the authoritative magazine about high fidelity

AUDIO

STEREO EQUIPMENT & RECORD REVIEWS

JUNE 1969 60¢

SPECIAL FEATURE: PHONO CARTRIDGE SPECIFICATION GUIDE

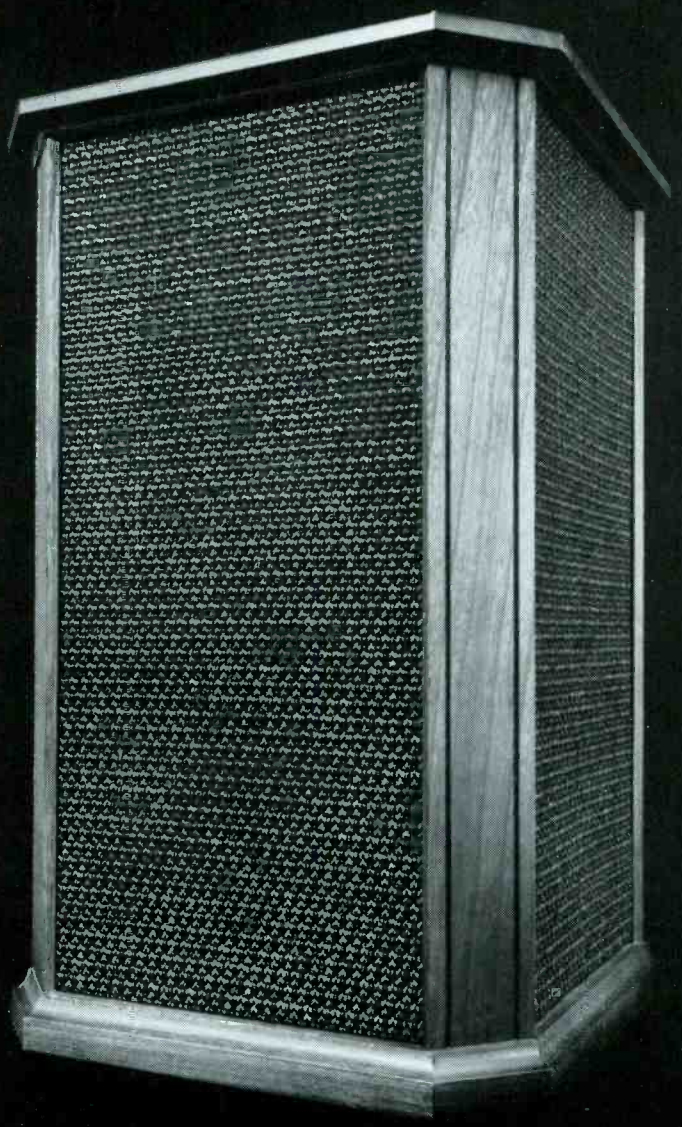
PLUS: CAN YOU "HEAR" CROSSOVER DISTORTION?

THE PHILADELPHIA ORCHESTRA'S NEW RECORDINGS

SOUL MUSIC PANORAMA

Introducing Scott's new Q100 Quadrant

The first successful 360° full range speaker system.



At last all-direction sound with wide range response plus full reverberatory effect.

Since the introduction of stereo, there have been many attempts to develop a speaker system that would reproduce the full-frequency sound and 3-dimensional audio effect of an actual live performance. Up until now, all of these attempts have failed in one or more respects. Either the frequency range was limited, or speaker placement was critical, or the listener had to sit in a certain limited area, or the expense involved was beyond the reach of the average audiophile. Now, with Scott's introduction of the Quadrant speaker system, these limitations have been eliminated.

360° of sound

The Quadrant idea is basically simple. The Quadrant speaker has four sides. An 8″ woofer (low-frequency speaker) is mounted on side One. Another 8″ woofer is mounted on side Three. Four 3″ midrange/tweeters (mid-to-high-frequency speakers) are mounted on all four sides, one to a side. Woofers radiate sound waves in a 180° arc . . . midrange/tweeters, in an arc of 90°. As a result, the Scott Quadrant covers a full circle with a full range of sound.

Stereo follows you everywhere

To use the Quadrant speakers, you place them virtually anywhere in the room (even with one corner against the wall!) and turn on your sound source. Now, walk around the room and listen. No matter where you go, you hear full-range, 3-dimensional stereo. Even the elusive high frequency notes follow you everywhere. Even in a funny-shaped room. Even in a room with so-called "dead spots."

Same principle as live performance

Here's why. A live performance gives you the stereo effect no matter where you sit. This is because you're listening to a 3-dimensional sound source . . . an orchestra, for example. You hear sounds, not only directly from the various elements of the orchestra, but also reflected from the walls of the concert hall. Similarly, the Quadrant speaker system projects sound, not only directly at you (as do conventional speakers), but also in all directions using the reflective qualities of the walls to heighten the "live" stereo effect.

Total stereo realism

The net result of Scott's innovation in the field of speaker development is the Quadrant speaker system . . . a total stereo speaker system, and an incredible state-of-the-art advancement in stereo realism. The Quadrant speaker system is priced at $149.95, actually much less than many speakers which can't measure up to the Quadrant sound.

H.H. SCOTT®

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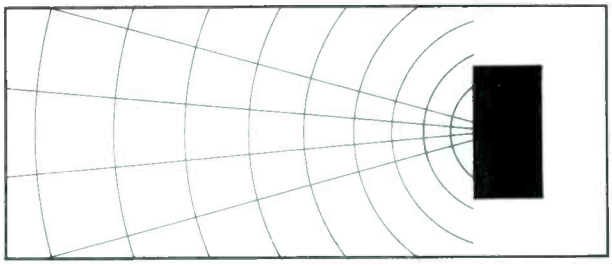
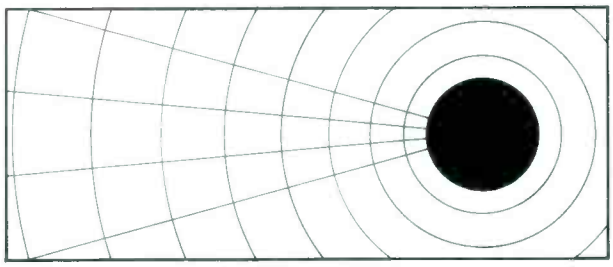
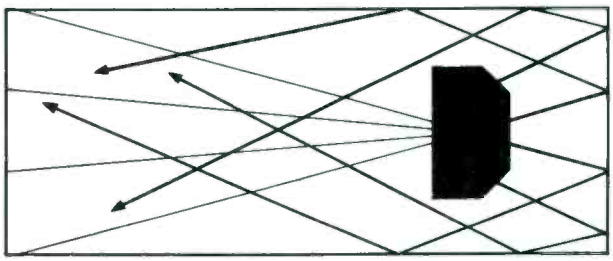


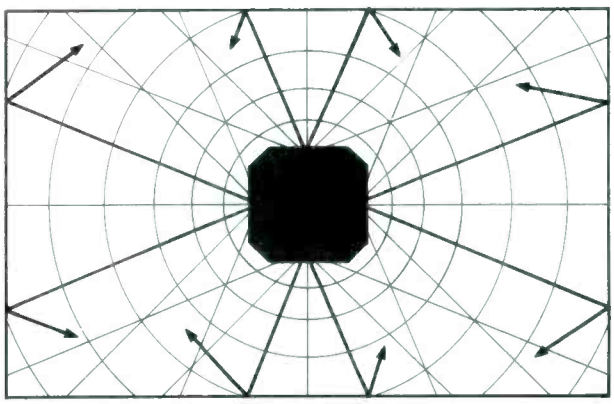
Conventional speakers . . these tend to be directional. They have good wide-range response only within a relatively narrow triangular listening area. Stereo "presence" is limited because not enough sound reverberates from the sides and rear of listening area.



Omnidirectional speakers . . . most are omnidirectional only in the bass range . . . but notice that the vital high frequency tones, regardless of elaborate baffle systems, are perceptible only in a limited listening area.



Reflective speakers . . . these can give a satisfactory illusion of presence and depth. However, these systems require an equalizer for flat response. This in turn generally requires the use of separate (and expensive) preamps and ultra-high-wattage power amps.



Scott's Quadrant speakers represent a no-compromise design. Quadrant speakers can be placed virtually anywhere, give extraordinarily good wide-range response and 3-dimensional stereo realism and presence throughout the room. In addition, no equalizers or special amplifiers are required.

June 1969 Vol. 53, No. 6

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EQUIPMENT TEST REPORTS

by Hirsch-Houck Laboratories

"In use tests, the Garrard SL 95 performed flawlessly. From both mechanical operation and listening quality standpoints, it left nothing to be desired."

Stereo Review, April 1969

Check No. 3 on Reader Service Card

Coming in July 1969

A New IM Test Method for Tape Recorders — Norman Crowhurst discusses the principles of a novel way in which to measure intermodulation distortion in tape recorders.

A Primer on Sound Level Meters—Bernard Katz examines sound level meters, from what they are to how they work.

Audio/FM Test Instrument Roundup—A sampling of test instruments used for audio and for FM test and measurement.

How Stereo FM Transmission Works—Leonard Feldman details how the sum-and-difference multiplex FM system operates.

PLUS: Reviews on the latest stereo hi-fi component equipment, LP records, prerecorded tapes; Audioclinic, Tape Guide, Behind the Scenes, Sound & Decor Styles, and other regular departments.

ABOUT THE COVER: Eugene Ormandy and the Philadelphia Orchestra are shown here with Artur Rubinstein during a recording session for RCA's Red Seal record label. The recording, the **Chopin Second Piano Concerto,** is reviewed by Edward Tatnall Canby on page 58, together with six other new Ormandy/Philadelphia releases. In addition, Mr. Canby gives his personal views of the Ormandy/Philadelphia move from Columbia Records to RCA Records, and its effect on future recordings, on page 14.

Audioclinic

JOSEPH GIOVANELLI

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

Intermittent Loss of Signal

Q. I am having a problem that I understand is relatively common. The audio output of my amplifier frequently drops out on one or both channels. It never becomes completely inaudible at such times. When this happens, it is possible to restore normal level by tuning the volume control up quite far. Then full sound returns with a loud "pop" in the speaker. This phenomenon occurs whether the source is the tuner or the changer.—Edward Moore, Chicago, Ill.

A. Your letter was not clear as to whether the trouble with your amplifier occurs simultaneously on both channels or just on one at a time. Therefore, I do not have much to go on. However, let's give it a try.

One reason that this sort of trouble takes place is that output tubes become gasy. Once this gas conducts, the normal function of the tube is impossible. When this trouble occurs, take a look at the output stage to see if the color has changed as compared to what it is when the stage is working correctly. You might not have to do much more than to change your output tubes.

Another possibility is that of defective coupling capacitors. Turning a volume control or an input selector switch could put a transient pulse across defective parts and temporarily restore them to normal operation. I recommend the use of a different audio amplifier to trace down from one stage to the next to see which one "acts up," resulting in this tremendous loss of gain. Once the faulty stage is located, check the various voltage and resistances in this stage against those in the manufacturer's manual.

We know that your trouble originates after the phonograph stage. We know this because the tuner circuitry is also involved when this condition occurs.

We talked in terms of a tube amplifier, but the same general tracing procedure would be followed if a solid-state amplifier is to be checked. You will again want to check voltages and resistances. However, the voltages are likely to be quite low on some base circuits. Be sure you have a meter which is capable of measuring them accurately.

If the trouble occurs simultaneously on both channels, then you'll know that it is the result of something which is common to both channels, and that can only be the power supply unless you have some kind of center-channel arrangement. Then you'd want to check the connections to this equipment for possible shorts or opens.

Speakers & Speaker Systems

Q. My question is: What is the difference between speaker systems and loudspeakers? What are the advantages of one over the other? Is the speaker enclosure a critical factor in sound reproduction? Could I just set one of the loudspeakers on a shelf and get good sound?—Capt. Thomas A. Nims, APO San Francisco, Calif.

A. A loudspeaker differs from a speaker system in that the loudspeaker is just one of the elements which make up a complete system. The speaker system generally usually consists of at least one woofer, perhaps a midrange speaker and a tweeter. Further, it contains a crossover network to divide the frequency spectrum among the various speakers. Finally, the complete system is contained within an enclosure or cabinet. The cabinet is designed to complement the parameters of the speaker, especially the woofer.

If you make up your own speaker system, you will need to obtain the woofer, midrange if any, the tweeter, and the crossover network, and place them in the enclosure yourself. This enclosure might not be a cabinet at all. It might be built into a wall, with the wall serving as what is known as an "infinite baffle." Some enclosures are simply closets. The large, interior volume of the closet provides good bass response. You will need to line the enclosure with insulation that will absorb sound. The sound produced by the back of the speaker is lost with this kind of system.

Touch and go!

Or stop. Speed up. Start again. Play it any way you want — on the A-4010SU tape deck, all you do is push a button. Its exclusive symmetrical control system makes anyone a smart operator. A flick of the finger turns reels right or left, fast or slow, forward or back.

Instantly, effortlessly. Like electric typewriter keys.

Another nice touch: off-the-tape monitoring while recording, thanks to separate record and playback heads. (Most other machines in this price range can monitor the sound source only.)

Calms tape tension, too: unique tape tension control is directly connected with reel motors. It actually adjusts motor voltage for smooth tension, even on half-and-quarter-mill tapes.

Now wouldn't you rather give a listen than get a lesson?

A-4010SU • Electric automatic reverse • 4 separately built precision heads • Mike-line mixing • Exclusive triple-motored drive system • 2 recording amps, 2 playback preamps

TEAC®

TEAC Corporation of America
2000 Colorado Avenue
Santa Monica, California 90404

Whether the enclosure is of the infinite baffle variety or of some other design, you must have one to achieve good sound. The speaker alone cannot be simply placed on a shelf for you'll never get good sound from it. Bass response will be affected mostly. Further, the loudspeaker is delicate. The moving elements of loudspeakers are paper cones. They can be easily ripped if they are exposed.

If you really want to learn something about loudspeaker systems, you might wish to construct a kit. Some manufacturers offer speaker systems which are not assembled. You are sent parts and instructions as to how to assemble them into a working system.

Speakers for Solid-State Amplifiers

Q. I have read that solid-state amplifiers have only one output impedance. or tap, to which speakers can be connected. Every set of specifications I have seen has shown that the highest power transference is delivered into a four-ohm load.

If amplifiers are most powerful at four ohms, why are most speakers 8-ohms models? Why do speaker manufacturers recommend 8-ohm speakers for use with solid-state equipment?—Robert A. Sisk, Boston, Mass.

A. Most solid-state amplifiers do deliver their rated power at around four ohms. Here is the problem with using four-ohm speakers. At certain points in their impedance curve, their impedance dips quite low to perhaps two ohms or lower. The solid-state amplifier is distinctly unhappy under these circumstances. The transistors want to supply even more power than ever, but this causes more heat to be generated in the output transistors. The stage could well destroy itself. Fortunately, the protection circuits in amplifiers are improving all the time. Hence, this danger is being reduced. However, it is a good idea to use a resistor in series with the speaker if a four-ohm speaker is to be used. The value of this resistor should be four ohms and its wattage rating should be equal to the power-handling capacity of the speaker.

The addition of this resistor will lower the damping to the speaker, however.

Eight-ohm speakers also will exhibit a dip in their impedance curves to perhaps as low as four ohms. This four-ohm impedance will not create undue heating of the output stage of a solid-state amplifier. Further, because no series resistance is required, damping of the speaker is maintained at a high degree.

Thus, the eight-ohm speaker is a good compromise in terms of solid-state amplifiers.

Electronic Crossover Considerations

There is an important difference between electronic and passive crossover networks. It is in the accuracy needed in the overlap at crossover. In the passive crossover, that portion of the signal not passed through one of the networks usually gets into another, while in the electronic crossover it is easy to leave holes or excessive signal at the crossover points. Unless the crossover is right on target, it could add coloration to the sound. This, I believe, is the most difficult problem in the electronic system. I caution the home constructor to avoid electronic crossover construction unless he has a flat audio oscillator, a good, wide-range a.c. meter, and lots of patience.—*Name Withheld*

unique: revolutionary Sound Effect Amplifier.

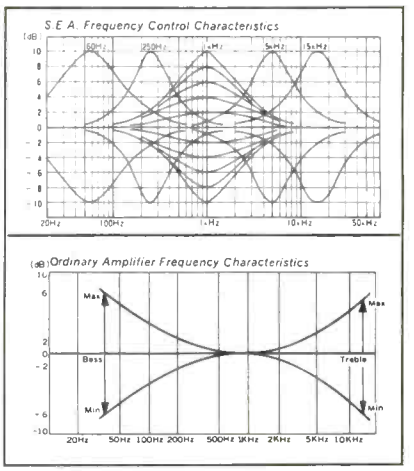
Unique "S.E.A." Sound Effect Amplifier tone control system of models 5001 and 5003 eliminates conventional bass and treble controls. Provides individual control of the five different frequencies that comprise the total tonal spectrum; 60, 250, 1000, 5000 and 15000 Hz.

In introducing the striking all solid state 60 watt 5001 and 140 watt 5003 AM/FM Multiplex Stereo Tuner Amplifiers, JVC brings the stereo fan a new dimension in stereo enjoyment—the complete control of sound effects.

This exciting innovation is made possible through the incorporation of a built-in Sound Effect Amplifier (S.E.A.), a versatile component that divides the audio range into five different frequencies. It enables the 5001 and 5003 to be tailored to the accustical characteristics of any room, or to match the sound characteristics of any cartridge or speaker system, functions that were once reserved for expensive studio equipment. But even without the built-in S.E.A. system, the 5001 and 5003 would be outstanding values. They offer improved standards in FM sensitivity and selectivity by utilizing the latest FET circuitry with four IF limiters in the frontend of the 5001 and five in the 5003. They both deliver a wide 20 to 20,000Hz power bandwidth while holding distortion down to less than 1%. They feature completely automatic stereo switching with a separation figure of better than 35dB. They allow two speaker systems to be used either independently or simultaneously. Indicative of their unchallenged performance is their refined styling. All controls are arranged for convenient operation. The attractive black window remains black when the power is off, but reveals both dial scales and tuning meter when the power is on. For the creative stereo fan, the JVC 5001 and 5003 are unquestionably the finest medium and high powered receivers available today.

How the SEA System Works

Glance at the two charts appearing on this page. In looking at the ordinary amplifier frequency characteristics where only bass and treble tone controls are provided, you can see how response in all frequency ranges at the low and high levels is clipped off. Compare this chart with the one showing the SEA frequency response characteristics, and the difference is obvious. No clipping occurs in the SEA system. It offers full control of sound in 60, 250, 1,000, 5,000 and 15,000Hz frequency ranges from −10 to +10db. For the first time ever, you have the power to determine the kind of sound you want to hear.



For additional information and a copy of our new full color catalog write Dept. AM:

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Letters

• For months I have been seeking a source of electrostatic tweeter units, but without success. Surely Robert Ehle's article ("How to Add Electrostatic Tweeters," AUDIO, April 1969), deserved a fill-in on what he was talking about. The speaker directory section mentions nothing in this specialty field.

Would you be so kind as to provide me with addresses of manufacturers of electrostatic speakers? The Japanese make the Electrostat line; the Electrostat-3 was once rated the equal of the Ionovac. Ehle mentions German made units for $1.50! I have been unable to find mention of any in the parts house catalogs at my disposal. Apparently much is available if one is lucky enough to live in an area where they can be encountered.

E. A. WALSH
Roy, Utah

Mr. Ehle used Stat. Hochton-Lautsprecher electrostatic tweeters, sold by Poly-Paks, Lynnfield, Mass., a few years ago. Other brands include the West German import, Kingdom-Lorenz, said by the author to be available for under five dollars, and the Electrostat model you mention. It is difficult to pinpoint which dealer has what on items that are not too popular. In addition to seeking such products from various dealers and mail-order houses, one may from time to time pick up a used product on a dealer's trade-in shelf. One may also search out hard-to-find products through the Classified Ad section of AUDIO*—Ed.*

• Specific reference is made on p. 70 of the December 1968 issue of AUDIO to Wireless Microphone equipment, incorrectly labeled "Part of the Sennheiser Line." These items are the Vega Model 5P Pocket Transmitter, Vega Model 5SH Hand Mike with Shure Cardioid Head, Vega Model 5L Lavalier Mike, and Vega Model 10 Receiver.

CLEVE WILKINSON
Vega Electronics Corp.
Santa Clara, Calif.

• Unfortunately I discovered an error in Fig. 7 of my manuscript, "Five-Channel Stereo at Home" (AUDIO, March 1969). To get the correct phase relationship, the leads to speakers three and four must be reversed.

Also, in one point, the middle of the second column on page 23, my text was modified to "Auto transformers may be used to simplify the installation," whereas my manuscript stated: "Auto transformers may *only be used if the ground connections* of the two amplifiers *do not lead to difficulties which will usually be the case.*"

That is something quite different! The outputs of the two amplifiers must be connected in such a way that the two voltages are not simply in parallel, but add up to get the desired effect.

If we had no galvanic connection between the existing left and right amplifier, auto-transformers could be used without difficulties. To get a common reference point they had to be connected together at one convenient point. Otherwise they would "hang somewhere in the air." It would also be advisable to connect that common point in some way to the ground or earth to avoid hum as it is usually done in most amplifiers.

In most, if not in all, practical stereo systems, there is a connection between the two amplifiers even if it may be hidden. In the diagrams I have drawn that connection with a dotted line. To simplify the diagrams I have shown only three speakers, but the taps are for all five. Now let's assume that we have a mono signal, i.e., exactly the same voltage and phase on the output terminals of both the right (R) and the left (L) amplifier. I have indicated that voltage or potential above a zero point at left.

To get an addition of the two voltages (of the left and right amplifiers) they must *not* be connected in parallel but in series or, in other words, one has to be set on top of the other (or below the other), always with the correct polarity.

In Fig. 1 we have no supplementary connection of the two auto-transformers but the (perhaps hidden) existing connection within the amplifier. Nothing will happen in that case, nothing at all; not even a sound will emanate from the center speaker! As the two auto transformers are connected in parallel their voltages will *not* be summed and the center speaker will only reproduce a *difference* of the left and right signal. With a mono signal both leads have the same potential. The five-channel system will not work in this case!

If as in Fig. 2 a supplementary connection (marked in all diagrams with an arrow) is made between the two auto-transformers, things become even worse: the left auto-transformer will be shorted and, of course, there will be no sound at all from it. But for some solid-state amplifiers, the shorting of the output will be "fatal"! *I do not take the*

(Continued on page 65)

When low distortion is a critical requirement, Acoustic Research speaker systems are a logical choice.

Acoustic Research speaker systems are carefully designed and meticulously inspected to be certain that they reproduce sound while introducing no sound of their own. This lack of distortion partly explains their natural, uncolored music reproduction in rooms both large and small, of delicate harpsichord tones or the **tutti** of a Beethoven symphony. As at a concert, the listener hears what the musicians have created, free of unnatural artifice or misguided attempts at enhancement.

At a recent performance of **Deserts** by Edgar Varese, a work for stereophonic magnetic tape and symphony orchestra, the Boston Symphony Orchestra was accompanied by six AR-3a speaker systems reproducing the composer's tape. The requirement was authenticity of reproduction without distortion of the acoustical setting provided by Boston's Symphony Hall, which Bruno Walter called "the noblest of American concert halls." The speaker systems are shown on the stage during tests.

AR-3a speaker systems are priced from $225 to $250, depending on cabinet finish. Write for complete technical data and an AR catalog describing our other speaker systems, turntable and amplifier.

Acoustic Research Inc.

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Overseas Inquiries: Write to **AR International** at above address

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BEHIND THE SCENES

BERT WHYTE

Metamorphosis of Retail Hi-Fi Stores

RECENTLY I had occasion to visit a number of retail hi-fi stores in the New York Metropolitan area. I visited stores belonging to independents, branch shops of several "chains"; from the biggest establishments to the smallest. What I encountered on these visits was, with rare exceptions, depressing.

Frankly, I had come prepared for the worst. Over the years, I have made a number of "store surveys." The "surveys" are infrequent enough, and the personnel turnover in these stores often enough, that my visits are usually on an anonymous basis. I had witnessed a gradual deterioration in overall quality of services offered by retail hi-fi sales outlets, but this last survey was shocking.

For the most part, the physical plants have become shoddier and even less functional than previously observed. The caliber of store personnel has shown a particularly sharp decline. There are few real salesmen or audio consultants left, merely a bunch of inept "order-takers," it seems. The chances for a person to get a pleasant, well-organized, meaningful demonstration are almost nil.

The "bill of indictment" against most of these places is endless. Many of them are just plain dirty. Smudged walls, dusty equipment, and either scuffed, abraded vinyl tile floors or carpet that is threadbare or badly in need of cleaning. One wall is usually given over to a hideous jumble of "bookshelf" type loudspeakers. These speakers are fitted together on a basis of their size. Some are placed vertically, others horizontally; some favored types are evidently placed a proper and reasonable distance apart, to afford some semblance of good stereo perspective. Other speakers are either too close or too far apart for stereo. In many places the wall of speakers extends right up to the ceiling, and those units so unfortunate to be placed at the top will produce less bass response than they would at floor level; and no matter how well their tweeters spread the high frequencies, they will be beamed over the heads of the auditors. The larger speakers (if any) are placed on the floor where they will fit physically, with little regard for sonic consideration. In general, the demonstration rooms are acoustic horrors. I'll grant that in many cases the shape and construction of the room may not be suitable to begin with and not easy to alter. But surely some attempt could be made to improve the acoustics by the use of carpeting on the floor, judiciously placed draperies of suitable weight, the use of acoustic tile on the ceiling or even on the walls. And conspicuously absent in most of the demo rooms I visited were any kind of chairs or benches. The sales philosophy seems to be a "get 'em in and get 'em out one!"

When it comes to "A-B" comparator boards in these shops, the situation is truly grim. Either there is no board at all, or it isn't working or it works sporadically. When they do work, they are often inadequate in flexibility. Further, most are hum creators, provision for impedance matching has long been ignored, and there is almost never any way to adjust levels so that the two components being compared are equal in output. Although phono cartridges are the one component that hi-fi enthusiasts change most frequently, few comparator boards are set up to "A-B" them. To top everything, the guy who designed and possibly even built the comparator board has generally long since left the store for greener fields. When repairs are needed, no one knows anything about the board, the circuit diagram usually is missing . . . and that's that!

As I have already noted, the personnel that mans these stores leave much to be desired. Their knowledge of audio is extremely limited, and while this is bad enough, worse still is that they are veritable fountains of *mis*-information. Small wonder that you see many incredibly botched and mismated component stereo systems in people's homes! On top of all this, more than a few of these "salesmen" are surly and downright rude. I must point out in all fairness, however, that much of the salesman's attitude is attributable to the sales policies of the store owners and to quite a degree to the customers themselves. Frequently, store owners exert tremendous pressure on their men to make a sale . . . any kind of a sale . . . no matter how incompatible may be the components under consideration, or ill-suited to the buyer's environment. But there is another side. With the rampant discounting that exists in the New York market (and elsewhere, as well) the salesman is continually harrassed by the customers who want to "make a deal." And these customers can be mighty abusive! Of course, basic to this whole business of personnel is that the store owners haven't sense enough to pay sufficient wages and incentive commissions to attract and hold the really knowledgable audio salesmen. These days many of the smart lads wind up working for the manufacturers.

Assuming you finally manage to arrange for a demonstration of some loudspeakers that have aroused your interest, here is what is likely to happen: the salesman will proceed to tune in an stereo FM program. Almost any station will do, as he rarely bothers to ask whether you prefer pop or classical music. Now I don't have a thing against stereo FM, but it certainly is not the best source for demonstrating loudspeakers. Ask to hear a record played through the speakers and chances are the salesman will lamely inform you that he is not set up to play records at the moment, as the cartridges have been removed to prevent pilferage. But you insist and, after removing the cartridges from their hiding place, he inserts one into the arm of a changer. You then tell him you prefer that he use a separate arm and turntable. After some dirty looks he produces the proper head and cartridge and inserts it in the arm and plops it on a record. Now if he happened to use an SME or Sony tone arm, both of which have many adjustments to ensure proper tracking, chances are that he will ignore these niceties and proceed in a heavy-handed way. However, assuming you get by this hurdle, what kind of recording does he use to demonstrate the speakers? Almost invariably it is some "super hi-fi" pop recording with a huge peaked middle range, lots of false boomy bass, ping-pong directional qualities, and "Mammoth Cave" reverb. Accompanying the music is often a fascinating collection of pops, ticks, scratches, hiss and other distortions. If by chance he demonstrates a classical recording, it is usually nondescript and it too is covered with a

IF YOU REALLY VALUE YOUR RECORDS

DON'T UNDERRATE THE GRAM!

(. . . a commentary on the critical role of tracking forces in evaluating trackability and trackability claims)

TRACKABILITY:

The "secret" of High Trackability is to enable the stylus tip to follow the hyper-complex record groove up to and beyond the theoretical cutting limits of modern recordings—not only at select and discrete frequencies, but across the entire audible spectrum—and at *light tracking forces that are below both the threshold of audible record wear and excessive stylus tip wear.*

The key parameter is *"AT LIGHT TRACKING FORCES!"*

A general rule covering trackability is: the higher the tracking force, the greater the ability of the stylus to stay in the groove. Unfortunately, at higher forces you are trading trackability for *trouble.* At a glance, the difference between ¾ gram and 1, 1½, or 2 grams may not appear significant. You could not possibly detect the difference by touch. *But your record can! And so can the stylus!*

TRACKING FORCES:

Perhaps it will help your visualization of the forces involved to translate "grams" to actual pounds per square inch of pressure on the record groove. For example, using ¾ gram of force as a reference (with a .2 mil x .7 mil radius elliptical stylus) means that 60,000 lbs. (30 tons) per square inch is the resultant pressure on the groove walls. At one gram, this increases to 66,000 lbs. per square inch, an increase of *three tons* per square inch—and at 1½ grams, the force rises to 75,000 lbs. per square inch, an increase of *7½ tons* per square inch. At two grams, or 83,000 lbs. per square inch, *11½ tons* per square inch have been added over the ¾ gram force. At 2½ grams, or 88,000 lbs. per square inch, a whopping *14 tons* per square inch have been added!

The table below indicates the tracking force in grams and pounds, ranging from ¾ gram to 2½ grams—plus their respective resultant pressures in pounds per square inch.

TRACKING FORCE		GROOVE WALL PRESSURE		
GRAMS	POUNDS	POUNDS PER SQUARE INCH		
		(See Note No. 1)		
¾	.0017	60,000		
1	.0022	66,000	+10%	(over ¾ gram)
1½	.0033	75,000	+25%	(over ¾ gram)
2	.0044	83,000	+38%	(over ¾ gram)
2½	.0055	88,000	+47%	(over ¾ gram)

SPECIAL NOTE:

The Shure V-15 Type II "Super-Track" Cartridge is capable of tracking the majority of records at ¾ gram; however state-of-the-art advances in the recording industry have brought about a growing number of records which require 1 gram tracking force in order to fully capture the expanded dynamic range of the recorded material. (¾ gram tracking requires not only a *cartridge* capable of effectively tracking at ¾ gram, but also a high quality manual *arm* [such as the Shure-SME] or a high quality automatic turntable *arm* capable of tracking at ¾ gram.)

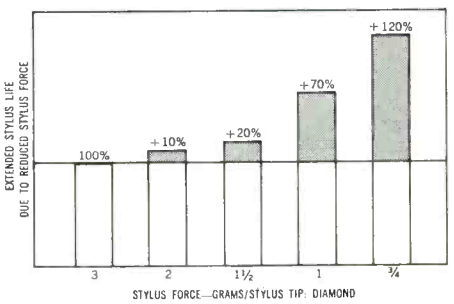
TESTS:

Our tests, and the tests of many independent authorities (see Note No. 2), have indicated two main points:

A. At tracking forces over 2 or 2½ grams, vinylite record wear is dramatically increased. Much of the "high fidelity" is shaved off of the record groove walls at both high and low ends *after a relatively few playings.*

B. At tracking forces over 1½ grams, *stylus wear is increased to a marked degree.* When the stylus is worn, the chisel-like edges not only damage the record grooves—but tracing distortion over 3000 Hz by a worn stylus on a brand new record is so gross that many instrumental sounds become a burlesque of themselves. Also, styli replacements are required much more frequently. *The chart below indicates how stylus tip life increased exponentially between 1½ and ¾ grams*—and this substantial increase in stylus life significantly extends the life of your records.

RELATIVE AVERAGE TIP LIFE VS. TRACKING FORCE



No cartridge that we have tested (and we have repeatedly tested random off-the-dealer-shelf samples of all makes and many models of cartridges) can equal the Shure V-15 Type II in fulfilling all of the requirements of a High Trackability cartridge—both *initially* and after *prolonged* testing, especially at *record-and-stylus saving low tracking forces.* In fact, our next-to-best cartridges—the lower cost M91 Series—are comparable to, or superior to, any other cartridge tested in meeting all these trackability requirements, regardless of price.

NOTES:

1. From calculations for an elliptical stylus with .2 mil x .7 mil radius contact points, using the Hertzian equation for indentors.
2. See HiFi/Stereo Review, October 1968; High Fidelity, November 1968; Shure has conducted over 10,000 hours of wear tests.

SHURE

V-15 TYPE II

SUPER-TRACK HIGH FIDELITY PHONOGRAPH CARTRIDGE

Write: Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois 60204

Check No. 11 on Reader Service Card

BEHIND THE SCENES
(Continued)

fine, gray patina of scratches, gouges, etc. So if you're shopping for equipment, be sure to bring along some mint-condition records with which you are familiar.

Perhaps you may think I am exaggerating this situation. I assure you that I am not. What is happening is that the store owners, in their furious pursuit for volume sales, are trying to use "appliance business" techniques with stereo hi-fi component equipment. Of course, these days one must be careful to distinguish the difference between bona fide stereo components and the flood of cheap jack "packaged systems" that are foisted on a gullible public. Much of these systems are slanted towards the burgeoning youth market. Stereo is very "in" with the kids, but most have neither the money nor the discrimination to indulge themselves in truly good component systems.

What a contrast it is to visit one of the "traditional" hi-fi "salons," where the courteous and knowledgable salesmen have the time and patience to present a pleasant and informative demonstration. There is an attempt to give their demo rooms some of the decor and feeling of a typical living room; there is attention paid to acoustic control and their room has been planned with foresight for the placement requirements of stereo speaker systems. Yes, a few of these places still exist, but they do not generally discount merchandise. Further, some open a carton before the customer takes home the equipment it contains in order to check it out thoroughly for possible defects. And after-sales problems are taken care of with genuine courtesy and concern. As always, "you get what you pay for."

However, even the better salons will be the first to admit that try as they might, listening to a system in their stores simply isn't as good as the actual home environment. Thus, with the aid of certain manufacturers, there is a trend towards the selling of components on a "free home trial" basis. The customer lives with the system in his home for two weeks, is able to play his favorite records or tapes and can really get a meaningful evaluation of the equipment. Experience has shown that a high percentage of these systems is sold, or that a certain component is substituted for another in order to consummate the sale. In the event the system is not sold and returned to the store, the manufacturer assumes responsibility for any scratches or damage to his particular component. Given this sort of option, most customers are fairly conscientious with the equipment and little actual damage is sustained. Admittedly there are certain problems with this approach. For example, some people insist on getting their components in factory-sealed cartons. As a former owner of a hi-fi salon, and with all due respect to the manufacturers, most of my customers were happier when I assembled and tested the components before delivering them to their homes. As long as the dealer and the manufacturer stand behind their product, the customer has little to fear as regards product substitution or an inferior or "used" product.

Guess I'm old fashioned for I still believe that top-quality merchandise should be sold with all the trappings and knowledgeability that can be mustered. Mixing mass-market stereo equipment with some of the more splendid examples of the hi-fi component art in the same showroom often reduces customer assistance to the least common denominator.

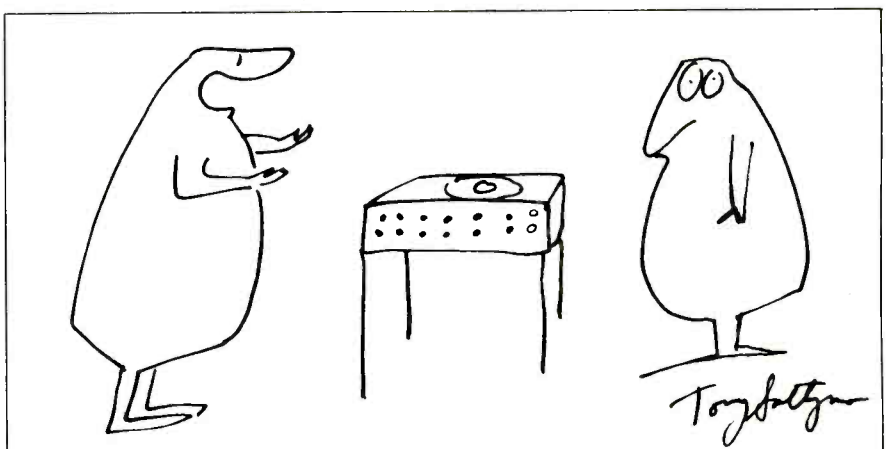
It's like selling Mustang and Ferrari autos under the same roof, with Mustang-trained people. Manufacturers are expanding their markets, of course, and hungrily eye large-volume sales. But I, for one, do not welcome the merchandising changes for component stereo hi-fi that mass-market product lines have wrought.

* * *

This seems to be gripe month so I may as well get something else off my chest. Lately I have been reading some articles by several "opera experts" in which they compare the almost legendary singers of the past with today's artists.

In general they wax rhapsodic about the prowess of Slezak and Caruso and Scotti, Galli-Curci, Mary Garden, *et al,* while denigrating the abilities of our Richard Tucker, Fisher-Dieskau, Boris Cristoff and Birgit Nilsson, Renata Tebaldi and Leontyne Price. The olden singers had "bigger voices," more "orotund tones," "better projection," "more expressivity," "sheer vocal beauty," etc., etc.

When these "experts" tell me they heard these artists in person, I will have to respect their impressions, even though the mind is notoriously poor in the retention of sound or tonal memories (that's why we have "A-B" tests). But when one of the "experts" says, "to clearly establish the superiority of the 'golden age' singers, one merely has to play one of their recordings. . . ." What comes out as far as I am concerned is a distorted caricature of a voice. The "experts" talk about "expressivity." To a degree, yes. But there never was an acoustic recording of any of their revered artists in which we ever could have any idea of a true pianissimo, since it was necessary for the artist to bellow into a huge megaphone in order to drive the crude cutting stylus, to say nothing of the fact that the high hiss background of the shellac record with its asphaltic gritty filler would swamp such sound in any case. They talk of "sheer vocal beauty," when all you can hear is this tinny compressed sound, completely devoid of the harmonics that give a voice its distinctive timbre, and totally lacking in "liveness" or "presence," with no reverberant information whatever. I think the old acoustic records are interesting mementoes from the dawn of sound reproduction, but to regard them as truly representational of these artists' voices is utter delusion. It's time we slew this silly dragon. *Æ*



". . . microphone, guitar, headphones, tape recorder, cartridge player, extra speakers, and two bullet holes from my neighbor."

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Compatibility at Philadelphia

EDWARD TATNALL CANBY

THE PHILADELPHIA ORCHESTRA has come home to RCA after twenty years with Columbia, and the sound of it is very good. It's an ideal re-marriage.

The Victor-Philadelphia recordings began in the acoustic days before 1920 when recording first turned from opera to symphonic repertory. During the electrified Thirties, a long series of RCA Victor (the latter name now being phased out)-Philadelphia albums set a top American standard that persisted straight through until the end of WW II. In those days between the wars, as I remember, an American record without the Philadelphia name on its label somehow looked wrong, like a box of film without Kodak. The Philadelphia was the only American orchestra to reach total equality with those illustrious imported names from classical Europe—the Vienna, London, and Berlin Philharmonics, the Paris Conservatoire, the Amsterdam Concertgebouw. Not even Boston rated so high.

Now RCA is back in Philadelphia and great is the rejoicing. It took a while for the first batch of new records to appear, and a lot longer for me to play through all of them. But now I am wholly won over. If Columbia will pardon me—it should have happened sooner.

A matter of compatibility. My thoughts on this score are strictly my own but I suspect that both RCA and Columbia will go along with me. The two giants, so closely parallel, are actually very different in personality. For my money, the Columbia image never did match that of Philadelphia, Whereas RCA's suits it to a T.

RCA's long-time approach to "first line" (red seal) classical music has been astonishingly consistent, in spite of fringe operations. It was once stated in so many words by an RCA executive whom I will *not* quote. In effect, it is: keep right on recording the solid, basically Romantic repertory heard in every symphony concert hall in America, along with the brilliant performing virtuosi who set it off. Do the same pieces over and over again, because there are always new listeners and new appeals in these highly reliable old products. Keep putting the vintage wine in slightly new bottles; it'll sell. It always has—that is, always for the last 40-odd years. These are the famed "Fifty Pieces" of the concert repertory cited by Virgil Thomson, and they do *not* include Baroque, sitar music, nor so much as a hint of electronics.

Thus how many times has RCA recorded the Grieg Piano Concerto! And the Pathétique Symphony? They appear again in the new batch from Philadelphia. Beethoven, Rachmaninoff, Chopin, Brahms, Tchaikowsky, Schubert, all roll off the RCA presses eternally. And they roll from the "live" instruments of the Philadelphia Orchestra, too. The very first Philadelphia concerts, in 1900-1901 (see reproductions in the new album), could fit into the 1969 schedule without raising a Philadelphia eyebrow.

Pianist Van Cliburn makes first recording with the Philadelphia Orchestra and Eugene Ormandy.

Outside the concert halls, music has changed. In the 1930s a new and diverse repertory previously unknown in this country began to flood in on imported records, to stir up wider interests among record fans. I was one of these—I spent airless hours in record booths going over the fascinating new stuff, spending every cent I could afford. My scorn for the "standard repertory" grew accordingly with each day, and I wasn't the only one! We were a new generation of listeners — and there have been more generations ever since. True, most of us grow up to like the Fifty Pieces, after all. But we do not forget the other and newer music, you may be sure.

Now though Columbia Records can probably match every RCA offering on a purely catalogue basis—the coverage is enormous—this company, nevertheless, has always had its ear somewhat tuned to musical change. Columbia's symphony orchestras, you will find, tend to be those where a certain unrest, on the home scene, has led to subdued but definite experiment in the regular concert series—new repertory, new evaluations of the old, special concentrations on one composer, even a leaning towards non-symphonic material, from concerti grossi to electronic tape. Uncomfortable at home, these orchestras tend to gravitate to Columbia for recording, where they find a greater freedom. Included is the New York Philharmonic, under two inveterate and idealistic experimenters, Bernstein and Mitropoulos. Columbia has even created special orchestras for such diverse music-makers as Bruno Walter and Igor Stravinsky.

We must realize that within its own walls the "live" symphony concert is a specialized and monolithic social institution, very averse to change. Those who rock its musical boat are in trouble—Leopold Stokowsky, for instance, in Philadelphia of the 1920s. Like the classic Greek-temple art museum (cf. Philadelphia), the Symphony cannot easily be modernized short of total demolition, and nobody really wants that. But outside the walls,

all is different. The audience for records is much larger, more diverse and more tolerant of change—for there's nothing monolithic about the home living room. Musical innovation on records is more practical. But is innovation *always* desirable? It depends.

You see, the Philadelphia is America's outstanding example of the perfectly adjusted Symphony Orchestra, living in peace within its own hallowed walls and with its special audience. Mr. Ormandy, its conductor since 1936, has a life contract; and for good reason. He *enjoys* playing the Same Old Pieces, over and over (even though he can add a good deal of modern when he wants to), because he believes in the music, and does not ever tire of the performing. To maintain a repertory and a tradition of superb playing is surely a worthy ideal when it is done with faith and conviction, as it is in Philadelphia.

Somehow, then, I have always felt that Columbia was ill at ease in Philadelphia. There was a curious feeling that the Orchestra was "relegated" to the standard repertory—while other orchestras did Columbia's venturesome things. Somehow, I heard a certain defensiveness in the Philadelphia's playing under this subtle implication. It was surely never a conscious thing on either side, but I think it was there. Even the Columbia engineers, making fabulous hi fi out of the Philadelphia sound, seemed often to be hyping up the old warhorses. Hype up the pride of the Philadelphia repertory! A profound difference in viewpoint, if I guess right.

Now, with RCA back, everyone is in seventh heaven. RCA is just as devoted to the enduring old classics as is Philadelphia. Under this beaming new approval, Ormandy's music has positively blossomed, as well it should. Even the RCA engineers have contributed their proper bit of stereo conservatism, a sound that is perfectly suited to the Philadelphia temperament though it might not do for a Bernstein extravaganza in New York. Don't expect raw miracles. Ormandy is still the elegant purveyor of the same old high-grade Philadelphia cream cheese. But is it good!! Of its sort, the best you can buy.

See page 58 for reviews of new RCA recordings of the Philadelphia Orchestra.

Tape Guide

HERMAN BURSTEIN

Amplifier vs. Speaker Power Ratings

*Q. I am the owner of a *** tape recorder, which puts out 12 watts of music power—16 watts per channel. I have decided to buy an amplifier rated at 18 watts per channel, and speakers rated at 40 watts each. What I would like to know is: Is the amplifier powerful enough to get the full effect of my speakers, or will I need a more powerful one?*—Edward J. Meschi, APO, San Francisco, Calif.

A. Generally, an amplifier that can deliver 18 watts per channel throughout the audio range at low distortion is adequate to drive any medium-efficiency speakers to a very loud level in rooms of a size ordinarily found in a home. The fact that a speaker is rated at 40 watts does not mean that it requires 40 watts in order to drive it to realistic volume. What is meant is that the speaker will not promptly burn out if as much as 40 watts happens to be fed into the speaker.

Portable Adjunct Recorder

*Q. I have a high quality *** tape recorder, which is in a permanent installation in my home. I would like to get a portable tape recorder, tape on the outside, and then play these tapes back on the *** machine. Would I be able to play back these tapes all right? Can you recommend a portable that I can use? Also, would it be all right if I bought a small TV set with an ear jack and used that to tape from TV?*—S. Valenza, Jackson Heights, N. Y.

A. Yes, you could use your *** machine to play back the tapes made on a portable. If the portable employs standard (NAB) equalization, you will obtain flat (substantially) frequency responses. However, depending on the quality of the portable, you may not obtain as good a recording—in terms of low noise, distortion, and wow and flutter—as if you employed the *** machine for recording.

You might get reasonably good results from the earphone output of a small TV set; however, make sure that the TV has a power transformer, or you run the danger of fatal shock. Also, make sure that the TV produces sufficiently little noise and buzz.

Left-Channel Dropout

Q. Using a 10-kHz signal into my tape recorder, and monitoring the output with an a.c. VTVM, I have observed marked fluctuations of 8 to 10 dB in the output of the left channel (tracks 1 and 4). The output of the right channel fluctuates only about ½ dB. To reduce this fluctuation I have unsuccessfully tried the following: increased tape tension, changing tapes, cleaning and lubricating all heads and tape guides, and cleaning the capstan and pinch roller. I hope you will be able to solve this problem.—Thomas T. Aoki, FPO, San Francisco, Calif.

A. Your problem with the left channel is not an uncommon one and is known as "left-channel dropout." It is due to imperfect contact between the head and tape. Contact is apt to be worst at the tape edges, where you have tracks 1 and 4. Adjustment of the tape guides might help. Slight adjustment of the vertical plane of the head might help. If your machine employs a pressure pad, greater pressure might help (although this may adversely affect wow and flutter). Your best appeal may be to the manufacturer or an authorized service station.

Adjacent Channel Spillover

Q. I seem to have trouble with the alignment of the playback head of my tape machine, which is intended to reproduce half-track or four-track prerecorded tape. When playing quarter-track tape, the head picks up the recorded material on the adjacent tracks. Can this trouble be corrected by the owner of a home tape recorder? If so, how can I proceed to correct head misalignment myself? Are there any special tools or electronic instruments necessary? — Raymond Arcand, Montreal, Canada

A. In a loose way of speaking, you could try making a vertical alignment of the playback head. In the absence of a vertical alignment tape or other necessary equipment, you would align the had so that the top edge of the upper gap is even with the upper edge of the tape, or *very* slightly below the upper edge of the tape. However. it is likely that in moving the head vertically you will upset its azimuth alignment, which calls for the gap being exactly perpendicular to the long dimension of the tape. This adjustment cannot be made visually, at least not satisfactorily. Instead, it calls for an azimuth alignment tape. While playing this tape, bearing a frequency of 10,000 Hz or higher, one adjusts the head for maximum output, usually checked with a VTVM. Æ

The best stereo tape deck your money can buy. Period!

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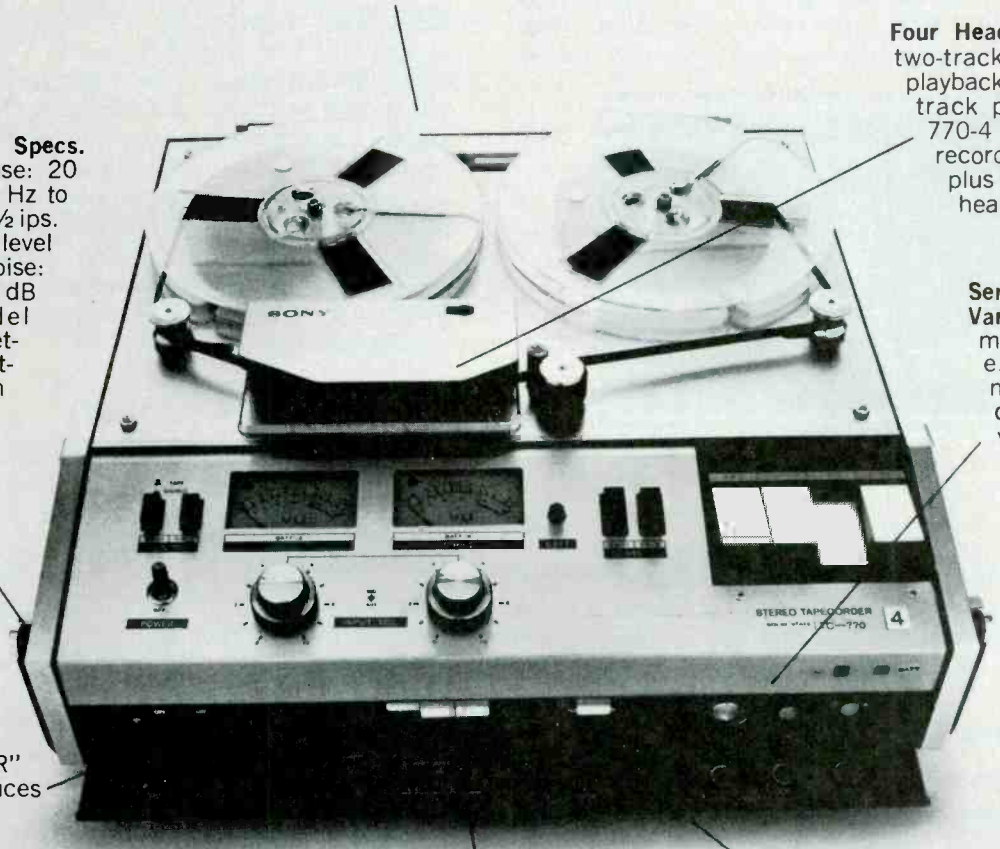
Four Heads. The 770-2 has two-track erase, record, and playback heads plus a four-track playback head. The 770-4 has four-track erase, record, and playback heads plus a two-track playback head.

Better-than-Studio Specs. Frequency response: 20 Hz to 22 KHz, 40 Hz to 18 KHz ±2 dB @ 7½ ips. S-N ratio at peak level to unweighted noise: (Model 770-2) 58 dB or better; (Model 770-4) 56 dB or better. Wow and flutter: less than 0.09% @ 7½, less than 0.12% @ 3¾, less than 0.2% @ 1⅞.



ServoControl Motor with VariSpeed Tuning. Automatically maintains exact speed during mechanical load changes and voltage variations. Built-in VariSpeed tuning permits vernier adjustment of plus or minus 7% of any of the three speeds. Ideal for pitch tuning to any musical instrument.

Exclusive Sony Noise-Reduction System. Sony "SNR" automatically reduces gain of playback amplifier by 6 dB during very low passages, when background noise is most predominant. Noise level is greatly reduced, dynamic range expanded 100%. Also incorporated is a built-in limiter to automatically control overload distortion. Both "SNR" and limiter are switch defeatable.

Three Speeds. 7½, 3¾, 1⅞ ips. Other features include two professionally-calibrated VU meters, built-in line-and-mike mixing, push-button operation, scrape flutter filter, low-impedance Cannon plug mike inputs, tape/source monitoring.

Sony Model 770. Priced at $750. For a free copy of our latest tape recorder catalog, write to Mr. Phillips, Sony/Superscope, Inc., 8142 Vineland Avenue, Sun Valley, California 91352.

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EDITOR'S REVIEW

Goodby "Nipper"

By the time you read this, the four 14½-ft. stained-glass windows ensconced 11 stories high near the top of RCA's Building No. 17 in Camden, N. J. will be gone, ending a 53-year vigil that started when the building housed the Victor Talking Machine Co. Each of the mosaic windows depicted one of the most colorful trademarks we have ever known—"His Master's Voice," with a painting of a fox terrier dog, Nipper, cocking his head while listening to a record playing on a Gramophone.

With RCA revamping its corporate image to reflect the varied, world-wide role it plays today (witness the recent change made in the RCA logo), "Nipper" has apparently become too provincial. The trademark was never owned exclu-

sively by RCA, as many know, since companies in foreign lands have claims on it too. But here in the U. S. A. it was synonymous with both RCA Victor and remembrance of a glorious period.

In place of the watchtower positions held by "Nipper" for so long will be four 22-ft. x 6-ft., white, plastic-and-aluminum RCA logos.

It'll never be the same.

"Filter-Tipped" Ear Plugs

With so many frightening reports about hearing impairment being caused by heavy exposure to high sound levels (reaching peaks of 120 dB) from bandstand "rock" musicians and from juke-boxes, Sigma Engineering, North Hollywood, Calif. took a tip from cigarette manufacturers and developed a device which is claimed to "filter out damaging noises while permitting harmless sound levels to pass through."

Called "Lee Sonic EAR-VALV," the tiny devices fit into the ears much as conventional earplugs do. The $3.95-per-set devices have a sound-actuated mechanism with a valve, a cylinder, and hairsprings which are said to act to protect persons who are faced with long exposure to high-level sound (say, bandstand performers who employ electronically amplified instruments).

New Developments

The Sony Corporation has introduced a monolithic power integrated circuit. Delivering a 26-watt output, this is said to be the highest power rating from a monolithic IC to date. (The 26 watts "maximum linear power" corresponds to 18 watts continuous power.)

Not all developments reach the practical stage, such as the one noted above. Last year, for example, N. V. Philips, the Netherlands electronics firm, developed a virtually weightless, high energy, throwaway battery, called "energy paper." A single sheet, weighing less than one-tenth of an ounce, was said to operate a prototype Norelco shaver for six or seven minutes. The battery was then thrown away and a fresh piece of "paper" was inserted in preparation for the next shave.

According to reports, the experimental "energy paper" exhibits a power density five times greater than that of ordinary dry cells, a flat discharge curve, and low cost. The paper "battery" is activated by inserting it into water. Again, we were cautioned last year that the "energy paper" was highly experimental. Its value would certainly be great if it evolves into a practical device.

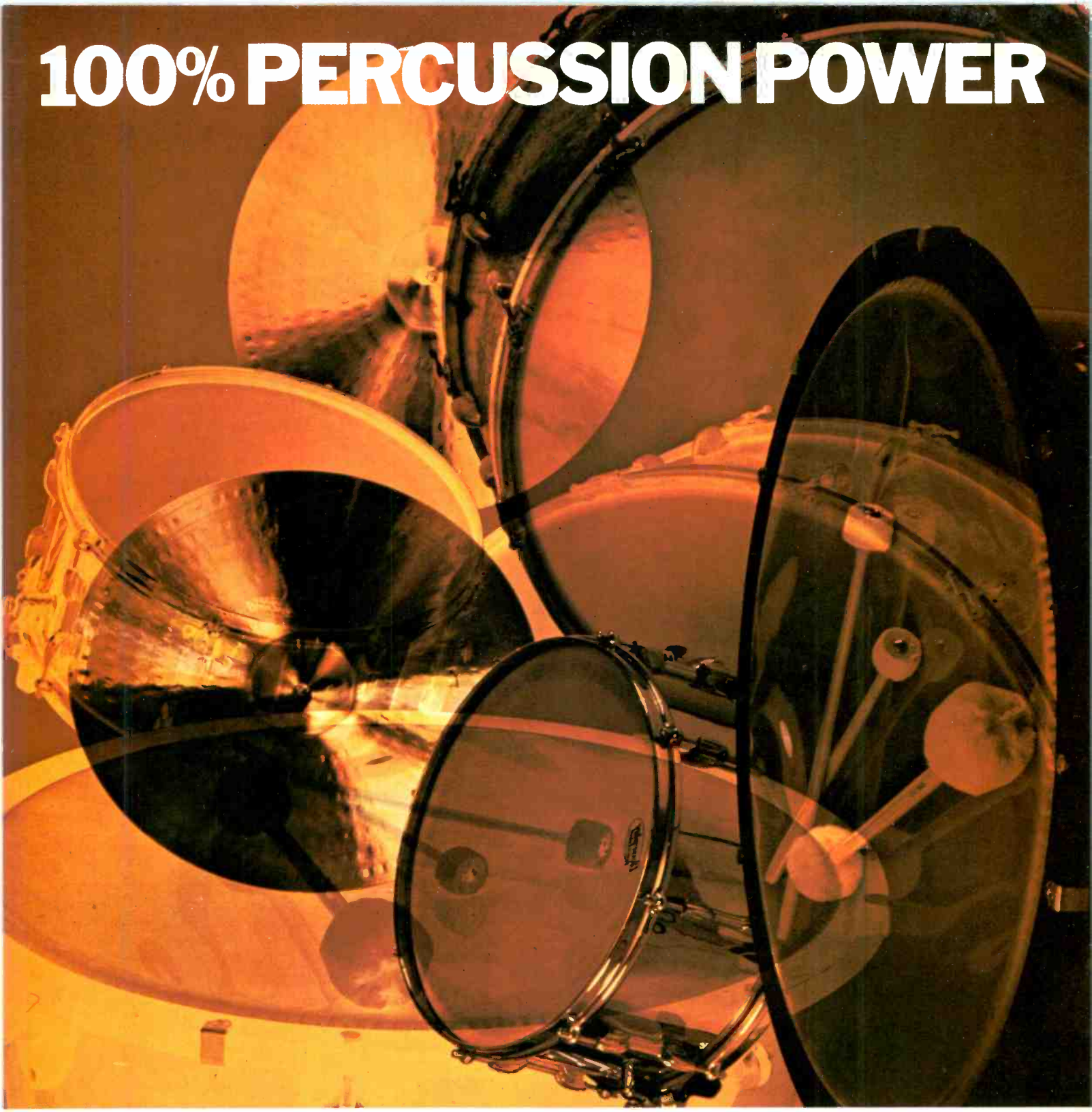
Another interesting experimental device is an electric typewriter that operates from Morse-code "dit-dah" sounds voiced into a microphone. Claim for the device, under development by a British division of ITT, is accurate typing at 20 words per minute.

"Studio Practice" Lectures

The *Los Angeles Watts Training Center* has engaged Oliver Berliner of SounDesign Engineers for a series of lectures on recording studio practices to be given to the underprivileged, it was announced recently. The free lectures and practice sessions—from microphone selection and placement through to cutting of the disc master and disc pressing—take place every week at Tel-audio Centre Studios, located near Disneyland.

Mr. Berliner observes that the "underprivileged" are getting instruction in an area that is not available to other persons. We can attest to this, since AUDIO has a continual flow of letters from readers who are searching for courses such as this, with no success. Recognizing the need for a training program in the field of professional audio, AUDIO had proposed to an officer of the Audio Engineering Society that the AES consider sponsoring a course in professional audio practices for both neophytes and persons in the field who wish to upgrade their knowledge. The subject was discussed at a Board meeting last year with inconclusive results. *A. P. S.*

100% PERCUSSION POWER



PHOTOGRAPH BY FRANZ EOSON

Words are inherently limited in stimulating the emotions aroused by music. This is especially so in describing how high fidelity components perform.

With cartridges, for example, we speak of flat frequency response, high compliance, low mass, stereo separation. Words like these enlighten the technically minded. But they do little or nothing for those who seek only the sheer pleasure of listening.

We kept both aspects in mind when developing the XV-15 series of cartridges. We made the technical measurements. And we listened.

We listened especially for the ability of these cartridges to reproduce the entire range of every instrument. With no loss of power. In the case of the percussion, this meant a cartridge that could recreate the exact nuances that distinguish the bass drum from the largest kettledrum. The big triangle from the little triangle. The felt drumstick from the wooden drumstick.

We call this achievement "100% percussion power."

When you play your records with an XV-15, you won't be concerned with even that simple phrase.

Instead, you'll just feel and enjoy the renewed experience of what high fidelity is really all about.

PICKERING

THE NEW PICKERING XV-15/750E.
PREMIER MODEL OF THE XV-15 SERIES. TRACKS AT ½ TO 1 GRAM. DYNAMIC COUPLING FACTOR OF 750 FOR USE IN FINEST TONEARMS. $60.00. OTHER XV-15 CARTRIDGES FROM $29.95. PICKERING & CO., PLAINVIEW, L.I., N.Y.

Layman's Guide to Phono Cartridge Specifications

JAMES H. KOGEN*

ONE OF THE MOST frustrating problems for the consumer is that of understanding and interpreting manufacturers' specifications. This difficulty is greatly magnified when standards of measurement do not exist or are not adhered to by manufacturers.

As of now, there is no officially approved set of specifications or standards for phonograph cartridges. There is no official test record or official test procedure. Thus, each manufacturer employs his own method of measurement, interprets the results as he sees fit, and advertises his specifications in accordance with the dictates of his own conscience.

Here are the phonograph cartridge specifications as they are most generally understood in the community of engineers who design and use these cartridges. These specifications will be related to the functional requirements of the user wherever possible.

Basic Performance Requirements

The primary function of a phonograph cartridge is that of converting the modulation in the record groove into electrical signals. The more important functional requirements for the stereo cartridge are:

1. The needle must follow all modulations on the record without losing contact with the groove. Loss of contact produces extreme distortion, which cannot be tolerated in high-quality reproducing systems. Although no standard exists for the terminology identifying this characteristic, the words *"tracking," "tracking ability,"* and *"trackability"* are commonly used.

2. The transforming of record modulation into an electrical signal must be performed with great fidelity. The ability of the cartridge to do this for the spectrum of tones is described in part by its *"frequency response."*

3. The stereo cartridge must reproduce both channels of the stereo record. In doing so, each channel must be reproduced independently; that is, information from one channel must not leak into the other channel. The term used to describe this characteristic is *"separation."*

4. The output voltage of the cartridge must be well above the level of the spurious noise sources which exist in any reproducing system. The terms used for describing this quality are *"output voltage," "output," "nominal output,"* and *"sensitivity."*

5. While the frequency response describes the ability of the cartridge to reproduce information which is on the record, the cartridge may produce signals that are not on the record. This is an undesirable quality, to which the generic word *"distortion"* is applied.

6. *"Channel balance"* specifies the difference in output level of the two stereo channels of the cartridge.

7. *"Hum"* is the noise induced into the cartridge by external electrical and magnetic fields.

Tracking Ability

There is little argument that the ability of the stylus to maintain continuous contact with the record groove is of paramount importance. What is often not recognized is the fact that the ability of the stylus to do this is dependent upon the frequency of the modulating signal. The following example illustrates this phenomenon.

Assume we have a record with three bands, containing 128 Hz, 1024 Hz and 10,000 Hz. These frequencies would be, respectively, one octave below middle C, two octaves above middle C, and a very high frequency which might be found as an overtone in some musical instruments. All of these bands are recorded at a peak modulation velocity of 5 centimeters per second. The term *"modulation velocity"* refers to the speed at which the stylus must move side-to-side while following the groove, as shown graphically in Fig. 1. Note that although the stylus reaches the same peak velocity at each frequency, it must do so many more times each second for the higher-frequency signal than for the low-frequency signal. Without going into the physics of the situation, our intuition tells us that the requirement for a stylus to follow the high-frequency signal is considerably different from that of following a low-frequency signal. For many cartridges, we would find that there would be little difficulty encountered in reproducing the 1024-Hz tone. A somewhat better cartridge would be required to produce the low-frequency tone also. And an even better cartridge would be needed to reproduce all three signals faithfully.

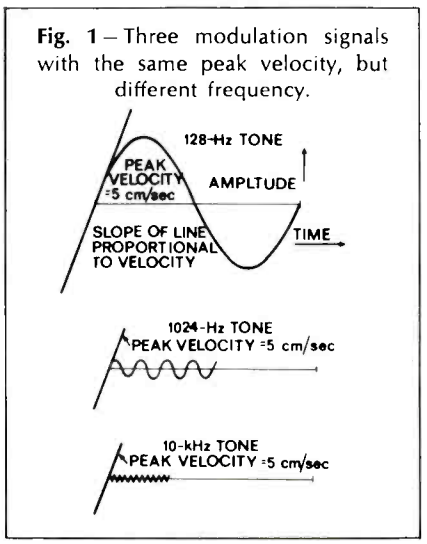


Fig. 1 – Three modulation signals with the same peak velocity, but different frequency.

Manufacturers specify the tracking ability of the cartridge in a variety of ways, some rather obscure. The following are the most common.

1. *Tracking.* The specification is normally given for a low frequency such as 400 Hz, although frequency is often not stated. The specifications will give the maximum modulation velocity which the cartridge can track at that low frequency. For a good quality cartridge, this velocity should be greater than 12 centimeters per second at the lowest specified stylus force and at 400 Hz. *It should be kept in mind that this specification in no way tells the user*

*Shure Brothers, Inc., Evanston, Ill.

the tracking ability of the cartridge at the high frequencies.

2. *Compliance.* The compliance of the stylus is a measure of how easily the stylus can be deflected. This parameter is related fairly closely to the low-frequency tracking ability. More-compliant cartridges generally track the low frequencies better. Most companies specify compliance under a static or stationary load. This is not too meaningful in that in operation the stylus is moving rapidly. Since compliance of most cartridges decreases as the frequency increases, the static compliance is generally higher than effective compliance when the stylus is in motion. All of this is to say that the compliance specification is practically meaningless to the user and might best be ignored altogether.

We should note here that compliance can be a meaningful characteristic if the proper value is known. This requires measurement of compliance while the stylus is in motion. Such measurements result in compliance figures lower than the static compliance. Dynamic compliance is useful in determining the resonant frequency of the tone-arm/cartridge system and is, therefore, important to the designer of tone arms.

3. *Stylus tip mass.* This term refers to the effective mass of the stylus assembly. Properly applied, it refers to more than just the diamond tip, and includes the stylus shank and other attached members.

This is a mechanical property of a cartridge which affects the high-frequency tracking ability. There is no standard method of accurately measuring stylus-tip mass. Specifications are normally based on weight measurements and calculations. Even if an accurate measurement were made, the existence of low tip mass does not necessarily guarantee good high-frequency tracking ability. With these two factors in mind, we would recommend that this specification also be ignored in reviewing phono cartridge specifications.

4. *Tracking-ability curves.* Since we are concerned with the tracking characteristic of a cartridge over the complete audible frequency spectrum, the ideal specification would provide just this information. Figure 2 is a curve showing such a specification in graphical terms. A graph of this sort gives a complete picture of the tracking ability of the cartridge and requires no inferences or interpretations by the user. Figure 2 also shows minimum limits required for the superior phonograph cartridge in terms of the theoretical maximum velocities to be found on 33⅓-rpm stereo records. Many good-quality records exist which exceed the theoretical maximum. The tracking ability of the cartridge should, therefore, be well above the theoretical maximum. Some of the 45-rpm monophonic records have modulation in excess of the velocities shown in this figure. A velocity of 35 cm/second at 400 Hz is not at all uncommon on "pop" records. Since such records usually contain considerable distortion and do not require high-fidelity reprotion, they are not normally considered in setting tracking ability objectives for high-fidelity phono cartridges.

Since there is no standard for specifying tracking ability, and since few manufacturers present the complete pictures shown in Fig. 2, the purchaser would do well to test the cartridge before he buys it. This can be done quite easily by asking the dealer to demonstrate the cartridge on a record which will exhibit the tracking characteristic of the cartridge. Some suggested records are:

(a) Polydor #237 310 (Stereo); "Elizabeth Serenade." Listen particularly to the bells.
(b) London #SPC 21010; "H.M.S. Pinafore," Side 2, Band 1. Listen for the "S" sounds while the male vocalist is singing.
(c) Nonesuch #H-71019 (Stereo); J. S. Bach, Four Concertos for Harpsichords and Orchestra.

Keep in mind that the records used should be in good condition, preferably new.

Frequency Response

The spectrum of frequencies which the human being can hear covers a range from about 20 Hz to 20,000 Hz. The phonograph cartridge should reproduce all frequencies within this range exactly as these frequencies were put into the record groove. An ideal cartridge would have a response curve of a horizontal straight line. The frequency response of a cartridge might look like that of Fig. 3. The manufacturer's specification for the cartridge of Fig. 3 could read: "Response: 20-20,000 Hz ± 2 dB."

Most manufacturers specify the *typical* frequency response of their cartridge. The typical response is the average of a large number of cartridges. Any single cartridge might vary from the typical by a tolerance stipulated by the manufacturer's quality standards and manufacturing capability. Thus, as shown in Fig. 4, any single cartridge might vary from the typical

Fig. 2—"Tracking ability" curve.

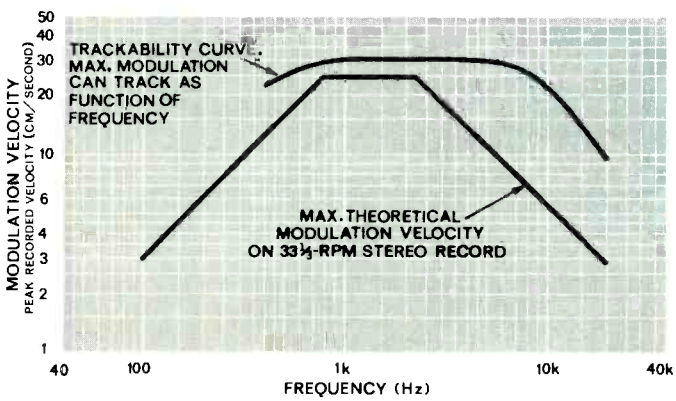
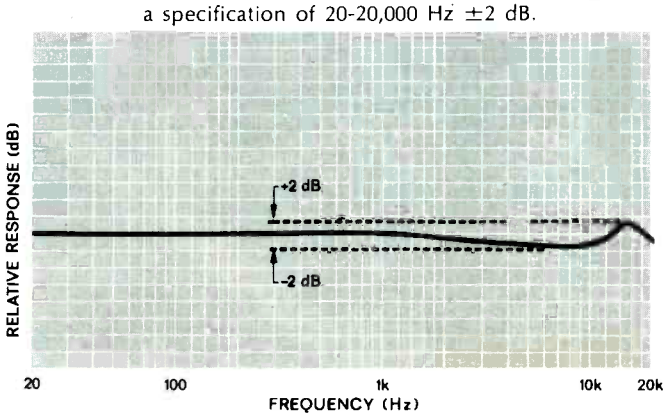
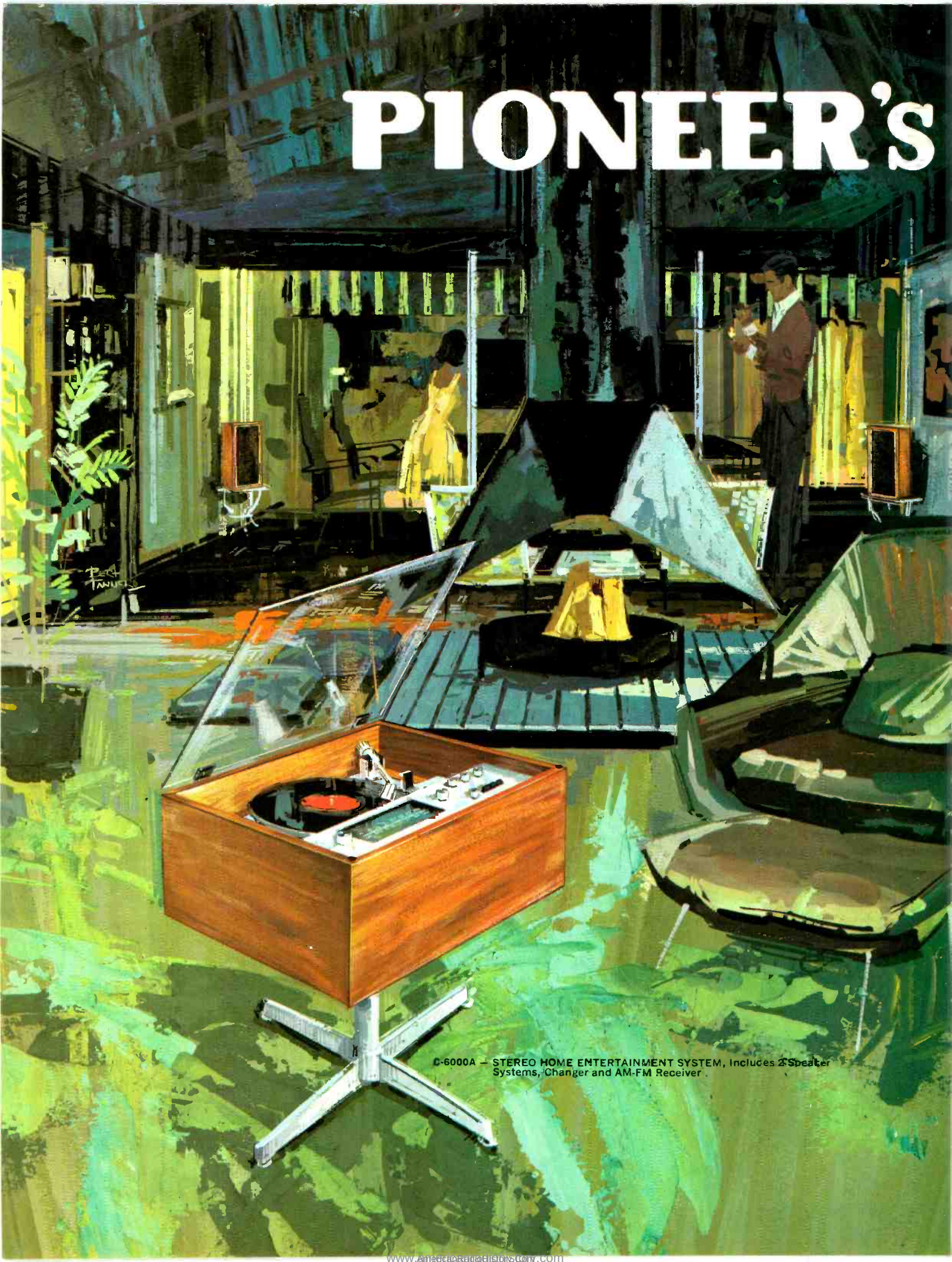


Fig. 3—Frequency response characteristic of phono cartridge with a specification of 20-20,000 Hz ±2 dB.





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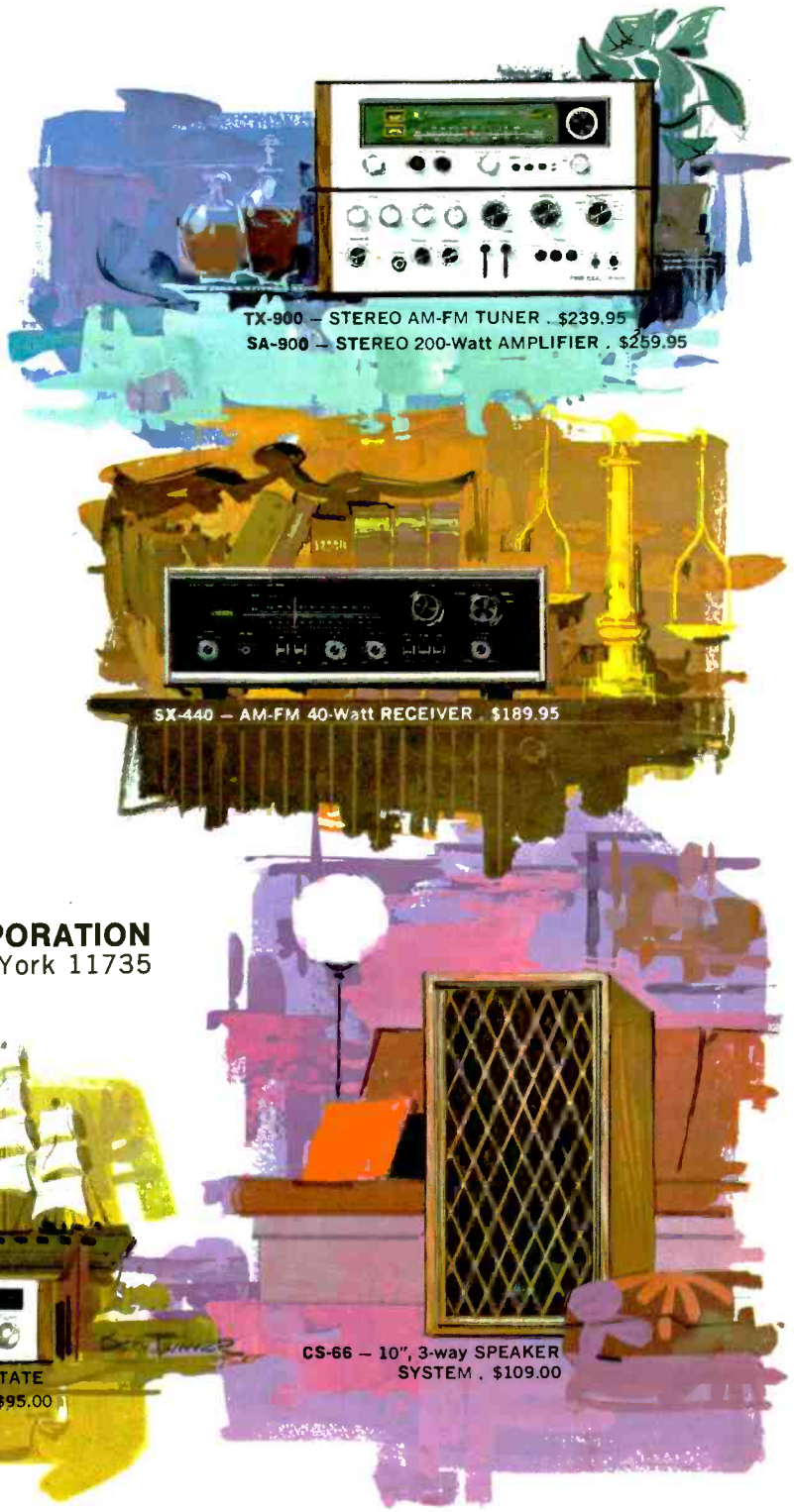

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Phono Cartridge Specifications

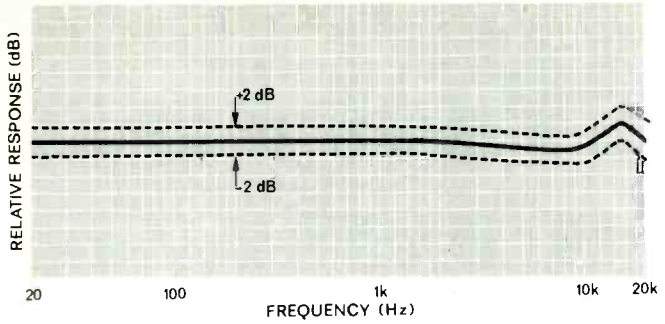


Fig. 4—Tolerance limits of a phono cartridge's frequency response, where solid line is typical response and dotted lines are variations due to manufacturer's quality standards.

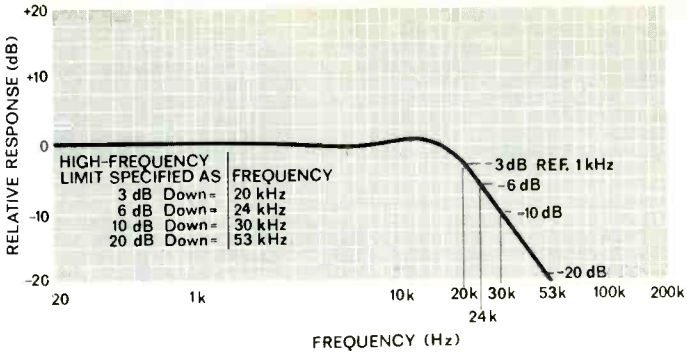


Fig. 5—Frequency-response curve showing several high-frequency limits, depending on how specified.

by some additional amount within the tolerance limits. This tolerance is not normally specified.

One source of confusion in specifying frequency response is the determination of the upper and lower frequency limits. The low-frequency response limit is determined to a major degree by the arm used with the pickup and the equalization of the preamp. The pickup itself has no lower-frequency limit. One point to note, however, is that an appreciable response extended below the audible limit of 20 Hz can make the system quite vulnerable to record warps, eccentricities, and floor vibration.

A complete specification would require a statement as to how many dB down the response would have to fall to reach the limit. Figure 5 shows a curve which rolls off at the high end. If the upper limit is specified at "3 dB down," the upper response limit is 20,000 Hz. If the upper limit is taken at 20 dB down, the upper limit is 53,000 Hz. Since in the latter case very little output is available, an unqualified specification of 53,000 Hz would be very misleading to the consumer. A meaningful specification should be based on response limits based on a maximum of "6 dB down," and preferably "3 dB down."

When reviewing the frequency response specification, the user should keep in mind the following:

1. Frequency response for top cartridges should extend over the complete audible spectrum of 20 to 20,000 Hz. Medium-quality cartridges should have a response to 17,000 Hz.

2. Under no circumstance should the cartridges have a peak at frequencies below 10,000 Hz.

3. Many good-quality cartridges do have a peak in the 13,000 to 17,000-Hz range. This peak should be no greater than 5 dB. While such a peak can be accepted, it is not desirable and is not found in the very-best-quality cartridges.

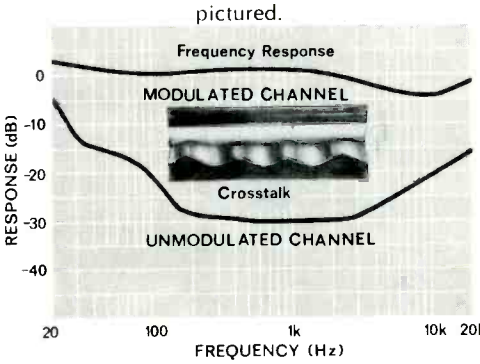
4. The best-quality cartridges should have no peak below 20,000 Hz.

Separation

The separation specification for a phonograph cartridge tells how independent one channel is from the other. Typically, the measurement would be made with a record groove that is modulated in only one channel. A measurement would be made of the output of the cartridge when playing the modulated channel. This would then be compared to the output of the other channel. Figure 6 shows the groove configuration and a typical graph of output for the two channels. The separation is shown as the difference in output between the two channels. Note that the separation varies with frequency. The ideal presentation should, therefore, be a curve showing separation *versus* frequency, such as Fig. 6. Most manufacturers simplify the specification by stating separation only at selected frequencies, such as 100, 1000, and 10,000 Hz. A further simplification would be a statement of separation only at one frequency, generally 1000 Hz. In reviewing separation specifications, the user should look for at least:

1. 20 and, preferably, 25 dB separation at 1000 Hz.
2. 15 to 20 dB separation at 10 kHz.
3. 15 to 20 dB separation at 100 Hz.

Fig. 6—Crosstalk curves illustrate the degree of leakage from one stereo channel to another vs. frequency. Measurement is made while playing a record groove that is modulated in only one channel, as pictured.



Separation specifications apply only when the cartridge is properly mounted. When viewed from the front, the bottom surface of the cartridge must be parallel to the record surface. Tilting of the cartridge only two or three degrees can result in a serious degradation of separation and must be avoided if the manufacturer's specifications are to be achieved.

Output Voltage

The output voltage is specified for a given modulation velocity. For example, a cartridge might be rated 0.6 millivolts at one centimeter per second modulation velocity (abbreviated at 0.6 mV/cm/sec). In reviewing the output specification, it is important to know the modulation velocity which was used used in making the rating. Table I shows specifications for three cartridges, all of which have the same output but with specifications based on different modulation velocities.

TABLE 1

Cartridge	Level	Test Velocity
#1	3.0 mV	5 cm/sec peak
#2	6.0 mV	10 cm/sec peak
#3	0.6 mV/cm/sec	Any

Typically, 0.6 mV/cm/sec is adequate output for high-quality, low-noise systems. Lower-quality systems often have higher noise levels, and cartridges with output voltages of 1 to 2 mV/cm/sec offer the advantage of a higher signal-to-noise ratio.

Distortion

As applied to a phono cartridge, the word "distortion" refers to any phenomenon that produces output signal components not in the record modulation. If the record modulation, for example, were a pure 400-Hz sine wave tone, distortion in the phono cartridge might produce an electrical signal with 800, 1200, 1600, and many more frequencies in addition to the 400-Hz

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fundamental. Distortion specifications should, therefore, indicate how much of the undesirable component is added by the phono cartridge.

Because of the complexity of the many mechanisms that produce distortion, it is impossible to provide a simple specification that completely describes this characteristic. We will describe two popular methods of measuring distortion, but must state from the beginning that both methods leave much to be desired. One of the major deficiencies of all distortion measurements is in the correlation between the measurement and subjective reaction. No measuring technique exists today which tells in simple fashion how bad the distortion sounds to the listener. The problem is further complicated by the fact that some kinds of distortion sound worse than other kinds.

The most commonly cited distortion measurement is total harmonic distortion. This measurement is made by using a record with a single frequency of, for example, 1000 Hz. This record must be as distortion-free as possible. An instrument called a "distortion analyzer" is used to measure the output of the phonograph cartridge at all frequencies that come out of the cartridge but are not in the record and are, by definition, distortion frequencies.

Measurements of good-quality cartridges on test records, such as the CBS-STR-120, produce total harmonic distortion figures in the range of 1 to 3 per cent. Distortion of this magnitude is generally considered to be subjectively tolerable. A specification in this range with this record would be acceptable, but, as stated previously, would not tell the whole story of distortion.

A second commonly used distortion measurement is based on intermodulation, usually referred to as "IM." When two frequencies are introduced into a distortive device, the output will contain, in addition to the two fundamental tones, sum and difference frequencies. The input signals often used are 400 and 4000 Hz, and the distortion products are 3600 Hz (difference) and 4400 Hz (sum), plus a large number of other tones related to these sum-and-difference frequencies.

A typical record used in making the IM test is the CBS STR-111. The output of the cartridge at the sum and difference frequencies is measured and compared to the output at 4000 Hz. The ratio in per cent is the IM distortion. IM specifications in the order of 1 to 2 per cent on the STR-111 are typical of good-quality cartridges.

It should be noted that distortion measurements can vary considerably, depending on the test record employed. At present, measurements to a minimum of about 1 per cent represent the state of the art.

At this time, extensive work is being carried out on the theoretical and practical aspects of phono-cartridge distortion. Much has yet to be done in perfecting measurement techniques and determining the relationship between measurement and subjective response.

Hum

Most cartridges are susceptible, in one degree or another, to the electrical fields which come from the turntable, amplifiers, and associated wiring. Good-quality cartridges are rendered insensitive to this hum pickup by adequate shielding or by other means. Hum should be specified in a given magnetic field normally rated in oersteds. A good-quality cartridge would have hum pickup of less than 0.2 millivolts in a 1-oersted field.

Channel Balance

This specification refers to the difference in output level from the two stereo channels. Typically, the specification might read "Channel balance within 2 dB." This says that one channel might be as much as, but no greater than, 2 dB higher in output than the other channel. Since all stereo amplifiers are provided with balance controls, channel-balance differences of as much as 2 dB can be corrected easily and, therefore, introduce no problem.

If, when installing the cartridge, it is found that the balance control of the amplifier must be offset by a very large amount, something in the system is out of balance. Along with the amplifier and speakers, the cartridge should be checked to make certain it is not defective.

Tracking Force

Several of the functional characteristics just described depend on the tracking force employed. It is important, therefore, to understand the effect and significance of this force.

The tracking force is the amount of force (specified in grams) between the stylus tip and the record. This is a very important specification because it is closely related to the rate of wear of both the stylus tip and the record. Extensive measurements have shown, as an example, that the life of a diamond tip can more than double when tracking force is halved at forces below 1½ grams. It is important, therefore, that the cartridge be capable of performing properly at a minimum tracking force.

Tracking force is closely related to tracking ability. Cartridges should never be used at a tracking force below that required for proper tracking. Although lower tracking force leads towards longer tip and record life, improper tracking will shorten record life. Thus, the tracking force must be set sufficiently high to ensure proper tracking.

The manufacturer's specification provides a range of tracking force over which the cartridge is supposed to track properly. At the minimum force, the cartridge should track most program material. Higher tracking forces may be needed for records with extremely high modulation levels and also when the cartridge is used with equipment that may be somewhat less than optimum. For example, a tone arm with some measurable degree of friction would require a higher tracking force than a completely frictionless arm.

The maximum tracking force generally refers to the force above which the stylus will collapse and the cartridge body will touch the record surface. With low-quality tone arms, it may be found that a very high tracking force is needed to maintain proper operation; and, thus, a cartridge which is capable of supporting the higher tracking force will be required. If, for example, a record changer requires 4 grams of tracking force for proper operation, one would not want to use a cartridge designed for ¾ to 1½ grams tracking force, since the stylus would collapse with the application of 4 grams.

In evaluating the tracking force specification, the user should:

1. Choose a cartridge compatible with his tone arm. In general, cartridges rated in the ¾- to 1½-gram range require the very-best-quality tone arm. Such arms must either be purchased separately or as part of a top-quality automatic turntable or changer.

2. When used in conjunction with medium- or low-priced changers, the higher-tracking-force cartridges in the 1½- to 3-, or 3- to 5-gram range should be employed. It should be borne in mind that the use of these higher tracking forces will accelerate wear of both the stylus tip and the records.

3. Careful consideration should be given to the validity of the minimum tracking force specification. This can be determined by the user through a simple demonstration, such as that described under "Tracking Ability." The dealer should be asked to demonstrate the operation of the cartridge at the minimum specified tracking force with the specified demonstration record. The user can then judge for himself the

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(3) TA-3120 amplifiers, $249.50 each; TA-2000 preamplifier, $329.50; TA-4300 3-way electronic crossover, $199.50; 5000FW FM stereo tuner, $449.50; TTS-3000 turntable, $149.50; PUA-286 arm, $99.50; cabinet for 5000FW, $24.50.

SONY®

Phono Cartridge Specifications

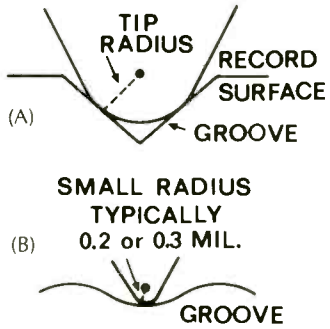


Fig. 7—(A) Illustrates a view of the stylus tip looking down the record groove. In (B), a view of an elliptical tip is shown looking at the record at an angle of 45 degrees (parallel to one groove wall).

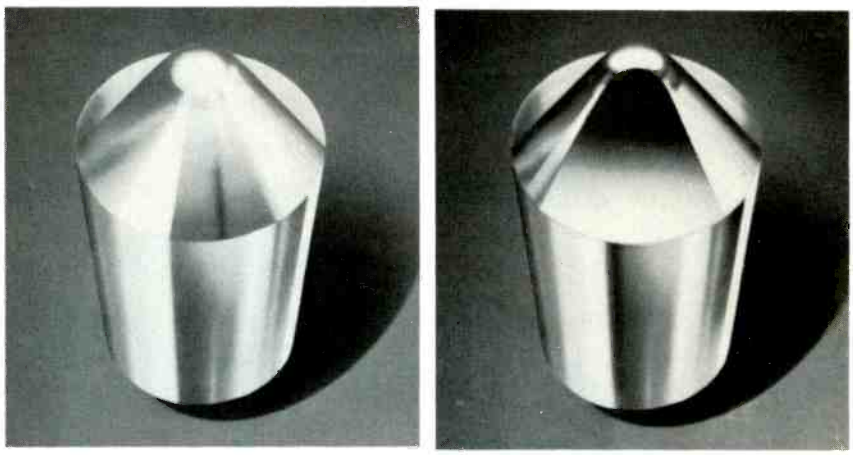


Fig. 8—A conical stylus (left) and an elliptical stylus (right) are shown here.

validity of the manufacturer's specification.

One final word on this subject relates to the range of tracking force suitable for a given cartridge. It has been our experience that a range of a little over two-to-one is the maximum that one can reasonably expect from a phonograph cartridge. Thus, ratings of ¾ to 1½ grams, 1½ to 3 grams, and 3 to 5 grams are typical. Cartridges which purport to operate over ranges of as much as 1 to 6 grams generally are designed for 6 grams and operate properly only down to about 3 grams. At 1 gram, such a cartridge would normally be found to track very poorly and would in no way be comparable to a cartridge designed specifically for 1-gram tracking force.

Superior tracking ability at low tracking forces of ¾ to 1 gram is far more difficult to achieve than at the higher tracking forces of 3 to 5 grams. For this reason, cartridges designed for ¾ to 1½ grams are generally identified by very lightweight, low-mass stylus mechanisms and commensurably higher price-tags.

Physical Characteristics

A. *Size and Weight.* The user should check the physical characteristics of the cartridge to make certain that it fits in the head of his tone arm and also to make certain that the weight of the cartridge can be balanced out by the tone arm employed. The following factors should be checked:

1. Overall dimensions to make certain the cartridge will fit in the tone arm head.
2. The mounting arrangement of the cartridge as compared with that of the tone arm.
3. The balance adjustment of the tone arm to make certain it is sufficient to balance out the weight of the proposed cartridge. Some tone arms do not have sufficient range of adjustment to balance out some of the heavier cartridges.

B. *Tip Radius.* This specification refers to that portion of the diamond tip that touches the record groove (Figure 7A). For conical tips with spherical ends, the most commonly used radius for both mono and stereo grooves is 0.7 mil (.0007 inches). Some manufacturers supply special tips of 2.7 mil (.0027 inches) radius for playing old 78-rpm shellac records.

Bi-radial or elliptical tips are specified with two radii, such as 0.2 x 0.7 mil. (The same tip may be described as .0002 x .0007 in.) The first number refers to the radius of the tip at the points where it touches the groove (Fig. 7B). The second number refers to the front radius of the tip (Fig. 7A). At present, typical elliptical styli are offered at 0.2 x 0.7, 0.3 x 0.7, and 0.2 x 0.9 for use in the ¾- to 1½-gram tracking force range. Elliptical styli with 0.4 x 0.7 and 0.4 x 0.9 are offered for use at tracking forces up to 4 grams. Figure 8 shows photographs of conical and elliptical tips.

Electrical Specifications

The industry has standardized on an impedance of 47,000 ohms at the input to amplifiers used in conjunction with magnetic phono cartridges. Most cartridges are designed to work into 47,000 ohms and most amplifiers are designed with an input impedance of 47,000 ohms. The user should check to make certain that this is the rating of his amplifier and that the cartridge is designed for this value.

Some manufacturers provide values of optimum load capacitance. All phonograph systems contain some capacitance in the tone arm, connecting cable, and amplifier input. Variation of this capacitance within a reasonable range is not significant for most users. The most critical user should follow the manufacturer's specification. This requires a measurement of the system input capacitance or use of values supplied by the manufacturers of the components. If the capacitance is lower than specified, a small capacitor connected across the amplifier input can be used to provide the optimum value.

A statement is usually made in the manufacturer's specification of the inductance and d.c. resistance in the cartridge. These figures are of little value to the user, since they are part of the design criteria relating to the use of the cartridge with the standard 47,000-ohm load.

Conclusion

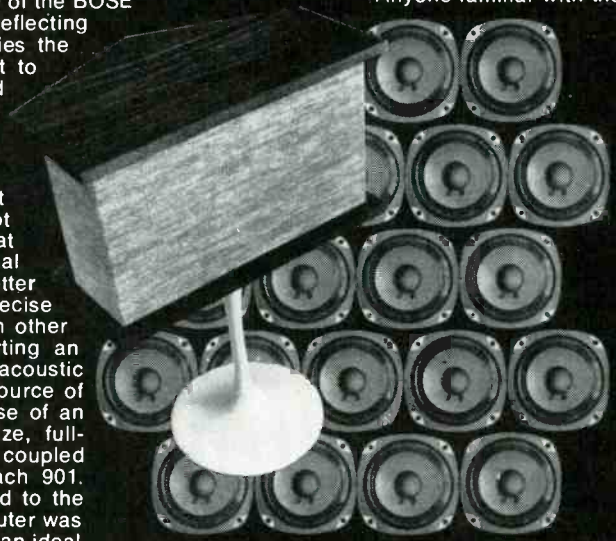
Great progress has been made in recent years in improving techniques for measuring and specifying phono cartridges. This progress has resulted in a better understanding of the characteristics of the cartridge which contribute significantly to the listener's subjective reaction. Many of these characteristics have been described here.

Unfortunately, little exists in the way of standards, either in terms of measuring means or in specifications. This makes the problem for the prospective purchaser of cartridges rather difficult. In reviewing a specification, an evaluation must be made of what a given manufacturer means in terms of methods and conditions of measurement. For many specifications, the user has no assurance that one manufacturer means the same as the next. To aid the user, the manufacturer ideally would supply very comprehensive specification data. Obviously there is a practical limit to what can be done in this regard. Today's specifications offer a compromise between completeness and practicality. Æ

How does the BOSE 901 eliminate audible RESONANCES?

If you have heard the BOSE 901 Direct/Reflecting™ speaker system, or if you have read the reviews in High Fidelity, in Stereo Review, and now in the December Audio, you already know that the 901 is the longest step forward in speaker design in perhaps two decades. Since the superiority of the 901 (covered by patents issued and pending) derives from an *interrelated group of advances*, each depending on the others for its full potential, we hope you will be interested in a fuller explanation than is possible in a single issue. This discussion is one of a series on the theoretical and technological basis of the performance of the BOSE 901.

The best known feature of the BOSE 901 is its Direct/Reflecting design, which copies the proportion of direct to reflected sound measured in the concert hall. But aiming a speaker at a wall does not magically give it greatness. What is not yet so well known is that even in conventional terms the 901 is a better speaker — a more precise instrument than other speakers for converting an electrical into an acoustic signal. The primary source of this precision is the use of an array of 9 same-size, full-range, acoustically coupled speakers in each 901. In the research that led to the 901, a digital computer was used to simulate an ideal vibrating surface "having no resonances, phase shift, diffraction, or distortion of any kind." It was then proved (and demonstrated at a professional group meeting of the I.E.E.E. in Nov. 1964) that a multiplicity of closely spaced, acoustically coupled, full-range speakers "can produce music and speech signals in a normal listening environment that are subjectively indistinguishable from those that would be produced by an ideal pulsating sphere in the same environment." *



Any speaker has many inherent resonances — frequencies where its response is irregular. Our research determined that when many similar speakers are closely spaced and acoustically coupled to a common chamber, the resonant frequencies of each speaker diverge from those of every other speaker. As a result, each resonance becomes inaudible, since it causes a change in the output of only one speaker of the many.

Anyone familiar with the problems of resonances in conventional speaker design will appreciate how important a discovery this is. In the case of the 901, it means that only one speaker out of 9 can be in resonance at a time — a proportion which is inaudible. The resultant freedom from audible resonances and other forms of distortion helps to account for the utter clarity and honesty of musical performance for which the 901 has already become famous. For the present, if you would like to hear the difference that a multiplicity of full-range speakers can make (in combination with 3 other major advances), ask your franchised BOSE dealer for an A - B comparison of the 901 with the best conventional speakers — *regardless of their size or price*. Then, go back to your present speakers — if you can.

***From 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', Dr. A. G. Bose, a paper presented at the 1968 convention of the Audio Engineering Society. Copies of the complete paper are available from the Bose Corp. for fifty cents.**

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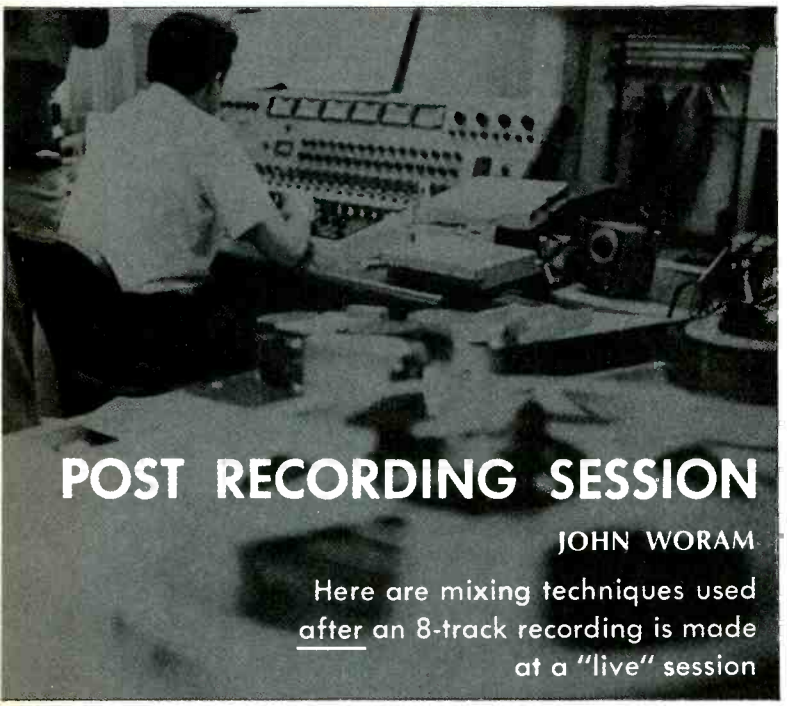


POST RECORDING SESSION

JOHN WORAM

Here are mixing techniques used after an 8-track recording is made at a "live" session

SOME YEARS AGO, all work on a record had to be done during the actual recording session. If you couldn't get what you wanted during the session; there was little possibility for after-session improvements. Today, conditions are different. In fact, in many cases, more work is done after the session than during it. This change has been brought about largely as a result of the new multitrack tape recorders now in use at most professional studios. In a previous article (AUDIO, May 1969), we described how, during the recording session, the instrumentation for Peggy March's new single, "Purple Hat," was spread out over eight separate tracks. This technique allows the producer more flexibility in creating a definitive final product during a so-called re-mix or tape-mastering session.

The expression "re-mix" is a current variation of the earlier "re-recording." At first, all mixing was done during the recording session. When more than one microphone was used, the outputs of the various mics were combined, or mixed, to form a single complex signal which was then fed to a disc-cutting lathe—and later on, as technology progressed, to a monophonic tape recorder. In some cases, this tape would later be copied, or "re-recorded" and some equalization or volume changes made. They would have to be slight, since any changes made would affect the entire sound, and not just the violins or drums, for example. In later years, the microphones would be mixed on to two (and still later, three) separate tracks, and these would later be re-recorded or "re-mixed" to form a final master tape. As this master tape was made, each of the separate tracks from the tape made during the recording session could be equalized and adjusted independently.

Now we come to a recording session where an eight-track tape machine is more often than not in use. If the recording group is small, it is entirely possible that each track contains the output from only one microphone, in which case no "mixing" at all is done during the actual session. On the Peggy March session, the tracks contained the outputs of anywhere from one microphone (the lead-guitar track) to 12 (the combined brass-and-string-section track).

One of the greatest advantages of the stereo tape or disc is that sounds need not be confined to either the left or right speaker, but may seem to originate from any point between them. Our first task was to determine a suitable left-to-right orientation for the various instruments. After a little experimenting, we arrived at the following:

1. Peggy	Center	5. Fender bass	Right
2. Lead guitar	Left ofCenter	6. Brass only	Right
3. Rhythm guitar & piano	Right of Center	7. Strings only	Right
4. Drums & percussion	Left	8. Brass & strings combined	Left

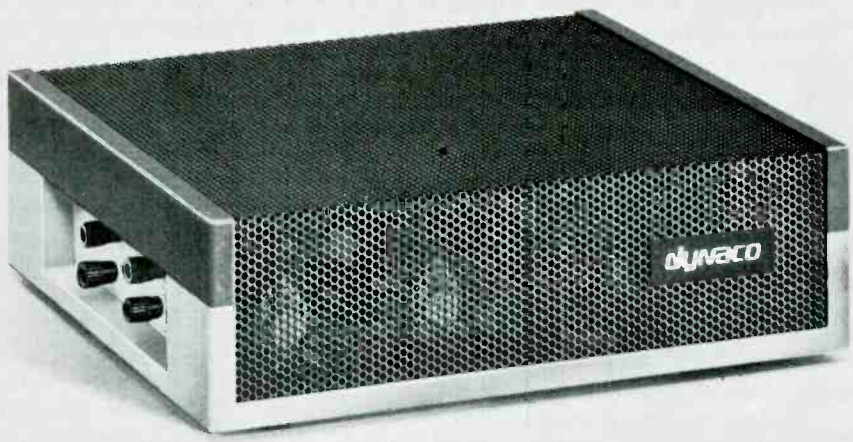
By a complex process, only partially understood, our ears are able to determine the point of origin of a sound. If a noise originates on our extreme left side, it reaches our left ear sooner (and louder) than it does our right. Both ears hear equally well a sound coming from directly in front of us. This comparison of left- and right-signal information is what helps us to locate the source of a sound with accuracy. For this reason, people who have lost their hearing in one ear often are unable to determine the direction from which a sound is coming.

In re-mixing, the illusion of a singer standing directly between the two speakers is created by feeding the vocal track to both the left and right tracks of the master tape. In playback, the listener sitting equidistant from the two speakers, hears the singer equally well with both ears, and concludes that the voice is coming not from both speakers, but from a point directly between them. The drums and percussion seem to be coming from the left because that signal has been fed only to the left track of the master tape. The slightly right-of-center rhythm guitar and piano sound that way because, although they have been fed to both tracks, they have been fed in unequal proportions, with more signal going to the right track. A tabulation of the left-to-right distribution of the eight tracks is given below. The numbers indicate the relative amount of each of the eight work-part tracks that may be found on the final two-track master tape. (The multitrack tape made during the recording session is usually called the "Work-Part" tape to distinguish it from the finished master tape).

Track	Contents	L-to-R Ratio
1	Peggy March	1 to 1
2	Lead guitar	2 1
3	Rhythm guitar & piano	1 2
4	Drums & percussion	1 0
5	Fender bass	0 1
6	Brass only	0 1
7	Strings only	0 1
8	Brass & strings combined	1 0

In other words, the left track contains twice as much of the lead-guitar signal as the right track; the left and right tracks contain equal amounts of the soloist, and so on.

Actually, the Fender-bass tabulation is not entirely correct. Last month, we described how the output from



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the Fender bass track is first divided at about middle C. The below-C segment is fed equally to both tracks, while the above-C segment is fed to the right track only. The reason for this was outlined earlier. Thus, even though the ratio given above is not electronically correct, it represents the illusion that the listener hears—that is, of the bass being on the extreme right side.

The modern pop recording studio is usually a fairly "dead" room. It does not possess any distinctive "room sound" such as found at Carnegie Hall. There is very little reverberation or echo within the studio itself, and what little there may be is further minimized by placing flats or "gobos" in strategic locations. The advantage of this treatment is that sounds produced within the studio do not travel very far. A microphone placed near a guitar will hear only the sounds produced by the guitar itself. There will be no echo as the sound of the guitar returns from distant walls since the treatment of the walls (and the gobos placed around the guitar) prevent the sound from ever reaching the walls and even it if did, they would keep the reflected sound from getting back to the microphone. Furthermore, there will be little or no sound picked up from adjacent instruments. As a result, the signal transmitted to the tape machine will be clear, crisp, clean, and perhaps a little too "dead" for most tastes. However, it will be a sound that can be later equalized, limited, compressed, and otherwise manipulated without affecting the sounds of other instruments recorded on other tracks. This treatment may be anything from an imperceptible boosting of some upper frequencies, to a complete electronics overhaul to produce some unusual effect beyond the capabilities of the instrument itself.

At any point during this process, artificial echo or reverberation may be added. This too may vary from an accurate simulation of a concert-hall type of reverberation to science-fiction-type multiple echo.

On the Peggy March re-mix session, we used just a bit of the latter at the beginning of the record. The song "Purple Hat" opens with Peggy singing an unaccompanied phrase, "She wore a purple hat when she went away." To help create a mood of detached loneliness, we used a mechanical reverberator. The vocal output from the eight-track tape was fed to the reverberation device from a point ahead of the vocal mixer. In this way, a signal is fed to the chamber even if the mixer is off. Thus, varying the amount of direct signal to the two-track master tape (by moving the vocal mixer) does not affect the echo signal. With the mixer off, the tape receives an echo signal only. As the mixer is brought up, the direct signal is fed to the tape also. As more and more direct signal is applied, the echo signal loses its apparent prominence, since it remains unchanged in level. The device we used has two random outputs. We fed one output to the left track, and the other to the right track, which offered a further contrast to the single direct-vocal track which was fed equally to both tracks. To begin the song, we kept the vocal mixer at a low setting so that there was a relatively higher echo effect. As the song progressed, the vocal mixer was raised slightly until a more "normal" effect was achieved.

The string and brass sections were treated differently. As described earlier, the combined brass-and-string track (#8) was fed to the left. The separate brass (#6) and string (#7) tracks were placed on the right. We added a little low end to track #6 and a bit of highs to track #7 so there would be a slight difference in the left-to-right sound. The lows helped to emphasize the trombones, while the highs brought out the upper strings.

We wanted a very spacious, airy sound on the strings and brass. This was achieved (I hope) by feeding the right signal into an echo room. As opposed to the mechanical devices, this is an actual room located in the basement of the studio building, and it contains an amplifier, a speaker, and a microphone. The treatment of the room makes it highly reverberant. The signal is sent down to the room, amplified, and fed to the speaker. The microphone located across the room receives the highly reflected sound and returns it to the re-mix console. We then took this echo-return signal and fed it to the opposite (left) track, so that the echo seems to come from a point far removed from the original source of sound. In like manner, the left brass and strings were fed to a different echo room and returned to the right side.

Often the signal being sent to the echo device is delayed slightly by first being fed to the record head of an auxiliary tape machine. The playback-head output is then fed to the echo device (or room). Thus, the signal is delayed by the time it takes for the tape to travel from the record head to the playback head. Frequently, this will create a more realistic impression, since natural echo always occurs slightly after the direct signal is heard.

By not applying echo to the guitars, piano and drums, these instruments retain their sharp clarity. Their more percussive sounds stand out in relief against the "wall-to-wall" brass-and-string background.

By its nature, the bass often produces an expansive sound lacking the definition of a regular guitar. Also, the note-to-note dynamic range is apt to be quite large. To give the bass a more percussive, "tighter" sound, its output was fed through a compressor, which, in studio language, is called a "limiter." At low levels, the compressor has little effect. However, when the output from the bass increases, the compressor "holds down" or "limits" this signal. The dynamic range is thus reduced, so that after "limiting," the entire bass signal can be raised in level. The result is a more-controlled, driving bass sound that can provide an audible pulse beneath the sounds of the other instruments.

After several trial runs to check the suitability of our settings, the two-track master tape was made, and later on, a reference disc was cut using the master tape as its source. After approval, a master lacquer will be cut and sent to the record plant for processing, pressing, and labelling. A few test pressings may be sent back to the studios for a final check-up to verify that the finished product matches the master tape. At a later date, if more pressings are required, a new lacquer disc will be cut, again using the same master tape, and stampers will be made from the disc.

And that's about all there is to a contemporary pop recording. The specifics vary from record to record, depending on the type of music involved, but the general procedures are usually much the same as those described above. Æ

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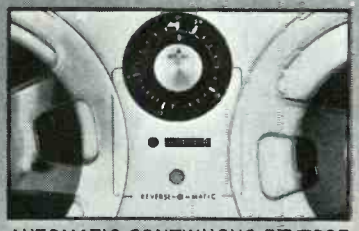

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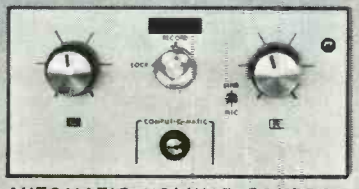

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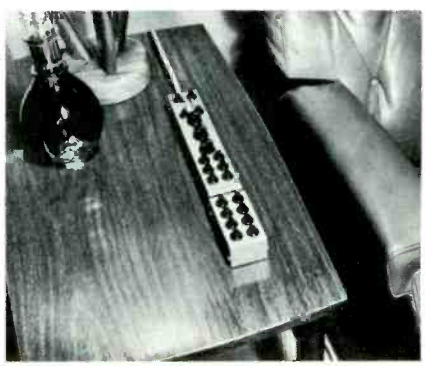
Tom Rose, Dallas, Texas

AFTER starting out in high fidelity in 1958 I progressed through many changes to the present system. This system was built to satisfy three main goals: (1) high quality, (2) maximum flexibility, both electrical and mechanical, (3) concealed speakers. Needless to say, this is not the final system. It was rack-mounted specifically to make it easy to change. At least once every six months there is a change in one of the components.

The stereo system itself is located in the study, while the main speakers are located in the living room. Wooden cabinets were first tried, but they lacked the flexibility required. Rack mounting, with its modular panel sizes, allows components to be shifted around within the system and new ones added as required. Short desk racks were chosen over full 6-ft. floor models because of cost considerations and the large amount of panel space that needed to be at a convenient operating height. The system is composed of four racks set on a home-built base that contains record and magazine storage in the bottom section. Draperies extend from the top of the system to the ceiling, and from floor to ceiling on the right side to make it appear built-in. Two International Electronics "Gigolos" are located behind the draperies above the system for monitoring purposes. The equipment from upper left to lower right consists of (Rack 1): Citation III multiplex FM tuner, Dumont 401R oscilloscope, Ballantine 300R VTVM, Power Supply; (Rack 2): Ampex 354, tape recorder, output VU meters; (Rack 3): Citation II preamplifier, system jack field, speaker comparison panel, remote control, speaker jack field, Dynakit "Stereo 120" power amplifier; (Rack 4): Ampex 351 tape transport, two-channel playback preamplifiers, audio oscillator. Not shown is a Dynakit Mark III power amplifier for the center channel. An AR turntable rests on the base.

The Dumont scope has identical X and Y amplifiers and is used for peak power measurement, stereo separation, and balance checks. The a.c. VTVM is used mainly for recorder adjustments. The Ampex recorders are each equipped with complementary 4-position head assemblies. One machine has 1/4-track erase, record and play and 2-track play, while the other one has 2-track erase, record and play and 1/4-track play. This allows any combination of track configurations to be recorded or played. The VU meter panel allows the system to be balanced before going into the listening room. With the normalized jack field, any element in the system is available at the front for testing. If I am trying out a new component, it can be connected into the system by the jack field without disturbing the system wiring. The jack field provides maximum system flexibility. For example, I can have as many as three separate stereo programs going through the system at once without interference.

All serious listening is done in the living room where the main speaker systems are located. The speaker systems



are located on the narrow wall in the corners looking over the two chairs. To increase the stereo illusion of a continuous wall of sound, a false wall of draperies was placed in front of the speakers. The speaker systems consist of a pair of AR-3s for the two main channels and a 15-in. coaxial in an 8-cu.-ft.,

home-built bass-reflex enclosure for center-channel fill. The material for the false wall has a loose, open weave. Frequency-response curves were run on over a dozen various fabric samples, and the one that was finally chosen was a compromise between a weave so loose and open that it did not hide much, but had very little losses, and the tighter weaves which had significant losses at the high end. The material used was flat, up to about 8000 Hz, and then it started gradually falling off. At 15 kHz about 2 or 3 dB is lost in the wall. The tweeter level controls compensate for this small loss. Reverberation time of the room can be varied slightly by the draperies on the side wall. The 18 ft. of draperies can be opened to expose windows.

A remote-control panel (see photo) in the living room provides for master 115 volts a.c. power "on" and "off," turntable a.c. "on" and "off," volume control for each of the three channels, and mode selection (FM, phono, Ampex 1, Ampex 2, or a mute position to mute the audio while retaining the original levels when the system is restored to normal). The accessory module that plugs into the front of the basic control unit provides control of the two Ampex transports. The remote-control system uses 48-V d.c. relays for switching and Raysistors (light-controlled resistors) for level control.

There are better ways to build false walls than the way chosen, but I did not want the cost or performance of a solid structural wall, so I used draperies. The success of any false wall, especially a non-structural one like this, is how well it "appears" to be an actual wall. Five lamps hanging down just in front of the draperies make them appear to be the end of the room. To make the draperies appear more continuous, wall to wall, and floor to ceiling, they were made from one piece of material without seams. Special drapery hardware was used to give uniform pleats, floor to ceiling. To further enhance the illusion that the false drapery wall is the end of the room, the adjacent wall is covered floor to ceiling with the same type of draperies for 3/4 of its length. The other walls and ceilling are painted the same color as the draperies.

The false drapery wall has proven better than originally planned. The absence of visible speaker enclosures increases the stereo illusion, and makes my wife happier because she doesn't have two "boxes" setting in the living room. This is an economical solution to the problem of how to integrate speaker enclosures into the room decor and make them appear unobtrusive. Æ

78's Live!

JAMES QUIGLEY

Browsing in a record store some time ago, I came across some selections I hadn't seen on a record label in a long time.

"That's a great record," the clerk commented as he walked past. Well, yes, I guess it is. But the funny thing is that is was recorded around 1935!

Although the LP jacket takes no specific note of the fact, these recordings were originally made in Italy as 78's. Now an American company has seen fit to dub them onto an LP and reissue them, with the words "HIGH FIDELITY" displayed prominently on the outside. If they were pops, the LP would probably be called a pirated recording today. But being classical collectors items no longer protected by copyright, the word "piracy" just doesn't come to mind.

You can still get the original 78's, if you want them. There are record dealers, often with avid mail-order followings, who specialize in servicing the collector. These particular discs (Rossini excerpts, sung by Conchita Supervia) are not rare, as such things are accounted. Of the half-dozen or so that were used in compiling the LP, most should turn up in good copies with a little digging. Total cost for the whole set (once you manage to get them all) —about ten times what the LP would set you back.

Ten times as much for "old-fashioned 78's" as for the same music on a modern, convenient, unbreakable quiet-surfaced, lightweight, compact, ravishingly beautiful LP? Well, just between you and me, there is undeniable snob appeal in owning the originals"—of anything. But for the audio fan, there may be very real advantages in terms of sound, as well.

Notice that I say "may be." Remember that those discs you pay six to seven dollars for (or much more, if they're harder to come by) are not new. They have been played—perhaps with a sapphire stylus, perhaps with a cactus needle, perhaps even with a rusty wire brad by someone fooling around with Aunt Martha's old wind-up Victrola. They have been subject to other kinds of wear, too: paper scratches, cat hairs, spilled Coke, stacking without covers.

But some surprising sounds are waiting for you if you haven't played a good 78 in some time. Listen, for example, to some of the Boston Symphony recordings made around the end of the acoustic era. Sometimes, when I feel a bit too smug about the current state of hi-fi, I put on the Petruchka Suite. The fullness, detail, and dynamic range of these recordings will astonish you if you think of this era in terms of the wheezy, "golden age" discs with which the apostles of the phonograph sprinkle their radio programs.

Similarly, if you think all 78's must have discouragingly high surface noise, try some of those glorious German Polydors or the Victors from the 30's with the scroll design on the label. Then compare them with some of those early, injection-molded, polyethylene LP's!

This question of surface noise can be confusing if you're not used to 78's. Sounds seem to vary all over the lot; and sometimes the same recording will sound quite different from one pressing to another.

I remember the look of distaste on a singer friend's face once when I bought some of the Galli-Curci/Schipa duets. "We had them at home," he complained. "I can't stand the way they sing off-pitch."

But I insisted he listen; and to his surprise, he was delighted. The difference was that I was playing HMV pressings, whereas he had been brought up on war-time Victors.

Formulas for "shellac" were carefully guarded company secrets in the days of 78's. RCA Victor had hundreds of formulas. Canadian Victor, however, developed its own (and some collectors prefer their products). A recording on these Victor labels might also be available from England in pressings by HMV. Their material, while matched by the best Victrola pressings from the

30's, enjoyed a reputation as the finest in the world.

But times change. If you have admired an old John McCormack disc, you may be able to get it in a postwar Irish pressing. But don't expect it to sound the same as the earlier one. Even more noticeable is the deterioration in the postwar Italian HMV (La Voce del Padrone) pressings of early electrical and late acoustic records by such operatic greats as Ponselle, Gigli, and Pinza.

Similarly, when World War II prevented Victor from getting the materials they had been using, they changed the formula completely. The resulting pressings which continued to be issued without major improvement until after the advent of vinyl, were recognized from the first to be a giant step backward.

To the user of modern LP's, it would seem to be a pity that more 78's were not pressed in vinyl. But the resiliency of the material makes a considerable difference to the reproduction. LP's are cut with that factor already allowed for. And besides, at slow speed, with light stylus tracking, relatively little "give" is induced in the material.

When you find vinyl 78's, however, you will usually also find mushy sound. And the tendency of vinyl to develop a static charge tends to undermine its intrinsically lower surface noise by substituting the crackling sound of dust for the even hiss of good shellac.

Frequency response? There's no getting around the fact that most (but not all) of the 78's in existence were recorded with equipment that we would not call wide range today.

Deutsche Grammophon (the postwar name for German Polydor) made some brilliantly wide-range 78's that are, if anything, even more vivid than the famous English Decca (now London) *ffrr* pressings. But still, dB for dB and Hz for Hz, 78's can't match the modern LP.

Yet, if you savor the individuality of sound with those subtle differences that make each recording unique, you owe it to yourself to get out those old 78's and give them another try. The truism that "modern hi-fi equipment can't do a good job with 78's" simply isn't true.

The more versatility you have in your system, the more yau can expect to get out of your 78's. Variable compensation curves, variable filtering, tone controls, variable loudness — all these can be an advantage in matching playback to the flavor of the originals. It sounds like a lot of work; but if you're a nut like me, it's worth it.

But how will these 78's compare with the LP dubs? Wouldn't you be better off buying the LP, which should have within its groove the best sound that can be got out of the originals? Not necessarily. Aside from dubbing jobs that are downright sloppy—and a good many of them have quietly been foisted off on the American record-buying public—there are two basic types. The first, and generally the best, is done by the owner of the original masters. The second uses records on which copyright has expired or makes use of special provisions of the copyright laws where the recording is more recent. Quality on this second type is sometimes pretty poor; try to listen before you buy.

For the company who owns the original masters (the "Vault Treasures," as they are wont to call them), this is an opportunity to pick up a fast buck without paying artists or studio costs. And some of the results betray the fact. More often, however, a great deal of energy is expended to ensure that the product is as fine as modern technology can make it.

Remember when RCA Victor was still holding out against Columbia's LP system? Having touted 45 as inherently superior, RCA had some fast talking to do when they put out their first LP issue. So, on a parchment scroll distributed to their dealers, they proclaimed that they would condescend to favor the LP format with their recordings where the program material was "suited to the peculiarities of the medium," if I remember the phrase. One of their first issue of LP's included a dub of Friedrich Schorr's singing of the Fledermonolog from the late 20's. Originally, it had filled both sides of a 12-inch 78. But in spite of the fact that continuity would certainly be reckoned one of the "peculiarities" of the LP medium (by contrast to both 78's and 45's), Victor didn't even bother to splice the two halves together.

In many cases, when plans are made to issue old recordings in the LP format, it develops that metal matrices no longer exist or are deteriorated to the point that pressings from them will be inferior to good shellac pressings of the original issue. In that case, the question arises as to the best way of dealing with the characteristic.

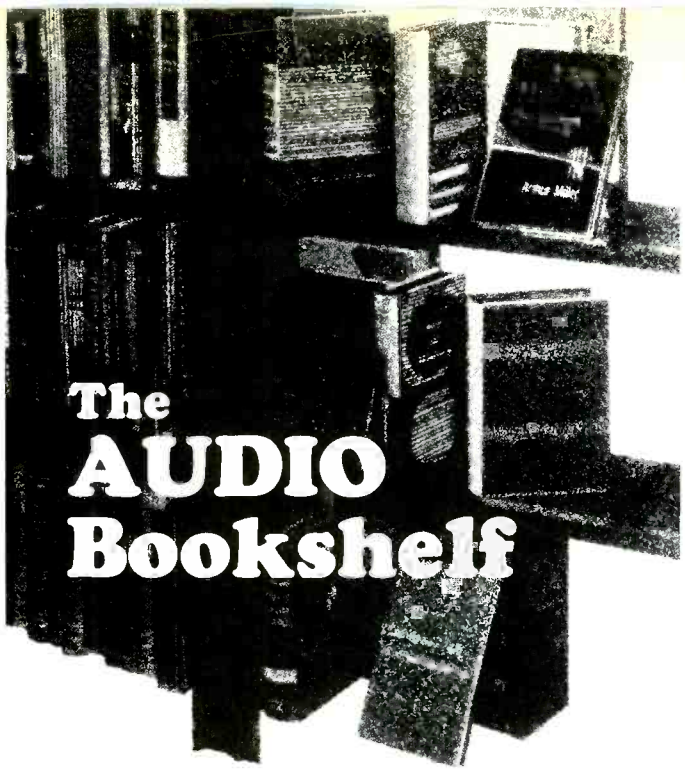
There are three basic methods of dealing with this kind of noise. The purist approach would not touch a hair of that precious sound: it would keep response in the copying equipment flat to beyond audibility on the theory that although the original recording equipment may not have had much to offer beyond 9,000 Hz, still there might be *something* that would be altered by filtering.

The high-handed approach would filter out anything that's there until all trace of surface (and a good deal of the sheen and sparkle of the music along with it) is gone. When a collection that includes some not-so-good originals is being put on LP, this approach would filter them all, reducing them all to the lowest common denominator of quality. The intent is to reduce the "intrusiveness" of surface-noise sounds and fluctuating quality; but the results can be dreary. (If you get the chance, compare the originals of the Carmen excerpts with Farrar and Martinelli with the Camden reissue, now out of print. About half of the originals were good, bright, late acoustics with all their "S's and T's" in place. A couple were poor. In the LP, everything is uniformly muffled and unintelligible.)

The third method of attacking the surface noise problem is the sneaky approach. Electrola (a German EMI affiliate, marketed in this country as Odeon) is among the best-versed in this technique. They have frequently employed it in their series, grandly titled *Unvergänglich, Univergessen* (which might be translated as "Unfailing, Unforgotten"). These recordings carry the legend: *Technisch verbessert im . . .*" (literally, "Technically improved [sic!] in shellac surface noise . . ."). The Marcel Wittrisch record I have in front of me as I write was *Technisch verbessert* in 1958; and if that's *verbessert*, I'll eat my copy of *The Victor Book of the Opera.*

The reason I call the method sneaky is because they try to make up for the highs lost in filtering surface noise by introducing a bump in the response curve just below the filter shoulder. The result makes the lovely lyric tenor of the original take on an odd, strangling quality. Sopranos treated to this method, particularly when the originals are early electrics (hardly a flattering vintage for the soprano voice), can develop the most appalling, pinched screech.

Fortunately, not all of the series (or others of the sneaky school) are so drastically *verbessert*. But, even allowing for the many superb and ingenious jobs of dubbing represented in the current *Schwann Catalog*, it should be obvious that a good deal of the delight can be retained only if you're willing to go back to the originals. It should be obvious, too, that there is a great deal more to be gained by seeking out some originals than there is with others. But next time a friend finds "some of those old 78 records" in his basement, don't just chuck them out. Give them a listen. Chances are you'll still want to chuck them out; but still, every now and then . . . . Æ



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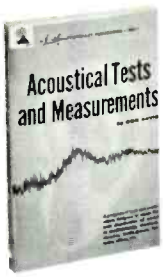

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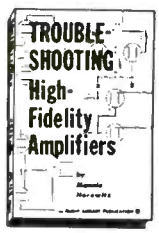

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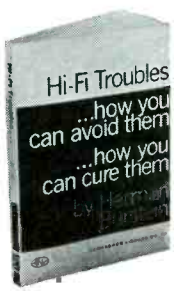

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Equipment Profiles

- EICO Model 3200 Stereo FM Tuner
- EICO Model 3150 Stereo Control Amplifier
- Thorens TD-125 Manual Turntable
- NordMende Model 8001/T Stereo Tape Recorder
- Harman-Kardon Model HK-50 Speaker System

EICO Model 3200 "Cortina" Stereo FM Tuner

MANUFACTURER'S SPECIFICATIONS:

IHF Useable Sensitivity: 2.4 μV. S/N: 60 dB. Capture Ratio: Under 4.5 dB. IHF Selectivity: 45 dB. Frequency Response: 20 Hz to 15 kHz $\pm$1 dB. Image Rejection: 45 dB. I.F. Rejection: 80 dB. Spurious Response Rejection: 80 dB. Total Harmonic Distortion: (Mono) Less than 0.75%. FM Stereo Separation: 40 dB at 1 kHz. Hum and Noise: 70 dB below output. Output Impedance: 5000 ohms. Dimensions: 12" W x 3 1/8" H x 7 3/4" D. Price: $99.95 (Kit); $139.95 (Wired).

"The easiest kit I ever built," said the kit builder who assembled the EICO Model 3200 "Cortina" stereo FM tuner. Never having tackled a tuner kit before (he constructed audio amplifier kits and instruments previously), he spent only five hours on assembly and one hour reading the manual and laying out parts. He found the instruction manual's parenthetical notes a great help, and construction time was speeded up by preassembled and prealigned sections.

The kit builder encountered very few problems, noting that construction was "amazingly simple." Except for a tuning dial that "turned harder in the middle than at the other ends," the tuner worked like a charm when completed, he observed.

In our investigation of this unit, we had an opportunity to compare the "factory wired" product with the kit, wired by a relatively inexperienced "do-it-yourselfer." Aside from a few mis-dressed and overlong lead lengths (in the power supply section, where lengths are not critical), the two units were very nearly identical.

A photo of the completed tuner, housed in its metal "cage" (included in the price of the kit or wired unit) is shown in Fig. 1, while the "insides" are displayed in Fig. 2. From this latter photo, you can observe the three basic components which make up the tuner: starting from the left, the multiplex stereo decoder board, the FM-i.f. strip and the r.f. front end, obscured by the dial-drive drum.

The simple, gold-finished, one-piece front panel has three slim "rocker" switches along its lower edge. The first of these is a mono/auto-stereo switch. This is followed by an AFC on/off switch and a power on/off switch. Illumination of the dial scale is adequate, if not startling, and frequency calibration

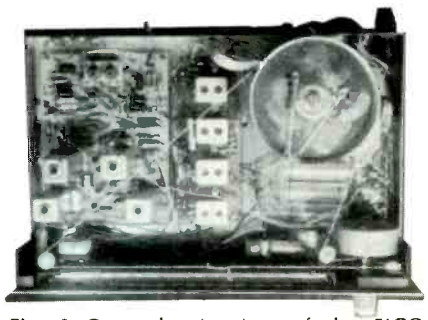


Fig. 2—Open-chassis view of the EICO Model 3200 stereo tuner, showing layout of three major modules.

was accurate within approximately one channel width (200 kHz). The megahertz spread from low end to high end is about the most linear we have seen. That is, there is no "bunching" of frequencies at either end of the band. A "logging" scale, calibrated from 0 to 100, and sub-divided into 100 divisions, is also provided. The dial glass area also contains a peak-reading tuning meter as well as a stereo indicator light which denotes the presence of a stereo FM transmission.

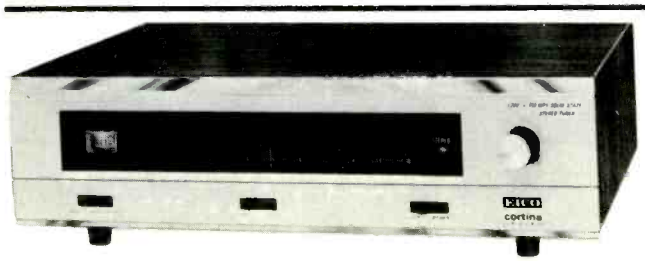
The circuitry employed in the Model 3200 is quite basic. Only bi-polar types of transistors are used (no FET's). There are three in the r.f. section, four in the i.f. strip and six in the multiplex decoder circuitry. Eight diodes, two silicon rectifiers and a varactor diode (for the AFC circuit) complete the solid-state count.

As disclosed in Fig. 3, IHF sensitivity measured 4 μV, falling short of the claimed 2.4 μV. No attempt at realignment was made. S/N ratio, on the other hand, was 62 dB, a bit better than claimed by the manufacturer. One-dB limiting was achieved at 4 μV. Total Harmonic Distortion (in both mono and stereo) measured 1.2% at full 75-kHz modulation. I.F. and Spurious Response rejection were excellent, measuring 80 dB, as claimed, while selectivity met its published claim.

Stereo FM separation, as plotted in Fig. 4, falls somewhat short of the 40 dB claimed. Again, no attempt at realignment was made.

Both the measured THD and the failure to meet IHF Sensitivity claims prompted us to investigate the state of alignment of this particular unit. Using sweep alignment techniques, we checked the detector "S" curve at signal input levels of 5 μV and 100 μV. Results are shown in the photos of Fig. 5A and 5B, respectively. As we suspected, the failure to meet the 2.4 μV sensitivity spec was caused by a constricted overall bandwidth at the lower signal-strength level. In both photos, total sweep width is 300 kHz ($\pm$150 kHz). At the lower signal level, however, there is curvature within the required 150-kHz central portion of the sweep. Thus, the "least usable sensitivity" limitation does not arise due to the presence of noise, but from excessive distortion at low signal levels. This is confirmed in Fig. 3 by the fact that if one were to consider *only* noise (as was the case before the IHF spec was devised) in determining "quieting sensitivity," the Model 3200 is capable of 30 dB of quieting at a mere 1.6 μV input! It is possible that realignment of the i.f. system might have "broadened" the response sufficiently to enable the tuner to meet its published IHF sensitivity spec, but, again, this was not attempted.

Listening to the tuner in operation, the 1.2% THD was not as objectionable as we might have supposed. This is largely due to the fact that most stations seldom permit full deviation (75 kHz) to occur. If one backs down on modulation to, say, 50 or 60 kHz, THD quickly settles back to a very acceptable 0.5 or 0.6%. The moderate sensitivity was in evidence, however. We were able to receive about 35 acceptable stations, some eleven of these in ac-



EICO Model 3200 stereo FM tuner, available as a kit or factory-assembled unit.

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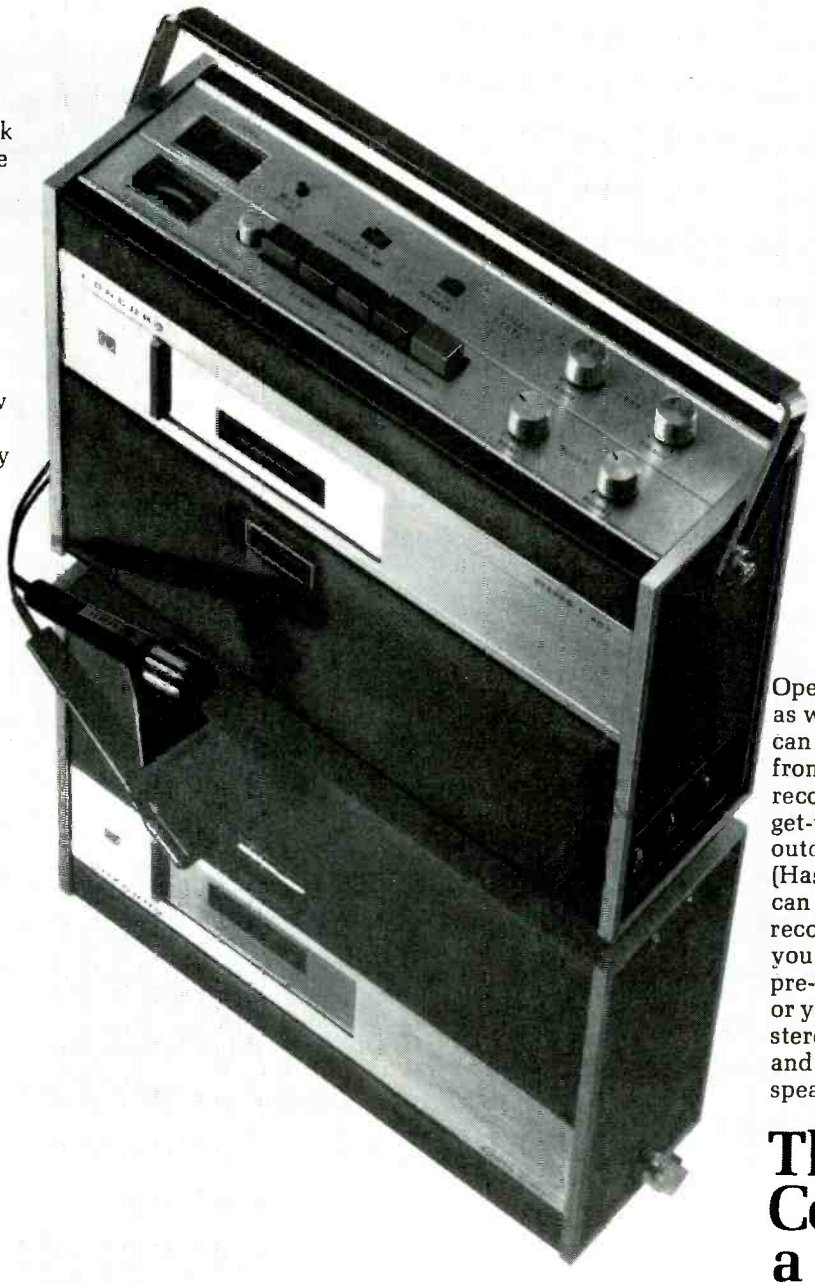

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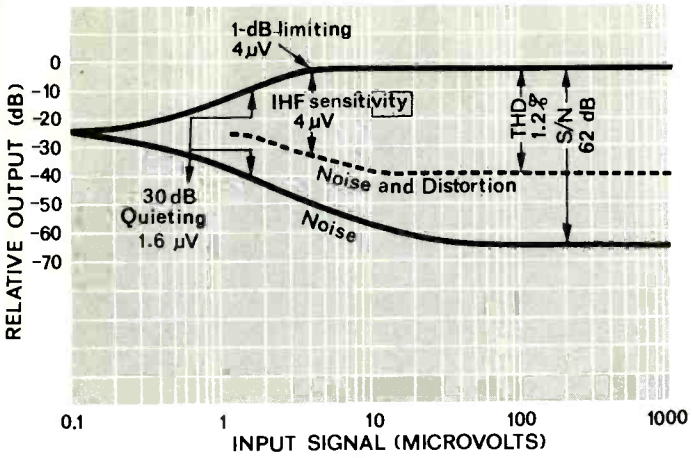


Fig. 3 – FM characteristics of the Model 3200 Cortina ◀ tuner.

Fig. 4– Stereo separation characteristics. ▶

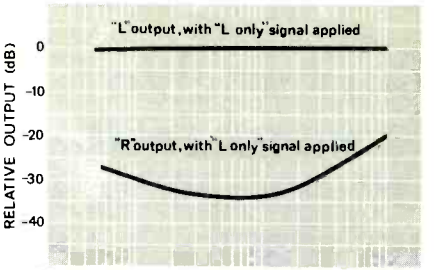
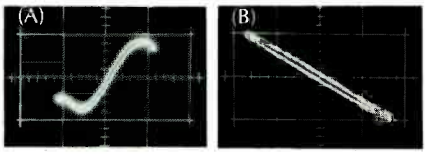


Fig. 5–Overall bandwidth response of the EICO stereo FM tuner for (A) a 5-μV input signal and (B) a 100-μV input signal. ▶



ceptable stereo. (For reference, the best we've ever done at this site is 49 usable signals, with 15 of them in stereo.)

The peak-reading tuning meter helped in tuning for center of channel. It cannot do double duty as a signal-strength indicator, however, because it is highly non-linear. In tuning from one station to another, we observed that interstation noise was rather loud, often "triggering" the stereo indicator lamp. Once "on station," there was no difficulty here.

In sum, the EICO Model 3200 stereo tuner, while not a great performer as separate tuners go, should do very nicely in non-fringe reception areas as part of a modest stereo hi-fi setup (especially when an adequate antenna is used). The tuner kit, in particular, impresses one with its relatively low cost, ease of assembly, and small size.

Check No. 40 on Reader Service Card

EICO Model 3150 "Cortina" Stereo Control Amplifier

MANUFACTURER'S SPECIFICATIONS:

IHF Music Power: 100 watts (total), 8 ohms. Continuous Power Output: 40 watts per channel (8 ohms). THD: Under 0.15% at 40 watts rms/channel, both channels driven. IM: Under 1% at rated output. Frequency Response: 10 Hz to 30 kHz ±1.5 dB. Hum and Noise: 80 dB below rated output. Power Bandwidth: 10 Hz to 20 kHz at 0.5% THD. Damping Factor: 35 or greater with 8-ohm load. Tone Control Range: Bass: ±15 dB at 50 Hz; Treble: ±15 dB at 10 kHz. Dimensions: 14 3/8" W x 3 1/8" H x 8 5/16" D. Price: $149.95 (Kit); $225.00 (wired).

The Model 3150 "Cortina" is a high-powered, well designed, moderately priced unit. We examined a factory-assembled unit.

The front panel of the 3150 model consists of a gold-finished heavy extrusion with six equally spaced rotary control knobs in the upper section and six evenly spaced rocker-switches in the lower section for secondary functions. An on/off indicator light and phone jack (for stereo headphones) at the extreme right end of the panel completes the layout, as shown in Fig. 1. Starting at the left, the rotary knobs consist of a three-position selector (phono, tuner, aux), a volume control, a balance control, bass and treble controls, and a speaker selector switch (for main, remote, both, and phones). The secondary rocker switches include a tape monitor switch, loudness-contour, on/off, mono-stereo, low-frequency filter on/off, high-frequency filter on/off and power on/off.

The rear panel (shown pictorially in Fig. 2A) contains a line fuse, switched and unswitched convenience a.c. outlets, speaker terminals for main and remote speakers (of the non-barrier type, offering less protection against speaker leads shorting), a ground terminal post, and input jacks corresponding to the three positions of the selector switch. In addition, there are tape-in and tape-out pairs of jacks. The tape-out jacks are used for making tape recordings of any of the other program sources, while the tape-in jacks serve a dual purpose. They enable listening to recordings from a tape deck equipped with its own preamplifier, and also permit tape monitoring from "three-headed" tape recorders. For either of these uses, the tape monitor rocker on the front panel must be placed in the "tape" position since the main selector switch has only three positions, neither of which is for tape, per se.

If ever a stereo amplifier could be thought of as two amplifiers, the EICO 3150 falls into that category. Unlike other compact designs we have seen, EICO has chosen to supply p.c. boards for each channel for magnetic preamplifier, voltage amplifier stages, and driver sections. Thus, the three boards of one channel are mounted on top of the chassis, while three identical boards of the other channel are similarly mounted below the chassis surface. It is this packaging technique which results in the 3 1/8 in. overall height of the amplifier, belying the high wattage capability contained inside.

About the only thing common to both channels is the rugged power supply, of

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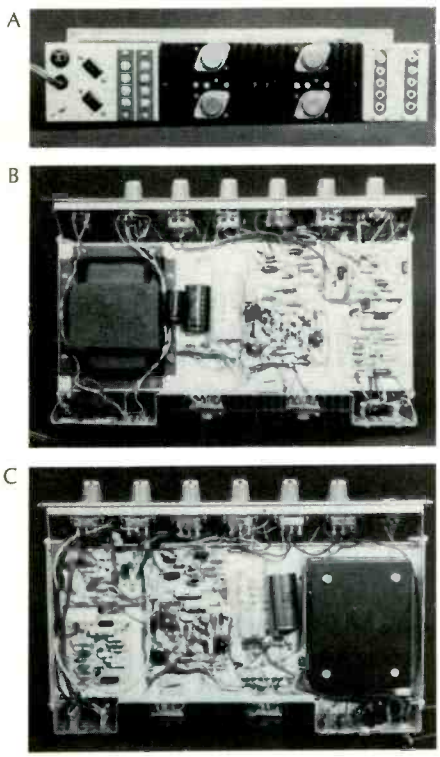


Fig. 2—The rear panel layout of EICO's Model 3150 stereo amplifier is shown in (A). Figures 2B and C show top and bottom views of the chassis, illustrating how duplicate printed-circuit boards are mounted for each channel. Twenty-six silicon transistors, six silicon rectifiers and twelve biasing and protective-circuit diodes are used in this design.

which the massive power transformer (shown in the views of Figs. 2B and 2C) is particularly impressive. As can be seen in the photos, it occupies about a third of the entire cubic volume of this amplifier. Other power supply components (such as electrolytics) are also conservatively rated for long life and cool operation. In protracted tests in which full power was extracted from both channels, the heat-sink area at the rear of the amplifier was warm to the touch, but not "hot," and even this moderate amount of heat would seldom result from normal musical listening, however high the level.

Measured Performance

EICO's engineers were conservative, too, in deciding upon the specifications for this amplifier. For example, we were able to drive both channels to 42 watts each before reaching a total harmonic distortion (THD) of 0.15%. But more significantly, we continued driving until an output of 55 watts per channel was attained, where the THD was then only 0.3%. Really objectionable THD did not occur until an output of about 60 watts was obtained, as shown in Fig. 3. Equally outstanding is the IM characteristic, plotted in Fig. 3. The 1% IM figure was not reached until an output power of 56 watts per channel was produced. And at rated output, the total IM per channel was only 0.5%. Power bandwidth, shown in Fig. 4, conformed very closely to published specifications, as did the tone control range, plotted in Fig. 5. Figure 5 also shows the filter action and the loudness contour compensation at ¼ and ½ volume settings. As for the high- and low-frequency filters, while they conform to published specs, they have a slope of only 6 dB/octave, limiting their usefulness as "scratch" and "rumble" filters.

A published specification given by EICO (but not summarized above, since it is not a specification required by the Institute of High Fidelity) is the rise time, stated to be 3.5 microseconds. While we did not measure this rise time directly, the photos of Fig. 4 show square-wave response at 100 Hz and 10 kHz. The 10-kHz square-wave response is about the best we have seen in an integrated amplifier (or even in a basic amplifier, for that matter).

Further proof of excellence in transient response was evident when we subjected the Model 3150 to extensive listening tests. A Cambridge recording of Bartok's *Sonata for Two Pianos and Percussion* (CRS-1803) served as a musical audition for this amplifier. The various shadings of the different percussive instruments were clearly discernible with this amplifier. Often, certain notes on a piano and the same-pitched tones of a xylophone are indistinguishable from each other when heard through "muddy" (low damping factor and poor transient response) amplifiers. Such was definitely NOT the case here—the "woody" sound of the xylophone was distinctly heard and well defined, as were all the other percussive instruments.

Residual hum and noise were quite acceptable, though the published specification might mislead one. The 80-dB S/N refers to full amplifier output with the volume control turned all the way down. Since hardly anybody listens to amplifiers in that condition, a more realistic figure for the high-level inputs is 75 dB; still more than enough dynamic range for any purpose. In phono settings, the S/N ratio was a respectable 62 dB below a 5-mV input reference, at full output.

For the prospective kit builder, this integrated amplifier is certainly an outstanding value at $149.95. For those seeking an amplifier that's factory wired, and packed solidly with honestly performing circuitry, the EICO 3150, at $225.00, is right up there with similarly priced and even more expensive competition. We believe it to be so good, that it outclasses the Cortina 3200 stereo FM tuner (see preceding profile), which is probably better paired to the 70-watt music power Cortina 3070 integrated amplifier. The latter is priced the same as the tuner, too.

Check No. 42 on Reader Service Card

Fig. 3—Total harmonic and IM distortion of EICO 3150. From 1 watt to 50 watts, THD consisted primarily of second harmonic distortion. Above 50 watts, 3rd and higher-order harmonics were evident.

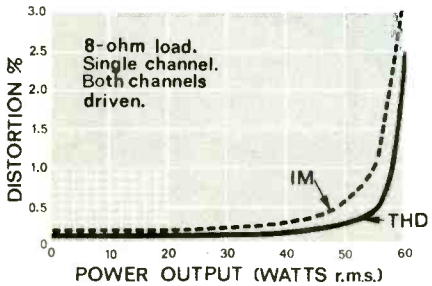


Fig. 4—Power bandwidth for 0.5% THD. Zero dB equals 50 watts into an 8-ohm load. Square-wave response at (A) 100 Hz and (B) 10 kHz are pictured here.

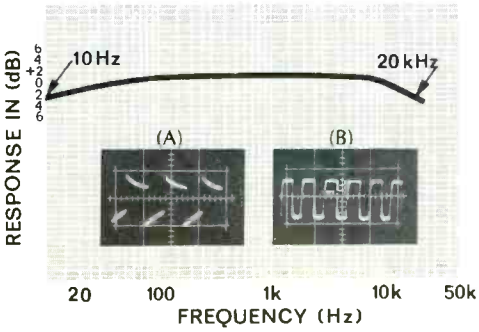
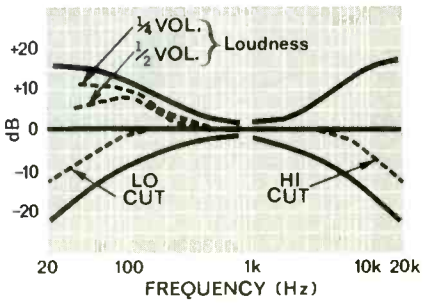


Fig. 5—Tone-control range, loudness contour, and filter reponse of the EICO 3150 stereo control amplifier.



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The KR-77 boasts 75 watts music power (IHF) at 4 ohms. 2 ICs, 2 FETs, 4-gang tuning condenser front-end provides outstanding 1.9 uV sensitivity, better than 60 dB signal to noise ratio and 2.5 dB capture ratio. The combination of special circuits and heavy-duty silicon transistors delivers exceptional frequency response and power bandwidth. New refinements as front panel jacks for stereo headphones and dubbing/tape record, inputs for two record players, left and right channel preamplifier outputs, terminals for 2 sets of stereo speakers, and unique keyboard controls to regulate muting, loudness and low/high filters . . . are some of the outstanding features that make the KR-77 such an outstanding value.

KENWOOD combines the new and noteworthy KR-44 Stereo Receiver with two perfectly mated compatible speakers to achieve "instant stereo", skimping not a whit on quality! The 48 watts of music power (IHF) at 4 ohms delivers enough power to drive two sets of stereo speakers . . . and there are plenty of tape and phono inputs for the most complete stereo system. Add to this the elegant styling of the oiled-walnut speakers . . . the rich feel of the controls . . . the compact design of both receiver and speakers . . . and it becomes apparent that the KRS-44 is the answer for low-budget music lovers with extravagant tastes!

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Check No. 43 on Reader Service Card

Thorens TD-125 Electronic Transcription Turntable

Shown with the Ortofon arm and cartridge, though any arm can be mounted.

MANUFACTURER'S SPECIFICATIONS'

Speeds: Three—45, 33⅓, and 16⅔. Motor Type: Synchronous. Motor Speed: 250 rpm at 33⅓. Interchangeable tonearm mounting board. Wow & Flutter: .08%. Rumble: —48 dB (unweighted); —68 dB (weighted). Drive System: belt. Power Requirements: 110-130 V a.c., or 200-240 V a.c., 50/60 Hz. Dimensions: 18" wide, 14" deep, 5" high. Weight: 32 lbs. Price: $185.00. Mounted on walnut base: $200.00. Dust cover optional.

The serious high fidelity enthusiast is continually looking for the best piece of equipment in every category—the best tuner, the best amplifier, the best tape recorder, the best cartridge, the best turntable, and a speaker system he likes. And aside from an ultra-expensive broadcast-type table, it appears that the features of the Thorens TD-125 place it as a favorite contender in the best turntable category. The performance features that the audio connoisseur wants are low rumble and low wow and flutter. The TD-125 excels in both. The construction is such that any user would be proud of the unit, and any mechanical engineer would be enthused by the obvious care that went into the design of this turntable.

The Thorens TD-125 uses a long sleeve bearing, with two highly polished contact surfaces, and with a single steel ball for a thrust bearing. (The highly polished sleeve bearing, two inches long, is more likely to continue to be rumble-free for a number of years than is a multiple-ball bearing, good as they have come to be.) Thus the drive to the platter cannot be transmitted through the shaft, as it was many years ago through various types of gearing. The drive to the rim is now almost universal, with most turntables being driven by an idler that contacts the motor pulley and the inside of the turntable rim at the same time. Thus, since the motor speed is much higher than that of the turntable, the motor rumble itself is transmitted directly to the platter. Some earlier Thorens models had the motor mounted on a separately isolated plate, and the motor drove the stepped pulley by a belt. This permitted mounting the stepped pulley on the framework on which the turntable bearing was mounted, with the idler still making the contact between the stepped pulley and the platter. This at least relieved the platter from direct contact with the motor, and was an improvement over previous models. The TD-125 uses a rubber-belt drive, isolating the motor from the platter.

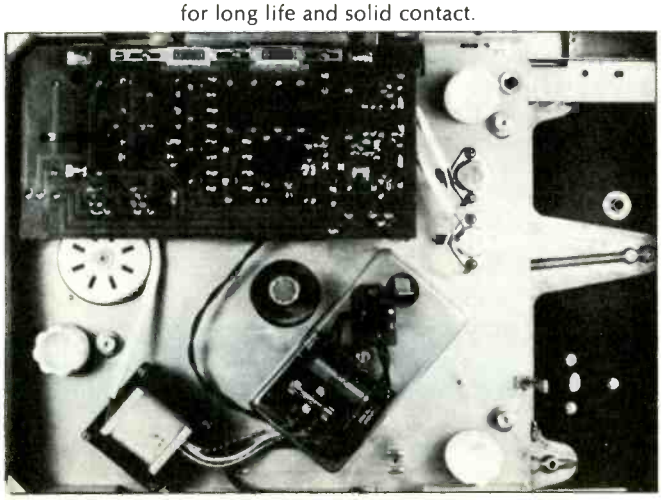
The step to the electronic turntable was an important one, since it permitted the use of a synchronous motor which could run at a much slower speed than is usual with the average induction motor (1725 rpm, approximately) or the 1800 of the hysteresis-synchronous motor. The reduction of the motor speed from the usual much-higher speed reduced the energy which causes rumble by the square of the speed ratio, and in addition, permitted the use of a larger motor pulley which provided a better drive ratio. For example, the motor pulley on the TD-125 measures 0.736 in., and the rim of the driven inner turntable is 6.28 in. This is a much better arrangement for the belt, since it does not have to wrap around a small-diameter motor pulley, which in the case of a 1725-rpm motor would have to be only 0.106 in. in diameter to drive the turntable at 33⅓ rpm.

Synchronous motors have their definite advantages as to consistent and accurate speeds, since their speed is directly dependent on the frequency of the a.c. line. But if one should want to vary the speed slightly, it becomes quite difficult with the line-operated synchronous motor, and if speed-changing elements are introduced between the motor and the platter, the advantages of the synchronous motor are lost.

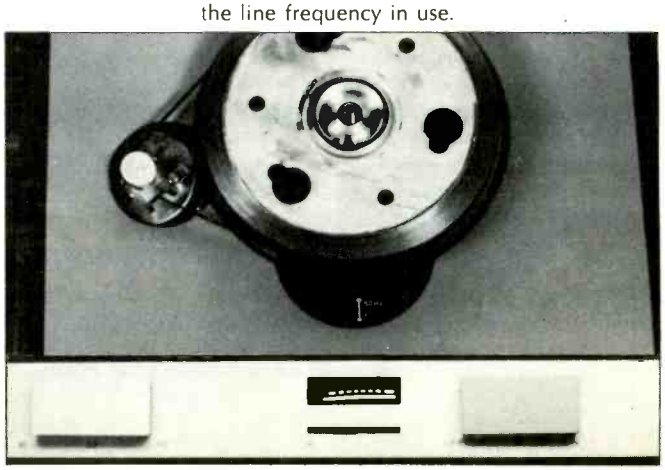
In the TD-125, Thorens does use a low-speed synchronous motor, but it is not driven in synchronism with the a.c. line.

Instead, it is driven by a locally generated a.c. voltage at a frequency which is determined by a Wien-bridge oscillator, which is an exceptionally stable device. The output of the oscillator is amplified by a 20-watt solid-state am-

Underside of the TD-125 turntable showing the synchronous motor at the left and the electronics assembly at the top. The speed-control switch is at the upper edge of the printed-circuit panel and is an integral part of it. The contacts and springs are gold plated for long life and solid contact.



The motor drives the inner turntable through a small belt which isolates motor vibration from the turntable assembly. Below: the stroboscope seen through the window at the front of the panel. The photo was taken at 33⅓ rpm, and the line of light below the dots is the position of the 45-rpm dots. A sliding window adjusts for the line frequency in use.



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How to recognize a stacked deck.

The Choice of Experts. This is the famous Sony Model 355 selected as a "best buy" by the nation's leading consumer reporting service.

Unprecedented Specifications & Features. Achieves true high-fidelity performance even at slower speeds: (20-22,000 Hz @ 7½ ips, 20-17,000 Hz @ 3¾ ips, 20-9,000 Hz @ 1⅞ ips). Three speeds, 4-track stereo and mono recording and playback, 7-inch reels, Automatic Sentinel Shut-off, two VU meters, stereo headphone jack, pause control, four-digit tape counter, record interlock, vertical or horizontal operation.

Instant Tape Threading & Vibration-Free Motor. Exclusive Sony Retractomatic pinch roller permits simple, one-hand tape threading. Automatic tape lifter protects heads from wear during fast-forward and reverse. Vibration-free motor is completely isolated from tape mechanism by exclusive Sony "floating" shock-absorber action.

Three Heads. Three-head design permits such professional features as tape/source monitoring and sound-on-sound. Exclusive Sony circuit eliminates record-head magnetization build-up, the most common cause of tape hiss.

Noise-Suppressor Switch. Special filter eliminates undesirable hiss that may exist on older recorded tapes.

Scrape Flutter Filter. Special precision idler mechanism located between erase and record heads eliminates tape modulation distortion. Formerly found only on professional studio equipment.

Sony Model 355. Priced under $229.50

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plifier and fed to the motor, which requires only about 5 watts to drive it, so there is always an abundance of available power. The frequency of the oscillator is 20 Hz for the 16⅔ speed, 40 Hz for 33⅓, and 55 Hz for 45 rpm. These frequencies are selected by a slide switch built into the printed circuit board and gold plated for permanence, as are the contacting springs. Slight variations can be made in the frequency by a vernier control. The a.c. line frequency is used only as a reference to illuminate the neon lamp which provides the stroboscopic action to tell you when you are exactly on speed. Thus if you want to play an instrument along with a record and need to change the pitch of the recorded music to match that of your instrument, you can do it easily, disregarding the stroboscope, by varying the oscillator frequency slightly by moving the plastic wheel which moves the arm of the control very gradually.

Since the oscillator and amplifier operate on d.c., they are not influenced by the a.c. line frequency, even though the d.c. does come from the a.c. line through rectifiers and filters.

The TD-125 has an inner turntable on which the platter itself sits, both being machined for a close fit, and both being dynamically balanced. The turntables and the chassis (or "motor board") are die cast from a non-ferrous metal, with the turntable weighing 8 lbs. The turntable bearing and the tonearm board are mounted on a separate framework which is shock mounted to the chassis. The motor, controls, amplifier, power transformer, fuses, terminal blocks and so on are also solidly mounted on the chassis, and handling the on-off switch or the speed control does not affect the flexibly mounted turntable and tonearm mounting board at all. The two controls, however, look like no controls ever seen before—instead they look like blocks of aluminum, but they are plastic, with an anodized aluminum plate bonded to the top surface. The stroboscope disc is viewed through a slot at the near side of the platter, and a sliding shield serves to cover the band for the unused frequency. Two bands are etched on a disc on the underside of the inner turntable—one for 50 Hz, and the other for the U. S. standard of 60 Hz. Most of the world is on 50 Hz (and also usually at 220 or 250 volts), while practically only the U. S. stays on 60 Hz and 117 volts. Hence the need for two supply frequencies and the adaptability for several voltages.

Performance

We tested the TD-125 with an Ortofon arm and the SL-15T cartridge. The tonearm mounting board was already drilled for the Ortofon, although the TD-125 is normally supplied with an undrilled board. Locating the center for mounting the Ortofon arm is simple because of a strip of metal with a hole in one end for the turntable spindle and one in the other end for a plastic gauge which is placed on the mounting board at the right position and the necessary centers marked through holes in the base of the gauge.

The TD-125 met all of its specifications that we could measure (we were stumped with the −68 dB weighted rumble). We were able to confirm the 48 dB unweighted rumble within 2 dB, but we were not too sure about the "silent" grooves on our test record. We did get down to −64 dB weighted (USASI "A" weighting). According to the NAB method, however, we measured the unweighted rumble at 46 dB below the 100-Hz reference of 1.4 cm/sec peak velocity (which corresponds to 7 cm/sec peak velocity at 1000 Hz). The NAB standard for an acceptable turntable is −35 dB, so the TD-125's measured 46 is 11 dB better than the NAB standard.

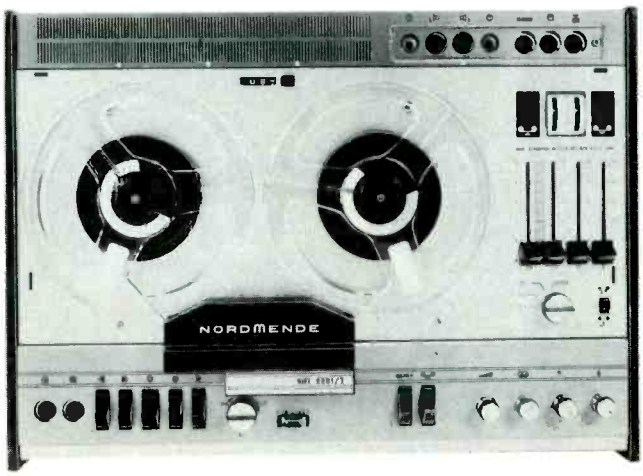
Wow and flutter measured .07 per cent, exceptionally good in a turntable, although not too uncommon in good tape recorders. But then, you can practically pound on a tape recorder while it's playing without affecting its wow and flutter figure.

Line-voltage variation between 95 and 130 volts produced absolutely no change in turntable speed. The vernier control provided a ±2½ per cent variation when needed to match the pitch of a record to your musical instrument if you want to "play along."

If you have room for its 18-in. width, you will most certainly find the TD-125 the answer to your continuing search for the ultimate in every department—beauty of functional design, virtual absence of rumble, low wow and flutter, a shock-mounted drive system independent of controls, and simple tonearm change facility. The turntable has a three-year warranty on parts *and labor,* but from its sturdy construction, which includes self-lubricating bearings, it would seem more likely that you could keep it in use for ten years without any performance or maintenance problems. If you do, its $185.00 price tag breaks down to $18.50 a year, which is a real bargain. (Base and tonearm are extra.)

Check No. 46 on Reader Service Card

NordMende Model 8001/T Stereo Tape Recorder



MANUFACTURER'S SPECIFICATIONS:

Frequency Response: 40-18,000 Hz at 7½ ips, 40-15,000 Hz at 3¾ ips, 40-8000 Hz at 1⅞ ips. Dynamic Range: 52 dB at 3¾ ips. Wow and Flutter: 0.15% at 3¾ ips. Amplifier Power: 3 watts rms/channel. Input Sensitivity: Microphone—2 mV into 200 ohms, Radio—5.0 mV into 50k ohms, High Level—300 mV into 500k ohms. Dimensions: 19½" wide, 14" deep, and 6" high. Weight: 36 lbs. Price $429.95.

The NordMende Hi Fi 8001/T is a compact (but fairly heavy) 3-speed, 3-head, 3-motor, solid-state stereo tape recorder with two built-in speakers. The 4-track, 7-in.-reel-capacity unit, features sliding-type attenuator mixing facilities and a sleek (it's only 6-in. high), modern appearance. This is capped by a handsome, fitted, plexiglas cover that snaps into place over the brushed chrome and black panel, leaving only the connectors exposed.

There are three sets of inputs on the recorder, all independently controllable with the sliding attenuators on the front panel. One set accepts microphones, which are supplied with the machine. A second set accepts a recorder output from a preamplifier or receiver, and the third input will accept a radio or some other low-level, unequalized source. The three inputs can be mixed by means of the sliding attenuators in any combination. Each

Anyone who wants the best, and is worried about spending an extra $20, ought to have his ears examined.

Look at what you're getting for the extra $20.00.

The Papst hysteresis motor for reduced noise and rumble, unvarying speed accuracy. An exclusive feature of the Miracord 50H.

The cartridge insert with slotted lead screw for precise stylus overhang adjustment. Without this Miracord exclusive, your whole investment in a record-playing instrument could go down the drain. Because if the stylus overhang is incorrect, the finest cartridge will not track accurately.

The exclusive Miracord pushbuttons—the gentlest touch is all that's needed to put the 50H into automatic play (stacks of 10 or single records). Or you can start the turntable and play single records manually by simply lifting the arm and placing it on the record.

In addition to these exclusive features, the Miracord 50H offers a metal cam (not plastic) for greater reliability; piston-damped cueing: effective anti-skate; a dynamically balanced arm that tracks to ½ gram.

Finally, consider what the leading experts are saying about the Miracord 50H. That $20 bill looks pretty tiny now, doesn't it? Miracord 50H less cartridge arm and base, $159.50. The Miracord 620 ($99.50) and the Miracord 630 ($119.50) follow in the great tradition of the 50H. See what we mean at your hi-fi dealer.

Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11735. Available in Canada.

MIRACORD 50H
another quality product from BENJAMIN.

slider controls one set of stereo inputs, except for the microphones, which have one slider per channel.

The tape drive chain is as follows: The tape is driven via a capstan and pressure roller. The capstan's concentric flywheel is driven by an interwheel which is powered by a stepped pulley. The pulley is driven by a rubber belt from the shaft of the hysteresis-synchronous Papst motor. Speed change is accomplished by changing contact between the interwheel and the three steps of the pulley. The capstan is highly polished and supported by a thrust bearing on top, making for very true rotation and contributing to the low flutter of the machine. The unit can be used either vertically or horizontally. One pressure pad pushes the tape against the left guide, while metal fingers hold the tape around the heads, with a metal shield pressing up against the tape at the playback head. (A small pressure pad here might improve the tape-to-head contact even more.)

The automatic-stop sensing system of the machine requires an electrically conductive strip of tape to make contact between either the first or last tape guide and its adjacent sensing post to actuate a relay which stops the motion of the tape. Since most domestic tapes do not have such strips attached to them at the beginning and end, the strips must be attached to achieve automatic stop, of course. In a single-motor machine which has a slow rewind (most of them do), there's not much of a problem if a full reel of tape just keeps spinning until the operator stops it. But in a machine such as the NordMende 8001/T, with its very fast—though even—rewind (it takes 48 seconds to rewind 1200 ft. of tape from a 7-in. reel), some tape will be damaged at the end of the reel if the machine is left to flap away for any period of time.

The microphones which come with the recorder are excellent for voice and home musical instruments. Their mounting and variable-angling arrangement are quite useful. They may be used together or they may be taken apart, having separate plugs with a dual cable which can be separated if the user wishes to spread the microphones far apart.

This recorder offers remarkable flexibility, what with pushbutton operation, a four-digit tape counter, sound-with-sound facility, monitor capability both before and after the signal, illuminated and color-coded function indicators, not to mention the mixing panel. A novel feature, also, is the on-off switch, which is key operated. That is, the switch, in the form of a plastic key, can be removed, rendering the machine incapable of being turned on (or off, depending on which position the key was in before it was pulled out). This should be a welcome feature for those recordists who can't keep their children's hands away from the works.

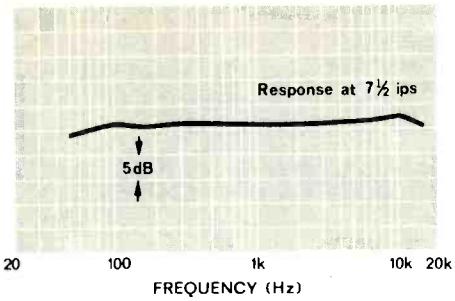
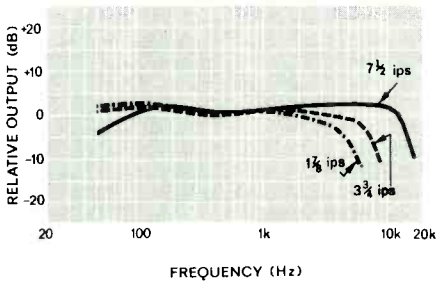


Fig. 2—Reproduce frequency response at two speeds of the NordMende 8001/T recorder.

Fig. 3 – Record-reproduce frequency response of the 8001/T at three speeds, using Scotch 111 tape.



The NordMende 8001/T performed well in all respects. Its playback frequency response, shown in Fig. 2, is practically a straight line. The record/playback frequency response as specified under the manufacturer's technical data only calls out the operating range. No dB variations are specified. It turns out that at the upper extremes of each range, the response is down quite a bit. We measured the following response, as taken from the graphs of Fig. 3: 50 to 15,000 Hz ±3 dB at 7½ ips, 50 to 8000 ±3 dB at 3¾ ips, and 50 to 4000 Hz ±3 dB at 1⅞ ips. These figures are for record/playback combined and are respectable for a machine in this class. In addition, both channels track each other quite closely and exhibit no irregular peaks or dips throughout their ranges. The test data were taken using the standard Scotch 111 recording tape.

The signal-to-noise ratio (dynamic range) as specified by NordMende is 52 dB at 3¾ ips. Our tests confirmed this, the data being as follows:

	7½ ips.	3¾ ips	1⅞ ips.
Left channel	53.5 dB	53 dB	50 dB
Right channel	52.5 dB	52 db	48 db

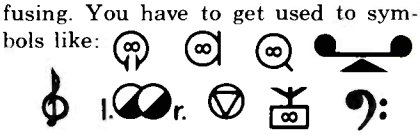
These figures are far above machines in the middle-priced field and actually approach those of $500 machines. One of the reasons for the wide dynamic range—or low noise—is probably the effective shield over the playback head.

Harmonic distortion measurements on our sample machine revealed 1% distortion at 1000 Hz at −15 VU (on the machine's meter) recording level, 2% at −5 VU, and 5% at 0 VU. To place these figures in their proper perspective, a measurement of 2% at 0 VU would be considered to be good. Since distortion, dynamic range, and frequency response are inter-related, it is possible that one was sacrificed for the other when adjustments were set by the manufacturer.

Wow and flutter was below 0.1% at 7½ ips, and below 0.14% at 3¾ ips, both of which are better than specified, and excellent.

The built-in amplifiers put out their specified 3 watts each before clipping, which is adequate to power the internal speakers to reasonable acoustic levels. Tone controls are effective. As expected, the built-in speakers are limited in sound quality—though as good as any others in the same environment. They are quite useful when playing back material immediately upon recording it, and acceptable as main speakers when the recorder is not used in conjunction with a stereo system.

We liked the way the machine handled. Controls are positive and "live," so you know when they're on. Unless one is accustomed to the non-standardized European-type of audio hieroglyphics, however, the labelling of the functions and connectors is a little confusing. You have to get used to symbols like:



All inputs and outputs are visible and accessible — a decided convenience when you have to connect and disconnect the machine often. The tape heads are easy to clean, although we would tend to leave the head cover off since it's pretty hard to remove it.

The vertical-swinging VU meters and illuminated recording-mode indicators are a pleasure to use, making recording particularly easy. A momentary-pause control further aids during recording operation. Thus, if you're willing to pay a little attention when using it, this machine is fun.

While primarily suited to the European tape recordist who is used to DIN connectors, high input sensitivities, and symbols in place of lettering on the front panel, the machine will neverthe-

"The finest loudspeakers I've ever listened to, regardless of size, type or price."

That's how Ronald M. Benrey, electronics editor of Popular Science, described a pair of **Rectilinear III** speaker systems in the May 1968 issue of his magazine, in an article on "The Stereo System I Wish I Owned."

Mr. Benrey went on to justify his ranking of the **Rectilinear III**'s:

"They produce beautiful bass tones without boom, accurate midrange tones without a trace of coloration, and crystal-clear treble tones without a hint of harshness. And they do it at any volume, including 'window-rattling' sound levels."

Of course, one expert's opinion may differ considerably from another's. But here's what Julian D. Hirsch wrote in the "Equipment Test Reports" of Stereo Review, December 1967:

"The **Rectilinear III** ranks as one of the most natural-sounding speaker systems I have ever used in my home. Over a period of several months, we have had the opportunity to compare it with a number of other speakers. We have found speakers that can outpoint the **Rectilinear III** on any individual characteristics—frequency range, smoothness, distortion, efficiency, dispersion, or transient response. However ... none of the speakers combine *all* of these properties in such desirable proportions as the **Rectilinear III.**"

Summing up his test report, Mr. Hirsch concluded: "In our opinion, we have never heard better sound reproduction in our home, from any speaker of any size or price."

Of course, both Mr. Benrey and Mr. Hirsch write for the readers of popular, large-circulation magazines. But here's what Larry Zide wrote for the more specialized audience of The American Record Guide ("Sound Ideas" column, October 1968):

"The transient response of the speaker is superb ... the overall quality is extreme in its fidelity to 'live' music. The bass is solid and firm, the midrange is clear and neutral, and highs are bell-like in their cleanliness.

"It all comes down to this: there are only a handful of speakers that I find completely satisfactory ... I have had these **Rectilinear III** units for a month now. Lately I have found myself listening to them just for the pleasure of it. They are among the very best speakers on the market today."

Of course, all of the opinions above appeared in publications that accept advertising. But here's what Buyer's Guide magazine wrote in their August 1968 issue, just in case you're more inclined to trust a consumer review without ads:

"**Rectilinear III** ... has had tremendous impact on the hi-fi industry ... This speaker's virtue is the fact that it is the first and only full-range dynamic speaker system that possesses sound quality which is directly comparable to electrostatic speakers.

"... Flute and violin concertos as well as string quartet were reproduced with honest clarity ... Piano and organ music were effortlessly reproduced in a manner that suggested the instruments were being performed live. Jazz and rock music were unpretentious and true sounding ..."

To such unanimity from such varied sources we need only add the dimensions and price of the **Rectilinear III:** 35" by 18" by 12" deep, $279.00 in oiled walnut.

(For further information, see your audio dealer or write directly to Rectilinear Research Corporation, 30 Main Street, Brooklyn, N.Y. 11201.)

Rectilinear III

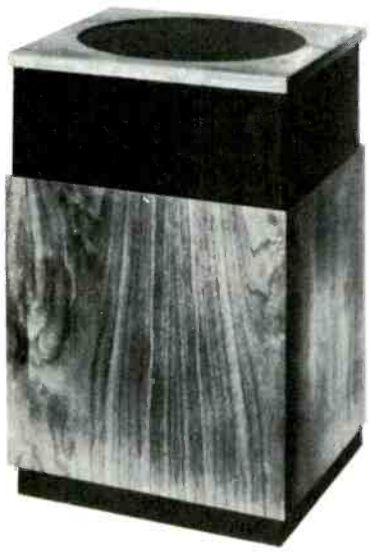
Check No. 49 on Reader Service Card

less find many devotees here because of its nice design features. Summarizing, the 8001/T's main assets are an excellent signal-to-noise ratio, smooth playback frequency response, quiet operation, effective tape guiding, low wow and flutter, and a built-in mixing facility. Its drawbacks are the lack of automatic stop without conductive foil, no monitor output to exernal equipment while recording except to headphones, and electronics that are easily overloaded at the inputs from standard domestic preamplifiers and receivers unless the signals are attenuated before they reach the inputs.

Considering overall construction, we conclude that this is a fine product of precision mass production and quality control. It should find favor here among persons who want good recording versatility in a modern-styled, compact machine, and who are familiar with (or willing to become so) with a variety of European symbols that identify controls, switching and other functions.

Check No. 48 on Reader Service Card

Harman-Kardon Model HK-50 Speaker System



MANUFACTURER'S SPECIFICATIONS:

Frequency Response: 30 Hz-18 kHz. Power Handling Capability: 50 Watts. Impedance: 8 ohms. Dimensions: 11¾" W x 11¾" D x 18¼" H. Weight: 22½ lbs. Price: $110.

The Model HK-50 is Harman-Kardon's latest entry into the highly competitive $100 price class of small speaker systems. From what we see and hear, it is a well-performing, nice-looking speaker system, is easy to use most anywhere, and not especially hard to pay for. It's the same component speaker system that is used as part of Harman-Kardon's Model SC2350 compact modular system.

The HK-50 is not a "me too" speaker system design. It does not project the sound from the front; nor does it direct the sound toward the rear, to be reflected from the wall. Rather, the speakers, which face upward, throw the sound waves up against a reflecting surface which is shaped so that it bounces the sound outward, all around. The intent is to achieve a broad dispersion of sound so as to approach an omni-directional sound source.

This is a two-way loudspeaker system, crossing over at 250 Hz. An 8 in. high-compliance woofer faces away from a fiberglas-filled, acoustic-suspension-type sealed enclosure, into the apex of the reflecting surface. The 2¼ in. cone-type tweeter also faces up toward one side of the reflector. Its position assures sound dispersion for at least 270 degrees, being blocked only by the tip of the reflector, as seen in Fig. 2. The crossover network's high-frequency level or "brilliance" potentiometer, as well as speaker input terminals, are all recessed into the bottom of the speaker enclosure. There is a pair of screw terminals as well as a phono jack for use as speaker inputs, either of which can be used.

The enclosure is acoustically sealed (even the phono jack has a rubber cap over it), while the back of the tweeter is sealed in its own compartment so that sound waves generated by the adjacent woofer won't interfere with it. A black, pleated grille cloth covers the four sound-emerging surfaces. A round, dark-gray, marble-looking insert is set into the top of the walnut cabinet. Besides enhancing the system's appearance by balancing some of the square lines of the cabinet, it acts as a marproof resting place for such things as lamps and ash trays, among other objects.

Performance

The almost omni-directional characteristics of the HK-50 allow great flexibility in its placement. Since the highs aren't radiated over the common 90-deg. angle, being spread around more, speaker placement is less critical than are conventional speaker systems for good performance. On the other hand, the HK-50 can exhibit a much greater variation in high-frequency performance, depending on what type of rear and side surfaces surround it since it is dependent on them for added reflection of sound into the listening area. Fortunately, the wide latitude of the "brilliance" control in the HK-50 is able to compensate for all but the most unusual conditions which are likely to occur. We certainly found no problem in using the speaker in our listening room.

Using our multiple microphone measurement technique, we plotted the frequency response of the speakers to fall between 50 and 14,000 Hz within 8 dB. There was a slightly accentuated range in the crossover region and a small peak at 10 kHz. The bass rolled off steeply below 70 Hz, though we were still able to reproduce 40 Hz. At the other end of the spectrum, it started to roll off above 13 kHz, and we tracked it right up to 17 kHz. The tone-burst photos of Fig. 3 show a respectable response despite the fact that it's reflected waves that we're looking at. Direct sound waves would make for a prettier picture.

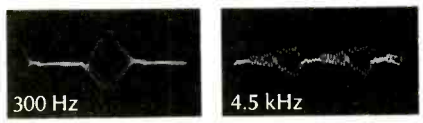


Fig. 2—HK-50's response to tone bursts of 300 Hz and 4.5 kHz. See text.

The HK-50 may be considered to be in the low-efficiency speaker category. That is, it needs lots of power to make it really blast; about 30 watts (rms) per channel, in fact. But as always, it depends on the size and acoustic properties of the room, as well as on how loud is loud enough for the listener. No doubt, there'll be plenty of 20 watt/channel amplifiers driving the HK-50s to the full satisfaction of listeners.

Stereo performance of the speakers impressed us during listening tests in a live and a medium-to-dead room. In both these environments the HK-50 speakers performed beyond our expectations for such diminutive units. Except for only a handful of musical selections, we didn't miss the lack of very deep bass (probably because most recorded material doesn't have much information down there). Neither did we meet any significant restriction at the high end, thanks to the good sound dispersion in the rest of the range. The beauty of the thing, though, lies in the broad sound image that the HK-50 speakers throw. In a symmetrical room, where the speakers were installed as end-tables at both side of a couch, a solid-sounding curtain of sound was projected right across to the other side of the room.

Thus, the walnut- and black-styled HK-50s represent a refreshing design approach that could well solve one's speaker location problems.

Check No. 52 on Reader Service Card

AUDIO magazine is probably the world's toughest critic of audio equipment.

Here's what they write about the Fisher 500-TX:

- "The Fisher 500-TX is a top-grade receiver. . . ."
- "The flexibility normally associated with Fisher products has been expanded in completely new directions. . . ."
- "In addition to an ample quantity of controls, this new receiver features *four* ways in which to tune in desired FM stations."
- "... the optional remote control (Model RK-30, $9.95) enables the user to change stations from his chair without approaching the receiver itself."
- "Station lock-in is flawless. That is, when the auto-scan [AutoScan] stops on a station it stops on the exact 'center' of that channel."
- "... AutoScan is probably more accurate in tuning to [the] center of [the] desired channel than can be accomplished manually..."
- "Usable sensitivity was everything we could have desired and limiting took place at a remarkable 1.5 μV. Ultimate signal-to-noise ratio was 65dB, as claimed. Stereo FM performance was excellent.
- "We can confirm the power output specification, as given in terms of r.m.s., as actually exceeding the 65 watts per channel claimed... Rated distortion (0.5%) is achieved at 66 watts, while IM reaches 1% at 68 watts. Power bandwidth extended from 8 to 38,000 Hz, based upon 65 watts per channel..."
- "The Fisher 500-TX is a top-grade receiver... wonderful tuning convenience features... powerhouse of an amplifier ... excellent transient response... truly 'big', clean sound."

Mail this coupon for your free copy of The Fisher Handbook, 1969 edition. This 72-page full-color reference guide to hi-fi and stereo also includes detailed information on all Fisher components.

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Long Island City, N.Y. 11101

Name

Address

City State Zip

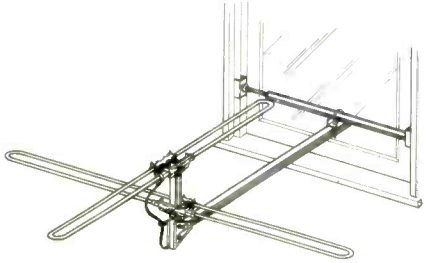
0306691

Check No. 51 on Reader Service Card

What's New In Audio

FM Window Antenna

FINCO's new Model FM-WT window-mounted FM turnstile antenna can solve FM reception problems where rooftop antennas cannot be installed. The all-directional antenna



can be mounted either horizontally or vertically to fit any type of window through use of extendable window-frame mounts which span up to 42 inches. For wider or higher windows, extension-mount bars are also available. The all-aluminum, corrosion-proof-finish antenna is priced at $16.95.

Check No. 18 on Reader Service Card

New 100-Watt Stereo FM/AM Receiver

Sherwood adds the new Model S-7600a stereo FM/AM receiver to its line, featuring 100 watts total power at 4 ohms, microcircuits, and front-end FETs. The front panel includes rocker-type switches for loudness compensa-

tion, main and/or remote speaker switching, and tape monitor. Other controls are loudness, bass, treble, balance, and variable FM muting for minimizing noise between stations. Phono input level can be adjusted with a three-position switch on the rear panel. Size is 16½" x 4½" x 12" deep. A walnut-grained, leatherette metal case or an oiled-walnut wood cabinet is available as an option.

Check No. 30 on Reader Service Card

Fibreglass-Cone Speaker

EMI's new Model 205 speaker system uses a fibreglass-reinforced paper cone in its 14½" x 8¾" elliptical woofer. According to Benjamin Electronic Sound Corp., the exclusive U. S. distributor of EMI high-fidelity components, the fibreglass cone eliminates paper fatigue and provides a great increase in cone handling power.

The three-way bookshelf speaker system also includes two 5-in. cone-type mid-range speakers and a new compression-type tweeter. The speaker has two crossover points, 1000 Hz and 5000 Hz. Compensation for room acoustic conditions is provided by switch-type controls: a three-position

switch for mid-range speakers and a three-position switch for the tweeter. The 14¼" x 13¾" x 24¾" oiled walnut enclosure has a pleated, removable grille panel. $225.00 each.

Check No. 32 on Reader Service Card

Record/Tape Filing System

Here is an interesting record storage and retrieval system, called THE COMPLEAT SYSTEM Filing Kit, that can be used to index from 50 to 350 LP albums, tapes or 45-rpm records. The kit contains 24 dividers, 315 printed labels, and 55 blank labels, so that the user can classify a collection by type of music, composer, and performer, both alphabetically and numerically. A cross-reference system is also included. $7.95.

Check No. 38 on Reader Service Card

Portable Recorder with Built-in Condenser Mike

Sony/Superscope introduces its new Servocontrol Model 800-B portable tape recorder, featuring a built-in condenser "electret" microphone, as well as a F-26S cardioid microphone for hand-held and remote start/stop use. (An "electret" condenser microphone, unlike a conventional condenser microphone, does not require an external polarizing voltage. With a diaphragm made of a special plastic film that retains the necessary electric potential permanently after being "charged" by the manufacturer, it is possible for this type of mike to be small and light. It is used here in conjunction with a miniature integrated circuit.) Interestingly, a special three-position switch enables the user to select either the internal mike, external mike, or both together.

The 800-B features battery or a.c.-power operation, 5-in. reel capacity, dual-track recording, a VU meter, and a digital tape counter. In addition, a fourth speed, 15/16 ips, permits record and playback time of up to eight hours; a built-in speed-adjustment knobs with an on/off switch varies the speed of the Servocontrol motor; the Sonymatic recording mode has positions for speech

and for music recording, which, according to the manufacturer, broadens the dynamic range capabilities of the recorder. A switch permits changing from Sonymatic recording to manual.

Signal-to-noise ratio is 48 dB. Wow and flutter is 0.1% at 7½ ips, 0.15% at 3¾ ips, 0.2% at 1⅞ ips. Price is under $229.50.

Check No. 54 on Reader Service Card

Literature

Magnetic Tape Heads: Twenty-page, two-color catalog from Michigan Magnetics contains specifications and performance data on tape heads: full-track, half-track, quarter-track, eight-track, and cassette. Each head description is accompanied by specifications and typical response curves.

Check No. 66 on Reader Service Card

New speaker systems from Jensen Mfg. Div., The Muter Co., are featured in their color High Fidelity Sound Products Catalog, No. 165-P. Also illustrated and described is Jensen's line of Sigma, Delta, and Triaxial coaxial and triaxial speakers, plus their line of hi-fi component speakers and accessories.

Check No. 68 on Reader Service Card

What impressed the professionals most when they tested the new $79.50 Dual?

Tonearm balance and design: "The arm is fully balanced... just as it is on the other Duals." (American Record Guide)

"Arm friction, laterally and vertically, was negligible at less than 10 milligrams each. The arm needed less than 25 milligrams to trip the automatic change mechanism, which bespeaks excellent balance and design in this area." (High Fidelity)

Tracking settings: "The built-in stylus force adjustment proved absolutely accurate." (High Fidelity).

"...anti-skating force adjustment... really works, as we verified by observing that the cartridge output waveform on high-velocity records was clipped symmetrically on both channels." (Stereo Review)

Cueing: "...you can use the cue control for a very gentle lowering of the pickup onto the record. You can also interrupt play at any portion of the record and resume play as you please." (High Fidelity)

Speed Accuracy: "It is quite immune to normal voltage changes affecting its speed... (American Record Guide)

Variable pitch control: "...each speed is adjustable by means of a 'pitch control' knob so that you can get on-the-nose speed accuracy (or slight deviations from it for special purposes)." (High Fidelity)

Tracking ability: "Significantly, the Dual 1212 went through its paces fitted with the Shure V-15 Type II, and it proved perfectly capable of handling a cartridge of this high quality." (High Fidelity)

Total Performance: "...compatible with the finest amplifiers and speakers, as well as the most compliant cartridges available today..." (Stereo Review)

You may be equally impressed when you read the complete test reports. Write to **United Audio,** 535 Madison Avenue, New York, N.Y. 10022. Dual

Check No. 53 on Reader Service Card

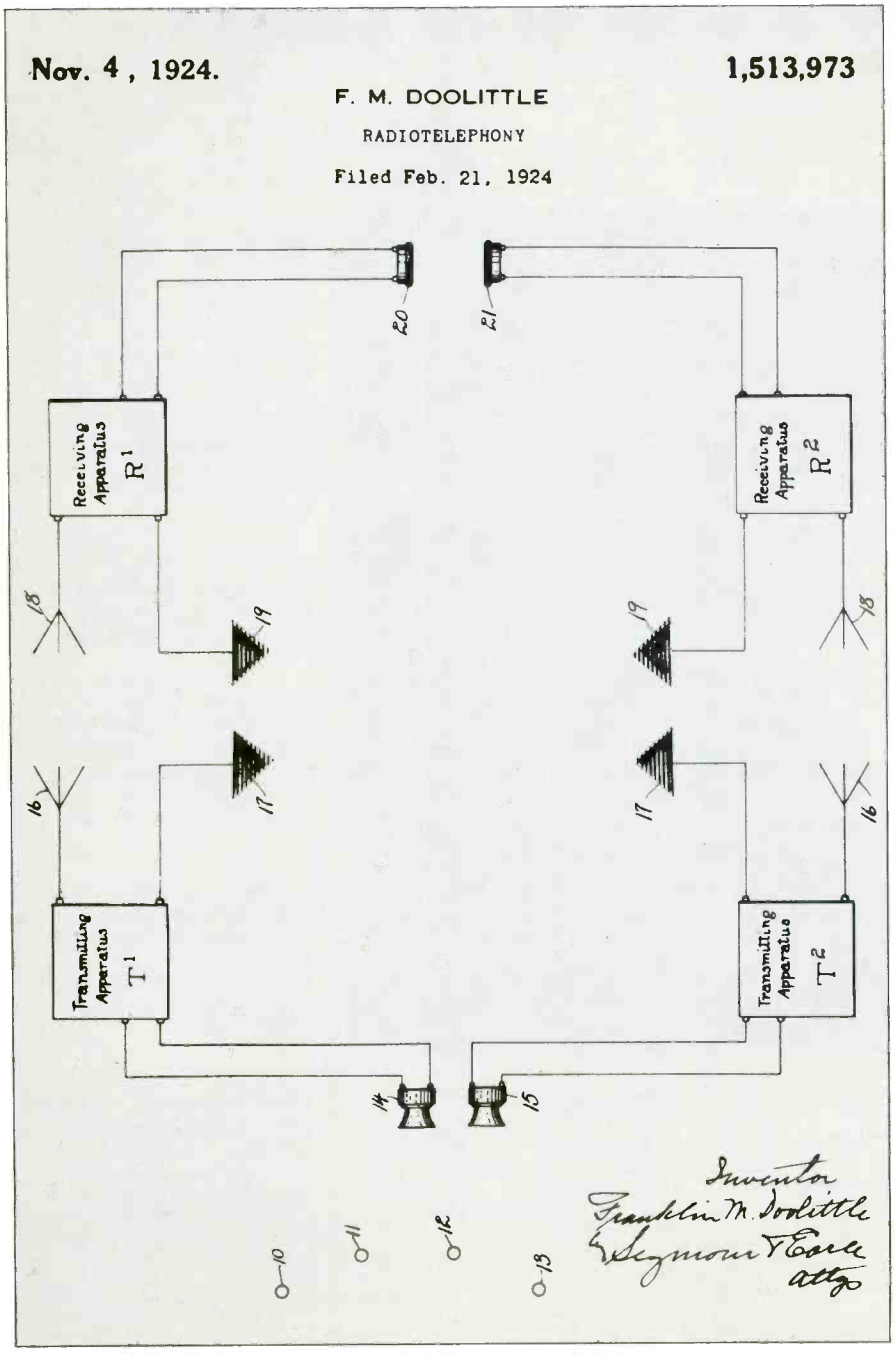
ABZs of Stereo FM

LEONARD FELDMAN

A Brief History of Stereo Broadcasting

ANYONE WHO THINKS THAT STEREO broadcasting is an innovation of the 1950's and 1960's would do well to search out some of the patents that have been brought to our attention in recent years. Here's an illuminating quotation from one of them (try to guess the year, as you read!):

"This invention relates to a method of transmitting and receiving radio telephonic impulses in such a manner as to evoke in the mind of the listener substantially the same consciousness of location of the source of the sound or sounds as he would have obtained had he been personally present at the transmitting station."



The patent description goes on, ". . . There is one serious defect in the reproduction of performances broadcast by radio . . . for, however true the tones themselves may be to the original ones, the listener is deprived of that consciousness of location of the performer or performers which he would have were he present in person at the performance and hence the rendition is distorted and unnatural . . ."

Both quotations are taken, word for word, from Patent #1,513,973 granted to one Mr. Franklin M. Doolittle of New Haven, Connecticut on November 4, 1924! As an aside, it's interesting to note that Mr. Doolittle had to wait less than eight months from the time he filed his application to the time his patent was granted. Today, most inventors wait four or five years for a patent to be granted—so jammed is our patent office in this age of technological geometric progression.

Nor was Mr. Doolittle a single, unique prophet. In the recent Federal Patent Infringement case of Crosby vs. General Electric, in which I participated as a witness for the plaintiff, at least twenty patents were submitted in evidence by both plaintiff and defendent, spanning over four decades of inventive effort all related to the problem of stereophony via radio. More about that case shortly, but let's not get ahead of our story. The cover page of Mr. Doolittle's patent is reproduced here at left, and any one conversant with even the rudimentary principles of stereophony would understand the concept without even reading the formal language of the patent itself.

Obviously, if two independent stations are used with two separate radio receivers, one of each pair may be used as a "left channel" while the other pair serves to transmit and receive the "right-channel" stereo information. It wouldn't matter if both set-ups were AM or FM (aside from fidelity and frequency response considerations), or if one station were AM while the other were FM (providing the listener was equipped with the proper types of receivers to match).

The fact is that in the mid-1950's, just about when tape recording began to provide the medium for preserving music in two-channel stereo form, radio station WQXR in New York (which has, even today, both an AM and an FM transmitter) began a series of experimental broadcasts in just this way. Listeners were told to turn on both AM and FM radios, to position them in appropriate corners of the listening room and to listen to a "stereophonic broadcast." There were obvious shortcomings, of course. The quality of re-

ception on the AM "channel" was never as good as that of the FM channel, both in terms of frequency response and static-free characteristics. These "unbalanced" conditions often marred the otherwise delightful experience. In addition, the unsuspecting listener equipped with only *one* radio (be it AM or FM) heard a totally "one-sided" performance — emphasizing either the left side of the orchestra or the right, depending upon which type of receiver he happened to be using.

It would seem only natural that if stereophonic sound is another step in the direction of high-fidelity musical reproduction, then stereo broadcasting should naturally occur on the "high-fidelity medium"—FM. Much has been written and said lately about the late Major Edwin Howard Armstrong, the acknowledged (finally) inventor of wideband FM as we know it today. A new, revised paperback edition of Lawrence Lessing's award-winning biography of this controversial man, entitled "Man of High Fidelity" was recently published, and should be on the "required reading list" of everyone interested in FM and audio. One of the early experiments conducted by Major Armstrong, a short while after his initial invention of wideband FM, involved the simultaneous transmission of *two* programs using a single transmitter and a single radio-frequency channel. While the two programs were not the "left" and "right" channels of a stereo program, the idea of using "multiplexing" for this purpose was born way back then—in 1934!

Those of you who have been following our earlier series, ABZs of FM, may recall, from an early installment, that it is possible to modulate the main FM carrier with more than just audio frequencies from 50 Hz to 15,000 Hz. Figure 2 illustrates the principle, showing how it is possible to utilize the 150-kHz-wide FM channel for dual-channel transmission. In this graph, frequency spectrum is plotted from left to right and extends out to 5 kHz (to each side of center frequency. Only the "upward" spectrum is shown. A more accurate presentation would include a "mirror" image of the spectrum drawn to the left of the vertical axis). Deviation or modulation of the main carrier is plotted vertically, above and below the unmodulated carrier frequency taken, arbitrarily, as 98 MHz.

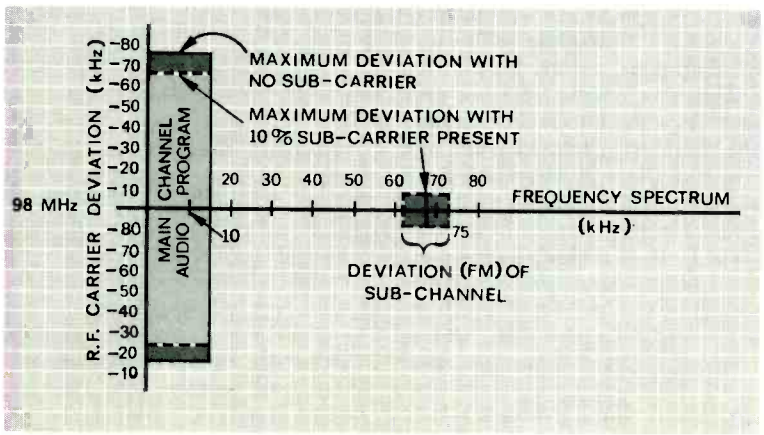
Main, monophonic programming is seen to extend to 15 kHz (the highest audio frequency transmitted under FCC rules), while deviation of the main carrier is seen to extend ±75 kHz above and below "center" frequency (in this case, 98 MHz).

It is quite possible, without exceeding channel limitations, to add a superaudible sub-carrier frequency to the total modulation pattern and, in Fig. 2, this sub-carrier is shown to have a nominal frequency of 67 kHz. Thus, it will be inaudible to anyone equipped with a conventional FM receiver. If such a sub-carrier modulates the main carrier by 10 per cent of total deviation, it is necessary to "back off" the main program deviation to a maximum of 90 per cent, as shown by the dotted line in Fig. 1. Thus, maximum deviation resulting from main-channel program will be ±67.5 kHz, while the deviation contribution of the sub-channel will be 7.5 kHz—the total of the two equalling the permissible maximum of 75 kHz, just as before. By backing down on the "loudness" or signal-to-noise ratio of the main program by about 1 dB (hardly detectible in terms of normal S/N ratios of 50, 60, or even 70 dB on good FM sets) space is made available for a second channel. The 67-kHz sub-carrier may be thought of as a sort of low-frequency "radio" carrier riding "piggy-back" on top of the 98-MHz main carrier. If its frequency is caused to deviate, in accordance with some new audio information, suitable circuitry in special receivers can detect this second sub-carrier along with its FM, and demodulate the FM variations in much the same way as the main channel FM is recovered. The second audio program can be recovered completely independent of the main program. The deviation of the sub-carrier is shown to extend about ±5 kHz either side of the sub-channel frequency of 67 kHz.

It is this principle that Major Armstrong used, first to transmit separate programs over one FM station and later, to demonstrate a crude but acceptable form of stereo or binaural broadcast. Of course, since the left channel was still broadcast on the main channel and the right channel was transmitted via the "sub-carrier," the system still suffered from one of the major objections raised against the AM-FM combined stereo broadcasts, namely, the owner of an FM set not equipped with special added circuits, heard only the left side of the program. In addition, because so little r.f. energy was assigned to the sub-carrier portion of the combination, its inherent signal-to-noise ratio was inferior to that of the main-channel program. Finally, because of spectral limitations, the sub-carrier program was not a "full frequency response" transmission either. Thus, about all that was gained in this pioneering effort was the fact that two transmitters were no longer needed and, a single, properly built receiver could be used instead of a separate AM and FM set as with the WQXR (and later, other stations) experiments in the fifties.

What we now call "compatible stereo FM" was waiting in the wings, in the form of a patent applied for in 1953 by Mr. Murray G. Crosby, another noted inventor in the FM field. By the time his patent was granted in 1958, all manner of schemes were being presented for consideration — all of which purported to provide the "perfect" answer for stereo broadcasting. Next month we shall examine the Crosby System as well as the approved FCC system proposed by General Electric and Zenith Radio, both of which offered the public truly compatible FM stereo. By compatible, we mean that the monophonic listener was in no way penalized by stereo broadcasting, since he continued to receive a totally balanced monophonic equivalent of the stereo broadcast—or the *sum* of the left and right channels. Æ

Fig. 2—How a superaudible FM sub-carrier may be added to a regular FM program on a single transmitter.



Can Crossover Distortion Be Detected By Ear?

JAMES BONGIORNO*

Five modified power amplifiers are compared subjectively to learn if "notch" distortion can be heard

I CONDUCTED AN unusual listening experiment to determine if crossover distortion in transistor power amplifiers is detectable on a subjective basis. Since the object was to compare a listening effect rather than specific products, the use of standard amplifiers was ruled out. Also, since the inherent distortions differ widely in types and amounts from products of different design, this was another reason for eliminating the use of commercial amplifiers. After all, the test was designed only to show some differences between crossover distortion and the absence of it. It was finally decided that the listening tests would be conducted using five different modified amplifiers driving stacked AR3a's. The choice of AR's was arbitrary—they are well-rounded systems, and using them stacked in series would call for a lot of power from the amplifiers, while at the same time ensuring that no speaker cone breakup would occur at extremely high listening levels. *(The cause and effect of crossover distortion was examined by the author in the May 1969 issue of* AUDIO*—Ed.)*

It was further decided that all five amplifiers should have identical voltage gains and must also start clipping at exactly the same power level. The power supplies were also adjusted for equal short-time-constant overloads. And in all fairness, one of the amplifiers chosen was of the tube type. This presented a problem in the sense that practically all transistor amplifiers exhibit a much wider frequency response than even the best tube amplifiers. It was felt, therefore, that the score should be evened a little bit in order not to make the tube amplifier's presence obvious. The tubed model selected was a Hadley Laboratories 601, which hasn't been available for a few years. Although the company isn't in business anymore this amplifier ranks as an outstanding tube model. A few modifications and adjustments were made to get the performance close to that of the four transistor amplifiers being used. The distortion was almost as low as that of the transistor models and the bandwidth extended out almost as far, falling about 20 kHz short of the others.

The four transistor amplifiers were characterized by the following: All four were of special design, but were exactly identical except that No. 1 had the special bias networks removed so that *primary* crossover distortion occurred above the two-watt power level (the two-watt level was chosen at will as only the effect was desired). No. 2 was normal with the exception that the bias network was redesigned in order to have secondary crossover distortion begin at the 2-watt level; this redesign was necessary because nothing was done to No. 3, and in this special proprietary circuit, crossover distortion cannot occur. The reason for the redesign, then, was to have No. 2 perform as closely as possible to most commercial units presently available. No. 4 was biased to full Class A operation as a further test of difference. It might be stated, that for one channel to provide 60 watts of Class A power into a 4-ohm load, each output transistor must dissipate a quiescent power of approximately 96 watts! In this unit, water-cooled forced-air convection was used to keep the junction temperature low. Amplifier No. 5 was the tube model.

All distortions were checked at a power level of 60 watts rms, both channels driven, and the distortions listed here were at a reference frequency of 20 kHz. As expected, No. 1 registered the highest distortion, 0.12 per cent, but the peak-to-average distortion of the spikes was approximately 20 to 1, indicating a peak level of primary crossover distortion of 2.5 per cent. Amplifier No. 2 measured .02 per cent, and again the peak-to-average level of *secondary* crossover distortion was about 20 to 1, which indicates a peak level of the notches at about 0.4 per cent. Obviously there is quite a difference between these two amplifiers, showing the effect of the two different types of crossover distortion. No. 3 measured .006 per cent and was pure second harmonic with absolutely no crossover distortion. No. 4, the full Class A amplifier, was the best, measuring .002 per cent, again being pure second harmonic (but it also might be stated that the residual of the test set-up was also .002 per cent). Amplifier No. 5, the tube model, measured .06 per cent with some high-order products visible, probably due to the output transformer. These were the measurements; now for the listening tests.

Listening Tests

The six listeners consisted of a pop singer, a jazz pianist, two engineers, and two avid hi-fi enthusiasts, the writer excluded. They weren't told what was happening and, furthermore, amplifiers were switched completely at will with no particular sequence. All that was wanted was their listening impressions.

Everyone rejected No. 1, the ampli-

*Consulting Engineer

fier with primary crossover distortion, almost instantly. Their impressions were that the sound was "dirty" and "gritty" and wasn't nearly as clean *as the others*. Could this be what characterized the early solid-state units? After No. 1 was eliminated, it took a couple of hours of solid listening to come to any valid conclusions. The music selected ranged through Chopin's Ballads by Rubenstein, Wagner's *Die Walküre*, the Oscar Peterson trio, the Gerald Wilson big band, and *The Planets* by Gustav Holst, although it must be said that the panel was not necessarily versed in the appreciation of everything that was played.

There was finally a general conclusion that No. 5, the tube amplifier, lacked the clarity and dimension of the others. According to the listeners, it seemed to have a mask or veil in front of the sound, especially at the frequency extremes.

After another hour of listening the panel could not come to any valid conclusions, so the meeting was closed for that night and it was planned to resume again the following week. At that next meeting, the two engineers had guessed the reason for the listening tests and were both very inquisitive, but information concerning the test amplifiers and test methods were not revealed. There were supposed to be three amplifiers left, numbers 2, 3, and 4. The tube amplifier was substituted for No. 4, however, in an effort to be tricky. Surprisingly, the change was noticed after about fifteen minutes! Number 4 was put back and the tube amplifier removed. Remaining, then, were an amplifier with a moderate amount of secondary crossover distortion, one Class B amplifier with no crossover distortion, and one Class A amplifier, obviously with no crossover distortion at all.

After about two and a half hours, four of the six people commented that one of the "sounds" was fatiguing and the other one wasn't. Notice that they said other *one*, as they didn't know that there were *two* other amplifiers being used. The other two people could not verify that there was any difference at all. Better results than this had been expected, since I thought a good panel had been selected. It was later learned that both of these people had limited experience listening to music through good-quality equipment. The other four people were known friends, with "seasoned" ears.

It was then decided to remove the unit that they said was fatiguing, No. 2, leaving only the two amplifiers with no crossover distortion. The evening continued with no other changes or conclusions. We met again the following week and for the first hour and a half we just listened to the two amplifiers that did not have any crossover distortion, again with no conclusive results. No. 4, the Class A amplifier, was then secretly removed and No. 2 (which had the secondary crossover distortion) took its place. Finally, after about another hour, the listeners observed once again that No. 2 produced a slight fatiguing effect after prolonged listening. All four people came to the same conclusion, but not necessarily at the same time.

Of course, it is realized that observations and conclusions on such a limited scale are probably subject to as much controversy *and* cross-examination as there are individuals who read them. Also, these are only the writer's own conclusions, based on limited tests. It is firmly believed, however, that ultra-high-frequency distortion such as crossover distortion, while not audible itself, does have a pronounced effect on music reproduction. *Æ*

AUDIO MUSIC REVIEW

Classical Record Reviews

Edward Tatnall Canby

The Philadelphia Orchestra—Eugene Ormandy—1969.
RCA (7 discs) Stereo. *(Records available separately—see below)*

This handsome maroon box represents a cross section of the first fruits of the RCA return to Philadelphia, plus a retrospective historical disc that includes an interview with Ormandy and the usual fancy booklet with pictures and background. If I am right, each new disc (and others to come) is available separately. Each has its own independent jacket design and annotation material. Here is a brief summary of first impressions as a general guide to the whole and the parts.

SP-33-555 (Limited Ed.). First, excerpts from Ormandy's first RCA Victor recording at Philadelphia in 1936, the "Pathétique," and the new version of the music—the old one slightly drippier but remarkably the same, even in the sound balance; in between, Roger Hall booms out written questions like the managerial genius that he is, and Ormandy answers wholly naturally, like the impeccably polite thinking man that *he* always is. Interesting recollections. After that, we hear Fritz Kreisler hamming up Paganini in 1936. On the flip, the lovely old Marian Anderson recording of the Brahms Alto Rhapsody is a pleasure to hear again, though its 1939 tone is muffled. Lauritz Melchior is startlingly close-up in a Lohengrin bit, the cellist Emanuel Feurmann is even closer in Strauss' Don Quixote—you can scarcely hear the orchestra. Flagstad sings a Fidelio aria in 1937, already in slightly forced tones, her instrument was beginning to slip.

LSC-3055. Rubinstein plays the second Chopin Concerto and a Chopin novelty of gorgeous filigree and no great weight, the Grand Fantasy on Polish Airs. Superb—a marvelous performance and luscious piano sound. (RCA has always known how to caress the piano.)

LSC-3057. "First Chair Solists" in Four Telemann Concerti. A favorite Philadelphia ploy, this works about as always. For those who really relish and know Telemann and other Baroque music of the sort, the sound here is all wrong though in sometimes intangible ways. Partly it is style—wrong trills, a lack of "bigness," odd tempi, vibrato in the solo violin. Even more it is a curious smallness, in spite of high-power playing. Not so much big chamber music as small symphonic music, that is the inevitable implication when symphony men play Baroque. Not bad—but there are better versions of some of these diverse works. Lots of loud brass for those who love it.

LSC-3058. Tchaikowsky "Pathétique" (Symphony No. 6). After a thousand playings, Ormandy's interpretation is smoothed down to a gorgeous but too-slick version for robust tastes. The inner torture of the work is toned down, where Bernstein might ham it up to the point of sentimentality. Better, perhaps, toned down and impeccably played, as here—but who knows?

LSC-3059. The Bruckner Seventh. Hard to say. Those who love the lengthy Bruckner will find, perhaps, that the polished Philadelphia sound isn't emotional enough for them. Since I always find Bruckner a bit obvious (and dated) in his large-orchestra effects (*now* am I damned!), I thought Ormandy's care and relative restraint did the music no harm. Its best qualities get through in accurate pitch, rhythm, tone color, and orchestral ensemble.

LSC-3060. The Ives Third Symphony and William Schumann's New England Triptych are the Philadelphia's modest contribution to modernity. Not very modern, and not very interesting. The well known Ives needs to be sonically racier, to sound as it must have (or would have) back in its own day a half century ago. William Schumann's exercise on tunes by the 18th century Boston composer William Billings is for my ear a triple etude in orchestral virtuosity, hard as nails and about as edible. Parts of it warm up, fortunately, and Ormandy warms, too.

LSC-3065. The Grieg Piano Concerto and the Liszt No. 1 ("Triangle"). Two hoary old favorites played by the indefatigible Van Cliburn. He is never exactly brilliant, but he does manage to make these works sound un-tired (and so does Ormandy). That's more than many piano-orchestra teams can manage. I enjoyed them. The sound is fresh and outdoorsy—it was made in a breezy open-sided festival pavilion at Saratoga where the Philly spends its summers. They managed to avoid unpleasant extraneous noises, somehow or other. Not a plane, a bird or even a milk truck.

(For more on the Philadelphia Orchestra, see article on page 14.)

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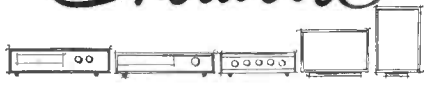

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CLASSICAL RECORDS
(Continued)
Edward Tatnall Canby

Nineteenth Century Classics

Helen Traubel Wagner Die Walkure. (Act III; Duet from Act I, Scene 3). With Herbert Janssen, Emery, Darcy, Vocal Ensemble of the Met. Opera, New York Philharmonic, Rodzinski. **Odyssey 32 26 0018 (2) (sim.) stereo** ($2.50)

What a magnificent album is this! It never was as good before. (This is its third appearance in the CBS catalogues.) Here we have one of the greater Wagnerian voices of the century, gorgeously recorded close-up in astonishingly good fi (the original was 1945) and backed by an orchestra rendition that is fully in the grand old almost-lost tradition. This is how Wagner sounded when it was still in full musical bloom! Von Karajan and others notwithstanding, it isn't any more, today.

The meat of the recording is in the long performance of Act III, in which Wotan puts the naughty Brunnhilde to sleep in her fiery trance—to be awakened many a long hour later (in opera terms), towards the distant end of the "Ring" cycle. Originally it filled an unconscionable number and weight of 78 sides. How ambitious we all were, then, both record producers and listeners! In LP form it still takes up no less than three sides, though presumably it might be compressed onto two, at a lower playing level. The wild-and-woolly opening side, with the assembled Valkyries shrieking like banshees, may put you off if you aren't used to Wagner. Take it easy! Let 'em shriek. Then go on, to listen to the long and wonderfully personal dialog between Brunnhilde and Father Wotan, head God at Valhalla, ending in the unforgettable fire music and sleep music as Brunnhilde sinks to semi-permanent rest. Side 4 constitutes that superb love music between Sigmund and Sieglinde which once, as a callow youth, had me uneasy because, after all, the two turn out to be brother and sister and nobody seems a bit bothered. Such were operatic morals in Wagner's Teutonic heavens.

The voice is all, of course. That marvelous, effortless, enormous big instrument that was the only great American-born Wagnerian soprano of the early century, an instrument with the potency of the greatest European powerhouses, and the almost casual I-can-do-anything approach that is so typically American. In quality, she sounds remarkably like Flagstad at this remove; but Flagstad had finer musical depths, a more subtle sense of pitch and even of pathos. Nevertheless, Traubel is better than I ever remembered her.

Like most opera recordings of 78 days, this one characteristically plays up the star and surrounds her with lesser material. Not by much, but enough. And the recording, also typically, puts the solo voice very close to the mike and blows it up to huge proportions. No distortion, though—not a trace. Those who can scarcely remember Rodzinski at the New York Philharmonic will have a new respect for him after this experience of his Wagnerian direction.

Performance: A *Sound:* B—

Brahms: The Complete Cello Sonatas. Janos Starker; Abba Bogin, piano. **Everest 3265 (sim.) stereo** ($4.98)

There are only two sonatas for cello in the Brahms catalogue, so "complete" is technically correct, if slightly exaggerated. They're both on this record, all right.

Familiar to most listeners to chamber music, these two are among the few cello works that really "sound" for any ear, and they are gorgeously played in this recording, if rather in a modern fashion, fast and furious. Brahms, like Beethoven, requires first of all in his sonatas an energetic pianist; Abba Bogin fills the bill beautifully, an accurate, fluent technician who is all over the keyboard in a perfect sweat of passion. Good! Nothing stodgy and dark brown about *this* Brahms. Janos Starker, the young peoples' cellist (his Bach solo suites are a favorite recording among many young people) is one of those rare players who always play precisely in tune, even up into the highest cello registers. A blessing, as anyone who has often heard the Brahms works will agree.

As always, the early Sonata No. 1, Op. 38, is sonically less effective than the No. 2, Op. 99, since the later work takes the cello over a much wider range of pitch and out of the "mud" of its lower tones. But the first sonata has such lovely melodies in it that few listeners will find it less attractive than the other.

Everest's simulated stereo is useful and the recording is modern enough to treat both cello and piano effectively. Cello a bit too close and tubby in the bottom, piano a bit on the distant side.

Performances: A— *Sound:* B—

David Oistrakh—Brahms: Violin Concerto in D Major. Saxon State Orch., Konwitschny. **Heliodor HS 25091 (sim.) stereo** ($2.50)

David Oistrakh is Russia's contribution to violinistic Romanticism, one of the last of the old pros who are as a matter of course temperamntally and technically up to the demands of the big old concertos. (Every young violinist thinks *he* is, and his Publicity says so, as well.) An old recording such as this is, given an over-all good performance, is thus of unusual value. You'll find that it *is* a splendid performance, by a younger and more pure-toned Oistrakh, presumably back in the early days of postwar recording or the first years of tape. The sound is moderately scratchy in the solo violin, less so in the orchestra—this is because the mike technique, in the old pre-stereo style, puts the fiddle up close and loud and subdues the orchestra into a semi-background. Within that miking style, howevre, the over-all blend is plenty good, the sound is big and the music, in two words, gets over.

'Course you can get Oistrakh in no less than three other versions of this same concerto! Not to mention a choice of eight or nine other available versions, new or old. Perforce, I speak only for this one. Definitely, it is good. If you want to play around, you'll find that Oistrakh is the most repetitive man in the business. He's recorded practically everything twice or thrice.

Performance: A— *Sound:* C+

Franck: Symphony in D Minor. Berlin Radio Symphony, Maazel. **Heliodor HS 25092 stereo** ($2.49)

Here's a reissue with a modern slant in musical terms. Lorin Maazel, out of the U.S., is one of Europe's most vigorous middle-aged young conductors (b. 1930), one of those who have picked up the old Romantic tradition and given it a new neo-Romantic twist, more in a hurry, less knowing, yet sincere in expression. The older standard symphonies come to some very odd new expressions—for older folks, anyhow—in these performances.

I definitely did not like this Franck the first time over. The symphony was my all-time favorite at the age of 15; I spent hours in the school music room absorbing the first 78-rpm (Orthophonic) version of it. By comparison, the Maazel Franck positively races along, where the old Franck was all leisure. (Paradoxically, you took your time when you had to fill so very many 4-minute shellac sides.) On second try,

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however, I think differently. Maazel does miss a lot of the elegant old subtleties but he understands the music's important attributes, its transparently sincere melodies, its filtered-Wagner shiftings of harmony, its old-fashioned ominous build-up technique. Maybe this *is* Franck, for today. Very modern, even though it is a reissue. After all, what are a few years in music history?

Performance: B *Sound:* C+

The Virtuoso Brass of Three Great Orchestras Performing the Antiphonal Music of Gabrieli. Philadelphia, Cleveland, Chicago Brass Ensembles. **Columbia MS 2709 stereo** ($5.95)

Because you really won't be able to tell Philly from Chi, nor from Cleveland, Columbia furnishes a color chart on this record sleeve delineating who plays what, and in which stereo spot, for every one of the 13 pieces by Gabrieli, all but one for double or triple choir. The one, nominally for four single instruments, is played as a grand finale by 17 of the 19 brasses — and what a noise! Assuming your hi-fi can take it.

The vogue for brass music by Gabrieli is not new by any means, even in our modern period, but stereo and present standards of dynamic range and low distortion have brought it to a presumed climax in this record. Those who know a fair bit about the music of c. 1600 are aware that Giovanni Gabrieli most certainly did not write for the powerhouse assemblage of shining brass that we have collected here. Some of his instruments, very likely, were made of wood; none of them had the potency of the modern instruments. Nor was the sound quality of the sort we hear today in the modern orchestral brass complement, nor even the style of playing, which might be described in this recording as Romantic-Modern. And so the inevitable argument advances itself, wouldn't Gabrieli have been thrilled to have had the combined brass of these great 20th-century orchestras to play around with?

Your own private answer to that hypothetical question will tell you whether you'll like the record or no. I can only report that though the musical sound is indeed anachronistic, these players do hold the music in good respect, they phrase it and shape it well and, within their own characteristic professional concept of brass playing, strictly conservatory, they do it honor. So do Columbia's stereo engineers.

Performance: B— *Sound:* B+

Arthur Grumiaux Plays Schubert. (Three Sonatinas for Violin and Piano Op. 137; Sonata in A, Op. 162.) Riccardo Castagnone, piano. **World Series PHC 9103 (sim.) stereo** ($2.50)

Three early Schubert violin sonatas and a fourth of more elaborate nature, all of them familiar and beloved by those who play this kind of music at home, or professionally, and all four very beautifully played in this restored recording, which is modern enough for full musical communication. (It is no doubt one of the vast number of pre-stereo tapes of first-class quality which can now be brought back on the economy labels.)

The trio of Op. 137 sonatas, 'teen-age works, are that sort of limpidly simple Schubert which requires an equally limpid, unaffected, yet expressive performance. Grumiaux is the ideal violinist for such music, a modest, self-effacing player yet with a strong and even a passionate tone, absolute accuracy of pitch and complete musical understanding. His piano partner — overly subordinated in the recording—is well chosen for the same qualities. In the more complex Sonata in A, a work of Schubert's 20th year but already foreshadowing the harmonic profundities of the late Schubert, both performers sense the importance of those strange changes of key, weird modulations, which many players do not even notice. *You'll* notice them here, as you must in any true performance.

Performances: A— *Sound:* B—

Dvorak: Symphonic Variations, Op. 78; Serenade in E for Strings, Op. 22. London Symphony, Colin Davis. **Philips PHS 900-196 stereo.** ($5.98)

A taste for Dvorak involves a taste for thick, richly orchestrated music of a very bland sort in terms of our present listening. Dvorak, so to speak, lacks salt and pepper — those acid dissonances and percussive rhythms that heighten the impact for us of later and even thicker music. You'll find the 1877 Symphonic Variations, thus, almost too sweet and thick to take, though many lovely moments-in-detail will haunt you. (They weren't sweet and thick in their own day. But our ears are different.) One whole side of them, and that's a lot, though nicely played.

The Serenade in A, an earlier work, is also sweet but in a more classical medium, the string orchestra. It tools along rather rapidly here—I'd say too rapidly for the players' abilities. There are unlovely smears here and there, instad of clean string articulation. You'll find at least six other worthy performances on records, if this work is your interest. (There's also a Serenade in D minor, Op. 44, with winds.)

Performances: B— *Sound:* B

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Double Concertos by Bach's Sons on Original Instruments. Leonhardt–Consort of Amsterdam, Concentus Musicus of Vienna, Leonhardt. **Telefunken SAWT 9490-A Ex stereo** ($5.95)

This is a record of extraordinary combined interests, for those whose

musical experience is wide enough to take in the unusual "scene"—the three sons of Old Bach, each in a concerto for multiple solo instruments and orchestra, each at his best and in typical character, the three works gorgeously recorded via a complete roster of authentic instruments of the time including an early piano, Baroque flutes, oboes, natural horns and trumpets (no valves), timpani, even Baroque strings. It took the combined efforts of two leading ensembles to do the job. The recording climaxes a notable series by the Consentus Musicus on its own that includes the Bach Brandenburg Concerti and the four orchestral Suites played on authentic old-type instruments, not to mention many more.

First of all is the excellence, the total proficiency and musicianship, of the playing itself—old instruments or no. This continues to astound; only a few years back they were still saying it couldn't be done (and even that the players didn't really do a job back in the old days). There is virtually no compromise in execution here, though the oboes and flutes have only finger holes, no keys, the brass tones are produced entirely with the lips, in a natural overtone series. Really amazing.

Second is the subtle contrasts of style between the three brothers, in the transition period when Baroque and Bach-Handel-Telemann turned into the new *galant* style that means, for us, Mozart and Haydn. The eldest, Wilhelm Friedemann, is the most like Papa Bach in his almost-Baroque Concerto for Two Harpsichords, strings, and lots of Bach-like brass. Carl Philipp Emanuel, the middle son and the most profound musical thinker, is portrayed in the year of his death, when Mozart had only three years himself to live — a splendidly complex work contrasting the piano *and* the harpsichord in a most revealing dialog, along with an array of flutes, oboes and other unusual sounds. Finally, Johann Christian, the youngest, the urbane, glittering showman, all graceful geniality, model for Mozart's own earlier music and wholly unlike the elder Bach, his father.

Thirdly — recording. Visually (in imagination), acoustically, these sounds are wonderfully alive and immediate, with both clarity and larger-than-life presence, an outstanding demonstration of good stereo mike technique in optimum acoustical surroundings. Only that inexplicable faint graininess that mars an occasional Telefunken, for reasons unknown, impedes a "perfect" score in recording technique.

Performances: A *Sound:* A—

BROWSER'S CORNER

Unusual Opera Revivals —

Weber: Der Freischütz. Watson, Schock, Frick, Berlin Opera Co., Matacic. **Everest S468/3 mono** (3 discs)

Prokofieff: Betrothal in a Monastery. Petrov, Isakova, Orch. Cho. Stanislavsky Mus Theatre Moscow, Abdullayev. **Everest S-465/3 mono** (3 discs)

J. Strauss: Die Fledermaus. Shock, Berry, Vienna Symph., State Opera Cho., Stolz. **Everest S-463/2 mono** (2 discs)

J. Strauss: The Gypsy Baron. Wachter, Schock, Kusche, Orch. Cho. Berlin Opera, Stolz. **Everest S-469/2 mono** (2 discs)

R. Strauss: Elektra. Konatzni, Ilisch, Mödl, Braun, Orch. Cho. Maggio Musicale Fiorentino, Mitropoulos. **Everest S-459/2 mono** (2 discs)

Gershwin: Porgy and Bess. Winters, Williams, Matthews, Long et al. Orch. Cho. Engel. **Odyssey 32 36 0018 (sim.) stereo** (3 discs)

Collection Bargains —

Bach Brandenburg Concertos (incl. alt. movements.) N. Y. Sinfonetta, Goberman. **Odyssey 32 26 0014 stereo** (2 discs)

Handel: The 16 Organ Concertos. Biggs; London Philh., Boult. **Columbia D3S 777/8 stereo** (3 discs each)

Couperin: Complete Organ Works. Michel Chapuis. **RCA Victrola VICS 6018 stereo** (2 discs)

Haydn: The (12) London Symphonies. Little Orch. of London, Jones. **Nonesuch HR 73019 stereo** (6 discs)

Beethoven: The Five Middle Quartets. (Opp. 59, 74, 95.) Guarneri Quartet. **RCA Victor VCS 6415 stereo** (4 discs)

Beethoven: The Complete Music for Cello and Piano. Casals, Serkin. **Odyssey 32 36 0016 (sim.) stereo** (3 discs)

Beethoven: The Five Piano Concertos. (also other works). Gilels; Cleveland Orch., Szell. **Angel SE-3731 stereo** (5 discs)

Bartók: The (6) String Quartets. Tatrai String Quartet. **Dover HCR-ST-7272/3/4 stereo** (3 discs) (Sep. available)

Switched-On Bach. Realized and Performed by Walter Carlos. (Moog Synthesizer).
Columbia MS 7194 stereo ($5.95)

Sort of late to review a best-seller sensation like this? Well, when I first heard it the record wasn't selling—it had just appeared. Not that I disliked it. Decidedly the opposite. I thought it was very fine Bach, anyway you heard it, and I still do.

Perhaps my ear is so hardened to, and accustomed to, electronic sounds that I don't guess the impact this disc might have. As of a recent survey, months before this review appears, it was not only "No. 1" in classical sales but was rising very rapidly through the twenties in the *popular* sales charts. For good reason I now say, with large quantities of hindsight.

The reason is simple. (a) Bach. (b) Excellent musicianship, very *musical* performances by Mr. Carlos and his assistance (I mean to spell it that way). (c) Superbly imaginative use of the Moog Synthesizer, the first electronic machine to respond to the human touch like a musical instrument.

Put these together and you have something. What I overlooked was the novelty of an all-electronic machine turning out good Bach. I just took it for granted, already having an enormous respect for Mr. Moog's talents in the way of instrument building. For those who have thought that electronic sound is somehow inhuman and "mechanical," this revelation, that even a Moog can reflect good performing characteristics, has been pleasantly shocking. This *is* good Bach, excellent Bach, almost human Bach! After all, aren't an organ, a harpsichord, a cello, all of them, music machines for projecting *human* musical ideas? So is Moog.

I accept every one of Mr. Carlos' tricky Moog sounds with equanimity and even delight. Bach's music can take them and benefit, given such good taste and understanding of the music. Only one item made me falter a bit—and not for the whizzes and swooshes it adds to the Bach idiom: the (properly) inserted free-cadenza middle movement for the Brandenburg No. 3. It is harmonically confusing where it should have a clear and definite function, to amplify the "phrygian cadence" effect that Bach indicates in the two chords he inserts at this point. Instead, we wander in neo-Bach fashion, like George Martin in the Beatle records, and lose touch with the basic key of the outer movements before we finally get back home. A minor quibble! All the rest is gorgeous, and particularly the "orchestration" that brings out so many legitimate inside-texture ideas. Even better than a live playing, I thought.

Performance: A— *Sound:* A—

LETTERS (Continued from page 8)

responsibility for possibly damaged expensive amplifiers.

If we reverse the leads to the left auto-transformer (Fig. 3) the supplementary connection does no harm, but it is useless because it is parallel to the existing connection. And as in Fig. 1, the voltages of the two amplifiers are not added. Furthermore I am not convinced that in all solid-state amplifiers one of the speaker terminals is grounded, but perhaps at another point. In such a case that wiring may cause trouble, too.

So only with the use of at least *one* transformer with both insulated primary and secondary will the system work, but with two such transformers we have much more freedom of connections. All the diagrams of Figs. 4 to 6 will give satisfactory results. If we examine Fig. 6 more closely we will find that this diagram is not only identical with Fig. 5 (only differently represented), but it is also identical with Fig. 7 in the March issue of AUDIO (except that the leads of speakers 3 and 4 should have been reversed, as mentioned earlier). In diagrams Figs. 5 and 6, we may even connect the heavily drawn supplementary connection to the ground without difficulties.

ERNST BAENNINGER
Baar, Switzerland

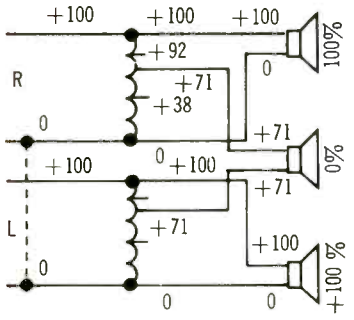


Fig. 1—Wrong! No voltage addition.

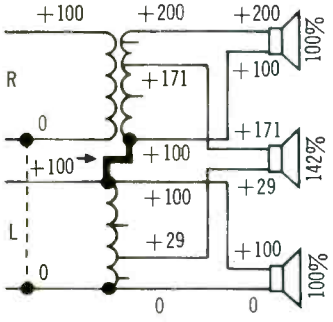


Fig. 4—O.K.

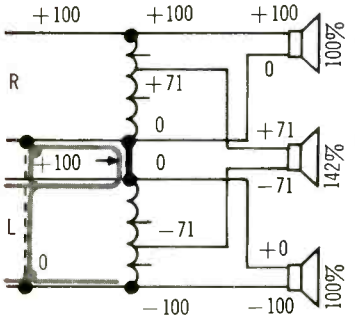


Fig. 2—Dangerous! Short circuit of one amplifier.

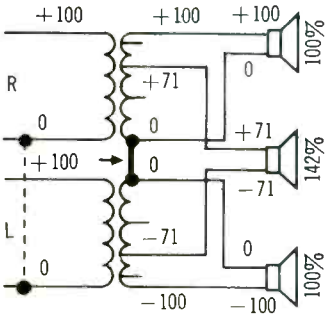


Fig. 5—O.K.

Fig. 3—Wrong! Similar to Fig. 1.

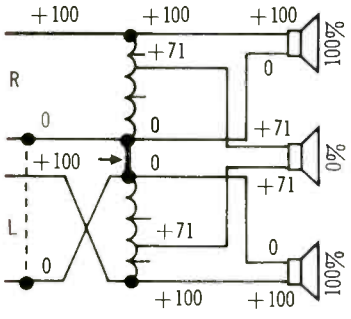
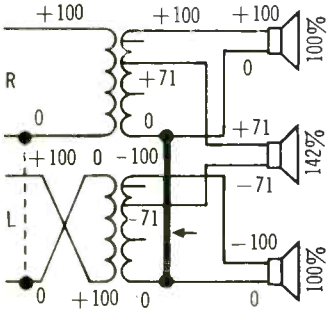


Fig. 6—O.K.



Soul Music Panorama

SHERWOOD L. WEINGARTEN

Trying to define soul music is as easy as killing a bear with a fly-swatter. You start by saying it has roots in Negro folk history, and it blossomed during the Rhythm & Blues era of the early '50s. But from that point, the genre takes on many colors—always pausing to build from Basic Black.

The top artists in the field theoretically should paint a definitive vocal picture. They don't.

■ **Aretha Franklin,** for example, has earned more gold records than any female singer in history and has been designated "Lady Soul." Yet her latest album, SOUL '69 (Atlantic, SD-8212), is a departure, with the emphasis on jazz.

Originally a gospel singer who switched first to blues, the thrush does retain the shouting and voice-stretching techniques that seem to epitomize soul. And indeed she leans heavily on attempts to find just the right note in mid-song, clutching one syllable through intricate series of gymnastic vocal screams. But pinning a song stereotype on what she does is as tricky as trying to catch that "Elusive Butterfly," which she transforms from a beautiful ballad with a mystic lyric to a wild, raucous number with unrecognizable words. "Ramblin'," the lead cut, showcases the blues heritage, framing her gusty voice with a brassy big band sound. But "Today I Sing the Blues" is a rendition that exudes sex, aided by a steady bump-and-grind beat. In further contrast is "River's Invitation," which carries a happy syncopation and an orchestrated fullness that rivals Basie. Sam Cooke's "Bring It on Home to Me" showcases an overzealous horn section apparently intent on drowning out the melody, leaving stress on the animalism of a beat. "Tracks of My Tears," however, utilizes Latin percussion to provide a smoothness and the best track of the LP. Voice and orchestra mesh neatly, beginning softly and rising to a crescendo, not unlike a pop Bolero. The singer also reaches back into the R&B bag for "I'll Never Be Free," in which a pensive introduction gives way to to a heavy, slow beat that ultimately melts into muted horns. Then, to complicate things even more, Aretha borrows John Hartford's country hit, "Gentle on My Mind," to spring into an up-tempo zinger that removes all vestiges of gentleness.

Throughout, jazz backgrounds are supplied by such stalwarts as Jimmy Cleveland, Urbie Greene, Pepper Adams and King Curtis, but the most effective instrument—since improvisation is minimal—remains the singer's blistering voice.

■ **Ray Charles,** one of the first to expose soul to a national audience, crosses musical barriers as easily as Zsa Zsa sheds men. He has amassed jazz, blues, and pop cults, due in part to a better voice and a more stable style than most soul singers, a combination that makes it unnecessary to rely on gimmickry or loudness.

Blind since 6, orphaned at 15, Charles began his bumpy ride to stardom by playing jazz piano and forming his own trio at 17. Zesty, ethnic performances led to later vocal smashes such as "Ruby," "Georgia on My Mind," "Hit the Road Jack" and "What'd I Say."

But now much of the soul singing is hidden behind strings. Witness I'M ALL YOURS—BABY! (ABC-Tangerine, ABCS 675), a collection of 10 tunes aimed at 3-a.m. romantics clinging to each other on a deserted, darkened dance floor. The entire package is straight pop, with flashes of soul and interludes of jazz only occasionally breaking through the whitewashed, sophisticated orchestrations. Extremely low-keyed, the LP might be termed mellowness personified; there is no hint of harshness, little reminder of a sandpapered past.

Charles' slightly raspy voice was never better as he digs deeply into successes from American musical history. Ira and George Gershwin's "Love Is Here to Stay," with the singer shadowing Billie Holiday's mournful cry, is the prime example. "Till the End of Time," with an easy Latin rhythm, is another glossy performance. And there's Rodgers & Hart's "I Didn't Know What Time It Was," plus a pair of Rudolf Friml melodies, "Indian Love Call" and "Someday."

If there's a flaw, it's that the Sid Feller arrangements often have a fuzzy, almost-bland sameness that points too far from black roots.

■ **Arthur Conley,** protege of the late Otis Redding, may be typical of the shouters. Despite the title, MORE SWEET SOUL (Atco, SD-33-276) is composed mainly of jump tunes with the kind of rock beat that youngsters and chiropractors dig.

A Lennon-McCartney winner, "Ob-La-Di, Ob-La-Da," starts it off with a driving, contemporary rhythm that effectively masks Conley's voice behind a deluge of sound. On "I Got a Feeling," though, he manages to outscream the heavy brass bleat that's normal for one of his faster tracks.

Like many others in the field, Conley writes much of his own material. Three included are "Shing-a-Ling," "Aunt Dora's Love Soul Shack," and "Run On," the last being the most danceable of the dozen tunes.

Atypical—yet probably the most enjoyable cut and one that proves he CAN sing—is "Is That You Love," a ballad with heavy organ accompaniment and a western flavor introduced by a harmonica. Sound separation is is faulty, however, with instrumentation streaming from the right channel while the voice is limited to the left (instead of seeming to come from between them).

Overall, the package is uneven—not one of Conley's better efforts. Perhaps now that he plans to go it alone and drop the background vocal combo that intrudes too often on this LP, his next will improve.

■ Humor is an item that rarely finds its way into the soul idiom, but it's the mainstay of compositions by Joe Tex. HAPPY SOUL (Atlantic, SD 8211), with all 10 songs penned by the singer, emphasizes the light side of misfortune while sticking to the hardy rock of the "Memphis Sound."

"Go Home and Do It," to illustrate, spotlights what might be termed a comedy monologue midway through the tune. Dealt with are kissing honeymooners, a drunk, and a woman who insists on removing her shoes—all center stage in a restaurant. "That's Your Baby" is flippant about bastardy, and "Chicken Crazy"—peppered by audience laughter and applause—takes the so-called soul food craze to a joyous, bouncy extreme.

A prolific tunesmith with several hundred pieces to his credit, Tex punctuates his vocals with squeals of delight. These, not incidentally, combine with his normally gravel-surfaced voice to give a uniqueness to "Baby, Be Good."

The flip side of the disc, more serious in tone than Side One, is highlighted by "Sweet Sweet Woman" and "You Can Tell," the latter being spiced by a verbal narration that splits the singing verses, a retrogression to early R&B formats.

■ Determining what soul is becomes even more difficult when the term is juxtaposed with another vague, all-inclusive word. Johnny Nash adds to the confusion by entitling his latest album SOUL FOLK (JAD, JS 1006) and producing a pop package with the focus on the traditional.

Nash, an ex-choir singer from Texas who at the age of 16 became the youngest member of the old Arthur Godfrey radio-TV cast, only last year formed the JAD label. Ostensibly the purpose was artistic freedom; the result, this LP, is slickness sans vitality.

"You Got Soul," an original by the singer-guitarist, opens and closes the disc. The best offering, it provides what may come close to a pigeonhole for soul: "Let yourself be free so the whole wide world can see." But Nash fails if that's his goal, for sandwiched between the two segments are a pile of stiff, over-roasted chestnuts. "Love Me Tender," the Elvis-composed ballad, is covered with goo, unaided by the choral accompaniment; "Cool Water" doesn't equal the Burl Ives version; Sam Cooke's "Chain Gang" contains as much adult impact as Humpty Dumpty, and is further marred by strings; the reverie of "Scarlet Ribbons" is interrupted by the plucking of a heavy, heavy bass.

Nash sounds too much like Johnny Mathis on the latter's "Twelfth of Never," and there are touches of early Belafonte on Bob Dylan's "Blowing in the Wind," changed to quasi-calypso. "Island in the Sun," in contrast, retains its haunting melody with a steel band sound hovering in the background.

There's really nothing terribly wrong with the album, produced in Jamaica, and there's nothing particularly outstanding or imaginative about it. Neither soul nor folk, it will please *Musak* lovers. Because of a 3-D cover inset, by the way, the list price jumps from JAD's normal $4.79 to $4.98.

■ Ambiguity also turns up on a recent Staple Singers' album title, SOUL FOLK IN ACTION (Star, STS 2004). The motif might more accurately be termed gospel-rock, for the quartet relies on frenzied shrillness and hand-clapping.

With a spiritual-like melody thrusting to great intensity on "The Ghettos," this is the most meaningful and moving of the cuts. Organ, guitar and brushes mourn in the background as the urban blues lyric, a highly personalized statement, is unleased.

"I See It" is a hopeful look toward peace featuring a harsh beat that pounds steadily. The song ironically ends with squeaky, shaky strings tuning up to the strains of our national anthem. An equal-rights theme, something surprisingly found only rarely on recorded soul music, runs through "Got to Be Some Changes Made." Contrasting tunes include Redding's posthumous hit, "Sittin' on the Dock of the Bay," done here as a deep blues, and "This Year," which uses an electric guitar to introduce the Eastern sound.

The two males and two females, each of whom takes the lead at times, show gracefully that soulful lyrics do not have to be unintelligible.

Just what is soul? Apparently no one knows for sure—despite so many singing it. And the word "soul," on an album cover is no guarantee at all that it *is* soul music. Even the record industry is in the dark, for the Grammy awards contain no such designations. The closest is four prizes for "Rhythm & Blues" efforts. Æ

Jazz

BERTRAM STANLEIGH

Milt Jackson and the Hip String Quartet
Verve Stereo V6-8761

Ever since jazz musicians started to read music, the gulf between jazz and classical music has been growing narrower. The rate of speed at which these two forms are beginning to converge is very slow, but nonetheless manifestations of the change continue to crop up. A recent manifestation of this trend (if "trend" doesn't suggest too strong an activity) is encountered on vibraphonist Milt Jackson's latest offering which makes use of a string quartet.

Strings aren't really new to jazz, many musicians have played jazz against a sustained melodic line from a string section, but with the exception of an isolated violinist or two, the men playing strings on jazz performances were involved in playing a non-jazz accompaniment to a dominant jazz solo. Things are really different on this new disc called *Milt Jackson and the Hip String Quartet*. First of all, the string quartet's balance is unusual. This one has one violin, one viola, and two 'cellos, one of which is tuned an octave below the violin. Secondly the quartet isn't really used as a quartet at all. Excepting Jackson, there are a total of nine instruments in the group: bass, piano, drums, flute, tenor, and strings. They all work together, not as contrasting groups of soloing and accompanying instruments. Only Jackson's vibes maintain a largely dominant voice in the proceeding. Each of the other voices has brief moments of prominence, but the overall effect is of a closely knit ensemble sound in which each of the strings blends as an individual instrument, rather than as a special sub group.

The effect is a new and different one that sounds wholly ungimmicky and pleasantly easy to take. Tom McIntosh, who arranged and conducted the group, was clearly concerned with making music, rather than playing around with new effects, and his arrangements have been neatly tailored to the special airy, rhythmic bounce of Milt Jackson whose unusual poise and detachment lend individualism to his fluent performances.

The string quartet consists of Sanford Allen, violin, Alfred Brown, viola, Ronald Lipscomb, and either Kermit Moore or Sidney Edwards, 'cellos. Ron Carter or Bob Cranshaw, bass, Cedar Walton, piano, Mickey Roker or Grady Tate, drums, James Moody, tenor, and either James Moody or Herbert Laws, on flute, fill out this pleasantly balanced group. Sound is good and the stereo balance is fine; however, for those who are as interested in the accompaniment as in Milt Jackson's solos, the strings do seem a bit far from the mikes.

Performance: A *Sound:* B

Oliver Nelson and Steve Allen: Soulful Brass
Impulse Stereo A-9168

If you're looking for some very bright, spacious stereo with a modern, easy-to-take spirit and a bit of a bounce, this platter fits the bill to perfection. It's thoroughly pleasurable music making in which Allen and a band of major jazzmen, including Roger Kellaway, Barney Kessel, Tom Scott, Jimmy Gordon, Larry Bunker, and Bobby Bryant, are heard in Oliver Nelson arrangements of such pop items as *Torino, Spooky, Goin' Out of My Head, The Dock of the Bay,* and a handful of Allen's own creations. For the first time on discs, Allen plays the RMI Rock-si-chord, an instrument for which he demonstrates a clear affinity. His approach to this electronic keyboard is vastly different from his familiar piano style, but the final result is not only very personal, but sonically expressive.

Performance: A *Sound:* A+

Guitar Sounds from Lenny Breau
RCA Victor Stereo LSP-4076

Raised in the ambience of country music, and recorded in RCA's "Nashville Sound" studio, Lenny Breau is a jazz guitarist with a strong country accent and a great debt to the late Wes Montgomery. He has an abundance of technique, and he is the recipient of some exceptionally fine enginering. If he has not yet developed the kind of long line that makes a cohesive whole of a composition, he has at least delved deeply into each phrase, and the highly attractive musical personality revealed in this debut recording may very well develop into one of the more expressive artists of the emerging generation.

Performance: B *Sound:* A

Gary Burton Quartet: Country Roads
RCA Victor Stereo LSP-4098

In view of Burton's sometime association with country music, the title of this new set could suggest a group of Nashville-style experiments. However, what emerges is a variety of progressive impressionism that is one of Burton's greatest achievements to date. Reservations apply only to a transcription for piano and vibes of Ravel's *Prelude to Le Tombeau de Couperin.* By means of overdubbing, Burton performs both parts with skill and sensitivity, but it isn't jazz; it throws no new light on Ravel; and it tends to present a jarring contrast between a giant of the century's first quarter and a minor master of our own day. Changes in quartet personnel find Roy Haynes on drums and Jerry Hahn, who recently headed a group of his own in San Francisco, replacing Larry Coryell on guitar.

Performance: A *Sound:* A

Ornette Coleman: Ornette at 12
Impulse Stereo A-9178

Twelve-year-old Ornette Denardo, a powerhouse of energy whose drumming never lets up, is the occasion for this souvenir. To quote from Coleman's liner note, "Ornette Denardo is hard to keep up with if you don't tell him what to do." That difficulty is made manifest on four medium length performances of Coleman's *C.O.D., Rainbows, New York,* and *Bells and Chimes.* Although the recording was made at a live performance, audience noises are slight: however, Dewey Redman, tenor, and Charles Haden, bass, could have benefitted from closer miking.

Performance: Variable *Sound:* B

Son House and J. D. Short: Delta Blues
Folkways Stereo FTS 31028

A "rechanneled to simulate stereo" reissue, this collections couples six recordings by Sam House, made in 1942 for the Library of Congress by Alan Lomax, with four songs sung by J. D.

Short in 1962 for Samuel Charters. Both House and Short represent good examples of the Mississippi Delta blues style, one of the richest strains of American folk music, and very possibly the earliest form of blues. While the re-recording does nothing to improve the quality of the sound, such repackaging has obvious commercial justification. And any practice that will help to keep valuable documents of this sort available should be encouraged.

Performance: A *Sound:* D

The Best of Wes Montgomery
Riverside Stereo RS-3039

This is the second Montgomery collection to be released with the same title. The first, on Verve, included recordings made shortly before the death of this sensitive and imaginative guitarist. The present set covers the years from 1959 to 1962 and includes two bands from Montgomery's first recording. Any comment on which of the "Best" recordings is really best is, of course, superfluous. Montgomery was one of the most directly accessible and enjoyable of jazz players, and it is fine to have these performances available once more. Just remember, when shopping, that there are two different sets with the same title.

Performance: A *Sound:* B

The Best of Chico Hamilton
Impulse Stereo AS-9174

Another set of reissues from previous collections. It begins to look as if we can expect this kind of rehash from every label on each performer who has made four or more long-playing records. In this instance, the practice serves a useful purpose since it brings together on a single disc performances by different Chico groups, thereby revealing the full dimension of a musician whose breadth is only appreciated when he is heard in a variety of musical styles and with widely differing personalities. Here he plays with Gabor Szabo, Charles Lloyd, Ron Carter, Richard Davis, Larry Coryell, Charlie Mariano, Jerome Richardson, and Jimmy Woods. Each performance is splendid, good not only because of Chico's magnificent drumming, but also because Chico has the ability to select the very finest talents and to inspire them to do their best work.

Performance: A *Sound:* A

Recorded Tape Reviews

BERT WHYTE

Bruckner: Symphony No. 9 in D Minor. Herbert von Karajan conducting the Berlin Philharmonic. Ampex/DGG–DGA9011, **open reel, 7½ ips, EX-Plus** ($9.95)

It is curious that von Karajan has recorded so little Bruckner over the years. Certainly on the evidence of this splendid recording his reading is one of the most convincing and compelling. Karajan's penchant for orchestral lucidity and detail (which sometimes can cause him trouble with certain music), is appropriate in this massive work. He keeps the whole huge musical structure moving along at a sensible pace — it never lumbers nor becomes too diffuse. Yet the great climaxes are delineated with stunning power and almost awesome intensity. The playing of the Berliners is an astonishing exercise in orchestral vituosity — the strings are ravishingly beautiful and the brass, so important in Bruckner and particularly in this work, sound out with great power and authority.

The recording philosophy here is what I would call a "calculated risk." It is always a temptation with Bruckner to strive for a big "concert hall" type of sound . . . but it is dangerous because much of the score is rather thick-textured and it can lead to very muddy, amorphous sound. Here we have fairly distant miking in a rather broad acoustic perspective, a definite try for a big spacious sound. It is surprisingly successful as orchestral detail and presence hold up well (although the contrabassi are muddy at times). Excellent balance is maintained between the orchestral choirs; good lateral directionality and a well-defined center-channel image; moderate dynamic range. In spite of the EX-Plus processing the tape hiss was too high at a room-filling playback level. Print-through and crosstalk no problem. The hiss may have been somewhat accenuated because it was necessary to play this tape at a fairly high level in order to achieve the proper perspective.

All in all, a superb performance. And appropriate, if not spectacular sound, add up to a desirable tape.

Chaucer: The Canterbury Pilgrims. Martin Starkie, narrator–The Gabrielli Brass. Ampex/DGG, DGM89380, **8-track cartridge** ($5.95)

This might seem like the last thing one would ever want to play on his car's stereo, and it does seem more comfortable at home. Yet I listened to this tape while stuck in a nerve-wracking New York traffic jam and found it so amusing I forgot my miseries.

Presumably extracted from the London show, these are rather straightforward translations from Chaucer concerning the pilgrims who were on their way to the shrine of Becket in Canterbury. The characterizations of the Nun, the Miller, the Doctor, and all the other pilgrims are earthy, even ribald often with a twist of wry humor, but compassionate withal. Martin Starkie narrates these tales with a pleasant well-modulated voice. He is recorded close-up and at all times is completely articulate. The music is mainly in the background in a broad acoustic perspective and is a sort of tongue-in-cheek put-on—baroque style brass integrated with a rock beat. Not particularly distinguished, but a pleasantly innocuous framework for the tales. Hiss moderate in home, low in car. Try this for something different.

No matter what you might think of Hollywood mixers, these pros almost always come up with a good sound on dialogue and vocals. Therefore it was doubly disturbing to hear male solo voices that were very nasal and peaky. Articulation was not good on solos and really quite poor in choral and ensemble sections. The voices were recorded

up close with a moderate amount of reverb and should have been clean. As it is, some of the scenes are a mish-mash and only marginally intelligble. Too bad, for the recording has many stereo virtues although stage movement seems restricted. Low hiss is at least another consolation.

L. A. Breakdown: Jack Jones; music arranged and conducted by Pat Williams. RCA Victor P8S-1408, **8-track cartridge** ($6.95)

It is always a pleasure to listen to the stereo cartridges of Jack Jones. I don't know if any special technique is used, but there is no question that the cartridges of this appealing vocalist are among the best engineered available. What is more, they are consistently good. I've never heard a clinker yet in his series wth RCA Victor. The voice is smooth and beautifully balanced against the clean sound of the orchestra. The acoustic perspective gives plenty of presence, the stereo effects are always tasteful. The processing is well nigh immaculate—very low tape hiss, print-through and crosstalk hardly discernible even at high playback levels. I have had more compliments about sound quality in these Jack Jones cartridges from passengers in my car than any other 8-track material I have played for them.

This is a typical Jack Jones program neatly balanced between "oldies" such as "Lost in the Stars" and "My Man's Gone Now" and contemporary items like the title song and several new ballads of which "Love Story" is most interesting for it's clever lyrics. Jack winds up the cartridge with an unusual treatment of the old Benny Goodman sign-off theme, "Good-Bye."

Love in the Generation Gap: Ferrante and Teicher, duo pianos. Ampex/United Artists, UAC6677, **open reel, 7½ ips** ($7.95)

Ferrante and Teicher attack a mixed bag of old and new ballads with their customary elan, and superb playing. As with Jack Jones, this team also seems to be favored with consistently good engineering. The piano sound is great with nice clean transient response, and although recorded quite closely, once again the engineer has avoided the sound of hammer action. If you know anything about piano recording, you realize this is no mean feat! Good piano/orchestral balance too, and the overall sound has plenty of presence.

The team plays such as "The Look of Love," "For Love of Ivy," "This Love of Mine," "When I Fall in Love," and eight other hits on the "love theme." Another F&T winner! ! *Æ*

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PHOTOGRAPH BY FRANZ EDSON

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