

Sequerra
Tuner Test

Audio

THE AUTHORITATIVE MAGAZINE ABOUT HIGH FIDELITY • AUGUST 1974 75¢

47425 

Speaker
Construction
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DON L HUNTER
2608 CENTRAL BLVD
EUGENE OR 97403



receivers the world

Pioneer believes that any objective comparison of quality/performance/price between our new SX-1010, SX-939 and SX-838 AM-FM stereo receivers and any other fine receivers will overwhelmingly indicate Pioneer's outstanding superiority and value.

The most powerful ever

Pioneer uses the most conservative power rating standard: continuous power output per channel, with both channels driven into 8 ohm loads, across the full audio spectrum from

20Hz to 20,000 Hz. Despite this conservatism, the SX-1010 far surpasses any unit ever produced with an unprecedented 100 + 100 watts RMS at incredibly low 0.1% distortion. Closely following are the SX-939 (70 + 70 watts RMS) and the SX-838 (50 + 50 watts RMS) both with less than 0.3% distortion. Dual power supplies driving direct-coupled circuitry maintain consistent high power output with positive stability. A fail-safe circuit protects speakers and circuitry against damage from overloading.

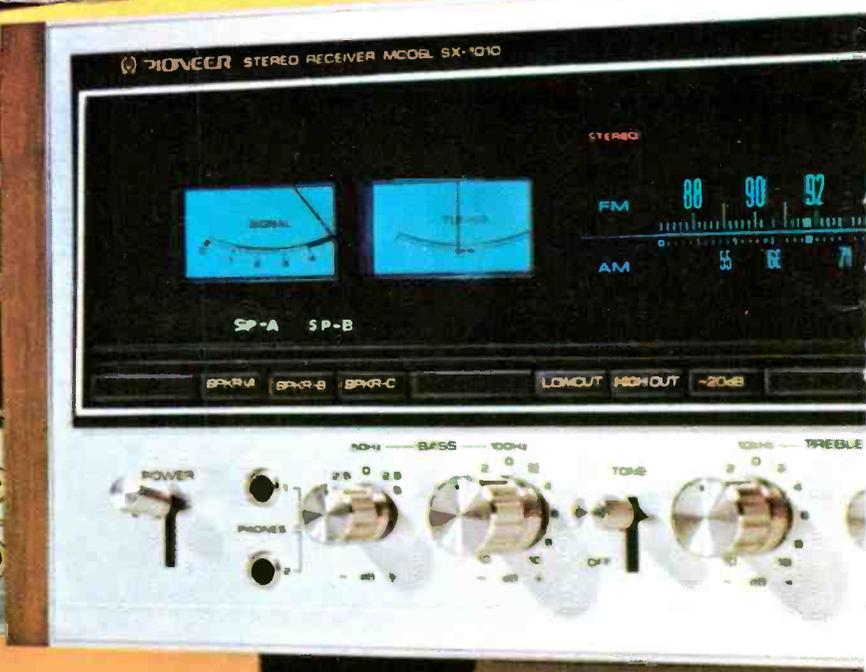
Outstanding specifications for flawless reception

FM reception poses no challenge to the exceptionally advanced circuitry of these fine instruments. Their FM tuner sections are designed with MOS FETs, ceramic filters and phase lock loop circuitry. The result is remarkable sensitivity, selectivity and capture ratio that brings in stations effortlessly, clearly and with maximum channel separation.

	SX-1010	SX-939	SX-838
FM Sensitivity (IHF) (the lower the better)	1.7uV	1.8uV	1.8uV
Selectivity (the higher the better)	90dB	80dB	80dB
Capture Ratio (the lower the better)	1dB	1dB	1dB
Signal/Noise Ratio (the higher the better)	72dB	70dB	70dB

Total versatility plus innovations

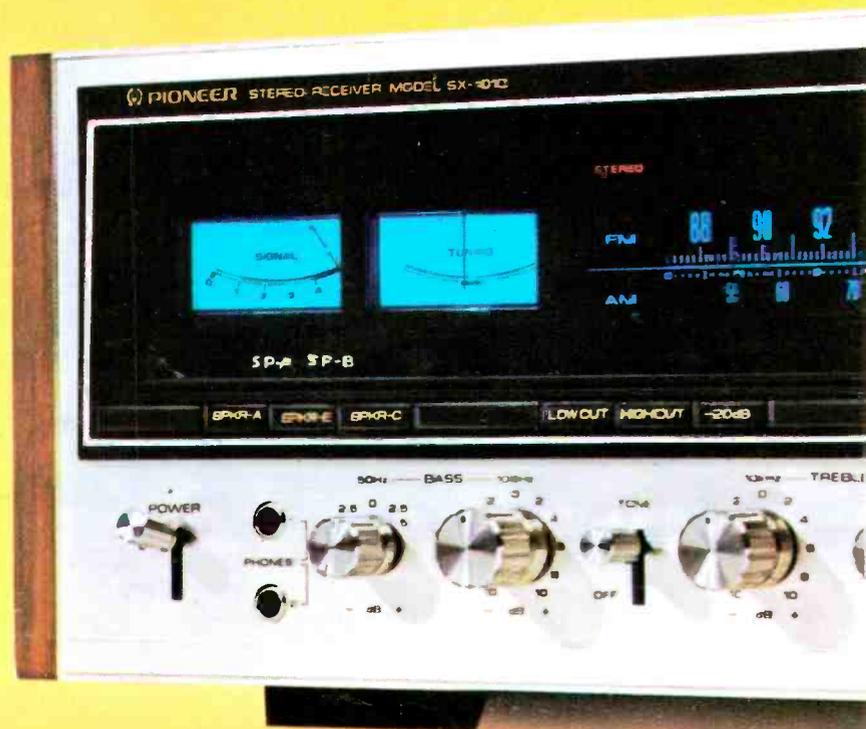
Only your listening interests limit the capabilities of these extraordinary receivers. They have terminals for every conceivable accommodation: records, tape, microphones, headsets — plus Dolby and 4-channel multiplex adaptors. Completely unique on the SX-1010 and SX-939 is tape-to-tape duplication while listening simultaneously to another program source. The SX-838 innovates with its Recording



The finest stereo has ever known.



There can be only one best.





3,025 possible tonal compensations with unique twin stepped tone controls (SX-1010, SX-939)

Selector that permits FM recording while listening to records and vice versa. Up to three pairs of speakers may be connected to each model.

INPUTS	SX-1010	SX-939	SX-838
Tape monitor/4-ch. adaptor	3	2	2
Phono	2	2	2
Microphone	2	2	1
Auxiliary	1	1	1
Noise reduction	1	1	1
OUTPUTS			
Speakers	3	3	3
Tape Rec./4-ch. adaptor	3	2	2
Headsets	2	2	1
Noise reduction	1	1	1
4-channel MPX	1	1	1

Master control system capability

Pioneer's engineers have surpassed themselves with a combination of control features never before found in a single receiver. All three units include: pushbutton function selection with illuminated readouts on the ultra wide tuning dial, FM and audio muting, loudness contour, hi/low filters, dual tuning meters and a dial dimmer.

Never before used on a receiver are the twin stepped bass and treble tone controls found on the SX-1010 and SX-939. They offer over 3,000 tonal variations. A tone defeat switch provides flat response instantly throughout the audio spectrum. The SX-838 features

switched turnover bass and treble controls for more precise tonal compensation for room acoustics and other program source characteristics.

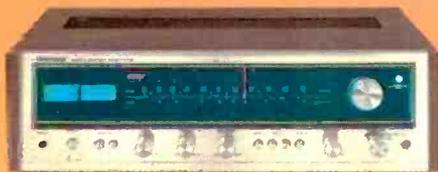
In their respective price ranges, these are unquestionably the finest values in stereo receivers the world has ever known. Audition their uniqueness at your Pioneer dealer. SX-1010 — \$699.95; SX-939 — \$599.95, SX-838 — \$499.95. Prices include walnut cabinets.

Also new and more moderately priced.

Pioneer's most complete and finest line of receivers ever, presents equally outstanding values starting at \$239.95. Shown here are the SX-535 — \$299.95, SX-636 — \$349.95, SX-737 — \$399.95. All with walnut cabinets.

U.S. Pioneer Electronics Corp.,
75 Oxford Drive, Moonachie,
New Jersey 07074
West: 13300 S. Estrella, Los Angeles
90248/Midwest: 1500 Greenleaf,
Elk Grove Village, Ill. 60007/Canada:
S.H. Parker Co.

PIONEER
when you want something better



SX-535



SX-636

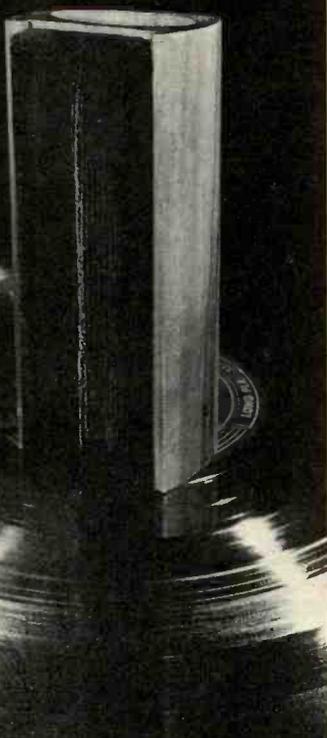


SX-737



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The New Line From **du**



That white line of dirt was scooped up from deep within the record's grooves by **du**. Some "record cleaners" only push record dirt and debris around. Not **du**. Others (the silicone based ones) gloss over the surface and hide the dirt left behind. Again, not **du**. That's because **du** is chemically formulated to solubilize all contaminants which affect your record's surface. Then the line of dust, along with all other particulate matter, is removed from your record through capillary action onto our brush fiber without leaving a trace of residue (or a trace of dust) behind. Send 25¢ and a self-addressed, stamped envelope for our Technical Bulletin "Clean Records and Chemistry", to find out what's happening to your records today.

Discwasher, 909 University,
Columbia, Mo. 65201



Audio

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In the beginning there was folded horn bass reflex acoustic suspension.

And now BIC VENTURI

For about 40 years, speaker designers have been juggling the characteristics they wanted from speakers: Compact size, high efficiency, high power-handling, and deep ranging, pure, clean, gut-reaction bass.

They tried folded horns: efficient, clean, good power-handling, but too large for most homes, quite expensive. They tried the bass reflex: Efficient, compact, but limited by uneven, one-note bass. Ditto the labyrinth, but far less efficient.

Today's favorite, the acoustic suspension: Compact, smooth, deep ranging bass. But inefficient (requiring costly, high-powered amplifiers) and limited dynamic range.

A virtue here, a virtue there -- but all with corresponding compromises.

Ironically, the principle that combines these objectives into one compact cabinet has been around for some 180 years: The VENTURI principle of fluid motion transformation, reapplied in a form better suited to acoustics (patents pending). Our simplified diagram shows how the scientifically formulated VENTURI coupled path functions as a step-up transformer. Up to 140 times more bass energy comes from the duct as comes directly from the woofer. And bass is reinforced broadly over the low frequency spectrum, not at a single "tuned" frequency.

The BIC VENTURI coupled path also operates as an acoustic, low pass filter, cleansing harmonics and distortion components from the bass waves. So, the bass not only goes down further and is louder, it's cleaner and more natural. And requires hundreds percent less amplifier power than other speakers of comparable size and performance. Yet, even though BIC VENTURI need less amplifier power, they can handle more. This new principle eliminates compromises in cone, suspension and magnetic design to "match" cabinet characteristics.

Above the woofer, you can see our mid-range. To match the exceptional high efficiency of the bass section, we had to invent a new horn, combining two different types of flare, conical and exponential, BICONEX™ (pats pend). It provides wide, smooth dispersion in both horizontal and

vertical planes, so placement in the home won't be critical. BICONEX covers the full midrange to well beyond 15,000 Hz without crossover network interruptions, for distortion-free, smooth response.

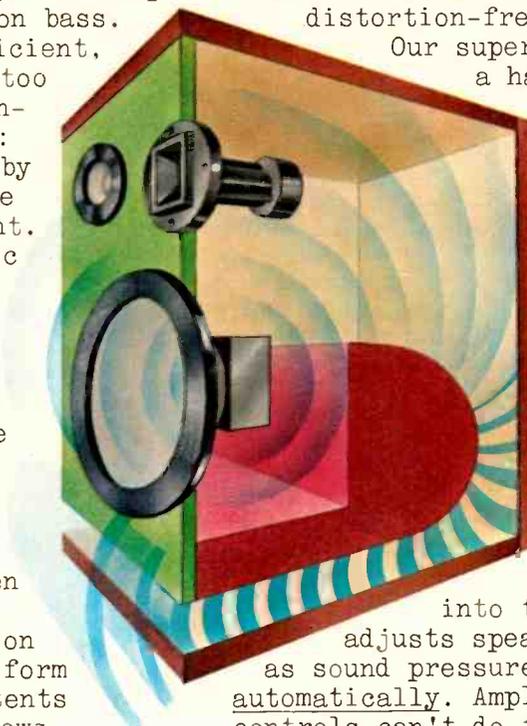
Our super tweeter handles just a half octave from 15,000 to over 23,000 Hz. While you can't hear single frequency tones in that range, the accuracy of musical "timbre" depends upon those frequencies being added in proper proportion to the complex tones you do hear. An important subtlety.

Because you hear less bass and treble at low and moderate levels, we built a DYNAMIC TONAL COMPENSATION circuit (patents pending)

into the speaker. It adjusts speaker frequency response as sound pressure output changes, automatically. Amplifier "loudness contour" controls can't do that. Result: aurally "flat" musical reproduction always, regardless of volume control settings.

Our Formula 2 is the most efficient speaker system of its size, yet can be used with amplifiers rated up to 75 watts per channel! Formula 4 has deeper bass and can be used with amplifiers up to 100 watts. Formula 6, the most efficient, will handle 125 watts. Hear them at franchised BIC VENTURI dealers. Or write for brochure:

BRITISH INDUSTRIES COMPANY
Westbury, N.Y. 11590, a div. of Avnet, Inc.
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 **BIC VENTURI**

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Coming in September

A Primer For Tape Selection—William A.

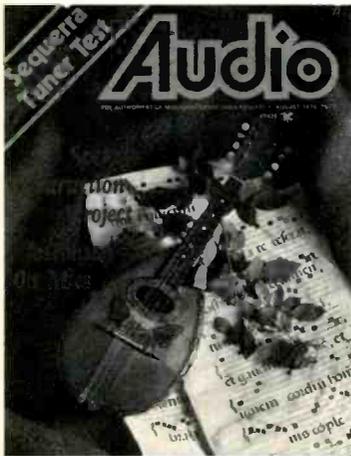
Manly discusses the "audio box" from which you choose tape

All About "Q"—Don Davis continues his article on speaker directivity

Understanding Speaker Tests—Richard Heyser talks about impedance

Plus all the regular features

Equipment Reviews Include: Marantz 4400 receiver



About the cover: This lovely mandolin and very old sheet music are from the collection of Janet Lee, our new designer.

Audioclinic

Joseph Giovanelli

Record Damage During Changer Cycling

Q. In your personal opinion, do you think records are damaged by using an automatic record changer of high quality instead of a manual turntable? I am thinking specifically of the short "sliding" that takes place when a record is first dropped onto another record—as well as the initial shock of the drop.—Leonard Wiener, Chicago, Illinois

A. I do not think that the dropping of one disc onto another or the sliding of one disc onto the one below it during record changer cycling will damage your records in any way. If you examine the construction of modern phonograph records, you will note that the outer edge of the discs are thicker than the playing surface of the disc. Further, the center area around the label is also raised. This means that when two discs are stacked on each other, the two raised areas will make contact; the actual recorded area will not.

Of course, records can warp. When this happens, it is then possible for grooves to make contact. Even so, I have not noticed any signs of damage because of this. This is true even of lacquer discs, which are softer than vinyl pressings, and which do not have raised portions.

Equalizers and Warped Discs

Q. I wonder if you will help me with my problem. I use a Dual 1219 changer with a Shure V15-II cartridge. I also use an Acousta-Voicette equalizer and two Altec 1-7-500's. Since I connected the equalizer, each time I play a record, no matter how slightly warped it may be, I hear a low frequency flapping sound. With the equalizer out of the circuit or with the low frequency filter of my receiver turned on, this sound disappears. Also, when changing records, the moment the stylus leaves the record, a low-frequency "thump" is heard. This sound is more apparent in one channel than in the other.

What can be at fault, the cartridge or the turntable?—Val de La Guardia, Panama

A. The problem of "thumps" which occur each time the disc rotates or when the tonearm is lifted appears to have something to do with the equalizer. When the equalizer is not in the circuit, you do not have the problem; when it is in the circuit, you do have it. I can only

conclude, therefore, that the equalizer is producing some bass boost at low frequencies. Perhaps this boost occurs at frequencies which are too low to affect the sound of the program on the disc. The fact that one channel produces more of this effect than does the other channel appears to be a problem of unequal response of the equalizers.

About the only way you can prove this is to make a frequency response run of each channel. You will probably see a bass rise on both channels, starting at perhaps 40 Hz. One channel, however, may show more of such a rise than does the other one.

The controls of an equalizer such as yours are sensitive. If you are just a bit off the true flat position of any control, you will experience a rise or fall in the response associated with that control.

Amplifier Overload

Q. I have a pair of relatively inefficient loudspeakers. My receiver is a 25 watt rms unit. Once in a while I wish to listen to my music at very high volume. When I do, the front panel lights on the receiver dim slightly, especially when low bass notes are struck. There is no exaggerated distortion until the receiver is driven to its full capabilities, but the dimming lights tend to make me think that I may be harming the amplifier.

Is this dimming a sign of amplifier overload? Am I harming my receiver by playing it this loud?—Randy S. Parlee, Greenfield, Wisconsin

A. I suspect that, when you turn up the volume on your receiver to a point where the music is really loud, your power supply voltage falls below its normal level, thus dimming the front panel lights. This dimming is not necessarily an indicator of possible damage to the amplifier but it is obvious that you are running the equipment near its overload point.

Check your instruction manual to see if there is any mention of dimming lights as a possible warning device.

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.

This is what makes the Sansui 771 so great: Specs. Features. Looks. And Price.

Sansui, already famous for quality and value has again outdone itself with the 771 receiver. Look at the specs: powerful 80 watts RMS total, both channels driven into 8Ω — more than enough to power two pair of speaker systems — at very low 0.5% total harmonic distortion, an FM sensitivity of $2.0\mu\text{V}$ (IHF).

Look at the features: two tape monitors, two auxiliary inputs, three pairs of speaker selectors, two filters (hi & lo) and more — even a microphone circuit. Visit your nearest Sansui franchised dealer and listen to the tremendous Sansui 771. Then listen to the price.



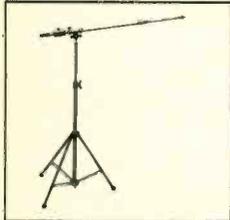
Sansui

SANSUI ELECTRONICS CORP.

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Nothing is beyond your reach with Beyer mike stands and booms.



As one of the world's leading manufacturers of quality microphones, Beyer believes that a microphone is only as good as its stand.

After all, it doesn't make much sense to spend hundreds of dollars on a microphone only to find you can't put it exactly where it's needed.

That's why we've designed a line of booms and stands that enable you to place a mike almost anywhere. From ground level to 13½ feet above the studio floor.

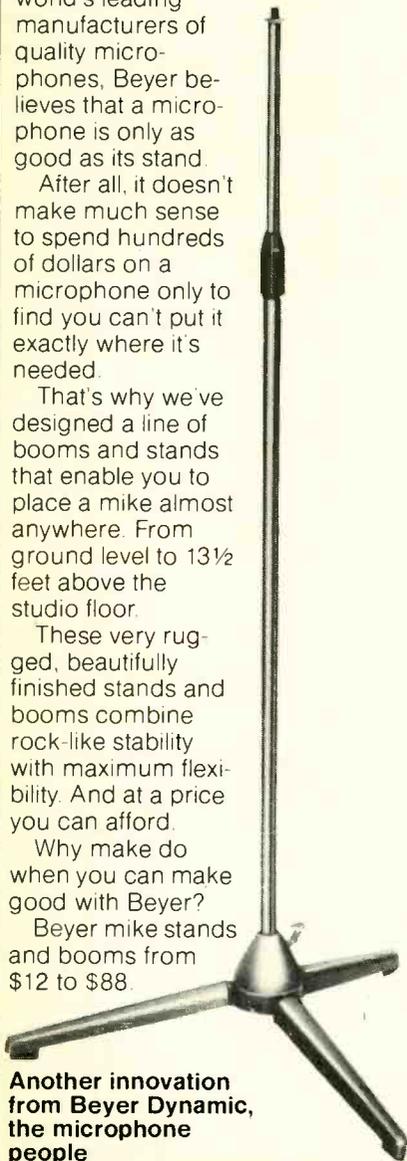
These very rugged, beautifully finished stands and booms combine rock-like stability with maximum flexibility. And at a price you can afford.

Why make do when you can make good with Beyer?

Beyer mike stands and booms from \$12 to \$88.

Another innovation from Beyer Dynamic, the microphone people

Revox Corporation
155 Michael Drive
Syosset, N. Y. 11791



Tape Guide

Herman Burstein

Cassette or Cartridge?

Q. It seems to me from what I have read that either a cassette or cartridge machine would answer my hi-fi needs. Would you be so kind as to tell me the advantage of each system. Since I'm a beginner, please do not get me involved with graphs and figures as I'm not an engineer. I find in reading such information that I'm twice as mixed up as before.—Alfred C. Leichman, New York, N.Y.

A. It appears that cassette is a bit ahead of cartridge in terms of quality. However, cassette is a 4-track system, while cartridge is generally 8-track. Thus cartridge has the advantage of more recording and playing time per reel. On the other hand, this additional time involves a sacrifice in quality. For hi-fi, my present vote is for cassette, particularly in view of new developments that are bringing cassette performance closer to the performance of open-reel machines.

Low-frequency Thumps

Q. I have encountered a problem with my Concord Mark III tape deck. During soft passages or during spots where no signal is on the tape, I can hear low-frequency thumps through my speakers. The thumps come at irregular intervals and usually come in clusters. The thumps can only be heard through the tape deck, and cease when the deck is turned off. So the amplifier is not defective. The thumps also happen on tapes recorded on another deck. Your help would be appreciated.—Robert L. Martindale, Chevy Chase, Md.

A. Your letter suggests that the problem of thumps originates in the playback electronics of your tape machine, most likely in the first or second amplification stage. It may be due to a defective transistor or other component. It may be in the nature of low-frequency oscillation, which is greatly amplified by the large amount of bass boost supplied by the playback electronics. Or the thumps may be low-frequency noise on the tape, which is due to oxide irregularities and "developed" into noise during recording. Shifting to another brand or quality of tape might then be of help. If the tape is not the problem, I suggest that you have your machine checked by a technician.

Citizens Band

Q. I have a neighbor who has gone completely off his rocker regarding the citizen band. He is on the air at all times of day and night, and when he is away his wife takes over. They have quite a bevy of kin folk also interested, and when there is a gathering of the clan, the street is full of many men and women walking about with walkie-talkie units. They use the units for more than a hobby and substitute the CB units for telephones which have been disconnected. This is in violation of FCC regulations. FCC knows about the problem. I pick up the unwanted conversations at the most inopportune times, especially during a pianissimo passage of a classical piece. I use only shielded cable throughout my system, and ground all units. Do you know of any other method of shunting out the interference?—Name withheld

A. Are you getting the CB signal in recording or in playback? In either case, try a small capacitance of a few pF between the first electronic stage and ground. The capacitance should be between the input (usually the base of a transistor) and ground.

Head Wear

Q. I own a TEAC 4000 and have used it for three years without any major problems to speak of. The one item that does concern me is head wear. All four of the heads show distinct wear, but the audio is just as fine as ever. How can I tell when head wear is too much?—Ronald A. Bohl, Clinton, Iowa

A. When treble suffers, excessive head wear is indicated, particularly wear of the playback head. A well-made head is constructed with deep gaps, so that a good deal of physical wear can occur before performance suffers.

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.

INVISIBLE SOUND



For the first time in your life, you can hear music precisely as it was recorded. Down to the last incredible detail.

Until now, the very best high fidelity loudspeakers have been described as transparent. Now, innovative design and precision engineering have made it possible to take a giant step beyond transparency—to the Invisible Sound of Braun speakers.

Music passes through Braun speakers with such natural clarity the speakers seem to disappear. Only the music is real. Once you experience the Invisible Sound of Braun speakers—the ear-opening sound of live music in your living room—you'll never be satisfied with conventional speakers again.

We'll be happy to explain to you how and why Braun, and only Braun, is able to achieve Invisible Sound. We'll also describe our complete line of speakers in detail, and send you the names of the selected group of Braun dealers in your city. Write: Braun Loudspeakers, 377 Putnam Avenue, Cambridge, Massachusetts 02139. Phone: 617/492-0970.

THE

SOUND OF **BRAUN**

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What's New in Audio

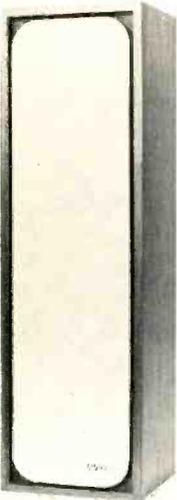
B&K Phase Meter



Type 2971 enables frequency response test systems to automatically plot phase response curves, not possible before. The Phase Meter can tolerate 50 dB changes in signal level of both the reference and unknown voltage. Readout is both digital and analog. The 2971 can be used for phase comparison of any repetitive waveform. Price: \$1920.

Check No. 50 on Reader Service Card

Avid Speaker System



Designed for use in four-channel setups, the Model 60 is a 2-way bass reflex speaker with a 2½-inch wide dispersion tweeter. The unit's unique shape, high efficiency and low cost all contribute to its adaptability to a quadraphonic system. A minimum of 5 watts drives the system, which can handle up to 35 watts and lists a frequency response of 60-17,000 Hz \pm 5. The floating grille is available in two colors and wall brackets are included. Price: \$59.95.

Check No. 51 on Reader Service Card

Quartz Crystal Chronometer



The all-electronic AR-720K from ARIES, Inc. is a digital time-keeper for use in many locations. The device displays either 12- or 24-hour time by means of red LED readouts. Silent, with no moving parts, and readable in the dark, the chronometer can be mounted vertically, horizontally or recessed behind a panel. Power consumption is less than 1/5 amp. at 12 V. d.c. The display can be shut off, leaving only the LSI circuit operating and using less than 1/100 ampere. Average building time is 2-3 hours and the kit version requires only a small soldering iron, wire cutter and screwdriver. Dimensions: 2½ in. square by 3-5/16 deep. Kit, \$69.50; wired and tested, \$99.50; 24 V. adaptor, \$10.00.

Check No. 52 on Reader Service Card

Technics Cassette Deck



Dolby circuitry and front-loading operation are featured in the RS-676US. In addition to the normal Dolby functions, this deck makes it possible to record directly from Dolby-encoded FM broadcasts, or to feed the decoded output to your amp or receiver, without recording, for ordinary listening. Other features include HPF heads, solenoid controls, three-digit counter, memory play switch, tape selector for CrO₂, for both record and playback, peak level check button, master level control and a balance control. Price: \$459.95.

Check No. 53 on Reader Service Card

Onkyo Receiver



The TS-500 is a fully automatic, all mode 4-channel receiver. It plays any 4-channel material—CD-4, SQ, or QS—in any sequence just by setting the automatic switch. All demodulators and decoders are built in and a joy stick control provides 4-channel sound balance. The unit delivers 25 watts/channel (rms) and is BTL strapped to provide better than 50 watt/channel (rms) in the stereo mode. Until December 31, Onkyo is offering two 4-channel test record albums (one for CD-4, the other for SQ) free with the purchase of the TS-500. Price: \$749.95.

Check No. 54 on Reader Service Card



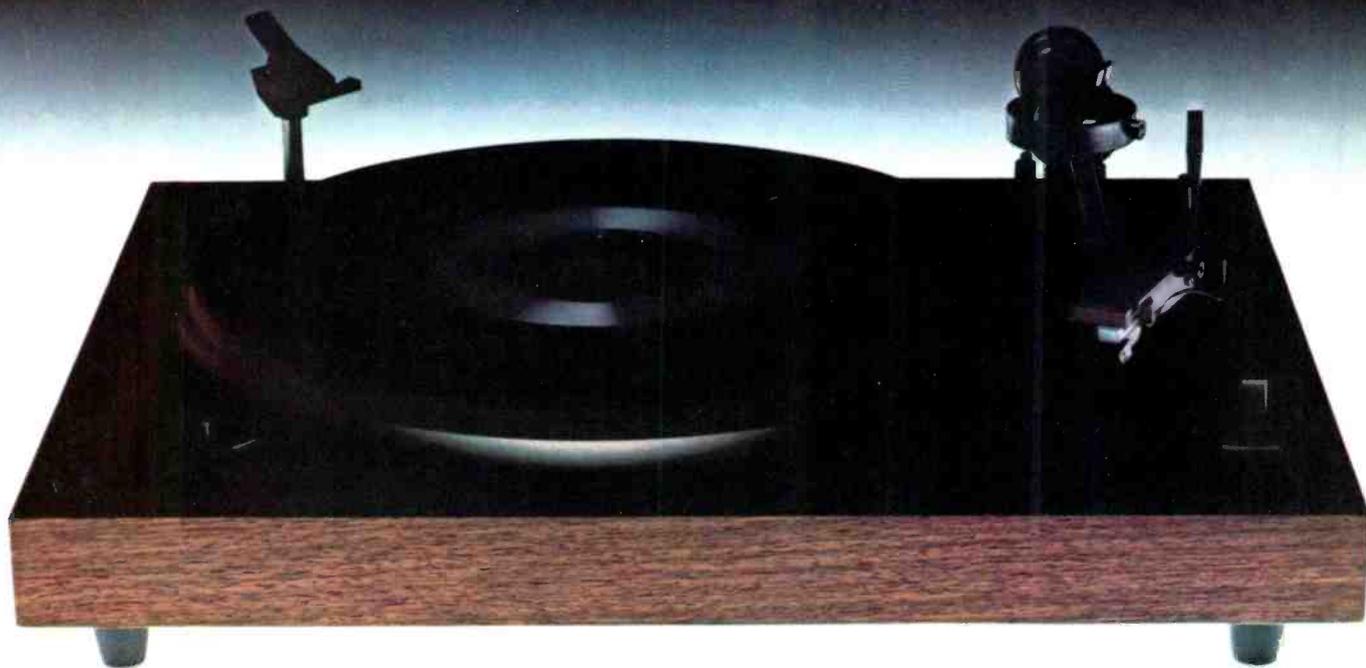
Harman/Kardon Demodulator Adaptor

The 44+ is designed for use with existing four-channel receivers lacking built-in CD-4 circuitry. It provides the impedance characteristics required by CD-4 cartridges and feeds the high level inputs on existing quadraphonic receivers. Controls include a push-push power switch and a 3-position function switch for: CD-4/AUTO, which actuates CD-4 circuitry when carrier frequency, impressed in the groove walls of all CD-4 discs, is present; STEREO, which defeats the CD-4 circuitry completely, and BYPASS, which directs the signal from the turntable or changer immediately into your amp or receiver. Price: \$119.95.

Check No. 55 on Reader Service Card

You are about to be introduced
to a fundamentally new concept
in record playing equipment —
the new family of B·I·C™ turntables.

You will discover in them
all the superiorities of manual turntables.
They are also the first belt-drive units
that can be programmed to play
a series of discs. A new generation
of turntables has arrived.





So, we have taken an unusual step.

We have created a warranty policy meant to be as solid as our turntables.

Your B-I-C 980 or 960 is fully warranted against defects in parts, materials, or workmanship for 2 full years. In addition, if it is found defective within 10 days after you buy it, your dealer is authorized to exchange it for a new one on the spot.

This warranty is the best testament to our faith in the fundamental excellence of these machines.

They are beautifully engineered and built.

They represent a departure from other designs, but a departure based on simplicity and rock-solid engineering and manufacture.

They eliminate the major objections which have been voiced by purists against automatic equipment.

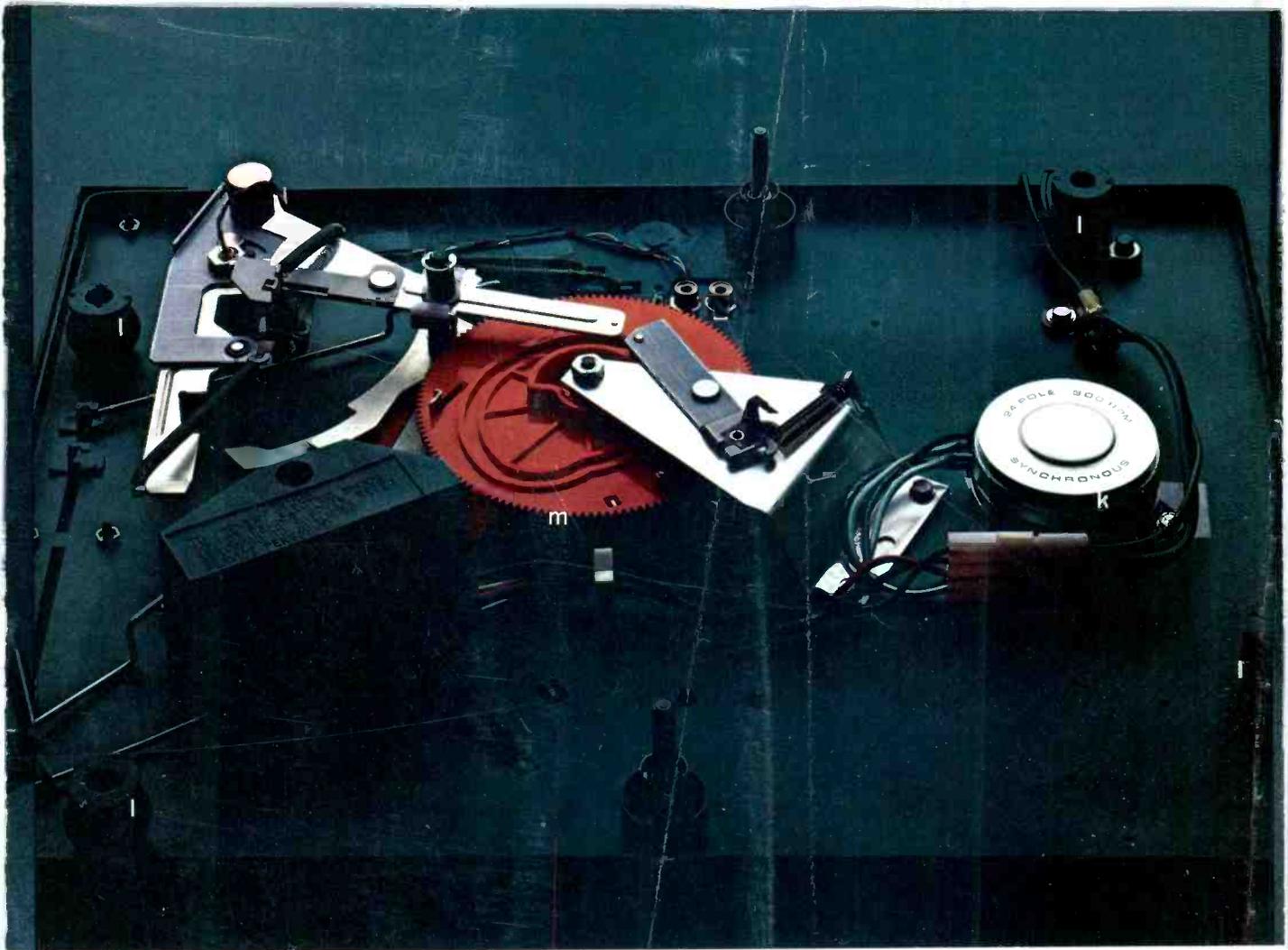
They will be sold by leading audio specialists from coast to coast.

Your B-I-C authorized dealer will have a full-color, 26-page booklet which discusses these remarkable instruments in greater depth than we can here. If he has run out of these booklets, we will gladly mail one to you if you'll write to us at the address below.

The 980 and 960 are being delivered to your dealer now. We invite you to inspect them soon.



The 980 and 960 are identical except for the 980's electronic speed and pitch control circuitry and its lighted strobe. Accessories available include solid oiled-walnut wood base - matte black molded base - and hinged dust cover.



To play one record automatically (which we recommend for the sake of your cartridge and your records) move the program lever to "1", tap the *cycle button* (j) and the play-shut off cycle proceeds. Perhaps the most unique feature of the program system is that it allows you to pre-program as many as 6 plays of a single record and then shuts the machine off automatically after the program is completed.

The cycle button is worth noting in that it requires only a feather touch (90 grams pressure) and travels only .0625". It controls all functions with so light a touch that it precludes jarring of the unit plate, and accidental damage to records or stylus. Even when the tone arm is tracking, the unit can be put into "reject" smoothly, without jarring the tone arm, as frequently happens in most automatics.

For automatic play you can program 1 to 6 records. For example: to play 6 records in sequence, place them on the spindle and steady them with the clip at the outboard edge of the platter. Slide the program lever to "6", press the cycle button, and go about your business. The 2-point record support has no sensing mechanism in the spindle. It is thus superior to other 2-point systems and completely does away with the instability and hang-ups typical of umbrella spindles. Even records with worn center holes drop smoothly.

The B-I-C program system is simple to operate. And it has simplified the turntable's underside to the point that the 980 and 960 are actually less complex than some manuals with automatic features which can play only a single side.

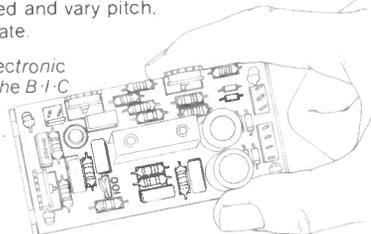
Underneath the turntable: The utter lack of confusion on the underside of the B-I-C turntables speaks for itself. Look under any changer or automatic turntable and you'll be amazed at the number of visible parts B-I-C engineering has eliminated.

There are other items under here which deserve your attention.

The *motor* (k) is a 24-pole synchronous unit which operates at 300 RPM. Its advantage is that at 300 RPM its fundamental vibration frequencies are well below audible levels. The 1800 RPM motors used in other automatics have audible vibration frequencies. A 24-pole motor delivers a smoother flow of power than a 4-pole unit. The superiority of the B-I-C power unit is one of the reasons that initial lab reports on these turntables look so good.

The unit shown above is the B-I-C 960. If it were the 980 you would see, in addition, the solid-state *circuit board* which electronically governs speed and incorporates pitch control. The 980 uses electronic circuitry to lock in speed and vary pitch. It is permanently accurate.

The solid-state electronic speed control of the B-I-C 980 allows pitch variations of $\pm 3\%$.



The mechanical "tapered pulley" pitch controls used on other machines, which inevitably go sour with age, have been eliminated.

Notice the four *shock mounts* (l) which form the interfaces between the unit plate and base...four small rubber Isomer shock mounts, designed specifically for these turntables. They protect the unit from external shock and acoustic feedback. More than that, they are further evidence of the care and attention which has been lavished on every detail in these machines. Compare them with the metal springs used on automatic turntables and you'll quickly see the difference.

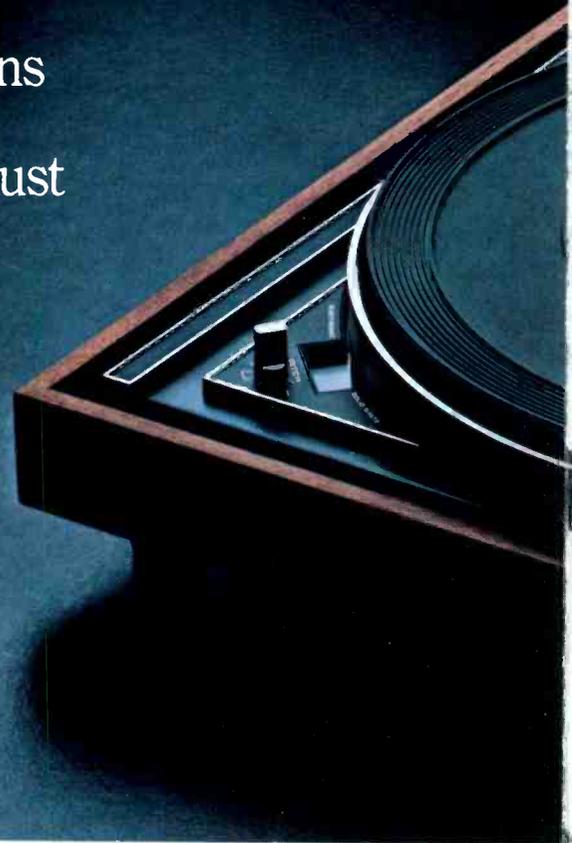
The *red cam* (m) in the middle of things is made of material which is not subject to the wearing effects which metal cams suffer. The material has its own internal permanent lubricity.

The *platter* (n) shown in the exploded view at right represents another technical advance. Old style heavyweight platters which were used for their flywheel effect are no longer needed because of innovations in electronics and system design. The B-I-C turntables carry this die-cast non-ferrous, 12" platter, which has been mated by computer analysis to the rest of the drive mechanism.

A few words about our warranty: B-I-C is the name on our turntables. Your dealer knows the name British Industries Co., very well.

If you have any questions about the special relationship we've had with record playing components for the past 37 years, why not ask him about us. But, reputation or no reputation, you may still ponder the wisdom of jumping into equipment that has not been proved in home trial, no matter how good it looks on paper.

The new B·I·C Programmed Turntables are engineered to do things no other turntables can do. In the face of more demanding cartridge designs and critical new 4-channel discs, the B·I·C 980 and 960 appear at just the right moment.



The Status Quo:

The mechanism that turns your records and carries your cartridge has become an increasingly critical part of your audio system.

More than ever before, today's turntable buyer is faced with a classic dilemma.

"Should I buy a single-play manual turntable for its playback superiority?"

Or... "should I buy an automatic for its superior record-handling capabilities?"

Until now, the dilemma has remained unsolved.

Enter B·I·C

British Industries Co., creator and builder of the new B·I·C turntables has been the major innovator in this field since 1936.

No company has better credentials or greater experience with record playback equipment in the components field. The best proof of that is the instruments which B·I·C now introduces.

The 980 and 960 are unique.

They have been engineered to solve once and for all the "manual vs. automatic" dilemma.

They are belt-drive as opposed to all automatic changers which drive the platter via an intermediate idler wheel.

They are powered by a 24-pole, low speed (300 RPM) motor while most automatics use 4-pole, high RPM motors.

In all three areas of function—platter drive, tone arm system, and multiple play capabilities, the B·I·C turntables offer refinements and advances which set them apart from everything else in the market. As a matter of fact, several B·I·C turntable features are not to be had on any other instrument at any price.

A Brief Introduction

The B·I·C 980 is shown above. It is identical to its companion, the 960, except for the 980's electronic drive, pitch control, and lighted strobe which are discussed later in this announcement.

You have probably already noticed its low profile. This is not an optical illusion or a styling trick. The 980 and 960 are indeed as low and trim as they appear.

This lack of bulk is your first clue that the B·I·C turntables are not merely manuals with automatic features added...that they are in fact "originals", designed from the start to be simple, as only sophisticated engineering can make them.

Moving parts found in conventional



automatics have been eliminated right and left. In the process, potential sources of malfunction have disappeared. Potential sources of noise and vibration have also been eliminated.

Operating controls are grouped in a single program panel on the right side of the unit. To say that this panel brings new logic to the turntable and new refinement and simplicity to its operation, barely does it justice.

The tone arm incorporates several dramatic improvements which set it apart from all others.

And of course you have noticed at the bottom of the page a cutaway drawing of the B-I-C platter which reveals the belt-

drive mechanism. No other turntable which can play more than a single record offers belt-drive and all its advantages.

The drive system alone sets B-I-C turntables apart. But there's more.

These turntables are built entirely in the United States of American-made parts. They are built in B-I-C's own plant where all aspects of manufacturing are in B-I-C's hands. They are the first fine turntables of their type built in this country, and they meet and exceed the high standards you have come to expect only from imported equipment. Beyond what that means in technical terms, they do not come to you burdened with import duties or fluctuating exchange rates.

They are rugged. They are built of the best materials that can be had.

The 980 will sell for about \$200.

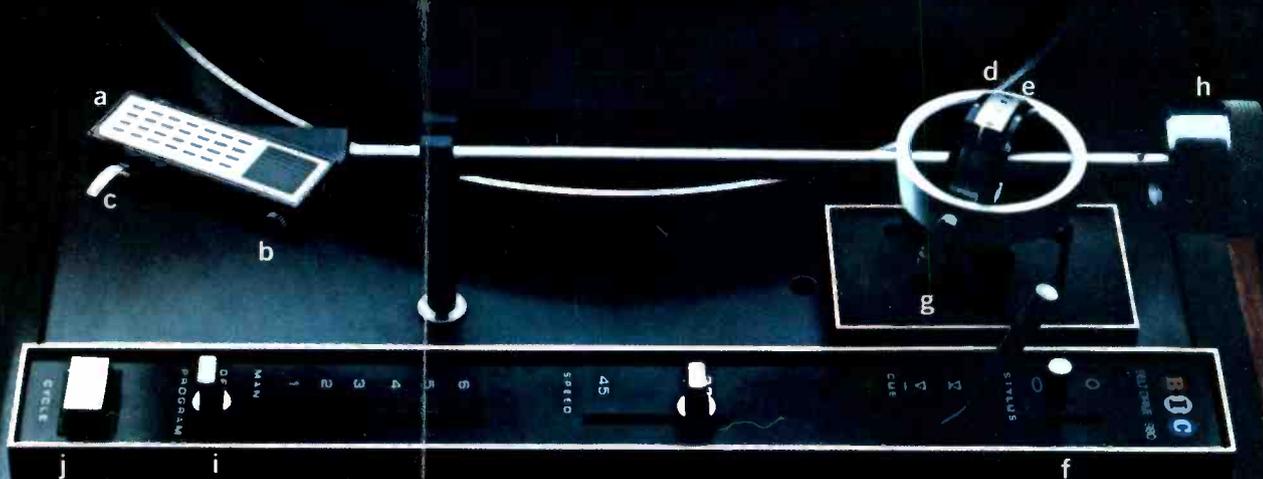
The 960 for about \$150.

While they are not inexpensive, they will stand stringent comparison with machines costing \$100 to \$200 more. Anything less, they outperform by a wide margin.



Belt drive eliminates the wow, flutter, and rumble-causing problems of idler drives used almost universally in automatic turntables and record changers.

A closer look at the B-I-C 980 and 960:



The tone arm system: The B-I-C tone arm incorporates both simple refinements and radical departures from current designs. The result is a system which is, in our view, better than anything else now offered. Let's review its features from left to right as you see them pictured above.

The cartridge shell (a) has two precision adjustments to combat playback distortion. In mounting the cartridge, overhang can be adjusted with the aid of a gauge which is supplied. And, for the first time, stylus angle is also adjustable, using the gauge and set-screw (b) in the side of the shell. Regardless of cartridge depth or other variables, the stylus can be set to track at precisely 15°—the forward vertical angle that generates lowest playback distortion.

The cartridge shell is securely mated to the tone arm by a fail-safe, 4-prong, side-mounted connector, and is locked in place by a threaded knob. This eliminates the potential problem of intermittent signal inherent in slide-in cartridge carriers which are used in automatics.

Even the *finger lift* (c) is a pleasure to use. It is a wide stainless steel arc like those on studio turntables. It is one more indication that these B-I-C turntables have been designed for the serious hobbyist.

The geometry of the *tone arm* brings lateral tracking error down to .3° of arc per inch, which is insignificant in terms of playback distortion. The pivoting of the tone arm produces another important result. When 6 records are played in series there is virtually no variation in tracking force from first record to last. This variation in tracking force, found in other machines, has been a major criticism of automatics.

The arm is mounted in a minimal friction gimbal and is designed to track flawlessly at forces below the lowest limits of any cartridges now available or conceivable at this time.

Anti-skating and stylus force adjustments (d, e) are mounted in tandem over the gimbal where they flank a single linear scale, calibrated in .25 gram increments. Gone are the usual separate scales for conical and elliptical stylii. Selection of stylus mode is made by a separate lever (f) on the program panel at the right of the tone arm.

Cueing is viscous-damped in both directions and, for the first time, its rate can be adjusted. A small knob at the base of the tone arm (g) allows you to vary climb and descent for from 1 to 3 seconds. This adjustment is found only on B-I-C turntables. It enables the owner to

accommodate his personal preference and also provides a means to compensate for variations in cueing time caused by changes in ambient temperature.

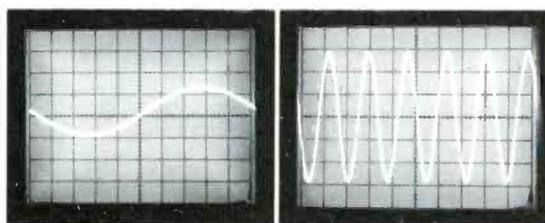
The massive *counter balance* (h) is completely isolated from the arm and incorporates a knurled band which makes balancing the arm fast and accurate. The entire tone arm system is protected by a safety bar which makes it virtually impossible to drop the arm on a record or on the platter.

The program system: The B-I-C turntables have been designed to play as many as 6 records in series. At the same time, the design eliminates some important criticisms which have been levelled at automatic changers in the past.

Automatic changers use a complex series of gears, cams, and levers to sense the number of records stacked on the spindle, and to activate the machine. The B-I-C design eliminates this sensing mechanism. Instead, all cycling information is set on the program panel by the operator. Many parts, a good deal of weight, noise, and vibration, are eliminated. Reliability is greatly improved.

To play one side this is all you do.

If you are hooked on manual play, insert the single play spindle which rotates with the platter. Move the program lever (i) to "MAN" and place the arm on the disc. After play the arm will return to rest and the machine will shut off.



B-I-C's 24-pole motor (left) has sub-sonic fundamental rotation frequency of 5 Hz with harmonics all below audible range. 4-pole units (right) have fundamental frequency of 30 Hz and harmonics all fully audible.

Dear Editor:

Cylinder Deck

Dear sir,

I've just finished reading Mr. Shifrin's article on early records and would like to offer some additional information just in case I'm not the only one around whose interest lies in cylinders.

I recently built a "state of the art" cylinder deck. I used an early Edison mechanism (pre 1905) with an end gate. This I stripped of motor, gears and worn assembly. I then installed a Philips 212 motor and servo-control system coupled with a new flat rubber belt. For an arm I use a Rabco SL8E. After debugging (you've gotta go pretty fast to track an Edison 2-minute cylinder) I mounted a Pickering V15 cartridge. For a "stylus" I use a BIC accountant's fine tip pen ball which I epoxied to the shank of the Pickering stylus assembly. The cartridge was wired for vertical pickup.

When I was finished I found myself running backwards, but found that the motor winding can be reversed without affecting servo action and if the Rabco is exactly tangential to the cylinder and the stylus centered on the top of the cylinder, it does no harm to have the cylinder surface "pushing" the stylus instead of pulling it.

An improvement in distortion can be achieved with the use of a .025-in. miniature ball bearing for 2-minute stylus. I have sent both two-minute and four-minute cylinders out for photographic analysis of their surfaces and soon hope to specify styli with precise accuracy.

Anyone desiring further details may contact me directly. I am interested in trading information for any Edison Grand Opera series cylinders which your readers may wish to give up. Back to Mono!

Richard N. Levine
Monadnock Audio
28 Main St.
Peterborough, NH 03458

Even AUDIO can Laugh

Dear sir,

After reading the article on "Converting to Monophonic Sound" on page 66 of your April issue I felt I had to write to express my delight . . . Thank you for providing a little educated humor in your already technically superb magazine.

G.J. Hugunin III
President
Magnetic Laboratories
Cincinnati, Ohio

Converting to Mono

Dear sir,

Gerrard Rejskind's "Converting to Monophonic Sound" (AUDIO, April, 1974) is a positively brilliant piece of humor. It made so much sense, and I so thoroughly enjoyed it that for a while I actually forgot I was reading AUDIO magazine.

Harron K. Appleman
HKA Audio Engineering
New York, NY

Dear sir,

The "Converting to Mono" article by Gerrard Rejskind in your April issue is a landmark which should make you justly proud. Keep up the good work.

Howard Greenlee, Jr.
President
Fun Music Radio
Scottsdale, AZ

Dear sir,

Your article re a student of professor Lirpa, was astounding. I happen to have a friend whose name is Hary Lirpa, a good old Hungarian. I don't know of any relationship.

My friend Hary gave me once an old document that he once found in one of Budapest's old libraries. It was written in the Cyrillic alphabet, which floored me for a while, until I discovered that the language was modern Greek. After some effort I came to the following translation, although I cannot guarantee that it is idiomatically correct.

" . . . When in 1891 Peter Ilyitch Tchaikovsky visited New York City, with his favorite valet Dmitri da Rimini, there was a little to do some night. Dmitri, by the way, came from first class old Milanese stock, and he was quite helpful in translating the Italian for Peter. Peter used to call him "Da" for short.

"Well after opening of Carnegie Hall, Peter went off to a local tavern with the musical notables of the day to have some little water (I believe that is the Greek translation for vodka!) and to celebrate the opening of Carnegie Hall. It became a rowdy affair as the little waters took their effect, with speeches and more little waters. Peter had to make a pass at one of the pretty waitresses of the place; Francesca de Valetta was her name. (Irish?)

"Later back in the hotel, Francesca's father came over to make a hell of a racket in front of the hotel. Dmitri woke up and later also Peter. Peter still quite

high, turned around in bed and said: 'Oh, don't worry it is only the father of Francesca da Rimini.' " . . .

Paul A. Elias
Clayton, CA

The New Stereo Bonanza

Dear sir,

In regard to (Mr. Canby's) article "The New Stereo Bonanza" . . . How right you are!

Since the rudimentary days of putting the last twists on the wiring for Dynaco's hookup, to today's use of wave matching logic circuitry, the biggest thrill in quadraphonics has been to make my existing library come alive with new presence and placement not before possible in conventional stereo. No, the placement and directionality may not be that of an encoded disc, but that's hardly the fair or correct comparison.

Here's hoping that more marketing people (and soon thereafter, the buying public) come to realize that the best reference point for anyone sitting amidst four speakers for the first time is material he is familiar with . . . whether or not that material is encoded for (four-channel).

Brien Lee
Partner
Sorgel-Lee Multimedia
Milwaukee, Wisc.

Uncensored Information

Dear sir,

At long last, you have provided in Mr. Heyser's speaker tests, the application of highly sophisticated measurement techniques apparently combined with the freedom to objectively discuss the problems a particular speaker might have without fear of a manufacturer reprisal. In this day when the public is being ripped off on everything from A to Z, your testing policies at last show some public responsibility and class. It will be indeed another blow to the concept of a free market place if the advertisers in your magazine put the pressure on to stop an unfavorable test report. Keep up with the good work! There are a lot of readers who appreciate the straight, uncensored information about high fidelity products you have pioneered in Mr. Heyser's speaker testing.

Gary C. Bailey
Engineering Development Co.
Los Angeles, CA

Behind The Scenes

Bert Whyte

THE ANNUAL conventions of the Audio Engineering Society are always interesting to attend, both from the standpoint of the scientific papers presented and the opportunity to see the "latest and greatest" in audio engineering equipment. The audio industry today is a very dynamic business, and there are usually some significant new developments revealed at every convention. The 48th AES convention, held in early May in Los Angeles, carried on in this tradition.

I am going to go out on a limb and state that the BASF people have come up with one of the most provocative new magnetic tape products in some time, and one which is bound to have far reaching implications for the entire industry. With virtually no fanfare, BASF introduced the "Unisetette," which is billed as a "professional 6.3 mm (1/4-in.) cassette." Picture if you will a conventional cassette, scale it up in size some 40-odd per cent, use standard quarter-inch magnetic tape, and operate it at 3-3/4 ips. Now design the cassette shell so that we can have such niceties as . . . openings to accommodate erase, record, and playback heads (making possible true monitoring facilities), tape drive with one or two capstans, and two other openings which can be used for tape tension control. the BASF Unisetette has all this and more. For example, instead of tape guidance being carried out in the cassette itself, as is the case with our present minicassettes, which is said to be "disadvantageous" to azimuth as well as wow and flutter, tape guidance in the Unisetette is exclusively controlled by the machine. In the words of BASF, "when the Unisetette is placed in the machine, those parts which are in contact with the tape, are automatically put in the correct position by the machine. These parts are the two roller guides and the two hubs. The accuracy of the tape guidance is adjusted on the machine and remains invariable for all Unisetettes used." Other features of the Unisetette include a "hub brake," which automatically locks the hubs when the unit is not on a machine, thereby preventing tape loops or loose tape, and two non-magnetic metal plates to protect the tape wind, so that no layers will come off during transport or from rough handling. As in conventional cassettes, there is provision to prevent accidental erasure. Recording on both sides of the Unisetette at 3-3/4 ips, regular 1/4-in. long play tape gives a total time of 30 mi-

minutes; double-play tape gives 40 minutes, and triple-play tape 60 minutes. Needless to say, inclusion of a two-speed motor in a machine will permit operation at 1-7/8 ips with subsequent doubling of recording time.

At this juncture someone is bound to say that the Unisetette is interesting, but haven't we traveled this route before? Indeed we have; some 12 or so years ago there was an ill-fated attempt by RCA to market a somewhat larger "cartridge" which used 1/4-in tape and ran at 3-3/4 ips. What happened? Perhaps the time was out of joint, and it was an idea that came too soon. Perhaps a technical problem was contributory . . . remember, this was pre-Dolby, and there were no fancy low-noise, high-density tape oxides, etc. In any case, it never got off the ground.

BASF feels that the Unisetette has particular application for automated radio programming, professional portable recorders, high quality audiophile recorders, language laboratory machines, etc. It is obvious that all the technology that has been lavished on the minicassette is equally applicable to the Unisetette. I talked with one of the Unisetette project engineers at the BASF exhibit, and in his technical manual he showed me the track layout for quadraphonic sound . . . four channels "in-line," single pass from supply to take-up hub. Using Dolby B noise reduction and with the track widths about the same as used on reel-to-reel quadraphonic recorders, signal-to-noise ratio should not be a problem. Okay, you say . . . the Unisetette sounds like a dandy idea, where do we go from here? For once it looks like there will be relatively quick action in getting this kind of product to market. None other than the prestigious Willi Studer is reported to be readying a Unisetette recorder to be available in the fall of this year with a projected price somewhere "between \$450-\$500." (I think that may be a bit low, but no matter.) Negotiations are also reported under way with Sony and TEAC to produce Unisetette recorders. It all sounds very enticing, and at the moment I'll do my best to keep you informed on new Unisetette developments, and leave the pros and cons on this new concept for a future time.

My head still full of the intriguing possibilities of the Unisetette, I wandered into another of the AES exhibit areas, and at the Haeco booth, in all its shining glory and precision, was a fully

operating Scully disc recording lathe. Beautifully indeed, but nothing new here. But hold on a second . . . I hear Haeco president Howard Holzer explaining to a visitor that all the variable pitch and depth automation on the Scully is operating without any signals from an advance (preview) head! How can this be? As you probably know, in the usual disc-cutting set-up, whether it be Scully or Neumann, the tape passes over an advance magnetic head, which tells the logic automation on the lathe what to expect from the program signal, and gives the logic time to act on this information. For example, if a triple fortissimo passage of music passes over the advance head, the logic "knows" that it must open up the lines-per-inch control and adjust the variable depth control to accommodate this high level signal. If in the next second a pianissimo passage is encountered, the reverse holds true and the lines-per-inch can be increased. Naturally, music consists of many complex waveforms at varying dynamic levels, and so the advance head furnishes the lathe logic the information it needs to operate on this same dynamic basis. This system is the reason that in recent years we can get better than 30 minutes on one side of an LP, with little or no reduction in level or in bass response. I have oversimplified this a bit, and should have mentioned that any equalization, filtering, noise reduction, limiting or other signal processing equipment that the program signal is going to pass through, must be duplicated for the advance head signals so that the lathe computer gets the correct information.

Now back to the Haeco booth . . . there is indeed no advance head in this disc cutting set-up, and Howard Holzer proudly introduces me to his new brain-child, the Haeco VP-1000 digital lathe-control system, occupying a mere seven inches of rack space. Our clever friend has designed a 15-bit stereo digital delay line which provides a 300 millisecond delay of the program signal. In other words, the lathe control circuits receive the identical signals as the cutting system. As Howard puts it . . . "any minute change made in the program channel is automatically (seen) by the lathe 300 milliseconds prior to the cutting transducer." Howard pointed out that one of the advantages of his VP-1000 unit was that duplicate signal processing equipment used as part of the advance head system is eliminated. He also said that with his

It's as important as your loudspeaker design...

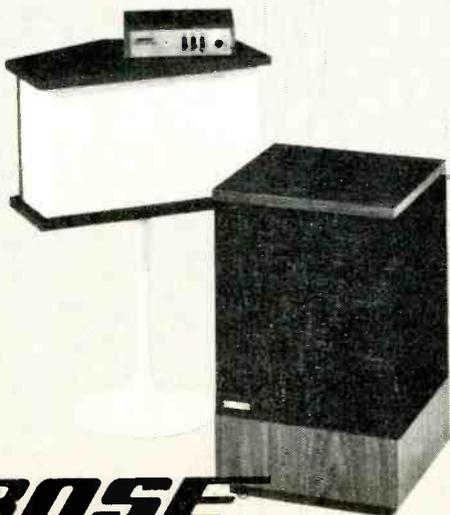
If you have ever spent time auditioning speakers under controlled circumstances, you know that consecutively produced speakers of the same model sometimes can sound very different. The difference can be as great as that found between speakers of diverse price ranges — a situation that challenges the validity of listening to a demonstration speaker and then purchasing another unit of the same model.

This problem resides in the measurements rather than in the speaker construction. It can occur whether the speakers are individually handmade or whether they are run on an assembly line.

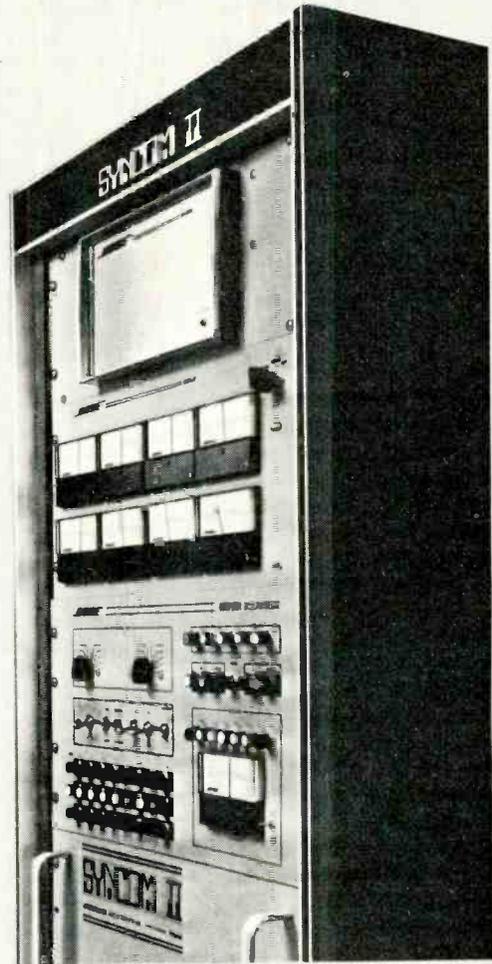
In a university research program started by Dr. Bose in 1956 and in continuing research at BOSE Corporation, it has been found that some of the most commonly made measurements on speakers are not adequately correlated to the perception of sound.* Extensive research has been performed to develop a set of measurements that correlate sufficiently to perception to provide a means of precise control of production speakers.

The result was a set of measurements that was not practical to implement with existing instruments. At this point (1970), the BOSE research department launched a program to design a special purpose computer, programmed to test for audible differences and to interpret these differences in a manner that would allow production engineering to detect and correct the assembly problems.

The SYNCOM™ II speaker testing computer is the long awaited result of this extensive research program.



BOSE
The Mountain, Framingham, MA 01701



It is now installed and it is controlling all production on the BOSE 901® and 501 speakers. The technical details of this computer are, of course, a closely guarded proprietary secret, as is any technology that enables one company to produce better products in a competitive market. While we cannot share this information with you, we are confident that you will share in the results of SYNCOM II's operation through the enjoyment of more natural music reproduction in your home.

The BOSE Direct/Reflecting® speakers and the SYNCOM II Computer are but two examples of the research of BOSE Corporation, founded by scientists and dedicated to continued leadership in the research of better music systems.

For information on the BOSE 901, circle your reader service card or write Dept.A7.

* For a description of the research, see the article entitled, "Sound Recording and Reproduction," published in TECHNOLOGY REVIEW (MIT), Vol. 75, No. 7, June '73. Reprints are available from BOSE for fifty cents per copy.

Incredible.

How else would you describe a preamplifier with:

- A **Peak Unlimiter** that restores dynamics lost in recording to closely approximate the original.
- A **Downward Expander** that reads "gain riding" and expands dynamics down to precisely the intended level.
- An **AutoCorrelator** that makes record/tape hiss and FM broadcast noise virtually vanish without affecting musical content.
- Plus an **Active Equalizer** that gives you flat energy distribution over the full audio spectrum, **Joystick Balance** and **Step Tone Controls** that allow precise music tailoring to your listening environment and **SQ*** and **Phase Linear differential logic** for Quad Sound.



The 4000 is an advanced stereo preamp that actually puts back in what recording studios take out . . . lets your music (at last) reach life-like levels without distortion . . . lets you (for the first time) hear your music from a silent background. It is, in a word, incredible. Ask your dealer for an audition.

Price: \$599

Cabinet: \$37

Warranty: 3 years, parts & labor.

Phase Linear 4000

THE POWERFUL DIFFERENCE

PHASE LINEAR CORPORATION
P.O. Box 1335 • Lynnwood, Wash. • 98036

*SQ is a trademark of CBS Labs, Inc.

digital system, more time than ever will be able to be cut on a disc, since groove geometry is now completely governed by the recording level. He further stated that lines-per-inch and depth changes are made only as required by the program material with variable pitch information updated every 15 milliseconds and variable depth information every 100 milliseconds. Coming on the heels of the Neumann SAL 74 computer cutting system I reported on in the June 1974 issue of *AUDIO*, the Haeco VP-1000 is further proof of the vitality of the venerable phonograph record and the continual updating of disc cutting technology. One absolutely intriguing aspect of Howard Holzer's new device is its application to direct disc recording. You have probably heard about the Sheffield Record Co. in Los Angeles which has issued a series of three recordings in which the output of the studio mixing console is fed directly into the cutting amplifier. Obviously since there isn't any tape, there isn't any advance tape head, and thus there is no possibility of lathe automation as far as variable pitch and depth are concerned. This is a handicap, and it is a tribute to the lathe engineer that he does so well and achieves a stunningly clean and dynamically exciting recording. Nonetheless, with a potential 80-dB dynamic range on a direct-cut lacquer, with the Haeco VP-1000 able to provide lathe automation, more of this great range can be realized and the result would probably be utterly spectacular.

While the Unisette and the Haeco units were outstanding items at the AES convention, there were, of course, many other interesting developments. In the quadraphonic area, JVC and Panasonic (Technics) both had operating CD-4 demonstrations in which they used their long-anticipated IC-chip demodulators. These prototype units were less than a third the size of their present demodulators and on a rather superficial hearing, each seemed to do an exemplary job presenting nice, clean, well-separated quadraphonic sound. The JVC and Panasonic chips are both made by Signetics, but the engineering approaches differ. The JVC chip is the product of their engineering group, while the Panasonic chip was designed by Lou Dorren of QSI. I expect to be testing one of these IC chip demodulators before long. At the Sansui exhibit, they were once again demonstrating their QS variomatrix, this time with a splendidly atmospheric and fascinating recording of the recent royal wedding of Princess Ann and Captain Phillips. Nippon Columbia is evidently solidly behind Duane

Cooper's UD-4 carrier/matrix quadraphonic disc system, as they have announced they will be making demodulators and software available by this fall. So we will have to wait until then, to put this system into perspective with the competing quadraphonic systems.

BGW Systems, manufacturers of a number of high-powered amplifiers, including a new quadraphonic unit of 4 X 150 watts per channel (!), was showing an impressive looking quadraphonic pre-amp with a multitude of controls for versatile signal processing. Price is reported to be "around \$800."

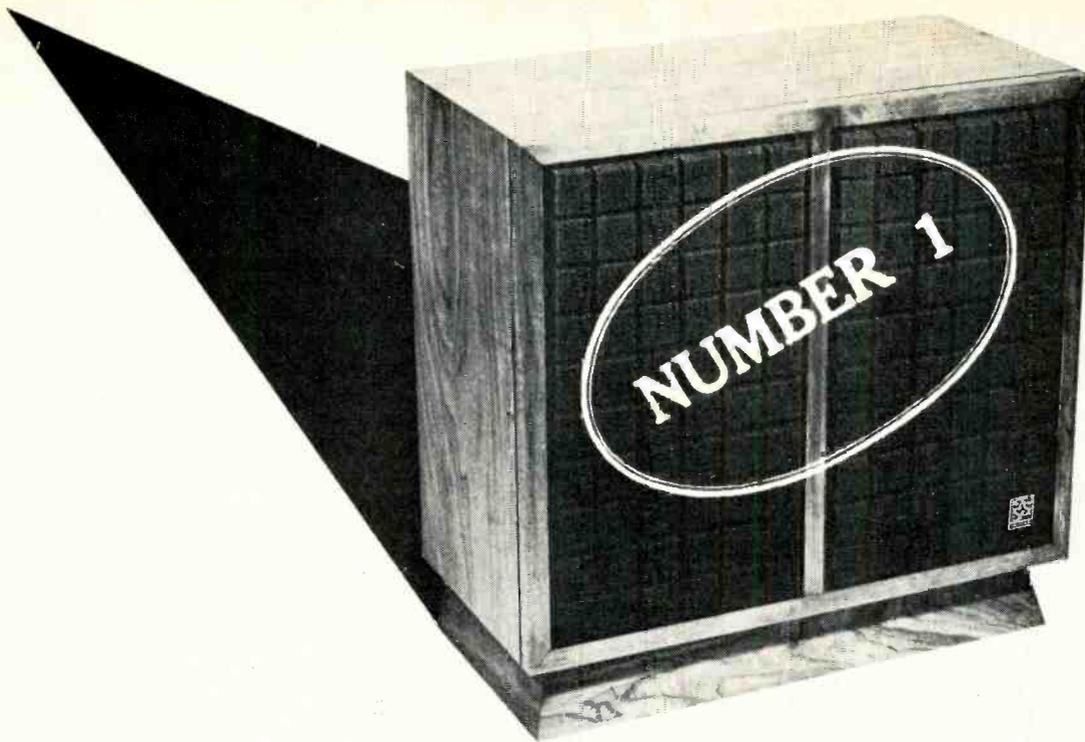
Mark Levinson was on hand with his superb standard LNP-2 pre-amp, I reported on some months ago. Now he has a new pre-amp, with simplified controls and less facilities, but the basic specs and the overall quality are the same as in the LNP-2 at a little more than half the price.

Affable Clyde Moore of Crown International was on hand with his new M600 power amplifier, busily lighting up 600-watt light-bulbs, which as the visual purple in my eye told me for a long time afterwards . . . are very bright indeed! Also on hand, a neat looking prototype of the new Crown electronic crossover, intended for us with Crown's electrostatic hybrid speakers and similar applications requiring bi- and tri-amplification.

Everywhere you looked there were professional tape recorders. As might be expected, pride of place at the Ampex exhibit went to their new model 440C. 3M and Scully had their top-of-the-line machines on hand, MCI created a lot of interest with their recorders which are now well in production. Studer, striking out on their own leaving the fold at Gotham Audio, was showing a huge 24-channel unit, as well as their well-known 2- and 4-channel units. With the establishment of several regional offices across the country, Studer will evidently take a more active role in the American market. Gotham Audio has, in turn, taken on the German Magnetophon, which claims exceptionally low wow and flutter specs.

As is usual, there were ever more complicated mixing consoles, with enough controls to frighten a 747 pilot. And there were new digital delay units, and equalizers, and . . . well, you name it. I could fill up many pages with descriptions of worthwhile recording or measuring equipment. If anyone feels slighted, my apologies.

So went the 48th AES convention and with any sort of luck I may recover in time for the 49th convention at the Waldorf-Astoria in New York . . . come September.



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Edward Tatnall Canby

EVERYBODY TRAVELS world wide these days. It isn't easy to make a sensation any more by announcing, say, I've just been to JAPAN! Which I have. Unbelievable. For my generation, the occasional big-scale "junket" is a rare and often incredible experience, and I do not intend to lose my continuing sense of almost childish wonder that such things can actually happen—that I, myself and me, along with 17 other journalists and editors, could travel no less than 30,000 miles, more or less, as the guests of a munificent hi fi maker introducing a new line of quality goods in our field. Yamaha is the company, and Yamaha made possible the junket of my life, for which, hi fi aside, I am enormously grateful. And, hi fi *not* aside, I am impressed by the goods themselves, which are clearly all-out in the best and topmost Japanese manner. New speakers, new receiver lines, including an unprecedented FET power output.

Yamaha is officially Nippon Gakki Co. which means Japan Music Co. It has been first of all a musical outfit, a producer of an incredible array of Western-type musical instruments, most notably the Yamaha pianos that are now establishing themselves in the highest places everywhere, as a good many startled musicians have lately been discovering. In Yamaha's Tokyo retail store I played on one of the loveliest full-size concert grand pianos I have ever had the luck to touch. It was pure 1900 Steinway, light to the touch, shallow in key depth, with a silvery treble sound and an impressive bass. I own a 1903 Steinway—I should know. Opposite was a medium grand—straight Bechstein in the continental manner. That slightly woody treble that the Europeans love. The higher keys, stiffer action, that most new pianos have. Yes, Yamaha knows its pianos impressively well.

But my pleasure at Yamaha sound (and friends have told me that Yamaha guitars also are cannily modeled upon the several finest Western types in the same way) turned to utter astonishment when we got to our tour of the vast Yamaha factories in and around Hamamatsu, the company's home town. One gets the impression, around these parts—the States—that the art of piano building is a true craft, with everything hand made in painstaking detail, in ye olde manner. Somehow, the mere idea that pianos could be automated seems a contradiction. Imagine, then, the sight of a hundred acres of humming factory

automation, a thousand huge machines sawing and drilling and polishing, huge veneer/plywood presses, enormous foundry operations, bright rivers of molten metal pouring into piano frames, the whole thing on a Detroit scale! Pianos, pianos, *pianos*—thousands of them. Vast automated rows of dangling curved frames, moving on assembly lines like car bodies. Whole floors of semi-finished instruments as far as the eye could see. Preliminary tuning, a soft, pervasive tinkle of a hundred tiny sounds, like an enormous flock of birds in song! And at the end of the lines, there were the great seas of shiny, finished instruments, big and little, grand and upright, sliding off towards the great world outside. How many hundred pianos a day?? I forgot to write it down, but I could not have believed that seven worlds or a dozen could absorb such an enormous output.

And Yamaha, as modern as Japan itself, has moved deftly into the electronic areas of music, as these have developed their importance. Miles and miles of Yamaha electric organs. Hundreds of little blue-clad factory girls, testing the keyboards and the stops—whizzing fingers, obviously trained to play, earphones on for checking, an occasional out-loud chromatic scale at speed. *Prrrrrr*, up the keyboard. Some things are best done by human intelligence. They use those odd-looking Yamaha "ear-shape" speakers for the organs, though these are not included in the new hi fi offerings which we were being shown.

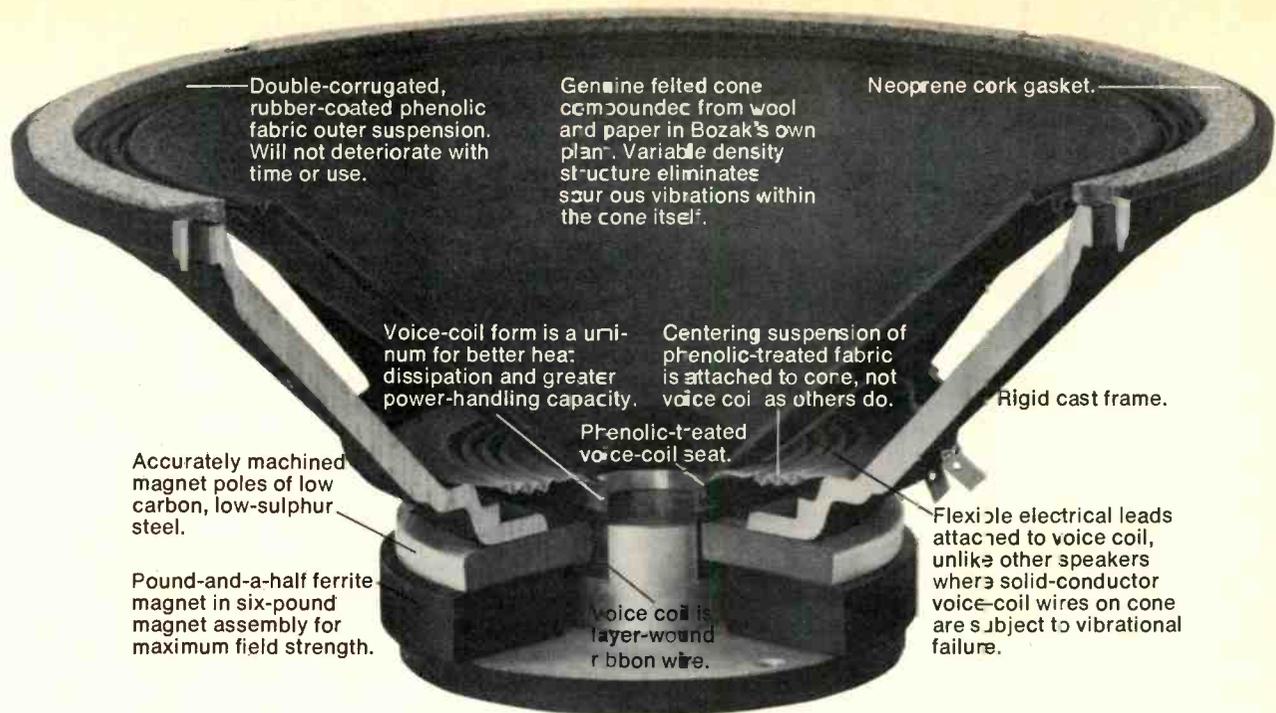
Then there were the electronic factories, all solid state. You'll pardon me if I have lumped a dozen enormous installations together in my mind and can't really remember which was which; I simply must somehow give you the impressions I received, just as they came to me. We went into "every corner" of Yamaha's plant, quite literally, and after several days I was, shall I say, in a daze. In and out, up and down, back to the bus, out at another parking place with greenery (like all of Japan, Yamaha never loses the aesthetic touch), up a stairway, down an endless corridor, past another thousand blue uniforms—exhausting but fascinating too. I have so much to say that is irrelevant! Like the institution of safe backing up, for public busses. . . .

Each bus has a hostess. She bows you into the bus and bows you out again and you bow back, if you have at least a sense of politeness. But her

main job is backing. The instant the bus goes into reverse, the tiny hostess leaps out the door, dashes to the rear and starts frantically blowing on a police whistle. *Tweep, tweeeeeep, tweep, tweeeeeep . . .* like a genial female maniac! Once we got sort of stuck on a narrow street and tried to back uphill for seven or eight minutes—I thought that little gal would bust; she never stopped for a second. All over Japan, I could hear those bus girls tweeping away, off in the distance, as the fleets of big tourist busses maneuvered around their parking places. Even with no soul in sight, in the middle of a virgin forest, the tweeps were mandatory. Great fun.

. . . Miles of electronics, semiconductors in all their magnificent proliferation, for Yamaha products, and for others as well. Including the new FET power producers. And finally, more miles of hi fi. The new speaker lines, the new receivers in all their silky brushed-satin glory. Mmmmm. Don't think I'm going to give you technical particulars; that's not my job and you'll be getting them soon enough, since the entire Yamaha line was introduced at the CES in Chicago this June. I'm just set on giving you the astonishing background into which this line fits and out of which it comes—a perfectly vast and huge company in the music field, out of a musical tradition, expanding and overflowing into the inevitable electronics and component area. In this respect I believe Yamaha is unique in Japan among the big hi fi makers, though whether this means in the end a better product I leave you to decide, along with the experts. It *should* make a difference, says this inveterate musician. I have never failed to believe that a musical ear and a musical tradition and a musical *interest* tend in hi fi to provide a healthy feedback toward wise, useful and intelligent componentry. As I've said a million times, the business of audio is music.

We were given an elaborate and formal presentation of the new hi fi in several lab sessions at headquarters, the technicians of the company lined up behind us, the top brass up front, the whole shining array of goodies displayed all around. To be frank, I didn't think too much of the acoustics of that lab. A curious big space *behind* the speakers, up front, a sort of thin transparent scrim blocking it off for the eye, but not the ear. We argued ourselves blue in the face with our usual enthusiasm as to exactly which setting on which speaker was



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best, but though the high ends were very definitely sibling on the two new featured models, the bass on the smaller NS 690 was oddly inadequate—too much so, my ear immediately told me. As a musician at heart, I always hear loudspeakers first of all as *music makers in an acoustic environment* and I do not have, nor do I cultivate, the ability to hear the speaker itself out of context. In the home, in my own home, it's another story. One quickly discovers—over a period of days and weeks, that is—a loudspeaker's special characteristics, in the very process of listening to music in a familiar acoustic environment. Not so in an unfamiliar laboratory, with relatively brief bursts of sound. I distrusted that seemingly weak bass immediately, though the larger and more expensive top-of-the-line NS-1000X seemed to do noticeably better, as we listened.

I think I was right. I heard the NS 690 later on in the big boss man's own private Japanese living room and there, lo! no problem. Again at the Osaka Audio Fair, in a very well designed listening room that was sealed off from outside noises, I heard the same two speakers and now I began really to recognize their qualities—no problem, again, with the NS-690 though the bigger and still more expensive NS-1000X still produced slightly heftier bass at top volumes. Both speakers give that clean kind of bass one achieves with a solid sealed enclosure.

The Yamaha top end is not dull by any means—nor is it in any way strident. I found the word “shiny” returning to my mind each time I heard it. Good description. We did much dithering with the midrange and high controls on the exposed front speaker panels and decided among ourselves that for pop and rock music the “flat” or normal position, as marked, was ideal, but for classical music a slight roll-down of both controls gave the ideal balance. We suggested, in fact, that two “normal” positions might be a good idea, one marked normal pop, the other normal classical. Continuously variable, of course, for those who want further to twiddle. Mind you, these two speakers, the NS-1000X brand new, head up a whole related line in which the NS-690 is roughly in the AR 3a price range, the 670, 645 and 625 ranging on downwards into the modest bookshelf category. How many of these will appear in the U.S. offering I do not at this point know.

As for those silky, shiny receivers and amplifiers, with the new power

FETs for output, I will do no more than tell you how good they felt under the fingers—and sounded, insofar as one could judge in a laboratory demo, which means not much impact for my ears. Really well designed and expensive controls, nicest I've run into for a long time—silky smooth toggle switches, up and down, big volume and tuning controls, tiny detents on most of the knobs which, ever so unobtrusively, set up points of reference without being gross and clicky. Maybe it's silly to talk of externals, but I do so deliberately; you'll hear plenty from others all about the insides and the FET power output.

One *very* big external: at last, a really workable and intelligent loudness control, like the very earliest ones years ago, before we slid into oversimplification, as on virtually all present component equipment. Apparent loudness depends directly on (a) volume setting and (b) acoustic environment and listening place. The loudness compensation curve is meaningless unless it is related to the actual, heard sound in a given room. Yamaha has two controls, one for volume, one for loudness. Set your maximum desired volume, for *your listening situation*, and then use the loudness knob to lower it according to choice. It works! It always did. Frankly, I find the usual loudness controls quite impossible and never use 'em if I can help it. I would have the Yamaha control in action virtually all the time.

To whet your curiosity, here are the Yamaha models we saw and heard. In the tuner department, CT by designation, two FM/AM models, CT 800 and CT 600, and in the combined receiver category a full panoply, from the very fancy and expensive CR 1000 with no less than 30 control functions on its front panel, FM only, through the sleek CR 800 and similar CR 600, AM/FM, and the relatively low-cost (but still very, very fancy) CR 400, also AM/FM. Then in the amplifier-only area, another super model the CA 1000 stereo integrated amplifier and the CA 800, both of these with an interesting featured alternative, high-power class B operation or, via a switch, lower-powered distortionless class A. A CA 600 model carries this line down into the lower stratosphere. All of these with so many top-area features I would be foolish to try to write them all out, and won't. But don't forget the FET power amps in the higher-bracket models of the line. As of the present, nobody else has 'em, though Sony, I

(Continued on page 26)

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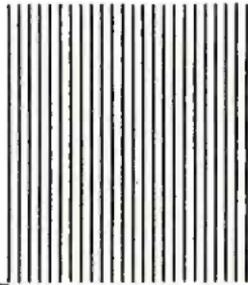
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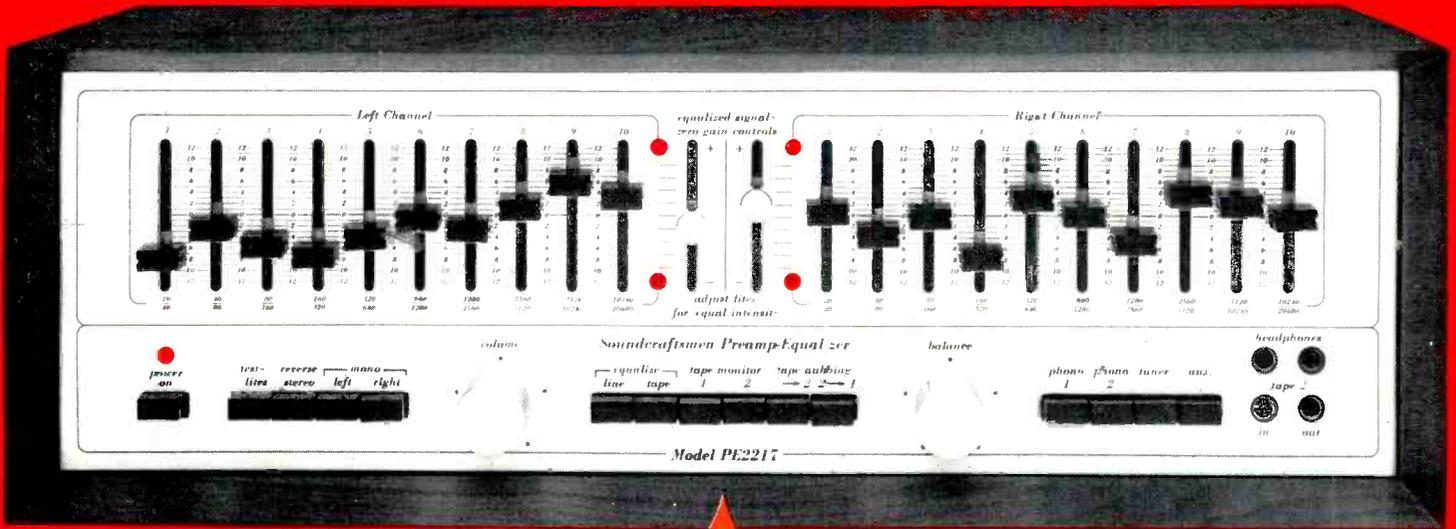
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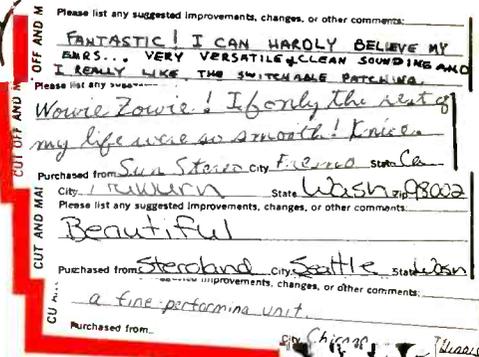
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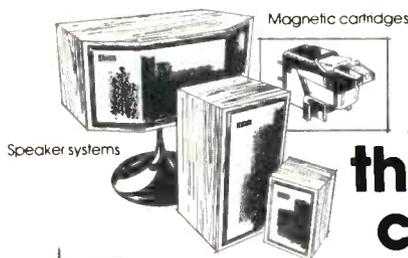
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(Continued from page 22)

believe, has a license or equivalent and will go into them on its own in due course of time.

So there you are—obviously a component line intended to hit the very top quality bracket, and at prices that such equipment deserves, which is sad indeed for those who are penniless. But the good life costs cash these days and there are a few pennies around, fortunately, to splurge on top quality hi fi. Yamaha wouldn't mind raking in a few of yours, needless to say. Go look. I'm merely putting all this nice stuff out on a literary tray for your inspection—like the realistic food displayed outside Japanese restaurants in glass cases, so you can choose your menu piece by piece before you enter. Take it or leave it; that's your business from here on out.

As for Japan, you know me and you know that I can't ever detach mere hi fi from the rest of life as it floods around me and hits my senses. And so I have come back from that country absolutely overflowing with impressions, and with quantities of stereo color shots, too, via Bert Whyte's brand new 20-year-old Revere, happily borrowed from him for the occasion. (Bert uses it all right, but keeps the thing so beautifully polished you'd never know.)

I was really stunned by the size and power of Japanese westernization. I was delighted by the odd contradictions (from our viewpoint) between an old, old civilization, dating straight back on every hand to the sixth century, and such a new, new Western experience, relatively, that even the toilets have delicate instructions, with pictures, for those who haven't yet encountered that Western device. It has all happened pell-mell, it is *happening*, at breakneck speed, and in this incredible conversion ten years is a century, though in the long Japanese tradition a century is no more than a moment. Next month, then, I plan to take off from the Yamaha base and give you the side excursions I've saved up, the genuine "etc." elements of the big trip. In particular, that never-ending source of personal delight, the English language in Japanese guise, one of the most intriguing bodies of expression I have encountered in a lifetime of amateur linguistics. (I wish I could speak enough Japanese so I could afford *them* such a pleasure, the other way around!) Pigeons on the glass, arras. People who rive in grass houses shouldn't throw stones. So I'm off in my Yamaha rimsheen, and next month it'll be moshi moshi everybody.

There are some things you'll appreciate about a Dual right away. Others will take years.

You can appreciate some things about a Dual turntable right in your dealer's showroom: its clean functional appearance, the precision of its tonearm adjustments and its smooth, quiet operation.

The exceptional engineering and manufacturing care that go into every Dual turntable may take years to appreciate. Only then will you actually experience, play after play, Dual's precision and reliability. And how year after year, Dual protects your precious records; probably your biggest investment in musical enjoyment.

It takes more than features.

If you know someone who has owned a Dual for several years, you've probably heard all this from him. But you may also wish to know what makes a Dual so different from other automatic turntables which seem to offer many of the same features. For example, such Dual innovations as: gimbal tonearm suspensions, separate anti-skating scales for conical and elliptical styli, and rotating single play spindles.

It's one thing to copy a Dual feature; it's quite another thing to match the precision with which Duals are built.

The gimbal, for example.

A case in point is the tonearm suspension. Dual was the first manufacturer of automatics to offer a true twin-ring gimbal suspension. More importantly, every Dual gimbal is hand assembled and individually tested with precision instruments especially developed by Dual. The vertical bearing friction of this gimbal is specified at 0.007 gram, and quality control procedures assure that every unit will meet this

specification. Only by maintaining this kind of tolerance can tonearm calibrations for stylus pressure and anti-skating be set with perfect accuracy.

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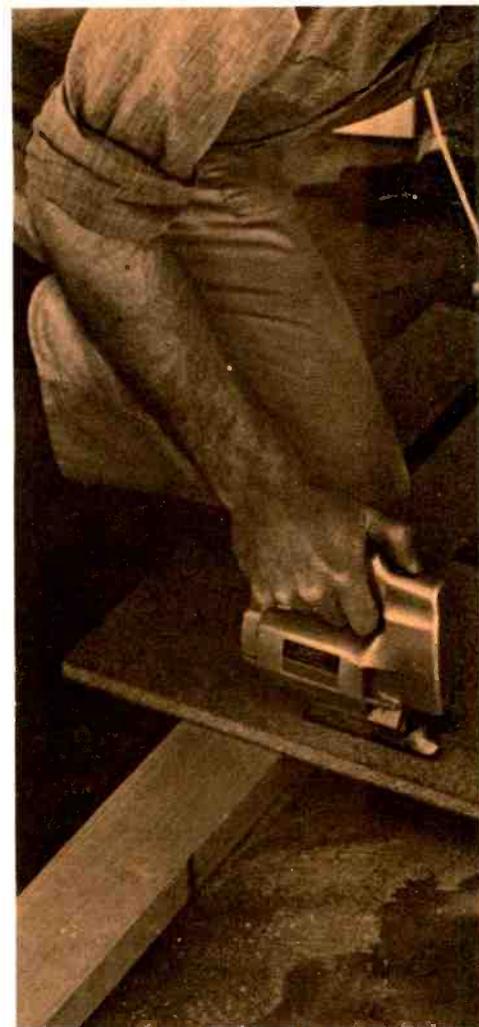
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Build An ES Tweeter / Cone Woofer System

Jan deVries and Michael Lampton



IN THE LAST few years, there have been substantial advances in the theory of low frequency loudspeaker performance.^{1,2,3,4} Furthermore, the growing popularity of electrostatic tweeters has brought a number of excellent commercial high frequency reproducers to the market, available at reasonable prices. Taken together, these facts lead to the conclusion that the hobbyist who wants to put together a high performance loudspeaker system can do so in a straightforward way, and have confidence in achieving the performance goals he sets. One of us has a good size living room and decided some good performance loudspeaker enclosures would increase the general living enjoyment and comfort of the room.

The project loudspeaker systems were fun to plan and build, and they work so well, that we want to share the ideas and details with other AUDIO readers. Bear in mind that there is a great deal of flexibility in the design: the shape of the cabinet, the mounting configuration of woofer, tweeter, and duct, the choices of woofer and tweeter. Because of this flexibility, we have tried to avoid loading this article down with too many details or precise dimensions. Nonetheless there is enough information for the home constructor to come up with a pretty close carbon copy, if he wishes.

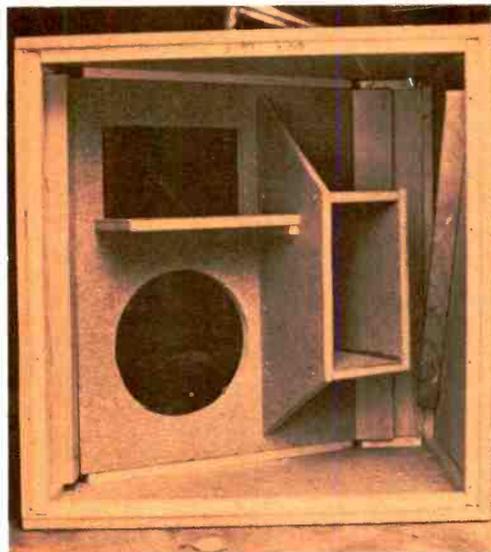
The simplest and sometimes cheapest type of loudspeaker system is a "one-way" system, where one or more similar loudspeakers cover the entire range of frequencies to be reproduced. Such systems face a severe compromise, however, when it comes to choosing a loudspeaker size: For smooth response and wide dispersion above a few kilohertz, the loudspeaker should be no more than an inch or so in diameter, while for low distortion below 100 Hz it should be at least six to eight inches.

One way around this situation is to arrange a large number of medium-size speakers on a curved baffle surface, to improve the total high frequency radiation pattern; the low frequency response is still often deficient, however. Another technique is to employ a loudspeaker whose effective cone area decreases with increasing frequency; these loudspeakers have mechanical crossover networks which give many of the benefits of two-way systems.

Two-way loudspeaker systems use separate woofer and tweeter units for the reproduction of the bass and treble notes. They have the advantage of permitting each unit to be optimized for its part of the spectrum with the result that broader total frequency response and less distortion can be achieved. This article describes a reasonably simple two-way system which realizes these advantages.

The Electrostatic Tweeter A push-pull electrostatic loudspeaker element consists of a thin conductive membrane suspended between two wire grids. In operation, the membrane is kept charged to a potential of 1000 volts or so, and the signal to be reproduced is applied between the grids. Thus the signal takes the form of an alternating electric field between the grids, and the membrane experiences an electrostatic force proportional to the audio signal. If the membrane is sufficiently thin and light, this force is directly applied to the surrounding air, and the radiated sound pressure directly tracks the applied audio voltage.

The frequency response limitations of an electrostatic loudspeaker are as follows. At the high frequency end, the response



will start to fall off when the inertial forces required to accelerate the diaphragm become comparable to the radiation resistance of the air; thus response to (say) 30 kHz requires membranes thinner than about 0.1 milligram per square centimeter. The fact that strong metallized plastic films of this thickness (thinness?) are readily available is what enables reliable electrostatic tweeter elements to be made cheaply. At the low frequency end, the response is limited by the necessary tension in the film suspension and by the radiation cutoff due to the element's finite size: The response will start to drop off when the element's diameter is less than about a quarter wavelength. Thus, a three-inch by three-inch square unit will not be useful below about 1 kHz.

Electrostatic tweeters have several advantages over the usual moving-coil tweeters. Foremost is, of course, their extended high frequency response, which goes about one octave higher than dynamic units. More significant is the fact that the electrostatic's response curves are inherently exceedingly smooth; the peaks and valleys, which are produced by the acoustical impedance mismatch between a heavy cone or dome and the surrounding air, are absent.

There are two important limitations of electrostatic loudspeakers, however. First, because they radiate well only at wavelengths smaller than their size, they produce appreciable beaming of the radiated sound. Consequently, at least two elements should be used in a corner-located system, angled 45° to 60° from each other; even more elements are needed in a wall-mounted or bookshelf system. Second, electrostatics have limited power handling capacity owing to the required strong electric fields and close grid spacing. Although per-

TABLE 1. Important Properties of a Few Loudspeakers

Size, inches	Mfr's name	Type number	Stiffness		BLproduct weber/meter	EIA sens dB
			FAR Hz	Resistance ohms		
8	JBL	D 208	55		6.25	44
	JBL	LE 8T	30	6	6.8	43
10	Altec	406-8C	30	800	6	49
	JBL	LE 10A	29	900	5	44
11	Janszen	350	39	950	4.6	5.4
12	Altec	412 C	35	1350	5	6.8
	Altec	414-8B	30		6	52
	E-V	SP-12B	50	2440	6	13.6
14	JBL	LE 14A	25	2500	5	15.2
15	Altec	416-8A	23	1340	6	16.1
	Altec	515 B	25		12	56
	E-V	SP-15	25	1860	6	21.3
	E-V	SP-15B	30			51
	JBL	130 A	36			20
	JBL	LE 15A	25	1700	5	22.3

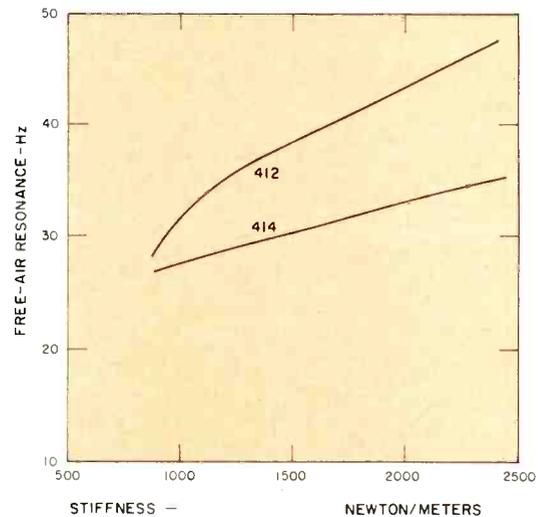


Fig. 1—Woofer free-air resonance vs. stiffness.

fectly adequate for living room sound levels, they are not suited for auditorium or outdoor sound reinforcement applications.

Rather than build our own tweeters, we purchased the Janszen Model 65 electrostatic loudspeaker unit, which includes two four-inch square elements and the required high voltage power supply, as well as a high quality step-up transformer needed to match the elements to an eight-ohm amplifier output. Although the Janszen unit contains its own high pass filter with a 700 Hz cutoff point, we chose a somewhat higher crossover frequency and so found it acceptable to leave the manufacturer's high-pass filter in place.

The Woofer The low-frequency radiator for this project system was designed using the technique described by Lampton and Chase (AUDIO December, 1973⁵). The enclosure type is a fiber-filled bass-reflex system, which has the greatest practical figure of merit of all common enclosure types and is not particularly difficult to build. In this system, our design objectives were to achieve an asymptotic efficiency of 2 per cent, while maintaining a 3 dB cutoff frequency below 30 Hz. From the Design Curve #1 of Lampton and Chase, such a system will require an enclosure volume of 7 cubic feet if airfilled, or 5 cubic feet if glass-wool fiber-filled. This particular level of efficiency means that, when driven from a 50-watt amplifier just reaching its clipping level, the system will yield 1 acoustic watt. In a typical living room, this corresponds to about 110 dB SPL (!) which is surely enough for any foreseeable application. By the way, this efficiency is about two to five times as great as is provided by the usual type of bookshelf loudspeaker systems, and the 30 Hz cutoff constitutes about a one-octave improvement over such systems. Although there are few steady tones found in this part of the spectrum in musical passages, there is substantial transient power in this bottom octave associated with percussion.

In order to come up with a woofer capable of satisfying these ambitious design objectives, we applied the method of Lampton and Chase twice. First, as in their design example #1, we plotted up the allowed maximum woofer free-air resonance versus suspension stiffness for 12-in. woofers giving a 30 Hz cutoff in a ten-cubic-foot enclosure (equivalently, a seven-cubic-foot fiberglass-filled enclosure). This enclosure volume

is larger than is absolutely necessary, but the extra volume allowance will give us a nice large working range of woofer parameters. This design constraint is shown as the upper curve in Fig. 1. Second, as in design example #3 of Lampton and Chase, we plotted up the allowed woofer parameters which can give at least a two per cent efficiency in a ten-cubic-foot enclosure. This design requirement then leads to the lower curve in Fig. 1. Any 12-in. loudspeaker whose free air resonance and suspension stiffness lie between the two curves in this figure will then satisfy both sets of requirements. Note that if we had not started out the calculation with any more volume than necessary, we would have ended up with only a skinny line in Fig. 1, on which the chance of finding some commercial woofer would have been quite small.

Are there any woofers which will do the job? After exchanging correspondence with several manufacturers, perusing a variety of specification sheets, and borrowing a few loudspeakers from friends for measurement, we made a table showing the more important parameters of a number of popular types; it is reproduced below as Table 1. Among the 12-in. speakers, the Altec 412 and 414 lie within the OK zone of Fig. 1 and so could be used in the present project. The Electro-Voice SP-12B lies just above this zone, and could be used if its FAR were lowered a few Hertz by putting adhesive tape on the cone, or if the 30 Hz cutoff were slightly relaxed.

The particular woofer we chose for the project system was the Altec 412. Although it is nominally a wide-range speaker,

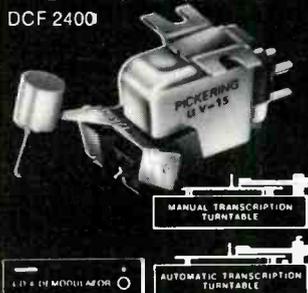
TABLE 2. Properties of the Project System

Type:	Two-way corner enclosure
Size:	Eight cubic feet, external
LF Section:	Single loudspeaker, bass reflex
Woofer:	Altec 412 C 12-inch
LF Cutoff:	-3 dB at 30 Hz
Efficiency:	2% based on 2π sound radiation
HF Section:	Two element electrostatic (Janszen #65)
Dispersion:	90° x 20°
HF cutoff:	30 kHz
Crossover:	1000 Hz, two-pole, constant power

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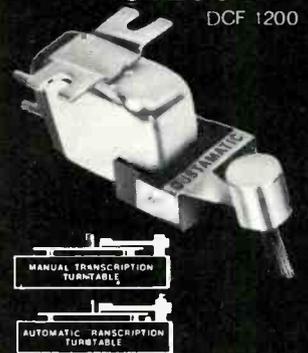
DCF 2000



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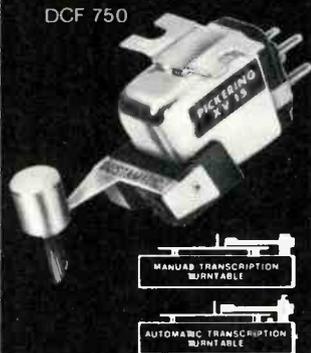
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DCF 1200



XV-15750E

DCF 750



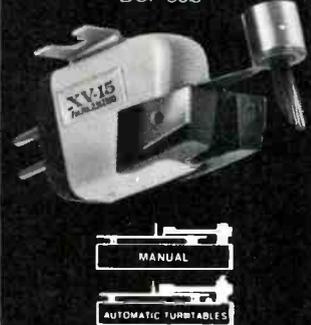
XV-15400E

DCF 400



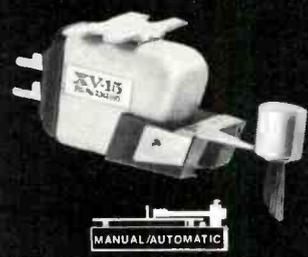
XV-15350

DCF 350



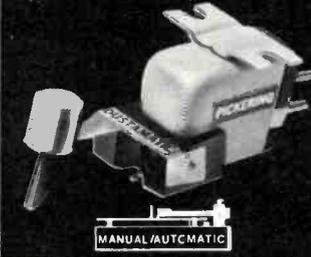
XV-15200E

DCF 200



XV-15150

DCF 150



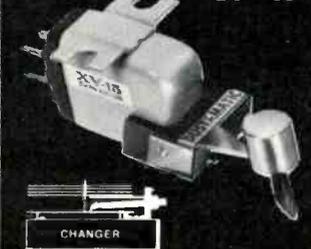
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and could have been used alone without an outboard tweeter, we regard the addition of the electrostatic tweeter as an improvement.

Having chosen an enclosure size and a specific woofer, we are all set to finish the design by calculating the duct details and then establishing the proper damping. From Fig. 7 of Lampton & Chase we see that we shall need a duct air mass ratio of 1.2; since the woofer has a mass of 28 grams, we find a needed duct air mass of 34 grams. This is provided by a duct having a cross section of 6 by 12 inches, and whose length is $9\frac{3}{4}$ inches, from the duct formula for 12-in. woofers:

$$\text{duct length (inches)} = .0082 m A - \bar{A}$$

where the desired mass, m , is expressed in grams, and the duct cross section area A is expressed in square inches.

The damping is established from the required speaker Q , given for example in Fig. 9 of Lampton & Chase: optimum performance would be obtained with a $Q = 0.45$. The chosen speaker has an inherent Q of about 0.5, meaning that it is slightly less damped than it should be for this application. The discrepancy is not serious enough to warrant fiddling with negative output impedance amplifiers. Had we wished to raise the speaker's natural Q value, a one- or two-ohm external series resistor would have accomplished the job.

We ran a computer evaluation of the final woofer/enclosure design. The computed response plot is shown in Fig. 2. The plot verifies that the response should indeed be quite flat down to

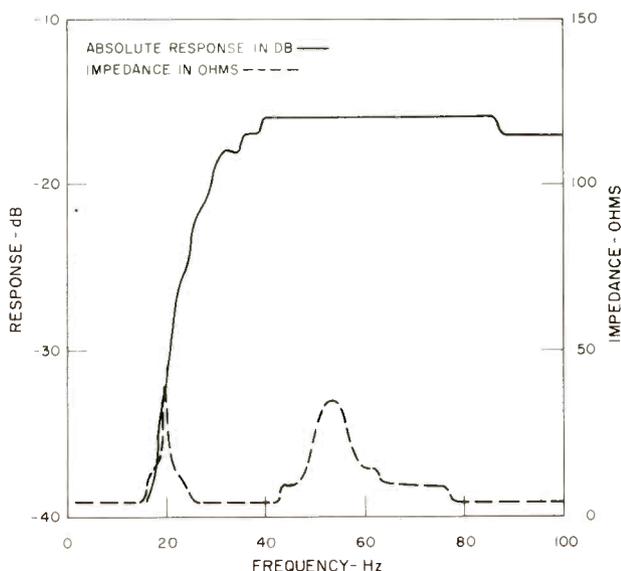
Fig. 2—Computer generated amplitude response and impedance plots.

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SYSTEM INPUT DATA ARE...
EFFECTIVE PISTON AREA      .051 SQUARE METERS
ADIABATIC ENCLOSURE VOLUME .286 CUBIC METERS
WOOFER FREE AIR RESONANCE 34.0 HERTZ
SUSPENSION STIFFNESS      1350. NEWTON/METER
B L PRODUCT                6.8 WEBER/METER
VOICE COIL RESISTANCE      4.2 OHMS
SUSPENSION Q FACTOR        5.44
REFLEX VENT AIR MASS       .034 KILOGRAM

FROM THESE DATA, CONSTANT PARAMETERS ARE...
EFFECTIVE WOOFER MASS      .030 KILOGRAM
ENCLOSURE AIR STIFFNESS    1300. NEWTON/METER
ELECTRODYNAMIC DRAG       11.01 NEWTON SEC/METER
HELMHOLTZ FREQUENCY        31.1 HERTZ
SUGGESTED VENT AIR MASS    .028 KILOGRAM
ASYMPTOTIC EFFICIENCY      1.806 PERCENT
G= .519      S= .963      M= 1.149
A= -1.89     B= 3.31      C= -2.09     D= .70

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about 40 Hz, and be down 3 decibels at 30 Hz. A computed impedance curve is also shown.

The Crossover In a two-way loudspeaker system, it is necessary to electrically divide up the audio spectrum into the frequency ranges the woofer and tweeter are capable of handling. This is accomplished with low- and high-pass filters. An important decision is to choose between a high-level or a low-level crossover network. A high-level network is designed to handle the output of the power amplifier, and is connected between the amplifier and the two speakers; a low-level network is connected between the preamplifier and two power amplifiers (one for the woofer, one for the tweeter). Low-level crossover systems were once called "electronic" crossovers, but that term is more properly reserved for distinguishing either from mechanical crossovers. The advantage of the high-level crossover is that only one power amplifier channel is needed to drive the entire loudspeaker system. It has the disadvantage that rather cumbersome LRC components are needed to handle the required power with low distortion. Experimenters prefer low-level crossover systems, largely due to the ease with which the crossover frequency, cutoff slopes, and relative gains of the LF and HF channels may be varied. Although we chose the low level method, we feel that either technique can give good results.

The choice of a particular crossover frequency is a compromise governed by these two limitations: the low frequency power limitation of the tweeter, and the high frequency response irregularities of the woofer. The lower the crossover point, the more total power must be handled by the tweeter. Since tweeters (especially electrostatics) are capable of only small linear excursions, too low a crossover point can lead to severe distortion. On the other hand, a high crossover point delivers substantial midrange power to the woofer, and this midrange power may not reproduce and disperse smoothly. For the present system, we found a crossover frequency of 1000 Hz to be satisfactory, based on manufacturers' recommendations and on a number of listening tests.

In the vicinity of the crossover point, the woofer and tweeter reproduce a comparable sound level. As a result, the sound you hear is a combination of the woofer and tweeter response. The goal of the crossover design is to drive the speakers in such a manner as to have the total system response as flat as possible. Incidentally, the filters should also have steep cutoff slopes in order to keep the crossover region as narrow as possible. It is especially important to keep the LF power out of the tweeter circuit, to minimize distortion.

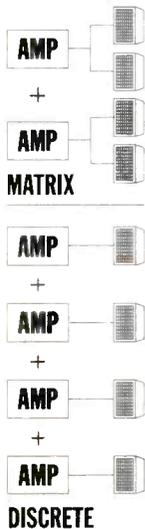
The designer would have an easy time of it if he were given the task of crossing over a two-way system for use on axis in an anechoic chamber. This is because on axis, the woofer-to-listener and tweeter-to-listener distances can be equal. Consequently the combination of the woofer and tweeter responses referred to above is exactly the sum of their separate sound pressures. So, *on axis* and with no reflected sound, you would obtain a flat overall frequency response curve by making sure that the total woofer plus tweeter voltage is constant with respect to frequency.

Out in the real world the situation is rather more complicated. Off axis, the woofer and tweeter sound pressures combine in a manner which depends on the difference in the phase shift along their paths to the listener. Reflections off walls and ceilings further complicate the picture, and it is quite difficult to make a system which takes all these individual phase shifts into account. The total sound power integrated over all angles can, however, very simply be made flat: We simply require a crossover network whose power gain to the woofer plus power gain to the tweeter, is constant with respect to frequency. This approach is justified by the fact that under most listening conditions, reflected sound constitutes the greater part of the

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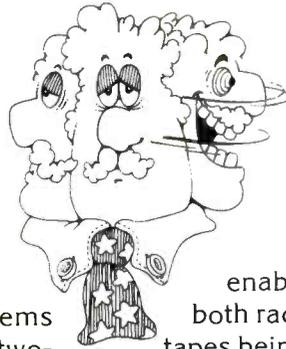


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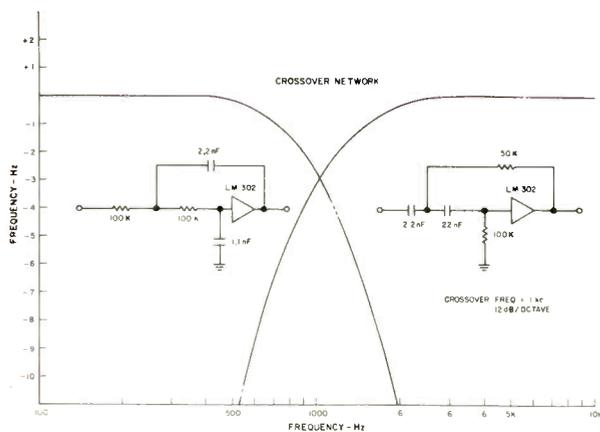


Fig. 3—Crossover network.

total (direct plus reflected) sound perceived. Reflected sound contains a large number of component paths, and among these the phase shifts are almost completely random; randomly phased signals add up as their total power, rather than as the sum of their individual sound pressures. It should be noted that there are a few applications where constant voltage and not constant power is appropriate. For example, in coaxial two-way loudspeakers the woofer and tweeter are within a quarter wavelength of each other and their sound pressures add directly.

There have been a good many crossover circuits described in the literature. Here, we'll give the details of a simple high-pass, low-pass filter which is easy to make and can be easily adjusted in frequency. It is known to engineers as a "two-pole Butterworth" filter, and has a power gain given by

$$\text{HF: Power gain} = \frac{(f/f_0)^4}{1 + (f/f_0)^4}$$

$$\text{LF: Power gain} = \frac{1}{1 + (f/f_0)^4}$$

where f is the frequency of the signal and f_0 is the crossover frequency. It is clear from formulas that the sum of the two power gains is 1, *i.e.* it is independent of f . Each section has a cutoff slope of 12 dB/octave. The filters can be built using only voltage followers (FETs, IC op amp followers) as active elements. A schematic is given in Fig. 3, along with the response curves of the HF and LF sections.

Construction With our components selected, we drew up plans which provide the required 7 cubic foot internal enclosure volume while making good use of the corner locations selected. The left hand and right hand enclosures are not identical, but are mirror images; due to the shape of the living room a 30° front-panel angle was preferable to the more customary 45°. Each front panel was drawn up with the tweeter directly above the woofer, with a great deal of internal bracing being provided by the shelves and ducts. Figure 4 shows a view of the assembly, and the photographs detail the relationship of the parts. The front panel and all shelves, etc. are made of rigid 3/4-inch particle board, which is denser and less resonant than laminated plywood. All internal panels are reinforced with securely fastened 1x2 and 2x4 lumber for added stiffness. removed from the enclosure for ease in installing the speakers or changing the grille cloth.

1. All panels for two enclosures can be cut from two pieces of 4x8 foot particle board, as shown in Fig. 5. If you have no table saw, a saber saw can be used for these long straight cuts provided that you clamp a straight 1-in. x 4-in. strip parallel to

the desired cut to act as a saw guide. Lumber retailers charge about \$5 for the 20 minutes of labor needed to cut up the panels. Since the finished enclosures will be covered with veneer, you have considerable tolerance in the straightness of the cuts, and no 45° bevel joints are necessary.

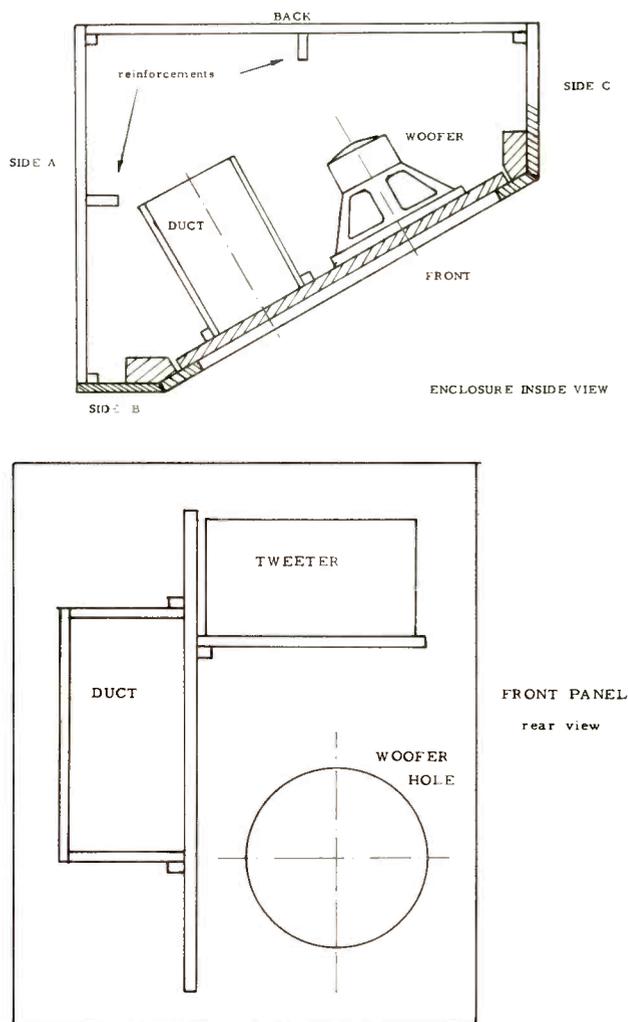
2. Measure in 3/4 inch from the inside edges of the bottoms and tops, and install 1-in. x 1-in. square glue block strips. For a removable front panel, make sure that there is no interference at the left and right sides with these blocks.

3. Secure the top and bottom to the sides and one rear panel. You'll have a much neater job if you put the screws in from the inside on all panels except the one removable rear panel. These joints should be glued as well as screwed down tight.

4. Install the tweeter shelf and duct on the front panel. Use plenty of glue here since this panel must be rigid. Paint the front panel surfaces flat black. The loudspeakers can be installed before or after the grille cloth is stapled around the front of the panel. The staples will be covered by the front frame when the panel is installed. The wiring can be installed at this point; it's convenient to mount a barrier-type terminal block on the non-removable rear panel for the connections to the woofer and tweeter.

5. Cut up 4-inch thick fiberglass insulating wool into four-inch cubes. Loosen up the material as much as possible; remove any foil which may be attached to the fiberglass. Staple some very loose cheesecloth over the rear of the woofer, and fill the

Fig. 4—Drawings of cross-section and front panel.



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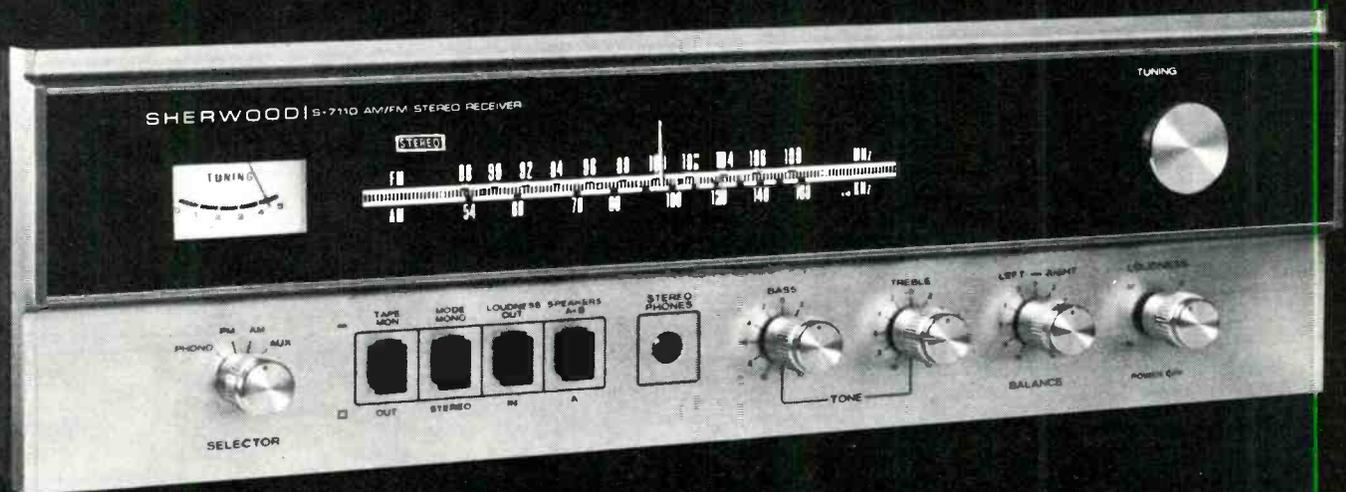
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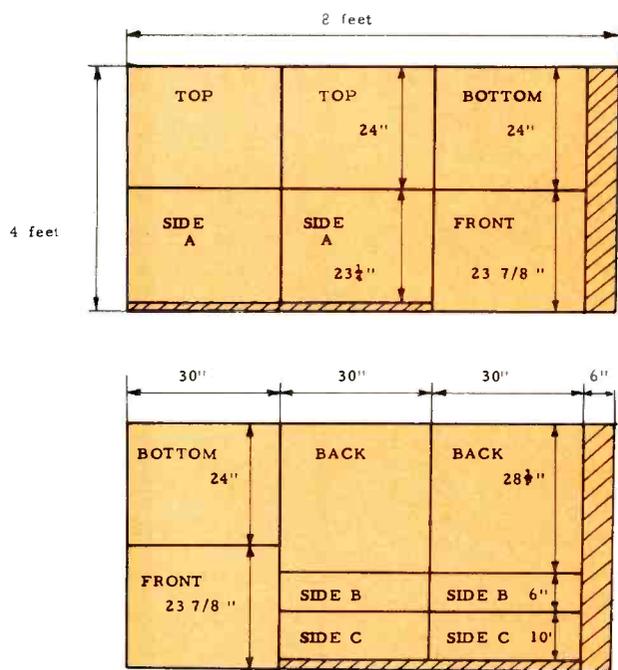


Fig. 5—Layouts for cutting major cabinet sections from two 4x8-ft. pressed wood sheets. Other materials needed are 10 ft. of 2x4 in. for corners of front panel, 50 ft. of 1x1 in. for corners, 10 ft. of 1x3 in. to give added stiffness to enclosure, 3x4 ft. plywood to construct the duct and shelf on front panel, fiberglass for inside lining and stuffing, wood glue, No. 8 flathead wood screws, and veneer to finish.

entire enclosure with the fiberglass cubes. Avoid packing the duct with them; more cheesecloth will probably be necessary here.

6. The rear panel can now be put into place with plenty of screws, and the whole system checked out. An audio oscillator is very helpful here. With a powerful amplifier, drive the woofer with a level of several watts at frequencies between 10 Hz and 1 kHz. Listen and feel carefully for any sign of panel resonance, which would reveal itself as a vibration or buzzing.

7. The best finishing job for the enclosure is done with commercially available wood veneer and contact cement. Make sure that the surfaces to be covered are flat, especially at the joints. Cut the veneer slightly oversize and coat the surface of the veneer with fast drying contact cement. When the cement dries, place a sheet of newspaper over the surface and center the veneer on the newspaper. Slowly withdraw the paper, allowing the veneer to contact the surface progressively. (With contact cement, you get no second chance!) With the veneer completely bonded, the edges can be trimmed using a razor blade or a sharp hobby knife. Several coats of shellac or acrylic resin, such as "Deft," will give the veneer sufficient hardness to stand up under everyday wear and tear.

Start Your Own Design The starting point for a custom design is to decide on the best speaker locations in your listening room. The locations should face as much of the listening area as possible, and be chosen with good stereo or quadraphonic panorama in mind. Corner locations are usually best. Try to avoid placement where much reflected sound can get to the listening area; hard flat surfaces are the most troublesome. One or two dominant reflections will give rise to severe frequency response irregularities throughout the midrange (as you

can verify with an oscillator) while numerous distant reflections are not at all harmful. Good listening rooms are remarkably dead; hi-fi showrooms have thick carpets and heavy drapes for more than one reason!

Since physical laws tell us that the larger the enclosure, the better the bass will sound, bear in mind that you will want to base your design on the maximum available enclosure size. Some thought should be given as to how you'll camouflage the monster once it's built. For instance, select an exterior veneer which blends with your other furnishings. Avoid grille cloth patterns which are too colorful and attention grabbing. An enclosure looks bulky if its frontal area exceeds about six square feet. A good way to obtain the needed volume is to choose enclosure locations where a good deal of depth is available, as is often the case in corners.

If you already own some loudspeakers and are considering building enclosures for them, you'll want to put them through the series of measurements described by Lampton & Chase to find out what their properties really are. If the enclosure is to give maximally flat response down to the woofer's free air resonance, you'll need an enclosure volume of

$$V = A^2/s \text{ cubic feet}$$

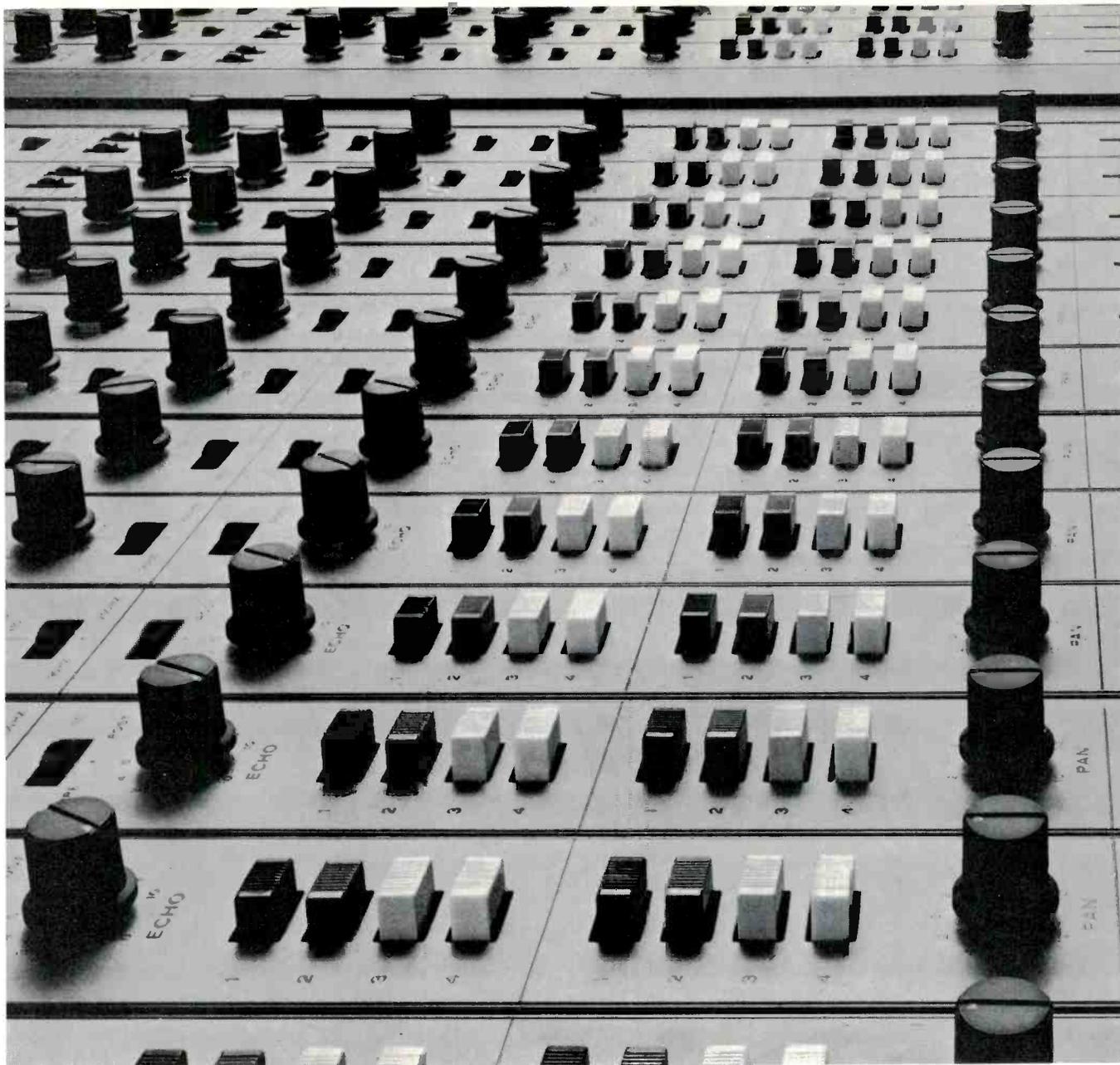
where the woofer piston area is A square inches, and s is the suspension stiffness in newtons per meter. Big, compliant woofers require very large cabinets to get down to their FARs. An even larger cabinet permits a response to below the FAR.

If you plan to select a new woofer for your system, contact as many manufacturers as you can. Many offer plans and even blueprints for building enclosures suited to their speakers. These plans are real bargains and disclose a number of useful assembly and mounting tricks, and can be helpful even if you don't use their specific designs.

Tweeter selection is more difficult than woofer selections, largely because their problems show up at the high end of the audio spectrum where lumped-constant thinking (e.g. Table 1) is inapplicable. A tweeter is perhaps best selected by ear. The things to listen for are smooth response (absence of harshness) and wide dispersion. Tweeters are of three kinds: direct radiator cone or dome types, driver/horn combinations, and electrostatic. Direct radiators are the cheapest and are reasonably efficient but too often show beaming and response irregularities above about 5 kHz. A small diameter is important if beaming is to be avoided. Horn-type tweeters are more costly but have much lower distortion and greater efficiency as a result of the impedance transformer action of the horn. They are well suited to high-power applications and generally have the lowest distortion of the three types. Due to their appreciable moving mass they are usually limited to frequencies below about 10 kHz. The low-frequency limit of a horn tweeter is set by the length and flare rate of the horn. For a one-foot length, the crossover frequency will have to be above 1 kHz. Electrostatic tweeters are best with regard to achieving a wide smooth response, but they are a bit fragile and will distort badly if over-driven.

REFERENCES

1. "Loudspeakers in Vented Boxes," by A. Neville Thiele, *Proc. I.R.E. Australia* vol. 22, p. 487, 1961, and reprinted in *Journ. A.E.S.* vol. 19, #5 p. 382 and #6 p. 471, 1971.
2. "The Theory of Maximally Flat Loudspeaker Systems," by Susan Lea and Michael Lampton, *IEEE Trans. Audio and Electroacoustics AU-20*, #3, p. 200, August, 1972.
3. "The Theory of Bounded-Ripple Loudspeaker Systems" by M. Lampton, *IEEE Trans. Audio and Electroacoustics AU-20*, #5, December, 1972.
4. "Efficiency of Direct Radiator Loudspeaker Systems" by Richard Small, *Journ. A.E.S.* vol. 19, #10, November, 1971, p. 862.
5. "Fundamentals of Loudspeaker Design" by M. Lampton & L. M. Chase, *Audio*, December 1973, p. 40.
6. "Vented-Box Loudspeaker Systems" by Richard Small, *Journ. A.E.S.* vol. 21, #5, 6, 7, June, July, August, September, 1973; p. 363, 438, 549.



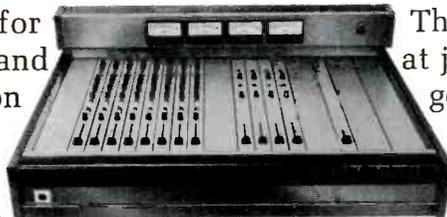
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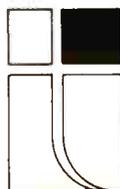
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Microphones—Vital Link In the Recording Chain

David Lane Josephson

With this installment, Mr. Josephson concludes his article on microphones, the first two portions of which appeared in December, 1973, and July, 1974.

Brass, Woodwinds, and Percussion

Small brass instruments, such as trumpets, saxophones, etc., can be miked effectively by the use of one decent quality capacitor or dynamic unit located roughly four feet out from the bell of the instrument. It should be remembered that the *recording* mic pickup, where the aim is for the highest accuracy of the live sound, is different from the *public address* type of mic placement where the aim is for reinforcement of the sound level. Brass instruments can produce very intense spikes and transients of sound which will distort and overload the mic if placed too close.

Woodwind pickups may be made in basically the same manner as brass pickups. The woodwinds are generally a part of a group, which will be covered later. Individually they may be miked with good quality dynamic or velocity units, placed roughly four feet from the instrument. At this distance proximity effect isn't troublesome and unidirectional mics may be used.

Percussion instruments, such as drums, must be miked with great care. Sharp, spiky instruments, such as snares and cymbals, should always be miked with capacitor units, such as the Neumann KM-83. Bass drums may be miked with just about anything at all, and many recordists use general purpose cardioid dynamics for this purpose, located just inside the drum itself, if it is open from the rear, or right in front if it is closed. A general stereo drum pickup may best be made with two high quality omnidirectional dynamic or capacitor mics, such as the Shure SM-76 or Neumann KM-83, directly over the drum set. These can be mixed for mono or one mic may be used.

Bands

Rather than individual instrument pickups, discussed above, the amateur recordist's most common pickup will probably be small musical groups of one kind or another. These may be miked with the multi-track technique, using individual instrument pickups mixed into two or four channels (during recording or later on by playback of a multi-channel tape), or else a general pickup using two mics with an accent if needed may be used. Either will give a pleasing stereo effect.

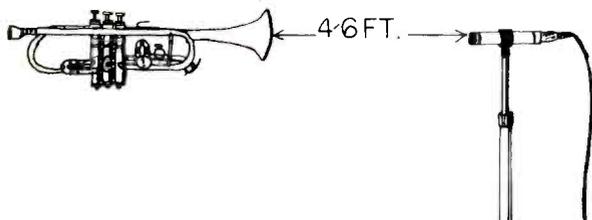


Fig. 4—Single mic pickup of brass instrument. Omnidirectional or unidirectional capacitor or dynamic preferred; mic must be able to accurately reproduce spikes of sound from these instruments. For this reason, capacitor mics are preferred.

Generally, the multi-track technique is preferred by commercial recording studios simply because it allows the musicians to come into the control room and decide for themselves where they want the various instruments placed in the stereo illusion. Each individual microphone is assigned to one channel on a multi-track tape (anywhere from 4 to 32 channels or more), the playback signal from which is then mixed down into quadraphonic or stereo.

For very simple but pleasing monaural recording, one single spot in the recording hall or studio may usually be found where the direct signal from the band will balance with the reflected sounds from the ceiling, floor, and walls. Several old and well respected record companies used this method exclusively, and it produced some of the clearest recordings ever made. The theory behind this simple approach is that if more than one microphone is used per channel, the same signal of audio will arrive at all of the microphones used to feed a given channel at *different times*, thus producing phase differences when all the microphones are mixed together that make the tape sound tinny and rather weird. If the distance from one microphone to another microphone used to feed the same channel (at the time of recording or later, in a multi-track mix) is more than six or eight times the distance between the microphones and their respective sound sources, however, the incident sound striking the wrong microphones will be low enough in level so this audio multipath distortion won't happen. With the two mics used for a stereo pickup, though, this isn't a problem since the mics are used to feed separate channels.

There are generally two schools of thought regarding the general binaural stereo pickup, using two microphones, with accents if needed. One method is to form an equilateral triangle, each side as long as the width of the band being recorded, and the apex somewhere out in the audience. Two mics are used, located exactly midway between floor and ceiling (if the ceiling were 20 feet high, each mic would be 10 feet off the floor) and about ten feet from the apex of the triangle and pointed toward the front. The main problem with this type of pickup is that if the hall is too reverberant or the audience too noisy, the reflections and audience noise may be louder than the band being miked. Mics should be high quality unidirectional capacitors or dynamics, with capacitors used if at all possible. This brings us to the other general pickup mic technique. Two mics are used, omnidirectional capacitor or dynamic (good quality dynamics being almost as good as capacitor mics if they are omnidirectional) units, mounted at most two inches off the floor at the very edge of the stage. The diagram shows how they should be placed. This technique can result in a surprisingly accurate stereo pickup that is acoustically pleasing as well. Shure and Electro-Voice both make stands for this purpose; the Shure being a wire tripod in sizes for $\frac{3}{4}$ - and 1-in. diameter mics, the Electro-Voice being a hunk of foam with a cutout for a mic. In any case, the point is to get the microphone as close to the floor as possible without actually touching it, to eliminate any possible reflections. The basis for all this trouble is that the prime reason most amateur band recordings are tinny and lack depth is the sound reflections from the floor, walls and ceiling that cause the audio multipath distortion mentioned above. This

is caused by the same sound arriving at one mic at different times. First there is the direct sound from the instrument, followed by bounce signals from the walls, floor and ceiling. If the distance is great enough, this is heard as reverberation, but if the difference between the direct path and the bounce path is relatively small, then the bounce signal is heard as multipath. The zero-reflection principle may also be used with the mics on the walls or the ceiling, whichever is closer to the instruments being miked and whichever is the most reflective.

For any live pickup, it helps immensely to experiment during a rehearsal with placement of mics. The walls and floor, for example, may be so heavily deadened already that the extra floor noise picked up with the zero-reflectance technique would cancel out any clarity that might be gained. On the other hand, it may be found that the room is so reflective that an elaborate multi-track pickup would result only in a hodge-podge of mushy sound. A considerable amount of liveness may be tolerated in a rehearsal that need not be expected in the actual performance—the audience makes a perfect sound absorber.

If it is found that one particular section of the band is weak when the microphones are placed best for the overall pickup, that section may be reinforced with an accent mic. This can be any half-decent unidirectional unit, since its prime purpose is reinforcement in volume level of a section of the band already audible through the main mics.

Performance Techniques

Small classical music ensembles, such as string quartets or chamber music groups, should be miked with a plain general pickup. The mics used are usually velocity or omnidirectional capacitor units. The mics are usually arranged around the instruments, in their usual performance setup, rather than the other way around. Each individual instrument may be miked separately and mixed later if necessary. With a decent ensemble (where mistakes in volume balance are not a problem), this shouldn't be required.

Orchestra pickups may be made with either single-mic techniques or multi-tracking. The same equilateral triangle scheme used for bands should be used, at least as a start in experiments. The zero-reflectance technique with the mics at the front of the stage generally won't work, since the instruments to the rear are much too far away from the mics. A zero-reflectance pickup with the mics on the ceiling might work—this writer hasn't seen any examples of this technique being used for orchestra pickups. The mics should be "flown" from the ceiling by nylon fish line or by their own cables. Hangers, such as the Neumann Z-68, will eliminate the strain placed on the mic connector itself (which might end with the mic dropping on the audience). High quality unidirectional capacitor mics, such as the Neumann KM-84, should be used. As with band recordings, an accent mic may have to be added to reinforce a weak section of the pickup. This is often the string section, where the subtle harmonics are easily lost as the distance between mic and instrument increases.

Drama pickups present an entirely different problem. A common technique is to place four or six mics, usually unidirectional dynamics, in the footlights of the stage. The left two or three are mixed into the left recording channel, and the right group go to the right channel. Often only two mics will be sufficient. If the mics are not too heavily coupled to the floor by way of their stands, foot stomping and other noises are effectively eliminated. The Shure and Electro-Voice floor wave stands are excellent for this purpose. It is also possible to mount a pair of mics in the proscenium arch, using a pair of decent unidirectional capacitor or dynamic units. When the actors can project and be heard effectively in the

audience, there should be no trouble in securing a decent pickup from the stage. Microphones may be hidden on the set or on the performers for reinforcement. If there is a particularly intimate scene in the play, it may be worthwhile to plant a mic in the set near where this is to take place, and fade this accent mic in when needed for reinforcement or special effects. Usually, if a working rapport is built between the recordist and the company producing the play, there is a far better chance of the recording coming out as everyone had wanted. This way the recordist can begin from a point of knowing what the desired mood and impressions are . . . and can place mics and ride level accordingly.

A very puzzling thing to be on the lookout for in drama pickups are singing filaments. The light dimmers used for many low-budget theaters have very poor output filtering for

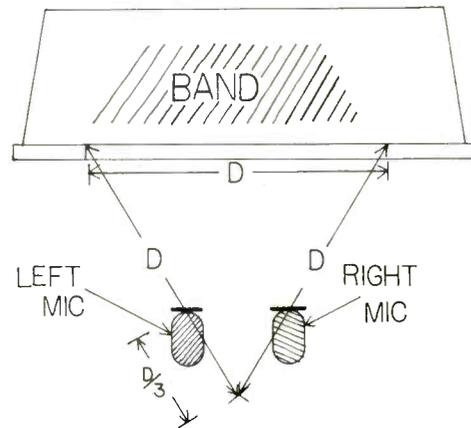


Fig. 5—Stereo pickup using equilateral-triangle placement. Two mics shown may be replaced with a pair of mics, as shown in Fig. 7, for a Blumlein-type or "X-Y" pickup, or with one mic at the apex of the triangle for mono. Distance "D" is the same for all sides of the triangle, and the distance between the mics and the apex is one-third of that or $D/3$. Mics can face either straight forward or can face the two angles on the stage.

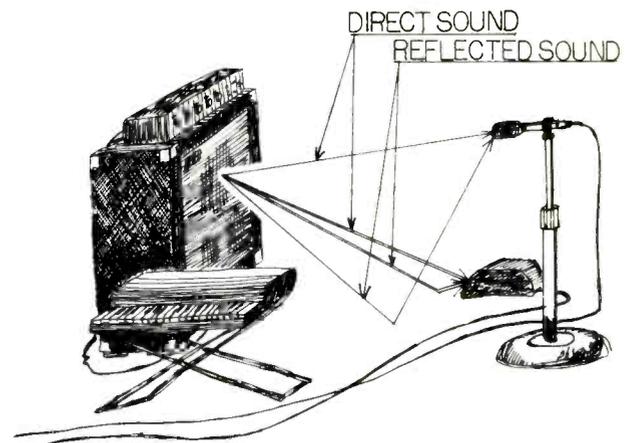


Fig. 6—Illustration of the zero-difference of floor-wave mic technique. Note that the **difference** between the direct sound distance and the reflected sound distance is greater with the mic mounted on a stand. Double lines indicate sound paths to the floor mic in a block of foam.

the SCR hash (noise made when the silicon-controlled rectifiers switch on and off), which doesn't do the dimmer or the lights any harm, but causes a 1,000 Hz or so tone to be emitted from all the lamps on dimmers—especially when dimmed to very low levels. This may be picked up from as far away as 20 feet, and it is nearly impossible to filter out. The recordist should make absolutely certain that the theater in which he is to record has quiet dimmers—or else don't go near the ceiling with the mics. A piece of #14 insulated wire about 30 feet long, scramble-wound on a wood or plastic core and placed in series with each dimmer output, should solve the problem.

Most amateur recordists attempt at one time or another to produce live *actuality* tapes—bird sounds, sporting events, sound effects. These require only a fertile imagination and half-way decent equipment to produce. Almost all of the commercially available sound effects records were produced in a studio, using equipment made especially for sound effects. But for the amateur with limited resources, improvisation is the only way. Surprisingly good bird and wildlife sounds may be recorded with a wooden salad bowl used as a parabolic reflector and an omnidirectional dynamic mic, hooked up to a decently quiet portable tape recorder like a Sony 800 or a Nagra. The mic is suspended in the focus of the parabola, and moved closer in for sounds further away and vice versa.

Extra Hardware

Microphone stands are probably the most taken-for-granted single item in the whole bunch of equipment used for

recording. Many recordists have never thought of making their own mic support equipment, but it's entirely possible. Desk stands are the easiest to make. A female $\frac{3}{8}$ -27 flange and a length of threaded pipe are available for far less than a good desk stand and may be mounted on a piece of wood—it doesn't *have* to look like all the other desk stands in the world. Floor stands are usually best bought unless you're a fairly competent wood and metal worker—the Atlas MS-25 and CS-52 being among this writer's favorites. The cheap imported units sold under various house names universally tend to be too light, and sheer weight (or extension of legs) is often what makes a stand tip-proof in any particular situation. The combination of a general purpose stand, such as the Atlas MS-25, with a small boom attachment, total cost roughly \$35.00, can handle almost any basic miking placement. The stand itself (floor stands tend to be curiously universal in this respect) will rise a little over five feet, and the boom will add an extra two feet of useful reach from that. The boom itself is close to three feet long, but this full length cannot be utilized with any but the lightest mics. An integral stand/boom unit, such as the Atlas BS-36 or the Neumann M/G-35, are larger and considerably more stable units of the same basic stand-plus-boom genre.

There are a number of ways to support a microphone besides hand-holding or mounting on a stand which rests on the floor. Many low-budget noncommercial radio stations "fly" their microphones, even huge velocity mics like the RCA 44-BX, from ropes or nylon lines strung from the ceiling. This is often a utilitarian approach when boom stands are out of

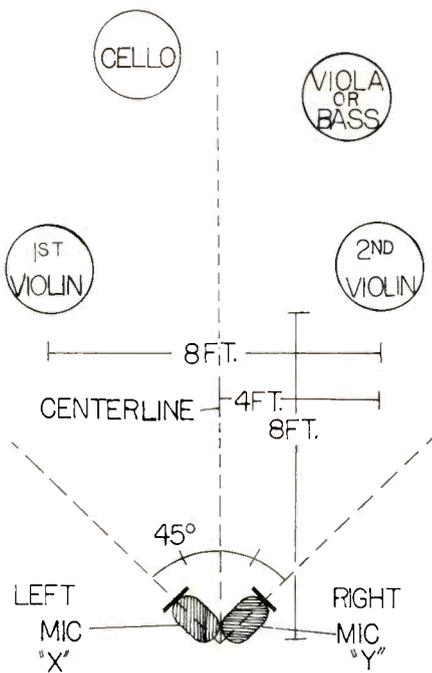


Fig. 7—Stereo pickup of a string quartet, using the "X-Y" or semi-binaural technique. This placement also results in a good ambience level for Dynaco or SQ quadraphonic encoding. Ideally, the mics should be at the same vertical angle from the center line. This can be done by mounting the two mics one above the other on a stand, or by mounting the right mic on the left and vice versa, but with the left mic pointing left and the right pointing right. An ideal single mic for this pickup is the Neumann SM-69fet, which includes both mics needed in a single case.

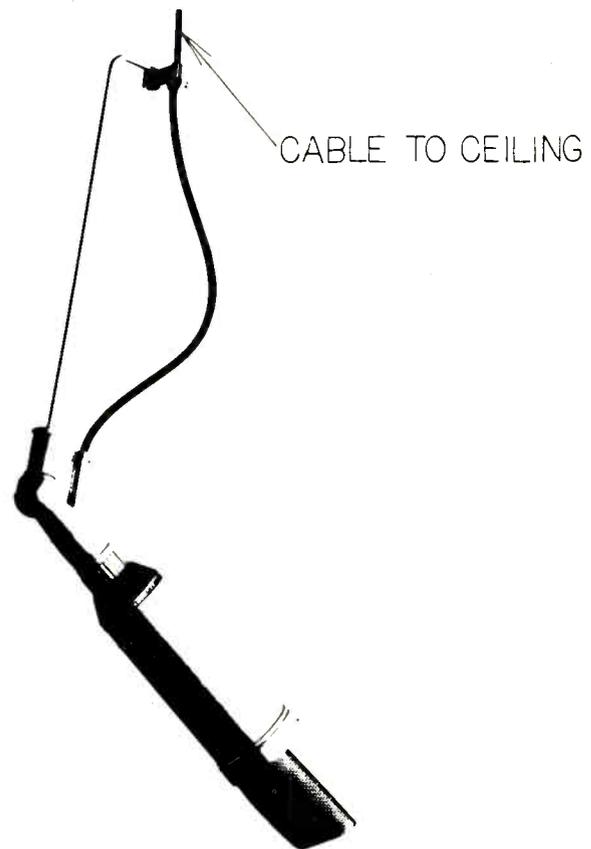


Fig. 8—Neumann Z-68 auditorium mic hanger. With this fixture or a homemade one like it, the mic may be hung from the ceiling without having the entire weight of the mic on the mic connector. The cable itself is more than strong enough to support any mic, but the connectors can often come loose under strain. A hanger like this also permits the mic to be angled for best pickup.

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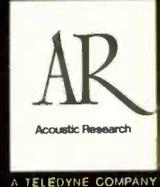
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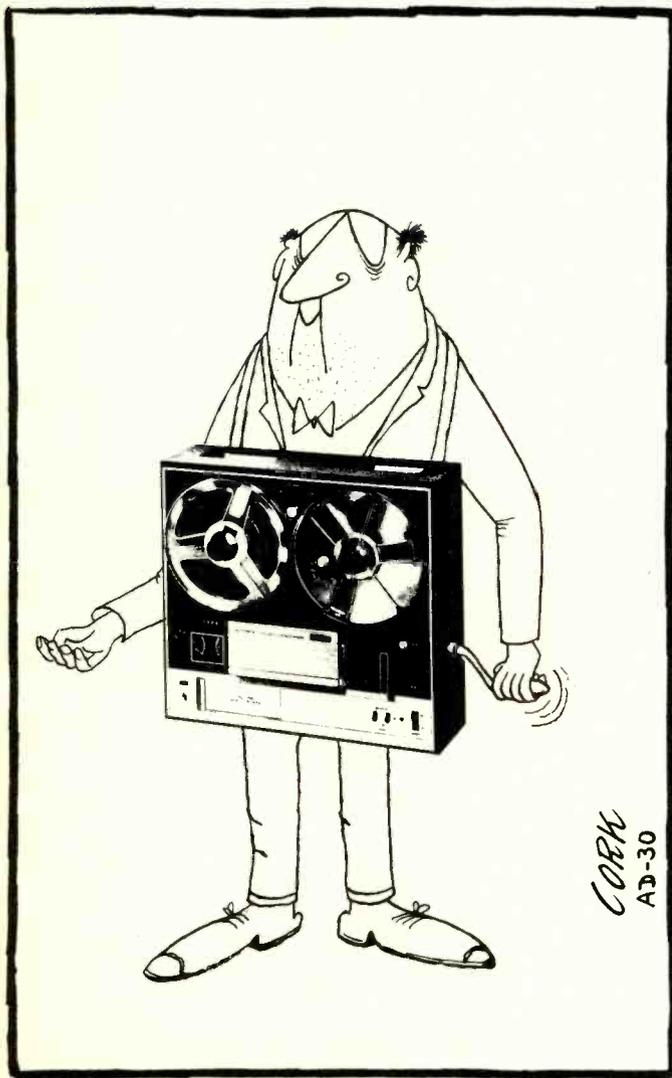
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Fig. 9—A typical zero-reflectance mic stand, the Shure S-55P. The mic should be adjusted so that its grille is about 1/8-in. from the floor.

financial reach for the recordist. An array of sturdy hooks and lengths of nylon rope is probably just as useful as a bunch of boom stands—and much cheaper. A very useful kit of gear to have around for the floor stand user is a variety of mic fittings and adapters. Unfortunately for the recordist, the 3/8-27 thread that has been adopted as standard for mic stands in this country is a custom thread, and this recordist has not been



able to locate taps or dies for this thread anywhere. RCA has the right idea by making most of their professional mics mount on 1/2-in. pipe stands—this can be adapted from any mic stand, and is easily available anywhere for custom stand-making. For the recordist with factory-made stands, however, a collection of threaded pipes, female-to-female couplers, lengths of running thread, flanges, swivels, etc., which are available from almost all electronics parts dealers, will be very useful.

The zero-reflectance (floor wave) miking technique has spurred its own separate collection of mounting hardware. Shure makes two models of stands (which look like ordinary tripod-type desk stands except the mic is *under* the legs instead of on top), one for 3/4-in. diameter mics and one for 1-in. Electro-Voice has a block of urethane windscreen foam, known as a *mike mouse*, that can be stretched to fit any stick-type microphone, and which has the added advantage of protecting the mic should it be kicked or fall off the stage.

Phasing

Most primers on microphone technique insist that all mics must be phased identically. This means that if all the mics used for a given pickup are given a positive pulse of audio, a positive pulse of electricity will appear at the "hot" lead of each mic output. If a mic is out of phase, its output will be a negative pulse. The phase may be reversed by transposing the two signal leads on a low impedance mic or reversing the two mic element leads inside a high impedance mic. In general, common phasing is a good idea, but reversing the phase of one mic in a pickup may save that particular mic placement. Boominess and excessive reverberation in a room may often be eliminated by placing an additional mic at least six times as far away from the main mic(s) as they are from the sound source(s). This echo-suppression mic is then mixed 180° out of phase with the others. The sound arriving at the echo-suppression mic from the sound source itself will be insignificant, but the sound arriving as a bounce signal will arrive at just about the same time and at the same level as at the main mic(s). Thus the output phase will be roughly the same—when they are mixed out of phase, anything arriving at one mic will automatically be cancelled out from the other mic—in this case, the echoes, reverberation and some of the background noise will be cancelled out. Experiment with the placement of the echo-suppression mic for best results.

Another bunch of accessories the amateur recordist would do well to have are various materials for suppressing noise: blocks and sheets of open-cell urethane foam, shock mounts, and some filters and attenuators. Most commercial windscreens consist of plain open-cell urethane foam, the same as is used in the newer automobile air filters. The differences between open-cell and closed-cell foam is that the walls of the air bubbles in the foam have disappeared in open-cell foam and are still solid in closed cell foam. As a result the open-cell foam can pass air while reducing its velocity, while the closed-cell foam cannot and is good for insulation and mattresses. The open-cell foam may be purchased in sheets 2-in. thick and wrapped around a mic to eliminate wind and breath noises at far less than the cost of a commercially made molded-foam windscreen. One thing that is extremely important when using windscreens with directional mics is to be sure that all open ports and vents in the case are windscreened just as well as the front grille. These ports are often more sensitive to wind and breath noise than the front of the mic, which is often windscreened inside already. The vents and ports may be found by looking for open holes, slots, and extra grilles anywhere on the mic case.

A shock mount is a device designed to isolate the mic from picking up any noise from its support. These are usually tubes



HOME GROWN HI-FI

At the June Consumer Electronics Show in Chicago, over 150 speaker manufacturers were displaying literally thousands of new models incorporating every conceivable twist in styling or concept that might lend an air of uniqueness to their products.

Yet if you were to look behind all this superficial diversity, you would discover the same mass-produced driver components being used in virtually every one of these "new" and "different" systems. Because the fact is, there are only a handful of firms actually building speaker components today -- everybody else buys drivers from one of the prime manufacturers, stuffs them in a box (of whatever shape), and puts their own name on the result.

At Cerwin-Vega, we don't just stuff boxes. We actually build our speaker systems from the raw steel and aluminum and copper and wood. The advantages of doing things this way are obvious. First of all, we have complete control of the manufacturing process at every step of the way. And, since we're our own main customer for drivers, we can build exactly what we want, instead of trying to please dozens of different buyers. By eliminating the supplier's profit, we can put considerably more value in our systems than any box stuffer -- and if you compare things like magnet weight, efficiency, and power handling, you'll see how much more.

Of course, all these advantages don't mean much if you can't get them in a speaker that fits your taste and budget. That's why we offer three complete lines of speakers (14 different models), from the new HED series that starts at under \$70, through the intermediate Cerwin-Vega line, all the way up to the mind-blowing CERWIN series. And every system we make features high efficiency, so you won't need a monster amplifier to get realistic sound levels from it.

So after you've checked out all the new gimmicks and gadgets on the market, make sure your final decision is based on what speakers are supposed to be all about -- the sound. Because whether you're shopping budget or "dream system", Cerwin-Vega gives you a real difference -- the quality that we build into every system we make. That's why we've gone from virtual unknowns to one of the fastest growing hi-fi manufacturers in a little over two years -- without hype or gimmicks.

Home grown hi-fi by Cerwin-Vega. The High Energy speakers. Write today for details.



Cerwin-Vega

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of metal which hold the mic rigidly, suspended from a ring of metal by rubber bands. The ring is then mounted to the stand. Other designs use sheets or rings of rubber between the two rings or tubes. This is another item that may be made by the mechanically talented recordist. A number of microphone companies have recently come out with filters, attenuators, and phase reversers that fit in the line from a microphone to the mixer or recorder. The Shure line includes attenuators (which reduce the audio level from very high output mics to avoid distortion), high-pass filters (to eliminate bass accentuation), and phase reversers (two jacks with the two signal wires

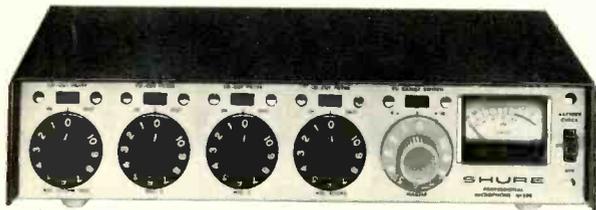


Fig. 10—An ideal small mixer for recording, the Shure M-67. This unit has four inputs; all may be used for low impedance balanced mic inputs; #1 may be switched to built-in tone oscillator for level correction, #4 may be switched to 600-ohm balanced line input. All inputs may have low-cut filter switched in (about 10 dB down at 100 Hz) for rumble suppression or voice tailoring. The unit has mixing buss jack so that more than one mixer can be paralleled for more inputs; all have the same output; meter on each reads only levels going out of that particular submixer. Outputs at both mic level and 600-ohm balanced line level (up to about +12 VU).

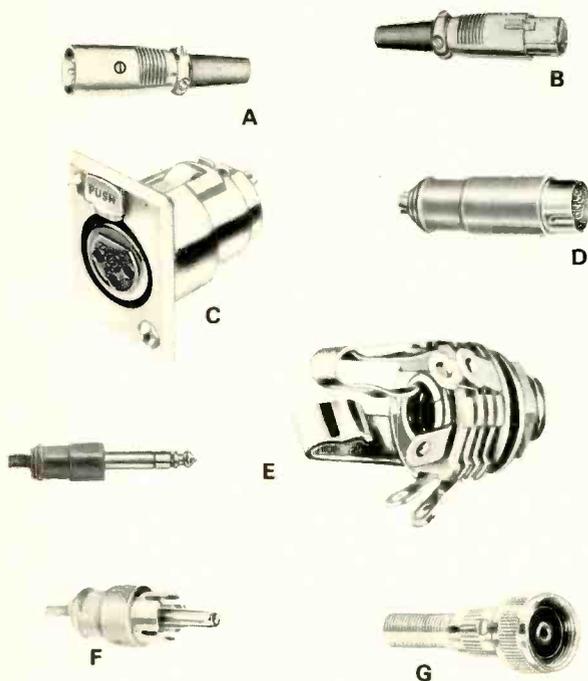


Fig. 11—Microphone connectors. Balanced types include Cannon male cord plug, A; Cannon female cord plug, B; Cannon female chassis jack, C, and DIN type, D, which has female counterpart. Unbalanced connectors include phone plug and jack, E; phono plug, F, and Amphenol screw type, G.

reversed in going through). Electro-Voice's line consists of variable filters and fixed attenuators.

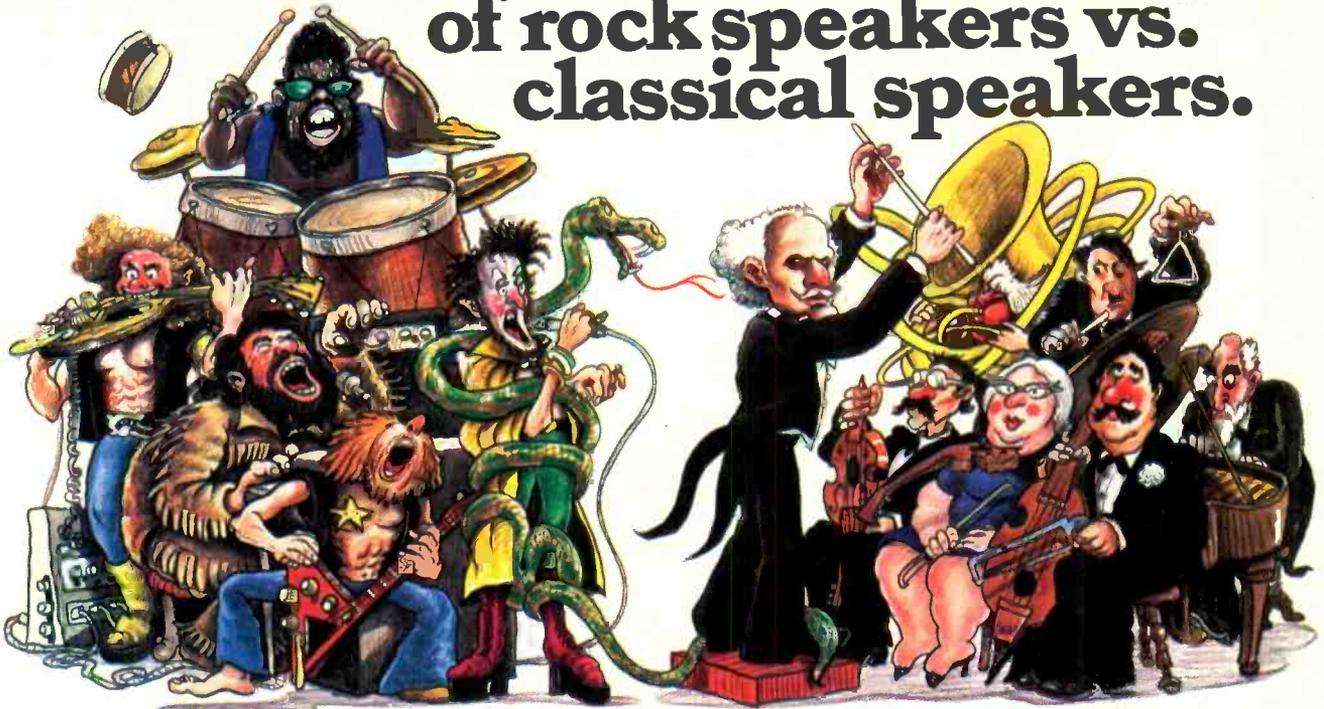
A decent mixer is almost a necessity for anything but the strictest single-mic mono recording. Having a unit with low impedance balanced inputs, reliable level meter and extras like a level-set oscillator, low-cut filters, and quiet potentiometers, can be a real pleasure. The Shure M-67 and M-68FC are good versatile units as is the Sony MX-16 series. Several other manufacturers put out mixers that can serve the amateur well. The circuits for any of this basic audio mixing and switching gear are very simple, and they may easily be built from scratch.

Microphone Cables

Getting the signal from the microphone to the mixer or recorder is almost as important as getting the mic in the right place to begin with. Most cables consist of two plastic- or rubber-covered conductors twisted together, shielded with braided strands of fine bare wire, and the whole encased in a plastic or rubber jacket. High impedance mics are universally unbalanced, and only one conductor plus shield is used. Foil-shielded cable should never be used for mic lines, or anything else that must move from time to time. The foil cracks and shrivels up very easily, destroying the shield. Most foil cables have a single "drain wire" running along with the foil shield, but if the foil disintegrates, the drain wire isn't much of a shield.

Most professional microphone lines are connected to one another and to the mic and recorder by round three-pin connectors $\frac{3}{4}$ -in. in diameter known as "Cannon XLR connectors." There are two fiercely warring schools of thought on this subject, the resilient (original Cannon) proponents and the rigid (old Cannon and new Switchcraft) people. As shown in the photo, the pins of the connector are set in a plastic insert inside the metal shell. The new series of Cannon connectors, as made by Cannon, have the pins set in a block of rubber. In the first Cannon connectors and in the present Switchcraft and Amphenol connectors, the pins are set in rigid plastic or bakelite. The resilient rubber connectors are supposed to make contact better since they can move around, but the new Switchcraft connectors have captive shell screws (means they can't get lost) and a ground lug that connects to the shell. This writer hasn't noticed any difference in reliability or noise between the rigid and resilient, although the rigid types may melt during soldering, and sometimes crack, while the rubber ones don't. The other type of microphone connectors in use today are mainly for high-impedance mics. The 'phone plug and its miniature counterparts are simply rods of metal with isolated tips. The ground wire is connected to the shell, and the signal wire goes to the tip. There is no way these 'phone plugs can be locked to the equipment as can Cannon connectors, and they will pull out if tripped over. The original high impedance mic connector, and one that is still in use, is the Amphenol MC-1 series, and its equivalents. This uses a $\frac{1}{8}$ -27 threaded ring which screws the male and female sections together, the center of the two being the signal lead. These, being unbalanced only, are for high impedance mics only. Amphenol also makes several types of multi-conductor connectors secured with screw rings which are used widely on the mic end of cables and in communications gear but not much for audio recording. One final word to the wise about connectors—avoid plastic like the plague. Plastic-shelled phone plugs and Cannon-type connectors will always break if stepped on or bashed against the floor (which too often happens), and the molded plastic connector-plus-cable assemblies are constantly falling apart. What's worse is that there is no way to remove the plastic potting compound and solder the pieces together again. Take a few extra minutes and make up your own cables with good metal connectors and decent shielded cable—it'll save you many hours of grief at the recording site.

The Rectilinear 5: end of the myth of rock speakers vs. classical speakers.



The new Rectilinear 5 is capable of playing very, very loud. Rock-festival loud. Even with a medium-powered amplifier.

At the same time, it's uncannily accurate. It sounds sweet, unstrained and just plain lifelike at all volume levels.

The temptation is great, therefore, to one-up that prestigious manufacturer who some time ago announced "The first accurate speaker for rock music."

But we refuse to perpetuate that mythology. It's perfectly obvious that the Rectilinear 5 reproduces classical music just as accurately as rock. We could never see how a voice coil or a magnet would know the difference between Jimi Hendrix and Gustav Mahler.

So we'd rather use this opportunity to set things straight once and for all.

Thus:

There's no such thing as a rock speaker or a classical speaker. Any more than there's a late-show TV set or a football-game TV set.

There are, however, speakers that impose a hard, sizzling treble and a huge bass on any music. And others that round off the edges and soften up the transient details of any music. That's the probable origin of the myth;

but these aren't rock and classical speakers, respectively. They're inaccurate speakers.

It's true that an aggressive treble and a heavy bass are characteristic of most rock music, even when heard live. It's also true that some record producers exaggerate these qualities, sometimes to a freakish degree, in their final mix of the recorded sound.

But that doesn't mean the speaker can be allowed to add its own exaggerations on top of the others.

A loudspeaker is a conduit. Its job is to convey musical or other audio information unaltered. If the producer wants to monkey around with the natural sound that originally entered the microphones, that's his creative privilege. He'll be judged by the musical end results. But if the speaker becomes creative, that's bad design.

By the same token, if some classical record producers prefer a warm, pillowy, edgeless string sound, that

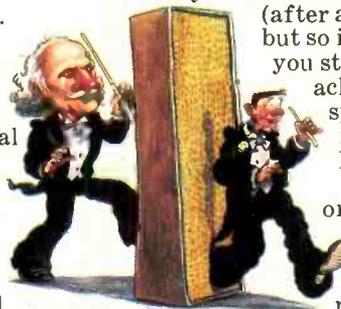
doesn't mean your speakers should impart those same qualities to cymbals, triangles or high trumpets. (Stravinsky's transients can be as hard as rock.)

And if you like to listen at very high volume levels (after all, that's what rock is about—but so is *Die Götterdämmerung*),

you still don't need a speaker that achieves high efficiency through spurious resonances. What you need is something like the Rectilinear 5.

Everything in this remarkably original design was conceived to end the trade-off between efficiency and accuracy. The four drivers are made to an entirely new set of specifications. The filter network that feeds the drivers is totally unlike the traditional crossover network. Even the cabinet material is new and different.

Equally wrong: Classical sound made vague and spineless by the speaker.



Of course, those who feel threatened by all this fuss about accuracy and naturalness will point out that the monitor speakers preferred by engineers and producers in recording studios are usually of the zippy, super-aggressive variety.

That's perfectly true, but the reason happens to be strictly nonmusical.

"I use the XYZ speaker only as a tool," a top producer explained to us. "I wouldn't have it in my house. It really blasts at you when you crank up the volume, so that any little glitch on the tape hits you over the head. After eight hours in the studio, that's what it takes to get your attention. I know how to deal with those unpleasant highs; they're in the speaker, not on my tape."

It's easy enough to find out for yourself.

Any reputable dealer will let you hear the Rectilinear 5 side by side with a "rock" or "monitor-type" speaker. Adjust each speaker by ear to the same high volume level, making sure the amplifiers are of good quality. Then listen. To rock or classical.

Then and there, the myth will crumble.

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Canada: H. Roy Gray Limited, Ontario

Rectilinear 5 Contemporary Laboratory Series bookshelf/floor speaker system, \$299.00. Delta Dispersion Base (patent pending) optional.



Wrong: Freaky sound made even freakier by the speaker.

Check No. 25 on Reader Service Card

From The Lab

George W. Tillett

MY REMARKS concerning the methods used by Consumers Union for testing loudspeakers have brought some interesting letters from readers. Daniel Queen writes, "CU would have created less confusion if they had said, 'We made our measurements of power response by measuring pressure . . . at 10 degrees. . . .' The method used by CU involved taking a large number of pressure response readings at many angles, but in only two planes: one parallel to the vertical axis, the other parallel to the horizontal axis. This method *may* be useful for measuring single direct-radiator loudspeaker systems with relatively symmetrical cabinets. It can lead to large errors in multi-radiator systems such as the two- and three-way or the 'direct-reflecting systems' where phase interference lobes and nulls appear throughout the polar response.

"Furthermore, CU measures the sound intensity within a sixty-degree solid angle in front of the speaker in order to determine the characteristic of the unreflected (direct) sound reaching the listener. However, the listener's head actually lies within a much smaller angle (which could easily be outside the sixty-degree cone) where one of the aforementioned lobes could occur. I agree, therefore, with your criticism of the use of this approach to derive a figure of merit. As I see it, error results due to the aforementioned lobes and nulls. The measurement would not indicate the presence of a severe lobe even when it falls within the sixty-degree included angle. This would cause a person sitting within a null to receive a reflected sound so much stronger than the initial direct sound, that directional perspective will be lost and attack transients muddled."

Absolutely true. In my original article (October, 1973), I said that a speaker with a 100 per cent accuracy would still *sound* like a loudspeaker. That is, it would still have some distortion and coloration.

Another reader, John Puccio of Concord, California, has this to say, ". . . but when *Consumer Reports* gets into the \$200 to \$300 speaker range and uses its same limited testing methods, I must

protest. . . . The speakers were tested on only one aspect of their abilities to accurately reproduce sound, namely, their average omni-directional frequency response. The fallacy of basing total speaker accuracy on just one dimension of sound reproduction can easily be seen. A speaker may produce uniform sound pressure levels at all frequencies around 360 degrees of the speaker and therefore produce a flat omni-directional response. But the speaker may also be quite bright on-axis and quite weak when tested from the rear and the resulting graph will not reflect this. The average of the peaks and dips may still produce a seemingly flat response. . . . Furthermore, *Consumer Reports* limits its omni-directional tests to the frequencies between 110 Hz and 14,000 Hz. *Consumer Reports* apparently feels that other measures of 'high' fidelity are unimportant to the average person. In other words, according to the tone of the February CU article, such matters as low bass capability, bass distortion, high frequency capability, and treble dispersion are of concern only to the stereo snobs."

I make no comment on that one, instead I would like to quote from *Audio Times*, a respected trade publication. "There is, after all, a great deal more to a fine loudspeaker than a flat frequency response curve. What CU discovered is that comparatively inexpensive speakers reproduce most of the music. Magazine reproductions of fine paintings likewise reproduce most of the picture, most of the colors. But a high quality art reproduction reproduces more—for a lot more money. It may add brush strokes, exact tonal reproduction and other details simply not possible in an inexpensive print." CU notes that "most people would be just as content, we think, with speakers that offer comparable accuracy and less strain on the pocket book." True enough, and most people buy speakers in the \$100 and under range. Speakers selling for \$200 or more aren't for most people. They're for the people who can tell the difference, who want that extra octave of bass, those extra brush strokes. The editorial goes on to imply that CU "tends to lay a veneer of pseudo-science and pseudo-objectivity over the results

to convey an impression of omniscience."

Ouch! But I must agree with John Puccio when he says that the danger of *Consumer Reports* is the reduction of all good things to a lowest common denominator; the elimination of the quest for perfection in favor of the mass-produced "bargain."

* * *

A reader (who shall be nameless) asks somewhat querulously, "Is the statement that records are superior to tape the humble opinion of the writer?" The answer is no, it is not just my opinion, humble or otherwise (arrogant?)—it is a fact. Records made without a tape transfer are unquestionably superior. In fact, test records like the CBS series with square waveforms cannot be made via tape. On the other hand—and here is what my critic might be thinking about—the average open-reel tape is superior to the average record.

Which brings me to the subject of tape hiss, record pops, scratches, and so on. Most tape enthusiasts are aware of the advantages of compressor-expander systems, like the DBX, for instance, which can increase the dynamic range as well as providing an impressive 15 to 20 dB noise reduction. Now records have been made using the DBX system, and David Blackmer of that company told me that a dynamic range of 90 dB has been achieved! No hiss, no pops—just a silent background. Unfortunately, we are not likely to see such records around for some time (apart from a few made by such companies as Klavier in Los Angeles). The reason is simple: If one of the giant companies like CBS or RCA were approached, they would say, "Yes, it IS a remarkable improvement, but we can't make records like this because everyone would need a special decoder to play them." This is true—but there might, there just might be a way. If we get a standard quadraphonic system some day, then a DBX type of noise suppression expander system could be built right in. After all, the present CD-4 system incorporates an ANRS noise reduction system and the basic principle is the same, although the DBX is much more complex as it employs log amplifiers.



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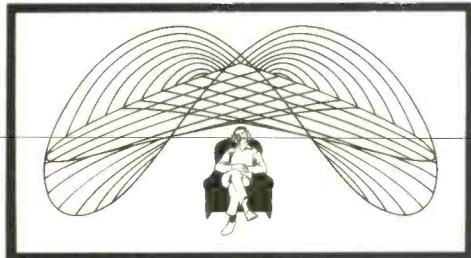


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expansion of the center channel on your recordings. You'll feel totally surrounded by the performing musicians. And as you rotate one Panoramic Source Control separately from the other, you'll feel as though you're sitting on the piano bench one minute and in the middle of

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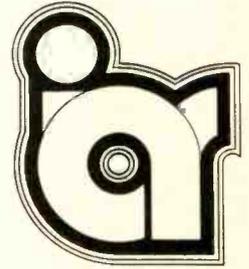
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iar— Classroom to Studio

Solomon R. Kunis



Electric Lady's Chief Engineer Dave Palmer demonstrates the operation of the Studio A Console to Suzanne Lanier and IAR Director Al Grundy.

SELF-TAUGHT recording engineers, who learned their trade at the mixing console without benefit of classroom, are a vanishing breed, says Albert B. Grundy, Director of the Institute of Audio Research (IAR). They will be gradually replaced by younger men and women who have mastered the fundamentals of audio engineering either at a college or a technical school like the Institute which Al heads.

The IAR, located at 64 University Place, New York City, was founded by Grundy and his partner Irwin J. Diehl in 1969 to train studio engineers. The school is regarded as the first and one of the best specifically organized to provide students with the technological foundation required in today's sound studio.

During its five-year history, the Institute has attracted students ranging in age from their early twenties to mid-forties. Many are newcomers seeking recording jobs, while some are already studio employees and wish to enlarge their knowledge of audio techniques. The school also serves a number of people each term who have less immediate vocational needs. These include hi-fi enthusiasts, musicians, and studio executives, who are primarily concerned with improving their understanding and appreciation of the sound recording process.

Institute alumni hold down studio jobs all over the United States and Canada—as well as overseas in England and in Israel. One of the graduates supervised the recording of Bob Dylan's latest album, *Planet Waves*, and served as sound engineer on Dylan's recent concert tour. Another now owns and

operates his own 16-track recording studio, while a third runs a record company and is highly involved with disc production.

The Institute has several women students each term. One recent graduate, Carla Bandini, is now employed at CBS Records in London. Suzanne Lanier, who migrated from Florida to attend the school last fall, obtained a studio job before graduation, and has since worked with hit record producer Todd Rundgren.

Between 60 and 80 students are enrolled each semester in one or more of the courses. The basic course, Studio Technology and Practice, is a 10-week, 60-hour evening laboratory/lecture class which covers recording fundamentals, magnetic recording, studio consoles, and signal processing equipment. In addition to classroom work, there are field trips to modern recording studios where students may observe the most advanced equipment and techniques in actual operation.

The class in Practical Disc Recording, also given at night, is a five-week, 40-hour workshop training course. The students work with live equipment, including a Scully lathe with Ortofon cutting head, to further their knowledge of vinyl records, disc-cutting lathes, recording blanks, and lathe layout, operation and maintenance.

The Institute also conducts a seminar in Audio Systems Design. This brief but intensive 4-day course covers in depth most aspects of the electrical design of studio systems. Considered in detail are topics of gain, loss and impedance interface to achieve maximum S/N and minimum distortion. And recently, a new seminar, Digital Logic Design, has been developed and was first introduced in the Spring, 1974 term.

The above courses are repeated three times a year. The Fall term begins in September, the Winter term in January, and the Spring term in April.



(Top) In front of the disc recording control panel, Suzanne Lanier discusses a problem with IAR Director Al Grundy. (Middle) Student David Smith studies the intricacies of a Scully lathe. (Bottom) John Woram, Director of Special Projects for IAR, instructs professionals seeking to expand their knowledge of advanced techniques during a four-day Producers/Arrangers Workshop.

Accelerated classes are also held during the Summer.

The course in Studio Technology and Practice is also given at the Institute's Los Angeles branch in May and October. Classes meet five times a week, and both morning and evening sessions are provided.

The training courses are primarily conducted by Al Grundy, who is the Director of the Institute and presently serves as Chairman of the New York Chapter of the Audio Engineering

Society. Grundy, Who obtained his bachelor's degree in electrical engineering from Columbia University, learned his trade at Columbia Electronics Research Laboratory. He virtually grew up with the recording industry and had designed and set up recording studios throughout the United States and in Europe.

"Years ago when the typical recording engineer entered the audio field, life and recording techniques were both a lot simpler." Grundy remembers. "What

those old timers lacked in technical know-how, they made up for by adaptability and willingness to learn. The typical studio in those days was equipped with relatively simple equipment, which hardly required a genius to master and understand.

"Today, a kid walks into a studio fully equipped for multi-track recording. He is confronted with 24-channel tape recorders, synchronizing equipment, reverberation and echo systems, limiting amplifiers, and a plethora of other electronic wonders which makes his head swim. Unless he has acquired the fundamental knowledge to make sense of this mass of hardware, he might just as well walk right out again. There is simply no way he can understand how the equipment functions, and his immediate boss will be too busy with his own problems to teach the neophyte Ohm's law."

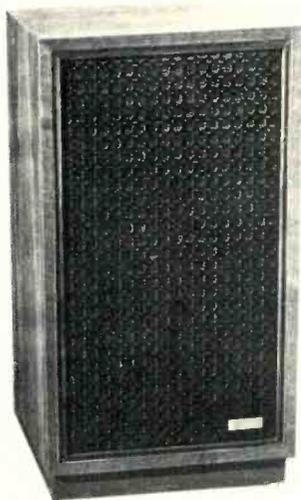
The administrative and physical operations of the Institute of Audio Research are handled by Irwin J. Diehl, a former professional musician who received a degree in Fine Arts from the Cincinnati Conservatory of Music. Before founding the Institute with Grundy, Irv Diehl headed up the studio operations at Caedmon Records and had previously been employed as a staff engineer at Bell Sound Studios.

As co-founder of the IAR, Diehl is deeply concerned with the Institute's integrity and its reputation in the audio field. Irv makes it clear to his students that there is no guaranteed studio job waiting for them at the end of a ten-week course, but IAR has excellent rapport with all the major studios in the New York, area and frequently recommends graduates for vacancies which may occur.

Irv is also the first to disenchant his students as to what the training courses will qualify them to do. The student's fantasy of stepping immediately into a full-fledged recording engineer's spot is quickly punctured. Regardless of how good the trainee is, he will still start as an apprentice. But, Diehl assures the newcomer, he will advance much faster because he knows what he is doing in the studio.

And so, relevant training could mean a "foot in the door" of a recording studio. But without a solid grip on basics, the newcomer will be hard-pressed to gain entry, much less meet the demands made on him by new hardware and unique artistic requirements. Once through this door, it's a lot of hard work, patience and putting it all together with talent and the right personality.

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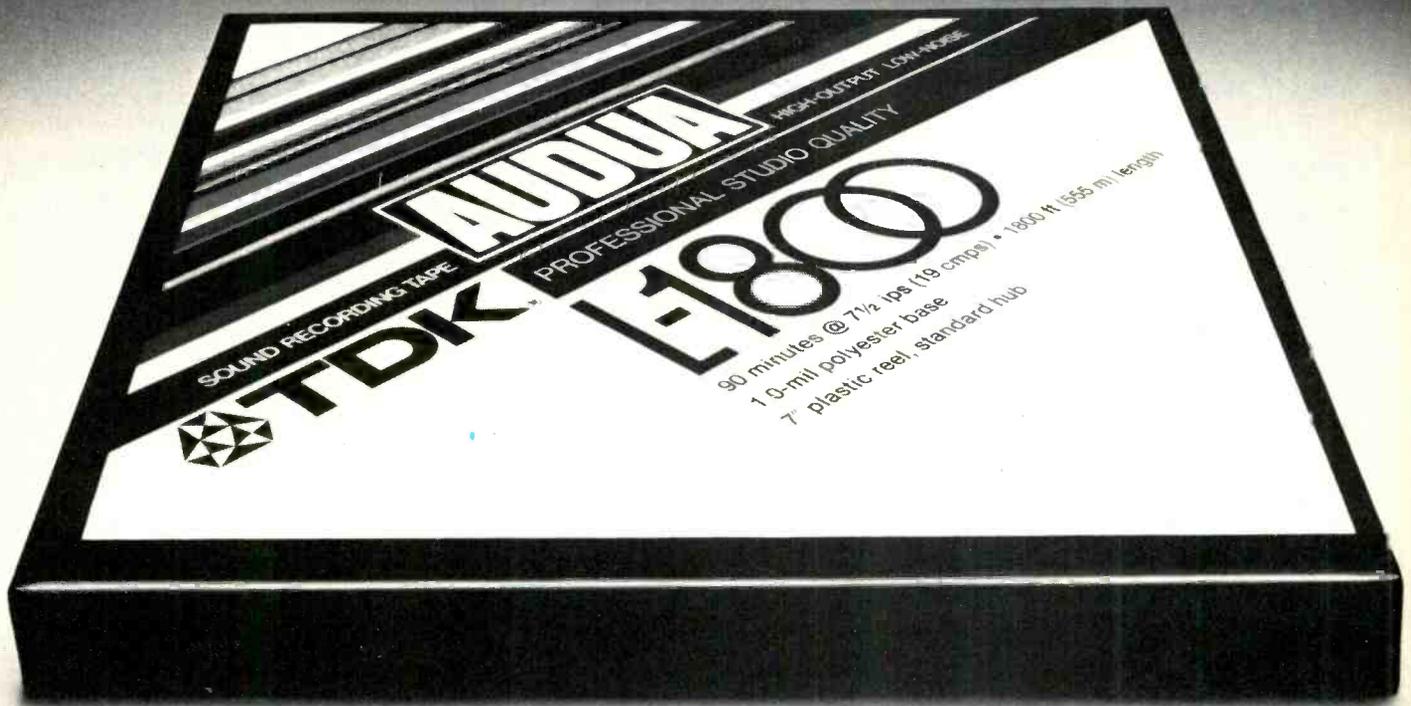
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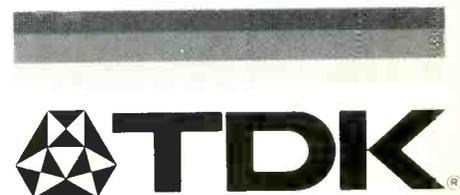
Audua was designed to provide higher output and

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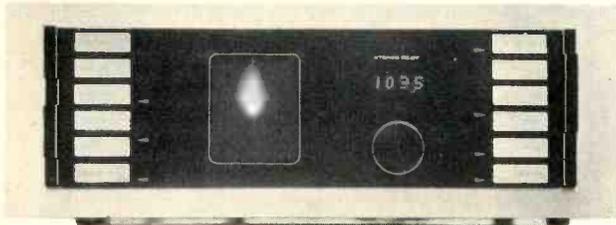
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Sequerra Model 1 FM Tuner



We have just seen, tested and listened to the world's best performing tuner, and it is called the Sequerra Model 1. We have just seen a most effective panoramic frequency analyzer and field strength meter for the FM frequency band and it is called the Sequerra Model 1. We have just seen a four-quadrant vector-oscilloscope capable of visually depicting stereo and quadrasonic signal separation and phase relationships, and it is called the Sequerra Model 1.

This report is somewhat different from our usual product test reports for several reasons: When we learned of the performance capability of the Sequerra Model 1, we concluded that the equipment in our laboratory would be totally inadequate for measuring the important parameters of this FM tuner, and so we arranged to conduct our tests right at the Sequerra engineering and production facilities, in Woodside, New York. We were thus provided with an in-depth understanding of the Sequerra operation and can speak with some knowledge of the lengths to which that company has gone to provide the performance and reliability built into the Model 1.

After completion of our usual tests, we were somewhat shocked to find that Sequerra's "published specifications" are so conservative that they simply do not do the product justice. That is why they do not appear as the opening paragraph of this report. For the record, here they are:

MANUFACTURER'S SPECIFICATIONS

IHF Sensitivity: Less than $2.0\mu\text{V}$. **S/N Ratio:** Greater than 70 dB. **Ultimate THD:** 0.07%. **50 dB Quieting Sensitivity:** Less than $2.8\mu\text{V}$. **THD at 50 dB/SN:** Less than 0.3%. **Frequency Response:** ± 0.3 dB, 30 Hz to 15 kHz. **Stereo Separation:** Greater than 50 dB. **Stereo THD:** Less than 0.2%. **Sub-Carrier Rejection:** Greater than 70 dB. **SCA Rejection:** Greater than 75 dB.

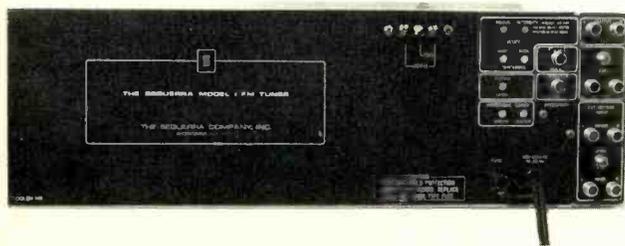


Fig. 1—View of the rear panel.

Now that you've read these few specifications, forget about them. They don't begin to tell the story. And, if you're wondering why some of the other commonly quoted specifications are *not* listed, be patient. It will all come clear shortly.

The product that confronted me when I walked into Richard Sequerra's expanding facilities is pictured here, but again, the simple elegance and beauty of its gold-and-black, heavy front panel cannot come across in a black and white photo. There is only *one* knob on the entire unit—the tuning knob. It is black, it looks good, and it rotates smoothly. Blending discreetly with the edges of the black central area are twelve pushbuttons, six along each edge. The left group include four buttons that determine what the $4\frac{1}{2}$ -in. flat-face instrument oscilloscope tube will display. If purchased with the panoramic analyzer option (first production runs all include this feature, because everyone seems to want the feature), the first button will cause a panoramic view of all broadcasting stations located 1 MHz above and below the tuned frequency to appear on the 'scope face as vertical "pips." More about the usefulness of this feature later. Depressing the tuning display button switches in a tuning display which shows instantaneous carrier deviation of the tuned FM station, signal strength (readable with incredible accuracy over a range of greater than 90 dB—from a few microvolts to close to a volt) and any AM products resulting from multipath reflection problems. The third button changes the display to a center-origin X-Y vector display which depicts left and right stereo channels in proper spatial relationship (pure left results in a vector pointing to the left upper corner, pure right points to the upper right corner). This display is used in checking separation and phase characteristics of stereo program material. The fourth display button provides access to four rear-panel input jacks for displaying external audio information of monophonic, stereo or four-channel sources. The fifth button of this group selects high-frequency blend during reception of weak stereo signals, to reduce noise at the expense of high frequency separation. The lowest button at the left introduces a Dolby "B" decoding circuit to be used when listening to stations employing the Dolby noise reduction method in their broadcasts.

Above the single tuning knob there appears the word "Megahertz" when power is applied, and just above that is a digital readout window which reads out frequencies to which the Model 1 is tuned. Readouts are in increments of 100 kHz (rather than 200 kHz, commonly used on other digital-readout tuners we have seen) for greater precision and because some countries of the world assign FM frequencies at "even" points rather than at "odd" 100 kHz increments as is done in the U.S. Above the readout window, the words "Stereo Pilot" light up whenever the set is tuned to a station which is transmitting a stereo pilot. The right-hand row of buttons consists of three interlocking switches which turn muting off, turn interstation muting on or mute everything but stereo transmissions. The three remaining push-push buttons select automatic stereo or mono, normal or dimmed panel illumination, and turn power on and off to the entire unit. Interestingly, there isn't a "commercial message" on the entire front panel other than a distinctive "S" (for Sequerra) engraved on the power on/off button. Sequerra feels (and we agree) that "everyone will know."

The rear panel, shown in Fig. 1, contains a three-terminal strip for connection of either 75- or 300-ohm transmission lines from antenna. Clustered at the right are seven screwdriver adjustment controls, fixed and level-controlled pairs of output

jacks, four external input jacks for connection of external audio channels in conjunction with the vector X-Y display on the scope (together with a four-section level control to permit setting display amplitude), a detector output jack, an accessory 10-terminal socket (intended for use with such accessories as a remote tuning control which will be available at a later date) and a "25 microsecond" Dolby jack. Since Dolby has suggested that his noise-reduction system could be put to best use if FM pre-emphasis and de-emphasis were officially changed to 25 microseconds (instead of the present 75 microseconds), Sequerra has provided this last feature which simply requires the insertion of a shorted "phono plug" to change the de-emphasis time constant internally.

The seven screwdriver adjustments accessible to the user include focus, intensity, vertical centering and horizontal centering for the scope display, muting level adjustment (from 3 microvolts to 30 microvolts) and two adjustments for centering the panoramic frequency display and for controlling its width. A one-ampere fuse holder and line cord complete the back panel layout.

Circuitry and Internal Construction

The block diagram of Fig. 2 should give you some idea of just how much sophisticated circuitry has been built into the Model 1. The photo in Fig. 3 is a view of the inside of the chassis, taken from the top, with the black cabinet wrap removed. The front-end of the tuner is unique in that it employs "balanced" circuitry all the way from the differential push-pull cascode r.f. input amplifiers (4 FETs) all the way to the balanced push-pull FET mixer stage which is "source" driven by a balanced transformer and whose "drain" outputs feed another transformer.

In addition to the normal i.f. output, the front-end supplies outputs to the 4-digit, 1 MHz clock counter and to the panoramic analyzer section. The r.f. section is varactor tuned, with tuning voltage ranging from 32 volts to 7.4 volts. Multiple varactor diodes are "stacked" for higher capacitance.

The i.f. section, shown in Fig. 4, contains an 18-pole Papoulis filter, each section of which contains 3 separate coils and two adjustable coupling capacitors.

There are six limiter stages, as seen in the view of Fig. 5, each with a gain of approximately 20 dB. AM detection points are taken from the i.f. filter and limiter sections and fed to the display section for use in its "Tuning" mode.

A newly designed Travis-Smith FM detector utilizes 2 peak detectors in quadrature. This arrangement serves to balance out 2nd and 3rd harmonic distortion products to an incredible low of better than 0.05%. Detector bandwidth is between 600 and 700 kHz wide.

The panoramic section constitutes a "receiver" in itself—one that uses its own local oscillator to produce a 2.4 MHz "i.f." swept frequency for application to the panoramic log detector.

Another circuit board includes the stereo multiplex circuitry and the Dolby circuits. De-emphasis and carrier rejection filter blocks occupy the left end of this module, most of which contains stereo parts, with the Dolby circuitry occupying the right-hand quarter of the board.

In all, there are some 22 p.c. board modules in the Sequerra Model 1. The power transformer is of an unusual double-coil design which employs a multiple-finger core. The regulated power supply section supplies the six important operating voltages ranging from the low +5 volts needed for the counter to the -1600 volts required for the CRT anode. We gave up trying to count the total number of transistors, IC's and diodes

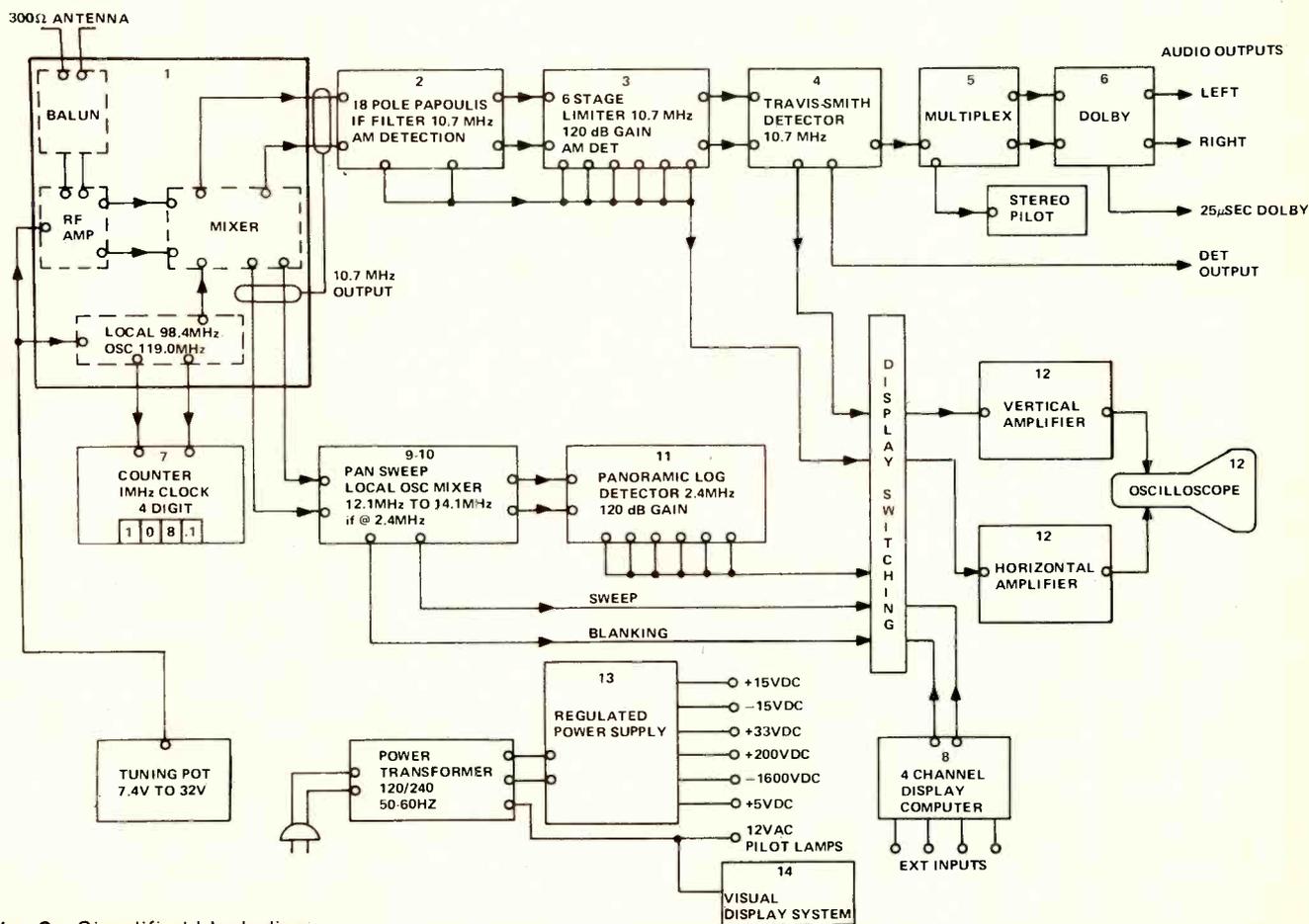
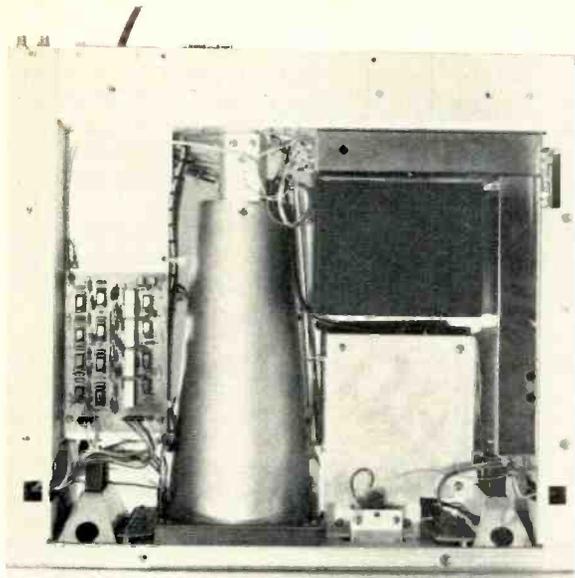
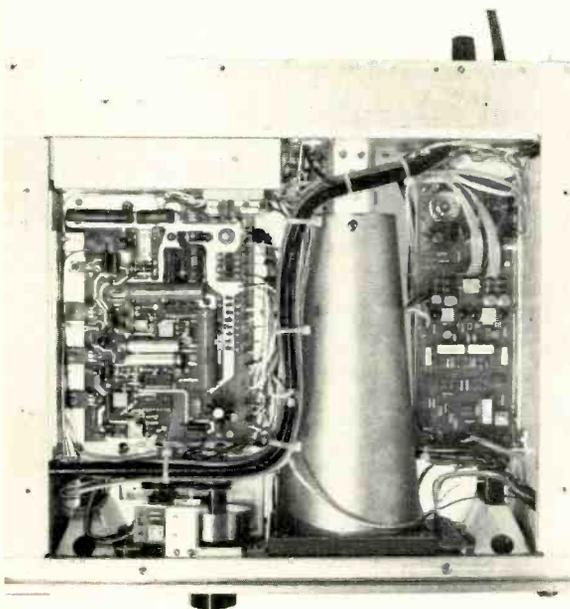


Fig. 2—Simplified block diagram.



A



B

Fig. 3—View of chassis from above (A) and below (B).

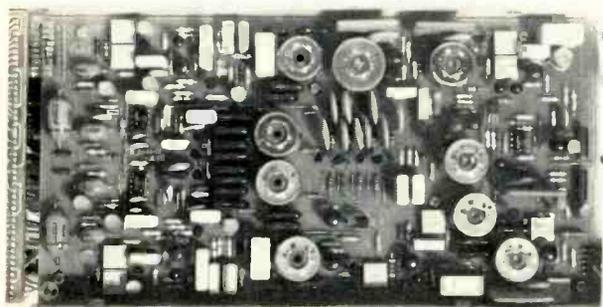


Fig. 4—Part of the i.f. system.

in this product, because to do so would have meant working well past Sequerra's closing time! There is practically no "hard wiring" in the entire tuner and boards are easily unplugged for servicing and/or replacement. Judging by the meticulous assembly and inspection procedures, the quality of the components used, and the rugged construction and layout of the tuner, there isn't likely to be too much of that going on in the field. Sequerra offers a straightforward five-year warranty for the Model 1 which covers labor and material on everything but the CRT tube, which is warranted for one year.

Laboratory Measurements

Our usual FM performance measurements were made on the Sequerra Model 1 tuner. Figure 7 attempts to depict, graphically, some of the results, but each curve must be qualified by an excuse. To begin with, IHF sensitivity measured exactly 1.7 microvolts—about as low as IHF sensitivity can ever be *if proper bandwidth is maintained*, as it is in this model. So, IHF sensitivity is indeed "less than 2.0 μV " as claimed. The 50 dB quieting point was reached with a signal input of 1.9 μV . We usually quote THD for this condition, since in most tuners it still predominates over noise. In the case of the Model 1, however, the residual output at 50 dB quieting, as observed on an oscilloscope was very predominantly noise. Therefore, using an ordinary distortion analyzer (which can't tell the difference between noise and distortion), you'd come up with a figure of 0.3% "noise plus distortion" at 1.9 μV . Actual harmonic distortion is not separately visible on the 'scope until the noise dips below 63 dB or so, which is equivalent to about 0.07% residual THD.

However, even this figure needs qualifying. We are convinced that the Sound Technology FM Generator was not capable of supplying a test signal with better than 0.07% inherent modulation non-linearity, and therefore our reading of 0.07% THD is strictly the result of the test equipment. In other words, Sequerra knows that the THD of the Model 1 is lower than 0.07%,

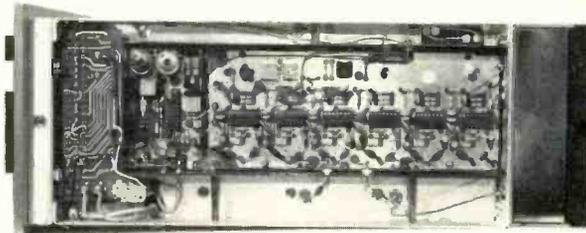


Fig. 5—Limiter section.

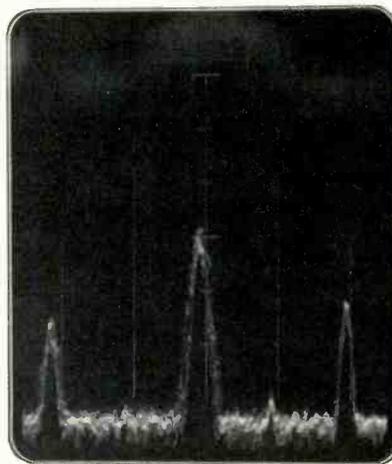
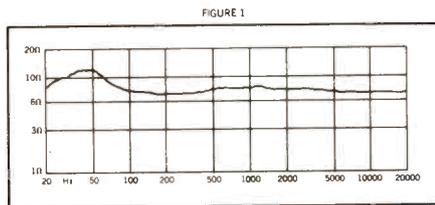


Fig. 6—Actual panoramic display. Note weak adjacent channel signal to the right of tuned-to-center signal, also alternate channel signals on each side of center.

RTR breaks through the wall of speaker distortion with "The Transparent Enclosure"

Throughout the history of high fidelity, the acoustic engineer and the audiophile have been plagued by the distorting influence of the never perfect speaker enclosure. The RTR 280DR represents the first major breakthrough in eliminating this adverse effect.

This breakthrough was not easy. It required a complex design incorporating four custom designed woofers ... one front mounted, two side mounted with balancing networks, and one planar slot loaded driven through a reverse phase bridge network. Proof of performance is shown by the complete lack of fundamental resonance exhibited by the broad, smooth curve shown in Figure 1.



280DR Impedance, Midrange control at "5," Tweeter control any setting

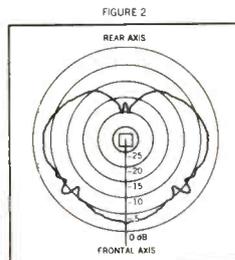
This unique design earned the following comments from Dr. R. C. Heyser in *Audio* magazine (Nov. 1973): "The harmonic distortion on the 280DR is extremely low. A flute tone E_1 (41.2 Hz) at 20 watts input produced 1 percent E_2 (second harmonic) and 1 percent A_2 (third harmonic). The critical mid bass remained below 0.4 percent at this same level.—The lack of sonic distortion lulled us into testing at high power.—Investigation of the impedance plot showed that we were in fact delivering close to 200 watts of heating power to the 280DR at maximum test level."

Total Dispersion

Many music lovers, relating to the concert hall experience, have maintained that the ideal speaker should radiate uniformly hemispherically. (This is not to be confused with the "reflecting concept.") The 280DR was engineered for "Total Dispersion."

To achieve this "Total Dispersion," six high frequency drivers were joined

with the four woofers to produce an incredibly uniform polar energy response which is shown in Figure 2.

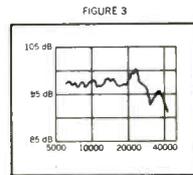


280DR Polar Energy Plot

Total Bandwidth

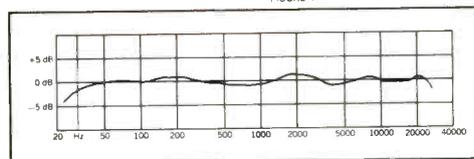
Total bandwidth is dependent on the proper in-system functioning of all transducers. The four woofers are designed and manufactured by RTR. They are special ten-inch transducers with butyl surrounds and two-inch epoxy impregnated voice coils. Five magnetic high frequency drivers are utilized to properly simulate concert hall ambience. A newly developed super tweeter, operating on the piezoelectric ceramic disc bender principle, extends overall response of the 280DR to 25,000 Hz. Figure 3 shows the uniformity of the frequency response of this super tweeter.

In an average listening room, the midrange and tweeter controls can be adjusted to yield the typical overall frequency response of the 280DR as shown in Figure 4 within ± 3 dB of the illustrated curve *without equalization*.



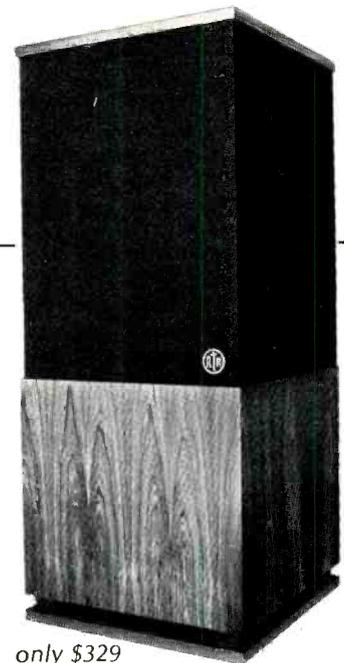
280DR Super Tweeter Frequency Response

280DR Response Characteristics



Creating Music

The 280DR does not create music. But it does reproduce music with great accuracy. Prove it to yourself by auditioning an RTR 280DR at your RTR franchised dealer and experience RTR "Total Capability."



only \$329

280DR Specifications

Enclosure:

Genuine hand-rubbed walnut veneers

Size:

16 1/2" x 39" x 16 1/2" deep

Shipping Weight:

95 lbs.

Frequency Response:

22 to 25,000 Hz

Speaker Complement:

Four 10" woofers, five 2 1/2" mid-range/tweeters, one piezoelectric super tweeter

Crossover Frequencies:

2500 Hz and 7500 Hz

Impedance:

8 ohms nominal

Recommended Amp. Power:

25w to 100w RMS per channel

Controls:

Midrange and tweeter level, speaker protect circuit breaker with push button reset, dual 5-way input jack.



For more information circle the number below or write RTR INDUSTRIES Dept. A, 8116 Deering Ave. Canoga Park, CA 91304

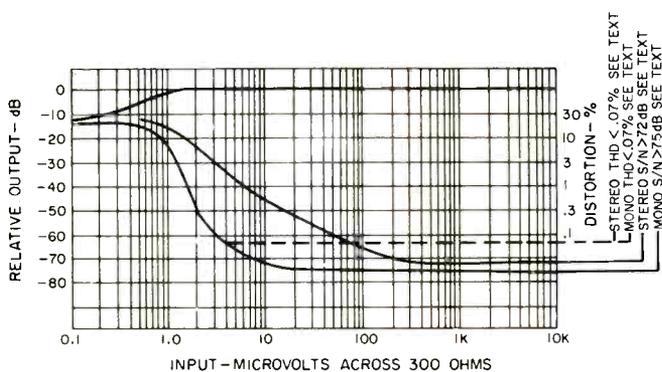


Fig. 7—FM quieting and distortion characteristics.

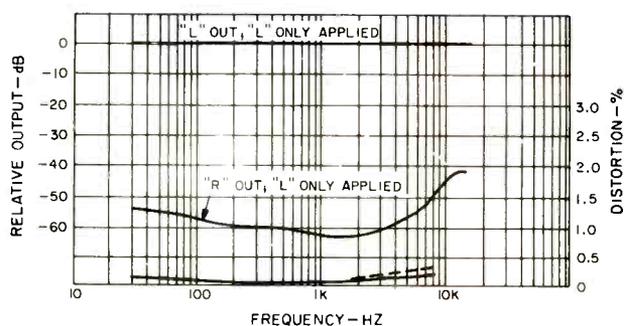


Fig. 8—Separation and distortion versus frequency.

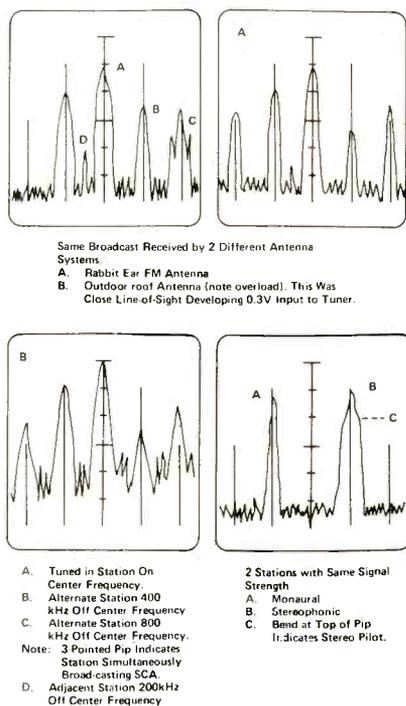


Fig. 9—Panoramic displays.

but can't really prove how much lower. His best guess is about 0.04%. The same applies to ultimate S/N, which measured about 75 dB. We know, however, that the generator is only guaranteed to suppress residual modulation down to ± 25 Hz when used in the CW (unmodulated) mode. This would permit readings of over 70 dB, and the generator we used did permit a reading to 75 dB. There is no way of knowing how much further down the noise of the Model 1 really is—but we do know that it's lower than -75 dB. As for stereo, residual modulation of the generator is a bit worse so we come up with a -72 dB reading—in itself the lowest reading we have ever obtained, by far, for any tuner operating in the stereo mode, but probably a good deal higher than the true figures, which are just not obtainable with present day test equipment.

Figure 8 shows stereo separation versus frequency and THD versus frequency. The separation curves, at least, are definitive and meaningful and, as can be seen, show separation in excess of 60 dB at mid-band audio frequencies. At 15 kHz, separation was still in excess of 40 dB and well over 50 dB at the low end of the audio spectrum. The only thing the THD curves show is that there is some noticeable increase in THD at the extreme high frequencies in the stereo mode—noticeable, that is, if you consider a change of THD from 0.15% to 0.25% significant at frequencies above 6 kHz. What is obvious from these curves however, is the fact that there were NO visible or audible "beats" produced at any frequency as a result of any interaction between the 38 kHz products and audio products.

Additional separate measurements were made for the specifications not listed by Sequerra, and it became obvious why he didn't bother with them. Here are some, with appropriate (and repetitious) comments. Alternate channel selectivity was in excess of 100 dB (we can't say how much in excess because of test equipment limitations). Image rejection was too high to be measured by our equipment. Spurious response rejection was in excess of 100 dB (we can't say how much in excess . . . etc.). Capture ratio, as nearly as we could measure it (and it gets pretty tricky below 1 dB) was about 0.75 dB. As Dick Sequerra pointed out, however, a more meaningful statement could be made by pointing out that at 4 dB difference in signal strengths, the stronger signal "knocks out" the undesired weaker one to the extent of over 50 dB!

Frequency response is something we can tell you about. It is accurate to the prescribed de-emphasis curve within ± 0.2 dB from 30 Hz to 15 kHz. Rejection of 19 kHz output products and 38 kHz output products was in excess of 70 and 75 dB and therefore these components would be totally insignificant in terms of any recorder, regardless of its bias frequency. Rejection of SCA (67 kHz) was too great to be measured meaningfully. After several hours of making these sometimes frustrating measurements, we decided to relax and play with the unit.

Listening and Utilization Tests

In case you have ever questioned the need for the kind of performance which the Sequerra Tuner can deliver—if you've doubted whether there is an audible difference—let me put those doubts to rest. You can (and I did) hear the difference. I don't think it's a simple case of lower distortion. I don't believe it's just better stereo separation. It's much more subtle than that, and I don't intend to explore the reasons in this lengthy report. Suffice it to say that even in the face of admittedly poor station and transmitter practice (which has become rampant in FM over the last few years) we were able to find program sources that sounded better than we have ever heard FM reception before. Cleaner, quieter, more stable and more like what we had always believed FM radio was all about. Both in its measurements and in its actual audible performance, the Sequerra Model 1 is at least a whole order of magnitude better than anything else around.

Naturally, we were fascinated with the panoramic and other 'scope displays. But, as we used the panoramic display for a

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It tracks any cartridge at one-fifth of the pressure, and with only one-twentieth of the wear on discs and styli, than is within the capability of any other tonearm of any type, ever made anywhere in the world.

A radically new device which has emerged from nine years of intensive and original research; it has demolished absolutely all current tonearm theory and put discs back firmly twenty years ahead as a program source for domestic Hi-Fi. It is strongly patent-protected in every technological country!

It tracks the most compliant cartridges at one-tenth of a gram, and those cartridges were made to withstand the onslaught of conventional massive arms. Emerging new generation cartridges will do far, far better still in this arm.

In the world of self-respecting Hi-Fi, all other disc playing systems are hopelessly outdated, all other arms hopelessly massive, destructive and wasteful.

SPECIFICATION	Best low mass conventional arm or parallel tracking arm, with best cartridge	Vestigal arm, with best cartridge	Perfect arm
Actual Moving Mass	Best 180 grams in all planes	37.5 grams horizontal; 25 grams vertical	Zero Mass
Inertia (effective mass) with Cartridge	Best 11 grams in all planes (often twice this figure)	6 grams horizontal; 1 gram vertical	Zero Inertia
Tracking Pressure	Best 1¼ grams on selection of highly modulated discs	Best one-tenth of a gram on selection of highly modulated discs	Zero
System resonance	2-30 C.P.S., system resonance within large air moving frequencies resulting in distortion and feedback	Over 180 C.P.S., system resonance well outside air moving frequencies no distortion or feedback	Over 30,000 C.P.S.
Disc Wear	Severe degeneration of discs after 15 playings, no longer Hi-Fi after 35 playings	Degeneration of discs at least forty times less due to low inertia and tracking force	No Wear



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while, we came to realize how much we could learn from it. We were able to accurately measure signal strengths by noting the vertical height of the signal pips. (see Fig. 6.) We could even spot SCA transmissions from those stations that engage in this extra service. In one case, we noted extreme overmodulation of the SCA sub-carriers, something we had suspected regarding this particular station for years. What a great field strength meter this would have made in our previous studies of FM antenna capabilities some years back!

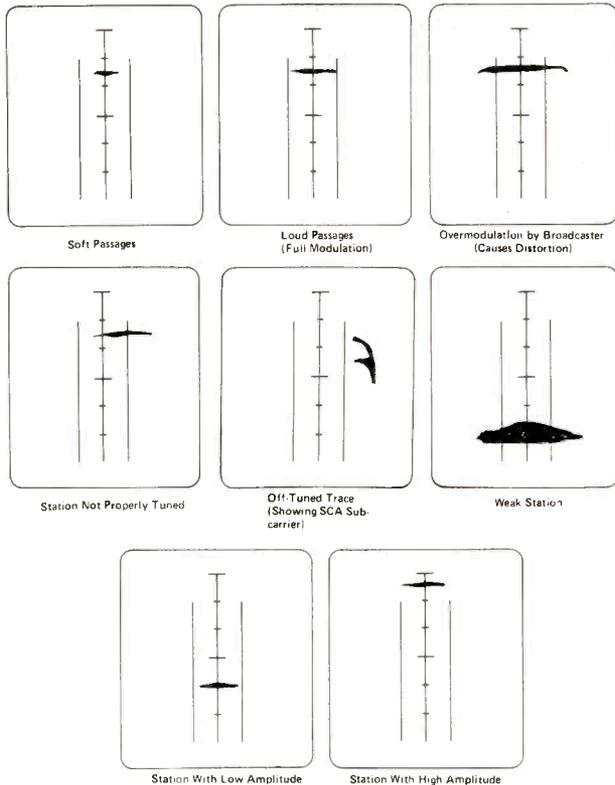
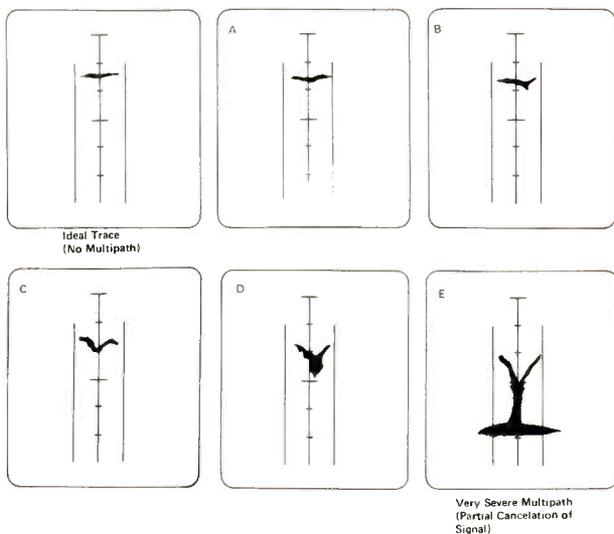


Fig. 10—Tuning displays.



Multipath progressively worse (A through E). The long gentle curve of A is preferable to B, etc. In tuning to eliminate or minimize multipath, rotate your antenna to get the smoothest trace. This will be your best listening position, even if it has less amplitude than in other positions.

Fig. 11—Tuning displays.

In the "Tuning Display" mode, we were able to perfectly center-tune any desired station, gauge station modulation levels (and, in many cases, overmodulation levels as well) and detect even the barest traces of multi-path interference. In this mode, too, signal strength is indicated by the vertical position of the display and calibration of the gradicule marks was just about perfect. The display, incidentally, has automatic brightness circuitry built in. When the display collapses to a dot (as it will with no modulation in the "tuning" mode, or in the absence of audio signals in the "vector" mode), brightness is automatically reduced so that only a very dim spot of light appears, so as to protect the scope face from premature "burn spots."

The kinds of displays we observed are illustrated in Fig. 9 (for the panoramic function), Figs. 10 and 11 (when using the display in the tuning mode), Fig. 12 (when using the display to check stereo separation and musical locations) and Fig. 13 (when using the display to feed separate, external audio signals via the rear input jacks). Our immediate thought after playing with these versatile functions for a while was that the FCC ought to equip every one of its mobile monitoring units with a Sequerra Model 1 unit. Perhaps then they could do some policing of the abuses in broadcasting practices which are prevalent all over the country. It wouldn't be a bad idea if every FM station in the country was equipped with this tuner too. It is sure to find its way into these places, because it can provide more useful information regarding a station's radiated signal than any other single piece of FM equipment (and that includes so-called "monitor" receivers) we have ever seen.

In the last analysis, a good FM tuner is for listening. And, ultimately, it is with the dedicated FM listener who demands perfection that the Sequerra Model 1 is sure to make its mark for years to come. As one who has been involved, professionally, with FM equipment for over two decades, I can remember only two tuners which became the classics of their time. The

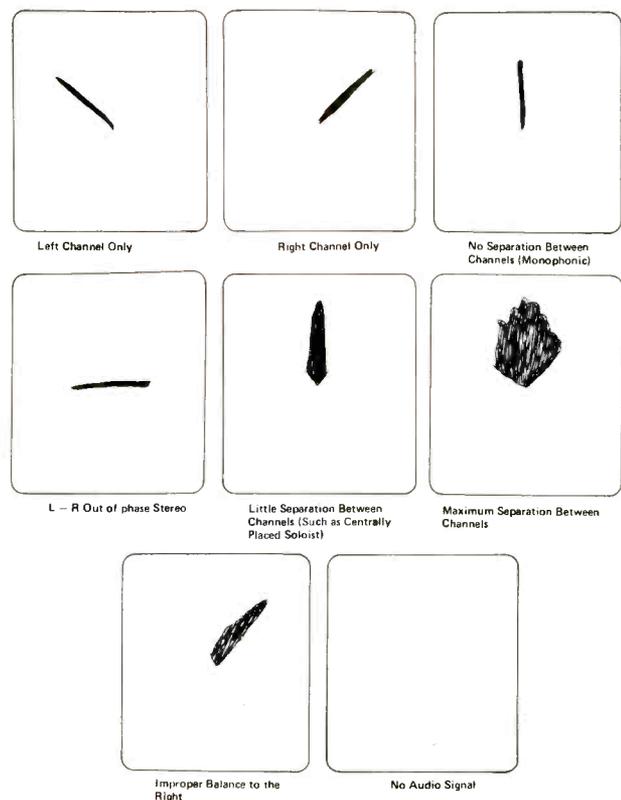
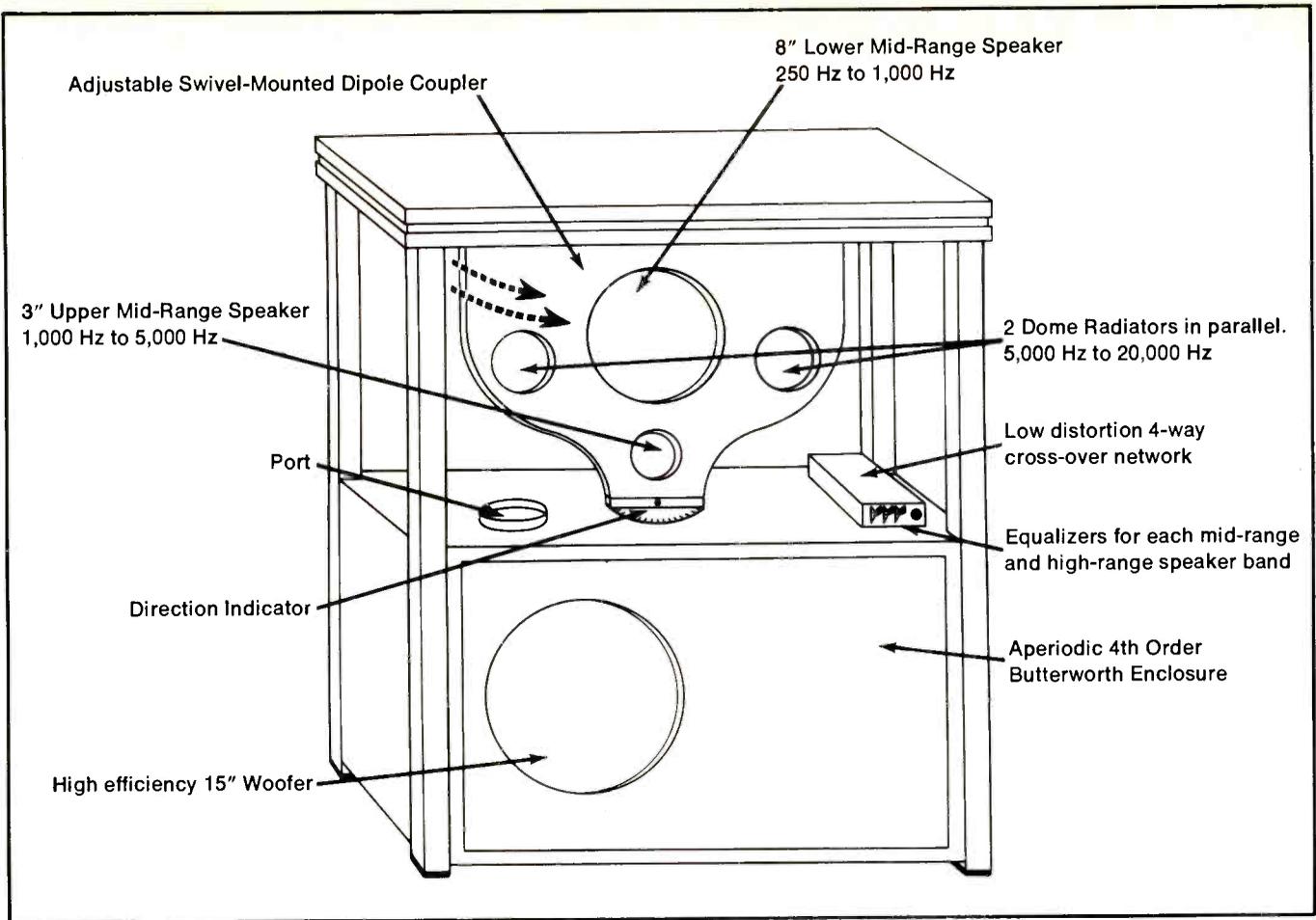


Fig. 12—Tuner vector for stereo display.



The new Leslie DVX Speaker: it adjusts to the geometry of your room!

CBS Laboratories and Leslie Speakers have now developed an amazing new loudspeaker system that is... quite frankly... amazing! The Leslie DVX speaker is a unique high performance, low distortion four-way system. Its exclusive dipole coupler is swivel mounted... so that you can "aim" the mid-range and high frequency speakers to fit the geometry of your room. This dipole coupler also gives you the optimum balance of direct and reflected energy to pinpoint and anchor the stereo image in the manner intended by the recording director.

The bass frequencies are reproduced by a high energy 15" woofer housed in an aperiodic 4th order Butterworth ported enclosure and descend smoothly to the lowest registers.

Leslie Speakers was the first company to introduce a truly effective "augmentation" system (the Plus 2 speaker) to eliminate the standing waves in your room. Now comes the amazing DVX speaker. D for dipolar, VX for variable axis. A whole new alphabet for sound! Hear it at your nearest Leslie Plus 2/DVX dealer.

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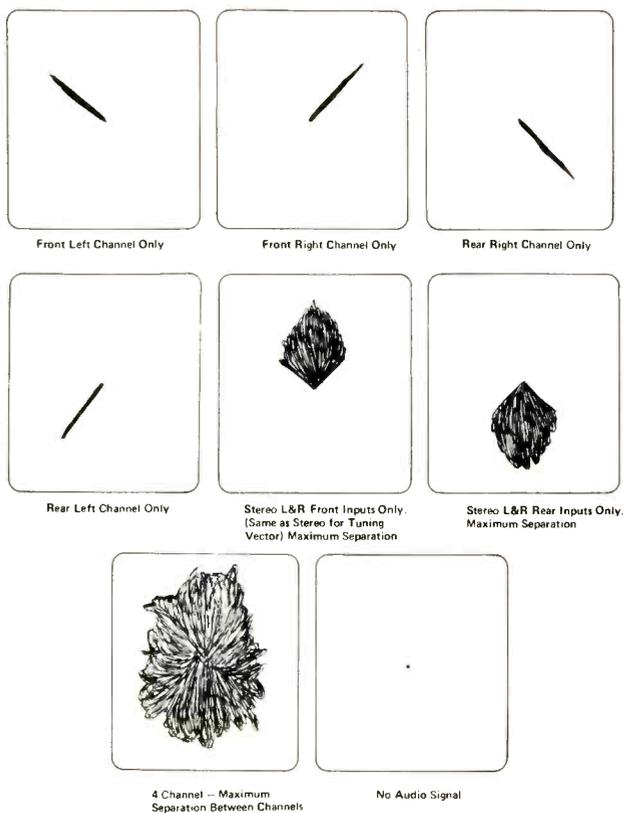


Fig. 13—External vector displaying external 4-channel audio program source.

first was the famous REL tuner which was head and shoulders above everything else in the 1950s. In the 1960s, we were introduced to the Marantz 10-B (designed, by the way, by Dick Sequerra and his present active associate Sid Smith—both of whom are as dedicated to good sound as they were when I first met them years ago).

And now, in the mid-70's, we have a new standard of excellence—The Sequerra Model 1. I have purposely avoided mentioning prices up to this point because I felt that it was important to understand that this product is in a class by itself and that price is secondary. When you come right down to it, for the features it has, for the performance it gives, and for the musical pleasure it can provide to anyone demanding the finest there is in an FM tuner, \$2500.00 is not really all that much to pay for the Model 1. If you're really strapped for cash, but want the tuner so badly that you're willing to buy it without the panoramic analyzer feature (a mistake, in my opinion), you will be able to walk away with one for an even \$2000.00—after Sequerra has filled his initial orders which all call for the panoramic version.

One final word for any of you who may have seen a prototype of this unit at various exhibitions and shows. The unit is *actually* in production. I saw dozens of completed and partially completed models with my own eyes. The waiting period is at an end. There really *is* a Sequerra Model 1 Tuner available for purchase. Final confirmation of this fact was brought home to me at the end of my visit, when Dick Sequerra began discussing his thoughts on the next product (in the audio field) that he and Sid Smith are beginning to work on. (I'm not at liberty to discuss it!) I know these dedicated engineers well enough to state, categorically, that they would not even be thinking about the next design program unless *they* felt that their first magnificent product was safely on its way!

Leonard Feldman

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Wollensak 4780 Cassette Tape Recorder



MANUFACTURER'S SPECIFICATIONS

Frequency Response: 35 to 15,000 Hz \pm 2 dB with Low Noise or CrO₂ tape; 35 to 14,000 Hz with regular tape. **Signal-to-Noise Ratio:** Better than 48 dB without Dolby. **Bias Frequency:** 110 kHz. **Input Sensitivity:** Mic, 0.25 mV; Line, 100 mV. **Output:** 1 volt. **Dimensions:** 16 in. W x 11 in. D x 8 in. H. **Weight:** 14½ lbs. **Price:** \$279.95.

The Wollensak 4780 is an unusual-looking machine—at least in comparison with the general run of cassette recorders. In fact, it looks more like a studio recorder with its sloping back panel and controls! Reading from left to right, there are four lever switches for the following functions:

power on/off, recording stereo/mono, line or mic input, and tape selection for CrO₂ or regular. Then come the two VU meters with the record indicator light in between. On the main panel (which also slopes to the front), is the cassette well and in front of that is a row of seven piano keys for EJECT, REWIND, RECORD, PLAY, FAST FORWARD, STOP, and PAUSE. To the right are three slide controls for level-left channel, right ditto, and master, which controls both channels. Behind these is the digital counter and memory and Dolby switches—both with indicator lights. At the extreme right are the microphone and headphone sockets. Input and output sockets, together with Dolby calibration controls are in a recess at the rear. A pre-set output level control is also located on the rear panel—a useful feature.

An end-of-tape switch disengages the pressure roller and heads from the cassette, reverting automatically to the STOP mode. This is a fairly common feature with good quality cassette machines but 3M engineers have gone a stage further with the 4780 and fitted what they call a "Cassette Guardian." This is a device that automatically puts the machine in the STOP mode if a defective cassette stalls or jams the tape transport mechanism. Not so common these days, but it's a worthwhile refinement for all that.

Measurements

Figure 1 shows the record-replay response with Maxell UD tape. The 3 dB point is 14,500 Hz. The next graph, Fig. 2, shows the response with CrO₂ tape (TDK KRO) and the 3 dB point is somewhat higher at 15,000 Hz with rather more "headroom." Figure 3 shows the response from a standard test tape and Fig. 4 gives the distortion at 1 kHz. It will be seen that the THD is less than 2% at 0 VU, increasing to 4.5% at +3 VU. Distortion versus frequency can be seen from Fig. 5.

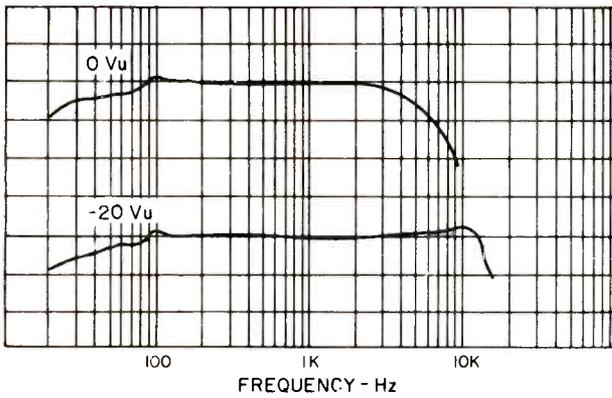


Fig. 1—Record-replay response with Maxell UD tape.

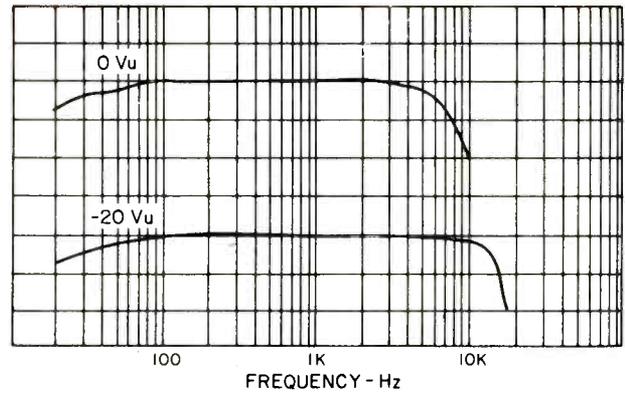


Fig. 2—Record-replay response with CrO₂ tape.

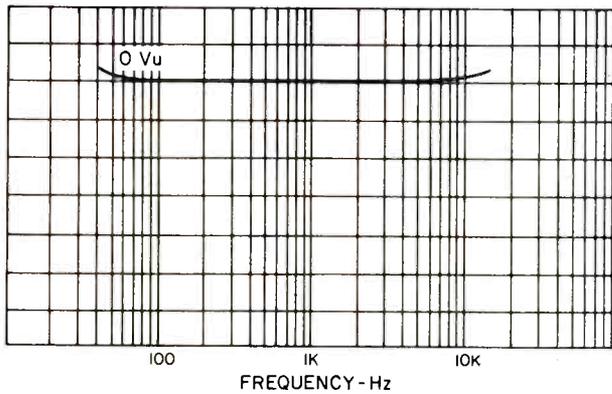


Fig. 3—Playback response from standard tape.

Signal to noise came out at -51 dB (ref. 3% or +1 VU) and 57 dB with Dolby, which is excellent. Input sensitivity was 120 mV for 0 VU and 27 mV for microphone. Output was just under 1 volt—985 mV, to be precise. Erase ratio was better than 59 dB and wow and flutter was 0.17% record-replay. Rewind time was 76 seconds for a C60 cassette and speed checked out 0.1% fast.

Listening Tests

I found the 4780 a very easy machine to use—partly because of the arrangement of the control switches and the rear panel. The VU meters are smaller than some, but they are illuminated and because of their position, they can be seen from quite a distance. The provision of three input controls is a little unusual, but it does permit channel balancing as well as dual control with the master slider. And, of course, you can fade a signal from one channel to the other if you desire. The eject key merely opens the compartment lid—the cassette isn't sent to the other side of the room—it just lies there waiting to be picked up.

Several tapes were made both with and without the Dolby switched in, mostly from CBS SQ matrix records and FM transmissions using a Dyna AFM-6 tuner. Phono cartridge was a Shure Mk III with a Thorens 125 turntable. No trouble at all. I *did* manage to find a bad cassette (made by a *deservedly* obscure company in L.A.) and I can report that the Guardian did what it is supposed to. A few words about the styling: It is a popular belief that a truly functional design will also look attractive. This is not true, but it *is* possible to combine the two

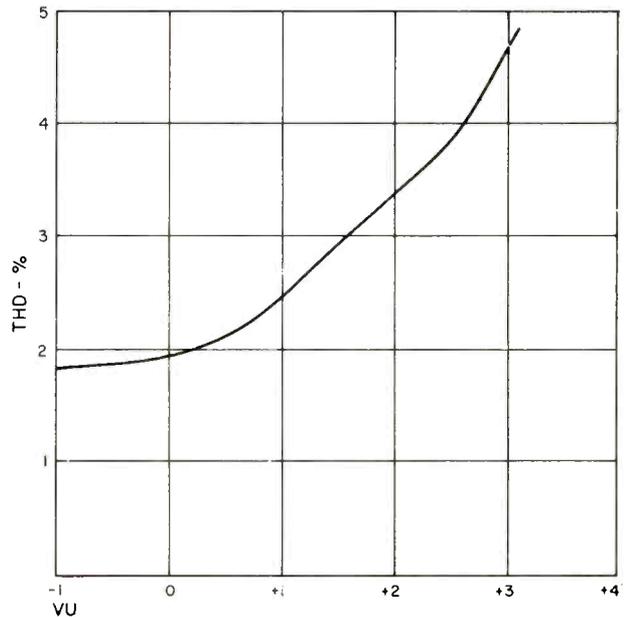


Fig. 4—Distortion at 1 kHz.

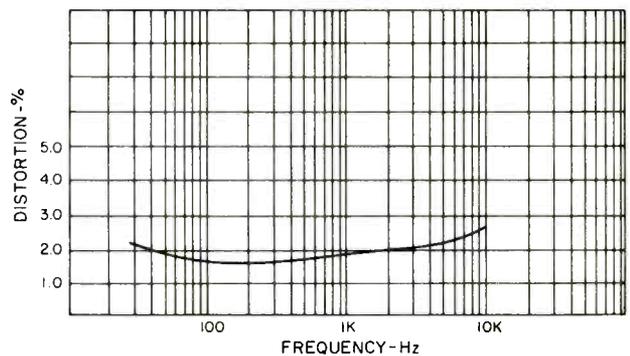


Fig. 5—Distortion vs. frequency (0 VU).

parameters and the 4780 *does* look very elegant with its matte black and silver panel—and it is completely functional. All-in-all, the Wollensak 4780 is certainly one of the best medium-priced Dolby cassette recorders now available.

George W. Tillett

Check No. 61 on Reader Service Card

Audionics High-Definition Quadraphonic Decoder



MANUFACTURER'S SPECIFICATIONS

Facilities: SQ, Ambience and Stereo. **Frequency Response:** 5 Hz to 100 kHz ± 1 dB. **Distortion:** Less than 0.025%. **Hum and Noise:** -80 dB rel. 250 mV. **Price:** Model A, \$39.95; B, \$74.95; C, \$99.95.

It is generally conceded that logic type quadraphonic decoders, that is, those using "gain riding" circuits to enhance separation, give the best all-round (sorry!) results. It is also true that many people object to the "pumping" action inherent in the cheaper types of semi-logic units. Full-logic decoders, such as the Sony 2020, are free from this defect but they are relatively expensive, and if classical music is the main interest, a good non-logic unit will give very acceptable results. One can also be used to add ambience and a sense of spaciousness to ordinary stereo records—or tapes for that matter. The Audionics 106 is made in Great Britain by TATE who specializes in matrix techniques (more from them later this year when they will release a "directional enhancement system") and it is available in three versions: Model A consists of a circuit board minus power supply, switching or hardware; Model B

includes these items but is minus cabinet and panel, and Model C is the complete version as tested. It is a small unit, measuring about eight inches by six inches by just over two and one-half inches high. The MASTER volume control is on the right—the large knob—and to the left is a row of seven push buttons. They are the ON-OFF switch, DISCRETE 4-CH, STEREO, SQ, AMBIENCE, TAPE, and BLEND. The discrete 4-channel is for tape inputs—in other words, the decoder is switched out of circuit. The ambience switch applies a smaller proportion of the signals to the rear channels and in a different phase relationship from the SQ mode. It is intended to create a surround sound from ordinary stereo records, although it does have other uses. The tape switch replaces the tape monitor switch on the receiver or pre-amplifier as this is switched to the decoder.

The SQ circuit is the basic matrix designed by CBS but Audionics claims that the frequency response, phase relationships and distortion are better than the original specifications. This was borne out by the tests.

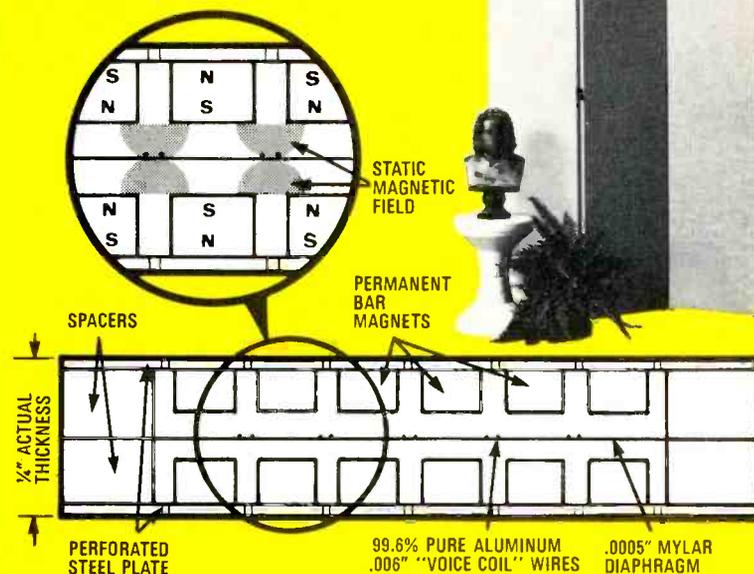
Performance

Figure 1 shows the output versus distortion and it will be seen that distortion is insignificant below 2 volts or so. In most cases, the signal input would be on the order of 200 mV where the distortion is well below 0.05%. Insertion loss is less than 1 dB. Frequency response was 1 dB down at 4 Hz and 60 kHz, and 10 kHz square wave resolution was excellent with only the slightest trace of rounding. Phase relationship was within 3% over most of the audio band, increasing at extremes but still well under the 10% specifications at 20 Hz and 20 kHz. Hum and noise was 82 dB (ref. 200 mV output).

On test, the 106 C came well up to expectations; overall sound quality was audibly unaffected by noise or distortion.

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The blend control operates on the rear channels and tends to cancel the rear center image, thus a vocalist will sound more sharply defined to the front when the blend control is used. It was found that some Sansui (QS) and old (relatively) E-V discs sounded better with the ambience position—others seemed more realistic on the SQ mode. But this is a matter of personal taste, room acoustics, and speaker dispersion characteristics. Summing up, the Audionics 106 C is a well made, inexpensive unit with a higher standard of performance than the average non-logic decoder. The only criticism I would care to make concerns the volume control—it felt too stiff and uneven. It is a four-gang component and it is mounted on the circuit board, but I feel it really ought to be a little better!

George W. Tillett

Check No. 62 on Reader Service Card

Panasonic Strain-Gauge (Semiconductor) Cartridge

THE EVOLUTION of the transducer for reproducing recorded sound since Edison's invention of the phonograph (1877) and, subsequently, the Berliner Gramophone, has been remarkable. The transducer used with the Berliner flat disc was of the acoustical-mechanical type. With the advent of electronic amplifiers, the subsequent transducers included the torsional-twisting Pfanstiehl, the Weathers FM demodulator type (which had to be tuned not unlike today's CD-4 cartridge), a variety of piezoelectric units, the moving magnet and the moving coil types, and finally, the strain-gauge (semiconductor) type.

Modern cartridges convert to convolutions of a recorded groove, as traced by the stylus, into an electrical signal. These cartridges fall into one of two classes—either the amplitude responding or velocity-responding category. Most cartridges are of the velocity-responding type, while such cartridges as the piezoelectric and piezoresistive types are amplitude-responding. The piezoresistance types includes the strain-gauge (semiconductor) type, where the stylus movement varies the resistance of the semiconductor elements. Unlike the piezo-

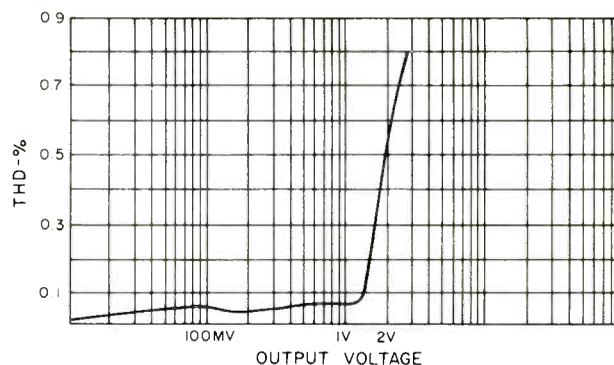


Fig. 1—Output versus distortion.

electric cartridge, the piezoresistive element does *not* develop a signal directly. When at rest, it is a simple resistor with a fixed value. Apply pressure or strain and the resistive value changes correspondingly. By applying a voltage to this resistor, the resultant current changes in step with the change in resistance.

The Panasonic EPC-450C cartridge, developed by Shuichi Obata in Japan, is a strain-gauge (semiconductor) type (Fig. 1). The stylus assembly (Fig. 2) consists essentially of a nude Shiba diamond stylus mounted on a light-weight titanium stylus lever. When the low-mass stylus assembly is inserted into the cartridge, it rests against an almost invisible metal resolver and assumes the relationship to the cartridge's moving system. When the record-groove undulations swing the stylus lever, they cause the metal resolver to press alternately against the two piezoresistive semiconductor elements (silicon sensor), causing them to change their resistive value correspondingly. However, there is no signal present unless the elements are supplied with a bias voltage, which is normally available from the Panasonic SE-405H CD-4 demodulator. As the piezoresistive elements change their resistive value, they modulate the direct current present, thus creating a corresponding signal in the CD-4 demodulator. Since the cartridge does not directly generate an electrical signal, there are no signal loss problems such as those normally associated with magnetic cartridges. The usual standard connecting cables may be used between the arm and the demodulator inasmuch as the standard cable capacitance does not have an effect on the high frequencies. However, it is suggested that the total capacitance not exceed

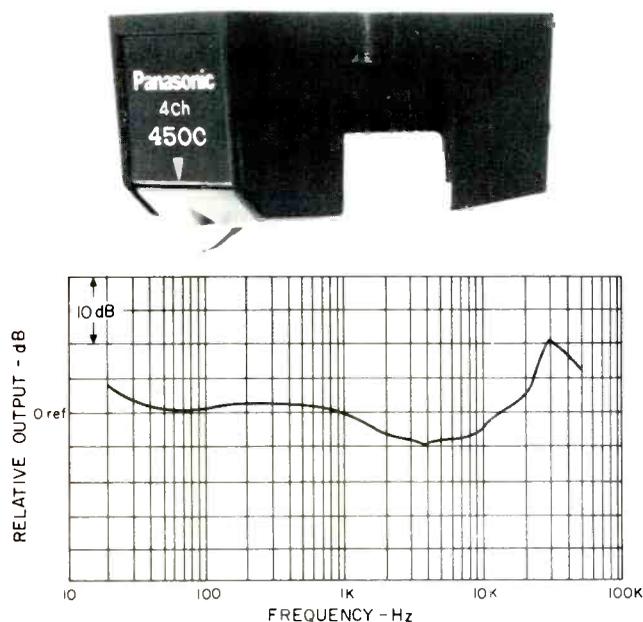


Fig. 1—Panasonic EPC-450C cartridge.

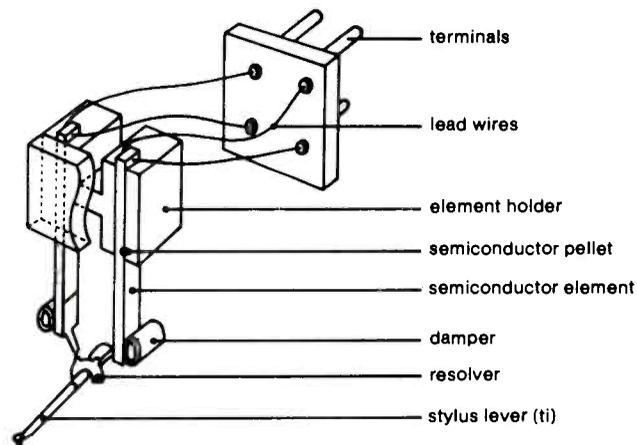


Fig. 2—Stylus assembly of the EPC-450C.

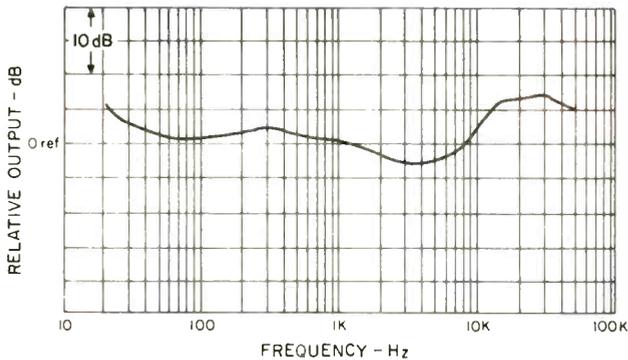
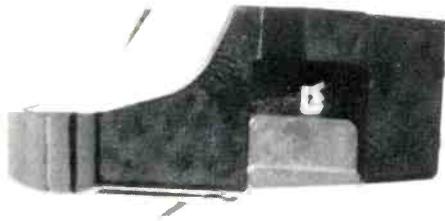


Fig. 3—Panasonic EPC-450C-II cartridge.

8200pF per stereo side. Also, because there are no coils present, there is no hum pickup.

The frequency response of the strain-gauge cartridge is essentially from d.c. (0 Hz) to 50 kHz. The frequency response characteristics of the Panasonic cartridge is for all intents and purposes equalized for the RIAA recording curve, thus it does *not* require an equalizer amplifier stage in the demodulator.

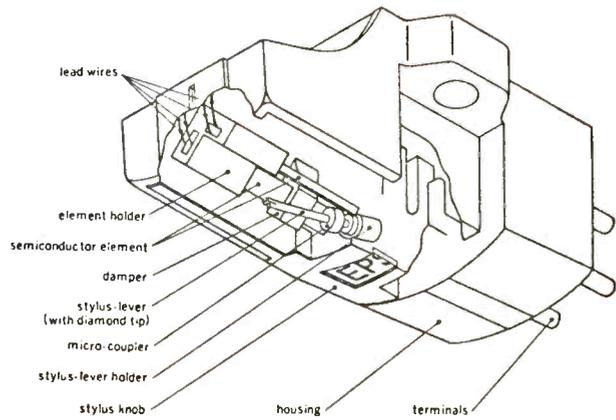


Fig. 4—Stylus system of the EPC-450C-II.

Recently, Panasonic introduced a new version of strain-gauge cartridge, the EPC-450C-II (Fig. 3) which replaces the now discontinued EPC-450C. The major change in this cartridge is that the two transducer elements and the stylus system are directly coupled by a tiny synthetic rubber ring ("Micro-coupler"). This new system (Fig. 4) overcomes the defects in the conventional "V-shape resolver," thus permitting a more efficient pickup of the vibrations (20-50 kHz) and at the same time increasing channel separation at these ultrasonic frequencies. The operating principle is identical to the EPC-450C. The nude diamond Quadratip stylus is somewhat similar to the Shibata design and covers the same groove contact area.

The EPC-450C stylus lever is made of titanium fused to a duralumin-like metal. The titanium tube has a diameter of 0.35mm, with the wall thickness being 20 u. The stylus is a

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nude Shibata diamond mounted on the titanium tube. The EPC-450C-II stylus lever is made solely from an aluminum alloy somewhat similar to duralumin and the nude Quadratrip diamond is mounted on this lever.

The manufacturer's specifications for the two strain-gauge (semiconductor) cartridges are given below:

	EPC-450C	EPC-450C-II
Frequency Response	0-50 kHz	0-50 kHz
Rated Output Voltage	7 mv (5 cm/sec., 1 kHz, lateral, 4ma)	5 mv (5 cm/sec., 1 kHz, lateral, 4ma)
Separation	>20dB (1 kHz); >15dB (30 kHz)	>20dB (1 kHz); >15dB (30 kHz)
Impedance	1000 ohms pure resistance	1000 ohms pure resistance
Tracking Force	1.7 - 2.3 grams	1.5 - 2.5 grams (optimum 2.0 grams)
Stylus Tip	Nude Shibata Diamond	Nude Quadratrip Diamond (radii = $75\mu \times 8\mu$)
Cartridge Weight	3.8 grams	3.8 grams
Compliance	10×10^{-6} cm/dyne (dynamic)	10×10^{-6} cm/dyne (dynamic)

The major disadvantage of the Panasonic strain-gauge cartridges is that they can be used only with the Panasonic built-in or separate demodulator. However, the SE-405H demodulator (Fig. 5) can be used with either the strain-gauge cartridge or any moving magnet cartridge. A switch on the demodulator bypasses the bias voltage producing stage.

The Panasonic strain-gauge cartridges have the RIAA equalization built into them, thus creating a problem in obtaining frequency response curves, IM distortion percentages, and square wave photographs. We have discussed the problem personally with Mr. Shuichi Obata, the developer of the Panasonic semiconductor cartridges. He agreed that unless special equipment is available, it will be most difficult to obtain the desired data. We did manage to obtain a frequency response curve through 50 kHz by using the Brüel & Kjaer (B&K) Response Test Unit 4409, Spectrometer 2113, Level Recorder 2305, and some other associated B&K equipment. However, we found it impossible to obtain separation curves because of some noise being generated more than 25 dB below the frequency response curve. We also were unable to obtain IM distortion data and square wave photographs from the Columbia STR-111 test record, despite the excellent equipment used. This problem is now being investigated and should we succeed in obtaining these parameters, they will be reported at a later time. Mr. Obata has shown us tracings that indicate separation for the EPC-450C-II cartridge from 20 to 100 Hz to be better than 20 dB, 30 dB from 100 - 1000 Hz, 20 dB from 1 - 8 kHz, 19 dB at 10 kHz, 20 dB at 15 kHz, 24 dB at 20 kHz, 22 dB at 30 kHz, 24 dB at 40 kHz, and 23 dB at 50 kHz, using the B&K QR-2009 and the JVC TRS-1005 test records. This is remarkable separation data which must be confirmed.

Measurements

As is our practice, measurements are made on both channels, but only the left channel is reported.

EPC-450C

The frequency response curve for this cartridge is + 4.5 dB at 20 Hz, + 2 dB from 20 Hz to 1 kHz, - 4 dB from 1 kHz to 10 kHz, rising to + 3 dB at 20 kHz, + 10.5 dB at 30 kHz, + 8



Fig. 5—SE-405H CD-4 demodulator.

dB at 40 kHz, and dropping to + 6.5 dB at 50 kHz. Wt. 3.75 g; d.c. res. 850 ohms; Output 1.44 mv/1-cm/sec; Crosstalk - 17 dB; Ch. Bal. 1 dB; Trackability: High freq. (10.8 kHz pulsed) 30 cm/sec; Mid-freq. (1000 + 1500 Hz lat. cut) 31.5 cm/sec; Low freq. (400 + 4000 Hz lat. cut) 24 cm/sec; Optimum tracking 2.0 g. EPC-450C-II

The frequency response curve for this cartridge is + 6 dB at 20 Hz, + 1.5 dB at 100 Hz, + 2 dB at 500 Hz, - 2 dB at 2 kHz, - 2.5 dB at 5 kHz, + 2 dB at 10 kHz, + 5.5 dB at 15 kHz, + 7 dB at 20 kHz, + 7.5 dB at 30 kHz, + 6.5 dB at 40 kHz, and + 5.5 dB at 50 kHz.

Wt. 3.33 g; d.c. res. 1493 ohms; Output 1.13 mv/1-cm/sec; Crosstalk - 27 dB; Ch. Bal. 1 dB; Trackability: High freq. (10.8 kHz pulsed) 30 cm/sec; Mid-freq. (100 + 1500 Hz lat. cut) 31.5 cm/sec; Low freq. (400 + 4000 Hz lat. cut) 24 cm/sec; Optimum tracking 2.0 g.

Listening Evaluation

The listening evaluation was made using all the CD-4 records previously reported in AUDIO, March 1974. We have added to this group of CD-4 records the Shostakovich *Symphony No. 15*, RCA Quadradisc, ARD1-0014. The last three-eighths of an inch of recorded music on Side B has a high frequency bell sound that is most difficult to track and reproduce clearly. Up to now, we have found that only the Audio-technica AT20SL cartridge has been able to reproduce these high frequencies without some shattering sounds. The Panasonic EPC-450C-II also reproduces these high frequencies without any shattering sounds. The sonic clarity of this cartridge is quite smooth, with the transient and bass response being excellent. However, the strain-gauge (semiconductor) cartridges do not seem to have quite the definition of the top CD-4 cartridges reported in AUDIO, March 1974. We believe the EPC-450C-II is about on par with the Audio-technica AT15S cartridge. In terms of music reproduction, the EPC-450C cartridge does not seem to perform as well as the EPC-450C-II.

B.V. Pisha

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4 Butterflies Created by Morton Subotnik on the Electric Music Box. Columbia MQ 32741, SQ quadraphonic, \$6.97.

George Crumb: Makrococosmos, Vol. 1, for Amplified Piano. David Burge, piano. Nonesuch HQ-1293, CD-4 quadraphonic, \$3.98.

Edgard Varèse: Amériques (1922); Nocturnal (1961); Ecuatorial (1933-4) Ariel Bybee, sopr., Univ.-Civic Chorale, Utah Symphony Orch., Abravanel. Vanguard Everyman SRV-308 SD, stereo, \$2.98.

Audities

The Stokowski Sound, Vol. 1—Dvorak "New World" 1927, 1973. Phila. Orch., New Philharmonia. RCA CRL2 0334, mono/stereo, \$11.96.

Colin Davis at the Last Night of the Proms. BBC Symphony. Philips 6588 011, stereo. Music for a Royal Wedding. (BBC, Westminster Abbey Nov. 14, 1973.) BBC Records 2966-001, stereo (via MGM Records).

Great Hits You Played When You Were Young, Vols. 1, 2. Morton Estrin, piano. Connoisseur Society CSQ 2058, 2059, SQ quadraphonic, \$6.98 each.

Music for Young Listeners: The Pied Piper; Puddintame; Set of Poems, by Netty Simons. Barbara Britton, Lou Gilbert, narrators, CRI SD 309, stereo, \$5.98.

Subotnik is a real electronic-music natural, born to the medium. Don't know which "music box" he uses here but the long, leisurely flow and large shaping plus the formidable jacket diagrams of structure (larva-cocoon-butterfly) are typical of this big-scale composer, who has put together remarkable quantities of his music, mostly available on discs—the medium for its best propagation.

Whether electronic, "natural," for live voices, or doctored-natural as here, late 20th c. music begins to sound alike! This "amplified" piano music—i.e. with an amplified sonic repertory—follows John Cage's long-ago experiments in an assured, versatile idiom, full of confidence and easy to listen to for all the well-practiced effects (including the pianist's voice and whistle). It has everything, including standard notation (in circles and spirals!), elaborate astrology and even quotes from Chopin. 12 astrological "Fantasy-pieces," remarkable variety, splendid recording, make for enjoyment.

The exuberant young French radical Varèse arrived in NYC in 1922 and immediately wrote *Amériques*—as wildly dissonant and enthusiastic now as then; sirens (mechanical), pounding drums, screaming woodwinds, proclaiming brass—the works! *Ecuatorial* and the unfinished (now completed by Chou Wen-chung) *Nocturnal* span Varèse's non-electronic idiom—so early into the present sort of "electronic" sound. See also Nonesuch's Varèse (CD-4), incl. *Ecuatorial*, somewhat lighter and more concise than this Utah product. Great stuff for the imaginative ear.

About time! A conductor for 65 continuous years by 1973, "Stoky" was once RCA's 78 mainstay, now makes it back to the old label in proper style at least. A fascinating historical comparison here—unique. Same man, same interpretation, 46 years apart—the musicians could be grandchildren! The old version, remarkably good in sound, is more youthful—the symphony was young (only 35!) and Stoky was impetuous; playing is lean, bit hasty in spots, but taut and modern. New Version is fatter, minus some older Stoky tricks—sliding strings—a bit less exciting; it's old-fashioned now. Excellent 78 transfer, scratch intact, music undoctored.

Two splendidly done hi-fi documentaries, easy in the listening, without a flaw. The final Prom night is Madison Sq. Garden, huge whistling/cheering youth audience, endless enthusiasm, P.A. remarks by an amusing Davis, audience singing en masse—and a rich plumcake program, Berlioz, Wagner, Mendelssohn, Elgar, "Jerusalem", a stunt piece by Malcolm Williamson plays *Rule Britannia* and *God Save the Queen* for dessert. What a classical riot! It's surpassingly good via matrix decoding into four channels, though not officially quadraphonic. The Wedding of Princess Anne is solemn but also lively and well paced (some editing?); interesting ecclesiastical accents in the readings, more plumcake music with choir boys. You can hear the P. and Capt. Mark, too, close-up.

Why didn't somebody think of this before! Here, played with awesomely pro styling and speed, are all those easy little Pieces everybody studied on the piano, and still studies. Amazing—I had 'em all (the easiest ones) a zillion years ago and here they are back. Nothing changes! You too can . . . etcetc.

Nothing wrong with "contemporary" music to go with children's stories, as here. But two things bothered me in the listening. First, Netty Simons' music interferes with the text, it is simultaneous, not interwoven; the two compete and impede each other and the conflict is aurally wearing. Second, the narrators go in for stage-exaggerated, mannered diction, a sort that is extremely bad for the close-up intimacy of the recorded medium. I found it all embarrassing—though the Simons material might be fine under other circumstances.

Music for Alto and Soprano Saxophone. (Stevens, Maurice Loeillet, Rodriguez). Harvey Pittel, R. Grierson, pf., M. Hamilton, hps., R. Adcock, cello. Crystal S105, stereo, \$5.98.

Anthony Newman Lutheran Organ Mass. Archdiocesan Boys Choir, Marier. (Bach Klavierübung, pt. III) Columbia M2Q 32497, SQ quadraphonic, 2 discs, \$13.96.

BHAJEBOCHSTIANNANAS. Anthony Newman (& friends). Columbia M 32439, stereo, \$5.98.

Bizet: Symphony in C. Prokofieff: Classical Symphony. Academy of St. Martin-in-the-Fields, Marriner. Argo ARG 719, stereo, \$5.95.

The Mahler Nine Symphonies. Conducted by Boult, Schwarz, Ludwig, Mitropoulos & others. Everest 3359/12, 12 discs, stereo, \$59.76.

Eleanor Steber Live at the Continental Baths. With impromptu remarks. Edwin Biltcliffe, pf., Joseph Rabb, vl. RCA ARL1 0436, stereo, \$5.98.

Great Rachmaninoff Transcriptions. Jorge Bolet, piano. RCA ARL1 0357, stereo, \$5.98.

Paul Hindemith Anthology, Vols. 1-3. Assorted instrumentalists (ausp. Monday Evening Concerts) GSC 1,2,3, stereo, \$6 ea. (GSC Recordings, 2451 Nichols Canyon, L.A. Ca. 90046)

Szymanowski: Masques and Etudes for Piano, Op. 4, 33,34. Carol Rosenberger. Delos DEL 15312, stereo, \$5.98.

So you thought—! Well, try this. A young sax genius with such fabulous technique, such perfect pitch and phrasing, that he makes his sax do anything, any style. Side 1, the alto, gives us solid academic modern by Halsey Stevens, a bit like Hindemith, then a very French folksy work by a lady, same generation (Paule Maurice). Side 2, the soprano, offers the most perfect French Baroque—a Loeillet sonata! The very high sax like a flute crossed with a fiddle and pure as snow; followed by an all-out atonal job (1973) by one Rodriguez, just as perfectly played. Yes—the saxophone!

Wide-ranging Anthony has a good idea here—the “Bach chorale” tunes (Lutheran hymns) in Bach’s sung harmonizations (plus a few earlier Gregorian chant and German trope versions) and in the several elaborated organ treatments of each tune, successively performed. The alternatives between singing and organ are smooth and easily listenable with plenty of variety, the tunes are easily followed from version to version, and Newman’s chorale-prelude playing is his best yet, with a fine range of Baroque-type organ color. Two discs full.

Impetuous talents like Newman know no fear—play anything, try anything! This starts with brash, loud Bach on organ and harpsichord, then into Newman’s own music—very pretentious and ill-digested, says *this* ancient critic. Though no doubt it’s en route to bigger things. Vast, crashing piano improvisation, with bells, bass, etc. Horrendously dissonant organ piece—running straight into a saccharine rock bit (out of Couperin). Young people in droves will groove or something. I took a Tum.

Nice juxtaposition—two youthful symphonies with similar aims, an exercise in pure classical structure—with a dash of humor as well (Prokofieff’s “Classical” is much less anti-Romantic than it used to seem). A generation back, the Prokofiev invariably went at breakneck speed and was spoiled; this version takes the newly reasonable slower tempi the Russians use and it matches up beautifully with the Bizet. Fine for a melodious evening’s listening!

I am just listing this—for your attention (and maybe a year’s listening on & off). Symphonies 2, 3, 4, 6, 7 and 8, 14 LP sides, are anonymous performances, by “others.” No. 1 is Boult and the LPO, No. 5 Schwarz and the LSO, No. 8 Mitropoulos and the Vienna Festival Choirs and Orch., No. 9 Ludwig and the LSO. “Some portions” of these discs are simulated stereo from mono. You take it from here.

“People have been singing in baths for many years,” say Steber at this “black-towel” event next to the steam room. She talks a lot, sings with a foot-wide vibrato, but has beautiful control and plenty of charisma—they love it. Oddly, the sound is too closet-like—audience damping, no doubt, plus the humidity! Good fun, good singing, much informality, a high old time had by all.

A major big pianist of middle generation—he’s up to all this showy music, and more. The Prokofieff 2nd is early and brash (you can already hear *Love for 3 Oranges*, the 3rd, 1921, wider and mature, both very piano-y—it never stops an instant. The Rachmaninoff transcriptions, Bach to Fritz Kreisler, are unashamed, old fashioned and honestly listenable. Some pyrotechnics! It all comes out Rachmaninoff.

Though Hindemith’s big-orchestra works seem to us ponderous, his chamber music, in every imaginable standard combination, is emerging as useful and enduring music ideal for close-up projection via recording, colorful, clean and energetic, very easy in the listening. Good local L.A. talent here; only soprano Marni Nixon’s taut vibrato is sonically difficult (vol. 2) though she is musical. Rest is all instruments. Try a volume—you’ll try another.

Of Ravel’s generation (d. 1937), Szymanowski is another of the pre-WWI mystical very-late Romantics now being revived. Passionately complex music, hair-tearing, tortured, with characteristic twisted far-out harmonies of the period on top of too much Chopin; you may find it “triumphant” but I hear plenty of unfocused floundering. Rosenberg’s piano is highly pro, without much subtlety—she plays everything well and all about the same. (Cf. also her Schubert, Chopin.)

The Column

Fred DeVan

AS A RECREATION of a live concert itself, *Ladies and Gentlemen, The Rolling Stones* just misses the mark. But that was the point. To create a film concert and originate a new way to present music. It's laid out exactly like an audio/visual double record album and thereby fully qualifies being a valid new music medium, a medium in which the film-audio or audio-film correlation is in itself the event and the event is very much the same for everyone. It is designed for a small theatre environment and managed by the king of big sound systems. The guy who did it well first, the one and only, Chip Monck. A small movie house (in N. Y. C.—975 capacity) filled to capacity with people is a very friendly place for a high quality quadrasonic PA system. Keep in mind that the system is endowed by the fact that it is a playback system for a tape recording. That tape can be and is optimized and equalized for the speakers, and the amps provided with equalizations for the room and the audience. In New York it wasn't the threshold of pain, nor an unintelligible blur of decibels; it was by no means low volume. Just clean, full, and loud. Just perfect.

If I took all the words there are to say about *The Rolling Stones* and their music, I would have to beg Ed Canby or Bert Whyte for all his space and include part two in some future issue. But all's well, since in any event most of what I have to say about the music of *The Rolling Stones* has been laid out by many others, many times, at great length; my attitudes, no matter how violent their written reaction, are just as vague and indefinite as my fellow scribes. Jaggerphobia, reverent compliance, or total detestation or a weird combination of all three. Through it all, The Stones are an unrefutable fact in the world of music. It's their music—it may even be their world and most of all they are The Rolling Stones!!!!?

Now with that dispensed with, let's talk about, *Ladies and Gentlemen, The Rolling Stones*. At first I didn't understand what that meant and, as expected, I am not sure I perceive its meaning now. I went to unfathom what licks the winged tongue was about to salivate on us. Well, it's a film—sort of. I say "sort of" because it is so straight, it's hard to believe or even accept as a film. None of the gimmicks and tools of the film

makers' craft are employed. None of the creative clichés that we expect. In short—no cinema. Plenty of pictures, but the same relationship between sound and image. You are at a point of focus in a quadrasonic sound image field (I'll get back to that) around which all revolves. Since you see only out of the front side of your head and hear from all sides, it feels completely comfortable. The camera or cameras (there are usually three) have one field of view for 90% of the hour and a half of running time. That field begins and ends with Mick Jagger. The total effect is like being at a Stones concert suspended three feet in

front or to the side of Mick Jagger while being on a level with his adam's apple. Since Jagger sings like he is one head-to-toe adam's apple, when the camera perspective does pull back, it seems perfectly normal. Too normal. Especially since you know to expect the unexpected. Wrong! There are no visual surprises. "Almost video" but too straight and too competent a filming and editing job to be hung with that somewhat put-down. I know this sounds contradictory, but hang on to your tickets the best is yet to come.

Now I said that this was not cinema. Here is the total confirmation of that statement. The audio is derived from four magnetic tracks. Two on each side of the 74mm wide film and picked up like any four-channel tape deck by use of a modified projector. This is not an optical sound film. It has none of the frequency limitations, none of the transient limitations, none of the distortion and noise. The sound is a discrete tape applied to the film. This is in turn fed to a custom board, built in Connecticut by an unknown wizard, where, as far as my memory serves, it is split into as many as sixteen channels and remixed. The mix is dependent on the soundman, who is on the board at audience level in the center of the theater. The mix up-down board feeds twelve to sixteen Crown DC-300A amps operating each into sixteen ohms at full rms output if called on. And they are much of the time. The soundman, who quickly hid most of what I wanted to see, said he was supplying 1600 to 2000 watts rms into 16 ohms. Now if you have been following the audio horsepower race that does not seem like an awesome amount, but it is large, even if he was being conservative. Most 16-ohm speakers, be they home or theatre/PA speakers, are extremely efficient. Ask anyone who owns an Altec A-7, JBL 4320 or any Tannoy how efficient they are. (I have driven my big Tannoy 15's with a pocket AM radio) But this theatre's 16-ohm "things" (no other description fits) are bigger than VW's Thing. I mean they are really BIG and IMPOSING. They are bi-amped two-way and tri-amped Goliaths around the Altec, Cerwin-Vega, Tannoy, Karlson collective school of design. The low-frequency units are bass-reflex, I guess by the black-shrouded bulk of the brutes, but are so well tuned that they are free of



the mid-bass rise that is too often part of the game of bass-reflex design. The rise that goes away anytime you optimize the box volume, driver(s), and method of port design and shape. Back to their drivers, the mid-high range units in the three-way front and two-way rear units appear to be compression drivers into cast acoustic lens arrays of enormous area and weird range (in the rear especially). The super tweeters in the front, six per side, are direct horns. In short, a sane-sized, over-amped, rock-concert crowd-killer with a twist. Low distortion of its own! I'm sure the theater itself has more sonic problems than the playback system. As you may have guessed, it is a killer!

Simultaneously put the two contradictory and complementary media styles together and you make something brand new. The perfect seat at a rock concert. Perfect sound, perfect reverb, perfect hall ambience, perfect and personal point of visual intimacy unattainable to the unwashed millions (the washed millions too). It's a creation of the future, indeed. When we at home get a color video disc projector system with a six-by-ten foot screen with full quadraphonic sound, then and only then will we have surpassed the format presented in *Ladies and Gentlemen, The Rolling Stones*.

The inevitable will happen soon. With Alice Cooper-David Bowie types making a grand, splendiferous production out of what The Stones laid down with sparseness and restraint. This is probably the only time I have used the words sparseness and restraint and The Rolling Stones on the same day! The only loss of total decorum and an added flair of a live performance that comes with the film is a troupe of sequined, feathered, glitter and mardi gras, resplendent *live* people. They dance a bop up and down the aisles of the theatre, flailing and providing a general ball all around you. They just happen spuriously at first, then just when it all just about has you nailed to your seat in a supersaturated stupor, ten or fifteen charge from all corners dancing, hurling confetti, and then the final fill-up. The flying tongue styrofoam frisbee (try that on TV). Yup, suddenly the air is full of white frisbees or if you will Rolling Stones hotcakes. Nice touch. Nice surprise. Nice way to experience The Rolling Stones. Believe it or not, the audience for the most part remains seated and pandemonium is not present. Try that at a live show! Anyhow, when the more packaged groups, acts and shows get into this business, every town of *Summer of '42* size will have its Rock giants in the local Orphiam on the big screen with big sound
(Continued on page 78)

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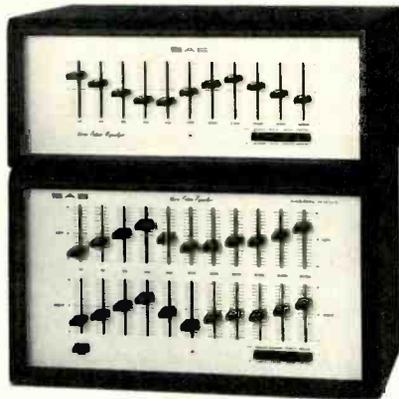
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(Continued from page 71)

brutes blowing the bricks out of every structure within one-quarter of a mile.

Look out world, I really think I saw the future. Looks great for plasterers and brick pointers!

TOWER OF POWER

Warner Bros. BS2749, \$5.98.

While most acts are trying desperately to bring their recorded sound and fervor to the live audience, to bring all those textures and overdubs off in the raw, cruel world of the stage, has been a common dilemma for most rock bands. Along comes **Tower of Power** who live or even on television is one of the tightest, hard-driving aggregations of fine musical talent around anywhere—long-winded, long-legged, and simply splendid. This band of eleven is a rompin', stompin', big rock band that makes other bands of similar size sound anemic. They have a fine lead singer, just to eclipse the accepted standard of essentials. A bigger, more robust sound is hard to find elsewhere. Their album **Back To Oakland** is clean and full; a real gem of recorded sound. So much so, I went to great lengths to extract as much sound as I could. This record certainly deserves a CD-4 version, but alas Warner apparently does not agree. So I went my own route. Sonic perfection of this kind is fantastic and even more so if you can employ some exotica. Before I continue with the band I need to explain my playback conditions. I took a Panasonic EPC 450C11 semiconductor cartridge with a handmade power supply which contains no filters, no ANRS, no equalization, and is nearly flat from d.c. to 60 kHz. It's as clean and pure as your wildest fantasy about little girls. Put it though my normal pre-amp and into a Sony 2020 decoder (RM position) and into four big speakers. That decoder opened up the sound to such a point that the added fullness elicited a phone call from a neighbor. Boy, was it good while it lasted! I simultaneously made a 15 ips 1/2-track tape of it. Clean, clean, clean. A really enjoyable experience. There was a reason for all this, and it has to do with the band and the record.

As good as the record is, it does not contain the kind of sound that Tower Of Power delivers in concert, which is a shame. If you have never seen or heard them live you will never notice this. If you have, part of the time the record seems like someone in Burbank kidnapped half the band. The part they left is still great, but subdued in comparison. They substituted strings for all the instrumental juggling they do on stage and still came up with a fine but differ-

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ent sound. *All The City Lights* is a gorgeous song and Lenny Williams really can sing, but *Oakland Stroke*, *Squib Cakes*, and *Can't You See* is really what this band means to me. In truth I should not put down anything about this record. As a record it's one of Burbank's best by some of Oakland's best.

THE EDGAR WINTER GROUP:

Shock Treatment
Epic EQ-31584, \$6.98.

How do you make it in the record business? There doesn't seem to be one answer, but a few pat formulas have worked before and still work now. They will probably work well for most people for a long time to come. **Edgar Winter** has taken the unbound book of successful formulas and thrown it up into the air. When the strewn pages fell back to Earth, they were given a dose of Winter logic and after a heck of a lot of hard work, became a nonconcept, noncommercial, commercial concept album. Mixed up? Yes and No. Let's see if I can explain. Maybe the album title is accurate: a vinyl shock treatment! No matter what you think of Edgar, this is a surprise. Especially after **Frankenstein** you would expect a ten-minute rework to be a sales winner, but no, it is not that at all. I have found an indefatigable record! It is not every sound effect you wanted to hear but were afraid to ARP. It's not what you expect from first note to last.

Edgar certainly knows how to use his ARP synthesizer well and he already overwhelmed us with that on **Frankenstein**. He uses it here too, but now he also plays vibes. How's that for a surprise? Well, he doesn't do that until the middle of the disc. You put it on and listen, and you are not sure what you just heard. It's a inventive, complicated, undulating, shocker rocker and you just don't know what to make of it. Polytonal, atonal, polyrhythmic sheets of sound in a rock-blues cloak. The transition from the first jolt, aptly called *Some Kinda Animal*, to *Easy Street* is your first sign to listen closely, something amazing is going on. Edgar's alto is more mature then ever. Gutsy and trick. The whole record is gutsy and trick. That could be its commercial downfall. Is music and namely Edgar and Company leading or following the musical comprehensiveness of our body politic? Only time and sales figures will tell.

The musical content of **Shock Treatment** is so comprehensive you just don't know what to think at first or second hearing. I will assure you its magic is:

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The better you know it, the better you understand it. The better you know the work of the whole group, the better you understand it. Just as the basis for **Frankenstein** is contained on Edgar's first "solo" album **Entrance**. The basis for this album is scattered throughout the discography of the members of this Edgar Winter group. This is a cumulative record in the broadest sense of the word.

The "new" (that's my word) Edgar Winter Group consists of Edgar, Rick Derringer, Dan Hartman, and Chuck

Ruff. So what's new about that? Nothing—but the roles they play. Hartman is without a doubt one of the best rock bass players around. But here he is more than a bass player, the composer credits and structure give that away. Chuck changes rhythms smoother than Kissinger changes location. Derringer the producer is again Rick the guitarist. Edgar has more fingers than he has keys to press and they all sing, play, and perform like they are possessed. (I always noticed something very strange in the quality of the Winter scream.)

NEW BEGINNINGS. Morgana King. **Paramount PAS-6067**, \$5.98.

If you have read one review of this record and still do not have a copy, somebody was not awake! This is without a doubt the most difficult record to write about that I have heard in ten years. The record is utterly perfect; Morgana is perfect; the arrangements are impeccable; the recording is state-of-the-art. It is the most complete package to emerge in a very long time. **New Beginnings** is my choice for best vocal record in the Rock, Pop, Jazz mélange of 1973. Unless Morgana does another album quick, it won't be bettered in 1974. The only thing I can find fault with is the jacket and that does not play well at 33 rpm. Paramount is notorious for graphics that defeat the initial impact of good records.

The songs are a marvelous selection of the best around. Writers like Stevie Wonder, Paul Williams, Leon Russell, Yvonne & Kenny Rankin are not just represented but embellished by Morgana King. With a voice like hers she can hardly avoid embellishing any song. She has long had a loving following, especially among musicians, hungry for more of her crystal clear, seemingly limitless range of tones and colors. Her voice exceeds any superlatives I can extol.

She, her style, and uncanny ability exceed all normal limits. Ms. King always makes any music or song she undertakes more musical. Her rendering of *You are the Sunshine of My Life* is sure to become one of the ageless "progressive rock" classics that will be getting regular airplay for years. **New Beginnings** will remain a cherished part of the music scene, and no one will wonder why!

JOHNNY MATHIS:

I'm Coming Home
Columbia KC 32435, \$4.98.

If ol' blue eyes can come back, why can't *Johnny Mathis*? After all they made Edsels in brown as well as pink and blue. Johnny Mathis under the tutelage, production, and arranging of Thom Bell is no longer an Edsel. This is not another nostalgia package. It's Mathis The Singer not Mathis The Song Stylist. He sings free, easily and without affectation. Almost a new Mathis. If you like gentle love ballads with a flair, or Johnny Mathis in general, here is a fresh new look at him. Be forewarned, some of you who think you won't like it—will. It will break your heart to admit it, but when you spring it unannounced on someone else with a Mathis block (like me) you will feel a lot better when they look at you and say, "Hey, who is that?" And you can softly, slyly reply, "Johnny Mathis."



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Folkways FA 2473, stereo, \$5.98.

"What?" one finds oneself asking. "No dobro, mandolin, harmonica, or bass?"

That's correct. It's the *Iron Mountain String Band*, a pure and unadulterated threesome which includes Eric Davidson, a "claw-hammer" banjo picker who has been playing the banjo for some seventeen years; Caleb Finch—the name really has it!—an old time fiddler who has been fiddling around for eleven years, and Peggy Haine, an accomplished flat-pick guitar player and ballad singer for eleven years. The Iron Mountain String Band grew up in the early sixties in Manhattan, of all places, and is presently located in Southern California.

Having relegated themselves up until now to merely publishing albums of old time music from southwestern Virginia and surrounding areas of Appalachia, they soon discovered that active musicians who practice and who are familiar with the pre-bluegrass musical tradition are growing increasingly rare. Thus this LP emerges in which the Iron Mountain String Band attempts to recreate the extraordinary music of this bygone era, having engaged in intensive and extensive field study of the traditional music of two counties in southwestern Virginia and North Carolina.

The expansive collection of nineteen tunes included herein may be divided into roughly three categories. The "earliest phase" was the co-existent tradition of ballad singing and instrumental dance music which utilized

ancient ballads transplanted from the British Isles played by a banjo and a fiddle. The guitar was all but unknown in the southwestern Virginia mountains until the turn of the century. This music may sound strange because a majority of it is based on pentatonic or Myxolidian hexatonic scales, according to the notes.

The bass of Bob Haggart opens and closes a cheerful *I Want To Be Happy* in which the band decidedly is, a real screamer which draws from the talents of Yank Lawson, trumpet; Bob Wilbur, clarinet; Bud Freeman, tenor sax, and Ralph Sutton, piano. Above all this one illustrates just what a coloristic drummer Johnson is. One simply never knows what he's going to do next!

The skillful charm of Bobby Hackett is perhaps best caught in a duet between the cornettist and trumpet man Yank Lawson in *Do You Know What It Means?*. Hackett leaves no rough edges, tying all his knots, drawing out his notes, his mellowness entirely suitable to the lazy texture of the tune.

It's all Ralph Sutton on *California Here I Come* who has great fun with it with his combination of ragtime and stride, his to-and-fro left hand which just doesn't stop. With a very crisp light touch, he is technically brilliant.

Fidgety Feet is exactly what the title suggests, fast and fidgety in which Hackett and Bud Freeman play a chase chorus, Freeman making some eelish contributions. But the best is the imaginatively fresh yet tightly controlled *Lover Come Back To Me* which is filled with lovely understatement and innuendos by Wilbur on a silky-smooth soprano saxophone, starting out by playing whimpering descending motifs against Lawson's muted trumpet. The two chat back and forth, engaging in musical dialogue at its very best.

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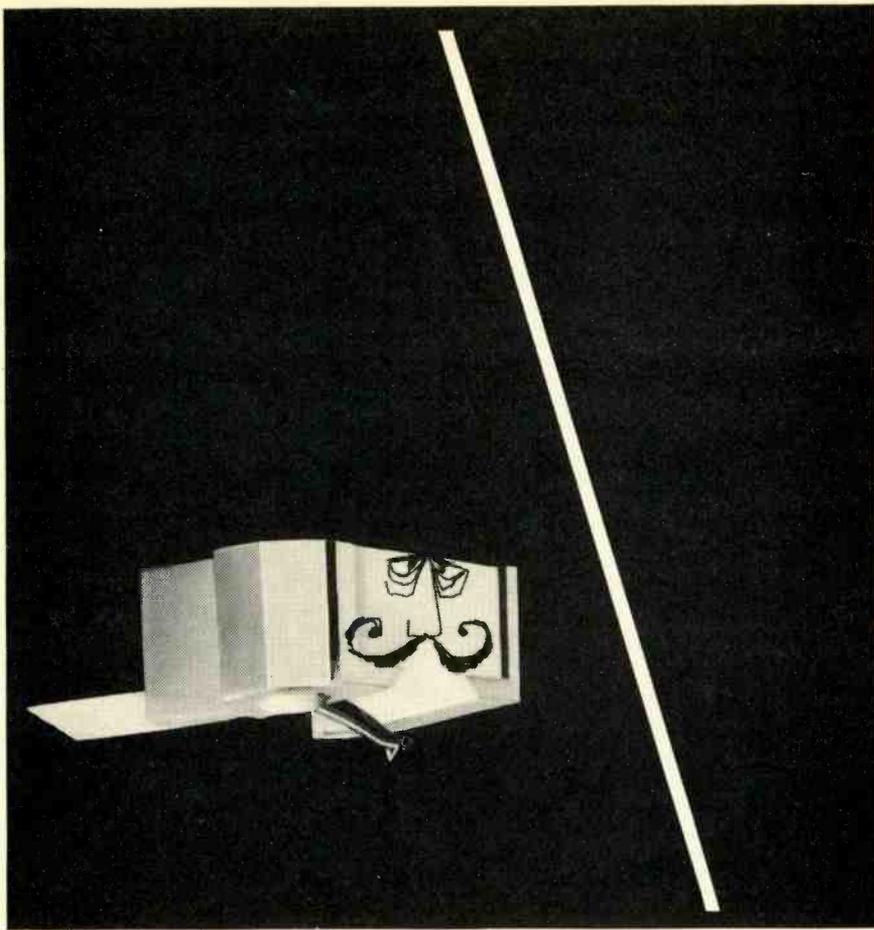
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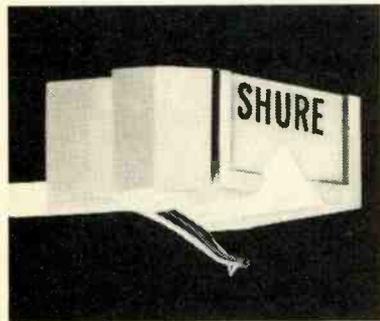
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PHARAOH SANDERS: Village Of The Pharaohs

Musicians: Pharaoh Sanders, soprano saxophone, tenor saxophone, bells, percussion, vocals; Sedatrius Brown, percussion, vocals; Arthur Webb, flute; Joe Bonner, piano, shakuhachi, flute, percussion, vocal; Cecil McBee, bass; Stanley Clark, bass; Calvin Hill, bass; Norman Connors, drums; Jimmy Hopps, drums; Lawrence Killian, congas, percussion, vocals; Kenneth Nash, sakara ceramic drums, mridangam, whistles, percussion; Marvin Peterson, percussion; Kylo Kylo, tamboura, percussion.

Songs: *Village Of The Pharaohs; Myth; Mansion Worlds; Memories Of Lee Morgan; Went Like It Came.*

Impulse AS-9254, stereo, \$5.98.

On the basis of his many recordings during the past few years, *Pharaoh Sanders* seems to have become one of those curious geniuses whose major innovative work is crowded into a very brief span, followed by a long period of consolidation and inconsistent success.

Sanders was a frequent associate of John Coltrane in the latter's last years, and it has often been debated which of the two had the greater impact on the other. What is probably more significant is the continuation, modification, and extension of their joint principles by Sanders after Trane's death in 1967. Sanders developed Coltrane's "African" approach to the tenor and soprano saxes, i.e., the denial of the "correct" European tone in favor of extracting as many sounds and methods of playing as possible—from harsh, chordal masses to screeching harmonics. He carried on the concern with music as a means of spiritual devotion and expression of an Eastern-derived philosophical outlook. He modified Trane's flexible, freer approach to rhythm, which denied the steady finger-pop of jazz, favoring either a flowing splash of rhythm patterns or an absence of definable rhythm altogether.

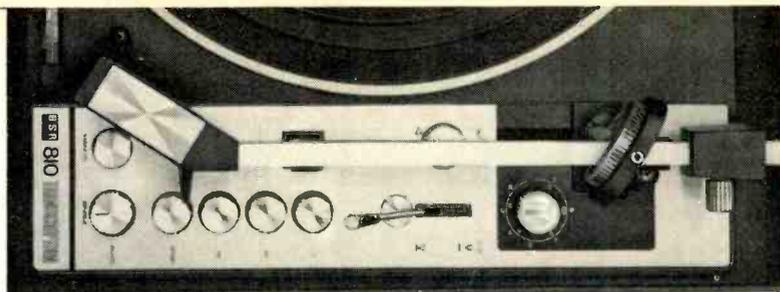
Sanders' most significant accomplishment—one which, it must be admitted, was not due solely to him, though his contribution outweighed all others—is the development of an Afro-American musical form, the main emphasis of which is the richness of texture and coloration. Jazz concerns itself primarily with the statement of the soloist, the imaginativeness of an improvisation built upon the chord sequence of the theme, while blues and other folk-derived forms are dependent on lyric sentiments, instrumental appropriateness, and emotion. But the music of Pharaoh Sanders derives its greatest

impact from the layered combinations of simple themes, simple rhythms, and simply-made sounds from a battery of simple percussion (shakers, bells, and the like) with non-communicative vocal utterances. All these unaffected elements are united and controlled in such a way that the sum total of these elements is freshly unique and excitingly beautiful.

All of the above-mentioned facets of Pharaoh Sanders' art can be heard on *Village Of The Pharaohs*. But that's the main problem, as they could also be heard on *Jewels Of Thought* four years ago and on *Karma* five years ago, and on virtually every Pharaoh Sanders record since that time. Indeed, on those few occasions when Sanders has tried to move beyond his customary formula (such as on *Black Unity*, where he seemingly tried to combine all the world's music into one simultaneous, chaotic mishmash), he has pretty much fallen flat on his face. Thus, the success of any new Sanders recording depends on the excitement engendered by the players and the novelty of the new elements continually being introduced to pep up the formula.

Fortunately, there is enough new material of interest to make *Village Of The Pharaohs* the best Pharaoh Sanders album in some time. In the title song, the tamboura of Kylo Kylo not only adds its unique sound but is used for periodic reinforcement of the composition's chordal base in a manner not associated with Western music. Sanders' Arab-influenced soprano soloing is very thoughtful and subtle. The vocal murmurings and wails of Sanders and Sedatrius Brown are only brought to the fore (as the singing of Leon Thomas was on Sanders' earlier albums) when the quick-tempoed song begins to wind down, falling off by layers, which results in an extended release with resounding gongs and heavy yogic breathing. This leads into *Myth*, a short vocal chant/prayer with bowed bass accompaniment by Calvin Hill.

Two cuts on side two feature Sanders' 1971-72 group, with Cecil McBee, Stanley Clark, and Norman Connors, all of whom made their current reputations during their stay with Sanders. *Memories Of Lee Morgan* is especially fine. Arthur Webb's flute and Sanders' soprano poignantly pierce above McBee's and Clark's transcendent arcing bass lines, Connors' slashing cymbals, and Sanders' apparently over-dubbed sleigh-bells in a spiritually resplendent tribute to the senselessly murdered trumpeter. The closing *Went Like It Came* is hopefully a joke, an overlong one at that.



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Village Of The Pharaohs is an extremely engrossing record, full of creative ideas, gorgeous percussive textures, and imaginative playing by all. Still, I can't help but wonder if it isn't time to move on to something new.

Tom Bingham

Performance: A

Sound: A

Coleman Hawkins: The Hawk Flies

Musicians: Coleman Hawkins, tenor sax; Thelonious Monk, piano; Edward Robinson, bass; Denzil Best, drums; Fats Navarro, trumpet; J.J. Johnson, trombone; Porter Kilbert, alto sax; Milt Jackson, vibes; Hank Jones, piano; Curly Russell, bass; Max Roach, drums; Nat Peck, trombone; Hubert Fol, alto sax; Jean-Paul Menegeon, bass; Kenny Clark, drums; Barry Galbraith, guitar; Oscar Pettibord, bass; Jo Jones, drums; Wilbur Ware, bass; Art Blakely, drums.

Songs: *On the Bean; Recollections; Flyin' Hawk; Driftin' on a Reed; I Mean You; Bean and the Boys; Cocktails for Two; You Go to My Head; Sih-Sah; Bay-U-Bah; Sophisticated Lady; Bean's Talking Again; Blue Lights; Laura; Juicy Fruit; Chant; Think Deep; Sanctity; Ruby, My Dear.*

Milestone M-47015, mono, 2 discs, \$6.98.

Few jazz musicians have ever achieved greater empathy with their instruments than the late tenor saxophonist Coleman Hawkins. During the Swing years, from the mid-30s until the early 40s, tenor men took their cues from Hawkins' rich, robust sound. The list of Hawkins' disciples is endless—Choo Berry, Ben Webster, Don Byas, Herschel Evans, Georgie Auld, Sam Donahue, Corky Corcoran, Buddy Tate, Tex Beneke, Lucky Thompson, Flip Phillips, Vido Musso, Illinois Jacquet, Arnett Cobb, and Charlie Ventura, to name a few.

One of the most remarkable things about Hawkins' career was his adaptability. He never stopped perfecting his art, freely adapting his classicism to the discoveries of his younger contemporaries. His merging of the swing and bop styles and his attempts to keep abreast of the latest jazz developments are impressively documented in this splendid Milestone double set.

The Milestone Hawkins reissue begins with four sides recorded in 1944, at the sunset of the Swing Era, and carries through to the spring of

1957. The 1944 recordings, made with Thelonious Monk, and the 1946 sides cut with a bop group which included Fats Navarro, Max Roach, Hank Jones, and J.J. Johnson, reveal that though "Bean" fell in easily with the modernists, his basic way of playing varied little. While Hawk absorbed the bopsters' melodic and rhythmic theories, tonally he remained a traditionalist. On *Recollections* and *Drifting on a Reed*, recorded with Monk, and on *You Go to My Head* and *Cocktails for Two*, where he's tastefully backed by Milt Jackson's supple vibes and Hank Jones' delicate piano, Hawkins works in his classic ballad vein, all silky power and singing, buttery intonation.

On a 1949 date recorded in Paris with a group of Gallic bopsters which included the expatriate drummer Kenny Clarke, Hawkins seems intent on putting more distance between himself and the Swing Era; his rhythm style is more forceful, and, under the obvious influence of Charles Parker, his uptempo attack has become increasingly hard toned. But *Sophisticated Lady* is the old Hawkins, a lovely rhapsodic statement on the Ellington standard.

By 1957, when Hawkins cut seven superb tracks for Riverside, his playing had taken on a thrusting vitality that seems to inspire the younger musicians who accompany him on sides 3 and 4. For two 1957 ballads, *Laura* and *Think Deep*, Hawk plays with extraordinary inventiveness, weaving complex and intricate melodic lines. His approach is less romantic than in the past, his tone not as soft and lush as in the swing days. The final track in the Milestone collection, a collaboration with Monk and his trio, is an absolute gem. Hawkins gives the pianists' *Ruby, My Dear* a sensitive reading, ranking with his finest ballad performance. It's a fitting close to a record album that belongs in every jazz collector's archives, and ought to be required listening for students of the saxophone.

Note on the sound: Since the Hawkins double set encompasses a period of 13 years, the sonic quality of the tracks is uneven. The 1957 Riverside cuts are recorded in excellent monaural high fidelity; the French Vogue sides are reasonably good; the 1944 and 1946 78 transfers are adequate except for *Bean and the Boys* which sounds like it was recorded in the men's room at the Waldorf-Astoria.

John Lissner

Sound: B Performance: A +

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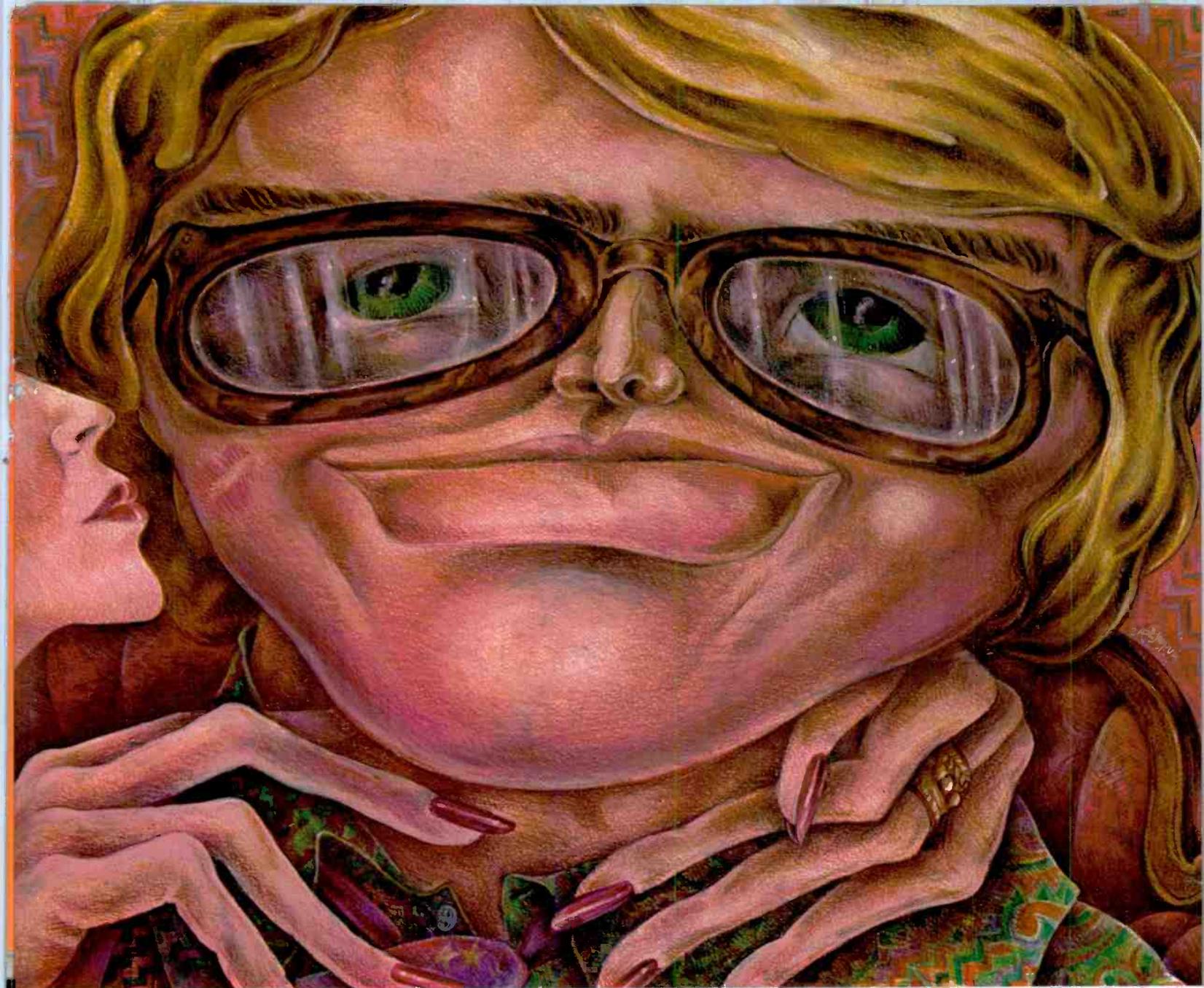
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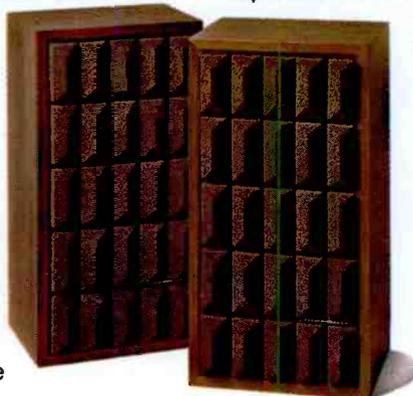
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LONG-TERM DRIFT	Less than 0.1% (over 30 min.)
MIN. STYLUS PRESSURE	0.25 grams
TRACKING ERROR	$\pm 1.6^\circ$

Technics

by Panasonic



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