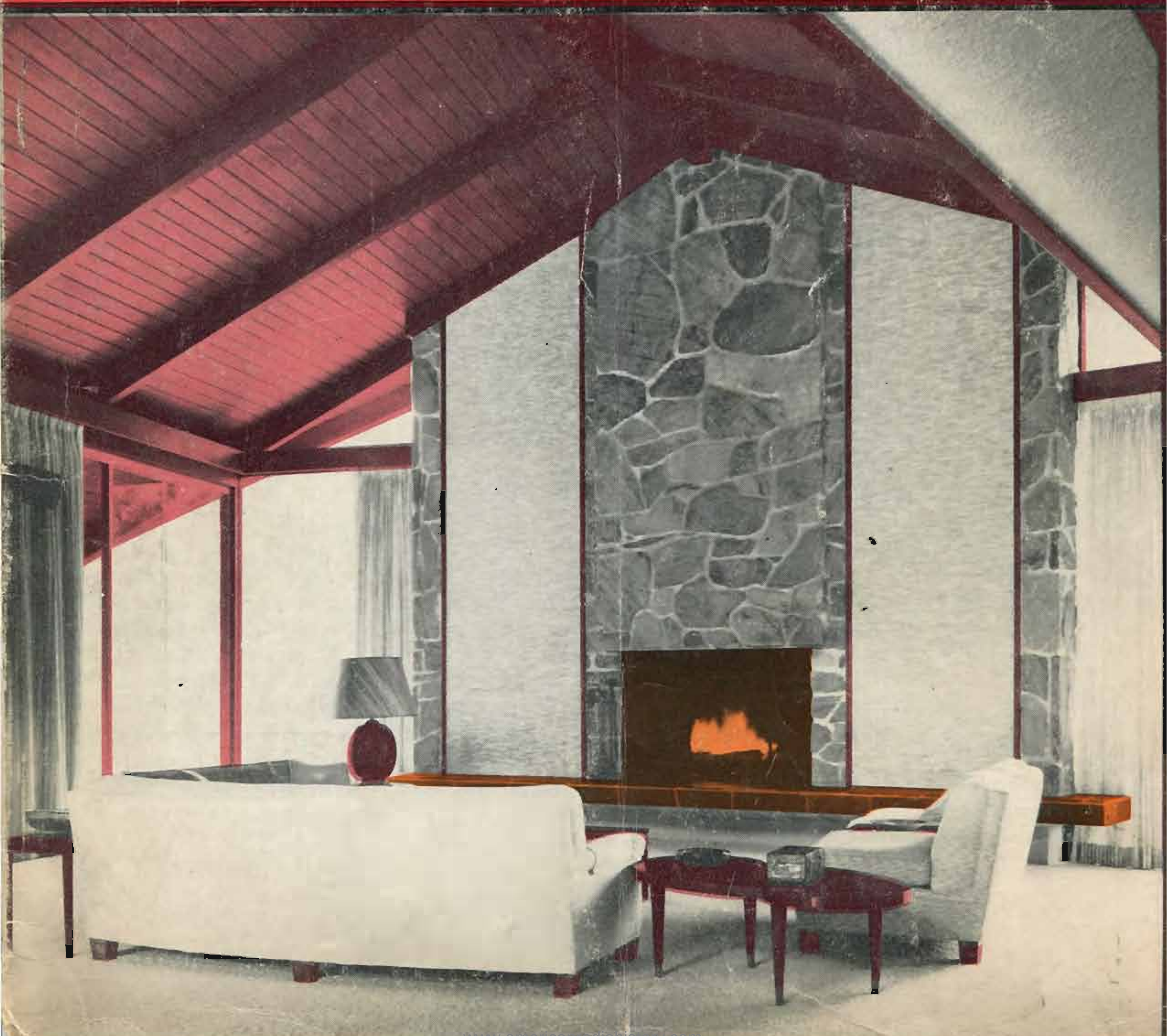
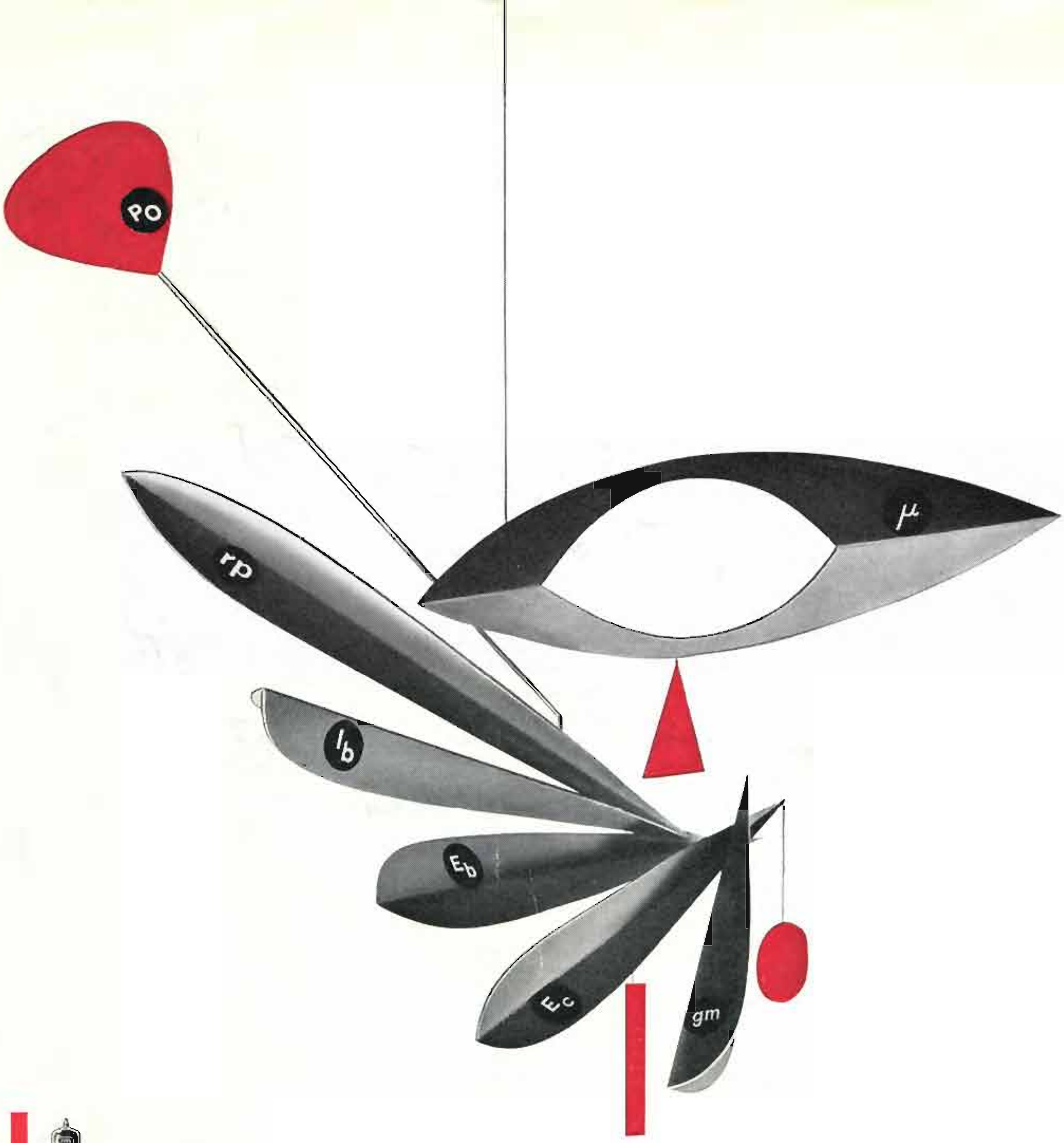
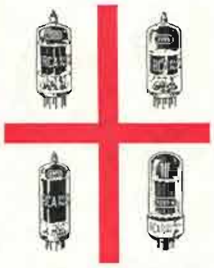
AUDIO

MARCH, 1960
50¢

...the original magazine about high fidelity!







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CONTENTS

COVER PHOTO — Stereo loudspeaker system in the home of Dr. John K. Hilliard, Vice President and Director of Advanced Engineering, Altec Lansing Corporation. For a full description of this installation, turn to page 26.

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AUDIO clinic

JOSEPH GIOVANELLI*

Trouble with a Stereo Amplifier

Q. *A friend recently purchased a dual 20-watt stereo amplifier-preamplifier unit, stereo cartridge, turntable and stereo arm, and an AR-2 speaker. He plans to buy the second speaker when he is again in the money.*

1. In the absence of a second speaker, how should the second amplifier be loaded? I added an 8-ohm, 20-watt resistor but detected an irregularity in operation which disappeared as soon as I connected a borrowed second speaker. With the resistor load the pilot light indicated a slow, pulsed dimming, and the driver tube in that channel gave forth with a momentary burst of light, accompanie by a loud, transient sound in the speaker.

2. Would it be feasible to connect a small, inexpensive speaker to the second channel, with the balance turned way over to the AR-2?

3. My friend wishes to use the dual 20 watts to give 40 watts playing monophonic records through his single speaker. How can a stereo amplifier be strapped to a single speaker?

4. The amplifier overloads at low frequencies when the gain control is in the loudness position and the bass is turned fully on, with the loudness control about a quarter on. Is this a normal result of such bass emphasis, and are not these two controls (loudness, bass) normally so designed that the amplifier is stable even during extreme operating conditions? D. R. H., Rochester, N. Y.

A. 1. Had you not beat me to it by running into trouble with the 8-ohm resistor, I would have told you to load the unused channel resistively. Apparently that channel does not like a resistive load. Since I do not have the circuit for your friend's amplifier, I cannot be sure of some of the points you have raised. You mentioned a pilot light, which I assume is in the channel which you resistively loaded. It would be important to know in which section of the circuit the light is located, and from whence the source of the lighting voltage comes. You mentioned that, as the light brightens and dims, the speaker gives out with a transient sound. Are you saying that the speaker connected to the normally loaded channel makes this sound? It appears that whatever is happening in this resistively-loaded channel is of such strength that it can modulate the B supply common to both amplifier units. It sounds very much as though the resistively loaded channel becomes unstable with a purely resistive load. Apparently a slight amount of inductance is needed. You could try to load the amplifier channel with this same resistor with a 2.5 mh choke in series or perhaps in parallel with it. This is not guaranteed, but it does sound reasonable. Of course, there is one obvious thing to do, and that is simply to pull out the driver tube for the unused stage. This should not be done unless you are sure that the succeeding stages are not direct-coupled to the one which has been disabled. The reason that I did not say that you should take all of your tubes in the unused stage out of the circuit is that the power supply load will change, and it is possible that the B plus voltage will become excessive under this operating condition. If the balance control is one which can vary the output of either channel from full output straight through to zero output, all you need do is to turn the balance control to the zero-output position for the unused channel.

2. Your second alternative is a good one. So long as you have the inexpensive speaker connected to the second channel anyhow, why balance the system in favor of the AR-2? Suggest to your friend that he use the second speaker for monophonic listening, even though it may not be a perfect match for the AR-2. Even a really inexpensive speaker can probably handle sufficient wattage to permit an acceptable listening level.

3. If your friend wishes to use his stereo amplifier as a 40-watt monophonic unit, all he needs to do is to feed the signal into one channel, set the selector switch to the position which will feed that channel into both power amplifiers, and then strap the outputs of the two amplifier sections together. If the speaker to be used is an 8-ohm unit, strap the two 8-ohm taps together and connect the speaker between these joined taps and common. For safety's sake, it might be a good idea to join the two commons together. This system, however, may or may not prove satisfactory. Your friend may again run into the same old instability problem which plagued him in section 1. This time, however, the instability may be noticed in both channels. If each channel contained variable damping, this can cause trouble. It is more than likely that the instruction manual provided with the unit will show the best manner

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

for connecting the power amplifiers for monophonic use.

4. The main consideration with any amplifier designed for high fidelity listening is that it sound good. Very few people will use their equipment with the bass turned to maximum boost. The loudness control shoud not be considered as a tone control, but as a compensation for changes in frequency response of the human ear with corresponding changes in volume. As the loudness control is put further and further into the circuit, the over-all volume of sound is decreased. Therefore, even if a listener does wish to use his equipment with maximum bass boost, the loudness control should not cause distortion. The problem begins to appear when the volume and loudness can be operated separately. Under these circumstances it is possible for the operator to turn the volume up as he turns the loudness into the circuit, which will maintain the signal level at the same point and will cause a boomy kind of reproduction not intended by the designer of the equipment. With the bass fully boosted and the loudness and volume controls operated as just described, the middle and high frequencies will be sharply attenuated, and the amplifier will appear to be playing quite softly. Bass never sounds very loud to most of us. The middle and higher frequencies are the ones which tell us how loud a sound is. All of this has been said to point out that you may, under the conditions, be driving your amplifier to the 20-watt limit and beyond, and not even know it because the sound is not loud. The amplifier does not know that the listener hears a fairly soft sound. All it knows is that the output tubes are being driven beyond their ratings, and that the output transformer is being saturated. This contributes to distortion. I think this is the more likely situation, rather than there being a design flaw in the amplifier.

Preamplifier Coupling Circuits

Q. *As a dedicated circuit butcher, I am familiar with the problems entailed in selecting values of coupling capacitors for the power output stage. However, regarding the preamplifier stages, I am at a loss. Could you suggest a practical approach to this problem? What troubles would I run into by using a 0.1-μf coupling capacitor in place of a 0.01-μf capacitor in a preamplifier stage? I know that time constants are involved. In going through standard circuits, I notice that coupling capacitors in low-level stages are small but increase as the circuit progresses toward the output stage. Allan M. Palmer, Brooklyn, N. Y.*

A. The reason for small values of coupling capacitors in low-level stages, as you have guessed, is a matter of their time constants. We are not as concerned with this problem in succeeding stages because of the lower gain of the tube being by the capacitor. As a general rule, the lower the gain of the tube, the more its control grid can be swung without cutting the tube off. High-mu tubes have a relatively small grid-voltage swing. Let us assume that we have a large coupling capacitor and a large grid resistor connected to just such a high-mu tube. Assume also that a sudden, low-fre-

(*Continued on page 71*)

Unequalled Performance in a wide variety of units

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AMPLIFIERS-PREAMPLIFIERS

353A STEREO AMPLIFIER-PREAMPLIFIER

- Advanced engineering features make the 353A today's outstanding single stereo unit.
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- Two or three channel stereo
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- Flexible controls for 13 separate stereo or mono conditions

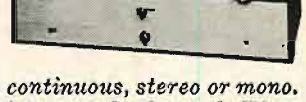
Specifications: Power output: 100 watts stereo program peak power; 50 watts rms continuous stereo or mono • Rumble filter: 12 db per octave below 30 cps • Distortion: Less than 1% THD at 25 watts 1000 cps each channel; Less than 1% THD at 20 watts 30-15,000 cps each channel • Response: 20-20,000 cps at 25 watts, ±1.0 db; 10-30,000 cps at 1 watt, ±0.5 db • Noise level: Radio, tape, multiplex (250 mv signal): 82 db below 20 w output; Magnetic phono (5 mv signal) 60 db below 20 w output; Tape head (2.5 mv) 58 db below 20 w output • Dimensions: 5⅞" H x 15" W x 11¼" D • Weight: 35 lbs. approximately • Price: **$199.50**

350A MONO AMPLIFIER

Unexcelled purity and perfection in performance. Distortion-free over entire audio range. Power tubes have 100 watt capacity. 70 v output for multiple speaker installations. Ideal for public address systems or addition for full stereo.

Specifications: Power output: 40 watts at less than 0.5% THD • Response: ± 1 db 5-100,000 cps • Load impedance: 8, 16 ohms and 70 v • Output impedance: continuously adjustable .14 to 7.5 times nominal load impedance on 8 to 16 ohm taps. Less than 10% of nominal load impedance on 70 v line tap • Noise level: 40 dbm; 86 db below full output • Controls: gain control RL/RG control, power switch • Dimensions: 7" H x 9⅝" W x 13¼" D • Weight: 27 lbs. Price: **$171.00**

345A STEREO POWER AMPLIFIER



This rugged power amplifier packs two 100 watt (peak) channels in one package. 60 watts rms continuous, stereo or mono. Independent level control for each channel. Five-control switching permits use in nine different combinations for stereo or mono. Speaker impedance is set automatically for each channel. Unity damping factor.

Specifications: 200 watts stereo program peak power; 100 watts each channel; 60 watts rms continuous stereo or mono • Response: ±1.0 db 10-100,000 cps • Gain: 66 db • Noise level: —40dbm, 85 db below full output • Distortion: Less than ½% THD 40-15,000 cps at 40 watts • Dimensions: 6½" H x 16½" W x 12½" D • Weight: 38 lbs. • Price: **$270.00**

445A STEREO PREAMPLIFIER

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Specifications: Channels: Two • Input: Total of 12—3 high level pair, 3 low level pair equalized for single or stereo reluctance pickups, tape heads, or flat for microphones • Outputs: Total of 4—1 main output each channel, 1 recorder output each channel, independent of volume setting • Range: 20-22,000 cps • Dimensions: 4⅝" H x 12½" W x 6¾" D • Weight: 6¾ lbs. • Price: **$189.00**

440C MONO PREAMPLIFIER

The ultimate in music reproduction equipment. Unique tape monitor function; separate controls to adjust high and low frequency recording. 25 input crossovers; inputs for phono pickups, cartridges, tape, tuners, TV sound, mike. DC heater supply for tubes.

Specifications: Inputs: 3 high level; 2 low level • Outputs: 2 — one main amp, one recorder • Gain: 60 db at 1 kc • Response: 20-22,000 cps • Noise level: 95 db below 1.5 v output • Controls: 7: switches for choice of inputs; separate volume, power, tape, bass and treble controls; 5 level controls • Power supply: self contained — 117 v, 60 cycles • Dimensions: 4⅝" H x 13¾" W x 5⅜" D • Weight: 11 lbs. Price: **$147.00**

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LETTERS

Corrections

SIR:

Regrettably, I made some errors in the manuscript and drawings for my article "Universal Feedback Amplifier Circuit," which appeared in the January issue, and would appreciate your advising the readers of the following:

In *Fig.* 1, a 15-μμf capacitor should be connected across the 240-k plate resistor, and the two 220-k grid resistors for the 5881's should be connected between the coupling capacitors and the 10-k grid stopper resistors.

The word "reviewed," in the twelfth line of the second column on page 19 should be "renewed," and the "+" sign before 5.28 μμf in the last formula in the second column of page 20 should be an "=" sign.

Please advise those who have been so kind as to write for reprints of this article that I have none, and suggest that they order copies of the magazine from you.

ARNOLD J. KAUDER,
448 N. LaJolla Ave.,
Los Angeles 48, California

(Mr. Dalzell also writes us again to say that he should have listed the P.I.V. for the selenium rectifiers listed under Miscellaneous Data in the table at the top of page 21 of the December issue should be 600 volts instead of the 400 volts indicated. ED.)

Loudspeaker Linearity

SIR:

Mr. Villchur, in an attempt to clarify some apparent misunderstandings about the functioning of acoustic suspensions (in the January issue) has unfortunately created additional misunderstanding about the linearity differences between the isothermal and adiabatic process.

Mr. Villchur states that the non-linearity in the pressure changes is characteristic of the adiabatic process. The implication is that the non-linearity is caused by the exponent in the gas equation $PV^{1.4}=K$. He concludes that the gas equation becomes linear when the exponent becomes equal to 1.0, as in the constant-temperature (isothermal) process.

"Thus, even the tiny amount of distortion associated with air non-linearity is not present . . ."

The gas equation is not a linear function for any value of exponent. It is a power function of the form, $y=ax^n$. When n is negative, as it is in the gas equation, the curves are hyperbolic curves and, therefore, non-linear for all values of n. The point is that if one concedes the existence of non-linearities in the adiabatic process, one must also concede non-linearities in the isothermal process. Distortionless operation cannot be claimed because of isothermal compression inside of the box.

JAMES F. NOVAK, Sr. Design Engineer,
Jensen Manufacturing Co.,
6601 S. Laramie Ave.,
Chicago 38, Ill.

Doppler Effect

SIR:

Your October, 1959, issue contained a letter by G. A. Briggs in which he attempts to lay to rest the Doppler superstition, particularly in view of the technical articles by Mrs. Jane Hall and Virginia Rettinger.

Mr. Briggs is quite graceful in tipping his hat to the ladies and he writes with considerable charm. But he fails to see ahead or to carry his analysis to any depth.

Mrs. Hall's and Mr. Briggs' analyses, from simple computation show that the average velocities of present day cone motions are so low that distortion due to the alteration in sound velocity appears to be insignificant.

First, I should like to point out that in the race for high-compliance suspensions and long cone excursions, we may soon see cone motions of several inches. This will mean significant velocities relative to the velocity of sound in air. Also, what happens under certain transients or waveforms with a steep rise where the velocity over a portion of the cycle may be 100 times the integrated velocity of a full cycle.

The alteration in pitch is not deduced by the change of sound velocity relative to a stationary cone, but the alteration is a compound of the lower velocity when the cone is moving away from the listener, related to the higher velocity when the cone is moving toward the listener during the following half cycle.

Doppler distortion is akin to turntable wow which the industry attempts to hold below 0.2 per cent. I grant that strict standards are necessary here because of the rhythmic nature of turntable wow and its independence of signal frequencies. But if we assume a cone having a peak-to-peak sinusoidal displacement of one inch at 40 cps, then the cone will move axially 80 in. per second. The variation of minimum to maximum sound velocity relative to a fixed listener is 0.6 per cent. For a sine wave of this frequency the maximum instantaneous velocity will be theoretically 122 in. per second for some finite time over the center of the swing. With larger displacements around the corner, or with high instantaneous velocities as in percussive sounds, square waves, and transients, this variation can be much higher.

It is the writer's belief, supported with some experimental evidence, that Doppler effects lasting only a few milliseconds, due to the shifting and rapid interplay of frequencies and amplitudes, destroy the "resolving power" of the loudspeaker. It explains in part why a bank of speakers possesses finer definition of the instruments in orchestral passages than a single speaker delivering the same total acoustic power. Or channelizing the frequency spectrum into 2-way or 3-way speaker systems will likewise sound cleaner. Horn-type woofers are noted for minimum distortion partly because they require minimum cone displacement for a given acoustic output relative to a cone working directly on the atmosphere.

The "resolving power" of a speaker, when properly understood, could become a new measurable characteristic and I feel will be closely related to Doppler distortion.

Under complex frequencies at high levels we can expect an aggravation of short-period intermodulation distortion because of the varying cone velocity, some of this generated acoustically in the atmosphere and some in our hearing mechanism, all contributing to acoustic debris.

In our rapidly expanding art, speaker diaphragm displacements of several inches are a coming possibility. As a matter of fact, the writer has designed and demonstrated a speaker with a peak-to-peak displacement of three inches, with built-in restoring force, for the purposes of studying Doppler distortion.

SAUL J. WHITE, Chief Engineer,
Audax, Inc.,
38-19 108th St.,
Corona 68, New York

New

HEATHKIT AS-2B (birch)
HEATHKIT AS-2M (mahogany)

$79.95 each

HEATHKIT AS-2U $69.95 (unfinished)

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ACOUSTIC SUSPENSION HI-FI SPEAKER SYSTEM KIT (AS-2)

A revolutionary principle in speaker design, the Acoustic Research speaker has been universally accepted as one of the most praiseworthy speaker systems in the world of high fidelity sound reproduction. Heathkit is proud to be the sole kit licensee of this Acoustic Suspension principle from AR, Inc., and now offers for the first time this remarkable speaker system in money-saving, easy-to-build kit form.

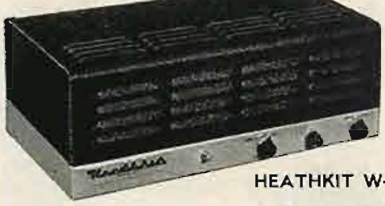
The 10" Acoustic Suspension woofer delivers clean, clear extended-range bass response and outstanding high frequency distribution is provided by the specially designed "cross-fired" two-speaker tweeter assembly.

Another first in the Heathkit line is the availability of preassembled and prefinished cabinets. Cabinets are available in prefinished birch (blond) or mahogany, or in unfinished birch suitable for the finish of your choice. Kit assembly consists merely of mounting the speakers, wiring the simple crossover network and filling the cabinet with the fiberglass included. Recommended amplifier W-7A. Shpg. Wt. 32 lbs.

SPECIFICATIONS—Frequency response (at 10 watts Input)*: ±5 db, 42 to 14,000 cps; 10 db down at 30 and 16,000 cps; **Harmonic distortion:** below 2% down to 50 cps, below 3% down to 40 cps at 10 watts input in corner room location. **Impedance:** 8 ohms. **Suggested damping factor:** high (5:1 or greater). **Efficiency:** about 2%. **Distribution angle:** 90° in horizontal plane. **Dimensions:** 24" W. x 13½" H. x 11¾" D.

*Power input required for average listening level will not exceed 10 watts.

New



HEATHKIT W-7A

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55 WATT HI-FI AMPLIFIER KIT (W-7A)

Utilizing advanced design in components and tubes to achieve unprecedented performance with fewer parts, Heathkit has produced the world's first and only "dollar-a-watt" genuine high fidelity amplifier. Meeting full 55 watt hi-fi rating and 55 watt professional standards, the new improved W-7A provides a comfortable margin of distortion-free power for any high fidelity application.

The sleek, modern styling of this unit allows unobtrusive installation anywhere in the home. The clean, open layout of chassis and precut, cabled wiring harness makes the W-7A extremely easy to assemble. Shpg. Wt. 28 lbs.

SPECIFICATIONS—Power output: Hi-fi rating, 55 watts; Professional rating, 55 watts. **Power response:** ±1 db from 20 cps to 20 kc at 55 watts output. **Total harmonic distortion:** less than 2% from 30 cps to 15 kc at 55 watts output. **Intermodulation distortion:** less than 1% at 62 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 80 db below 55 watts, unweighted. **Damping factor:** Switch on front panel for selecting either maximum (20:1) or unity (1:1). **Output impedances:** 4, 8 and 16 ohms and 70 volt line. **Power requirements:** 117 volts, 50/60 cycles, 90-160 watts. **Dimensions:** 8½" D. x 6⅛" H. x 15" W.

HEATHKIT EA-3

$29.95

A NEW AMPLIFIER AND PREAMP UNIT PRICED WELL WITHIN ANY BUDGET

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

Delivers a full 14 watts of hi-fi rated power and easily meets professional standards as a 12-watt amplifier.

Rich, full range sound reproduction and low noise and distortion are achieved through careful design using the latest audio developments. Miniature tubes are used throughout, including EL-84 output tubes in a push-pull output circuit with a special-design output transformer. The built-in preamplifier has three separate switch-selected inputs for magnetic phono, crystal phono or tape, and AM-FM tuner. RIAA equalization is featured on the magnetic phono input. Shpg. Wt. 15 lbs.

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

HEATHKIT UA-2

$22.95

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

Meeting 14-watt "hi-fi" and 12-watt "professional" standards, the UA-2 lives up to its title "universal" performing with equal brilliance in the most demanding monophonic or stereophonic high fidelity systems. Its high quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Buy two for stereo. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: Hi-fi rating, 14 watts; Professional rating, 12 watts. **Power response:** ±1 db from 20 cps to 20 kc at 17 watts output. **Total harmonic distortion:** less than 2% from 20 cps to 20 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 14 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 73 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms. **Damping factor:** switched for unity or maximum (15:1). **Input voltage for 14 watt output:** .7 volts. **Dimensions:** 10" W. x 6½" D. x 4¾" H.

HEATHKIT SP-2A

$56.95

(two-channel stereo). Shpg. Wt. 15 lbs.

HEATHKIT SP-1A $37.95 (single-channel monophonic). Shpg. Wt. 13 lbs.

HEATHKIT C-SP-1A $21.95 (converts SP-1A to SP-2A). Shpg. Wt. 4 lbs.

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

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

CHESTER SANTON*

The symbol ● indicates the United Stereo Tapes 4-track 7½ ips tape number. When Mr. Santon has listened to the tape only, the tape number is listed first. Otherwise, the corresponding tape number is furnished by United Stereo Tapes.

POP RECORDINGS had a relatively easy time during stereo's formative years. Compare the earliest pop and classical releases from RCA Victor, to take one label almost at random. Issued at the same time, the Abbe Lane (LSP-1554) and Hi Fi Fiedler (LSC-2100) stereo discs provide quite a contrast. Play them with today's pickups and you'll find less distortion in the pop release. The wider dynamic range of classical music created another problem for the first stereo cutting heads. If you recall, it was a long time before the level on the classical disc came up to the present-day figure. Even the succeeding models of stereo cutters were not immediately used at full level because some of the pickups, in the monitoring of test pressings, gave a false picture of permissible recording level. At the present time, classical and pop recordings are pretty evenly matched but, while this column is in progress, I shall be listening to the former for relaxation.

STEREOPHONIC

Johnny Desmond: Once Upon A Time — Columbia CS 8194

This release strikes me as the most successful recreation to date of an outfit that has become a legend—the Glenn Miller Air Force Band. Johnny Desmond first hit the limelight as vocalist with Miller's military aggregation. Now, fifteen years later, more than half of the original members of the orchestra assembled for this recording session to accompany Desmond in the original ballad arrangements he had used with the band in personal appearances and on V-Discs. I found it impossible to listen to this record with any semblance of detachment. During my early days in broadcasting, I had announced, for an entire summer, the first series of network remotes by the Miller band when Mutual carried them from Atlantic City. The band was so new at the time (it had been organized in Boston only a few months before) that its theme song didn't have a title and Glenn spent every spare moment before broadcasts trying to get the best sound with the batch of "saltshaker" Western Electric mikes we had.

Although the Air Force Band recreated on this record emphasized strings in its ballads, the reeds and brasses are still in the style that had its origin in the late thirties. Johnny Desmond, obviously moved by the reunion, sings with great warmth in *Night and Day, Where or When, All the Things You Are, Amor, and Symphony.* The voice is centered in stereo that's spacious enough to recall the band's theatre appearances.

Japan: Its Sounds and People — Capitol ST 10230

This is a very useful item to have on hand when comparing stereo pickups, especially the newer jobs that can do justice to some of the material on this record. There are plenty of early stereo discs around that do not sound significantly better with an up-to-date cartridge but this on-the-spot recording by Japanese engineers should arouse interest among audio fans. Some of the sounds associated with everyday life in Japan have been processed by Capitol with wave-fronts steep enough to present a cruel facade to most stereo pickups available today. In one of the episodes, a night watchman on the lookout for fires strolls past the microphones clapping together polished blocks of very hard, seasoned wood. My next-to-last cartridge, valued for its pleasing musical quality in earlier stereo days, simply does not make the grade on these transients. Similarly, the tug boats and temple drums do not reach full definition in the bottom lows until I switch to my latest stereo pickup.

Other insights into Japanese life include wrestling matches, a tuna fish auction, gongs and fireworks. The songs of geisha girls and the music of native string instruments round out the local color. The record, quite incidentally, also reveals how much Western influence is to be found in Japan by now. The traffic, fire engines, and trains sound very like our own. Perhaps the oddest touch in the album is a brief portion of a service held in Tokyo's Greek Orthodox Cathedral.

Clebanoff: Songs From Great Shows — Mercury SR 60065

Each new Clebanoff stereo release crumbles away some of my former objection to a studio full of mikes. Mercury's Chicago crew has worked out a system of multiple-channel recording that can lull the ear into the belief that it's getting normal stereo. The first clue to the arbitrary nature of the proceedings is the absence of room noise that usually would surround a group of this size. Closer listening reveals that the playback area has a lateral series of dovetailing tonal images that reach from speaker to speaker. Each image represents the signal of a separate group of instruments. Clebanoff's solo violin shares little of the acoustical environment belonging to the violas and cellos. Accustomed to stereo's directionality, the ear accepts most of this concept. Hit songs from Broadway shows of the past two decades are grist for the Clebanoff approach. His mikeside manner is still the most soothing in the business. Neatly balancing the soloist are cellos miked for optimum gruffness and a percussion section comprising tam-tam, xylophone, vibraharp, and the small hand cymbals of India.

Lena Horne: Songs By Burke and Van Heusen — RCA Victor LSP 1895

Lena Horne is still the queen of the carefully chiseled casual phrase and this collection of Johnny Burke-Jimmy Van Heusen tunes tailors easily to her style. As a matter of course, Lennie Hayton's orchestra takes care of instrumental duties in Victor's Studio A. Stereo placement is straightforward—the now almost standard center location for the vocalist. There is a mature disinclination to toss the accompaniment from one part of the orchestra to the other. A trace of sibilance sometimes encountered with condenser mikes accompanies some of the lyrics. Pickup of voice is clean enough to accommodate mild rolloff of highs. This disc is sure to receive repeated plays wherever top styling is admired. Some may miss the rapport with an audience that was an important part of Lena Horne's Waldorf-Astoria session but the essential magic is still here.

Sammy Davis: Porgy and Bess — Decca ●ST 7-8854 Dec. 78854

One of the first Decca recordings released by United Stereo Tapes carries a few surprises for Davis fans as Sammy swaggers through lead tunes from Gershwin's Porgy and Bess. The feminine songs are handled with smooth authority by Carmen McRae. The advantages of tape show up best in the recording of the solo voices. In this respect, realism exceeds that of the disc previously issued. A partial explanation lies in a reasonably smooth frequency response that doesn't imitate some of the peaks found on other four-track tapes. Although three different conductors take turns on the podium, Sammy Davis ties together one of the more likeable and believable Porgy and Bess albums.

George Wright: Have Organ Will Travel — Hi Fi ●R 721

The four identical woofers in my reviewing rig jumped forward to the end of their excursion when I fed them the pedal notes in this recording of the Wurlitzer organ at the Fox Theatre in San Francisco. George Wright is an old hand at this sort of foot work. His mono discs contained more than an inkling of extreme lows but it takes a tape to really let them loose. The travel theme gives Wright a good excuse to indulge his sense of humor in non-domestic settings of *Granada, Istanbul, April in Paris,* and *Sabre Dance.*

Sabicas: Furioso — Decca ●ST 7-8900 Dec. 78900

Cuadro Flamenco — Elektra ●ETC-1504 Elek 259X

Flamenco recordings show every sign of carving their best niche in the tape catalogs. Castanets, guitars, gypsy singers, and dancers manage very well within the present frequency range of four-track open-reel tape. I like the way a good stereo disc handles orchestral overtones above 10,000 cps but it must be admitted that tape alone can now take the full wallop when the performer's heels strike the floor in Flamenco dancing. Dolores Vargas, known in her world as the "Gypsy Earthquake," scorches the boards of the floor in this performance. The team of guitarists accompanying Sabicas, Los Companeros del Flamenco, helps to fill out the stereo area. A solo guitarist, no matter how talented, still sounds rather lonely in stereo. The sound is the most vibrant I've heard so far on four-track.

Elektra's Flamenco team, two dancers, a singer and a guitarist, doesn't have the flair and virtuosity of the Sabicas group. On the other hand, several Spanish ensembles now before the public would sound tame under similar comparison. If you're not too familiar with most of the Flamenco recordings on the market, the Elektra entry will fill the bill. The aficionado will prefer Sabicas.

(*Continued on page 73*)

* *12 Forest Ave., Hastings-On-Hudson, New York.*

AUDIOMAN NO. 6

Robert F. McDonald, lithographer, long-time hobbyist, organ builder, kit constructor, Siamese cat breeder, rifleman, sports car enthusiast, and occasional tennis player, joins list of Audiomen.

Manual dexterity appears to be the main element in common among the various hobbies of this month's Audioman—with the possible exception of Siamese cat breeding, which he does only in a small way anyhow. But it is interesting to note that those who have made a hobby of audio seem also to share their time with other hobbies that involve working with their hands—we rarely encounter an audiofan who is an avid student of history, for example.

Mr. McDonald, who lives in Oakland, California, first became interested around 1921, when his late father was building radio receivers, using them for a while, and then selling them to friends or neighbors (sounds familiar, doesn't it?). He remembers loose couplers, variometers, filament-current volume controls, storage-battery power supplies (with occasional holes in the carpet from spilled sulphuric acid), and even the old Kellogg set which used tubes with heater connections on a unique dual top cap—and the Kellogg set they had has been reconverted into a bar. His first P.A. "system" was put together in school to simulate a broadcast-station studio so the kids could put on their own programs—a telephone transmitter, a battery-operated Westinghouse amplifier using WD-11's, and a morning-glory horn.

His first entry into the business professionally was as a P.A. rental operator with a high-school friend, and he remembers as a big event the acquisition of a Brush Sound-Cell microphone, for which they had to build a preamp. When they went out on a job, it looked as though they had half of NBC with them, considering the amplifiers, preamps, preamp power supplies, speakers and field exciters, and remote boxes. After getting married, Mr. McDonald either found no time or no money for audio equipment, so his own rig had to wait until he had some spare time in Japan while he was in the service.

But since then he has moved upward continually and his equipment roster is now as follows: Heathkit SP-2 stereo preamp and XO-1 electronic crossover, National Criterion tuner and Horizon 20 amplifier, Bogen DB-20, two Pilot AA410's, a Rek-O-Kut turntable, two Pickering arms and three pickups, a Fairchild 225 pickup, and a speaker array consisting of an Electro-Voice 15WK, Wharfedale 12CS/AL and a 3-in. tweeter, a 12-in. Tannoy, and a JBL D-130 in a Harkness enclosure. His tape recorder is a Magnecord M-30, and he is one of the first builders of a Schober organ kit.

The illustration at the lower left shows the mounting of preamp, turntable, tuner and tape recorder in a River-Edge chairside cabinet, and one of his current projects is converting the Magnecord to stereo. The E-V speaker is in a home-built Georgian enclosure, which is topped with another enclosure that houses the two 12-in. cones and the 3-in. tweeter. For test equipment, Mr. McDonald relies on Heathkits again for tube checker and VTVM.

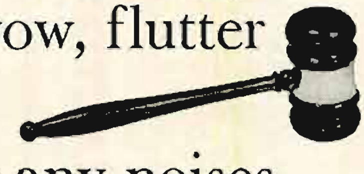
Like most avid audiofans, Mr. McDonald has some ideas about equipment he would like to see on the market. One unit in particular would combine the functions of the usual preamplifier-control unit with its normal complement of inputs but would include, in addition, a recording amplifier with bias and erase provisions for each channel as well as tape-head amplifier with proper equalization to permit monitoring off the tape. In brief, what he wants, he says, is "complete electronics for every need, leaving the tape deck to mechanical considerations only as is the case with disc turntables."

A highly commendable suggestion, we say, and one which would be simple enough if all tape decks had the same requirements. Æ

Verdict:

Collaro

stereo
record players
are innocent
of rumble,
wow, flutter



or any noises
that
interfere
with enjoyment
of music

The Constellation, Model TC-99—$59.50

The Continental II, Model TSC-840—$49.50

The Coronation II, Model TSC-740—$42.50
***The Conquest II, Model TSC-640—$38.50**

Transcription Turntable, Model 4TR-200—$49.50

Manual Player, Model TP-59—$29.95

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Corporation

Every Collaro stereo record player is built with typical British attention to every detail. They are precision engineered and rigidly tested to give truly professional performance and the ultimate in operating convenience. Here are some of the more important features that make Collaro the logical choice for stereo or monophonic records. • Performance specifications exceed NARTB standards for wow, flutter and rumble—with actual performance test reports accompanying each model TC-99. • Extra-heavy, die-cast, non-magnetic turntables (weighing up to 8½ lbs.). Extra-heavy weight is carefully distributed for flywheel effect and smooth, constant rotation. • Shielded four-pole motors are precision balanced, screened with triple interleaved shields to provide extra 25 db reduction in magnetic hum pick-up. • Detachable five-terminal plug-in head shells (on TC-99, TSC-840, TSC-740, TP-59) provide two completely independent circuits, guaranteeing ultimate in noise reduction circuitry. • Transcription-type stereo tonearms are spring-damped and dynamically counterbalanced to permit the last record on a stack to be played with virtually the same low stylus pressure as the first. • All units are handsomely styled, available with optional walnut, blond and mahogany finished bases or unfinished utility base. There's a 4-speed Collaro stereo record player for every need and budget! Prices slightly higher in the West. For free catalog on the Collaro line, write to: **Rockbar Corporation, Dept. A-3, Mamaroneck, N. Y.** (*Not shown. Similar in appearance to The Coronation.)

AUDIO ETC.

Edward Tatnall Canby

Don't Throw it Out

1. Columbia 360

I have a persistent way of keeping track of certain of my more elderly pieces of equipment, long after they are written up in AUDIO and written off as no longer of current interest. The longer they stay around usefully, the better I like them. Mostly, these odds and ends of past epochs are farmed out to friends, in part just because I am interested to find out what happens to them under such dreadful duress and—when it does, how they go about describing the trouble to me and/or what they do themselves to get it fixed.

(Do I have my finger on the public pulse in this respect! Other day, for instance, a girl who sings in my chorus lamented that her phonograph was on the blink; she said it sort of groaned and the music played too slow. Changer motor gummed up, I thought, and so I asked her—remember, she's musical—I asked her did the pitch sag when the machine played slow, did it get lower? "Oh no," she said brightly. "It stays right on pitch. No change at all! But the trouble is, the music *plays too slow*. What *can* I do?" She's got me stumped, there. What would *you* suggest?)

Anyhow, back some six years ago, I think it was, I wrote at length here about the first of the home-type "hi-fi" phonographs, the Columbia 360 in its original format. The machine was then really quite enterprising and original in design, of its now-familiar sort, and was the prototype of millions since, both good and terrible. It had two small speakers, one on each side of the cabinet, and the top closed to make a resonant chamber that peaked up a considerable blast of fairly effective bass —for a table box. The cartridge was a good Sonotone turnover ceramic, the single tone control wisely did no more than provide a limited roll-off, enough to compensate for differences in room acoustics. And, finally, an optional extension speaker for highs (with clock) provided a tricky pseudo-stereo spread of sound, long before stereo itself had made this idea attractive to an inquiring public.

It was a good machine and, relatively, a well made one. After a couple of years I turned it over to the kids in our summer community in Connecticut, for music, dancing, and whatever else kids usually do with a phonograph.

They did it. The original kids have grown up and departed but the current crop tells me that the thing broke down and they took it to the nearest big-small town radio repair, $18 including a new sapphire needle. It broke down again (they say) and went back a second time. It must have been on this trip that it acquired a new cartridge. I was horrified—the excellent Sonotone was replaced by a cheap all-groove model of highly doubtful tone and worse effect upon our records.

Then one boy took it to college with him for the winter—by this time it was thought of as mainly a piece of junk, and to be sure, it looked it. Sounded it, too. He needed something—anything—and this would do. I guess, come to think of it, he had the all-groove cartridge put in, for about $10. (Bet it cost the service man all of 50c.) He fussed around with it a bit, but the machine just sounded worse and worse and he almost threw it out—only it wasn't his.

So back it came and last summer I went to a folk dance party and met up with the old beast once more, for what most certainly appeared to be the very last time. In fact, the dance had to be cut short halfway through. The longer the old 360 played, the more fuzzy and fainthearted did the sound become, until finally it was so dreadfully distorted we couldn't even catch the dance rhythms from it. Old piece of junk, said the kids. We ought to get a new one . . . and it was at *that* point that I boiled over (internally). Just let *me* look at it first, I said.

I took it home and turned it over to my competent assistant, Ray Prohaska, who knows a bit about electronics and hi-fi, which is more than some servicemen know. I was just darned well going to find out what was *really* wrong with that machine before it was junked for good. Isn't this what happens to virtually every old phonograph, after a year, or three or five? Are they *really* just "worn out"? Are the parts really gone, the resistors and capacitors shot or changed in value beyond practical repair?

Could be. But, this time, I was going to find out.

So we set 'er up in Ray's basement lab —and, allowing for the dismal cartridge, it sounded fine, at first. That is, it played, and seemed not to have anything seriously wrong with it but just old age. Yet I remembered that dance. I figured: it had been at least a half hour before the thing became really fuzzy. *Would any serviceman listen for that long?*

Ray already thought he knew the answer, and he turned out to be right. Sure enough, after a whole LP side of a battered "Sacre de Printemps" (Ray's only record), the famous Russian fertility rite began to go askew. The thumps and bumps became fuzzy, the volume trailed off, distortion rose to hundreds of per cents. That was it.

So—Ray opened the machine up, replaced a leaky capacitor that was throwing a positive current at the tube grids—after warming up—also replaced a small resistor and both 35L6 tubes, for safety, and put it all together again. Cost of parts $2.57. The thing worked like new.

Except, of course, for the cartridge. We put in another Sonotone, twin of the original (what'll you bet it never was bad at all) and got us a diamond needle. But if it hadn't been for that, the proper repair cost, counting labor, would have been around $12 to $14. Ray threw in a few odds and ends of improvement while we were at it, and polished up the wood work, cleaned and lubricated the changer—which still works like a charm. (I think it was a special V-M model, the type that doesn't shut off after the last record.)

And, by golly, I now have what amounts to a brand new Columbia 360 table phonograph. It sounds terrific, much better than I would have imagined it could. My point has been well proved, as far as this particular six-year-old is concerned. Its insides are in general perfectly good; there is no audible deterioration. The trouble was specific, in one particular part; it was *not* general debilitation, as most people expect and as dealers so often imply. Not out-of-date sound, either. Six years of ads have blown home hi-fi claims sky-high, but when you come down to earth, this Columbia 360 sounds just about as good as any comparable machine today and a lot better than some.

Nope, it's not stereo. And as a matter of fact I was stupidly absent-minded in not installing a turnover stereo cartridge (hooked up mono) so that the kids could play any old record on it, from 78's to stereo 7-inchers. Maybe I'll do that later. But for a mono machine it's a bargin, at $12!

My conclusion: Servicing of component hi-fi is a problem almost anywhere and we could do better. But repairs on "ordinary" home phonographs are absolutely outrageous. It seems as though nine times out of ten, the way I hear it, service men carefully and expensively replace parts that don't need replacing and fail to fix what is really wrong. Often they do more harm than good, as in the all-groove cartridge deal, above. I won't go very far on a limb here; my experience is not all-inclusive and I haven't the facts and figures. No doubt many repair men do fix the old machines the way they ought to be fixed. But to date I haven't heard of any such happy occurrence, and my mistrust of such operations is therefore prodigeous.

Maybe the home machines are junky. Probably they are far less sturdy and reliable than component parts. But, I hereby suggest, the junky innards and sleazy construction are less often the cause of final collapse than simply a series of ever-more-futile, ever-more-expensive wrong repairs, culminating in the inevitable "why don't you get rid of that piece of junk."

2. Empire 98

I am quite happy with my newest discovery in the way of phono arms, the Audio-Empire 98 "Stereo/Balance." No discovery for the trade, of course, since the arm is well known already; but in terms of first-hand satisfaction it has been a good discovery for me, so far. I first saw this arm in action at last year's High Fidelity Show in New York. I've been using it for some time now, with a Shure M3D cartridge in its detachable shell.

This is a current example of the type of arm that, to many people's utter amazement, will "play uphill," and in the stereo age this is a valuable feature. The arm is so balanced with its cartridge installed that you may tip the turntable sidewise until loose objects slide downhill, yet the music plays on, never missing a groove—in the case of the Empire 98 even at 2 or 3 grams stylus force. Astonishing to watch, but also practical in all cases where turntables are apt to be out of level, which is virtually always in most homes, unless

(*Continued on page 44*)

EDITOR'S REVIEW

LIGHT LISTENING

For years, readers have been suggesting that we recognize the importance of "in-between" music which does not fall rightly into either M. Canby's classical Record Revue or Mr. Robertson's Jazz and All That, but we have never found the right man to do the job to our satisfaction. But the resurgence of the stereo tape market, particularly in the four-track 7½-ips reel-to-reel field, has made this type of music more important to the listener than ever before. It is not the function of our record review columns to attempt coverage of every disc issued, particularly the 45-rpm singles, but there are many of us who enjoy music in the lighter vein at times when neither Frescobaldi nor Prokofiev seem to suit our mood, and when Brubeck and Hampton seem a bit too noisy for relaxation. At such times, we just might enjoy show tunes or possibly a *pot pourri* of listenable music for incidental listening, as contrasted to "cidental" listening—as described in these pages many years ago by an old friend, J. N. A. Hawkins.

We feel that we were fortunate in securing the services of Chester Santon to cover this particular area of music, which appears under Light Listening beginning on page 10 of this issue. Predominantly, his reviews will be of four-track tapes, which are in practically every case paralleled by LP's.

Mr. Santon is well known to New York radio listeners—and over the QXR network in upper New York State and in Connecticut and Massachusetts—for his Sunday evening "Adventures in Sound" program which was on the air for several years, only recently having been displaced by another program with considerably less interest to most of us. He has a particularly large following in the Schenectady-Troy-Albany area, where he has been a guest speaker at meetings of the Tri-City Hi-Fi Association on several occasions. We feel that we are fortunate in having Mr. Santon join us and trust that readers will welcome this additional musical coverage.

SAN FRANCISCO HI-FI SHOW

While our comments last month on the Los Angeles High Fidelity Show were not altogether complimentary, we were unable—because of deadlines—to get in a few words about San Francisco's show. Perhaps, however, the contrast will not be as drastic when separated by a month as it would have been if both had been covered on the same page.

Jim Logan deserves a lot of credit for the layout of his exhibit area and for some of the other features of the San Francisco show, and although the situation was still far from ideal as regards acoustics, it must be admitted that the Cow Palace is better suited for a hi-fi show than the Pan-Pacific Auditorium. To begin with, the ceiling—typical of a factory sawtooth roof—was lower and did not serve as a concentrator for all the sound originating under it. The exhibits were in one of the side halls, and not in the cavernous main arena area of the Palace, which would undoubtedly have been as objectionable as the Pan-Pacific. Booths were arranged in rows, separated by wide aisles, and each row of booths faced on its own aisle so there were no facing entrances from booths across the aisle from each other. The exceptions were on one end, where the wall booths were facing the entrances to the demonstrating booths, but those along the wall were not supposed to make any sound anyhow—although a few did, nevertheless. Then, too, all of the sound booths were roofed with fiberglass which decreased the high-frequency sound radiation appreciably. True, there was a fairly high level of muffled sound in the aisles, but in the booths themselves it was possible to obtain a fairly good demonstration without too much interference. It was not perfect, by far, but we fail to see how any arena show can do much better.

Another innovation introduced by Mr. Logan was the provision of a nursery area for children—this feature alone must have saved exhibitors literally tons of literature—where the kiddies could be parked and entertained in a manner far more attractive to them than traipsing through the exhibits would have been. TV and radio personalities accustomed to entertaining children were on hand, and a registered nurse was in attendance at all times so parents could leave their offspring without a single worry. To these large points in favor of the S.F. show we must add that two large studios were available for recording aggregations who entertained the visitors, refreshments were conveniently available and parking was free with no more than about 500 feet to walk from your car to the Palace.

We feel that this was an excellent show, and that Mr. Logan deserves considerable credit for the way he carried it off. We won't say it was perfect, but we have yet to see a perfect set-up for a hundred exhibitors to create sound levels of 90 to 100 db in their own booths and still have the booths close enough for people to get from one to another without a block's walk. If anyone has ideas about how this can be done, we think the industry would be glad to hear about them.

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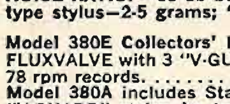
For example, the 380 is fully encapsulated in **radiation-proof** precious mu-metal for **absolutely** hum-free performance in any record player regardless of type—make—model. The only true way to judge a high fidelity component is to compare it with another... measure its performance with the most vital instrument of all... the ear. For—those who can hear the difference choose PICKERING*.

COLLECTORS' SERIES 380. Totally new and unique to high fidelity is the "Collectors' Ensemble"... a complete quality "pick-up-package" for reproduction of all records—stereo, microgroove, 78's.

OUTPUT: 15 mv per channel. **CHANNELSEPARATION:** 30-35 db. **FREQUENCY RESPONSE:** + 2 db 20-20,000 cycles. **SIGNAL TO NOISE RATIO:** —65 db below reference. **TRACKING FORCE:** "A" type stylus—2-5 grams; "C" type stylus—3-7 grams.

Model 380E **Collectors'** Ensemble includes the Stanton Stereo FLUXVALVE with 3 "V-GUARD" styli for stereo, microgroove and 78 rpm records. $60.00
Model 380A includes Stanton Stereo FLUXVALVE with D3807A "V-GUARD" stylus for transcription arms. $34.50
Model 380C includes Stanton Stereo FLUXVALVE with D3807C "V-GUARD" stylus for auto-changer arms. $29.85



Only the Stanton Stereo FLUXVALVE features the safe, comfortable, easily replaceable stylus assembly.

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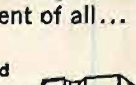
PRO-STANDARD SERIES 371. Now, the new and revolutionary PAC† technique developed by PICKERING has effected economies in manufacture which permit a reduction in the price of the Pro-Standard Series... an industry standard and the universal choice of professionals. Features four coil push-pull hum rejection circuit.



OUTPUT: 10 mv per channel. **CHANNEL SEPARATION:** 20-25 db. **FREQUENCY RESPONSE:** 20-15,000 cycles. **TRACKING FORCE:** "A" type stylus—2-5 grams; "C" type stylus—4-7 grams.

Model 371A Mk II Stanton Stereo FLUXVALVE Pickup now $26.40
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FOR THOSE WHO CAN HEAR THE DIFFERENCE

Pickering

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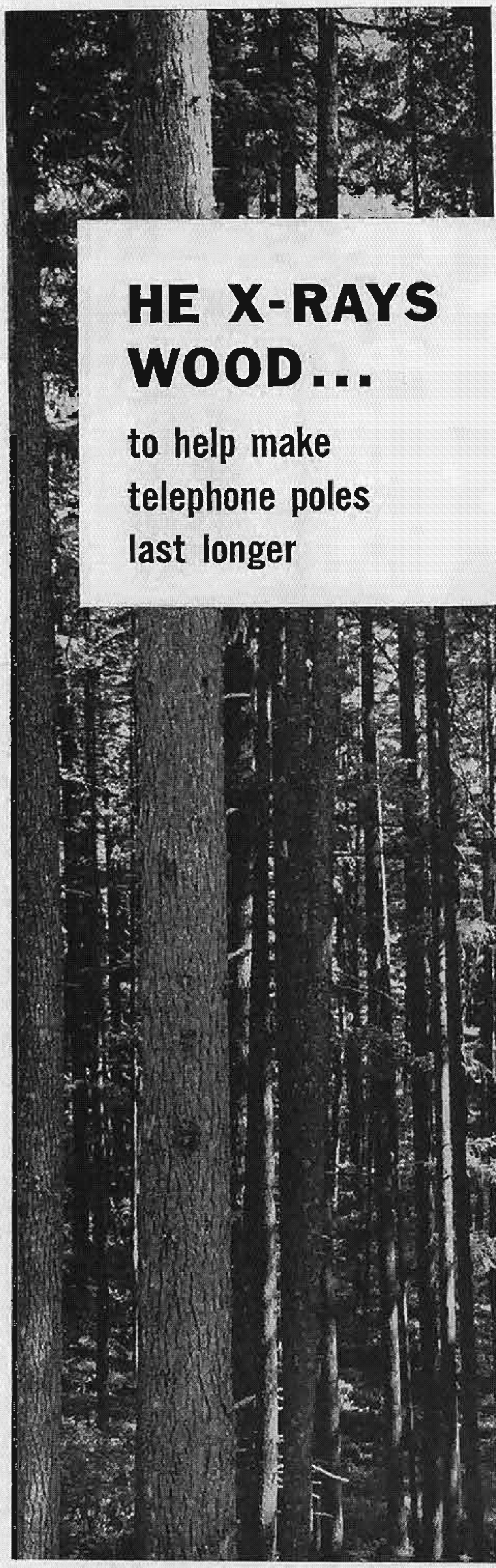
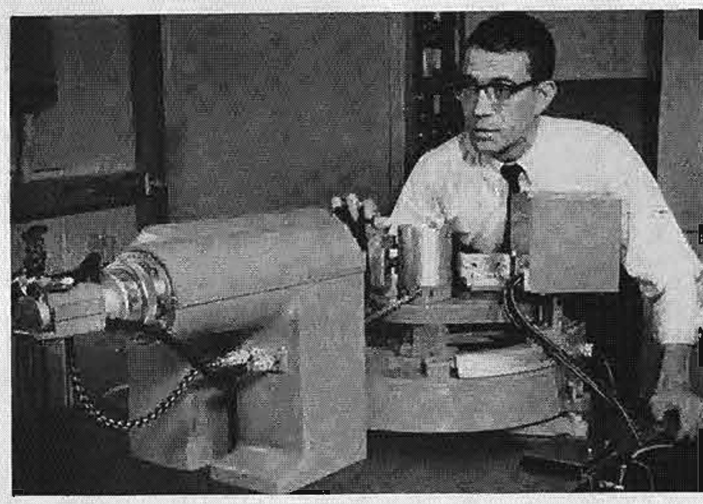


HE X-RAYS WOOD...

to help make telephone poles last longer



Chemist Jack Wright developed the use of this X-ray fluorescence machine for testing the concentration of preservatives in wood. Here he bombards a boring from a test telephone pole with X-rays.

This Bell Labs chemist is using a fast, new technique for measuring the concentration of fungus-killing preservative in telephone poles.

A boring from a test pole is bombarded with X-rays. The preservative—pentachlorophenol—converts some of the incoming X-rays to new ones of different and characteristic wave length. These new rays are isolated and sent into a radiation counter which registers their intensity. The intensity in turn reveals the concentration of preservative.

Bell Laboratories chemists must test thousands of wood specimens annually in their research to make telephone poles last longer. Seeking a faster test, they explored the possibility of X-ray fluorescence—a technique developed originally for metallurgy. For the first time, this technique was applied to wood. Result: A wood specimen check in just two minutes—at least 15 times faster than before possible with the conventional microchemical analysis.

Bell Labs scientists must remain alert to *all* ways of improving telephone service. They must create radically new technology or improve what already exists. Here, they devised a way to speed research in one of telephony's oldest and most important arts—that of wood preservation.

Nature still grows the best telephone poles. There are over 21 million wooden poles in the Bell System. They require no painting, scraping or cleaning; can be nailed, drilled, cut, sawed and climbed like no other material. Scientific wood preservation cuts telephone costs, conserves valuable timber acres.

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An Adjustable Power Supply

JOHN P. WENTWORTH*

For the many applications requiring a readily controllable d.c. voltage, this simple power supply will provide the answer. Not automatically regulated, the unit will provide voltages adjustable within close limits.

MANY CIRCUITS have been proposed for a power supply with variable output voltage, ranging from a simple rectifier-potentiometer combination to the ingenious controlled rectifier proposed by Peschel.[1, 2, 3] However, the author has not seen to date a really simple circuit that will provide continuous variation of voltage from maximum all the way to zero, except for the primitive method employing a potentiometer in the output. The circuit shown in *Fig.* 1 fills this gap.

To understand the operation of this circuit, consider the simplified diagram at (A) in *Fig.* 2. Alternating voltages 180 deg. out of phase are applied to the grid and plate of each triode, so that, whenever the plate of one section is positive, its grid is driven negative. If the grid drive is sufficient, the tube remains cut off. On the other hand, when the grid is allowed to swing in the positive direction, the plate is negative, and there is again no plate conduction. Grid conduction is held to an insignificant value, as the small pulse of grid current on each cycle charges the coupling capacitors to maintain the grid voltage below cut-off during most of the cycle. The small pulse of charging current is supplied through a very high impedance, and does not produce a measureable output voltage.

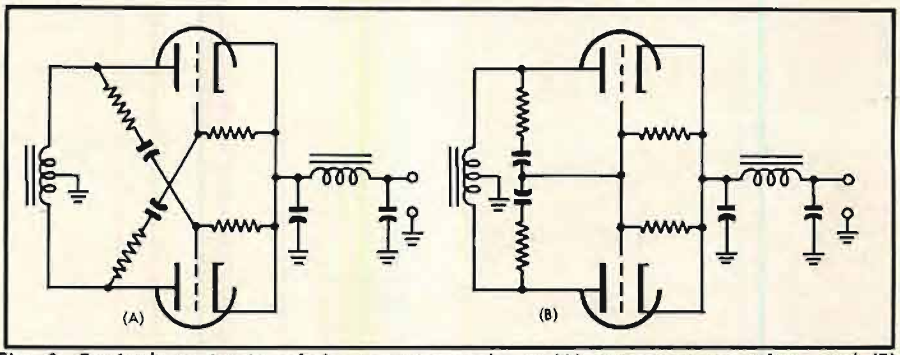

Fig. 2. Equivalent circuits of the power supply at (A) zero output setting, and (B) maximum output setting.

Now suppose that a short circuit is connected between the two grids, as shown at (B) in *Fig.* 2. If the resistances in this circuit are properly proportioned, there will be no alternating voltage at the grids, and the triodes will operate continuously at zero bias, producing a high direct voltage output. If, on the other hand, a finite resistance is connected between the two grids, the output voltage will be somewhere between the two extremes. Use of a rheostat, as in *Fig.* 1, permits continuous variation in output.

The optimum values for the circuit components will depend on the type of tube used for the rectifier. For the sake of simplicity, it was decided to use triodes, or triode-connected tetrodes or pentodes, rather than to worry about screen and suppressor connections. Of the many tubes that would be suitable for this application, including the 6AS7G and triode-connected 6L6's and 807's, the 6AS7G was chosen by the author, in spite of its high price, for the following reasons:

1. The two triode sections required for a full-wave rectifier are included in a single envelope.
2. The zero-bias resistance is lower than that of the other tubes, leading one to expect a higher maximum output voltage.
3. The high cathode-heater voltage rating (300 volts) and the 6.3-volt heater voltage permit use of the filament transformer winding to supply external loads, as well. However, the high heater drain of the 6AS7G (2.5 amperes) reduces the current available for other uses.

Consideration might be given to the use of a pair of 5AQ5's, with their heaters supplied from the 5-volt winding usually provided in power transformers for the rectifier filament.

The complete circuit, using a 6AS7G rectifier tube, is shown in *Fig.* 1. If a different triode is chosen, R_1, R_2, R_3, and R_4 should be selected so that the tube will be fully cut off when the rheostat is set at the zero position (maximum resistance). In general, the portion of the plate voltage needed to be supplied to

(*Continued on page 69*)

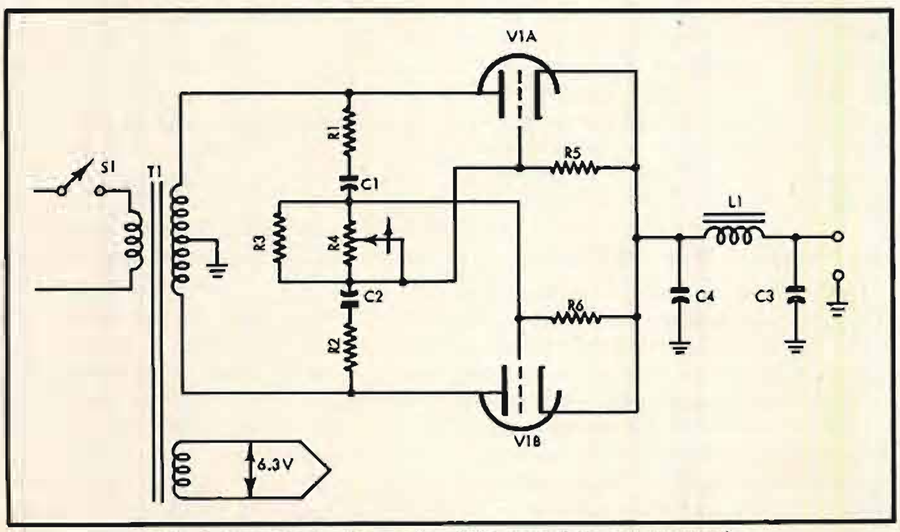

Fig. 1. Complete schematic of the variable power supply.

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*2531 Key Boulevard, Arlington 1, Va.

[1] S. S. Peschel, "Power supply output voltage control." *Radio & TV News*, October, 1948.

[2] S. S. Peschel, "Novel controlled rectifier." *Radio & TV News*, November, 1948.

[3] Frank H. Tooker, "The 'd.c. varivolter'." *Radio & TV News*, April, 1958.

The Wood Panel That Talks

ABRAHAM B. COHEN*

A new loudspeaker system employs a heavy wood panel which is stiffly supported, but it reproduces low frequencies with a minimum of piston motion which results in low distortion and high electromagnetic efficiency.

IN MODERN LOUDSPEAKER APPLICATION, the large packing crate type of enclosure has given way to the "bookshelf" type of system; the "high-efficiency" driver has been superseded by the "low-efficiency" type; the complex baffle has been replaced by a simple sealed box. All these changes have brought us to a new level of quality—otherwise, despite size reduction, these small systems would not have been accepted. There is always room, however, for further progress toward higher plateaus of performance.

The speaker system to be described in this article was designed with several goals in mind. First, of course, it was to set a new plateau both of acoustic performance subjectively and objectively. Second, it was to be mininaturized not only in aspect but in depth as well. Third, it was to overcome the prevalently accepted philosophy that low frequencies do not have stereo directivity, and this was to be overcome by changing the pattern of radiation from hemispherical contoured field (for the lows) to a beamed pattern so that low-frequency orientation would be as definitive as the high-frequency field.

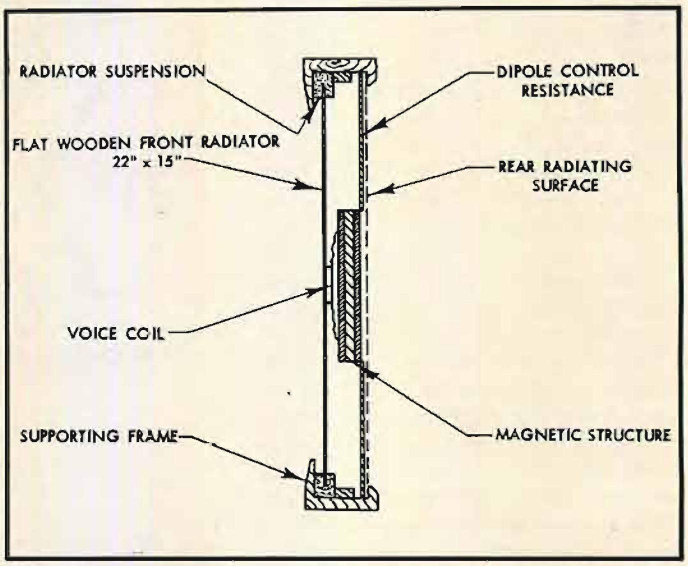

Fig. 2. Essential elements of the Bi-Phonic Coupler.

In the consummation of these objectives, we arrived at a final structure which apparently flies in the face of conventional loudspeaker design. The system is completely unbaffled, its vibrating element is literally as stiff as a board, and as flat as a pancake. This is, of course, a real far cry from the prevalently popular, very loose, deep conical structure, in a tightly sealed box. In the early stages of the development of this speaker, the question was asked, "What kind of a speaker is it and in what type of enclosure does it operate?" The answer was very simple: it is neither a speaker, nor an enclosure, and there it rested until it could be unwrapped. We have now unwrapped it, and its design details are now available.

Low Frequencies From Stiff Boards

However, before we go into these details, it would be worthwhile first to describe the system in its completed form and to illustrate its new characteristics as an acoustic radiator, which both mathematically and physically add a new spatial dimension even to monochannel reproduction. Now, lest this seem a "sales pitch," the author begs the reader to reserve judgment until the technical details are enlarged upon, at which time it will be recognized that this new dimension is literally one that can be measured by a physical yardstick. The best way to describe the system, shown in *Figs.* 1 and 2, is to illustrate its differences from conventional systems. The typical deep compounded-pulp woofer *cone* has been replaced by a large 15 x 22 in. braced flat wooden panel, which is the main acoustic radiator. The "long throw"—usually about ½" travel—excursion of the conventional low-efficiency woofer has been replaced by only microscopic motion of the large radiation panel. The low level of *electrical* damping in the low-efficiency systems due to the incomplete linkage between the voice coil current in the overhanging coil and the magnetic gap has been replaced by the maximum possible coil-to-magnetic-circuit coupling factor without loss of linearity since the radiating panel motion is so microscopic in magnitude. The low level of acoustic radiation efficiency, typical of a 12-in. speaker with an effective piston area of 75 square inches, has been superseded by high acoustic radiation efficiency of the 330 square inch flat panel radiator. The closed sealed box has been replaced by a completely open frame supporting the flat panel vibrating structure, a completely unbaffled radiator. On this last item, we have with-

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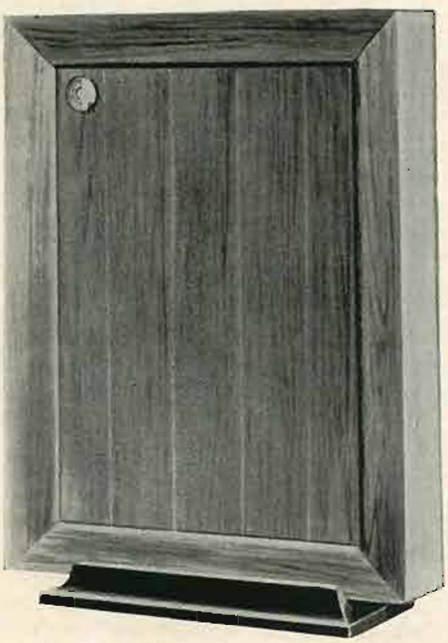


Fig. 1. The Bi-Phonic Coupler, measuring 18 by 24 by 4½ in. over-all.

out fail been asked at every preview how it is possible to get 30 cps response from an unbaffled speaker. The answer comes first in the listening, and then in the mathematical analysis of the free radiating system.

Low-Freqoency Musical Instruments

On the matter of the mathematical treatment of the system we will in due time take it up in detail. There are, however, some interesting thoughts that should be explored concerning the manner in which low frequencies are originally *produced* by musical instruments themselves, and how the conventional loudspeaker that is called upon to reproduce these bass notes deviate so radically in its philosophy of design. Consideration of this problem led to the design principles behind the Bi-Phonic Coupler.

If we were to examine some of these well recognized *bass-producing* musical instruments we would find that instead of producing sound by means of loosely suspended piston devices, they use tighly secured wooden or metal panels, or tightly stretched membranes. Secondly, rather than being "boxed in" devices with solid non-vibrating acoustic restraining walls, they are completely free radiators with no acoustic baffling or damping other than that provided by the acoustic radiation upon the driving system itself. We have in reference such instruments as the piano, the string family, and the percussion family, from where stem most of the orchestral bass notes. A beautiful example of these *stiff* plate, *unbaffled* musical instruments is the grand piano where in the bass end of the keyboard the acoustic spectrum goes down to 27.5 cps.

In this discussion we should not think of the usual resonators of musical instruments as baffles. In our acoustic terminology, baffle is specifically meant to imply an acoustic deterrent to the destruction of the wavefront from one side of the loudspeaker by the wavefront from the other side. In the case of the sealed box, the piston rear wave is completely imprisoned. In the vented box, the pison rear wave is angularly acclererated in phase so that it emerges from the vent *in* phase with the front wave; front wave deterioration is thereby reduced. In the true infinite baffle, complete front-to-back radiation separation is obtained by the wall holding the speaker, with the piston radiating independently into the two "half space" areas on either side of the wall. These are baffles in the true acoustic sense, and are not primarily resonators.

With this simple statement concerning acoustic baffling we may return to the case of the grand piano. The piano keyboard hammer strikes a stretched string causing it to vibrate at its fundamental frequency and its many harmonics. Now we know that if the string were in open space it would not create much sound, anymore than does a tuning fork unless brought in contact with some resonator device. In the instance of the piano, the string that is struck is stretched tightly over two supports in direct communication with the massive metal frame that supports the wood sounding board in the body of the piano. The vibrations of the struck string energize the sounding board putting it into vibration with the string. It is this massive taut "diaphragm" which radiates the sound wave originated by the struck string. Now this radiator *is not a loosely suspended light* diaphragm. It is practically an *immobile pinned down wooden plate.* It is *not boxed* in to prevent front to rear radiation. It is completely open to space on both sides, *allowing both sides* to radiate equally. The radiated sound due to the mechanical flexing of this sounding board is not imprisoned on one side—it is not boxed in, but free to radiate from both sides. In fact, the piano lid itself in its raised position, does more than just reflect the sound out to the listener. It is also sent into sympathetic vibration by the sound hitting it from the sounding board; it vibrates as an independent panel (but in synchronism with the original note) completely unrestrained on either side: unbaffled, unboxed, but yet an efficient low-frequency radiator.

The bass viol is another instrument which reaches far down into the lower acoustic spectrum, and deviates in some highly thought-provoking ways from commonly accepted "enclosure" practice. It may at first glance seem that the body of the bass violin is a resonated vented box. However, mathematical analysis will show that the open "f" holes in the body of the instrument are far too small to resonate the large physical volume of the instrument for the lowest frequencies it reproduces. Applying the standard resonator formula, calculations will show that the first cavity resonance of instrument to be about an octave or more higher than its first fundamental bass note. Even were the body volume and "f" hole areas compatible to resonate to the low frequencies, the body walls of the instrument are themselves comparatively vibratile, not at all flexure free as is required by good standard acoustic enclosure practice of "at least ¾-in. plywood, rigidly braced, or 'sand filled' walls." In short, the body of the bass violin is not primarily a resonator; it is a driven (double) panel structure. The strings impart the vibrations to the bridge, which energizes the entire belly panel. The belly panel in turn transmits its vibrations to the back panel via the sound post which rigidly and mechanically couples the front to the back, and via the surrounding belt of wood which holds the front and back together. This results in both front and back of the instrument both being energized as sound radiators with very complicated phase relationships between them. In effect, then, the bass viol is essentially a double vibrating panel structure without any acoustic baffling to prevent front-to-rear wave cancellation. In addition to the absence of any baffle structure, the vibrating panel structure is itself a solid heavy rigidly secured panel compared to its conventional loudspeaker counterpart. Despite its *unbaffled* condition, and the "infinitely" *stiff* suspension of its vibrating panels, the bass violin is productive of the most respected low frequency notes in the musical repertoire; yet its vibratile parts appear practically immobile—when at the same time to reproduce these notes the conventional loudspeaker employs a boxed-up violently vibrating element.

It was primarily through a feeling that despite the profoundly excellent performance of some of our present loudspeaker structures, that reproduction more nearly duplicate of the original could be obtained if our reproducers were themselves built more nearly like our musical instruments, based on the above analysis.

Stereo Advantage of Low-Frequency Dipole Operation

From this study then, emerged the basic "Bi-Phonic Coupler." As we observed in detail above, the essential characteristic of the low-frequency musical instrument is the (*a*) *heavy,* (*b*) *rigidly suspended,* (*c*) *unbaffled vibratile panel.* Of these three aspects of design, the unbaffled characteristic promised to be most intriguing on the basis that the spatial radiation pattern from an unbaffled source is not circular, but a "figure 8" cosine function. As shown in *Fig.* 3, a completely baffled radiator produces essentially a hemispherical radiation pattern for low frequencies. However, when unbaffled, a loudspeaker piston acts as a dipole radiator with characteristically doubled looped, or "figure 8" pattern, even at, or shall we say especially at, low frequencies. When this fact is assimilated, there will come the realization that this latter condition is one that should be highly desirable to overcome the "spread eagle" effect of low-frequency ambiguity in stereo reproduction.

This low-frequency ambiguity has, of course, been put to use in creating stereo systems of the satellite or outboard speaker type where the direction of origin of the middle- and high-frequency

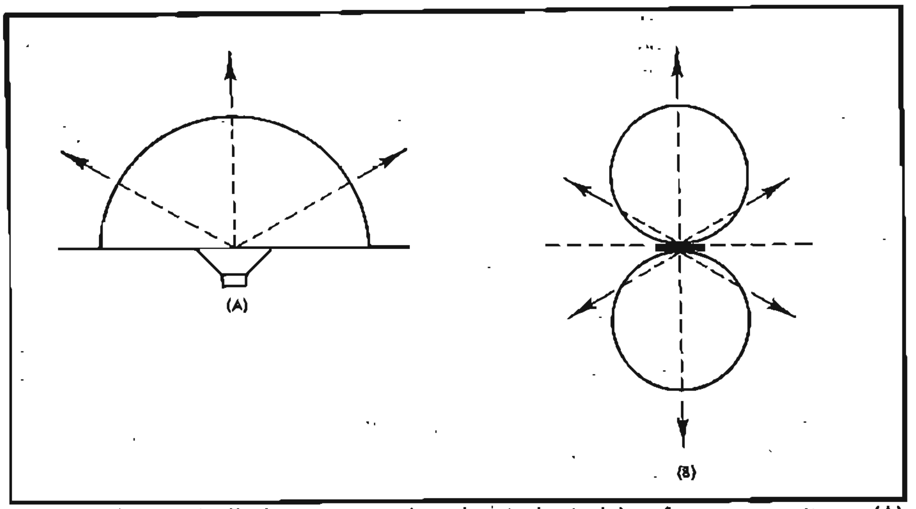


Fig. 3. Whereas baffled pistons produce hemispherical low-frequency patterns (A), baffled dipole systems (B) produce directional fields improving low-frequency orientation.

components of the bass notes created an apparent source for the basic low-frequency notes themselves. This system "works" because the low frequencies from baffled speakers are so spherically diffused, that they are joined to the disembodied middle and higher frequencies in some other part of the room. These outboard stereo systems work, but there are profound problems of space phasing between the diffuse woofer radiation and the woofer harmonics originating elsewhere in the room. To overcome these problems where space permits, completely identical systems are used for both stereo channels. Though we may have overcome space phasing problems between component harmonics of low frequency tones we have not overcome the basic low-frequency ambiguity due to the hemispherical radiation and diffusion of lows from completely baffled speaker systems. The unbaffled radiator, however, with its sharpened "figure 8" pattern for *all* frequencies, including the very lowest, may serve to eliminate this low-frequency directional ambiguity not only for stereo reproduction but for monochannel reproduction as well.

Thus, for purposes stemming both from a desire to simulate more nearly the basic structural operation of bass-producing instruments, and at the same time to gain a stereo directional advantage—the unbaffled radiator approach was specified as one of the prime design parameters. We were now faced with the problem of choosing the diaphragm structure itself, and the determination of its size to produce the necessary bottom of acoustic response.

Radiation Panel Design

The starting point of the diaphragm design lay in doing away with the fragile paper cone—such a device just does not exist in musical instruments—neither in terms of the paper pulp from which it is made, nor the shape of the structure which it is given. Of course, the shape of the conventional cone is governed by the simple fact that to give the paper strength and rigidity for large woofer excursions it just had to assume the deep conical shape. In fact, the more excessive the excursion of the diaphragm, the deeper does the paper cone have to be to maintain its stability. As a matter of fact so prevalent is the break-up characteristic of conventional pulp diaphragms that many a commercial loudspeaker design as actually predicated upon *lack* of piston action, through which defection spectrum band separation is obtained between high frequencies and low frequencies. This condition is usually referred to as "mechanical crossover." Well, for obvious musical reasons, whereby a paper cone does not find existence, and from years of field experience with cone break up, the first step that had to be taken to return to basic musical acoustics seemed to call for retiring the paper cone.

For both decor and musical instrument design the choice of the radiator construction was a wooden panel that would be both functional in a musical sense, and be intrinsically decorative so that it could take its place in the home without being hidden behind a grill cloth. From all considerations it seemed that a flat wooden panel vibrator was called for since we could, through proper bracing, (such as the bass bar beneath the body of the violin) give the panel structural rigidity even though flat, and at the same time give it a musical instrument type of finish. A step to be taken simultaneously with putting the paper cone out to pasture was one whereby the actual sound reproducing element for all practical purposes would stand "still" while it is radiating, like the sounding board of the piano or the body panels of the bass violin, rather than flex back and forth over comparatively great distances as do the conventional loose cones when reproducing the bass tones.

This much we did know, that no matter how we redesigned the loudspeaker we weren't going to rewrite any of Mother Nature's laws of physics, we were only going to re-interpret them to our better advantage. Now, this simply means that if a 12-in. diaphragm has to transverse a given axial distance to produce a certain sound pressure at our ear drums, we can't simply say to the piston, "Stop vibrating, but mind you keep developing the same sound pressure at our ears." This would mean the rewriting of our acoustic laws, for which we are as yet inadequately prepared. However, we can look at the diaphragm with the intention of redesigning it so that even though its vibratile motion is decreased, its sound power output may still be retained. There is a standard formula in our art which, *on the face of the problem,* makes it fairly simple to maintain a given fixed sound pressure at a distance as the size of the vibrating piston changes. After some mathematical manipulation, the final succinct and simple formula for the soundpower output in watts of a vibrating piston is given as $P = r_{ma}\,\chi\,10^{-7}$ where χ is the piston displacement and r_{ma} is the mechanical resistance seen by the vibrating piston. This tells the simple story that the greater the piston displacement the more the power output; it also tells us that the greater the resistance r_{ma} seen by the diaphragm, the more power can be transferred from the diaphragm to the air load responsible for the resistance.

Baffle Conditions Affect Piston Radiation

Now this radiation resistance is not a simply written quantity. It is a function of the size of the piston, the frequency of operation, *and the condition of baffling.* This relationship is shown in *Fig.* 4 for three general conditions: (A) where a piston is vibrating in the plane of an infinite baffle, (B) where it is vibrating in an infinitely long tube with the piston terminating one end of the tube, and (C) where the piston is completely unbaffled. Curve A is frequently seen in the literature, and equally as often applied in practice. To clarify later discussion however, a few words about curve (B) in this figure would be germaine. While the values represent the resistive loading upon a vibrating piston at the end of an infinitely long tube, it may be applied to any type of structure where the rear radiation of the piston is completely absorbed but where the front face of the piston is not integral with any other baffling surface sharing the same plane. Beranek[1] says

[1] Leo L. Beranek, *"Acoustics,"* page 103. McGraw Hill.

on this point: "In many instances sound is radiated from a diaphragm whose rear is shielded from the front side by a box or a tube. If the box does not extend appreciably beyond the edges of the diaphragm, its performance may be estimated by comparison with that of a rigid piston placed in the end of a long tube." Somewhat later in the same reference,[2] "The magnitude of the front radiation impedance depends on whether the box is very large so that it approaches an infinite baffle, or whether the box has a dimension of less than 7.6 cubic feet . . . in which case the radiation impedance is approximately that of a piston in the end of a long tube." Similarly, Olson[3] ". . . the radiation resistance for a vibrating piston in an infinite baffle is two times the radiation resistance of a vibrating piston located in the end of an infinite tube."

Curve (C) of *Fig.* 4 is seldom confronted in practice, for one hardly ever thinks of operating a speaker in an unbaffled condition. But this particular parameter is precisely the set of conditions with which we will be dealing in the direct explanation of the system.

But before we get down to considering this new design in detail, we must lay some groundwork by discussing some interesting facts concerning the first two conditions. Both of these situations are relatively common in practice. Whenever a loudspeaker is mounted *in* a wall or in the face of a large cabinet where there is a large flat space coupled directly to the loudspeaker piston plane (and where there is no front to back radiation) then condition (A) holds. For a given size of piston and for a given frequency we may readily find the radiation resistance into which the outward face of the piston work. It will be observed, for instance, that when the circumference of the piston is equal to twice the wavelength being radiated, that the radiation resistance per unit area, curve (A), just about reaches the levelling off maximum of 42 ohms per square centimeter, above which frequency the radiation resistance remains fairly constant. We are at present interested in the condition that prevails below this settling down plateau, since it is in this toboggan-slide area where most of our loudspeaker problems arise.

For example, consider a 12-in. loudspeaker. We will stretch a point and credit this 12-in. speaker with a piston of 11-in. effective diameter. Now, put it into a true infinite baffle and feed it a signal which, from today's standards, we should expect it to really reproduce. Converting 40 cps into terms of wavelength in centimeters ($C = \lambda f$) we get 860, and converting the 11-in. (effective) diameter piston to circumference in centimeters we get 87.6, so that the circumference/wavelength ratio becomes very nearly 0.102; this, in turn, yields a radiation resistance per square centimeter of 0.210, considerably removed from the 42-ohm maximum! How can we raise it to a more optimum value? Simply (!) by increasing the speaker size to let us say 15 in. (with an effective piston diameter of 14 in.). Proceeding through the same arithmetic as before for this new size of piston, again operating at 40 cps we arrive at a C/λ ratio of 0.13 which yields a radiation resistance of 0.378 ohms per sq. cm. as against a value of 0.210 for the 11-in. piston. Now, multiplying these unit values by the respective total areas of their pistons we get $0.378 \times \pi \times (7 \times 2.54)^2$ for the 15-in. speaker and $0.210 \times \pi \times (5.5 \times 2.54)^2$ for the 12-in. unit, the ratio of the two being 2.8. In other words, the 15-in. unit produces better lows than the 12-in. one because the total radiation resistance that the former sees is close to three times as great as that seen by the latter.

Now, lest it seem that we have dwelt too long on some of the simple facts concerning basic loudspeaker performance, we wish to explain that the design of the bi-phonic coupler is specifically based on modifications of the above type of analysis. We are concerned with determining the parameters of the design of an unbaffled radiating panel which will provide the desired low-frequency response. A rider to this parameter is that the panel be of such a size that when reproducing the proper frequency at a desired sound pressure, the motion of the panel be reduced to a value that the hand can feel, but the eye not see.

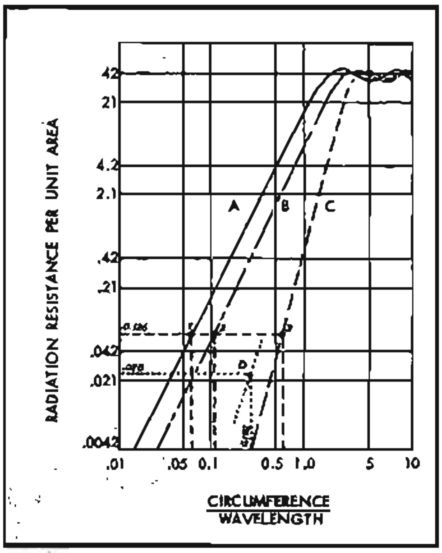


Fig. 4. Radiation resistance for pistons in (A) infinite baffle, (B) small box, and (C) free space.

This, of course, implies a completely "no throw" voice coil, in contrast to the "long throw," which leads to some interesting and important discussions concerning efficiency and transient response.

But to continue our thesis concerning the unbaffled radiator, we have seen that a small sealed box is by no means an infinite baffle in an acoustic-radiation sense. The radiation from the piston falls back and folds around the box, which completely alters the character of the load upon the diaphragm. Actually, for a given frequency below the transition point where the piston circumference to wavelength ratio is less than 2 (see *Fig.* 4), the radiation impedance of the boxed piston is essentially half of that when placed in a true infinite baffle, with essentially half of the radiated power of the latter. In the case of the small closed box, the piston radiates into a "full spherical" space of 4π steradians[3] by diffracting around the box. In the case of the true infinite baffle, the baffle divides space into two parts with the piston radiating into one of these "half spaces" while at the same time the baffle creates an image of the sound source placed within it to be re-radiated along with the original sound power thus doubling the total sound power, as against that obtained from the small box type of radiator.

Unbaffled Load Upon the Piston

In full recognition of these baffle complications and configurations, and furthermore whetted by the desire to sharpen the low-frequency radiation directivity, we determined to free ourselves of the baffle problem entirely, and the only way to accomplish this was to provide a completely free-space piston vibrating without any baffle restriction whatever. Now off hand, there should be a virile chorus of objections that such a system just cannot work, that doublet radiation would immediately cancel out all radiated power for those frequencies where the wavelength was large compared to the piston size. Certainly, there are valid objections, but only insofar as they may be numerically verified. The fact of the matter is that from the set of curves of *Fig.* 4, it is possible to put a straight edge along any one horizontal level indicating any desired unit radiation resistance value and pick off as at points (1), (2), and (3) the circumference-to-wavelength ratio for a piston in an infinite baffle, a second value for one in a small box, and a third value for one completely unbaffled. From these values we could then determine, for a fixed frequency, a rising progression of different piston sizes to produce a given sound pressure for the conditions of infinite baffling to no baffle at all.

(*Continued on page 65*)

[2] *Ibid.*, pages 216, 216.
[3] Harry F. Olson, "*Acoustical Engineering*," page 98. D. Van Nostrand 1957 edition.

Audio Engineering Society

SEVENTH ANNUAL WESTERN CONVENTION AND EXHIBIT

The 1960 Western Convention of the Audio Engineering Society will be held March 8th to 11th at the Alexandria Hotel, 210 West 5th Street, Los Angeles, California.

In addition to the presentation of the technical papers listed below there will be the customary exhibit of professional audio equipment, silently displayed, allowing engineers to see and evaluate new methods and devices under suitable testing conditions.

A special attraction at the convention this year will be an exhibit of early sound and recording equipment. The New Almaden Museum, run by Douglas Perham, has loaned the Society many historical pieces of equipment for display. Among them are the first magnetic phonograph pickup; one of the first amplifier-loudspeaker combinations, made by Telemegophone; an early Victor His Master's Voice disc phonograph; and what is believed to be the first commercial radio broadcast microphone, a carbon unit manufactured by Western Electric. In addition to these, there will be on display a very early Marconi loudspeaker, an Edison Gem recorder, and two mechanical amplifiers designed for electrical application and which predate vacuum tubes. Many other museum pieces have been loaned for the exhibit by AES members and friends throughout California. The entire display has been planned as a representation of the periods and progress of the recording and reproduction of sound.

In order to defray expenses, there will be a registration fee of $1.00 for members and $3.00 for non-members. Upon registration, a lapel card will be issued which will admit holders to all exhibits and technical sessions. For non-members planning to attend the exhibits only, the admission fee will be $1.00.

The symposium on Friday night, March 11th, will be open to all previous registrants free of charge. There will be a $1.00 admission charge for all others.

Registration opens at noon on Tuesday, March 8, on the second floor of the Alexandria Hotel in time for the first session which begins at 1:30 p.m. Many of the forty papers have never been presented before and cover the most recent developments in the audio field.

Tuesday, March 8.

1:30 p.m. MAGNETIC RECORDING

Walter T. Selsted, Ampex Corp., Chairman.

A Multichannel Language Laboratory Recorder.
Ralph H. Sogge, Magnasync Mfg. Co. Ltd.

Recent Achievements in Missile-Borne Magnetic Tape Recorders.
Mark M. Siera, Lockheed Aircraft Corp.

Professional Recorder Design, Service, and Maintenance.
James I. Stultz, Ampex Corp.

The Multichannel Recording for Mastering Purposes.
Mort Fujii, George Rehklau, and John McKnight, Ampex Corp.

Synchronized Separate Sound for the TV Tape Recorder.
Ross H. Snyder, Ampex Corp.

7:30 p.m. MAGNETIC AND DISC RECORDING.

Ross H. Snyder, Ampex Corp., Chairman.

Audio Message Synthesis.
Louis MacKenzie, MacKenzie Electronics, Inc.

New Techniques in Miniature Recorders.
Walter Stancil, Stancil Hoffman Corp.

Maximum Peak Velocity Capabilities of the Disc Record.
J. W. Stafford, Westrex Corp.

The Use of 35-mm Sprocket-Type Magnetic Film in Recording Phonograph Masters.
John G. Frayne and J. W. Stafford, Westrex Corp.

35-mm Sprocket-Type Magnetic Film Compared with One-Quarter Inch Magnetic Tape.
Frank G. Lennert and John G. McKnight, Ampex Corp.

Wednesday, March 9.

9:30 a.m. STEREO AND MONOPHONIC REPRODUCTION.

John G. McKnight, Ampex Corp., Chairman.

Synchronous Audio-Visual Display Techniques.
John T. Mullin, Minnesota Mining & Mfg. Co.

Quality Control Stereophonic Review Equipment.
Pell Kruttschnitt, Capitol Records, Inc.

Eliminating the Stereo Seat.
John Mosely, Audio Fidelity, Inc.

Auditory Transmission of Information without Conscious Awareness.
Lawrence Zeitlin, Dunlap and Associates, Inc.

Performance Criteria and Design Consideration for Language Laboratory Systems.
E. H. Taylor, DuKane Corp.

1:30 p.m. AUDIO CIRCUITS.

Norman Chalfin, Hughes Aircraft Co., Chairman.

Automatic Phasing of Stereophonic Signals.
B. B. Bauer, A. A. Goldberg, and G. D. Pollack, CBS Laboratories.

Practical Transformerless Complementary Symmetry Audio Output Amplifiers.
W. F. Palmer and A. Finneault, Sylvania Electric Products Co.

A Signal-Biasing Output Transformerless Transistor Power Amplifier.
Richard C. Heyser, California Institute of Technology.

A Low Distortion Volume Expander for Home Use.
R. J. Matthys, Minneapolis Honeywell Regulator Company.

A New Bias Method for Power Amplifiers.
George Brettell, Ampex Corp.

7:30 p.m. AWARDS BANQUET

Thursday, March 10.

1:30 p.m. LOUDSPEAKERS, ENCLOSURES, AND ACOUSTIC DEVICES

Dr. Vincent Salmon, Stanford Research Institute, Chairman.

Stereophonic Earphones.
B. B. Bauer, CBS Laboratories.

An Electro-Pneumatic Loudspeaker.
John K. Hilliard, Altec Lansing Corp.

Electrostatic Earphones.
Walter T. Selsted, Ampex Corp.

A New Extended-Range-8-Inch Loudspeaker for Minimum Volume Enclosures.
Edmond A. May, James B. Lansing Sound.

A New High-Frequency Loudspeaker.
Earl Matsuoka, University Loudspeakers, Inc.

7:30 p.m. STEREO BROADCASTING AND STUDIO INPUT SYSTEMS.

Sidney P. Alder, Minnesota Mining & Mfg. Co., Chairman.

A Flexible Combination 3-Channel Stereo Microphone and Rerecording Console.
Philip C. Erhorn, Audiofax Associates, Inc.

L-300-D Compressor Limiter Expander.
Donald F. Dimon, Halex, Inc.

An Advanced Audio Console for TV Broadcasting.
Theodore B. Grenier, American Broadcasting Co.

Modern Recording Studio Techniques.
DeWitt F. Morris, United Recording Corp.

Recording Studio Control Room Facilities of Advanced Design.
Milton T. Putnam, United Recording Corp.

Friday, March 11.

9:30 a.m. ACOUSTICS, REVERBERATIONS AND AMBIOPHONIC TECHNIQUES.

Pell Kruttschnitt, Capitol Records, Chairman.

Industrial Acoustics—A Survey.
Dr. Vincent Salmon, Stanford Research Institute.

The Unconventional Use of Conventional Materials to Obtain Highly Desirable Results in Auditorium Acoustics.
Ludwig W. Sepmeyer, Systems Development Corp.

Practical Sound Reinforcement for Churches.
Lauren Matson, Audio Consultant.

Loudspeaker Response in Rooms.
William B. Snow, Consulting Engineer.

1:30 p.m. AUDIO MEASUREMENTS AND ANALYSIS.

Ward Widener, Ampex Audio, Inc., Chairman.

Some Phenomena of Underwater Acoustic Propagation.
Dr. H. G. Ferris, Hughes Aircraft Co.

The Convergence Zone Effect in Acoustic Transmission in Deep Water.
A Lubell, Hughes Aircraft Co.

Use of High-Speed Digital Computers for Ray Tracing of Underwater Acoustic Paths.
Don A. Murphy, Hughes Aircraft Co.

Acoustic Instrumentation for Measurements in the Minute-Man Missile Silo.
D. N. Keast, Bolt Beranek & Newman, Inc.

Precise Measurement of Large Dynamic Response Characteristics of Passive and Active Audio Networks.
David S. Cochran, Hewlett-Packard Co.

The Advantages of the Peak-Indicating Volume Meter Over the Standard ASA Moving-Coil Volume Meter as Applied to Recording.
Stephen F. Temmer, Gotham Audio Development Corp.

7:30 p.m. SYMPOSIUM (See note below)

The Recording Industry—Its Past, Present and Future.
Harry L. Bryant, Radio Records, Inc., Pres., AES, chairman. Æ

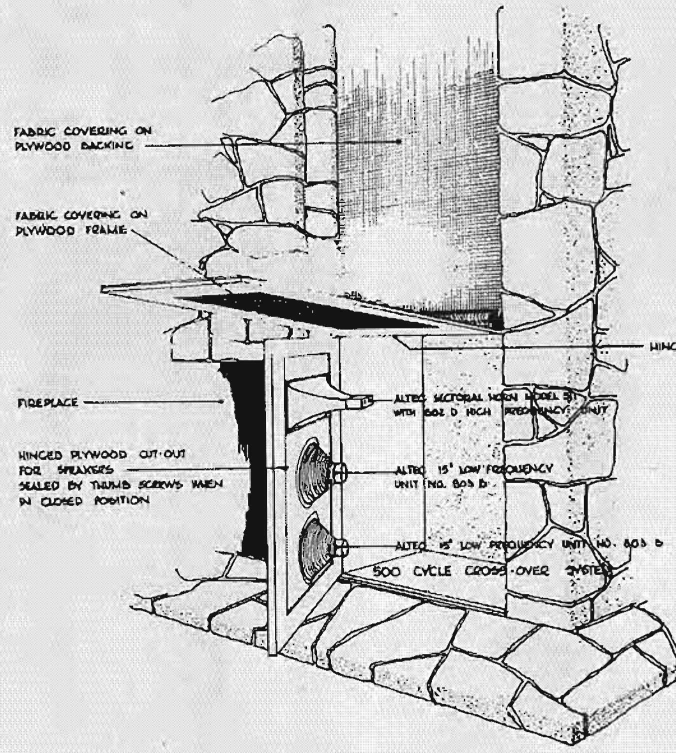
Hi-Fi System with a Roof

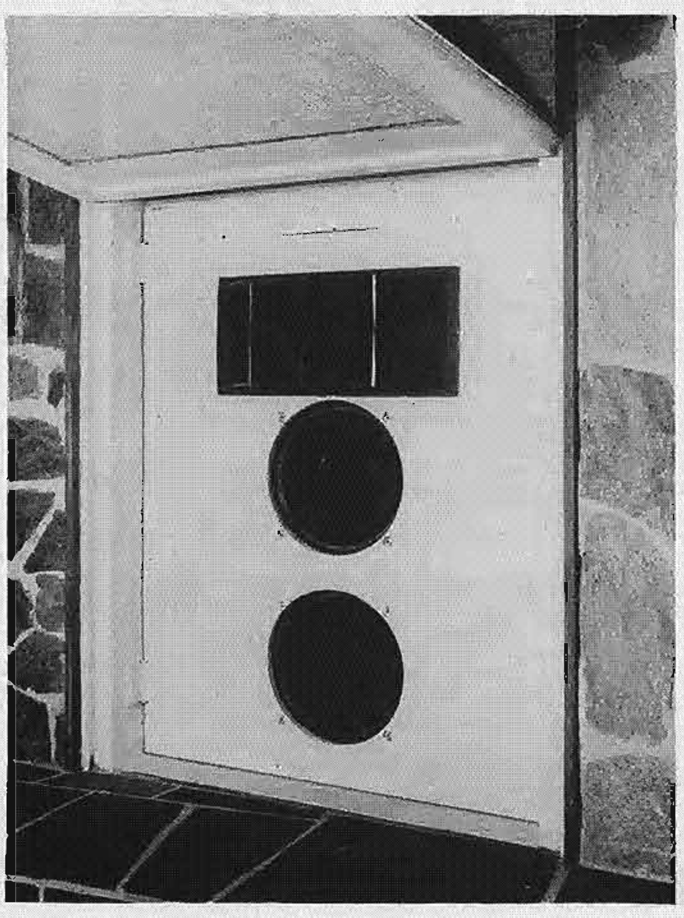
Twenty-five ton stereo loudspeaker enclosure proves that its owner and designer practices what he preaches—and ends up with superb sound and a truly magnificent decor.

One of the high points of our recent trip to the two West Coast hi-fi shows was an opportunity of seeing and hearing the installation pictured on the cover. Although we had already seen pictures, we are of the opinion that no sound installation can be judged solely from photographs, so we just *had* to see and hear it. Since we had committed ourselves to use the photo on the cover of Audio, it was quite simple to wangle an invitation.

To begin with, the house itself is located on a hilltop in Cowan Heights, a section of Santa Ana, California, with a 270-deg. view which extends, in one direction, to the islands some 25 miles offshore. The two-acre site precludes next-door neighbors—always a disadvantage to dyed-in-the-wool hi-fi enthusiasts, of which group Dr. John K. Hilliard is practically a charter member. In his spare time he is Vice President and Director of Advanced Engineering of Altec Lansing Corporation, whose main offices and plant are located in nearby Anaheim.

The house, designed by architects Ramberg & Lowrey, fits the location perfectly, and the living room is the center of attraction—both to the eye and to the ear. Dr. Hilliard planned the basic dimensions of the room, 30 feet across the fireplace wall, tapering down to 20 feet at the opposite end so as to have no parallel walls. The beam at the top of the fireplace is 20 feet high, while at the opposite end, some 40 feet back, it is only 16 feet high, thus continuing the non-parallel configuration. The fireplace-loudspeaker enclosure structure contains 25 tons of stone, with each speaker section comprising 300 cubic feet. The "grille cloth" extends from floor to ceiling and is pale gray Belgian linen, the same as the draperies in the room. The size of the speaker grilles completely eliminates the feeling that there are two loudspeakers—one of the deterrents to good stereo listening, for if you can see two speakers, you can hear two, and they do not blend into a wall of sound as a good stereo system should. No trace of this sensation is felt when listening to this system.





The interior of each enclosure is 4 feet square by about 18 feet high, giving an almost true infinite baffle. The drawing above shows the internal arrangement, while the photo at the left shows the physical appearance of the speaker panel. Each channel consists of two Altec 803B low-frequency drivers, one Altec 802D high-frequency driver on a 511B sectoral horn with a 500-cps crossover, together with an N-500D network. The electronic complement consists of Altec 445A stereo preamp, 345A stereo power amplifier, and 306A AM-FM tuner, an Ampex 960 tape reproducer, a Garrard 301 turntable, and a Pickering 196 Unipoise arm and Fluxvalve. All of these units are installed in a closet at the left side of the room. In addition, five Altec 408A speakers driven by a monophonic Altec 355A amplifier are located in the lanai, workshop, and bedrooms for "ordinary" listening.

The superb reproduction from this "uncramped" stereo system has been heard by a number of local and distant architects of fine homes, notable among them being Frank Lloyd Wright, Jr., who presently is designing similar systems in several homes for his clients. Unlike the proverbial cobbler who has holes in his shoes, Dr. Hilliard—in the high fidelity business—has the best possible system in his own home. Æ

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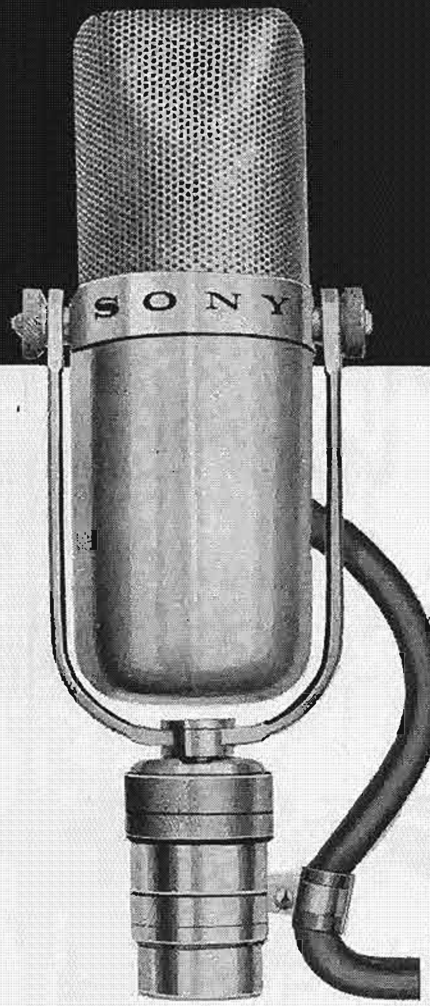

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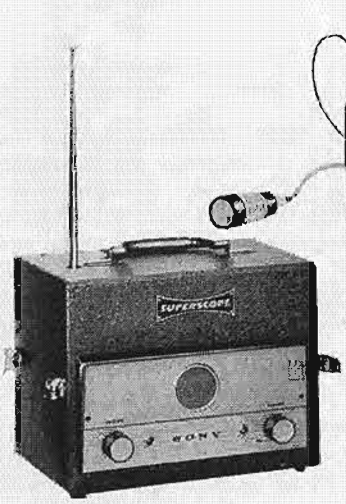
* *Actual anechoid response curve and descriptive brochure available upon request.*



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The Sony model CR-4 is a complete professional wireless microphone with an all-transistor FM transmitter, a dynamic lavalier microphone and an 8-tube FM receiver.

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- Detachable small dynamic microphone
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- Small size and lightweight, very attractive for desk use
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Maintaining Frequency Response in Recorders

If you are not satisfied with the frequency response you are getting from your tape recorder, this article may tell you why and it may also tell you what you can do to correct it.

HERMAN BURSTEIN*

IN TWO PARTS—PART I

As is usual in discussions of frequency response, we are concerned with response that is smooth, full at the low end, and maintained substantially to the upper limit of the audio range—at least to 12,000 cps and preferably to 15,000. In the case of tape recording and playback, the greatest problem is to preserve the high frequencies, and so it is this particular aspect of the subject of frequency response that will figure largest in the following discussion. Preservation of the upper audio range is relatively more difficult in tape recorders than with other elements of an audio system. This is particularly true when tape speed is 7.5 ips or less.

While a tape machine may perform well initially, its frequency response may deteriorate with age, use, or mishap. Maintaining frequency response as it should and can be requires care on the owner's part. On the other hand, frequency response of a tape machine may not initially be all that it should be. Alert to this possibility, the purchaser is in a position to reject a particular model or a particular unit of a given model that cannot deliver a desired standard of performance. Through comprehension of the various factors that enter into a tape machine's frequency response, the prospective purchaser or the present owner maximizes his chances of obtaining suitable frequency response.

At the same time, one obtains very little for nothing in the electronics realm. When maximizing frequency response in the sense of extending the range to 15,000 cps or so, sacrifices may be required with respect to distortion, signal-to-noise ratio, or both. Accordingly, the problem may be of finding a suitable compromise among conflicting considerations, namely treble response, distortion, and noise.

* *280 Twin Lane E., Wantagh, N.Y.*

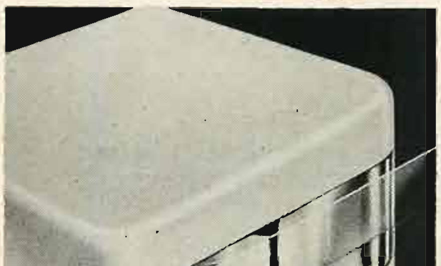


Fig. 1. Erosion of the gap of a tape head due to abrasive action of the tape.

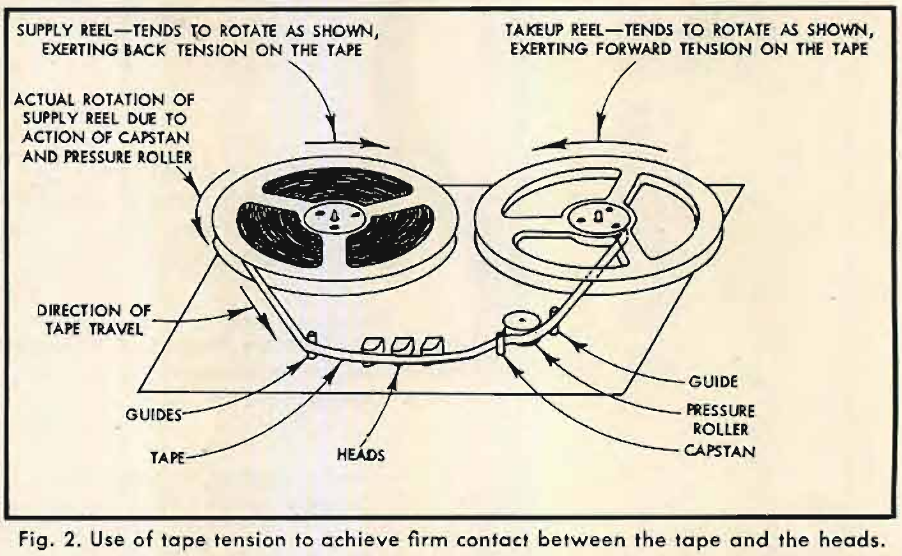


Fig. 2. Use of tape tension to achieve firm contact between the tape and the heads.

Tape Speed

Frequency response is closely associated with tape speed. In recording, certain losses occur that increase with frequency, and the slower the tape speed the greater the loss at any given frequency. In playback, there are losses associated with the playback head that similarly increase with frequency and

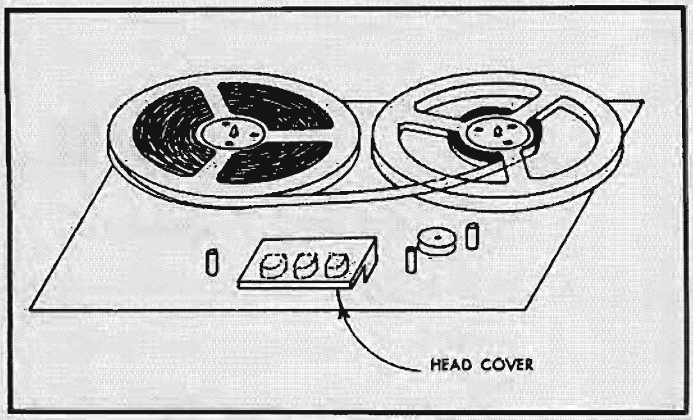


Fig. 3. Winding the tape directly from reel to reel can reduce head wear during rewinding.

become more acute as speed is reduced.

For some time it has been possible at 7.5 ips to achieve results consistent with the concept of high fidelity—namely, response extending to 15,000 cps or at least to 12,000 cps. Quite recently, it has appeared feasible to reach out to 12,000 cps or better at 3.75 ips as well, and even 1.875 speed has been gaining a place in home use. While it may be adequate for moderate quality reproduction of the voice and some forms of background music, as yet this last speed is incapable of high fidelity performance. Nevertheless, considering the constant progress that takes place in the tape art, it is conceivable that not too many years from now it will be possible to have high fidelity at 1.875 ips. At such a time the 15/16 ips might then play the role of a secondary speed where results of only moderate quality are required. Returning to the present, it may be said that nothing less than 3.75 ips is compatible with a first-rate home music system, and that to be really sure of good results it is still necessary to operate at 7.5 ips.

Head Losses

Head losses are of two kinds: (1) frequency-dependent and (2) speed-dependent. Frequency-dependent losses have nothing to do with tape speed and are electrical in nature. Specifically, they are eddy current and hysteresis losses, which have to do with the construction and material of the head, and they increase with frequency. In modern heads, these losses are very small within the audio range and may be left out of the following discussion.

The principal head loss is due to gap width of the playback head and varies inversely with tape speed. The narrower the gap, the higher is the maximum frequency that the head is capable of reproducing. As a rough approximation, one can use the following formula to estimate the upper response limit of a playback head:

$$f = \frac{S}{2G},$$

where f is the approximate upper frequency limit in cps, S is tape speed in inches per second, and G is the physical gap of the head, in inches, as specified by the manufacturer.

To illustrate, assume that tape speed is 7.5 ips and the gap of the playback head is .00025 in. according to its manufacturer. Then $f = 7.5/(2 \times .00025) = 15,000$ cps. At a tape speed of 3.75 ips, however, the upper response limit for this head would be only about 7500 cps. It is therefore apparent why gaps considerably narrower than .00025 in.—heretofore widely used in machines of good quality—are required if extended response is to be achieved at 3.75 ips. The newer heads have gaps in the vicinity of .0001 in. Inserting this value into the above formula, with speed at 3.75 ips, the upper response limit appears to be 18,750 cps. This is the feasible response *in playback*. In recording there are very serious losses that make it difficult to maintain this kind of treble response at 3.75 ips.

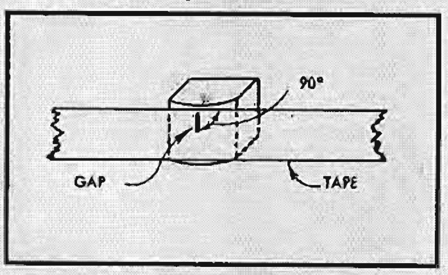


Fig. 4. Meaning of azimuth alignment.

It should be noted that the physical gap is not the same thing as the magnetic gap. The above formula takes into account that in a well-made head the magnetic gap tends to be about 10 per cent wider than the physical gap. However, in a poorly constructed head, where the gap is not extremely straight and sharply defined, the magnetic gap may be considerably more than 10 per cent in excess of the physical gap, so that the upper response limit is correspondingly lower than indicated by the formula. As a result, it is quite possible that a head with an advertised gap of .0001 in. may afford better treble response than another head with an advertised gap of .00009 in., or 90 microinches.

While a head may initially have a gap sufficiently narrow and linear for good treble response at the speed in use, the gap may widen due to head wear and thereby cause a noticeable fall-off in reproduction of high frequencies. The rapidity and extent of head wear depend upon the following factors:

1. *Head Construction.* Laminated heads generally wear better than non-laminated ones.

2. *Smoothness of the Tape.* Depending upon the brand and quality of the tape and therefore upon the extent to which the tape has been lubricated and polished, head wear will vary. *Figure* 1 *suggests* the nature of head wear due to abrasive action of the tape; for visual clarity, the effect of abrasive action has been exaggerated in the drawing.

3. *Pressure of the Tape Against the Head.* For good treble response it is important that the tape and the heads maintain intimate contact. However, the pressure required for close contact results in friction as the tape moves past the heads. Thus the pressure should be just enough to maintain good contact and no more. The reels *tend* to pull the tape in opposite directions, so that the tape is held more or less taut against the heads, as illustrated in *Fig.* 2. This is the scheme generally employed in semi-professional and professional tape recorders to achieve close contact between the tape and the heads. Excessive pressure can result from excessive back tension exerted on the tape by the supply and takeup reels. There is usually provision for adjusting back tension.

Most home machines rely on pressure pads to obtain firm contact between the tape and the heads, because the path followed by the tape does not assure such contact. If the pressure pad holder is improperly adjusted, head wear may take place at an excessive rate.

On the other hand, it sometimes happens that a brand new head will offer improved treble response after a moderate period of wear. What happens is that the head wears down to the point where the gap is narrowest. But eventually the gap will begin to widen with increased wear and high-frequency response will deteriorate.

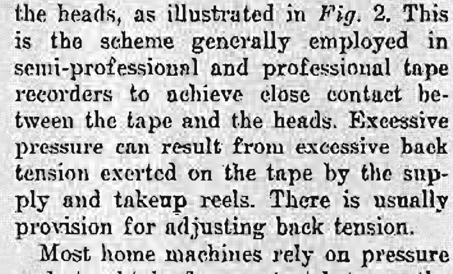
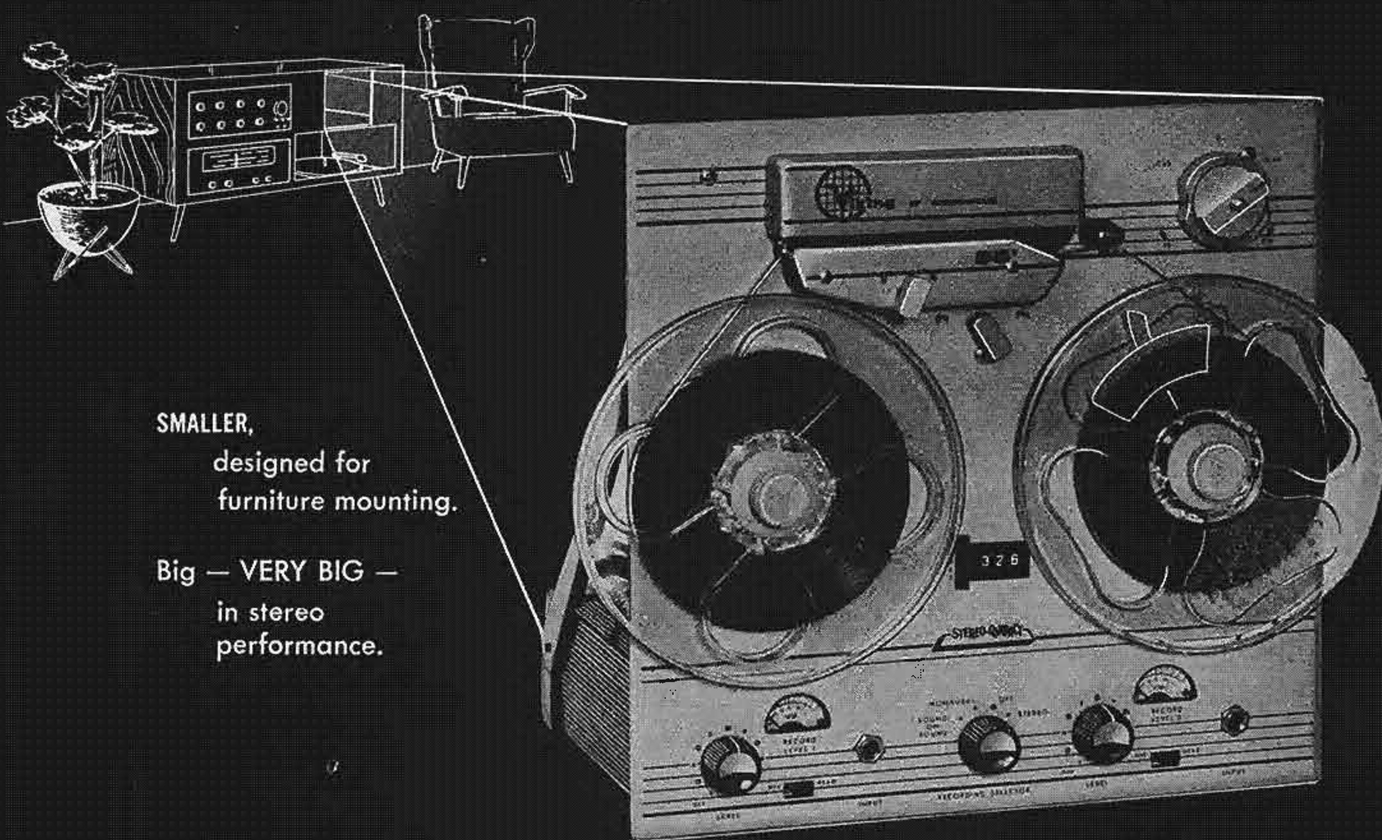


Fig. 5. Effect of azimuth misalignment upon response at 7500 and 750 cps at 7.5 ips.

NEW

The Viking *Stereo Compact*



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The Stereo-Compact provides amplifiers for recording only. Utilizes the music system stereo preamplifier for playback and monitoring during recording.

Available in quarter-track recording model with exclusive wide-gap record head and short-gap play heads. (Ask for the Viking Stereo-Compact RMQ.)

Available with half-track erase and record heads and short-gap quarter-track play heads. (Ask for the Stereo-Compact ESQ.)

Both models employ high performance *laminated heads* and feature head shift for use with either half-track or quarter-track tapes.

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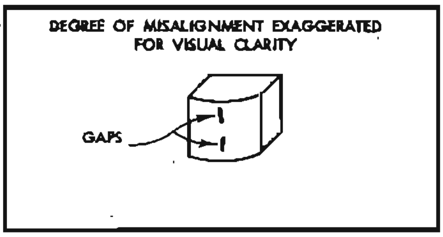

Fig. 6. Relative misalignment of the gaps of a stereo head.

4. *Manner in Which the Tape is Wound and Rewound.* When the tape is wound rapidly in the forward or reverse direction, some machines "lift" the tape slightly away from the heads. Many, possibly most, home machines fail to space the tape away from the heads during rapid wind and rewind, thereby causing appreciable head wear, perhaps more wear than occurs during normal record and playback. To avoid this unnecessary head wear, it is generally possible to wind the tape directly from one reel to the other without going past the heads, as illustrated in *Fig.* 3. It is merely necessary to lift the tape out of its normal path past the heads—usually a guide slot—and allow it to take the shortest path between reels. The possible disadvantage of this procedure is that the tape may not be wound as smoothly as if it were following its normal path.

5. *Care of the Heads.* Head wear can be minimized through suitable care, which includes regular cleaning of the heads to remove accumulated tape oxide, and the application of lubricants to minimize friction between the heads and the tape. Once the gap of the playback head has widened appreciably, nothing can be done except to replace the head, which is a good deal more costly than preventive maintenance. The gap does not have to widen very much before the head becomes unable to reproduce high frequencies. To illustrate, a gap of .0001 in. permits response to 18,750 cps at the 3.75 ips speed. If the gap widens by just one ten-thousandth of an inch, the upper response limit is reduced to 9375 cps at 3.75 ips, which is too low for high-fidelity purposes.

Azimuth Alignment

Improper azimuth alignment is one of the most common reasons for inadequate treble response. The gap of a correctly aligned head forms an angle of exactly 90 deg. with respect to the length of the tape, as shown in *Fig.* 4. If the angle differs from 90 deg., however slightly, there are losses that increase with frequency. For a given degree of misalignment, the loss at any given frequency goes up as tape speed is reduced. On the other hand, the narrower the track—for example a half-track recording compared with a full-track one, or a four-track stereo tape compared with a two-track one—the proportionately smaller are the azimuth losses.

The foregoing assumes that different heads are used for recording and playback. If the same head is employed for both modes of operation, the azimuth error cancels. However, when a misaligned record-playback head is used to play a commercial recorded tape, then treble response of course suffers.

Figure 5 shows how severe the losses due to azimuth misalignment can be. The curve shows the drop in response at 7500 cps for various degrees of misalignment when a half-track head is employed at 7.5 ips. It may be seen that misalignment of one half of 1 degree reduces output by more than 17 db under the stated conditions. If the frequency were greater than 7500 cps, if the tape speed were reduced, or if the track width were increased, the losses would be greater.

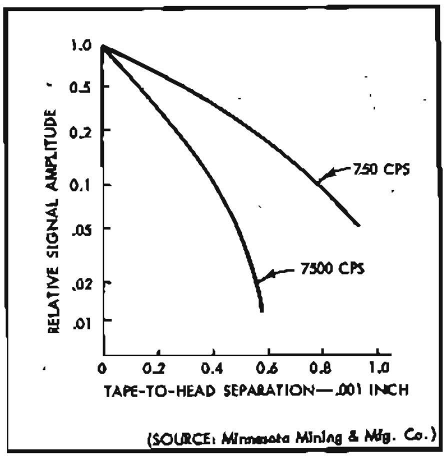

Fig. 7. Separation losses when recording frequencies of 7500 and 750 cps at 7.5 ips.

In the case of stereo heads, it is important to realize that it is possible for the two gaps to be out of alignment with each other, as shown in *Fig.* 6. Ideally, the two gaps should be in a perfectly straight line. If they are not, as sometimes happens, then it is not possible to obtain correct azimuth alignment on both tracks. Aligning one gap automatically throws the other gap out of alignment. Else one has to find a compromise position where both tracks are equally affected. The best solution is to replace the head, unless the degree of misalignment is so slight as not to cut response more than two or three db at the upper end of the audio range.

As stated before, the effect of azimuth misalignment decreases as track width is reduced. Hence four-track stereo heads have an advantage over two-track heads, because for a given degree of misalignment between gaps the effect upon treble response will be less with four-track heads.

Tape-to-Head Contact

Intimate contact between the tape and the heads is vital to preservation of high-frequency response. Failure of the tape to hug the heads may be due to various factors; inadequate pressure when pressure pads are used; inadequate tension when pads are not used; accumulation of tape oxide on the heads.

Losses due to separation of the tape and the heads can occur in recording as well as playback, although they are generally more severe in playback. *Figure* 7 shows the losses at 7500 cps and 750 cps for various amounts of separation in recording at 7.5 ips. The curve for 7500 cps shows that separation of about 0.4 thousandths of an inch, which can occur due to accumulation of tape oxide on the record head, will reduce the recorded level to about one-tenth of the level in the case of perfect tape-to-head contact—a loss of 20 db. The curve for 750 cps exhibits considerably smaller, but nevertheless substantial, losses. At frequencies above 7500 cps, the losses would be much greater than indicated in *Fig.* 7.

Figure 8 shows the separation losses for a playback head. Here it may be seen that at 7500 cps at a speed of 7.5 ips a separation of 0.1 thousandth of an inch reduces the signal to about one-fourth of its potential level, a loss of 12 db, compared with a loss of about 6 db in recording for the same amount of separation. If the same head is used in recording and playback, and if separation is .0001 in. at both modes, then a loss of 18 db altogether can occur at 7500 cps.

The moral is clear. Heads must be regularly cleaned every few hours to remove tape oxide. To be on the safe side, cleaning should take place before every recording or playback session. In addition, at suitable intervals, the machine should be checked to ascertain that tape tension is correct or that pressure pad holders are properly adjusted.

TO BE CONTINUED

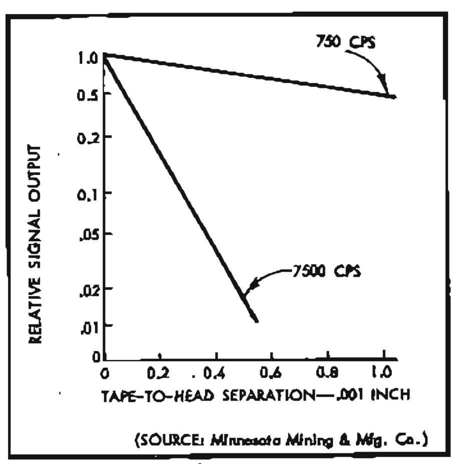

Fig. 8. Separation losses when reproducing frequencies of 7500 and 750 cps at 7.5 ips.

Output Transformers

An easy-to-understand discussion of the factors that affect the performance of all output transformers.

JAMES MOIR*

IN TWO PARTS—PART II

Though it seems a drastic step, all the high-voltage circuitry can be removed. Indeed when the performance of the valve and transformer is being considered, the whole of the valve circuit—valve, bias resistor and its shunt capacitor, grid capacitor, and grid resistor—can be removed and replaced by a single resistor having a value equal to the slope resistance r_a of the valve under its working condition. However, the valve is an active device in that it produces signal power and thus we have to add to our slope resistance r_a a generator that we can assume to produce the same power as the valve. When this is done the whole of the circuit inside the dotted box can be replaced by the two devices in (B) of *Fig.* 6, a resistor r_a and a generator, the combination appearing as a power generator having no resistance in series with a resistance equal to the valve slope resistance.

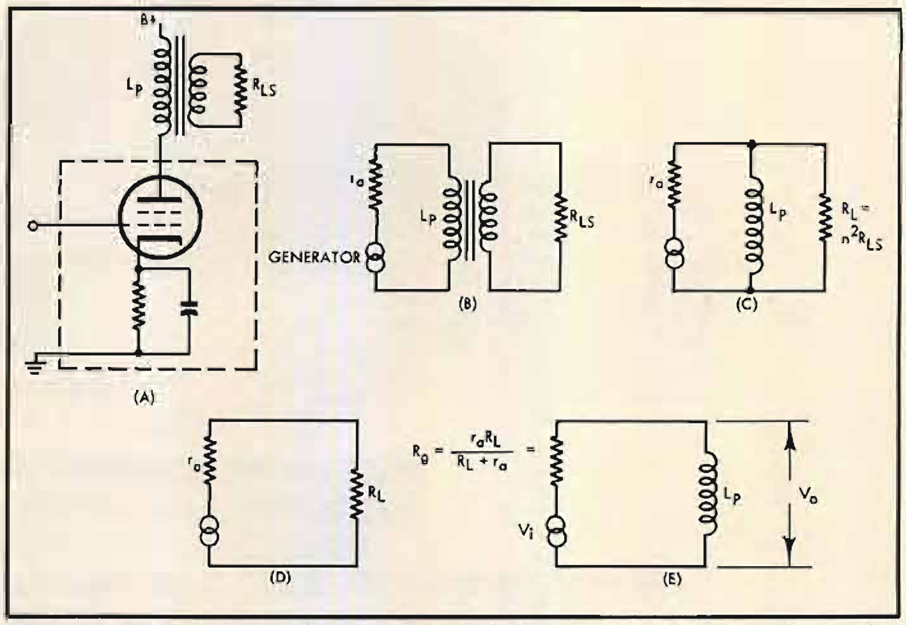

Fig. 6. Practical single-ended output circuit, (A), and its equivalents; (B), simplest form; (C), at low frequencies; (D), between 150 and 4000 cps; (E), final equivalent circuit at frequencies below 150 cps.

The output transformer itself is again a little more troublesome. The practical circuit is that of (A) in *Fig.* 4, two separate windings coupled by the iron core with the second winding supplying power to the loudspeaker. A start can be made by substituting a resistor R_{LS} for the voice coil to give (B) of *Fig.* 4, but at the moment the next step will have to be taken on trust for later verification. The transformer ratio, usually denoted by the symbol n, has no effect on the frequency response, so to avoid having to multiply every impedance by n^2 it is simpler to assume that the turns ratio is 1:1, the two windings having equal numbers of turns.

As was seen earlier in this discussion, a load resistor of, say, 1000 ohms connected across the secondary of a 1:1 transformer has exactly the same effect as the same resistance connected across the primary winding, at least at the low-frequency end of the audio range. The practical circuit has now been reduced to the much simpler circuit of (C) in *Fig.* 6 the transformer and speaker voice coil being reduced to a resistor R_L and an inductance L_p in parallel, the inductance being that of the transformer primary winding measured at some low audio frequency with the secondary winding open circuited.

If the generator is assumed to produce constant volts at all audio frequencies, the variation of voltage across R_L and L_p will follow exactly the same law as the variation with frequency of the voltage across the loudspeaker voice coil in the practical circuit. This is the simplification that is desired.

Even without putting values on R_L it is easy to see the sort of frequency response that will be obtained at low frequencies and to get an idea of the design steps that are necessary to get a flat response. With the generator (an a.f. oscillator) set to a near-zero frequency, current will flow around the circuit and the generator voltage will be dissipated across r_a in series with R_L and L_p in parallel. The voltage across R_L and L_p will only be a small fraction of the total generator voltage for the reactance of L_p. ($X_L = 2\pi f L_p$) will be small.

As the generator frequency is increased the reactance of L_p will increase (being directly proportional to frequency) until at some higher frequency the reactance will be much higher than R_L. At, and above this frequency, the inductance L_p can be removed for it has no effect on circuit performance and the circuit then consists of the generator and two resistors, and R_L. At these frequencies the equivalent circuit r_a will be that of (D) in *Fig.* 6, the output voltage will clearly be

$$V_o = V_i \times \frac{R_L}{r_a + R_L}$$

and will be constant at this value at all higher frequencies (though see the later comment about high-frequency response). The requirements for a flat response are now fairly clear; the inductance of L_p should be sufficiently high to ensure that it does not shunt current away from R_L for when the current in R_L falls the voltage across R_L falls and the frequency response begins to deteriorate.

The more technically minded will see

* *Technical Director, Goodmans Industries, Ltd., Wembley, Middx., England.*

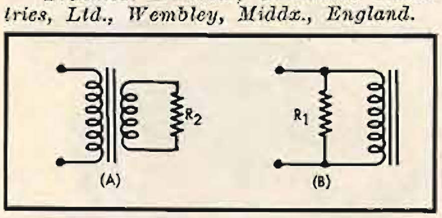

Fig. 4. When the ratio of primary to secondary turns equals n, the transformer and resistance of (A) can be replaced by (B), where $R_1 = n^2R_2$.

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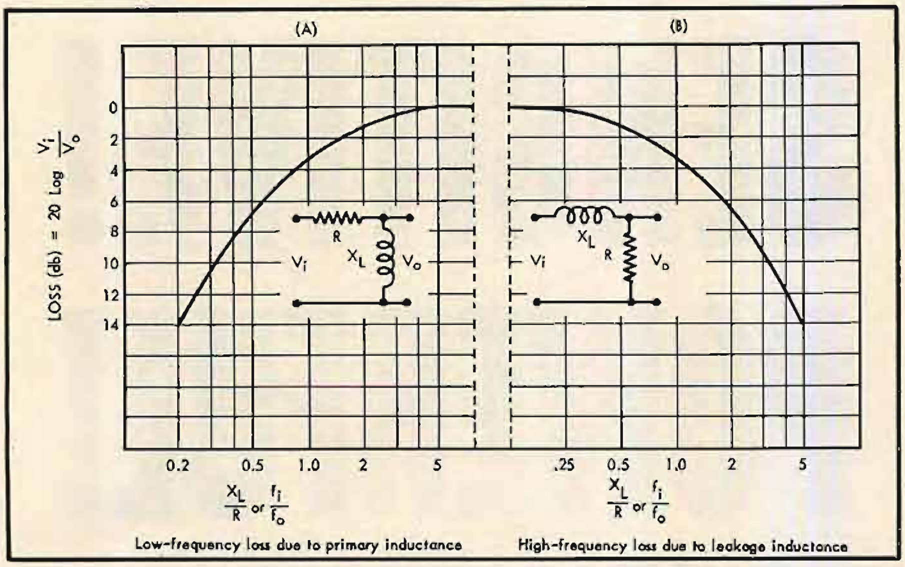

Fig. 7. Basic output transformer characteristics. f_o is the frequency at which the reactance X_L is equal to the resistance R, and f_i is the frequency at which the loss is to be determined.

a flaw in this reasoning. At those low frequencies where the reactance of L_p is low compared to R_L, the total circuit impedance will fall and the current drawn from the constant-voltage generator will rise and thus tend to maintain constant the voltage across R_L and L_p. A detailed analysis shows that this compensating effect can be exactly allowed for by assuming that the generator resistance has a value lower than the slope resistance r_a and in fact is equal to the valve slope resistance r_a and the load resistance R_L in parallel. The equivalent circuit then reduces to that of (E) in *Fig.* 6 and has the same voltage/frequency relation for V_o/V_i as the appreciably more complex circuit of (A) in *Fig.* 6, an effective demonstration of the advantages of equivalent circuits.

In a simple circuit such as that of (E) in *Fig.* 6, it is fairly easy to see that V_o will tend to approach V_i as the reactance of L_p becomes large relative to the resistor R_g. The reactance $X_L = 2\pi f L_p$ is directly proportional to frequency and thus it is clearly going to be difficult to maintain X_L large compared to R_g, down to such very low frequencies as a few cycles per second. When transformers are used there is no alternative to accepting a frequency response that falls away at low frequency, but the frequency at which the falloff commences can be moved down to any desired frequency by increasing the value of L_p.

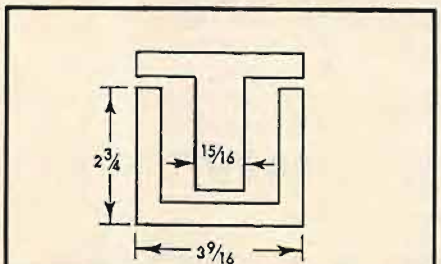

Fig. 8. Typical lamination shape.

For reasons that will emerge later, it is usual to take as the cutoff frequency, that frequency at which the reactance of L_p equals the resistance R_g, this being the frequency at which the output is down by 3 db. This is an arithmetical simplification rather than the point in the frequency range at which there is a significant cutoff, for the power output is only falling away at the rate of 6 db per octave.

The *shape* of the frequency response, i.e. the relation between the ratio V_o/V_i and frequency, is controlled by the ratio of X_L to R_g and thus is unalterable. All output transformers have the same shape of frequency response but a good transformer is up to its level value at a very low frequency whereas a poor transformer does not achieve its "flat" value until a much higher frequency is reached. It is convenient to display this universal response in the form of a single curve *Fig.* 7, f_o being the frequency at which the reactance X_L of L_p equals the resistance R_g. From this it will be seen that at this cutoff frequency where $F_i/F_o = 1$, the loss is 3 db, but at half this frequency the loss is only 7 db. Some of the simpler relations are given in Table I.

Some realism is put into the picture by taking a look at the sort of values of primary inductance L_p that are required in practice if a flat frequency response is to be obtained. The two EL34's used in the earlier example require an anode-to-anode load of 3400 ohms and have a quoted slope resistance r_a of 15,000 ohms, though as a push-pull stage is being considered the effective source resistance can be taken as 30,000 ohms. This is some ten times the required anode-to-anode load, a relation typical of tetrodes and pentodes and it results in the effective generator resistance R_g being 3000 ohms, only slightly lower than the required anode-to-anode load 3400 ohms. If it is decided to allow a loss of 3 db at 50 cps the reactance of the primary inductance L_p must also be 3000 ohms at this frequency and L_p is then 3000 $(2\pi \times 50) = 10$H approximately. If the 3-db point must be at 10 cps, then the inductance must be five times higher or 50 henries.

Practical Design

While dealing with a specific example it is worth calculating the number of turns and the size of transformer required to obtain the primary inductance suggested. Any required value of inductance can be obtained in either of two ways; a small number of turns on a large iron core, or a large number of turns on a small iron core. A large core and few turns should result in small signal power losses and a high price, with the converse being true if a small core and a large number of turns are adopted. The choice of core size is thus somewhat arbitrary unless the permissible power loss can be specified. An examination of the lists of some of the leading manufacturers shows that their high-quality transformers have an over-all volume of about two cubic inches per watt, suggesting that a $1\frac{1}{2}$-in. stack of the laminations shown in *Fig.* 8 will handle 20 watts, though this is a point that will be checked more closely at a later stage when the distortion products are being studied.

The inductance of a coil wound on a closed iron core such as *Fig.* 3 is given (but only approximately) by

$$L = \frac{3.2\, T^2 \mu\, A}{10^8 \times l} \qquad (3)$$

where T = number of turns.
A = cross sectional area of core.
μ = permeability of core.
l = length of flux path.
(all dimensions in inches)

All the factors that appear in this formula are unambiguous except μ, the permeability of the core material, and this is difficult to specify because the permeability of any of the usual core materials is a function of the core flux

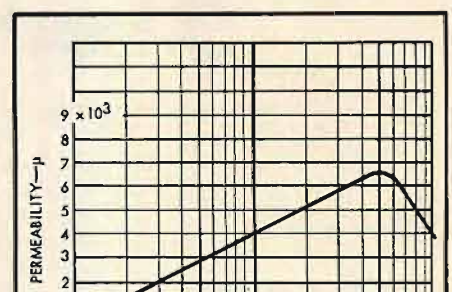

Fig. 9. Typical relation between core flux density and permeability for transformer steel.

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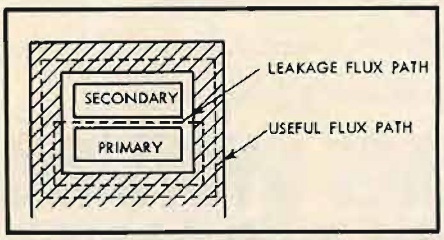


Fig. 10. Secondary wound over primary. Suitable only for transformers dealing with a restricted frequency range.

density. Typical variations in permeability with flux density taken from the data sheets in a manufacturer's lists, are illustrated by *Fig.* 9, but experience shows that these permeability values are not achieved under working conditions. Data for these curves are invariably taken on ring samples without air gaps and after annealing. Laminations punched from the same material are rarely annealed after punching, are then assembled with air gaps that are small but unavoidable and finally used in transformers that carry small unbalanced anode currents, all important factors in reducing the permeability below the ring-sample value. It is more realistic to use permeability values that are half those read from *Fig.* 9 when calculating the winding inductance from Eq. (*3*). The permeability will be seen to vary by a factor of about five times over a range of flux densities between 200 and 5000 gauss.

The inductance of the primary winding will also vary with flux density by the same factor of five times, so that the frequency response will change with power output unless the inductance measured at some low flux density is adequate to maintain a flat response. The choice of an appropriate flux density and the related value of permeability is somewhat arbitrary but if a value for μ of 1500 corresponding to a core density of 500 gauss is used, the final performance is likely to be very acceptable. However, this problem of core density will come up again at a later stage when harmonic distortion is being considered.

Using the two cubic inches per watt figure it might be expected that a 1½-in. deep stack of the laminations shown in *Fig.* 8 would handle 20 watts with ease. The core area of a 1½-in. stack is roughly 1½ sq. ins. and the iron path length 8 inches. Inserting these values into Eq. (*3*) shows that about 1100 turns are required to give an inductance of 10 henries while 2400 turns are necessary to obtain 50 henries. When harmonic distortion is considered at a later stage, it will be shown that in general the primary inductance required to hold harmonic distortion to an acceptably low limit automatically ensures a good frequency response.

The specified number of turns can be wound on to the core as a single coil having the secondary turns wound on top as in *Fig.* 10, though this is not the usual practice when a transformer having a high-quality performance is required. Why is this simple (and therefore low priced) construction not adopted? The answer is that the relative disposition of the two windings on the core controls the high-frequency performance, an aspect of the design problem that can now be considered.

It is best approached by returning to the first section of this discussion dealing with the choice of turns ratio. It was then stated that all the magnetic flux produced by the primary winding was confined to the core and thus interlinked both coils. When the turns ratio and number of turns are being considered, this assumption is perfectly valid but when the high frequency performance is under examination the assumption is too sweeping. In the simple example of *Fig.* 11 magnetic flux lines emerging from the top of the coil have two alternative paths that can be followed back to the bottom of the coil. The designed path is that through the iron core, the path that is followed by the great majority of the magnetic flux. However, a very small proportion of the total flux leaks out of the iron and follows paths through the air as indicated, with the result that all the flux from the primary winding does not link with all the turns from the secondary winding. In a good transformer as much as 99.9 per cent of the flux from the primary winding links with the secondary but the remaining 0.1 per cent is responsible for the majority of the high frequency losses. A return to the equivalent circuit of (C) in *Fig.* 6 will ease the explanation.

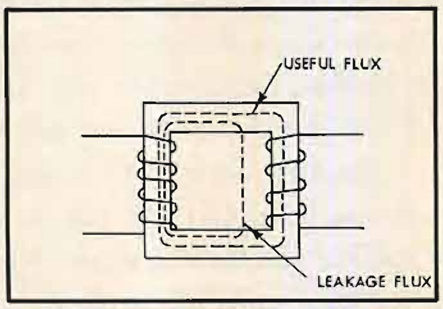


Fig. 11. Paths of working and leakage fluxes in basic transformers

The primary inductance L_p appears in parallel with the load resistance R_L but above a quite low frequency (50 to 150 cps) the reactance of this inductance becomes so high in comparison to the resistance R_L that the current shunted off the load resistance becomes quite negligible. Above this frequency, L_p has no effect on the frequency response which is then determined by the resistances r_a and R_L and is thus independent of frequency, the conclusion arrived at when discussing the low-frequency performance. A flat frequency response is maintained up to frequencies of a few thousand cps but it then begins to fall away again, an effect that is not predicted by the equivalent circuits as they stand in *Fig.* 6. The missing element is an inductance that represents the effect of the magnetic flux which strays from the iron path and thus fails to link both coils. It is omitted from *Fig.* 6 because it has no effect on the performance of the transformer at low frequencies.

The clearest mental picture is obtained by assuming that the whole of the flux produced by the primary winding bypasses a few of the secondary turns, leaving these few turns as an inductance outside the transformer and in series with the secondary load resistance R_L. It is really immaterial whether we consider that 99 per cent of the flux links with 100 per cent of the secondary turns or that 100 per cent of the primary flux links with 99 per cent of the secondary turns, for it is the product of (flux) × (turns) that is important; but a clearer picture of the process is given by the second approach. The inductance that exists as a result of the failure of the primary flux to link all the secondary turns is generally known as the leakage inductance and can be measured on any of the standard a.c. bridges by short circuiting the secondary terminals and measuring the inductance that appears at the primary terminals. The same final answer is obtained if the primary terminals are shorted and measurements made at the secondary terminals but the two measurements will differ in the ratio of the (turns ratio)^2.

The general effect of this leakage inductance on the frequency response is now fairly easily seen from a consideration of its position in the equivalent circuit where it appears in series with the secondary load resistance R_L as in *Fig.* 12. As the signal frequency rises, the reactance of L_{SC} rises proportional to frequency, eventually becoming comparable in value to the secondary load resistor R_L and with further increase in frequency the reactance of L_{SC} will exceed R_L. The signal voltage produced by the generator is now divided between three circuit elements—r_a the equivalent resistance of the generator, L_{SC} the leakage inductance, and R_L the secondary load resistance—and therefore V_o will fall off with increase in frequency at the rate of 6 db per octave.

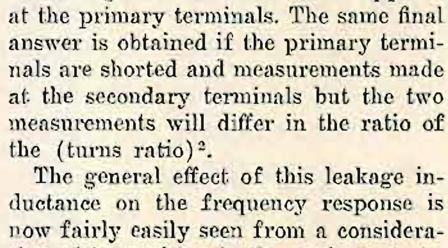
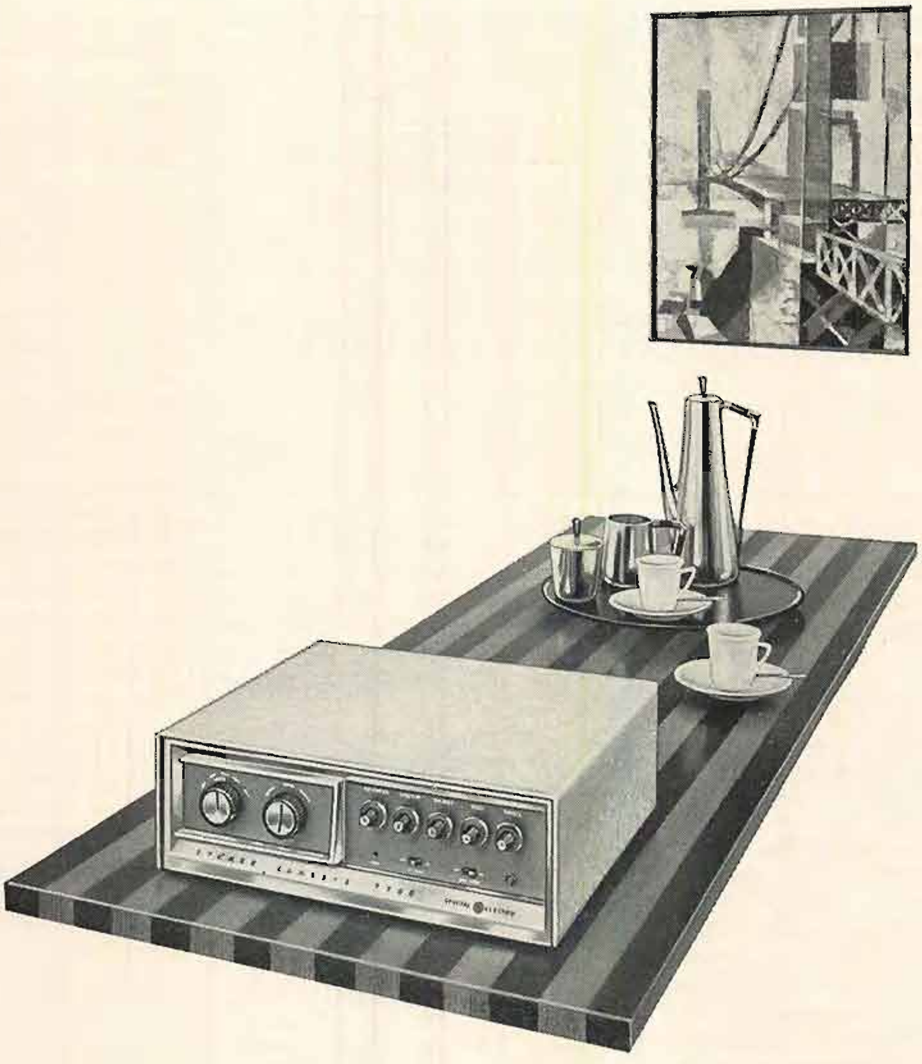


Fig. 12. Equivalent circuit at frequencies above 4000 cps.



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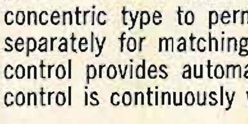

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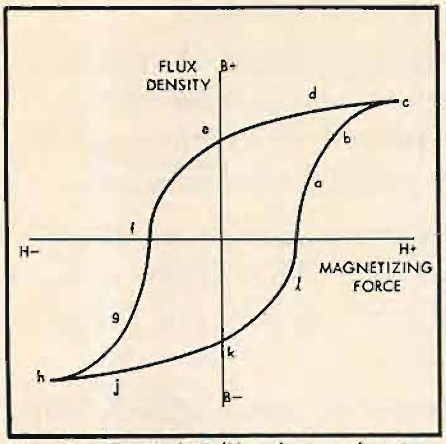


Fig. 16. Typical B/H relation for iron laminations.

ing coil. Neither of these requirements is met in a magnetic circuit that consists wholly of magnetic material. What does happen is illustrated by *Fig.* 16, a typical B/H relation for a transformer steel.

Starting from zero current in the magnetizing winding, but with the iron path magnetized by the previous cycles of the supply, the flux density in the iron rises roughly proportionately to the current up to point a in *Fig.* 16 then less than proportionately from a to b, and finally saturates at c; very large increases in magnetizing current are then required to produce very small increases in flux. If the direction of the current flow is reversed, B commences to fall, not along the path c, b, a, but along a new path, d, e, f, where the values of B are always higher than were obtained for the same values of H when H was increasing. The magnetizing current must be *reversed* to reduce B to zero at f, a symmetrical path g, h, i, k, l then being traced as H increases to a negative maximum, reverses, and returns to zero. The point of importance is that the path followed by the value of B encloses an area instead of merely following a straight line. From the B/H relation of *Fig.* 16 it may be deduced that a sinusoidal magnetizing current in the primary coil will not produce a sinusoidal flux waveform in the iron circuit. As the secondary voltage is proportional to the rate of change of flux, a sinusoidal secondary voltage can only be produced by a sinusoidal flux waveform and this will in turn only be produced by a non-sinusoidal current wave in the primary winding.

At this stage it would appear that an impasse has been reached for distortionless reproduction demands that a sinusoidal voltage on the grid of the output valve produces a sinusoidal voltage across the output transformer secondary, though it has been shown that this result can only be achieved by supplying a non-sinusoidal current to the transformer primary. However, the impasse is only the result of shallow thinking about the problem as it may be shown that if the impedance of the source is very small, a sinusoidal voltage applied to the transformer primary will result in a non-sinusoidal primary current, a sinusoidal flux waveform, and a sinusoidal secondary voltage. The significant point is contained in the phrase "if the resistance of the source is very small" and the question that immediately jumps to mind is, how small? There are few abrupt discontinuities in nature and it is unlikely that the distortion will prove to be zero when the source resistance is zero and yet rise sharply for very low values of source resistance. Common sense is right on this point. A detailed analysis shows that the percentage distortion is related to the ratio of circuit resistance to the inductive reactance of the primary winding of the transformer and is a function of the maximum flux density at which the iron is worked. This latter result is to be expected for there is a fair degree of proportionality between H and the resultant B if the flux density is not allowed to exceed point a in *Fig.* 16. Unfortunately a low flux density means a large core and an expensive transformer.

The advantages of a low-resistance source in minimizing harmonic distortion are less obvious and need a more detailed explanation. If a generator of zero resistance and a sinusoidal voltage waveform supplies current to a resistive load, both the current and voltage have sinusoidal waveforms. When the resistance load is replaced by an inductance the voltage waveform remains sinusoidal but the current waveform is distorted by just the right amount to produce a sinusoidal flux waveform and thus a sinusoidal secondary voltage waveform. The primary current wave is then found to contain a high percentage of third, fifth, and seventh harmonics. In an intermediate condition when the circuit contains some resistance, the current drawn from the source is less distorted but the distortion of the voltage waveform is increased. In general any resistance in the circuit prevents the inductance drawing the harmonic currents it requires to maintain a sinusoidal flux waveform. If a sinusoidal flux waveform is not maintained then the waveform of the secondary voltage will be non-sinusoidal.

When considering the low-frequency response of a transformer it was shown that the resistance that controls the response is the parallel combination of the source and load resistances. The same parallel combination also controls the harmonic distortion that is generated. If the transformer is a poor example with high resistance windings these winding resistances must be added to the load resistor before working out the parallel combination.

Most of the manufacturers of transformer steels have produced curves showing the relationship between distortion and the ratio of the effective circuit resistance to the reactance of the primary winding. Typical curves for a 4 per cent silicon steel commonly used in high quality transformers are shown in *Fig.* 17. The most significant information to be obtained from the curves is the very high distortions that occur even at low flux densities when the source resistance is comparable with the reactance of the transformer primary winding. Earlier in the contribution it was shown that a transformer having a primary inductance of only 10 henries would have a frequency response only 3 db down at 50 cps when used with two EL34 valves working into a load of 3400 ohms. It is interesting to calculate the harmonic distortion that is produced if such a transformer is used.

At a frequency of 50 cps an inductance of 10 henries has a reactance of 3140 ohms, approximately equal to the effective generator resistance when using two EL34's in push-pull. The left hand curve for $\omega L = R$ is then appropriate. The core flux density when the power

(*Continued on page 68*)

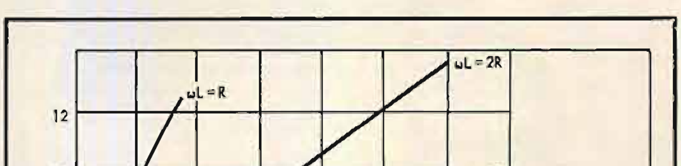
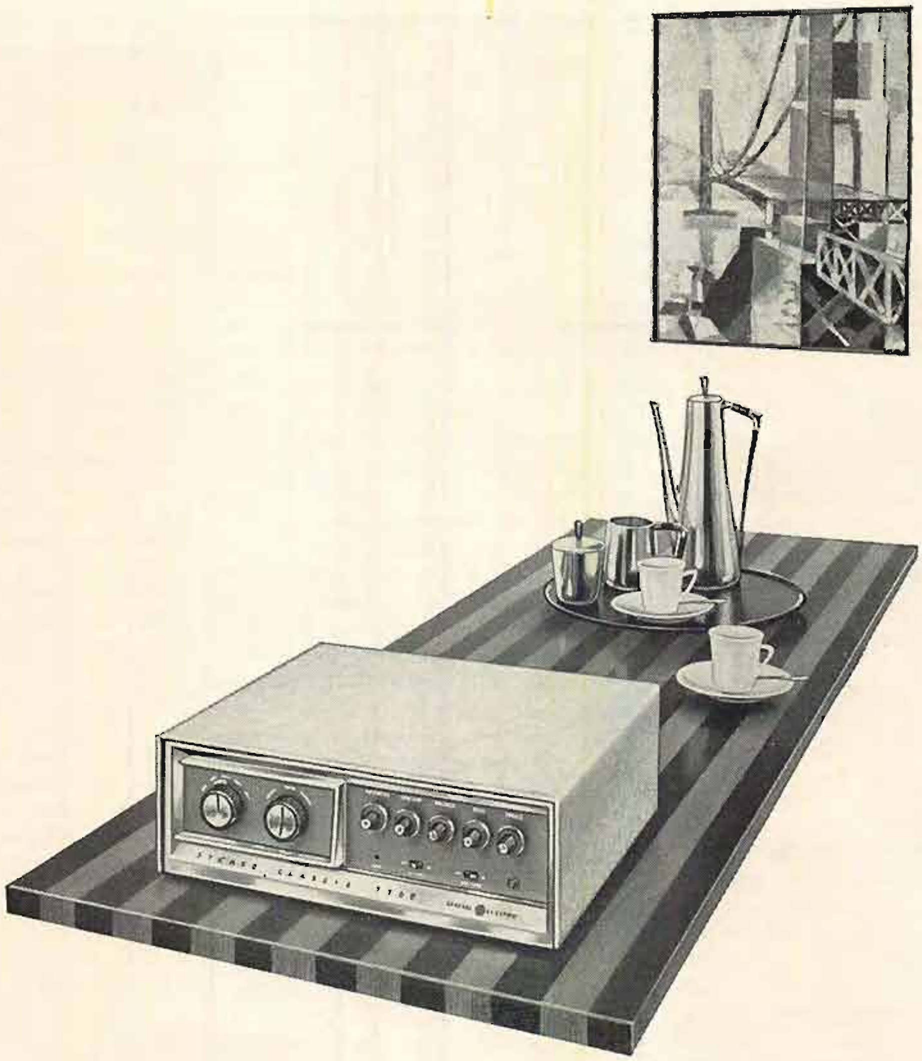


Fig. 17. Third-harmonic distortion in the voltage across L as a function of the flux density B for values of ω_L/R.



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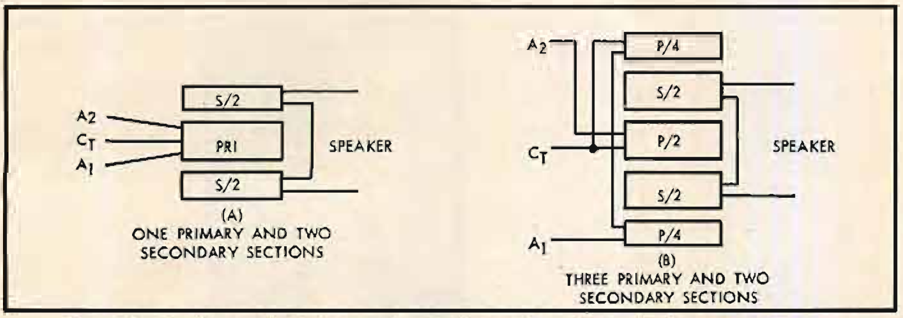

Fig. 13. Further subdivision of windings to reduce leakage reactance.

The point in the frequency range at which the falloff begins to be significant (rather arbitrarily, the frequency at which the response is 3 db down) is a function of the ratio of the reactance of L_{SC} to the combined total circuit resistance $r_a + R_L$. When $X_{SC} = 2\pi f L_{SC} = r_a + R_L$ the loss is 3 db and increases at the rate of 6 db per octave as shown at (B) in *Fig.* 7. The similarity between the relations governing the high-frequency loss and those governing the low-frequency loss will be apparent on comparing (A) and (B) in *Fig.* 7.

Leakage Reactance

Clearly if the response is to be well maintained up to the highest frequencies, L_{SC} must be reduced to a minimum so the factors that affect L_{SC} will now be considered. Little thought will be required to decide that the leakage inductance will increase as the number of turns on the windings increase, following the normal law that inductance is proportional to $(\text{turns})^2$. Advantage cannot be taken of this relation to reduce the leakage inductance, for as we have seen earlier the total turns are fixed by the response that is desired at the low-frequency end of the range. The alternative course of action is to reduce the amount of leakage flux from the primary that fails to couple with the secondary winding. This is a question of bringing the secondary winding as close to the primary winding as is physically possible. Some possibilities will be considered.

The worst possible arrangement is that of the elementary transformer of *Fig.* 11 where the primary winding is arranged on one limb and the secondary winding on the other limb. Leakage flux then follows the path shown and may amount to an appreciable fraction of the total flux. It may be greatly reduced by winding the secondary on top of the primary winding as shown in *Fig.* 10 and abandoning the core type of lamination shown in *Fig.* 11 in favour of the shell type of *Fig.* 8. Magnetic leakage then follows the path shown in *Fig.* 10 and will obviously be a great deal less than in the simple arrangement of *Fig.* 11. Further reduction in leakage may be achieved by dividing either winding into two halves and disposing them about the other winding. This technique of sub-division may be carried still further, both primary and secondary windings being sub-divided into sections and interleaved. Some typical arrangements are shown in *Fig.* 13. That of (B) has particular advantage in push-pull circuits in that the two half primaries can be made to have the same resistance by using *P/4* and *P/4* in series for one half primary, with *P/2* for the other half. This also equalizes the leakage inductance from either half primary into the secondary.

There are two alternative approaches to the problem of reducing leakage inductance that are worthy of comment. Reduction of the spacing between the primary and secondary sections is clearly an advantage but a limit to this technique is set by the necessity of providing interwinding insulation between the sections capable of withstanding the plate supply voltage and signal voltage excursions. It is usual to operate amplifiers with the secondary winding at or very near ground potential but with the primary winding at B+ potential. The newer insulations with high dielectric strengths that are now appearing offer considerable advantages in reducing the thickness of the intersection insulation.

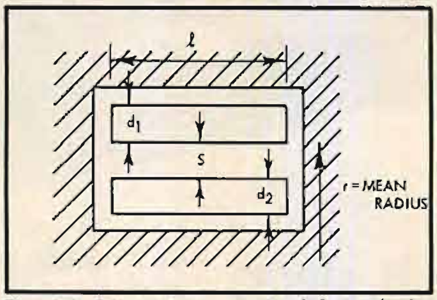

Fig. 14. Dimensions required for calculation of leakage inductance.

The leakage inductance of any particular arrangement of coils can be calculated with a moderate degree of accuracy and it is worthwhile examining the relationship for the light it throws on the factors responsible for leakage. A simple formula that gives good agreement with measured values is

$$L_{SC} = 3 \cdot 2 \times T^2 \times \frac{2\pi r}{l} \left(S + \frac{d_1}{3} + \frac{d_2}{3} \right) \times 10^{-8}\ H.$$

the symbols having the meaning shown in *Fig.* 14. From this it will be seen that the leakage inductance is increased by an increase in the radius r of the winding, by an increase in S, the spacing between coils or decreased by an increase in l, the wound length of the coil. A lamination having a long narrow window such as that of (A) in *Fig.* 15 will give a lower leakage inductance per turn than one with a square window such as that at (B). This is not quite the advantage that it appears at first sight, for laminations with long windows tend to have long iron paths and thus have a lower primary inductance L_p per turn than one with a square window. Nevertheless there is an advantage to be gained by an appropriate choice of lamination shape.

Distortion

The last performance characteristic to be discussed is the generation of harmonics and intermodulation distortion by an iron-core device. This is not such a well understood subject and in consequence will be covered in rather greater detail than was thought necessary for some of the earlier characteristics.

How does distortion arise in an iron-cored device? Fundamentally it is due to the non-linear relation between the magnetizing force H and the resultant flux density B produced in the iron core, but it is also due to the presence of hysteresis in magnetic materials.

In an ideal magnetic material, the magnetizing force H would produce a magnetic flux density B proportional to H. Thus if H were doubled (by doubling the current or the number of turns) B should double. Moreover, B should have the same value for any particular value of H, irrespective of the direction in which the current flows in the magnetiz-

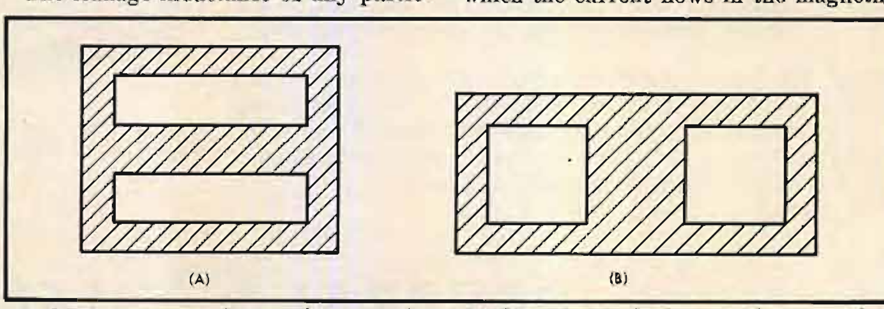

Fig. 15. Laminations having long windows (A) have lower leakage inductance than those having square windows as at (B).

U.S. PATENT 2,775,309

There are hundreds of United States Patents on loudspeakers. Most of them relate to minor improvements; a few have changed the face of the speaker industry.

AR's patent on the acoustic suspension speaker system has had far-reaching effects. A very large number of speakers has been produced under the patent by AR and its licensees, and speaker design in general has been given a new direction. In our opinion this patent has proved to be the most significant issued in the speaker field since 1932, when Thuras was awarded a patent on the bass-reflex enclosure.

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The acoustic suspension principle is now used in four AR models—the AR-1, AR-2, AR-2a, and AR-3, priced from \$89 to \$225. We invite you to listen to these speakers at your dealer's, or, if you live near New York City, at the AR Music Room in Grand Central Terminal.

Literature on AR speakers is available for the asking.

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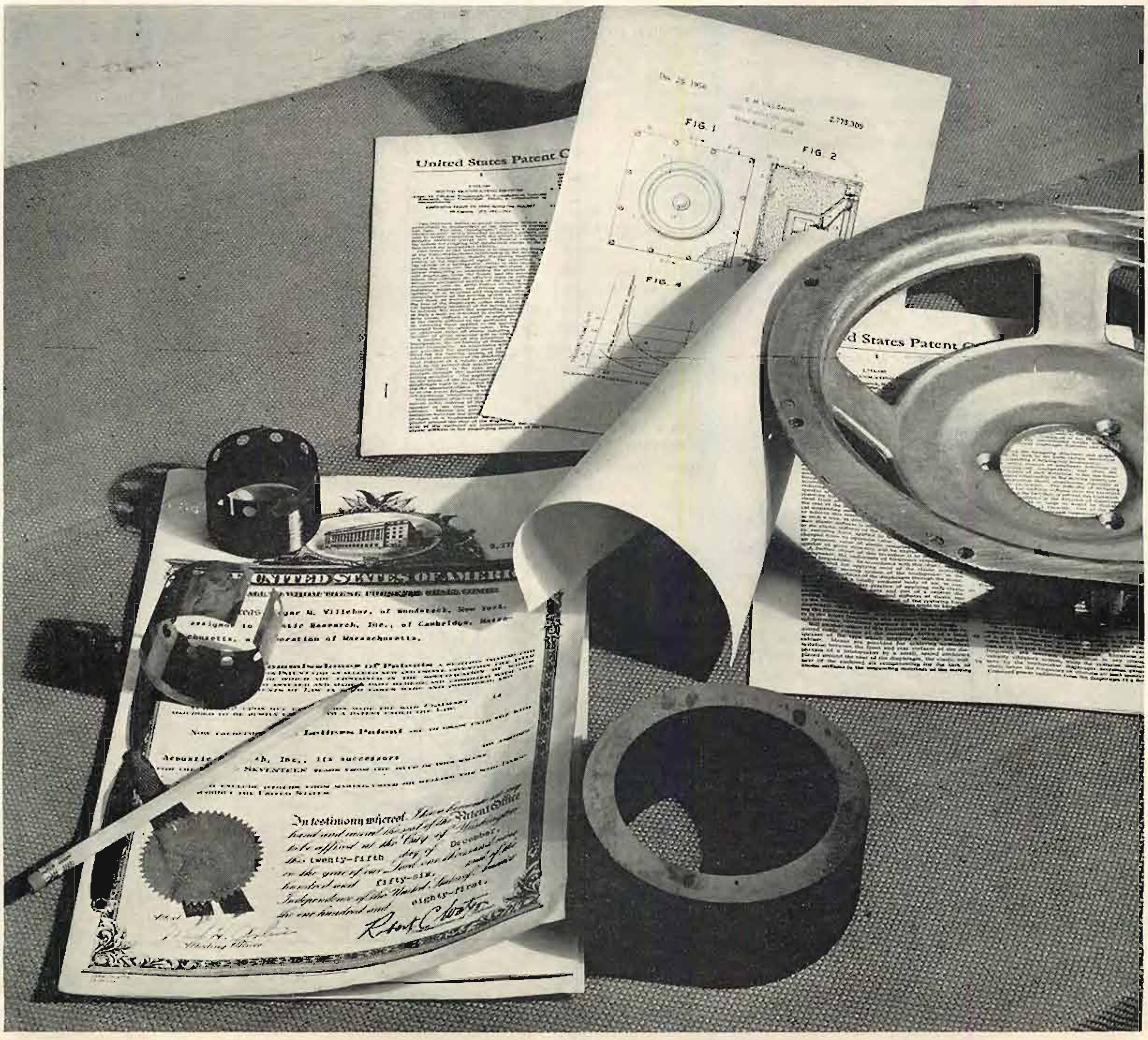


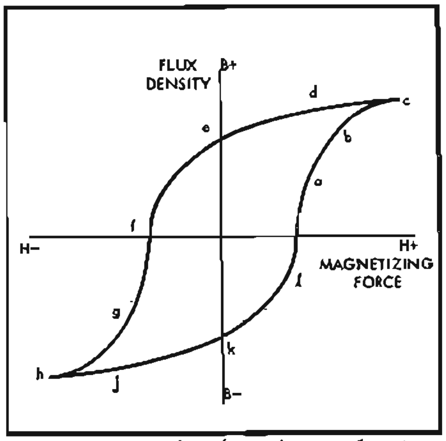


Fig. 16. Typical B/H relation for iron laminations.

ing coil. Neither of these requirements is met in a magnetic circuit that consists wholly of magnetic material. What does happen is illustrated by *Fig.* 16, a typical B/H relation for a transformer steel.

Starting from zero current in the magnetizing winding, but with the iron path magnetized by the previous cycles of the supply, the flux density in the iron rises roughly proportionately to the current up to point a in *Fig.* 16 then less than proportionately from a to b, and finally saturates at c; very large increases in magnetizing current are then required to produce very small increases in flux. If the direction of the current flow is reversed, B commences to fall, not along the path c, b, a, but along a new path, d, e, f, where the values of B are always higher than were obtained for the same values of H when H was increasing. The magnetizing current must be *reversed* to reduce B to zero at f, a symmetrical path g, h, i, k, l then being traced as H increases to a negative maximum, reverses, and returns to zero. The point of importance is that the path followed by the value of B encloses an area instead of merely following a straight line. From the B/H relation of *Fig.* 16 it may be deduced that a sinusoidal magnetizing current in the primary coil will not produce a sinusoidal flux waveform in the iron circuit. As the secondary voltage is proportional to the rate of change of flux, a sinusoidal secondary voltage can only be produced by a sinusoidal flux waveform and this will in turn only be produced by a non-sinusoidal current wave in the primary winding.

At this stage it would appear that an impasse has been reached for distortionless reproduction demands that a sinusoidal voltage on the grid of the output valve produces a sinusoidal voltage across the output transformer secondary, though it has been shown that this result can only be achieved by supplying a non-sinusoidal current to the transformer primary. However, the impasse is only the result of shallow thinking about the problem as it may be shown that if the impedance of the source is very small, a sinusoidal voltage applied to the transformer primary will result in a non-sinusoidal primary current, a sinusoidal flux waveform, and a sinusoidal secondary voltage. The significant point is contained in the phrase "if the resistance of the source is very small" and the question that immediately jumps to mind is, how small? There are few abrupt discontinuities in nature and it is unlikely that the distortion will prove to be zero when the source resistance is zero and yet rise sharply for very low values of source resistance. Common sense is right on this point. A detailed analysis shows that the percentage distortion is related to the ratio of circuit resistance to the inductive reactance of the primary winding of the transformer and is a function of the maximum flux density at which the iron is worked. This latter result is to be expected for there is a fair degree of proportionality between H and the resultant B if the flux density is not allowed to exceed point a in *Fig.* 16. Unfortunately a low flux density means a large core and an expensive transformer.

The advantages of a low-resistance source in minimizing harmonic distortion are less obvious and need a more detailed explanation. If a generator of zero resistance and a sinusoidal voltage waveform supplies current to a resistive load, both the current and voltage have sinusoidal waveforms. When the resistance load is replaced by an inductance the voltage waveform remains sinusoidal but the current waveform is distorted by just the right amount to produce a sinusoidal flux waveform and thus a sinusoidal secondary voltage waveform. The primary current wave is then found to contain a high percentage of third, fifth, and seventh harmonics. In an intermediate condition when the circuit contains some resistance, the current drawn from the source is less distorted but the distortion of the voltage waveform is increased. In general any resistance in the circuit prevents the inductance drawing the harmonic currents it requires to maintain a sinusoidal flux waveform. If a sinusoidal flux waveform is not maintained then the waveform of the secondary voltage will be non-sinusoidal.

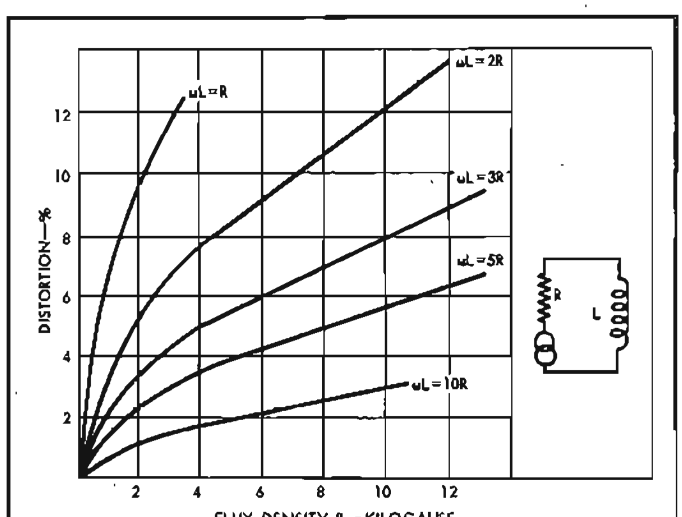
When considering the low-frequency response of a transformer it was shown that the resistance that controls the response is the parallel combination of the source and load resistances. The same parallel combination also controls the harmonic distortion that is generated. If the transformer is a poor example with high resistance windings these winding resistances must be added to the load resistor before working out the parallel combination.

Most of the manufacturers of transformer steels have produced curves showing the relationship between distortion and the ratio of the effective circuit resistance to the reactance of the primary winding. Typical curves for a 4 per cent silicon steel commonly used in high quality transformers are shown in *Fig.* 17. The most significant information to be obtained from the curves is the very high distortions that occur even at low flux densities when the source resistance is comparable with the reactance of the transformer primary winding. Earlier in the contribution it was shown that a transformer having a primary inductance of only 10 henries would have a frequency response only 3 db down at 50 cps when used with two EL34 valves working into a load of 3400 ohms. It is interesting to calculate the harmonic distortion that is produced if such a transformer is used.

At a frequency of 50 cps an inductance of 10 henries has a reactance of 3140 ohms, approximately equal to the effective generator resistance when using two EL34's in push-pull. The left hand curve for $\omega L = R$ is then appropriate. The core flux density when the power

(*Continued on page 68*)

Fig. 17. Third-harmonic distortion in the voltage across L as a function of the flux density B for values of ω_L/R.



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PRESTO

AUDIO ETC

(from page 14)

levels are carefully checked and the table built into one permanent spot, immovably.

I will admit at once that my turntables are only sporadically level. For one thing, they aren't built-in. They sit, in boxes placed on tables or side shelves; or they stand on attached legs. I have yet to find a shelf or table that is automatically flat —or even flat all over; most are varyingly rounded over their minutely irregular surfaces. The legs on my floor-standing tables are adjustable, but the floor is too tricky for me to keep up with. My New York apartment building, for example, is relatively new and built on a steel frame, but the floors roll and heave like a stormy sea. Bookcases lean out from the walls and must be propped, tennis balls and such tend to roll downhill to the center of the room. Each time my table gets moved an inch or so for cleaning or the like, the legs are left with at least one and often two of them dangling in the air an eighth-inch or so.

I'm aware that good engineers *always* true up *all* turntable equipment. I don't—though I try. Neither does the public, I'll wager. So: I'm all for any arm that will play uphill and, more important, will play without side-pull and at correct pressure regardless of the billowing wooden waves in the normal American floor!

Oldsters will remember, in this connection, a large arm in the Pickering line that played uphill in similar fashion. It looked even more odd in the act, since it was long, heavy-looking, solid like a steel beam. But the general principle was the same then as now; arm weight is divided equally between the rear and front segments of the arm shaft, and stylus force is applied delicately as needed. But the Pickering arm pivoted only laterally; the vertical motion was taken care of up front by a built-in miniature "arm," somewhat as the Shure Studio Dynetic cartridge now operates at the front end of its long dart-shaped protuberance. The Empire 98 pivots both directions, in standard fashion, and its cartridge shell is also of the usual type, plugging into the front of the arm (with a screwtight holding ring to keep it there).

The specific principle of this arm involves a two-fold adjustment to a given cartridge, and this two-fold approach (also used in the ESL arm) had me so interested that even before I tried the Empire 98 I worked out a sort of adaptation of it, via movable weights, for my own older arms. More of that shortly. It works this way. First, you balance your arm to zero for the chosen cartridge by adjustment of the weight on the far side of the arm pivot. When this operation is complete, your cartridge just sits in the air, weightless. Perfect balance, fore and aft. Then you apply enough downward pressure upon the cartridge to give it the desired point pressure, and you're in business.

The Empire 98 adjusts to zero via a round rear weight that slides back and forth, with a set screw. (A bit of trouble with this; we removed the screw and rammed in a rubber plug that does a better job of holding.) When your cartridge floats, you move a handy dial-like knob on the side of the pivot housing, away from a point marked "O" and past a series of marks that say nothing, but imply grams of stylus force; the dial operates a nicely contrived spring that introduces downward push upon the front of the arm, gram by gram. This calibrated adjustment—starting with the cartridge floating at zero force—is claimed to be more accurate than any commercially available gram scale; I'm not inclined to argue though I don't go in for micro-accurate stylus-force tests. The scale is clear, unhampered, positive and very simple, and the range of adjustment is widely spread out. If I am right, the spring is such that the downward force is virtually linear over the normal range of vertical arm movement.

Now this last is a vital point. A non-linear spring—and we have plenty of them in millions of older changers, pulling the arm upward against its own weight—drastically increases stylus force as a changer arm is lifted upward, lowers it as the arm drops. In the old days when heavy stylus forces were measured mostly in ounces, the difference was a drop in the bucket, to mix metaphors. But now, when stereo pressures are so slight and stereo styli are as sharp as needles—real needles—the slightest variation is serious. (And how many dozens of springs can you remember that gave one reading as you tightened them up, slipped to an altogether different one when the adjustment was turned the other way?)

Present stereo changers have done ingenious things to get away from this, towards a light and constant stylus force, regardless of the height of the pile of records, and also to provide an accurate and trustworthy force adjustment. But I still feel that this is one of the weaker areas in changer performance, perhaps by necessity under the circumstance, and that therefore the separate ("manual") arm is generally a safer bet for performance. Especially if it is fixed up like this Empire 98 model.

Once your stereo cartridge is mounted, the balance set for zero and the gram scale turned to provide the desired stylus force, the Empire 98 goes to work and shows its stuff.

Mine promptly went dead. Ugh, says I. Gremlins again. But this was a baby Gremlin—a bad connection in that crucial spot, the small-bore joint between cartridge shell and arm, where the multiple stereo contacts must be made securely and minus shorts. There was a bit of play in mine; if you wiggled the cartridge shell, the sound came and went. But after a close look, my engineer assistant fixed it up and his grumbles were only half-hearted, which implied that it wasn't much of a job. No trouble since; but you might check that point when you get yours.

The next flurry of excitement was strictly my fault—I skittered the arm across a record and maybe damaged a high-compliance stylus. Just goes to show that you must learn to "run" your equipment almost by instinct, as you do your car. I change arms so often that I don't get the right habits. The Empire 98 has an ingenious and really very workable self-locking arm rest; it tripped me up only once, right at the beginning as described. The arm goes in, down and towards you and stays put, but lifts easily out again with a slight back-and-up motion. (Reminds me of the old trolley poles that used to hook down under a similar catch when not being used.) Of all the light-arm resting systems I've tried, this one is for me the best, so far. Some, like the magnetic arm rest that tends to bounce, seems to me downright dangerous, unless—like the Shure Dynetic—the cartridge force is so light that a skitter sidewise on the record does no harm but merely generates a perfectly hideous squawk. Bad for the nerves, anyhow, even so.

The minor troubles once corrected, the arm behaved beautifully and, indeed, has aroused in me a desire to convert my entire semi-permanent set-up to the Empire 98, a project that is technologically too drastic at the moment. The arm not only plays uphill and down and at any plane of inclination that my box happens to choose, but it also tracks like a breeze at almost no stylus force, which is an especial blessing for me.

You'll remember the old Canby Loose Floorboard test. I'd almost forgotten it; but I suddenly became aware that this arm was tracking merrily onward even while I trod heavily on the same old springy boards that in the past have so often thrown good cartridges into a tizzy of groove hopping. You can't bother this arm; as I understand it, the shocks and vibrations sort of cancel out—they hit both ends of the area, both sides of the pivot, and neutralize each other, A–A'. That is an inherently excellent virtue that should recommend any arm to you which can boast it. Groove-jumping from external shocks and resonances is still a major bother in present-day home hi-fi of many sorts, fancy and lowbrow alike.

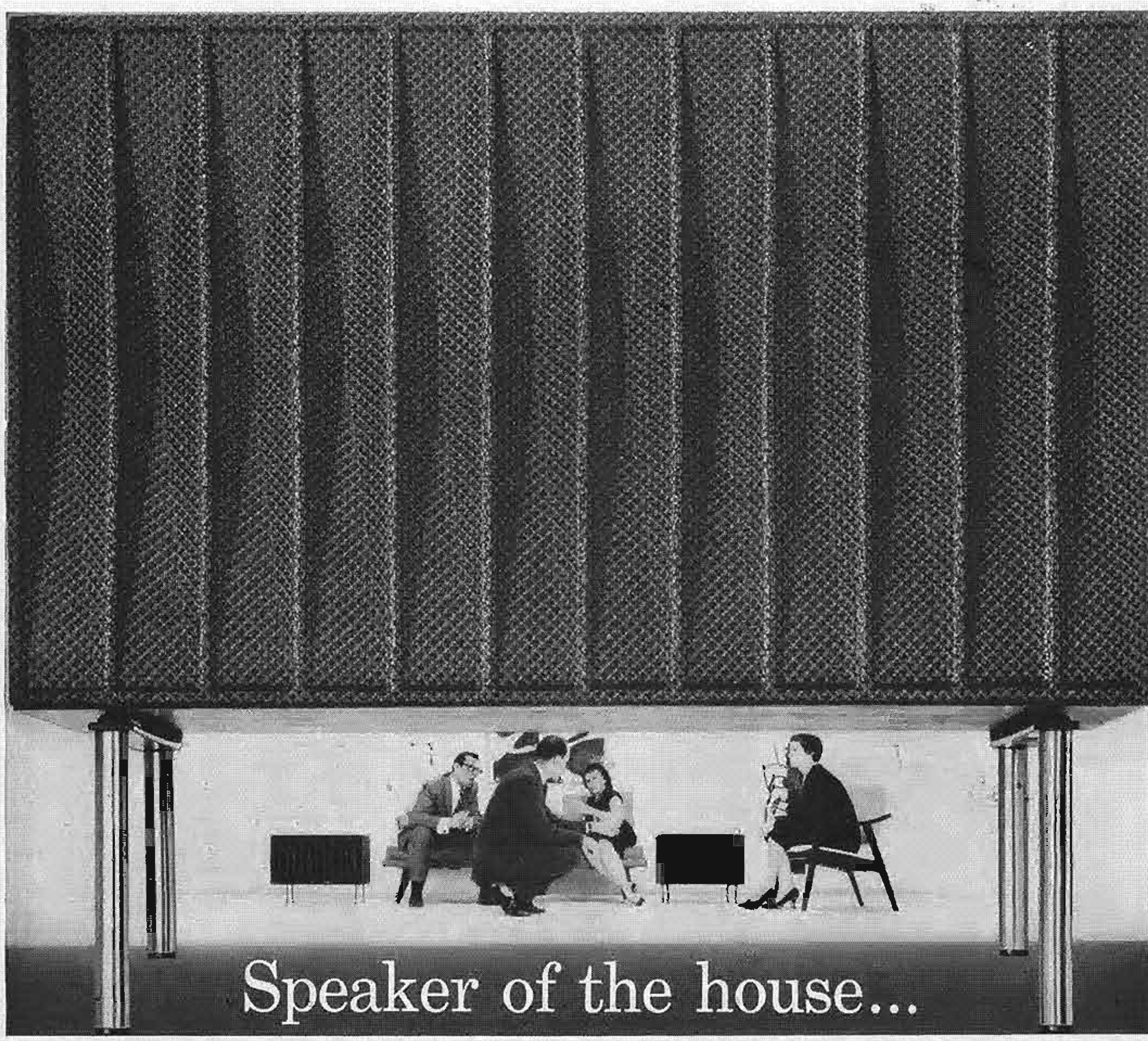
One recent record changer that I'm using at the moment in the country place goes into such violent oscillations on its spring mountings when I walk past it on certain of my familiar loose boards that the cartridge actually jumps up and down and skips as much as an inch of record. The blame there is mainly in the changer mounting; but it illustrates one more of the many household tracking hazards that must be coped with in every area where they occur, from floor boards to stylus. A stable, unshakeable arm like the Empire 98 is one very good element in a skip-proof set-up.

3. Floating Your Own Arm

I must describe my somewhat clumsy home-style flotation job, worked out on one type of arm that I've recently been using. Mine is not the only system worth experimenting with and it works only for flat-top arms—no tubular jobs. But it may at least start you thinking on your own modification of the idea. If you can do it without adding over-all weight, more power to you; I couldn't. It is possible that I've put on more extra weight than is desirable, but somehow I rather doubt it. I have a feeling that no harm is done and I refer the same to you technicians in case you want to verify it. The arms I used to try out floating system were a trio of the inexpensive viscous-damped arms imported from Japan—I reported on one of these some years ago upon receipt of it from a friend in that country. This little arm was excellent in its pristine state for mono use. (Mine is the simplest of the viscous-damped models; the fluid spills if you tip the arm sidewise for more than a few minutes.) It tracks marvelously—important for me—and it has a quick-change slider cartridge mount, which I need for comparing cartridges. The arm was cheap and I didn't mind buying three at a throw.

When stereo came, though, I almost threw them out. First, they weren't wired

(Continued on page 71)



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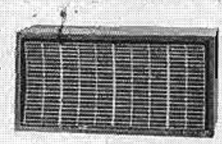

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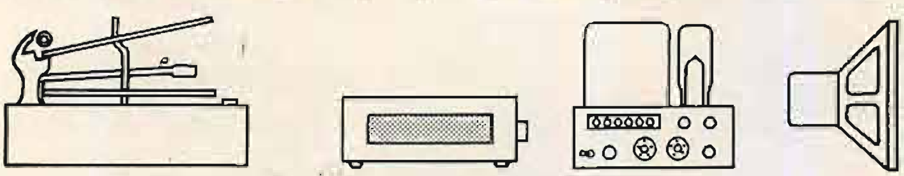

PROFILE

H. H. SCOTT 299 STEREO AMPLIFIER

In the November, 1959, issue, this section profiled a Scott 299 amplifier which was one of the earliest units built and which had been in our hands since the previous April—in fact, the company had no record of our having received it for test and wondered how we had gotten it. Since the measurements were not expressed in the now standardized IHFM terms, H. H. Scott Inc. forwarded us two recent units to be checked and rated under the IHFM Standards.

Measurements under these Standards become rather involved, as is apparent to anyone who has read them carefully. For the specification of output, power in watts is measured for a rated percentage of distortion, which for the Scott amplifier is 0.8 per cent, in contrast to the recently adopted standard of the Electronic Industry Association which calls for a distortion of 5 per cent. We still believe firmly that all high fidelity component manufacturers should rate their products' outputs in "Hi-Fi Watts," which we have heretofore proposed as being the power output at 1 per cent distortion, in contrast to the much higher figure used by most of the so-called "package" manufacturers. However, 0.8 per cent is even better than 1 per cent, which is to the credit of Scott.

In accordance with the Standards, therefore, the latest measurement on the 299 gives a figure of 18.6 watts on one channel and 19.1 watts on the other at 0.8 per cent distortion.

Power Bandwidth is the term which is used to specify the performance of an amplifier at the frequency extremes, and is stated as the highest and lowest frequencies at which the distortion is the rated value (in this case, 0.8 per cent) at 3 db below the rated output, which is 17 watts for the 299, according to the manufacturer. On the two channels, we measured 33 and 22 cps, respectively, as having the 0.8 per cent distortion at 8.5 watts (3 db below the rated 17) for the low end, and 22,000 and some value beyond the range of our distortion-measuring equipment. Therefore, the poorest Power Bandwidth figure would be 33 to 22,000 cps.

It should be reasonably obvious that measurement accuracy attains a rather high order when variations of less than 1 db are encountered; in this range, for example, from 16 to 20 watts is only 1 db. Power outputs are usually calculated from voltage measurements made across a load resistor (which in itself *should* be a pure resistance, which is almost impossible to obtain; a wire-wound resistor has considerable inductance, and this can cause unusual effects in the higher frequencies) and since power varies as the square of voltage, the effective "power" scale is spread out on a voltmeter scale. For greatest accuracy, a calibrated oscilloscope should be used.

IHFM Standards have not yet been promulgated for measurements of intermodulation, distortion, and until recently we have applied our own rating to amplifier output on the basis of the power at which IM distortion was 2.0 per cent. Some engineers believe that present IM methods (two frequencies, 60 and 7000 cps, with the higher tone 12 db below the lower) serve only as a measure of low-frequency distortion of the amplifier, while others (including ourselves) believe that IM measurements give a closer measure of the audible distortion in an amplifier than do harmonic measurements, since music is largely harmonic in structure and harmonic distortion is not so detrimental to quality as is IM. This argument has not yet been resolved in the IHFM, although many other reputable organizations subscribe to IM measurements as being perfectly valid—notably the SMPTE, Westrex, and Altec. In any case, we made IM measurements on the 299, and at 1, 5, 10, and 15 watts the distortions were 0.13, 0.24, 0.33, and 0.64 per cent, reaching 1 per cent at 16.6 watts and 2 per cent at 18.0 watts. Thus we would normally rate this amplifier at 18 watts.

One other measurement relating to power output is described in the IHFM Standards, and this gives a higher numerical value than Continuous Power Output. The term "Music Power Output" is given to a measurement made with "significant supply voltages maintained at the same value as they were under no-signal conditions." Actually, this is an important figure, since the ability of an amplifier to handle instantaneous peaks of power is important with music waveforms where tones such as a piano have a high peak value but the integrated power output over any appreciable amount of time is considerably less. Thus, for example, it is likely that an amplifier with an MPO rating of 20 watts and a continuous power rating of 15 watts would undoubtedly sound better than a 15-watt amplifier with a MPO rating of only 16 watts. The usual (and simplest) method of making this measurement is to introduce a shunting resistor across any series resistance or choke in the power supply so that under high power outputs, when the output stage draws more current than in the no-signal condition, the voltage applied to the output tubes is the same as in the no-signal condition without the shunting resistor. Factors tending toward a high MPO rating are a large storage capacitor (the one from the output-stage supply tap to ground) and a low value of series resistance between rectifier tube and the supply tap. On the 299 measured, we found the MPO rating to be 21.2 watts on one channel and 22.0 on the other, both at 0.8 per cent distortion at 1000 cps, in accordance with the Standards.

IHFM Standards specify that hum and noise measurements shall be made using the weighted 40-db (A) curve of ASA Standard Z24.3-1944. The 299 measured showed, under these conditions, a hum and noise level of −69 db on the phono and tape-head inputs and of −86 db on the high-level inputs, both figures being significantly better than stated in the earlier PROFILE. For the information of anyone who cares to duplicate hum and noise measurements in accordance with IHFM Standards, a circuit consisting of a .03-µf capacitor in series with 10,000 ohms can be used ahead of the high-impedance VTVM, which is then connected across the 10,000-ohm resistor. This will approximate the 40-db (A) curve of the ASA Standard. C-24

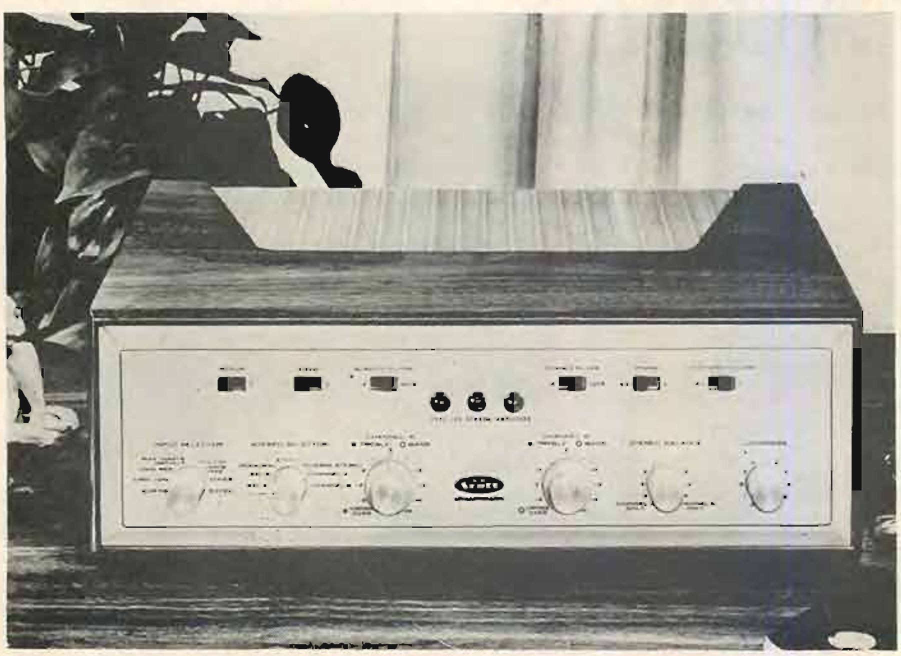

Fig. 1. H. H. Scott Model 299 Stereo Amplifier.

Record Review

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Handel: Royal Fireworks Suite; Water Music Suite. Phila. Orch. Ormandy.
Columbia MS 6095 stereo

This is unregenerate Handel for those who go nuts over Bach-Stokowski. I suppose there really is a continuing market for such stuff, among people who have discovered that old Handel isn't so bad if you make him sound enough like Rachmaninoff. To tell the truth, I was once nuts myself (aged fifteen) over the Hamilton Harty arrangements (and the Beecham ones) of the Fire and Water music. But I went on to higher things and so, too, have we all as a group. Even kids now like Handel himself, these days, minus doctoring.

The Fireworks Suite is in the Harty arrangement, played here with the largest possible forces and the biggest possible blur. The Water Music is listed as arranged by Ormandy; the sound is that of the familiar Harty arrangement, touched up and enhanced with extra ultraviolet. Dreadful—absolutely dreadful, is all I can say.

(P.S. If huge sales on this disc help pay Columbia for the cost of some of its more worthy offerings, I can't complain too hard.)

(P.P.S. I forgot—there's also one of those dirge-like Corelli suites that date from the times before we had discovered that Corelli was a human being.)

Handel: Israel in Egypt. Dessoff Choirs, soloists, Symphony of the Air, Boepple.
Vox STPL 511.642 stereo

This is the first recording of the big Handel piece (double chorus, three soloists and orchestra) to do justice to its dramatic force—the very essence of the music as first conceived. I'm prejudiced, of course; I sang in this performance as a Chorus II tenor.

The performance was recorded at a concert, necessarily (with some re-recording afterwards), and suffers in some respects, inevitably—though not from coughs and noise; an attentive audience and good tape editing have virtually removed all sense of audience interference. The sound, picked up from fairly close-up mikes on the stage, is spatially not as ample as it might be and some sections of the large singing chorus are a bit too close for a good blend, notably the tenors of Chorus I. But the dramatic impact of an exciting, arresting performance is captured beautifully. Even the slight raggedness here and there of a stage performance not subject to leisurely re-takes will please any informed listener who is after the meat of the music, merely by its genuineness and sincerity.

And it is the meat that we hear, no two ways about it. This predominantly choral piece (only a few scattered solo arias) paints the great events in Egypt—the plagues, the crossing of the Red Sea on dry land, the overwhelming of Pharaoh's soldiers in the flood—with almost violently dramatic force, cumulatively, one thing hard upon another, building excitement. Boepple, this conductor, piles up the tension and draws out the pictorial magic straight through—where so many performances treat each piece as a static, separate "oratorio" number, minus a thought of drama. (See the incredible Huddersfield recording, on Angel.) Other recordings have aimed in this direction—but the Westminster Utah version is raw and somehow collegiate in sound, musically unpolished, the ancient Concert Hall British recording is done with a tiny chorus in madrigal style.

The complementatry drama of grand philosophising that is Handel's most magnificent dramatic tool of all is gorgeously handled by Mr. Boepple—those great eight-part choruses of comment, glorifying the Lord and his works, the big, fugal climaxes recounting what has been accomplished. Good stuff here, even with a few amateurish yawps and shouts from over-enthusiastic singers and some bloopers of a minor sort in the orchestra.

The stereo is particularly good and useful in this double-chorus music, close-up miking adding more impact to the intended separation of the two choral groups. Even the orchestra is nicely spread out, though close.

Miriam Burton, Betty Allen, and Leslie Chabay are the three competent soloists, all very musical if not exactly Handel-type singers. There's organ and harpsichord (Prince-Joseph, Conant) nicely balanced. One soloist makes a serious mistake in one aria, but I'll bet you can't find it, so deft was the recovery, unless you follow with a score and have razor-sharp ears for parallel fifths.

Haydn: Horn Concerto in D; Trumpet Concerto in E Flat. K. Arnold, horn, W. Gleisle, trumpet; Pro Musica Orch. Stuttgart, Reinhardt.
Vox STDL 500.480 stereo

This attractive and simple album is one of a new international-type series on Vox, (Music of Five Centuries), manufactured for sale in various countries, the notes in this album printed in both English and French. After so many garish color-covers, this one's plain light blue with a pink label stands out by reason of its very simplicity. (But the cover tends to curl a bit.) My eye likes it.

An interesting listening-point comes up in respect to these two works. The musicological scholarship quoted in the notes tries hard to pin down the horn work as to its problematical date, but isn't very convincing; the familiar Trumpet concerto is well known as a late-Haydn piece, from 1796, the time of the big oratorios ("The Creation" and "The Seasons"), written after the last of the symphonies.

Now I maintain that any good listener who has heard a lot of Haydn, Mozart, Bach, and the like can spot the approximate dates of these two works without any help at all from scholarship, just by their sheer sound. If you've listened to the period, you'll recognize the styles as you can spot, say, a family photograph of the 1920's by the clothes the relatives wear as well as by their familiar faces.

No trouble with the Trumpet Concerto, which is here played admirably and without those once-usual modernizing alterations. This is obviously, in the listening, of the, shall I say, almost-Beethoven period. Being Haydn, it is not as emotional, as Romantic, as much late Mozart. But many a passage is already technically beyond Mozart, sounding like early Beethoven. And all the way through, you'll hear tunes right out of the "Creation"—if you know that work. Haydn, all right, even if you didn't get told of it officially.

The Horn concerto is much earlier—clearly, to any listening ear. It belongs in that interesting in-between period, before Mozart (or in his childhood), dominated by the Stamitzes and then the Bach sons, notably K. P. E. Bach. You can tell, by the way it sounds, the "busy" effects, the ultra-simple harmonies, the quick arrival at the rudimentary "second theme" idea . . . but, as I say, these things are heard much more easily than they are described.

The musicologists have laboriously dated this music as "before 1781." Boosey & Hawkes publish its score as of 1767, "without," as the notes say, "quoting evidence to support" the date.

Well, the evidence is there all right. It's right in the sound of the music. Try it and see, in pleasing stereo, nicely recorded.

Chopin: The Fourteen Waltzes. Alfred Cortot, piano. (Recorded in 1934).
Angel COLH 32

What an extraoldinary experience this reissue turns out to be! To hear this great pianist of another time play these works in his prime, in a manner that simply does not exist any more, is a joy indeed and a revelation of the true meaning of the waltz as Chopin composed it.

True, Cortot played a full hundred years after the composer himself, and we today have added a mere quarter century to the span. Nevertheless, time's horizon's are narrow, twenty-five years is just about the full span of living memory, and in this last quarter century the world—and music too—has changed with frightening speed.

It's hard for me to believe that in those very days, the mid-thirties, I myself bought a companion Victor 78-rpm album by Cortot, the 24 Chopin Preludes, and found them very dull, in my youthful snobbishness! Chopin himself was unbearable to me at that age; now, with these many years of listening behind me, I marvel at the fluid, alive sound of these waltzes, and so will you. Live and learn.

Above all, Cortot, in the manner of his time (which was the early part of the century, beginning even before 1900), was a master of what we call *rubato*, a most inadequate word used to describe the subtle art of irregularity in the time values of performed music. *Rubato* is taboo nowadays in most playing; when it does appear, it is no longer the old sort, or seems stiff, false, exaggerated and uneasy—the art of it is largely lost. Waltz time is waltz time, and that is that. But Cortot's waltzes are incredible. You can't possibly "beat time" to them; no two beats are alike, many are virtually non-existent, deftly shortened or even omitted where they have no expressive function, others are subtly lengthened, for the most poignantly lingering accents on those big moments of supreme poetry that make the waltzes live. The music under Cortot's hands seems to fly, as light as air, passionate, musing, poetic, ultra-intense but gentle and winsome too. Extraordinary!

No, I don't suppose we can prove that Chopin himself played like this. The printed music doesn't indicate it, and wouldn't in any case. But Cortot surely persuades us that this *must* be the grand tradition, the true intent of the music—it couldn't be otherwise! It is a way of playing that is now beyond recapture, except through such living recordings as this one.

Technically, the piano sound is excellent, scarcely ever distorted even in the loudest parts. Surface noise has been almost eliminated in the LP processing, no doubt from the original masters.

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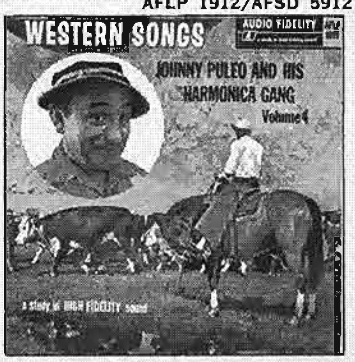

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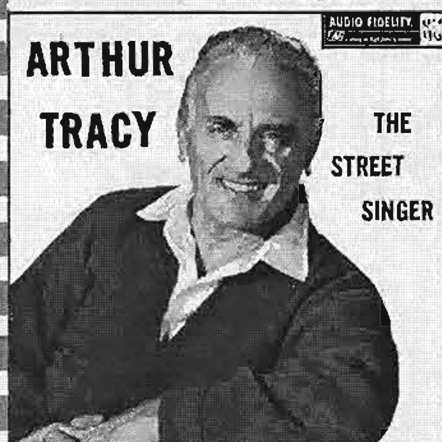

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Brahms and Strauss Lieder. Irmgard Seefried; Erik Werba, pf.
Deutsche Grammophon DGS 712018 stereo

This is just one more in the long series of records by this extraordinary singer, but it is as uniquely exciting as any in the past.

What makes a great singer? First of all, a keen musical ear—even before a great voice; but along with the ear, in lockstep with it, there must be personality, emotional intensity, passionate devotion. Seefried has a strange, almost unearthly instrument not like any I've ever heard before; I keep thinking that in some way, it is a tomboy voice, a wild, passionate, lusty, peasant-like, little-boy voice that quite often squeaks and yawps in strangely homely tones, yet somehow projects a musical sincerity and passion that—also—reminds me of, a peasant, Joan of Arc, Bernard Shaw's Joan, full of fire.

She makes a new thing of every song she sings, personalizing the music, bending the line and shape (within acceptable bounds) to fit her peasant-pure delivery, the flat, wobble-free low tones, the almost shrieking high tones, utterly true in pitch and emotional projection. This little gal will never bore you with *her* singing!

Erik Werba is her ever-excellent accompanist. The stereo sound is so-so, the piano rather distant and lacking in bass, the voice rather too noticeably off to one side for natural realism. In two minutes you'll forget all about such minor considerations.

Strauss: Don Quixote; Till Eulenspiegel. Berlin Philharmonic, Kempe.
Capitol SG 7190 stereo

This is a limpid and lovely recording of the well known tone poems, leisurely, relaxed, low-voltage yet never dull. Those who have been nurtured on the high-tension Strauss of Fritz Reiner (on RCA Victor) may find this kind of Strauss hard to accept for awhile—it is very different. But, length aside, it is well worthwhile, Reiner notwithstanding (and I think Reiner is the greatest Strauss man alive).

Length is the main difficulty in "Don Quixote." It never fails to fascinate me at the beginning, this work—and I am always driven to saturation long before it ends. *Such* endless spinning-out of a good idea! Fortunately, a recording may be played in bits and pieces to taste; Capitol (EMI) obliges here by splitting the big piece onto two sides. Maybe you'll never get to side 2.

But you should, for "Till Eulenspiegel" gets its corresponding pleasing and gentle treatment there, in the same manner. In both works the stereo sound is quite lovely, a gentle, big, shiny sound but somehow very natural and modest, the many solo passages throughout the orchestra nicely located and related in the comfortably big space. Excellent.

Gershwin: Rhapsody in Blue; American in Paris. Leonard Bernstein, Col. Symphony, N.Y. Philharmonic.
Columbia MS 6091 stereo

Here is the familiar Gershwin pair in new-style stereo, with Bernstein the pianist in the "Rhapsody" and the conductor of both, and never has Geshwin been given the red carpet treatment so fully. Both works have a huge, monumentally symphonic air to them, bathed in a vast liveness according to currently prevailing tastes for "symphonic" music of the higher classical sort. Both have excellent jazz-style soloists—the clarinet and trumpet in the "Rhapsody" are very much in style—but they are distantly situated, far off in the vast concert-hall spaces, melting in a buttery sort of way into the great, golden symphonic sound.

Nope—this I don't like. I keep remembering (but can't find) the ancient Whiteman dance band version of the "Rhapsody" on 78-rpm records, done up in the dry 'Twenties style, snazzy, hard, close-to, without a trace of golden liveness or romantic bigness. This new version seems just right for a super-colossal movie spectacular, which isn't my idea of the Gershwin sound at all.

To be sure, Bernstein has an unerring sense of the right musical approach for the lilting, tipsy parts and he has picked soloists who play right, too, minus any symphonic snobbishness. (Yet even so, that curiously sentimental, Chopinesque streak in Bernstein shows up here in the slow piano "blues" sections.) The musical sound is generally right, therefore, if pretty thick in texture. But why, then, does Columbia have to give it the huge symphonic treatment? I suppose because this was Gershwin trying hard to go classical! That must be the thinking, anyhow—unless it's done this way simply out of sheer habit, big liveness being standard for any symphony orchestra microphoning nowadays.

Perhaps if the disc had been done as a pops record, in another department, it might have had a more appropriate close-up treatment in the miking. But *that* wouldn't do—not for the Philharmonic and Bernstein.

The *real* trouble is that the Gershwin music is in itself a hybrid type, neither pops nor classical, and therefore simply will not fit into the machinery of either sort in the conventional way. Seems as though Columbia could have coped with this a bit more imaginatively—nobody wants a real pops stereo recording, with the clarinet one inch from one mike and the wah-wah trumpet a half inch from the other; but something could have been done to give a better and truer pops-jazz flavor to these works in their recorded sound.

Bartok: Piano Concerti #2 and #3. Gyorgi Sandor; Pro Musica Orch. Vienna, Gielen. Vox STPL 511.490 stereo

What wonderfully zestful music this Bartok is—now that we have grown to the point where we can take it without being horrified! The Second Concerto is the violent one, the most hi-figenic, out of the brassy, noisy 'Twenties and just before that sudden return to a softer near-Romanticism that came about in the whole musical world along with the Great Depression. If you have enjoyed the whirlwind music of the Bartok Music for Strings, Percussion and Celesta of slightly later (1935), you'll find this piece dear to your hi-fi heart. It's from 1931, and never were such marvelously furious sound generated in a piano and an orchestra. The opening movement uses winds alone, the second movement is for strings and the final movement turns on all the stops, with everything.

The Third Concerto is of a much gentler nature, from Bartok's last period, but this, too, has overwhelming attractions for those who know the Concerto for Orchestra of a year earlier.

I won't qualify the above enthusiasm one bit as far as the fi of this disc is concerned—it's a fine stereo, wisely and effectively miked with a good liveness but plenty of sharp, modern-style edge as well, the piano situated oddly off to the right and in excellent balance with the incisive orchestra. (It was to the right as I played it, anyhow.) But the performances are not up to my description, alas. I wish they were.

The pianist, Sandor, is a Hungarian and sometimes I think only a Hungarian can play this music. Sandor produces the requisite furiously, his fingers fly like the wind. But that isn't enough. The peculiar thing about Bartok is the immense, profound, Beethoven-like humanity in musical terms that lurks just behind all the sound and fury. It's enough to say that Sandor simply does not evoke that higher musical sense, as I hear it. His fingers are fast and furious, but the sense is missing. (He's better in the Third Concerto, a simpler and more easily projected work, which has been a specialty with him in the past.)

As for the orchestra, it betrays what seems to me a Viennese softness—quite unlike Sandor's hardness. The notes are all there, but the spirit is diffident, even a bit squeamish. An American orchestra would do far better in understanding, I think.

However—unless you know these works fairly intimately from other performances, don't let my hair-splitting bother you too much. The sound on this disc is terrific in stereo, which is enough to get much of Bartok's impact over.

BACK THROUGH OPERA

Strauss: Der Rosenkavalier. Schech, Seefried, Streich, Fischer-Dieskau, Boehme; Saxon State Orch., Boehm.
Deutsche Grammophon DGSR 7301 (4) stereo

Fanciers of this famous opera have their own special favorites for its important roles —the Feldmarschallin, Baron Ochs, the young Octavian (sung by a soprano)—and the opera even seems to have, like "Carmen," a number of distinct national styles, surprisingly different in view of the now-universal world exchange of artists via air travel.

New Yorkers, for example, may not find this all-German version quite what the Met might order; but I found it a moving and very musical performance on its own merits, interestingly cast with important German voices who know how to act via the musical medium. In addition, it is recorded in a strikingly dramatic manner, the singers so very close to the stereo mikes that the rapid-fire sung "conversations" of the Strauss idiom are startlingly personal and real, like dialogue in film and TV.

The orchestra, in this set-up, is relatively neutral in space, at some distance in the background. It is active enough, decidedly, and its details are entirely clear and beautifully projected in sound—but the violently close foreground impact of the singing voices sets it off a bit, somewhat as the unseen orchestra plays in many a film sequence while spoken dialog goes on in the foreground. Of course this is wholly foreign to the original musical intention as of the opera house, but in terms of the new medium of hi-fi stereo sound it is highly effective. The only detracting fault I can name is that to some extent the close-up voices are more breath-y, more strident than Strauss might have envisioned, the lovely tones less lovely at such close range. The extra dramatic (and musical) impact makes up for it, I say.

The album is handsomely got up in an appropriate orchid purple, the inner plastic record sleeves also of the same perfumed color, as is the large and informative booklet. Complete text and translation makes it a real pleasure to follow the opera's continuity. As to soloists, all are excellent in their roles and wonderfully dramatic, but Irmgard Seefried's Octavian is quite extraordinary, though not at all in the more or less expected style for the role. Her strangely boyish, flat tones may bother some who know the opera well, but most of us will enjoy her sheer musicality and dramatic fervor.

Donizetti: Lucia di Lammermoor. Callas, Tagliavini, etc., Philharmonia Chorus and Orch., Serafin.
Angel 3601 B/L (2) stereo

Puccini: Manon Lescaut. Callas, di Stefano, etc. La Scala company, Serafin.
Angel 3564 C/L (3) mono

I'm not much of an Italian opera expert and will not pretend to judge these performances in the whole; what interests me is the Callas voice; she has the lead part in both operas and dominates both recordings, one made in England, the other in Italy.

I'm not a Callas fan. In fact, all I have to say here is simply that for my ear she has one of the most unmusical singing personalities I have run into for a long while. I find her voice itself strident, uncontrolled, effective only in the low registers and at the top little more than a scream. Her musical instincts are rudimentary and her approach unsubtle, if I hear right. She sings with little feeling for pure pitch, her tones sloppily off-tune, colorless in the intonation. She apparently has no idea of a high note other than a wide-open screetch, she fumbles for notes, stretches, slides . . . well, why say more. Maybe I'd better go and hide, at this point.

All this applies in particular to the "Lucia" recording, one of her famous roles, I gather. I sampled the La Scala "Manon Lescaut" briefly and got the quick impression that in this more sumptuous and elaborate music of a later time she was more at home and did a better job. (It is early Puccini, from 1893). Try that for yourself.

I can state positive things about the two recordings, which are strikingly unlike in technique. The stereo "Lucia" is one of those experiments in stage-distance stereo recording, with the singers mostly off in a big space, not far in front of the big orchestra, the whole thing immersed in the expected huge liveness. Frankly, I think the technique is unsuccessful here—even though it might be claimed that this is nearer to the original intention. But keep in mind that stereo recording has its own rules and values, not all of them completely worked out as yet; it depends as much on illusion as any mono recording, must operate on its own, via its own advantages, as must mono.

These singers, even with stereo space to help them, are "off-mike," decidedly; their immediacy of impact suffers from far too much ring and blur. (Is it my correct impression that La Callas manages to get a bit closer to the mikes than anyone else? Maybe just my imagination.) The chorus and orchestra are both good in this big space. Not the solos.

The "Manon Lescaut" from Italy is not only done in mono but is served up in a drier, closer microphoning, for considerably improved effect, I would say. Opera needs close-up miking, even in stereo. Of these two I would immediately pick the mono recording as the more effective.

Bizet: Carmen. Rubio, Simoneau, Alarie, Rehfuss; Chorus, Orch. Concerts de Paris, Le Conte. **Epic SC 6035 (4)**

This is a rousing good "Carmen," even in mono. Indeed, it is an ideal mono-style operatic recording, with maximum advantage taken of the standard operatic know-how developed over so many years, prior to stereo. The performance is thoroughly French even though, oddly, the heroine is actually Spanish (as is Victoria de los Angeles in the rival recording) and one male lead is Canadian, the other German. The production is, so to speak, a stylish one and full of life. The Spanish Carmen herself has the rich, wobbly voice we associate with the role and she is full of vigor, too, even when fate closes in; the superb voice of Leopold Simoneau makes a passionate suitor for this frivolous-tragic heroine. Diction throughout (with close-to microphoning) is excellent and ultra-clear; those who know French will have no need of the libretto, though it is included.

The orchestra and chorus are lively, too, but not of first-rate calibre; the opera is carried here by its enterprising soloists. The chorus isn't overly important, but it could sing with better pitch. The orchestra tends to be metronomic when it plays alone, which is most likely the fault of the conductor. His accompaniment of the singers, though, is impeccable.

All in all, an enjoyable "Carmen."

Bizet: Carmen. De los Angeles, Gedda, Blanc, Micheau, etc.; Orch. Nat. de la Radiodiffusion Francaise, Beecham.
Capitol SGCR 7207 (3) stereo

I had time to play a good part of this one before deadline closed in—after I had written about the Epic recording preceding. This one has the magic name of Beecham attached to it (via EMI in England) and there is no doubt of his decisive part in its powerful impact.

But in contrast to the Epic version, and in spite of several excellent soloists, this "Carmen" mainly features the glories of the Bizet orchestra. It is a sort of grand orchestral tone poem, with voices added. In two minutes of play you'll be aware of its potency, this orchestra, even as the singers perform; it surrounds the singers, laps hungrily at their very feet, will not be denied—it plays up the smallest details of scoring and phrasing for top persuasiveness—fantastic. But I can't help feeling that this is, somehow, more than the opera itself calls for. "Carmen" after all, is not a tone poem in any sense, unless you prefer a voiceless version. Beecham would do *that* marvelously!

The performance is more international in style than the Epic version, even though French musicians abound in it—soloists, orchestra, and chorus. Bizet was accused of

Wagnerism in this music—you can hear what was meant in this Beecham version, so high-powered is the impact, so vast and impulsive the sound. Again, mighty impressive—but is this really Bizet, is it French? I have some doubts. The French orchestra itself, like most French ones, plays characteristically out of tune now and then and with the French-style nasal tone colors, but the Beecham-inspired style imposed upon it is not really French; it is much too lush and too passionate, if beautifully shaped in detail.

De los Angeles is an even more energetic and wobbly-voiced Carmen than Rubio. Her dramatic climaxes are arresting, and Beecham's accompaniment is dazzling. The chief tenor, Gedda, is, however, very much of an internationalist and not at all like the ultra-French Simoneau in the Epic version. Janine Micheau is left to uphold the pure French way of singing, and does it well, against pretty high odds.

Net result: though this performance is powerful and large-scaled, it seems to me to take "Carmen" away from its French sphere and blow it up to a heroic scale that has not only too much Wagner in it but also an overly big dose of latter-day Italian opera. I can't help feeling that these almost shrieking, high-tension climaxes, under Beecham, are too much for the music and for the French classic sense of proportion and reserve. The performance is incomparable in the orchestral playing; but as a whole, and in spite of its remarkable persuasiveness, I find it not really to my taste. Even with a lack-lustre orchestra I like the Epic version better.

The stereo sound is huge for the orchestra and places the singers mostly at a fair distance, as in the Angel "Lucia" recording—same company makes both.

Rossini: The Barber of Seville. Merrill, Peters, Valletti, Tozzi, etc., Metropolitan Opera Chorus and Orch., Leinsdorf.
RCA Victor LSC 6143 (4) stereo

RCA has hit upon a very satisfactory operatic procedure in this series of Met-inspired recordings, produced entirely under RCA direction. The best of the RCA team are here put to work, a smoothly professional cast of international scope, from Roberta Peters and Robert Merrill to the Italians Tozzi and Valletti—they sing as one, blended like so much good mayonnaise under the international skill of German Erich Leinsdorf.

The performance is so remote from an actual opera, at these recording sessions, that it constitutes virtually a new musical medium—I was on hand, with others of the press, for a section of this recording. No stage, no pit, no costumes and glamor; the big barn of a recording hall had a small stage just big enough for the soloists to walk on, before three spaced stereo mikes; the orchestra occupied two widely separated segments of the big floor, below at a distance and with separate mikes; the harpsichord and cello, for accompaniment, were isolated off to one side, with more mikes. Mikes were everywhere—dozens of them; two complete networks, one in triplicate for the stereo, an independent set for the mono. And the conductor waved from the rear of the room, then turned to talk via squawking "talk-back" speakers, to the glass-enclosed directors and other functionaries.

In the hall, the sound was not that of any conceivable operatic performance, no matter where you stood; but the multiple mikes fused the disparate elements into one, as heard here on these records. A dizzy but highly effective way of doing things.

RCA goes in for some calculated movement here—I saw some soloists walk as far as six or seven feet, from a side mike to a center one, during their singing. As elsewhere explained, I find this a doubtful procedure, leading more often than not to confusion and falsity in the listening. Better a static position, with quick, positive changes of location during silences. That, too, was used here, and is the best of the resulting sound.

RCA sells four records here at the price of three, in order to allow for high sound quality throughout. A worthwhile bargain, decidedly. Æ

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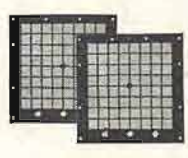

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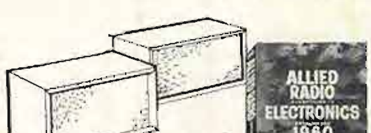

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JAZZ and all that

CHARLES A. ROBERTSON*

STEREOPHONIC

Jimmy Witherspoon At Monterey
Hifijazz J421

Carefully planned programs and the practice of allowing musicians rehearsal time have helped Monterey win a place at the top of the jazz festival heap—all in the short span of two years. After neglecting the first series of concerts, record companies made an appearance at the second and taped a fair share of performances. Surprisingly enough, the initial release ignores the principles on which Monterey's reputation is based, favoring instead such intangibles as spontaneity and audience communication.

When Jimmy Witherspoon closed the opening night bill last fall, he stepped on stage without benefit of rehearsal and dipped into his huge bag of blues at will. His instructions, limited to a shouted "Down home, A flat!" to pianist Earl Hines, are left on the record for everyone to hear. This signal for blues ad-lib is all the introduction the accompanying septet needs. The way it picks up the beat and rallies around is as fine an example of the true nature of jazz as you are likely to find anywhere. There is also the sound of the crowd's warm response which prompts the blues singer to pause and salute his mother, a devout churchwoman who had never heard her son sing in public before, since she will not enter the night clubs where he usually appears.

While serving in the Merchant Marine during World War II, Witherspoon gained his first experience singing with a band when a tour of duty in the Pacific took him to Calcutta. At the Winter Garden of the Grand Hotel, he was made welcome by Tommy Weatherford, a pianist from West Virginia who brought the blues to Asia by way of New Orleans and Chicago. On returning home, Witherspoon worked four years with Jay McShann before setting out on his own and making several hit single records. His chance to make an LP was a long time coming, but each in a series of three registers an improvement over the last and the singer is finally attaining the wider recognition he so richly reserves.

As several numbers picked are also on his album for World Pacific, there is an opportunity to compare a fine studio performance with one before a live audience. Despite rough edges and one or two disorganized moments, the concert version gains immensely from the festival atmosphere. In his ability to preach a sermon over surging horns, Witherspoon is in a class with Jimmy Rushing, Joe Williams, and Joe Turner. All are known as urban blues men and much has been written about how they differ from their country cousins. Both groups are alike in the determination to tell a story, however, and the city dwellers can no more be called band vocalists, in the ordinary sense of the term, than the guitar-playing singers of folk blues. They like to take charge and are at their best when instrumentalists, following their lead, sing along with them. When Witherspoon made that happen at Monterey, the crowd jumped to its feet and cheered.

The septet had warmed up during the previous set and two of its members were due to play featured roles the next day in an Ernie Wilkins composition on the evolution of the saxophone. The thought of this impending event may have impelled Coleman Hawkins and Ben Webster to write another historic chapter on the subject. Webster plays a magnificent, unstudied solo on *Ain't Nobody's Business*, and Hawkins spells out his mastery in large letters. Roy Eldridge gives a lesson on open and muted trumpet, while Woody Herman's clarinet figures weave in and out. Hines provides deep-toned introductions and shepherds the group throughout, aided by Vernon Alley, bass, and drummer Mel Lewis.

A description of the system of sound reinforcement installed for the first Monterey Festival can be found in the December, 1958, issue of AUDIO. Anyone who missed R. J. Tinkham's enlightening account of how he and his associates at Ampex Corporation dealt with a number of problems should retrieve a copy from the files. Besides being an excellent treatise on outdoor sound, it gives details of a stereo microphone setup designed to accommodate groups ranging in size from a trio to seventy-five pieces.

Appreciation of the many fine recordings likely to come from Monterey in the years ahead will be increased by a study of the article. It explains the absence on the present offering of the public address acoustics common to many live concerts. The stereo spread, broader and deeper than a septet would ordinarily receive in a studio, is just right to convey stage presence and the encouraging words to the soloists interjected by Witherspoon between choruses. Even the audience, whose dollars put the roof over the band shell, is repaid by the natural sound of its applause.

Jackie McLean: New Soil
Blue Note ST84013

Although the monophonic version appeared a month or so ago, this date took five weeks in the planning and the resulting blend of ideas indicated that it would be worth hearing in stereo. Haphazard recording sessions have left a mark on the careers of both alto-saxist Jackie McLean and Donald Byrd, his companion in the front line on trumpet. The constant shifts in personnel among modern groups are partly dictated by economics and reasons other than musical, but a good share are made in an effort to discover colleagues who think along similar lines. A good example is the alliance formed recently by Art Farmer and Benny Golson, which incidentally seems to be blessed with financial success. The team of McLean and Byrd fits equally well together and it is to be hoped that the association will be lucrative as well as pleasant.

Aiding them immensely is Walter Davis, pianist in the group and writer of three themes creative enough to serve as limber springboards for the soloists. Along with two originals by McLean, they combine current trends in blues, gospel music, and a marching beat set by drummer Pete La Roca. Rudy Van Gelder's engineering pairs the horns in a lifelike stereo setting.

Pee Wee Erwin: Down By The Riverside
United Artists UAS6071

Throwing some of the traditional conventions to the winds, Pee Wee Erwin arranges a set consisting mainly of spirituals for a revised edition of his septet. Milt Hinton on bass, Osie Johnson on drums, Lee Blair on banjo, and pianist Dick Hyman doubling on organ are in the rhythm section. The tread is lighter than before, not that all dancers will welcome the change but listeners may. A distinct gospel beat propels *Gloryland*, indicating that the leader has listened to recent developments, although his trumpet calls forth a strict New Orleans march tempo on *Walking With The King* and *The Saints*. Trombonist Lou McGarrity pays his respects to Jack Teagarden on *Careless Love*, and Kenny Davern turns an occasional George Lewis phrase on clarinet. Erwin knows this music well enough to find new things to say, and the rhythm men are flexible enough to carry out his intentions. The passages that Hinton and Johnson share together are especially effective in stereo.

Count Basie: Chairman Of The Board
Roulette SR52032
Count Basie: Basie Basement
RCA Camden CAL497

Recorded about a dozen years apart, these Basie items reflect changing times and a completely altered band personnel, except for the rock-steady Freddie Greene, but are bound together by the continuous thread which runs back through the leader's work to Moten and beyond. The connecting link is the blues, and trombonist Al Grey, of the current group, is one of the earthiest soloists the Count has played behind since Lips Page was blowing in the dawn for Moten back in 1932. Each of his eruptions is of the sort to bring a gleam to the eye, and his preaching style is urgent and forceful on Thad Jones' *The Deacon*. But the session's most gratifying aspect is the writing of a triumvirate from within the band. Jones, Frank Wess, and Frank Foster are responsible for all the tunes but *Kansas City Shout*, a spirited exercise for the ensemble from alumnus Ernie Wilkins. They drape a number of new ideas onto the Basie framework, with an assist from the leader in the cutting and the other band members in the fitting. Giving credit where due becomes difficult when trumpet solos from Jones enliven settings by Wess, while Jones allots tasty flute passages to Wess, and Foster's reed voicings depend upon exact shading from the section. Just let it be said that the Count has an awesome array of talent at his command, and it sounds wonderful in stereo.

The Camden reissues take on historic importance as marking the last days of the famed rhythm section of Basie, Greene, Jo Jones and Walter Page. All but one of eleven numbers are from sessions dated 1947, and *Hey, Pretty Baby*, a vehicle for Jimmy Rushing recorded in December, represents the final appearance of the foursome as a regular part of the band. Basie's piano solos run to greater length than now and he plays organ on the title tune, one of several made with a small group that year. It is to be hoped the others will be reclaimed eventually. Rushing delivers five tunes in the vocal style he adopted for stage shows, a medium which has virtually disappeared today, along with pieces like Willie Dixon's *The Jungle King*. The recording is pre-stereo, but the poor surfaces of the original post-war pressings are also absent.

Stan Kenton: The Kenton Touch
Capitol Stereo ST1276

Of all the unusual instrumental combinations at which Stan Kenton has tried a hand during a long career, the present turns out to be one of the most successful. Putting aside grandiose concert schemes for the moment, he remains close to the crossroads of the many directions he has followed in the

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past and avoids going too far toward any extreme. The prevailing mood, set by the leader's spare, direct piano passages on *Theme For Sunday,* is serene and unruffled. He balances a trombone section on one side of the stereo picture against twenty string players on the other, while Milt Bernhart, Laurinda Almeida, Red Mitchell, Shelly Manne, along with other soloists are heard near the center. Pete Rugolo's setting for strings combines the better elements of jazz and symphonic writing, attaining a full, rich sound in stereo without encroaching on the lushness of mood music. Much of the thematic material is familiar from previous recordings, but it is likely to reach a wider audience after this treatment.

Ted Heath: My Very Good Friends The Bandleaders
London PS174 ●LPM-70009
Glen Gray: Solo Spotlight
Capitol ST1234

The last time these leaders were reviewed together here their positions were reversed and Glen Gray was saluting famous bands, while Ted Heath turned the spotlight on his personnel. But turnabout is fairplay, and it will probably happen again before their careers are over. Heath's good friends are Benny Goodman, Louis Armstrong, Billy May, Count Basie, Les Brown, Ray Noble, Stan Kenton, Glenn Miller, Woody Herman, Duke Ellington, Ray Anthony, and Buddy Morrow. Now guess what tunes he picked to represent them.

Among the soloists featured by Gray are Murray McEachern, Skeets Herfurt, Shorty Sherock, Mannie Klein, Ray Sherman, Joe Howard, Gus Bivona, and Nick Fatool. Guessing is more difficult this time but try anyway. Both albums are meant for dancing and the stereo will impress wallflowers.

Lambert, Hendricks, & Ross!
Columbia CS8198
The John LaSalle Quartet: Potluck
Capitol ST1238

After making a series of recordings with the support of various assemblages, including the Basie band, Lambert, Hendricks and Ross are heard here under a new contract and in the company of the Ike Isaacs Trio, a group which has grown accustomed to their intricate vocal juggling as a regular part of the act prepared for jazz clubs. Harry Edison, who supplies muted trumpet obbligatos as an invited guest, is also no stranger, having served before as both an accompanist and an example to imitate. The performance is brought to a higher degree of polish than any previous one, as a result, and the voices sound much less crowded in the dimensions of stereo. The group claims an active repertoire of seventy numbers, by recent count, which is no small achievement when the demands of the various styles and material are considered. Among the tunes translated from instrumental originals are Bobby Timmons' *Moanin',* Ralph Burns' *Bijou,* Horace Henderson's' *Charleston Alley,* the Adderley's *Sermonette,* and the Miles Davis-Gil Evans reading of *Summertime.* Annie Ross revives her version of Wardell Gray's *Twisted,* Edison solos on his own *Centerpiece,* and Hendricks adds two originals.

The John LaSalle Quartet also enjoys the distinction of being able to intrigue the adult, sophisticated listener and affords a pleasant contrast to the Lamberts. Organized to fill an engagement at Dick Kollmar's Left Bank in Manhattan, the group was introduced on an excellent debut Lp titled *"Jumpin' At The Left Bank."* At the start, its style bore the trademark of updated swing, but now is broad enough to encompass *A la Claire Fontaine,* and an a capella *Christopher Robin Is Saying His Prayers.* The leader and Marlene Ver Planck are soloists, while Bill Ver Planck contributes arrangements and the title tune. His practice of voicing a harp or flute on ballads and the sound of a full band on swing items is splendidly realized in stereo.

Johny Puleo: Western Songs
Audio Fidelity AFSD5919

The constant companion of cowboys and loners everywhere is the harmonica. Johnny

Puleo prefers to call it a mouth organ and takes all the old familiar gang along to keep him company while riding the range. He spreads fourteen Western songs out in stereo, riding herd on such grassrooted tunes as *Wagon Wheels, Tumbling Tumbleweeds, San Antonio Rose,* and *Red River Valley.* When the tempo becomes too brisk, he turns the stampeding herd with a mournful ballad, even resorting to *When Your Hair Has Turned To Silver.* Watching him in action could well lead to the belief that a lasso is needed in the studio to keep him still long enough to record. Whatever the methods used, his wandering ways are curbed in stereo and movement occurs only when the solo voice is tossed from one instrument to another.

The Limeliters **Elektra EKS7180**
The Kingston Trio: Here We Go Again **Capitol ST1258**

San Francisco's "the hungry i," where the Kingston Trio first hit the trail to fame and fortune, sends along a new group which seems destined to follow the same heady byway. Organized less than a year ago, the Limeliters were held over at the club for five months, appeared on network television and readied this debut LP. Abandoned somewhere along the route was the proposed title "Folk Songs for Moderns," and the album is being promoted for its popular appeal. The trio, formed after the chance meeting of singers successful as single acts, unites Alex Hassilev and Glenn Yarbrough under the leadership of Louis Gottlieb, a worldly gentleman whose Ph.D. in musicology fails to conceal a knowledge of jazz and the string bass. Several of his arrangements are the property of the Kingston boys and he performs the same duties on a broader scale here, writing hilarious versions of *The Midnight Marauder,* and *Gari, Gari.* The humor is sophisticated without being too far out, and the satire is sharp but friendly. The group refrains from working any one vein to exhaustion, quieting the customers with Yarbrough's earnest tenor lead on *When I First Came To This Land.* Assisting at assigned intervals from various points on the stereo spectrum are John Pisano, Charles Berghofer, Gene Estes, Frank Devenport, and Vincent Terri.

No need for the Kingstons to bid for popular approval—they have it, and to spare. After citing their present effort as the best yet, it might be remarked in passing that two tunes are by the aforementioned Gottlieb. Blame him for any deviation from the straight ethnic path.

Leon Berry: Giant Wurlitzer Pipe Organ, Vol. 6 **Audio Fidelity AFSD5904**

Although labeled as Leon Berry's sixth appearance at the giant Wurlitzer, some volumes in the series involve the smaller instrument installed in the basement of his home. The organ heard here, however, is easily recognized as the three-manual behemoth harbored in Chicago's Hub Skating Rink. The numerous color effects are broader and, to allow for a greater reverberation time, the tempos are slower. Its size is fully capable of accommodating *76 Trombones,* and the sunny panorama of *Mexican Dance.* Among old favorites recalled are *Ida, At Sundown, Frenesi,* and that skater's delight, *Lichtensteiner Polka.* As before, the recording affords a stiff test of both equipment and stereo techniques. Considering the nature of the mammoth, which permits no time-stretching devices, the eighteen-minute playing time on each side is excellent, and the sound leaves little to be desired.

Oscar Brand: Every Inch A Sailor **Elektra EKS7169**

Seemingly bent on documenting the present-day folklore of this nation's Armed Forces, Oscar Brand follows up his collection of Air Force songs with one from the Navy and has a set of Marine ballads ready to sail in its wake. Some months were spent in research before the singer decided on reliable, rather than strictly "authentic," versions of fourteen lusty and salt-stained tunes. Along with the native attractions of *Guantanamo Bay,* a base currently in the headlines, scenes of World

War II are revisited on *Reuben James*, and *Battle of Ormoc Bay*. Just how new are the verses selected for *Barnacle Bill*, *Zamboanga*, and *Didn't She Ramble* will depend largely upon the listener's own age and experience. If a young inductee is numbered among your acquaintances, he will find this an ideal step toward developing sea legs. Brand's assisting yeomen, distributed about the deck in stereo, are Billy Faier, Mike Seeger, Milt Okun, Russell Savakus and Ted Tyle.

MONOPHONIC

The Cannonball Adderley Quintet In San Francisco — Riverside RLP12-311

While playing an engagement last October at The Jazz Workshop in San Francisco, the Adderley brothers celebrated their reunion with this on-the-spot recording. The ebullient Cannonball returns to lead the family group with a sense of discrimination acquired while playing more than a year under the caustic eye of Miles Davis. An equal amount of discipline might have been imposed more conveniently by listening to brother Nat, whose cornet phrases are always economical and direct rather than florid, but such exchanges are rare even in the best of families. These virtues are plainly evident on *This Here*, a gospel-based tune by Bobby Timmons, the group's pianist. During the current trend, gospel music has entered the rarefied precincts of the Modern Jazz Quartet and, at the other extreme, the blatant rock and roll of Ray Charles. Cannonball prefers a middle ground, remaining close to the blues and the uncomplicated message of the simple theme, while clothing it with warm expression and rhythmic soloing on alto sax. Gospel groups able to operate this well are all too few, especially over the twelve-minute span allotted here.

Another high point is reached on *Hi-Fly*, by Randy Weston, a pianist whose writing makes fertile ground for groups other than his own. Sam Jones, on bass, and drummer Louis Hayes provide rhythmic impetus. William Claxton engineered the date, allowing the right proportion of club atmosphere to seep through.

The Music Of New Orleans, Vol. 5: New Orleans Jazz—The Flowering — Folkways FA2465

While assembling this series of recordings, Samuel Charters spent more than seven years in research and gathered a large amount of new material on the music of New Orleans. With the release of the final volume it becomes evident that his accomplishments must be considered in any future attempt to write a history of jazz. But anyone rash enough to undertake such a project would be wise to await the completion of the work William Russell is doing for Tulane University. As Charters limits himself to the musicians who remained in the city, his findings need to be correlated before they can be placed in a broader context. His recent monograph on the subject contains a large amount of factual and biographical information hitherto unknown. By means of the recordings and copious notes, Charters endeavors to illustrate some of his discoveries and place them in correct historical perspective.

The main topic of the fifth volume is one largely ignored in other treatises and concerns the trumpet players who returned to New Orleans after service in the first World War. Punch Miller describes the styles of Buddy Petit and Chris Kelly, discusses Louis Armstrong, and reminisces about the group which included Sam Morgan, Kid Rena, and Louis Dumaine. The band of Emile Barnes and Peter Bocage plays *Down In Honky Tonk Town*, and Billy Pierce returns on *Lonesome Road*. George Lewis joins the Eureka Brass Band on *You Tell Me Your Dream*, while Kid Clayton and Albert Burbank unite on *Shake It And Break It*. Tony Parenti talks briefly about the city's Italian-American colony, so popularly represented today by Sharkey Bonano, Louis Prima, and the Dukes of Dixieland, thereby opening a subject which could easily fill another five volumes. But Charters seems to have moved on to the country blues singers, a field much more convenient to document than early New Orleans styles. On Rinehart & Company's current list, his book about these colorful personalities is full of interesting detail on the methods of early recording companies.

Benny Golson: Groovin' With Golson — New Jazz 8220

Before Art Farmer joined the group, Benny Golson worked with trombonist Curtis Fuller, touring as far as San Francisco, and the sampling offered here is an example of their partnership during an informal moment. Because a fine sense of interplay was developed on the road trip, the session maintains a higher level than many such affairs. The warm, lyric tone of the leader's tenor sax indicates a thorough absorption of the elements in John Coltrane's style that drew his attention recently. If anything, his voice is more strongly personal than before. Under his tutelage, Fuller seems to be headed in the same direction, helped by a natural aptitude for the blues as expressed on the three originals. Art Blakey is featured on *Drumboogie*, and Ray Bryant's blues piano is an asset throughout. Bassist Paul Chambers solos on *Yesterdays*.

Arnett Cobb: Party Time — Prestige 7165

Injuries received in an automobile accident in 1957 placed Arnett Cobb on the shelf until last year when he started on the comeback road. Notice of his complete recovery is served on *Flying Home*, the number which made him a star in the Lionel Hampton constellation back in the days when his tenor-sax solo was featured nightly. This time there is no need to shout over a milling crowd of dancers and the performance is thoughtful and relaxed. Just how relaxed the quintet was in the studio is plainly evident on *Slow Poke*, an improvised blues that can be heard as though it materialized out of thin air. The version preserved is the timing take, with conversation in the background and a long, searching piano introduction by Ray Bryant before Cobb begins his probing. It repays the price of admission by itself, particularly on the heels of news that Bryant is moving to Columbia and branching out into the single field. No more first takes from him, but it should be interesting to watch Prestige develop a new house pianist for mainstream groups.

Cobb also revives *When My Dream Boat Comes Home*, *Lonesome Road*, and *Cocktails For Two*. Wendell Marshall plays bass, and Art Taylor gets an assist from conga-drummer Ray Barretto. Æ

Fable Forest — Playhouse 202

Jim Copp and Ed Brown, two Los Angeles bachelors who happen to know what children of all ages like, have learned the secret of how to run a record company with the least possible trouble. They produce but one LP a year, combining their respective talents to prepare the script, handle the narration and create unusual noises, compose and play the music, design the liner, and engineer the tricky blend of sound effects on the multiple recording. Fully as delightful as its predecessor, "Jim Copp Tales," the second in the series is guaranteed to lure youngsters away from television and enchant the ear of the passing audio enthusiast. There is the quaint violin recital of an ant and a horrendous storm at sea, with the shivering of ship's timbers and wind shrieking through the riggang. Copp is accountable for about sixty voices, including fish, frogs, birds, and even trees. Only once in the telling of fifteen tales is the audience played down to, and that occurs on the liner in the listing of the record as unbreakable (with normal usage). Even the most destructive little terror is likely to treat it with reasonable care and affection.

Still, it is to be wondered if a copy will be around when the Grammy's are passed out for imaginative engineering of a popular recording or the best children's record. None of last year's seems to have been available to displace "Alvin's Harmonica."

Carnegie Hall Concerts Of 1938-9: Spirituals To Swing — Vanguard VRS8523/4

Tucked away somewhere in a stack of old jazz magazines are my programs from these two concerts, with the cover of the first bearing the smiling features of Bessie Smith, for the great blues singer had died just the year before and the evening was dedicated to her memory. Other tangible mementos were to result from the beneficial effect a Carnegie Hall appearance had on the recording careers of Sidney Bechet, Sonny Terry, Big Bill Broonzy, Ruby Smith, Joe Turner, and the boogie-woogie piano team of Pete Johnson, Albert Ammons, and Meade Lux Lewis. Some were unknown before stepping on the stage, while the depression had forced others into making a living away from music, and the helping hand of John Hammond arrived at an opportune moment. As the show's producer, he gathered performers from all over the country and then was drafted into active participation as master of ceremonies. On the heels of this bold adventure came his appointment as associate recording director for Columbia Records, a post which enabled him to engage many of the same artists again. Other companies followed suit, while the Solo Art and Blue Note labels were founded for the express purpose of recording what the commercial firms were likely to miss.

On this two-disc set, a goodly portion of both concerts is exhumed from the Hammond archives at last, making the assembled nuggets available to all. They assay high on the basis of today's market and are sure to enrich any collection. While confirming my impression of two wonderful Christmas holiday evenings, the editing makes no attempt to adhere to the original order of events. Anyone who wants to assign a performance to the proper year can do so by referring to the thorough notes. Besides featuring the Benny Goodman Sextet, the second concert brought back the Kansas City Six from Count Basie's band and the splendid work of these groups is prominently displayed. At the peak of his powers, Lester Young can be heard developing his characteristic long lines on tenor sax, while Charlie Christian sits in on *Good Morn ng Blues*. Those who remember Christian only for his single-string guitar solos should listen to him operate with Freddie Green, who is still Basie's rhythmic standby.

Other highlights are two piano solos from James P. Johnson, and Sidney Bechet leading his New Orleans Footwarmers, with Tommy Ladnier playing trumpet, on *Weary Blues*. Ida Cox shouts a blues over the support of Buck Clayton and Dickie Wells. Mitchell's Christian Singers and the Golden Gate Quartet document gospel singing during that period of its development. Oran Page, whose trumpet is too sparingly represented on LP, joins the full Basie band on *Blues With Lips* and *Rhythm Man*. And finally, an inspired jam session mounts gradually in intensity to climatic exchanges between bassists Walter Page and Arthur Bernstein.

The acetate masters were made by Zeke Frank, who a short time before had used the same single overhead microphone to record Benny Goodman's first Carnegie Hall appearance, which Columbia was to issue eventually on LP with such outstanding success. Let's hope the sales of this set are as good, because Hammond has enough material left over for another three LP sides. The improved techniques available today have enabled Seymour Solomon and John Beaumont to produce a superior processed sound, although it is possible to tell Hammond's favorites from the varying amount of wear on the acetates. Perhaps he will be encouraged to embark on another series of concerts. Earl Hines is on the road again, and Lightnin' Hopkins, Jesse Fuller, Snooks Eaglin, and Jimmy Witherspoon have yet to set foot on a New York stage. The aftermath might be equally rewarding as he has returned to an artists and repertoire position at Columbia. That company is stepping up jazz releases to keep pace with an expanding record club, but Hammond will maintain his ties with Vanguard also. Columbia is reported to be planning an ambitious jazz reissue series, starting with Fletcher Henderson and Mildred Bailey. Æ

ABOUT MUSIC

HAROLD LAWRENCE*

High Fidelity—Enemy or Friend of Live Music?

If one were asked to single out the most important development in the audio field during the 'Fifties, the answer might be the emergence of high fidelity as a mass-market commodity. The industry has come a long way since the days when record buyers were urged to purchase 33 1/3-rpm attachments which could be plugged into the table radio. Component manufacturers who had once sold their products only to professional sound engineers, and a handful of enlightened audiofans, now discovered that the general public could be weaned from ready-to-play merchandise. Accordingly, they expanded their trade advertising and eventually bought space in national, non-technical magazines. Newspapers and FM broadcasts, too, provided effective means of reaching the potential audiofan.

In the same decade, the record industry rose to new sales peaks, and the audio show became an annual affair in a number of cities. It is interesting to note here that "packaged high fidelity" was specifically barred from participation in some of the major shows. Before the decade was out, the term *high fidelity* belonged not to the few, but to everyone. Once in the public domain, however, it was soon transformed into the slicker and shorter *hi-fi*. In the process, the concept of high fidelity fell by the wayside. For example: "Dear, please turn down 'the hi-fi'." (The wife refers, of course, to her mate's sound system.)

To the best of my knowledge, Englishmen never say, "the hi-fi"; they call their equipment either by the old-fashioned "gramophone," or by the newer "rig." But the term, high fidelity, is as popular there as it is in all other audio-conscious nations. In their two-man hit show, *At the Drop of a Hat*, the Britons, Michael Flanders and Donald Swann, sing a song about an audio enthusiast whose total preoccupation with his rig drove his frustrated wife into a state of "low fidelity with high frequency." The popularity of "hi-fi," however, far outweighs its verbal predecessor. A couple of years ago, for instance, a leading manufacturer of cosmetics borrowed the term from the audio industry to launch a new line of lipsticks.

The High Fidelity Writer

The impact of high fidelity on the national scene produced an apparently endless flow of articles on the technical, musical and philosophical implications of sound reproduction. It was not unusual to leaf through a magazine specializing in food or travel and come across an article on "What is High Fidelity?" Some were written by competent authors who were recognized in their own fields, but many were of the pseudo-technical variety that make the informed audiofan wince. Under the best possible circumstances, esthetics and engineering are uneasy partners either in the task of recording a musical work, or in expressing an audio-musical idea. The audio literature of the 'Fifties abounds in articles containing half-digested engineering concepts, written by non-technical writers who would dearly love to give us all the impression that they are intimately familiar with the underbelly of an amplifier or the drive mechanism of a tape recorder.

On the other hand, some writers are equally determined to have no truck with the mechanics of sound reproduction which, according to Virgil Thomson, "give [music] a slight flavor of canned food." Mr. Thomson's reference was to processed music of the early 'Forties, but I would venture to guess that his opinion has not altered basically since then, despite the remarkable audio advances to date; his only concession might be to change the word, "canned," to "frozen." Thomson's remark appeared in an article printed in the *New York Herald Tribune* on May 16, 1943. In a certain sense, it graphically illustrates the progress of high fidelity sound reproduction over the past seventeen years: "The easily noticeable differences between fresh and processed music are several. Deformation of instrumental timbres is not the gravest of these. . . . Diminution of the original dynamic range is a far greater musical distortion. The limits between loud and soft at any given tuning are so much narrower than the dynamic range of a full orchestra, or even of a singer or of a pianoforte."

The microphones and tape recorders of today enable us to keep distortion down to the barest minimum, while the dynamic range has been vastly increased—though not yet as full as the 95 db output of a large orchestra. Time, however, has not affected Thomson's comparison of processed and fresh music from another standpoint: "[The former] may occasionally be preferable to fresh [music]; but it does not sound like fresh music, and one's relation to it is that of a listener to a live executant. It is like a photograph of somebody—that is to say, more or less resembling. But there is no communication between the observer and the subject of the picture."

Copies and Originals

The record-photograph analogy was employed more recently in an essay on live *vs.* recorded music appearing in the January issue of *Harper's*. The author, Hubert Lamb, bemoans what he calls the Age of Facsimile. The music facsimile, he writes, "[is] a product of the exercise of the discretion of monitors and the skill of editors, is a composite image of performances conducted in the vacancy of an empty hall. It

* *26 W. Ninth St., New York 11, N. Y.*

is necessarily without serious blemish. The maker of facsimiles, like the fashion photographer, must concern himself first not with poetry but with perfection."

In his three-pronged attack on music recording, Mr. Lamb implies the following: 1), tape editing somehow destroys the integrity of a performance; 2), the absence of an audience makes for listless results; and 3), the recording man is more interested in notes than music.

I should like to review these points one by one. First, the skillful tape editor selects the best played 'takes' of the session for his master reel, but he does not put them together willy-nilly on the sole basis of note perfection. Tempo, balance of instrumental choirs, continuity, intensity, and over-all feeling are some of the factors which he must take into consideration before making each splice. He must possess keen ears, and he must be meticulous but not Beckmesserish. Second, the lack of an audience is admittedly a difficult hurdle to overcome at a session. But with a dedicated conductor at the helm, there is every reason why a recorded performance can be every bit as good as its concert equivalent from the point of view of the musicians' spirit and attitudes. It is the recording director's job, too, to smooth the way for truly musical results in his pacing of rest periods, retakes, and musical movements. Third, for obvious reasons, note perfection is a desirable objective in a recording. But the recording director's principal goal is to help make it possible for the "poetry" to emerge while at the same time keeping an ear out for accidents, lost notes, and faulty musical balance.

Later in his article, Mr. Lamb goes even further on the subject of music *vs.* records. A recording of Mozart's Symphony No. 41, "is not the Jupiter Symphony. It only sounds like the Jupiter Symphony. The players are not there. There is, in fact, no performance. We are therefore not participants in anything; and unless our experience with music itself intrudes, we may converse, play our games of chess, and read our newspapers, quite unconcerned, taking note or not, as we will, of the engaging fabrics of sound with which we have surrounded ourselves."

Mr. Lamb is plainly flaying a dead horse. Certain exuberant advertising copy to one side, no one seriously expects a phonograph disc to magically transform the grill cloth of your loudspeakers into living musicians; nor does one look forward to a live concert-hall experience. A recording is simply a musical document shorn of the accouterments of the concert hall; that is, without the full acoustics of the auditorium, the sound of the actual instruments, or the thrill of mass participation. Nevertheless, if one is not playing chess, reading newspapers, or conversing, but is listening intently to a recording of, say, Boris Christoff singing Moussorgsky songs, one would have to be quite insensitive to escape the drama and beauty of the music—yes, and even of the performance.

Probably the most extravagant statement in Mr. Lamb's article occurs at the conclusion. Seeing nothing but danger ahead for the state of music if the current popularity of recorded music continues, the

(*Continued on page 71*)

NEW PRODUCTS

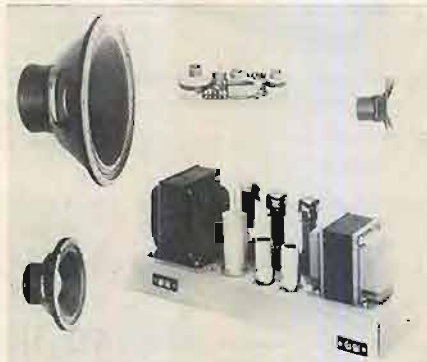
• Battery-Powered High-Fidelity Tape Recorder. Despite its light weight and self-powered feature, the Butoba MT-4 is stated to have a frequency response of 50 to 13,000 cps with less than 0.5 per cent flutter at 3¾ ips; it will also operate at 1⅞ ips for extended play. It is equipped with separate volume, treble, and bass controls, and uses 5-in. reels with maximum

recording time of three hours. In addition to operating on internal flashlight cells, the recorder may be operated on any intermediate a.c. voltage between 110 and 260, and from a car battery with the use of a converter which is available as an accessory. It may be operated in any position except upside down. Unusual technical refinements include the motor speed being kept constant within 1.0 per cent regardless of the life of the batteries, by means of devoting the entire function of a transistor to speed regulation, over and above a regular motor speed regulator. Motors are protected by twin fuses. Other features of the MT-4 include fast forward and rewind, push-button controls, recording-level indicator, time indicator, and completely climate-proofed dynamic microphone. Butoba Division, Turning Corporation of America, 60 E. 42nd St., New York 17, N. Y. **C-1**

• E.M.I. "Stereoscope" Amplifier. Precision matching of stereo sound channels is accomplished by means of a cathode-ray indicator tube in the Model 555 amplifier recently introduced into the United States by Electrical & Musical Industries, Ltd., Hayes, Middlesex, Eng. Intended to increase the ease and accuracy of both stereo and monophonic adjustments, tracings on the face of the tube may be used to measure signal strength, check frequency response, monitor input or output voltages, and maintain a continuing check of the performance of turntables, pickups, and other system components. Consisting of twin preamplifiers and two independent 20-peak-watt power amplifiers on a single

chassis, the 555 is the first unit in a new line of high fidelity components being introduced into the U. S. by E.M.I. A precision amplifier in every respect, it meets or exceeds professional standards in all areas of audio performance. When desired the 555 may be used as two separate monophonic amplifiers. A separate 7-position function switch is afforded for each channel. A front panel switch may be used for injecting a 60-cps sinusoidal voltage into the preamp section which may be used for balancing purposes. Distribution rights for E.M.I. high-fidelity components in the United States have been assigned to Scope Electronics Corporation, 10 Columbus Circle, New York 19, New York. **C-2**

• Ampex Amplifier-Speaker Systems. Ampex has recently introduced two unique amplifier-speaker systems based on the system-engineered concept, wherein each separate element was designed not as an individual component, but as an integral, properly matched unit within the system. The new Model 303 system, illustrated, makes available in component form the same impressive sound offered by the Ampex Signature home music system console. The units are identical with those used in the Signature models, and within a comparable enclosure will produce sound of identical quality. The system contains an

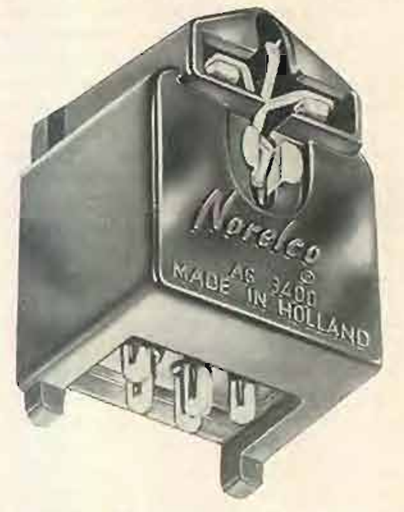


Ampex 30-watt amplifier, a multiple L/C crossover network, a 3-in. tweeter, an 8-in. mid-range speaker, and a 15-in. woofer. Two such systems are necessary for stereo. Operating characteristics are flat within 0.1 db throughout the maximum range of hearing ability, at rated output. Total harmonic distortion is less than 0.5 per cent at rated output and noise level is down 80 db. The Model 302 system is identical with the amplifier-speaker assembly engineered for the Ampex Custom series home music system. The amplifier power rating is 15 watts. A 3-in. tweeter and 12-in. woofer make up the speaker system, which requires a 2-cu.-ft. enclosure. Characteristics, except for power rating, are virtually identical with those of the 303. Ampex Audio, Inc., 1020 Kifer Road, Sunnyvale, Calif. **C-3**

• Heathkit Multiplex Adapter. This instrument is the newest addition to the Heathkit line of high fidelity equipment. Designated Model MX-1, it is designed to permit reception of FM stereo programs transmitted in accordance with the Crosby system of stereo broadcasting. Among its

features are a self-contained power supply, stereo-dimension control, channel-balance control, function selector switch, inputs for FM (main channel) and multiplex (sub-channel) and cathode-follower outputs for both channels. The function switch provides for stereo, main channel, or multiplex channel mode of operation. Heath Company, Benton Harbor, Mich. **C-4**

• Norelco Stereo Cartridge. Featuring the unique combination of exceptionally high vertical compliance and high output, the Model AG3400 cartridge will play a stereo record innumerable times without loss of quality, at the same time eliminating hum and noise generated by amplifiers forced to operate at maximum gain. Vertical compliance is better than 3.5×10^{-6} cm/dyne, lateral compliance is 4.5×10^{-6} cm/dyne, and output is 30 mv per channel. Channel separation is 22 db at 1000 cps. The cartridge does not require a matching transformer, and may be used with any load resistance from 47,000 to 100,000 ohms. Optimum loading is 68,000 ohms. Stylus replacement can be handled by the user in a matter of seconds. Each replacement stylus comes mounted with its own damping blocks, thus assuring a permanent high level of performance. Frequency response is virtually flat from 50 to 18,000 cps. Stylus pressure required is 3



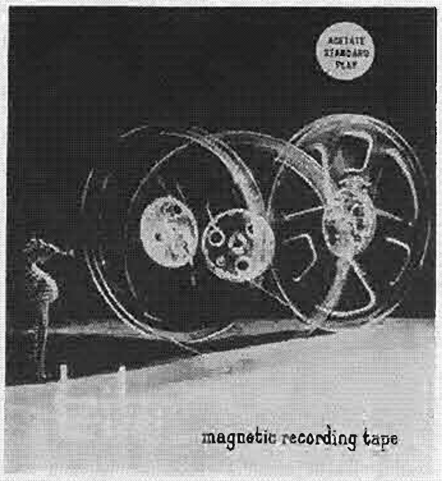
to 5 grams. Effectively shielded by mu metal throughout, the influence of external magnetic fields on the cartridge is negligible. For further information, write North American Philips Company, Inc., High Fidelity Products Division, 230 Duffy Ave., Hicksville, N. Y. **C-5**

• Portable Tape Recorder. Fully transistorized, this new two-speed book-size tape recorder weighs under four pounds and operates from its own self-contained batteries, 117 volts a.c. or from the cigarette lighter receptacle of a car. Known as the Concertone Transicorder, it utilizes a complement of six transistors and two diodes. It has a one-hour recording capacity. A dual-function meter serves to monitor recording level as well as to check battery condition. Operating speeds are 3¾ and 1⅞ ips. Two heads are incorporated, one each for record/playback and for erase. Accessories for the Transicorder include hand- and foot-operated remote controls, telephone pick-up, stethotype earphone holder, and adapters for 12-volt d.c. and 117-volt a.c. power sup-

plies. Developed particularly for those demanding good quality sound reproduction combined with portability, the recorder can be carried with a shoulder strap for in-field interviews, laid on the seat of a car for dictating while driving, or used in an office or home. It uses standard reels, batteries and tape, and records half-track. American Concertone Division, American Electronics, Inc., 9449 W. Jefferson Blvd., Culver City, Calif. **C-6**

• Magnetic Recording Tape. A deluxe recording tape, accompanied by a unique guarantee, has recently been introduced by the Triton Tape Company, Woodside,

N. Y., to meet the demands of discerning recordists, both amateur and professional. The guarantee promises the Triton tape purchaser a replacement reel of any American-made brand of the same type should he find the Triton deficient in performance or characteristics for "any

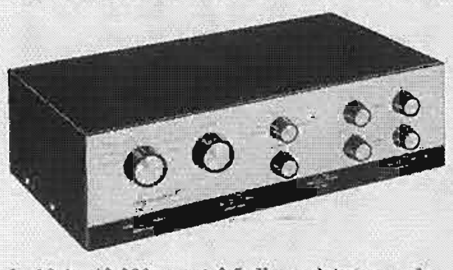


reason whatsoever, or in any way not as represented." Triton tape is processed with an exclusive "Trionizing" technique, which incorporates three essential tape production processes in sequence, assuring a product of high quality and reproduction capabilities. All Triton tape is splice-free, wound on non-warp, non-squeal reels, and includes a heavy-duty Mylar leader at both ends to facilitate and protect labeling of recordings. A tape retainer clip is supplied for holding the tape tight on the reel. For details, contact Brand Products, Inc., 39 W. 55th St., New York 19, New York. **C-7**

• **Dyna-Twin Headset.** This new headset recently introduced by Telex is intended essentially for private listening to stereo program material. The twin wide-range dynamic receivers have a frequency range of 50 to 15,000 cps. They are engineered

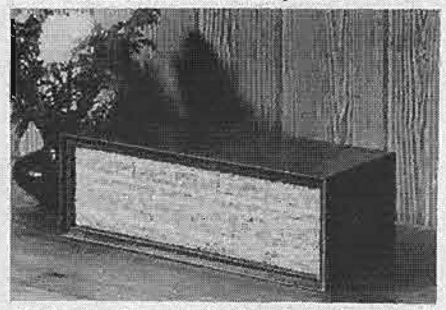
specifically for headset application and are equipped with two comfortable ear-muff-type earphones. Construction of stainless steel, Teflon and Neoprene assures maximum protection from damage. The Dyna-Twin comes complete with 8-ft. flexible cord and 3-contact plug or two standard phone plugs. It can be used either binaurally or monaurally. Manufactured by Telex, Inc., St. Paul, Minn. **C-8**

• **Dynakit Stereo Preamplifier.** Available in both wired and kit form, the new Dynakit Model PAS-2 is a deluxe stereo control unit which features unusual versatility and flexibility along with exceptionally low distortion and noise. Although as many as seven stereo, or fourteen monophonic, inputs can be utilized, the PAS-2 is simple in operation and uncomplicated in appearance. Construction of the instrument from the kit is greatly simplified by the use of two factory-assembled printed-circuit boards which include about three-quarters of the components. Average construction time is approximately eight hours. The built-in power supply enables operation with any power amplifier. Frequency response of the PAS-2



is 10 to 40,000 cps ± 0.5 db, and intermodulation is below 0.05 per cent at sufficient output to drive an average amplifier. Equalization characteristics are closely controlled through the use of 1-per-cent-tolerance components in the critical networks. Full details are available from Dynaco, Inc., 3916 Powelton Ave., Philadelph.a 4, Pa. **C-9**

• **Fisher Speaker System.** The new WS-1 "Wide-Surround" speaker system offers stereo console and component owners



distinct advantages in that it greatly enhances the stereo effect of conventional speaker arrangements. According to Fisher engineers, "by placing a WS-1 on either side of the listening area (and closer to it than the main speakers), the augmented stereo sound pattern will be heard not merely as a straight-line curtain of sound, but 'curved,' totally surrounding the listener." Although the WS-1 reproduces only the middle and high frequencies, 250 to 15,000 cps, the non-directional character of low frequencies permits the illusion that the WS-1 is reproducing bass tones as well. On late model Fisher consoles—there is a special WS-1 output. Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. **C-10**

• **Stereo Test Tone Generator.** This device, which is called the Twin Tone and is completely transistorized, permits balancing the output of stereo speakers in a matter of seconds. It is simply plugged into unused inputs of a stereo amplifier and is

ready for immediate use. By sliding a switch located on the front panel, a constant 1000-cps tone is produced. The volume controls on the amplifier are then adjusted until the speakers have identical output. A volume control permits adjusting the signal to any desired level. The Twin Tone is powered by an internal mercury battery. Kinematix, Inc., 1616 N. Damen Ave., Chicago 47, Ill. **C-11**

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• **Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill., announces the release of a new 36-page booklet entitled "This is Stereo High-Fidelity." Prepared by the publications staff of Allied, with the editorial assistance of Edward Tatnall Canby, columnist and chief record reviewer for AUDIO, this easy-to-understand booklet is a highly informative guide for anyone who wants the facts on stereo. Written in straightforward, non-technical language and fully illustrated, it covers every aspect of component-type stereophonic music systems. The function of each component is described, and explanations of important features and specifications are included. For the "do-it-yourselfer," some tips are offered on selecting components in kit form. Price of "This is Stereo High-Fidelity" is twenty-five cents. Request Stock No. 37 K 387. **C-12**

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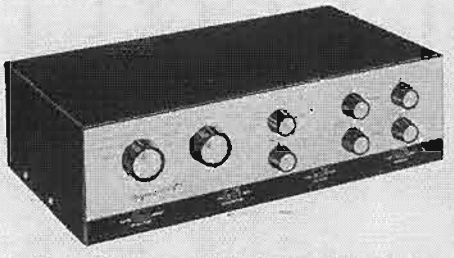

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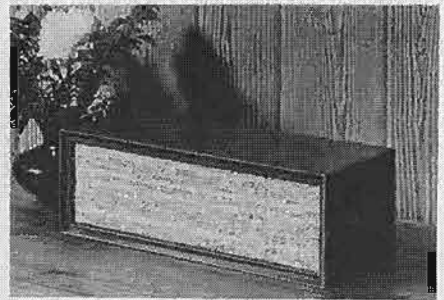

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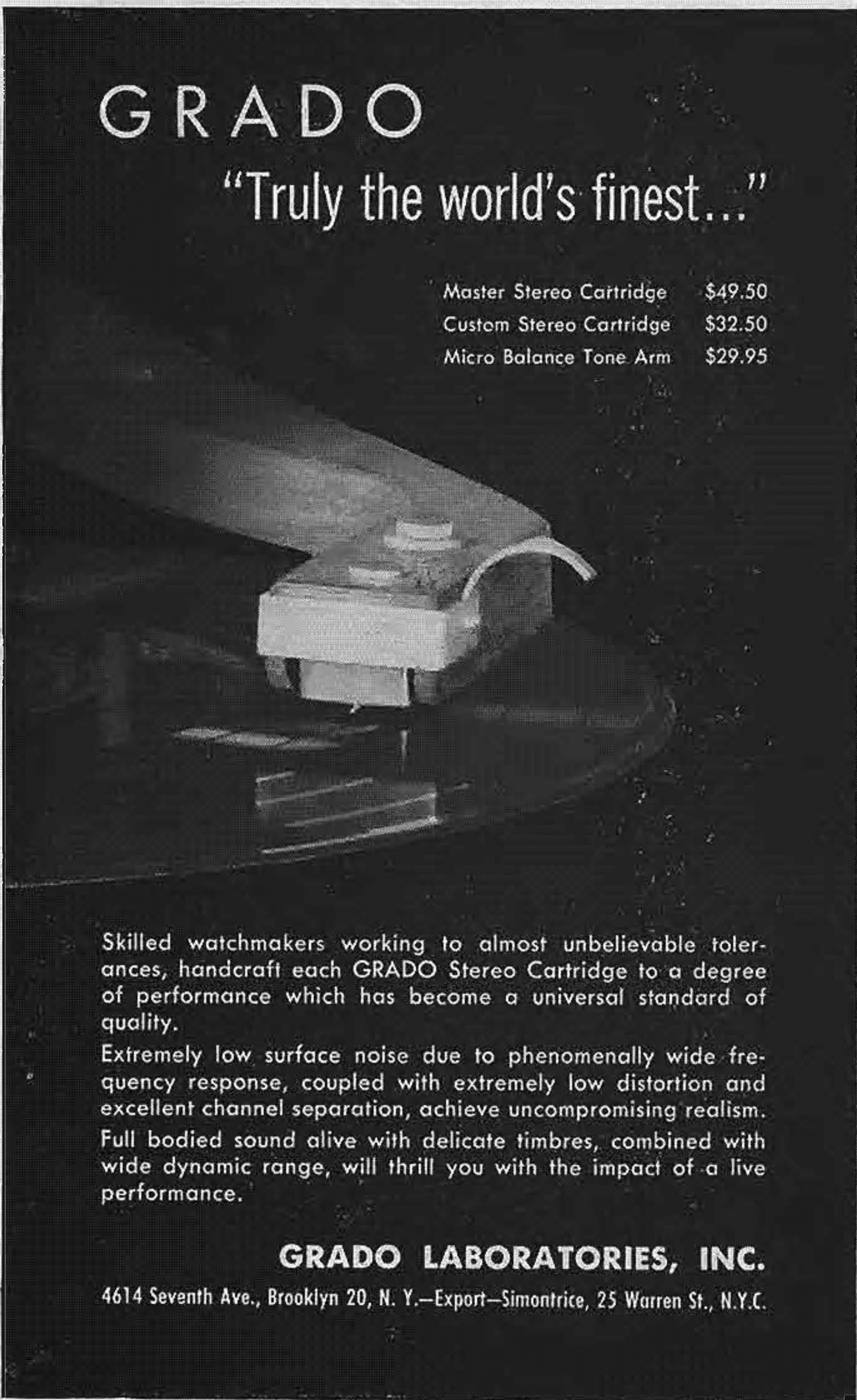

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WOOD PANEL

(from page 23)

However, our practical aim was, of course, to come down to some reasonable size and still maintain the desired low-frequency response without resort to any essential baffle in the conventional sense. Some practical size had to be selected, and for purposes of preliminary calculations we selected a radiator size of 22×15 in., to be operated essentially unbaffled. Using the motif of choosing equivalent radiation resistance values leading to different C/λ ratios depending upon type of baffle, let us explore, the region of response say at 40 cps for curve (B) representing a small sealed box, then curve (C) representing the unbaffled condition. (Curve (B) is chosen as being typical of the better-quality small enclosure systems in use today). For this chosen frequency of 40 cps and a piston diameter of 11 in., we again have a circumference to wavelength ratio of 0.102 which yields a unit radiation resistance of 0.126 ohms. Now for this value of radiation resistance for the 12-in. piston in a small box we can move over horizontally directly to curve (C) for the unbaffled condition to get the equivalent piston size for the same level of radiation resistance.

But here we must add an interim step. *Unit* radiation resistance does not give the complete picture, we must deal with total radiation resistance which is a function of piston area. Now the 12-in. piston has an effective piston area of about 75 square inches, while our chosen panel has a radiating area of $22 \times 15 = 330$ square inches, approximately 4.5 times as large. Conversely, for purposes of *equating* the total radiation resistance of the two pistons in question, the unbaffled larger panel may be considered to have a *unit* radiation value lowered by an equivalent factor of 4.5, or $0.126/4.5 = .028$ ohms.

Keeping this modified radiation resistance figure in mind, we must next get the equivalent "circumference" to wavelength ratio of the 22×15-in. piston. The equivalent circumference of this panel area turns out to be 164 centimeters. The C/λ ratio for 40 cps becomes $164/860 = 0.192$. We now intersect this C/λ value of 0.192 with the "modified" resistance radiation characteristic of the panel which is .028 ohms. This intersection, as shown in *Fig.* 4, is to fall fairly close to the curve for a completely unbaffled piston. This condition may then be interpreted to mean that the 22×15-in. unbaffled piston can produce radiated power output at 40 cps equivalent to a boxed-in 12-in. piston when only a *small percentage* of the rear wave from the unbaffled panel is subdued.

Dipole Control Resistance

In order to attenuate the rear wave by the proper degree it required surprisingly little acoustic resistance (item 4, *Fig.* 2) placed in the path of the rear radiation to drop it the small amount necessary to move the operating characteristic of the system to fall along the dotted curve (D) of *Fig.* 4. Actually, the rear resistance consists of a controlled layer of fibre glass backed up against a porous screen whose apertures added somewhat to the effect of the resistance material.

So limited, however, is the effect of the resistive material, that the sound radiated from both sides of coupler are discernibly different only under very critical listening. Essentially, the radiation from the system is then bi-polar with lobes of radiation from both sides. The frequency response of the system compared against a conventional long-throw, low-efficiency, low-resonance piston in a sealed acoustically stiffened box is presented in *Fig.* 5. Because the biphonic coupler is a doubly radiating system, the curve comparison was made in a semi-live room to simulate the conditions that would hold when the double-poled radiation pattern was effectively used. Such bi-polar operation would, of course, have been meaningless in an anechoic chamber, for the rear wave would not have contributed to the response of the system since it would have been absorbed.

Choice of Piston Size and Material

It may be asked why for instance was a 22 × 15-in. piston size chosen. There are several facets to the answer. Primarily, of course, we needed to select a large piston for radiation purposes, but yet we wanted it to be small enough to be easily accepted into any room acoustic situation without taking up valuable floor space. Despite the fact that the final radiator remained to be the same size as our original trial calculations—the over-all thickness of the entire biphonic coupler assembly turned out to be only 4½ in. We knew what we were in for as far as providing a diaphragm of these dimensions that would be stable under the violent impulses of heavy low-frequency signals. We realize full well the problems that would be encountered were this to be just another paper pulp diaphragm.

We had many choices of types of wood from which to choose the diaphragm material. As far as theoretical considerations were involved, the weight of the diaphragm was relatively immaterial. Of course, there are practical limitations that are imposed, not necessarily by diaphragm weight consideration, but by good usable audio power available to the average consumer, and we had to design the total coupler piston to be within the power sensitivity of prevalent loudspeaker designs. Yet, notwithstanding these considerations which however are strictly met, the actual weight of the coupler diaphragm is over 160 grams. This contrasts greatly with only 30 to 40 grams for the weight of the "heavy" diaphragms of the presently

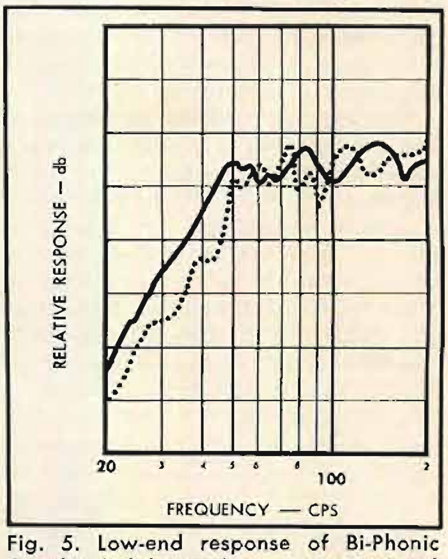


Fig. 5. Low-end response of Bi-Phonic Coupler (solid curve) vs. a conventional low-efficiency, long-throw, low-resonance piston in a sealed acoustically-stiffened box.

popular "low-efficiency" systems. Yet the *over-all* efficiency of this heavy massive piston design is such that a good quality 20-watt driver amplifier will all but push out the walls of the listening room. The reasons for this will follow shortly after we have examined an interesting side effect of this heavy piston. In order to resonate the coupler piston to the desired frequency of 30 cps at which it is producing full output power, it had to be suspended so extremely taut that the diaphragm became almost immobile unless one placed his palm flat against the piston and really pushed hard, in which case it *might* deflect 1/8 in. Now we were beginning to approach our musical instrument—with a large *flat* radiating piston, tautly suspended, and yet capable of resonating at any low desired frequency.

Transient Advantage of a Stiff Radiator

Because the diaphragm is held so taut, it is almost completely restrained from moving. In fact, it is only under the influence of the strongest percussion notes—the kinds that are actually ear shattering in intensity—that any motion of the diaphragm can be seen. Motion of the diaphragm can be felt, of course, by simply placing the hand directly upon the wooden coupler piston which operates without being masked by the grill cloth, for in its wooden rigid form it requires no such protection.

The fact that the diaphragm is practically immobile, even under the intense driving signals, makes it possible to have almost completely perfect electromagnetic coupling between the entire voice coil and the magnetic gap, and yet maintain excellent linearity of magnetic coupling for even the lowest desired frequencies. But linearity of motion within the gap is not the only criterion of good performance. The electromagnetic coupling efficiency between the voice coil and the magnetic gap determines to a great measure the transient response of the moving system, both for the initial step function and the ensuing decay function. The point may best be underlined by considering the transient decay function. In the general case, when the driving signal stops, the diaphragm will continue to oscillate until brought to a stop by a combination of mechanical, acoustical, and electrical factors. Treating first the matter of electrical damping: in the case of the voice coil that completely matches the gap configuration, when the (undriven) diaphragm oscillates, a back e.m.f. is induced within the voice coil, which in turn generates a current through the circuit which includes the coil and the output transformer secondary winding. This produces the well known electrical braking effect, or damping, that brings the moving system to a halt. However, where there is a considerable percentage of coil not in the gap, the generated current through the coil and transformer circuit produces a field that is not completely linked with the magnetic circuit, and hence the effectiveness of the electrical braking is reduced, with subsequent deterioration of the transient response. Of course, such deficiencies in electrical damping may be compensated by acoustical damping such as treating the inside of a box enclosure with sound absorbent material to the extent that critical damping may be obtained.

In the case of the piston coupler design, however, such resistive acoustic damping becomes unnecessary not only because of the extreme efficiency of the electromagnetic coupling between the coil and the gap, but also because of the extra measure of true acoustic radiation resistance loading upon the large diaphragm, which further damps the vibrating structure.

Conclusion

Because of its heavy mass and its extremely taut suspension, the coupler piston motion is extremely restricted, enabling high electromagnetic coupling to be realized between the coil and the gap, leading to high electromagnetic efficiency and to optimum damping. Because of the minute motions of the large diaphragm, magnetic linearity is of an extremely high order. All of these factors fall into place simply because we postulated a large flat diaphragm, and because we did it had to become a heavy one. Since the diaphragm turned out to be a heavy one, it became tightly suspended, and so the radiator circle closes in on itself.

While this discussion has been mainly about the low-frequency portion of the Bi-Phonic Coupler, let it be said that the high-frequency aspects have not been neglected. These are handled by a tweeter, seen in *Fig.* 1 as the small circle in the upper corner of the panel. It consists of a deep-molded phenolic dome serving as a semi-direct radiator with a crossover at 2000 cps. The entire system has an impedance of 8 ohms, and will handle powers up to 50 watts.

Objectively, the live room response curves shown in *Fig.* 5 indicate that the analysis from which the bi-phonic coupler was derived was basically correct, and that it is possible to get excellent low-frequency response from a stiffly suspended heavy immobile, unbaffled radiator. Subjectively, several dozens of listening sessions with outside personnel have without exception credited the bi-phonic coupler with a "freeness", or "largeness" of sound as against the limited spaciousness of the boxed systems. Æ

TRANSFORMERS

(from page 42)

output is up to the rated figure of 20 watts may be computed (see appendix) to be approximately 10,000 gauss, a value that is well off the curve but it will be seen that the harmonic distortion is up to 12 per cent for a flux density of only 3000 gauss and continues to increase rapidly at higher flux densities, a quite intolerable result for a high-quality transformer.

The alternative discussed was to use a transformer having a primary inductance of 50 henries and thus having a response that is flat down to about 10 cps. Reference back to the earlier discussion indicates that such an inductance would be achieved with a primary winding of 2400 turns on the same core. The increased turns bring the core flux density on full load (20 watts) down to about 4500 gauss, the core material having an effective permeability of about 3200 at this flux density. The resultant primary inductance has then risen to about 110 henries, making the ratio of primary reactance to effective source resistance approximately 11.5 at 50 cps. Extrapolating the curves on *Fig.* 17 it is found that the harmonic distortion is about 1.7 per cent at full load, a very considerable improvement in performance.

These figures make it quite clear that when a high-quality amplifier is being designed, the frequency response must extend well below the nominal lower frequency limit required by the signal spectrum if harmonic distortion is not to be intolerably high on low-frequency signals. In this particular, though typical, example, the response must be flat down to 10 cps in order to achieve distortion values as low as 2 per cent at 50 cps.

The reduction of flux density appears advantageous in reducing harmonic distortion but to a great extent this is an illusory advantage. Provided that the flux density is kept below about 5000 gauss at full rated power, there is little to be gained by further reduction, for though reference to *Fig.* 17 would suggest that the distortion is falling as the flux density is reduced, it must be remembered that μ and in consequence the primary inductance L_p and the ratio of ωL to R is also falling. Thus there is no very significant reduction in the percentage harmonic distortion percentage as the maximum flux density is reduced. None of the alternative core materials at present available offer hope of any significant improvement in this situation.

The curves of *Fig.* 17 also suggest that distortion can be greatly reduced by decreasing the effective resistance of the source. At first thought, tetrodes and pentodes appear appreciably worse than triodes in this respect but further investigation does not always support this view. Two EL34's have an effective slope resistance of 30,000 ohms as pentodes in push-pull but only 6000 ohms connected as a pair of triodes, but it should be remembered that the effective source resistance from the point of view of harmonic generation is the parallel combination of valve resistance and load resistance. As pentodes, two EL34's require an anode to anode load of 3400 ohms, making the effective source resistance about 3000 ohms. As triodes the valve slope resistance had dropped to 6000 ohms but the optimum load has risen to 10,000 ohms, making the effective source resistance about 3,700 ohms. Thus in this instance triode connected valves are slightly worse than the same valves pentode connected.

Ultra linear operation of pentode or tetrode valves offers a significant reduction in effective source resistance, another reason for the obsolescence of "straight" operation of pentodes or tetrodes. Negative feedback, either over the whole amplifier as a distortion reducer, or from the anodes of the output valves back into the cathode circuit of an earlier valve as a source impedance reducer, has great advantages and is in fact the only method of obtaining distortion values in the region of 0.1 per cent at full rated load.

Appendix

The flux density B in a transformer core can be calculated from the following equation

$$B = \frac{V \times 10^8}{4.44\, f\, T\, A} \text{ lines/sq. cm.}$$

where B = flux density
V = voltage across winding
f = frequency
T = number of turns on winding
A = core area sq. cms.

In the example used in the discussion V is the voltage developed across the anode load R_L of 3400 ohms at the rated output power of 20 watts. This is

$$V = \sqrt{W R_L} = \sqrt{20 \times 3400} = 260\ V.$$

Using a core having an area of 1.5 sq. ins. (10 sq. cms.) and the 2400-turn winding, the core flux density B at a frequency of 50 cps is

$$B = \frac{260 \times 10^8}{4.44 \times 50 \times 2400 \times 10} = 4900 \text{ gauss.}$$

At this value of flux density the effective permeability may be taken as 3200 and the inductance of the 2400-turn winding is then

$$L_p = \frac{3.2 \times 2400^2 \times 3200 \times 1.5}{8 \times 10^8} = 110 \text{ Henries.}$$

L at 50 cps = $34{,}400$ making $\omega L/R = 11.5$

The distortion where $B = 4900$ lines/sq. cm. and $L/R = 11.5$ is, from *Fig.* 17, approximately 1.6 per cent. Æ

POWER SUPPLY

(*Continued from page 19*)

the grids for cut-off will be a function of the amplification factor of the triodes.

In order to achieve the maximum possible output voltage, R_1 and R_2 should be matched to compensate for tolerances in R_5 and R_6, in C_1 and C_2, and in the location of the center tap of the transformer winding. Matching may be accomplished as follows: with R_4 short-circuited, and with power applied to the transformer, R_1 and R_2 should be chosen so that the alternating voltage at the grids is zero. This match is not very critical, and a suitable pair of resistors should be found among five or six resistors of ten-per cent tolerance.

It is evident from *Fig.* 3, which plots

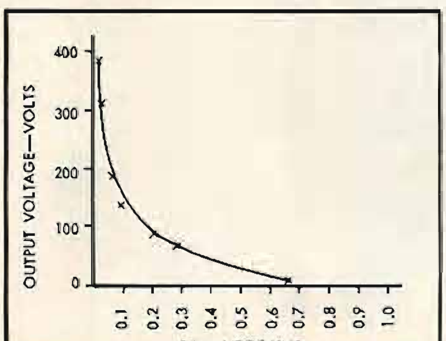


Fig. 3. Output voltage variation with respect to potentiometer setting.

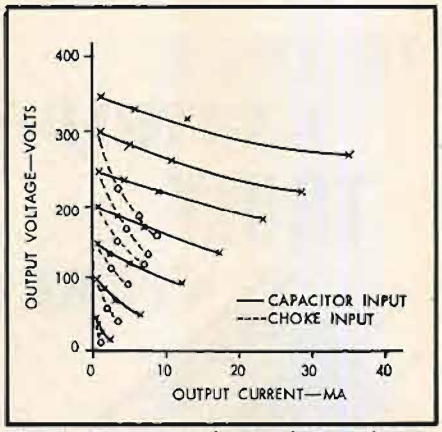


Fig. 4. Power supply regulation characteristics.

voltage against the resistance of R_4, that a potentiometer of reverse logarithmic taper (such as IRC taper P or Q) will give the most satisfactory variation of output as a function of pot setting. To improve the resolution of the control setting, a padding resistor, R_3, can be connected in parallel with the potentiometer, so that the output reaches zero just as the control setting approaches the full counter-clockwise position. It is suggested that component values be chosen so that zero output is reached a little before the end of rotation, to insure that the voltage can always be set at zero in spite of changes in parameters due to aging, temperature changes, line-voltage variations, and so on. If a further improvement in resolution is desired, a vernier adjustment can be added, in the form of a 100-k or 200-k rheostat in series with R_4.

CAUTION: If a larger power transformer is used to provide higher output voltages, the effects of increased power dissipation in the resistance elements must be accommodated, and the capacitor voltage ratings should be revised as appropriate.

Regulation

The regulation of this power supply, as is always the case when voltage control is accomplished by introducing a series resistance element, leaves much to be desired. Consequently, any adjustments of voltage should be made under load conditions. The regulation characteristics of the circuit are shown in *Fig.* 4, which plots output voltage against current for several settings of the control. However, the poor regulation characteristic does not constitute a serious drawback, as regulation is seldom a significant issue with the experimenter, if the control can be adjusted with the load in place.

Unexpectedly, the regulation of this circuit is better with a capacitor input filter than with choke input, for the following reason. With choke input, bursts of current through the tube generate positive voltage pulses at the cathode. These pulses increase the tube's internal resistance by driving the cathode more

PARTS LIST

C_1, C_2	0.1 μf, 600 v, paper
C_3, C_4	8 μf, 600 v, oil filled
L_1	4 Hy choke, d.c. resistance, 250 ohms.
R_1, R_2	100 k ohms, 1 watt
R_3	padding resistor, about 2 megs (see text)
R_4	2 megohms, potentiometer, reverse log taper (IRC type Q-17-139, "Q" taper, or equivalent)
R_5, R_6	2.2 megs, ½ watt
S_1	SPST switch
T_1	Power transformer, 280-0-280, 6.3 v at 2.5 amps.
V_1	6AS7G tube.

positive than the grid, and thereby decrease the d.c. output voltage. A capacitor at the input to the filter smooths out the cathode voltage. For comparison purposes, the power supply regulation with choke input filter is also shown in *Fig.* 4 (dashed curves).

The output voltages plotted were obtained with the filter circuit shown in *Fig.* 1. However, any conventional filter would be suitable, with some change in output voltage and regulation resulting if the circuit values are changed materially from those shown. Æ

External appearance of the variable power supply.

ABOUT MUSIC

(*from page 61*)

writer fears that our concern with facsimiles "degrades the very artists upon whose reputation the production and distribution of these facsimiles depend. It deceives those composers who, through overexposure to the limited areas caught by the facsimile process, are in danger of taking too little note of the opportunities and the responsibilities beyond. And it can mislead audiences into seeking, in the concert hall, those qualities that distinguish the facsimile, and into evaluating what they hear in terms of its faithfulness to copies and to the codes of copyists."

Well, that's quite an indictment! I must say, however, that I cannot share any of Mr. Lamb's apprehensions: I know of no artist who feels he has been degraded by the mere act of recording, nor have I yet encountered a composer who was deceived by having his music released on a disc; I do not seek facsimiles in the concert hall; and, as for the "limited areas caught by the facsimile process," where has Mr. Lamb been for the past ten years? The recorded repertoire available to the inquiring musical mind is astonishing in its scope and diversity, and provides a valuable adjunct to the often weary format of the majority of concert seasons in America.

Behind all of Mr. Lamb's arguments lurks the man-against-the-machine bugaboo. In this case the machine is an audio instrument, and, as with all sophisticated instruments, its value is entirely dependent upon the person who uses it. At its worst, it is nothing more than audio wallpaper; but at its best, it can bring us truly enriching musical experiences. Æ

AUDIOCLINIC

(*from page 4*)

quency transient came along and charged the capacitor negative. As a result, the grid would go negative, and might go far enough negative so that the tube would be completely cut off. The length of time that this cutoff would continue would depend upon the size of the coupling capacitor and upon the size of the grid resistor with which it is associated. By making the capacitor relatively small we do two things: (1) we eliminate a long time constant during which the signal may blank out, and (2) we introduce a voltage division action between the capacitor and its grid return which will serve to prevent low-frequency transients from appearing on the grid. We do not make the coupling capacitor so small in value that the audio response is restricted. We want to remove the 1 to 10-cps transients which are not heard anyhow.

A 0.1-μf capacitor is certainly a large value, and if it is associated with the usual 0.5-meg grid return, a long time-constant will be present which will definitely be of sufficient strength and length to cause the effects noted above. Æ

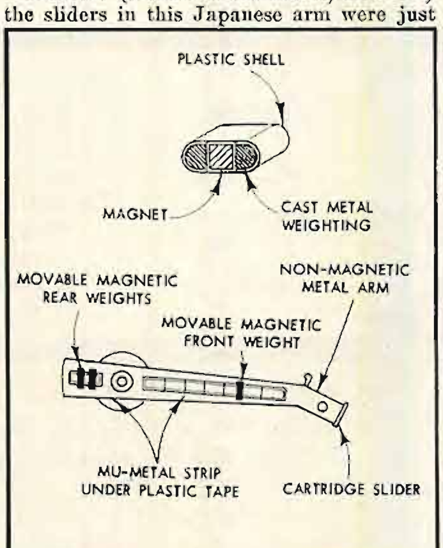
AUDIO ETC

(*from page 44*)

for stereo, especially for four-wire stereo. Second, the viscous damping is potentially dangerous in stereo; a viscous impediment to up-and-down motion can put enormous forces, relatively speaking, on the vertical compliance of the stylus, especially when the record is warped—has waves in it. Lots of them do. I found that without even trying to measure it, I could hear definite distortion in my stereo sound when the damping was heavy. Fortunately, the damping in this arm is variable, via a set-screw on the top of the pivot; so I loosened it up until it was virtually gone and the arms moved free. That did it.

But another odd habit of this type of viscous-damped arm made more practical trouble. The arm "sits" on its pivot and will wiggle freely in any direction. It therefore seeks its own level and if the turntable isn't precisely level will tilt the stylus at an angle to the record. Now this is no great problem if your table is flat, but as I have said, most people's aren't. I kept seeing the tilt, one way or the other, with my naked eye, and wasted much time in minute level adjustments. But a more immediate tilt trouble arose to complicate the issue. Nickels and dimes.

You see (I hate to confess it, but . . .) the sliders in this Japanese arm were just



fine, but the weighting inserts just didn't turn out to be very practical—or least not

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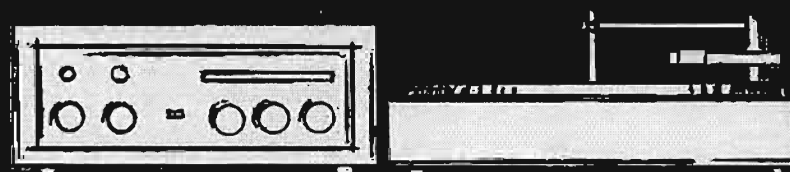

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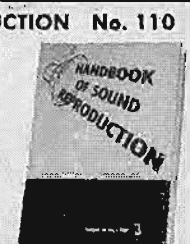

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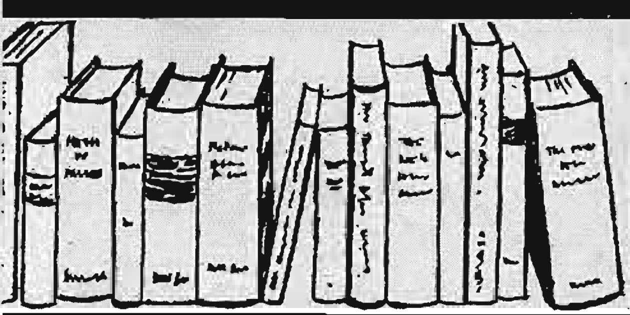

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NAME________________ ADDRESS________________

CITY________________ ZONE_____ STATE__________ for my multiple-cartridge situation. We tried to pre-adjust the weight for each in the installation, but it wasn't easy. I found, in my perennial haste to get my work done, that generally the cartridges were too light and that a small and judiciously placed weight on the arm brought things to the proper state. It was sometimes a bit of metal or a washer or bolt, but more often and conveniently, a coin. So simple, and so handy.

It did work, I asure you, and I achieved very proper stylus forces. (I can now judge the force fairly well by the effect on my finger tip, even without fancy measurements.) The hitch was that they were tipsy. If the coin wasn't *exactly* in the middle and the turntable exactly flat—or equivalent combination—the arm quietly leaned sidewise and the coins kept falling off, anyhow.

I'll put aside any account of my other adapting procedures for this interestingly outdated arm, except to say that we did fix it up for multiple-contact sliders (we have actually used five contacts) via a special and ingenious plug and socket; we installed a mono-stereo switch (paralleling the two leads for mono) and even an automatic ground (more on this, later). It was stereo in all respects now, and except for the stylus-force problem was highly satisfactory.

Well, I got one whiff of the zero-balance idea and decided at once that it could be combined with a better weight system for the Japanese arms before we finally replaced them. What we needed were two elements. (1) An adjustable weight on the rear overhang, for zeroing out the cartridge balance. (2) A movable, adjustable weight—much less heavy—to slide along the main body of the arm for the stylus force desired, after the zeroing process. A third necessity (3) was a means to attach these weights to the arm, yet leave them movable for adjustment. That was tricky, and you wouldn't guess our dizzy answer. Magnets and mu-metal strips.

I happened to have some odd pieces of thin mu-metal, in the shape of transformer leaves or the like, and my assistant cut some of this up. A narrow (⅜") strip was placed on the flat top of the arm (which is non-magnetic) for about seven or eight inches, from the pivot down to the neck of the arm "head," and sealed down neatly with a half-inch strip of plastic sticky tape over it. On the rear overhang we put a shorter strip in the same way.

We had experimented to find the proper weights and my assistant now proceeded to cast them. He mounted a small piece of bar magnet, of the sort you can buy for household use, into a plastic holder and added weight via Wood's metal, which melts in boiling water. As an industrial engineer he has this sort of thing at his finger tips. The plastic is a sort of flattened tube section with one end sealed, maybe three-quarters by a half by a quarter inch. The finished weights are neatly colored, a pair of heavier magnet-weights for the rear-end balance (two for more range) and a much lighter one, different color, to do the front-end sliding adjustment. They stick to the mu-metal strips very nicely and won't fall off short of a major displacement of the turntable box. (We put a small plastic box near the turntable to take them when moving day arrives.) The mu-metal strip itself with its neat plastic tape covering is a guide for centering and thus minimizes the problem of the leaning stylus.

The procedure is simple. Plug in your cartridge, mounted in its slider. Put one or both rear weights on the mu-metal strip and adjust until the cartridge floats. Then put the front weight on its longer strip and slide forward to the proper stylus force.

It works just fine—and I have a very rough calibration in garms marked on the plastic strip, just for looks. It could, of course, be made accurate since this scale is invariable, once the cartridge's weight has been balanced out to zero.

But I think I like the more professional arrangement on the Empire 98 arm even better. Æ

LIGHT LISTENING

(*from page 10*)

MONOPHONIC

Jerry Bock: Fiorello

Capitol WAO 1321

The wail of a siren at the start of the overture notifies the listener that this musical biography of one of New York City's more popular mayors isn't going to take itself too seriously. The authors selected the segment of Fiorello La Guardia's career that would provide the most colorful backdrop for the show. This is the story of his personal life while getting started in politics during the wild administration of Jimmy Walker. Capitol's original cast recording proves one point immediately. The producers of Pajama Game, Damn Yankees, and West Side Story can turn out a hit show on almost any subject and give it enough color and life to register in a recording. *Politics and Poker,* one of the hit songs, establishes the atmosphere early in the record. *Unfair* introduces Tom Bosley in the title role as he coaches the female employees of the Nifty Shirt Waist Co. in picketing techniques. Fiorello's campaign song when running for Congress, *The Name's LaGuardia,* is delivered in several languages. The love songs are handled in ladylike fashion by Patricia Wilson, Pat Stanley, and Ellen Hanley. Eileen Rodgers and a girl's chorus introduce some of the corn of the times in the Walker campaign song, *Gentleman Jimmy.* On the evidence of this record, the production number most enjoyed by the cast occurs late in the show—*The Little Tin Box.* It's one hand you'll be tempted to repent as a procession of politicians takes turn explaining, with deeply injured innocence, how the loot happened to worm its way into their tin boxes. Capitol's sound is bright without straining for effect. The miking of the orchestra is particularly successful in getting the touches that underline the action in any polished show.

Percy Faith: Bouquet

Columbia CL 1322

Ray Ellis: I'm In The Mood For Strings

MGM E 3779 ●STC-3779

Perseverance apparently pays off in the recording studio even when background music is on the docket. For years, Columbia has assigned the same recording engineer to the Percy Faith sessions to ensure a continuity in miking methods. In this Bouquet album (*Solitude, Ebb Tide, Laura,* etc.) Percy Faith dispensed with his normal complement of brasses and winds. The orchestra was divided into four sections for easier control at the console—two banks of violins, one section of low strings and a section occupied by piano, harp, guitar, and vibraphone.

The MGM project with Ray Ellis doesn't display much luster. A dull studio diminishes some of the natural appeal in the straightforward string arrangements. Each tune is further burdened with a wordless choir—a device that, one of these days, is going to become old hat even at the consumer level.

Les Baxter: The Sacred Idol
Capitol T 1293

Do people still buy this sort of thing? Somehow I've been under the impression that music dealing with Aztec gods went out with the early talkies yet here it is again on a brand new disc from Hollywood. The men of Les Baxter's orchestra have been hardened to this activity in previous excursions to non-existent faraway places. The twenty-five-voice chorale does its best to show interest in selections with titles such as *Gardens of the Moon, Fruit of Dreams*, and *Pyramid of the Sun.*

Peggy Lee: Latin Ala Lee
Capitol T 1290

Once committed to the concept of Broadway show hits in Latin tempo, the producers of this latest Peggy Lee album didn't settle for half-way measures. A wavering in resolve would probably have undermined the entire project. After all, the conversion of Oklahoma's *Surrey with the Fringe on Top* into a cha-cha-cha leaves little room for indecision or weakness of nerve. Drawing upon the pool of Latin instrumentalists in the Los Angeles area, conductor Jack Marshall has assembled a group capable of sailing through a dozen show tunes as though they were the brainchild of some South American songsmith. Four Afro-Cuban drummers add further spice throughout the album. Peggy Lee displays, in addition to the easy warmth that always has been her trademark, a poise that should be the envy of every gal who faces a mike in the line of duty. Recommended more for its audacity than as a possible start of a general trend.

Buddy Cole: The Most Recorded Songs Of All Time **Warner Bros. B 1357**

There is little need to check the accuracy of the statistic claimed in the title of this album. The ten can't-go-wrong tunes include *Star Dust, Begin the Beguine, Body and Soul, St. Louis Blues, September Song*, and *Over the Rainbow.* The Cole keyboard style retains its incisive command of color without lapse into mannerisms. The sound has a tinge of commercial reverberation although in nowhere near the quantity found in some Hollywood pop recordings previously released on this label. Æ

WANTED: 18-inch Cinaudagraph speaker. Box CC-1, AUDIO, P. O. Box 629, Mineola, New York.

SEVERAL Audio Process model AP-11 low resonance, damped cone woofers: 4.5 lb. magnet, $14 each. Requires recommended 2 cu. ft. sealed baffle. G. Cain, 15 Manet Circle, Chestnut Hill, Mass., LAsell 7-0826.

CLASSIFIED

Rates: 10¢ per word per insertion for noncommercial advertisements; 25¢ per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

TRADE UP TO STEREO: Largest selection of new, used hi-fi components. Professional service facilities available. Write Audio Exchange, Dept. AE, for trading information. 153-21 Hillside Ave., Jamaica 32, N. Y. Branches in Brooklyn, White Plains, Manhasset.

HIGH FIDELITY SPEAKERS REPAIRED
Amprite Speaker Service
168 W. 23rd St., New York 11, N. Y. CH 3-4812

ENJOY PLEASANT SURPRISES? Then write us before you purchase any hi-fi. You'll be glad you did. Unusual savings. Key Electronics, 120 Liberty St., New York 6, N. Y. EVergreen 4-6071.

WRITE for confidential money-saving prices on your Hi-Fidelity amplifiers, tuners, speakers, tape recorders. Individual quotations only; no catalogs. Classified Hi-Fi Exchange, AR. 2375 East 65th St., Brooklyn 34, N. Y.

UNUSUAL VALUES. Hi-Fi components, tapes and tape recorders. Send for package quotations. Stereo Center, 18 W. 37th St., New York City.

SALE: 78 rpm recordings. 1900–1950. Free lists. Collections bought. P. O. Box 155 (AU), Verona, N. J.

RENT STEREO TAPES—over 900 different—all major labels. Free catalog. Stereo-Parti, 1608-H Centinela Ave., Inglewood 3, California.

INDUCTORS for crossover networks. 118 types in stock. Send for brochure. C & M Coils, 3016 Holmes Ave., N.W., Huntsville, Ala.

WESTERNERS! SAVE MONEY on your components! Free delivery and advisory service. Special prices on package deals. Charles Munro, Audio Components, 475 Linden Ave., Carpinteria, California.

FOR SALE: "Hi-Fi Music at Home," Nos. 1–38; "Audiocraft," Vol. I complete; AUDIO, Oct. '54, Dec. '54, Feb. '55–Dec. '59. Best Offer. Snader, 105 E. 35th St. Wilmington 2, Del.

LOW QUOTES on everything. Hi-fi & Stereo tapes. Bargain list. HiFi, Roslyn 4, Pa.

EXCHANGE: Altec 633A microphone, rugged non- or semi-directional dynamic, famous "saltshaker" in perfect condition, for an AR-1 or KLH-4. R. Kessler, 1300 York Ave., New York 26, N. Y.

AUDIO and "Radio News" Jan. '50–Dec. '54, each set $10; Sargent-Rayment SR-808 AM-FM tuner and preamp, $75; Atlas HF-1 tweeter, $15. All f.o.b. Oakland. Snyder, 409 Orange St., Oakland 10, California.

HI-FI COMPONENTS, tape recorders. Special quotes Dynakits, Bell equipment. Bayla Co., 1470-0 Elmer Road, Wantagh, N. Y.

FOR SALE: ACA Model 808C Twin-Trax tape recorder mechanism, 15 ips, in good condition, $40; Electro-Voice Model 650 microphone, $30; Jackson audio oscillator, $20. Donnie Brown, 1305 Watson, Moberly, Mo.

SELL: Electro-Voice T250 driver, X6 network, 6HD horn, $75; Jim Lansing 375 driver, N500 network, 537-509 horn-lens, $275; University 15W woofer, $60. John Haner, 683 Locust St., Galesburg, Ill.

TEST YOUR AUDIO ACUITY! Ultra-sensitive recording techniques capture and amplify the essence of sounds that ordinarily go unheard. Using these techniques we've recorded the everyday "small" sounds of the home. The results will challenge your sound judgment. Entertaining and informative. Introductory offer of twenty sound surprises on tape for $2.00 postpaid. Tapes are full track 7½ ips recordings made on Ampex. Audio Specialities, Dept. A, Box 8203, San Antonio, Texas.

FOR SALE: Scott 130 stereo preamp, like new, $95; Grado stereo arm, $15; Shure M3D stereo cartridge, almost new, $20. Houland, 151 Hartford Tpke., Hamden 17, Conn.

Circle 75A

Circle 75B

Circle 75C

Circle 75D

Circle 75E

Circle 75F

Industry People...

C. Robert Paulson has been appointed manager of the Professional Audio Products Division of Ampex Professional Products Company. He replaces **Frank G. Lennert** who will remain with the company in an advisory capacity on audio matters. As well as taking on his new duties as division manager, Paulson will continue in the position of marketing manager for the Professional Products Division until a replacement is appointed . . . **Leon Kuby** is the newly-named sales manager of the Citation Kit Division of Harman-Kardon, Inc. . . . New additions to the administrative staff of Audio Devices, Inc., at its Stamford, Conn., plant are **Donald J. Moore** and **David W. Murphy.**

Appointment of **Don Kirkendall** as assistant manager of advertising and sales promotion has been announced by **Everett Leedom,** advertising manager of Electro-Voice, Inc. He succeeds **Dean Nordquist** who was recently named assistant sales manager of the new E-V Cartridge and Needle Division . . . **Rod Kershenstein,** formally with Ampex Corporation, is the now general sales manager for Glaser-Steers Corporation. He will be responsible for all sales activities and will report directly to **Julius Glaser,** president.

William H. Miltenburg, former chief engineer and manager of recording studios for RCA-Victor, has been named manager of operations for United Stereo Tapes, a division of Ampex Audio, Inc. . . . Appointment of **Dr. Harvey Fletcher** as a consultant has been announced by **S. N. Shure,** president of Shure Brothers, Inc. One of the pioneers of acoustical science, Fletcher was director of physical research for Bell Telephone Laboratories until his retirement in 1949.

Industry Notes...

NEW TAPE PLANT. A new pilot plant designed to evaluate and produce esoteric magnetic tapes has been completed in Lodi, N. J., by **Ferrodynamics Corporation.** Part of the company's expanded research and development program, it will be used to investigate manufacturing techniques for such sophisticated tapes as those used to instrument missiles and satellites, reproduce television programs, automate factories, and process computer data. In slightly more than three years, Ferrodynamics' annual sales have grown to nearly $1,000,000. It has reached its present volume almost solely with recording tape for high fidelity music reproduction. Besides its "Sonoramic" and "Brand Five" tapes, Ferrodynamics supplies tapes for the private labels of other firms.

NEW U. S. REP FOR BEAM-ECHO. To represent exclusively in the United States the complete line of sound reproducing equipment manufactured by **Beam-Echo Ltd.** of London, Eng., a new agency known as **Beam-Echo International Ltd.** has been established with offices, showroom, warehouse facilities and service and parts department at 820 Greenwich St., New York 14, N. Y. Andre Rahmer, managing director of Beam-Echo Ltd., England, is chairman of the new company, and Michael Muckley is president. Also represented by Beam-Echo International Ltd. is **Ferguson Radio,** prominent British manufacturer of packaged stereo phonographs and table radios. Manufacturers representatives are now being appointed for both lines. Æ

Circle 75G

Circle 75H

ADVERTISING INDEX

•

a quality stereo tape recorder
built in America
to sell for under $200

The New Viking 76 Compact

A major achievement! Viking quality and dependability in a stereo recording/playback unit for home use and **priced below $200.**

The new Viking **76 Compact** is the simplest, most rugged of all tape mechanisms with complete stereo recording electronics.

ALL THESE FEATURES PLUS A BUDGET PRICE:

Records and plays monaural and stereo quarter-track tapes (3¾ and 7½ ips).

Uses your existing music system for top playback fidelity (As with the 85 Series "Stereo-Compact," you buy only a high-quality transport and recording amplifiers.)

A single motor for maximum signal-to-noise ratio. Motor hum 50 db below normal tape output.

Wow and flutter less than .2% rms.

80 kc bias for smooth, extended range recording—25 to 16,000 cycles ± 3 db.

Tremendously flexible. One quarter-track stereo model which can be used for all types of monaural and stereo recording and duplicating records and tapes.

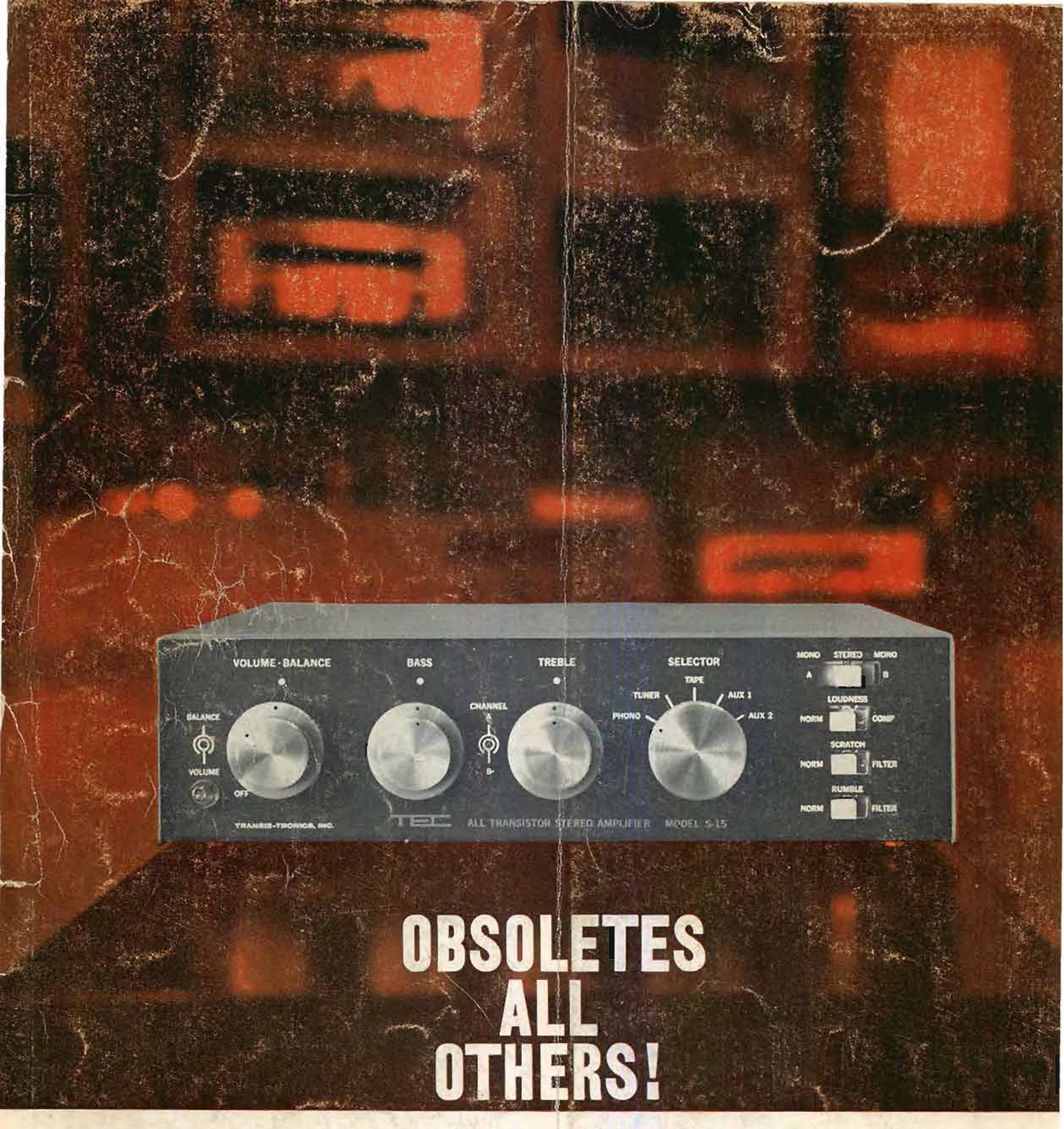
Recording and playback quality to meet or exceed professional standards.

You'll find the new Viking **76 Compact** at most major hi-fi-stereo dealers now. Stop in and ask for a demonstration. For catalog or technical information, write Customer Service Department, Viking of Minneapolis.

SOLD ONLY THROUGH VIKING DEALERS

Viking OF MINNEAPOLIS, INC.
9600 Aldrich Avenue South, Minneapolis 20, Minnesota

BUILT IN AMERICA—by Danes, Swedes, Irishmen, Germans, Poles, Frenchmen, Canadians and a host of others.



The TEC S-15 all transistor 40 watt stereo amplifier brings a space age concept to high fidelity. Never before has the audiophile been able to get so much high quality sound for so little. A neat package 10″ long and seven pounds light puts out 40 watts of pure undistorted sound. And the price is as exciting as the package—only $129.50. Because of its all-transistor circuitry, the unique S-15 has no heat, no hum, no microphonics. Quite naturally, from Transis-Tronics. Write for your copy of complete specifications. Power Output 40 watts (20 watts per channel). Frequency Response ±0.5 db 20-20,000 cps. Response is 3 db down at 6 cps and 45,000 cps. Intermodulation Distortion less than 0.9% at rated output, 60 and 6000 cps. Harmonic Distortion less than 0.5% at rated levels. Inputs 5 pair: magnetic phono, tuner, tape, auxiliary 1, auxiliary 2. Front Panel Controls: volume, power; balance; bass channel A; bass channel B; treble channel A; treble channel B; function (phono, tuner, tape, auxiliary 1, auxiliary 2); mode (mono A, stereo, mono B); loudness; scratch filter, rumble filter. Balance Control for equalizing speaker outputs. At full rotation will completely cut off sound from either speaker. Circuitry, 2 germanium diodes, 3 silicon diodes. Power Requirements 105-120 volts AC, 50-60 cps; 12-28 volts DC for battery operation.

TEC S-15

TEC Transistor Engineered Components TEC

Transis-Tronics, Inc., 1601 Olympic Boulevard, Santa Monica, California