
AUDIO
DECEMBER
1972 60c
The Authoritative Magazine About High Fidelity ® A
23602
MICROPHONE BUYER'S GUIDE
JIM LONG: MICROPHONE PRIMER
PERCY WILSON ON RECORD CARE

S R SPEAKER SYSTEMS

at is destined to become the nd reproduction system.

R500

R300

PIONEER'S NEW SERIES

An acoustic achievement th
universally preferred sou

R700

Brilliant sound from a distinctive newcomer.

And the critics agree:

OPERA NEWS (Hans Fantel)
"The cadre of relatively low priced high-performance speakers has recently been augmented by a distinctive newcomer: Pioneer's R300, whose tonal characteristics have been tailored to the results of extensive preference-testing with large groups of listeners. The R300 has a quality of 'presence' and immediacy which made Salome's murderous ecstasies positively scary when I listened, and the massive sonorities of the Strauss score didn't faze this speaker a bit."

STEREO & HI-FI TIMES (Larry Zide)
" . . . This (R500) speaker will please many with its big, bright sound . . The middle ranges . . . are most prominent, but there is more than enough good bass, too . . . The high end response is excellent; midrange and tweeter contribute to a smooth, wide range sound that goes well beyond audibility . . . It's time that we began to demand appearance along with performance. This, Pioneer is certainly giving us with this model, and they are to be commended for the effort . . . The R500 is a quality speaker and deserves your attention."

MODERN HI-FI & STEREO GUIDE (Robert Angus)
"There are some important differences between the R series . . . and most other bookshelf speaker systems on the market . . . The R500 is designed to make electronic rock music sound more dramatic . . . There's no doubt that with either folk or rock music, these speakers really produce brilliant sound . . . bass is remarkably clean and full under any circumstances . . . Sound is clean and undistorted up to 18,000 Hz . . . at the low end, clean frequency response is measurable down to 22 Hz."

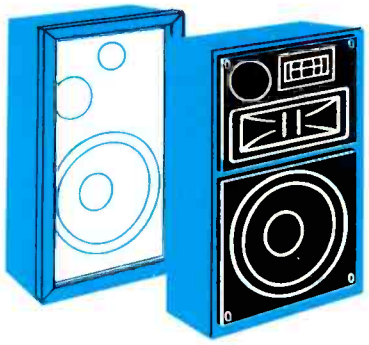
Too often these days superlatives are used to camouflage mediocrity. Let's just say you'll be excited with the magnitude of the achievement of the new Pioneer series R speaker systems, once you hear them. They represent the culmination of our more than six years of intensive research in every phase of speaker design on just this series alone.

We investigated, tested and evaluated every known area: frequency response, dispersion, distortion, transients, drivers, configurations, cabinetry — rejecting, accepting, improving until we were completely satisfied that we had the perfect combination. The sound most people would prefer when compared with the conventional speakers now available.

The story behind the grille

To achieve this exceptional sound reproduction, Pioneer has endowed the new series R with a host of meaningful refinements that have become the hallmark for our extensive collection of high fidelity components.

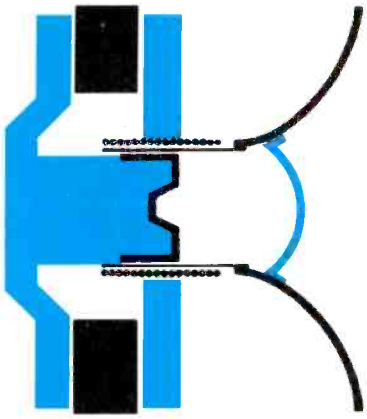
Flush mounting. Unlike other speaker systems on the market today, the R series' drivers are flush mounted to the face of the enclosure, rather than recessed. Combined with the advanced design of the individual speaker units, there is added vitality to the mid tones and wider dispersion.



Conventional recessed speaker mountings. **New up-front flush mounting of Pioneer series R.**

Exclusive FB cones assure robust bass, clear mid and high tones, improve damping, while keeping distortion at an absolute minimum. High input signals are handled with complete ease.

	R700	R500	R300
Speakers	12″ woofer, midrange horn, multicell horn super tweeter	10″ woofer, 5″ midrange, horn tweeter	10″ woofer, horn tweeter
Maximum Input Power	75 watts	60 watts	40 watts
Crossovers	750 Hz, 14,000 Hz	800 Hz, 5,200 Hz	6,300 Hz
Dimensions	15″ x 26″ x 13 3/16″	13 3/4″ x 24″ x 12 1/16″	13″ x 22 1/2″ x 11″
Price	$229.95	$159.95	$119.95



Unique concave center pole design and pure copper cap/ring combination. The concave center pole of the drivers' magnetic structure is covered with a pure copper cap. Not only does this reduce the inductance of the voice coil, it also decreases the voice coil's intermodulation distortion generated by the magnetic field. The result: vastly improved bass and midrange transient responses. Another example of Pioneer's meticulous engineering detail.

Improved design horn tweeters of die-cut aluminum have completely replaced the more conventional (and less costly) cone and dome-type tweeters in the entire series. You can hear the difference with wider dispersion, and you gain all the advantages of horn drivers, such as high transient response and lowest distortion.

Crossovers are precisely designed in each model. In contrast to other speakers that rely on the capacitance method only, Pioneer has combined both inductances and capacitances for minimum intermodulation distortion. And you'll never hear bass tones wandering to the tweeters, or highs intruding on the woofers. You couldn't ask for better linear response.

The acoustically padded enclosures are sturdily built and faced with handsome two-piece, two-color, removable grilles. The staining process of the hand selected walnut requires ten steps alone, and utilizes an exclusive oil created by Pioneer. Each unit is produced as if it was the only one.

Sound-absorbing foam polyurethane surrounds the woofers of the R700 and R500 to reduce distortion even further. The three R series models each employ long-throw voice coils providing greater cone movement for higher excursions.

There are many technical reasons why you should buy a pair of the new Pioneer series R speakers systems. But, in the final analysis, when you compare them with comparably priced speakers at your Pioneer dealer, their absolute superiority in sound reproduction is why you will buy them.

U.S. Pioneer Electronics Corp.
178 Commerce Rd., Carlstadt,
New Jersey 07072

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when you want something better

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AUDIO

DECEMBER 1972 *Successor to* RADIO *Est. 1917* Vol. 56, No. 12

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EQUIPMENT PROFILES

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RECORD REVIEWS

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HERE IS THE WORLD'S ENTIRE SELECTION OF AUTOMATIC TURNTABLES WITH ZERO TRACKING ERROR.

There they are. All one of them.

Garrard's Zero 100, the only automatic turntable with Zero Tracking Error.

Not that there haven't been attempts by other turntable makers. Many have tried. This is the first to succeed. And it has succeeded brilliantly. Expert reviewers say it's the first time they've been able to hear the difference in the performance of a record player...that the Zero 100 actually sounds better.

It's all because of a simple but superbly engineered tone arm. An articulating auxiliary arm, with critically precise pivots, makes a continuous adjustment of the cartridge angle as it moves from the outside grooves toward the center of the record.

This keeps the stylus at a 90° tangent to the grooves. Consequently tracking error is reduced to virtual zero. (Independent test labs have found the test instruments they use are incapable of measuring the tracking error of the Zero 100.) Theoretical calculations of the Zero 100's tracking error indicate that it is as low as 1/160 that of conventional tone arms.

Zero tracking error may be the most dramatic aspect of Zero 100, but it has other features of genuine value and significance. Variable speed control; illuminated strobe; magnetic anti-skating; viscous-damped cueing; 15° vertical tracking adjustment; the patented Garrard Synchro-Lab synchronous motor; and exclusive two-point record support in automatic play.

The reviewers have done exhaustive reports on Zero 100. We believe they are worth reading, so we'd be happy to send them to you along with a 12-page brochure on the Zero 100. Write to us at: British Industries Co., Dept. L-12 Westbury, N.Y. 11590.

GARRARD ZERO 100

$199.95

less base and cartridge

Check No. 3 on Reader Service Card

Mfg. by Plessey Ltd. Dist. by British Industries Co.

The Tape Guide

Herman Burstein

Coming in January

AUDIO looks at the new receivers and tuners

FM Tuner Specifications—by Len Feldman

The Language of High Fidelity—Part 8 of Martin Clifford's series for beginners.

Equipment Reviews Include:

The EPI 601 speaker system

ESS VII speaker system

Onkyo 20 speaker system

About The Cover: The lady is wearing a lavalier type microphone. According to Mr. Webster, the name comes from the French *Lavallière*—"A pendant on a fine chain that is worn as a necklace." This kind of microphone has a restricted response at the low end—for obvious reasons.

Tape Squeal

From time to time readers write in to complain about tape squeal, usually occurring with just certain combinations of tape and tape machine. That is, a given tape will squeal with some machines and not others and a given machine will squeal with some tapes and not others. Following is a helpful commentary by Roger K. Odom, Engineering Manager, SPARTA Corp., 1931 Shelfield Dr., Carmichael, Calif.:

In every case I have experienced, squeal can be directly related to the back-tension of the feed reel, that is, if the tape-tension is properly adjusted the squeal will disappear. The basic solution is to reduce tension on the tape. The cause is a bit more complex and results, in part, from manufacturers' attempts to reduce head wear and increase tape life and response. It is directly related to factors such as the elasticity of the tape, the coefficient of friction in the tape-to-head contact, the geometry of the tape transport, and the damping (if any) between the feed reel and the tape head. Almost always it occurs in transports which rely upon back-tension in the feed reel to avoid the added head wear of pressure pads.

Hot Chassis

Q. I have a TV set without a transformer, one whose chassis can be hot. At some time in the future I want to connect the signal from the TV volume control to my high fidelity system. If the chassis is hot and I reverse the plug in the house receptacle, will that remove the danger? The service manual says to use an isolation transformer when the set is serviced. Can an isolation transformer be left permanently plugged into the power line? Would this remove all danger?—John J. Kiesel, Valley Stream, N.Y.

A. Reversing the plug may or may not eliminate the danger of electrocution to someone touching the audio system when the TV is connected to it. I wouldn't take the chance. The fact that the service manual says to use an isolation transformer when servicing the set is evidence of this. The isolation transformer can be left permanenty plugged in and would remove the danger of electrocution. When the TV set is off, the transformer of itself will consume negligible current. (When you are away for a prolonged time, it might be a good idea to disconnect the transformer from the a.c. line.)

Receiving Microphone

Q. Here's a strange one for you. The other day when using my Uher 4000-L portable tape recorder on playing back some music, I noticed a few extra notes which weren't on the guitar I was playing when I made the recording. Curious, I pushed the record button and waited. The VU meter wiggled a little. Playing back what should have been random room noise, instead I heard a series of tones in random three-note segments of different pitch. I recognized this as what I used to hear on channel 23 of a C.B. set I owned about five years ago. Channel 23 is used for remote control, and I had been told that what I heard was the city utilities being remotely controlled. The microphone I am using is an Electro-Voice 676. Since I don't have the phantom note problem when recording on line input, I suspect the mic. What do you suspect?—Howard Mills Lang, Panorama City, Calif.

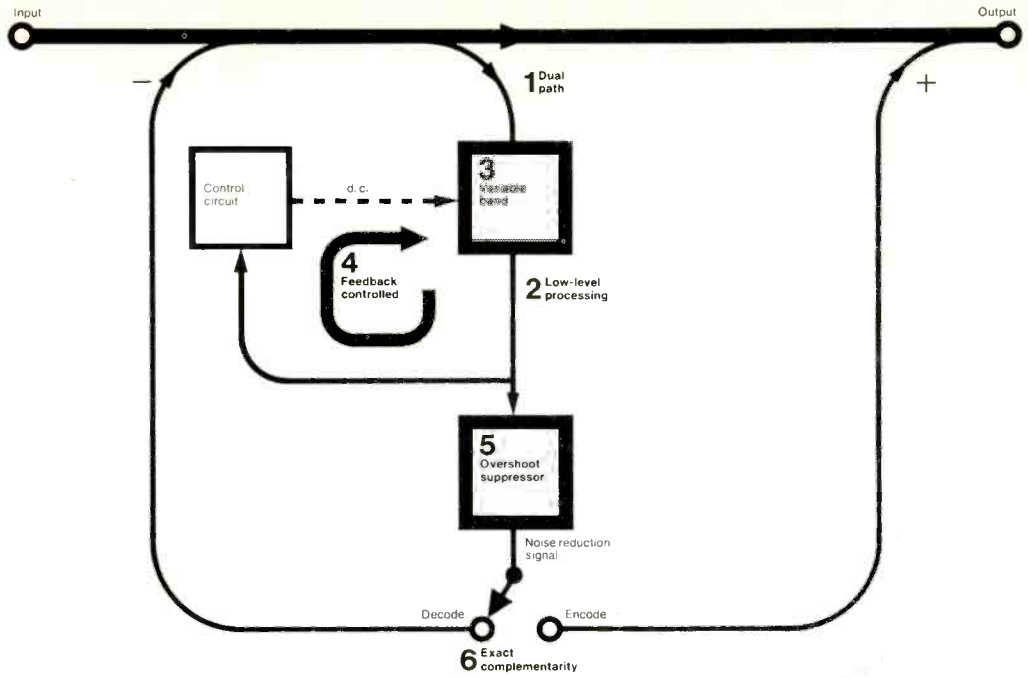
A. I am more inclined to suspect the first recording stage than the microphone. On the other hand, conceivably it is the microphone or its cable that is picking up the C.B. broadcast. Disconnecting the mike should tell you; if you still get the phantom notes, the fault is not the mic's. If the fault is not the mic's, you may be able to solve the problem by placing a small capacitance—a few pf—between the input of the first recording stage and ground. Should the mic be the source of the phantom note pickup, I suggest that you query the manufacturer of the mic for a solution.

HF Bias Oscillator

Q. In going through some audio magazines I noticed a statement that lower bias noise is possible by increas-

(Continued on page 103)

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.



Dolby found the 6 pieces that solved the noise reduction puzzle

Noise reduction isn't a new idea; it's as old as noise. Engineers tried to solve the problem for years, rejecting one circuit after another. They knew that some kind of compressor-expander was needed; that part of the puzzle was solved long ago. The parts that seemed to defy solution were the distortions, noise modulations, overshoots and other side effects of compressors and expanders.

Then Dolby Laboratories solved the remainder of the puzzle. First for professionals. Then, using the same basic ideas, for home listeners – with the Dolby B-Type noise reduction circuit.

This is how Dolby did it:

1. Dual path circuitry
The incoming signal goes two ways; the main path is straight through the circuit, with no signal changes of any kind. Distortion in the output is therefore inherently low. All of the signal processing is done in a separate side chain, the output of which rejoins the main signal either additively or subtractively.

2. Low-level processing
Processing in the side chain takes place only at very low levels – where the noise is. Because side chain distortion is already low, and since at high levels the side chain output is only a small fraction of the main path signal with which it is combined, distortion in the output of the B-Type circuit is remarkably low.

3. Automatically variable noise reduction band
The Dolby B-Type circuit automatically adjusts the bandwidth in which it acts when the spectrum of the signal changes. Most of the time noise reduction is obtained over quite a wide band (from 500 Hz upwards), but there are no noise modulation effects (breathing) when high-level mid-range signals appear. Such signals simply shift system action upwards, instead of shutting it off. This part of the circuit is a variable high-pass filter with an automatically variable cutoff frequency. The effect of the circuit is to restrict the noise reduction signal to the low-level region in which it is required.

4. Feedback control
The variable filter is controlled by closed loop d.c. feedback in both the encoding and decoding modes; during decoding, an additional a.c. feedback loop goes around the entire circuit. This extensive use of feedback results in an inherently stable and reliable circuit.

5. Overshoot suppression
Transients cause problems for conventional compressors and expanders, regardless of the speed of action of their control circuitry. The Dolby dual path, together with low-level processing, allows overshoot suppressors to be used without introducing audible distortion into the output signal. This freedom from signal overshoots means that Dolbyized signals cannot overload tapes or FM transmitters.

6. Exact complementarity
Encoding and decoding are truly complementary because of the symmetrical configuration of the system. The symmetry not only ensures exact encoding and decoding, but it simplifies mode-changing. Switching from encode to decode takes just one single-pole switch – and circuit simplicity means circuit economy.

Put the pieces together yourself. The Dolby solution to the consumer noise reduction puzzle means optimum noise reduction, no compromise of signal integrity, and lowest cost.

Dolby Laboratories Inc
1133 Avenue of the Americas
New York NY 10036
Telephone (212) 489-6652

346 Clapham Road, London SW9
Telephone 01-720 1111

Tiger Building 30-7
4 – Chome Kuramae
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Joseph Giovanelli

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped self-addressed envelope.

Note

A tremendous amount of mail has been received with regard to this column. I wish to thank all for your confidence in what I am trying to do.

Because of this heavy volume, it will take some time to get to any given letter. I answer all letters in the order in which they are received.

Letters are answered regardless of whether or not we can use them in "Audioclinic." When material is to be so used, I always indicate this fact in my letter, giving you time to indicate that you do not wish your name used. When I receive a request that a name not be used, I acknowledge this fact by mail so you can have the assurance that your request will be honored.

In closing, I wish to thank you for your patience while awaiting a reply to your questions.—*J. G.*

Organ Tonal Balance

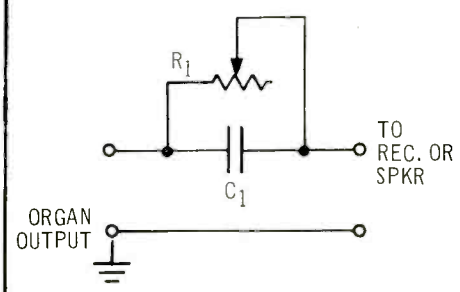
Q. *My electric organ contains a stereo speaker system. I have installed jacks to which I can connect external speakers, which I also use for making stereo recordings. The sound produced by the left channel output is excellent. The right channel, however, carries the pedal tones and tends to over-power and blur the treble information, some of which is also carried on that channel. Can you suggest a circuit which would provide variable suppression of the bass frequencies without affecting the treble?*—Lee Ryer, Reseda, Calif.

A. You probably need very little in the way of special circuitry in order for you to attenuate the pedal tones. This can usually be accomplished via facilities contained in the instrument.

This might take the form of discrete pedal stops or by a potentiometer located right on the console. Some instruments employ pots located within the instrument which are intended for preset tonal balance.

Bass can be attenuated by placing the "hot" output terminal in series with a capacitor. The value of this capacitor will depend on whether the instrument is to feed directly into loudspeakers or whether it is to feed into a tape recorder.

In the event that you feed the recorder, perhaps you can find another point in the circuit from which to extract signal. This point may provide better tonal balance than is available from the speaker output you are now using. If you must use the speaker output, place a small capacitor in series with the "hot" lead. The value must be determined experimentally, but perhaps a good starting point is 0.005μF. The working voltage is no consequence because you won't have more than a few volts appearing across the capacitor. Adjust the value of this capacitor so that you obtain almost enough bass. You can then shunt the capacitor by a potentiomer whose value will depend on the impedance of the circuit driven by the organ. A 0.5 meg pot is a good one to use for experimental purposes. The purpose of this potentiometer is to shunt low frequencies around the capacitor, providing you with a bass tone control. You should choose a value for this pot which will provide very little bass boost when open all the way. When you begin to close the pot, bass should gradually rise. If the value of this control is too high, the boost will take place only when it is nearly closed, making for difficulties in accurate balancing. If the value of the pot is too low, too much bass will be shunted around the capacitor, regardless of the setting of the pot. This bass boost circuit is shown in Fig. 1.



DRIVE REC.
START WITH
C_1 = .005 MFD
R_1 = .5 MEG.

EXPERIMENT WITH VALUES
DRIVE SPKR.
C_1 = 100 MFD NON-POLARIZED
R_1 = 100Ω 10W

Fig. 1—Bass tone control.

A similar arrangement can be constructed for driving external speakers. In this instance the value of the capacitor is considerably greater, and the resistance of the potentiometer is considerably lower. A good starting capacitor value is 100 μF. This must be what is often referred to as a non-polarized electrolytic or motor-starting capacitor. If such a capacitor is not available, a serviceable substitute can be fabricated as shown in Fig. 2. Note the polarities shown and be sure to observe them.

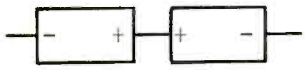


Fig. 2—Equivalent of non-polarized capacitor.

A reasonable starting point for the potentiometer would be 100 to 500 ohms. Here again, the purpose of this pot is to provide you with a means to adjust the tonal balance.

This potentiometer should be capable of handling at least 10 watts, though wattage for the potentiometer used to drive your tape recorder is not at all critical.

If the external speakers or a suitable dummy load is attached to the organ when you make your tapes, you can use the components needed for speaker tonal balance; you won't need the first network described here.

If your music system contains a separate preamplifier, you can use it as an alternative method by which to obtain proper tonal balance. Feed the organ directly to one of the high level inputs. The main outputs can be used to drive either a power amplifier or tape recorder. In either case, the bass and treble controls are available to enable you to adjust tonal balance.

Do not use the "tape out" jacks because the tone controls will not be operative.

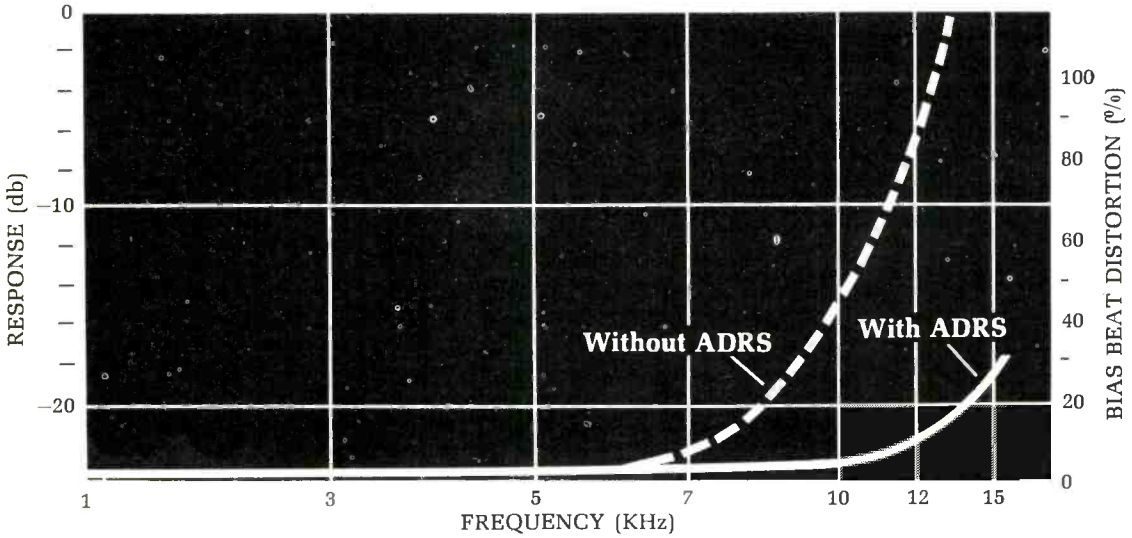
Phono Cartridge Aging

Q. *Could you please tell me to what extent phono cartridges are subject to aging? Specifically, my present cartridge is three years old. The stylus was just*

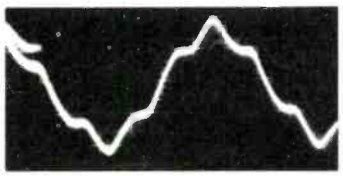
(Continued on page 104)

ADRS*

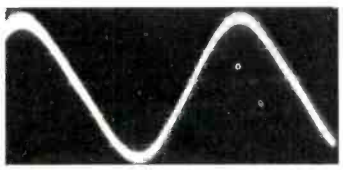
The curve that bent the Cassette Market out of shape.



You are looking at a distortion measurement curve. It compares high-frequency distortion found in other cassette decks to the exclusive new AKAI cassette line equipped with ADRS. The results are extraordinary. ADRS eliminates almost all distortion above 8,000 Hz. And only AKAI combines ADRS and GX** Heads with Dolby to give you the most perfect cassette recording in the world today.



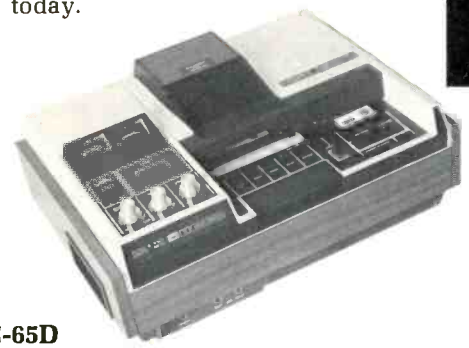
Without ADR System



ADR System

Illustrated at left are the actual output curves of a 13KHz signal from a Dolby equipped cassette deck without ADRS, and a comparable curve from a new AKAI GXC-46D cassette deck with ADRS, GX Head and Dolby. The clear, undistorted signal is a pleasure to behold. And an even greater pleasure to hear.

*Automatic Distortion Reduction System
**Glass and Crystal Ferrite Head



GXC-65D

Invert-O-Matic - Automatic Continuous Reverse - Mechanism guaranteed two full years . . . parts and labor

GXC-46D

Why settle for second best in cassette decks?

Only AKAI offers you ADRS, GX Heads and Dolby at a price no more than you would pay for decks equipped with Dolby alone. See . . . and most of all hear . . . our revolutionary new GXC-46D and GXC-65D. Your ears will make up your mind for you.

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WHAT'S NEW IN AUDIO

ESS Trans-Static I speaker system

This electrostatic and transmission line system is said to be capable of handling large amounts of power and delivering concert size sound. Claimed frequency response is 25 to 20,000 Hz ±2.5 dB, and distortion is rated at 1.0% at 90 dB. Price: $577.50.

Check No. 4 on Reader Service Card

Leader curve tracer

The quality of solid state devices can be tested either in or out of circuit, with precise voltage or current steps, using the LTC-905 curve tracer from Leader. Featured is a variable, horizontal length adjustment to 100 volts of sweep. This helps place the entire horizontal trace on the 'scope face and enables use with any 'scope. The unit checks for opens, shorts, leakages with a sweep frequency of 120 Hz and a sweep voltage of 10 to 100 V, selectable in 8 steps. Transistors, unijunction transistors, triacs, SCR's, zener diodes, signal diodes, rectifier diodes, GET's and MOS FET's—both depletion and enhancement types—can all be tested with this device. Price: $119.95.

Check No. 5 on Reader Service Card

Onkyo AM/FM receiver

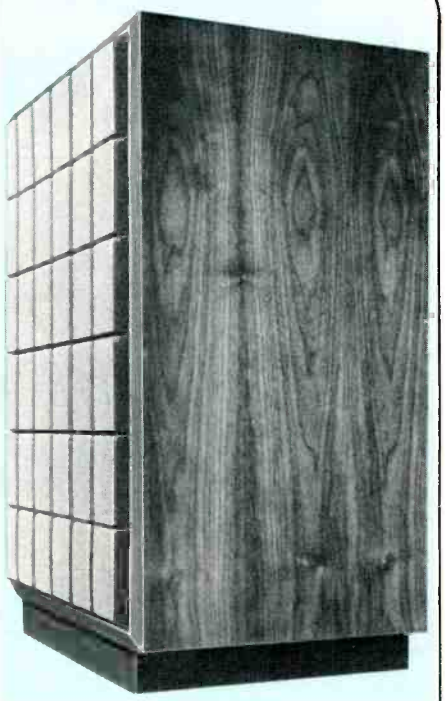
The Model TX-666 is rated at 50 watts per channel rms, 8 ohms, both channels driven, with 0.2% THD. Frequency response and power bandwidth are 10 to 40,000 Hz ±1 dB, and IM distortion is 0.2% at 1 watt output. FM sensitivity is 1.8 μV, separation at 400 Hz is 40 dB, capture ratio is 1.5 dB, and image and i.f. rejection are 70 and 100 dB, respectively. Two inputs for both TAPE and AUX are provided, as are controls for two sets of speakers. Front panel mic input and headphone output are featured. Price: $429.95.

Check No. 6 on Free Information Card

APL-16 speaker

This reflecting speaker system from Applied Physics Laboratory uses 16 4½ in. full range drivers coupled in phase to a pure resistive passive equalizer, without the use of any RLC crossover or dividing networks. This infinite baffle system is constructed of ¾ in. industrial particle board for the vertical panels, which are glued into notched corner posts, and 1½ in. particle board top and bottom. Minimum power requirement is 30 watts rms per channel. Price: Not available.

Check No. 8 on Reader Service Card



Utah MP 3000 speaker

This four-speaker, three-way system features a 15 in. woofer with 2 in. diameter voice coil and 6¾ lb. magnet. Cloth edge rolls smooth the response of the acoustically isolated 5 in. midrange. Two dome radiators, with horn amplification, reproduce high frequencies throughout a wide dispersion angle. Both midrange and tweeters have controls. Price: $199.95.

Check No. 11 on Reader Service Card

Pioneer TX-500A tuner

This AM/FM stereo tuner has a 2.3 μV sensitivity, capture ratio of 3.5 dB, better than 50 dB image rejection, and better than 70 dB spurious response rejection. Separation at 1 kHz is better than 40 dB. Front-end design features an FET and three-gang variable capacitor. Price: $119.95.

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if you are serious about music use the tape of the pro. TDK

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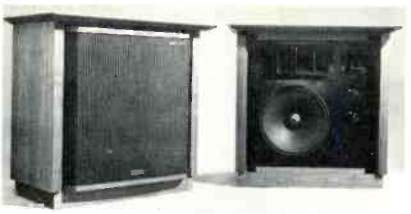

Onkyo 100 speaker

Designated the Model 100 "Studio Monitor," this system is said to have wide dispersion, excellent directivity, and low distortion. A three-way design, the speaker has a 14 in. bass unit and one-piece cast aluminum sectoral horns for mid-range and tweeter. Crossovers are at 700 and 7,000 Hz, and minimum amplifier power is recommended as 15 watts rms. Nominal impedance is 8 ohms, and crossover controls for the mid-range and tweeter each provide five ±2 dB step adjustments. Price: $499.95.

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Rocky Mount electric piano

The Model 668 Electra-Piano and Rock-si-chord has been given seven additional notes at the top of the scale and a bass boost to beef up the lower range. The instrument's two-channel system has two separate tone generators for each note. Also built in are individual volume controls for each channel, giving a moving sound effect if desired. Weight: 100 lbs. Price: $2045.00.

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Hartley Zodiac speaker

This unit features a 10-in. woofer with treated cone and has a resonant frequency of 28 Hz. The 1-in. tweeter is a dome type. Frequency response is specified as 30 to 22,000 Hz. Nominal impedance is 8 ohms and amplifier power requirements are from 10 to 50 watts rms. Price: $120.00.

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Marantz power amplifier

The Model 240 stereo power amplifier delivers 125 watts rms per channel from 20 to 20,000 Hz, both channels driven. Relay operated circuitry protects output transistors, power supply or speakers from excessive levels of subsonic frequencies or high power surges. Connections on the power transformer primary are provided for either 120 V or 240 V a.c. lines. Optional accessories include a rack adaptor or walnut cabinet. Price: $395.00.

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Radio Shack 1973 catalog

The 180-page Radio Shack catalog features the firm's line of Realistic audio equipment, Archer antennas, Micronta test instruments, home entertainment products, citizen's band two-way radios, and Archerkit and Science Fair electronic and hobby kits. New for '73 are stereo and four-channel amplifiers, receivers, adapters and tape decks; speaker systems, CB radios, stereo radios, scanning monitor receivers, and a miniature electronic calculator.

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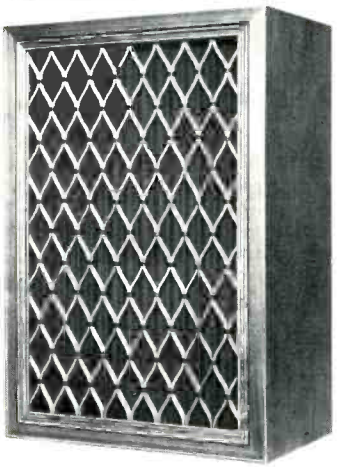

Pioneer CS-99A speaker

This system incorporates six speaker units, including a 15-in. woofer, a 5-in. midrange cone, a 4-in. midrange cone, a multi-cell horn type tweeter, and two ½-in. dome tweeters. The walnut enclosure is an air suspension type. Frequency response is specified at 25 to 22,000 Hz and impedance at 8 ohms. Price: $229.95.

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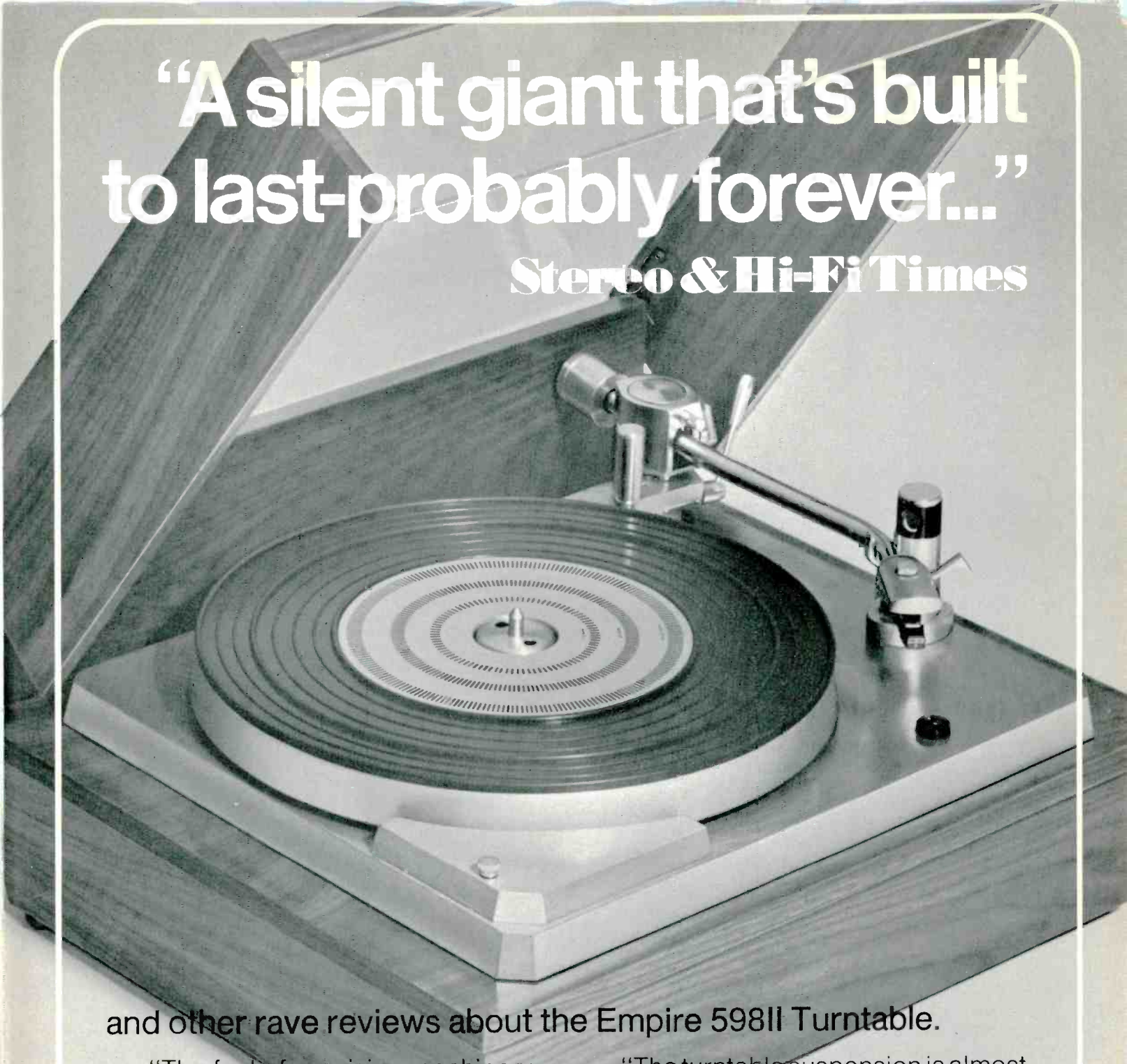

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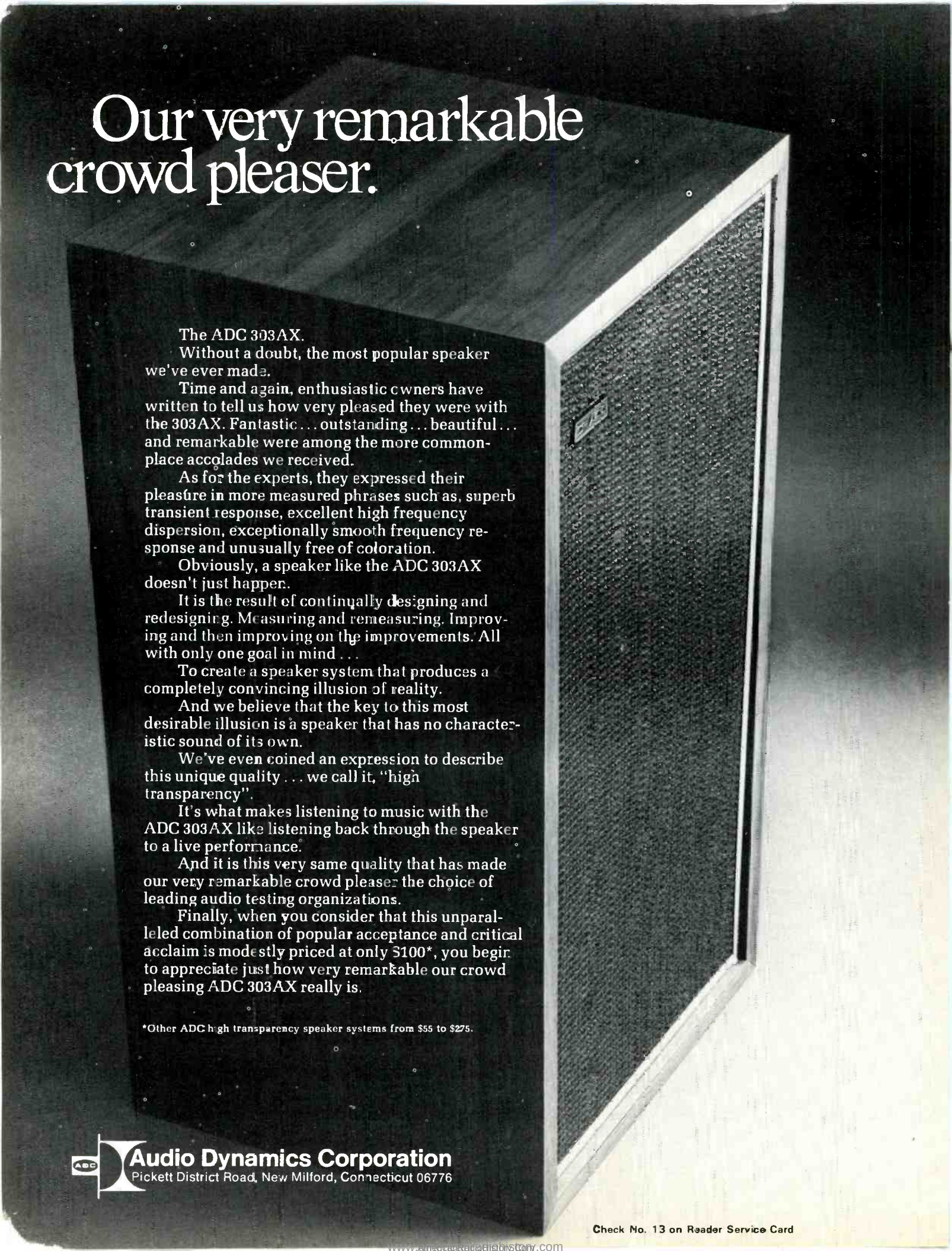

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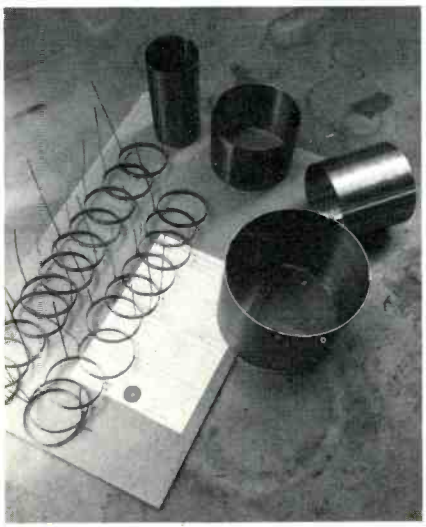
Behind the Scenes

Bert Whyte

IT IS GENERALLY accepted that the hi-fi industry really began to build momentum in the late forties. In the hi-fi milieu of those days, you weren't considered one of the cognoscenti unless you owned an Altec loudspeaker. If you had limited means, you played your Prokofiev through the Model 603, a 15 in. speaker with an aluminum dome for high frequency dispersion. More usually, the "in" people owned the famous Model 604B, the granddaddy of all co-axial loudspeakers. Those who could afford the cost . . . and the space . . .indulged themselves with 15 in. theater woofers crossing over at 500 or 800 Hz into huge multi-cellular exponential horns. It must be noted that these speakers were not "derived" from theater or broadcast monitor speakers, but were the actual units used in these applications. Of course, in large theaters the woofers and horns were used in multiples. Fortunately for the owners of these speakers, who used them for listening in the home, all of the models were of fairly high efficiency and could be driven to high output levels with the 10 to 30 watt amplifiers of that era. Needless to say, in those days you had to construct your own baffles for these speakers, with bass reflex design favored for the smaller speakers and back-loaded horns for the woofer/tweeter combinations. Somewhere around 1948 Altec sensed a trend and built a handsome mahogany-and-brass-grille furniture enclosure to house the 603 or 604B speakers. It might be said that this marked the "official" entry of Altec into the consumer hi-fi market. A quarter of a century has passed since then and Altec is still going strong . . . a dominant factor in the theater and public address markets and a highly respected "senior citizen" in the hi-fi establishment. Some months ago I had the pleasure of visiting the Altec plant in Anaheim, California, where I was given a fascinating "behind the scenes" look at the process of manufacturing loudspeakers.

Altec has a slight problem in respect to its visitors, as there is another fairly interesting attraction across the street . . . called Disneyland! My co-hosts at Altec were Don Davis, Vice President of Marketing, Industrial Products, and old friend John Eargle, Director of Sales, Commercial Sound Products. Don Davis is no stranger to the pages of AUDIO, having contributed a number of articles on various subjects, including one on the Altec "Acousti-Voicing process of room equalization, a project he conceived and has championed for the past several years. John Eargle is familiar to readers of this column from my descriptions of his unique process of quadraphonic synthesis and for his expertise in so many diverse areas of audio engineering. John was a colleague of mine at RCA Victor where he was director of quality control for recorded products. Then came a stint as chief engineer of Mercury Records. In his present position John really wears a number of "hats" and, as you might expect, is deeply involved with Altec products for recording studios and the professional audio market.

The first thing that struck me about the Altec plant is that it is far larger than I imagined it would be. This was impressed upon me quite physically, as I dragged my excess avoirdupois through many different production sections, up and down corridors, and even from building to building. Altec is a very successful operation, as evidenced by the extensive facilities, but I understand that sales in public address and commercial sound are burgeoning so fast that plant capacity is sorely taxed. In one huge area there are squadrons of women working on electronic subassemblies . . . amplifiers, crossover networks, Acousti-Voice equalizers. Another area is devoted to speaker assembly, with cones, voice coils, spiders, baskets, magnets, and retainer plates being deftly fabricated into various models of loudspeakers, with much mechanical and electrical testing accompanying each successive step of assembly.



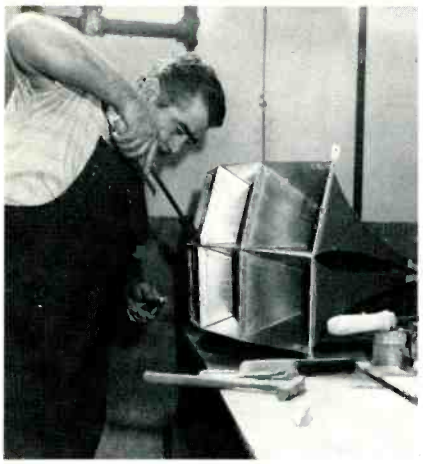
Flatwire—Milled on the premises, the flatwire passes through many processes before final attachment to cones or diaphragms.

Quite apart from the purely assembly type operations, many of the basic parts are made right in the Altec plant. For example, all voice coils used in Altec speakers are made of edge-wound flat copper ribbon. This ribbon really starts out as copper wire which is fed into a special milling machine, which compresses the wire into flatwire, which in turn is annealed and varnished and then wound by a special machine onto various diameter formers to make bulk cylinders. After further heat treatment the cylinders are ready to be used. Ribbon is broken off into segments of the proper size, and excess turns are pulled off until the proper resistance is reached. The ribbon is then attached to either paper, plastic or aluminum formers and again heat treated. At this stage they are then ready to be attached either to cones or high frequency diaphragms.

One of the most fascinating processes I witnessed was the fabrication of the multi-cellular exponential horns. Depending on the size of the horn, pre-cut steel pieces are mounted on special jigs which will give the finished section the correct rate of flare. Once on the jig, the seam of each section of the horn is soldered by hand. The artisan picks up a huge soldering iron which has been heated to a fiery red by a blast torch, liberally gunks it with flux, and then with a king-size bar of solder in his hand, runs iron and solder down the seam in one smooth flowing sweep. What a technique! When I think of my own puny soldering attempts, I am in awe of such skill. Each seam is so treated in turn, and then each horn section is joined together and reinforced to prevent rattles. The entire multi-cellular assembly is then coated with a

material called Aquaplas, which insures good damping and freedom from resonances.

Another interesting process was one in which the aluminum diaphragms used in high frequency drivers are placed in a machine, which with a sort of embossing action forms a tangential compliance on the diaphragm, somewhat analagous to the "soft surround" on the cones of several types of loudspeakers, especially of the acoustic suspension variety.



Multi-Cellular Horns—Like pipe organs, they are built from metal pieces, soldered by hand, and reinforced to prevent rattles.

Altec has extensive machine shop facilities, including a large room I saw crammed with lathes, drill presses, etc. Much of this is devoted to the machining of the very intricate slits in the phasing plugs of the various high frequency drivers. These phasing plugs convert high pressure, low velocity soundwaves at the throat of the exponential horns to low pressure, high velocity waves at the mouth of the horns.

All the speaker frames or baskets in Altec speakers are die cast, as are certain types of cast aluminum sectoral horns. These parts are supplied by a vendor foundry with the machining facilities at Altec used for imparting a fine finish. The cone loudspeakers are ready for final assembly, with the cones with voice coils attached, being centered on the die cast frames, and spiders and magnet structures added. The final step is magnetization of the Alnico or ceramic slug, the sensitivity and response checks are performed.

Altec makes a great deal of specialized equipment for the recording studios, including huge mixing consoles, portable mixers, monitor speakers, etc. In the area of public address, in addition to the speakers, Altec makes amplifiers and input consoles. Sort of overlapping into the PA and recording areas are the Acousti-Voice equalizers and real-time analyzers used in this process.

With John Eargle's experience in the recording field, I am sure we will be seeing some innovative ideas in the area of mixing consoles and associated equipment. He has already lent his talent to upgrading and new designs in monitor speakers. At the present time, the growing instrumental complexity and sophistication of rock music is making new and severe demands on the monitoring facilities of recording studios. The rock producers want to be able to hear the extreme 30 Hz frequencies of Fender bass and electronic music synthesizers like the Moog and Arp units. The synthesizers also require extended high frequency response. And the producers want all this at the usual ear-splitting monitoring levels prevalent in today's studios. These new requirements have set off a sort of race among several speaker manufacturers to see who can come up with a design that will capture this new market. Up to now, most studio monitor speakers (including Altec's) were characterized by a rather elevated "peaky" mid-range, a somewhat restricted high frequency response, and poor low frequency response with a rather rapid roll-off below 60 Hz. The new speaker parameters precluded any practical extension of current design practices. John came up with a solution that combined two seemingly

HF Diaphragms—Pressure-formed aluminum diaphragms are glued to voice coil assemblies and the outer frame.

incompatible speakers. To produce the requisite bass response and yet keep the size of the monitor speaker within usable studio limits, he turned to an acoustic suspension system, utilizing a 15 in. speaker with flexible "surround" and long-throw voice coil. This was to operate up to 500 Hz and then a multicellular horn with a new configuration of throat and a special high frequency driver would carry on from there up to at least 15 kHz. As we all know, acoustic suspension speakers are of very low efficiency, while the exponential horn is a high efficiency device. John's answer to this was to use bi-amplification. Altec built a special 60 watt continuous output amplifier to handle the acoustic suspension section up to 500 Hz, then built an electronic crossover, and finally a 30 watt continuous output

High Frequency Drivers—Large 3 in. and small 1¾ in. diameter drivers are exploded to show the intricate slits in the phasing plugs.

amplifer for the horn. This unit, designated the Model 9846, has proven very successful for its intended application, with a solid "gut-thumping" bottom end, well-defined mid-range and crisp top. More to the point of the studios . . . this full-spectrum output can be employed at tremendous levels without breakup. I visited John's apartment, where he had two of these speakers installed in his living room, which he had Acousti-Voiced. The sound of these units was very impressive indeed and did full justice to the spectacular 15 ips tapes he played on his big Ampex. On the famous Mercury recording of Sir William Walton's Crown Imperial march, there are some bass drum shots and some really rousing brass which are reproduced through John's speaker system with stunning impact and clarity. For "the man who has everything," you can always Christmas-gift him with the Model 9848, John Eargle's "monster monitor," which has *two* 15 in. woofers in an acoustic suspension system of heroic proportions, with a giant exponential horn to match. Gadzooks!

All in all, I thoroughly enjoyed my visit to Altec. I think I learned a great deal, and I know I came away with a heightened appreciation of the problems and complexities of the high-precision technology necessary to manufacture such high quality loudspeakers. Æ

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Editor's Review

SO ANOTHER New York Audio Show has come and gone. This was held in the Statler-Hilton and must be rated as a resounding success in spite of the difficulties involved in moving several thousand people through a confined space. Among the new or recently introduced products shown were the Crown dynamic-electrostatic speakers, the Harmon-Kardon Dolby tuner, and the Fisher Studio 2/4-channel receivers. Sony was demonstrating their new FM tuner which has no less than 100 push buttons—one for each channel. Other features include a memory bank. The price is $1200.00. Another exotic tuner which attracted much attention was the long-awaited Sequerra, which costs $1600.00 and incorporates a display tube. Saul Marantz was demonstrating two speaker systems designed by Jon Dahlquist. One was a full-range electrostatic with piezo tweeter, and the other was a dynamic system styled rather like the Quad speaker. Both sounded clean and very smooth. Benjamin-Concord introduced a Nakamichi professional cassette recorder which is intended to compete with 15 ips studio machines. It uses two motors with IC logic control, three heads, and a Dolby system plus dynamic noise limiter (DNL). Wow and flutter is quoted as less than 0.1% and response is 3 dB down at 20 kHz.

Phonics, Sonics, and Semantics

The word *Quadraphonic* seems to have been generally accepted, not only in this country but all over the world. However, there still are objections from pedants who say it is a Latin-Greek hybrid and the correct prefix should be *Quadri.* Quite true, but there are many hybrids in our language—television and superheterodyne for example. As for *quadri,* it does not roll off the tongue so easily as *quadra,* which is probably why there are such words as *Quadraflex, Quadrasound,* and *Quadrajet.** *Quadrasonics* gives the impression of four sounds instead of *four sound sources,* and it does not conform with stereophonic and monophonic. *Tetrasonics* does not conform and tetraphonic is too unwieldy and does not abbreviate that well. Language is a living thing, it is constantly changing and cannot remain static. Its purpose is to communicate clearly and unambiguously and whether a certain word is derived from two sources is irrelevant—or so it seems to me. On the other hand, I am opposed to careless and confusing semantics such as *album* for a single record, *alibi* for excuse, and the common use of the conjunctive *like* for *as.* But I see no ambiguity in the word quadraphonics, none at all. *Satis verborum.*

*Not forgetting RCA's Quadradisc!

Percy Wilson, who contributes a short article in this issue, is one of the best known pioneers in the field of sound reproduction. He was technical editor of *The Gramophone* for many years and designer of a large 40-ft. horn speaker which was considered the state-of-the-art around 40 years ago. This monster was housed in London's Science Museum and every Sunday afternoon records were played there to the hi-fi enthusiasts of the day. Mention of *The Gramophone* reminds me of the report of an instrument designed by one professor McKendrick which appeared in that august journal back in 1923. It seems that the professor "had invented a gramophone in which he entirely eliminated scratch by passing the sound through 40 feet of tubing filled with peas; the peas absorbed all the scratch and nearly all the other sound. What remained of the other sound was then magnified by valves and the results are said to have been absolutely perfect." It was not stated whether the peas were cooked or not, but in any case the ingenious professor seems to have anticipated the Dolby system by a good many years!

* * *

A Merry Christmas to all, but especially to Professor Lirpa (whom God preserve), Mr. and Mrs. McProud (Mac and Betty) in sunny Florida, and to Leon Schiffman, who celebrates 44 years with the same company—the Lafayette Corp.

G.W.T.

A significant advance in the state-of-the-art

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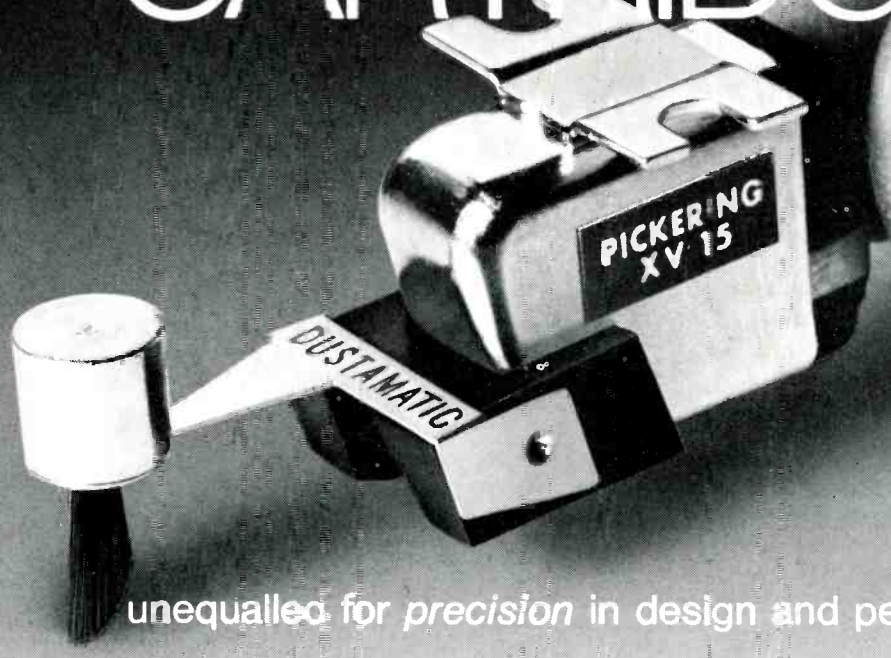

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"PRECISION" is the one word that best characterizes the extraordinary quality of the new Pickering XV-15/1200E cartridge, the culmination of Pickering's 25 years in contributing important technological advances to the manufacture of magnetic cartridges.

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All Pickering cartridges are designed for use with *all* 2 and 4-channel matrix derived compatible systems.

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A Microphone Primer: Basic Construction, Performance, and Applications

Jim Long*

A MICROPHONE is a *transducer*—it changes one form of energy into another. Specifically, a microphone converts the air pressure variations of sound into corresponding changes in output voltage.

The ways of accomplishing this task are many, each full of pitfalls for the would-be successful microphone user. This review refuses to yield to the "we have analyzed the situation and selected the best microphone for you" temptation. Instead, it outlines (in Part I) the key differences in microphone construction and performance characteristics, followed (in Part II) by a practical applications guide [in a future issue —Ed.]. The goal is to provide basic information from which an intelligent and relatively painless microphone selection may be made. The review applies to both sound reinforcement and recording, but greatest emphasis is placed on the recording of musical events by the serious amateur.

Part I: Basic Construction and Performance

A microphone is often listed in a catalog as "Dynamic Cardioid, Hi-Z" or "Condenser Omnidirectional, Low-Z." Each description, though by no means offering anything near complete definition of the microphone, includes three of the most important factors needed to define a microphone: 1, type of generating element, 2, type of pickup pattern, and 3, microphone impedance. Part I is devoted to these three primary factors. The new microphone enthusiast will be surprised by the many byways discovered along the way!

Generating the Output Voltage

A microphone's output voltage is produced by two basic components acting together. The *diaphragm* is a membrane which vibrates in accordance with the air pressure variations of sound. A *generating element* converts the diaphragm vibrations into output voltage. Generating elements vary greatly in expense, fidelity, complexity, ruggedness, and longevity.

Piezoelectric Generating Elements

The diaphragm of a piezoelectric microphone is attached to a special material which produces an output voltage when bent or stressed. A piezoelectric generating element is shown in Fig. 1. Two types of piezoelectric materials are generally used. *Crystal* microphones employ a Rochelle salt crystal. Though crystal microphones have a moderately high output level, the crystal is easily damaged by heat and humidity. *Ceramic* microphones, which use a barium titanate ceramic, are immune to heat and humidity but exhibit more average

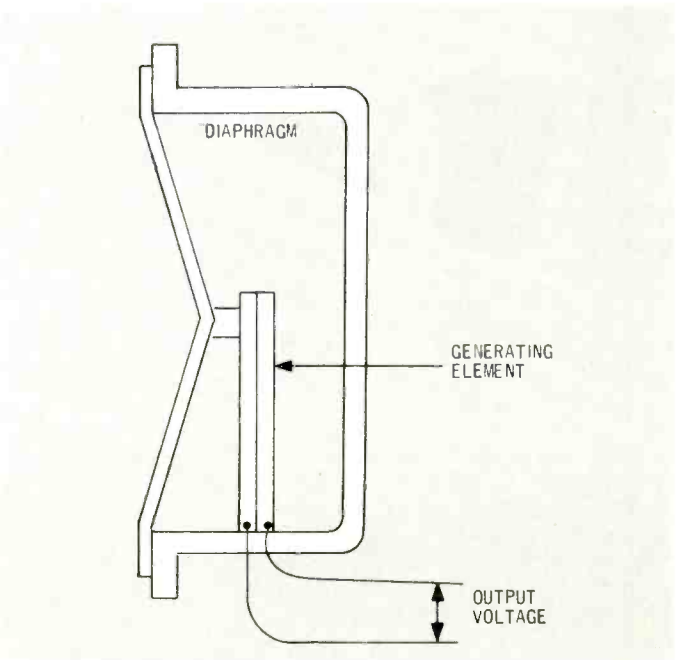
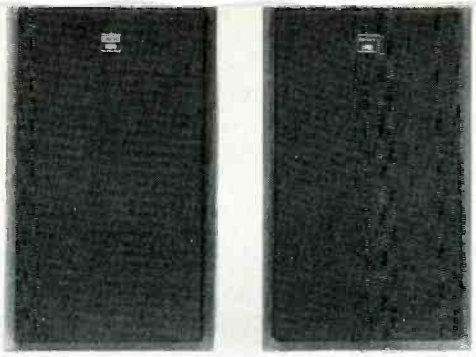


Fig. 1—Piezoelectric generating element.

output level. Both crystals and ceramics, when designed for practical output levels, exhibit limited, rough frequency response, making them unsuitable for audiophile and professional use. Their low cost, however, makes piezoelectric microphones widely used in communications work.

It is interesting to note that ceramic microphones with smooth, wide frequency response can be constructed—if low output levels can be accepted. Many precision sound level meters employ such microphones. However, the low basic

*Electro-Voice, Inc., Buchanan, Mich. 49107.



How to move gracefully from two channels to four

Just flip the mode switch on Sony's new TA-1150 and it switches from mono to stereo to true four-channel sound. It's the first stereo integrated amplifier designed for the four-channel era. Because it has built-in circuitry and switching specifically designed for an SQ four-channel decoder (our SQD-1000 is perfect match) or decoders for any other quadraphonic disc system. You can even put your SQ decoder and your rear-channel amplifier out of sight, and control the volume of all four channels with the TA-1150's master volume control.

And the four-channel connections are additional to the two sets of stereo tape output and monitor connections (with direct dubbing provisions).

The amplifier section puts out 100 watts IHF music power at 8 ohms, very clean watts, too, thanks to our direct-coupled circuitry. The TA-1150's bass and treble controls let you select the degree of tonal correction you want, as well as the frequency at which that correction takes effect. And you can disconnect the TA-1150's preamplifier from its power amplifier section, to insert electronic crossovers or equalizers. Two quite delightful channels, now, two more for later. And all for only $229.50.* The ST-5150, a superb FM stereo tuner matches the TA-1150's performance, appearance, price; $229.50.* Sony Corp. of America, 47-47 Van Dam St., Long Island City, N.Y. 11101. *Suggested retail price.

SONY® TA-1150

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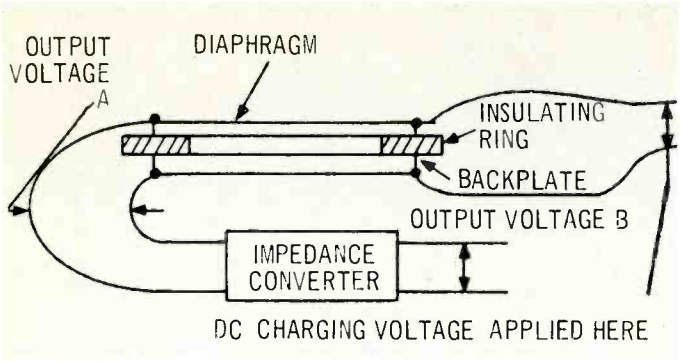

Fig. 2—Condenser generating element.

output level coupled with additional losses encountered in a cable of practical length[1] make these ceramics unsuitable for more general use.

Conventional Condenser Generating Elements

The diaphragm of a condenser microphone is a movable plate of a condenser or capacitor. A condenser generating element is shown in Fig. 2. If a condenser is charged or polarized by applying a d.c. voltage (usually 45 to 200 volts) across the diaphragm and backplate, motion of the diaphragm with respect to the fixed backplate produces an audio output voltage (Output Voltage A). Unfortunately, Output Voltage A cannot be put to practical use. The output impedance (the impedance "looking back" into the generating element) amounts, quite naturally, to a small capacitance. Anything but a few inches of cable and a very high load impedance (500 Megohms, typical) would eradicate, for all practical purposes, the output of the generating element as well as its low-frequency response.[1] Therefore, an impedance converter, often of unity gain (no amplification), is built into each condenser microphone to "eliminate" the cable and provide the necessary high input impedance for the generating element. The output impedance of the converter is relatively low, essentially resistive, and quite suited for connection to the cables and preamplifiers of real life.

Condenser microphones burst on the domestic recording scene in the early 1950's, where their extended frequency response (with even a bit of a "haystack" at the high end) literally made "hi-fi" recording. Today, condensers, available in both flat and subtly-tailored response versions, are widely used in professional recording. Good commercial designs encompass 1, very high output level, 2, wide, smooth frequency response, and 3, excellent transient response. Several factors, however, have precluded the wider use of conventional condenser microphones in broadcast and public address fields: 1, high cost, 2, the rather fragile mechanical construction of many specific designs, and 3, the reliability problems associated with the external power supply and the internal impedance converter.

Today, solid-state technology has increased the reliability of conventional condenser microphones. Additionally, some designs may be successfully operated from battery-powered as well as a.c. powered power sources.

Electret Condenser Generating Elements

Despite improvements in conventional condensers, it would certainly be nice to permanently charge a condenser generating element *at the time of manufacture* and then throw away the bulky high-voltage power supply in the interest of lower cost, lower weight, and increased reliability. Then only a low voltage for the impedance converter would be required—from a small battery.

Materials that will accept and keep a charge have been around for years—in the laboratory. These materials are called *electrets*. Of course, the factory-impressed charge is only useful if it is truly permanent. Experimental electrets of a few years ago would go dead in a matter of minutes in a humidity chamber. The humidity of a typical Midwestern summer day could do the same job in a few months. Today, new materials and charging techniques have changed this situation dramatically, but electrets are still not likely candidates for a hot car trunk in Florida! Under most conditions, performance is satisfactory: 30-day tests in 90 degree, 90% relative humidity environment revealed a permanent level loss limited to 3 dB. Oven tests at 120 degrees and above, with low humidity, showed losses of less than 1 dB. 120 degrees and high humidity, however, prove deadly.

Commercial electret designs now frequently combine 1, high output level, 2, excellent transient response, and 3, moderate-to-low cost with 4, reliability that can at least be compared to, if not equal, that of dynamic microphones. Remember, the very existence of a battery in the microphone is a potential headache that many sound installers will not want to contemplate. The probability of failure, however, is low enough to be tolerated in many broadcast and recording applications, professional and amateur alike. Frequency resonse *can* be essentially equivalent to fine dynamic and conventional condenser designs but most currently-available modestly-priced electrets suffer in such a comparison. More

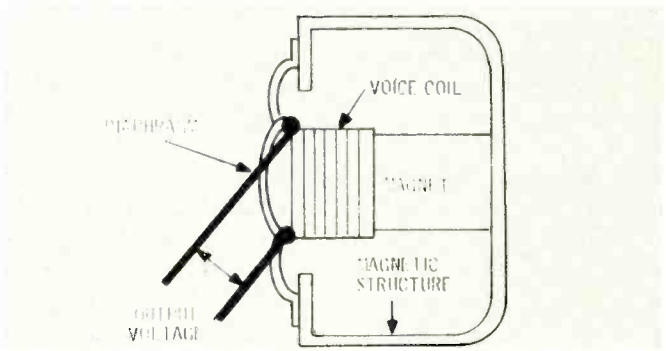

Fig. 3—Dynamic generating element.

detailed comments on this and other comparisons are included in Part II.

Dynamic Generating Elements

The diaphragm of a dynamic microphone is attached directly to a coil of wire (voice coil) located close to a magnet. When the voice coil vibrates, an output voltage is produced. A dynamic microphone is shown in Fig. 3.

Practical dynamic designs can easily combine 1, adequate output level, 2, wide, smooth frequency response, 3, very good transient response, 4, very high reliability, and 5, moderately-low to moderately-high cost. This fortunate combination has made the dynamic microphone used more than any other type in broadcasting and sound reinforcement. Dynamics are also frequently employed by professional and amateur recordists. More detailed comments, comparing dynamic performance with that of other types, are contained in Part II.

Ribbon Generating Elements

Ribbon microphones are similar in basic principle to dynamics, except that a metal foil ribbon serves as both diaphragm and voice coil. A ribbon generating element is shown in Fig. 4.

[1]For a more detailed discussion of the effect of cable and load impedance on the output level of capacitive sources (piezoelectric and condenser generating elements), see Jim Long, "Layman's Guide to Microphone Specifications," AUDIO, Vol. 33, No. 8 (August 1969), p. 23f.

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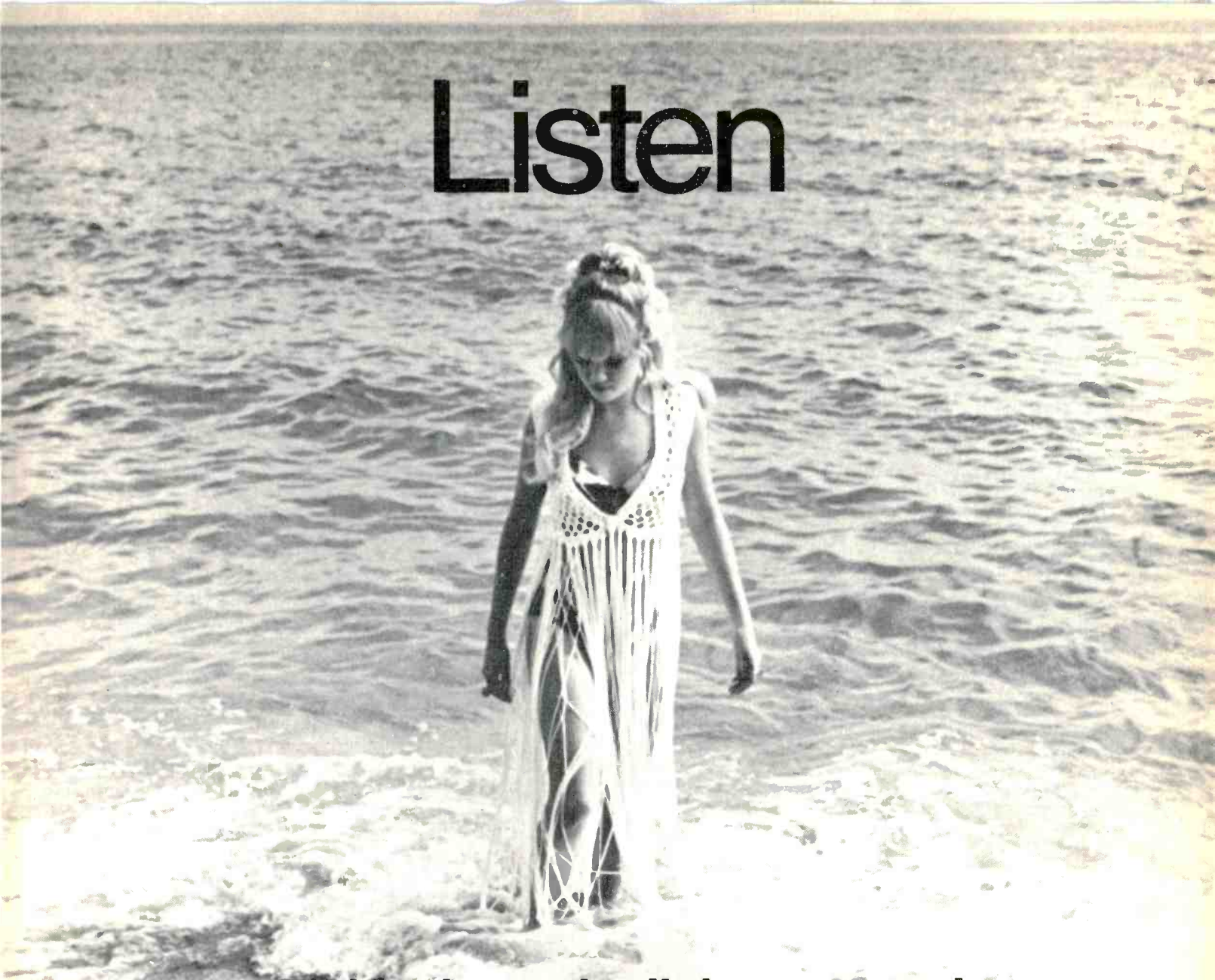

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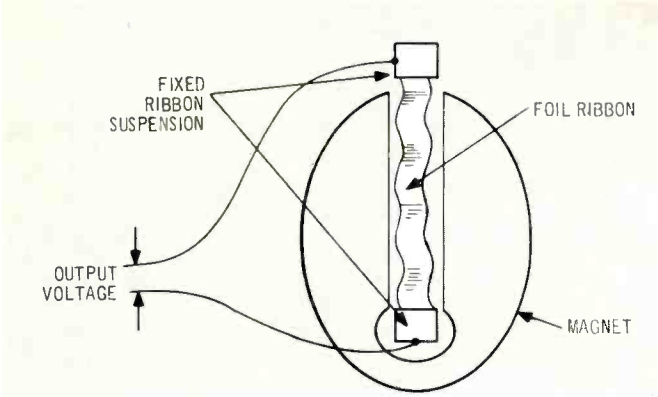

Fig. 4—Ribbon generating element.

Ribbon microphones were very much a part of the early days of broadcasting and recording. However, in order to obtain 1, adequate output level and 2, wide frequency response, these microphones employed ribbons that were—all at the same time—thin, light, soft, and floppy. One breath of air could alter the performance characteristics or render the microphone useless! Additionally, acceptable output level was obtained by using magnet material not particularly well suited to the large air gap inherent in a ribbon design. The finished microphone, then, was a rather bulky affair. Because of this ruggedness and size problem, unaided by any significant domestic innovation in ribbon design during the last 20 years or so, the availability of fine dynamic and condenser designs has virtually eliminated the use of ribbon microphones.

Some new designs are now available, however, which result in a microphone of very practical size and with greatly improved reliability.

Microphone Pickup Patterns and Some Implications.

A microphone's *pickup pattern* is three dimensional in character and shows how the microphone responds to sound from different directions. *Omnidirectional* microphones pick up sound from all directions. *Directional* microphones—of several specific types—reject or reduce sounds from their sides and/or rear. These types include *cardioid* (the most

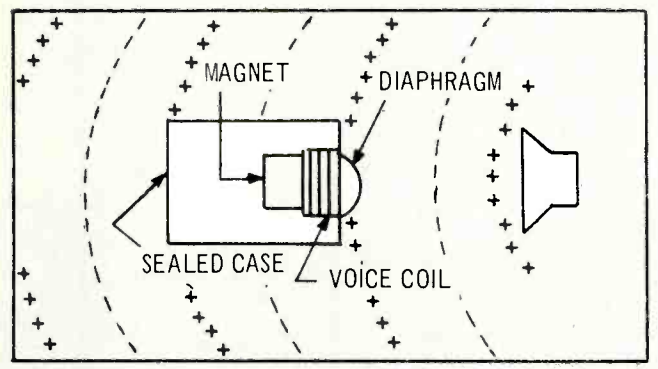

Fig. 5—Omnidirectional microphone.

popular), *bidirectional*, and *super-cardioid*, the details of which will be covered later. In general, all generating-element types—condenser, ribbon, dynamic, piezoelectric—may be designed around any specific pickup pattern.

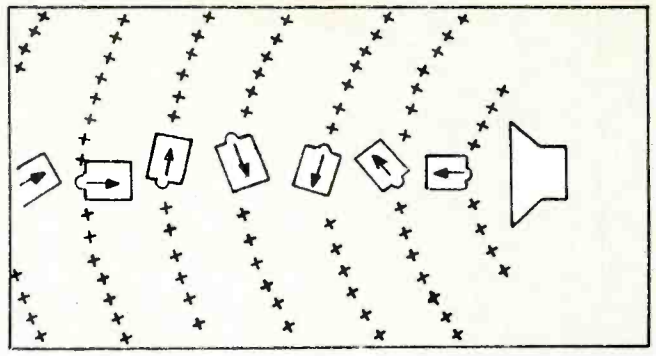

Fig. 6—Omnidirectional microphone at various angles.

The advantages of directional microphones are fairly well publicized, but the compromises are not. The following review covers both aspects!

Making and Understanding An Omnidirectional Microphone

The sketches accompanying this section are cartoon versions of a dynamic moving-coil microphone. The general principles apply to all other generating elements as well. The case of the microphone in Fig. 5 is *totally sealed*, so that sound pressure can strike only the front of the diaphragm. For instance (referring to Fig. 5), when a positive wavefront strikes the diaphragm, the pressure on the outside of the diaphragm is greater than that on the inside. The diaphragm moves in and microphone output results. Figure 6 points out the reasonably interesting fact that *air pressure variations move the diaphragm in no matter how the unit is oriented with respect to the sound source.* Microphone output is therefore constant regardless of orientation. Our totally-sealed microphone is an omnidirectional microphone!

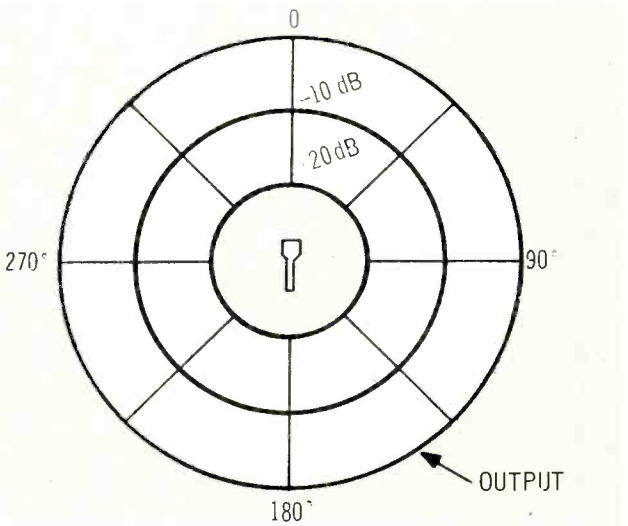

Fig. 7—Omnidirectional polar pattern.

Showing the Omnidirectional Pickup Pattern

The pickup pattern of an omnidirectional microphone may be thought of (though a bit frivolously) as an inflated balloon with the microphone at the center. This at least emphasizes the three-dimensional nature of a pickup pattern, but

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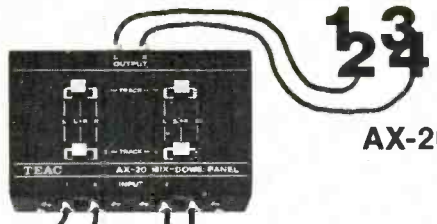

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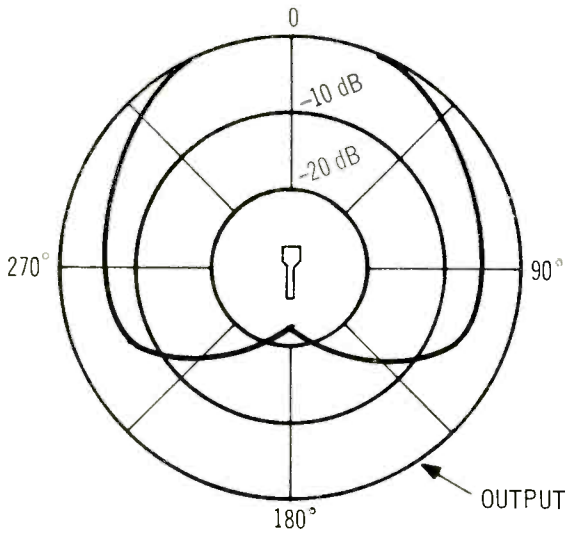


Fig. 8—Cardioid polar pattern.

is a bit hard to reconcile with the two-dimensional world of the printed page. If we cut out balloon in half, we produce the standard two-dimensional representation of a pickup pattern—the *polar pattern* or *polar response*. Figure 7 shows the polar pattern for an omnidirectional microphone. Note the orientation of the microphone, at the center, aimed at 0° for reference. The heavy circle at the circumference of the polar pattern represents microphone output and shows that no loss in output (in dB) is experienced as a constant-output sound source moves a full 360° around a fixed microphone at a fixed distance from the microphone. Polar patterns are often described as too formidable for consideration, but a few moments study will greatly enhance your knowledge of what a microphone can do for you!

Polar Pattern for Directional Microphones.

The output line for a directional microphone departs, at some range of angles, from the constant-output circle of the omnidirectional microphone. Figure 8 shows this condition for the most prevalent type of directional microphone—a *cardioid*, meaning "heart-shaped." A cardioid polar pattern is typically 6 dB down at 90° to either side of the reference, 0° axis. Output then decreases further to a minimum (15-to-25 dB down) at the rear (180°). Despite the rejection of sounds from the sides and rear, *it should be noted that a cardioid's output is essentially constant—just like an omnidirectional—over a relatively wide 80° angle*! Don't expect any ordinary kind of directional microphone to ferret out a single voice in a crowd.

Other frequently-encountered directional types are shown in Fig. 9. The *bidirectional* or *figure-eight* pattern surpresses sound from the sides but is equally sensitive at the front and rear. The bidirectional pattern is inherently produced by a ribbon generating element. An infinite number of stages between cardioid and bidirectional are possible. One such stage that has been found useful is the *super-cardioid*. The super-cardioid has two nulls at 150° off axis with somewhat greater rejection at the sides and just to the rear of the sides, compared to a standard cardioid.

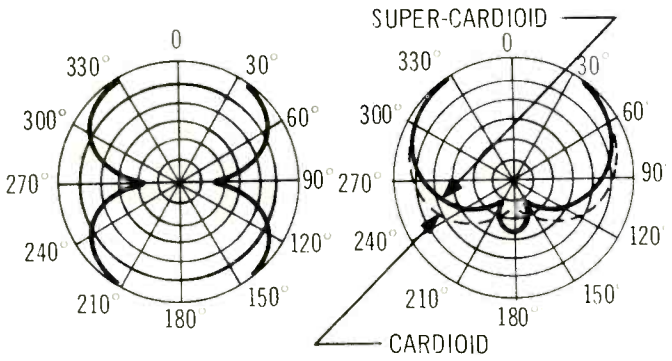


Fig. 9—Bidirectional and super-cardioid polar patterns.

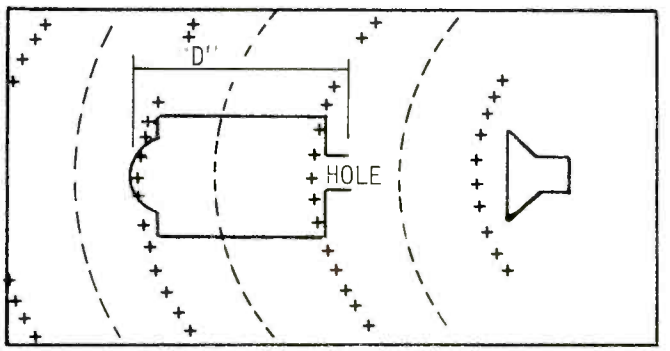


Fig. 10—Single-D cardioid microphone with source at rear.

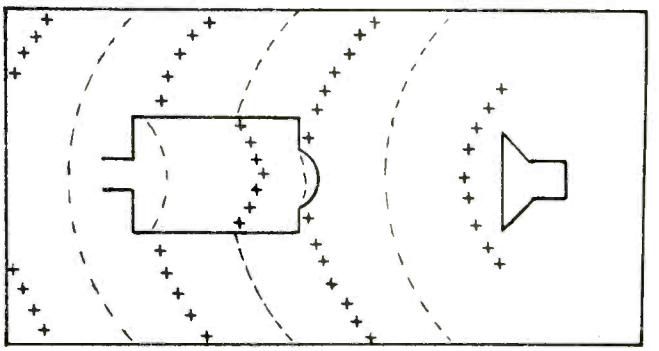
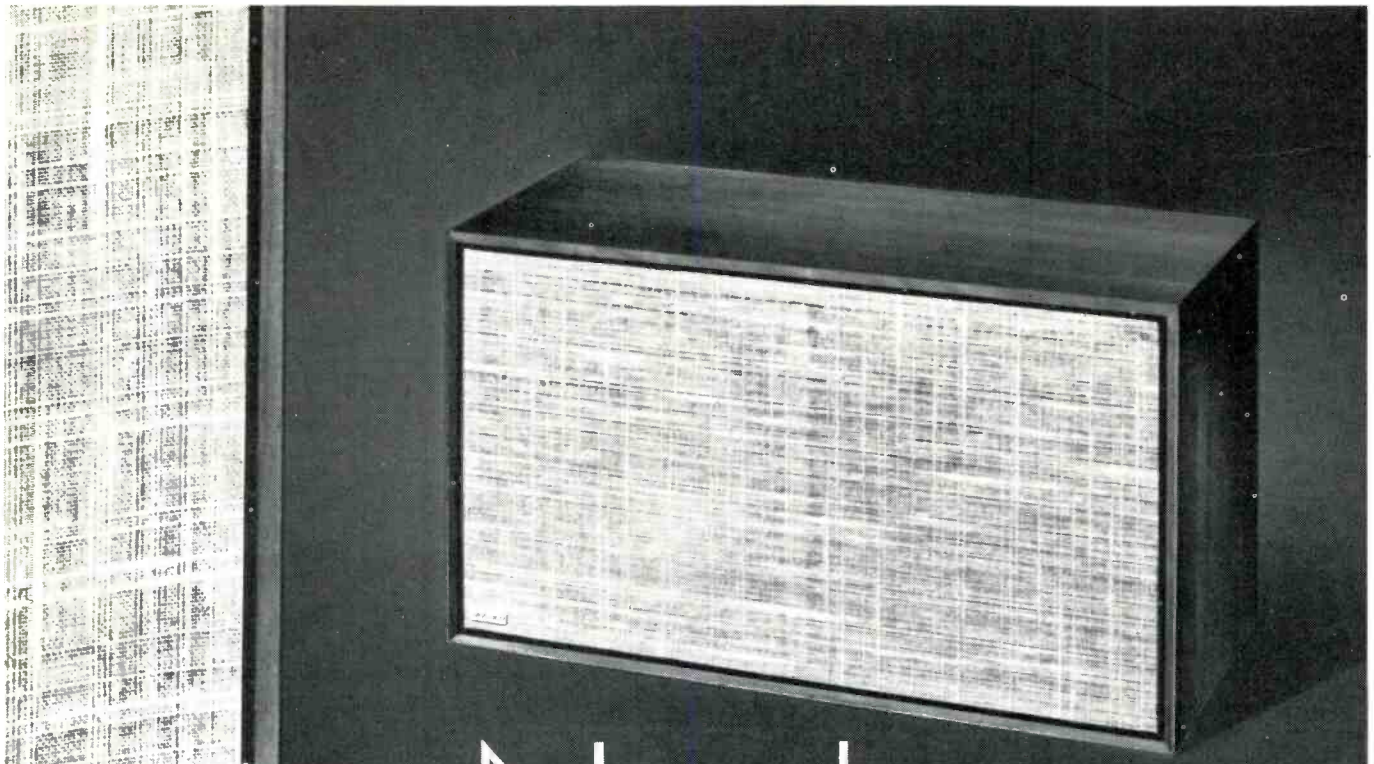


Fig. 11—Single-D cardioid microphone with source at front.

Making a Cardioid Microphone

In delightfully simple terms, a cardioid microphone may be made by piercing a hole in the case of a sealed omnidirectional microphone. Now sound pressure is permitted to contact the diaphragm from the rear as well as from the front, as shown in Fig. 10. Diaphragm motion is closely related to the pressure *difference*. This type of cardioid microphone is often called *single-D*, for the single effective acoustic distance between the front and rear openings.

Figure 10 shows the cardioid with the sound source at its rear. This representation would make an acoustician cringe, but serves to remove the specter of vector diagrams, etc., and elicits the response "Gee, I see how it works!" With sound coming from the rear of the microphone, diaphragm motion is neutralized by opposing sound pressures on both sides simultaneously. (Note the "plus" sound pres-



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sures on *both* sides of the diaphragm). No output results. However, with sound originating from the front, as shown in Fig. 11, a "minus" pressure is present at the rear of the diaphragm at the very same time a "plus" pressure appears on the front. Both pressures are trying to move the diaphragm "in" so diaphragm motion can occur and output results.

Why a Directional Microphone?

Compared to an omnidirectional microphone at a given working distance, rejection of sound from the sides and rear of a directional microphone:

1. *Reduces reverberation.* If a recording with an omnidirectional microphone sounds too distant and lacks presence, use of a cardioid microphone will produce a substantially tighter, brighter sound.

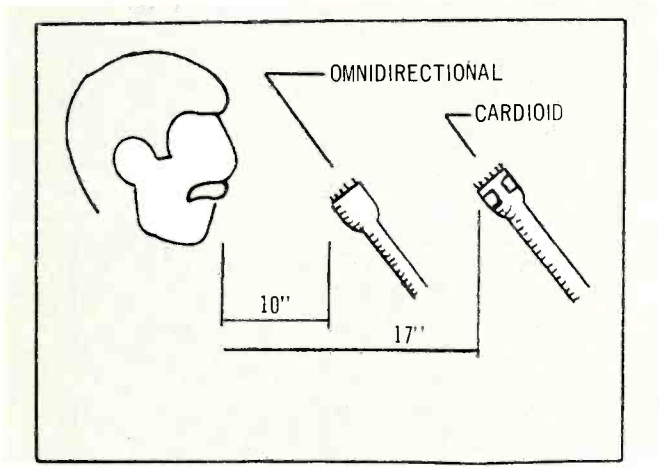

Fig. 12—Working distance comparison.

2. *Reduces unwanted noise.* When recording a voice in an environment full of random noise (such as a factory), switching to a directional microphone will substantially reduce the level of noise with respect to the voice. In other words, the directional microphone provides in improved signal-to-noise ratio. The level of discrete noises (a gurgling radiator, refrigerator, compressor, tape recorder, motor, etc.) can also be reduced if the "dead" area of the microphone's polar pattern is aimed at the offending noise source.

3. *Reduces feedback.* The level provided in a room by a sound reinforcement system will increase when a good directional microphone is used, especially when direct sound from the loudspeakers strikes the "dead" portions of the pickup pattern.

The effect of a directional microphone can be put another way: if an omnidirectional microphone is providing satisfactory pickup at a given working distance, a directional microphone will give the same results at a greater working distance. A cardioid microphone provides an increase of 1.7 times, as shown in Fig. 12.

Compromises in Single-D Cardioid Performance

Here are three unfortunate compromises, compared to an omnidirectional:

1. A cardioid is significantly more susceptible to "breath popping."

2. A cardioid is significantly more susceptible to mechanically induced noise (ring clankings, cable thumpings, foot stompings, etc.).

3. A cardioid has a frequency response that is rougher and rolled-off in the extreme bass.

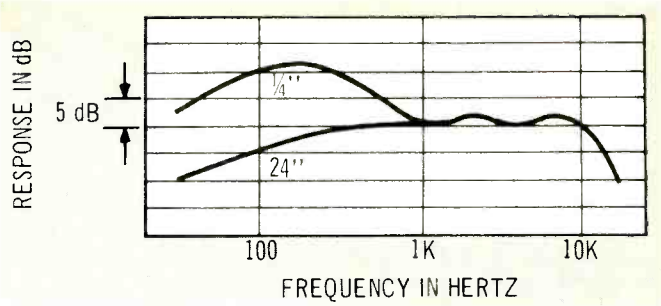

Fig. 13—Single-D proximity effect.

All three problems can, of course, be attacked by careful design, but success is rarely if ever total and is often accompanied by increased cost and/or other performance compromises. The cardioid compromises are basic enough to be found in many, many commercially-available designs.

Proximity Effect in Single-D Cardioids

The simple single-port or single-D cardioid has a bass response that varies strongly with working distance. As shown in Fig. 13, the bass response at one-quarter inch is boosted *fifteen dB* over the response at 24 inches and beyond.

Proximity effect can be a boon or a boondoggle in many applications but mostly it has been a mysterious variable of which most microphone users are not aware. Bass-boosting proximity effect, at the pleasing end of things, gives a "robust" quality to speech and "free" gain-before-feedback in close-up, hand-held sound reinforcement situations. However, these results must be balanced against a decrease in clarity, due to the masking effect of the bass boost, as well as the problem posed by yet another variable for the already-harried sound man to face.

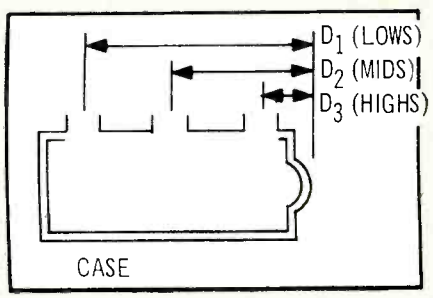

Fig. 14—Variable-D cardioid microphone.

Eliminating Proximity Effect

In single-D cardioids, bass-boosting proximity effect occurs because the pressure differences to which the diaphragm is sensitive becomes extraordinarily large for close low-frequency sound sources. Variable-D® design, where several entrances are provided to the rear of the microphone diaphragm, is shown in Fig. 14. Variable-D design employs multiple ports, with high frequencies entering the port closest to the diaphragm, mid frequencies entering midway along the length of the microphone case, and low frequencies entering the port farthest from the diaphragm. Variable-D construction maintains a much more constant pressure difference on the diaphragm as frequency is reduced for both close and far sound sources. Proximity effect is for all practical purposes eliminated, as shown in Fig. 15.

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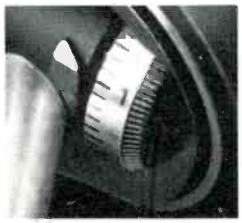

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Another refinement is on the stylus pressure dial which is now calibrated in tenths of a gram from 0 to 1.5 grams. This provides finer control in setting optimum stylus pressure for today's finest cartridges, designed for tracking in this range.

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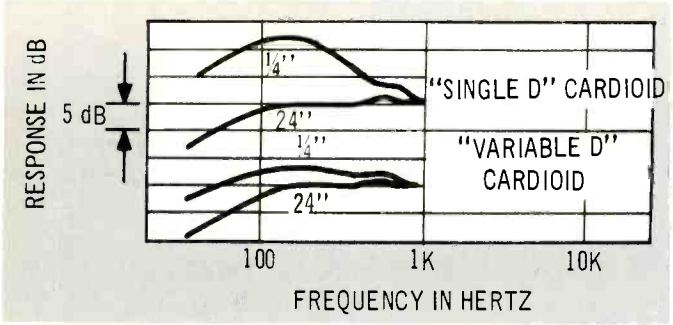

Fig. 15—Proximity effect comparison.

Continuously Variable-D is a refinement that permits more uniform frequency and polar response. The three ports of Variable-D design are replaced by a long slotted entrance which has a continuously varying frequency acceptance along its length, as shown in Fig. 16.

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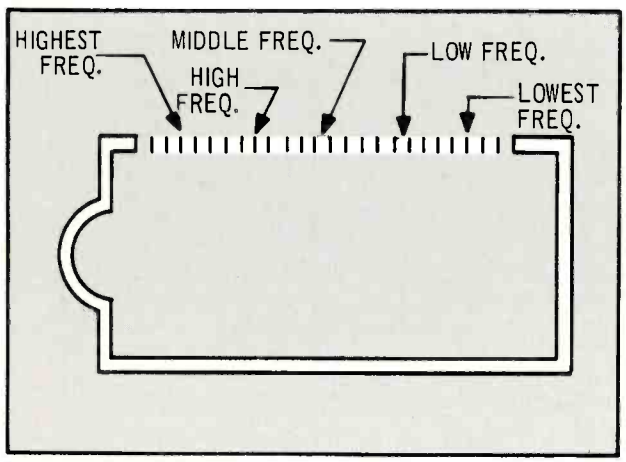

Fig. 16—Continuously Variable-D microphone.

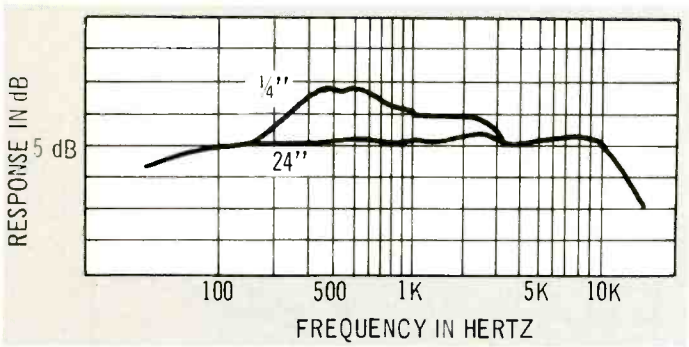

Fig. 17—Proximity effect of high frequency head in two-head cardioid design.

Reduced Pop and Shock Sensitivity

Variable-D design substantially reduces susceptibility to breath popping and mechanically-induced shock, compared to single-D designs. The Variable-D, then, tends to combine many desirable omnidirectional characteristics with the cardioid's noise, reverberation, and feedback-reduction advantages.

Two-Head Cardioid Designs Alter Proximity Effect

Some cardioids employ a second generating element, with a crossover network between the two at about 250 Hz. The rear entrance to the low-frequency head is at the rear of the microphone case, virtually eliminating the *low-frequency* proximity effect, in the area broadly centered around 100 Hz. The remaining proximity effect of the high-frequency head, located above the 250 Hz crossover frequency, is displayed in Fig. 17.

Microphone Impedance

Microphone impedance refers to the impedance seen when electrically "looking back" into the unit's output terminals. Microphones are usually described as either high impedance or low impedance. Low impedances typically range from 50 to 250 ohms, or perhaps to 600 ohms, while high impedances range from about 25,000 ohms on up to several megohms. Some medium impedance microphones (several thousand ohms) exist but the inputs appropriate to the characteristics of these microphones have largely disappeared.

A microphone's impedance may be *capacitive*, as in piezoelectric designs, or *resistive*, as in ribbon, dynamic, and condenser (after the impedance converter) designs. This difference is important, because it determines the effect of cable and preamplifier loads on microphone output level and frequency response. Since piezoelectric microphones are seldom used for high-quality work, however, the discussion of resistive-source microphones is adequate here.

High impedance resistive-source microphones have their high frequencies drastically rolled off by any reasonable length of microphone cable: a 20-foot cable might put response down 6 dB at 10,000 Hz! In contrast, low-impedance resistive source microphones may be used with hundreds of feet of cable with essentially no loss below 20,000 Hz. The moral, of course, is to avoid high-impedance microphones if at all possible!

High impedance microphones do have higher output level. High impedance is attained by having a large number of turns on a voice coil or a transformer built into the microphone. Having a large number of turns in the magnetic field simply produces a higher output voltage than having a small number of turns: the increase is approximately 20 dB into an open circuit (approximated by having the microphone terminated by an impedance at least ten times its own impedance value).

It is worth noting that the higher output voltage inherent in high-impedance microphones is not immediately obvious from a casual inspection of their *sensitivity* rating. The raw numbers come out about the same for both impedances, such as "–55 dB," but this is because there are two basically different rating schemes commonly employed for high- and low-impedance types. These differences will be discussed later.[2]

A good way of achieving high output voltages from low-impedance microphones, where the microphone input demands it, is to employ an in-line transformer (commonly called a "line matching transformer") *at the equipment end* of a low-impedance microphone's cable. The high-impedance cable coming out of the transformer can be very short so that no high-frequency rolloff occurs.

To be continued

[2]**For a detailed discussion of the two sensitivity rating methods, including calculation of the actual voltage delivered to a given load, see Long, AUDIO, pp. 61-63.**

Inside artistry in sound...

Take a brief, close-up look into an Onkyo Audio System. Your immediate, lasting impression will be . . . "Here is unmistakable excellence in craftsmanship and materials that can only result in outstanding performance." Our Model 25, 3 way system, (detailed below) illustrates the point. But, ultimately, sound quality concerns you most! That's simple to resolve. Stop in at any of our select franchised dealers . . . and listen! You will hear tonal definition that audio experts say is "almost beyond belief" . . . with the entire audible range of original source material re-created as the optimum expression of Onkyo's technical expertise and artistic sensitivity. Scepter Speaker Systems retail from $149.95 to $499.95; 5 year **guarantee**, labor and parts.

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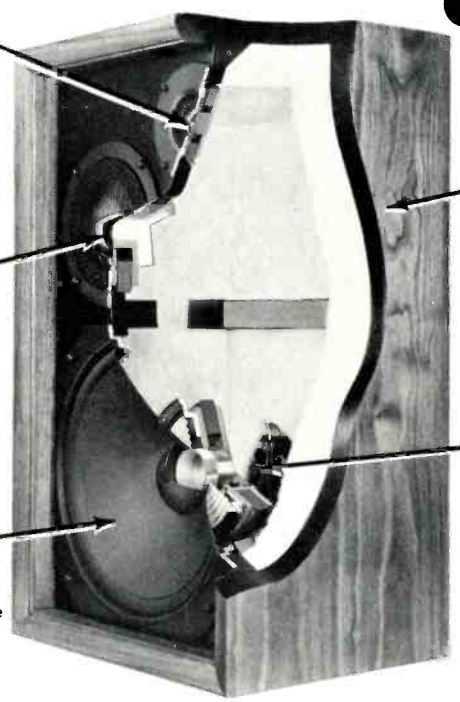

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- Magnet — ½ lb. Ferrite
- Frame — Cast Aluminum

MID-RANGE
- Diaphragm — 2" dia. Super-Hard Duraluminum
- Magnet — 2¾ lb. Ferrite
- Cavity Damping — 2"d. Fiberglass

WOOFER
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- Molded Non-Press Cone, Ported Dome
- Neoprene Surround
- Cast Aluminum Frame
- 3¼ lb. Ferrite Magnet
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- Heavy Bolted Construction

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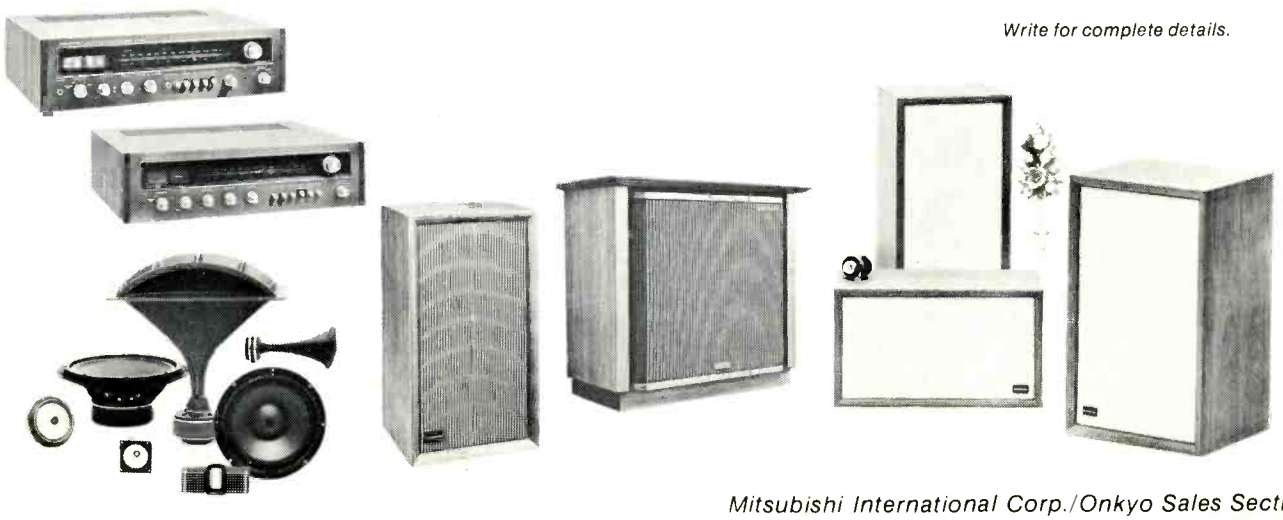
- Large Air Core Chokes
- Mylar Non-Polarized Capacitors
- 12dB per Octave Slope
- Choke Attenuator, 5 position, 2dB per Step, Tweeter and Mid-Range

Write for complete details.



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Care of Records

Percy Wilson

NOTWITHSTANDING all the gadgetry that has been produced commercially, there are still many complaints that the records the public buys soon develop serious faults—pops, crackles, and warping, and may right from the beginning have eccentric holes. This even applies to records bought from specialist firms who guarantee that the records they sell will be unplayed and delivered in sealed envelopes.

There is little one can do about eccentric records—"swingers" we used to call them. Fortunately they are much rarer than they used to be.

Warping can be cured. The method is a little troublesome, but it is certainly worth while for anyone who really values his record collection. Two sheets of plate glass about 12½ inches square are needed. (Actually I use two circular sheets taken from the ports of old aircraft.) One of the surfaces of each of these should be scrupulously cleaned and polished. The record is then placed between the two and the assembly placed on top of a warm stove. If the glass sheets are thick, it is unlikely that the record will get too hot, though a temperature above about 150°F. at the record surface should be avoided. On the top of the upper glass a heavy weight can be placed. I used to use three volumes of the Encyclopedia Britannica. In about 12 hours the record can be removed and tested, on a turntable of course, for warping. In some cases the treatment may have to be repeated for a longer time.

The "pop and crackle" problem is more difficult. I have spent the best part of 10 years in research and have written two papers to the Audio Engineering Society describing my conclusions. Unfortunately, these indicated a remedy which was most expensive, since it demanded first of all an efficient method of wet cleaning and then a means of suction of the deposits from the record surface. I constructed about half a dozen pieces of apparatus to secure the result. My present system could not be marketed for less than about 250 British Pounds ($600), which as Euclid said, is absurd.*

So I concluded that one must search for a simpler and less expensive procedure for avoiding the contamination. I think I have found it, and I am arranging with Metrosound to market the appropriate (and quite inexpensive apparatus.

First of all, though, may I explain the problem? Years ago, when Cecil Watts devised the Dust-Bug, and I applauded it in my *Gramophone Handbook* (now out of print), and Julian Herbage repeated my approbation in his Sunday morning broadcast on *Music Magazine*. Cecil wrote to me saying,

"What have you done to me? I have 5,000 letters to answer and no means to doing it."

But he proceeded to make a commercial device out of the Dust-Bug. All praise to him. He himself described it in his contribution to Gilbert Brigg's *Audio Biographies*.

Percy Wilson is one of the most respected pioneers in this industry. He was Technical Advisor to *The Gramophone* from 1924 to 1938 & Technical Editor 1953-1968. He is the author of the famous "Gramophone Handbook" which is now being revised.

*250 Pounds or $600 is a lot of money however you look at it, and we will be pleased to print details of the cheaper machine as soon as available —Ed.

His device dealt effectively with all the loose deposits which bedevil the records by electrostatic attraction. These are mostly fluff, but there are also fine particles of grit. These must be removed, and the Dust-Bug technique was aimed at minimizing the electrostatic discharge and removing the particles that broke through.

Our research, however, showed that there was a more subtle problem. The rotating record creates a sort of vortex which sucks down the air above the record, and then disperses it over the surface and shoots it over the edge. You can easily test this for yourself, as I demonstrated at the A.E.S. Fall convention in New York in 1964, by getting a piece of plastic tubing and inserting a metal tube about six inches long at the end (as a sort of cooling device). Then, holding this metal tube about six inches above the spindle of the rotating turntable, you fill your mouth with tobacco smoke and slowly blow it through the plastic tubing.

You will find that the smoke descends onto the turntable in a sort of exponential curve, and then shoots rapidly over the edge. A most intriguing picture!

This vortex, of course, drags down any minute particles that are suspended in the air, whether from smog, smoke, or aerosol activity (anti-fly, cosmetics, etc.) in the room.

These particles often escape the general vortex stream and deposit themselves mostly in two rings on the record surface—the principal one near the outer edge and a minor one at a radius of about 3½ to 4 inches.

Now these deposits, from their very nature, are sticky, and being so tiny in structure get right into the groove. Surface brushing does not move them, and if they are allowed to remain, they gradually harden and retain particles of grit which accompanied them on their vortex descent. Hence pops and crackles.

The present surface brushing devices do not remove this type of contamination. Wet cleaning with suction can do so, and the success is spectacular.

Is there any alternative to the wet-cleaning/suction process which is so expensive? I have recently come to the happy conclusion that there is, provided one is careful. But it is progressive, and this means that it may take time in difficult cases.

One other qualification. Pops and crackles due to scratches cannot be removed. The sign of a scratch is that a pop occurs regularly at every revolution. So make sure that your inner sleeves are clean and free from grit. I

prefer to slit the sides open so that one need not slide the record in and so rub the surfaces.

In all cases, new records as well as old, there are some rules that must be obeyed if the records are to be kept in good order. Following is a summary:

1. Never touch the recorded surface. Two methods of handling can be recommended.

A. In the open, place a second finger on the spindle hole with the thumb on the edge.

B. In putting the record onto the turntable and taking it off, hold it between the folds of a visting card or an old Christmas card.

2. Keep your turntable clean by regular brushing with a velvet or plush pad.

3. Never blow on a record to remove fluff. If you do, you will be sure to spray it with drops of spittle, and these are difficult to remove except by sophisticated wet cleaning.

4. Do not make the mistake of thinking that you can clean a record by a thorough washing with either detergents or under the tap. You can, indeed, but drying them afterwards is a difficult and risky business unless suction is used. Because of the grooves, a liquid adheres strongly by surface tension. When the record has been thoroughly wetted, a suction of 16 to 20 inches of mercury is needed to obtain a completely dry surface.

5. Be most meticulous in cleaning the stylus after every playing. Mere stroking is not good enough. If you were to examine the stylus through a deck microscope (say 100X), as I do, after playing a single side, you would be shocked to see how much debris it has picked up, even though you thought the record was clean. This has become much more troublesome with modern pickups which have short styli so as to reduce the tip mass. The former cartridges which we used to use for mono records had longer shanks, and the debris spread up them. Now it is all disposed near the tip. If it is not removed, it may settle down to the tip, and when you play the next side you will be using the debris as your playing point and of course distortion will result. Correspondingly, if you find the distortion has appeared during the playing of a record and suspect that the stylus has collected an unusual amount of debris, stop playing and clean the stylus.

To do this, a liquid must be used which will not affect the cement which fastens the stylus to the cantilever, and it must not have a high proportion of water. In addition, it must evaporate quickly. Moreover, care must be taken not to let the liquid spread to the other end of the cantilever, otherwise it will cause the moving magnet to rust.

A safe liquid is alcohol. Ethyl alcohol is the most efficient but is difficult to obtain. So as a general rule, one must fall back on isopropyl alcohol (which is the constituent of most of the commercial stylus or tapehead cleaners), or on vodka, which is almost pure alcohol, I am told.

The liquid should be used sparingly, preferably on a camel-hair brush such as children use in their painting lessons. Stroke the stylus gently from back to front, and, I repeat, do not splash the other end of the cantilever.

6. Never leave the record lying about out of its sleeve or on a rotating turntable unnecessarily. In the latter case, of course, the vortex action previously described will continue to put sticky deposits on the disc.

7. For storage, the records in their sleeves should be disposed vertically on shelves or in cases with slight but firm side pressure. There is on the market a cunning spring-loaded device which secures this pressure. But I have myself used two perhaps more amateurish ways. The problem, of course, is that the side pressure should not make it difficult for the record to be withdrawn from the stack.

The first device is to divide the stack by wedge-shaped partitions and provide the side pressure by the insertion of subsidiary wedges of opposite taper. (See Fig. 1.)

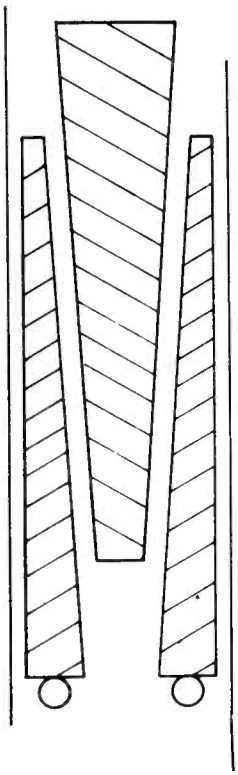


Fig. 1—Wedge method of obtaining pressure.

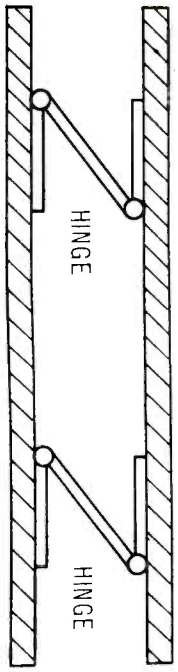


Fig. 2—Configuration of double hinges.

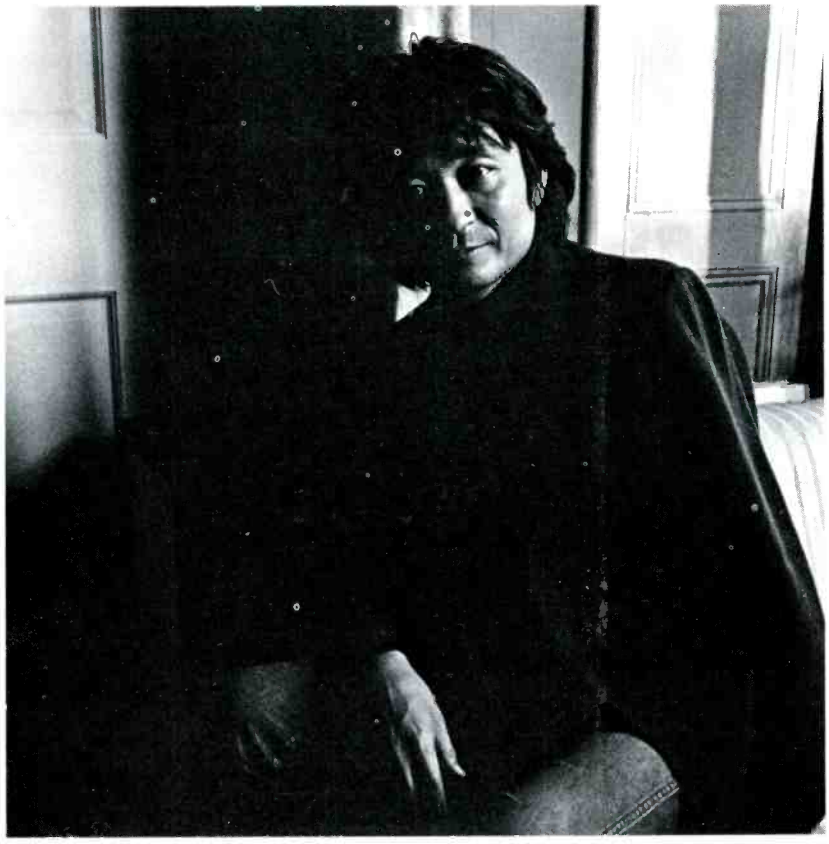
Insertion of the subsidiary wedges provides the required pressure; withdrawal of them releases the pressure and enables one to get hold of any record by grasping the empty top corner of its sleeve.

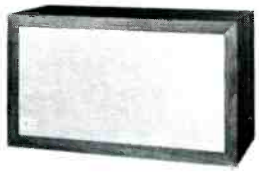
The second device is to have a partition in two halves joined together by double hinges. Such hinges are available at hardware stores. (See Fig. 2.) It will be clear from the diagram that their use enables the width of the double partition to be increased or reduced, and therefore to increase or reduce the side pressure.

8. So as to avoid unneccessary handling, do not make any attempt to store the records in any prescribed order on the shelves. For identification, number the sleeves either with sticky-back numbered tags or with a ball-point pen. Then have a loose-leaf notebook classified according to composer, artist or whatever you will. Suitable notebooks are of course not hard to come by.

9. Fortunately, in modern record-playing conditions, with diamond styli and playing weights of not more that 1 to 3 grams, stylus and record wear have become negligible. But do be careful not to drop your stylus by rough handling and do keep your equipment clean. AE

The AR-3a is Seiji Ozawa's choice for home listening.





Seiji Ozawa is acutely familiar with the sound of the world's great orchestras. He is also sensitive to the sound of the same orchestras on records, having made a prodigious number of recordings during recent years.

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A Christmas Story

"THIS A GRAND SOUND and no mistake," said Paddy as he reached out his hand for a glass of porter. The four of us were sitting in the Irish House where some doltish manager had just installed a neon-encrusted juke box, which was thumping away like a wounded elephant. Three waiters in convoy passed our table bearing trays, and I was about to remark about their dexterity when a hiccup intervened.

Paddy said, "Did I ever tell ye about my cousin O'Toole and his hi-fi?"

"No," replied Jimmy, and the other two, Peter One and

Peter Two shook their heads a little wearily.

I said, "Hasn't O'Toole got a first name?"

"Yes, he has so," answered Paddy, "but he has always been called O'Toole or Fishy O'Toole, as you know." I didn't know, but said nothing.

Paddy finished his drink and began,

"This O'Toole was very fond of music. I remember he used to sing *The Wearing of the Green* when he was only three years old—and put his tongue out at the Orange. Well, one day didn't he win a packet on the Sweepstake and so he

up and bought himself a big hi-fi from Dublin. It was called a Component and it must have cost 500 Pounds cash. Yes, I will have another one," and Peter One signaled the waiter.

"So, anyway, when he got this Component fixed up, he asked me over to listen. Well, it was loud as *this*." "This" was a frenzied series of booms from the juke box.

"He had moved his big fish tank into the middle of the wall and put a big loudspeaker box on each side. So, I listened for a bit, had a drink or two, listened some more, and went home. A week later the trouble started."

"It broke down," shouted Peter Two across the table.

"No," replied Paddy, pulling his egg-stained tie from his empty glass. "No, the thing wouldn't switch off—at least that's what O'Toole thought when he heard it playing away at 3:00 a.m.—in the morning that is. But you see the funny thing was, when he got downstairs, everything was quiet. No music, no nothing. So he thought he must have dreamed the whole thing and went back to bed. The next night he woke up and listened; there was no doubt the music *was* coming from downstairs and he recognized one of the records he'd bought at Danny's Record Store only the day before. By the time he'd got downstairs all was quiet again. The whole thing had got him worried and he just couldn't work the next day."

"Is he the same O'Toole who used to run the funeral parlor?" asked Jimmy.

"The same," acknowledged Paddy. "But this day his heart just wasn't in his job. I saw him in Murphy's an' he told me he thought he was going round the bend and would soon end up in one of his own pinewood boxes. You know they are outrageous. They cost . . . but never mind. Thank you, Jimmy." Another set of refills had arrived.

"As I was saying, er, that night he ran downstairs as soon as he heard the first note but he was too late again. But now, listen 'til I tell ye—this is the crooks of . . . "

"Crux," said Jimmy.

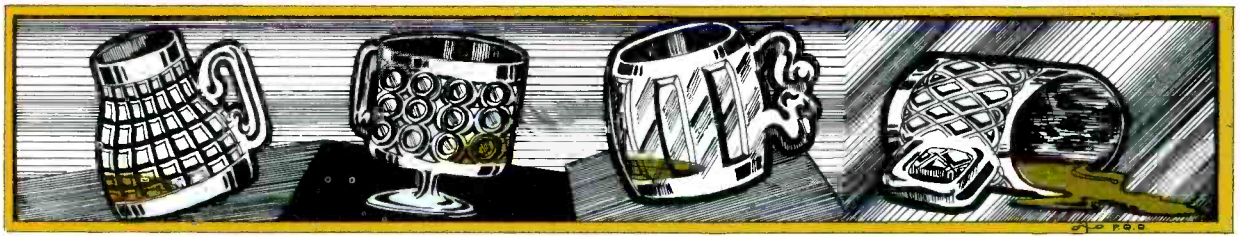
"Crooks, crux—when he went to his records, he saw one was not in its little jacket and it was wet. That solved the mystery."

"Paddy, Paddy," we cried, "*Now* you've gone *too* far. You really can't expect us to believe it was the fish."

"It's true. It's the truth, as sure as I am sitting here, and—hic—you know what that O'Toole did?"

"No," we said, shaking our heads.

"He put underwater speakers in that fish tank and I would say those fish are the most contented fish in the whole of Ireland . . . Good night!" and he was gone. *T.W.G.*



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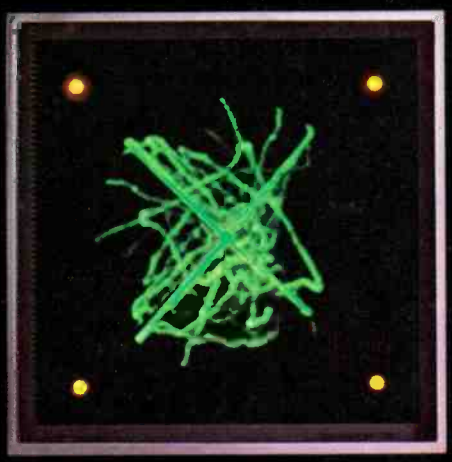

change the size of the wave form. Plus a Scope Mode switch for either matrix or discrete sound.

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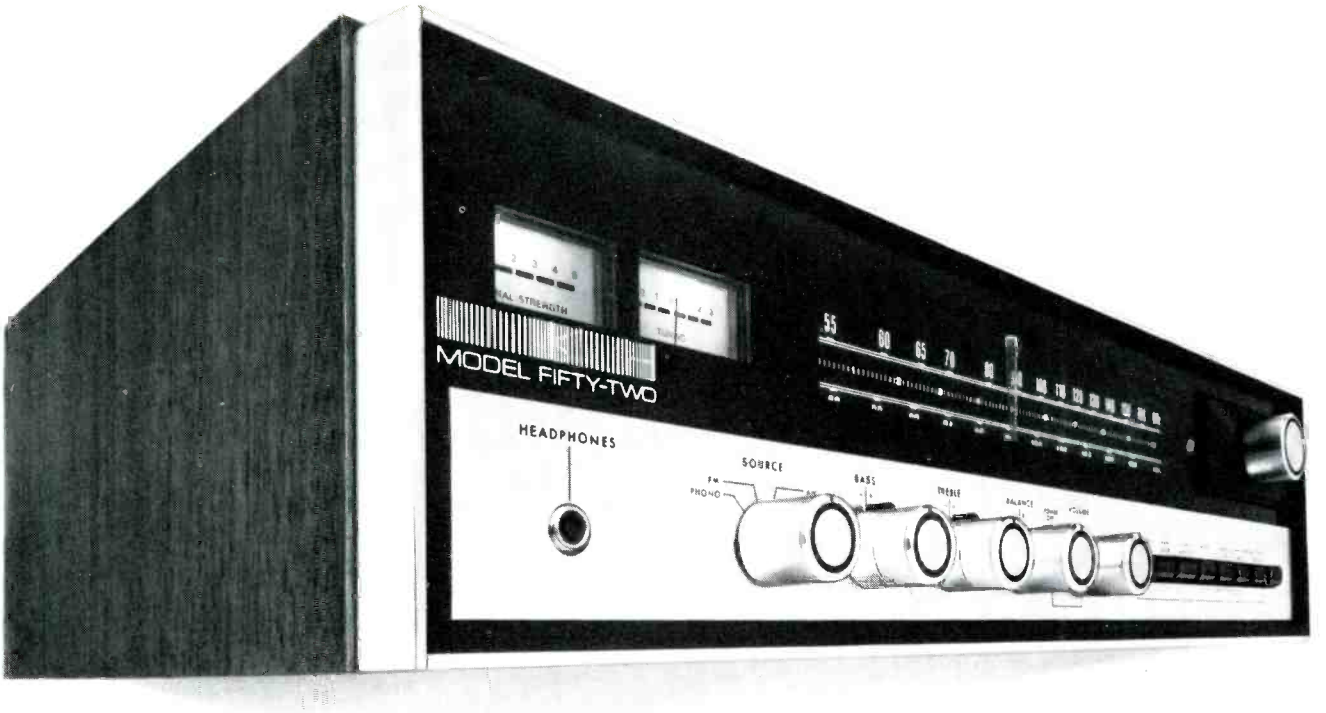
AKG (PHILIPS)	C-451E comb.	Card.	Cond.	Metal	Brushed	50/200	30-20k ± 2½	135	XLR3	Not furn.	Not furn.	4½ x ¾	4½	Adapt.	189.00	Interchangeable capsules; phantom a.c. or d.c. powering.
	D-160E	Omni.	Dyn.	Metal	Brushed	200	40-18k ± 2½	148	XLR3	15	Not furn.	6 x 1½	7½	Adapt.	60.00	With removeable windscreen.
	D-200E	Card..	Dyn.	Metal	Gray	200	30-15k ± 3	151	XLR3	15	Not furn.	7¼ x 1⅝	8	Adapt.	70.00	2-way with hi- & lo-freq. units.
	D-202E	Card.	Dyn.	Metal	Blk.	200	30-15k ± 2		XLR3	15	Not furn.		8	Adapt.	130.00	As above, with swit. bass filters and cut filters.
	D-1000E	Card.	Dyn.	Metal	Brushed	200	40-16k ± 3½		XLR3	15	Not furn.	6 x 1½	9½	Adapt.	60.00	3-pos. swit. for bass rolloff.
	D-190E	Card.	Dyn.	Metal	Brushed	200	40-15k ± 3		XLR3	15	Not furn.	6¼ x 1½	6	Adapt.	50.00	
	D-109	Omni.	Dyn.	Metal	Brushed	200	50-15k ± 5			30	Not furn.	2¾ x ⅜	1½	Lav.	49.00	With lavalier neck cord, tie clip, case.
	D-707E	Card.	Dyn.	Metal	Brushed	200	50-15k ± 3½		XLR3	15	Not furn.	6 x 1½	4	Adapt.	40.00	
ADVENT	MDC-1	Card.	Dyn.	Zinc	Matte blk.	500	50-16k ± 5		Phone	20	Phone	5¾ x 1¼			90.00	Stereo pair; bal. or unbal. conn.; with clamps, desk stds., carry case.
AUDIOTEX, DIV. HYDROMETALS	31-2314	Uni.	Dyn.	Steel	Matte	50k; 200	50-13k	58	Amph.	20	Phone	7 x 2	22		39.95	
	30-2312	Omni.	Dyn.	Steel	Matte	50k;200	55-13k	62	Amph	15	Phone	7 x 1	10		34.95	
	30-2310	Uni.	Dyn.	Steel	Matte	50k	80-13k	58	Amph.	10	Phone	5½ x 1½	12		29.95	
BEYER (REVOX)	M160	Super card.	Rib.	Metal	Chrome	200	40-18k ± 2	57	Can.	16	Not furn.	6 x 1½	7	Cmp.	180.00	
	M320	Super card.	Rib.	Metal & plas.	Blk.	200	30-18k ± 2	57	DIN	16	Not furn.	3½ x 2½	11	Adtr.	100.00	On/off/bass cut swut.
	M101N	Omni.	Dyn.	Metal	Gray	200	40-20k ± 2	55	Can.	16	Not furn.	4½ x ⅞	3½	Cmp.	80.00	
	M260	Super card.	Rib.	Metal	Blk.	200	30-18k ± 2	57	DIN	16	Not furn.	6 x 1¾	7	Clamp	90.00	
	M88	Super card.	Dyn.	Metal	Chrome	200	30-20k ± 2	50	Can.	16	Not furn.	6½ x 1¾	8	Clamp	175.00	
	M500	Super card.	Rib.	Metal	Alum.	200; 500	40-18k ± 2½	55	Can.	16	Not furn.	7½ x 3	7½	Clamp	100.00	
	X1HLM	Card.	Dyn.	Metal & plas.	Blk. & silv.	200; 500; 25k	30-18k ± 2	52	Can.	16	Not furn.	7⅜ x 1¼	14	Clamp	75.00	Pop filter; hum comp.; swit. imped.
	M69	Card.	Dyn.	Metal	Gray	200	50-16k ± 3	50	Can	15	Not furn.	6½ x 1¾	8	Clamp	75.00	Opt. on/off/bass cut swit.
	M810	Card.	Dyn.	Metal	Blk.	200; 50k	50-16k ± 3	73	Integ.	16	Phone	5½ x 1¼	10	Clamp	45.00	With wind shield, clamp, carry case.
	M550	Omni.	Dyn.	Metal	Chrome	200; 50k	70-16k ± 3	73	Integ.	6½	Phone	5 x 1	8	Clamp	30.00	With clamp & table std.

At last a serious rival to the KLH Model Fifty-One.

The new KLH Model Fifty-Two.



When it comes to power, performance and overall product integrity, KLH's classic Model Fifty-One is a tough stereo receiver to beat. At $259.95†, it literally wipes out its competition. We just could not make a better AM/FM stereo receiver for the money.

So we've made a more expensive one.

It's called the Model Fifty-Two. And it costs $289.95†. The additional thirty dollars buys you additional power (30 watts per channel RMS compared with the Fifty-One's 20 watts per channel RMS). The Fifty-Two also has a new KLH look, dual tuning meters, and a host of new convenience features. Now we know the Fifty-Two will never replace the Fifty-One; we never intended it to. But if you have a special need for somewhat more power than the Fifty-One offers, *but* you want the same dependability, precision engineering and super quality, we have a new receiver for you. The Fifty-Two . . . the Fifty-One's serious, but friendly rival.

See the Fifty-Two at your KLH dealer now. Just $289.95† (including walnut-grain enclosure). Also see the rest of the KLH receiver line, especially KLH's newest and lowest priced AM/FM stereo receiver, the Model Fifty-Five. Powerful. Dependable. And very special for just $199.95†. For more information, write to KLH Research and Development, 30 Cross Street, Cambridge, Mass. 02139.

KLH RESEARCH AND DEVELOPMENT
A Division of The Singer Company

†Suggested retail price. Slightly higher in the west.
*A trademark of The Singer Company

Check No. 37 on Reader Service Card

Olson M-327

RCA BK-16

PML EC-71

Radio Shack 33-1045

MANUFACTURER	MODEL	Directional pattern	Operating principle	Case material	External finish	Impedance, ohms	Frequency response, Hz to kHz, ± ? dB		EIA Sensitivity, dBm	Mic connection	Cable length, ft.	Cable plug type	Dimensions, in.		Weight, oz.	Mounting method	Price	SPECIAL FEATURES
OLSON	EC-100	Card.	Elect. cond.	Alum.	Brush gold	Lo	30-16k ± 1½	140	Swt. A3S	20	Not furn.	8½ x 2½	5		Clamp	32.98	
	EC-200	Omni.	Elect. cond.	Alum.	Brush gold	Lo	30-16k ± 1½	135	Swt. A3S	20	Not furn.	8½ x 2½	5		Clamp	24.98	
	MM-327	Card.	Dyn.	Alum.	Brush gold	600; 50k	50-15k ± 2	125	Amph.	20	Phone	7½ x 1⅞	10		Clamp	22.98	On-off swit.
	MM-329	Omni.	Dyn.	Alum.	Blk.	50k	80-15k ± 2	125	Amph.	20	Phone	9½ x ¾	5		Clamp	15.98	On-off swit.
PEARL/PML	EC 71	Card.	Cond.	Metal	Satin chrome	*	40-18k ± 3	164	Preh	12	Not furn.	2¾ x ¾	1¼		⅝ x 27	109.50	A.c. or d.c. power; EK71 similar but omni., $99.50. *Hiz: 30/50, 200, 600.
	DC 20	Omni.	Cond.	Metal	Satin chrome	*	30-20k ± 3	180	Preh	32	Not furn.	2⅞ x ¾	1⅜		⅝ x 27	139.50	*As above. DC 21 similar but card., $149.50.
RADIO SHACK	1045	Card.	Elect. Cond.	Cast		600	30-15k		Can.	15						29.95	Can work with 20K imp.; with pop screen, desk std.
	1044	Omni.	Elect.	Cast		600	3015k		Can.	15						24.95	As above.
	Highball	Card.	Dyn.	Cast		50-200; 50k	50-15k		MCIF	15						39.95	With ¼-in. phone plug adptr.; dual imped.
	Highball 5	Card.	Dyn.	Cast		600; 20k	70-13k		¼-in. phone	15						28.95	Dual imped.
RCA	77-DX	Omni., card., bi	Rib.	Metal	Chrome	30,150, 250	35-18k ± 4	150		30	Not furn.	11½ x 3¾	48		½ or ⅝ x 27	224.00	3-pos. voice/music swit. & directional pattern choices.
	BK-5B	Uniaxial card.	Rib.	Metal	Gray	30, 150, 250	30-20k ± 4	151		30	Not furn.	7 x 1¾	27		½ or ⅝ x 27	172.00	Can be boom mtd.
	BK-14	Omni.	Dyn.	Metal	Chrome	30, 250	40-20k ± 5	154		30	XLR	8 x ¾	4		⅝ x 27	149.00	Wind & pop resistant; stand mount or hand held.
	BK-16	Omni.	Dyn.	Metal	Nickel	30, 350	40-20k ± 5	154		30	XLR	8 x ¾	3		⅝ x 27	139.00	Hand held or stand mount.
	BK-1A	Omni.	Dyn.	Metal	Gray	30, 150, 250	50-15k	146		30	Not furn.	7¾ x 1⅞	18		½-in. sock.	99.00	Low sens. to wind & mech. vibra.
	BK-6B	Semi. direc.	Dyn.	Metal	Gray	30, 150, 250	60-15k	159		30	Not furn.	2½ x 1			Lav.	85.00	Contoured resp.
	BK-12	Semi. direc.	Dyn.	Metal	Opt.	30, 250	60-18k	159		30	Not furn.	1½ x ¾	¾		Tie clip	85.00	Contoured resp.
	SK-30	Omni.	Dyn.	Metal	Blue	30, 250	50-14k	149		20	Not furn.	4½ x 1½	8		⅝ x 27	22.00	Hand held, stand or gooseneck mount.

MAXI-FI®:

A sound so pure, so spectacular we don't call it hi-fi.

By testing the listening reactions of thousands of people we determined exactly how the human ear absorbs sounds. Then we mathematically tabulated our findings into a unique "Sound Design Chart". The result is a sound so pure, so spectacular we don't even call it hi-fi. We call it Maxi-Fi®.

RECEIVERS: The extensive use of low temperature transistors reduces noise to practically nil and results in fine FM tuner sensitivity. To eliminate cross-modulation all receivers operate on a stable, precise time switching principle, giving clear-cut channel separation on FM stereo broadcasts. From $199.95 to $419.95.

SPEAKERS: Hitachi has achieved an acoustical balance between three elements . . . our patented gathered-edge suspension woofer, a linear horn tweeter and a bass reflex enclosure. From $65.00 to $275.00.

AMPLIFIERS: Harmonic distortion has been reduced to less than 0.1%. Efficiency is so great that new levels of performance can be obtained. From $219.95 to $600.00.

There's a complete line of Maxi-Fi® components . . . receivers, integrated amplifiers, speaker systems, record players, decks, FM tuner . . . everything for the individual taste and budget.

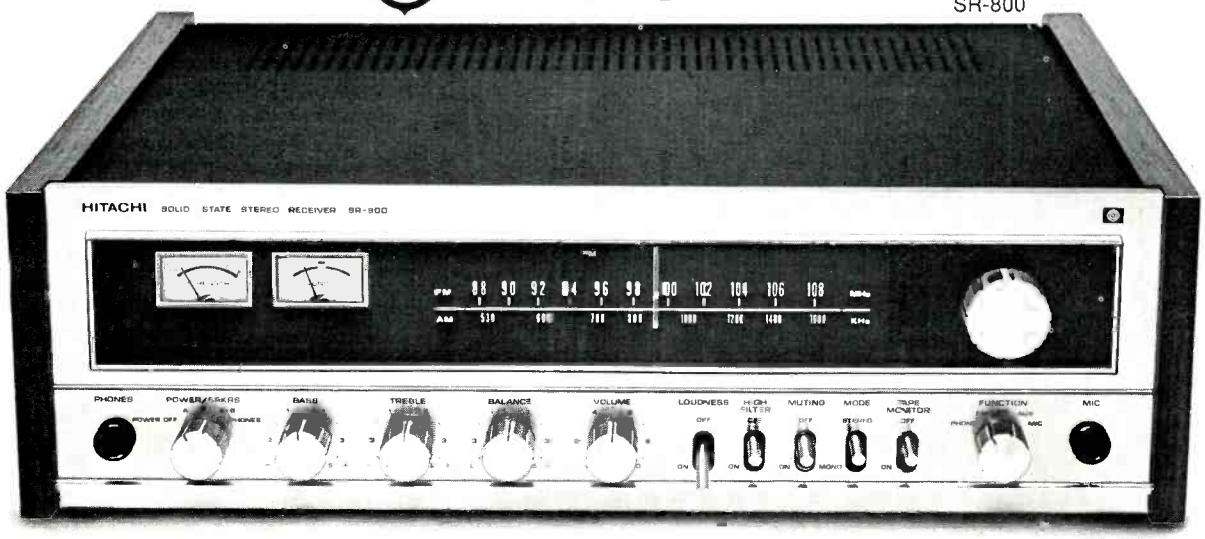
Maxi-Fi: It's the sound you've been wanting to hear all your life. Ask to hear it at your dealer. For more information, write.

Dept. A-2, Hitachi Sales Corp. of America,
48-50 34th Street,
Long Island City, N.Y. 11101

Quality always comes first at

HITACHI

SR-800



Check No. 41 on Reader Service Card

Shure SM-53

Sony ECM-22P

TEAC MC-201

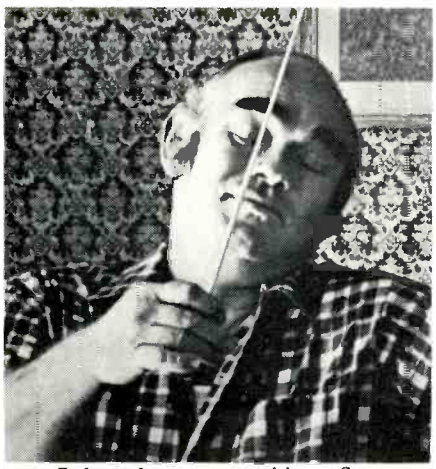
Turner TC-10

MANUFACTURER	MODEL	Directional pattern	Operating principle	Case material	External finish	Impedance, ohms	Frequency response, Hz to kHz, ± dB	EIA Sensitivity, dBm	Mic connection	Cable length, ft.	Cable plug type	Dimensions, in.	Weight, oz.	Mounting method	Price	SPECIAL FEATURES
SHURE	585SA	Card.	Dyn.	Diecast zinc	Chrome	HiZ	50-13k	153½	Amph. MCIF	15	Not furn.	6¾ x 2⅛	13½	Adapt.	45.00	Unisphere A; also avail. Lo Z model 585SB.
	588SA	Card.	Dyn.	Diecast zinc	Chrome	HiZ	80-13k	155	XLR	15	Not furn.	6½ x 2⅛	12	Adapt.	39.00	Unisphere B; also avail. Lo Z model 588SB.
	515SA	Card.	Dyn.	Diecast zinc	Blk. Chrome	HiZ	80-13k	154		15	Not furn.	6½ x 1½	12	Adapt.	27.00	Unidyne B; also avail. Lo Z model 515SB.
	579B	Omni.	Dyn.	Diecast zinc	Chrome	LoZ	50-15k	151	XLR	20	Not furn.	6⅜ x 1½	5½	Adapt.	45.00	Vocal sphere.
	548	Card.	Dyn.	Diecast zinc.	Blk. & chrome	HiZ, LoZ	40-15k	151	XLR	15	Not furn.	6⅛ x 1½	9	Adapt.	69.00	Unidyne IV; also avail. with mag. reed swit. as 548SD.
	565	Card.	Dyn.	Diecast zinc	Blk. & chrome	HiZ, LoZ	50-15k	150½	Amph MC4M	15	Not furn.	6 x 2	11	Adapt.	64.80	Unisphere I; also with mag. reed swit as 565SD.
	545	Card.	Dyn.	Diecast zinc	Blk. & chrome	HiZ LoZ	50-15k	151	Amph. MC4M	15	Not furn.	5¾ x 1¼	9	Adapt.	57.60	Unidyne III; also with mag. reed swit. as 545SD.
	55SW	Card.	Dyn.	Diecast zinc	Chrome	HiZ, MedZ, LoZ	50-15k	151½	Amph. MC3M	15	Not furn.	7¾ x 3⅛	26	⅝ x 27	58.80	Unidyne II with on/off swit.
	SM33	Super card.	Ribbon	Diecast zinc	Gray enam.	30-50; 150-250	40-15k	148	XLR	20	Not furn.	8 x 1¼ x 1⅞	26	⅝ x 27	150.00	
	SM53	Card.	Dyn.	Alum.	Matte metallic	150	40-15k	151	XLR	20	Not furn.	7⅛ x ½ x 1½	8	Adapt.	153.00	Rolloff swit.
	SM58	Card.	Dyn.	Diecast zinc	Gray enam.	30-50; 150-200	70-16k	148	XLR	20	Not furn.	6½ x 2	15	Adapt.	96.00	Built-in wind and pop filters; shock-mounted cartridge.
	SM60	Omni.	Dyn.	Alum. & steel	Matte metallic	150	45-15k	153	XLR	20	Not furn.	6¼ x 1⅞	6	Adapt.	49.20	
	SM61	Omni.	Dyn.	Alum. & steel	Matte metallic	150	50-14k	153	XLR	20	Not furn.	7⅛ x 1½	5½	Adapt.	66.00	
SONY/SUPERSCOPE	ECM-22P	Card.	Cond.	Metal	Silver	250; 600	40-15k	55	Can.	20	Can. XLR	7⅝ x 1	4		99.95	IC; FET; low-cut filt.; swit. Z; windscreen.
	ECM-99	Card. *	Elect. cond.	Metal	Silver	600	50-12k	53	Int.	10	2 mini	7⅝ x 1¾	10		39.95	*1 pt. stereo mic; 2 cards. in single housing; FET; internal batt.
	ECM-16	Omni.	Elect. cond.	Plas.	Silver	600	50-13k	58	Int.	6	Mini	1½ x ½	1	Tie clasp	29.95	FET; internal batt.
	ECM-18	Card.	Elect. cond.	Plas.	Silver & blk.	250	50-12k ± 3	57	Int.	6½	Mini	6½ x 1¾	5.3		19.95	Windscreen; FET; internal batt.
SPEEDEX, DIV.	31-850	Uni.	Dyn.	Steel	Matte	50k	100-15k	59	Amph	3	Mini phone	2½ x ¾	8	Lav.		
	31-854	Uni.	Dyn.	Steel	Matte	50k	80-13k	58	Amph	10	Phone	5½ x 1½	12			
	31-856	Uni.	Dyn.	Steel	Matte	50k; 200	50-13k	58	Amph.	20	Phone	7 x 2	22			
TANDBERG	TM-5	Omni.	Dyn.	Alum.	Alum.	600	70-13k		Can. XLR3	15	Can.	6⅝ x 1⅜		Tbl. std.	89.80	
	TM-6		Dyn.	Alu.	Alum.	250	50-15k			13	Yes	7⅛ x 1	5⅝	Tbl. std.	49.80	
TEAC	MC-201	Omni.	Elect. cond.	Alum. alloy	Chrome & blk.	600; 10k	40-20k	52	Phone	10		6 x ⅞	6	Clamp	77.00	
	MC-105	Uni.	Dyn.	Alum. alloy	Chrome	600; 10k	50-20k	78; 65	Phone	5½		5¾ x 1½	21	½-in. pipe	53.00	
	MC-106L	Omni.	Dyn.	Plas.	Chrome	600	55-18k	78	Phone	5½		5½ x 1	6½	½-in. pipe	17.00	MC-106H, similar but 600 & 10k z, 78 & 65 dBm sens., $17.00
TURNER	TC-10	Card.	Dyn.	Alum.	Etch. alum.	150	50-15k ± 2	149	Swcft. A3F	20	None	6 x 1½	7	⅝ x 27	135.00	Dual system of rear entry cancellation ports; metal case; indiv. resp. curve.
	TC-11	Card.	Dyn.	Alum.	Etch. alum.	150	50-14k ± 2	149	Swcft. A3F	20	None	6 x 1½	7	⅝ x 27	75.00	TC-11S, lo Z with switch, & TC-12S, Hi Z with switch, also available.
	2250	Card.	Dyn.	Plas., steel	Satin chrome	HiZ	60-13k	154	Swcft. A3F	20	¼-in. Phone	5 x 1	6	⅝ x 27	39.00	Plastic case. 2255, Lo Z.
	2300	Omni.	Dyn.	Steel	Satin chrome	HiZ	50-16k ± 3	154	Swcft. A3F	20	None	6 x 1¼	9	⅝ x 27	48.00	With switch. 2302, Lo Z.

This receiver gives you more control over Beethoven's Fifth than Beethoven had.

We call it our SEA.

What it stands for is sound effect amplifier. What it does is nothing short of amazing.



It breaks up sound into five different frequency ranges, instead of just the usual bass and treble. So you can tailor sound to your own taste.

If you're crazy about a certain singer, but not so crazy about the band that's playing with him, you can bring up the voice and push the music into the background.

The same thing can be done to emphasize a particular section of an orchestra. Or even a particular instrument.

And since there's not much point in having a great receiver with not-so-great acoustics, SEA lets you compensate for the shape of your room and the furniture in it.

But the nicest thing about the SEA system is its ability to create entirely new sounds by mixing and altering other recorded sounds.

This SEA receiver also has a linear dial scale with "Bull's Eye" tuning. Which takes the guesswork out of tuning FM.

Another great thing about this powerful FM/AM receiver: it's ready to handle 4-channel sound any time you are. Because it has all the necessary inputs and outputs for 4-channel sound.

So any frustrated conductor can now improve on Beethoven in the privacy of his own home.

JVC America, Inc.
50-35 56th Road,
Maspeth, New York 11378

JVC

Distributor in Canada: Magnasonic Canada Ltd., Montreal, Toronto, Winnipeg, Edmonton, Calgary, Vancouver, Halifax.

Check No. 39 on Reader Service Card

Dear Editor □□□

Dolby Broadcasting

Dear Sir:

While going over some back issues of your excellent publication, I read a very interesting letter in the January 1972 edition on the pros and cons of Dolby "B" processing of FM stereo broadcasts. As we have had some small experience in this medium, we'd like to add some comments to the writer's conclusion that it wasn't worth the trouble.

It is extremely frustrating to live 50 or 60 miles from the only FM station in the area, or from the only station with programming one enjoys. Just as the cassette tape medium is dramatically improved by Dolby "B" encoding/decoding, so will fringe-area reception be improved, although crosstalk from other channels, flutter fading, and multipath problems won't be helped a bit. One engineer suggested that what FM stereo really needs now is the abolition of the steep pre-emphasis curve, and the mandatory imposition of Dolby. At least one manufacturer has announced a simple, cheap Dolby circuit in chip form, which could add not more than $10.00 to the cost of a new tuner. But, alas, since the FCC would be more concerned (and perhaps rightly so) with the compatibility of such resulting broadcasts with the countless numbers of tuners in existence, it shall never be. . . .

What appears to me to be a major stumbling block to hinder the use of the Dolby process is the wide-spread use of high-frequency clippers/limiters, such as the CBS Labs "Volumax" and the Fairchild "Conax," which roll off the treble response in proportion to the input level, in order to reduce the danger of overmodulation. Most FM listeners are totally ignorant of such devices, and my experience shows that fewer still can perceive their operation *until* they have the technique explained and demonstrated. For a small core of audio purists (myself included), the resulting sound is highly unpleasant and unmusical, and we sit back in our chairs grumbling about the listening fatigue from high-frequency square waves and wish that the stations would simply cut their overall dynamic range back a few dB instead. Imagine the sound of a Dolbyized broadcast on a station which also employs a "Volumax," as heard on a non-Dolbyized receiver: the low passages are crisply over-brilliant, and the *fortes* are by contrast horribly dull and wooden. No amount of tone-control manipulation could possibly restore original sonic balance.

I am also pessimistic regarding Dolby FM from a personal experience. After promoting a special two-hour long program in not only Dolby "B" encoded sound, but also utilizing E-V 4 encoded tapes and discs, and running the show in great anticipation of listener approval, we received not **ONE** comment from any listener, though our engineer loved it. We customarily hear from many enthusiastic supporters of our popular and classical music programs, but to our total surprise, this special effort drew a complete blank. Nobody cared to let us know, though we literally begged for phone and letter response, how the program appealed to his audio sensibilities with or without Dolby in the playback. A further quadraphonic show the following week, says Dolby, drew so many calls we couldn't answer the phone and run the board at the same time. Maybe it was an especially good television night. . . .

Now that I think of it, perhaps Dolby in TV audio?

Stephen R. Waldee
Classical Program Director
Peninsula Broadcasting/KPEN
San Francisco, Calif.

We understand that, among others, WQXR in New York and WFMT in Chicago, have been extremely satisfied with the results of their tests. We would be interested in hearing from other station personnel about their experiences.—Ed.

Dolby Cassette Decks

Dear Sir:

In the cassette and cartridge recorder section of your September 1972 Directory issue (pages 94 to 98) you correctly indicate in the column which lists Special Features that the following cassette machines incorporate Dolby noise reduction:

Advent 201,
Advent 202,
Concord Mk-7,
Harman-Kardon CAD-5, and
Hitachi TRQ-2000.

By use of the code letter "D" to identify other machines with Dolby, you were using a symbol which many readers might have missed, for by failing to make any indication, readers might not realize that all of the following machines listed in your Directory also have the Dolby circuits built into them:

AKAI GXC-65D,
Concord Mk-IX,
Fisher RC-80B,
Harman-Kardon HK-1000,
Kenwood KX-700,
Lafayette RK-D40
Panasonic RS263US, RS277US, and RS276US,
Pioneer CT4141D,
Radio Shack SCT-6,
Sansui SC-700,
Sanyo RD-4300,
Sony TC-134SD and TC-160SD,
Tandberg TCD-300,
TEAC A-350 and A-250, and
Wollensak 4760A.

In addition to those in your table, seven more machines with the Dolby circuits are available in the United States. These are:

AKAI GXC-46D,
Beltek M-1150,
Bigston BSD-200AS,
Panasonic RS271US and RS279US,
Sharpe RTX-3000, and
Wollensak 4780.

Because your Directory issue is so widely used in the industry for reference purposes throughout the year, I hope that you will bring this information to the attention of your readers through your letters column.

Dolby Laboratories
Robert Berkovitz
Dolby Laboratories
London

Nagra Magnetics is located at 19 W. 44th St., New York, N.Y. 10036.

Audio Research

Audio Research points out that the price of their Mageplanar speaker systems is $995.00 a *pair* and not $995.00 *each* as might be thought from the September Directory.

The Language of High Fidelity, Part VII

The Basic High-Fidelity System

Martin Clifford

CHAOS IS A FRIGHTENING word for it conveys a sense of anarchy, terrifying since it saturates us with a sense of impotence, of helplessness. It is fortunate, then, that we are unable to see the madhouse of radio signals surrounding us, zipping through and about us, in all directions, with varying amplitudes and a constantly changing multiplicity of shapes. To compound the confusion, these waves have a fantastic number of frequencies, carrying sound signals with them. And from this polyglot assortment we are supposed to be able to select a single signal, render it completely free of any influence by any other, amplify it, and then transduce or change it into the more familiar form of sound energy. Obviously an impossible job, one that cannot be done, but which is done all the time with precision, with ease, and with superb attention to detail.

The device that reaches out to pick the one desired signal from this seething electronic cauldron is the tuner, similar to, but not quite as completely equipped as a receiver. It is a most important high fidelity component, now refined and improved by electronic manufacturers to a point where today's in-home use tuner would have been a proud laboratory possession just a decade or so ago. The tuner, precision device that it may be, is just one of the group of components that, taken together, form a complete hi-fi system.

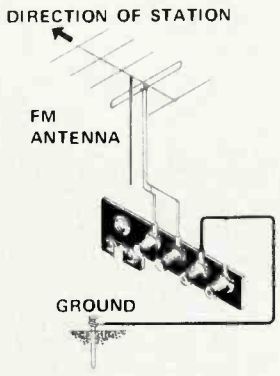


Fig. 1—For best reception, the outdoor FM antenna is preferable. The dipole shown here should be broadside to the signal. Ground can be any convenient coldwater pipe or radiator.

The Antenna

We start with the antenna (Fig. 1), a sort of electronic probe, preferably stuck up as high into the sky as we can manage, somewhat like inserting a naked finger into a hot broth, for subsequent licking and sampling purposes. Hurtling through the antenna with about the speed of light, all of the radio waves (and other types of waves as well) that pass through it, induce voltages across its length. Some of these signals are so weak that they perish on their way down the transmission line, the pair of conductors connecting the antenna and the input of the tuner or receiver. Others, more robust, fight for possession. Arriving at the input, some of the signals reverse their direction of travel, go back up the transmission line and are radiated by the antenna out into space. But enough signals remain at the entry portal, the input of the tuner or receiver, to set up an electronic donnybrook (Fig. 2).

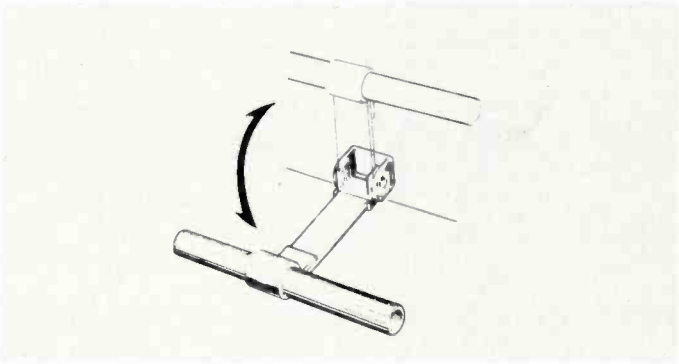


Fig. 2—The modern AM/FM receiver generally has a built-in AM antenna, with some sort of pivot arrangement to allow adjustment for best reception. For urban areas, this kind of antenna is adequate.

The Tuner Input

Not all the signals at the input are of equal strength. Buried in this electronic morass could be one signal, weak, attenuated, yet wanted. Whether your tuner or receiver will be able to rescue this signal from oblivion, hoist it from

the clamoring and quite likely stronger other signals, will depend on the sensitivity of the tuner. If the tuner (or receiver) isn't sufficiently sensitive to the plight of this signal, if the tuner is unaware of the presence of the signal, then send not to ask for whom the bells toll. The tuner input becomes the terminal point for that signal. *Requiescat in pace.*

If the tuner is sufficiently sensitive to that weak signal, it must now rescue it, separate it from all the other, more brutally strong siganls. The extent to which the tuner is able to do this is known as its selectivity.

All is not well yet, for the signal, recognized among all the other signals by the sensitivity of the tuner, and chosen from among all the others by the tuner's selectivity, must now be fed and pampered. Before it reaches the speaker it will have been amplified some ten million times, somewhat akin to starting a business career with one dollar and retiring as a multi-millionaire. The tuner, though, accomplishes this in a fraction of a second.

At birth, the signal weighs in at a few millionths of one volt. Divide a volt into a million parts, pick two or three of these parts, and you have some idea of possible signal strength. Not enough there to shock a mosquito. And yet this may be the signal that is supposed to drive two to four speakers with enough volume to shake an auditorium. We have a long way to go.

Generally, tuners have a rated IHF sensitivity of around 3 microvolts, although some are 2 microvolts or a bit less. This has led to the misconception that tuners having such excellent sensitivity can respond to 2 or 3 microvolt signals.

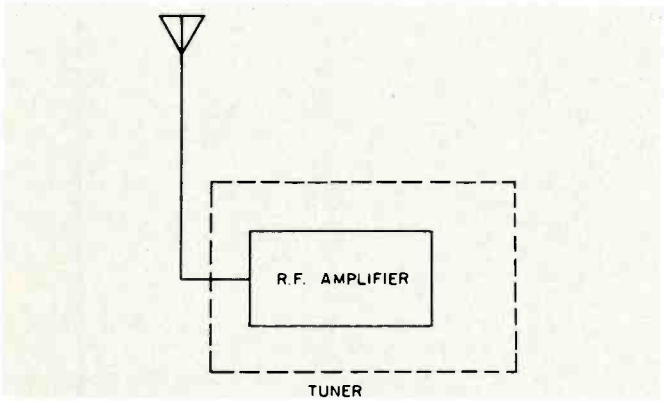


Fig. 3—The first circuit reached in the tuner or receiver by the signal is the r.f. amplifier.

They can, but only to be all but drowned out by the noise level. No rose without its thorn; no signal without its noise. For mono reception the signal should be several times larger that the sensitivity figure, and for stereo a safe number would be at least ten times as large. For most urban areas, signal strengths are generally measured in terms of hundreds of microvolts. However, ultra-sensitivity is essential in fringe areas or for those who tune in distant FM stations as a sport.

The R.F. Amplifier

The first step is to feed the signal electronically intravenously. This is done by an amplifier known as a radio frequency of r.f. amplifier. This section of the tuner (Fig. 3) does two jobs. It helps select the one desired signal, thereby contributing to the overall selectivity of the tuner, and it amplifies the signal. However, it is just a single tuned stage and so it cannot possibly pick out just one signal from among all the others, but at least it narrows the field. At the output of the r.f. amplifier, then, we have a variety of signals (but not as many as at the input) refreshed and invigorated, ready for their next adventure.

Not all tuners or receivers use a tuned front-end. Less expensive units have r.f. amplifiers that amplify only, but do not select.

Capture ratio, a term frequently appearing in manufacturers' spec sheets, is the ability of the tuner or receiver to respond only to a desired signal while rejecting all others. Capture ratios are expressed in dB and the lower the better. For quality tuners or receivers, the capture ratio will be about 2 dB, or even less.

The FET

Better grade tuners and receivers use a field-effect transistor (abbreviated as FET) as the first amplifying device to

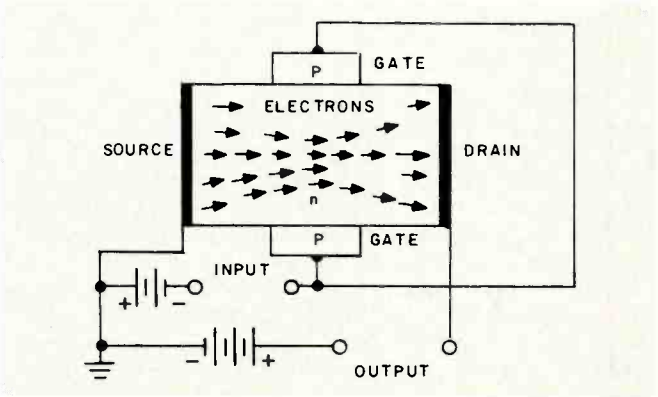


Fig. 4—The field-effect transistor. Letters *n* and *p* refer to negative type and positive type germanium or silicon. The drain is comparable to the anode in a tube, the source has its counterpart in the tube cathode, while the gate behaves like a control grid. Electrons move from source to drain but amount of flow is varied by signal applied to the gate.

which the signals are introduced. FETs achieve current control by an electrode voltage, and so in this respect they are more like tubes than other transistors.

There are two basic types of FETs, the junction type and the insulated-gate field-effect transistor, a metal oxide semiconductor, hence referred to as a MOS FET. In the FET, the control electrode (comparable to a tube grid) is called the gate, while the output electrode is the drain. The input is the source. When a voltage is connected between the source

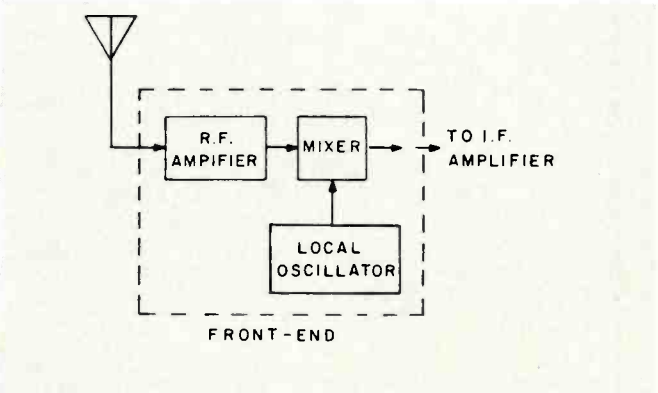
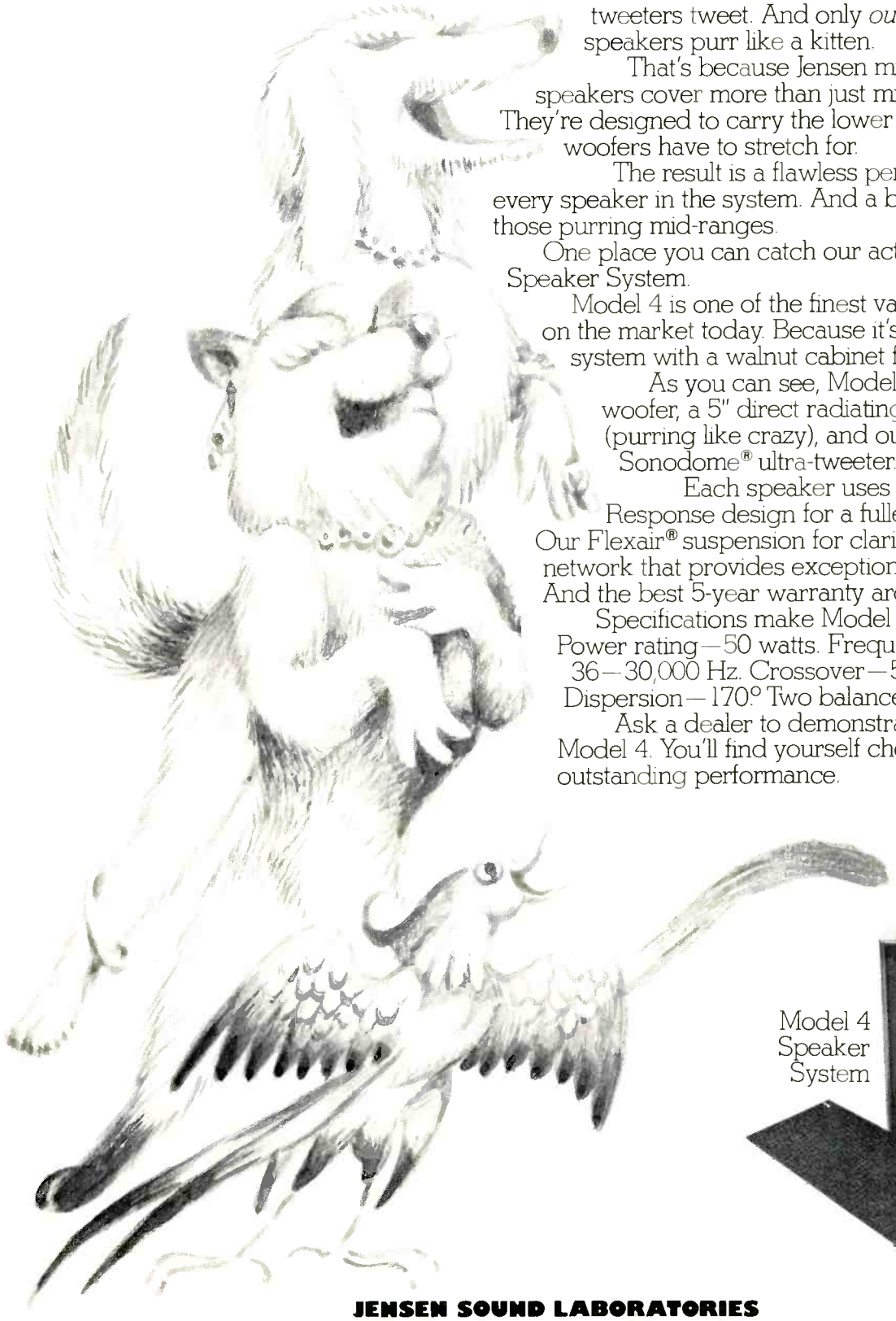


Fig. 5—The front-end of a tuner or receiver consists of an r.f. amplifier, a mixer and a local oscillator.

The first purr in speakers.



At Jensen all our woofers woof. Our tweeters tweet. And only *our* mid-range speakers purr like a kitten.

That's because Jensen mid-range speakers cover more than just middle ground. They're designed to carry the lower mid-ranges that woofers have to stretch for.

The result is a flawless performance from every speaker in the system. And a big credit is due those purring mid-ranges.

One place you can catch our act is in the Model 4 Speaker System.

Model 4 is one of the finest values—bar none—on the market today. Because it's a three way system with a walnut cabinet for only $99.

As you can see, Model 4 has a 10" woofer, a 5" direct radiating mid-range (purring like crazy), and our spectacular Sonodome® ultra-tweeter.

Each speaker uses our Total Energy Response design for a fuller, richer sound. Our Flexair® suspension for clarity. A crossover network that provides exceptional tonal blend. And the best 5-year warranty around.

Specifications make Model 4 look good, too. Power rating—50 watts. Frequency Range—36—30,000 Hz. Crossover—500/4,000 Hz. Dispersion—170° Two balance controls.

Ask a dealer to demonstrate Jensen's Model 4. You'll find yourself cheering an outstanding performance.

Model 4
Speaker
System

JENSEN SOUND LABORATORIES

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and drain, current flows through the FET from the source to the drain. A bias voltage is put between the source and gate, controlling current flow. When the bias is varied, current flow will change in step. As in a tube, variations are produced by the signal. The gate does not draw current, and so the input impedance is high.

The advantage of the FET is that it doesn't yield as readily as ordinary transistors to strong signals, hence does not become overloaded, and is less susceptible to cross modulation.

Mixer-Oscillator

This preliminary treatment of signals (for quite a number are still grouped together) could be repeated by additional tuned amplifiers. This repetitive signal weeding out and amplifying process was used in the early days of radio, circa 1925, but it was never really satisfactory, the end result being a cacophony of two or more signals out of the speaker.

Greater selectivity and better amplification were achieved with the introduction of the superheterodyne circuit, now used in all hi-fi tuners and receivers. The first step in the superheterodyne is the use of a mixer-oscillator. The purpose of the mixer oscillator is to reduce the frequency of all signals, ranging from one end of the tuning dial to the other, to a single frequency. This is done by using an oscillator, known as a local oscillator (just an a.c. signal generator) to heterodyne or beat with the incoming signal. The result of this beating or mixing action is the production of a signal at a different frequency.

The frequency of the local oscillator is always larger than

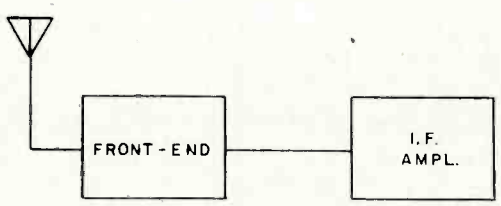

Fig. 6—The output of the front-end is fed into the i.f. amplifier.

that of the incoming signal by a fixed amount. Assume the incoming signal is 100 mHz. If the local oscillator is 110.7 mHz, then the difference between these two signals is 110.7 – 100 = 10.7 mHz. If the receiver is now tuned to another station, possibly at 105 mHz, the frequency of the local oscillator is automatically increased to 115.7 mHz. The difference signal becomes 115.7 - 105 = 10.7 mHz. And so, no matter what signal is tuned in across the entire FM band, the result is a fixed frequency signal referred to as the intermediate frequency and abbreviated as i.f.

The local oscillator is simply an a.c. generator whose frequency is changed every time you adjust the tuning dial of your receiver or tuner. The signal out of the r.f. amplifier and that from the local oscillator are both fed into the mixer circuit, appropriately named since it beats or mixes the two signals. The resultant signal, the intermediate frequency, is now fed into the i.f. amplifier section.

The I.F. Amplifier

The i.f. amplifier (Fig. 6) consists of a number of fixed tuned amplifier circuits, ordinarily adjusted to 10.7 mHz. Using a large number of stages, three or more, the signal undergoes increasing selection and amplification.

Budget priced FM sets use double-tuned i.f. transformers,

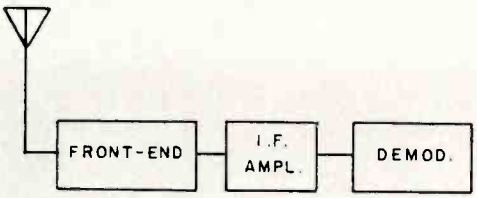

Fig. 7—The i.f. amplifier delivers the signal to the demodulator. Not shown here are additional circuits such as muting, to cut down interstation noise, and multiplex (MPX) for stereo reception.

but because of the high intermediate frequency, just a small shift in the adjustable components, generally a variable iron core, can cause detuning. This is more of a nuisance than a serious problem since realignment is then necessary to keep the i.f. transformers working at optimum performance. Better grade tuners and receivers use fixed-tuned circuits with ceramic or quartz filters or possibly coil-capacitor filters of special design.

The i.f. sections of better grade tuners and receivers use integrated circuits, popularly known as IC's. An integrated circuit is a complete circuit, a sort of block arrangement that does the job of semiconductors, resistors, capacitors, coils, etc. It is a circuit in miniature. By eliminating wiring it avoids the troubles caused by poor connections, plus the unhappy tendency of wires to act as antennas.

The Demodulator

The i.f. signal is really a two part affair. A portion of it consists of a wave that has behaved as a transportation medium, much as a truck is used to carry freight. The freight in the receiver is the audio signal. With selectivity accomplished, with amplification partially achieved, the two signals, the carrier and its audio load, are ready to be separated. This is done by a demodulator (Fig. 7) or detector circuit. Here the transport signal is discarded and the audio signal, still somewhat weak, emerges, ready for further treatment.

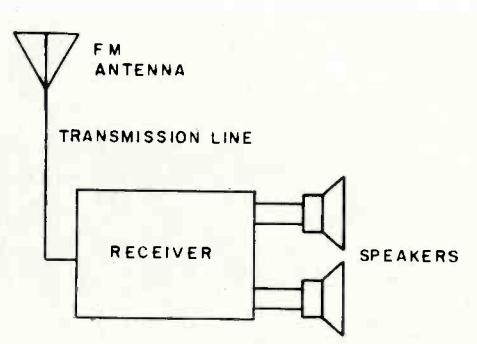

Fig. 8—This is the simplest hi-fi system and consists of a stereo receiver and a pair of speakers.

Would you be more impressed if this ad were in Playboy?

This new tuner/amplifier combination represents one of the best values Sherwood has ever introduced.

We designed it for the individualist who wants the versatility of separate components. With features no one else can offer for the money.

The S-2400 tuner costs only $229.95. The S-9400 amplifier, $259.95.

Maybe you'd be more impressed if you saw it advertised in the mass consumer magazines.

But to do that, we'd either have to charge more money. Or offer fewer features.

The Sherwood Experience

S-2400 AM/FM Stereo Tuner
- Four gang variable tuning capacitor
- 1.8 μV FM sensitivity —65dB Alt. Channel Selectivity
- Ceramic filtering
- "Stereo Only" switch
- Multipath outputs for reading multipath distortion on an oscilloscope
- FM four channel output provision
- Walnut case included

S-9400 Stereo/Dynaquad Amplifier
- 100 watts RMS, 8 ohms 20-20,000 Hz @ 0.7% T.H.D.
- 80 watts RMS, 8 ohms 1KHz @ 0.7% T.H.D.
- Built-in Dynaquad four channel matrixing circuit
- Inputs for 2 phonos, mics, tuner, 2 auxiliary sources.
- "Main Out/Pre In" provision
- Provision for Four Channel decoder (can double as a second tape monitor).
- Center Channel output (preamplified).
- Walnut Case Included

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The Audio Amplifier

Following the demodulator, the audio signal travels through one or more amplifiers whose function is to increase the voltage strength of the signal, hence are referred to as voltage amplifiers. In the case of a tuner, the demodulator might be the final stage or it could have a single voltage audio amplifier. The output of the tuner would then be fed into still another component, a group of voltage amplifiers housed in a single cabinet and known collectively as a pre-amplifier or pre-amp. In the receiver there is no separate pre-amp. Instead, the voltage amplifier is contained within the receiver.

Voltage is *not* power. Power requires both voltage and current. You have voltage present at every outlet in your home. There is no charge for this until you connect some appliance to the outlet, using both voltage and current—that is, power. Now you begin to pay. Similarly, a speaker requires power in the same sense that an electrical appliance demands it. And so, following the voltage amplifier section is a power amplifier circuit, a circuit that will still amplify the signal, but which is capable of delivering not just an audio voltage, but audio current as well. This is the payoff, for the audio voltages and audio currents supplied to the voice coil of the speaker, produce that long awaited result, sound.

In a receiver, the power amplifier is part of the unit. All that is needed here is to connect the receiver to one or more speakers (Fig. 8). In a separate component system, the tuner is wired to a pre-amp, but the pre-amp, in turn, is joined to still another component, the power amplifier, and that, of course, is attached to the speakers.

There are some variations, of course. You can buy a receiver, in which case you need not concern yourself about pre-amps or power-amps. It is also more economical to buy a receiver and it involves less interconnecting wiring cable problems. But there are also some disadvantages. Most power amps in receivers do not supply high power. 75 watts is rather high for a receiver. Using a tuner and a separate pre-amp, you can select a power amp capable of delivering several hundred watts. Further, the pre-amp, or possibly a pre-amp/power-amp combination, makes the hi-fi system more flexible, since it usually has switched and unswitched outlets (hi-fi systems never seem to have enough available outlets) plus a variety of controls: bass, treble, balance, volume, stereo vs. mono, selector for choosing different inputs (such as phono, tuner, mic, cassette deck, tape deck, etc.), tape monitor, loudness, filter.

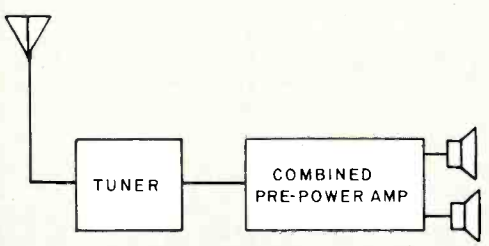


Fig. 9—For maximum flexibility, the pre-amp and power-amp are separate units.

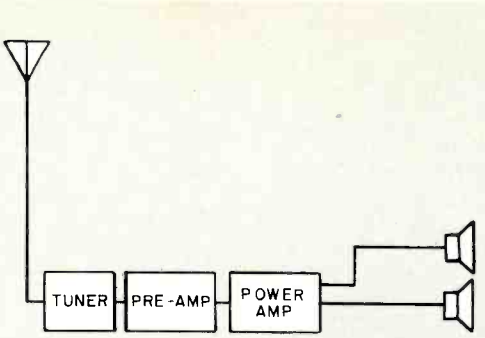


Fig. 10—The pre-amp and power-amp are sometimes combined.

The pre-amp (Fig. 9) may be separate or combined with the power amp. The combined pre-amp power-amp can be an integrated unit, with separate outputs from the pre-amp and power-amp, permitting you to substitute a different pre-amp or a different power-amp, for the one in the combined unit (Fig. 10). For maximum flexibility in a hi-fi system, separate components are preferable. While this setup costs more, it allows updating individual components when needed.

Power output can be specified in a number of different, often confusing, ways. Continuous power output, also known as root-mean-square or rms power, doesn't really mean what it implies . . . that the power output is kept going ad infinitum. It is just the maximum power the amplifier can deliver for 30 seconds minimum. The amount of distortion during this maximum power delivery time should be indicated, otherwise the power output specification is meaningless. Distortion means both harmonic and intermodulation types. (A more complete discussion of power ratings can be found in the article "Amplifiers—A Look at Requirements and Specifications," AUDIO, April, 1971.)

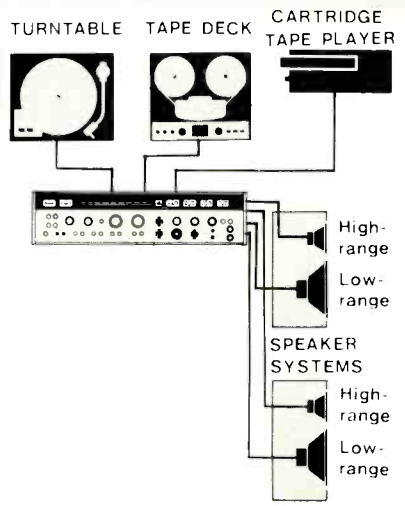


Fig. 11—Additional components can be connected to the receiver, or to the pre-amp power-amp.

Universal Decoder/Rear Channel Amplifier
Model SD4A-Q wired only, $149.95

4 channel sound.

Metrotec makes it easy! Just add 2 speakers.

Universal matrix system decodes all the new SQ and EV 4 channel records and FM broadcasts plus synthesizes quad sound from any 2 channel source.

Metrotec engineers have designed matrix/phase shift decoding circuits which will decode all types of the new 4 channel records and FM broadcasts. Just a flick of a switch gives the exact phase shifts and coefficients to match the program material. Featured are . . . a front to back balance control which eliminates the need to adjust the volume controls on separate amplifiers . . . a master volume control which adjusts the volume on all 4 channels simultaneously . . . tape monitor switch . . . and a source selector switch. In addition to precisely reproducing the 4 channels as they appear on the new 4 channel records, synthesized quad sound can be generated from any 2 channel source. This unique circuit separates the ambiance information that would otherwise be lost and mixes it into the rear channels.

The Model SD4A-Q includes a powerful 30 watt rear channel amplifier with all controls on a single panel. All you add are the two rear speakers.

Most major record companies are producing 4 channel records. Columbia, Project 3, and Ovation to mention a few already have over 50 selections with many more on their way. 4 channel is here to stay. Look into it.

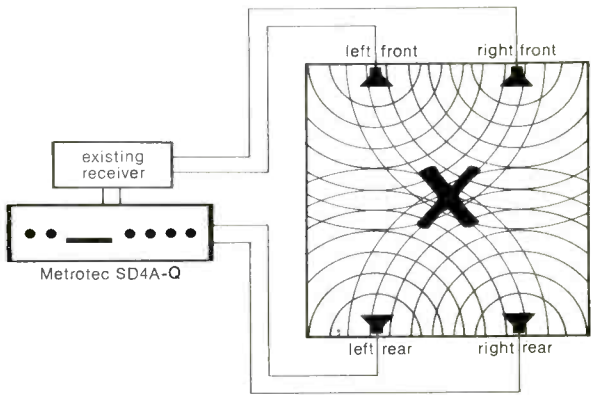
Model SDW-Q wired $69.95
Model SDK-Q kit $54.95

If your equipment consists of separate preamp/basic combination, all you need is another basic amplifier and a Metrotec SDW-Q.

The heart of the Metrotec 4 channel system is a new universal 4 channel matrix/phase shift decoder. This amazing break thru in electronics and recording allows 4 channels of information to be put on records, tapes and FM broadcasting. No special turntables, cartridges or FM tuners are required. The matrix decoder analyzes the information and separates it into 4 separate channels. Recordings are made using as many as 16 microphones. This allows for reproduction of all separate, direct, indirect, complex phase and reflected acoustic signals. The startling 4 channel sound is far more dramatic than anything you have ever heard. The sense of special distribution adds a new and important dimension to realism.

A great deal of this complex information already exists on many stereo records. It goes undetected because the standard 2 speaker stereo system cannot reproduce multi-dimensional signals. Your entire 2 channel collection has sound that you have never heard before. Try it.

The matrix coefficients have been designed and constructed in such a way that they can be modified should changes be required at a future date. This special care in engineering will make these products valuable for many years.



Frequency Equalizer

Be sure to look into the Metrotec Stereo Frequency Equalizer. Match the speakers to your room. Guaranteed to improve any stereo system. You've got to hear it to believe it.

Model FEW-1 wired $99.95
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Metrotec Electronics, Inc.

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AM Reception

So far the emphasis has been on FM or frequency modulation reception. The choice between AM (amplitude modulation) and FM is made by the tuner or receiver. Switching to AM from FM means switching in a whole new set of parts in the front-end, a different i.f., and a new detector. However, the pre-amp and the power-amp can be utilized for both AM and FM. In effect, going from FM to AM, or switching back to FM, means switching in a different tuner. Some sets make radio parts do double duty; others have completely separate parts to be used when the switch is made.

Growth of The Hi-Fi System

The most elementary, the most basic hi-fi system consists of a receiver, usually stereo, and a pair of speakers. That is all it takes. A more elaborate system would be one using separate components, a tuner, followed by a pre-amp and then a power amp. These two systems are identical. What is different is the approach.

In the case of the component system, additional units are easily included (Fig. 11). These could comprise a record player, or automatic record changer, a reel-to-reel tape deck, a cassette tape deck, and one or more microphones. For quadraphonic sound (Fig. 12) a decoder-amplifier could be put in as an "add-on" unit, or the decoder could be an integral part of the receiver or tuner. For quad sound, the total speaker requirement now becomes four. No one, though, except the highly affluent, start with a system *in toto*. Each extra component can be bought separately, when finances permit, but allowing enjoyment of a hi-fi system without all the extras.

To Be Continued

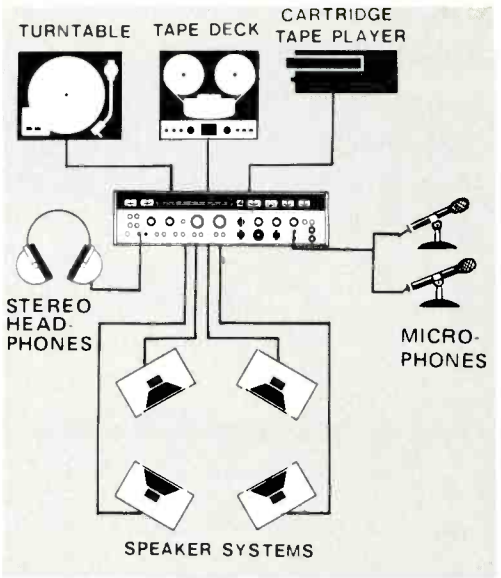
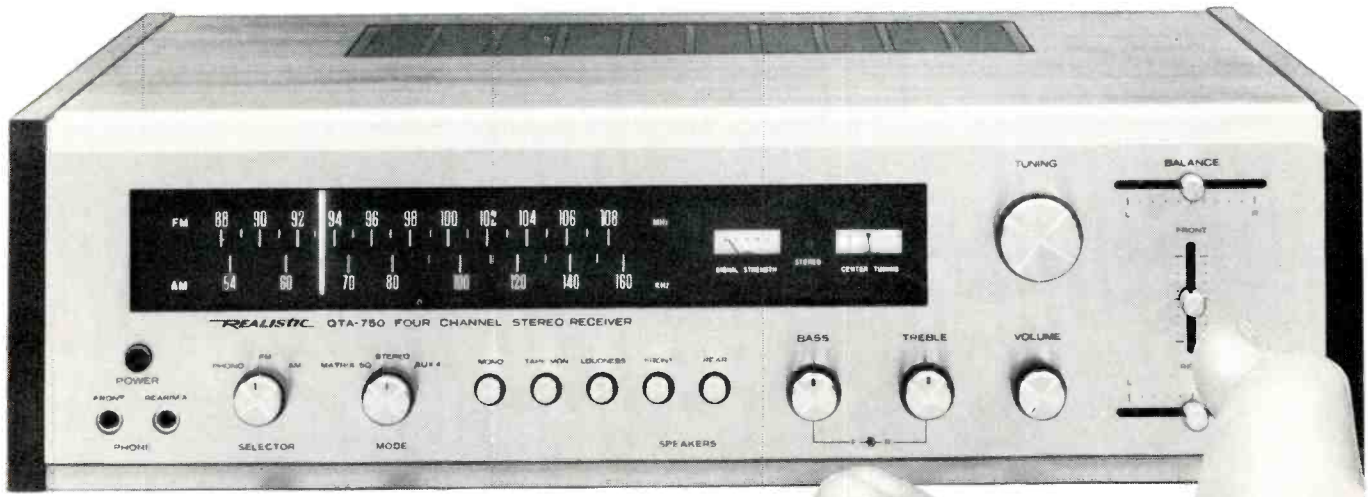


Fig. 12—For quad sound, an existing stereo receiver can be used by adding a decoder-amplifier, or you can use a receiver with a built-in decoder.

PROOF THAT 4-CHANNEL HAS REALLY ARRIVED. AT LEAST AT 1600 RADIO SHACK STORES IN 50 STATES!

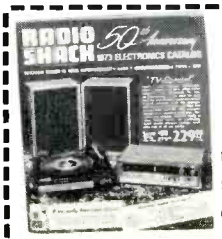


SAVE $96.73 ON ALL-REALISTIC® QTA-750 "EVERYTHING" SYSTEM

The QTA-750 receiver; four Optimus-1 speakers; 40A turntable with elliptical magnetic cartridge, base; 494 reel-to-reel 4-channel deck; 4-channel headphones; four MC-1000 mikes; 1800' reel of Supertape; indoor FM antenna. Regular separate items price $1075.73.

COMPLETE $979.00

We call our new Realistic QTA-750 our "Today and Tomorrow" receiver because it's ready for anything. Its built-in SQ-matrix decoder gives you ultimate enjoyment from true four-channel SQ records and broadcasts. Or use it to convert regular stereo records, tape and FM to startling four channel sound. Ample 100-watt output (±1 dB) assures effortless "cruising power" with four channel speaker system. Provisions for recorder use include inputs and outputs for professional taping with three-head decks. Separate auxiliary inputs are provided for discrete four-channel Q-8 cartridges and reel-to-reel tapes. Its "Accu-Balance" control is a joy to use in adjusting for maximum separation from left to right and front to rear. There's a long list of other great features, too: Center-of-channel FM meter; AM "S" meter; four-channel loudness control; master volume control; FET front end; "even power" OTL audio system; stereo light; four-channel headphone output; ceramic filters for pin-point station selection. Handsome gold-finish panel is complemented by a $30-value walnut-wood cabinet. Treat yourself to a close-up of the QTA-750 at your Radio Shack Store! **259.95**



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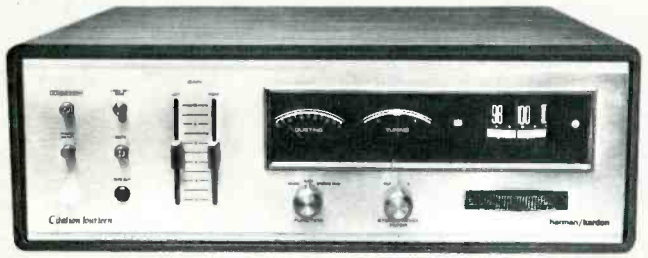

Harman-Kardon Citation Fourteen Stereo FM Tuner

MANUFACTURER'S SPECIFICATIONS (All stated by manufacturer as minimums) **Usable (IHF) Sensitivity**: 2.0 μV at any frequency. **Selectivity**: 60 dB. **THD**: Mono, 0.25%; stereo, 0.35% (both at 1 kHz). **S/N**: 70 dB. **Image Rejection**: Greater than 100 dB. **I.F. Rejection**: Greater than 100 dB. **AM Rejection**: 60 dB. **Capture Ratio**: Less than 2.0 dB. **SCA Rejection**: Inaudible. **Pilot and Sub-carrier Rejection**: Greater than 50 dB. **Stereo Separation (1 kHz)**: 45 dB. **Dimensions**: 16 in. W, 4¾ in. H, 15 in. D. **Price**: $525.00.

Now Harman-Kardon's new Citation line is complete! The introduction of the Citation Fourteen tuner will enable Citation fans to put together a complete system, consisting of a Citation Twelve stereo power amplifier, a Citation Eleven control preamplifier, a Citation Thirteen speaker system, and this new Citation Fourteen tuner for a total of $1760.00! While the product numbering system eludes us, the product performance leaves little to be desired. The new Citation Fourteen, pictured above, includes circuit and styling innovations worthy of the Citation reputation. Just below the blacked-out dial area (which is illuminated in a soft green glow when power is applied) is a massive, horizontally mounted thumb-wheel tuning knob, knurled for easy finger-spinning. The knob is vernier-coupled to a flywheel and a cylindrical dial scale which turns as the knob is turned, disclosing only a few MHz of dial spread at a time. We could swear we saw similar arrangements way back in the 1930's, but somehow, as executed by Harman-Kardon, this tuning approach is fresh, clean, and practical. The blacked-out area also contains the familiar stereo indicator light, a light which becomes illuminated when the Dolby circuit is actuated, a center-of-channel tuning meter and, best of all, a quieting meter which is quite unique and differs from the usual signal-strength meter commonly found on two-meter tuners and receivers. We'll have more to say about this innovation later.

Below the dial area are two rotary switch knobs: one a three-position stereo noise-filter selector, the other a function switch with positions for mono, automatic mono-stereo switching and stereo-only reception. The left-hand portion of the panel (which, by the way, is machined from a chunk of ¼ inch, solid, gold-anodized aluminum) includes linear slide controls for left and right output level, four push-push buttons for power on/off, Dolby circuit on/off, muting circuit on/off and, finally, a push button with which a built in 400 Hz tone, corresponding to 50% FM modulation, can be applied to the outputs for pre-setting tape recorder levels. A tape-out jack (in parallel with the fixed output jacks on the rear panel) completes the front panel layout.

The rear panel, shown in Fig. 1, includes a pair of variable outputs (level is controlled by the front panel slide controls),

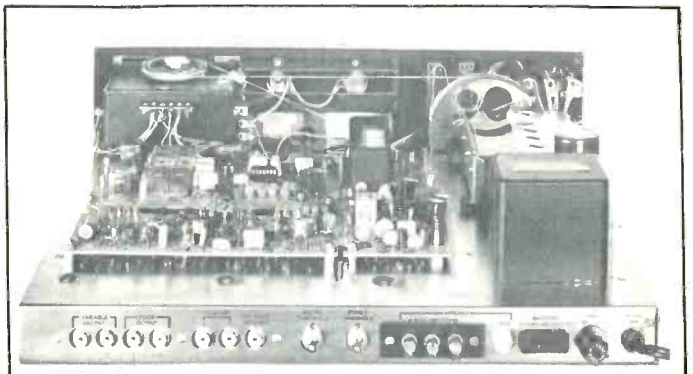

Fig. 1—View of the back panel and interior from the rear.

the fixed output jacks, horizontal and vertical 'scope connection jacks (for output signal observations if you own an oscilloscope), a quad-decoder jack (for the four-channel broadcast system of the future), a muting threshold adjustment, antenna screw terminals for 300 or 75 ohms trans-

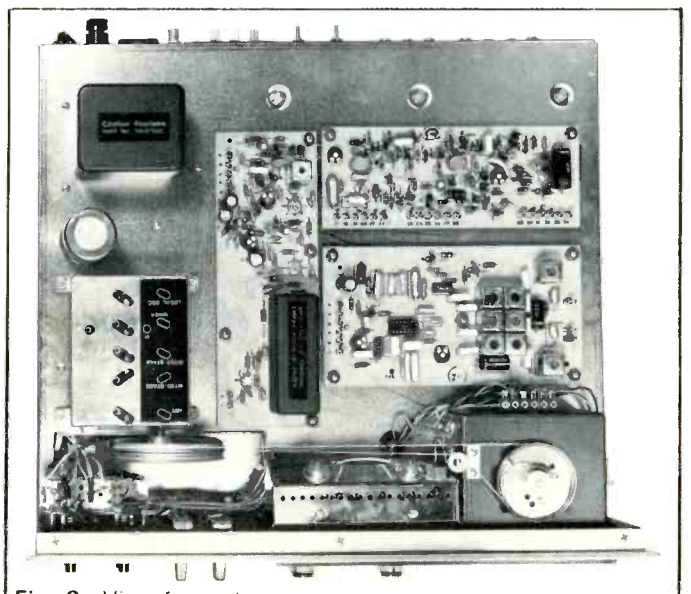

Fig. 2—View from above.

The ESS Mk VII speaker system was promised for this issue, but unfortunately had to be put off until next month because of a lack of space.—Ed.

mission lines plus a 75 ohm coaxial connector, a switched convenience a.c. receptacle, and a line fuse.

Top view of the inside of the chassis is shown in Fig. 2. In addition to the sealed front end there are six other printed circuit board modules. The front end features a five-gang tuning capacitor, three FET's and a bi-polar local oscillator. The i.f. module includes 2 high gain IC's and a sealed 9-pole phase-linear LC network plus a highly linear ratio detector circuit which is the only tunable element in this section. The quieting meter and muting circuit board contains no less than 22 NPN transistors. Rear panel muting and stereo threshold controls are associated with this PC board, as is the new type of meter mentioned earlier. This meter works just opposite to the usual signal strength meter. Its "zero" is at the extreme right and the numbers progress to the left, from 0 to 10. Were it simply a "backwards wired" meter, however, there'd be nothing much to discuss. As it is, this meter gives a direct indication of quieting, or signal-to-noise ratio. In tuning to a station, you are instructed to tune for the highest number attainable (lowest reading, if you can't help thinking from left to right). To verify this new concept, we plotted meter readings against actual measured S/N and

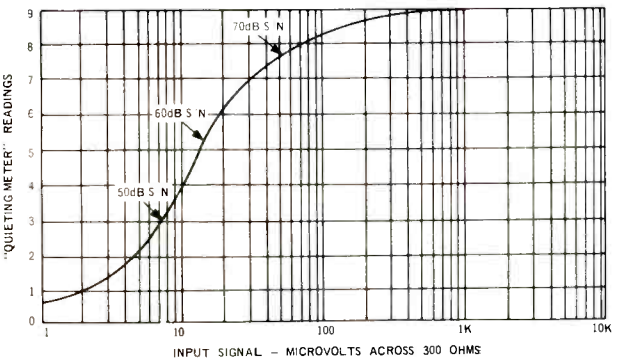

Fig. 3—Special meter reads quieting (S/N), rather than signal strength.

the results are shown in Fig. 3. As you can see, the action is almost the exact inverse of the "noise" curve shown in Fig. 4, unlike most so-called signal-strength meters which generally "do their thing" almost linearly from 0 to 40 to 50 microvolts and then "hover" at maximum from that point upward in signal strength. We found, in using this tuner, that the "maximum" S/N indication is an even finer indication of correct tuning than the center-of-channel meter which is also included.

The heart of the multiplex PC module is a new integrated circuit which employs phase-lock-loop circuitry for "locking on" to the incoming 19 kHz pilot signal. There are no coils to adjust for best separation, just a couple of factory pre-set resistive potentiometers. An elaborate system of pi section

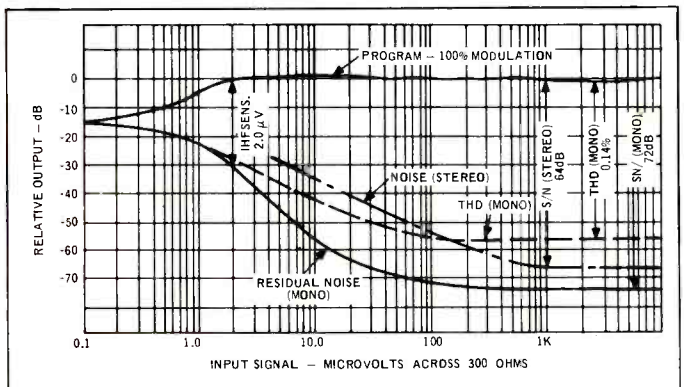

Fig. 4—FM performance characteristics.

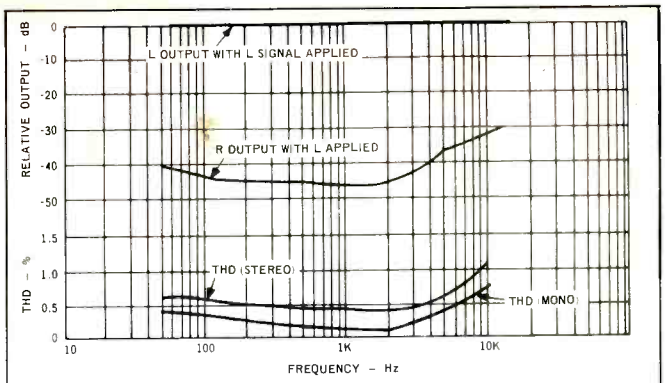

Fig. 5—Multiplex decoder section.

filters accounts for the very excellent pilot, subcarrier, and SCA rejection characteristics of the Citation Fourteen. A partial schematic of this section of the tuner is shown in Fig. 5, to give you an idea of just how many parts can be eliminated when a well-designed IC is used in a circuit of this kind.

Other PC boards include the power supply module which contains two zener diodes and five transistors in a regulating circuit which supplies stable +15 and –15 voltages to the other modules. The output module contains a pair of transistors in a direct coupled configuration for each channel output. Supply voltage is a high 50 volts to insure extremely linear characteristics with wide signal swings.

Finally, the Dolby module contains six transistors plus an FET per channel. Its action will be described shortly.

Electrical Measurements

Because of the quality inherent in this Citation Fourteen, we took more than the usual number of measurements to give as complete a picture of performance as possible. In Fig. 4 you can see that ultimate quieting is 72 dB, a bit better than the 70 dB claimed. Mono THD (at 1 kHz) goes below 1% for an input signal strength of 8 microvolts, reaching an incredibly low figure of 0.14% at all signal levels above about 100 microvolts. It should be noted that our new Sound Technology FM Generator only guarantees internal THD of 0.1% (lower than any other FM generator available) and, as you can see, the Citation Fourteen *almost* calls for another advance in measuring instrumentation! (We just finished paying off the $1800.00 for the new generator at that!) An additional curve presented is that of residual noise in the *stereo* mode. This figure reaches an amazing 64 dB—amazing when you take into account the fact that included in the reading are any residual 19 kHz and 38 kHz components which, though extraneous, are not normally perceived as audible "noise." This additional curve is usually meaningless if taken on most tuners because of the presence of these components at the output at a level of –40 to –50 dB or so. IHF sensitivity proved to be 2.0, as claimed but, more important, full (–1 dB) limiting was reached at 1.5 μV input and 50 dB of S/N was attained with 7 microvolts of input signal.

Figure 6 depicts stereo FM separation at all significant frequencies as well as mono and stereo THD from 50 Hz to 10 kHz. It is in the area of separation, particularly, that the new phase-lock-loop circuit pays off. Separation of better than 40 dB from 50 Hz to just over 4 kHz is something you just don't run into with more conventional multiplex decoding circuits. Of course, the phase linear i.f. system helps a great deal too. Again, with a test instrument capability of 50 dB separation, this tuner is "pushing it." Even at 15 kHz, separation still measured 30 dB.

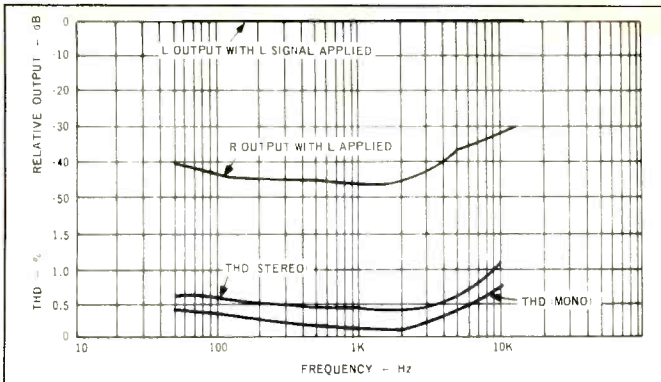

Fig. 6—Stereo separation and mono and stereo THD versus frequency.

The THD characteristics for mono and stereo, also shown in Fig. 6, are outstanding. If you've been following our last few reviews, you'll recall that stereo THD at the high end is usually quite severe (and usually not quoted by manufacturers). In the case of the H-K Citation Fourteen, stereo THD at 10 kHz is only 1.1%, with values hovering just below 0.5% over most of the useful audio range. In the case of mono, too, the 0.14% figure quoted for 1 kHz THD is not just a "best frequency" reading. Even at 50 Hz, THD was still well under 0.5% while at 10 kHz, it measured about 0.7%. All of these readings are referred to 100% modulation.

For those not familiar with Dolby noise reduction, a brief explanation is in order. The Dolby system is based upon the principle that loud music masks background noise. In other words, when the program is instantaneously loud in volume, any background hiss or noise will be "hidden" psychoacoustically. On the other hand, during quiet passages of music, our ears "home in" on the noise and it becomes annoyingly apparent. A further correct premise of Dolby is that we are most sensitive to high frequency noise. Based upon these premises, Dolby suggests that FM broadcasters employ his equipment to boost the level of high frequency programming when that level is low, but to leave it unaltered when loud passages are broadcast. To re-establish correct relative amplitudes in the tuner, it should have circuitry which plays back all frequencies uniformly when levels are loud, but progressively attenuates high frequency levels when instantaneous program levels are lowered. In the course of this attenuation, residual high frequency noise will, of course, be lowered as well, but the overall frequency response of the desired program material will be restored to "flat" if both ends of the system are reciprocals of each other.

The Dolby circuit in the Citation Fourteen, when introduced into the circuit by means of the front panel switch, provides this dynamic attenuation in accordance with the curves shown in Fig. 7. Notice that when program material is at full modulation, no such attenuation takes place. With decreasing modulation (corresponding to soft passages), attenuation becomes greater and greater, so that with only 10% modulation, attenuation at 10 kHz is of the order of 8 dB. In effect, signal-to-noise ratio has been improved by several dB at that instant of low program level. The switch on the front panel is provided, of course, since only a few stations now employ Dolby processors, and in the absence of such pre-processing, the Dolby circuit should not be used or treble will sound deficient at low program levels. (In this area, Philadelphia, I could receive several New York stations free of noise by using the Dolby mode and compensating with the amplifier treble control—or more elegantly with a Soundcraftsmen equalizer.—Ed.)

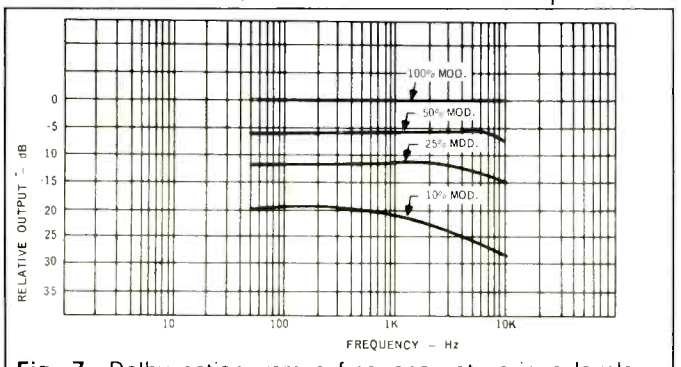

Fig. 7—Dolby action versus frequency at various levels.

We checked range of the rear panel muting control and found it to be adjustable from 30 microvolts threshold down to zero (no muting action). The stereo threshold control is variable from about 30 microvolts down to 10 microvolts. Referring again to Fig. 4, this is just about ideal, for S/N in stereo at 10 microvolts of input signal (always worse than in mono) is about 36 dB. In our opinion, you're better off listening in mono if S/N is any poorer than that, and evidently Harman-Kardon feels the same way about it.

Listening Tests

We were delighted to see that the extra pains taken in the design of the stereo circuitry are audibly apparent. The stereo reception we were able to obtain was flawless (at least when tuned to those few stations in our area which put out a good stereo signal). We are convinced that it's not so much the great separation that accounted for this audible difference as it was the low, low distortion figures for that portion of the circuitry. Equipped with a rotator on our outdoor Yagi antenna, we found that the quieting meter actually helped orient the antenna for best reception *and* least multipath. This should not come as a great surprise, since one of the effects of severe multipath is reduced S/N ratio, which is readily seen on the meter. The vernier tuning method is elegant and precise—calibration was just about perfect—as it would have to be with such an expanded scale arrangement. Maximum audio output on our unit was about 3.0 volts rms for 100% modulation and we did have to lower the two slide level controls quite a bit to match the rest of our system. Some tape recorders not equipped with input level controls might have their first stages overloaded by such a large signal.

Rather than "count stations" on this tuner, we listened at greater length to only those stations which had adequate signal strength to allow the Citation Fourteen to perform optimally by setting the mute threshold control to 10 microvolts. At that setting, 40 first-rate signals were heard and 22 of those were stereo. All were amazingly quiet (except for some "studio hum" on some) and, except for those which were loaded with—shall we politely say—poor station practice, distortion was much lower than we're used to hearing. There is one station in our area (WQXR-FM) which has Dolby equipment and so we had a chance to check that circuit in our listening tests as well. It works! We purposely lowered signal strength (by hanging on a "no-no" short piece of wire instead of an antenna) to the point where noise was just audible and threw the Dolby switch—Presto, the noise disappeared!

We understand that there is a less expensive Citation tuner available (Citation Fifteen) which omits the Dolby circuit (plus some other refinements—such as the five-gang tuning in the front end), but it seems to us that if you really want perfection in a tuner (or as near to it as the state-of-the art has come), you'd want to go "all the way" to the Citation Fourteen.

Leonard Feldman

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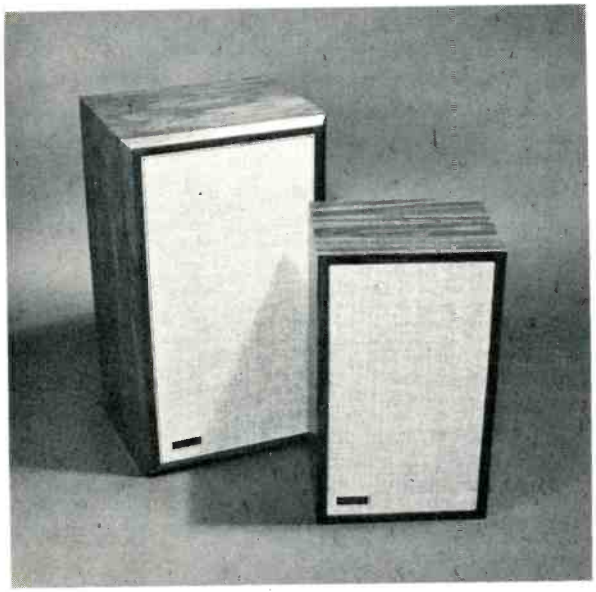
If You Would Like Nothing Less Than the Best in Loudspeakers, But Doubt That You Can Afford Them, Please Read This Ad.

Both the loudspeakers shown—the original Advent Loudspeaker and The Smaller Advent Loudspeaker—are intended to be compared in audible performance, including frequency bandwidth, with the most elaborate and expensive speakers available. That may be difficult to



accept, we realize, but it is true and verifiable in the listening.

Both Advent speakers were designed after more than fifteen years of experience in designing and manufacturing high-performance speaker systems, including some of those of other brands still held in highest regard by critical listeners. They were designed simply, out of knowledge that most complex, multi-speaker systems are the result of long-outdated notions that got their start when the first high-fidelity speakers for the home were adapted from the theater speakers of the 1940's. And they were designed to take advantage of new manufacturing techniques that had been developed over many years of experimentation.

Over-engineering—needless elaboration of design in imitation of what has existed so far—is a common problem in audio equipment, and one for which the customer often pays heavily in many ways. Good design to us is represented by the simplest approach that permits reaching a design objective without compromise.

Both Advent speakers are two-way systems. A single speaker would be a more "ideal" device, but in practice has to give up either the frequency range or the power-handling needed for a no-compromise speaker. The use of several "full-range" speakers of any size doesn't preserve the theoretical advantage of a single speaker. And three-way and four-way systems are not only unnecessarily expensive and elaborate, but often inferior-sounding because of interference effects and abrupt electrical cut-off of drivers in different operating ranges. The two-way design is simple and effective, and both Advent systems exploit it more thoroughly than any previous speakers. No more elaborate design is capable of wider range or subtler characteristics.

Both Advent systems were also designed to waste nothing in imitation of theater speakers. They are intended for use—heavy and hard use—in a home, not an auditorium or laboratory, and they include nothing but what is needed for the best possible performance in a home.

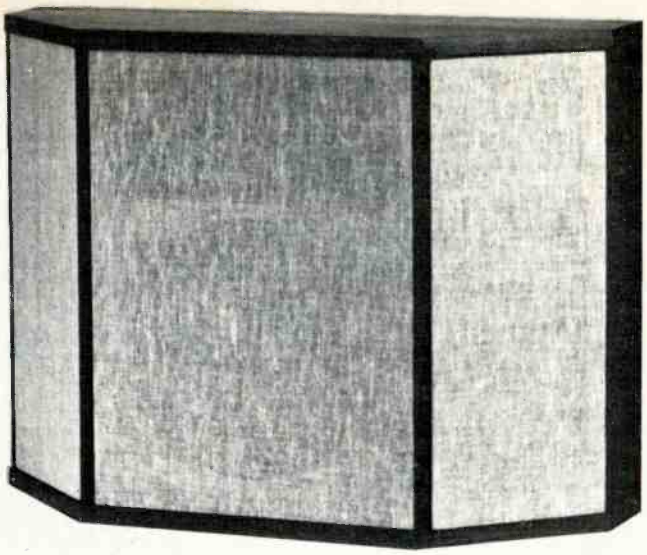
The original Advent Loudspeaker, which costs between $105 and $125 depending on its cabinet finish and the part of the country we have to ship it to, can withstand absolute, no-holds-barred comparison with any speaker of any price, and sounds obviously and dramatically better than many far more expensive speakers. The Smaller Advent Loudspeaker ($70-$75) sounds the same as the original, but will not play quite as loud as the original in as big a living room.

We will be happy to send you a full explanation of the design of both Advent speakers. Please write us at the address below and ask for our Speaker Packet, which includes reprints of reviews.

Thank you.

Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

Acoustic Research LST Speaker System



MANUFACTURER'S SPECIFICATIONS

System Type: Three way, acoustic suspension. **Components**: One 12 in. woofer; four 1½ in. hemispherical dome mid-range units, and four ¾ in. hemispherical dome tweeters. **Power Handling Capacity**: 1,000 watts for 2 seconds; 23 watts long terms average. **Nominal Impedance**: 4 ohms. **Dimensions**: 27⅛ in. W, 20 in. H, 9⅞ in. D. **Weight**: 90 lbs. **Price**: $600.00.

The Acoustic Research LST was primarily designed for use as a studio monitor—hence the name "Laboratory Standard Transducer" or LST. Nonetheless, because of its wide dispersion, low distortion, and high power handling capabilities, it should be seriously considered by those enthusiasts who are fortunate enough to have fairly large listening rooms. Sensitivity is on the low side, so the LST is ideally suited for the new breed of high power amplifiers like the Marantz 500, Crown 300, and the Phase Linear 700 and 400.

Fig. 1—Showing what is behind the grille cloth.

Nine speaker units are used, a 12 in. heavy-duty bass unit, four 1½ in. mid-range plus four HF domes. Figure 1 shows how these units are placed. Crossover frequencies are 575 Hz and 5 kHz, as in the AR-3a. A six-position switch adjusts the levels of the mid and high frequencies using taps on an auto-transformer (see Fig. 2). Response changes between each step are only in the order of 1 dB, so the effect is quite stable, although the overall difference of 6 dB or so is more than adequate for most requirements. Position 1 gives a

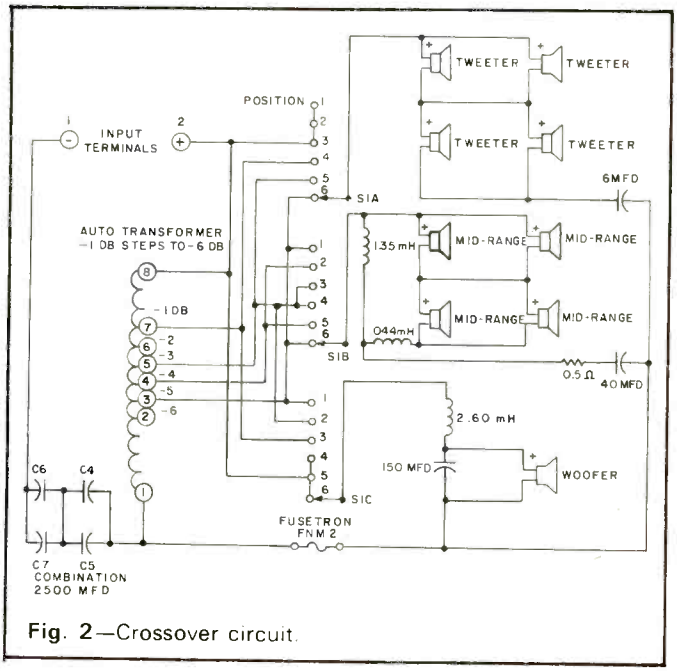


Fig. 2—Crossover circuit.

rising frequency response above about 500 Hz, position 2 is the normal flat position, and the other four increase the output below 500 Hz. Position 6 gives a slight attenuation above 5 kHz.

The cabinet is solidly constructed and turns the scale at 90 lbs., so it is no lightweight. Our review models were finished in walnut but an alternative black finish is available. Like all AR models, the system is totally enclosed, using the air suspension arrangement pioneered by Ed Villchur. System resonance was just below 40 Hz.

Figure 3 shows the frequency response measured with one-third octave pink noise. The top curve is the response measured on-axis, and B was taken at 60 degrees off-axis. The difference between these curves is so small that we did not bother to take our usual five intermediate measurements. Distortion at 10 and 20 watts input is shown in Fig. 4. At 10 watts input, an SPL of 92 dB was measured at a distance of 1 meter for 400 Hz. At a continuous power of 100 watts, an

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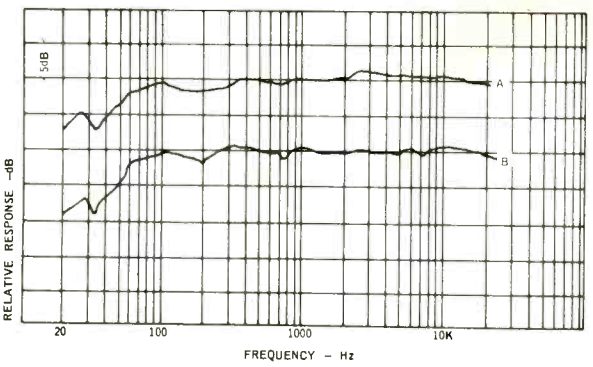

Fig. 3—Frequency response measured with one-third octave pink noise. **A** is taken on-axis and **B** at 60 degrees.

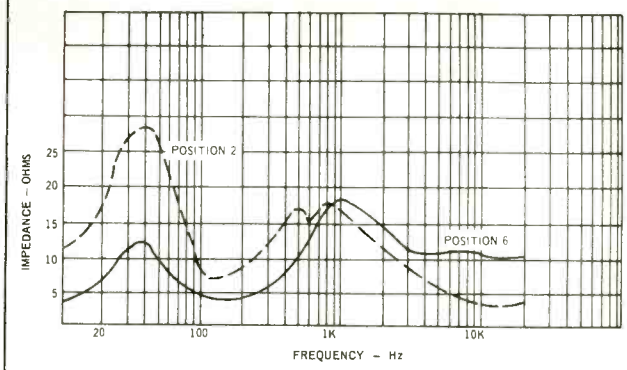

Fig. 6—Impedance curves at positions 2 and 6.

SPL of 102 dB was produced under the same conditions. Distortion came out at 4.3%, which is remarkably low. Power handling capacity is given as 180 watts for 10 seconds, 64 watts for 30 seconds, and 23 watts long-term average which we found a little conservative. A peak power of over 500 watts could be handled without distress, and at 45 Hz just over 100 watts input was required before frequency doubling or other distortion made themselves heard.

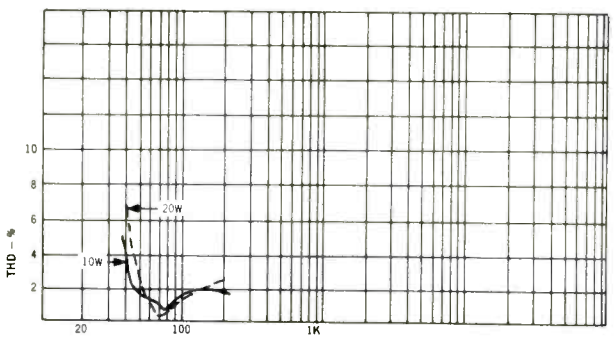

Fig. 4—Distortion at 10 and 20 watts input.

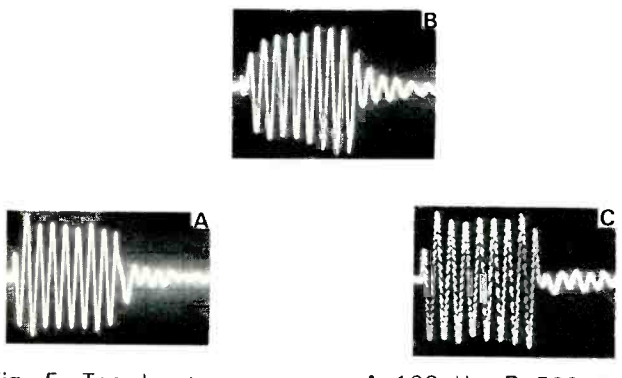

Fig. 5—Tone-burst responses at **A**, 100 Hz, **B**, 500 Hz, and **C**, 5,000 Hz.

Tone-burst response was good (see Fig. 5), but the high frequency traces show the usual interference effects given by multiple speakers at short distances from the microphone. White noise tests showed a commendable lack of coloration and again confirmed the wide dispersion. Figure 6 shows the impedance characteristics taken with the level control at position 2 and position 6, and it will be seen that the lowest point is over four ohms.

Listening Tests

The amplifier used for most of the listening tests was a Phase Linear 400 (which gives forth more than 250 watts of power per channel), and the preamp was a Sony 2000F—a nice combination. Tuner was a Sherwood SEL-200 and the phono pickup a Decca Mk V or an ADC 25. The first chore was to find the best positions for the speakers, and we finally placed them near the corners, about two feet out into the room and on a stand some 16 in. high. Bass was rather too heavy if the units were stood on the floor, although high frequency dispersion was still good. It has often been said that lab measurements tell only part of the story—so they do but a lot can be learned from them, and so we expected a high standard of performance from the LST's just on the basis of the tests. And we were not disappointed. Sound was clean with an effortless quality, not unlike the best electrostatics. Bass was full but well-defined with none of the spurious resonances that spoil some otherwise excellent systems. Transient response was excellent and the wide dispersion gave a good stereo image without that vagueness inherent in many so-called omni-directional systems. Some quadraphonic discs were played using a Sony 2000F decoder, a Sony 1130 amplifier, and two AR-3a's for the rear channels. Because the 3a's use the same basic units as the LST, the image was stable and results were very satisfactory indeed. One of the records used was the new E. Power Biggs' "Music for Organ, Brass, and Percussion," recorded in St. George's Church, New York. The organ is a five-part Möller with a gallery section at the rear, and so there are contrapuntal effects that are very effective in this medium. You can really feel those low notes too. Incidentally, the best position for that level switch was the "flat" position, No. 2, but in another more heavily damped room, No. 1 was considered best.

Summing up, the AR LST must be considered one of the best speaker systems now available. If only some of our recording studios can be persuaded to use them in preference to the "presence-peaked" monitors, maybe record quality would improve. *T.A. & G.W.T.*

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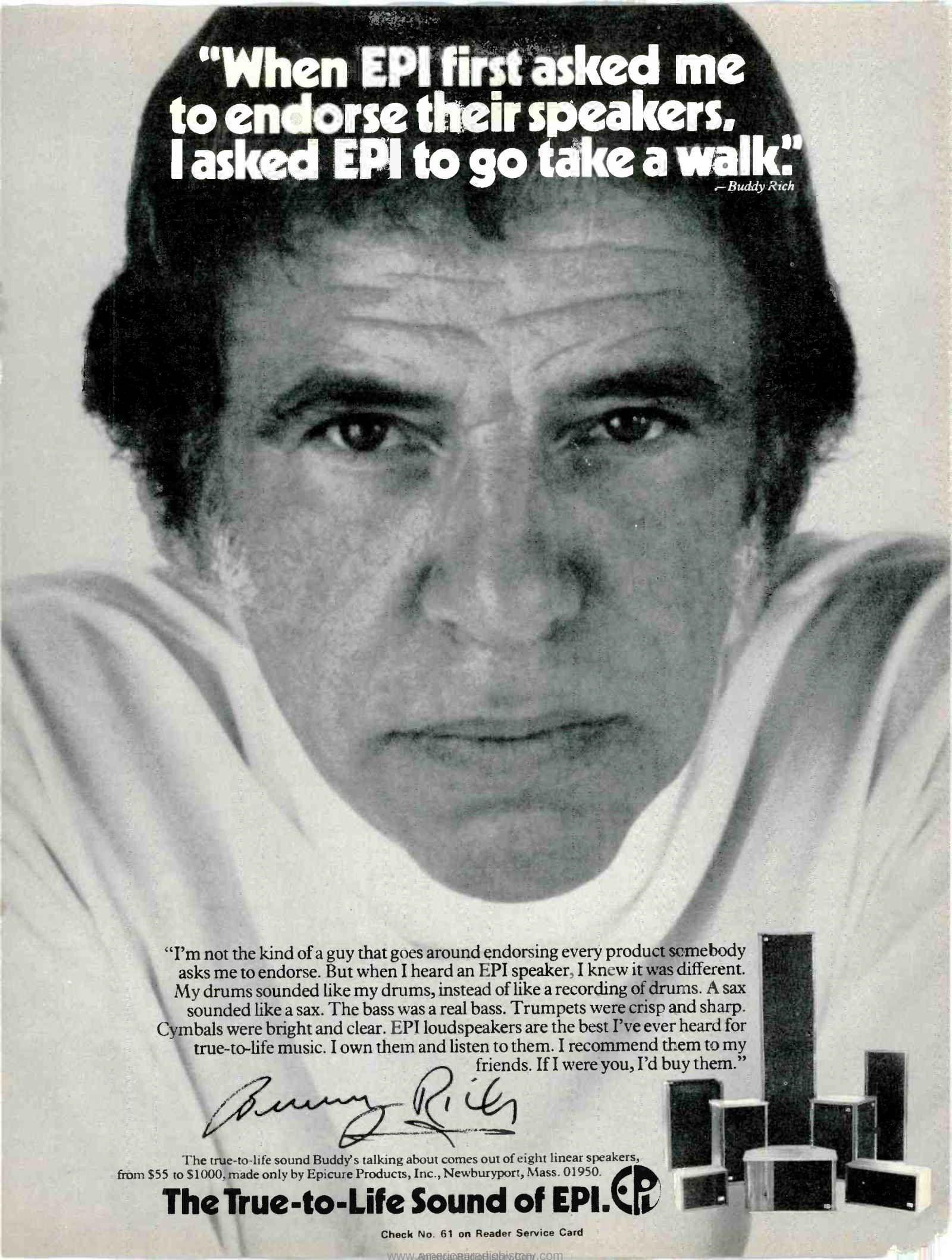

"I'm not the kind of a guy that goes around endorsing every product somebody asks me to endorse. But when I heard an EPI speaker, I knew it was different. My drums sounded like my drums, instead of like a recording of drums. A sax sounded like a sax. The bass was a real bass. Trumpets were crisp and sharp. Cymbals were bright and clear. EPI loudspeakers are the best I've ever heard for true-to-life music. I own them and listen to them. I recommend them to my friends. If I were you, I'd buy them."

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The True-to-Life Sound of EPI.

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Realistic (Radio Shack) STA-120B
AM/Stereo FM Receiver

MANUFACTURER'S SPECIFICATIONS

FM SECTION.
IHF Sensitivity: 2 μV. **S/N**: 65 dB. **Image Rejection**: 75 dB. **Stereo FM Separation**: 35 dB @ 1 kHz.
AM SECTION.
Sensitivity: 40 μV. **S/N**: 50 dB. **Image Rejection**: 80 dB.
AMPLIFIER SECTION.
Power Output: 40 Watts rms per channel, 8 ohm loads. **THD**: Under 1.0% at rated output. **Frequency Response**: 20 to 25,000 Hz ±1 dB. **Phono Sensitivity**: 2 mV (low setting); 5 mV (high setting). **Hum**: Phono, –65 dB **Tone Control Range**: Bass, ±12 dB @ 100 Hz; mid range, ±6 dB @ 1500 Hz; treble, ±12 dB @ 10 kHz.
GENERAL.
Dimensions: 19⅜ in. W, 5⅜ in. H, 15⅜ in. D. **Shipping Weight**: 36 lbs. **Price**: $299.95.

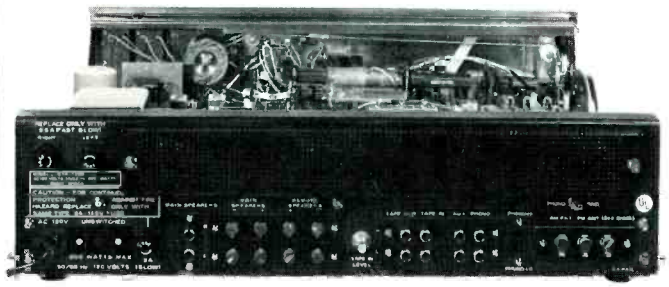

Fig. 1—View of back panel.

The front panel of this receiver is an aluminum extrusion with an anodized black center and brushed top and bottom strips. Controls, which can be seen in the photo, include a selector switch, bass, treble *and* mid-range tone controls (each operating for both channels simultaneously), a good sized tuning knob (with effective flywheel action) and two slide controls for left- and right-channel volume adjustment. By gripping the two slide controls simultaneously with thumb and forefinger we found that we could maintain good channel balance at all level settings even in the absence of a conventional balance control. A separate push-push power on/off switch can be seen adjacent to the volume controls. In addition there are eight "piano key" switches for such functions as speaker selection, stereo/mono mode, tape monitoring, AFC on/off, loudness on/off and low and high frequency filters on/off. The dial scale area includes two meters (center of channel and signal strength) as well as the usual stereo indicator light which lights up when you are tuned to a stereo station. One of the positions of the selector switch is for stereo FM only—allowing reception of stereo stations and acting as a form of muting circuit between stations. If you are seeking mono stations, however, there is no provision for interstation muting in the regular FM setting of the selector switch. At the extreme left of the panel is a stereo phone jack.

The rear panel of the STA-120B is shown in Fig. 1. Speaker terminals are widely spaced and are of the knurled-screw type making speaker connection quite easy. There are the usual input jacks for AUX and PHONO, with a slide switch associated with the PHONO inputs for selecting the 2 mV or 5 mV preamplifier input sensitivity. FM antenna terminals are for 300 ohm connection, and there is a terminal for external AM connection, if required. A tape input level control enables the user to set up tape playback level to match that of FM or AM. A pair of phono-tip jacks wired in parallel with the main speaker terminals enable you to connect speaker systems having their own plugs attached. A pair of speaker fuses, a main line fuse, and a convenience outlet (unswitched) plus a ground terminal for connection to record changer or turntable ground complete the back panel layout.

Circuitry

A view of the top surface of the chassis is shown in Fig. 2. There are nine basic modules used in its construction, including a sealed FM front-end which contains three FET's and a bi-polar transistor. The variable capacitor contains four tuning sections and is completely separate from the three-gang AM variable capacitor seen in the photo. The two are coupled together mechanically. The i.f. section includes three high-gain IC stages, a conventional ratio-detector circuit

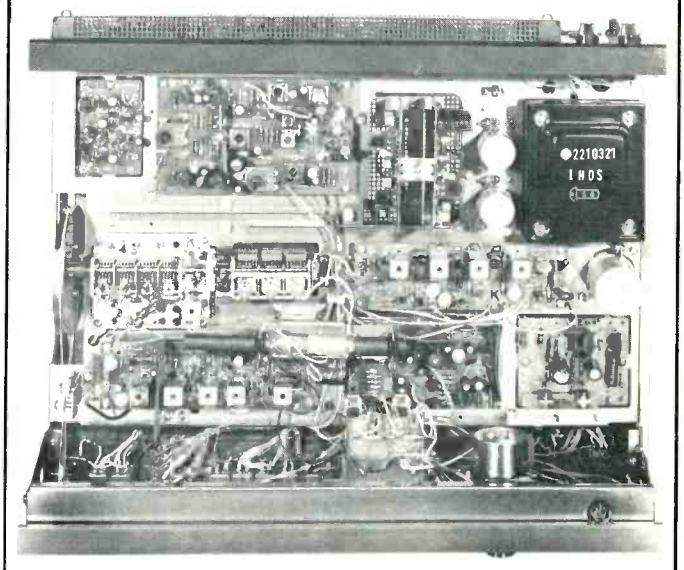

Fig. 2—Internal view.

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The Stak-Pak is the answer to a cassette's prayer. It's a double drawer made of heavy-grade molded plastic, custom-engineered to hold two cassettes. By itself, it's an extremely convenient way to hold two cassettes.

But the ingenious part of the Stak-Pak is that if you have more than one of them, you can snap or slide them together to form a chest of drawers. If you have fifty of them, you automatically have a file cabinet that holds a hundred cassettes. The more you have, the higher you can Stak them.

When you record a cassette, you put it in a drawer and identify the program with a special drawer label that comes with each Stak-Pak. Presto! Your cassette library is magnificently organized for easy and quick reference.

To find a cassette in a hurry, read the label, and open a drawer. How's that for putting an end to cassette clutter!

THE WORLD'S BEST IRON-OXIDE TAPE ALSO COMES IN REELS.

Capitol 2 Ultra-High Output, Low-Noise tape, with the Cushion-Aire backcoating, is the best-performing tape you can buy on reels. At 15,000Hz (3-3/4 ips) Capitol 2 is, on the average, 4.5 dB more sensitive than the top reel tape made by the best-known brand.

THE WORLD'S MOST ACCLAIMED CARTRIDGE IS ALSO CALLED CAPITOL 2.

Ask anyone, "What's the best cartridge?" and they'll undoubtedly tell you it's the Capitol 2 Audiopak.® It's been a standard of the industry for as long as there's been an industry.

Capitol®

Capitol 2™

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plus four other input and output stages using four additional NPN devices. Two-transistor preamplifier equalizer circuits are used in each channel. The usual treble and bass controls are in a feedback Baxandall arrangement, while the mid-range tone control (similar in action to a "presence" control) utilizes a "losser" circuit. Output stages are "push-pull single ended," requiring output coupling capacitors (1000 μF are used) but since the drivers are arranged in complementary symmetry, no interstage transformers are required. The physical arrangement of the modules is orderly and interconnection wiring was found to be of high quality workmanship, with good access to all sections for servicing.

Electrical Measurements

Monophonic FM performance is depicted in the curves of Fig. 3. IHF sensitivity measured 2.5 μV as opposed to the 2.0 μV claimed. Ultimate signal-to-noise was 62 dB as opposed to the 65 dB claimed. This in itself is not a significant discrepancy but we must point out that this figure was obtained only with the bass control turned fully counterclockwise. In its "flat" setting, the hum content was greater than the residual noise so that a new reading of something under 58 dB was all we could get. Aurally, however, this is not disturbing since the low frequency hum at –58 dB is not as audible as wideband noise would be at the same absolute "dB" readings. Ultimate THD in mono was just under 1%.

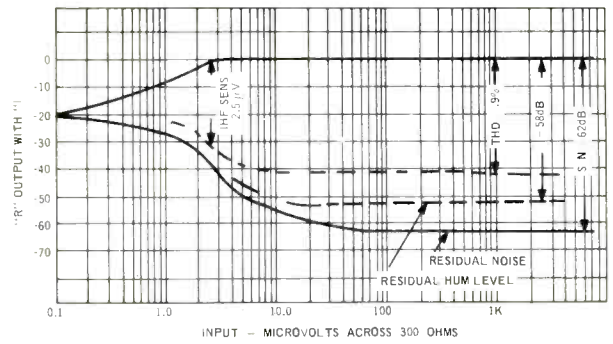

Fig. 3—Mono FM performance.

Stereo FM separation measured just under 30 dB at 1 kHz, tapering off to 15 dB at 10 kHz on the high end and down to about 20 dB at 50 Hz at the low end, as shown in Fig. 4.

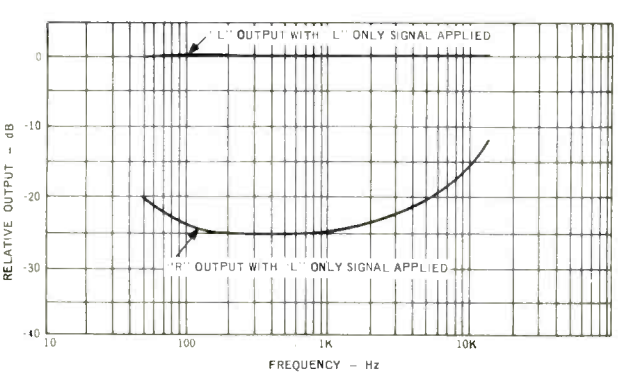

Fig. 4—Stereo FM separation.

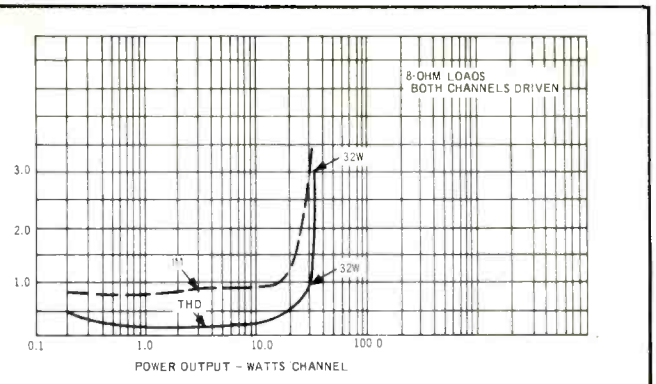

Fig. 5—THD and IM characteristics.

In keeping with our usual practice, we measured power output with both channels driven into 8 ohm loads and came up with a figure of 32 watts per channel at the rated THD of 1%, as can be seen in Fig. 5. At normal listening levels, THD hovered around the 0.2% mark. IM distortion reaches 1% at about 18 watts per channel and at 32 watts, it measured 3.0%. This characteristic is also plotted in Fig. 5. Power bandwidth extends from 18 Hz to 20 kHz, based upon the half-power point referenced from 32 watts. THD at levels of 1 watt, 16 watts, and full power output for all audible frequencies is plotted in Fig. 6. Square wave response, measured at nominal 1 watt level for 40 Hz and 10 kHz square waves, is shown in the photos of Fig. 7.

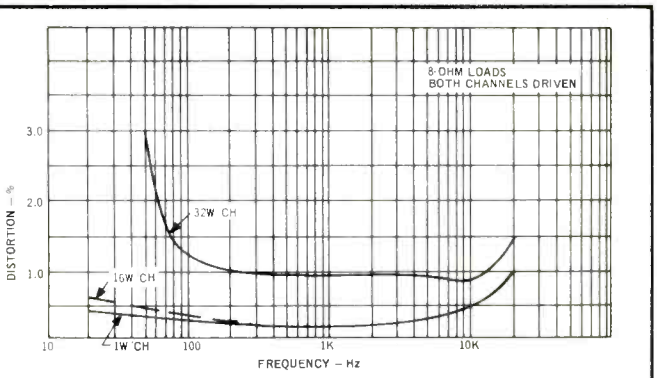

Fig. 6—Distortion versus frequency at various power levels.

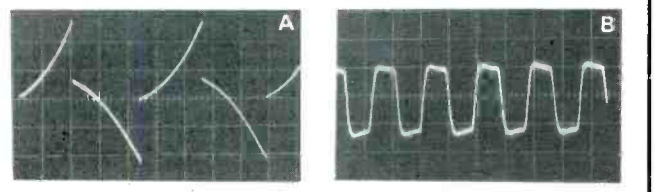

Fig. 7—Square wave response at **A**, 40 Hz, and **B**, 10,000 Hz.

The action of the tone controls, loudness control, and filters is plotted in Fig. 8. We have always felt that a mid-range control (or presence control, if you will) is a nice addition to any amplifier or receiver product if it is executed correctly—and the mid-range control in the STA-120B is perfectly positioned in the frequency spectrum and moderate enough in its effect to be useful rather than overpowering. There is little or no interaction between it and the more conventional bass and treble controls, all three of which

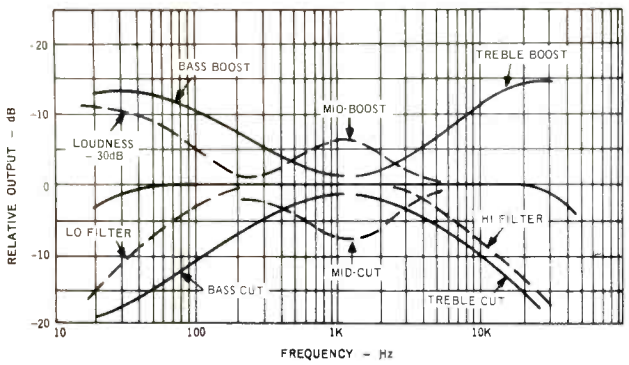

Fig. 8—Tone control, loudness, and filter response.

afford the listener a good opportunity to really "tailor" the tonal compensation to meet individual taste. All the tone controls, by the way, have a mechanical detent notch which enable the user to find the mid- or flat-position readily. Unfortunately, when the bass control was set in the notch, response was down about 3 dB at 20 Hz and we had to re-set it at about 1:30 o'clock for truly flat response, electrically speaking.

The phono preamp sections are very well designed and our hum measurement was actually better than the 65 dB claimed (which in itself would be an excellent number), reading about 68 dB. Bear in mind that this measurement was made in the "2 mV sensitivity" setting of the phono input switch, which makes the reading even more remarkable. Residual hum and noise (volume controls at minimum) is really "way down in the mud," measuring better than –92 dB below full output, and even with volume full up, high-level input noise and hum is down over 75 dB below full power output.

Listening Tests

At moderate to medium-loud listening levels, the Realistic STA-120B provides very clean sound using loudspeakers of relatively low efficiency. If you want to go for the ear-shattering kind of sound that seems so popular these days, however, you'll need relatively high-efficiency speakers or else you'll hear that bottom begin to break up at such levels—particularly if you try to boost the bass to unrealistic levels.

FM reception was judged to be quite good for a product in this price range. We logged 40 usable signals with our outdoor Yagi, of which 19 were "stereo-listenable." The stereo-only setting of the selector is very effective and narry a mono signal was able to sneak through when we set the switch to that position. The flexibility of the speaker switching arrangement (separate switches for main and remote, unrelated to the headphone jack) is also a welcome feature that we'd like to see more often.

While unrelated to the actual performance of the unit itself, we do have to quibble with a portion of the owner's manual which states, in part:

"The [specifications] are subject to variables unrelated to performance, just as frequency range, the number of transistors or IC's or watts, etc., is totally irrelevant to the end product in terms of sound quality." We feel it is sufficient to point out that this was probably not written by the engineer who designed the unit.

Summing up, the Realistic STA-120B represents good value in the low-to-medium price category of stereo receivers, with good basic design, adequate power for clean sound at medium levels with any speakers, and several features worthy of considerably higher priced equipment. *Leonard Feldman*

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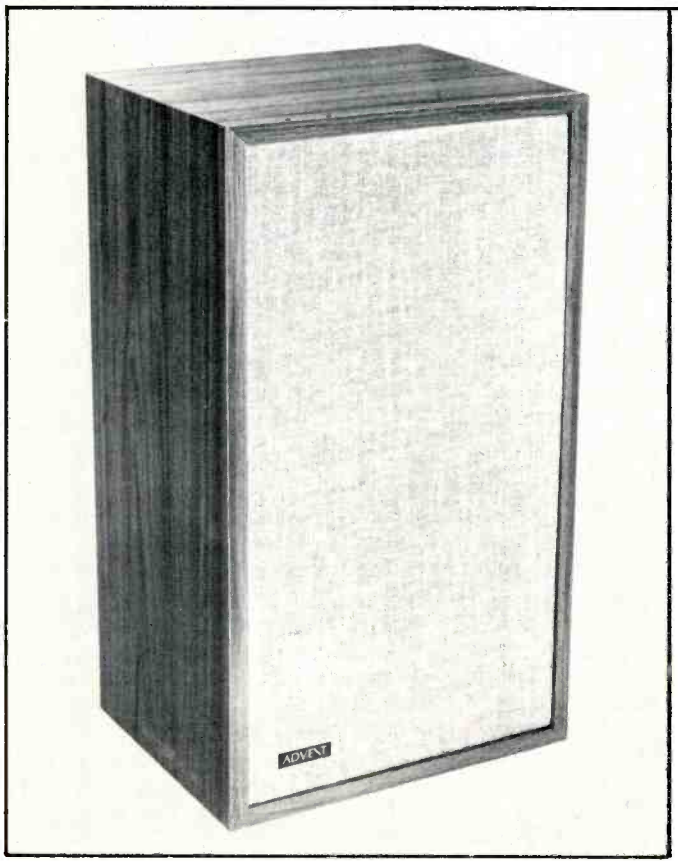

Advent Smaller Loudspeaker

MANUFACTURER'S SPECIFICATIONS

System Type: Two-way, acoustic suspension. **Components**: One 9½-in. woofer, one ⅞-in. dome tweeter. **Frequency Response**: 30-20,000 Hz ±4 dB. **Nominal Impedance**: 4 ohms. **Dimensions**: 11½ in. W, 20 in. H, 9¼ in. D. **Weight**: 27 lbs. **Price**: $69.95.

As most readers know, Advent makes two speaker systems which are designated with some logic as "the Advent loudspeaker" and "the Smaller Advent loudspeaker." It might have been less confusing if they had model numbers but there it is. . . . The larger system was reviewed in these pages in July 1970, and the reviewer, Alex Rosner, said, "One could say at twice the price the Advent speaker would be good value, but at $112.00 it is a bargain." The price is now $116.00 but the $4.00 increase is not *that* significant. The large system uses a 10-in. bass unit with a 2-in. tweeter but the smaller version has an 8-in. bass speaker (actually 8½ in. cone) with a 2-in. tweeter. This is fitted with a ⅞-in. center dome which aids dispersion. Cabinet size is half the volume of the larger model but the system resonance is about the same, 40 Hz or so. As might be expected, the two systems sound quite similar, the main differences being a reduced handling capacity and 2 or 3 dB lower sensitivity, probably due to the mass loading of the bass unit to bring the system resonance down. Crossover frequency is 1,500 Hz.

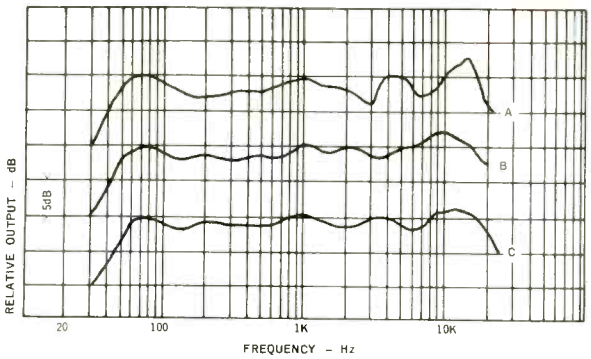

Fig. 1—Frequency response to one-third octave pink noise. Curve **A** is taken on-axis, **B**, 45 degrees off-axis, and **C** is an average of five positions.

Measurements

Frequency response measured with one-third octave pink noise is shown in Fig. 1. Curve A is taken on-axis, B at 45 degrees off-axis, and C represents an average of five positions. Note that the off-axis response is slightly smoother than the direct on-axis curve which, incidentally, was taken at the standard distance of one meter. Bass was well maintained with a fairly broad rise in the 50 to 70 Hz region. Fig. 2 shows the tone-burst performance at 100, 500 and 5,000 Hz.

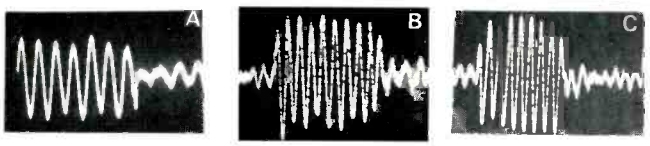

Fig. 2—Tone-burst response. **A** is 100 Hz; **B**, 500 Hz, and **C** is 5,000 Hz.

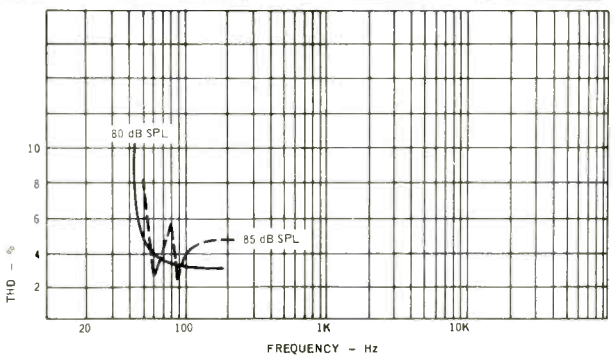

Fig. 3—THD at 80 and 85 dB SPL, which correspond to 4 and 10 watt inputs, respectively.

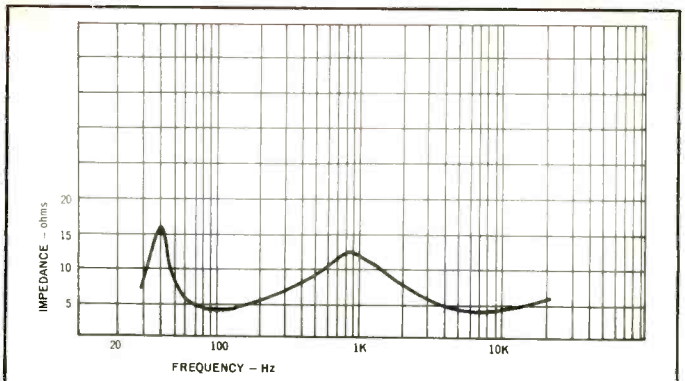

Fig. 4—Impedance characteristics. The low point is 4.2 ohms.

The distortion is shown in Fig. 3 for output levels of 80 and 85 dB SPL, equivalent to power inputs of 4 and 10 watts. The impedance characteristics are shown in Fig. 4, and it will be seen that the lowest point is 4.2 ohms with an average of 6 ohms.

Frequency doubling commenced at 40 Hz with an input of 25 watts rms continuous power, but the system could put out quite an appreciable amount of fundamental down to 35 Hz—which is remarkable for such a small enclosure. At 60 Hz it would handle 60 watts rms continuous power, without distress. White noise showed low coloration—just a trace of hardness on-axis.

Listening Tests

How did it compare with the larger model? Well, first of all, it must be said that they both had the same kind of sound quality, so you could use them as rear channel speakers with the larger ones up front in a quadraphonic system without losing too much. Overall power handling capacity was less and more power was necessary to drive them. However, a 20 to 30 watt (per channel) amplifier should be adequate for small or medium size rooms, although the system will handle much greater power. Bass was equally as deep and satisfying, and really the differences were not as great as we expected. Indeed, the Smaller Advent (see what I mean about the lack of a model number?) compared more than favorably with several larger systems costing a lot more. Even our latest test record—"Music For Organ, Percussion, and Brass" with E. Power Briggs (CBS) sounded quite impressive and those low notes came over remarkable well. Would they be a bargain at twice the price? Possibly, but if you are spending *that* much—buy the larger model. However, if space or the budget is limited, then by all means consider the smaller version.

G.W.T. & T.A.

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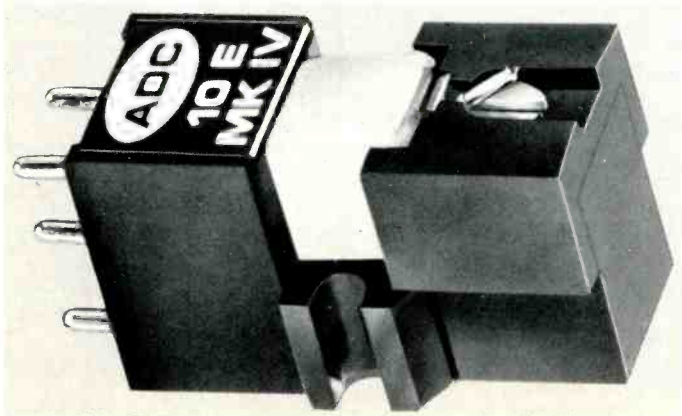


ADC Stereo Cartridge 10E MK IV

MANUFACTURER'S SPECIFICATIONS

Type: Induced magnet. **Output**: 4 mV at 5.5 cm/sec recorded velocity. **Tracking Force**: 0.7 gram. **Frequency Response**: 10 Hz to 20 kHz ±2 dB. **Channel Separation**: 30 dB from 50 Hz to 12 kHz. **Compliance**: 35 x 10¾ cm/dyne. **Elliptical Stylus Tip**: Contact radius, .0003 in.; lateral radius, .0007 in. **IM Distortion**: Less than 0.5%—400 & 4000 Hz at 14.3 cm/sec recorded velocity. **Vertical Tracking Angle**: 15 deg. **Recommended Load Impedance**: 47,000 ohms nominal. **Price**: $50.00.

While similar in appearance to the earlier Models 25 and the single-stylus version, the Model 26, the 10E MK IV differs in several categories. Both the newest model and the earlier ones employed the "induced magnet" arrangement—in which the stylus does not move a permanent magnet which has an appreciable mass but moves instead a soft iron collar which moves between the pole pieces and induces a flux in them—the MK IV is designed for a fixed stylus force. This undoubtedly simplifies the design, since compromises are not required to permit operation over a stylus force ranging from 0.5 to 1.5 grams. In addition, this allows the designer to reduce the stylus restoring force to a minimum commensurate with the fixed stylus force. This does not mean that the cartridge will not operate at other stylus forces, but only that performance specifications are obtained with the rated value.

It does mean, however, that the cartridge should not be used with low-quality record playing equipment, which is, after all, a logical way to build up a system anyway—you don't put General Dual 90 tires on a 1932 Packard. You do need a pretty good changer or arm in order for the performance to be reliable at a stylus force of as low as 0.7 grams. However, there are plenty of current models of automatic turntables, as well as of separate arms, that will work perfectly under this condition.

Since the magnet is not part of the stylus assembly, a larger magnet can be used, and such is the case in the MK IV. It is enclosed in the molded housing, along with the tiny pole pieces and the coils, and still provides space for adequate shielding. The stylus assembly is enclosed in a U-shaped plastic molding which slips over the body of the cartridge and holds the soft iron ring in precise alignment with the four polepieces. The stylus assembly is at the 15-deg. vertical tracking angle at which all modern LP records are cut.

Performance

Figure 1 shows the frequency response and the separation as an average between the two channels—which differed by less than 1 dB throughout the range from 20 to 20,000 Hz. Response was well within the ±2-dB specification over the entire range, and within ±1 dB from 300 to 15,000 Hz. Separation was better then 20 dB from 40 Hz to 15 kHz, dropping to an excellent 15 dB at 20 kHz.

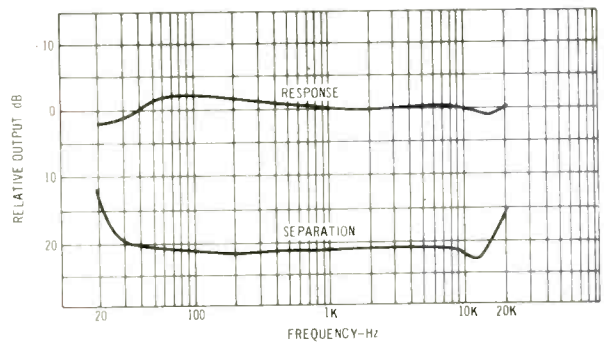


Fig. 1—Frequency response and separation curves for the ADC 10E Mk IV.

Since the manufacturer suggests that the connecting cables be not longer than 5 feet, we measured frequency response with several additional values of capacitance corresponding to longer-than-normal connecting cables between cartridge and amplifier. The normal value of our connecting cable was measured at 145 pF, and we made frequency response measurements with additional values of 100 pF, 160 pF, 250 pF, 360 pF, and a whopping 650 pF, with the results plotted in Fig. 2. We have long known of the effect of additional capacitance in reducing high-frequency peaks in cartridges, usually with a slight build-up of response in the 5000- to 8000-Hz ranges. It is not uncommon for manufacturers to specify the preferred value for load capacitance for flattest response. The 10E MK IV does not show much of a droop in the 5000- to 8000-Hz range, so often encountered in some other models, and the effect of additional capacitance is only slightly noticeable until the extra loading reaches 160 pF, which would correspond to a cable length of 10 to 12 feet. This amount of connecting cable should certainly be avoided, if only to reduce the possibility of hum pickup in the leads.

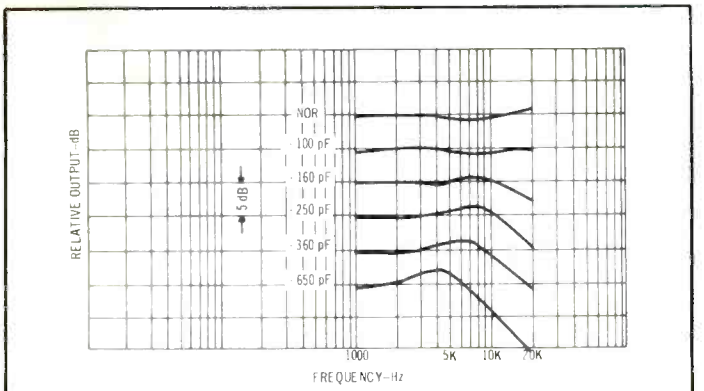


Fig. 2—Curves showing the effect of added capacitance across the output of the ADC 10E Mk IV. Note that there is little difference until the added capacitance exceeds 160 pF.

At the specified 0.7-gram stylus force, there was no trouble in tracking the test 100-Hz groove cut with an amplitude of .005 in., which is a level not usually encountered in most records.

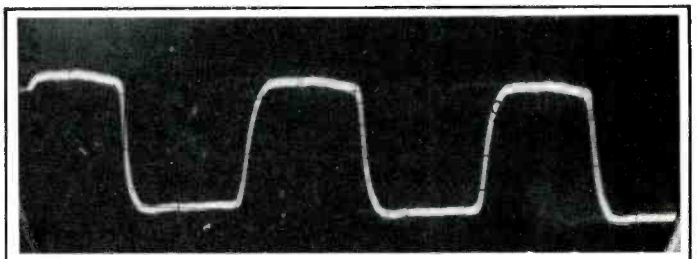
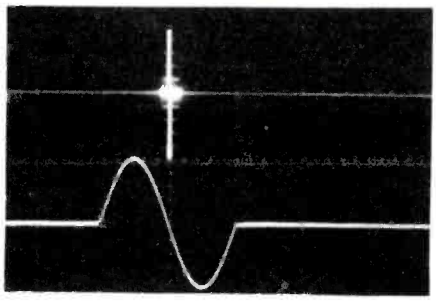


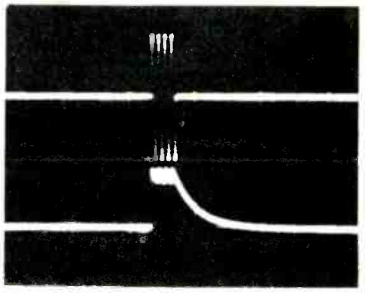
Fig. 3—Square wave response of the ADC 10E Mk IV.

Square-wave response, using the CBS STR-111 test record, is shown in Fig. 3, a fairly clean, smooth trace. IM distortion was measured, using the 200/4000 bands on the CBS-STR-110 record, resulting in a distortion of 0.6 per cent at the +9 dB level—the band used heretofore in reporting lateral IM distortion. Similarly for vertical IM distortion, we have heretofore reported the same 200/4000 section—more critical than the 400/4000 bands—and at the +6-dB level we noted a distortion of 1.8 per cent. All of these distortion figures are low in comparison with many other cartridges.

The crucial test of any cartridge is in the listening, of course, as it is with any high fidelity component. We could find no complaint with its sound—silky and smooth in the high end and solid in the bass. We tried it with several different types of music, and would readily welcome the MK IV in any system. It was installed in a high-quality automatic turntable, as it should be in any user's system, and its performance was flawless. *C. G. McProud*



THE WORKBENCH



Heathkit Microwave Oven

I must confess that I hesitated before giving up the time and space to a report on a microwave oven, but then I thought, well, it *is* an electronic kit and who is more competent to make such things than the audio enthusiast? Besides, we *did* publish a cookbook several years ago, and so went ahead.

Unlike most other Heathkits, there is not a great deal of money to be saved by building this one but there are other advantages. You can service it if it gives trouble (*that* can save quite a bit), and there is still that satisfaction in doing it yourself. A man can acquire a little prestige by building a receiver or amplifier but one who builds a microwave oven is *really* respected in domestic circles!

The Heathkit GD-29 has an oven space of 8 in. high by 14 in. deep and 15½ in. wide. Energy is supplied by a magnetron working at 2450 MHz with a peak power of 650 watts. Food in the oven absorbs the microwave energy producing heat which cooks the food. Heating is confined to the food itself and the cookware does not heat—except by contact with the food. Thus, food can be cooked on paper plates, glassware—even on paper towels if so desired. The magnetron is coupled to the oven by a waveguide, and underneath this is a metal stirrer, which deflects the microwaves in all directions to give even heating. Figure 1 shows the basic arrangement. A fan draws air in through a filter on the back panel to keep the magnetron cool.

Questions frequently asked are, how safe are microwave ovens? Are they a health hazard or not? Well, there is no doubt that microwave radiation *can* be dangerous; if both safety switches were disconnected and you put your hands into the oven, they would receive burns—so they would if you put them in an ordinary oven! Prolonged exposure to low power radiation can also cause trouble so the FCC has laid down standards of leakage from microwave ovens and other equipment. Stringent precautions are taken with the GD-29 and a safety interlock switch is fitted to the oven door on one side and another is fitted on the door handle. Both these switches are connected to the primary of the power transformer. The door seal is made of conductive vinyl material and other precautions include a plastic door baffle and a capacitive door seal mounted on the door. The FCC regulations stipulate that maximum radiation must be less than 1 mW/cm^2 at a distance of 5 cm, so after the oven was finished the actual radiation was checked using a borrowed Narda Radiation Survey Meter. It was very difficult to get any reading at all and the maximum was not much more than the thickness of the pointer or less than one one-hundreth of the FCC figure.

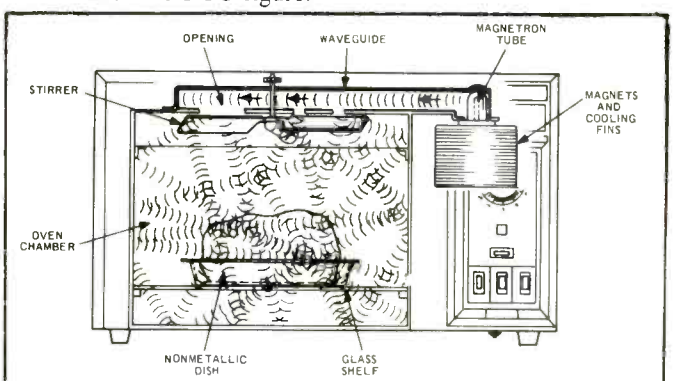


Fig. 1—Showing basic layout.

Circuit Details

Figure 2 shows the circuit and it will be seen that the electronic section comprises a high voltage supply, interlock solenoid assembly, indicator lights, timer switch, fans, thermal cut-outs, and so on. The high voltage section is shown in Fig. 3. The device on the right is an avalanche diode which rectifies the high voltage (3.5 kV) for the magnetron. The interlock assembly with its SCR is shown in Fig. 4. Gate voltage is supplied via the door handle switch and the SCR then conducts, energizing the relay which releases the door.

The manual is written in the usual Heathkit manner with step by step instructions with large pull-out diagrams. Al-

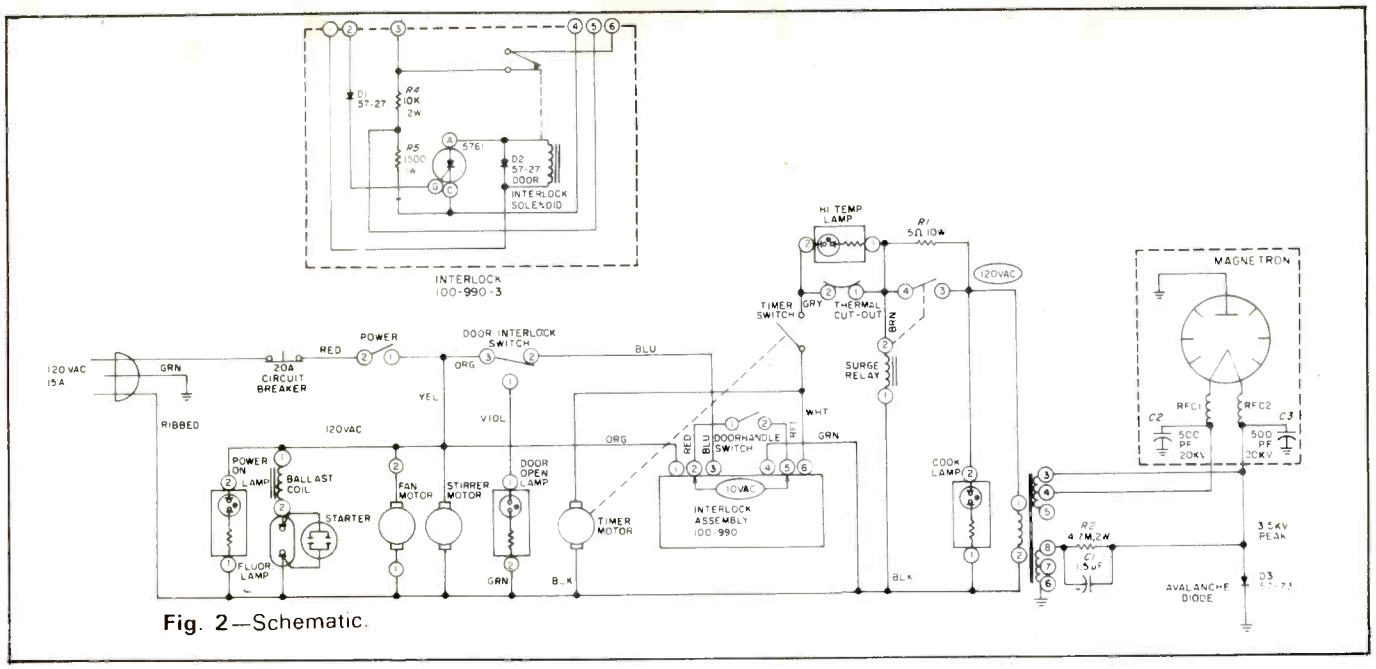


Fig. 2—Schematic.

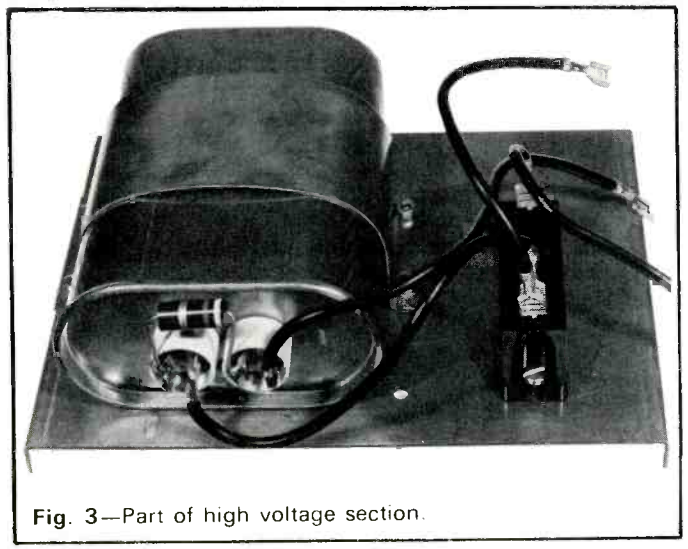


Fig. 3—Part of high voltage section.

though there is a fair amount of wiring, most of the time was taken up with the mechanical assembly, mounting the various switches, and so on. No particular problems were experienced and the total time from assembly to hamburger, so to speak, was 16 hours—spread over three weekends. One word of warning—don't forget the magnetron contains two powerful magnets, so take off that wristwatch!

After the initial tests, the operational check was made. This is equivalent to hearing music from a newly built receiver and in this case, it consisted of Boiling a Glass of Water. Just as exciting really—after two minutes, there were the bubbles, so everything was fine and the oven was passed over to Mrs. Editor for the performance tests.

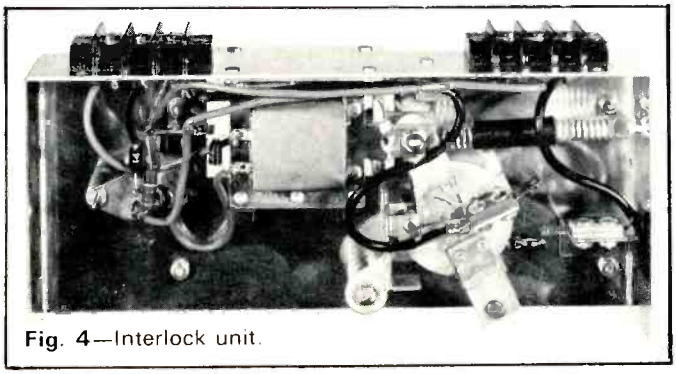


Fig. 4—Interlock unit.

Cooking Tests

Being a keen and enthusiastic cook, I was thrilled to get the chance of trying one of the Heathkit microwave ovens. I found it a great time-saver and still marvel at the ease and speed of cooking in this oven—and no messy clean-ups, no burnt-on food spills. The oven and dishes stay cool, only the food gets hot.

I enjoyed the novelty of taking frozen hamburgers from the freezer, placing them in frozen buns, and popping them on a paper plate and into the oven. Set the timer for 5 minutes and before the coffee has finished perking, the electronic timer is gently pinging and all is ready for eating.

A beef roast is another time-saver, at 5, 7, or 9 minutes per pound, according to preference for rare, medium, or well done. Baked potatos also cook quickly. One potato takes 5 minutes; two, 8 minutes, and four, 16 minutes. Length of cooking time depends on quality as well as on size.

A beef stew can be ready in a total of 23½ minutes of cooking time, but I was irritated by the constant attention this dish needs. Every 5 or 6 minutes, it was necessary to add something, stir it, or turn the dish. Most dishes need to be rotated two or three times while in the oven to insure even cooking throughout.

I was fascinated when making a layer cake to watch the mixture rise before my eyes immediately on closing the oven door, to be cooked in 5 minutes. But, like all foods cooked in electronic ovens, cakes are not browned when cooked. If you like your baking done to a nice golden brown color, you still need a regular oven.

If you have a family with irregular meal times, here you will find this type of oven most useful. Simply serve all the food, when ready, on regular china plates and set aside. When the late-comers arrive, put the dinner, as is, in the oven for 2 or 3 minutes. The food will taste fresh cooked and will not be dried out. Another advantage is the fact that the oven does not heat up the kitchen—a big plus in hot weather.

An excellent little cookbook comes with the oven and if one follows the step-by-step instructions for preparation and cooking time, it is impossible to go wrong. Price: $379.95; optional roll-around cart, $27.50. *P.V.T.*

Literature

Christiansen Radio offers a four-page folder describing the Mini-Mount Breadboarding System of miniature etched patterns, each designed to mount one or more electronic components. Pressure-sensitive adhesive holds the Mini-Mounts onto a ground-plate base while interconnecting wires are soldered in place. A variety of patterns are available, including mounts for DIP IC packages, multilead IC's, transistors, trimmer pots, capacitors, diodes, and resistors.

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Switchcraft has released a four-page flyer on their DVR (dual visual recognition) switches which offer immediate, continuous recognition of "in" or "out" positions. A black color band behind a color recognition cap indicates the "out" position, while the black band disappears when the switch is depressed to the "in" position.

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General Radio offers the "Handbook of Noise Measurement," 7th edition, by Arnold P. G. Peterson and Ervin E. Gross. Some topics new to this edition include methods of time-series analysis, industrial audiometry, and the noise provisions of the Occupational Safety and Health Act (OSHA). Also included are chapters on noise and vibration, what noise and vibration do and how much is acceptable, instrumentation for measurement, noise and vibration control, and other topics of significance to engineers, managers, and others involved with the measurement, analysis, and control of noise and vibration. 328 pages; $7.50. Copies may be ordered from General Radio, 300 Baker Ave., Concord, Mass. 01742.

Nortronics has announced a revised and expanded edition of their "Recording Equipment Maintenance Manual," which describes the importance of regular preventive maintenance to preserve listening quality and extend the operational life of all tape recorders. Included is a program for determining the condition of recording equipment, together with sections describing head demagnetization, splicing and splicing tapes, lubrication, capstan and pinch roller maintenance, liquid and spray cleaners, and a typical recorder maintenance program.

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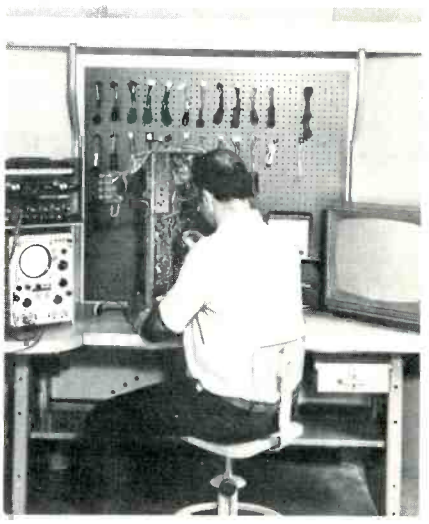

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Check No. 24 on Reader Service Card

how to read an orchestral score

Dr. Robert F. Weirauch

TO MANY PEOPLE, a full symphonic score represents a compendium of Etruscan hieroglyphics. Moreover, if someone were to sit down at the piano and reduce this super-secret code to meaningful sounds, then surely that individual must be possessed by the devil (if not by the spirit of Franz Liszt). While there is much intricacy and study involved in reading a score, nevertheless, anyone can read the basic "do-re-mi's" should be able to derive a good deal of understanding and musical comprehension with just a little effort. Even if one cannot read a single note of music, a certain amount of understanding and recognition can be obtained by being able to differentiate between the musical elements—melody, harmony, and rhythm—and by following the graphical rise and fall of a given musical line (as many chorus singers, who learn their parts by rote, are forced to do). By connecting the visual notes with the aural impression, especially when clever compositional techniques are not so easily grasped by the ear alone, the appreciation of a given work is heightened tremendously.

Many good conductors consider it *sine qua non* to be able to play a score at the keyboard (even, if necessary, at first sight). Surprisingly enough, on the other hand, quite a few composers are their own worst orchestrators, requiring others to correct or actually transcribe their scores for them. But conductor, composer, and the millions of music lovers who enjoy their combined recorded (or concertized) efforts can all share in this creative manuscript, without the need for advanced degrees in musicology, electronics, and/or computer programming (toward which goals the audiophilic art appears headed). Opera houses all over the world reserve special rows of seats in their balcony with tiny lights for those patrons who bring their own scores with them to performances. The purpose of this article, however, will be to encourage consultation of a score before and after a hearing, at a time when one can leisurely make intelligent use of the principles to be enumerated.

A score is simply the combined listing of all instrumental (and vocal) parts in a manner (parallel, one above the other) such that at any given moment the note (or rest) assigned to any given performer can be viewed with all others in a single, vertical column. The music as a whole is then read in normal fashion (i.e. from left to right), taking in up to an entire page at a time. This is what terrifies the uninitiated . . . having to read as many as two dozen horizontal lines all at once. The secret, of course, is that one need not read each individual part simultaneously, but, recognizing duplication and similarity, condense them into three or four basic parts. Usually only one or two chords at a time are studied in such detail that everyone's contribution to it is methodically analyzed. Before delving into this esoteric art, however, let us limit somewhat the boundries of our investigation.

We will only consider symphony orchestra scores, since the vast bulk of instrumental music was written (and recorded) for this particular ensemble. This means we will not consider bands (military, symphonic, jazz, or studio), since they each have their own unique instrumentation—all differing from that of the symphony orchestra—and are deserving of a special investigation in their own right. Moreover, we will not consider the orchestra prior to the first quarter of the 19th century (the so-called Romantic Period), since instrumentation was undergoing a rapid development from the Renaissance, Baroque, and into the early Classical Period. Our principles, however, can easily be applied to orchestras before 1825, insofar as the orchestra is basically a nucleus of stringed instruments complemented by varying numbers of woodwind, brass, and percussion instruments.

As an interesting historical observation, it should be pointed out that the ratio of woodwinds and brass to strings has more or less progressively increased through the years. In the Haydn and Mozart orchestras of the 1770's, there were added to the 30 or so string players anywhere from two oboes and two French horns to pairs of flutes, oboes, bassoons, horns, and trumpets—clarinets were only used in two of Haydn's 104 symphonies and five of Mozart's 41—thus, providing a ratio of up to one to four. With Beethoven, who added two more horns and three trombones, the classical orchestra ratio was approaching one to three. Brahms, Bruckner, Tchaikovsky, and other Romantic composers then added at least two more horns, a piccolo, English horn, bass clarinet, contra-bassoon, tuba plus various percussion instruments. All the while the numbers of stringed players was also increasing, as witnessed by Berlioz—whole volumes have been written on what this genius did to and for the orchestra—calling for at least 15, 15, 10, 12, and 9, respectively, for the first and second violins, violas, cellos, and basses. With Wagner, Mahler, and Richard Strauss, woodwinds were sometimes increased from three's to four's, horns doubled to eight or more, and trumpets similarly augmented, although four trombones seemed to satisfy the most demanding. As if that were not enough, Wagner invented a quartet of tubas. Thus, in some late Romantic and early Modern works, the ratio of winds, brass and percussion to strings approaches one to two.

Our investigation, then, will limit itself to what is customarily called the modern symphony orchestra: winds basically in threes, at least four French horns, two or three trumpets (although the French and Russian composers favor a pair of trumpets plus another pair of the softer sounding cornets), three trombones plus tuba, a battery of percussion instruments (including harp and piano), and the string body. With the increased string players, a large orchestra of about 96 players will again be in the one-to-three ratio. A good orchestra will cut down its string players for early classical works and will bring in extra performers if needed in modern selections.[1]

Our included score samples will not contain works representative of the ultra-modern school (Stockhausen, Berio, Boulez, Cerha, Cage, et al.) and that called "alleatory"—which means the actual performance is left up to chance permutations of the musical elements and is usually never played the same way twice (indeed, it often cannot be)—since the score becomes a mathematical plan of symbols and instructions with charts, graphs, and sliding rulers. For the same reason, we will not consider electronic music, but will choose several interesting symphonic works (in which specific notes were written to be performed in unalterably specific ways) from Berlioz (1830) to Prokofiev (1944).

The order of instruments in a symphonic score reading from top to bottom pretty well adheres to the following shceme: piccolo (also doubling as 3rd flute), two flutes, two oboes, English horn (technically neither a horn or English in origin, but in reality an alto oboe—also doubling as 3rd oboe), two clarinets and a bass clarinet, two bassoons and a contra bassoon, four French horns, two or three trumpets (or two trumpets and two cornets), three trombones (usually two tenor and one bass—in Beethoven's time there was the higher alto trombone, but a good tenor trombonist today can achieve the same upper register), timpani (two or more drums played by one or more percussionists), snare drum, bass drum, cymbals, triangle, etc., harp and piano, and the usual five-part strings.

Fig. 1—Treble, bass, alto, and tenor clefs, each showing "middle C."

Before looking at the music there are two problems to be overcome. One is the fact that the different instruments will be listed in either French, German, or Italian, depending on the nationality of the composer or publisher. Most names are easily recognizable, but a few can cause some confusion. For example, "cor anglais" means English horn (and therein lies the misnomer—"anglais" is incorrectly derived from the word meaning "angled," referring to the shape of the tube), "corno" means French horn and not cornet, "tambur" means drum and not tambourine, "timbales" (three syllables) are kettle drums and not cymbals, etc. When abbreviations are used the confusion becomes even worse.[2] The only solution is to obtain a small pocket dictionary of musical terms, which will also be invaluable with respect to the annotations given to the performers and conductor by the composer.

A more serious problem concerning score reading deals with the fact that some instruments are in concert pitch, while others are transposing. This means that when all instruments play

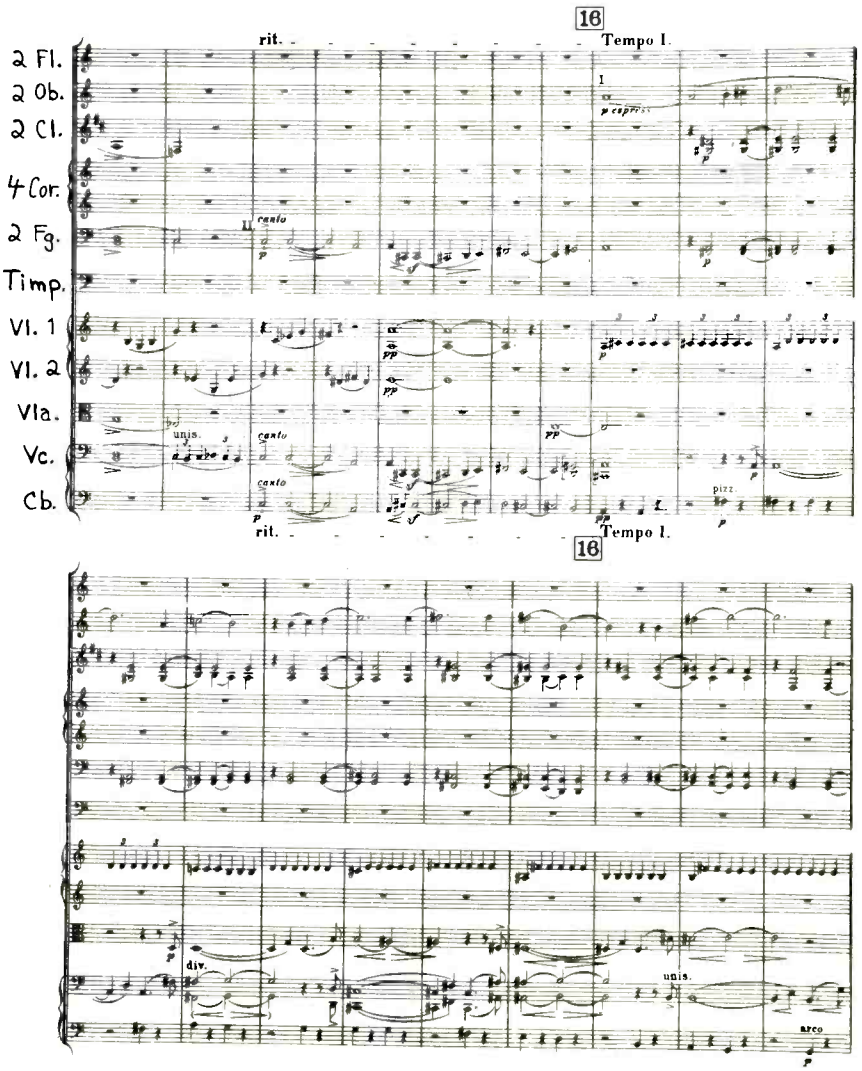

Fig. 2—Berlioz' *Symphony Fantastique,* Opud 14, page 23, Edwin Kalmus Publishers, New York, (No. 144).

[1]Notice the trend toward performing Barogue works (such an Handel's *Messiah*) with reduced instrumental forces, on antique musical instruments and using the original manuscripts.

[2]In German, B-flat is translated "B," while B-natural becomes "H."

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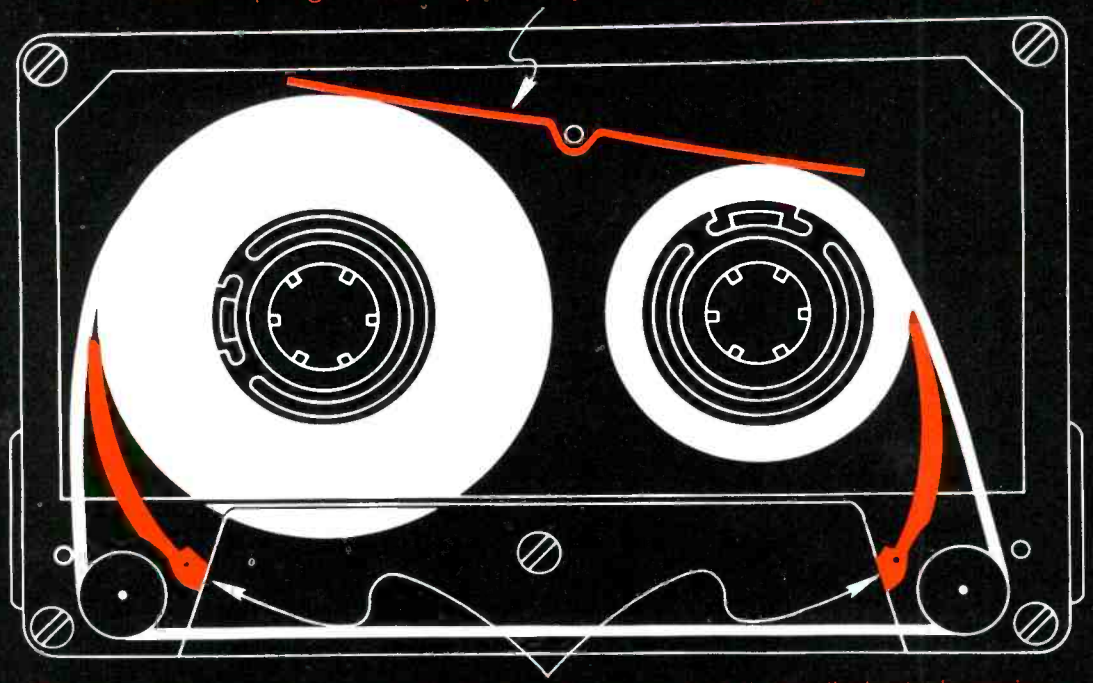

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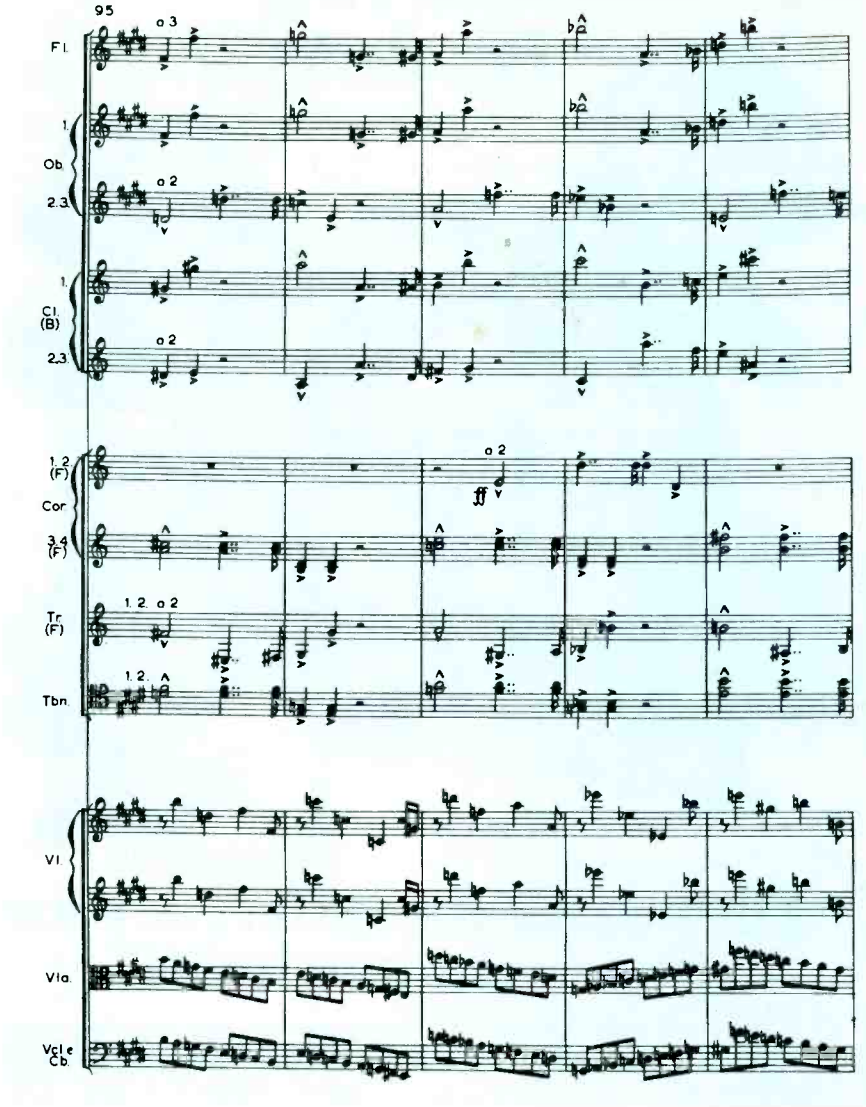

Fig. 4—Bruckner's *Symphony No. 9*, page 181, Ernst Eulenberg, Ltd., London, (No. 467).

German, and the only abbreviations which might cause any difficulty are Hb. (Hautbois for oboe) and Br. (Bratsche for viola). This is a very celebrated example in that it shows three main themes playing simultaneously, with no other harmonic or rhythmic background. Theme one (that of the mastersingers, which opens the overture) is found in the bassoons, bass tuba, and contrabass. Theme two (the mastersinger guild, which occurs early in the beginning, only twice as slowly) is played by flutes, oboes, second clarinet; second, third, and fourth horns, and trumpets. Theme three (Walter's *Prize* song) can be found in the first clarinet, first horn, first violins, and cello. As with the previous example by Berlioz (whose music had more of an influence on Wagner than he cared to admit), there is an interesting canonic counterpoint in the second violins and violas (measures two and three).

The third example is from the final movement of Bruckner's Ninth Symphony. At this particular point the instrumentation finds flutes, oboes, and clarinets in three's, four horns, two trumpets, two trombones, and strings. The principal melody is in the trumpet part (doubled) with a basic contrapuntal "walking" bass line in the violas, cellos, and contrabasses. The harmonic background is provided by the first and second violins, who spell out the chords in slow arpeggios, plus the third and fourth horns and two trombones playing the exact rhythm of the trumpets. Now take a closer look at the woodwinds. The second and third oboes are playing the mirror inversion of the melody in the trumpets. The flutes, clarinets, and first oboe are then playing a canonic answer to the trumpets one measure later. Finally, in the third measure the first and second horns play a cononic answer too, and one half measure after, the mirror inversion! Even with a score all these lines are not easily followed, but it helps.

For the last example, let us take a page from the final movement of Prokofiev's *Fifth Symphony*. The instrumentation here is piccolo, two flutes, two oboes, English horn, a piccolo clarinet (pitched higher than the standard one), two B-flat clarinets, two bassoons, three trumpets, four horns) the Russians like to reverse these two groups), three trombones, tuba, timpani, triangle, wood block, snare drum (*tambur militaire)*, piano, harp, and strings. The first interesting thing to note about this score is that all instruments are in concert pitch —they sound the notes you actually see, although they may play different written notes. Even though this score can be considered quite modern, it is basically simple to read and analyze. The melody is found in the first trumpet, three trombones, and violins, violas, and cellos (with the tuba and contrabass adding individual notes occasionally). The harmony is given by repeated eighth notes in the horns, second and third trumpets, and bassoons. The remaining woodwinds are divided into two different rhythmical figures outlining the harmony, and the various percussion instruments (including piano and harp) accentuate these figures.

As a serendipitious reward to our score study, consider that rhythmical figure played by the piccolo, flutes, and piccolo clarinet. Since they are in unison and octaves, it doesn't require too much musicological expertise to discover the printed mistake in the first measure of the piccolo clarinet (the circled "g" should be an "a"). This calls to mind the humorous story concerning a new guest conductor so desirous of making a good impression with a prestigious symphony orchestra that he penciled a mistake in one of the obscure back-row instruments. During rehersal the next day the conductor suddenly stopped the orchestra and said, "Excuse me, second bassoon,

Henry Fonda

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Pittsburgh, Listening Post, 5500 Walnut St.
Pittsburgh, Record-Rama, 639 Butler St.
Pittsburgh, Opus One, 3519 Forbes Ave.
Pittsburgh, Opus One Inc., 400 Smithfield St.
Pittsburgh, The Soundpiper, 1835 Murray Ave.
Pittsburgh, Wander Sales, 7901 McKnight Rd.
Pittsburgh, Wolks Kamera, 312 Forbes Ave.
Plymouth Mtg., Franklin Music. Plymouth Meeting Mall
Reading, Electronics TV Dist., 201 S. 4th St.
State College, High Fidelity House, 101 Heister St.
Uniontown, TV & Radio Parts, 19 W. Fayette St.
Wyncote, E. J. Korvette, Cheltenham Ave., Easton Rd.
Wyncote, Lafayette Radio, 8156 Ogontz Ave.

R.I., Cranston, Sound-O-Rama, 758 Reservoir Ave.

Tenn., Chattanooga, College Hi-Fi, 5768 Brainerd
Kingsport, Watkins Stereo Ctr., 1019 Center St., E.
Memphis, Stuber's, 1523 Union Ave.
Nashville, Electra Dist., 1914 W. End Ave.
Nashville, Miller Clinic, 602 Gallatin Rd.
Nashville, Nicholsons, 115 19th Ave., So.

Tex., Amarillo, Appliance Center, 3309 Beli
Amarillo, Capitol Electronics, 1800 Washington
Austin, Home Entertainment Ctr., 7530 Burnet Rd.
Austin, High Fidelity, 1710 Lavaca St.
Dallas, Discount Records, 4003 Northwest Pkwy.
El Paso, Howell Electronics, 2873 Pershing
Houston, Home Entertainment, 5310 Kirby Dr.
Houston, Home Entertainment, Nassau Bay Shppg. Ctr.
Lubbock, Hi Fidelity, 2217 34th St.
McAllen, McAllen Radio, 415 S. Broadway
Midland, Barton Elecs., 1023 N. Midkiff
Midland, Midland Camera Shop, 317 N. Colorado
Richardson, Electronics Unlimited, 61 Richardson Hts. Vilg.
San Antonio, Case Sound, 3522 Broadway
Tyler, Cole Electronic, 335 S. Bonner

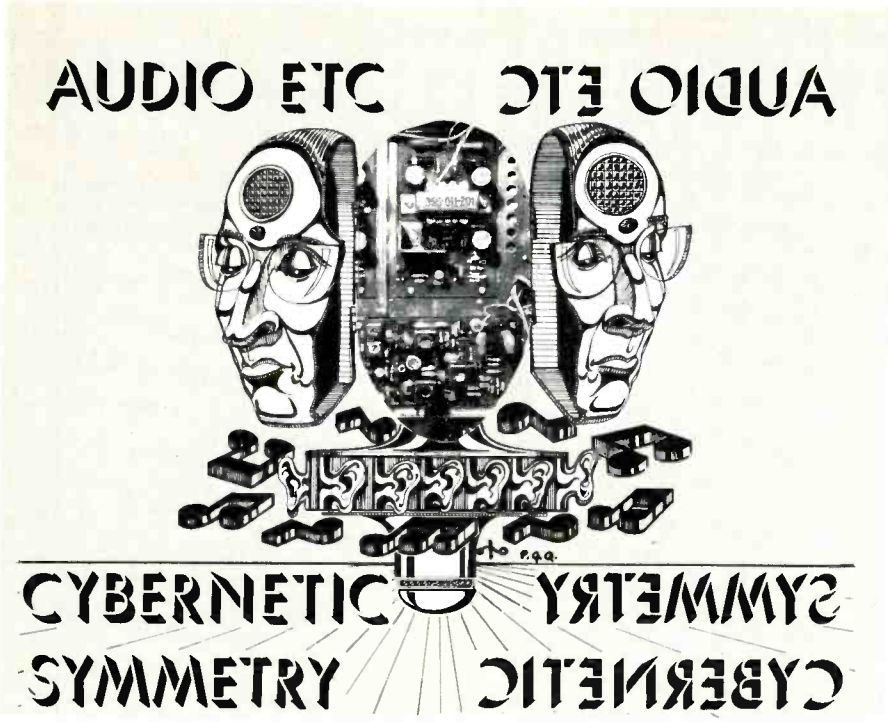
Ut., Salt Lake City, House of Music, 156 S. Main

Va., Arlington, Audio Associates, 3441 Fairfax Dr.
Baileys Crsrds., E. J. Korvette, 1335 Leesburg Pike
Blacksburg, Audio-Tronics, 113 N. Main St.
Blackburn, Carver's, 153 College Ave.
Falls Church, Lafayette Radio, Wilson & Roosevelt Aves.
Hampton, Stereo Designs, Mercury Plaza Mall
Norfolk, Lafayette Radio, 1730 E. Little Creek Rd.
Norfolk, Sound Shop, 7862 Tidewater Dr.
Richmond, Audio Fidelity, 6521 W. Broad St.
Roanoke, Audio Fidelity, 3032 Trinkle Ave. N.W.
Virginia Bch., Lafayette Radio, 5112A Virginia Bch. Blvd.
Woodbridge, Lafayette Radio, 14402 Jeff Davis Hwy.

Wash., Seattle, Electricraft Stereo Ctr., 5030 Roosevelt Way N.E.
Spokane, Hal's Stereo, N. 2514 14 Div. St.
Spokane, Huppins Hi Fi, 419 W. Main Ave.

W.Va., Morgantown, Stereo Component Ctr., 465½ High St.

Wis., Appleton, Consumer Electr., 518 N. Appleton St.
Janesville, TV Hi Fi Center, 117 W. Milwaukee St.
Milwaukee, Discount Records, 434 W. Wisconsin Ave.
Milwaukee, Hi-Fi Fo-Fum Inc., 2532 W. Wisconsin Ave.
Milwaukee, Hi Fi Salon, 7204 W. Greenfield
Whitewater, Golden Ear, 112 First St.



Edward Tatnall Canby

CYBERNETICS is the prime unsung problem in consumer hi fi as we multiply our channels and our controls, hardware, cables, and, above all, our choices for possible action. I am in the midst of some very cybernetic four-channel taping right now, and I've got so much to groan about that I'm taking time off in order to toss out some helpful suggestions.

Consumer organizations have been busy for years pointing out that if your automobile's headlight switch looks and feels the same as your wiper switch, then when it starts to rain one of these nights you'll switch the lights out. Some cars make it possible for you to douse the light when you reach for the horn—a disastrous idea. The possible combinations of disasters-in-the-making are indeed awesome. The solution is in controls that look, and feel, and act the way they are, in knobs that are where they ought to be and not where some other knob is. Same in hi fi. Perhaps our audio gear is less dramatic in action when the wrong thing is pushed or the wrong knob turned. But damage can and often does result. Much more often—no damage, but a lot of sheer annoyance, leading to high blood pressure.

It must be admitted that manufacturers design their equipment not merely to satisfy ME (or you), but to fit into all possible worlds and suit every hi fi temperament. That is a tall order. You can't do everything right—and be fail-safe too. Moreover, internal requirements are hideously complicated, and a plus on the outside controls often brings along a minus with it. More often than not, I suggest cynically. Oh, for mono. Manufacturers do try to foresee problems, each according to his lights. They all work hard; they don't all succeed. But mostly they have fixed things so that the more obvious mistakes, like plugging a microphone into a speaker power output, can be avoided by anyone with half a brain.

Yet with all our new complexities, things like that do go wrong. The other day, I did it myself. I plugged a speaker power output into a mic input. It wasn't the mouse that died, it was the elephant. I now have half a stereo amplifier as a result. The mic input is doing fine, thanks.

Note that four channels increase our options (to put it positively) by a geometrical, not an arithmetical factor—*sixteen* times as many possibilities, give or take a few. Do you remember the hideous complexities when stereo first arrived? Those complications are now cybernetically under beautiful control and few of us really get tangled up in our standard stereo. We have ganged switches and volume controls, paired cables with plugs attached, nicely marked inputs, neatly laid out for the eye, and so on. It's all quite easy once you get the idea. But now—we begin all over. Believe me, the four-channel hi-fi makers are sweating out there, behind the scenes. It's bad. What unforeseen combination of buttons did we forget, the one that tore up a whole tape in two seconds? Did we accidentally wire the front right mic preamp into the rear left phono? And howcome when I push TAPE IN and TUNER simultaneously there is that smoke coming up? It's a nightmare for all, and if an item gets to the store and *works*, without fail or confusion, the miracle really has happened. But though they test and test, the designers are only human.

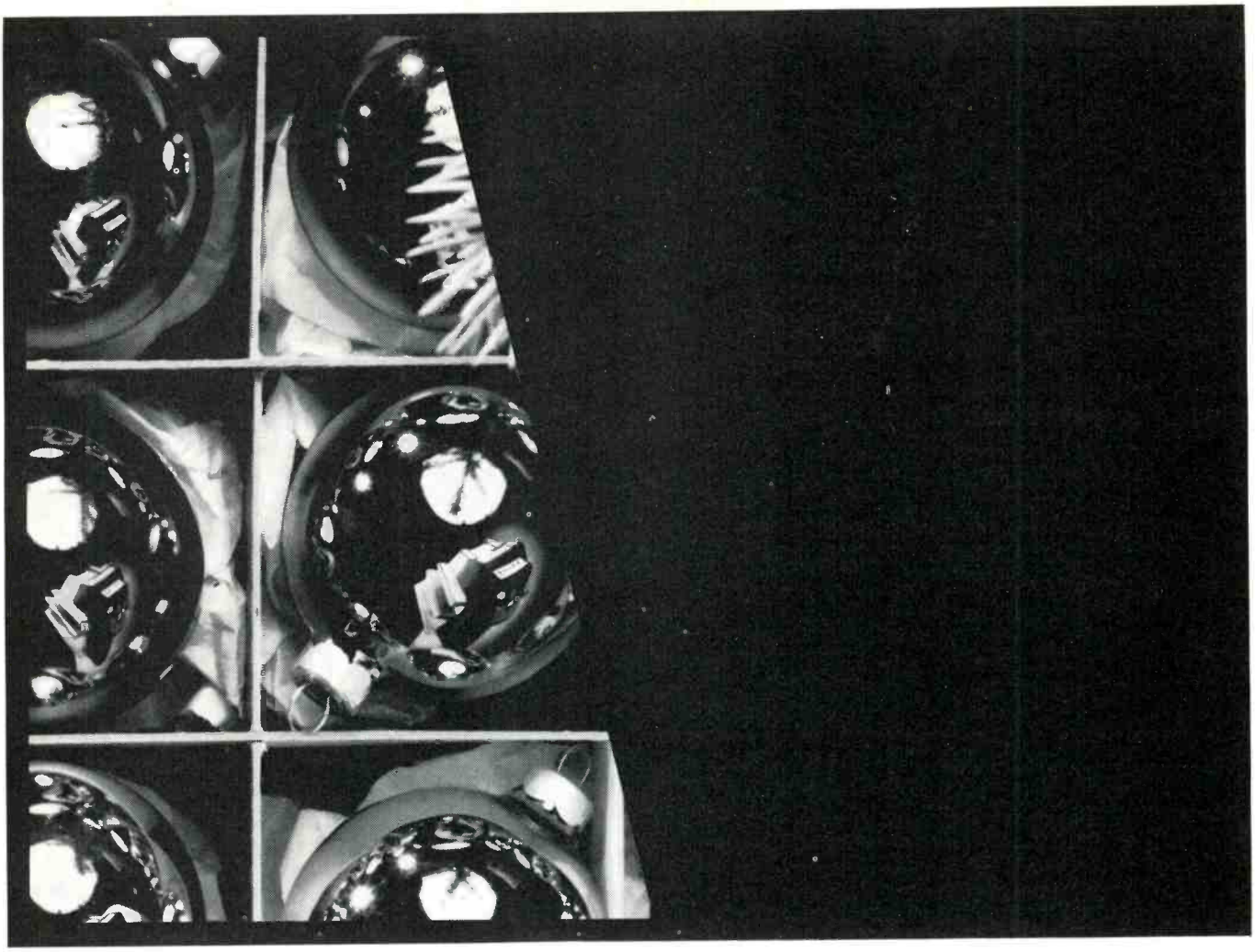
So take the following observations on equipment as merely typical and not exclusive. You'll find similar problems of the petty sort in lots of other equipment. I am *not* picking out horrid examples. Just typical ones. Maybe the manufacturers who read here will profit a bit in their next production runs, and the rest of us will get a laugh out of it. Nice equipment, too.

The most obvious reason for confusion in controls and connection layouts, alas, is neither electrical nor mechanical. It can only be described as Art. Manufacturers have an overriding urge to produce slickly gorgeous machinery, even if it costs them money. Granted, this ties in with sales appeal; the customer tends to agree. It's not merely expensive knobbery, switchery, chromery, fancy lettering, and brushed panelings but, above all, *symmetry and pattern*. Shapes, lines, colors, neatly laid out for the harmonious eye. That's the trouble. It looks fine, and who wants an ugly row of controls, each a different shape? But that's just what we need, or equivalent.

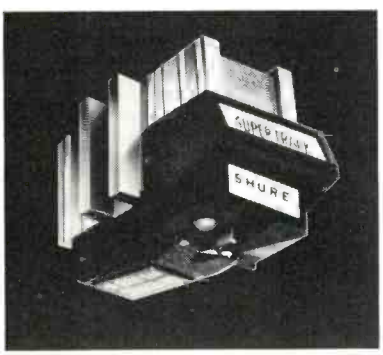
The finest example I can think of is in my home right now. Read all about the Crown IC-150 control unit and its companion D-150 power amp in our Equipment Report (AUDIO, January 1972). An astonishing pair of units. Distortion so low that our equipment couldn't measure it, etc. Quite a story, and I was delighted when these units in due course came my way, to be put to instant use as my main audio center.

You won't even look at the power amp, which is basic and out of sight. (It has a box, which I didn't get.) I have only one little complaint of a typically petty sort—the d— thing uses *phone plugs* for inputs. You have no idea what a blarsted nuisance that can be for one who changes things around frequently. You should see the jerry-built, patched-up cables I've invented (and lost at crucial moments) in order

(Continued on page 84)



A cartridge in a pear tree.



A gift of the *Shure V-15 Type II* Improved stereo phono cartridge will earn you the eternal endearment of the discriminating audiophile who receives it. What makes the V-15 such a predictable Yuletime success, of course, is its ability to extract the real sound of pipers piping, drummers drumming, rings ringing, et cetera, et cetera. Stereo Review, in a test report that expressed more superlatives than a Christmas dinner, described the performance of the V-15 Type II Improved as ". . . . Unstrained, effortless, and a delight to listen to." All of which means that if you're the giver, you can make a hi-fi enthusiast deliriously happy. (If you'd like to receive it yourself, keep your fingers crossed!)

Shure Brothers Inc.,
222 Hartrey Ave., Evanston, Ill. 60204.

SHURE

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to cope with those presently nonstandard inputs! Well, rumor says Crown has added more prosaic standard inputs in later production. See? Cybernetic feedback.

As for the control unit, the IC-150, it is beyond this world, a supersplended doubled unit with two of everything that you'd expect only one of: two phono inputs (and mag preamps), two tape-outs, two tape-ins, two audio outputs, etc. Reminds me of a city railroad station with fifty tracks all narrowing down to an ultimate pair. This machine *is* two-channel, if you can call it that. To accomodate all those alternatives, Crown has gone out of its way. On the rear you'll find a big sunken plug board with a thousand or so RCA sockets, oddly set onto a horizontal shelf built inward underneath. At the inside edge, vertically, is a panel with instructions as to what is what. Unbelievable! I haven't yet figured out what is right and what is left; I just go by plug and hunch—you really can't tell, since a front-rear pair of sockets is pictured on the panel as top-bottom. When the board is filled up with plugs—my usual situation—the instructions are invisible in any case, behind all the cable spaghetti. Even without spaghetti (a different sort this month) I have to do as I always do, shove a VW mirror down in back, aim a flashlight at it, and try to read backwards *and* upside down. I'm really learning that trick, thanks to many obliging manufacturers who require the same of me.

Look, fellas, what if my equipment is up against the wall? You assume that I can walk around back and read your rear instructions right-side-up. My wall is too thick. My equipment is all hooked up. So I use a mirror and read backwards. If I can read at all. Gotta get the light just right. . . .

(Ha! I note that when I lean over the top of my new four-channel TEAC recorder I can look down on the inputs and find them in *the same plane and relationship as the front controls,* my head still facing the same way. Just reach over, and plug. Somebody, finally, is on the right track.)

On the Crown rear panel it is virtually impossible, too, to plug in (or pull out) a back cable when the front one is in place. Can't get your fingers in. You have to pull out the front one—and then you lose track of which pair of holes you're dealing with; so out with the flashlight and the mirror all over again. Not very cybernetic, and I cannot allow myself to sympathize with the Crown engineers who had to get that horrendous number of connections underneath the rows of sockets. That's *their* problem. Ha ha.

How about an optional decal or card, for viewing all inputs from the front position?? That could help a lot.

Peanut problems, these. The visible glory of the IC-150 is the gorgeous front panel, resplendent in chrome and brushed aluminum, with the four big, silky knobs and the dual tone controls. Those knobs! A semantic headache. I have very nearly wrecked my system time and again, through mis-aimed adjustments. Wrong knob; *wrong position.* They are all identical. But not their functions nor their working positions. A typical cybernetic stew, if you ask me, though I do love 'em, both as to looks, not to mention performance.

Knob One, to the left, is SELECTOR, seven positions. No problem. Knob Two, visually identical, is VOLUME and, mind you, a lot of wattage is thereby smoothly controlled. Normal volume is around ten o'clock. At noon I'm blasted. Beyond that—mayhem. So *one does* **not** *turn this knob beyond the top position.* But the next identical knob,

Knob Three, is BALANCE—and the normal position is up, at noon. To get right channel, you turn it all the way clockwise, and vice versa. Fine—except that I grab VOLUME half the time. Disastrous! There's worse. Knob Four, identical again, is called PANorama. Now, *its* normal position is turned far left, counterclockwise, which gives you normal stereo. At noon, you get mono. Far right and you have reverse stereo. Phew! Three knobs, each with a different "normal" position, and all lookalike. Turn the wrong one the wrong way and you have either disaster or sonic chaos. I have it much of the time. I just can't learn. You have to think each time—and you shouldn't. That's what I mean.

This IC-150, nevertheless, is the finest and most versatile control unit I have ever used (coming after the ancient Fisher 400 CX, only recently retired—the one with the colored lights that really worked). I owe the IC-150 a debt of gratitude. For the first time I can hook *all* my equipment together at once, a marvelous convenience. I find many semi-pro operations possible with it that I have never before been able to pull off, including a first-class equalization of old tapes and discs via the smooth and distortionless tone controls (and the second main audio input and output). I have rescued some of my earliest broadcast tapes by this means, recopying them to sound better than they ever did before. A fine machine, if a bit whacky in its externals; so thanks muchly, Crown, and better cybernetics next time.

Then, in four-channel, there's the handy little add-on Lafayette LA-524 with SQ decoding (and "composer"), which includes a stereo power amp for your rear speakers, but uses your present amp for the front pair. A lopsided configuration, to meet a present need, and it invites some confusion—but I've been using the thing for some months with great success. It connects so that you can run all four channels via its volume control or balance front and rear or individual channels. Alas, it is now out of service. Ahem, er, etc. I made a little semantic mistake. I misread a visible symmetry. Now there's only one channel. My fault for being stupid, but not *entirely* my fault.

The problem was that I misread the layout. It was more lopsided than I thought. Two pairs of RCA output sockets, one at each end of the rear panel. (But, I'll admit, not quite

symmetrically placed—probably on purpose.) One pair was to feed the power amp for the front speakers. Regular "line" level. The other pair fed "remote speakers," rear channels. But at what level? A switch on front turned off the rear speakers and diverted the signal to those rear outlets.

Well, what I needed was a feed from the four channels which I could mix with voice signals—music and voice in each of the four inputs to the recorder. The TEAC has a mic and "line" mix for each channel and I had nothing else on hand—so I figured I'd use the mic inputs, feeding very low. It worked fine on the front two channels. At Lafayette's lowest volume, the front outputs didn't overload the mic input and only a bit of hum resulted. Now, the other two channels? Well, thought I, maybe the other two outputs are also at "line" level. (Amateur line, that is, home-style.) Suppose you wanted to bypass the Lafayette built-in rear amps? There *ought* to be a pair of outputs for that, to match the front ones. And symmetry of position (more or less) indicated that just maybe, that designation "Remote speakers" in fact meant "output ot remote amplifier for rear speakers." Four RCA plug outputs, one for each channel. Yes?

Well, I was wrong, as I found out when the power signal that I actually had from those rear "remote" RCA sockets accidentally touched ground as I tried the mic recorder input. *Pssst*, and that was that. Power transistor. Funny thing is, it worked, until then. The speaker output *did* drive the mic input, usably, for an emergency operation with nothing else on hand.

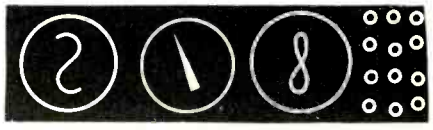
Sure, the moral is: read the instructions. There weren't any. This was an early production model. I figured everything else out OK, but I didn't take into account the basic lopsidedness of the unit—I fell for a false symmetry. (When you get yours, there'll be instructions.)

The incident, and the Crown panel configuration, serve to illustrate the unsuspected dangers of misleading design symmetry for the eye—or a symmetry, when that is misleading. Plugs, sockets, knobs, all have instant meaning. They carry a very real message; they should always give the *right* message, at a glance and without ambiguity.

If our hi-fi engineers would think of their visible controls and connections as in themselves a form of direct communication, as precise as words and a lot faster, we would have fewer mistakes and confusions of the outward sort I am now describing. Knobs speak. Front panels talk loud. Rear panels shout. If the electrical connections inside your equipment must be precisely right, then the visual connections between equipment and the eye (and by feel—equally important) must be just as clearly defined. Functional symmetry for the eye must reflect exactly the same symmetry in actual operation—and the same for unsymmetrical layouts. If two operational functions are really different, then they should be different in looks, in placement, in feel. Not easy in the designing. But then, what is?

There are endless ways in which the basic cybernetic aim can be accomplished. Location is important. You will never confuse two identical controls at opposite ends of a panel—unless their normal settings are confusing. Remember when we finally standardized tone controls, normal or flat position straight up, boost right, attenuate left, and the bass tone (like the piano) on the left of the treble? Before that, tone controls were dismally confusing. Position is first, but color is good, too. Shape counts heavily. Avoid those rows of indentical knobs! Surface texture is very useful. Action counts. Clumping of related controls is an obvious necessity. (But be careful!) Above all, use symmetry only when it is meaningful, and the same with asymmetry. For motions, be natural. Remember the Shure pickup arm where you pushed a button *down* to lift the head *up*? The arm was vertically rigid. Nice, but wholly against nature, and of course, opposite to all other arms. Nobody could ever learn to use it right. I tried, then gave up and lifted the little head *up* off the record with my own fingers. Don't make 'em push a left button to activate a right speaker either. That's like a steering wheel that turns the wrong way. Nobody does things like that? Oh no? On my TEAC, in order to go fast forward you must (a) move a lever towards the *left* and then (b) push a button on the *right*. I muff it every time. No matter that TEAC has excellent reasons for having that lever right there. Very useful in other respects! But deadly for fast-forward.

No wonder designers have headaches. It's an unsymmetrical world. AE



Classical Record Reviews

Edward Tatnall Canby

Mozart: Chamber Music on 18th Century Instruments. (Flute Quartet, K. 298; String Quartet in C, K. 157; Clarinet Trio in E Flat, K. 498.) Die Instrumentisten. **Musical Heritage Society MHS 1169,** 1991 Broadway, New York, N.Y. 10023, stereo.

Mozart on old instruments! The new wave of "authentic" performances now spreads into territory where modern instruments are so much taken for granted that it is almost a shock to realize that the music surely sounded much like these performances when it was first heard. All the instruments used here—strings, clarinet, flute, piano—are of the Mozart period or earlier.

The early-Mozart String Quartet is the least affected. Its four instruments, all made in Vienna in the 1720s, a half century before Mozart, are of course relatively "new" as strings go; but they are without the modern tightenings-up that have given our present powerful sound to violins much older. Their sound is a bit less brilliant than we are accustomed to, more gut-like (literally) and—we may guess—their collective volume is less than that of a standard modern string quartet. On discs, volume is purely relative and brilliance depends on recording acoustics and mic placement. The Flute Quartet is another story. The sound of the Mozart-period flute, a wooden instrument with finger holes like a recorder, is curiously breathy and coarse in the lower register but soars into the upper regions with a fine sweetness of tone, not as silvery-golden as that of the modern metal flute but lovely even so.

As for the clarinet and piano, the sounds are startlingly different if you have not had experience with similar old instruments before. The clarinet sounds much like ours but with a strangely animal-like quality, a more growling tone in the low (chalumeau) register, an almost horn-like turgidness in the upper areas. The 1795 Viennese *Hammerklavier* used in this recording has the characteristic jangling, half-harpsichord sound already familiar in other recordings of early piano music, but I would say that this instrument was not in very good condition and/or was injudiciously exposed to close-up mics. The tone is thumpy and twangy, the action uneven, if rapid—surely not the sound of an instrument of 1795 in the condition Mozart would have expected. Nevertheless, with a bit of mental reservation on this score it is easy to hear the sound of the Trio as it might have been, and it is a good sound.

Nicely thought out performances throughout the disc, intelligently musical and very professional.

Performance: B Sound: B

Mozart: Quintet for Piano and Winds, K. 452; Oboe Quartet in F, K. 370; Horn Quintet in E Flat, K. 407. Frank Glazer, pf., Ray Still, Oboe, John Barrows, horn, the Fine Arts Quartet, New York Woodwind Quartet. **Orion ORS 7281,** stereo, $5.98.

For those of us who constantly make "AB" comparisons on records of a sort very seldom heard by practicing professional musicians, the qualities of an all-American stellar performance, such as this, are startlingly unlike those of imported European performances, from the European heartland. It may be increasingly One World, but our American music still is worlds away from the sources of its literature, over there in Germany, Austria and so on.

These are all "prime" Mozart works, the best known in the area of wind chamber music with strings and piano, all of them frequently played wherever Mozart is heard. The quartet for winds with piano is given an expert but curiously fussy performance, notably in Frank Glazer's somewhat nervous and over-elaborate playing, a bit more piano than Mozart, so to speak. The wind playing is impeccably professional and a trace on the deadpan side—all of which is typically American. Nothing really *wrong;* and yet one feels that most top-rank European performances would put Mozart himself more in the foreground.

The works for oboe and horn solo, involving the smoothly professional Fine Arts Quartet, have a similarly objective sound, somehow detached, if objectively expressive. The oboe, however, is excellent—Mr. Still really puts his soul into his solo line. The well-known John Barrows does a fine modern-type horn performance—except for the trills, which for some reason are agonizingly muffed every time. Why didn't he just leave 'em out? (Mozart's hornist, remember, did not even have valves; the playing was all done via the lips.)

It isn't easy to put the American-ness of this recording into words. Perhaps most listeners will not even hear it. But it is surely *there.* Somehow, even among these top ranking musicians, there is upgrading of professional production, a subtle downgrading of the composer himself and of the whole idea of differing musical styles. These are not so much performances of *Mozart*—though Mozart is really not at all harmed—as performances of string music and wind music, with solos for oboe, horn, piano. That is the product of our conservatory training system, every time.

I am sorry to note that on my machine the two string recordings, with the Fine Art Quartet, are edgy and unpleasant in sound. Could be stylus trouble (mine *or* theirs); but in any case the recording itself is loud enough and brilliant enough to strain any equipment towards its distortion limits. Not a good idea.

Performance: B Sound: C+

Luciano Berio: Laborintus II. Ensemble Musique Vivante, Perio. Edoardo Sanguineti, speaker. **RCA LSC-3267,** stereo, $5.98.

Wow! If you enjoy unusual uses of the medium of sound, keep your eyes and ears peeled for Luciano Berio and

buy him quick whenever he appears with a new LP—which is often. He'll wow you every time.

Berio is offically a "classical" contemporary composer, but whether that kind of category makes any sense for him is a question. He deals with extraordinary sound structures in the round, which combine a hair-raising use of the human voice in every sort of sound it can produce, and more—singing, laughing, shouting, wailing, shrieking or merely talking—with an equally sophisticated use of conventional musical instruments plus, of course, various electronic sounds. But it is always the voices that predominate: the instruments reinforce, though with immense strength.

This piece is a vast "3-D" sound projection of the poem in Italian of the same name (hence "II") by Edoardo Sanguineti, who speaks portions (or all of it?) here and there in the midst of the disciplined hubbub. The vast surrounding amplification of vocal and instrumental sound is what makes this work and *is* the work. There is nothing, but nothing like the human voice for sheer dramatic impact, as any Italian knows! Maybe Berio can be thought of as the ultimate Italian opera composer—for there is all the excitement, verve, pathos here of the corniest, most glorious Italian opera you ever can imagine, in totally contemporary terms. Marvelous stuff.

Performance: A+ Sound: A

Stravinsky: *L'Histoire du Soldat* (complete). Actors, Instrumental Ensemble, Dutoit. **Musical Heritage Society MHS 1356,** (*1991 Broadway, New York, N.Y. 10023*), stereo.

If you can follow spoken French, this is by far the best of a number of excellent complete performances of this little stage work with music now available on discs. Indeed, though the music is beautifully played, it is the spoken drama itself which comes through here in a new and powerful way. Usually, the semi-parable of the foolish little soldier, taken in again and again by the devil in various disguises, is put on in a semi-ironic vein, stylized, sing-song, dry, urbane. In contrast, the story here is acted realistically, almost furiously, and the results are impressive. The soldier himself is sullen, defiant, low-key, until he is aroused to passionate despair. The devil is not only shrewd and cunning but, in the acting of François Simon, a chilling sort of a horror figure, the arch-fiend himself, epitomizing all the evil seducers of the helpless from the dawn of legend down to our own chilling time. I was really jolted. I had not realized that the little piece could be given such genuine dramatic power.

Even the recorded acoustics are newly intelligent—instead of the conventional vast liveness of this stereo age, this one is dry and cool in sound, exactly suiting the music. I own Stravinsky's own original French recording of this music, done back in the very early 1930s; it has a very similar acoustic setting.

Performance: A Sound: B+

Cristina Deutekom in Vienna. (Zeller, Ziehrer, J. Strauss, Jr., Josef Strauss.) Orch. of the Vienna Volksoper, Allers. **Philips 6500 228,** stereo, $5.98.

It is astonishing how at any level, high or low, an ideal and perfect musical performance can make a memorable impact! Here's one for fair. A marvelous disc. What is it? Nothing fancier than a batch of Strauss (Strauss-type) Viennese waltzes and the like, not the originals but arranged for a coloratura soprano solo, with words to fit. Sort of second-hand Vienna, if you wish, a hand-me-down idea, like mood-music transcriptions of Beatle songs, or grand opera for the piano.

Technically—yes. And the words, which I assume were written to fit the already-composed tunes, are about as sappy as you can possibly imagine, the Austrian equivalent of the moon-June biz. No translation is provided, and just as well.

But just listen! And listen further. The loveliest *echt*-Viennese orchestral waltz playing you are likely to hear—how do they do it? How can they play this familiar stuff so stylishly, so freshly, so musically? It's a tradition more than a century old that for reasons unfathomable seems to stay youthful, at least in its home town.

And then, there's this lady who sings, this Cristina Deutekom. I don't know whether she, too, comes from Vienna, and they don't say. But she is, one way or another, a Viennese singing genius, with a lovely, gentle, brilliant voice, superbly controlled, musically accurate and sensitive, who sings so utterly easily that the vocal art of it is almost unnoticeable. Superb! Her sense of style is uncanny, even to the singing of the sappy words, which she projects with just enough emphasis to get their shapes over, plus a trace of their meaning, enough—who wants more? The slightest exaggeration or over-emphasis

would bring the whole down in ruins. (Which is why I sometimes detest our fabled American musical comedy. It never knows when enough is *enough*.)

Well, even if you are a U.S. musical comedy aficionado, you'll fall for this gal and her music and that of the wonderfully stylish Strausses and their less well-known cohorts, Zeller, Ziehrer, et al. The waltzes, by the way, are in the long, complete format, with traditional slow symphonic introductions and all, and some of the works are non-waltz, for contrast: Csárdás, polka, etc.

Performance: A Sound: A-

Richard Strauss: *Symphony for Wind Instruments* (1945) "The Happy Workshop"; *Serenade for Winds,* Op. 7 (1881). Netherlands Wind Ensemble, Edo de Waart. **Philips 6500 097,** stereo, $5.98.

A *first recording* of a late Strauss work? Hard to believe. Yet there it is, and I found this one of the most enjoyable performances of "new" Strauss I have ever heard. It is a suite for winds, in effect, a normal-length "symphony" that grew—in typical Strauss fashion—out of a piece that was more or less intended to be a small thing. It is long, as usual with the old man. But it does have, relatively, a small-scale feeling, and a conciseness, that is dismally missing in, say, the endless lengths of his "Metamorphosen" or for that matter the vast and familiar early tone poems.

The ancient composer had been sick; he recovered and turned out two works, this and another, as a sort of recovery or convalescent exercise. The music is in fact full of *joie de vivre*—at eighty-one—and all sorts of easy good humor. It is a miracle of late-Strauss craftsmanship, too, with all pretentions and pomposities washed clean away nor even the slightest attempt to be modern, or pseudo-modern. Why should he? After all, his musical voice found its language in the 1880s when even Tchaikovsky was youngish and the big Romantics were still alive and busy. The complex early Strauss style is now, in this late period, simplified and condensed, built out of the most elementary harmonies, almost free of dissonance, yet of an intensity that goes far beyond his prolix early music. Yep, I like it!

And these young Dutch performers, two-thirds with long hair (including the young conductor), are without a doubt the finest wind ensemble I have

ever heard. It literally breathes as one; the expressiveness, the *unity* of musical feeling, is uncanny. This is wind playing at its absolute best. I cannot imagine any listener, any listener that is who is willing to give the music his foreground attention for at least a quarter hour or so, who will not be affected by this extraordinary communication in sonic terms.

The short (relatively) Serenade was a high school exercise on the part of the young Strauss and one of his first works to get around. It sounds pleasantly like early Brahms or Schumann, but the technical high-jinks that quickly develop are ever so definitely of the composer-to-be. Nice companion piece to the bigger one, composed more than a half century later. The Philips recording is superb throughout.

Performance: A+ Sound: A-

Glière: *Ilya Murometz* (Symphony No. 3). Philadelphia Orch., Ormandy. **RCA LSC 3246,** stereo, $5.98.

If you follow the works which have been proved "ever popular" by somebody or other, you'd better get this one. It's ever-popular, I suppose, because orchestras like the Philly keep right on playing it. In musical terms I can see no better reason. Of course, the splendidly lush orchestration could have a lot to do with it. What with Beethoven and Mozart asking for so few active players (and the rest of the orchestra eating its head off), we need a big, lush piece like this to keep everybody happy at their work.

Who but the Philly could play this with such a professional éclat? Totally deadpan. After all, if they became too involved, they might start to laugh out loud. It's pretty dated bombast when you come down to it, even for busy musicians.

Performance: B+ Sound: B+

Copland: *Piano Sonata* (1939/41) *Passagaglia* (1922); *Four Piano Blues* (1949); *The Cat and the Mouse* (1920). Robert Silverman, piano. **Orion ORS 7280,** stereo, $5.98.

We all know Aaron Copland's semi-popular symphonic and ballet music of the 1930s and 1940s, *Billy the Kid, Appalachian Spring, El Salon Mexico.* The "serious" Copland, throughout his life, is very much the same man but may shock you if you expect it to be easy. The composer has always cleaved to the American idea of "classical" music or serious music and his output

has been divided along these lines from the beginning of his career. Lately, it is all "serious"—even the orchestral works.

The big *Piano Sonata,* already familiar to my ears, is the major item on this disc. The others are short, with only the youthful and Debussy-like *Cat and Mouse* and the trifling little *Blues,* gifts for friends, in a light vein. The *Sonata* has found a dedicated and earnest proponent here in Robert Silverman. He will make more sense of it by far for you than any other performer I have heard. He is serious, too, but he plays gently as well as powerfully; he really tries to communicate; he is not merely showing off his ability to toss off tough modern works. He also writes a refreshingly honest set of personal notes to the music. Unpretentious pianist, but a very, very good one as well.

Performance: A- Sound: B+

Highland Bagpipes. Seumas MacNeill. **Everest-Tradition 2099,** sim. stereo, $5.98.
18th Century Hunting Music. Collegium Musicum of Prague. **Everest-Tradition 2102,** stereo, $5.98.

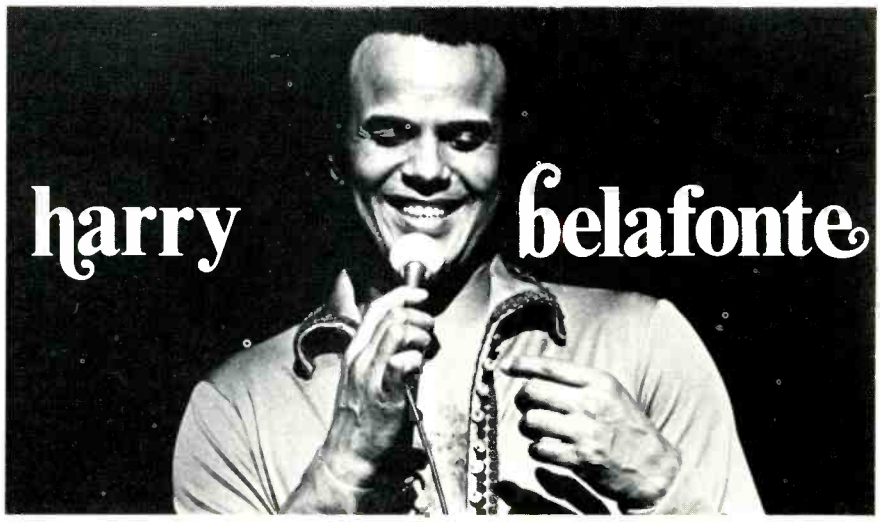
Two items out of Everest's enormous bag of bought-up reissue material from all over, both with special interest.

Well—what can one say about bagpipes, if one isn't a bagpipe expert? This disc is "hi fi," if not stereo, and the sound is close-up and without space; it isn't one of those distant marching-effect recordings. All the tunes are played on the one instrument, evidently, and so the drones are always in the same key, if you don't count a tape slow-down on side 2 that sags the pitch downwards a halfstep. Not really noticeable. Fast pieces, slow ones, with exotic and pleasing titles, like the Stool of Repentance or Playing in a Draft; but in the listening it's all just so much bagpipe music. What else?

As for the hunting music, it is a mixed bag of Czech stuff, by a brace of Czech composers, out of the later 18th century, of whom Dušek is moderately well known. Hunting calls on horns—they won't get you up and out into the woods; in the living room they are not inspiring. More elaborate hunting-style pieces—these are nice. They include two "Parthias" for woodwinds, duets, trios, a quartet, marches, all very horny and woodwindy.

Performances: B Sound: B

weingarten: Off The Record



WHOOOOOOOOSH! Where'd the time go?

To most, **BELAFONTE. . . LIVE!** (RCA Victor, VPSX-6077) will just be a double-disc album, albeit an excellent one; to me, however, it's a time capsule.

It's been 10 years since I heard Harry Belafonte sing on stage, but his new LP makes that evening as clear as this morning's shower. The similarities amaze me, from his emphasis on calypso to his slightly hoarse sound, from his overt sensuality to the format of his show.

In a decade, naturally, he's broadened immensely—mainly by entering other arenas, the movies, television and politics; I've gone through one or two changes myself, of course, but not enough to alter my view that he's one of those rare performers who cannot fail to electrify an audience.

The album, recorded at O'Keefe Centre, Toronto, Canada, contains 15 cuts, four of them by South African singer Letta Mbulu (a decade ago the distaff side of his show was another new arrival from the African continent, Miriam Makeba). Most live vinyls today, with the stress on rock at a decibel count almost guaranteed to deafen and lyrics buried beneath the sound avalanche, leave much to be desired; this one, with extraordinary reproduction for a live outing, can only be termed slick, slick, slick.

Belafonte, who is well-supported throughout the show by the Howard Roberts Chorale, begins with a soulful, rousing medley, *Look Over Yonder* and *Be My Woman, Gal.* He slides, then, into Jerry Jeff Walker's *Mr. Bojangles,* which is the closest he comes to aiming directly at a youth market via contemporary tunes.

Leonard Cohen's haunting *Suzanne* is next, poignant despite an almost-cutesy orchestration, with Belafonte, as usual, enunciating as clearly as if he'd just stepped from a speech class.

Wedding Song he offers with all its loveliness and meaning, surpassed only by the undertones of pure sorrow in his encore, perhaps the most moving ballad-allegory of the Sixties, *Abraham, Martin and John.*

He's good when doing the slow stuff, but where he's best, for both nostalgia buffs and moderns just learning of the marvels of the genre, is when he does a number on calypso. *Out de Fire,* for instance, is a throwback to his recording roots, including audience participation, a zest impossible to duplicate and just plain fun. It's not quite as fantastic as the *Matilda* things he used to play with, but it'll more than do as a second-time-around gig. And *Carnival Medley,* a 17-minute, 20-second interlude, may be the best commercial calypso montage ever cut.

Belafonte has outlasted most recording artists being pressed when he was starting. The reason's obvious: talent. And if you want to toss in an overworked word, try "charisma" too.

Besides that, he knows how to sur-

round himself with people blessed with the same attributes. Ms. Mbulu, for example. I don't know the language, but Mbulu *must* mean marvelous, for she has a voice that reminds me of twinkling crystal. And the native-land tunes she recreates, two slow and two with a quicker tempo but all *now*, make the eardrums quiver with excitement.

Another part of the Belafonte troupe is Ella Mitchell, a gospel thrush who causes things to shake—via two tambourine-tapping stompers plus a high-powered, less heavily beated opus from the Mahalia Jackson school of religious music.

All in all, the double-disced album is sure to please, even if you don't have whiskered memories to cling to.

Another top-notch double-record album, in a different vein entirely, is **LIGHTS OUT: SAN FRANCISCO** (Blue Thumb, BTS 60004). Voco, a producer-writer, presents an 11-cut anthology by various artists that he collectively labels "The Soul of the Bay Area." But that tag is misleading, for the collection's mostly jazz, although it also delves into blues and soul, Eastern music and country material.

Sound quality, it must be noted, is exceptional; there's a richness throughout that can hold the listener spellbound.

John Lee Hooker's earthy voice and weary guitar are featured first, on the title tune, a jazz-blues piece on which Robert Hooker shines on organ. *Voco* is next, spotlighting some wild piano by its composer, Clifford Coulter.

Loves to Do It is a soul screecher featuring the voices of Jo Baker, Linda Tillery, Lydia Pense and Rich Stevens, all solo vocalists with heavy groups. Sylvester, backed by his own main men, sings and plays piano on Leonard Cohen's *Hey, That's No Way to Say Goodbye,* and *Why Was I Born?* provides blues with gospel overtones.

Brother Antrainik, penned by Voco, puts Fadil Shahin in the limelight with electric and acoustic oud, zils and dumbeg, and the Eastern mini-show continues with the more lyrical *Dina.* Finally, *20/20 Vision*, with Dan Hicks, Maryanne Price and Naomi Eisenberg contributing the vocals, is a down-home bluegrass-jazz entry.

The whole thing's sort of a de luxe musical smorgasbord; nibble at each piece for a while and you end up wanting to devour more than you can at a single sitting.

A third double-barreled entry in the two's-better-than-one sweepstakes is **RICHIE HAVENS ON STAGE** (Stormy Forest, 2 SFS 6012). Havens, whose low-register voice often has much to say, backs his singing with rhythm guitar and a section consisting of Paul Williams on lead guitar, Eric Oxendine on bass and Emile Latimer on congas. Their effect is that it sounds like a lot more musicians on stage than there really are.

The singer-writer, unfortunately, limits himself to three of his own creations, leaning on interpretations of contemporaries for the other 13 tracks. The result is that he's put out much better discs, particularly those emphasizing his inner self and his fury at a society that torments blacks. And here, because on too many of the songs he performs alone, his strumming the same chords over and over and over and over becomes an irritant.

Highlights include a driving, cookin' number, Billy Edd Wheeler's *High Flyin' Bird* and Jesse Fuller's *San Francisco Bay Blues.* In contrast, though, Pete Seeger's *Where Have All the Flowers Gone* loses its anti-war

poignancy because it's speeded up and the poetry disintegrates.

Among the things possibly worth a spin, if you enjoy Havens, are Paul Simon's *Old Friends,* Fred Neil's *Dolphins,* George Harrison's *My Sweet Lord,* Bob Dylan's *Just Like a Woman* and the Beatles' *Rocky Raccoon.* But overall this is an umbrella step backwards.

For those who, as I, like to wait around for hit compendiums, a couple of new ones merit more than a casual listen. **THE BEST OF OTIS REDDING** (Atco, SD 2-801) offers 25 cuts on two records, and **TONY BENNETT'S ALL-TIME GREATEST HITS** (Columbia, KG 31494) provides 20 on a pair of vinyls.

Redding, who died in 1967 and spawned an ardent cult of followers, shows what soul singing is supposed to be. Backed by Memphis-based musicians who have gone on to name-flights of their own, he is best on Mick Jagger's (I Can't Get No) *Satisfaction,* a musical blue streak; his own *I Can't Turn You Loose,* a bouncer that you can't help moving with, and a tune he penned with Steve Cropper, the bluesy (Sittin' On) *The Dock of the Bay.*

But don't miss *Tramp,* a duet with Carla Thomas; *Fa-Fa-Fa-Fa-Fa* (Sad Song), *Try a Little Tenderness,* his own *Respect* and Sam Cooke's *Chain Gang.* Winners all.

Support, not incidentally, comes from the guitar of Cropper, the piano and organ of Isaac Hayes, the bass of Donald "Duck" Dunn, the drums of Al Jackson Jr., and the piano and organ of Booker T. Jones.

Bennett, who probably bridges the gap between commercial pop music and jazz better than any current male singer, offers a wide range of material, originally cut as long ago as 1951 and as recent as this year.

Pick the best? Impossible! I'll just catalogue some of the wares so you can see what's available: *Something, For Once in My Life, The Shadow of Your Smile, Rags to Riches, I Left My Heart in San Francisco, Because of You, Boulevard of Broken Dreams, Stranger in Paradise, I Wanna Be Around,* and *Just in Time.*

Slow, fast, moderate; sweet, sad, loud and soft; a little bit of everything and, as I've heard someone or other say, a little bit o' heaven too.

Lastly, there's a spoken-word album that's been bouncing around quite a while that merits special attention despite its age. *Ken Nordine's* **HOW ARE THINGS IN YOUR TOWN?** (Blue Thumb, BTS 33).

The package, two discs containing 22 cuts crammed with reissued material, is a specialized novelty, a unique set that is humorous and playful with serious undercurrents. Originally recorded on four "Word Jazz" platters between 1957 and 1960, the mental meanderings, usually backed by mild instrumental jazz modes, shows how much foresight Nordine had, how many of his ideas were valid then and valid now, the passage of time making no difference at all.

The liner notes explain that, in his own words, Nordine's themes were comprised of "a thought followed by a thought followed by a thought ad infinitum, a kind of wonder-wandering . . . It's what I am; it's what we all are."

He further indicates that the albums "are existential facts of some of my thought-travels, collections of the truths, half-truths and fractions of truths that I wonder about."

Nordine, whose clear, low-key voice is alternately sexy and profound and cute, runs the gamut of ideas in free-

form style, not unlike the technique used so well by the late Lenny Bruce. The difference is that Nordine is more casual, much less hyper, and less flamboyant in his approach to satire. There's no hammer, unless its head is draped in cotton, and often you get from his material what you bring to it.

Among his topics are unthinking people, getting hung up on a one-faceted life, hallucinogenics, the inability of man to accept heroic figures for long, and charlatan political candidates who speak only in platitudes.

If there's a dusty copy on your local record shop shelves, pay the price. At worst, it'll be a conversation piece; at best, entertainment—thoughtful entertainment—graded A.

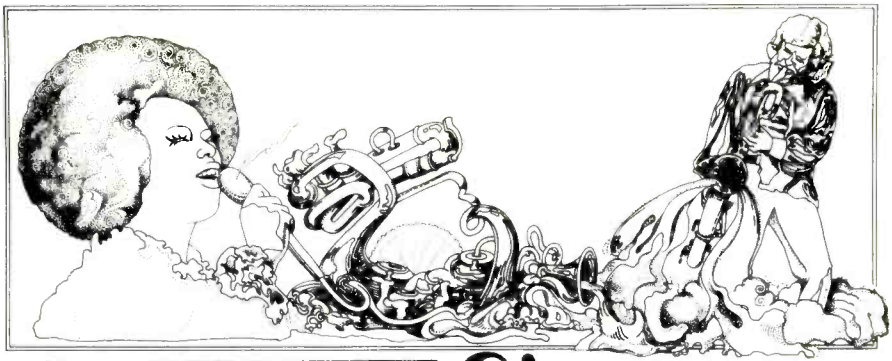
You'll Never Be Lonely With Me (Kama Sutra, KSBS 2049) puts *Jim Dawson* in the lime light. He sings, plays guitar and piano, and manages to stay within the confines of mediocrity. His folkish voice is shallow, his range limited. And despite one good tune, the moody "Wednesday," he doesn't get his druthers ("I wanna know I'm not just an ordinary man," one of his lyrics intones).

Rocky Mountain High (RCA Victor, LSP-4731) finds *John Denver* getting better and deeper. The composer-singer offers eight cuts, including the five-part *Season Suite.* Highlights include the hit title tune, the melancholy *For Baby* (for Bobbie), the Beatles' *Mother Nature's Son,* John Prine's bluegrass special *Paradise,* and *Prisoners* (which deals with entrapment by life's routine).

Day By Day (Paramount, PAS-6036) is a middle-of-the-road sound from *Frank Pourcel,* sleepy-time music for the most part that reeks of professionalism. Of the 11 instrumentals, the orchestra is best on *Mammy Blue,* a sprightly thing with especially good horn riffs; the silky smooth title tune, from *Godspell; Love Theme from The Godfather,* heavier than most versions, and *I Don't Know How to Love Him,* with vitality spreading outward like sunspots, perhaps because the melody is sandwiched between that of the flashy title tune from *Jesus Christ, Superstar.*

The Best Of Billie Holiday (Verve-MGM,V6-8808) gives us a dozen cuts electronically recorded to simulate stereo. Lady Day, as the great blues singer was called, is as beautifully creaky-voiced as ever, the sorrow oozing from every phrase. Moody backgrounds are provided by such jazz stalwarts as Charlie Shavers, Oscar Peterson, Barney Kessel, Ray Brown, Ben Webster, Harry "Sweets" Edison, Tony Scott and Kenny Burrell. The recordings, done in 1952 and 1957, are scratchy and filled with surface noise, but you overlook most of it as you become overpowered by the drama in the late Miss Holiday's voice. Best songs? Pick any of them, but my money's on *Strange Fruit.*

Memphis Menu (RCA Victor, LSP-4656) is not up to the usual standards of *Jose Feliciano.* The soul seems faded, and the guitar work dulled. Best is *One More Mile,* a rockin' Mark James tune. Of the 10 tunes, half are his own; 'tis a pity, for he's better at interpreting others (hear, for instance, Dylan's *Lay, Lady, Lay,* Marc Benno's *Good Times* and Jackie DeShannon's *Movin'*). Æ



Jazz & Blues

Martha Sanders Gilmore

Roy Buchanan

Musicians: Roy Buchanan, lead guitar and vocal; Ned Davis, drums; Dick Heintze, organ and piano; Teddy Irwin, rhythm guitar; Chuck Tilley, vocal, and Pete Van Allen, bass.

Songs: *Sweet Dreams; I Am a Lonesome Fugitive; Cajun; John's Blues; The Messiah Will Come Again,* and *Hey, Good Lookin'.*

Polydor PD 5033, stereo, $4.98.

Roy Buchanan is an incredible stylist, an instrumentalist in the purest sense of the word, who handles an electric guitar with care and FEELING. Roy Buchanan plays with inner fire. Roy Buchanan never assaults. After noticing this record peep out through store windows, curiosity would finally have its way. And I'm glad, because I couldn't recommend it more highly. It's a threefold attraction—for anyone who knows the blues, for those with rock inclinations, and for anyone with even a remote interest in the guitar. Buchanan's melodies are staggering, welling up from fresh country springs and forming from a rich lode of blues.

Although this is the first album by the Washington-based guitarist, he is already having a pervasive nation-wide influence. Buchanan was the subject of a National Educational Television special which has earned itself two reruns. In addition, he recently played for a standing-room-only crowd at Carnegie Hall.

If you're in D.C. and are lucky enough to find Buchanan in town at the Crossroads or My Mother's Place, you'll join the cult. He has had rave notices in the Capital too.

The thing that strikes one immediately is his spare attack, a harsh word for the poignant feeling that emerges from the few notes on an instrument on which others play many. Teddy Irwin complements Buchanan well on rhythm guitar, achieving a loose jazz sound abounding with spry chordings and Wes Montgomery octaves. Hear them together in *John's Blues*, a blues that will pucker your mouth and a Buchanan original which tears at the heart strings.

There is no doubt that Buchanan's closest affinity is to the blues and one could buy the album just for *Pete's Blues* alone, in this listener's opinion. Here are seven minutes of highly developed guitar work by Buchanan against a pile-driving Jimmy Reed accompaniment that is insinuating and hard-knocking. Buchanan reaches Alpine high notes, bending tones and transforming his guitar into its Indian cousin the sitar, playing way up the neck, then plucking it like he was riding it down a corduroy road, squeezing out those inner juices.

Buchanan is above all an authoritative melodist as we hear in *Sweet Dreams* as he zings and sings and alludes to Polynesian temperaments. His very own *Cajun* is raunchy and turbulent, while *The Messiah Will Come Again* is a religious statement where soul reigns supreme.

Chuck Tilley comes off well in vocals in *I Am a Lonesome Fugitive* but Dick Heintze's piano is hazy and the rhythm section is at times overly aggressive. Although it is a pleasure to hear them dredge up Hank Williams' *Hey, Good Lookin'*, it somehow falls short of artistry.

Instrumentals have it over vocals in this stunning LP. Roy Buchanan has star quality. Listen to him. He'll keep travelling.

Performance: A+ Sound: B+

Anthony Braxton

Musician: Anthony Braxton, alto saxophone.

Songs: *Dedicated to multi-instrumentalist Jack Gell; To composer John Cage; To artist Murray De Pillars; To pianist Cecil Taylor; Dedicated to Ann and Peter Allen; Dedicated to Susan Axelrod; To my friend Kenny McKenny,* and *Dedicated to multi-instrumentalist Leroy Jenkins.*

Delmark DS-420/421, stereo, $5.98.

The musical entity that is Anthony Braxton bursts forth vehemently on this two-for-the-price-of-one excursion, barreling out viscerally like a train out of a tunnel, spilling everything, unleashing all, stampeding, breaking all rules. It is a one man super-show for Braxton, a total commitment by the young alto saxophonist and musical sculptor who would walk another path. The music is, to say the least, unstructured: melodically, rhythmically, metrically, tonally. It is not intended to be counted. No tuneful purpose was carried out.

Braxton's tonalities are at once abrasive as a chair scraped across a floor and as glass-smooth as highly polished marble. His *To pianist Cecil Taylor* is simply a long single needle-like note held as to infinity—pure, uncluttered, immortal. *Dedicated to Susan Axelrod* is full of quacks, slippery rippling scales and even a few rock-solid notes. But Braxton's art is also a sinewy, muscular contrivance, screaming agony punctuated with goose honks, squeaks, screams, Niagara leaps, and car horns that one never realized an alto could simulate as in *Dedicated to multi-instrumentalist Jack Gell.* In *Dedicated To Ann and Peter Allen,* Braxton recalls an English heath shrouded in fog and one pictures Pip setting out across the moors as Braxton wheezes into his horn like a soft wind in a haunting understatement that only gathers a modicum of velocity.

The sound is not the best and an audible model airplane sound emerged from my right earphone that may have been a stowaway.

There is no question that Braxton is superb technically. His dynamics alone give one pause although his pyrotechnics are perverse and his art, dense and abstruse. This is a self-portrait of Anthony Braxton, depicting his many moods. Music? Well, maybe . . . this

falls into absolutely no category for that is the way Anthony Braxton would have it.

Delmark is indeed adventurous with Braxton. Intense, controversial, this is a record for the connoisseur. You might have to work up to it. This is definitely music for the *fore*ground—not everybody's dish!

Performance: A Sound: B–

The Swingle Singers: Bachanalia
Musicians: Ward Swingle, Jeanette Baucomont, Christine Legrand, Anne Germain, Claudine Meunier, Claude Germain, Jean-Claude Briodin, and Jean Cussac, vocalists; Guy Pedersen, bass, and Gus Wallez, drums.
Songs: *Fugue in D Minor; Prelude for Organ Choral No. 1; Aria; Prelude in F Major; Bourree; Fugue in C Minor; Prelude No. 9; Sinfonia; Prelude in C Major; Canon; Invention in C Major; Fugue in D Major; Badinerie; Air; Gigue; Largo; Prelude No. 19; Preamble; Fugue; Allegro; Prelude No. 7; Solfeggietto; Der Fruehling,* and *Prelude No. 24.*
Philips PHS 2-5400, stereo, $6.98.

There is not a moment's doubt that each of the eight Swingle Singers is a first-rate musician when one hears this two-record compilation of Baroque music adapted and arranged for the group by their very talented 36-year old leader Ward Swingle who studied piano under Walter Gieseking. You may recall the songs from other LPs as they were formerly issued as "The Swingle Singers Going Baroque" and "Bach's Greatest Hit," for which they won a Grammy in 1963. All classically trained vocalists who have laid bare their talents in the field of opera, they show not a hint of strain in this rich "Bachanalia" of Bachdom. Their collective timbre is pleasing at all times, their breathing techniques exceptional and without a telling gasp, and they are punctual, incisive, and well-rehearsed.

But for one who likes his Bach straight—on the rocks, if you will—this project, although novel and ambitious, emerges as a somewhat mechanical contrivance, a highly polished tour de force that, while charming in part, seems to require an untoward amount of detachment by its participants who pay an experimental social call upon jazz (which gives "a certain added stature to jazz," according to Dom Cerulli's notes) and at Bach's expense. Not that J.S. Bach doesn't have the ability to swing, for he lends himself well to syncopation, 4/4 meter, and emotional projection, but the Swingle Singers toy with jazz and Bach with

the cunning of a cat with mouse. It all has the proficient pallor of circus acrobatics and finger-twisting exercises.

Only in a couple of cases have keys been transposed to accommodate the limitations of the voice but so far as possible the works of J.S. Bach and his contemporaries Handel, Vivaldi, and other members of the Bach family have been strictly adhered to. The bass and drums add an attractive voice to Bach's fugal lines and contribute undeviating counterpoint that even Bach may have smiled upon. Accolades to Gus Wallez on drums, who showed off his skills well in *Invention in C Major*, and to bassist Guy Pedersen.

The Swingle Singers use their voices as instruments much the way bop era vocalists did. They bring to mind Lambert, Hendrix, and Ross/Bavan, King Pleasure, Eddie Jefferson, Ella Fitzgerald, Anita O'Day, scat singing with the best of them.

It is an elevating experience to hear the Swingle Singers romp fluently through this familiar Baroque material that was originally composed for harpsichord and organ, but the slow numbers have more appeal than the faster ones which tend to race along at breakneck speed. Bach's *Aria from the Suite In D Major* is soft and lovely, tranquilly accomplished through a kind of calm closed-mouth humming against Wallez's tasteful cymbal work, while *Prelude In F Major* is notable for its chime-like effect and *Bourree* suggests a hummable carol. Christiane Legrand, sister of arranger-conductor Michel Legrand, lends her excellent soprano jazz voice to Bach's *Largo* in one of the few solos, singing out in music that recalls the score of her brother's *Umbrellas of Cherbourg*. *Preambule*, bustling with running scales, is a remarkable technical feat.

The quality of the sound is certainly adequate although not exceptional. The Swingle Singers are of good cheer. Why not listen to their skillful bacchanal interpretations?

Performance: A Sound: A–

Country

Musicians: Michael Fondiler, vocals and rhythm guitar; Tom Snow, vocals, piano, and organ; Steve Fondiler, vocals and bass guitar; Ian Espinosa, lead guitar, dobro, and mandolin; Bobby De Simone, drums; Mark Andes, bass guitar, and Matt Andes, rhythm guitar.

Songs: *Beverly Glen; Love Quite Like Her Kind; Give My Best To Everyone; Traveling Salesman; Janie; Going Away; Fine and Easy; It's All The Same; Man From Alabama; Aragon Ballroom; Killer,* and *Rock and Roll Heaven.*

Clean CN 600, stereo, $4.98.

Country plays soft rock if you will, a low-key fivesome which strikes a balance between the rhythmic turbulence of rock and the gentle commentary that is the way of the folk idiom. They are country. They write their own material, and their greatest talent lies in their harmonics which are apple-wide and optimistic. Vocally they seek the highs much as does the Crosby, Stills, Nash, and Young team.

Here they sing a dozen tunes, employing a dobro and mandolin played by Ian Espinosa in *Give My Best To Everyone.* But trouble is, it's impossible to tell who is actually singing. The notes do not specify on the individual numbers and one has the choice of Michael Fondiler, Tom Snow, or Steve

Fondiler—all are good vocally but one would be hard put to say which is which, where.

The album, while pleasant, is not firey, dynamic, or exciting in the imaginative sense. But it might be a sleeper, the kind of music that ripens upon repeated listenings. And several of the cuts would make fine singles: *Janie,* which is gristly and recalls the r & b of the fifties; *Fine and Easy,* with its sunny lyrics depicting the simple everyday life; *It's All the Same,* a trip in nostalgia, and the list continues throughout side two which is much the better.

The mixing and engineering by Keith Olsen is excellent, achieved with a minimum of electronic phoniness and glimmickry that often plagues the production side of rock recording. Country is on Clean (which well describes them), a subsidiary of Atlantic Records. Try to hear them.

Sound: A Performance: B

Dave Brubeck: Summit Sessions

Musicians: Steve Addiss, guitar and vocal; Louis Armstrong, trumpet and vocal; Tony Bennett, vocal; Chris Brubeck, bass guitar; Dan Brubeck, drums and finger cymbals; Darius Brubeck, piano and vina; Dave Brubeck, pianos, acoustic and electric, and vina; Bill Crofut, banjo and vocals; Alan Dawson, drums; Paul Desmond, alto sax; Billy Kyle, piano; Amos Jessup, vocal; Carmen McRae, vocal; Charlie Mingus, bass; Thelonious Monk, piano; Jim Montgomery, rhythm guitar; Joe Morello, drums; Gerry Mulligan, baritone sax; New York Philharmonic conducted by Leonard Bernstein; Peter, Paul and Mary, guitars and vocal; Palghat Raghu, mridangam; Jimmy Rushing, vocal; Jack Six, bass and Fender bass, and Eugene Wright, bass.

Songs: *That Old Black Magic; Raga Theme for Raghu; Men of Old; C Jam Blues; Our Time of Parting; Blues in the Dark; Allegro Blues; Because All Men Are Brothers; Non-Sectarian Blues; Trav'lin' Blues; Theme for Jobim;* Lonesome/*Summer Song,* and *Koto Song.*

Columbia C 30522, stereo, $4.98.

That many jazz devotees were weaned on the music of Dave Brubeck is a fact. A classically trained musician and a great popularizer of jazz, Brubeck travelled about from campus to campus during the fifties and sixties, playing for thousands of college students all over the country and thereby addicting young ears to this music called jazz. However, his ability to truly swing was and still is a matter of controversy among jazz aficionados. Brubeck's intellectual and experimental approach to the piano through the use of unconventional meters, tempo mixing, counterpoint, and percussive blocks of sound appear in the final analysis academic, contrived, stylized, and somewhat rigid although complex harmonically and rhythmically.

Columbia Records has come out with a rich cross-section of Brubeck here, with all the experimental veins, for which he has become so renowned, laid bare for the sampling. There are his forays into meters weird by Western standards such as in *Raga Theme for Raghu,* excursions into music of other countries in *Koto Song* and *Our Time of Parting,* several blues, a venture into the folk idiom, and a symphonic journey into larger works as in *Allegro*

Blues from Howard Brubeck's *Dialogues for Combo and Orchestra* recorded with Leonard Bernstein and the New York Philharmonic in 1959.

Columbia has skimmed the cream off the top (thus the title) of sessions dating back to the early sixties with some twenty-four well-known musicians and vocalists. Take, for example, the marvellous see-saw dialogue between Brubeck and Charlie Mingus in *Non-Sectarian Blues* from the film *All Night Long* shot in London in 1962. Mingus fairly sings at his work, thumping along right on pitch against Brubeck's spry chordings in a nicely developed number which is pure Brubeck and Mingus.

Brubeck plays and plays, demonstrating his adventurousness and versatility with a roster of luminaries such as Tony Bennett giving us some of *That Old Black Magic*: Mr. "Five By Five", the late Jimmy Rushing, shouting out his own *Blues in the Dark* in a collaboration with Dave dating back to 1960 with some stealthy blues work by the pianist; the stylish Carmen McRae with *Trav'lin' Blues*, in which her sardonic bite gives just the right edge to the blues, and Gerry Mulligan. An energizer of tremendous vitality, Mulligan swings melodically in *Theme for Jobin*, a bossa nova that even Brazilians could learn something from.

Also featured are Peter, Paul, and Mary in a majestic carol-like *Because All Men Are Brothers*, adapted from a chorale from Bach's *St. Matthew's Passion* which is awesome harmonically. The musical talents of Brubeck's entire family are documented here as well. Brubeck's oldest son Darius emitting some Eastern vibrations on the vina, an Indian "four-foot-long stringed instrument with movable frets" in *Our Time of Parting*.

But perhaps our favorite is the classic treatment Thelonious Monk and Dave Brubeck give Ellington's *C Jam Blues*. Monk taciturn and contrite, Brubeck lighter, notier, loquacious. For this track alone it is well worth buying the album! Louis Armstrong's recitation of *Lonesome* is all too sentimental but he more than redeems himself in *Summer Song*, rendered with a smooth legato. Paul Desmond puts on a stellar performance on alto saxophone in *Koto Song* from Brubeck's Japanese tour, Desmond's sound reedy and willowy alongside Brubeck's dreamy notations which resemble twinkling stars and are definitely not delivered with the usual Brubeck percussive touch.

The sound reproduction varies in this LP. Some of the numbers were recorded before audiences, others at Brubeck's home in Connecticut.

Here is a better than average Brubeck sampler, unabashedly eclectic sketches that are neither fish nor fowl. Lovers of Dave Brubeck, whose musical showmanship dates back to the late forties, will be exposed in turn to the persuasive sounds of a glittering array of other fine musicians.

Sound: B+ Performance: B+

Takis Elenis: Dance the Greek Way—The Spectacular Bouzoukee of Takis. **Monitor MFS 722**, $4.98.

The music of Greece tends to be intensely passionate, infectiously rhythmic, and hauntingly melodic. Takis Elenis, a 24-year-old bouzoukee player from Rhodes, captures the very essence of this music in his debut recording on Monitor.

This frisky gaggle of Greek dances of mixed moods and tempi—some are in 7/8, some 9/8—whisk you straight

away non-stop to Greece on the musical wings of Takis and his unnamed instrumental cohorts which include among others, a flutist and accordionist. They romp through "Koritsaki Mou," "Minore Taxim," an improvisation in a minor key, and medleys of popular tunes. Takis is phenomenally fleet of finger and races over the bouzoukee in an artistic albeit stenographic style. The bouzoukee is a stringed instrument out of the Balkans but Takis can be heard in person in these United States at the Britannia Cafe on New York's Eighth Avenue. According to the notes, soon after this recording was made, Takis was invited to join the Trio Bel Canto.

This music of near primitive drama suggests the caprices of Alexis Zorba and most definitely invites the dance. And the audio isn't bad either.

The Travelling People: A Radio Ballad by Ewan MacColl, Peggy Seeger, and Charles Parker.

Vocalists: Ewan MacColl, Peggy Seeger, Belle Stewart, Jane Stewart, Joe Heaney, and John Faulkner.

Musicians: Alfie Kahn, clarinet, piccolo, harmonica, and flute; Bryan Daley, guitar; Dave Swarbrick, fiddle; Alf Edwards, concertina; Peggy Seeger, banjo and guitar; Jim Bray, double bass; Dinah Demuth, oboe, and Bruce Turner, clarinet and alto sax.

Argo DA 113, mono, $5.95.

Here is a fascinating and vivid account in the form of a radio ballad of the travelling people: gypsies, tinkers, and vagrants. It is hard to believe that some 25,000 of them, who came originally from India hundreds of years ago, still float about the Continent and the heaths of the English countryside. Ewan MacColl's lyrics and music are sensitive and "of the folk," interspersed with anecdote after anecdote related by the gypsies themselves describing their long history as outlaws and their struggle to survive as hunted animals, "a despised but clever race."

More than sheer artistry, this is a poignant sociological statement concerning a people who have been persecuted and "run off" in the manner of the Jews. Caravans of them are shoved off of roadsides, driven away like animals, evicted, told to "move on, shift," the lyrics of a tune that threads in and out of the drift of the ballad. The Travelling People have become the victims of industrialization and the man-versus-machine syndrome wherein technology supplants mankind. Thus the need for their rural

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country crafts is negated and they are forced into obsolescence.

The imagery is fraught with the vigor, exuberance, and immediacy of the oral tradition as various spokesmen for the tribes speak of their livelihoods such as horse trading, tinkering, and harvesting. They are a people who resemble our migrant workers but are more diversified jacks-of-all-trades. It is a poignant account with the dramatic feeling and marvellously realistic delivery that only radio can convey. Sound effects abound such as the neighing of horses, the roar of automobiles, and the sounds of children chanting:

My mother said, I never should
Play with the gypsies in the wood;
If I did, she'd surely say
Naughty boy to disobey . . .

The music captures the rustic melancholia of the transition from past to present. Alfie Kahn and Bruce Turner's clarinet work deserves meritorious praise and Peggy Seeger's arrangements and banjo picking captivatingly portray the Travelling People who, like poets, are born, not made.

The radio ballad is well recorded although because of their strong accents, it is difficult at times to understand the words of the gypsy folk. If the enigma and romanticism of the gypsy people has gnawed at your imagination, you will be charmed by this very original effort. And Charles Parker's notes are highly informative.

Argo, a first-rate record company in England, is located at 115 Fulham Road, London SW3, England, in case you can't find this one locally.

Performance: Authentic Sound: B+

Stan Getz: Marrakesh Express
MGM Stereo SE-4696

The big Getz sound is featured on 10 cuts, ranging from the title tune through *I'll Never Fall in Love Again,* Joni Mitchell's *Both Sides Now (Clouds),* and *Raindrops Keep Falling On My Head.* He's backed by a rather large orchestra, conducted by Richard Hewson, who also did the arrangements. Normally a jazz giant, even of Getz' caliber, isn't able to fight his way through "Hollywood extravaganza" arrangements such as this, but careful mixing has kept Getz in front of this group, even if he isn't leading them. Getz is mellow and sweet, and the disc won't turn you off, even if it won't keep you fascinated straight through.

Performance: B *Sound:* A

Tape Guide

(Continued from page 4)

ing the bias frequency. I am thinking of building a new bias oscillator to operate in the range of 200 kHz to 500 kHz, and would appreciate your comments. (I would keep the old 80 kHz oscillator to power the erase head.—Joseph Feng, Kenilworth, Ill.

A. By increasing the bias frequency above 80 kHz I doubt that you will decrease noise except to minimize the chance of "birdies" due to interaction between the multiplex subcarrier and the bias frequency. The principal avenue to decreasing noise due to the bias frequency is to purify the oscillator waveform, which is achieved through excellence in the design and components of the oscillator circuit. Another avenue, I am informed by a correspondent, is to eliminate the erase head (meanwhile using a substitute resistive load on the oscillator) and do your erasing by bulk eraser.

Tape Standards

Q. I would like to standardize on a particular tape. In an article the author indicates that Sony SLH-180 tape is particularly good, and therefore I think perhaps I should use that as my standard tape. But I don't know if my tape deck is adjusted for that tape. I don't know what is involved in adjusting my tape deck to the Sony tape. Can I make the adjustments myself? I don't care for the idea of lugging the deck to a repairman, unless really necessary.—Peter A. Brodney, New York, N.Y.

A. Chances are good that your tape machine and the Sony tape are compatible. Tape machines, particularly those of good quality and reputable manufacture, are adjusted so they will operate properly with quality tapes in widespread use. New tapes coming on the market, in order to compete, must have characteristics essentially similar to other tapes that have already arrived; people won't buy non-compatible items. I suggest that you try the Sony tape and ascertain for yourself whether it creates problems, which are most likely to arise, if at all, in connection with frequency response. If such a problem does come up, it would be necessary to have an authorized service dealer make the required adjustments. Unless you are technically well qualified, I don't think you should play around with internal adjustments of your tape recorder.

Preamp Needed?

Q. I plan to buy a tape recorder to make on-location recordings of local music groups. From these tapes I will make phono records. I don't need a preamp, do I? I can just play the phono records using the preamp in the tape recorder, can't I?—Craig Sutherland, Troy, Mich.

A. Your tape machine's playback preamp provides different playback equalization than required when playing a phono disc. Standard tape playback equalization at 15 and 7½ ips consists of bass boost commencing (3 dB up) at 3,180 Hz and ending (3 dB below maximum) at 50 Hz. RIAA phono playback equalization consists of bass boost commencing at 500 Hz and ending at 50 Hz and of treble cut commencing at about 2,120 Hz. So the answer is that you need a separate preamp for phono disc playback.

Recording a Center Channel

Q. I am going to record a rock group with my stereo tape recorder. My problem revolves around recording the vocalist. Is it possible to split the output from his mic and feed this signal into both channels without affecting the frequency response or other characteristics of the mic?—Harold R. Petrie Jr., Troy, N.Y.

A. I think it is possible to split the signal as you indicate without problems. To minimize the possibility of high frequency loss (particularly if the mic of medium or high impedance) or hum pickup, it is advisable to make the split at the tape recorder end of the cable rather than at the mic.

Storing Tape

Q. I've read several times that to lower print-through on recorded tapes, you should fast wind the tape at least once before playing it, and for that reason to store the tape tail out. I've tried without success to accomplish this. At the end of playback, the tape doesn't wind up on the original reel.—Francisco X. Ramos, Summerland, Calif.

A. If you store a tape tail out, this means you have to rewind it before playing, which puts it on what we'll call reel 2. Then you play it from reel 2 onto reel 1 (the original reel), and you leave it on reel 1 for storage. In short, the tape does get back onto the original reel.

Four-Channel Conversion

Q. Quadraphonics being so much in the news lately has brought the following idea to me. To utilize existing equipment, I have concentrated on using the two-channel capability of my Ampex tape deck. I have decided to add a supersonic frequency-modulated carrier to each channel. This means that the bias has to be set higher than at present. I hope that with a tape speed of 15 ips, a bias frequency of 200 kHz, and special high frequency equalization, a supersonic band of 25-40 kHz of reasonable uniformity can be recorded. Using 32.5 kHz as the center frequency, a 7.5 kHz signal would generate maximum deviation. The tape deck would not need to have the $100 four-channel head and would provide twice the tape playing time of the four-channel system. Do you think such a system is workable?—Thomas Hillard, Downers Grove, Ill.

A. Offhand your idea seems workable. The chief question concerns tape speed. I wonder how many home users are willing to employ 15 ips, considering what this entails in the way of more tape and/or larger tape reels and decks. (In fact, I wonder how many are willing any longer to use 7.5 ips, considering how well one can do today at 3¾ ips with a high quality machine.) The extra cost of a 15 ips machine might easily exceed the extra cost of a slower-speed machine with the $100 four-channel head, particularly taking into account the extra electronics for filtering, FM modulation and detection, etc. There is a further question as to whether a bandwidth of 7.5 kHz for two of the channels is adequate.

Hum at One Speed

Q. I own an Allied TD-1030 Tape Deck. Some time ago, I accidentally unplugged one of the output cables while the machine was running. At 3¾ ips, the speed at which the machine was operating when the accident happened, there is now a loud hum superimposed on the recorded signal for the channel affected. However, at 7½ ips there is no such hum. My obvious question is what would cause hum to be present at one speed but not at another?—John Streby, Flint, Mich.

A. The only explanation that occurs to me is coincidence. Something may have occurred which is unrelated to the unplugging of the cable except that it happened at the same time. For example, a defect may have occurred in the switching mechanism that comes into play when changing speeds. An open switch terminal could pick up hum. As most servicemen can tell you, strange and baffling coincidences are not uncommon. Æ

Audio Clinic

(Continued from page 6)

replaced. When I received this stylus, I also received a brand new cartridge which I did not order.

Depending on what you have to say, I will either install the new cartridge or hang on to it for that rainy day when something will go wrong with the original cartridge.—Brian A. Bauer, Lake Forest, Ill.

A. You should not encounter aging problems with the cartridge itself. Basically, the components inside the cartridge are magnetic material plus very fine wire. I have seen a couple of cases where the varnish covering this wire was of such a nature that it attacked the wire, causing it to open circuit. This, of course, resulted in a sudden, catastrophic failure of the cartridge. Until that time, the cartridge worked flawlessly.

I have seen stylus assemblies which employ damping material which can change in compliance with time. This will give rise to a gradual change in frequency response and overall smoothness. This is a rare condition.

Because you have installed a new stylus in your original cartridge, you should now obtain sound quality as good as was produced by the cartridge when it was first purchased. Chances are very good that you will never need to use that second cartridge.

Any change in the performance of your cartridge would be small. Probably the only way you could keep track of these changes is by checking periodically with a good test record. Check for both distortion and for frequency response. If distortion begins to rise, it is probably an indication of stylus wear rather than changes in the cartridge's performance.

Harmonic Distortion

Q. *What is harmonic distortion?*—Ray Segura, New Orleans, La.

A. Suppose we feed a tone of 1 kHz into an amplifier. No amplifier is perfect. Therefore, in addition to amplifying the 1 kHz tone, it produces energy at frequencies which are multiples of 1 kHz, such as 2 kHz, 3 kHz, 4 kHz, etc. (These multiples are known as harmonics.) Each added harmonic, as a rule, is less in strength than the preceding one.

The fact that these harmonic frequencies were not present in the original signal indicates that the amplifier itself is generating them. These added signals are, or course, unwanted and are, therefore, considered to be distortion. Because the added frequencies are related harmonically to the signal fed into the amplifier, this phenomenon is called "harmonic distortion."

Multiple Use of Dolby Equipment

Q. *The issue of noise reduction is confusing. This is especially true with the talk of Dolbyized FM broadcasting and the possible use of the Dolby system in home disc playback. If I purchase a Dolbyized tape deck, I assume the Dolby system will operate only for the deck in which it is incorporated.*

Will a single, separate Dolby unit be able to serve as a noise reduction unit for all music sources: i.e. tape deck, FM broadcasting and eventual Dolby discs? Even with a separate Dolby unit, will I need an individual one for each music source?—Samuel Neiditch, Highland, Calif.

A. If it appears likely that there will be extensive use of Dolby FM broadcasts and the like, tape machine manufacturers will probably arrange their circuitry so that the built-in Dolby circuitry will be available for use with external equipment such as FM tuners. (It appears that phonograph reproduction would have to employ a variant of the Dolby B system; the spectrum of noise found in phonograph record reproduction is different from that of tape recording noise.)

Let us assume that in your area there is to be experimental broadcasting using the Dolby system. Let us also assume that your tape recorder includes a Dolby system which is unavailable for use by external equipment. The only way to decode these broadcasts is to record them WITH NO DOLBY ENCODING and to play them back with Dolby decoding. Otherwise you will need an independent Dolby system.

If all broadcasters and record makers use the parameters of the Dolby B system, a single unit can be used for all applications. There would be no need to have separate units for each signal source, so long as you are willing to recalibrate it each time the source is changed.

The Dolby system does require a small setup procedure before it can decode the signals properly. At this time I wonder how the FM broadcaster or record manufacturer will provide the proper level tones for use in making these adjustments. Æ

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Are your receiver and speakers compatible? Scott's are!

New Scott fully integrated audio component systems

AM-FM stereo receiver	IHF sensitivity	*Watts per channel	Matching speaker	Frequency response	Power handling capacity, watts
357B	2.5 uV	28	**D-41**	35 Hz to 20,000 Hz	35
377B	1.9 uV	42	**D-51**	30 Hz to 20,000 Hz	60
387B	1.9 uV	57	**D-51**	30 Hz to 20,000 Hz	60
477	1.9 uV	78	**D-61**	30 Hz to 20,000 Hz	80
525	1.7 uV	100	**D-71**	28 Hz to 20,000 Hz	100

All Scott power ratings are continuous (RMS) into 8 ohms, all channels driven.

One superiority of Scott component audio systems over others is that our amplifiers, receivers and speakers are designed from the drawing board up to complement each other precisely in dynamic impedance and power transfer characteristics. This means that when you buy one of the receivers listed above with its matching controlled impedance speaker system, you know the ensemble will reproduce sound better than a component system selected at random. In each Scott integrated system the components are carefully selected so that the receiver has sufficient power to drive its matched speaker pair to more than adequate listening levels, yet not so much as to cause damage to the speaker or drive it into serious distortion.

You'll know the implications of this after you've visited your Scott dealer to hear the fully integrated Scott audio systems he has on display. Or you may receive complete product information by circling our number on the reader response card. All Scott audio components are designed and manufactured in Maynard, Massachusetts USA.

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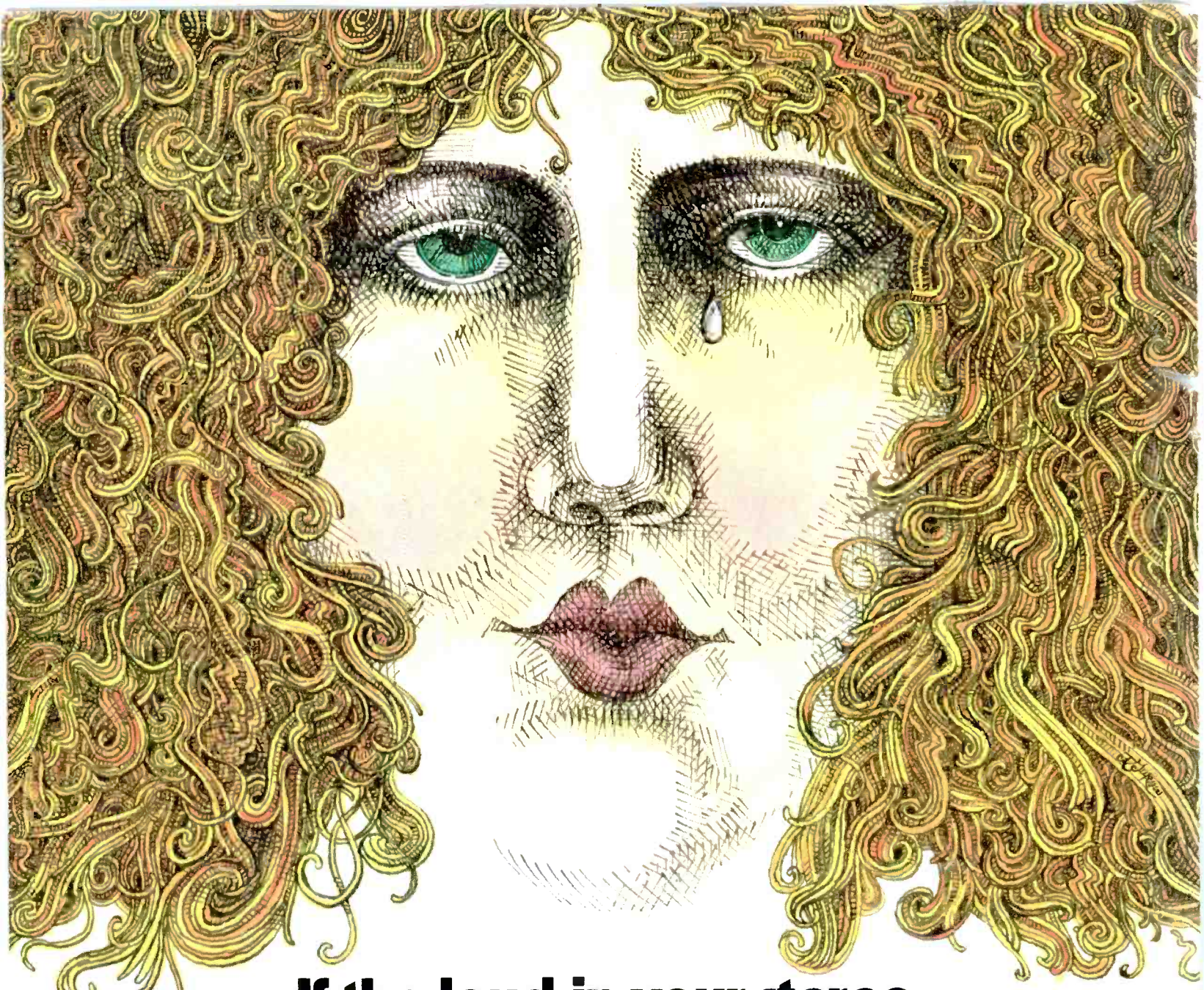

If the loud in your stereo gives her a pain in the head get a Marantz.

It's not that she's got super-duper sensitive hearing (like that spotted beagle two doors down), it's because most women hear better than men, so when she screams turn down the sound what she really means is turn down the damn distortion because the distortion is driving her bananas.

Not so with Marantz stereo. Take the Marantz 2270 stereo AM/FM receiver for $549.95. It delivers a walloping 140 watts RMS power at less than 0.3% distortion...which means virtually NO DISTORTION. And because Marantz measures distortion at continuous full power through the whole listening range—it won't bring tears to her eyes or a pain to her head. NO MATTER HOW LOUD. Other companies measure power and distortion only in middle listening range. So they quote their highest power and lowest distortion only in the middle. But on the low and high sides their power is down and their distortion is up. So if you pay for 140 watts be sure you get 140 watts at both ends and in the middle.

With Marantz you get exactly what you pay for. If all you need is 30 watts, take our model 2215 for $249.95. Want twice as much power? Our model 2230 gives you 60 watts RMS for $349.95. And our model 2245 at $449.95 delivers 90 watts RMS. ALL FULL RANGE CONTINUOUS POWER.

No matter which model you choose, remember this. You're getting Marantz quality. The same quality that goes into the magnificent Model 19 FM stereo receiver (shown) that costs $1200. YES. That's right, a cool $1200! But it is the absolute, ultimate, very best there is.

Visit your Marantz dealer. And take your wife along. (Or that spotted beagle two doors down.)

Marantz®
We sound better.

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