Finding and Curing the Trouble

The best solution is to follow the example of our old friend, Ed Goldenears. Get a sine-wave oscillator and start experimenting. Your primary requirements are a lot of patience and the ability to maintain diplomatic relations with the woman in your house. The human ear is, after all, a very sensitive sensory device. Attempting to explore a typical room with a microphone is very difficult, or impossible, because of the multiple reflections.

What do you do if you find that standing waves are affecting the quality of your reproducing system? The best answer is to move, and this time make certain that your new hi-fi quarters involved rooms of adequate dimensions, with no parallel walls or floors and ceilings, and with optimum reverberation characteristics. If such an upheaval in your domestic life poses problems, there is another answer.

What must be done is to insert a deliberate nonlinear characteristic into your amplifier response. Thus, at the critical frequencies, your hi-fi rig will put out less energy, but this lesser energy will be amplified by the room resonance to make the over-all response approximately correct. (It's things like this that make high fidelity an art and not a science!)

Ed Goldenears followed the first plan of action, moving not because of the hi-fi system, but because of his job. He soon discovered that his new home had standing-wave resonances, also! He then

(Continued on page 65)

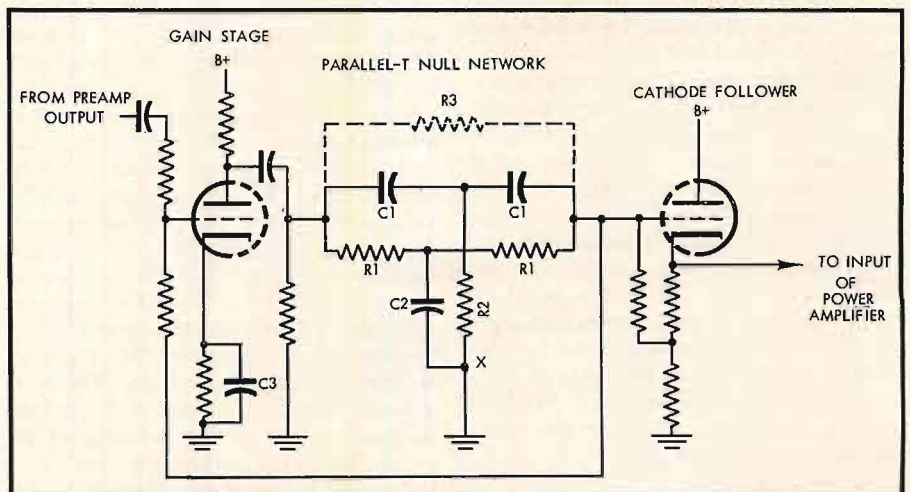


Fig. 2. Standing-wave neutralizing circuit.

A Simplified Audio Amplifier

R. G. CHAPLICK*

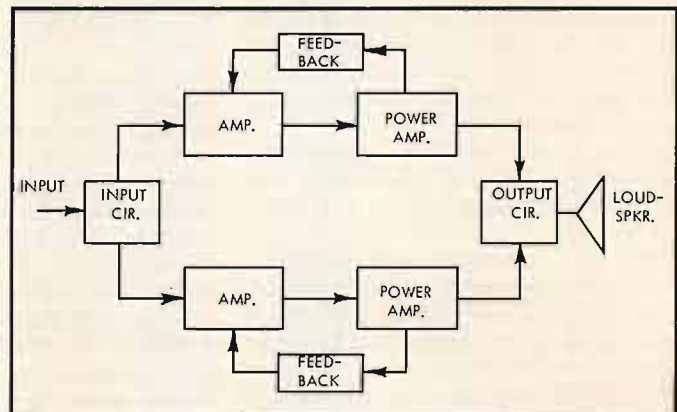
For the home constructor who wants reliability and permanence of performance, this return to time-tested engineering principles will be thoroughly appreciated. In addition to a simple and clearly presented design, the author throws in some excellent tips useful in everyday audio work.

RECENT DESCRIPTIONS and photographs in audio magazines indicate that there is a marked lack of simplicity in home audio systems. Operation of some systems can only be compared to the complexity of a guided missile count-down. The advantages of system simplicity were previously presented by the author,¹ and the application of simplicity to an amplifier unit will be discussed herein. The main benefit of simplification is improved reliability instead of the built-in obsolescence characteristic of present day American products—what one buys becomes obsolete between the store and home. A simplified amplifier having year-in, year-out dependability can be installed and forgotten.

Because countless amplifier circuits, ranging from small ten-watt units to the 100-watt laboratory units which are now popular, are available, readers undoubtedly will question the need for still another circuit. Unfortunately, designers of high fidelity amplifiers have not retained design features of professional broadcast equipment. These features, which help to improve reliability, have changed very little in the past decade. For example, broadcast amplifiers are of fixed design and do not need adjustment whereas nearly all high fidelity amplifiers require at least one adjustment for proper tube operation and a few require elaborate test equipment for this purpose. Many of the power supplies are over-elaborated beyond actual needs. Finally, the over-all gain of many preamplifier-amplifier combinations is too high. Current practice is to buy and to assemble a train of amplifiers with 30 to 50 db too much gain. Gain setting is then confined to the first 20 deg. of a rotary control, and the remaining 300 deg. is wasted. (This situation is somewhat analogous to those automobile engines which have 300 horsepower although only 100 are really needed.) Questions asked in audio magazines verify that too many people have the misconception that only the first 20 deg. should be used. Listeners should not be alarmed by the necessity for full rotation of the gain control.

* 10001 McKenney Avenue, Silver Spring, Md.

Fig. 1. Simplified block schematic of amplifier.



The reliability of an amplifier is improved by several methods. (1) Individual parts which have a known high reliability are used exclusively. (2) Reliability is inversely proportional to the number of parts. Therefore, by a simple decrease in the total number of parts the reliability can be increased. Although distortion is also inversely proportional to the number of parts, reduction of distortion will not be as startling as the improvement of reliability. (3) Design unity is built-in. That is, each chassis is complete in itself and is not dependent for power on any other chassis.

Critical Points

High fidelity enthusiasts probably will feel helpless with an amplifier without adjustments. However, a few disadvantages of adjustments are as follows. First, sliding contacts are notoriously unreliable, and elimination of them improves reliability. Second, assume that an amplifier has a potentiometer in the cathode circuit of the output tubes to balance the plate currents and to prevent saturation of the transformer core. How often is it balanced? Third, is this balance really critical? An extremely low percentage of distortion can be achieved by precise adjustment. Conversely, misadjustment of the same control results in high distortion. Moreover, a home amplifier is not a laboratory instrument and should not require readjustment or recalibration each time the power is turned on. Since small degrees of distortion can scarcely be heard

and large degrees are intolerable, a fixed, dependable, middle ground is preferred. Furthermore, the output transformer recommended herein has a permissible d.c. primary unbalance of 15 percent. In this manner audible distortion results chiefly from aging tubes which can be replaced.

An amplifier intended to reproduce music should reproduce the music as naturally as possible. Maximum naturalness depends upon a number of factors. The speaker system and the listening room acoustics have great influence, but a discussion of these items is out of place in this article. Noise in both the amplifier and the listening room should be at a minimum. Obviously, a noisy room is not the proper place in which to listen to music, but the amplifier should be designed to have low noise in order to produce a high signal-to-noise ratio.

In addition, the dynamic range of the amplifier also should be high. That is, the amplifier should have enough power to reproduce any sudden high amplitude signal without clipping. Unfortunately, it is not always possible to predict whether the signal source will overdrive the amplifier. An ample reserve of power can be maintained easily by designing the system to drive the amplifier to half of its maximum power output with the average peak output signal from the preamplifier or control unit. Some automobile buffs may retaliate and say that half the power output is being thrown away. Such is not the case because a Hearing Contour Com-

this purpose. Many of the power supplies are over-elaborated beyond actual

feel helpless with an amplifier without

to listen to music, but the amplifier should be designed to have low noise in

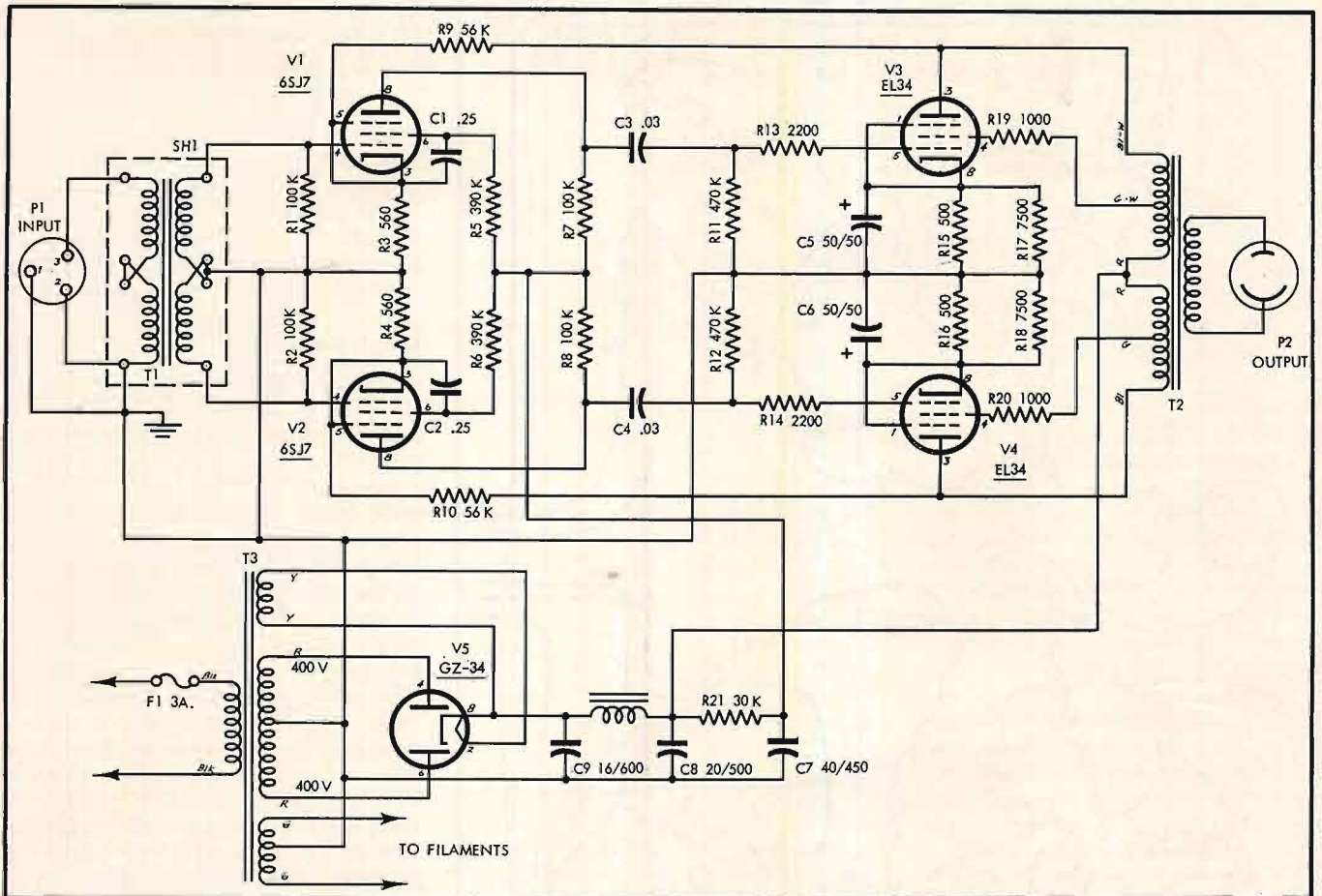


Fig. 2. Over-all schematic of the author's amplifier, which follows professional practice in design.

pensator in the control unit utilizes full output at low frequencies.

A properly designed amplifier does not require an elaborate and expensive power supply. A separate power supply to produce direct current for tube filaments is unnecessary in high-level circuits. Nor do filaments have to be biased above "ground" in such circuits.

Before a reader starts building an amplifier he should determine the needed

sensitivity. For example, the Mullard 520 amplifier² requires only 0.3 volts rms input to be driven to full output. On the other hand, one kit-type pre-amplifier has "Output to main amplifier, 0 to at least 2.5 volts rms from any normal program source." If this pre-amplifier-amplifier combination is used, a slight turn of the volume control can easily overdrive the amplifier. Obviously, more attention should be paid to the

input sensitivity.

Specifications for a simplified amplifier are now easy to make:

1. The amplifier should be flat from 20 to 20,000 cps.
2. Distortion should be at a minimum.
3. The signal-to-noise ratio should be high.
4. The input sensitivity should be matched to the preamplifier output.
5. There should be no adjustments.
6. No high-voltage leads should be out-

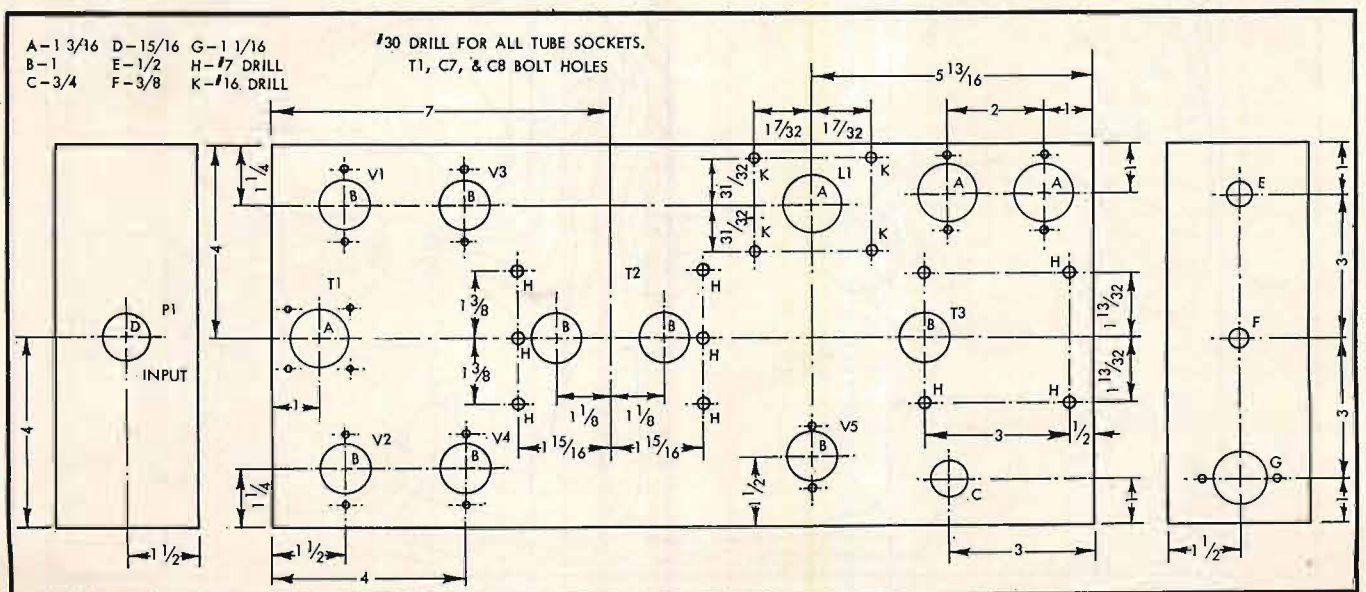


Fig. 3. Dimensional chassis layout for the amplifier.

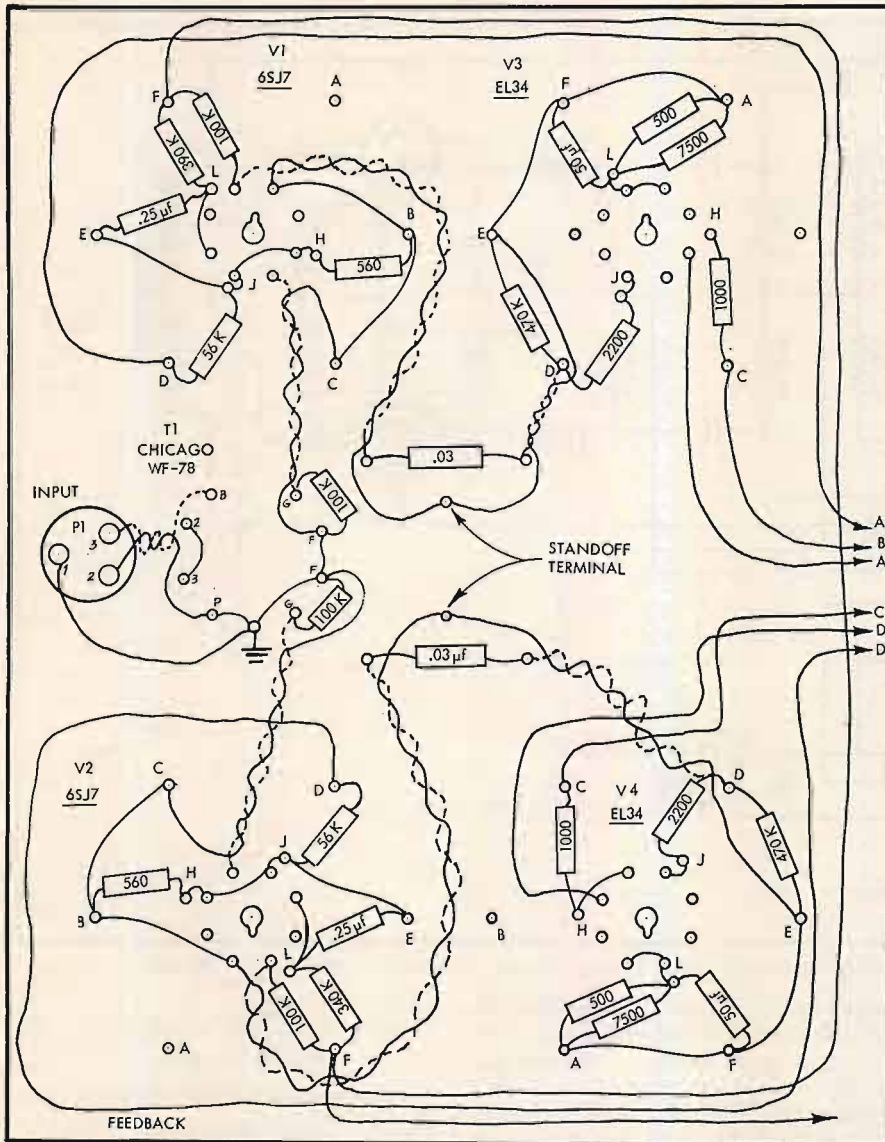


Fig. 4. Wiring diagram for Vector sockets used in both amplifier stages.

side the chassis. With proper part orientation the amplifier and its power supply can be on a single chassis.

7. For home use the peak power output should be about 30 watts.

Discussions of these specifications with an audio consultant lead to the amplifier block diagram shown in Fig. 1, and the complete schematic in Fig. 2. Essentially, the amplifier consists of three main circuits: output, input, and feedback.

Circuit Description

Output Circuit. The output circuit of the Mullard 520 amplifier² is used to take advantage of the high power output.

Input Circuit. The input circuit consists of the necessary amplifier and phase-splitter stages to drive the output circuit. Much has been written recently on the subject of phase splitting. Unfortunately for the high fidelity field, a very simple device, an input transformer, has been avoided for phase splitting. The input transformer probably has fallen into disrepute because it will not pass a perfect square wave. The author does not listen to square waves, since other methods of testing steady and transient response are available and the lack of square corners is of little importance. High-quality musical reproduction is the primary object of this amplifier.

After reading about phase splitters the author finds no scientific and only two non-technical disadvantages of input transformers. The disadvantages cited most often are cost and space required. The Chicago Standard transformer

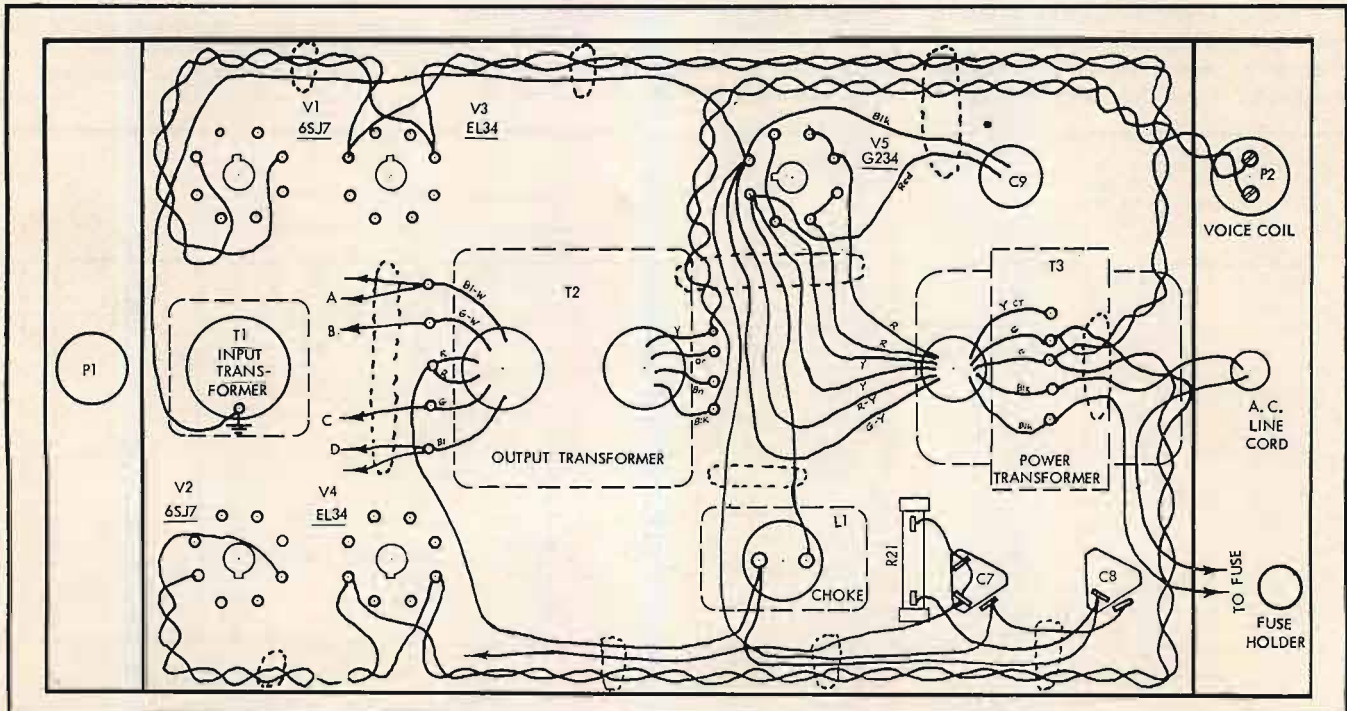


Fig. 5. Wiring diagram for interconnection of main chassis parts with amplifier sockets.

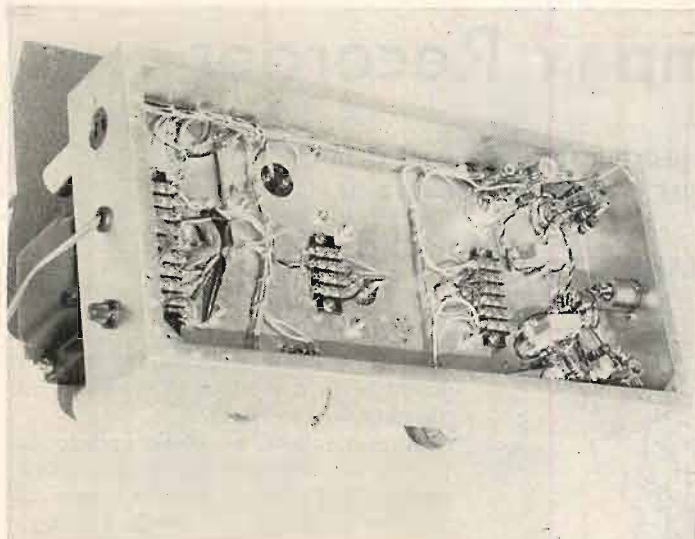


Fig. 6. Underside view of complete amplifier chassis.

(WF-28) suggested herein has base dimensions of $1\frac{1}{2} \times 1\frac{1}{2}$ inches. This area is no greater than that required for a 6SN7 or even a 12AU7. Therefore this argument is no longer valid. High-quality transformers are expensive (WF-28 is \$10.70), and manufacturers of amplifiers can use this as an excuse for not employing the transformer. Now consider the phase splitter in a Williamson-type amplifier. If low-noise resistors are used, the cost of the stage is six to seven dollars. On the other hand, if the builder adds six more dollars for the transformer and its shield he makes substantial gains in performance. Furthermore, in an audio system whose over-all cost can approach eight hundred dollars the sacrifice of quality for a few dollars is hardly justifiable.

The input transformer enables this amplifier to be separated a very long distance from the preamplifier or control unit without being subject to switching transients or r.f. pickup. The transformer has a higher inherent stability than a tube phase splitter, and it is balanced at all frequencies. In a tube phase splitter the resistance-capacitance characteristics of the plate and the cathode circuits are not equal at all frequencies. Therefore, compensation is necessary to overcome this deficiency. The main advantage of a precise center-tapped input transformer is that it provides a fixed, balanced, input amplifier, and controls or adjustments for this purpose are unnecessary.

Feedback. Three types of feedback are employed, and in order of importance they are:

- (A) Primary voltage feedback from the plates of V_3 and V_4 to the cathodes of V_1 and V_2 .
- (B) Feedback in the output stage itself via the screen grids of V_3 and V_4 .
- (C) Subsidiary current feedback caused by the unbypassed cathode resistors of V_1 and V_2 .

Feedback (B) is adequately described in reference (2). Hence, no explanation is needed in this article.

Feedback (A) and (C) comprise a form of Duerdoth's multiple feedback, and the two feedback voltages must be added together to determine the performance.



Fig. 7. Arrangement of Vector sockets for amplifier stages.

The performance, however, will be determined primarily by (A). The subsidiary feedback increases the stability by reducing the slope of the βA characteristic over a wide range of very low and very high frequencies. Readers

should consult reference (3) for a more detailed and technical explanation of this feedback.

Transient response is improved with this type of feedback. Most amplifiers have feedback from the secondary of the output transformer to the cathode circuit of the input tube. The leakage reactance of the output transformer will create phase shift and delay. Thus, the transformer holds up the feedback information, and the transient response is not as good as it could be. The feedback circuit contains no reactive elements and results in low phase shift and feedback delay and improved transient response. For a general discussion of transient response, reference (4) is recommended.

Construction

Figure 3 shows the dimensions for drilling and punching almost all the holes in the chassis. Some holes, e.g. tube socket screw holes, are best located with the socket itself and are therefore omitted. An aluminum chassis must not be used because it is inadequate to support the weight of the transformers. A steel chassis is stronger, provides electromagnetic shielding, and is worked almost as easily as an aluminum one. Pilot holes for chassis punches are made with the following technique. An "egg-beater" hand drill is used with a succession of small drills to obtain a $3/16$ " diameter hole. Then a $1/4$ " and a $3/8$ " diameter drill are clamped in a carpenter's brace and used in succession to produce the pilot hole for the punch. When all holes are drilled, punched, and deburred, the chassis and the bottom plate are washed thoroughly with a detergent to remove all grease and oil. After they are rinsed and dried, the chassis and bottom plate are sprayed with clear plastic.

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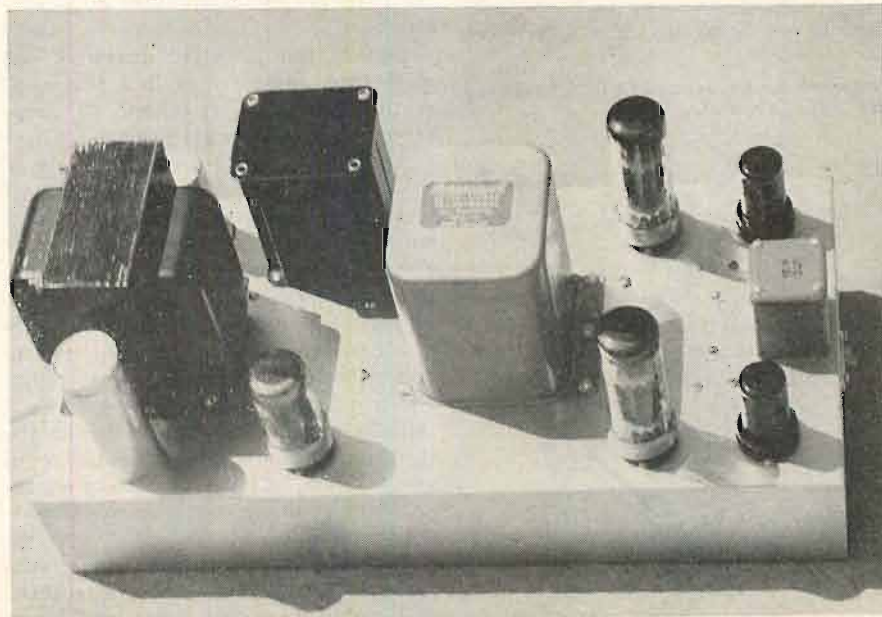


Fig. 8. Top view of completed amplifier.

The New Steampax Recorder

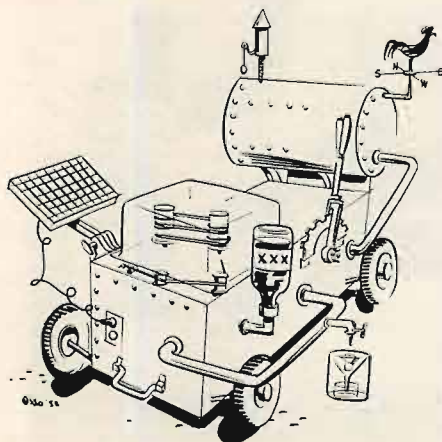
Documentary evidence that just because you read it in print is no reason you must necessarily believe it.

LLESSUR MAHKNIT*

AT RECENT INDUSTRY-WIDE TRADE Shows, the new Steampax Model SP-3 three channel stereo tape recorder has scored an immediate success in the professional field of recording. As a consequence, the editors of this magazine have asked that this fresh new concept of well-known and long accepted principles (antedating the conventional *magnetic* tape recorder by several decades) be set forth in some detail as a matter of record, and as a tribute to those investors who have taken the business risks of underwriting the new Steampax Corporation, manufacturers of this intriguing 1.59-pound portable.

The author has been identified with this project since its inception approximately three years ago, when he was first approached by Mr. S. E. Morper, now president of the corporation. Mr. Morper at that time expressed the opinion that many of the deficiencies and shortcomings of the modern day magnetic tape recorder might be overcome, and final results improved, if much of the older art were re-examined and applied with new relationships. The results of this development program on this steam-powered recorder have far exceeded the expectations of Mr. Morper, his technical and administrative staff, the investors, and the author. It is a distinct privilege to have been asked to set forth in some detail the

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STEAMPAX MODEL SP-3



STEAM MUST THEREFORE BE TRAPPED
WITHIN THE MAGNETIC TAPE ITSELF

technical aspects of this new 15.9-pound recorder.

A brief survey of the shortcomings of the conventional motor driven magnetic tape recorder will serve to illustrate the manner in which the original design for the new recorder was conceived. Parenthetically, let it be stated that the author is convinced that the magnetic tape recorder, like the phonograph disc, unfortunately, is here to stay, and that co-existence of the new Steampax recorder and magnetic tape recorders is certainly possible and probable.

One of the principal drawbacks of most tape recorders is that their operating range is restricted to areas served by commercial electric power companies. In many areas, not only in this country but throughout most of the rest of the civilized and uncivilized world, commercial electric power is erratic, undependable and more often than not, especially in the more remote regions, completely unavailable. Hence a self-powered system was conceived to be highly desirable for the new recorder. Electric battery power was considered initially and discarded early during the investigation, as like electric power in general, new batteries or battery charging equipment are not always conveniently available.

It is well-known, however, that four-fifths of the earth's surface is covered with water. Therefore steam was chosen as a source of primary power, since

wherever water is available, the operator would be in a position to replenish his "battery," so to speak.

Magnetic tape recording systems in general are characterized by many shortcomings which have been overcome in the new Steampax (patents pending) recording system.

These magnetic recorder faults are summarized:

- (1) *A loud hissing noise.* This seems strange since one would normally suspect such a disturbance would result from the use of steam in the system. Manufacturers of magnetic tape recorders, without exception, use no steam in any such system, it is claimed. This author concludes that steam must therefore be trapped within the magnetic tape itself during its manufacture. The several tape manufacturers contacted on this point claim that their tapes do not hiss, and that if they do, it is the responsibility of the machine manufacturer to use a suitable hissing filtering device. This stand-off attitude taken by both tape and machine manufacturers is completely eliminated in the new Steampax system.
- (2) *Piggyback noise.* This distraction, sometimes referred to as modulation noise by magnetic recording proponents, is present only when signals are detected on magnetic tape systems. Since the basic system used in the revolutionary Steampax recorder has nothing whatever to do with magnetics, this irritation is removed.
- (3) *Frequency response.* Implied in this term is one of the most serious defects of magnetic tape systems: i.e., that the response of the system is intermittent as it occurs as a "frequency" phenomenon. In the Steampax, the response is continuous to the point of distraction, yet it may be turned off at will by the operator.
- (4) *Harmonic distortion.* If a characteristic of a system is classed as a distortion, it is difficult to conceive that such a degradation could be harmonious, yet purveyors of magnetic systems speak freely of this anomaly in connection with their systems, even to giving it a numerical value. Such values are the source of numerous controversies. No such problem exists in the Steampax system.
- (5) *Intermodulation distortion.* Again, a system discontinuity is implied: i.e., "between the modulations": thus, interruptions to them. To allow this vagary to occur in a magnetic system would seem to be an admission of inferior quality. It should be noted that magnetic recording advocates ignore completely this basic fault in their systems, refusing absolutely to discuss the matter publicly. Steampax engineers have no such sensitivity regarding this phe-

nomenon. Absolutely; and that is a basic stand.

(6) *Overload distortion.* This is a phenomenon having to do with flimsy construction. It can be recalled that in the early days of cylinder and disc recording, the professional recording gear was "built like a battleship" as the saying goes. Recorders in those early times were sold by the pound. The heavier the recorder the more costly it was. Then came magnetic recording. While some of the early recorders of this type were constructed along the same lines as battleships (and painted in similar colors) and were priced, again, by the pound (very expensive), still other magnetic recorders then available went to much lighter construction and were priced proportionately. The predominant color was still battleship gray, but there the similarity ended. These recorders were the first of a long succession of such units constructed on more flimsy lines. So flimsy are many of today's descendants of such machines, that the mere picking up of them causes them to distort due to their own weight. Hence, overload distortion.

The new 15,900-pound* Steampax Editor's Note: When asked about what appeared to be a series of typographical errors in connection with the weight figures, the author referred us to the well-known (?) Enrico Ferment Principle of the Migrating Decimal Point.

portable recorder, on the other hand, borrowing from the better things of the past (as well as taking advantage of the most recent developments in science), has made a rugged, well-braced, stiff (through the use of alcohol fuel) system sufficiently rigid as to be unyielding. As a consequence, there is no measurable overload distortion anywhere present within and throughout this phenomenal instrument.

(7) The many other vagaries of magnetic recorders are of such a whimsical nature and so widely known by now that the author will not presume upon the reader. Such irritations as broken switches, sticking relays, vibrating head mounts, spalling tape, deteriorating electron valves, broken cables, and the like, are problems that magnetic tape recorder operators have become resigned to, and seem to accept with nothing more than a suppressed resentment. The Steampax Corporation, in an early market survey, determined that beyond a shadow of a doubt, sales fall-off in the recorder market would lead to a recession in late 1957. And that such a decline in recorder sales could be directly attributed to the many petty annoyances foisted on the public by irresponsible manufacturers of such devices. That this early survey was completely valid has been substantiated by the recession of late 1957. The present apparent change for the better in the domestic economic picture may similarly be traced to the tremendous potential offered to a hungry market by the recent public showing of the new Steampax Model SP-3 recorder.

We have enumerated above many of the problems and shortcomings of the mistakenly popular *magnetic* recorder. The question naturally arises as to how the Steampax System of Recording functions.

Principles of Operation

The history regarding the generation

and use of steam power is much older than any known work (other than the early Franklin¹ research) on the generation of electricity. Consequently one might expect that steam power would lend a more elegant solution to the problem at hand. Studies of the large volume of available literature as far back as the early work of Watt² were made and proved that the steam concept was feasible and even desirable. To be sure, certain refinements were borrowed from the newer and less popular electrical technology, such as feedback³, as we shall discuss later.

Having decided on steam power, it was necessary to select the proper type of transducer system for adding basic solar energy to the water for the steam formation. Again, the quest for materials widely found throughout the world was found to be in order. Recent rocketry developments⁴ gave a clue to the system finally chosen for incorporation in the design. Since hydrogen constitutes 66 $\frac{2}{3}$ per cent of the ever present water, and since alcohol is a principle constituent of intoxicating liquors which are ever present in all ethnological groups and cultures throughout the world, it was decided that a simple extraction apparatus could be incorporated in the 159.0-pound package recorder to furnish the necessary fuel. This was done.

Liquid hydrogen readily transforms to a gas. Thus a mixture of alcohol and hydrogen under pressure, once ignited with, say a cigarette lighter or match (or even the common flint and steel), could be expected to force the fuel into the combustion chamber where it is used to heat one side of a thin copper plate, where it immediately turns to superheated steam at 1100 psi.

The steam thus formed is conducted to the turbine motor which provides the necessary rotating forces for all rotating elements in the 1590-pound package. This discharge stream from the turbine is directed downward through an elliptical orifice in the base of the recorder case. The resulting reaction⁵ reduces the apparent weight of the package by a factor of 100, thus yielding a total

¹ Benjamin Franklin, "Drawing the electric fluid from thunderheads with ambivalent kite string and brass key." *Saturday Evening Post*, April 13, 1775.

² James Watt, "Some early notes on steam kettle generating equipment." *Proceedings of the Steam Engineering Society of Scotland*, Vol. 54, No. 117, June, 1764.

³ Black, U. S. Patents #2,102,671, 2,131,365 (very wordy).

⁴ White Sands Monograph Series, No. 124756.3 (declassified from Supersecret), "Mixtures of Hydrogen and Alcohol."

⁵ c.f. White Sands Monograph Series, No. 4.37526 $\frac{1}{2}$ (declassified from Confidential), "Practical Reaction Theory."

system weighing not more than 15.9 pounds when in actual operation.

The rotating force of the turbine is led through suitable power takeoffs to the tape reels and capstan drive. Built-in reactive flutter compensation in the capstan drive system is achieved by means of a feedback loop around the flyball governor. A more complete and rigorous analysis of this technique is presented elsewhere.⁶ The resulting tape motion is so uniform that to date the industry has been unable to develop a flutter bridge of sufficient sensitivity to detect the remaining wideband flutter components.

The arrangement of the tape handling elements on the mechanical portion of the recorder is somewhat conventional.

The most significant advancement in the recording art, however, has been achieved in this 1590-pound Steampax in the recording technique which was developed and incorporated into the system.

It is well known that the magnetic circuits of magnetic recorders are seriously affected by stray magnetic fields, the earth's magnetic field, electro-magnetic (Hertzian) radiation, passing trolley cars, and automobile spark plug discharge. In fact, one modest sized steel company in Pennsylvania, specializing in special high permeability magnetic alloys, makes no secret of the fact that their economic well-being and significant capital appreciation over the years since World War II, has been due almost entirely to the tremendous amount of money spent in furnishing electro-magnetic shielding to the magnetic recording industry.

The Steampax System of Recording employs an entirely different principle of recording: Electrostatics. It has been common knowledge for generations that huge potential energy of this type has been available. Franklin's early work¹ has been too long overlooked. From this sprung the Van De Graft generator.⁷

⁶ J. Watt Mahknit, "Feedback stabilization of flyball governors." 1955, unpublished, privately distributed to the membership of the Steam Engineering Society of Scotland, commemorating the 190th anniversary of Watt's development of the steam engine.

⁷ Van De Graft, "How to make BIG sparks", *Scientific American*, January, 1867.

(Editor's Note: An explosive controversy is currently raging behind the scenes on this point. The director of engineering for a large west coast manufacturer of *magnetic* tape recorders claims that it is not possible to detect any signal of any sort on the tapes made on the Steampax recorder. This, however, is open to question, as the editor has heard rather startling 17-channel stereo reproduction from a developmental Steampax machine. Ventriloquism and charlatanism were conclusively ruled out at the demonstration.)

(Continued on page 98)

Compatible Stereo Multiplex Adapter

LEONARD FELDMAN*

The first Multiplex adapter to appear on the market is described fully, together with details of its operation. This design will demodulate and matrix M-S stereo signals to feed out right and left channel information.

Now that stereo discs and stereo tapes are solidly entrenched upon the hi-fi scene there remains but one important signal source which is devoid of uncompromising stereo—FM. The high fidelity industry, which is responsible for the so-called re-birth of FM, has not deliberately overlooked FM insofar as stereo is concerned. Many men in many places have been working on the problem for years with varying degrees of success and utilizing many techniques.

In the interim, some broadcasters have resorted to other schemes in their eagerness to provide *some* stereo service to their listeners. Notable among these early systems are simultaneous AM-FM stereo broadcasts in which one channel of a stereo program is transmitted via the AM transmitter while the other channel utilizes the FM transmitter. A system employed in Los Angeles for some time involves the use of *two* complete FM stations (at different frequencies—hence *two* FM tuners required) each broadcasting one channel of a stereo program. There have also been some experimental TV-FM combination broadcasts and even some AM-TV combination deals (stereo maybe, fidelity never!). In the case of AM-FM and AM-TV it is clear that the fidelity of one channel (the AM side) under most circumstances will be inferior to the other, due almost entirely to the narrow-band superheterodyne receivers, not to mention time delay between transmitters, (which serves to destroy or distort the stereo effect), difference in signal strength between the two channels (volume settings which afford balance during daylight may be all wrong in the evening!), static interference, and so on. In the case of all three systems it is clear that anyone not possessing *both* means of reception who desires to listen to the particular program monophonically will hear a totally unbalanced program. Some broad-

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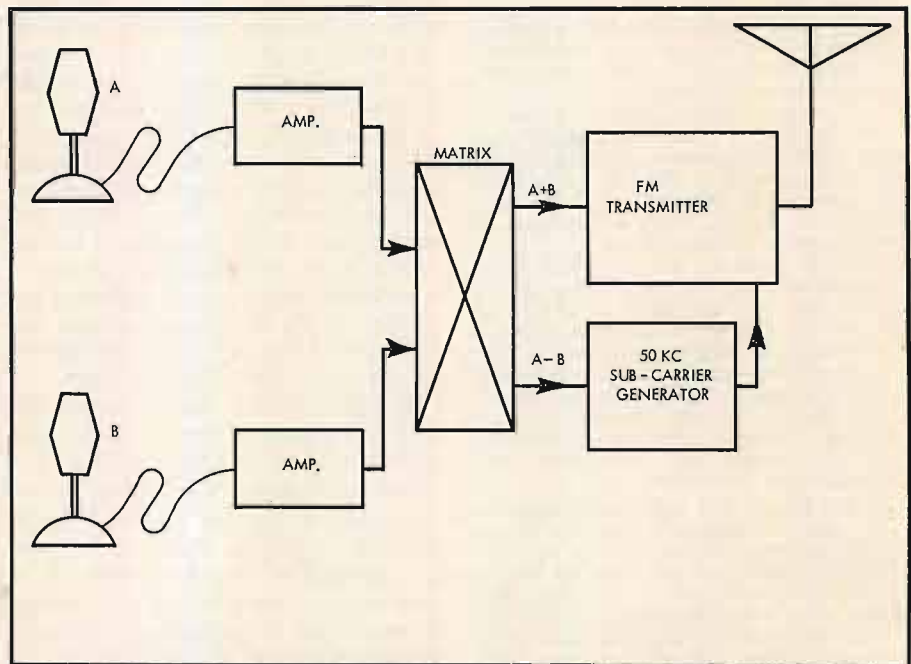


Fig. 1. Method of transmitting compatible stereo over one FM transmitter.

casters, aware of this problem, have confessed to "mixing back in" a bit of the left channel into the right and a bit of the right into the left to avoid indignant phone calls from monophonic listeners who want to know "what's happening down at the station?" Thus, in effect, the stereo listener doesn't quite have stereo, for all his dual tuners, amplifiers, and speakers and the monophonic listener doesn't quite have a complete program.

Compatibility

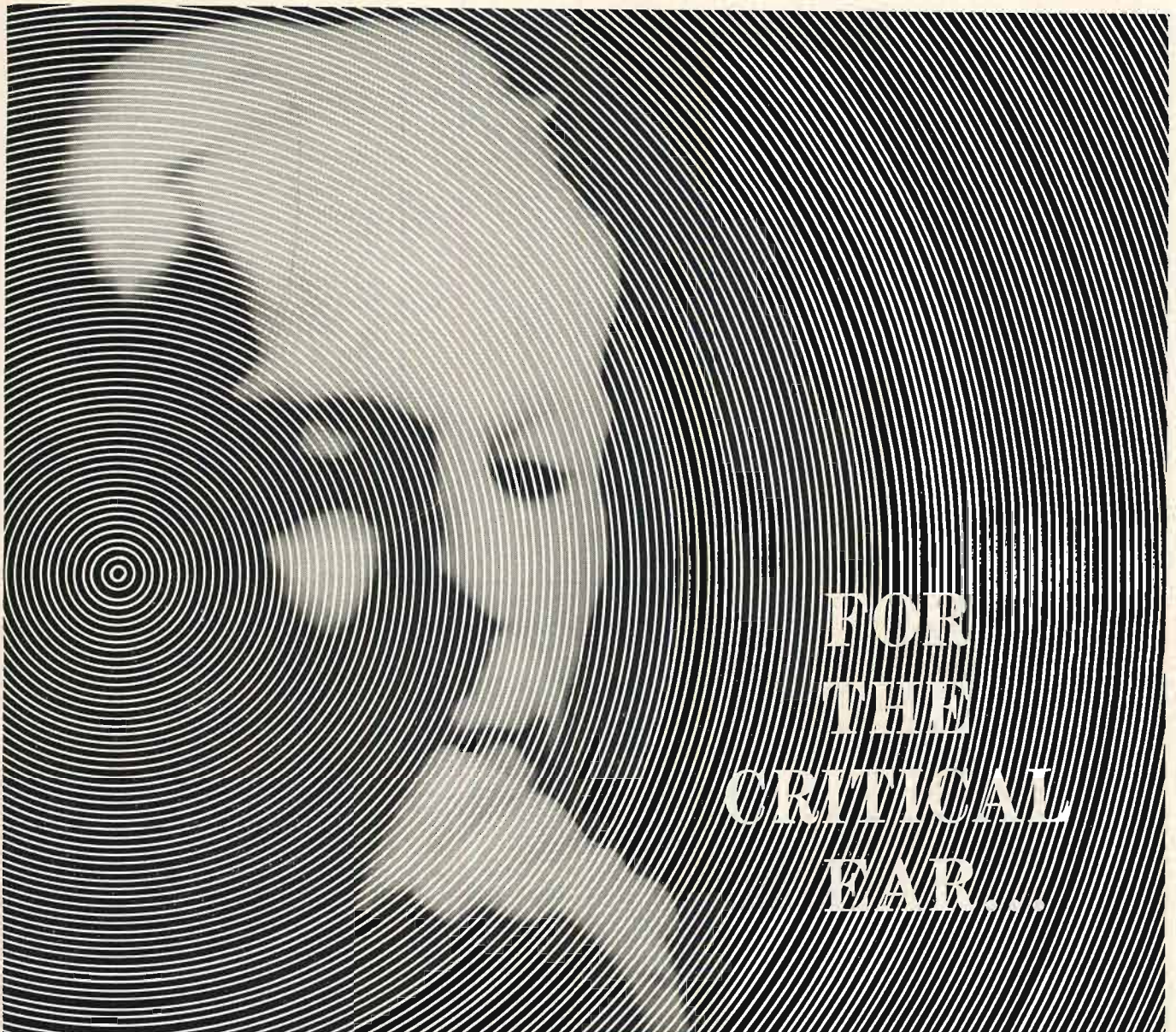
The present situation recalls a similar state of confusion which existed when an early form of color TV broadcasting was prematurely approved by the FCC. Until the decision was revoked, owners of TV receivers faced the prospect of neither receiving color pictures *nor* black and white whenever a color broadcast was on the air unless they were prepared to invest considerable money in a new receiver. Fortunately, compatible

color TV came along just in time and the sophistication of its engineering was so great as to force immediate reversal of a not-too-old FCC decision.

We are equally fortunate at this juncture in our quest for stereo broadcasting, for along has come compatible FM stereo. Much of our thanks must go to Mr. Murray G. Crosby, a pioneer in the field of FM multiplexing. Mr. Crosby has been granted patents covering his process and we explain it here.

Sum and Difference

The stated aim of the Crosby system is to transmit a stereo program over a single FM station in such a manner that anyone having *only* an FM receiver will receive the entire program material in balanced form. To do this, the main FM carrier must transmit the *sum* of the left and right channels, labelled A and B in Fig. 1. Simple resistive or inductive mixing adds the two signals in what has been called a matrixing network. In addition, a second signal is derived



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Stereo Dynetic

C A R T R I D G E

The Shure Stereo Dynetic Cartridge is designed and made specifically for the listener who appreciates accuracy and honesty of sound. It separates disc stereo sound channels with incisive clarity. It is singularly smooth throughout the normally audible spectrum . . . and is without equal in the re-creation of clean lows, brilliant highs, and true-to-performance mid-range. Completely compatible . . . plays monaural or stereo records. It is manufactured in limited quantities for the music lover—is available through responsible high fidelity consultants and dealers at \$45.00, audiophile net, complete with 0.7 mil diamond stereo stylus.

Literature available: Dept. 10-J

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SHURE ALSO MANUFACTURES HIGHEST QUALITY PICKUP ARMS, MICROPHONES, MAGNETIC RECORDING HEADS



MODEL M3D

a note to the technically inclined:

Shure Stereo Dynetic Cartridges are individually tested and must meet or exceed the following specifications before being placed on the market:

Frequency response: 20 to 15,000 cps
Compliance: 4.0×10^{-6} centimeters per dyne
Channel separation: More than 20 db throughout the critical stereo frequency range.

Recommended Tracking Force: 3 to 6 grams.
The M3D fits all 4-lead and 3-lead stereo changers and arms. 10 second stylus replacement.

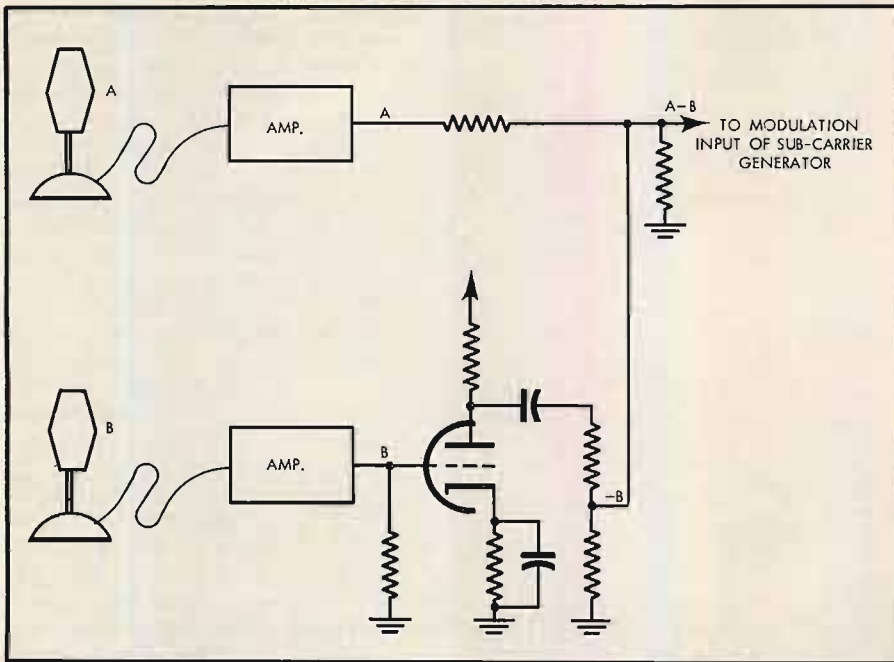


Fig. 2. One possible means of achieving the "A - B" signal. The "B" signal is passed through a triode phase inverter, making it "- B", which is then mixed resistively with the "A" signal, forming "A - B".

from the matrixing network. This signal is $A - B$, or in other words the difference between what the left and right microphones "hear." Clearly, this difference is really the stereo information content, in much the same way that the 3.58-mc color carrier contains the color

does the number of stations possible in a given area. (Consider this versus the California-two-FM-station per-stereo-broadcast technique which, if carried to extremes could result in half as many stations throughout a given area.)

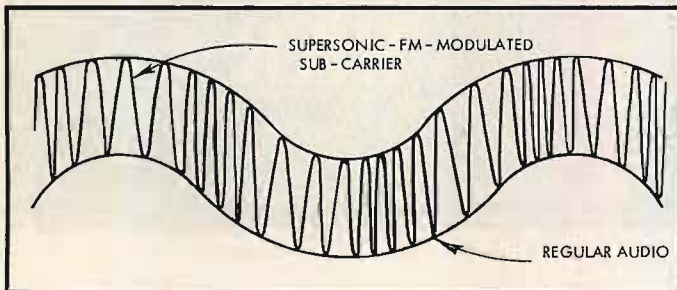


Fig. 3. Typical output of FM tuner when multiplex is broadcast. Information on sub-carrier is inaudible without suitable converter.

information content in color TV. The $A - B$ information is used to frequency modulate a 50-ke generator between limits of 25 and 75 ke. This ultrasonic signal is then used to modulate the main FM transmitter along with the regular $A + B$ audio information. Each modulating signal is allowed a frequency deviation of 37.5 ke, so that the total deviation is still only 75 ke just as in standard FM broadcasting. Thus, the channel width per FM station remains unchanged and, as a consequence, so

Just in passing, in case you are puzzled as to how the $A - B$ signal can be derived electronically, one possibility is shown in Fig. 2. In this arrangement, the B microphone channel, after suitable amplification, is applied to a triode amplification stage having a gain of one. Since the plate signal is 180 deg. out of phase with the grid signal, the output of this stage is $-B$. This electrical quantity is then added passively through resistive networks to the A channel (which has *not* undergone phase re-

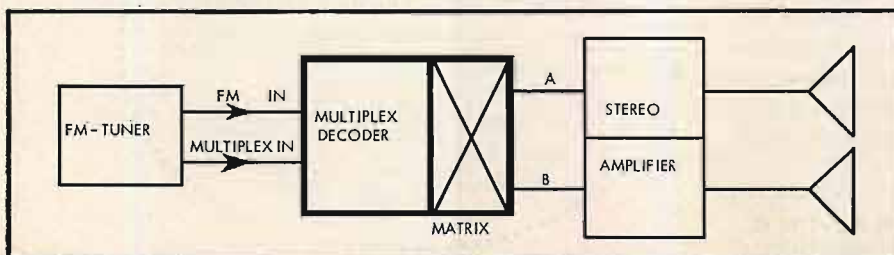


Fig. 4. How the multiplex stereo converter fits into a typical stereo installation.

versal) yielding a total signal which is, in every way, $A - B$. It is this signal which is used to modulate the multiplex sub-carrier.

Monophonic Listening

Suppose a listener tunes into an FM station using this technique and that he has only an FM receiver. The demodulated signal appearing at the output of his tuner contains both $A + B$ audio as well as a supersonic sub-carrier, varying in frequency between 25 and 75 ke. The signal would be somewhat like that shown in Fig. 3. The supersonic sub-carrier will be inaudible to the listener and all he will hear is the "regular" program. But this regular audio has been stated to be the sum of $A + B$ which is just another way of saying *the entire program*,—not stereo, of course, but still the entire program, not just the left or right side of the orchestra. This listener has therefore lost nothing and has spent nothing.

Now, suppose the listener desires full stereo programming at home. The inexpensive adapter which will accomplish this feat has only two functions: 1, to amplify and de-modulate the sub-carrier; and 2, to do a little simple algebra. The first of these functions is easily accomplished. The level of sub-carrier after the FM-discriminator of the main receiver is through with it is of the order of 0.25 volts, a nice hefty signal compared to the microvolts into an r.f. stage. All that is needed is a bit of amplification, some limiting and some FM detection scheme. Best of all, no high-Q tuned circuits are required, for this signal is *practically audio*. One vital requirement that does remain is that we eliminate the regular $A + B$ channel completely, so that it does not get involved with the $A - B$ signal we are trying to extract. A high-pass filter which rejects all frequencies below 20 ke (hence anything being broadcast on the main channel) does the trick.

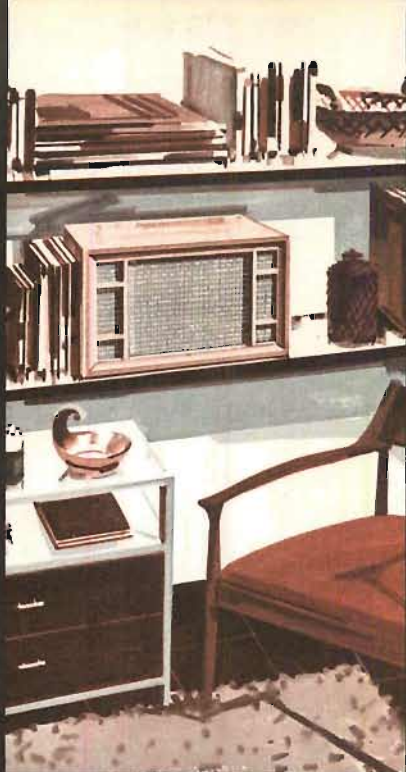
As for the algebra, once $A - B$ has been recovered, it is quite simple. First we add the two signals, $(A + B) + (A - B) = (A + B + A - B) = 2A$. But $2A$ just means A twice as loud. Next we subtract: $(A + B) - (A - B) = (A + B - A + B) = 2B$, which is nothing less than B twice as loud. Thus we have recovered the separate left and right channels intact and can feed them to our newly acquired stereo amplifier by means of a pair of cables, just as we are now doing with tape and stereo cartridges.

Dimensional Control

The set-up for stereo reception is shown in Fig. 4. As you can see, if you already have stereo in any form, all you

(Continued on page 37)

An important announcement for everyone considering a small-space wide-range speaker system . . . monaural or stereo



ACTUAL TESTS PROVE UNIVERSITY RRL*

ULTRA LINEAR RESPONSE SYSTEMS

SUPERIOR

75% less bass distortion

Wider, uniform frequency range

Lower power requirements

No "damping factor" problems

AT \$40 to \$85 SAVING (USER NET)

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HIGH COMPLIANCE SMALL-SPACE SPEAKER SYSTEMS

*RRL -- Radiation Resistance Loading

University ultra linear
response systems

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Radiation Resistance Loading



Now, from the famed laboratories that have pioneered two decades of loud-speaker "firsts," come RRL ultra linear response systems . . . a significant advance over previous small-space high compliance speaker systems.

University RRL systems contain a new type of high compliance woofer that achieves extremely low free air resonance, and virtually linear response to 30 cps. Magnetic assembly employs the NEW Hiflux UNIFERROX-7 magnet material in specially designed twin spider suspension assembly ensuring positive transient control during maximum excursions. Although the woofer cone is capable of great excursions, the high efficiency of the RRL enclosure requires only a small portion of this potential to produce maximum sound output. Thus, distortion is virtually eliminated, *achieving clean bass response at higher acoustic levels than ever before obtained from ANY small-space speaker system enclosure.*

This is accomplished by a precisely matched acoustic coupler that increases the total radiation resistance of the system and therefore enables the speaker to radiate large amounts of power with small cone excursions. Response is flat, precise, free of spurious resonances or "doubling." Tweeter response has been carefully matched to the acoustic output level of the woofer and extends well beyond 20,000 cps with a uniform polar pattern.

Previous attempts to exploit the full design potential of high compliance woofers in small enclosures were based on totally sealed enclosures using "air spring" capacitance loading. However, these widely publicized approaches suffered certain flaws, such as: bass distortion due to their tendency to overload at higher acoustic levels, deficient low frequency sensitivity and the need for controlling the amplifier damping factor for optimum frequency response.

But now, for the first time, *all* these problems have been solved . . . by RRL. Result: better bass, cleaner treble . . . smoother response than any competitive units . . . proved by actual laboratory *and* listening tests . . . *and at far less cost.*

ALREADY THE ACCEPTED LEADER

The impressive performance and undeniable superiority of RRL ultra linear response speaker systems have been recognized by those whose work *demands* the finest in speaker systems.

ITEM: WFUV-FM, pioneering stereo via FM-Multiplex, has standardized on two RRL S-10's for control room monitoring; and two RRL S-11's for public demonstration of this new stereo system. Authorities at this N. Y. C. station, famous for its high quality transmissions, evaluated many speaker systems before selecting RRL.

ITEM: The beautiful enclosure design as well as quality performance of the RRL systems has earned them the SEAL OF

RESEARCH APPROVAL from Research House, 1958 (located in Beverly Hills, Calif.) This famed architectural "field test laboratory," which sets the trend for interior decorators throughout the country, selects and exhibits only those products rated most suitable for contemporary homes.

ITEM: Fred Waring chose University RRL systems for his sensational 1958 nation-wide concert tour. Even in large auditoriums, just two RRL systems were able to fill the entire hall with stirring, dynamically effective high fidelity sound.

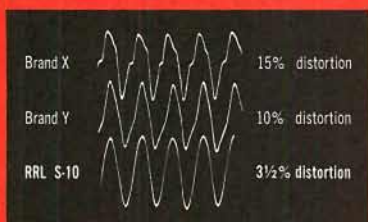
People like these . . . authorities who *know* music and fine sound reproduction . . . quickly recognized University's amazing achievement in obtaining such quality performance from speakers so compact.

PROOF OF SUPERIORITY

... as demonstrated by actual comparative measurements* of University Model S-10 RRL ultra linear response system ... and widely publicized competitive brands X and Y, under identical conditions.

75% LESS BASS DISTORTION

Distortion measured at 30 cycles with equal sound output for all systems:



The highly efficient S-10 requires only ¼ of the cone excursion of Brands X and Y to produce the same sound output. Result: greater inherent linearity and 75% less distortion.

Brands X and Y reach overload conditions 4 times sooner (6 db) than the S-10. Bass distortion at higher sound levels is therefore considerably greater with X and Y than with the S-10.

LOWER POWER REQUIREMENTS

Measured average of acoustic energy in 30-100 cps range, demonstrated that 30-100 cps range, demonstrated that Model S-10 performed ...

4 db better than Brand X
2 db better than Brand Y

This test shows that the S-10 is, in effect, 100% more sensitive. (The ultra linear response systems will fill any average room with sound above normal listening level, using any high quality low power high fidelity amplifier.)

* HOW TESTS WERE CONDUCTED

Frequency response was obtained in an anechoic chamber, using a calibrated Western Electric 640AA Microphone and RA-1095 Amplifier, a General Radio Model 1304B Beat Frequency Oscillator and a Sound Apparatus Model FRA Graphic Recorder.

Distortion was measured with a Hewlett-Packard Model 330B Distortion Analyzer. The speakers were driven from a Hewlett-Packard Model 200AB Audio Oscillator, feeding a McIntosh 50-watt Power Amplifier.

WIDER FREQUENCY RESPONSE

Brand X 7 db down at 15,000 cps
Brand Y 2 db down at 15,000 cps
RRL S-10 flat to beyond 20,000 cps

Measured average acoustic energy, 7000-20,000 cps, for equal power inputs, demonstrates that Model S-10 performs ...

5 db better than Brand X
2 db better than Brand Y

Ultra linear response systems are not handicapped by the treble deficiencies common to competitive systems. With clean program material, the remarkably flat response and exceptionally true reproduction of upper harmonics by the S-10 result in amazingly realistic reproduction without "harshness." A Program Distortion Filter is provided which can be switched into the circuit to correct for inferior radio programs, worn records, tapes, etc.

NO "DAMPING FACTOR" PROBLEMS

Model S-10 RRL will work at maximum effectiveness with any modern minimum effectiveness with any modern (low internal impedance) high fidelity amplifier. No damping factor adjustment at all is needed, whereas both Brands X and Y require optimum settings. If an amplifier does not have this control the performances of Brands X and Y may be adversely affected.

ALL THIS...AND MAJOR COST SAVINGS TOO!

You don't pay a premium for RRL's improved quality and performance. University's superior design and manufacturing know-how has resulted in substantial cost savings to the consumer. Compare for yourself!

Brand X over \$180
Brand Y over \$220
RRL Model S-10 \$139

EVEN GREATER SAVINGS WITH STEREO!

The University ultra linear response systems incorporate an exclusive University woofer feature ... a *dual voice coil* ... which provides perfect two-channel bass separation of the stereo program, without expensive or complicated auxiliary networks.

While the lower frequencies do not contribute much to the directional effect of stereo, the bass energy from both channels must be preserved and utilized in order to get authentic, full bass response. This is ingeniously accomplished with the dual voice coil woofer. As shown in the illustration, the lower frequencies from both channels are fed directly into the woofer of the RRL system; one winding of the dual voice coil receiving the full bass from Channel A, the other voice coil receiving the full bass from Channel B. One channel of the mid and high frequen-

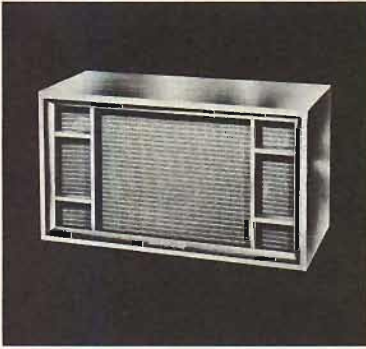


cies (predominantly responsible for spatial separation) is then reproduced by the remainder of the RRL system, the other by the stereo adapter, a speaker system with bass response attenuated below the 150-200 cps range.

Since there is no need for an additional woofer and woofer enclosure, major savings are possible. Thus, a complete stereo speaker system consisting of one RRL S-10 and matching stereo adapter costs about the same as one Brand X, and less than one Brand Y.

*Only from UNIVERSITY... a complete line of
RRL Ultra Linear Response systems and kits*

OUTSTANDING FOR MONAURAL... IDEAL CHOICE AS A STEREO PAIR



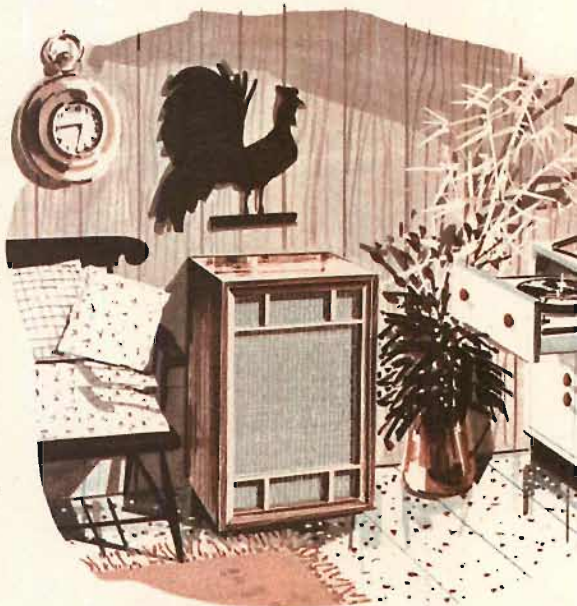
Model S-10 2-Way systems

Components of the S-10 comprise the new 12" C-12HC high compliance, low resonance, dual voice coil woofer with magnetic assembly employing the NEW Hiflux UNIFERROX-7 magnet material; the UL/HC 2500 cps tweeter and the special matched-level HC-2 crossover network. Also includes the Program Distortion Filter to correct for stridency of inferior radio programs, worn records, tapes, etc. The enclosure is constructed of extra heavy 3/4" furniture hardwoods. Graceful styling gives it a character all its own, in harmony with any decor. Model S-10H is for use where minimum width must be considered; S-10L where height must be conserved. Cabinet base removable for shelf, bookcase, or built-in applications. 24" x 14" x 14 1/2" deep. Shpg. wt., 51 lbs. USER NET: Mahogany—\$139.00, Blond or Walnut—\$143.00.

... AND FOR GREATER ACOUSTIC EFFICIENCY AND GREATER RRL ADVANTAGES

Model S-11 3-Way systems

The S-11 truly stands *alone* in its field! It cannot be compared with any other existing high compliance system... but only with the most elaborate speaker systems, such as University's famed "Classic." Its handsome compact RRL enclosure houses the new heavy duty high compliance 15" C-15HC dual voice coil woofer. Magnetic assembly employs the NEW Hiflux UNIFERROX-7 magnet material in specially designed twin spider suspension assembly ensuring positive transient control during maximum excursions. The new HC-3 matched-level network provides 500 cps crossover to the 2-way Diffusicone-8 Diffaxial for mid-range and 2500 cps crossover to the special UL/HC Hypersonic Tweeter for special UL/HC Hypersonic Tweeter response to beyond audibility. The unique Program Distortion Filter and variable balance control complete this magnificent system... for those who demand uncompromising performance from a compact system. Model S-11H is for use as upright; Model S-11L, as lowboy. 26 7/8" x 19 1/2" x 17 1/2" deep. Shpg. wt., 80 lbs. USER NET: Mahogany—\$245.00, Blond or Walnut—\$249.00.



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**Ultra Linear Component Kits
CUL-10 and CUL-11**

Enjoy the satisfaction of assembling your own superb Ultra Linear Response system along with the added savings thus made possible. Speaker Kit CUL-10 comprises the identical components of Model S-10; speaker kit CUL-11, the components of Model S-11. Both kits are furnished with all wiring cables and complete easy-to-follow instructions for building and installing your own RRL enclosure. USER NET: CUL-10 — \$88.50. Shpg. wt., 15 lbs. CUL-11 — \$164.50. Shpg. wt., 37 lbs.



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WEST COAST PRICES SLIGHTLY HIGHER PRICES, TRIM AND SPECIFICATIONS SUBJECT TO CHANGE PRINTED IN U. S. A. 78A89

(from page 32)

will need to add for compatible FM stereo reception is a multiplex adapter such as the Madison Fielding MX-100, which is shown in the schematic form in Fig. 5. The cost of the adapter is small, compared with the price of a quality FM tuner and, as such, does not represent a major investment in terms of the reward.

The adapter could have been built with no controls whatsoever. As has been pointed out, no form of tuning is necessary. Simply tune the FM tuner to a station broadcasting stereo and the whole thing pops into place. We could not resist adding two very flexible controls once we realized the advantages to be gained. If $(A + B)$ of itself yields monophonic sound and if $(A + B) + (A - B)$ and $(A + B) - (A - B)$ yield fully stereophonic sound then it follows that $(A + B) + \frac{1}{2}(A - B)$ and $(A + B) - \frac{1}{2}(A - B)$ will yield *half as much* aurally

apparent separation and, more amazingly $(A + B) + 2(A - B)$ and $(A + B) - 2(A - B)$ will yield twice as much separation. Here's what it all means: if, because of space limitations, the two speakers of your system have necessarily been placed too close together to really derive full stereo effects from your other stereo sources, you can actually "spread the sound apart" electronically with the aid of the DIMENSION control on the MX-100 adapter. Conversely, this same control can help "pull the orchestra together" if you suffer from the new audio affliction known as "hole in the middle."

The two inputs of the MX-100 are labelled MULTIPLEX IN and FM IN. A very short cable should be used to connect from the multiplex output of the standard FM tuner to the MULTIPLEX IN jack to prevent attenuation of the 50-ke sub-carrier. The second input is for connection of the regular FM output of your tuner. The first of these signals—

the multiplex subcarrier—is fed through a cathode follower V_{1A} . This stage serves to isolate the signal and create a source impedance suitable for application to the low-pass and high-pass filters which follow. The signal at the cathode of V_{1A} is of the order of 0.25 volts (assuming that the tuner feeding the adapter has reached full limiting). The main audio carrier is removed from the signal by two full T-section constant-k filters having a cut-off frequency of 20 kc. The 5-mh inductances in the leg of each of the T-sections need not be "high-Q" in terms of r.f. circuits, but their inductance must be held to fairly close tolerances. Between the two high-pass filter sections is a single T-section low-pass filter having a cut-off frequency of 75 kc with a terminal impedance equal to that of the high-pass sections (1200 ohms). The purpose of a sharp cut-off filter above 75 kc is to eliminate any high-frequency noise which might be

(Continued on page 63)

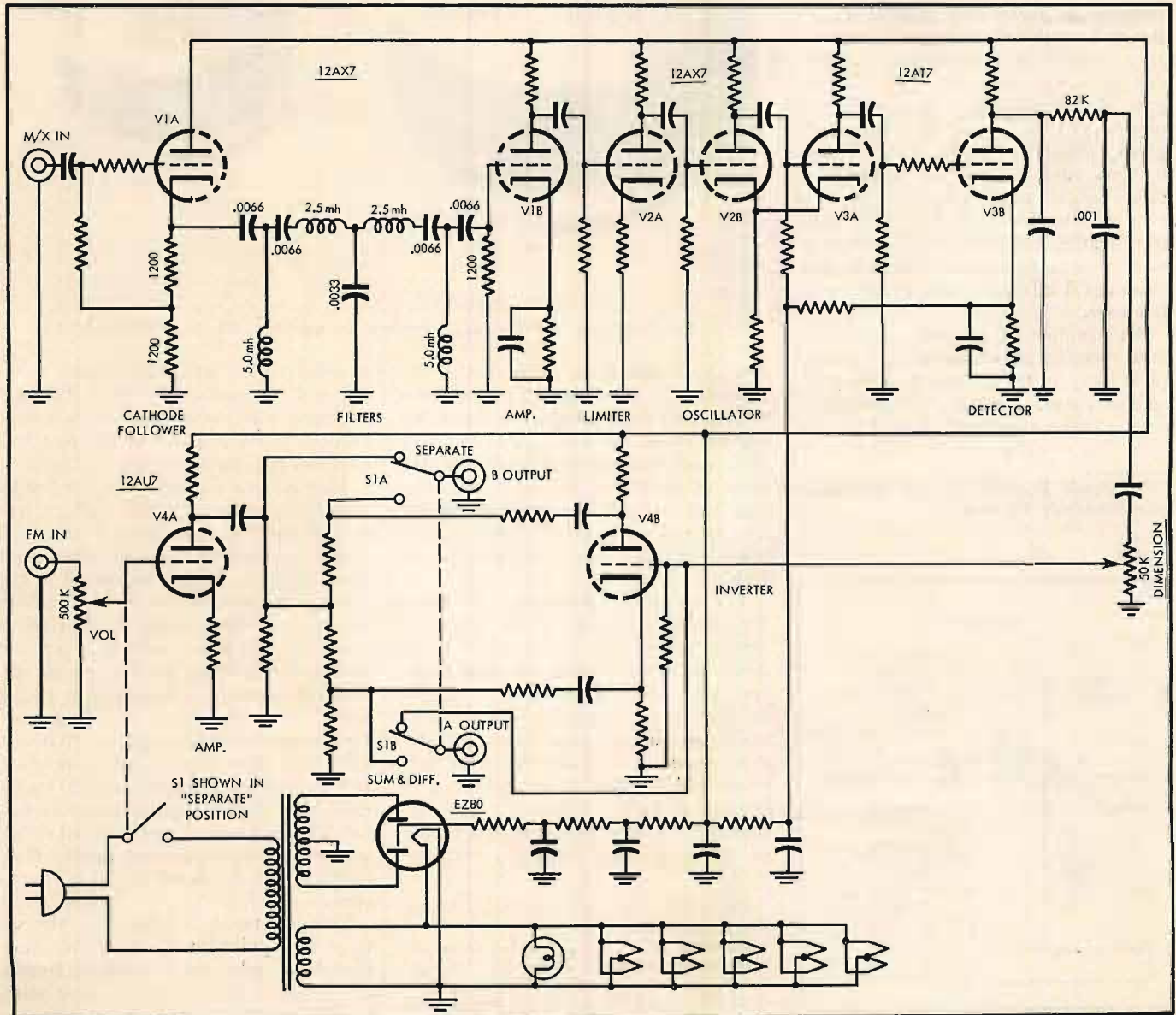


Fig. 5. Circuit arrangement of the compatible stereo multiplex adapter described in the text.



New High-Frequency Speaker

EDGAR M. VILLCHUR*

The author describes a new approach to high-frequency speaker design, resulting in what he calls a "distillation" of tweeter construction to the simplest device possible. Using neither spider, cone, nor horn, this hemispherical radiator is used in the AR-3 speaker.

IT IS GENERALLY AGREED that the loudspeaker is still the weakest link in the chain of sound reproducing components, and therefore in most need of improvement. Irregularities in frequency response, transient ringing associated with peaks and dips in the response curve, distortion, and progressive beaming of the higher frequencies are well known deficiencies.

These deficiencies, as recorded objectively by measuring equipment, are associated with definite subjective effects. It is possible, with experience, to predict quite accurately the type and degree of coloration that a speaker will impose on the music it reproduces, given sufficient objective data. Unfortunately such information is rarely if ever available to the consumer; there is also considerable work yet to be done in validating and standardizing speaker-measurement techniques that will give meaningful information to the prospective user.

An example of a speaker performance specification which tells an incomplete story is the on-axis frequency-response curve. Methods for recording such a curve are described in RETMA

* Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass.

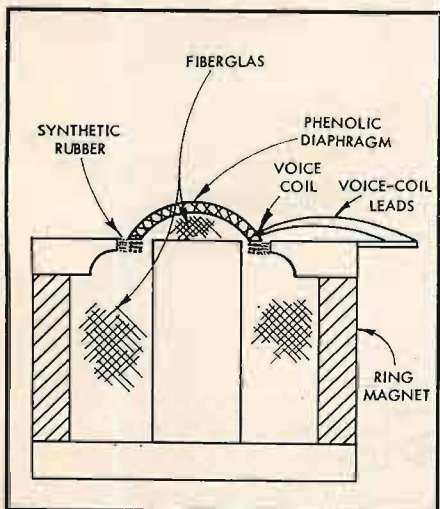


Fig. 1 Structure of the tweeter.

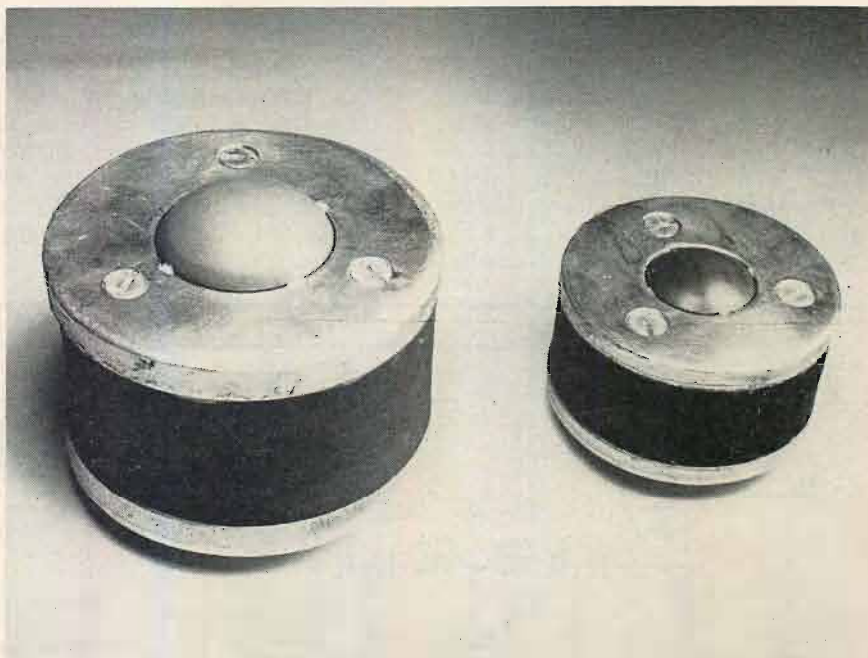


Fig. 2. 2-inch and 1 3/8 inch tweeters, unmounted. (Photo by Bunker.)

and ASA Standards¹, and useful information is provided as to smoothness of response. But the treble balance of the speaker—whether it will be brilliant or dull, and whether it will convey the sense of space that existed in the original hall—is not adequately predicted. The on-axis curve does not tell us how much relative energy is radiated in the treble.

For example, a speaker with relatively flat on-axis response in the high-frequency region may show response 15 db down 30 deg. off-axis; the total high-frequency power radiated must clearly be very much attenuated. Since a normally reverberant room tends to integrate on-axis and off-axis sound the final effect will be that of a speaker with attenuated treble response². This attenuation could be predicted by a family of curves showing frequency response

¹ RETMA Standard SE-103 and ASA Standard C 16.4-1942.

² Arthur A. Janszen, "An electrostatic loudspeaker development." p. 89, *J.A.E.S.*, Vol. 3, No. 2, April 1955. The importance of treble dispersion to over-all sound quality has also been brought out in the design work of A. S. Hegeman.

at different azimuth angles (both vertical and horizontal), or by a "power-response" curve which showed the actual relative power radiated at different frequencies for constant input.

Flat on-axis response combined with good dispersion—that is, uniform response over a reasonably large solid angle—apparently creates the right ratio of direct to reflected sound in the room so that a maximum sense of realism exists. Good horizontal and vertical dispersion does not merely determine that a speaker can be listened to off-axis; it strongly influences the sound anywhere in the room, including positions on-axis with the speaker. Without such dispersion the sense of the original hall acoustics is reduced, the total treble energy radiated is decreased, and awareness of the speaker as an artificial sound source of dimensions much smaller than an orchestra or choral group is sharpened.

This last result is sometimes referred to as the "point-source effect", meaning that the sound seems to originate from a single point. It is an unfortunate term to use, because a true point-source—acoustically speaking—has perfect dis-

STEREO

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Low Cost—*

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803A 15" BASS SPEAKER: Designed for the sole purpose of efficiently reproducing the full depth of exciting bass tones. This is assured by its limited frequency range of 30-1600 cycles.

Specifications: 30 watts • 16 ohms • 30-1600 cycles • 2.4 lbs. Alnico V magnet • 3" voice coil • 45 cycle cone resonance • Price: \$66.00



800E DIVIDING NETWORK:

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802D HIGH FREQUENCY DRIVER: Made specifically for the 811B horn for smooth 22,000 cycle high frequency reproduction.

Specifications: 30 watts • 500-22,000 cycles • 16 ohms • 1.3 lb. Alnico V magnet • Price: \$63.00



811B HORN: Incorporates the exclusive ALTEC direct radiating sectoral exponential principle for brilliant clarity in the high frequency range.

Specifications: I.F. cutoff—800 cycles • distribution —hor., 90°; vert., 40° • Price: \$30.00

TOTAL COST ONLY \$205.50

"Voice of the Theatre" speaker components also are available in three cabinet designs for home use—



831A Capistrano

1. 831A Capistrano—typical of the elegant styling of ALTEC home systems incorporating "Voice of the Theatre" components. In walnut, blond, or mahogany. Price: \$426.00

2. The A-7 is designed for the brilliant reproduction of sound at low cost. Price: \$299.40

3. The 832A Corona is corner designed for greater bass reproduction. Its fine styling will enhance the decor of any room. In walnut, blond, or mahogany. Price: \$414.00

12-34

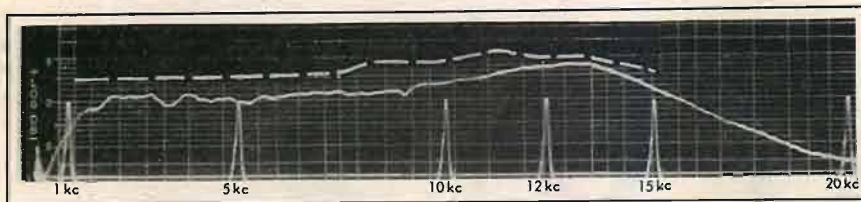


Fig. 3. Photograph of the on-axis response trace (linear frequency scale) of the 2-inch tweeter. Microphone calibration curve is drawn in above. Marker pips at frequencies indicated.

persion, while the larger the radiating diaphragm the sharper is the beaming of treble frequencies. It is the writer's experience that dispersion is the controlling element in the so-called point-source effect, and that a speaker with good dispersion least conveys the sense of sound issuing from a particular spot in the room.

Design of New Tweeter

The tweeter here described derives from a sort of distillation of speaker design to the simplest device possible in terms of its basic function—that of

audio spectrum than the larger one, but it does have better dispersion and power response above 7000 cps³. It will be noted that the dome shape makes a rim suspension device of the type used with cones (a skiver or surround) unnecessary.

The dome is attached directly to an aluminum self-supporting voice-coil, and the assembly is held in the gap by synthetic rubber material placed right in the gap. Two types of material are used; one a substance which foams up after insertion in the gap (anchored by four notches in the top plate), providing

dome-shaped diaphragm filled with Fiberglas, a voice-coil (with pig-tail leads formed by its own wire ends), a magnetic structure, and suspending material in the gap. The Fiberglas in the magnetic structure is to damp out internal acoustical resonances which originally produced a response peak in the 500-cps region.

Some of the speaker parts used in various types of current conventional tweeters but eliminated here are the skiver, the external spider, the voice-coil former, separate pig-tail leads and eyelets, the dispersing device, and the horn. The tweeter's moving system consists of only the diaphragm, voice-coil, and rubber suspension, and has a mass of slightly more than one gram.

Performance Measurements

It was felt that photographs of the actual automatic response traces (plus microphone calibration curves), published in addition to the final interpolated data, would provide greater interest than the digested data alone. Conditions of measurement are described in some detail and are in compliance with the existing American Standards previously referred to. This makes possible evaluation by the reader, as well as duplication of tests by other laboratories.

The speakers were mounted with their top plates flush to the baffles, and were placed so that they radiated into a solid angle of 180 deg., into an anechoic chamber. For off-axis readings the baffle was turned in a horizontal plane. (Vertical dispersion was identical to horizontal by virtue of the symmetrical construction of the tweeters.) During azimuth readings the edges of the baffle, which was cut to the size of an AR-1 enclosure, were exposed and allowed diffraction effects.

The microphone was hung to receive the sound at grazing incidence—the condition for which the calibration curve applied—at a distance of 4½ feet from the speaker. The tweeters were fed by an automatically repeating, one-second sweep signal from an amplifier with a damping factor of 15, and the output of the microphone fed to a cathode-ray tube screen with synchronized horizontal trace, over three separate ranges on a linear frequency scale, each range covering approximately 5000 cps. The divi-

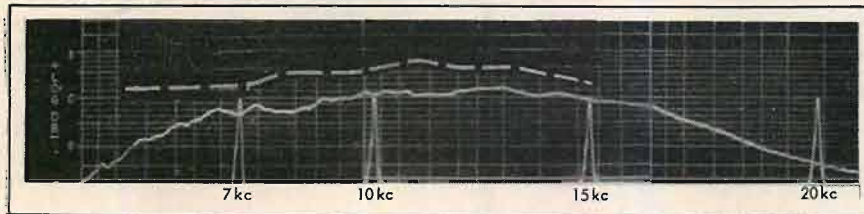


Fig. 4. On-axis response trace of the 1 3/8-inch tweeter, recorded as in Fig. 3.

converting treble electrical energy to acoustical energy with maximum uniformity of both on-axis and power response. A novice unsophisticated in the ways of current speaker construction might conceive of such a tweeter.

The dynamic type of speaker was chosen as an inherently simple one. Thus the moving force is provided by a voice-coil and magnetic structure, as shown in Fig. 1.

The introductory remarks of this article explain the choice of diaphragm size and shape—a section of a small sphere. Although such a diaphragm, subjected to longitudinal vibration as here, does not have the perfect dispersion characteristic of a pulsating sphere, its dispersion is good indeed. Two sizes of phenolic diaphragm are used in the tweeter system, a 2-inch diameter and a 1 3/8 inch diameter (see Fig. 2.) The smaller unit has only slightly better on-axis response at the upper end of the

the adhesion necessary to hold the voice-coil permanently in place, and the other a very compliant butyl which fills the remaining portion of the gap. The latter keeps dust out, helps create positive centering, and provides a certain amount of damping, although the major burden of damping is borne by the electro-magnetic circuit. Chemicals had to be found that combined the proper performance qualities with stability over the years. Chemical changes with time, if any, are expected to increase compliance slightly rather than to stiffen the system.

Thus, the entire tweeter consists of a

³ It may be of interest to note that the frequency of ultimate air-load resistance for the 2-inch diaphragm is approximately 4400 cps, and for the 1 3/8-inch diaphragm 6600 cps. This implies that, even assuming pure mass control above these frequencies and complete diaphragm rigidity (neither of which assumptions holds entirely true) the total power response of the larger unit will be down only 6 db at 8800 cps, and of the smaller unit 6 db at 13,200 cps.

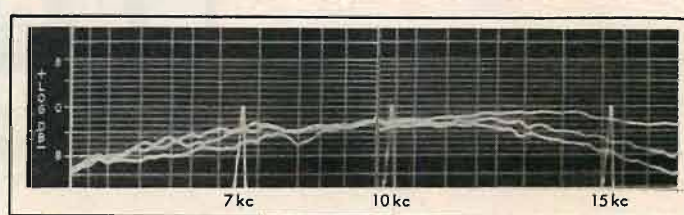
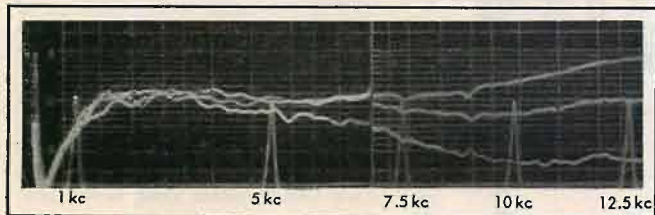
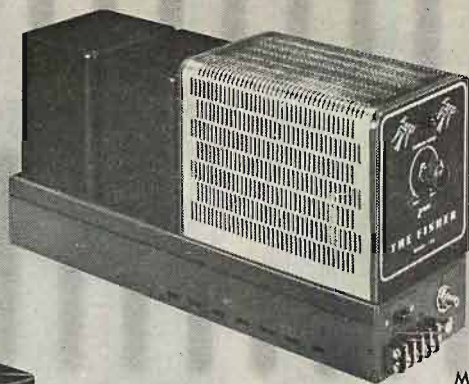
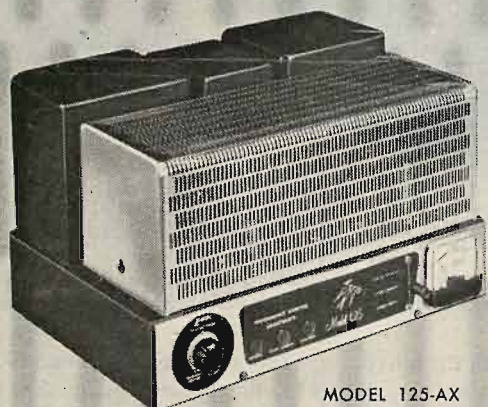


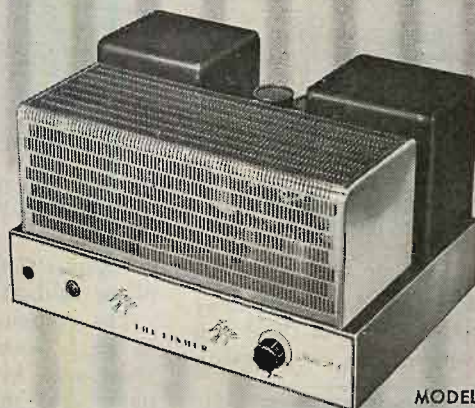
Fig. 5. (left). Response of 2-inch tweeter on-axis (top), 30 deg. off-axis (middle), and 45 deg. off-axis (bottom). Fig. 6. (right). Response of 1 3/8-inch tweeter on-axis (top), 30 deg. off-axis (middle), and 45 deg. off-axis (bottom).



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sion into three ranges, and the unfortunate use of a linear rather than a logarithmic frequency scale was dictated by the nature of the test equipment used. The sweep rate was validated as sufficiently low by comparing results to those made with a 1000 cps/second sweep.

The input voltage across the tweeters was 2 volts, representing 1 watt to the rated impedance of 4 ohms. It may be mentioned that the single-frequency sound levels produced would be associated with a relatively high over-all level of musical sound.

The test equipment included the following:

1. Anechoic chamber (AR) that can be considered non-reverberant to an octave below the lowest frequency measured.
2. Panoramic Sonic Analyzer LPla, Sonic Response Indicator G2, and Power Supply PS1C.
3. Altec 21-BR-150 capacitor microphone, Serial No. 10386, with individual calibration curve supplied by Altec, with Altec Microphone Power Supply P526A.
4. Dynakit Mark III power amplifier.
5. Dumont Oscillograph-Record Camera type 302.
6. Krohn-Hite Oscillator 430-AB.

Figure 3 is a combined photograph of the on-axis response traces of the 2-inch unit (24 μ f capacitor in series), with

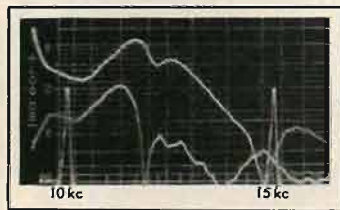


Fig. 7. Response of another tweeter on-axis (top) and 30 deg. off-axis (bottom), showing sensitivity of measuring equipment to frequency irregularities.

the three frequency ranges juxtaposed. The microphone calibration curve, transposed to a linear scale, is drawn in above the trace in dashed lines.

Figure 4 combines photographs of the on-axis response traces of the 1 3/8-inch unit (6 μ f capacitor in series) over the

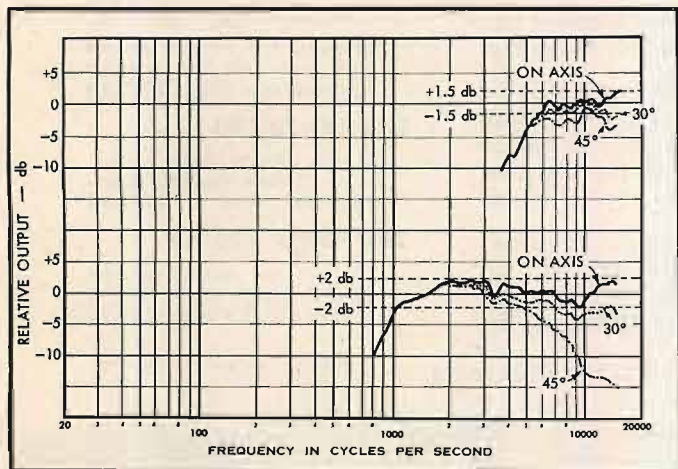


Fig. 8. (Top) Response curve of 2-inch tweeter on-axis, 30 deg. off-axis, and 45 deg. off-axis, corrected for microphone and plotted on audio log. scale. (Bottom) Same, 1 3/8-inch tweeter.

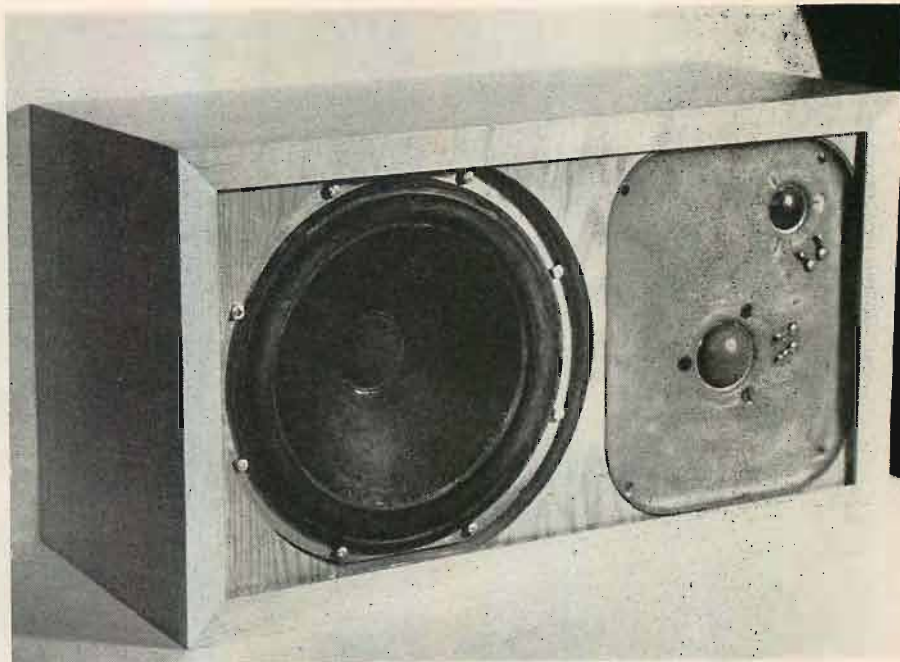


Fig. 9. Prototype of AR-3 speaker system, including AR-1 acoustic suspension woofer and the two tweeters described in this article. (Photo by Bunker.)

two higher ranges, again with the microphone calibration curve above.

The response of the tweeters above 15 kc is shown primarily to indicate smoothness in this range. The microphone was uncalibrated above 15 kc, but it can probably be assumed that microphone response continued the downward slope apparent in the calibration curve.

Dispersion

Figures 5 and 6 compare the on-axis response of the two tweeters with the response of 30 deg. and 45 deg. off-axis, each in its respective frequency range.

Figure 7 is not shown as a contrasting "horrible example", but merely to indicate that the measuring equipment is properly sensitive to speaker response irregularities when they exist. It is the response trace of a relatively low-priced but well made tweeter, comparably baffled.

The final response curves, shown in Fig. 8, represents the AR tweeter response traces corrected for microphone calibration and plotted on a standard 30 db/decade audio log scale. It can be seen that the on-axis response of each unit in its range is uniform within narrow limits: ± 2 db for the 2-in. tweeter and ± 1.5 db for the 1 3/8-in tweeter, unusual characteristics for loudspeakers. The off-axis losses of the 2-inch unit (apparently not too serious as determined by listening tests) are picked up by the smaller tweeter, and the off-axis response curves remain smooth, another unusual circumstance for loudspeakers.

Smooth frequency response is associated with reduced speaker coloration, clarity and definition of individual musical instruments, and subdued record surface noise even when there is considerable high-frequency energy radiated. Peaky response selectively emphasizes discrete frequency regions of surface noise, making it much more obtrusive.

Distortion, Efficiency and Power Capability

For response curves to be valid they must represent fundamental speaker output only. Validating harmonic distortion measurements were therefore made for the frequency ranges covered, at the same input power. The total harmonic distortion did not exceed 2 per cent at any frequency.

The efficiency of these units is slightly higher than that of an AR-1 woofer, and some attenuation is required for proper balance in typical rooms. Al-

(Continued on page 104)

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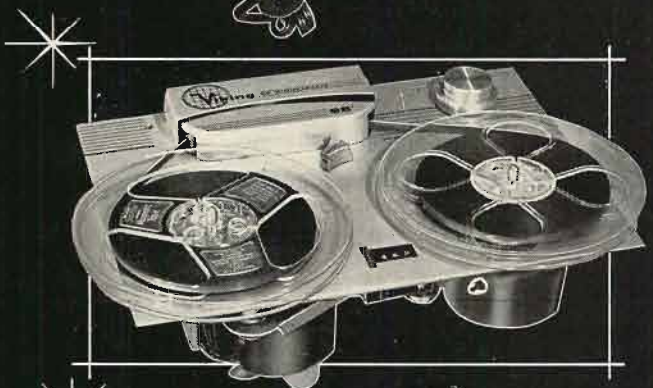
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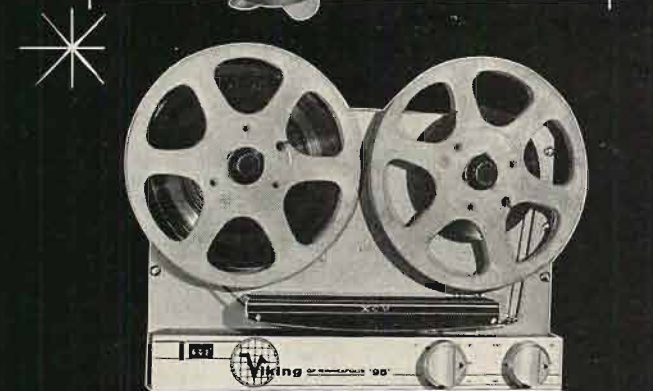
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Toward an Optimum Stereo Cartridge

HERBERT H. HOROWITZ*

The subminiature application of the ages-old principle of the gimbal results in an interesting and effective design for a stereo cartridge which comprises two d'Arsonval "meter" movements for its generating elements.

INDUSTRY AGREEMENT on the selection of the 45/45 cut for stereo disc recording, the release of demonstration discs, and the alacrity displayed by commercial recording companies in making stereo pressings available to the consumer, gave impetus and direction to engineering development of an optimum playback unit consistent with:

- the design previously used for monophonic pickups;
- feasibility of manufacture;
- eventual consumer cost; and
- a release target date—based upon a multiplicity of considerations, including: materials and components availability, required tooling change-overs, publicity timing, and established marketing channels.

These factors were undoubtedly accorded varying degrees of prominence in establishing organizational policy regarding the final product—consonant with the attitude of manufacturing, management, and sales divisions—toward what the public would accept. The prime motivator—consumer demand—had already, in large measure, been established.

Certainly, it had to be determined whether release was to be delayed until design effort had reached the *ultima Thule*, or limit engineering effort to the

* Chief Engineer, Electro-Sonic Laboratories, Inc., 35-54 Thirty-sixth Street, Long Island City 6, N. Y.

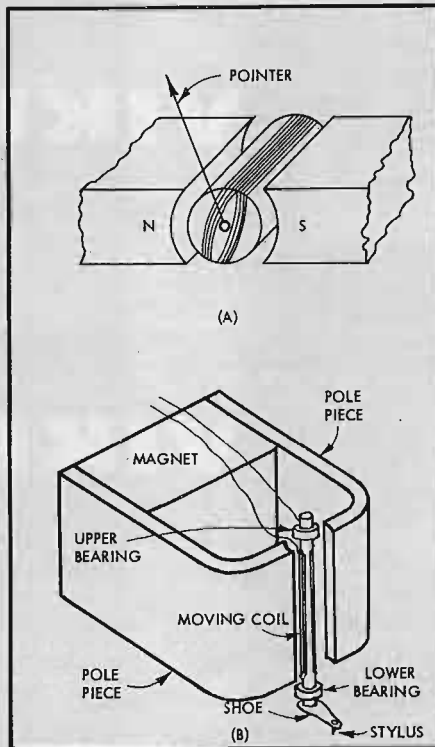


Fig. 2. (A) Diagram of a typical d'Arsonval meter movement, and (B) its adaptation as a phonograph pickup—the ESI C-60.

creation of a device adequate for the reproduction of present offerings by the recording industry—trusting that im-

provement in the quality of the recorded material would not obsolete the product within its probable life-span. Each manufacturing organization resolved the question according to its own experience and conscience.

Although both aesthetic and technical criticism have been leveled at some stereophonic pressings released within recent months, the improvement in both areas is already apparent. With the many types of stereo playback cartridges now available to the enthusiast (piezo-electric, moving magnet, moving coil, moving vane), the consumer may select a pickup compatible with his budget, or reflecting his listening tastes.

Evaluating the Design

To evaluate justly the design approach and the subsequent performance of a stereophonic cartridge, one ought to begin with an inherently perfect recording. Any inadequacy in the test disc would invalidate the test results or require "allowance for" when comparing several pick-up units. Assume that by some engineering sorcery, a flawless test recording could be prepared. The following technical conditions will have been met:

- The material of the disc will have been infinitely plastic during cutting and will have attained surpassing hardness at the exact instant that the cutting stylus passed to the next point to be inscribed. The first condition is necessary to ensure that each miniscule excursion of the stylus is faithfully recorded, while the second requirement ensures that no subsequent distortion of the recorded undulation can ever result through stylus friction.
- There is no unwanted coupling between input channels in any portion of the recording equipment.
- As a corollary to item (b), no motion of the cutter stylus toward one groove wall has in any manner affected the opposing groove wall.
- Accurate and properly balanced depth of cut represents precise intensity of channel information supplied.

Now, given a recording, faithful in all

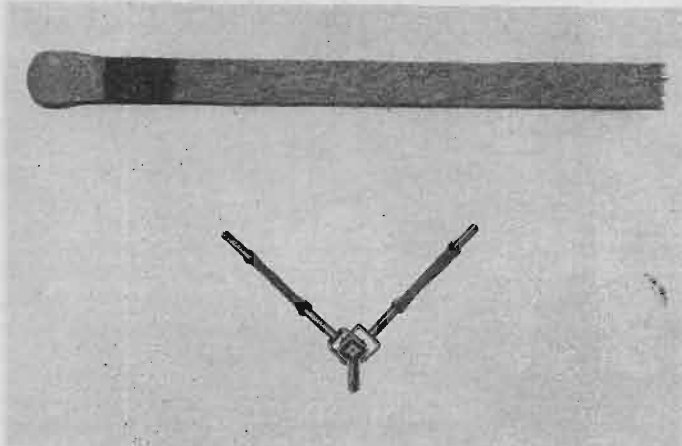
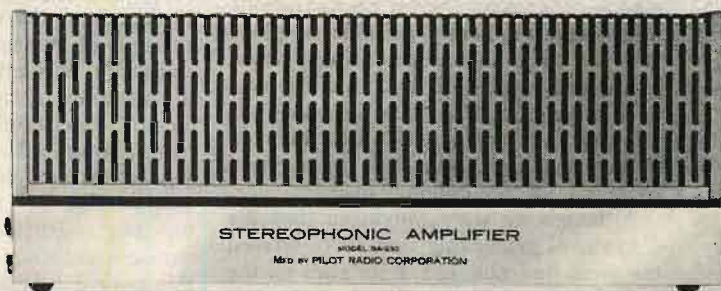
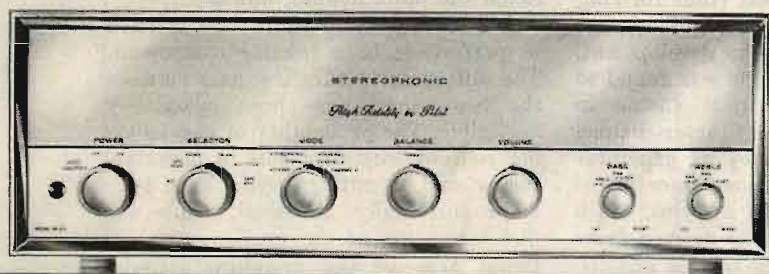


Fig. 1. Comparison in size between moving elements and book-type paper match, about 2-1/3 times actual size.

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The SP-210 consists of two identical preamplifiers with ganged controls for balanced stereo operation. Every measure has been taken to achieve maximum quality and versatility. Premium type, low-noise triodes are used in all low level stages, and hum-free dc on all tube heaters. Inputs with equalization are provided for all possible stereo source material: phono, tape, microphones,

FM-AM and FM multiplex. The extreme sensitivity of the phono input makes the SP-210 ideal for magnetic stereo cartridges, as well as for other types of pickups. There are also auxiliary outputs for making stereo tape recordings.

The SP-210 is housed in a modern, low silhouette metal cabinet with brass control panel. Price is \$89.50 complete, less power supply. The P-10 Power Supply is priced at \$19.50.

The SA-232 and SA-260 Basic Stereo Amplifiers each consists of two identical power amplifiers. The SA-232 delivers a total of 32 watts of undistorted power (64 watts peak) the maximum power obtainable without exceeding the tube manufacturer's specifications. The SA-260, with 60 watts of undistorted power (120 watts peak) is well within operating characteristics of the output tubes. Both units have power tap-offs for operating the SP-210.

The SA-232 is priced at \$89.50, and the SA-260 at \$129.50. Both are supplied with brass finished metal covers. (Slightly higher in West.)

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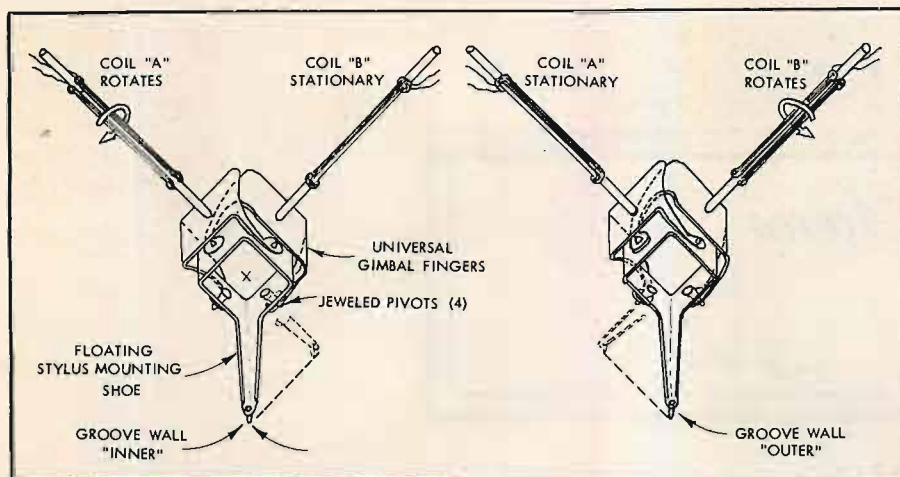


Fig. 3. Two d'Arsonval movements set at 45 deg. from the vertical and connected with the Gyro/Jewel coupling system.

details, will the playback result equal the quality of the recording? It should if the pickup is equally good.

Gyro/Jewel Design Approach

The ESL Gyro/Jewel stereophonic cartridge is, first of all, *not* simply a marketable redesign of a reproducer system originally developed for monophonic recordings. Design configurations which were eminently suitable to playback of monophonic recordings, when paired and rotated 45 deg. from the vertical, were found to have become considerably less competent performers on stereo recordings than their prototypes' rendition of monophonic discs.

Although we were convinced that the d'Arsonval generating movement offered the most desirable characteristics as the transducer element(s) for stereo reproduction as well as monophonic, the designs of many other domestic and foreign laboratories were scrutinized to determine the capabilities of their products.

Experimental models of competitive units were carefully constructed by ESL engineers and technicians and were then exhaustively tested, measured, an evaluated both by the use of laboratory test gear and in listening tests.

Not to be stamped into preliminary

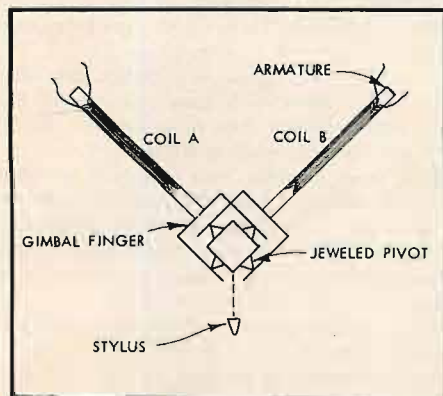


Fig. 4. Simplified mechanical diagram of coupling system.

freezing of production designs, the entire organization agreed that no stereo pick-up would be released until the valid approach had been determined: one which would embody all the desirable features necessary to an ideal system, and would yield a device that could be produced with consistent quality. Early experimental units were devised with two d'Arsonval movements mounted at 45 deg. from the vertical (thus forming an angle of 90 deg. with each other). Incidentally, throughout the development, the accuracy of this angle was found to be an exceedingly critical factor in maintaining satisfactory inter-channel separation and constancy of generator output. The two armatures were yoked together and fitted with a stylus. Much valuable information was derived from this approach before the scheme was discarded as furnishing a fallacious solution. *Figure 6* shows one early model.

In our opinion, every indication pointed to the d'Arsonval movement as the superior generating element for the application. The movement could be built to have an exceedingly small mass; it is inherently linear, as a characteristic of the constant location of the coil in the flux concentration between the magnet pole-pieces and its rotational motion about its own axis in the fixed magnetic field; and it could be made to generate adequate output with the necessarily small rotational movements of the coil.

In *Fig. 2*, (A) is a simplified line diagram of a typical d'Arsonval movement, while (B) shows the application of the principle to a monophonic pick-up, the ESL-C60 Series cartridge. Two similar systems were devised, and mounting assemblies designed to hold the armature axes at exactly 45 deg. from the vertical and at precisely 90 deg. from each other. The functioning of the movements is shown in *Fig. 3*.

As shown in the diagram, latex mounting blocks hold the armature core so that only *rotational* motion of the coils can occur. This mounting not only exhibits

mechanical stability, but further, inhibits any possible electrical non-linearities resulting from coil shift out of the maximum flux density area between the magnet pole-pieces. As the latex blocks do not slide on the armature, rotational friction is non-existent.

In order to provide generating elements which would be of sufficiently small mass and yet develop a usable output, a wire having cross section diameter of approximately 1/1000 in. was needed. Obviously, copper "magnet" wire could not be used for this application—a copper filament of this diameter would have almost no physical rigidity, and would probably disintegrate upon handling.

In order to wind coils using a wire of this diameter, a special precious-metal alloy conductor was developed. This almost microscopic conducting filament—about one-third the diameter of a human hair—could not be mounted in the pick-up on a bobbin. Even the smallest of bobbins would have increased the mass and physical dimensions of the system to intolerable limits. The 60-turn coils are wound, shaped, and mounted directly on a rigid armature shaft, which is then assembled in the armature holder between the latex holding blocks.

A solid armature shaft was selected in preference to a tubular component. The difference in effective mass between the two would have been completely negligible. The probability of encountering concentricity problems in manufacturing and mounting would have been disproportionately increased, while the flux saturation of the smaller cross-sectional area of the armature material would have restricted output.

The magnet/pole-piece assembly is worthy of note, too, in that precision grinding is employed at the area of juncture. The pole-pieces are screw-clamped rather than soldered, as the possibility exists in production that during soldering, capillary flow of the solder might result in an air gap—materially reducing the effective flux density through the coil mounting area.

Coupling the stylus to the two armatures requires a reliable linkage having the ability to differentiate completely between stylus motion in the two planes of motion. The linkage design must be such that instantaneous motion in the desired direction is unrestricted. Mechanical coupling between systems must be prevented or made ineffective. A short, rigid stylus bar would be desirable to further reduce system inertia (the effective mass increases as the square of the distance from the point of applied force). The linkage should be free of any self resonance within the audible frequency range to prevent distortion in frequency linearity.

The development of a stylus arm and



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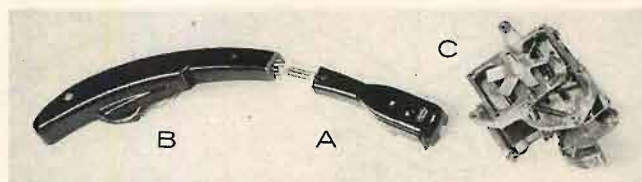
A. Five-terminal plug-in head. (Exclusive with Collaro.) By providing two completely independent circuits, the new five-terminal head guarantees the ultimate in noise-reduction circuitry — a vital need for stereo reproduction.

B. Counter-balanced, transcription-type tone arm. Another Collaro exclusive. Stereo cartridges require light tracking pressures. As records pile up on a changer, tracking pressure of a conventional arm tends to increase. Result may be damage to records or cartridge. This *cannot happen with the Collaro counter-balanced arm* since it varies less than a gram in pressure between the top and bottom of a stack of records. The arm will accept any standard stereo

or monaural cartridge and it has no spurious resonances.

C. Motor. Dynamically balanced and so rigidly mounted that wow and flutter specifications are superior to any changer in the world. (.025% at 33 $\frac{1}{3}$ RPM)

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coupling "shoe" along with the attaching yokes for converting the angular motion of the stylus to rotational motion for the d'Arsonval generators resulted in a straightforward, essentially friction-free design, with inherently low mass and minimum response to any but the desired motional mode.

The final design adopted employs four jeweled pivots for attaching the stylus shoe to the armatures of the d'Arsonval generators. Figure 4 is a simplified mechanical diagram of the assembly.

As the stylus is influenced by the undulations of the record groove—in Fig. 3—angularly, to the left, the armature of generator A is caused to describe a corresponding rotary motion, while that of generator B, restricted by the armature mountings is unaffected by this excursion of the stylus.

By reason of the friction-free jewel pivots attaching the shoe to system B, no restriction is offered to the movement of the system A armature, nor is any of the angular motion of the stylus as it moves to the left transmitted to the armature of system B.

When the excursion of the stylus is to the right, the opposite effect takes place and the armature of system B is caused

to rotate. In this instance, no motion is coupled to system A.

The yokes—which serve the dual purpose of coupling stylus motion to the armatures of the generators and supporting the stylus shoe assembly (the universal gimbal fingers at the jeweled pivot points)—possess the necessary qualities of rigidity to prevent deformation under stress, and the hardness to resist wear at the pivot points.

The clamping action of the gimbal fingers on the jeweled pivots—a quality of the resiliency and mechanical design of the yokes—provides a mounting which will remain secure even under conditions of unusual mechanical shock, yet retain the ability to swing freely.

Cartridge Performance

Response tests of the ESL Gyro/Jewel cartridge show that no mechanical resonances occur in the audible range. This condition, coupled with the natural linearity of the generator system, permits the over-all response of the cartridge to remain flat within ± 2 db over the frequency range from 30 to 15,000 cps on presently available stereo test discs, which are restricted to this range. When playing conventional mi-

crogroove test records, the frequency response extends to well beyond 20,000 cps.

The complex motion to which the system must respond in the 45/45 system is applied at an angle of 45 deg. to the vertical. To achieve unrestricted response to this angular mode of motion, the measured vertical and lateral compliance should be essentially equal (the resultant vector angle of two equal forces acting at right angles being 45 deg.). By accurate assembly methods and precision manufacture, the production cartridge has vertical and lateral compliances equal, with a value of 5×10^{-6} cm/dyne or greater.

By reason of the extreme miniaturization of the moving components of the reproducer system(s), the dynamic mass of the ESL Gyro/Jewel stereo cartridge is held to a value of 2 mg. The high compliance and low dynamic mass contribute greatly to reduced record wear.

A stylus force of six grams on the 0.7 mil stylus used for stereo playback results in record wear as great as a tracking force of twelve grams on the 1.0 mil stylus used for monophonic pickups. In an arm of proper design, a tracking force of two or three grams is

(Continued on page 58)

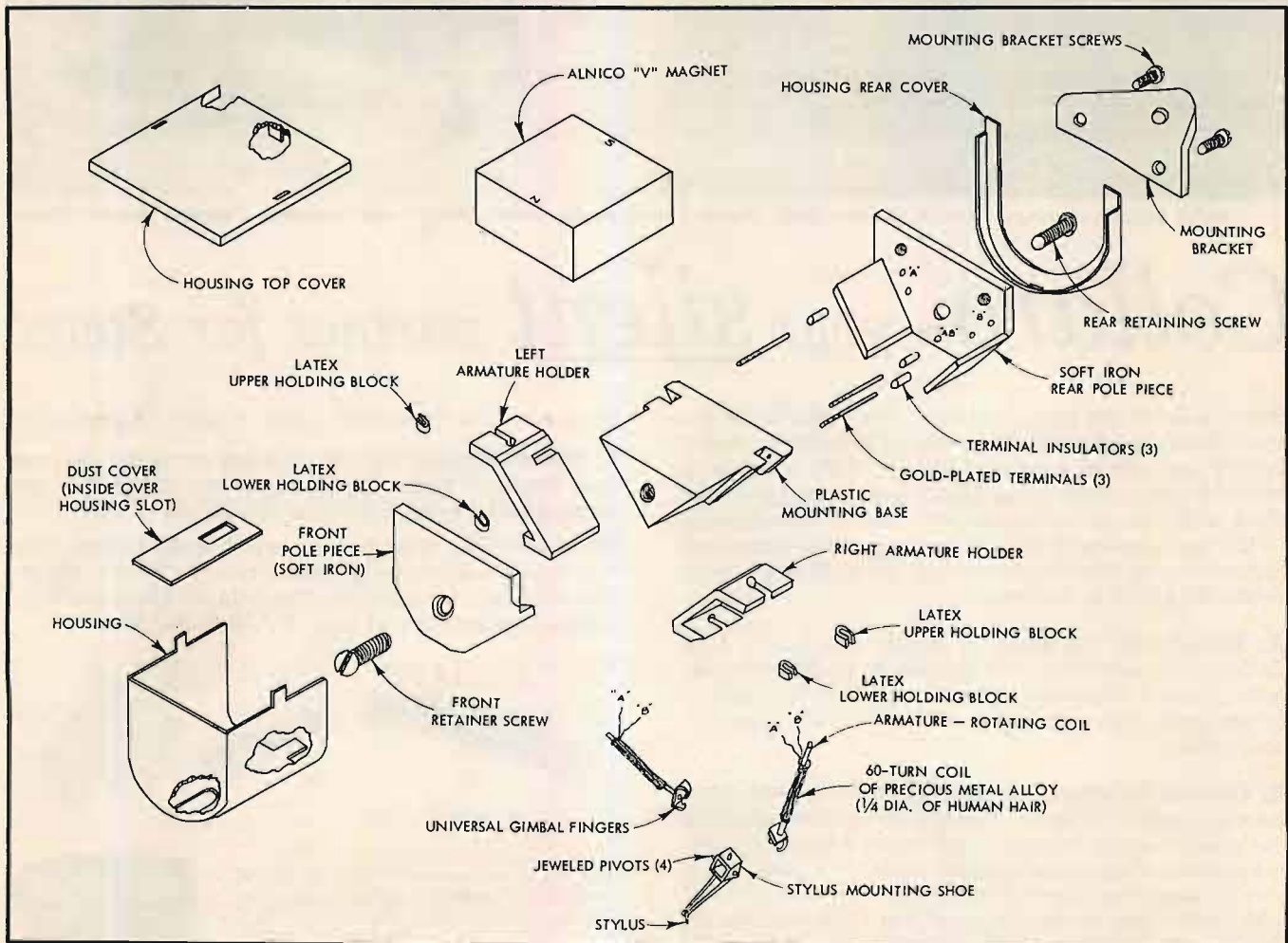
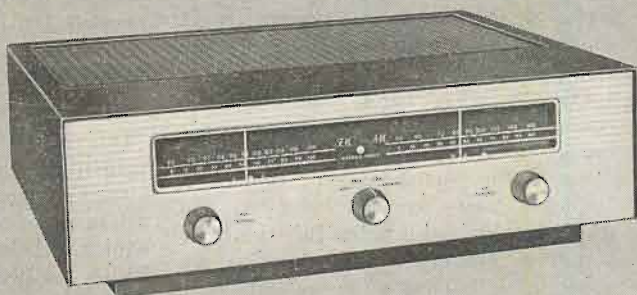


Fig. 5. Exploded view of the complete cartridge.



HARMAN- KARDON MAKES STEREO SENSIBLE



Harman-Kardon stereo instruments are the most flexible on the market today. Intelligent design assures ease of operation. The new Duet stereo tuner and Trio stereo amplifier — make stereo attractive, effective, inexpensive — and sensible.

THE TRIO, Model A-224, Stereo Amplifier — actually embodies *three* excellent instruments in one handsome, compact unit. The Trio is: A complete stereo preamplifier with two separate 12 watt power amplifiers (24 watt peaks each.) A complete 24 watt monaural amplifier (48 watt peak.) A 24 watt monaural amplifier with complete stereo preamplifier arranged to convert an existing monaural amplifier to stereo. Outstanding features include: Separate ganged treble and bass controls, balance control, mode switch, speaker selector switch for local and remote speaker systems, contour control, tape output for recording application and rumble filter.

THE TRIO, Model A-224 \$99.95
the Cage (AC-24) optional 7.00

THE DUET, Model T-224, Stereo Tuner: Monaural! Binaural! Whatever the application, this new tuner is designed to give maximum performance. A superb monaural tuner—the T-224 incorporates separate AM and FM channels for receiving stereo broadcasts through this *one* unit. Rear jack makes it adaptable for multiplex reception.

While the DUET is an ideal AM/FM monaural tuner—it's specifically designed for the growth in stereo broadcasting. As stereo broadcasting grows—the value of the DUET multiplies for you. Costs just a few dollars more than conventional monaural tuners! (The DUET incorporates a simple indexing scale to permit easy identification of five pairs of "stereo" stations).

THE DUET, Model T-224
\$114.95

Prices slightly higher on the West Coast.

For additional information on Harman-Kardon stereo and monaural units, simply send a postcard with the word stereo on it to Harman-Kardon, Dept. A-10, Westbury, N. Y.

harman kardon

Employer Rights in Employee Inventions

ALBERT WOODRUFF GRAY*

In the absence of a specific patent agreement, inventions of an employee remain his own property unless he was employed "to invent." In many cases, though, employer retains "shop rights."

EMPLOYED BY THE GOVERNMENT, two scientists were assigned to radio research in airship bomb and marine torpedo control. Both projects required the designing of a mechanism for use on an airplane to receive the output from a radio receiver, thence to relay it to a coil on an airplane which would operate through a visual indicator or trigger that in turn released a bomb on a pilotless plane or a marine torpedo.

While working on this problem and impelled solely by their own curiosity they also directed their attention to the substitution of power-line alternating current for direct current from batteries in the operation of radio apparatus. Patents were later issued them for these discoveries in this line of research.

On the ground that these inventions, perfected through the discoveries of these scientists while employed by the United States, were the property of the government, suit was brought against them by the United States to compel the transfer of these patents to the government.

In a summary of the law by the government that these inventions were the property of the United States it was asserted that inventions made by employees outside of work hours and without the aid of material belonging to the employer, when the inventions have no relation to the employee's duties, are the property of the employee in which the employer has no interest. This proposition according to the court, was obviously sound.

In support of the government's claim the second proposition was that inventions arising out of or made in connection with the employee's duties and incidental thereto, by an employee whose duties did not include the carrying on of research or inventive work, are the property of the employee in which, however, the employer has a shop-right or a nonexclusive license to use the invention. That too, the court conceded was sound.

However, the third proposition and

* 112-20 72nd Drive, Forest Hills, N. Y.

conclusion of this argument of the government was, "Inventions made by an employee in connection with his work and within the scope of his work, whose duties include the carrying on of research and inventive work, become the sole property of the employer together with the accompanying patents." This conclusion the federal court refused to accept.

Patent Right Belongs to Paymaster

When this case ultimately came before the United States Supreme Court on appeal, that court in sustaining this judgment denying the right of the government to these patents, said that anyone employed to make an invention, who succeeds during his term of service in accomplishing that task, is bound to assign to his employer any patent obtained.

The reason is that he has only produced that which he was employed to invent. His invention is the precise subject of the contract of employment. A term of the agreement necessarily is that what he is paid to produce belongs to his paymaster.

On the other hand, continued the court, if the employment is general although it may cover a field of labor and effort in the performance of which the employee conceived the invention for which he obtained a patent, the contract is not so broadly construed as to require an assignment of the patent.

In an explanation of the underlying principle of this conclusion, the court added, "The reluctance of courts to imply or infer an agreement by the employee to assign his patent is due to the recognition of the peculiar nature of the act of invention which consists neither in finding out the laws of nature or in fruitful research as to the operation of natural laws, but in discovering how those laws may be utilized or applied for some beneficial purpose, by a process, a device or a machine. It is the result of an inventive act, the birth of an idea and its reduction to practice,

the product of original thought, a concept demonstrated to be true by practical application or embodiment in tangible form."

Then of the distinction between the idea of the inventor and its manifestation or reduction to practice, the court continued, "Though the mental concept is embodied or realized in a mechanism or a physical or chemical aggregate, the embodiment is not the invention and is not the subject of the patent. This distinction between the idea and its application in practice is the basis of the rule that employment merely to design or to construct or to devise methods of manufacture is not the same as employment to invent.

"Recognition of the nature of the act of invention also defines the elements of the so-called shop right which, shortly stated, is that where a servant during his hours of employment, working with his master's materials and appliances, conceives and perfects an invention for which he obtains a patent, he must accord his master a non-exclusive right to practice the invention."

"Shop Rights" Rule

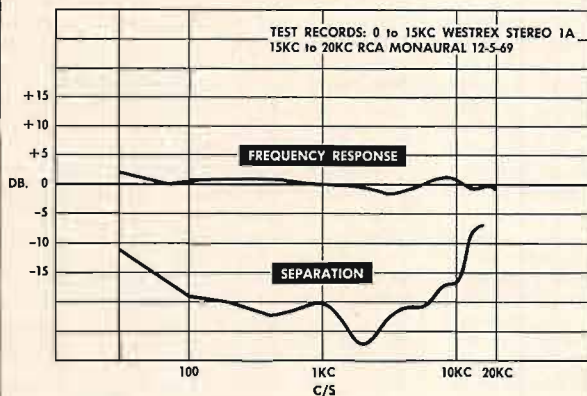
In conclusion it was said by this court, "This is an application of equitable principles. Since the servant uses his master's time, facilities and materials to attain a concrete result, the latter is in equity entitled to use that which embodies his own property and to duplicate it as often as he may find occasion to employ similar appliances in his business.

"But the employer in such a case has no equity to demand a conveyance of the invention which is the original conception of the employee alone, in which the employer has no part. This remains the property of him who conceived it together with the right conferred by the patent, to exclude all others than the employer from the accruing benefits."¹

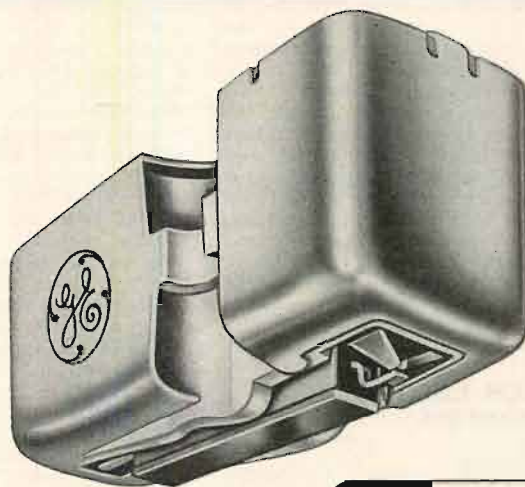
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¹U. S. v. Dubilier Condenser Corp., 289 U. S. 178, April 10, 1933, aff'g. 59 Fed. 2d 381, May 24, 1932.

New G-E "Golden Classic" stereo-magnetic cartridge



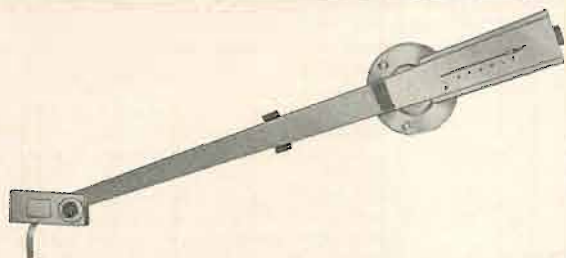
Smooth response on both stereo and monaural records. Consistently high separation between stereo channels.



- Compatible with both stereo and monaural records
- Full frequency response, 20 through 20,000 cycles
- "Floating armature" design for increased compliance and reduced record wear
- Effective mass of stylus approximately 2 milligrams
- High compliance in all directions—lateral compliance 4×10^{-6} cm/dyne; vertical compliance 2.5×10^{-6} cm/dyne
- Recommended tracking force with professional-type tone arm 2 to 4 grams
- Consistently high separation between channel signals. (Specifications for Model GC-5.)

Stereo is here! General Electric makes it official—with the new "Golden Classic" stereo-magnetic cartridge, a fitting climax to the famous line of G-E cartridges. It makes stereo a superb, practical reality—at a very realistic price. Model GC-7 (shown) with .7 mil diamond stylus, **\$23.95**. Model GC-5 (for professional-type tone arms) with .5 mil diamond stylus, **\$26.95**. Model CL-7 with .7 mil synthetic sapphire stylus, **\$16.95**. (Mfr's suggested retail prices.)

...and new "Stereo Classic" tone arm



- A professional-type arm designed for use with G-E stereo cartridges as an integrated pickup system
- Features unusual two-step adjustment for precise setting of tracking force from 0 to 6 grams
- Lightweight brushed aluminum construction minimizes inertia; statically balanced for minimum friction, reduced stylus and record wear **\$29.95**. (Mfr's suggested resale price.)

See and hear the G-E "Stereo Classic" cartridge and tone arm at your Hi-Fi dealer's now. For more information and the name of your nearest dealer, write General Electric Company, Specialty Electronic Components Dept. A108, W. Genesee St., Auburn, New York.

GENERAL  ELECTRIC

Equipment Review

Audio-Tech Laboratories' speaker system—Telematic "Minstrel" speaker system—Karg Laboratories' "Tunematic" FM tuner and M/X-Stereo adapter units—Tannoy "Belvedere" Speaker system.

WITH THE CURRENT HIGH INTEREST in all things pertaining to stereo, one might think that one component common to both stereophonic and monophonic systems—the loudspeaker—might sit quietly by and simply sell in double the normal quantity. It seems, however, that we are practically overwhelmed with new systems, many intended especially for stereo. While a good speaker system can serve for either type of installation, those that are smaller and more compact lend themselves to the decor of the average home. All types reviewed this month might be considered stereo types, since they range from medium to tiny, the first being the largest of the three.

AUDIO-TECH LABORATORIES SPEAKER SYSTEM

Designed by Joseph Giovanelli, who conducts the AUDIOCLINIC column, the Audio-Tech speaker system offers some unusual characteristics at a reasonable price, and while smaller than many of the more familiar units on the market, its performance puts it alongside many of them. The unit, roughly 30 by 30 by 15 inches in size, employs a 15-inch woofer together with a tweeter to cover the range from 30 to 17,000 cps, according to the manufacturer. The woofer is built to the designer's specifications, and is suspended with an elastic

material which provides extremely high compliance. With adequate acoustic damping and a very heavy cabinet, bass response is smooth and without apparent resonances, with the exception of a measurable increase in impedance at 50 cps. The nominal impedance of the system is 8 ohms, with the maximum impedance throughout the entire audio spectrum not exceeding 20 ohms—which indicates an almost complete lack of audio resonances. Because of the tweeter coupling circuit, there is also a peak in the impedance curve at around 2000 cps, above which the impedance drops to the nominal value up to 8000 cps, when it begins to rise again. The over-all result of the smooth impedance curve is reflected in a smooth mid-range. The crossover network is of the L-C type, with the woofer rolling off naturally to the 5000-cps crossover point.

In listening tests, the speaker was found to perform down to about 32 or 34 cps, using the "King of Instruments, Vol. I" organ record for a quick determination. The scale played on side 2 of this record begins at 16 cps, and as the tones go up the scale, the listener can determine easily the note at which the tones begin to sound musical. From 16 cps up to that audible change in sound quality, the tones come out as low-frequency flutters or wheezes, with no musical quality whatever. Thus by counting up the scale as the record plays,

the listener can recognize immediately the lowest frequency at which the speaker begins to function as a speaker should.

Our second test record—for a quick analysis of speaker performance—is the old recording of Varese's "Ionization," (Elaine Music Shop, EMS-401), a record definitely not recommended for speaker testing in early morning hours. If we had to choose a single record to indicate speaker performance, this would be the one, for it is full of transients which serve to show high-end performance, while the eight-foot bass drum shows the low-frequency performance. It is not satisfactory as a quantitative measure, of course, but for a quick qualitative analysis it serves very well. The test oscillator is more useful for a thorough study, to be sure, but these two records are available to anyone and will give plenty of information.

The Audio-Tech speaker gives an excellent account of itself on the high-frequency end of the spectrum, both with the oscillator and with the test record. Transient performance is excellent, and output is readily audible up to this observer's limit, which is about 14,500 cps.

In addition to its good listening quality, the speaker is equipped with two refinements which all speakers should have—one is a calibrated control for tweeter balance, and the other is the use of colored binding posts for terminals to indicate polarity, thus making it easy to connect in proper phase relation. While we prefer a screwdriver-set control for balance, so as to avoid tampering or unauthorized changing of the setting, the calibration provides some reference for resetting the control to its "normal." We believe a speaker system should be set up once for its acoustic environment and then left alone permanently, any necessary changes in tone being made thereafter with the usual bass and treble controls.

The Audio-Tech speaker is available in bleached and dark mahogany as standard, and in other woods at a slightly increased cost. The cabinet design is simple, as seen in Fig. 1, and should fit into practically any modern home. L-27



Fig. 1. Audio-Tech Laboratories' speaker system.

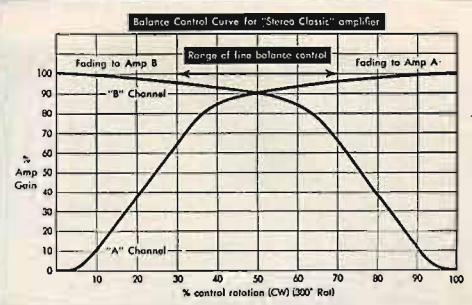
TELEMATIC "MINSTREL" SPEAKER SYSTEM

We are normally quite skeptical about extremely small loudspeakers—not having heard any up to this time which even approach the performance claimed for them by their manufacturers. We recall one which was purported to go down to 40 cps, but listening tests indicated that the 40-cps signal was apparently tripling and that whatever measuring instrument was used was simply indicating the output at the third harmonic—we could hear nothing below about 120 cps.

The "Minstrel," Fig. 2, is undeniably small—8½ in. high, 15¼ in. wide, and 9¼ in. deep, even smaller than the 9×9×16 specified in the literature. Consequently we didn't expect too much in the way of performance. Then we turned it on—and promptly checked our switching to make sure we hadn't crossed up our A-B connections. But no, everything was normal. The sound from such a small speaker was hard to believe. The balance over the range was good, output is audible to over 13,000 cps, and at the low end down to below 40 cps.

Literature describing the "Minstrel" tells us that it uses a new "Acoustic Transformer" principle which gives it dynamic air coupling. Beyond that, there is little information. The speaker unit itself is a 6-inch cone, and there are two semi-circular reflex ports which radiate an appreciable amount of sound in the lower range.

New G-E 40-watt "Stereo Classic" Amplifier



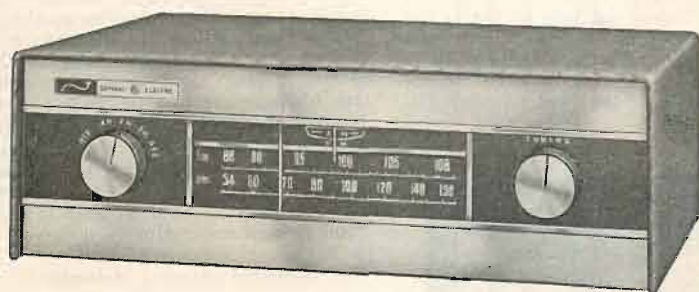
Versatile, convenient switches and controls. In this completely new and striking General Electric design you'll find every useful variation in stereo and monaural amplification, controlled swiftly and accurately. Balance control allows you to adjust for maximum stereo effect *without* overloading one channel when the other is cut down. New contour control boosts the bass smoothly, gradually, without increasing sound intensity. Each control handles *both* 20-watt channels.

- Full 20-watt power output from each channel at the same time.
- No audible distortion at full power.
- Flat response within .5 db from 20 to 20,000 cycles.
- Outstanding sensitivity, extremely low hum and noise level.
- Inputs: FM-AM tuner (and FM multiplex adaptor), stereo and monaural phono cartridge and tape, auxiliary.
- Speaker modes: stereo, stereo reverse, single or two-channel monaural.
- Speaker phasing switch saves manual phasing. **\$169.95***.



New 28-watt Stereo Amplifier has similar features, except for speaker phasing switch. **\$129.95***.

...and new FM-AM Tuner



Top performance in a trim, modern cabinet. Receives even weak signals with unusually low distortion, hum and noise level. No audible drift. Visual meter provides center channel tuning of FM and maximum AM signal. RF amplifier stage in both FM and AM for increased sensitivity. FM multiplex jack for stereo adaptor. Built-in AM antenna; folded FM dipole included. **\$129.95***.

Model FA-11 (left) has russet leather vinyl finish. Model FA-12 finished in willow gray vinyl. Both models are style-matched to the amplifiers. Cabinet removable for custom mounting.

*Manufacturer's suggested resale prices.

GENERAL  **ELECTRIC**

See and hear the G-E "Stereo Classic" amplifier and tuner at your Hi-Fi dealer's now. For more information and the name of your nearest dealer, write General Electric Company, Specialty Electronic Components Dept., A108, W. Genesee St., Auburn, N. Y.



in both FM and AM for increased sensitivity. FM multiplex jack for stereo adaptor.

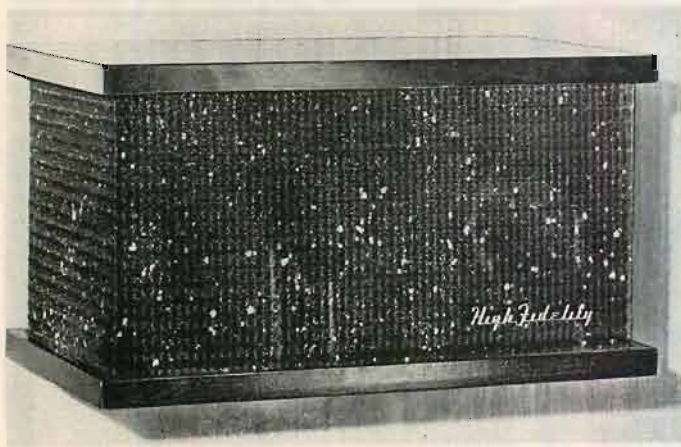


Fig. 2. The Telematic "Minstrel," a speaker of exceptionally small size, good performance.

The speaker has a nominal impedance of 4 ohms, will handle an input power of 10 watts continuously, according to the specifications, and covers the range from 50 to 15,000 cps. Because of its small size, it is especially adaptable for stereo installations, since two of them could be hidden quite readily. The manufacturer suggests that they could be built into valances if desired, which would be ideal for stereo use if the elevated location was not objectionable to the user—as it might be to some.

On the whole, however, two of these tiny units would undoubtedly outperform anything available in small portable stereo phonograph cabinets which are featured in so many advertisements currently. And while they cannot be compared to many of the larger speaker systems for over-all listening quality—nor should they be, considering their low price—the Minstrels are exceptionally listenable loudspeakers and would be ideally suited to a small listening room, apartment, or office.

The units are available in walnut, mahogany, blonde, or ebony, and may be used either vertically or horizontally. They are truly exceptional speakers for less than three-quarters of a cubic foot. L-23

KARG "TUNEMATIC" FM TUNER —STEREO-MULTIPLEX ADAPTER

Two separate units, these, but identical in size and similar in appearance. The FM tuner—called "Tunematic" because each station is on a separate position of a switch, and with crystal control to ensure exact tuning every time—employs seven tubes: an ECC88 cascode r.f. amplifier, a

6AU8A mixer-oscillator, with the triode section serving as the mixer and the pentode section as the crystal oscillator, two 6BZ6 i.f. amplifiers, a 6BN6 and a 6AU6 as limiters, a 12AU7 a.f. amplifier and cathode follower, with an EZ80 for power rectifier. Two CK705 diodes are used in the discriminator circuit.

The input circuit accommodates a 300-ohm twin lead or a 75-ohm coaxial lead-in, and an image interference trap is used in the r.f. amplifier grid circuit. R. f. chokes in the power line isolate the transformer and permit the use of the line cord as an antenna, which is sufficient for typical installations in reasonable proximity to the transmitters. We found it perfectly adequate for use 20 miles from the New York stations, and have found no need for an outside antenna. Specifications indicate a sensitivity of 2 μ v for a 300-ohm line and 20 db of quieting, or 6 μ v for 40 db of quieting. Half these signal strengths give the same quieting with a 75-ohm input.

The Tunematic is available with six, eight, or ten stations, and must naturally be set up by the factory, since each station requires a different crystal. The "tuning dial" is simply a plastic disc on which the station call letters appear, illuminated from behind through a small rectangular window. Except for the a.c. power switch there are no other controls. The tuner is shown in Fig. 3.

The i.f. amplifier stages are conventional, except possibly for the use of the high-transconductance 6BZ6 in both. One of the most efficient limiters so far is the gated-beam, zero-time-constant 6BN6, and this stage is followed by the 6AU6 pentode saturation limiter, giving a high degree of limiting ahead of the Foster-Seeley dis-

criminator. Following the de-emphasis network is the level-set potentiometer, which is a screwdriver control located on the connection panel, an a.f. amplifier, and a cathode follower which provides an output of approximately 3 volts to high-impedance loads, and an output of approximately 0.5 volts to feed a 600-ohm line. A third output is multiplex, which is connected ahead of the de-emphasis network.

There are more advantages to the use of crystals than might at first be apparent. Simplicity of tuning is, of course, readily noted, and along with it the absolute accuracy of the crystal control. A second advantage is the complete freedom from microphonics, to the extent that the unit can be installed in the speaker cabinet if desired. A third advantage will seldom be noticed by the user, but will be welcomed if a.v. servicing is to be done—and that is the fact that complete alignment can be made with absolute accuracy using only a vacuum-tube voltmeter connected to test jacks on the chassis. A signal generator is not required at all, since the necessary adjustments can be made with the stations involved.

In performance, the Tunematic is above average in sound quality—and anyone in the family can tune in the stations perfectly, there is never any "sideband" reception with this tuner. Using only the power-line antenna connection, we had a pleasant—if confusing—surprise one evening when WBAI (99.5 mc, New York) was apparently having some trouble, in any case the station was going off the air for intervals of perhaps ten minutes at a time. With no apparent change in volume, the announcer began talking about stores in Wilmington, Delaware. Every time WBAI went off the air, WJBR became audible. Both are on the same frequency, but WJBR is approximately 115 miles from Mineola, while WBAI is only about 20.

Aside from its obvious advantages, the Karg Tunematic is available with several features for special applications. One is the addition of a signal-strength meter, which is simply a 50- μ a meter switched in at appropriate places so as to provide two ranges—5 to 50 μ v, and 0.5 to 5 μ v. A second feature that would be invaluable to those who want remote control is the addition of a motor assembly on the back of the housing, and coupling to the tuning switch, which extends out through the shield around the oscillator section.

The Tunematic is not inexpensive, but it is a superb tuner which will give optimum reception from up to ten desired stations. One obvious question is, "What do I do if I move to another area?" For a nominal charge, the manufacturer will provide new crystals for the other area, together with a new dial, and will do a complete factory checkup on the tuner so that it is just as good as new every time you move.

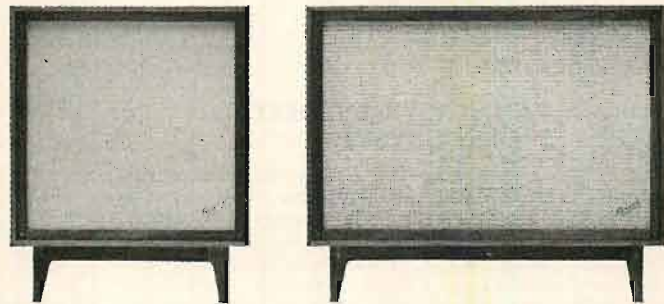
The Multiplex-Stereo Adapter

This adapter is the first commercial unit we have encountered—and it is still so new that we have little except first-hand information about it. This unit employs the Crosby system, having a broad-band acceptance for sub-carrier stereo use. It is the same size as the Tunematic and similar in appearance, as shown in Fig. 4. It has two controls in addition to the power switch—the selector switch with three positions, MULTIPLEX, MAIN, and STEREO, and a balance control.

The unit uses five tubes—two 12AU7's, two 12AX7's, and an EZ80. The multiplex and 3-volt outputs of the Tunematic are fed to the inputs of the adapter, and two audio outputs are fed to a stereo preamp.



Fig. 3. Karg Laboratories' Model XT-1 "Tunematic" FM tuner, crystal controlled with six, eight, or ten stations selected by the turn of a switch.



DEBUT

of the Bozak *Urban* enclosures for
the B302A and B305 speaker systems.

See and hear them at the Audio Fairs
and franchised Bozak dealers—or write
The R. T. Bozak Sales Co. Darien, Conn.

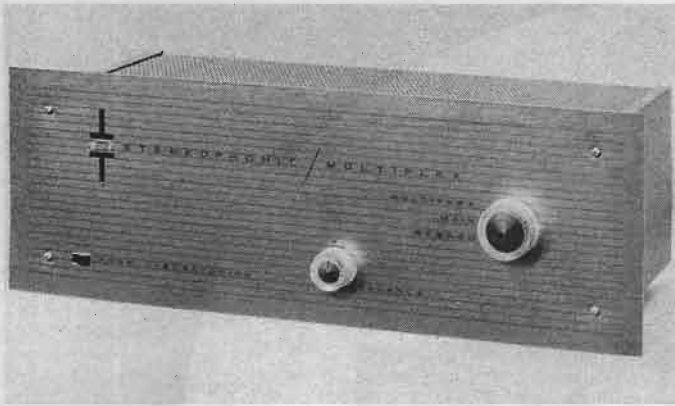


Fig. 4. Karg's new Multiplex - Stereo adapter.

In the MAIN position of the selector switch, both channels are fed from the de-emphasized output of the tuner; in the MULTIPLEX position of the switch, the "detected" multiplex signal is fed to both outputs; in the STEREO position, the two signals are matrixed and the resulting L and R signals are fed to the outputs.

The adapter works perfectly on the two background multiplex stations covered by the crystals on the tuner we examined. The Crosby circuit does not silence on the absence of sub-carrier, but when the sub-carriers were on, reception was good—if one discounts the quality of the musical works being played. We did hear WBAI on its multiplex testing a few times, and there was little difference between the main and sub-carrier quality. We have not so far heard WBAI testing with stereo sources, but it would appear that this should be no problem, since the quality of sound is the same—or practically so—when both main and sub-carrier are fed with the same signal.

Both of these Karg units are available with wood cabinets, or they may be mounted in equipment cabinets using small brackets to hold them against the panel without the need for screws through the panel. For installation in walls, the housing is the right size to mount between studs with the usual 16-inch spacing. Both units have panels 16 in. wide and 5½ in. high, over-all depth behind the panel is 5½ in., and 19-in. panels are available for rack mounting. L-29

TANNOY "BELVEDERE" SPEAKER SYSTEM

Employing the well-known dual-concentric Tannoy speaker, the "Belvedere" is an innovation in this company's cabinetry, since it is considerably smaller than anything they have shown to date. But with the U. S. market becoming increasingly conscious of size—with a consequent demand for speaker systems which, when used in pairs, still leave some space in the listening room for people, chairs, and perhaps an equipment cabinet—some steps in this direction were necessary.

The "Belvedere" is of intermediate size—measuring 26 in. high by 18 in. wide and 12 in. deep, or if the user prefers, 18 in. high by 26 in. wide, since all four surfaces of the cabinet are finished so the unit may be used in any position. The cabinet is of exceptionally heavy construction, and is a modified bass-reflex model. In addition to the opening for the speaker cone, there are two additional openings as ports, approximately 1½ × 14 in. each, on either side of the speaker. The interior of the cabinet is lined with acoustic material, and a controlled thickness of the material completely covers the ports, resulting in a considerably higher loading on the cone at the low frequencies.

Over the period of development of this enclosure, Tannoy engineers ranged from an infinite baffle to completely open ports, both with and without acoustic treatment in the interior—the cabinet size being

fixed at the beginning as one which market surveys had shown to be ideally acceptable for the home. As an infinite baffle device, the low frequencies were somewhat attenuated, although they were clean and completely free of "muddiness." At the other extreme—unloaded ports—there was adequate bass, but a noticeable muddiness. The design finally accepted retains the good features of both, and the resistance loading of the ports allows excellent bass response with a minimum of coloration.

Using the organ test record again, the speaker may be said to perform properly from D of the second octave, or possibly even down to the second C, which is 32 cps. We would describe the lower limit unquestionably as 35 cps, or perhaps even a cycle or so lower. At the top end, the output is a function of the tweeter section of the Dual-Concentric Tannoy speaker, and this is measurably flat up to 20,000 cps, although we do not hear that high.

Tannoy speakers are noted for their ruggedness, and in properly designed cabinets they cease to sound like loudspeakers but seem to sound more like the original instruments. There is a crispness throughout the voice range which gives a solid feeling of clarity to speech, yet there is never any "chestiness" which indicates a peak in the 150- to 300-cps region. On the whole, Tannoy speakers are remarkably lifelike, but we had never before heard them in small cabinets. This particular design, however, retains the high quality of performance that we first noted in the G. R. F. "Autograph" models when we first saw and heard them.

This is one of the models that we would not hesitate to describe as having made no compromises between size and performance—the performance is still there even in the smaller enclosure. It is interesting to consider how much speaker development has been done in the past year or so to reduce cabinet cost as well as size, and it is likely that more development will follow so as to result in a completely satisfactory stereo speaker system in not more than one cubic foot of space, yet retaining the spatial characteristics needed for good stereo reproduction. L-30

HARMAN-KARDON COMMENTS

The engineering department of Harman-Kardon takes exception to our discussion of de-emphasis time in the review of their F-10 tuner, which was referred to several times as FA-10, which combines the tuner with an amplifier. The tuner sections of both are the same, however, and the information would apply to both. H-K's comments follow:

"Here is the way we compute the de-emphasis time constant. The formula is $T = RC$. The R consists not only of the 22K resistor mentioned, but also includes the discriminators source impedance (about 10K ohms). The C consists not only of the .002 μf capacitor, but also the cable capacitance (280 μf) and the stray capacitance of the tuner board and the amplifier input (85 μf). The total nominal R equals 32K ohms and the total nominal C is 2365 μf . The product of these two is 75.7 microseconds. Ten-percent tolerance components are used in the network and 1-db deviation may be expected. Since frequency response is of crucial importance in any high fidelity equipment, we measure the response of all tuners in production, and all measure within ± 1 db of the standard curve as per our specifications."

We are pleased to have this clarification to avoid giving an undesired wrong impression of the tuner's performance. AE

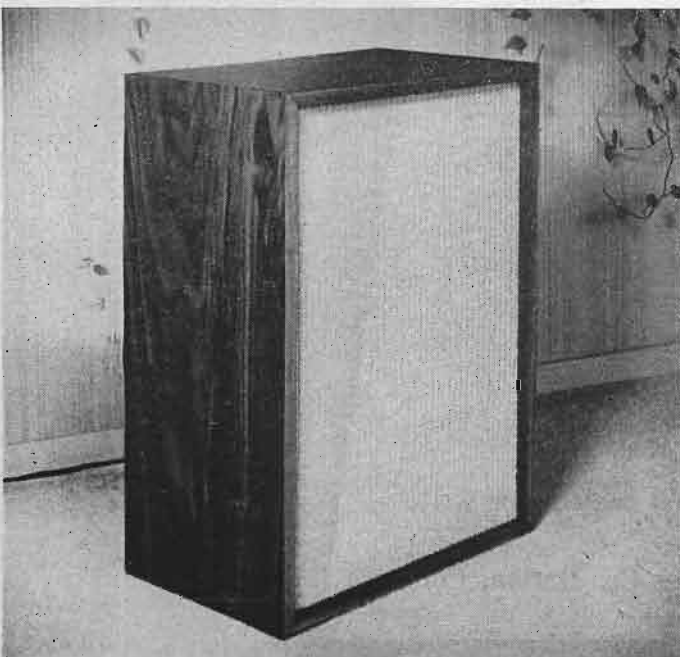


Fig. 5. The Tannoy "Belvedere" speaker system.

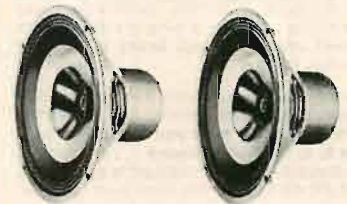
**WHAT THE
RESPONSE CURVES
DON'T
SAY ABOUT
THE NEW
GOODMANS
SPEAKERS**

The response curve charts below reveal the basic quality of all Goodmans loudspeakers: smooth, undistorted frequency response over the audio spectrum. This is impressive and important—but you can't listen to test tones all the time. Eventually you have to face the music. You must select a speaker that, in your opinion, reproduces music best.

When you translate these curves into musical terms, you'll find that a Goodmans speaker displays no false projection or overpowering brilliance; that it simply reproduces recorded or live sound with proper balance, clarity and realism. Given a good program source, you will hear a fine separation of instruments, peak-free highs and clean, well-defined bass. Test any Goodmans loudspeaker against the competition. You'll discover that Goodmans sounds more natural, more musical—giving you the kind of sound you must have for true stereo.

All new Goodmans speakers are available in handsome, superbly designed, acoustically matched enclosures featuring the famous ARU units. These Acoustical Resistance Units, an exclusive Goodmans feature, enable you to achieve superior performance and response in an enclosure only 2/3 to 1/4 the size normally used.

**GOODMANS
BEST BY TEST
SPEAKERS**



AXIOM 450: New twin diaphragm, extra wide range 12" speaker. Handles frequencies from 20 to 16,000 cycles with a preciseness and efficiency never before attained in a 12" speaker. Goodmans unique "RIGIDFLEX" cone has a completely flexible free-floating cone rim and completely rigid cone center to provide pure piston action. Continuous power handling capacity 45 watts. Price, \$89.00 (AXIOM 350: same as 450 in response and performance; power handling capacity, 35 watts. Price, \$68.50.)



DUAXIOM 800: Exclusive 10" twin diaphragm speaker featuring free edge cone suspension resulting in low free air resonance of 20 cycles. Extremely smooth response 20 to 20,000 cycles. Most efficient 10" free cone speaker available. Will handle up to 15 watts. Price, \$59.50.



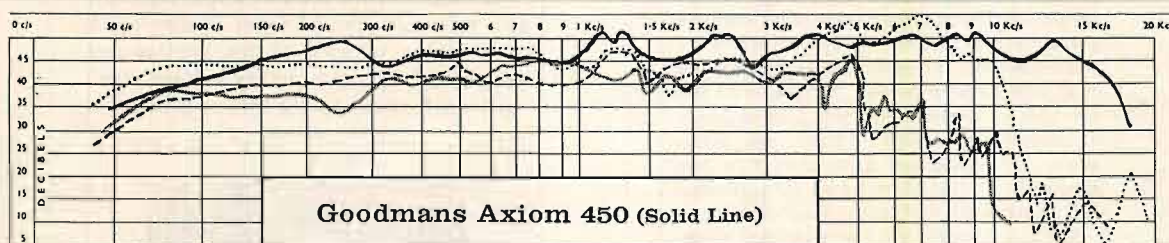
AXIETTE II 8: Exceptionally fine, smooth response over entire audio spectrum. One of the great loudspeaker values in performance and efficiency. Heavy duty 8" extra wide range speaker with RIGIDFLEX hyperbolic free edge cone suspension. Price, \$27.00.



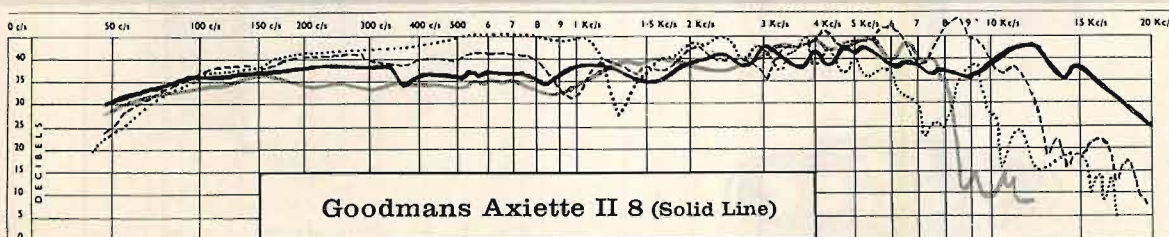
TREBAX 50: High frequency pressure driver with built-in elliptical horn for silky, peak-free highs from 2500 cycles to beyond range of human ear. Perfect match in 2- and 3-way speaker systems. Handles 50 watts with 5 000 c/s crossover. Price, \$32.50. (TREBAX 35: Same as Trebax 50 in construction and performance. Handles 35 watts in 2- and 3-way systems. Price, \$24.50.)



MIDAX H-750: With utmost precision handles frequencies from 400 to 13,000 cycles, with suggested crossover of 750 cps. Compression type driver, custom assembled to jewel-like tolerances. With its matched flared exponential horn, will handle 50 watts in multi-channel speaker systems. Price, \$58.50. (MIDAX H-950: Same as H-750 in design and performance; crossover point at 950 cycles. Overall frequency range 650 to 13,000 cycles. Price, \$48.50.)



CONSTANT TEST CONDITIONS: Microphone 18" on axis. Anechoic conditions. Infinite baffle for Axiom tests. Input 1/3 watts at 400 cycles in all tests.



Graph at top shows test results of Goodmans Axiom 450 (solid line) as compared with three leading competitive speakers. Note overall smoothness of Goodmans performance in this graph, as well as in one below, which shows Goodmans Axiette II 8 (solid line) compared with three leading speakers in its class.

ROCKBAR Corporation
American Sales Representative
for Goodmans Industries



For full information on the complete Goodmans line write to **SPEAKERS**, Dept. A-10, Rockbar Corp., Mamaroneck, N. Y.

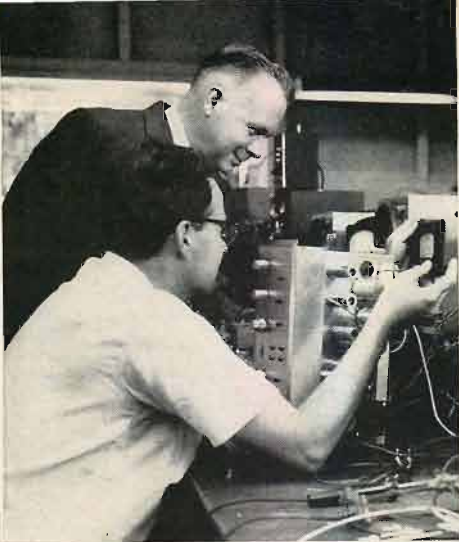


This Man is Using an Electronic Crystal Ball

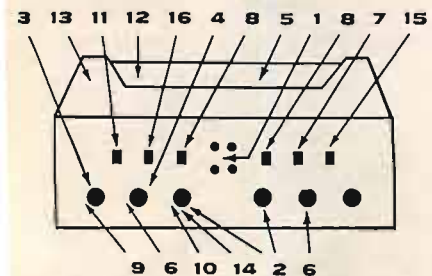
The H. H. Scott advance development team must foresee the future. They must design new products so that they stay current for many years. Hermon Hosmer Scott insists on this as a protection to your investment.

The new 130 Stereo preamp is an example of the way Scott engineers work ahead. Engineering of this brand new product was started when stereo was nothing more than a hobbyist's delight. This allowed time for thorough testing of its many advanced features.

Every H. H. Scott component is designed to defy obsolescence. Careful planning, fine engineering, exceptional quality mean your investment in the new H. H. Scott stereo-preamp . . . or any H. H. Scott product . . . is an investment in a component that will still be up-to-date many years from now.



17 reasons why you should buy the New H. H. Scott Stereo-Preamp



1 Visual signal light display panel shows mode of operation at a glance. 2 Completely separate bass and treble controls on each channel so that different speakers may be matched. 3 Play stereo from any source — Records, FM-AM Tuner, Tape. 4 Reverse channels instantly, or play monaural from any source through both channels doubling your power. 5 Play Trereo — a center channel output lets you use your present speaker as a middle channel. 6 Special circuitry lets you balance channels quickly and accurately. 7 Reverse the phase of one of your channels 180 degrees instantly. Lets you correct for improperly recorded tapes. 8 Separate 12 db/octave rumble and scratch filters. 9 Complete record equalizer facilities.

10 Use as an electronic crossover at any time. 11 Two stereo low-level inputs. You can connect both a stereo phono pickup and stereo tape head. 12 Stereo tape recorder inputs and outputs. 13 Provision for operating stereo tape heads without external preamps. 14 Quick-set dot controls allow any member of your family to use equipment. 15 Loudness-volume switch. 16 Stereo tape monitor switch. 17 The exceptional quality of all H. H. Scott components . . . PLUS all the features and specifications long associated with H. H. Scott monaural preamplifiers.

Sensitivity $1\frac{1}{2}$ millivolts on tape head input, 3 millivolts on phono for full output. Hum level 80 db below full output on high level outputs. Size in accessory case $15\frac{1}{2}w \times 5h \times 12\frac{1}{2}d$. Model 130. Price \$169.95 (\$172.95, West of Rockies).



Write for complete technical specifications and new catalog A-10.



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EXPORT: TELESCO INTERNATIONAL CORP., 36 W. 40TH ST., N. Y. C.

CARTRIDGE

(from page 48)

sufficient to permit the Gyro/Jewel stereo pick-up to follow all groove undulations accurately. The manufacturer recommends that tracking force should not exceed four grams, as greater vertical force not only increases record wear, but set up mechanical biasing effects leading to unbalance in the response pattern.

Channel Separation

If stereophonic reproduction is to be effective, separation of channels must be as complete as possible *throughout the entire frequency range*. In stereo reproducer systems which depend upon elastic damping of any sort to remove mechanical resonances, the danger exists that at one end of the frequency spectrum or the other (possibly both), or at indeterminate frequencies elsewhere in the spectrum, some mechanical coupling between channels may take place.

Early efforts at recording showed evidence of this undesired interchannel coupling. Where channel separation of about 20 db was measurable at frequencies from 1000 to 5000 cps, this separation had dwindled to some 5 db at 10,000 cps.

The undamped design of the ESL Gyro/Jewel stereo cartridge system precludes such variations in channel separation/frequency response ratio. Channel separation is maintained at a constant 20 to 25 db over most of the audible range. Moreover, the design is such that factory adjustment of the two d'Arsonval movements, by means of eccentric screws, permits optimum cross-talk ratios.

A mean output level of approximately two millivolts per channel is developed at a stylus velocity of ten centimeters per second. Highest quality voltage step-up transformers to the stereo preampli-

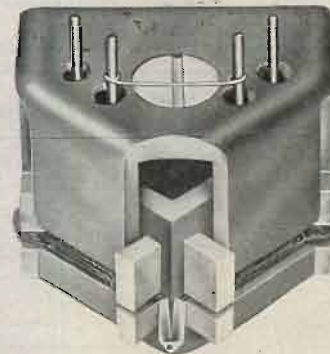


Fig. 6. An early design having direct channel separation by means of a bifurcated stylus shoe. Discarded because of inadequate separation above 8 kc.



SUPERB FOR STEREO

... and better than ever for monaural records

When it comes to the selection of a record changer to meet the exacting requirements of both modern stereo and modern high fidelity monaural records — there is only one choice, the GS-77.

From the day this modern record changer was born, strict adherence to rigid precision standards and advanced engineering made it the ideal high fidelity record changer. Now, new features have been added to make it the ideal stereo changer. An easily accessible stereo-monaaural switch directs the stereo signal to the proper speaker. On monaural records, it provides a signal to both speakers adding extra depth. A double channel muting switch assures complete silence at all times except when the stereo record is being played. New GS-77 quick-change cartridge holder makes it easy to change from stereo to monaural cartridge with the turn of a knob.

Other GS-77 features assure the finest reproduction, stereo or monaural. The tone arm exhibits no resonance in the audible spectrum, and virtually eliminates tracking error. The arm counter-balance is so designed that stylus pressure between the first and tenth record in the stack does not vary beyond 0.9 gram. These characteristics virtually eliminate vertical rumble — to which stereo is sensitive. Turntable pause eliminates the grinding action which takes place where records are dropped on a moving turntable or disc — protecting the delicate stereo record grooves.

The GS-77 is the perfect record changer for stereo as it is for monaural high fidelity. \$59.50 less cartridge and base. Hear it at your hi-fi dealer, or write for complete details: Glaser-Steers Corp., 20 Main St., Belleville 9, N. J. In Canada: Alex L. Clark, Ltd., Toronto, Ontario. Export: M. Simons & Sons Co., Inc., New York City.

new

GLASER-STEERS GS-77

the modern record changer

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Weathers products are not copies, adaptations, or mere improvements over other Hi Fi components or systems. Unfettered by precedent, Weathers equipment is designed on bold new principles which add astonishing quality and brilliance to Hi Fi reproduction.

Weathers Pickups

FM Monaural • FM Stereo • Ceramic Stereo • All Weathers pickups play both monaural and stereophonic records without damage. All are available with diamond or sapphire styli. **FM Monaural** and **FM Stereo** cartridges are designed only for the Weathers Tonearm in which an oscillator develops the signal. They track at 1 gram . . . cannot damage records. They have exceptionally wide frequency range, low intermodulation, low cross modulation, and low harmonic distortion. **The Weathers Ceramic Stereo Cartridge** fits all other tonearms and is superior to any magnetic pickup. Tracks at 2 grams. Complete absence of hum. 25 db separation between channels.

The Weathers Micro Touch

Tonearm is designed exclusively for the Weathers FM Pickups. It is light and so perfectly balanced that accurate levelling of turntable is unnecessary. Shock mounting isolates it from outside vibrations. Viscous damping prevents tonearm resonance down to 15 cps.

The Weathers Oscillator-Modulator

Transforms the impulse from the pickup and produces the FM signal. Signal-to-noise ratio is considerably higher than that of the best magnetic pre-amps.

The Weathers Turntable is unquestionably one of the World's finest. Exceptionally light construction eliminates the mechanical noises inherent in heavy turntables. Noise level is 25 db lower than that recorded on today's best records. Shock mounting eliminates floor vibrations. A cool running 12-pole synchronous motor brings the platter up to correct speed in $\frac{1}{4}$ of a revolution and maintains correct speed regardless of variations in load or line voltage. Cueing features make the Weathers Turntable ideal for broadcasting station use. \$59.95. Also available in kit form, without base or mounting plate, \$34.50.

The Weathers Discusion suspends any size record on its outer rim and protects playing surfaces from dust and contamination. Only \$2.95.

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A simple and accurate way to measure and control exact tracking force. Makes records last longer—sound better. Priced at only \$2.00.

Four Superb Speaker Systems

The Fiesta, Decorator, Monte Carlo, and Barrington fill every need from den to concert hall. From \$59.95 to \$510.00.

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fier inputs prevent degradation of the signal quality.

Installation Factors

An adaptor plate is supplied as a part of the mounting hardware for the ESL Gyro/Jewel cartridge so that it can be mounted in any standard phono arm or record changer. For optimum results, it is recommended that the arm used be rotationally balanced as well as laterally balanced. Lateral and rotational balance can be achieved only in an arm whose stylus force adjustment is independent of the arrangement for counterbalancing the mass of the cartridge in the arm head.

A perfectly level turntable is not unattainable, and is desirable in order to reduce any tendency for one side of the stereo groove to be favored over the other. Even with a perfectly level turntable, slight warp in a disc can create similar problems on playback.

Because of the complicated series of motions described by the stylus in stereo playback, more serious reproduction faults are detectable when playing warped records than under similar conditions during monophonic playback. In stereo reproduction, interchannel separation is degraded, IM distortion rises, frequency response characteristics are likely to bounce out of specifications, and listening pleasure is markedly reduced.

A new playback arm has also been developed: one which through its design permits realization of the advantages of the Gyro/Jewel stereo cartridge. In order to reduce the need for exact levelling of turntables and to prevent degradation of the output signal quality when encountering warped discs, the tubular member of the ESL Gyro/Balance arm is displaced laterally. This configuration permits rotational balance through the point of effective mass of the head assembly, the lateral pivot, and the counterbalance weight.

Actually, with the Gyro/Balance arm, it is quite possible to play discs at any angle to the horizontal up to 90 deg. *without degrading the stereo channel separation ratio.* All vertical and horizontal pivots are precision ball bearings.

The zero-balance counterweight is used to accomplish exactly that for any cartridge used. Stylus force is then separately adjusted, by rotating a knurled knob on the side of the bearing gimbal against a spring. This arrangement allows for infinite stylus force adjustment, within the recommended range for the cartridge in use. Although developed for stereo use, this arm also works improvement on the playback of monophonic discs.

Enhanced Stereo Listening

The advent of stereo disc recording is

Actually, with the Gyro/Balance arm, it is quite possible to play discs at any

WEATHERS TECHNICAL MAGIC IS SOUND

perhaps as great a step forward in re-creating the effect of "presence" when listening to recorded music, as was the introduction of the full-fidelity micro-groove recording a few years ago. The listening public has become accustomed to the experience of clean full-range—both frequency and dynamic—reproduction from good monophonic discs, and is sure to demand equal quality from stereo discs. Æ

INVENTIONS

(from page 50)

Recently a suit involving this principle of law was brought by an employer for a judgment declaring that the employee had no right of any nature in a loop antenna for which the employee had been granted a patent.

When the employee had been hired he had represented himself to be an experienced mechanical engineer and had been assigned the work of designing and improving loop antenna assembly. His invention, he protested, had been made by him at night at home.

Here the conclusion of the court throws into sharp contrast the incidents in which the employer may be either awarded the patent itself or a shop right—the right to its use—and instances in which the invention is the sole property of the employee.

"He together with others," said the court, "was ordered to develop the loop to meet specifications and he did so in the course of his employment at his employer's plant. Under such circumstances the employer is entitled to the invention and to any patent embodying it."²

In the latter half of the past century suit was brought against the United States and in that action the owner of a stamp used by the Internal Revenue Department on whiskey barrels sought the recovery of compensation for its use. In this instance the inventor had been employed by the government while making these experiments. In addition to that, however, the stamp was not only adopted by the government on his recommendation but he said he would make no charge if it was so adopted for the express reason that he was a federal employee.

Of the principles establishing the ownership of an invention in either the employer or the employee, the court said in its decision of this case,

"An employee performing all the duties assigned to him in his department of services, may exercise his inventive faculties in any direction he chooses with the assurance that whatever invention he may thus conceive and perfect is his individual property. But this gen-

²North American Philips Co. v. Brown-shield, 111 F. S. 762, February 4, 1953.

Recent PRESS COMMENT on the AR-2



audiocraft (Joseph Marshall)

"There are many systems, both large and small, whose claimed or casually measured curves will match that of the AR-2... The paradox is that in comparison with most of these the AR-2, on musical material, seems to have response about an octave lower. "... low distortion seems to add another octave [of bass] to the AR-2 or, if you prefer, ... distortion takes an octave away from speakers with seemingly similar response curves."

review of recorded music (Fred Grunfeld)

"... too much cannot be said for the little AR-2's... they have a wonderfully natural quality—totally unlike the metallic timbre that mars so many top-ranking speakers. They are particularly the answer for anyone who demands a very clean string tone."

THE DIAPASON (Joseph S. Whiteford)

"... the problem of reproducing very low frequency organ tone without distortion or coloration was considerable. 'Electronic' sound would not do. Acoustic Research speaker systems [10 AR-2's installed permanently in a synthetic reverberation device at Christ Church, Cambridge, Mass.] provided an ideal solution."

PLAYBOY (John M. Conly)

"One exception to this rule: [of selecting a single-cone unit from among low-cost speaker systems] the Acoustic Research AR-2, at just under \$100, is a two-way speaker (tweeter and special air-supported woofer), of extraordinary smoothness. It is definitely a bargain."

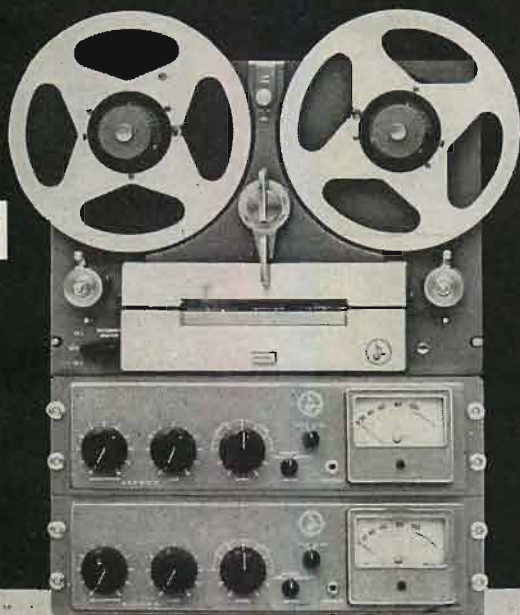
AR-2 acoustic suspension speaker systems are \$89 to \$102, depending on cabinet finish. Literature is available for the asking.

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CUEING & EDITING—simplest, fastest, most accurate means of locating tape at exact desired spot, splicing in desired sections, cutting out undesirable sound.



4½ SIGNAL LEVEL METER—eliminates guesswork in recording by accurately measuring input signal and output signal. Reduces distortion due to over-modulation. Measures bias level to insure proper operation.

ALL REEL SIZES TO 10½"—separate reeling motors. No adaptors necessary. Record and playback up to 4 hours of uninterrupted music... complete programs at 7.5 ips.

PLUS! Hysteresis Synchronous direct-drive capstan motor... dual speed (3¾-7½ or 7½-15)... plug-in transformers... advanced electronic circuitry and a host of other deluxe features. The Concertone Series 33 is a custom-manufactured, rugged, reliable instrument designed to give the most discriminating user the maximum quality of sound recording and reproduction—and years of trouble-free operation. Retail net price with:

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eral rule is subject to these limitations."

The first of these exceptions, as here outlined, are those instances when the inventor is hired for the particular work of developing an idea representing the discovery. "If one is employed to devise or perfect an instrument," continued the court, "or a means for accomplishing a prescribed result, he cannot after successfully accomplishing the work for which he was employed, plead title thereto against the employer.

"That which he has been employed and paid to accomplish, becomes when accomplished the property of the employer. Whatever rights as an individual he may have had in and to his inventive powers and that which they are able to accomplish he has sold in advance to his employer."

Of the intermediate ground, when the employee conceives the invention with the facilities and on the time of the employer, and of the rights of the employer in the joint accomplishment, the reduction to practice of the idea of the inventor with the aid and facilities of the employer—shop rights—the court added,

"When one is in the employ of another in a certain line of work and devises an improved method or instrument for doing that work and uses the property of his employer and the services of other employees to develop and put into practicable form his invention, and expressly consents to the use by the employer of such invention, he has so far recognized the obligations of service flowing from his employment and the benefits resulting from his use of the property and the assistance of the co-employees of his employer as to have given to such employer an irrevocable license to use such invention."³

The decisions of two recent cases, one by the federal court in New Jersey and the other by a court in New York outline the boundary separating inventions by employees of which ownership is in the employee from those that by virtue of the employment contract are the property of the employer.

In the New Jersey instance an employee had been hired as an engineer in the production of electrical instruments. Patents of a photographic device, perfected by this employee, were claimed in this action by the employer to compel the assignment to it.

"A manufacturing corporation," asserted the court holding the patents to be the property of the employee, "which has employed a skilled workman for a stated compensation to take charge of its works and to devote his time and services to devising and making improvements in articles there manufac-

(Continued on page 91)

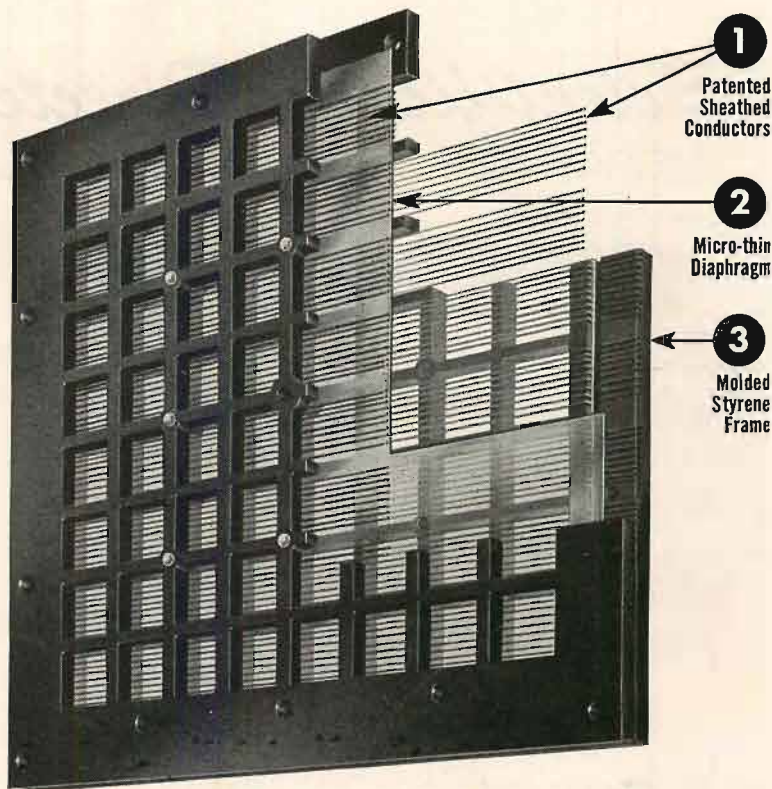
³ Solomons v. United States, 137 U. S. 342, December 8, 1890.

MULTIPLEX

(from page 37)

later demodulated when the adapter is used with wide-band types of tuners having i.f. bandwidths as great as 1 megacycle or more. Thus, following these filters, the signal is made up entirely of frequencies ranging from 25 to 75 kc (with a nominal center frequency of 50 kc when no FM modulation is applied to the sub-carrier).

V_{1B} is simply a stage of amplification, raising the amplitude of the signal to about 6 volts. V_{2A} at first glance appears to be another stage of amplification. Actually, with a 6-volt signal applied to the grid and an un-bypassed cathode, it is a very efficient limiter stage, affording both positive and negative clipping of any residual noise present. The heart of the decoder is V_{2B} and V_{3A} which is a form of relaxation oscillator or "one-shot" multivibrator. For each cycle of subcarrier applied to the grid of this oscillator, it will produce one complete square wave cycle. With no positive voltage applied to its grid (in the absence of a subcarrier), the two triodes produce no oscillation. The circuit is alternately known as a Schmidt Trigger Circuit. At this point (the plate circuit of V_{3A}) we are therefore no longer dealing with the sub-carrier (which, from different tuners, might have different amplitude and shape and lead to difficulties in subsequent demodulation) but with our own self-produced, consistently shaped square-wave train whose frequency corresponds exactly with that of the original sub-carrier at any given moment. The square waves are differentiated by means of the capacitive resistive network in the grid circuit of V_{3B} . The stage V_{3B} is arranged to form a "counter detector" FM type of demodulator, one of the most distortion-free types of FM detectors possible. This form of detector "counts" the plate pulses and creates varying d.c. level based on the number of pulses per second. The 82-k ohm resistor and .001- μ f capacitor combination serve as a de-emphasis network (just as your regular FM tuner output circuit) and further serve to remove a large amount of sub-carrier still present in the resultant output. Thus, at the top of the 50-k ohm DIMENSION control the A-B signal contained in the supersonic sub-carrier is recovered. If desired, this signal can be fed as it stands to an amplifier by throwing slide switch S_1 (located on the rear of the chassis) to the SEPARATE position. The sound of A-B is rather curious. It is decidedly deficient in lows (bass tones, being essentially non-directional in character, will have been equal in the A and B channels originally and will therefore have cancelled



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delicately balanced by 176 "strings"

Each radiating element of JansZen Electrostatic Speakers contains 176 push-pull sheathed conductors. This dual array of "strings" is the most durable and efficient ever patented. Without any chance of electronic breakdown, it provides uniform opposing forces to move the sensitive diaphragm with the same amplitude and in the same phase over its entire area. Like a true piston, the diaphragm behaves as if it had neither stiffness nor mass—in short, as if it were not there at all. This enables the JansZen to precisely recreate the acoustic pressures recorded by the microphone without unnatural coloration.

Model 65 Electrostatic Mid/High Range Speaker

Using two of the JansZen Electrostatic elements with a built-in high-pass filter, this remarkable new speaker combines all of the advantages of the model 130 but with 60° dispersion. Gives absolutely clean response to 30,000 cycles. \$86—\$91.50 depending on finish. Slightly higher in West.

NEW!



Model 130 Electrostatic Mid/High Range Speaker

For those who insist on the most gracious sound attainable, only this original JansZen model will suffice. Excellent for multiple woofer systems. Contains four Electrostatic elements individually tested for distortion and matched within 1 db for output. Room-filling 120° dispersion to 30,000 cycles. \$161—\$188 depending on finish. Slightly higher in West.



JansZen*

*including designs by Arthur A. Janszen
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Scientifically Directed SEPARATE AND BALANCED

STEREO

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Write to Dept. A for Informative Bulletins

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Utilizes two Frazier Mark II high fidelity speaker systems with 30-degree separation, in smart contemporary enclosure. The 30-degree separation and projection assure excellent stereo effect at distances of five feet to as much as sixty feet. Balanced reproduction from 30 to 17,000 cps. High efficiency permits use of any 12-watt stereo amplifier. When used as a monaural system, "bigness" is obtained way beyond the cost. Size: 54" x 43½" x 32". Finished in Fruitwood Mahogany, Blonde Korina, Walnut, Dark Mahogany, or Ebony. Net, \$295

STEREOGRAMA JR. Designed like the Stereorama, but utilizes two Frazier F-8-3X Black Box speaker systems. 40 to 15,000 cps. Size: 45¼" x 30" x 18". Net, \$195

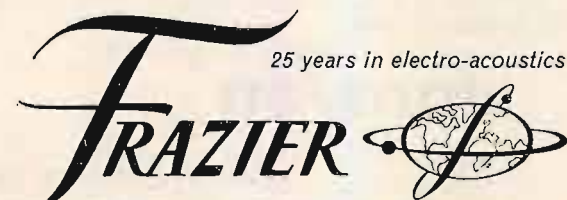
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Exceptionally wide range high fidelity speaker system. Employs Frazier modified Helmholtz-type enclosure with specially-designed 8-inch woofer and compression-type tweeter. Smooth response 30 to 17,000 cps. Use as is or in walls, closets, or other locations. Size: 22½" x 26" x 16". Net, \$99.50

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International Electronics Corporation
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each other in the course of subtracting $A - B$). The remaining highs have a somewhat unearthly, echo-like quality about them. The purpose of slide switch S_1 , however, was not to create meaningless sound-effects for the listener but rather to provide for what we feel will be the rare broadcaster who elects to broadcast stereo with one channel over the main FM carrier, and the other over multiplex, without the sophistication of the Crosby sum-and-difference technique. Such practice may be expected in some parts of the country until sufficient transmitting equipment can be built to meet the needs of every station desiring to adopt this system. In any case, with S_1 in the SEPARATE setting, the decoded multiplex channel is recovered at the B output jack while the regular FM material, after undergoing some amplification through V_{4A} is simply recovered at output jack A .

Re-Matrixing

Assuming that the station under consideration is utilizing the Crosby system, S_1 is thrown to the sum-and-difference position. In this setting, the $A - B$ signal (from the 50-k ohm DIMENSION control) and the $A + B$ signal (from the plate circuit of V_{4A}) are mixed resistively in phase ($A - B + A + B$) to create the A channel at output A while the same signals are mixed in the plate circuit of V_{4B} ($A - B$ having been inverted in phase) to re-create the B channel ($A + B$) - ($A - B$) at output B . The monophonic volume is first set up by means of the 500-k ohm control following the FM in jack. Then the balance control or individual level controls of your stereo amplifier are adjusted until the sound seems to be coming from directly between your two loudspeakers. Then simply add dimension, as required, by means of the DIMENSION control on the adapter. Once set, neither of these controls need be readjusted. The entire adapter, therefore, requires no additional "up front" space in the Hi Fi installation and can, if desired, be tucked away behind amplifier or tuner.

Is this the FM Stereo Answer?

We feel that the Crosby system of multiplexed FM *must* succeed because it is definitely in the public interest and, from a technical standpoint, will provide ideal stereo for those who want it without deteriorating the entertainment value of the accompanying monophonic program. Our decision has been, therefore, to make these converters available now so as to encourage FM broadcasters to embark on this adventure and assure them as great an audience as our production facilities will allow. Only time will tell whether or not we chose the "winning side." Æ

BOOBY TRAP

(from page 23)

tried the second plan of inserting a dip filter in the system. It worked, too. Now Goldenears is all smiles because his hi-fi system sounds good to his golden ears.

What kind of a circuit will compensate for standing-wave resonances? The answer to this problem depends upon your ingenuity in designing circuits and the kind of hi-fi rig you have. First, of course, you must find the resonant frequency to be damped, using the experimental techniques described before. Once the frequency is known, a corrective circuit must be designed. Attempting to make the correction within the power amplifier is difficult because feedback loops prevent introducing non-linear characteristics. Similarly, tone controls and equalization circuits within the preamp cause difficulties. Because minimum distortion will be created at lower signal levels, one acceptable plan is to use a special equalizing stage between the preamplifier and the power amplifier.

Figure 2 shows one possible circuit for neutralizing the effect of standing waves. Such a circuit can be built using a single dual triode with B-plus voltages taken from either the preamp or the power supply. To understand the operation of this circuit, consider the parallel-T null network which is redrawn in Fig. 3, along with its response curve. This circuit is capable of achieving a complete null at a selected frequency, using only RC components. Assuming the resonant frequency f_0 to be known, the design procedure is to calculate values of the components in the

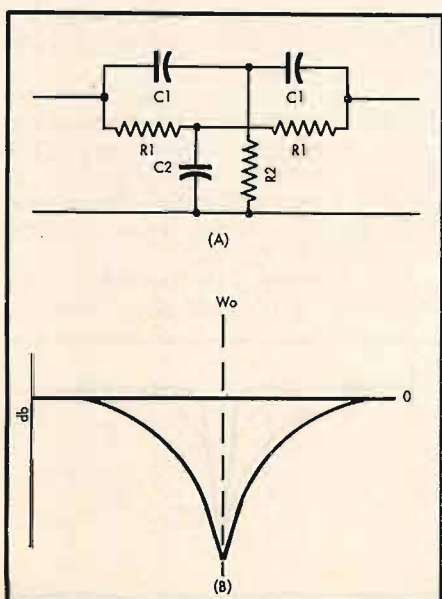


Fig. 3. Parallel-T null network, and typical response curve.

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2) Dust Bug

- ▶ Do you realize that stereo records are even more vulnerable to dust and dirt than standard LP's are? Those pops and clicks due to dust particles are much louder on stereo and therefore even more annoying than on standard discs. Still worse, permanent and expensive damage to your stereo records may result from this oft-overlooked enemy.
- ▶ The ESL Dust Bug is world-famed as the safe, effective record groove cleaner. It cleans record grooves automatically while they are played, and eliminates the static charge present in all records which would attract more dust.
- ▶ Insist on the reliable ESL Dust Bug at your audio dealer's. The standard model is only \$5.75 complete; the Record Changer Dust Bug is only \$4.75 complete. Both are magnificent with monophonic records, too!



FOR LISTENING AT ITS BEST
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parallel-T network from the following equations:

$$\omega_o = 2 \pi f_o \quad (1)$$

$$R_2 = 2 R_1 \quad (2)$$

$$C_1 = \frac{1}{2 R_1 \omega_o} \quad (3)$$

$$C_2 = 2 C_1 \quad (4)$$

Knowing f_o , a value can be assumed for any one of the four components and the remaining three values calculated. Reasonably high impedances should be used to avoid undue loading of the triode stage that drives the parallel-T network. The attenuation achieved with this circuit is the con-

ventional 6 db per octave possible with a single stage RC circuit. It is obvious, therefore, that attempting to use the parallel-T circuit directly would attenuate a wide band of frequencies. What we seek is the attenuation of a narrow band of frequencies. This result is achieved by taking the output from the parallel-T network and applying it as feedback to the input amplifier stage, as shown in Fig. 2. At first consideration, this circuit is confusing, since the effect of placing the equalizing network inside the feedback loop is to cause the feedback to attempt to minimize the equaliza-

Sharpening the Null

Figure 4 shows the effect of the overall circuit. Curve A, when the loop gain is zero, is the conventional 6-db-per-octave attenuation curve. Curve B shows the output with a loop gain of 20, and Curve C shows the results with a loop gain of 100. Thus, we see that the feedback is doing exactly what we anticipated, trying to correct the nonlinearity.

The reason that attenuation exists at the selected frequency is simply that the parallel-T circuit is null at that frequency. Regardless of the amplification ahead of the parallel-T circuit and regardless of feedback—the null network still produces a null output at the selected frequency. Therefore, the response curves of Fig. 4.

In order to balance our room acoustics properly, we have three variables under our control: selection of the resonant frequency, the rejection band width, and the amount of attenuation.

The rejection frequency is determined by the design of the parallel-T network as explained earlier. Accuracy of the rejection must be checked with a signal generator. Practically, it is very difficult to design the parallel-T circuit of Fig. 3 so that an exact null is achieved. This result can be approached only by very accurately matching the components with a high-precision bridge. This requirement for accurate matching of components for a true null need not concern us in the present application, however, because we don't want a complete null. Instead, we would like to attenuate a narrow band of frequencies by possibly 10 db.

The rejection band width is controlled by the gain of the triode stage, as Fig. 4 demonstrates. The tube type employed and the value of the plate load resistor can be selected for greater or lesser gain. Also, the cathode by-pass capacitor C_s can be eliminated for reduced gain.

The amount of attenuation is affected by the loop gain and by the mismatch in the components of the parallel-T. A bridging resistor, shown dotted as R_s on Fig. 2, will also reduce the attenuation. So will a series resistor inserted at point X on Fig. 2.

Unfortunately, it is impossible to design our equalizing circuit so that opti-



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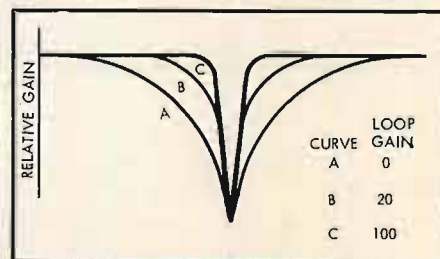


Fig. 4. Response curves showing the effect of placing the null network within the feedback loop.

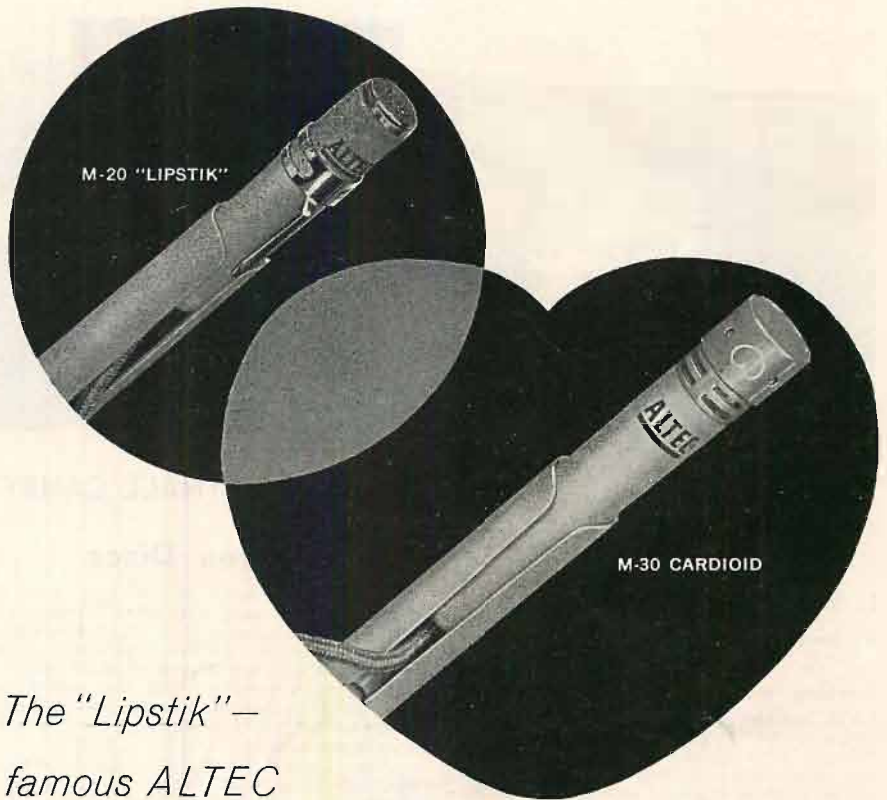
mum results are guaranteed. Instead, the empirical approach must be used. Once an attenuating circuit has been built and proved to be operating with the desired attenuation at the resonant frequency, it is then necessary to try the circuit with your high-fidelity system and judge with your own two ears if the results are better. Narrowing the band of frequencies and varying the attenuation by one of the devices described above will produce different results. It is up to you to select by trial-and-error methods the circuit configuration that does the best job for your room. The final criterion is what sounds best. If standing waves of significant amplitude are generated in your listening area, you will find the time and effort spent in matching your hi-fi system to its environment is well invested. Æ

REFERENCES

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2. Frayne and Wolfe, "Elements of Sound Recording." John Wiley and Sons, Inc., 1949, Chapters 1 and 31.
3. D. T. N. Williamson, "Design of tone controls and auxiliary gramophone circuits." *Wireless World*, October and November, 1949.

HI FI SHOWS

- Sept. 30-Oct. 4—New York; Trade Show Bldg. (IHFMM)
- Oct. 10-12—Philadelphia, Pa.; Benjamin Franklin Hotel. (IHFMM)
- Oct. 10-12—Cincinnati, Ohio; Sheraton-Gibson. (Rigo)
- Oct. 17-19—Boston; Hotel Touraine. (Independent)
- Oct. 17-19—Detroit, Mich.; Statler. (Rigo)
- Oct. 17-19—St. Louis, Mo.; Ambassador Kingsway Hotel. (St. Louis Electronics Club)
- Oct. 24-26—Milwaukee, Wis.; Wisconsin Hotel. (IHFMM)
- Oct. 24-26—Kansas City, Mo.; Bellerive Hotel. (High Fidelity Music Guild of Greater Kansas City)
- Oct. 29-Nov. 1—Montreal, Canada; Windsor Hotel. (Dominion High Fidelity Association)
- Oct. 31-Nov. 2—Indianapolis, Ind.; Hotel Pick-Antlers. (Electronics Show Corporation of Indiana)
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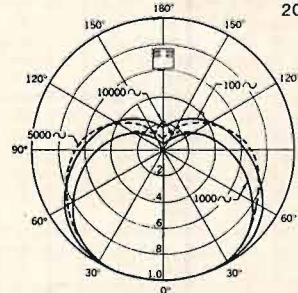
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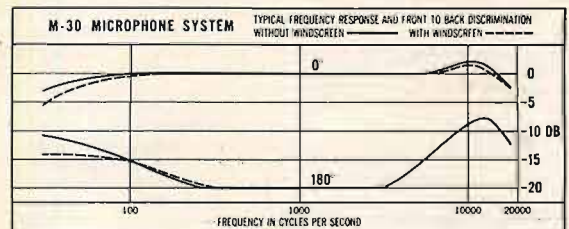
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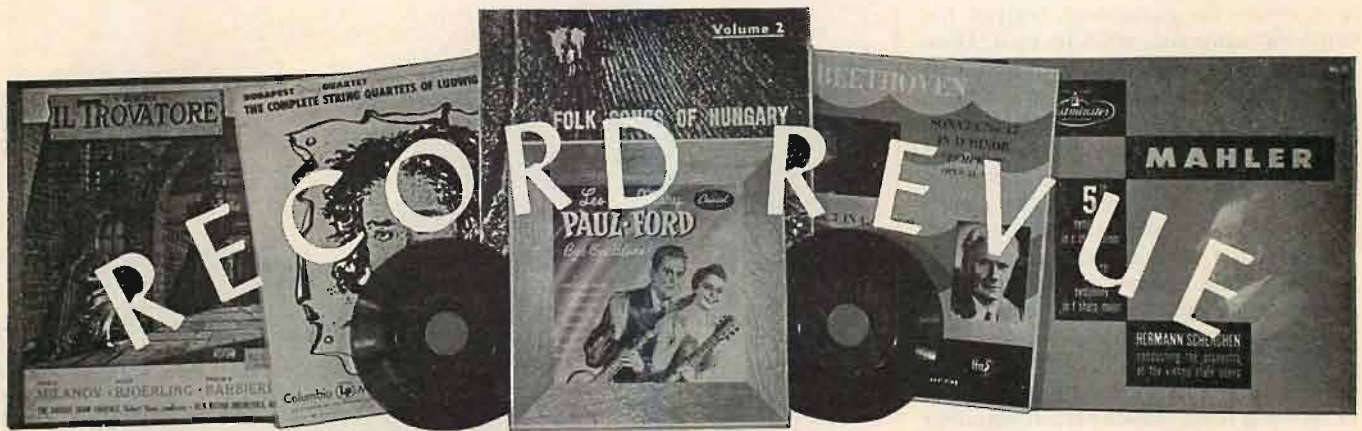
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Stereo Discs

1. SAMPLERS

A Journey into Stereo Sound

London PS 100 (SD)

Listening in Depth

Columbia SF 1 (SD)

The sampler record is becoming a useful means of trying out recordings, in the absence of home trial or store listening room. The idea is excellent—a dollar or so brings you bits of a whole range of new recordings. Now if only *all* the catalogue of each company could be put systematically onto sample discs, maybe to be made available for trial at record stores, free, as well as for home sale. . . .

Anyhow, here are two stereo samplers, one of each of the common types. London's has a running commentary to tie the excerpts together and is more in the nature of a stereo demonstration, including sound-sequences not necessarily to be had on regular London records; the Columbia sampler is a straight series of excerpts in cross-section, with a fancy accompanying booklet on stereo.

London's sampler was a knockout when it first appeared, awhile back. Nobody, but nobody, had heard stereo disc sound like this. Nobody could have imagined such crisp, loud, solid sound-projection, cut at a remarkably high level yet with full-time bass, unattenuated, and with stereo presence absolutely superb in its showmanship. The record's impact is somewhat less by now, merely because other fine stereo records have since appeared in the expanding disc field. It's still good.

This sampler (and other Londons, too) is one of those *not* cut on the now familiar Westrex 45/45 cutting head, developed in the U.S.A. I've heard say that the London stereos are cut with a vertical-lateral head, probably similar to that which cut the vertical-lateral London demonstration stereo discs heard here a year ago in the fall. It can be done—easily. (And vice versa.) Just feed two stereo signals into a "matrix" circuit and send the resulting sum and difference signals to the head's lateral and vertical cutting elements, the sum to the lateral, the difference to the vertical. The record that is cut plays back 45/45, though the two driving elements are physically oriented laterally and vertically, not on the slant as in the Westrex cutter.

Whether this accounts for the fine quality of this sampler or not I wouldn't know. Perhaps it's just London's over-all technique, from mike to record press. It's good, any way you listen, and that includes the presentation of the varied material, which is pleasingly British (for our ears, anyhow), easy to follow, relatively unassuming in the commentary. Excellent items are Ernest Ansermet rehearsing Stravinsky's "Sacre du Printemps" ("Un . . . deux, trois, quatre, cinq, six"), some intriguing night club acts, an honest-to-goodness British railroad train complete with dozens of closing compartment doors and, best of all, the changing of the guard at the ceremony of the keys in the Tower of London. Fine stuff, beautifully presented.

* 730 Greenwich St., New York 14, N. Y.

Columbia's sampler is just that, with the actual record numbers attached for your convenience. The range is from "West Side Story" to Bartok, Grofé, assorted pops and jazz; the quality varies from superb to so-so (the Bartok Violin Concerto); and the record does just what it ought to, giving you an honest cross-section of the company's initial effort in the stereo field.

The enclosed booklet is comprehensive on the subject of stereo, in case you still need instruction, with a good deal of material on the rest of the recording process—pressing, etc.—in addition. A big argument is given for the crystal playback cartridge versus the magnetic, on which subject I'll reserve comment here; the crystal plugged is Columbia's own, of course, but the argument applies elsewhere too.

2. OUTSTANDING

Stravinsky: Firebird Suite; Chant du Rossignol. Berlin Radio Symphony, Maazel.

Decca DL 79978 (SD)

Any outstanding stereo disc, especially in the classical field, must have all the usual virtues of a good recording in the musical sense plus extra hi-fi additives that count heavily in stereo listening. There must be a topflight stereo pickup by the mikes, enhancing the natural effect of the music involved—and a kind of music, to begin with, that is good for stereo. (Some music positively begs for it.) There must be a clean tape in the first stage, and in all the incidental processing, plus a clean disc, cut with as little distortion as is currently possible, if short of the perfection that we some day hope to achieve.

In the listening, we're likely to merge all of these things together and judge the over-all effect. We can't pin down the details of the over-all impact, except by conjecture and keen listening; we're likely to assign all the credit in a lump where it should be divided all over the place, a bit here and a bit there. That's the way a good record works.

This is an outstanding classical disc, as of now. It is clean in its effect—even though a few loud passages, in the inner grooves, are less than perfect as to distortion. (They're as clean as most, today.) The tape seems to have been a good one, well processed; the stereo pickup is excellent, thus minimizing any distortion that may be present, and it is of the sort that is reasonably at a distance—so that the sharp highs are not too close to the mike. (Close-up miking of trumpets and strings and voices just asks for distortion trouble.)

Stravinsky's music itself has a lot to do with it. His scores are tremendously complex, for big playing groups, but they go onto tape and disc a lot easier than you might imagine. They can be recorded much more easily than, say, a Beethoven symphony, in spite of the larger orchestra.

Finally (or perhaps first of all), there is here a sparkingly musical pair of performances by the dynamic young Decca conductor, Lorin

Maazel. That adds a lot to the over-all effect.

"Firebird" is familiar to most of us, in all its lush early Twentieth century brilliance. "Chant du Rossignol"—Song of the Nightingale—is an orchestral piece made out of Stravinsky's early opera on the Emperor's Nightingale; its colorful, acid harmonies and lush, astringent textures will please plenty of today's ears. A fine novelty to pair with the Firebird. My congrats to Decca on a good stereo beginning.

Stravinsky: Le Sacre du Printemps. New York Philharmonic, Bernstein.

Columbia MS 6010 (SD)

This one goes well with the Decca, above, and has similar qualities. At first I didn't much like the fast, rapid-fire, nervous playing by Bernstein, but I've come to enjoy it a lot and perhaps prefer it to such hard, steely versions as Mercury's with Dorati, or the more solemn and heavy slow-down practiced by the eminent Ernest Ansermet in London's recording.

This is one of Columbia's cleanest—and the company's product seems to be somewhat varied in that respect. The sound is louder and somewhat more brilliant than that of the Decca Stravinsky above, but in their general approach they are quite similar, the recording done at a fair distance but with plenty of spread and liveness. Some of the more violent passages in this famous score would seem to be almost too much for the recording stylus to manage, but even the biggest blasts come through with reasonably high cleanness. The cymbals sound only slightly like broken glass, the triangle is really more like a triangle than a telephone bell.

Credit Stravinsky with a good deal of it. Modern scores, oddly enough, are good for modern recording. Strange coincidence.

Breaking the Sound Barrier. Vol. 1: Percussion. American Percussion Society, Price.

Urania USD 1007

Urania, which under its old regime had the finest collection of well played distortion in the entire LP catalogue, is starting out on top with its new stereo. To be sure, a percussion group like this lends itself to maximum stereo effect and to cutting cleanness, with far less stylus-stress than in many conventional Romantic works. (Cleaner, simpler sound, less complex compound wave forms)—But even so, Urania has done a top job here.

I didn't think too much of this record in its earlier mono form and still find that "Ionisation," the Varèse classic of 1926 that was born to hi-fi and stereo thirty years early, is the only piece here of first quality. But the rest, important or trivial, comes through with enormously added punch in stereo form, and "Ionisation" is sensational! Quite a stereo dazzler, all in all.

(Continued on page 75)

ilar to that which cut the vertical-lateral London demonstration stereo discs heard here a

some day hope to achieve. In the American recording history, etc.

than a telephone bell. Credit Stravinsky with a good deal of it.

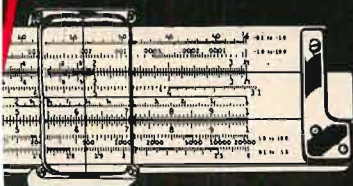
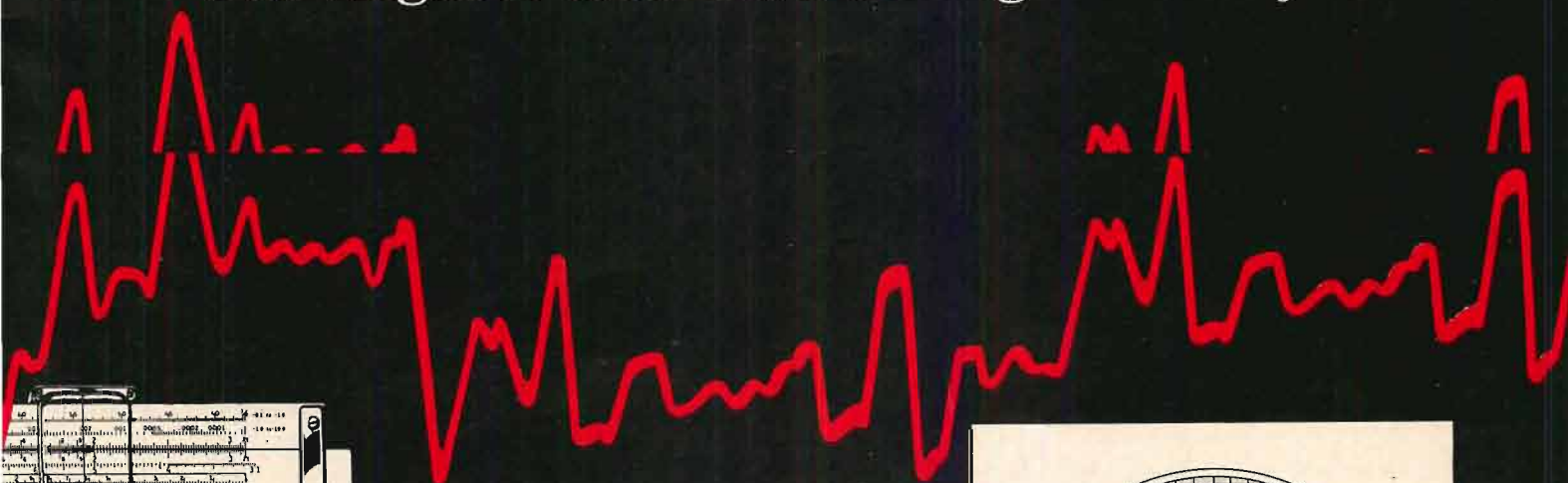
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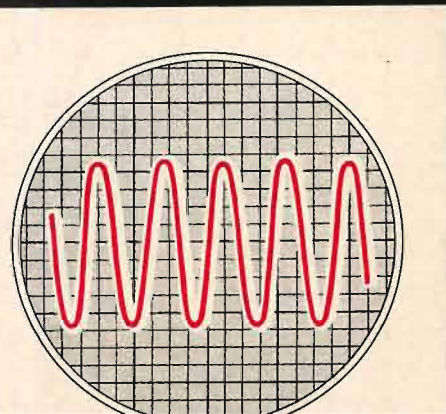
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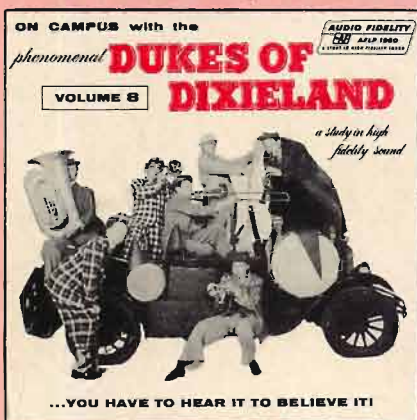


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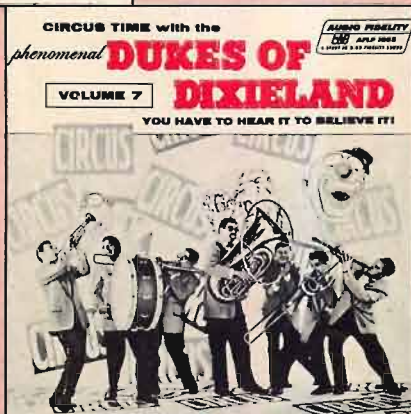
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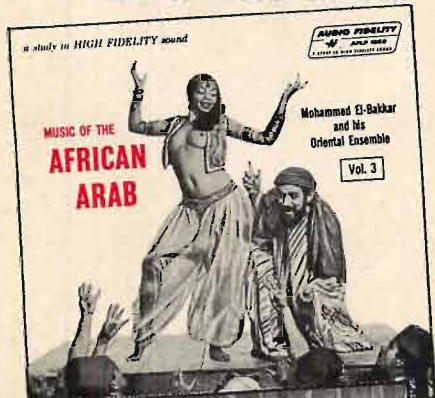
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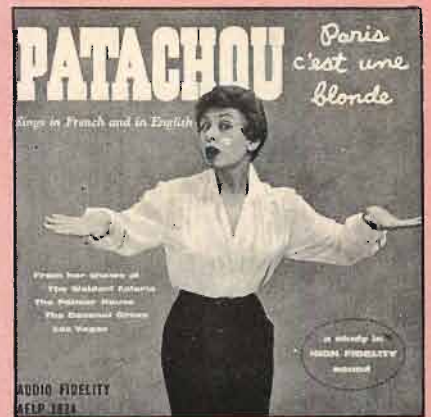
Leon Berry at the Giant in the Basement and an exciting session of pop favorites. Volume 3 AFLP 1844



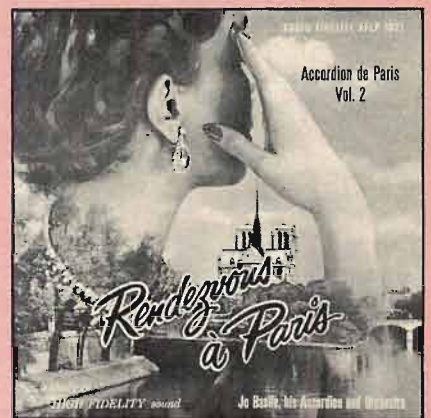
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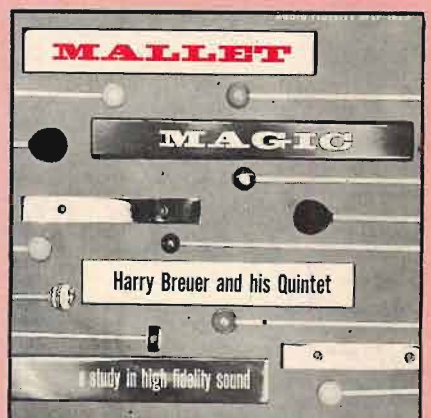
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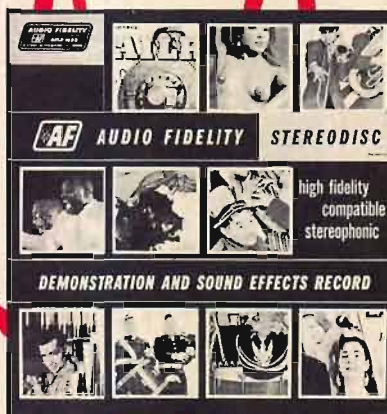


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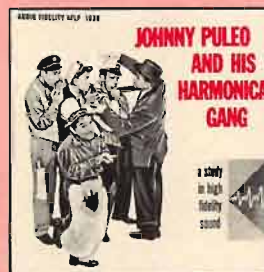
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Tchaikowsky: Symphony #2 ("Little Russian"). Vienna Philharmonica, Swarowsky. Urania USD 1006 (SD)

Urania has something even better here to put in the top-grade category. This is a whiz of a stereo disc, even though we have what might seem to be just another of those familiar European "pickup" orchestras that have appeared under so many odd names these last years. Pickup or no, after a somewhat slow start these players light into the fresh Russian score (we don't often hear it) with excellent and spirited precision playing. The disc cut, again, is clean and low in distortion, the stereo mike pickup first-rate, with a wide spread and impressive presence yet plenty of naturalness in the spacing of the instruments.

What is best about this record is the music itself—it is fabulously well suited to stereo, above and beyond other Tchaikowsky scores. How? Mainly in the large proportion of short, quick transient sounds employed, notably the plucked *pizzicato* strings, which abound in the work. You must have discovered already, if you listen to stereo, that the very best stereo effects are in the ultra-short sounds, not in the long-drawn-out held tones. If you want a fine illustration—many of them—play this.

Rimsky-Korsakoff: Scheherazade. Royal Philharmonic, Beecham.

Angel S 35505 (SD)

Well, well—old Sir Thomas (Tommy) himself, in stereo! It's a humdinger, too, and well ahead of some of the other Angel releases in over-all stereo effectiveness. This one again has certain qualities in common with the records discussed above—a wide, impressive sound but one that is not picked up ultraclose, a natural and gradual depth from the apparent front to the rear as you listen, and no "hi-fi" close-up effects. The music, of course, makes good big-time stereo, there are plenty of quiet, pin-point sounds, lots of short, quick transients. This disc seems to be cut at a higher level than some other Capitols and Angels, too, though I haven't looked at a meter to check on the point. It might be an aural illusion, thanks to good microphoning.

Sir Thomas Beecham's ever-persuasive way with the old war horses of the symphonic repertory is a big factor in impressiveness here. He gets precision, perfect phrasing and ensemble, plus an old-fashioned sense of Romantic drama and show that brings out the best in the piece. Yes, a top record, as of the moment.

It's interesting to try to guess which of three basic types of stereo miking has been used in a given recording—two-channel, three-channel or M-S (the double mike that takes down stereo from a single mid-orchestra location). I've heard that EMI has used the M-S technique with the Philharmonia; perhaps other stereo discs on Angel and Capitol made with that orchestra are M-S-recorded.

My wild guess about this one, on the basis of listening experience to date, is that maybe it was a straight two-channel job, not M-S. Just a hunch—but it is not unlike some of the earlier RCA two-channel stereos, with a broad sound, lots of middle and yet a certain two-sided feeling, a fleeting sort of "one-two" echo, that smacks of two, not three channels. Wonder whether I'm right.

Offenbach: Gaité Parisienne. Boston Pops, Fiedler. RCA Victor LSC 1817 (SD)

Odd—RCA Victor, after plumping full-tilt for stereo disc this spring, has since been somewhat chary of us reviewers, sending out only handfuls of stereo disc here and there; the last two I received, strangely, were both "oldies," dating as far as I know from well before RCA's much-discussed three-channel stereo recording. This is one of them, and my records show that I received the mono version of the recording 'way back in 1955.

Now, why RCA chooses to send out its 1955 two-channel stereo first, ahead of the vast quantity of modern three-channel stuff it has on hand, I don't know. It really doesn't matter, to you—for this is a very nice disc, good stereo, a splendid selection (for a ballet) of assorted Offenbach at his best, and a really superb performance in the best "Pops"-Fiedler tradition, foamy and spirited, full of

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super-hi-fi test disc, excepting its inner half-inch or so. Too close to the label; things get a bit fuzzy there.

Sensational sound, hi-fi style, is the main specialty of this record. First of all—it has the biggest bass drum in stereo to date. It'll shake the floor down to the basement for you. And to go with it there's the clashingest clean cymbal yet. Zzzzzz-boom! You won't bother with much else if you're a good hi-fi bug.

But there also happens to be a solo piano and—miracle of miracles—it's right down on the concert stage along with the orchestra. No blowing-up, no exaggeration, no solo miking. The pianist plays, for once, in a normal concert balance with his colleagues, both as to volume and as to apparent distance from you. It's good, very good.

In mono recording a certain amount of solo-mike blowing-up is really necessary. Stage-distance solos are ineffective, deprived of the visual element and the "live" dimensional presence of the concert. For many years, soloists of all sorts in recordings have been enlarged and brought up close, to compensate—and quite rightly, too.

But in stereo that need is largely removed and, indeed, the grossly blown-up, close-miked solo introduces spatial contradictions that can be most unpleasant. A huge piano floating bodily in space in front of your nose, *between* your speakers, with a fine orchestra spread out yards and yards behind it, is not good listening. Maybe we'll get used to the effect, but we shouldn't have to.

Most stereo pianos-with-orchestra (and other soloists) have nevertheless been recorded for stereo in the old way, often using the third (center) channel as a solo channel. Though Mercury's is a three-channel job, the piano does not monopolize the middle channel; instead, it is in the middle, but strictly in scale. Excellent effect, and congrats to Mercury for trying it.

I've heard the same in several other stereo recordings, here and there, each time with pleasure. Concert Hall, now defunct, took down Philippe Entremont that way in several taped concertos—I thought it was terrific. RCA, who blows up Artur Schnabel to huge proportions in his concertos, has a fine stage piano in the Liebermann Concerto for Jazz Band and Symphony Orchestra—but the pianist is, natch, anonymous. RCA hasn't tried the system on its big stars, piano or otherwise. Another place where you can hear real stage-distance piano is in the several recordings of "Petrouchka" by Stravinsky. There, too, the pianist, though important in many solo passages, is usually anonymous and just another member of the orchestra, so he automatically gets the stage-distance treatment for his solos. Excellent!

The Gershwin playing under Hanson is pretty dry, in a quite dry recording hall, too. But oddly enough, several minor soloists in the orchestra blossom forth with terrific enthusiasm in their short bits, notably the clarinet, who opens the Rhapsody with a gorgeous up-slide, and the "wah-wah" trumpet, who obviously is having the time of his life. These and other individuals really dig Gershwin here though I don't feel that Dr. Howard Hanson does. As for pianist Eugene List, he plays warmly in the style of Brahms, more or less, which isn't Gershwin but sounds pretty well even so.

Stravinsky: Petrouchka (complete ballet, original ed.). L'Orch. de la Suisse Romande, Ansermet. London CS 6009 (SD)

—And now we come to London! English Decca (the parent company in England) is an extraordinary outfit. With the utmost persistence, with almost diabolical know-how, they have stuck to a type of recorded sound that remains today about the most brilliantly successful of any on records, still unique in spite of its enormous influence on all other recording during the last decade. And now—the self-same sound has been transferred to stereo. It is just as typically *ffrr* as ever—though named *ffss*, for Full Frequency Stereophonic Sound.

Out of the first batch of complete Londons (not counting the excellent Sampler, reviewed above) I've picked this one as possibly the most effective in the over-all. The *ffss* sound, made close-up in a huge, golden liveness just

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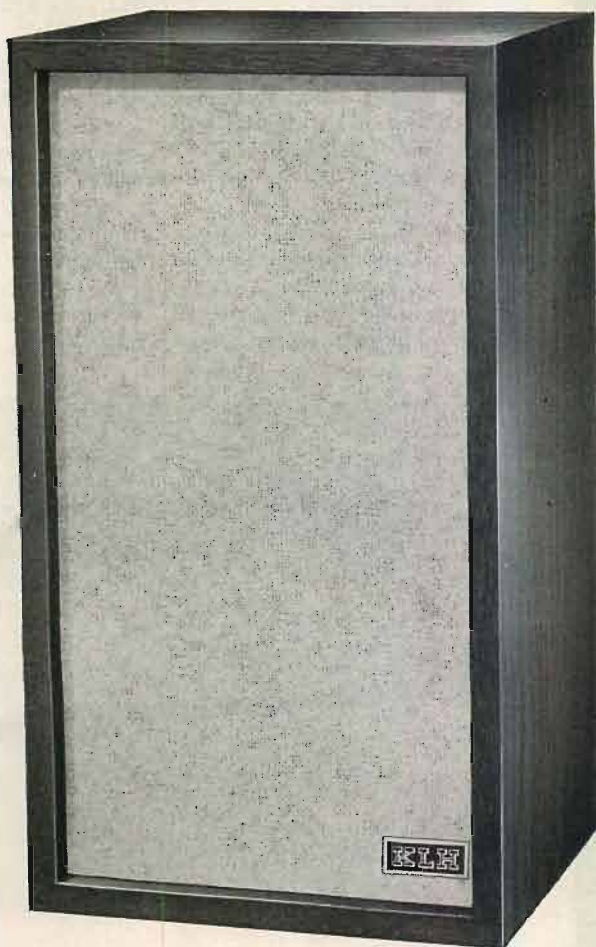


obviously is having the time of his life. These and other individuals really dig Gershwin here though I don't feel that Dr. Howard Han-

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like the old frr, is subject to some troubles in stereo recording on disc. Brilliant, close-up massed violins, frr style, invite distortion and in some cases, on some Londons, it is definitely apparent as far as my present observations can tell. Not bad—just a too-brilliant, edgy fullness. Big, shiny climaxes also tax the stereo record's presently touchy capabilities, tending to blast a bit on high-quality equipment. There is an audibly measurable quantity of the aforementioned broken glass when ffs triangles go TINGALING, at high volume (and close-to), when huge cymbals clash at ultra-short range. Altogether London has set itself some whopping problems and, at that, the London recorded level is about the highest in the business, the stereo bottom bass the biggest anywhere.

The solutions are generally brilliant, in the best sense of that word as well as the worst, and this particular disc, I'd say, shows off the unique London sound for better or worse in its most favorable aspect.

You won't be able to beat London's stereo miking anywhere. It is, as I say, radically unlike most other classical stereo pickups. It features huge, close-up detail, yet the balance and perspective between instruments is excellent, the sense of presence absolutely uncanny. On first trial, after a group of the above discs, the London product will both amaze and astonish you. For awhile it will tend to put all other stereo in the shade. It is like chile con carne after plain canned beans. The colors are high, the effect almost strident (emotionally and distortionally), the impact tremendous.

Don't try to mix Londons in with other stereo classics, then. They mix badly. Play this one, then turn to a Columbia, a Decca, a Urania, an Epic, Vanguard, Angel, Capitol etcetcetc. and any one of these will tend to sound at first dismally narrow, unimpressive, in comparison. It takes a good many minutes before the ear re-adjusts to the more modest effects of these other record brands—but adjust it will, and in the end you'll understand that while London is at the top in brilliance of stereo impact, without question the others have permanent values that are in the long run just as good.

Nevertheless—there's something about ffs, like frr, that you won't be able to get out of your ears. This example, Ansermet playing Stravinsky in his best classic manner, is as fine as any, with distortion as low as its likely to be for awhile in any London record. A good one to try.

3. AND STILL MORE . . .

(There are many more discs in the "outstanding" category but I'm tired of splitting hairs; so I'll just move on to other reviews—outstanding or no. I'll start in by companies, for a change.)

CAPITOL-ANGEL

Orff: Die Kluge. Schwarzkopf, Cordes, Frick; Philharmonia Orch. Sawallisch.

Angel S 35389/90 (2 SD)

If you have heard Orff's "Carmina Burana," the immensely popular piece for chorus and orchestra, you'll know what to expect from this dramatic work. My advance test copy has no text nor notes, but I found the music stimulating, if not too profound, in the usual brilliant Orff style of tricky vocal effects, with much hypnotic repetition of rhythmic figures, a monotony of key that is equally hypnotic if not very subtle. Nevertheless, it's the kind of modern stage music that finds a ready and enthusiastic audience. There are some really beautiful songs here, too—notably a sort of cradle song (Schwarzkopf) with a refrain "Schu-schu."

A large part of the work is in spoken dialog (German), which is brilliantly acted here, for once making use of a real spatial stereo effect from side to side. If this, incidentally, is an example of M-S recording, then it's terrific. Excellent presence, huge lateral spread, remarkably clear, sharp recording of the voice, both singing and speaking, altogether an excellent record with very low distortion. Recommended, even though it's two discs long.

The Angel stereos are recorded in Europe but the discs are cut by Capitol in the States.

AUDIO • OCTOBER, 1958

Orff: Die Kluge. Schwarzkopf, Cordes, Frick; Philharmonia Orch. Sawallisch.

Angel S 35389/90 (2 SD)

Gilbert & Sullivan: The Mikado. Pro Arte Orchestra, Glyndebourne Festival Chorus, soloists, Sargent.

Angel S 35586/87 (2 SD)

Not the D'Oyly Carte presentation and hence beyond the pale for true Savoyards, this Glyndebourne G & S is nice, but somehow not very funny, too professional, too much like the serious operas it takes off. I found it somehow dull; the voices are too good.

The stereo effect is odd, too. The orchestra is splendid, situated large-as-life in the background; so is the chorus. But the soloists are all projected in disembodied form, close-up and slightly to the right, like a tight little group of floating plaster angels in mid-air. (Or, more realistically, like a cluster of concert soloists on a concert stage.) What's more, they aren't well recorded; there is metal and edge to their sound in too many places.

It would be much better, especially in Gilbert & Sullivan, if the soloists walked the invisible stage like human beings, or at least sang from slightly varying fixed locations as though in some sort of spatial action. Who wants a lopsided concert-stage Mikado with everybody on one side?

It could have been done like the excellent Orff job above. Same record company, after all.

Shostakovich: Symphony #11. Houston Symphony, Stokowsky.

Capitol SPBR 8448 (2 SD)

This work, which I've been hearing in test versions, first in mono acetate and then in stereo tape, now comes along on stereo disc but still in advance white label form. My identifying numbers may be the wrong ones—ask your dealer.

It is the latest Shostakovich Symphony, one of his long ones, on the theme of the Russian Revolution of 1905, the music making use of a number of Russian revolutionary tunes that you'll like, Revolution or no. (Shostakovich hasn't been one to set folk tunes in his Symphonies very often in the past.) Other reviews have taken a dismal stand; I'm no enthusiast for late Shostakovich myself, but I found that I did enjoy this work even though I was not persuaded it is any sort of supreme masterpiece.

Perhaps the best reason is simply that it is rather sparse, if long, with relatively few big noisy climaxes of the sort I intensely dislike in the heavyweight Seventh and Eighth symphonies of the war period. There's much quiet writing here with a good deal of spare color, some interesting and quite expert treatment of the abovementioned Revolutionary themes, a lot of lean, musical counterpoint. Like most Shostakovich, this work is an absolutely no hurry at all and goes on and on—four sides. But if you are in a leisurely mood, you'll likely find it quite impressive, for the time being.

Perhaps I should say, too, that Stokowsky, that durable old dramatist, is mostly responsible for my liking this music—he gets all there is out of it that can be squeezed and coaxed. (He conducted it before the composer in Russia this summer.)

The stereo here is Capitol's best, wide, broad, full, in an armory-like sort of liveness. The louder parts of the disc aren't quite as clean in the sound as it would be nice to have them.

Beethoven: Symphony #7. Philharmonia, Cantelli.

Angel S 35620 (SD)

A somewhat slurred, imprecise Seventh in the playing, as conducted by the late Cantelli, this disc suffers for my ear from inferior stereo effect. The recording is OK, if so-so, but the cut is remarkably low in level (maybe to get all the music on one disc). If this is an M-S stereo, it isn't a very good example of the technique. You can do better on the Seventh elsewhere in stereo.

Dohnanyi: Variations on a Nursery Theme.

Britten: Young Person's Guide to the Orchestra. Concert Arts Orch., Slatkin. V. Aller, pf.

Capitol SP 8373 (SD)

I don't much tucker to either of these per-

(Continued on page 93)

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CHARLES A. ROBERTSON*

Stereophonic

Ted Heath: Hits I Missed London PS116
Ken Moule: Jazz At Toad Hall

London PS108

Only those diehards most resistant to the stereo disc will be able to face the temptation of the seventy-five items offered by London in its first release and not succumb to the lure of *ffss*. It is a sound calculated to draw a contented sigh and murmurs of approval from the discriminating audiofan. An equally bounteous listing, promised for well before the holiday season, should cause any who have malingered to place the means to convert to stereo at the head of the Christmas agenda for hearth and home.

The cataloguer of the popular series depends mainly on material available in monophonic form and carefully skirts the serial number thirteen, though his classical counterpart has no such qualms. The Band of the Grenadier Guards, Mantovani, Frank Chacksfield, and Edmundo Ros are all liberally represented on the twenty-five albums. Stating the case for British jazz are the polished musicians of Ted Heath's band on "All Time Top Twelve," PS117, and a new collection of such enduring hits as *High Noon*, *Moulin Rouge*, and *Learnin' the Blues*. And Ken Moule, by composing a suite with parts for *Mr. Toad* and a *Mouse Carol*, continues his excursions into the delightful world of Kenneth Grahame.

Because this release is likely to assume historic importance as a principal factor in establishing the stereo disc on a firm footing, some insight into the planning and techniques involved were obtained in an interview with Stephen F. Temmer, president of Gotham Audio Development Corporation, shortly after his return from Europe this summer. The company is the representative in this country for several electronic firms on the continent and his visit took him to the centers of stereophonic activity in Germany, Denmark, Switzerland, Holland, Belgium and Austria.

England was not included in the tour and even those persons aware of the complicated alliances formed by record companies may wonder where English Decca, parent company of London, comes into the picture. It is half owner of Teldec Corporation, located in Hamburg, manufacturers and distributors of Telefunken, English Decca and RCA Victor records. It in turn developed the Teldec stereo cutting system, manufactured in Berlin by Georg Neumann Laboratories. Engineers of the three companies worked closely together

* 732 The Parkway, Mamaroneck, N. Y.

in perfecting the Neumann SM-2 stereo microphone (described in an article on "M-S" stereophony in the April, 1958, issue) and Teldec cutter head, which play an important part in the preparation of London stereo recordings.

Gotham is North American representative of Neumann and distributor of the electro-acoustic products of Telefunken, uniting them under one roof in this country. During his travels, Temmer visited the laboratories of the three German companies. In the course of relating recent progress there, he consented to give a general review of their part in the events leading to the demonstration given here last Fall by Arthur Haddy, chief engineer of English Decca, which touched off much of the current stereo excitement. It will serve to clear up some misconceptions until the day when the true story is told in detail.

First he extracted from his files a photostat of A. D. Blumlein's E.M.I. patent application of Dec. 14, 1931, granted June 14, 1933. "It all began here," Temmer said, "and the principle of the vertical/lateral and the 45/45 systems are clearly stated. His death in a plane crash during the last war was a great loss. However, when Decca began to work on stereo in 1954, research was conducted on the carrier modulation system, similar to that explored by Jerry Minter in this country. This was fully developed by 1956, when the apparent cost of the reproducing equipment caused a reexamination of the systems proposed by Blumlein. It used a carrier frequency of 14,000 cps with a top frequency band from 15,000 cps to 28,000 cps, but the effort was not wasted since we now have a cutter head able to trace these frequencies.

"Horst Redlich, chief engineer of Teldec, and his colleague Hans Joachim Klemp have assembled a small museum of experimental models of cutter heads and cartridges that passed through their hands during the four years they worked on the project—and they are still adding to the collection. Both systems were thoroughly investigated and the present Teldec cutter head was developed before last year's demonstration. Either system could have been shown then, but the V/L was selected because it was felt the problem of rumble could be dealt with best by limiting it to the vertical channel and then filtering it. Advocates of the 45/45 system believe that rumble is reduced to tolerable limits by distributing it between the channels.

Referring again to the Blumlein patent, Temmer pointed out that it showed the

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in establishing the stereo disc on a firm footing, some insight into the planning

tems proposed by Blumlein. It used a carrier frequency of 14,000 cps with a top frequency band from 15,000 cps to 28,000

two systems to be equivalent and provided transformer arrangements to cut either groove. "The addition of two transformers is all that is needed to convert a Teldec cutter head from V/L operation to the 45/45 system," he stated. "But Blumlein could only dream of the advances which would make the stereo disc possible. These consist of improved microphones and new microphone techniques, new metals which permit great reduction in the mass of cartridges and cutter heads, magnetic tape and the use of plastic in pressings. The transformers adjust the relation of one track to the other and actually tune to the greatest separation. A two-inch cube weighing only 12½ ounces, the head is the lightest manufactured and can be mounted on any lathe. It has a single magnet system, feedback damping and a single armature of aluminium oxide."

Gotham will supply an integrated Teldec system, complete with everything needed to make a stereo master, to anyone willing to pay the tidy sum of \$38,000, though the individual components are priced to meet competition. However, production of the cutter head is limited and only two will be available in this country before the first of the year. One will go to RCA Victor, due to its affiliation with Teldec, and the other is promised to a laboratory for experimental purposes. The first twenty-five made were divided between English Decca and Teldec. Delivery in this country, Temmer said, will begin in quantity next January.

As in the case of the Fairchild cutter head, because of the feedback damping it will be sold only with its complement of allied amplifiers with equalization built in. "The lathe and tape console are optional equipment," said Temmer, "but Teldec has successfully cut stereo sides of twenty-nine minute duration using the complete system. The Neumann lathe is fitted with a variable depth control which operates electronically, based on the difference between the two channels. This amount of playing time is equal to that advisable for single-channel discs and is only possible, at present, with this type of pitch and depth control. We have just made delivery to American Sound Corporation, manufacturers of Urania records, and Olmsted Sound Studios in New York.

Before arriving in this country in 1939 at the age of eleven, Temmer was a member of the Vienna Boys' Choir in his native city and a student of the violin and piano. He was graduated from Brooklyn Technical High School in 1946 and attended M.I.T. for a year on a scholarship. After spending two years in radio broadcasting, he helped found the Gotham Recording Corporation, disposing of his interest last year to limit his activities. He is president of Teldon Productions, Inc., producers of foreign language broadcasts for the Voice of America and other radio outlets, and partner with Hal Michael, former owner of Goldeu Crest Records, in the newly established Gotham Audio Sales Co., Inc.

While in Europe, Temmer attended recording sessions at the Hamburg Teldec studio, consisting of 81,000 cubic feet, and its Berlin studio, of 50,000 cubic feet. He also accompanied a mobile unit to a Munich cathedral, the scene of the recording of an Handel organ concerto in the hours of the night when traffic could be halted in the surrounding four-block area. Other clients visited were the manufacturers of Lyrec lathe motors and Beyer dynamic microphones and headphones.

From his observation of stereo activity on both continents, Temmer hazarded a



INTEGRITY IN MUSIC



STROMBERG-CARLSON RF-484 15" COAXIAL TRANSDUCER...

utilizes a 15" soft skiver woofer for a low-frequency reproducer and an induction tweeter of exclusive, patented Stromberg-Carlson design.

The woofer has superb performance in the extreme low-frequency range due to a very rigid high mass moving system. It has been damped to provide optimum transient response and control throughout its operating range. It is unusual in that combined with this exceptional transient response the RF-484 performs in an extremely linear manner.

The induction tweeter employs a Stromberg-Carlson design principle that results in an extremely light and sensitive moving system. This flat and extended frequency response characteristic is a direct result of our patented design. A carefully calibrated diameter and shape of cone afford dispersion capabilities that are definitely superior.

SPECIFICATIONS:

Power Handling Capacity: Woofer—Over 100 watts Program Material; Tweeter—Over 50 watts Program Material. **Effective Frequency Range:** 15 to 20,000 cps for 10:1 average loudness range re. 32 sones (90 phons). 15 to 20,000 cps for 5:1 average loudness range re. 32 sones (90 phons). **IM Distortion:** 100 cps and 700 cps at 2.8 volts, 1:1 ratio, an instantaneous power input of 4 watts: 0.3%. **Dispersion:** 140°—Test Signal, constant amplitude noise band, 1 kc to 20

kc. The intensity at the outer limits of the 140° solid angle is within 10 db of the intensity on axis. **Free Air Resonance:** 20 cps plus or minus 5 cps. **Maximum Flux Density in Magnet Structure:** Woofer—14,000 Gauss; Tweeter—18,000 Gauss. **Flux Density in Air Gap:** Woofer—10,000 Gauss; Tweeter—10,000 Gauss. **Total Flux In Air Gap In Maxwells:** Woofer—152,000; Tweeter—27,900. **Nominal Impedance:** 16 ohms. **Dimensions:** Diameter (OD)—15¼"; Depth—6⅞". **Price:** \$149.95 (Audiophile Net).

*Zone 1

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**First
the
fabulous
TD-124**



TD-124 \$99.75 net

NOW

**two
new "TD"
Stereo-Monaural
turntables**



TD-134 \$60.00 net



TD-184 \$75.00 net

Here's good news for budget-minded hi-fi aficionados. These two new Thorens turntables (with integral tone arm) give you the same basic drive mechanism you get in the ultra-precise TD-124 transcription turntable, but they're streamlined for economy. See the new TD-184 and TD-134 at your authorized Thorens hi-fi dealer's today.

TD-134 Manual Player. 4 speeds. It has the same precision-machined, adjustable-speed drive as the Thorens TD-124 transcription turntable for minimum wow, flutter and rumble. Turntable floats on nylon bearings. Integral tone arm equals tracking performance of separate arms costing as much as half the price of this entire unit. Plug in adapter for standard stereo or monaural cartridges. 15" x 12", extends 2½" below panel, 3" above.

TD-184. Same as TD-134 with semi-automatic operation: One dialing motion selects 7", 10" or 12" record size, starts motor. Arm literally floats down into first record groove on air; adjustable piston controls lowering speed. Absolutely no connection between arm and table during playing. Featherweight position trip shuts off player at end of record, idler disengages and arm lifts. Manual reject control permits shut-off, interruption or manual operation.



Thorens celebrates 75 years of progress in music reproduction

THORENS

SWISS MADE PRODUCTS
HI-FI COMPONENTS • LIGHTERS
SPRING-POWERED SHAVERS
MUSIC BOXES
NEW HYDE PARK, NEW YORK

guess that the next developments would come after a period of stocktaking this fall. "The rush to bring stereo to market has forced many engineers to concentrate on one aspect of the subject," he said. "Let's hope they have a short breather so the expert on cutter heads can apply his thinking to cartridges and vice versa. There are a hundred ways to make a cutter head and I heard of some interesting theories. Deutsche Grammophon is using one developed by Ortofon and I auditioned some of their pressings before I left. Neumann is making a cartridge of professional quality and charts of its response are the best I have seen for separation at high frequencies—18 db at 10kc.

"More than one hundred Neumann SM-2 microphones are in use in European studios, mainly in association with other microphones as a convenient and economic means of providing a third-channel without building it into a console. Central impressions are distributed to both the left and right channels, ensuring absolute compatibility, and no separate monophonic setup is necessary. One of its characteristics is a pleasing absence of listening fatigue, due in part to the single stereo spread.

"But it has other applications," Temmer concluded, "depending upon the ingenuity of the engineer. It is the only means for duplicating the single-microphone technique in stereo and is frequently used alone to record an organ or solo piano. At a live performance where the distraction of an audience might cause a soloist to shade one of two separate microphones more heavily than the other, it is especially valuable. Olmsted Sound Studios used one this summer to record the Great South Bay Jazz Festival."

The big, brash sound of the Ted Heath band is heard in full stage presence, with the soloist usually at the center and the brisk exchanges of the brass and saxophone choirs coming from either side. It is an effect dramatized at the end of *Three Coins in the Fountain*, where the tokens plop into the water in similar sequence to provide a realistic demonstration bit. The arrangements allow for a few more stereo surprises, but nothing to interfere with the band's primary function to provide a swinging beat. For this release takes the stereo disc safely out of the curiosity stage. It can stand comparison to the best in monophonic reproduction and the advantages of stereo are presented with lifelike realism.

Pianist Ken Moule is also a writer aware of the adaptability of two flutes to stereo and contrasts them boldly with George Chisholm's resurgent trombone and the baritone sax of Ronnie Ross. His four-part suite features a reflective *Wind in the Willows*. Don Rendell, Tony Kinsey and Ross contribute originals and there is an unrestrained *The Boy Friend*, from the British musical which visited these shores.

MONOPHONIC

The Gerry Mulligan Song Book, Vol. 1
World Pacific PJ1237

Stan Kenton: Back To Balboa
Capitol T995

The gradual breakdown in geographical division between West and East Coast sound is no better illustrated than here, as Stan Kenton features arrangements by Johnny Richards, now living in Manhattan, and Bill Holman forwards from California his scoring of compositions by Gerry Mulligan, who is also now based in New York. These provide for a sax section of Zoot Sims, Al Cohn, Lee Konitz, and Allen Eager to cushion the leader's bar-

and contrasts them boldly with George Chisholm's resurgent trombone and the

tone sax, with drummer Dave Bailey, bassist Henry Grimes, and the invaluable Freddie Greene on guitar. Several of them are Mulligan's earliest writing, dating from nearly a decade ago, and are given clean, fresh settings. All but *Crazy Day*, the one number composed and arranged by Mulligan for the date, have recorded histories.

The second of the on-location dates from the far reaches of the Rendezvous Ballroom is an ambitiously arranged project, with Marty Paich providing his *Big Chase*, and a base for Bill Perkins to rekindle *My Old Flame*. Lennie Neihaus solos on Holman's *Royal Blue*, and Richards distributes zestful Afro-Cuban rhythms throughout a full-throated *Begin the Beguine*, *Beyond the Blue Horizon*, and *Rendezvous at Sunset*. As on the first of the new series from Balboa, the open hall sound is exceptionally fine.

Patachou: International Soiree
Audio Fidelity AFLP1881
Paris: Its Sounds And People
Capitol T10142

Without a French singing star in one of its theaters or cafes, New York would seem a less cosmopolitan place. Since her appearance at the Waldorf-Astoria in 1953, Patachou has been a reigning favorite and drew critical plaudits this season for her performance in Arthur Lesser's revue "International Soiree." Her steady growth as an entertainer is shown here in the sharp satire of Irving Berlin's *Only For Americans*, a vivacious *Wonderful Guy*, and the romantic *Fascination*. She is in top form in the Bohemian songs which first brought her fame, detailing the trials of *Brave Margot*, *Complainte de la Butte*, and *Piano du Pauvre*. Both the fine recording and the orchestra under Jo Basile give her a natural setting. His accordion brings her closer to the spirit of Paris than is the case with most chanteurs.

If Patachou's persuasive voice kindles a desire for more of the sounds of the city, there is the second of Capitol's recorded travelogues. The narration by Robert Berthe introduces a Renault taxi of a vintage year, the bells of Notre-Dame, and a band of Poulbots atop Montmartre. With an accordion leading the way, he visits a boxing match, the Metro, the Eiffel Tower, and presents a view of the Mona Lisa via the gasps from an admiring throng. Eleven months were spent by the engineer, Jacques Dubourg, in patiently stalking the various effects.

Theodore Bikel: Jewish Folk Songs
Electra 141
Oranim Zabar Israeli Troupe: Shalom!
Electra 146

As a sequel to his collection of the folk songs of Israel for the same label, Theodore Bikel returns closer to home in a group sung in his own family circle. Rich in the sources of Jewish tradition, their value to him is expressed in his note, "To me, my people's past is very real, and both our languages—Yiddish and Hebrew—a living source which will not dry out in my house while I am alive." Fred Hellerman conducts an orchestra in his arrangements of eight numbers, including the comic tale of the first meeting between a landsman and a moist, unpius train. Bikel accompanies himself on guitar on the remaining eight and, as in the case of the previous album, the text is supplied in three languages.

On a tour of this continent for the last year and a half, the troupe of six young Israeli artists travel under the shortened title of OZ, a Hebrew symbol of the strength which energizes their performances of the newly formed music and dance of their country. Traditional European elements are colored by a spirited Near-Eastern influence, as detailed by the throbbing rhythms of Michael Kagan on an oriental drum and the percussive effects of the dancers. The merging of the two styles is further evident in the love songs of Geula Gill, and the accompaniments of Dov Seltzer on accordion and Amitai Neeman on flute. It is a blend that makes an exciting recording and reveals the pioneering vitality of a new culture.

(Continued on page 89)

INTEGRITY IN MUSIC



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Here is unequivocally the very finest means available to maximize the performance at low frequencies of quality loudspeakers.

When properly coupled to the low-frequency radiator of a speaker system—it achieves a system resonance that is lower than the un baffled free air cone resonance of the low-frequency radiator itself.

The system utilizes mass loading and frictional damping as acoustical devices to properly extend the low-frequency range of the system with extreme flatness of response.

For example, when the Stromberg-Carlson RF-484 loudspeaker, which has a cone resonance of approximately 20 cps, is used with our RH-416 Labyrinth cabinet—the system resonance is about 16 cps.



RH-412 12" Speaker Enclosure



RH-413 12" Speaker Enclosure



RH-414 8" Speaker Enclosure or RS-461 Speaker System



RH-416 Speaker Enclosure or MS5-491 Speaker System



RH-417 Speaker Enclosure or MS5-492 Speaker System

See your dealer or write to us for full data on our complete new line of amplifiers, speakers, speaker systems, enclosures and program sources.

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Electronic and communication products for home, industry and defense; including High Fidelity Consoles; School, Sound, Intercom and Public Address Systems.



NEW PRODUCTS

● **Romik Speaker System.** Simultaneous production of the necessary line sources for critical stereophonic presentation as well as the wide dispersion for natural quality in all forms of playback have been incorporated into the Model RM-101. The enclosure has a specially-constructed horn



giving the bass a clean non-resonant response without frequency doubling down to 40 cps. The 20-watt system handles transients well and is smooth throughout the frequency spectrum to over 15,000 cps. Small size and modest price make the RM-101 an excellent choice for both stereo and monophonic installations. Dimensions are 32" h x 22" w x 11 1/2" d. Available in various finishes. Manufactured by Rolem Sound Reproduction Company, Stirling, N. J. **L-1**

● **Thorens Turntables.** Two new high-fidelity turntables with integral tone arm, in reality modestly priced versions of the well-known Thorens Model TD-124, are now being distributed by the Thorens Company, New Hyde Park, N. Y. The Model TD-134 incorporates the same pre-



cision-machined adjustable-speed drive as the TD-124. The four-speed table floats on Nylon bearings, and a newly-developed arm provides excellent tracking. The new TD-134, illustrated, is identical except for semi-automatic operation. A dial selects record size, starts motor, actuates arm which lowers automatically into first groove. Adjustable air piston controls lowering speed. Featherweight trip shuts off player at end of record, idler disengages, and arm lifts automatically into rest position. Further information will be mailed upon written request. **L-2**

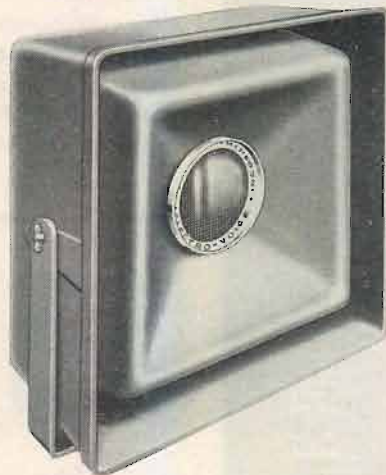
● **Hysteresis Motor.** Of interest principally in the audio industry to manufacturers of high-quality turntables and tape recorders, this new sub-fractional horsepower motor, although small in size, has an extremely low heat rise of only 23° C. to 38° C., depending on horsepower rating. Notwithstanding a high standard of performance, due to a unique stator design,

it is an exceptionally low-cost motor. Horsepower ratings are from 1/20 to 1/200, with a running torque of 2.3 to 28 inch-ounces. Different rpm's can be se-



lected by varying input frequency. The motor reaches full speed in one revolution and maintains synchronous speed at rated load. Totally encased for protection against environmental conditions, it measures 4 3/8" diameter by 3-5/16" thick and weighs 4 1/2 lbs. The motor shaft, which is available in stainless steel for tape-recorder applications, runs in self-aligning Oilite bearings and is ground and lapped to size with a 0.0002-in. bearing clearance. Write to Dale Products, Inc., Columbus, Neb. for technical bulletin H-60 for complete specifications. **L-3**

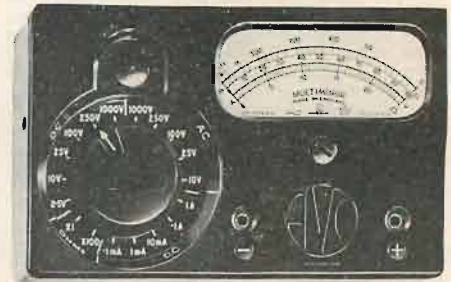
● **E-V Portable Hi-Fi Speaker System.** The Musicaster is an integrated high-fidelity speaker system for use indoors and out. Highly portable, the unit weighs only 24 lbs., and measures but 21" h x 21" w x 8 1/2" d. Frequency range is 60 to 16,000 cps. The entire assembly is treated to provide protection against weather and fungus. Structurally, the Musicaster is a folded-horn enclosure utilizing a Radax 8-in. speaker. It is interesting to note that the die for



casting the all-aluminum enclosure was machined from a three-ton block of steel, and the enclosure itself is the largest aluminum close-tolerance vacuum casting ever successfully produced. In addition to outdoor home application, stores, schools, offices, banks, and restaurants will find the Musicaster ideal for music and paging. Further information can be obtained from Electro-Voice, Inc., Buchanan, Mich. **L-4**

● **Miniature Multimeter.** The AVO Multiminor, a miniaturized volt-ohm-milliammeter, has accuracy, versatility, and ruggedness comparable to standard-size instruments costing considerably more than its modest price. D.c. voltages from 2 mv to 1000 volts are measured in seven ranges,

with an accuracy of 3 per cent at a sensitivity of 10,000 ohms/volt. A.c. voltages from 200 mv to 1000 volts are meas-



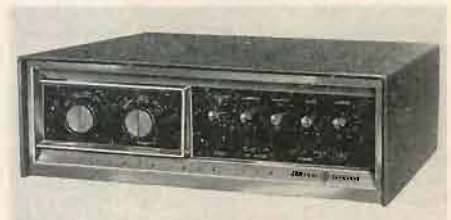
ured in five ranges, with 4.0 per-cent accuracy and sensitivity of 1000 ohms/volt. D.c. current range is 2 microamperes to 1 ampere. Resistance range is 5 ohms to 2 megohms. Only two jacks are used, range selection being accomplished by means of a rotary selector switch. The AVO Multiminor is being introduced in the United States by British Industries Corporation, 80 Shore Road, Port Washington, N. Y. **L-5**

● **Dynakit Dual Power Supply.** This unit furnishes power for two preamplifiers used in a stereophonic music system. It features two independent heater windings, which permits minimizing the hum level of each preamp individually. Designated Model PS-1, the dual power supply includes provision for maintaining constant voltage regardless of whether one or two pre-



amplifiers are being powered. Substantial filtering is incorporated to assure low hum and excellent stability. Although designed primarily for use with Dynakit preamplifiers, the PS-1 can also be used with other preamps which do not include a built-in power supply. Assembly time of the dual power supply kit is less than one hour. Dyna Company, 617 N. 41 St., Philadelphia 4, Pa. **L-6**

● **G-E Stereo Amplifiers.** High-quality stereo performance, excellent control flexibility, and striking appearance characterize two new "Stereo Classic" amplifiers recently announced by General Electric. The MS-4000 40-watt model with two 20-watt channels, and the MS-2000 28-watt model with two 14-watt channels, are



slated for October and November availability, respectively. Each model has two power amplifiers and two preamp-control units on a single chassis. Both models are virtually identical in external appearance. Except for power rating, the two are similar in many basic circuit features. Controls are ganged for simultaneous adjustment of both stereo channels. Other features of both the MS-4000 and MS-2000 are: channel reversing switch, rumble filter effective on all inputs, an independ-

● **G-E Stereo Amplifiers.** High-quality stereo performance, excellent control flexibility, and striking appearance character-

ent switch position and input for monophonic cartridges, low hum and noise, and better than 40 db channel separation. Frequency response is 20 to 20,000 cps \pm 0.5 db, and harmonic distortion is under one per cent at full rated output. Further information is available from General Electric Company, Specialty Electronics Components Dept., W. Genesee St., Auburn, N. Y. **L-7**

• **Fisher Stereo Tuner.** Complete on a single compact chassis, the Model 101-R tuner provides entirely independent FM and AM channels for either stereo or monophonic operation. Separate tuning indicators are afforded for FM and AM. The FM tuner has 0.75-microvolt sensitivity for 20 db quieting and 1.1-microvolt sensitivity for 30 db quieting. Decoupling circuitry insures channel separation with no interaction between FM and AM tuners. Four i.f. stages on FM offer maximum gain and bandwidth, with limiting in two stages to suppress both random and impulse noise. The bridge-type low-noise



triode mixer is equipped with a compensated coupling network. A "gold-cascade" high-gain low-noise r.f. stage assures maximum sensitivity and signal-to-noise ratio. On AM, a tuned r.f. stage offers optimum signal-to-noise ratio and i.f. rejection. Overload on strong signals is effectively prevented by an efficient delayed-a.g.c. circuit. Four types of operation are possible with the 101-R: FM-AM stereo, FM multiplex stereo (with multiplex adapter), FM and AM standard monophonic. Jacks are provided for stereo or monophonic recording. The tuner incorporates 15 tubes plus 2 germanium diodes. For full description and technical specifications of the 101-R, write Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. **L-8**

• **Collaro Stereo Changers.** Three new record changers specifically engineered for stereo are now being introduced into the American market by Collaro, Ltd., British manufacturers. Heading up the new stereo changer line is The Continental, Model TSC-840, which features a two-piece arm



with a new five-terminal plug-in head. Two completely independent input circuits are available when needed for hum minimization. The counterbalanced transcription-type arm will accept any standard stereo or monophonic cartridge. The arm is so designed that there is less a gram difference in tracking pressure between the top and bottom of a stack of records. Other features include four speeds, manual-play switch, automatic intermix, and automatic shut-off. Wow and flutter are stated to be 0.25 per cent rms at 33 1/3 rpm. The heavy-duty four-pole induction motor is equipped with a muting switch. The Coronation and Conquest models are designed essentially for the economy-minded user, although they incorporate many of the exclusive features incorporated in the Continental. Further information may be obtained from Rockbar Corporation,

incomparably *the Best* in build-your-own hi-fi

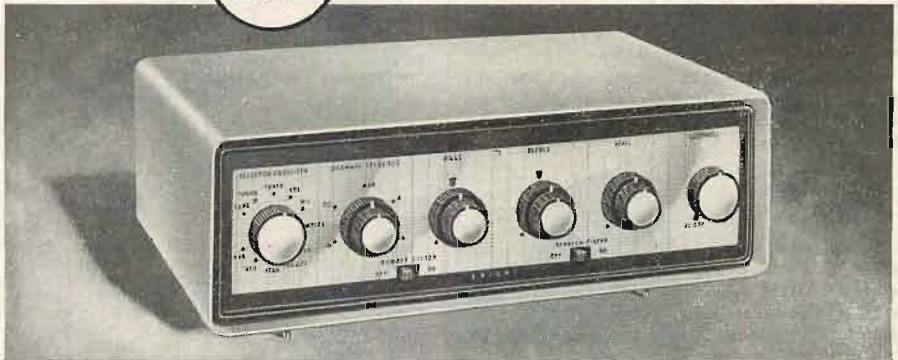
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AN ALLIED RADIO PRODUCT



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- Advanced, Easiest-to-Build Design
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EASY TERMS AVAILABLE



knight-kit Stereo Deluxe Preamp Kit

Model Y-776 **\$62.50** \$6.25 down

There's nothing finer in Stereo—it's in a class by itself—a control center that will do *anything* and *everything* you want.

Superior Features: Amazing input flexibility—5 Stereo inputs (including tape heads), additional 4 inputs for monaural; all can be permanently connected and controlled from single switch. 6 record equalizations for monaural; RIAA for Stereo. Volume, bass and treble controls on concentric shafts with special clutch for both individual channel adjustment and overall control. Single switch selects straight Stereo, Stereo Re-

verse, either channel separately, or either channel into total monaural output. Continuously variable loudness control; cathode follower output and special recorder outputs; hum-free—DC on all tube filaments. Distortion, 0.15%; response, 7-120,000 cps. Exclusive printed-circuit switches and printed-circuit boards. Step-by-step construction manual with wall-size picture diagrams for simplified assembly. Beautiful custom-styled case, 4 1/4 x 15 x 8". 17 1/2 lbs.

Model Y-776. Net, F.O.B. Chicago, only.....**\$62.50**

knight-kit 60-Watt Stereo Basic Amplifier Kit

Model Y-777 **\$84.50** \$8.45 down

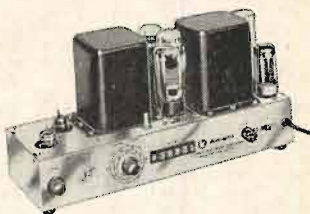


Absolutely the finest amplifier you can build—equal to highest-priced factory-built units. Ideal for use with preamp above, either as two 30-watt stereo amplifiers or 60-watt monaural amplifier. Response flat from 10 cps to 42,000 cps. Amazing 0.08% distortion at full 60 watts. Printed circuitry for easy assembly. Black and chrome styling; 9 x 14 x 8 1/4". 36 lbs.

Model Y-777. Net, F.O.B. Chicago, only **\$84.50**
Y-779. Gray metal cover for above.....**\$ 6.50**

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Model Y-793 **\$44.50** \$4.45 down



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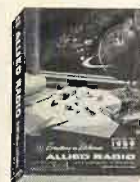
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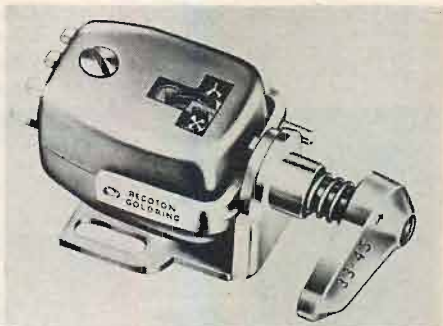
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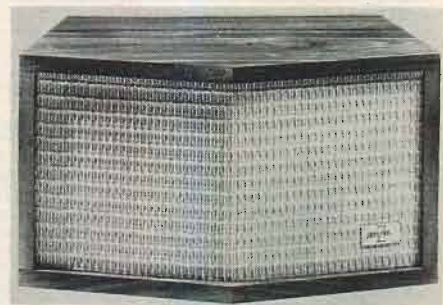
Mamaroneck, N. Y., American sales representatives for Collaro, Ltd. L-9

● **Recoton Turnover Stereo Cartridge.** The new Series RG745 magnetic cartridge is of the turnover type, usable on all turntables and changers and with all speeds and types of existing phonograph records. Two models are available. Model RG745-1SD is equipped with a compatible stereo ele-



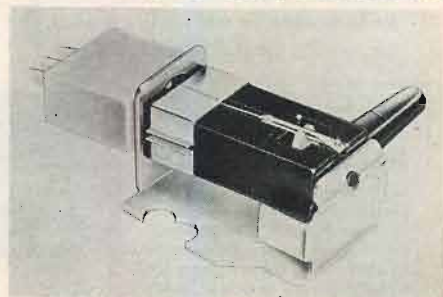
ment containing a 0.7-mil diamond stylus, backed with a monophonic element containing a 1-mil diamond; in essence, a standby monophonic cartridge for micro-groove records. Model RG745-3SD is similar except that the monophonic unit is equipped with a 3-mil sapphire for 78-rpm's. Further information concerning these cartridges may be obtained from Recoton Corporation, 52-35 Barnett Ave., Long Island City 4, N. Y. L-10

● **JansZen Electrostatic Tweeter.** The Model 65 is a new lower-cost tweeter based on the design of the original JansZen Model 130. Heart of the 65 is two push-pull electrostatic radiating elements identical in construction and performance to that of the four radiators in its larger counterpart. Use of JansZen patented con-



struction—a method of employing totally-sheathed and insulated conductors to eliminate possibility of electrical arcing—permits high per-unit-area output, with very low distortion. Designed to match the efficiency of most high-quality director-radiator woofers, the 65 has a frequency range from 1000 to beyond 30,000 cps. Literature is available from Neshaminy Electronic Corp., Neshaminy, Pa. L-11

● **Electro-Voice Magnetic Cartridge.** Moving forward on the wave of popular acceptance accorded the Model 20 series of ceramic stereo cartridges, Electro-Voice has expanded its line to include the recently-announced Model PZT magnetic stereo cartridge. Characterized by exceptionally low hum and high output, the PZT delivers 13 mv into a matched input



circuit. All models of the PZT are equipped with a replaceable stylus assembly, available from dealers, which can be snapped in or out without the use of special tools. The cartridge is offered in four models with diamond and sapphire styli. Electro-Voice, Inc., Buchanan, Mich. L-12

Tandberg stereo

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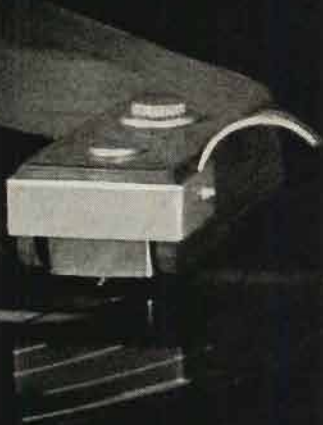
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Circle 87A

NEW LITERATURE

• **James B. Lansing Sound, Inc.**, 3249 Casitas Ave., Los Angeles 39, Calif., is now distributing an illustrated folder on the new JBL-Ranger "Paragon" Model 44000 stereo speaker system. Developed by the Lansing organization in collaboration with Col. R. H. Ranger, president of Rangertone, Inc., the Paragon stereo reproducer is made unfinished for studio, laboratory or built-in use, as well as in finished wood for installation where the huge cabinet must fit in with decorated surroundings. Shipped in three easily-assembled sections the D-44000 has a shipping weight of 850 lbs. **L-16**

• **Fisher Radio Corporation**, 21-21 44th Drive, Long Island City 1, N. Y., has just issued two attractive brochures on its new Fall stereo and monophonic console and component lines. The radio-phono catalog contains complete information and illustrations on nine new Fisher ready-assembled home music systems. The component line folder offers complete information on 14 units, including the new Fisher stereophonic FM-AM tuner and the Master-Audio-Control/Duplex Amplifier. Both of these handsomely-prepared catalogs will be mailed by the manufacturer upon written request. **L-17**

• **Amatom Electronic Hardware Co., Inc.**, 88 Drake Ave., New Rochelle, N. Y., has prepared a comprehensive reference manual of standard electronic hardware to facilitate the selection and procurement of hardware items by electronic equipment manufacturers. Prepared for convenient reference, the 75-page booklet contains pictures, diagrams, dimensions and other data pertinent to the buying of hundreds of different types of hardware items. **L-18**

• **Burnell & Co.**, 10 Pelham Parkway, Pelham, N. Y., stresses the importance of toroids, filters and related networks in military and industrial communications, in its new Catalog No. 104. Containing scores of applications with schematics and performance curves, this latest publication by a pioneer company in toroids, variable inductors, crystal and other types of audio filters, includes 16 pages of authoritative information. Of particular interest to professional and laboratory engineers, Catalog No. 104 will be mailed free upon written request. **L-19**

• **CBS Hytron**, Parker St., Newburyport, Mass., has issued a bulletin giving complete specifications, an outline drawing, a frequency response curve, and installation instructions for the Columbia CD (for constant displacement) stereo cartridge Model SC-1. Linearity of the cartridge is said to be excellent due to its constant-displacement design. A precise lever system is designed to assure that, regardless of frequency, the output voltage is essentially constant for a given displacement of the stylus. Requests for copies of the data sheet should be addressed in care of Advertising Service and should specify Bulletin-289. **L-20**

• **Motorola, Inc., Semi-conductor Division**, 5005 E. McDowell Road, Phoenix, Ariz., is making available free a group of brochures outlining transistorized circuits of interest to the hobbyist, engineer, or student of electronics. In announcing the brochures, H. S. Berck, Motorola sales executive, stated that "Interest in transistors and their applications has been high but up-to-date information on practical circuitry has not been too easily obtainable. We hope this material will close that gap." **L-21**

• **Alpha Wire Corp.**, 200 Varick St., New York 14, N. Y., has available a catalog sheet which lists the company's new and complete line of wire for all stereo cartridges. The line consists of seven constructions of flexible lightweight miniature cables, having 2, 3, and 4 conductors, with and without shielding. The sheet will be mailed free upon written request. **L-22**

* *audiofacts*

How big is the move to stereo?

How much has stereo sound captured the imagination and fancy of the American public? Everyone knows that there is a "stereo boom" underway—the advent of the stereo disc seems to have made the public really aware of "three-dimensional" sound. But most authorities publicly state that despite the assured popularity of the stereo disc, the best stereo sound will continue to come from tape recorders.

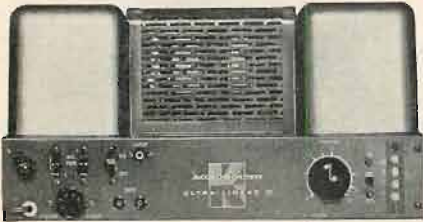
Are tape recorder manufacturers ready for the stereo boom? How much has stereo impressed the people who make recorders? Probably the best source for this information is the authoritative Tape Recorder Directory, now in its tenth year. The latest issue lists over 300 models. Of the basic models, 113 are completely monaural, 39 have stereo playback, and 29 have stereo record and playback. In other words, about a third of them have some stereo feature. The 1955 Tape Recorder Directory listed only six stereo machines out of 110 total—that's how far stereo tape recorders have come in three years.

Another clue to the trend is provided by a leading tape recorder manufacturer who has recently been selling three stereo machines to every 2 monaural units. A year ago the ratio was reversed. And 2 years ago, the company didn't even make a stereo machine.

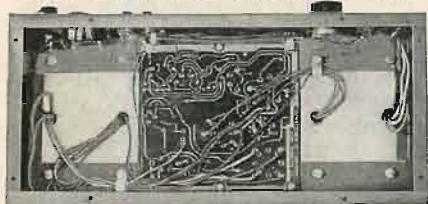
If you're trying to decide between stereo and monaural—or have already decided and now wonder what make or model of tape recorder to buy—you'll want the new 1958-59 Tape Recorder Directory, just off the press. It's absolutely free, published as a service to the tape recording industry by Audio Devices, makers of the famous Audiotape magnetic recording tape. To get your free copy, send a card to Dept. AA, Audio Devices, Inc., 444 Madison Avenue, New York 22, N. Y.

Circle 87B *one of a series

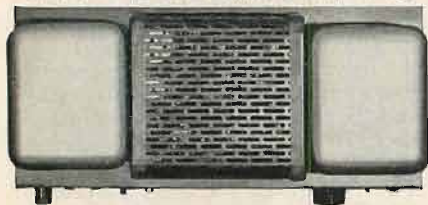
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PRICE In preassembled kit form so that you may save money, learn while doing, and have the proud satisfaction you built the best for only \$79.50 net... or if you feel you would prefer it laboratory assembled it still represents a bargain at \$109.50 net.

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ABOUT MUSIC

HAROLD LAWRENCE*

Musical Values in Stereo

IT IS EASY to predict that stereo will rule the sound waves at the audio shows this fall. The corridors will reverberate with the crash of glass, the roar of thunder, and the whiz of racing cars—all reproduced stereophonically. As their heads turn from one loudspeaker to its stereo partner, visitors to the shows will resemble nothing less than the audience at a tennis match following the progress of the ball across the net.

Among the new dimensions of stereophonic recording, direction is the most readily apparent to the novice. It is little wonder, therefore, that it plays such a prominent role in demonstrating stereo sound. To successfully launch their products, manufacturers of stereo tape and disc recordings and playback equipment employ the shock techniques of directionality mentioned above in the same way that movie exhibitors introduce their wide-screen technique by contrasting it dramatically with one of normal size. The announcer's voice on a stereo demonstration tape or disc is usually heard emanating first from one loudspeaker, then from the other. To underline this effect, one record company had the voice bouncing back and forth like a ping-pong ball on each word!

Musical illustrations, too, are selected for maximum directional effect in stereo demonstrations. In popular music, which can be tailor-made for stereo, "isolation" is utilized for vocalists and instrumental sections. This applies especially to small groups, but larger bands can also be recorded with powerful directional impact merely by concentrating, for example, the rhythm section on one channel, and the brass on the other. This aural division, however, can be overdone. In its extreme form, it could result in a "hole in the middle" large enough to accommodate a steam locomotive.

Direction in symphonic music is a somewhat more subtle matter. Here, it is not, or should not become, the sole outstanding difference between monophonic and stereophonic reproduction. Not that you are unaware of it. On the contrary, the ringing brass chords in the opening of Tchaikovsky's Fourth Symphony come distinctly from the right of the orchestra, and the rataplan of drums in Bizet's *Patrie* Overture from the left. (These positions may vary, of course, with each orchestra's normal seating arrangement.) Equally essential to successful stereo symphonics, however, are the dimensions of depth, spaciousness, and "spread" of sound.

Since the advent of stereo tapes and discs, spatial relationships, both in depth and spread, have become all-important factors. It is not unusual these days to

listen to a stereo recording and suddenly discover that the flute you heard a few moments ago smack in the center of the orchestra has wandered over to the left. This effect is even more apparent in a concerto, where the unfortunate solo instrument sometimes seems attached to a balloon and is floating across our aural field of vision between the two loudspeakers. This curious lack of stability is brought about by 1) engineering procedures at the recording session, and 2) faulty processing. The flute can probably blame the engineer at the mixing panel for its disembodied state, since balance and level adjustments which might pass in a single-channel multimicrophone recording will sometimes show up all too plainly as phase distortion in stereo. The soloist's predicament in the second case could have been caused either by "mixing," or, as in the stereo tape form, by a malfunctioning duplicator.

Because the soloist in a stereo recording so often resembles an electron hovering between two positively charged atoms, some recording engineers have taken the easy way out by confining him to one of the outer channels. Stability is thereby achieved, and the instrument isn't stretched out like a rubber band between the loudspeakers. In terms of concert-hall realism, however, this is not a satisfactory solution to the problem, since no one expects the soloist to perform his part from somewhere among the fourth-desk violins on the left, or the fourth-desk cellos on the right. The musical effect is lopsided. There is no arguing the point that true balance and perspective should dictate instrumental placement at a recording session.

In a certain sense, recording solo instruments or chamber groups in stereo is perhaps even more challenging than capturing the sound of an orchestra. One of the principal differences between monophonic and stereophonic reproduction is the fact that the latter introduces the element of "separation" into orchestral recording. Countless details that were obscured in single-channel recording, subtle contrasts between string textures that often could be only guessed at monophonically, can now emerge with astonishing clarity. But it is precisely this factor of separation that can have adverse effects upon the stereo recording of a piano, violin, string quartet, or voice. One of the major pitfalls of this type of recording is the tendency to blow up the sound into larger-than-life proportions, or to otherwise distort the aural picture. Solo instruments in stereo often suffer from split personalities due to inept microphone placement and differing characteristics of the microphones themselves. Stereo may also pull apart the natural homogeneity of

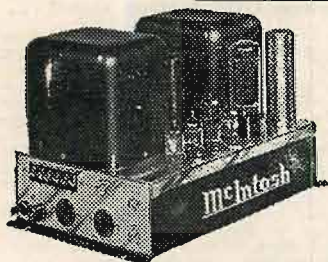
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Circle 92B

The basic principles underlying these and other decisions of the courts for more than a century of litigation, were summarized recently by the federal court of appeals, "The law is fairly clear. Absent a contrary understanding the mere existence of an employer-employee relationship does not entitle the employer to ownership of an invention of the employee. This is true even though the employee uses the time and facilities of the employer, although the latter, in that event, may have 'shop rights' therein, that is, the right to a free, non-exclusive personal license to use the invention in his business.

"On the other hand, if the employee is hired to invent or is assigned the duty of devoting his efforts to a particular problem, the resulting invention belongs to the employer."⁶ **Æ**

⁶ Marshall v. Colgate-Palmolive-Peet Co., 175 Fed. 2d 215, June 2, 1949.

TWO-WAY AMPLIFIER

(from page 20)

signal which determines the main quality and power of both stereophonic channels. Distortion is kept low because of the push-pull action. The parallel transformer handles the difference signal, and here saturation is unimportant, because the difference signal may be attenuated at low frequencies without appreciable loss in stereophonic localization. A loss of separation will occur at the extreme low frequency which is actually advantageous in that it diminishes the problems of rumble and mechanical feed back. Furthermore, the *L* and *R* channels are now identical and the symmetry of the system is preserved.

A practical circuit for the amplifier is shown in Fig. 5. A ceramic pickup may be used, with suitable connection to produce the (*L*) and (*-R*) signals. The two inverse feedback loops are provided from the output stage to the cathodes of the input stage, with the usual benefit of the inverse feedback, plus an added improvement in channel separation. The power handling capacity of this amplifier is 10 watts average or 20 watts peak at 0.8 per cent total harmonic distortion for both channels and about half that amount for each of the two channels used singly.

The authors appreciate the many valuable contributions made by Mr. William S. Bachman in applying this circuit to the Columbia line of stereophonic phonographs.

The two-way amplifier will be available in the near future as a kit from the Heath Company. **Æ**

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The MINSTREL, embodying this startling new advance in the science of sound, not only matches the impedance of the speaker to the amplifier (4 ohms), but also matches the impedance of the enclosure to the room.

The result is a clear, smooth, undistorted sound from 50 cycles to 15,000 cycles, with radiation characteristics that make for superb Stereo reproduction.

SPECIFICATIONS

Cabinet: all hardwoods, in Walnut, Mahogany, Blonde, or Ebony finishes; Size: 9" x 9" x 16" wide; Power: 10 Watts continuous RMS; Response: 50 to 15,000 cycles; Efficiency: 7% measured, with 3 octaves of white noise; Impedance: 4 Ohms.

MODEL NO. MS-555
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Mahogany — MS-555M,
Walnut — MS-555W,
Blonde — MS-555B,
Ebony — MS-555E

TELEMATIC INDUSTRIES, INC.
251 Lee Avenue, Brooklyn 6, N. Y.

Circle 93A

RECORDS

(from page 79)

performances though, as usual with these expert operators, it isn't easy to say just what is the matter other than the whole thing is cold and extraordinarily efficient. That is the style for many of these Capitol standard semi-classic releases and I'll admit that many a buyer is likely to enjoy them. I like more of a musical soul to mine—even for these brilliant orchestral showpieces.

Good Capitol-style stereo effect, not too close, plenty live, plenty big; but the sound isn't quite tops in clarity in the louder parts.

Beethoven: Piano Concerto #5 ("Emperor"). Philharmonia, Ludwig; Emil Gilels, pf. Angel S 35476 (SD)

My ears are pretty much numb to this piece, after too many versions. I can only say that Gilels does his usual powerful, musically Romantic job, with never a harsh or banging note, his piano sounding huge, but somehow off in the middle of the stereo orchestra.

The general effect of this recording is somewhat lubby and lacking in stereo presence, which has started me on a complex train of thought. It could be Beethoven himself, who writes a pretty thick-set and heavy-sounding score—still, though this sound is unmistakably stereo in its right-left spread, it isn't exactly sensational, except for the nicely placed stage-distance piano. I'd describe it as cavernous, too deep, too far down into a sort of huge cave, lacking in close-up immediacy such as we so often get in our present two-track or three-track standard stereos.

Now, I say (thinking out loud), maybe *this* is an M-S recording? The slightly reduced side-to-side sense, the rather unsensational over-all spread, seems to contrast with the exaggerated clarity and closeness of the outer edges in many other stereo recordings. (Even ordinary two-channel stereo is apt to over-emphasize the ends, for dramatic effect; three-channel stereo miking often goes out even further, bringing the far end-positions violently close to you as you listen, balanced by the close middle that comes from the center channel.)

The double M-S mike is placed at a center position in front of the orchestra, one mike pointing bi-directionally at the two ends of the music, the other aiming uni-directionally straight ahead. (These are usual settings, though others are possible.) If I am right, the M-S system, from this one place, can give a fairly smooth, though unsensational, over-all picture of the sound from one side to the other—if the pick-up point is fairly distant. (The ends should be not too much farther away than the middle for good balance.)

But any speculation on actual M-S sound must hinge on a fine trick here, namely, that the two M-S mikes are fed through a "matrixing" circuit, combining the sidewise and straight-ahead signals into sum and difference signals. It is these which go to the two stereo channels—not the direct signal from either mike.

Each final stereo track, then, is a combina-



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**That alone is not
the reason why
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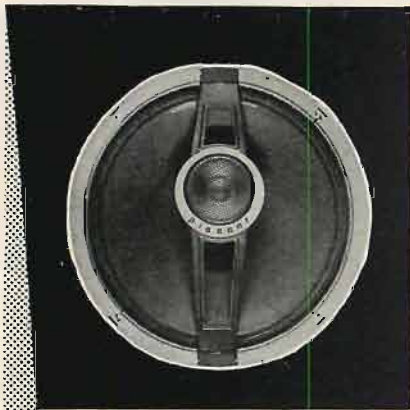
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you should use**



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tion of the output of both mikes. It is this peculiar arrangement that places every sound for you where it belongs in space, via the two-speaker relationships set up, sum-signal on one side of you, the difference-signal on the other. It all adds up (or subtracts) to a stereo spread. Tricky—very tricky.

Anyhow . . . in this record you do have a cavernous stereo sound, whatever the technique may have been, and it is not entirely Beethoven's fault. P.S. I've listened again and the music itself has now begun to sink in—I like it, both the orchestra and pianist Gilels. A very nice "Emperor" musically, cavernous or no, M-S or not.

VANGUARD

Erich Kunz Sings German University Songs, Vol. 2. With Male Chorus, Orch., Vienna State Opera, Paulik.

Vanguard VSD 2009 (SD)

I offer congratulations to Vanguard's directors on the imaginative way that they have used the stereo medium here. The scene is evidently the same as in the "Scheherzade," above (same orchestra) and this one makes an even better sound demonstration, though it is more of a specialty and there is just maybe a slight trace of edginess to the male voices' sound in the louder parts—a very minor distortion.

These are delightfully Schmaltzy German tunes, practically dripping in beer, but sung with wonderful precision and gusto, even so. The sound-spread is gorgeous. In back is the mighty Vienna Philharmonic (in its opera guise), playing as gently as a lamb, beautifully spread out side to side; Herr Kunz, a good humored basso, sings fairly close, over at one side (but not too close to be out of the orchestra and in the speaker), the male chorus answers him sometimes on the other side—fine antiphonal effect—sometimes all around. The separation is extremely sharp and definite, but there is not the slightest breaking up of the sense of one complete tonal scene; everything, everybody, is within that space. A tour de force of stereo microphoning and a pleasure in the listening.

N.B. Plenty high level here—almost as loud as the loudest Londons.

Beethoven: Symphony #6 ("Pastoral"). Philharmonic Promenade Orch. of London, Boulton. Vanguard VSD 2004 (SD)

Modestly played Beethoven, modest stereo, here. I'd heard others in this series of Beethoven symphonies in the mono version and had enjoyed them, as straightforward, unassuming, conscientious, un-fussy playings, where too many performances are full of self-conscious show-off stuff. In the stereo versions these recordings seem somehow even more unassuming, even a bit unspectacular. Just the same, they'll probably please people who are tired of too much stereo drama. You can afford just to listen to Beethoven here.

Only one aspect of the Beethoven Vanguard series has me a bit in doubt: the records are cut at an unusually low level: you must turn your dual volume control up considerably higher than for many other stereo discs. A

tridge on both types of record and you'll see.

If you make your AB comparison between stereo and mono versions on the same equipment, using the same cartridge, then the cartridge itself is neutralized. The difference in bass is in the record. Logical.

Generally speaking, then, I am reasonably convinced that some present stereo discs are indeed deliberately weakened in the bass range, to favor other more crucial factors.

And so it's interesting to find that, on the contrary, some stereo discs are very definitely *not* compromised as to bass, or so says my ear. You must of course keep an alert ear for "false" bass effects that may be musically convincing enough. (A tuba, which sounds very bassy, actually plays few really low tones. It just sounds low.

cautious, careful way of cutting stereo, that insures low distortion and allows for maximum length of play (which is undoubtedly required here by Beethoven). The recording is nicely clean, with no rasping, no shrillness, in the louder parts, the sounds of strings, triangles, trumpets never edgy or harsh.

On the other hand, the twin problems of hum and rumble are never very far away in a good deal of our playing equipment, during these early months of stereo disc. On good equipment, the best, Vanguard's low-level Beethoven will do beautifully. Just jack up the volume. But I suspect that there will be a bit too much hum and rumble in the background for comfort on many machines when the volume is opened up for these Beethovens. I've had some hum-and-rumble trouble myself with them—mostly in the softer passages. The loud places drown it out.

The difference in level between this Beethoven Sixth (also the others in this series) and, say, London's Ravel and Debussy for orchestra (below) is really quite startling. The hum-rumble difference, of course, will be in proportion, if and when.

Maybe later on, technical improvements will allow these to be re-cut at a better level, with the same playing time and no more distortion.

Stereophonic Demonstration Disc—Rimsky-Korsakov's Scheherzade. Vienna State Opera Orch., Rossi.

Vanguard SRV 103 (SD)

Every so often Vanguard comes up with some particularly good demonstration material and slaps it onto a special Demonstration Disc. At a reduced price, this one makes a fine stereo trial record. (It isn't a sampler—just the one complete work on it.)

Demonstration material is, of course, of a type that is by nature excellent for recording. Whether it is also top-rate music or not is beside the point. The precise difference between this disc and the Beethoven above is simply that here we have top hi-fi stereo stuff, whereas in Beethoven we have top music. There's room for both in the stereo catalogue.

Accordingly, Vanguard has here been able to go to town. The levels are noticeably higher than in the Beethoven—Rimsky isn't as long. The stereo effect is more dramatic, with a bigger sense of space, a larger liveness, a more pronounced right-left separation. And to top the effect, the violin and cello solos (representing the Young Prince and the Young Princess) are set 'way out in front, about five feet from your nose, with the rest of the music well behind them, some of it quite distant. Definitely dramatic, if slightly forced in the musical sense. (The violin's scrapings get a bit tiresome at this close range, where on the normal concert hall stage the sound blends into the larger orchestra.) Nevertheless, the two solos do give an added depth and presence to the whole, just as close-to objects set off the background in a stereo photograph. They aren't too close, though—they remain clearly away from and behind the speakers, as part of the musical scene. That's good. **AE**

AUDIO ETC.

(from page 14)

Much excellent stereo drum sound is good mainly because of its clean overtones and transients and because of the effective "wall-bounce" in a large hall, rather than because of true low bass.) Nevertheless, to the best of my awareness, low bass is being cut straight into some stereo discs. It can be done.

I cite as tentative examples (I can't prove anything by ear alone.) Mercury's Gershwin, already referred to and reviewed in this issue, as well as any number of the new London ffss stereos. These discs seem to have as good bass as any mono equivalent heretofore released. And, come to think of it, I don't notice any particular difference in RCA's bass, as between stereo and mono, though RCA's bottom isn't sensational, in the hi-fi sense. (Not necessarily lacking, just not emphasized. RCA may, or

your dual volume control up considerably higher than for many other stereo discs. A

the speakers, as part of the musical scene. That's good. **AE**

may not, attenuate the low end but in any case the stereos are not noticeably different from the monos.) So it goes . . . other companies also seem to be getting down a good proportion of bass. It all depends. Still, weak bass is something to watch for in all stereo disc. If it's there, you can bet the reasons were compelling.

Subjective Distortion

Distortion is the biggest question mark for the listener in stereo disc. The complex stylus motion in the 45/45 system has made it a big physical problem all over again, and it is involved at every point with the factors already mentioned. Juggle them all like crazy—then hope to come up with a clean stereo cut. Not easy!

But in our listening end of the business, actual distortion is overshadowed by the tricks that the ear can play with distortion in stereo reproduction.

I've always known that our perception of faulty sound depends drastically on the musical (or other) illusion, on the rightness of the miking and particularly on the faults and virtues of the playback situation. A poor playback room exaggerates every bit of distortion present in the system and, indeed, can make a clean sound seem dirty. A good listening situation covers up a multitude of distortion—your ear simply ignores it, overriding it in favor of what it wants to hear—the excellent listening fare.

This willful sort of illusion, I now realize, is of greatly increased importance in stereo. Increased for the time being, at least, until we are more sure of our stereo recording techniques and, especially of our stereo listening situations.

Until we learn how to listen, until really effective stereo listening arrangements are common in our homes, a lot of us will be hearing violent distortion in exaggerated and unpleasant form—and we'll even invent it when it isn't there, if things are bad enough. They often are. All along the line, inexperience in stereo listening can lead to grossly false judgments on distortion and its whereabouts.

Take as one small example, my own experience with an early stereo cartridge, the Fairchild XP-4. I still have it right now and it is playing sweet music for me without a trace of unpleasantness. But last spring, after I had used it only a short while, I almost called up the company to report that either the thing was distorting like crazy or the stylus was shot, or both. Yet something told me to hold off; I knew that things weren't settled down yet, however positive the agony may have seemed to my then ears. I waited.

True, it is possible that this early, semi-prototype XP-4 was not as perfect as it might be. I suspect it had already had a good playing life, before I got it. It is surely no better now than it was then. And yet now, it's doing fine. Then, I was "blaming" it for dreadful sounds.

The difference can be accounted for, I think, in externals. Throughout my early experiments with this cartridge I had trouble (a) with associated equipment, (b) with early test stereo discs, not quite up to present standards and (c) most important, with bad listening arrangements—worse than I knew. On top of all this was the supreme factor—I was unfamiliar with disc stereo, as were we all; my ear was not yet trained to discriminate and separate out factors. I was aurally distressed, but was at a loss to explain the distress in detail. I wanted to blame it on the cartridge—but didn't.

I've learned a lot since then. My ear is

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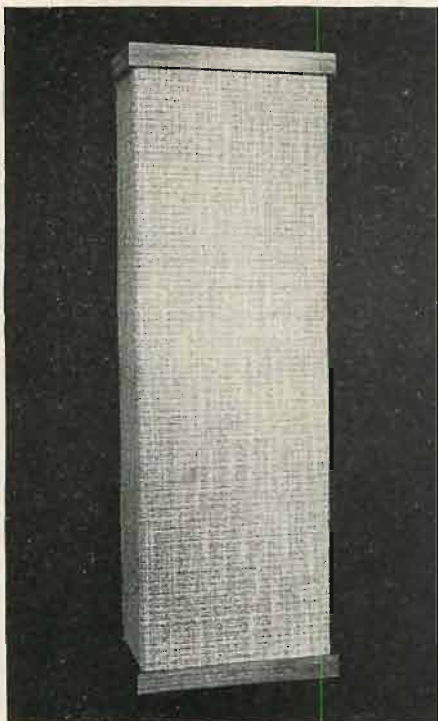
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better educated (I'm still slaving away), my judgment is on a steady keel, more or less. And now I know when I have a good listening set-up.

Only a day or so ago I spent some three hours or so decisively moving furniture in my New York apartment and at last, I have a really good stereo set-up there. I know it's good, it sounds so good. The old one, as of last spring, proves to have been startlingly bad—but I couldn't tell until I had found the better one. In the old speaker positions, my stereo sound screeched and shrilled, sounded hollow metallic, nasty. Now, from the same pair of speakers, the same cartridge, the sound purrs beatifically, almost perfect, if not quite. The very speakers that I found rasping and harsh last spring (though I had the sense to withhold judgment there, too, knowing the nature of my room's acoustics) now also are purring, as I never expected them to purr! Even the amplifier is the very one that occasioned some of my gloomy writing about hum troubles, last month. It is unchanged, it still hums, and no excuse. But in the improved listening set-up I don't half notice it. A very subjective business, this listening to stereo.

And so, you can understand, the fact that my present stereo discs are themselves somewhat better than the first test samples is merely a small aspect of my present Great Improvement in distortion. Other factors, once heavily a torture, now begin to fade into the background by mere force of the aural illusion, of "right" listening in an improved set-up, instead of wrong.

Before I stop this months-long spiel on stereo—what else can we write about, these days?—I hope to get to some of the strange effects I've run into experimenting with various listening arrangements (and believe me, I've experimented, if in a slightly unscientific way. You should hear my country stereo out on the lawn, the speakers fifty feet apart. It's lousy.) But now, back to actual, real distortion.

Distortion Latitude

It was in the early 1950s that we were fussing most about what I then amateurishly called "fuzziness" in LP record reproduction. Even earlier, I had gone through the great discovery period that indicated to my naive mind how important was stylus compliance—an element that had just then been given attention in practical terms by the cartridge makers themselves in their new LP models. It wasn't easy, then, to tell how much of the "fuzziness" in loud LP passages was in the record groove itself and how much was in the reproduction, notably in the stylus. But "fuzziness" there was. New cartridges with better styli, improved cutting heads, now hot-stylus cutting techniques, variable-pitch grooving for improved inner-groove areas, all contributed in a major way to the slow lessening of actual distortion in loud LP reproduction.

It's amazing to go back and play some of the earliest LP records now, in comparison with their later successors. The improvement in a decade was really profound, on all fronts, including plenty not here mentioned. A good LP today, as we know, can be just about as clean in the louder parts as in its softer passages. I'll coin a term—Distortion Latitude. In present LP and LP playing equipment the Distortion Latitude is wonderfully increased over that of ten years ago.

Now comes stereo LP and Distortion Latitude is back down again. It won't be for long. The climb upwards should proceed much faster than the pioneer LP

improvement, since this time the experience is partly a repeat, involving new problems but the same old standards. Tough, but the factors are better known, the ultimate goal much more clearly in mind what with standard LP as a shining example in front of every engineer's ears and nose.

The sound of stereo distortion? Let's omit phasing and related distortions, where images ripple and float and bob about in the air. I'm speaking of plain groove distortion and playback trouble, which can be analyzed technically but interests me more in its audible effects. They're the same old sounds! As in early LP playing, many a present stereo reproduction sounds just fine in the soft parts, but tends to grow harsh and edgy in the loud passages. Very, very familiar from a decade ago. Part of this may be in the pickup, part in the groove itself (via the cutting head), but the sum of the two is that good old "fuzziness" the louder the fuzzier—of long years ago.

The plain fact is that, as with single track LP back then, whenever things now get tough for the stereo stylus, when the going is rough, the tracing complex, the amplitude extreme, then sounds of distress may be heard. Not bad, usually. Not enough in most cases to spoil the musical ear's pleasure in a good stereo set-up. But the tell-tale signs of old-fashioned distortion are there, if you are in a mood to notice them—the loud cymbal clashes that sound like broken glass, the brilliant strings that seem somehow to screech, slightly hysterically, the growling wiry bass voice and the edgy, metallic tenor, the sibilant syllables that over-hiss, like snakes, the vocal "eeee" sounds that peel off like so many metal shavings from a lathe. That's audible distortion!

There are the too-strident massed choruses, overloading the system into assorted IM, the full-orchestra blasts that crumble at the edges like crumbling masonry, the piercing trumpet—too piercing—and the booming bass drum—too booming.

These are sounds of transient and IM distortion under stress, I suppose; but no matter what the type, the quick relation between extreme stress and incipient distortion is apparent. There's not enough Distortion Latitude in the stereo system—yet.

Everywhere this year we've been hearing of the strenuous work being put in by the recording engineers, to cope with the whopping distortion problems posed by the new three-dimensional stylus motion. Sweat has been poured, I know, and frankly I am amazed at how rapid progress has been, to date, considering the dismal groans I kept hearing last winter as to the "impossible" mess of stereo cutting and playing problems. If only we didn't have the perfected ten-year-old lateral LP's on every side, for a goading comparison! If there were no LP's around, the present stereo discs would be hailed as miracles of sound engineering. (But without the LP they would not have been possible.) They are miracles, to be sure, even if still imperfect here and there.

Things will move along. By this time next year the stereo disc should have caught up with the standard LP in most respects. It'll be as uniform, as low in over-all distortion, as hi in the fi, as reliable. Home playing equipment, being far more diverse and costing less than professional equipment, will take longer to catch up with present hi-fi equipment, on every level. Only logical. But even so, next year should see plenty of home stereo stuff that should

rate at least 90 per cent of the equivalent performance in present hi-fi. (Well, forget the percentage. But expect to find stereo equipment still a bit untrustworthy, even a year from now. That's my guess.)

The ultimate disposal of the problems of stereo disc distortion will in all likelihood be lost to view in what seems to me an inevitable coming merger—which, I hereby suggest, will blend both present types of record, stereo and standard, into one new and universal record—the LP with Variable Stereo. So I envision it now. In a few years there won't be any important distinction left between the present two types of record. Why not merge them?

2. THE GREAT MERGER—VARIABLE STEREO

First, visualize the upcoming home situation. In a very short time, by all indications, virtually all home phono equipment will be able to trace a stereo groove safely. Included will be all coming full stereo equipment, in grades both high and low, mass-produced and component-hi-fi; also the millions of one-channel systems, monophonic in sound but equipped with stereo cartridge—the universal cartridge of the immediate future. (Just possibly a few "compatible mono" cartridges will be made, designed with vertical compliance but no vertical response; they'll hardly be worth the trouble.) We must also include a large number of older phonographs whose old-type lateral cartridges are going to be playing stereo discs, one way or another, like it or not. Many of them will do no harm, thanks to adequate compliance. (The GE cartridge in all its millions seems to be OK for the stereo groove, also many low-priced ceramics.) Some will still be busy ruining stereo discs right and left—but right now they're probably ruining ordinary records at about the same rate. What do you expect?

Consider, next, that in this near-future time the professional cutting of lateral and of stereo discs will be on a par, the results in practice equally sure and reliable, just as at present the LP micro-groove can be cut as readily as the old 78—though it wasn't so at first. Moreover, there'll eventually be no distinction in cutting equipment. Note the already visible signs of this amalgamation—the Mirrosonic organ records, cut laterally on a Westrex stereo cutter operating non-stereo, the report that London's 45/45 stereo discs are cut on a lateral-vertical cutter, via matrixing. Interchangeability. Any cutter will cut any type of record and all types in-between, to taste.

Now consider, at last, that lovely aspect of 45/45 stereo whereby the *sum* signal, the element of identity in the two stereo channels, is cut laterally, the *difference* signal, the unlikenesses, the actual stereo component itself, is cut in the vertical plane. (See our articles on Columbia's ASRA in the May issue.)

In this happy situation, the lateral aspect of the stereo groove is simply the mono element, indistinguishable from any normal one-channel recording (as picked up by several mikes). This lateral sound appears in the center between your two balanced stereo speakers—IF they are rightly phased—and it doesn't matter a bit whether the source is a standard or a stereo original.

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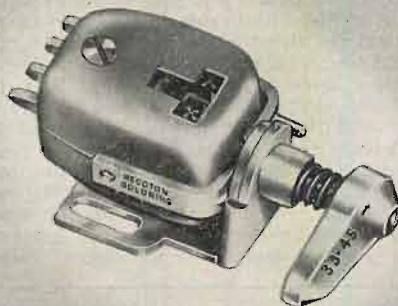
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ASRA's shaping to the point where a "compatible" record could be cut and still labelled stereo—then obviously, it can be reduced still further to approach closely the pure lateral-only record. Yet still with some stereo effect.

In fact, why not control the vertical element all the way down to zero, itself? That merely represents a special form of the general type, stereo. This is what will happen.

In other words, we have a potentially complete control, *continuously variable, to zero*, over the entire stereo element in disc recording, and what's more we can use it.

And so I say that, when approximate compatibility is here (as above), there's no reason why our records shouldn't range in commercial form over this whole area, from maximum stereo separation to minimum—straight lateral. There'll be only one type of record, completely interchangeable on all machines, with a stereo component continuously variable to fit the situation in each recording.

Ah, but there's a price difference, isn't there? Shucks! So there is—but it won't last. A couple of record companies already price stereos the same as standards (Counterpoint Records?) and in the end everybody will do it. It's only a nominal dollar difference now, and record prices have jumped that much for purely political reasons.

With all the records at the same price and the novelty of stereo a bit worn off, the great merger can take place quietly and easily. Maybe the word "stereo" will just get smaller on the labels, as it gets more and more taken for granted. Maybe somebody (like Columbia, for instance) will up and make a grand pronouncement, that hereafter all its records will be cut with stereo variably tailored to the precise degree suitable for each and every recording as determined by musical experts.

Even a pure mono record (lateral) could be legitimately labelled stereo under this arrangement if there simply was no need for a difference signal; but in practice there would always be a certain residue of vertical, perhaps only a trace, perhaps present in some spots and not in others. "Cut with Variable Stereo" might be the term—and it offers fascinating possibilities.

The "degree" of stereo (vertical) would not, of course, be stated to the public. You buy the record, made with variable stereo, you play it on your stereo equipment, and the company guarantees that the musical effect is the best possible. No words wasted on technicalities such as the ratio of vertical to lateral modulation. That's for engineers. It's their business to make the finest record for every need. You just listen—and be convinced. So it would go.

And there will, indeed, be a great difference from one musical (or other) subject to another. For chamber music, more middle (lateral), less separation. (We could use this right now in some quartet stereos I've heard.) For solo voice and guitar in a small room—almost no vertical compo-

nent at all; just enough to give a bit of liveness spread. For jazz, big symphonies, railroad trains—maximum stereo, maximum vertical cut. This is a fruitful field, you may be sure, and it is already very much under exploration, under the present rigid stereo heading. The whole thing will fall neatly into its new place when the great merger finally arrives.

And don't forget that we already have, under the blanket stereo heading, a huge variety of effects. Big-liveness symphony stereo is already utterly different from dry, close-up right-left chamber jazz stereo. Some alleged stereos are scarcely to be told from their mono equivalents, as things are even now. Silly to pay an extra dollar for them.

So stereo is designed to become one more variable working tool in the recording business, along with others such as reverberation, multiple recording, variable groove spacing. A major technique, to be sure, but in future we'll use it or not as we find necessary, as much or as little as needed, and we won't bother to explain (unless in those fancy little hi-fi technical notes that get printed on the backs of record cases).

It will be up to Publicity to make a big thing of the changeover. They'll manage. They'll plug their new Records with Variable Stereo like Colgates with Gardol. The Stereo Advantage will be translated into catchy trade names, appealing as all get out.

I can almost imagine it. Instead of Westminster with Natural Balance and Capitol with Full Dimensional Sound, we'll have Columbia with Stereoreality; Decca, maybe, will go for the new Sound With Superstereo. M-G-M will counter with the Ultimate Ingredient—StereoMagic, the most advanced tool of modern recording science, magical stereo tailored to fit each requirement of the world's greatest music. Wow—it grows clearer by the minute!

As for Westminster, it will blossom right out with the same old thing, Natural Balance. ("The *natural balance* of the original music, faithfully re-created. . . . Listen and Compare".) Won't have to change a single word; the description fits variable stereo like a glove. I'll admit that Capitol might have to alter the Full Dimensional Sound label a bit. Might make it Multi-Dimensional Sound—that'd do it.

"Capitol proudly announces the greatest advance in finer music in a decade (well, in years, then . . .)—Multi-Dimensional Sound. Every subtle nuance in the living music is transferred with breathless realism to these magnificent new records, thanks to the magic of modern Variable Stereo. From the solo refrain of a lone folk singer to the glorious strains of the Bach B Minor Mass in all its majesty, Capitol brings you now—Multi-Dimensional Sound! Try it! Buy it! Swing it! . . ."

Ugh, guess I've been dreaming; I'd better get to bed. P.S. No offense intended to Capitol or anybody else in this little futurama. Just for fun. Æ

STEAMPAX

(from page 29)

And from this work came the elegant refinement in electrostatic generators used so successfully in the 15,900-pound Portable Steampax Recorder. Large potentials are conducted within the recorder from the electrostatic input modulator to the electrostatic head by

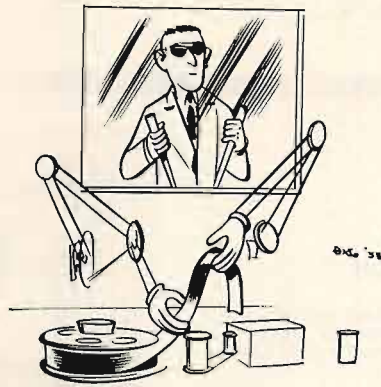
means of syntheon plastic belting swung over a multiplicity of amplifier pulleys which augment the signal to be impressed on the electrostatic tape. The system, being non-magnetic, is not sensitive to magnetic fields. However, the system is somewhat sensitive to high

handle the promotion of any worthwhile product. . . .

on technicalities such as the ratio of vertical to lateral modulation. That's for engineers. . . .

ism to these magnificent new records, thanks to the magic of modern Variable Stereo. From the solo refrain of a lone

relative humidity conditions. Therefore a compact dehumidifier system is furnished with each Steampax Recorder at no extra charge, together with an hermetically sealed enclosure for the equipment. This simple system overcomes this problem without difficulty. An ingenious adaptation of the remote



MAKES IT POSSIBLE TO LOAD, THREAD, AND RUN THE RECORDER WITHIN ITS LOW HUMIDITY CHAMBER

control "hand" apparatus, usually associated with nuclear reactor equipment, plus appropriate periscopes, makes it possible to load, thread, and run the recorder within its low humidity chamber after a few hours of practice. This short learning time is based on observations of the problems encountered by an average group of Ph.D.'s, the lowest having an IQ of 168. Others possessing lesser skills will absorb the factory indoctrination course in much less time, probably, although to date only this highly skilled group have been allowed to operate the equipment.

The total electrostatic system is here described:

The conventional dynamic microphone is replaced by a condenser type. This obviously is the compatible source of electrostatic modulation. The flexible coaxial cable, $\frac{1}{4}$ " in outer diameter, is an ingenious device made of syntheon. This outer or protective shell is driven toward the microphone by a power take-off at the recorder. At the microphones, the outershell is reduced in diameter and turned within itself to become the center conductor which is driven back through the outer, or protective, cover to the input stage of the recorder. As it passes through the inner chamber of the microphone the vibration of the diaphragm impresses a static charge variation on the center or returning syntheon conductor. At the input stage the process is reversed and the center conductor again turns inside-out to become the shield; that is after the charge carrying the information from the microphone has been fed to the input modulator. The speed of this conductor is 185,000 miles per hour. Thus, it is virtually as fast as ordinary electric circuitry. This

development in itself was no small trick, and will be discussed in a forthcoming article in the magazine, *What's With Plastics?*, for November, 1958.

Input Modulator

A word regarding the input modulator. As the patents have not been issued on this portion of the system as yet, it cannot be discussed in much detail.

The syntheon belt amplifier alluded to in a preceding paragraph, operates on the well known theory of the static generator,⁷ and is too elementary to discuss farther. That it was never used by Edison, Poulsen, Berliner, or Camras is almost beyond comprehension. But thus are born inventions to clutter the patent office and keep the search clerks busy.

A syntheon tape one-fourth inch wide by 0.0001 inch in thickness, traveling at a speed of $1\frac{7}{8}$ inches per minute, is capable of retaining twelve parallel, individual tracks of information thereon. Thus it is possible to store $9\frac{2}{3}$ weeks of information on a five-inch reel. Considering the cost of syntheon this is not too much. Furthermore, the slow tape speed reduces the number of times it is necessary to employ the factory-trained Ph.D. to change the reels.

Stereophony from twelve tracks leaves nothing to the imagination, except perhaps the smells associated with a jazz concert. (We are currently working on an overlay track to record smells. The input and output transducer problem appears to be the crux of the system.)

The sound output is fed by means of a 3.14159" in outer diameter syntheon inside-outside reversing pipe, to the electrostatic (single or multiple) speaker of advanced design. The present speaker unit is in the form of a sheet spread loosely over an ordinary "turkish" bath towel (used as an insulator) behind which is a slab of pure India rosin 1.2345 inch thick suspended at the center of percussion. This suspension system was found necessary in order that the 16-foot bass drum of the Purdue Marching Band could be reproduced with the necessary live quality. Earlier experiments in supporting the device at other than the center of percussion rendered all sound of percussive type inaudible. An accessory mount is available using this depressing method of mounting for those who do not like drums.

The general style of this magnificent Steampax Portable leaves something to be desired. However, regardless of its seeming bulk, rendered less so by the reactive steam jet in the base, it promised to capture the major share of the recorder market within the next twelve months. Deliveries are starting on production units just as soon as possible.

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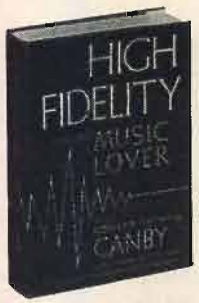
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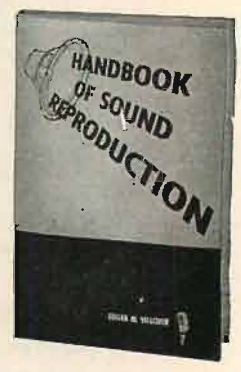
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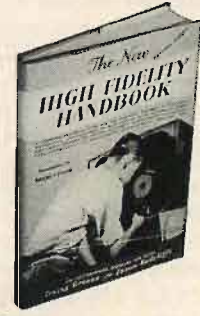
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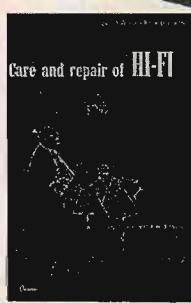
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AUDIO AMPLIFIER

(from page 27)

Anyone who desires to duplicate this amplifier is urged not to substitute parts. Each part is chosen with respect to size, tolerance, and proved reliability. Before being soldered into the circuit, each resistor and capacitor should be checked with an ohmmeter to ascertain that the part is "good." Inspection of parts before assembly provides reliability by eliminating the butchery that results from parts replacement. Low-noise resistors can be used if desired but are not necessary since the circuits are designed to function at an extremely low noise level with ordinary resistors. The Mullard 520 output circuit specifies a 470-ohm, 5-watt resistor in the cathode circuit of each EL-34. Unfortunately, such a resistor is not commercially available. This value is obtained by paralleling a 500-ohm, 5-watt resistor with a 7500-ohm, 1/2-watt resistor.

Wiring

Figures 4 and 5 show the method for wiring the amplifier. These diagrams should be studied carefully before any actual wiring is done. Note that in Fig. 4 the parts are shown as though the Vector turrets were exploded. The letters A to L refer to the letters on the turret. Assembly on the turret sockets is made before installation in the chassis. Hold the resistors and capacitors on the turret to ascertain that the parts fit properly. On V_1 and V_2 turrets the resistors are mounted first and against the turret body. C_2 and C_3 can then be mounted. On V_3 and V_4 the 500-ohm resistors are mounted away from the other parts because of the heat generated. R_{11} and R_{12} can be mounted across the end of the turret. Figure 7 is a close-up photograph showing the turret assemblies. The resistor and capacitor leads do not have to be wrapped around the terminals since good solder (60% tin, 40% lead) has adequate strength to support these parts. When the soldering is being done, use alligator clips to conduct heat away from the parts. The use of a high wattage soldering gun is forbidden. For most audio purposes a 35-watt soldering tool is adequate and is faster than the gun. The Wall 18 soldering tool with a production-type tip is highly recommended.

After the turret assemblies are complete, mount them on the top of the chassis. This top-of-the-chassis technique, which provides ample working room, offers the greatest accessibility and ease of wiring. The "U" nuts make the turrets very easy to mount. Wire the

turret sockets completely as shown in Fig. 4 with the recommended hookup wire. Use twisted pairs of color-coded wires and solder them at the turret terminals only. The color code facilitates tracing and locating the end of a particular wire. Do not twist a pair of wires by grabbing one end and twisting the other. Cut two pieces of wire to the proper length and clamp one end of each together in a vise. Then twist each wire clockwise with the fingers. Simultaneously move the wrists about each other counterclockwise. The twisted pair will be neat, tight, and symmetrical. The wires should be long enough so that, after groups of wires have been laced, there will be no strain on the soldered joint.

When the wiring of the turrets is finished, inspect all soldered joints before removing the turrets from the top of the chassis and remounting them inside. Now install the transformers, capacitors, and other hardware. Use 10-32 machine screws to fasten the transformers to the chassis. Mount the output transformer as shown in Fig. 5. Minimum hum will be induced by the power transformer if it is properly oriented. Mount capacitors C_7 and C_8 by means of the phenolic wafers in order to insulate the cans from the chassis.

Three barrier terminal strips are needed. The Cinch-Jones type 240 is recommended but seems to be unavailable from usual sources. The type 140 "W-140" solder terminals is the best substitute. One strip is needed under the power transformer, and the number of terminals will be determined by the number and length of the power transformer leads. If the proper leads are long enough to reach the socket of V_5 as shown in Fig. 5, then only a five-terminal strip is needed for the 6.3-volt winding, the primary leads, and a convenient point for getting the center tap of the 5-volt winding out of the way. Before being soldered, these center-tap leads should be well scraped and tinned. If the transformer leads are too short to reach the rectifier tube socket then enough terminals to accommodate these leads will be needed. A four-terminal strip is required for the output leads of the T_2 . Cut the leads and solder them to the terminals. The output impedance is easily changed by moving one wire to the proper terminal. If the primary leads of T_2 are long enough, the plate and screen leads can be soldered directly to the turrets. In this case only one chassis terminal for the high-voltage center tap is needed. If the primary

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graph showing the turret assemblies. The resistor and capacitor leads do not

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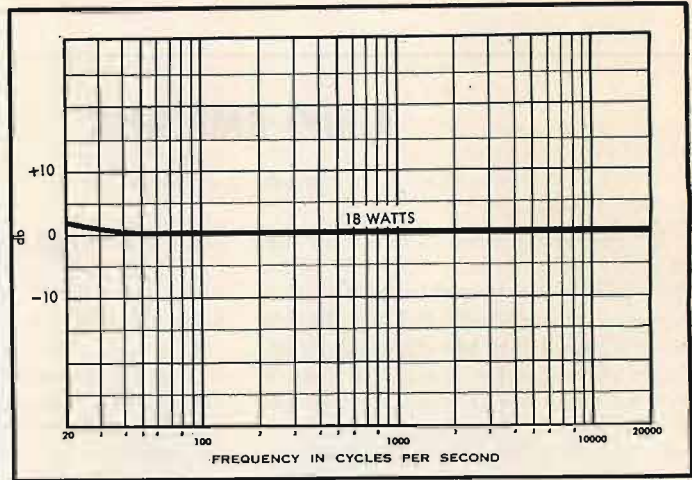


Fig. 9. Frequency response of amplifier at half-power output.

leads have been cut too short, then a five-terminal strip is necessary. Figures 6 and 7 show how terminal strips are used in the prototype amplifier.

Capacitors C_3 and C_4 are mounted vertically by means of small angles made of thin sheet metal. Standoff terminals are employed as junction points for the "ground" lead. Figure 7 shows this arrangement. The wiring can be completed at this point. Observe the wiring of the chassis input connector. The highest numbered terminal (3) is the signal-carrying lead.

The next lowest number (2) is the signal-return lead. The lowest number (1) is the shield which is not connected to the chassis of the preamplifier. Readers will find the assembly of the input connector (Cannon XL-3-12) to the Belden 8412 cable a distinct pleasure in comparison to the standard phono connector. One suggestion is necessary. After $\frac{3}{4}$ " of the outer covering has been removed, unravel the shield and twist it into a single lead. When twisting, however, orient the lead so that the three leads will fit into the soldering pots without one lead having to be twisted around another. This symmetry will become obvious.

Note the wiring of the rectifier tube socket. Should the recommended rectifier tube (GZ-34) fail, any 5-volt rectifier tube with an octal base can be used temporarily. Lace the wires of the output and power transformers so the wires with a high potential will not be too

close to the chassis. The twisted pairs of wires carrying the signals should be short but not so short that the wires will be strained.

Each soldered joint should be examined carefully. Check the filament and plate circuits for "shorts" to the chassis. If the amplifier passes a mechanical and electrical inspection, the wires can be laced as shown in Figs. 5, 6, and 7, thus completing the amplifier. Figure 8 is a photograph of the external arrangement.

Performance

The performance of the finished amplifier is very satisfactory. Figure 9 shows the frequency response at 18 watts output (average peak output). Maximum output is 36 watts allowing a margin of 3 db. The gains without and with feedback are 65.4 and 44 db respectively. Thus 21.4 db of feedback is applied. The measured internal generator impedance is 4.4 ohms which with a 16-ohm load provides a damping factor as 3.64. Background noise is nearly unmeasurable: 63.7 db below the average peak output of 18 watts. (Neither harmonic and intermodulation distortion nor the square-wave response has been measured for lack of test equipment.) The input sensitivity is 2.2 volts rms for 18 watts output.

This amplifier is installed in an audio system consisting of an ESL Concert cartridge, a Heath WA-P2 preamplifier, a JBL D130 low-frequency speaker,

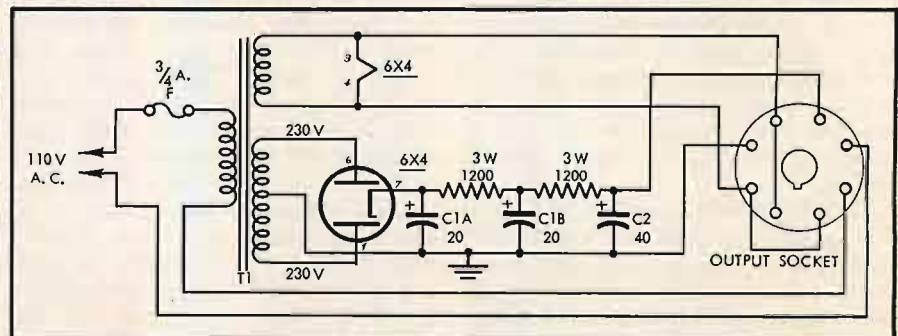


Fig. 10. Schematic of power supply for Heath WA-P2 preamplifier.

...the recommended rectifier tube (GZ-34) fail, any 5-volt rectifier tube with an octal base can be used temporarily.

...the input sensitivity is 2.2 volts rms for 18 watts output.

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Industry Notes...

In an effort to expedite correspondence between its engineering department and the public, **University Loudspeakers, Inc.**, has formed a Technical Service Department under the direction of Robert Miller. Acting as liaison between the engineering department and customers who write in for technical information, the new division will handle all letters relating to the use and installation of loudspeakers. Also it will advise sales and other departments on product application.

RCA-Victor is making available to other original equipment manufacturers five stereo components, including diamond and sapphire cartridges, tone arms, and two types of tape heads. According to Raymond W. Saxon, vice-president and general manager of the RCA-Victor Radio and Victrola division, the units are being offered in response to interest expressed by several manufacturers. The list will be expanded soon to include tape heads for stereo tape cartridge players.

Sales of magnetic tape for the first half of this year were up 31 per cent over the corresponding period last year at **Audio Devices, Inc.**, according to William C. Speed, president. Total sales of all products totalled \$3,055,000. Earnings from tape and disc sales for the first six months of 1958 were \$176,967 after taxes, equal to 22.4 cents per share on 788,457 shares of common stock outstanding.

In an effort to curb the tendency of some exhibitors to play their equipment too loud, a "Decibel Detail," equipped with a sound-level meter, will patrol the 1958 **New York High Fidelity Music Show** to maintain friendly but firm control. The man with the meter will be on duty daily during the run of the show, with instructions to keep sound and music within reasonable bounds. This year the New York show will occupy six full exhibit floors in the New York Trade Show Building, featuring more than \$5,000,000 worth of equipment shown by 135 manufacturers.

Audio Fidelity, Inc., manufacturers of Audio Fidelity and Stereodisc recordings, has filed separate suits in federal court against Cosnat Distributing Corporation and King Karol, Inc., alleging trade mark infringement. Audio Fidelity asks the court to enjoin the defendants from using the term "Stereo Fidelity" or any other mark confusingly similar to the plaintiff's. Accounting and damages for alleged infringement are also asked.

The Federal Communications Commission has granted **WBAI-FM**, New York, permission to operate an FM-multiplex stereophonic system experimentally until October 31. The grant is subject to extension. Hours of multiplex transmission now are between 4 and 5 p.m. Later they may be expanded to include evening hours as well. The station will use the Crosby compatible stereophonic system which consists of a standard multiplexed signal, mixed by a "sum-and-difference" amplifier before being put on the air. Standard FM sets pick up a balanced monophonic signal, while those equipped with a special adapter to matrix the two channels will be able to reproduce the sound.



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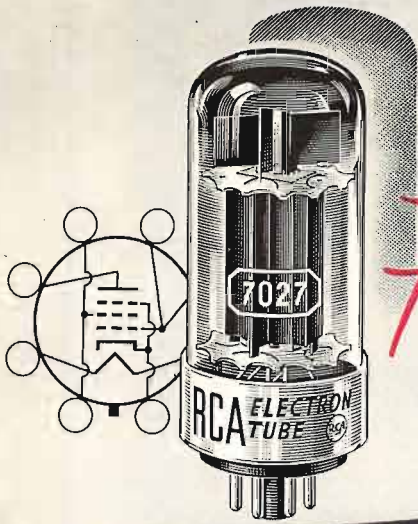
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Specify the new RCA-7027 for your amplifier designs

Stronger and stronger grow the chords, the fervent expression of the artist—yet the sound is sweet, most pleasing to the listener's ear. The Concert Grand makes stringent demands upon high-fidelity amplifiers for *high power and low distortion*. Can your designs meet these demands? They can if you "design around" the RCA-7027!

RCA-7027 is a glass-octal type beam power tube. Two 7027's in Class AB₁, push-pull service with 450 volts on the plate can handle up to 50 watts of audio power with only 1.5 percent distortion. Structural features contributing to the exceptionally high plate dissipation (25 watts) of this compact tube are: button-stem construction, heavy stem leads having high heat conductivity, heavy plate material, radiating fins on control grid, and double base-pin connections for both control grid and screen grid.

Achieve for your hi-fi designs the advantages of high dissipation, exceptionally low distortion, and high power amplification offered by the new RCA-7027. Ask your RCA Field Representative for further details. For technical data, write RCA Commercial Engineering, Section J-91-Q, Harrison, N. J.

RCA Field Offices

EAST: 744 Broad Street
Newark 2, N. J.
HUmboldt 5-3900

MIDWEST: Suite 1154,
Merchandise Mart Plaza
Chicago 54, Illinois
WHitehall 4-2900

WEST: 6355 E. Washington Blvd.
Los Angeles 22, Calif.
RAymond 3-8361



RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

step UP your speaker system with **ELECTRO-VOICE BUILDING-BLOCK KITS**

first, choose an acoustically-perfect Electro-Voice factory-assembled enclosure or a do-it-yourself enclosure kit

| | | | |
|---|---|--|---|
|  <p>E-V Coronet net \$35.50</p> |  <p>E-V Aristocrat net \$72 E-V Aristocrat KD4 Kit net \$39</p> |  <p>E-V Regency net \$130 E-V Regency KD4 Kit net \$73</p> |  <p>E-V Empire net \$99 E-V Empire KD5 Kit net \$51</p> |
|---|---|--|---|

second, choose an Electro-Voice full-range coaxial two-way speaker

| | | | | |
|--|---|--|--|---|
|  <p>SP88 net \$29.50</p> |  <p>SP128 net \$35</p> |  <p>SP132 net \$36</p> |  <p>SP158 net \$43</p> |  <p>SP15 net \$89</p> |
|--|---|--|--|---|

STEP ONE add-on an Electro-Voice high-frequency Building-Block Kit for a separate two-way system

| | | | |
|--|---|---|---|
|  <p>BB1 BUILDING-BLOCK KIT includes T35B Super-Sonax VHF Driver, X36 Crossover, AT37 Level Control, Wiring Harness. net \$37</p> |  <p>BB2 BUILDING-BLOCK KIT includes T35 Super-Sonax VHF Driver, X36 Crossover, AT37 Level Control, Wiring Harness. net \$50</p> | <p>BB1 BUILDING-BLOCK KIT net \$37</p> | <p>BB2 BUILDING-BLOCK KIT net \$50</p> |
|--|---|---|---|

or start with
an Electro-Voice integrated
three-way speaker
(equivalent to coaxial
plus high-frequency driver)

| | | | |
|---|--|--|--|
|  <p>12TRXB net \$66</p> |  <p>12TRX net \$125</p> |  <p>15TRXB net \$79</p> |  <p>15TRX net \$149</p> |
|---|--|--|--|

STEP TWO add-on an Electro-Voice mid-range Building-Block Kit for a separate three-way system, the ultimate in high fidelity reproduction

| | | | | |
|---|--|--|---|--|
|  <p>STEREO'S STANDARD</p> |  <p>BB3 BUILDING-BLOCK KIT includes T10A Driver, BHD Horn, X825 Crossover, AT37 Level Control, Wiring Harness. net \$85</p> |  <p>BB4 BUILDING-BLOCK KIT includes T25A Driver, BHD Horn, X8 Crossover, AT37 Level Control, Wiring Harness. net \$114</p> |  <p>BB3 BUILDING-BLOCK KIT includes T10A Driver, BHD Horn, X825 Crossover, AT37 Level Control, Wiring Harness. net \$86</p> |  <p>BB4 BUILDING-BLOCK KIT includes T25A Driver, BHD Horn, X8 Crossover, AT37 Level Control, Wiring Harness. net \$114</p> |
|---|--|--|---|--|

Picture your speaker system with E-V Building-Block Kits.* You can start with a single, full-range Electro-Voice Loudspeaker and expand it step-by-step to a multi-way system as your budget permits.

Electro-Voice enclosures are ready for future addition of high-frequency and mid-range speakers. Your E-V enclosure can never be obsolete because there's *always* room to expand your system.

*E-V Building-Block Kits may also be used with some non-E-V quality systems. Ask your high fidelity specialist or write Electro-Voice for details.

Two ways to a Separate Three-Way System

1. Start with an Electro-Voice full-range coaxial speaker. Then, when your budget permits, add-on the correct E-V high-frequency Building-Block Kit to give you a separate two-way system; later add-on the E-V mid-range Building Block Kit for a superlative separate three-way system.

2. Or, begin your system with an E-V integrated 3-way speaker; merely add-on the E-V mid-range Building-Block Kit to achieve a separate three-way system.

Of course, you can purchase a complete three-way system composed of low-frequency driver, high-frequency driver BB Kit, and mid-range driver BB Kit.

Electro-Voice

FOREMOST IN ELECTRO-ACOUSTICS—Microphones, Phono-Cartridges, High Fidelity Loudspeakers and Enclosures, Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material. ELECTRO-VOICE, INC., Buchanan, Michigan

Electro-Voice has the industry's most complete and versatile line of speakers, enclosures, and kits. Ask your high fidelity dealer or write E-V for complete information on how to step-up your system.