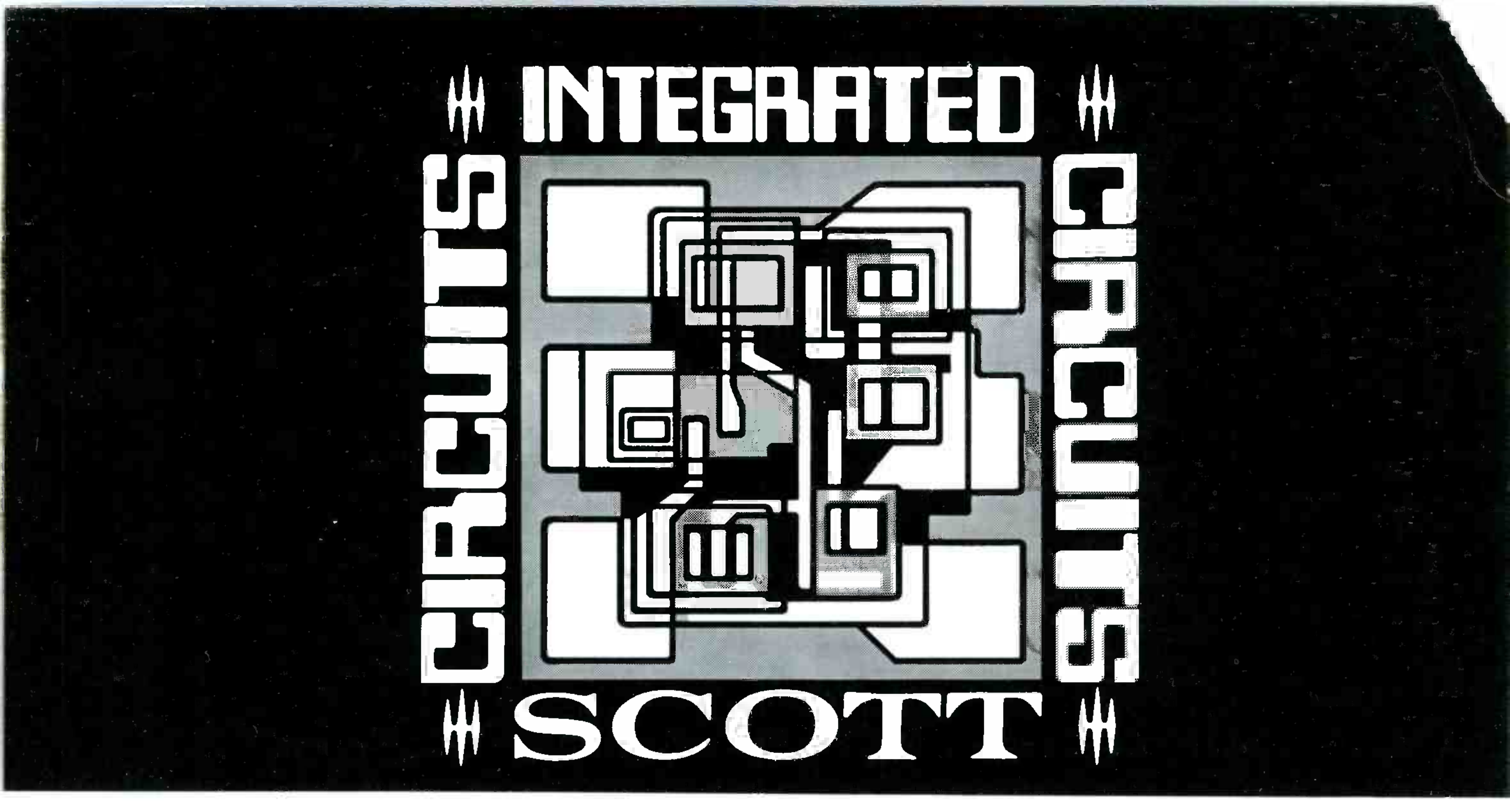
AUDIO

MARCH 1967 60c

... the authoritative magazine about high fidelity

SPECIAL RECORD PLAYING EQUIPMENT ISSUE – PLUS ENLARGED RECORD REVIEW SECTION



Announcing an important Scott innovation in high fidelity . . .

Scott Integrated Circuits...now in 4 Scott receivers

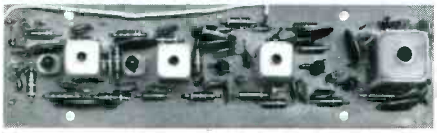
Hear stations you've never been able to hear before . . . brought to life with amazing clarity!

Integrated Circuits . . . the computer-born miracle.

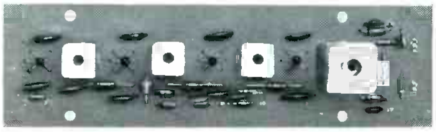
Originally developed as a space-saving device in giant computers, the integrated circuit ("IC") is a complete circuit in miniature . . . often barely larger than a grain of sand. The various elements of the circuit . . . transistors, resistors, and wiring . . . are permanently carved into a microscopic layer of silicon. There are no lose wires or parts that can change, age, fall out, or wear out. In fact, Scott Integrated Circuits can last literally thousands of years.

More performance in less space.

Used in the vital FM tuner IF strip, Scott Integrated Circuits actually incorporate more circuitry in less space. The new Scott IF strip now contains 20 transistors, as compared to four in the previous model. Scott's previous IF strip, without IC's, gave superb capture ratio and selectivity figures of 2.5 dB and 45 dB, respectively. Scott's new Integrated Circuit IF strip is conservatively rated at 1.8 dB capture ratio and 46 dB selectivity. Independent test reports, however, show the new Scott Integrated Circuits to be consistently capable of an incredible 0.8 dB capture ratio!



old IF strip



IC IF strip

What Scott IC's mean to you.

Now you can hear more stations with less noise and interference. Weak, distant stations that you never have been able to receive before will suddenly appear with amazing clarity. Outside interference from electric razors, auto ignitions, etc., will be drastically reduced. And, you can count on enjoying this amazing performance for many, many years . . . thanks to the absolute reliability of Scott Integrated Circuits.

When will Scott IC components be available?

Scott IC receivers are now at your Scott dealer's showroom. Scott IC's are incorporated into the design of the 388 120-Watt AM/FM stereo receiver, the 348 120-Watt FM stereo receiver, the 344 85-Watt FM stereo receiver, and the 342 65-Watt FM stereo receiver. Your Scott dealer will be glad to demonstrate to you the amazing capabilities of these new receivers.

Scott . . . where innovation is a tradition

SCOTT®

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Another innovation from Scott, manufacturers of superb components, compacts, kits, speakers, and consoles.

AUDIO

March, 1967 Vol. 51, No. 3

Successor to RADIO, Est. 1917

AUDIO Articles

AUDIO Reviews

AUDIO Profiles

AUDIO in General

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Coming Articles

Next month we will present a Forum on Loudspeakers. This provocative format will include questions and answers of concern to all serious hobbyists. In addition we will feature a product compendium illustrating the latest speaker and speaker systems.

The usual complement of feature articles, plus columnists, and the expanded record review department will be on hand.

Profiles

Dyna PAS-3 preamplifier and Stereo 120 amplifier.

On the newsstands, at your favorite audio dealer's or in your own mailbox.

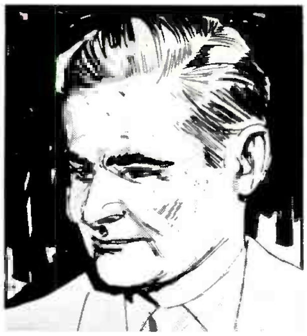
About the Cover

Our bouquet of musical flowers present something of a puzzle. Can you guess the names that go with our five faces?

Answers on page 55.

AUDIO CLINIC

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.

Tuner Muting Control

Q. What is the muting control on a tuner? John J. Kiesel, Valley Stream, L. I., N. Y.

A. A muting control on a tuner is used to quiet interstation hiss when the tuner is changed from one station to another.

There are various schemes by which this is accomplished. Basically, what is done is to cut off one of the audio stages in the tuner so that the hiss cannot be transmitted, but the signal can be passed along. One common arrangement is to set a tube up so that when no voltage appears on its grid, the tube is highly conductive. The cathode of this tube is connected to the cathode of an audio amplifier. Because of the high conduction of the control tube, the cathodes of both tubes are positive with respect to the grid of the audio tube. The grid of the control tube is connected to the grid of the first limiter amplifier. Therefore, when a signal appears, the limiter grid goes negative. This causes the control tube to become less conductive. The audio tube is no longer cut off and the circuit performs as a normal audio amplifier.

Sometimes a neon lamp is introduced into the plate circuit of the control tube. Such a lamp has the property of going into heavy conduction suddenly. What this does, therefore, is to eliminate the tendency of the audio amplifier to be cut off gradually; cutoff will occur suddenly, at the moment the lamp "fires," or ignites.

There are other similar schemes which involve the use of a relay in the plate circuit to accomplish the sudden turn-on and turn-off characteristics which are desirable in such circuits. The contacts of this relay are placed in the audio section of the tuner in such a way as to short out the signal when only noise is present.

In sophisticated communications type receivers, the muting, or "squelch," circuit is so arranged that the noise is amplified separately and fed into the control amplifier. Added noise will only make the control tube open the circuit further rather than allow noise to enter, as is often possible with the less sophisticated muting arrangements. This sort of noise-gating arrangement is quite involved, but it works well in communications equipment. I have not seen it used in FM tuners.

Speaker Impedance

Q. I have a stereo music system. My speakers are of the multiple-array type, each channel using 25 6-inch speakers in series-parallel in the midrange, plus six, hard-core tweeters in the treble section. I also have a University Sphericon tweeter in each channel to take care of the ultra highs. My low frequencies are produced by a 12-inch, dual-voice-coil woofer.

In each channel I use a 2-way crossover network. I would appreciate a simple, accurate method which would give me the right impedance values of the various elements in the system. I do own a VTVM. Adam Kohlhoff, Clearwater, Fla.

A. The VTVM you own will be of help in telling you the impedance of your speaker system, but it is useless unless you have access to an audio oscillator. This instrument is connected to the input of your amplifier and it is a source of signal for the tests to be outlined here.

The impedance of your system may vary considerably over the frequency range because of the presence of the crossover network and because of the inductance and mechanical resonances in the speakers themselves. You may

GARRARD'S 50 MARK II

A NEW COMPACT AUTOMATIC TURNTABLE WITH HIGH PERFORMANCE FEATURES AT ONLY $54.50

Far from being keyed to the level of budget or even medium priced music systems, the 50 Mark II deserves comparison with the finest and most expensive automatic turntables. Its dramatic impact begins with styling . . . functional, handsome and beautifully coordinated. Operating features are equally impressive . . . encompassing the latest advances in convenience and performance. The 50 Mark II is one of five new Garrard Automatic Turntables. For complimentary Comparator Guide describing each model, write: Dept. AC-1, Garrard, Westbury, N.Y. 11590.

notice the greatest departure from an average impedance in the midrange and perhaps in the upper portion of the audio spectrum because of the many speakers involved. Once you know the average impedance of the entire system, you can connect the system to the amplifier tap which most closely resembles the impedance that you have determined. You do have a complication in your particular system because you appear to be trying to employ a two-way crossover to work with a three-way speaker system. I do not know how this was done. It seems to me, however, that this was not the best approach to obtain proper operation of a three-way system. You can make an improvement in the impedance curve by obtaining a crossover network which is designed for a three-way system. If the network uses an 8-ohm impedance as a design center, use speakers of 8 ohms impedance. In the case of the 25 speakers connected in series-parallel, they must be connected in such a manner as to provide an impedance of as nearly 8 ohms as possible. If the impedance of the speakers does not match that of the crossover network, the crossover point will be moved from its design frequency and the sharpness of the roll-off will change.

Now we come to what you wished to know specifically—the method for determining the impedance of the various speakers in your system.

Obtain a potentiometer whose ohmic value is of the order of 50 ohms. Connect as you would a rheostat, in series with your speaker or speaker array. Feed a signal of, say, 400 Hz into the amplifier so that the output voltage appearing across the amplifier is one or two volts. Adjust the potentiometer so the voltage across it just equals that produced across the speaker terminals. The resistance of the pot at this point will be equal to the impedance of the speaker at 400 Hz. Try various other frequencies in the range to be covered by the particular speaker under test, including the crossover frequencies. You will be able to determine the smoothness and sharpness of the impedance curve of the individual speakers and of the speaker system as a whole. The smoother and the flatter this curve, the better the speaker system will be.

Intermittent Hum

Q. Several months ago I started getting an intermittent hum in my amplifier. The amplifier would be working quietly on records or on FM. Suddenly a loud hum would be heard for a few seconds and then stop just as suddenly. The periods it would remain on gradually grew longer, until it would stay on for 20 seconds or more, and then disappear for a couple of minutes. I asked the manufacturer about this. The company recommended checking the tubes. I did this and found that one output tube had a short. I replaced the tube. Still the hum persisted.

I took the amplifier to the repair department of a leading high-fidelity dealer. He kept it a week and found that the trouble was caused by three defective 12AX7 tubes—cost $12.00. (I did not mind the bill if I could have gotten rid of the hum, but it is still present.) In addition, I replaced the rectifier tube which seemed to induce hum when I tapped it.

I wonder if you have any ideas on this problem? William C. Day, Cincinnati, Ohio.

A. When we think of hum of the type you have described, filter capacitors come to mind as the thought first and foremost after tubes have been checked. The filter may be fine in terms of having its rated capacitance but it may have loose contacts. The lugs on the bottom of the capacitors often are not well soldered or riveted. This can lead to intermittent operation of the capacitor. Tap the capacitors rather severely and see what happens. If the hum comes and goes in accordance with your tapping, you have probably found the trouble. Be sure that when you tap something that you attribute your actions to what you hear. To illustrate this, you tapped the rectifier tube and noticed the hum coming and going. Perhaps what really was taking place was that the vibration caused by the tapping of the tube was transmitted to the defective component via mechanical shaking of the chassis. Make sure that this is not what is happening when you tap a particular capacitor can. Look for the component which appears to be most sensitive in terms of affecting the hum heard in the speakers.

Unfortunately, you sometimes will not be able to produce the hum in the manner just described. It may be a function of heat rather than something which is mechanically loose enough to show up when tapped. You might be able to cause the failure of the weak part merely by increasing the line voltage to the amplifier by 10 per cent. This can easily be done by a power-control auto transformer, if one is available. If the component fails altogether, you can find the trouble more easily than you can when the condition is intermittent. This kind of servicing is the most difficult. Hence, it is also the most expensive. It is not surprising, then, that a service shop, after spending a considerable amount of time on the equipment believes that the trouble has been found, only to be proved wrong later on.

There is another tracing scheme which I have not seen used very much, but it is one which I like to use at times.

It involves placing a pair of headphones or the input of another amplifier across the B supply at various B plus points. Naturally, the input of the headphone amplifier is coupled to the circuit via a capacitor. The idea is to note whether the hum is heard in the phones at the same time it is heard in the speaker of the offending amplifier. By connecting to various B-plus points, you can find the one which produces the greatest amount of hum. The chances are good that this portion of the circuit is defective. Æ

New Literature

One of the latest of the Allied Publications is this 96 page book. Titled "Using Your Tape Recorder," the book covers the following chapters: Sound—What Is It?; Your Recorder; Microphone Recording; Recording 'Off the Air'; Dubbing from Records and Tape; Editing; Sound and Special Effects; Sound for Slides and Home Movies; Recorder Maintenance. The author is an old hand at writing entertaining and instructive audio manuscripts. He is our own Harold D. Weiler—to be found here each month in SOUND AND SIGHT. Price of the paperback volume is 50 cents postpaid directly from Allied Radio Corporation, 100 N. Western Avenue, Chicago 80, Illinois.

Decorating With Consoles

H. H. Scott has just announced a free brochure entitled "At Home with Stereo." This full-color 20-page publication is in fact a catalog of the expanded Scott line of stereo consoles. Each is mounted in an exclusive collection of decorator-styled room settings. Included are many informative articles on high fidelity, the role of music in the home, choosing the correct console to match individual room decor, and complete explanations in non-technical terms, of the more technical aspects of stereo consoles.
Check 5

VTVM-VOM Guide

A new twelve-page Triplett test equipment catalog describes a line of panel and portable electrical and electronic test instruments. The catalog defines a selection of instruments including VOMs, combination VOM-VTVMs, laboratory and burnout-proof VOMs, and other instruments. Photos and complete technical details are given for each item. Also listed are accessory items and carrying cases, and list prices. This is catalog 49-T; it is free, and may be ordered from the Marketing Department, The Triplett Electrical Instrument Company, Bluffton, Ohio 45817.

Check No. 102 on Reader Service Card →

Fundamental AUDIO

Martin Leynard

How do sounds differ? In loudness, of course, and in frequency (or pitch) both of which we've covered in the last two installments of "Fundamental Audio." But not all sounds of the same frequency and amplitude sound the same: "A" on a violin is quite plainly different from "A" on a trumpet; Callas and Sutherland sound different even when holding the same note from the the same aria. What gives each sound its individual character?

Basically, only two characteristics: harmonic content (the number, variety and intensity of frequencies besides the fundamental one which sets the pitch), and wave envelope (the shape of the imaginary line drawn along the peaks of the waveform from its beginning to its end).

Let's look first at harmonic content. Back in January, we showed a typical music waveform and said that "despite its jagged shape, it can be analyzed into its component sine waves." A look at a vibrating string will show us why.

If we pluck a string whose ends are fixed, it will flex up and down continuously along its length (*Fig.* 1A). The main frequency of this flexing (which is determined by the length, mass and elasticity of the string) is called its fundamental vibration, and the resulting tone is what we hear as the pitch of the string.

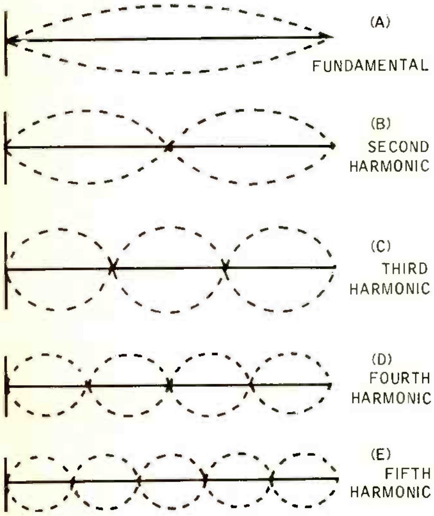


Fig. 1. The basic way in which a pure wave, and then a wave plus progressive harmonics, is generated.

MORE ON WAVES

But this is not the only frequency at which it vibrates. There are, in addition, several higher frequencies—all exact multiples of the fundamental—called harmonics. The "second harmonic," whose frequency is exactly double that of the fundamental, arises because the string also tends to vibrate in two segments whose effective lengths are each half that of the entire string (*Fig.* 1B). The string also vibrates as though it were divided into three, four, five and more sections, and the resulting vibrations are known as the third, fourth, and fifth harmonics and so on.

All of these "overtone" vibrations occur at the same time as the fundamental, and are superimposed upon it. And because each of these overtones is both higher (and therefore faster) and weaker than that of the fundamental, their vibrations are usually close to impossible to see (except on very low strings, whose fundamental and overtone vibrations are slower than those of high strings).

In *Fig.* 1, for clarity, we drew each of the string's harmonic vibrations with equal amplitude. Though this might seem to imply that all of a string's harmonics are equal in amplitude (and volume) to the fundamental, this is far from being the case. In practice, some of these harmonics are louder than others, and none of them is as loud as the fundamental. This is important, for these harmonics (and other overtones) give different sounds their individual characters, or timbres; without them we would be unable to tell one instrument from another.

Stringed instruments, as *Fig.* 1 indicated, produce all the odd and even harmonics. So do open-pipe instruments. Closed pipes, however, will not produce the even harmonics (2nd, 4th, 6th, etc.) although they do produce the odd ones.

Harmonics, those overtones that are exact multiples of the fundamental frequency, are not the only overtones produced by musical instruments. The first overtone of a tuning fork, or other "clamped bar" is 6.27 times the fundamental frequency, the second overtone is 17.55 times the fundamental. That of a xylophone, or other device using a free, or unclamped bar, is 2.76 times the fundamental, its second overtone being 5.4 times the fundamental frequency. Drums and similar membranes have similarly inharmonic overtones, such as 1.59 and 2.3 times the fundamental. Gongs, cymbals, and other circular plates produce different overtones (though still inharmonic) depending on how they are supported when struck.

Not all of these overtones are heard, by any means. To begin with, since each overtone is higher than the preceding one, the uppermost overtones are beyond the limits of human hearing. This will affect the overtones of higher notes more quickly than it will low ones: one might conceivably hear the 40th harmonic of a 440-hertz "A" (17,600 Hz.) but the 6th harmonic of the piano's highest "A" (3520 Hz.) would be a very inaudible 21,120 hertz.

And as the overtones get higher, they become weaker. *Fig.* 2 shows the waveform and a frequency spectrum diagram for a clarinet note. The spectrum diagram shows the relative amplitudes of the clarinet's fundamental and all of its overtones up to the 9th. Now while the 5th harmonic is the loudest overtone, and the even harmonics are fairly weak (two of the characteristics which give the clarinet its distinctive sound), we can also see that from the fifth harmonic on, the overtones decrease in intensity, and contribute less and less to the timbre of the sound. Æ

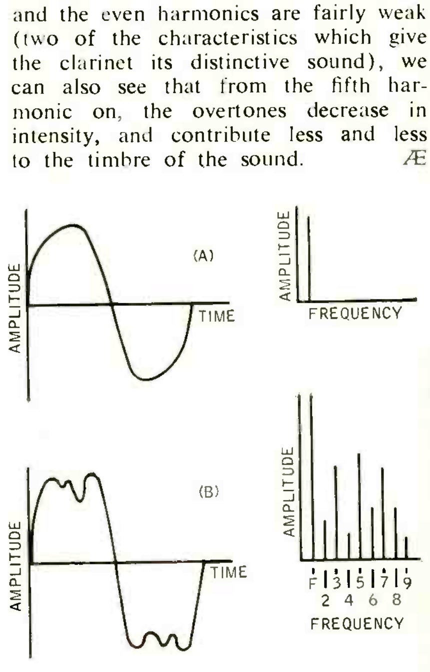


Fig. 2. A pure tone compared with the same note blown on a clarinet. It is this special distribution of overtones that gives each instrument its specific sound.

Mark of the leader...

GARRARD'S LAB 80 MK II

The ultimate expression of over 50 years of Garrard leadership, this much-imitated but unequaled automatic transcription turntable contains many developments invented, perfected and brilliantly refined by the Garrard Laboratories, and now considered essential for the finest record reproduction.

Just two years ago, the stereo high fidelity world was introduced to the Lab 80, the first Automatic Transcription Turntable. It was instantly acclaimed because of the significant developments it contained. These imparted professional performance capabilities never before anticipated in automatic record playing units. Now, the Garrard Laboratories have refined and surpassed the original model with the Lab 80 Mark II, still priced at only $99.50, less base and cartridge. It is one of five new Garrard Automatic Turntables each of them the leader in its class. For complimentary Comparator Guide, write Garrard, Dept. AC-1, Westbury, N.Y. 11590.

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AUDIO ETC.

Edward Tatnall Canby

THE DOLBY

Last October and November the British audio and record magazines were full of a new device, made in England by an American engineer, called the Dolby S/N Stretcher, a *veddy* British title that is about as meaningless at first glance as you can imagine. Now the Dolby—as I will call it—has hit America. And I expect it will turn out to be one of the most fundamental improvements in the way of noise reduction in audio systems; for that is what it does. Especially in hi-fi professional tape recording.

The Dolby is pro, strictly for the trade and not the home. (Home users will get its results indirectly in terms of better records.) This system is, to be sure, "just one more" compresser-expander circuit and it might, so it seems, sound bad. Circuits of this general sort have been appearing for many years and with many a claim and many a fussy over-ingenuity. For good sound, most of us tend to distrust them like murder.

But this one is really different. This one works. It goes straight to one of the most difficult of today's residual hi-fi recording problems — low-level noise. Principally, for us, in tape recording. But also in many other areas not my concern: motion pictures, video tape, mastering and dubbing (this *is* part of the recording process . . .), land transmission lines and—for all I can figure —broadcasting, telemetry, a hundred areas where noise at low levels is a problem. Let's talk only about recording on tape. That's plenty.

I was sent the Dolby literature and specs some time ago, as were many editors and engineers. Most of the recipients, I suspect, took one look and put the info aside for later study—then forgot. I did myself. But luckily for me, the inventor, Mr. Ray M. Dolby, phoned up unexpectedly one day in New York. We talked for a half hour and the upshot was that I went back for a closer look at the literature. Glad I did.

Not long after, I ran straight into the Dolby itself, large as life. It was in actual use, first-in-America, by one of our enterprising independent recordists, Marc Aubort (Elite Recordings), who had just completed some tapes with it for the Nonesch label. I was supposed to be listening to Rachmaninoff and Kodaly and Handel on the tapes, with a view to the musical annotations which I was to write for Nonesuch. (That's my other self.) Instead, I ended up talking Dolby like crazy—and listening.

I heard two tapes, one made straight from the mikes and the other, same performance, put through the Dolby on recording and playback. Astonishing. This thing has its cake and eats it, let me tell you! It didn't do *anything* wrong. To the best of my ear, it did everything *right*. That's what Aubort thought too. An amazingly effective noise reducer, and—as Marc explained to me (and Dolby in his literature) a lot more, too. This thing goes on working far into the future. It catches things like print-through as they occur, methodically reducing them, whenever the Dolby tapes are played back.

To give you basic specs in a few words, the Dolby lowers effective low-level noise content in tape playback (our immediate concern) by 10 dB and more, down in the crucial low end of the dynamic range where the really bothersome noise is found. It reduces tape hiss, modulation noise, stereo crosstalk, high-speed flutter or "scrape" and, most especially, PRINT-THROUGH, all by this major factor of 10 dB-plus, as compared to the signal itself. And this *without introducing any measurable distortion of any kind into the signal-proper*, which remains unchanged in all respects. So they say. So I heard.

Overshoots and Undershoots

Oh yeah? You don't believe it. Never heard of any kind of insertion gadget that didn't do *something* unpleasant to signal quality? More intruded circuitry? NO! And in particular, a dynamic compression-expansion system—definitely not *that!* Leave our hi-fi alone. Let's have a clean signal and forget the noise. It's extremely low-level, isn't it? Why fuss?

For too many years we've known all about the nasty side effects of compression and expansion circuitry, the overshoots and undershoots, the swishes and the hush-hushes, the ringing and sneezing sounds, the multiple types of distortion therein implied, not to mention plain degradation of signal as it goes through much too much circuitry. And not to mention, also, the falsities in the sound itself, the musical distortions of space and distance which are perpetrated by many such circuits—enough to have put me well off them a long time back. (Compression makes the music recede in space as it gets louder, the space itself seeming to grow smaller; expansion brings the music rushing forward on climaxes, the hall size suddenly much bigger.)

Let's limit compression-expansion, then, to extreme necessities. Like broadcasts from Vietnam. Or sports comments from baseball sidelines. We're talking about hi-fi.

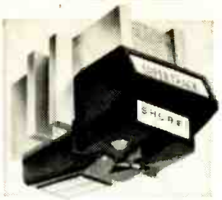
Nevertheless, the Dolby, more lengthily entitled the Dolby A301 Audio Noise Reduction System and costing a couple of thousands (two systems for stereo) does compress during its initial phase (before recording in our case) and expands, to match, in the second phase (playback). Yet the darned thing really does *not* seem to have any effect at all on signal quality. I heard it. It just reduces noise, and that by a major degree of audibility. Hard to believe.

Excellence

Many factors, of course, are involved in this. There's first the solid-state circuitry, with 9 silicon transistors and 138 semiconductor diodes—count 'em if you dare. That, plus generally high quality and highly intelligent design (so I would gather) contributes a vital element, rock-stable exactitude of values of a sort impossible with tubes. The Dolby unit has no controls whatsoever. It doesn't need them. It never changes. Its values are fixed And exact. Believe it or not.

Then there is excellence of fidelity. The over-all noise level is "better than the most important advance in phono cartridges since the advent of stereo

THE TYPE II SHURE V-15



...a new genre of cartridge, analog-computer-designed, and measured against a new and meaningful indicator of total performance:

"TRACKABILITY"

The radically new V-15 TYPE II heralds a new epoch in high performance cartridges and in the measurement of their performance. We call it the era of high *Trackability*. Because of it, all your records will sound better and, in fact, you will hear some recordings tracked at light forces for the first time without distortion.

THE PROBLEM:

While audiophiles prefer minimum tracking forces to minimize record wear and preserve fidelity, record makers prefer to cut recordings at maximum levels with maximum cutting velocities to maximize signal-to-noise ratios. Unfortunately, some "loud" records are cut at velocities so great that nominally superior styli have been unable to track some passages: notably the high and midrange transients. Hence, high level recordings of orchestral bells, harpsichords, pianos, etc., cause the stylus to part company with the wildly undulating groove (it actually ceases to track). At best, this produces an audible click; at worst, sustained gross distortion and outright noise results. The "obvious" solution of increasing tracking force is impractical because this calls for a stiffer stylus to support the greater weight, and a stiffer stylus will not track these transients or heavy low-frequency modulation, to say nothing of the heavier force accelerating record and stylus wear to an intolerable degree.

Shure has collected scores of these demanding high level recordings and painstakingly and thoroughly analyzed them. It was found that in some cases (after only a few playings) the high velocity high or midrange groove undulations were "shaved" off or gouged out by the stylus . . . thus eliminating the high fidelity. Other records, which were off-handedly dismissed as unplayable or poor pressings were found to be neither. They were simply too high in recorded velocity and, therefore, untrackable by existing styli.

Most significantly, as a result of these analyses, Shure engineers established the maximum recorded velocities of various frequencies on quality records and set about designing a cartridge that would track the entire audible spectrum of these maximum velocities at tracking forces of less than 1½ grams.

ENTER THE COMPUTER:

The solution to the problem of true trackability proved so complex that Shure engineers designed an analog-computer that closely duplicated the mechanical variables and characteristics of a phono cartridge. With this unique device they were able to observe precisely what happened when you varied the many factors which affect trackability: inertia of tip end of the stylus or the magnet end of the stylus; the compliance between the record and the needle tip, or the compliance of the stylus shank, or the compliance of the bearing; the viscous damping of the bearing; the tracking force; the recorded velocity of the record, etc., etc. The number of permutations and combinations of these elements, normally staggering, became manageable. Time-consuming trial-and-error prototypes were eliminated. Years of work were compressed into months. After examining innumerable possibilities, new design parameters evolved. Working with new materials in new configurations, theory was made fact.

*Thus, the first analog-computer-designed, superior trackability cartridge was born: the Shure SUPER-TRACK*V-15 TYPE II.* It maintains contact between the stylus and record groove at tracking forces from ¾ to 1½ grams, throughout and beyond the audible spectrum (20-25,000 Hz), at the highest velocities encountered in quality recordings. It embodies a bi-radial elliptical stylus (.0002 inch x .0007 inch) and 15° tracking.

It also features an ingenious "flip-action" built-in stylus guard.

It is clean as the proverbial hound's tooth and musical as the storied nightingale.

THERE ARE MANY WAYS TO PROVE ITS SUPERIORITY TO YOURSELF:

(1) Shure has produced a unique test recording called "An Audio Obstacle Course" to indicate cartridge trackability. It is without precedent, and will be made available to Shure dealers and to the industry as a whole. You may have your own copy for $3.95 by writing directly to Shure and enclosing your check. (Note: The test record cannot be played more than ten times with an ordinary tracking cartridge, regardless of how light the tracking force, because the high frequency characteristics will be erased by the groove-deforming action of the stylus.)

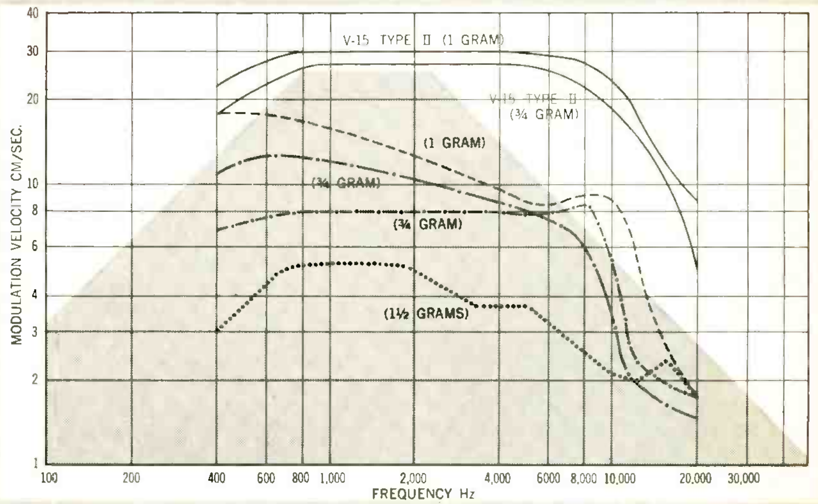
(2) A reprint of the definitive technical paper describing the Shure Analog and trackability in cartridges, which appeared in the April 1966 Journal of the Audio Engineering Society, is available (free) to the serious audiophile.

(3) A representative list of many excellent recordings with difficult-to-track passages currently available is yours for the asking. These records sound crisp, clear and distortion-free with the Shure V-15 Type II.

The Shure Super-Track V-15 TYPE II is available at your dealers at $67.50.

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

TRACKABILITY AS A NEW SPECIFICATION:



This chart depicts the new performance specification of *trackability*. Unlike the oversimplified and generally misunderstood design parameter specifications of compliance and mass, trackability is a measure of total performance. The chart shows frequency across the bottom, and modulation velocities in CM/SEC up the side. The grey area represents the maximum *theoretical* limits for cutting recorded velocities; however, in actual practice many records are produced which exceed these theoretical limits. The smoother the curve of the individual cartridge being studied and the greater its distance above the grey area, the better the trackability. The trackability of the Shure V-15 TYPE II is shown by the top (solid black) lines. Representative curves (actual) for other cartridges ($80.00, $75.00, $32.95, $29.95) are shown as dotted, dashed and dot-dash lines for comparison purposes.

*T.M.

Check No. 112 on Reader Service Card.

80 dB (unweighted) below peak operating level" and the over-all total harmonic distortion is less than two tenths of a percentile at the same very low levels—surely unusual in transistor circuitry if I am right—this from 30 Hz to 20 kHz. (Ugh, don't like. 30 to 20,000 sounds so much more convincing . . .) This being a dual unit, there are similar readings in the way of internal crosstalk between the two, down in that 80 dB range again. And there are maximum advantages, reasonably new in this area, that accrue from the low-impedance operation throughout. Also advantages thanks to "special control signal rectifying and smoothing techniques," by means of which Dolby achieves "both very low distortion at low frequencies *and* a very fast response time . . . aspects which are mutually exclusive in normal time-constant circuits." Those are Dolby's words for you. Strong words.

Near the Mud

General excellence, and let the engineers argue as to the details; they go beyond my official engineering know-how, if not beyond my intuitive sense of what looks good and what doesn't. What struck me at once, though, was a more important single innovation that is crucial in the Dolby as compared to other compression-expansion circuits — an aspect that instantly persuaded me that this gadget, of all gadgets, just *had* to work for recording.

This compresser-expander, you see, operates only down in the very lowest signal levels, down near the mud. It compresses ONLY the faintest components of the ingoing signal, boosting them from almost nothing to a bit more than almost nothing. Then, in the precisely equalized output, it pushes this tiny sound component back where it was in the first place. With it, pushed down into nothingness, goes *all the additional noise that may have been added after the fact,* after the original Dolbyizing of the signal.

Get the idea? This is, of course, a two-stage operation. Dolbyizing and de-Dolbyizing. Two units in one. They are the same; you may strap them for either function, in or out. First you Dolbyize your signal, boosting the lowest levels of sound 10 dB before recording. Then, on playback, you de-Dolbyize, restoring all the original levels exactly. (Yep, exactly.) And reducing whatever noise has been added in the meantime by the recording (or other) system.

You see, if this complex circuitry operates only on the lowest levels of sound, then the rest of the signal is left as is. The main body of your sound is neither "distorted or affected in any way whatever," as Dolby so positively puts it. What low levels? *Very* low levels, and thereby lies a trick of tricks. For it is at the bottom level that we now find our most deadly noise problems—and the better we get, the worse these tiny residual noises seem, thanks to the incredible sensitivity of the ear for extreme low-level sound.

That's the rub, all right. The more noise we remove, the more clearly we hear what is left. Down to that Ivory-pure 99 44/100th per cent—in terms of sound power. It shouts, that residue.

Masking

Enter here the masking effect, that sublime and helpful phenomenon which counteracts our undue ear sensitivity. Thank the Lord for masking! Loud sounds mask out lesser sounds, which are unheard even though still measurably present. Dolby uses masking, like everybody else. As soon as signal level is high enough to mask the residual noises, they disappear. Since they are *extremely* tiny—if very obtrusive, all by themselves, the masking effect covers all but those annoying instants of near-silence, down near the mud. That's where noise shows.

But masking is tricky, as many an engineer has found to his disgust. Masking goes by frequency. You can't easily mask a low tone by a louder high tone. It even goes by wave-shape or content. A speaking voice can be understood against a musical sound at the same level. Indeed, the whole area of apparent effect in masking is of the utmost subtlety and complexity. So what matters here is not that Dolby uses masking in his automatic adjustment to dynamic sound levels, but that the specific aspects of the automatic adjustment are workably and rightly calculated. That's where the man shines! Get to that in a moment; but go back to the over-all fact that this compresser-expander *works only at the lowest levels.* That makes it already a likely bet. For, you see, it takes enormous advantage of our acute hearing down in the tiny, infinitesimal bottom range, down where the print-through and the tape hiss live, where our persnickety ears are grossly annoyed by micro-sounds that won't even make a meter pointer move a millionth of a millimeter. Deal with *those* and you deal BIG, with physically tiny signals. Maximum advantage, for minimum outlay.

Down there, we're dealing with the good old human ear in its own coinage. So the ear "exaggerates" these unwanted mini-noises, like print-through and tape hiss? OK, we'll exaggerate them right back. We'll get in there 'way down and do something selectively where it matters. Leave the macro-sound alone. It's not the problem. Push down the mini-sound in its own bailiwick. By 10 dB and more.

You see, if this circuit really works as intended, something good is bound to happen. It's aimed precisely at the heart of the problem—tiny unwanted sounds with a big relative impact.

Exactitude

Now, after this slightly roundabout approach, let's look closer. Two vital elements of the Dolby system impress me further in detail. First—the exactitude of the equalization, the compression and its matching re-expansion. Via older tube circuits, there would be inevitable trouble right here, due to an inexact match. *Non-linear* trouble. Worse, that non-linearity would vary from unit to unit despite the best of designing—and worst of all, it would vary in time, as old fashioned components usually do.

To maintain any sort of exact standard, there would have to be constant adjustments, check-ups, alignments and what have you. And controls. That sort of variableness simply cannot be introduced into top-quality recording circuitry —we have enough trouble as it is, thanks.

How can Dolby dare add another set of possible variables? It's just plain unthinkable.

Well, Dolby answers persuasively. First, of course, is that low-level business. His pre-shaping and re-shaping of signal applies only to the faintest low-level area. No heavyweight compression or expansion—no overloads due to an expanded macro-signal, nor any of the ills that the grosser kinds of compression usually bring. The Dolby treatment is, so to speak, dainty and delicate. Just a touch of treatment, at precisely the right place. The main signal virtually unaffected.

But even so the Dolby in-and-out match itself really does appear to be extraordinarily exact, and extraordinarily permanent. Modern technology, solid-state, at work. It can be done. It *is* done, here. How else would he have the nerve to produce identical units minus all controls? And at a professional level, mind you.

The standard Dolby match, he says, "is straightforward, being accomplished simply by connecting networks identical with those used for recording in the feedback loop of an amplifier. In this way all steady-state and transient effects are automatically taken into account and the output signal becomes identical with the input signal in all respects."

No two ways about *that*. And, furthermore, he says, "this can be proved with an oscilloscope and sine waves, square waves, impulses, and keyed wave forms, as well as by the most critical A-B listening tests using any type of program material." He really puts it on the line. He's asking for it.

Seeing is believing via a good scope and known input signals. So is hearing, via a good A-B type ear. That's the instrument I used and it said "excellent!". The piano square waves, for instance, those violently sudden initial transients, were totally unchanged and wholly natural after Dolbyizing and de-Dolbyizing. I heard no trace of signal degradation. The "in" and the "out" matched as claimed, and the improvement in terms of noise reduction was astonishing, even with the best low-noise tape and top-grade equipment. The "out" signal, to put it plainly, sounded like what you hear directly through the mikes. That's precisely the idea.

So confident is Dolby of all these

PAS-3X PREAMPLIFIER
69.95 KIT, 109.95 ASSEMBLED

FM-3 TUNER
99.95 KIT, 154.95 ASSEMBLED

UNCOMPROMISED QUALITY

This combination of PAS-3X preamplifier, FM-3 tuner, and Stereo 120 amplifier represents the highest level of quality which can be attained with high fidelity components. It combines the virtues of both tubes and transistors in a flexible modular system without skimping to squeeze it into one unit.

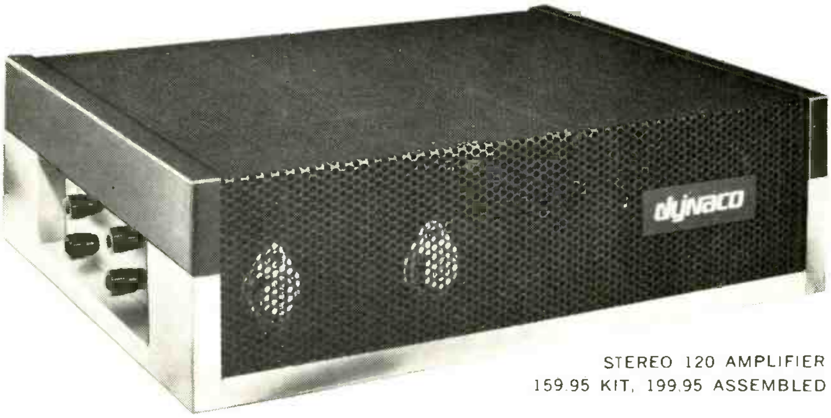
Two of these components have passed the test of time — years of increasing public acceptance. The Stereo 120 is an all new design. All have been engineered and produced with the same underlying Dynaco philosophy of offering superlative performance at the lowest possible cost—when you buy it, and as long as you own it. Everyone recognizes that Dynaco is "best for the money." **We** know that it should be judged regardless of price—Dynaco quality has never been compromised by cost considerations.

Our sole concern is sonic perfection. We don't follow the herd in engineering, styling or promotion. Fads, status and "revolutionary new sounds" never enter our planning. We avoid regular model changes and the planned obsolescence they engender. We take the extra time to do things **right the first time.** That probably explains why our limited product line has become increasingly popular each year. It's why our kits are so easy to build; why maintenance is so easy; and service problems so few. We constantly strive to improve our products though, and when we do, these changes are available to our customers to update existing equipment at low cost.

Our detailed literature, available on request, gives the full specifications which help to explain why the Dynaco components illustrated (PAS-3X, FM-3 and Stereo 120) will provide the finest sound possible. Specifications are important, but the most complete specifications cannot define truly superb sound. Go to your dealer, and compare Dynaco with the most expensive alternatives, using the very best speakers and source material you can find. Be just as critical, within their power limitations, of our best-selling Stereo 70, Stereo 35 and SCA-35.

Of course, if you are now a Dyna owner, don't expect us to convince you to replace what you already have.

But your friends might benefit!



STEREO 120 AMPLIFIER
159.95 KIT, 199.95 ASSEMBLED

dynaco inc. **3912 Powelton Ave. Philadelphia, Pa. 19104 U.S.A.**

Check No. 113 on Reader Service Card.

parameters of performance that all his units, and all the tapes made with them, are claimed to be *permanently interchangeable*. Any tape, any Dolby unit anywhere, anytime. That's the vital point for the recording industry and he had better be right!

Any Dolby tape may be equalized out, i.e., played back on any Dolby-equipped system. Tapes may be interchanged, interspliced, dubbed at any time, new or old. (Phase response, by the way, is not a significant factor, again being equalized out.) You may Dolbyize (*stretch*) and de-Dolbyize a signal over and over again in successive copies, too, and the net distortion is almost entirely that of the output amplifiers, cumulatively less than two tenths per cent per copy; the noise addition, of course, keeps getting removed time after time. (Hence the usefulness of the Dolby in dubbing operations.)

Independent Suspension

There's still the second big technical feature to describe. Granted the Dolby system is inherently stable, uniform, precise, and interchangeable, that it affects only the lowest sound levels—what else?

Plenty. Dolby's circuitry does not (as did the original and well remembered H. H. Scott noise suppressor circuits of late 78 days) vary the frequency band pass. Nor does it operate a macro-compression and expansion of large segments of signal. To meet the peculiar phenomenon of low-level sound masking by the ear at its own exact terms, Dolby has hit a circuit jackpot. He operates in four separate bandwidths, to cover the major areas of noise without interaction between bands. In other words —here we have a kind of four-way independent suspension, like a Volkswagen.

Each band (down in the ultra-low levels, remember) compresses and expands independently: in the hum-and-rumble range (these are Dolby's terms), in the mid-audio range, in the medium high frequencies (that would be the troublesome and controversial "presence range," wouldn't it?) and in the high frequencies. A high signal level within any one of these bands *will not prevent noise reduction in the other bands wherever the signal may be low*.

Boy, is that tricky! No swishes and hush-hush effects. Each sound-type given its own treatment, and no unpleasant interactions. It can't be that simple? Well, at macro-levels it might not work so well. But at the low Dolby micro-levels, I guarantee you, it does work. Just like a Volkswagen works. Reliable too.

Inestimable Distinction

Now finally, let's get to practicalities. You may need to do a bit of quick double-take thinking here. I did. You can't make something out of nothing. You can't, for instance, treat a tape that is already made. *Except* to copy it with a minimum of added noise—which is a very valuable feature, by the way, since tape copying is done by the mile in every recording company, and every dubbing adds more noise and general degradation. (By dubbing through the Dolby you "convert" an older tape into a Dolby tape, using the tape playback as the "original." Any noise already on that tape will be dutifully preserved in the copy. But *new* noise will thereafter be minimized.)

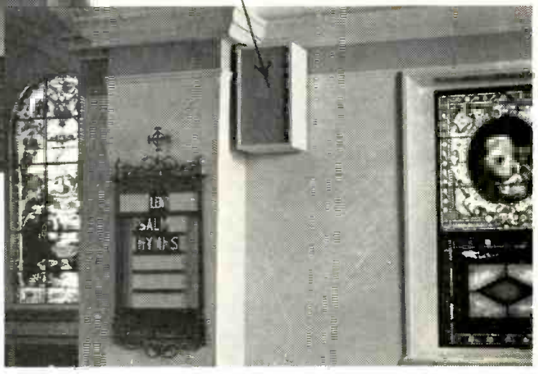
The Dolby noise reduction affects *only* those signals which are added after the initial Dolby treatment. In recording it is done before the tape-recorder input, right at the recording session. Just plug into the input circuit. Everything that is wanted goes through the Dolby first —and then is recorded. The tape machine doesn't know the difference, of course. It takes down the Dolbyized signal (boosted 10 dB or more in each of the four low-level bandwidths) as so much gospel.

Later on, it plays back the same, as well as it can. Then the playback signal is put through the second Dolby unit, which knows exactly what it is doing. All elements of the original that were boosted up are now pushed back down to normal. But all *added* noises (low-level) are pushed that much *below* normal, not having had the inestimable distinction of having been boosted by Dolby in the first place.

I'm moved to think in terms of convention delegates. Maybe at a sports-car convention. Or even a hi-fi show. The Dolby pre-emphasis of the separate bands of low-level signal is like the convention badge you pin on your lapel, to boost your big ego. It doesn't really change *you* very much (*you being the bulk of wanted signal . . .*) but it does let you through the mighty gates with wallet intact and personality undented, when the showdown comes. (*Playback.*) Whereas other people, minus badge, unboosted (*the added outside noise components . . .*) are pushed down, reduced, robbed of their cash and their ego. *Get it??* (OK—forget it.)

Space is used up. Between now and next month I expect a lot of recording executives, big and little, will be tearing their hair and investigating Dolby right and left. I don't think Dolby has a U.S. address yet; but you can get the literature from Dolby Laboratories (Laboratries), 590 Wandsworth Road, London, S.W. 8, England. Or call somebody and find out what's happened since I wrote this.

By next month, these gentry won't need any more comment from me. But for the rest of youse, I'll expatiate then on what the Dolby can mean in specific terms for the future of the recording industry. It could mean very nearly a revolution in many ways, I suspect. Æ



COURTESY AEOLIAN-SKINNER ORGAN COMPANY

The AR-2ˣ loudspeakers marked by arrows—there are 16 in all—are part of a synthetic reverberation system installed by the Aeolian-Skinner Organ Company in St. John's Episcopal Church, Washington, D. C. This system corrects building acoustics that are too "dead" for music.

Listeners are not even aware of the speakers (which simulate normal hall reflections), since the sound of the organ and chorus is completely natural. AR speakers were chosen by Aeolian-Skinner for this and other installations because of the need for full range, undistorted bass, absence of false coloration, and reliability.

AR INC. SPEAKERS ARE USED PROFESSIONALLY WHERE LIVE MUSIC IS THE IMMEDIATE REFERENCE—BUT THEY WERE DESIGNED FOR THE HOME.

Folk singer Phil Ochs, sitting on the stage of Boston's Jordan Hall, checks Elektra's master tape for a concert album he has recorded there. The tape will become Elektra record EKS-7310, (mono EKL-310) "Phil Ochs in Concert."

The artist and recording staff must listen for technical as well as musical quality, and therefore require loudspeakers that provide the most natural sound possible—no bass where there shouldn't be any, no "speaker sound." AR-3's are used.

COURTESY ELEKTRA RECORDS

AR speakers are $51 to $225. A catalog of AR products—speakers and turntables—will be sent free on request.

ACOUSTIC RESEARCH, INC., 24 THORNDIKE STREET, CAMBRIDGE, MASSACHUSETTS 02141

 Check No. 114 on Reader Service Card

LETTERS

Dear Sir:

I am thinking of updating my equipment. I have $500 to spend. What would you suggest as the best way to spend my money.

Sir:

I want to get a modern receiver and before I spend my money, I would appreciate your advice. Should I buy ***, ***, or *** in the $300 to $500 range.

Sir:

My present speakers are now more than ten years old. My ears tell me that many current models provide superior performance to what I now have. I am restricted to the bookshelf-sized models and a price of around $100 each per unit. Could you suggest what is likely to be the best value in this group?

(These letters are perhaps characteristic of the many we receive each month of those for which there are no ready answers. We cannot recommend specific equipment. We really cannot test each new piece of equipment, nor do we hear every new product under conditions that favor an accurate impression.

We do get to most of the new high-fidelity component shows so it could be said that we are in a position to see and hear much of what is new. This is, on the surface, true. But the impressions gained at these expositions are incomplete—we cannot form honest opinions from them. As an example: we have at shows often heard speakers that sound poor under the influence of local acoustics only to find that this was a false impression when we hear the speakers some other time.

There are many such examples. For this reason alone we cannot recommend specific instruments. And if this is not reason enough, think of this. Much equipment is purchased on the basis of purely subjective analysis. How can we responsibly suggest to a stranger what he will like?

We can go on and on. But the message here is simple. We cannot respond to requests for specific product recommendation. This should not be construed to indicate that we are unresponsive to requests for information we can respond to. Quite the contrary. We welcome your letters and promise to answer all: either in this column or directly. Ed.)

The Authoritative Word

(This letter was received regarding E.T.C.'s explanation of the word Seraphim.)

Sir:

Seraphim is a plural word. In the Hebrew language, the letters "im" are added to masculine nouns to form the plural. Cherubim ditto. Angelim, no. It's charming, but it's not kosher.

Mrs. Eva Kaplan
Physics Librarian
The Weizmann Institute of Science
Rehovoth, Israel

Dear Sir:

I wish to take this opportunity to thank you for your extremely comprehensive and accurate Tape Recorder guide in the December issue of Audio Magazine.

It has been called to our attention that our listing incorporates an error in the wow and flutter column in each of these issues. Specifically the wow and flutter figure at 7½ ips, is listed at 0.9% on all models, in reality this is 0.09%. This may have been a copying error, or the information originally supplied by me may be in error.

Incidentally, the large picture of the four-channel 800 in your December issue is very impressive. I do hope that the customer is not confused or mislead into thinking that this is a standard SS-822 or SS-824 model; in reality it is of course an SS-844 four-channel recorder.

John W. Haines
Customer Service
Crown International
Elkhart, Indiana

Dear Sir:

Compliments on the December Tape Recorder Compendium. However, the price shown for two of our Magnecord models was as wrong as wrong can be. The 1022 and 1028 models are shown at $1788.00 and $1995.00 respectively. This is exactly $1.000 too much. The correct prices are, of course, $788 for the 1022 and $995 for the 1028.

James S. Arrington
Magnecord Div. Telex Corp.
Minneapolis, Minn.

(What can we say after we say—oops! Ed.)

Check No. 115 on Reader Service Card →

There are so many Miracord 50H features to talk about: Papst hysteresis motor, anti-skate, cueing, push buttons, and others. Why pick on a measly little screw?

As any expert can tell you, one of the most flagrant causes of record playback distortion and record wear is tracking error. But how come tracking error if the tonearm is properly designed, and its geometry correctly calculated?

It has to to with stylus position.

The distance between the stylus and the tonearm pivot, sometimes called stylus overhang, is an integral part of the arm's design and a critical factor in its performance. A deviation in that distance by as little as 1/16th inch can throw the tracking geometry and the performance entirely out of kilter. Result: distortion and excessive record wear.

How can you be sure about this distance? There aren't two make cartridges physically alike. Where do you measure from, and how? Seems an almost impossible task.

Yet, amazing how easy it is with the Miracord 50H! There's a retractable pointer on the turntable deck which shows the exact position for the stylus, no matter what cartridge make. You insert a screwdriver in the slotted leadscrew at the front of the tonearm, and turn it until the stylus lines up precisely over this pointer. That's all there is to it.

A little thing, to be sure, but what a big difference it makes in performance. And it shows how much attention is paid by Miracord to even the littlest details.

At $149.50, less cartridge and base, the Miracord 50H is probably the most expensive automatic available. But this is entirely understandable, when you consider that is also the finest. Your hi-fi dealer will be glad to show you. For descriptive literature containing further details, write:
Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11736

EDITOR'S REVIEW

CONTINUAL PROGRESS

If there is one characteristic for which the high-fidelity industry is noted, it is change. Over the history of AUDIO, we have seen triode tubes in output stages, then pentodes, then tetrodes, then the Ultra-Linear circuitry which makes tetrodes perform more like triodes, and now most new models are entirely transistorized, including the output stages. More recently, the FET has made considerable headway, with several makes employing them, and the next forward step is likely to be integrated circuits, some of them already having made their appearance. Aside from their saving in space, it is claimed that their performance can improve the over-all performance of the equipment in which they are used. We certainly expect to see more of them in the future.

We made no mention of nuvistors or hybrid types of circuits, for in general they appeared to be a transitional step from all-vacuum-tube operation to all-transistor circuits. It took some time to make a good front end with transistors, and some fairly sophisticated transistors to make them work as well as we had taken for granted as normal for tube equipment.

Without getting into the argument as to whether tubes or transistors are better, we can only surmise that the transistor is here to stay. There is certainly a difference of opinion among users as to which is the better. Letters from readers often seem to be most vociferous in their praise of one or another of the tube amplifiers, and an equal dislike for transistors. Yet many are strongly in favor of transistors. Our only suggestion is that each person make up his own mind. As between triode tubes and tetrodes, there was always a dispute, yet it is well recognized that there were (and are) good amplifiers of both types, and that discussion has never been resolved. Similarly, there are good amplifiers using tubes and good ones using transistors. You takes yer choice.

We have always faced the same difference of opinion about loudspeakers and enclosures. It has always been our position that the ultimate user is going to listen to his system and that someone else couldn't possibly tell him which was the best. Each person's own ears must help him decide. There is enough good equipment of all types to provide a choice. We honestly do not believe that one type is *necessarily* better than another—there are good and bad examples of all types. Our recommendation is that a comparison of specifications should be the guide to an intelligent selection. All other things being equal, the listening test is then the final step in making a selection. If you can afford an amplifier in the .05-per-cent-distortion class, and if you like the way it sounds, then by all means, buy it. If you don't like the way it sounds, don't buy it under any conditions.

BUCKNELL IS A UNIVERSITY

In our story about the Bucknell student who has been a hi-fi enthusiast for six years, we referred to Bucknell as a college and of course, were reminded that it is a University. Now if we were to say we didn't know there was a difference, we would be called to task for *that*. We do know the theoretical difference—which is something like the difference between a ship and a boat. We learned that during a short sojourn on a Navy vessel some twenty years ago—a boat is something that is carried on a ship.

And while we are on the subject, we want to credit Thomas Trout as the "professor in hi-fi" to the young man pictured on our January cover, who described Mr. Trout in that fashion. Wonder how many other AUDIO readers have served in a similar capacity to their neophyte friends.

PASSING OF AN ORACLE

We were saddened to learn of the death of one whose work has long been regarded as of inestimable value to the audio buff. Fritz Langford-Smith, author of the "Radio Designer's Handbook" recently passed away in Sydney, Australia, at the age of 62. The first edition of this book, although only some 375 pages in length, devoted considerable space to audio circuitry, and was probably the most used audio reference book of its time. The massive third edition was practically an Audio Handbook in itself, and all of us will miss future editions. It is not likely that another such encyclopedic volume will be attempted, in spite of the great need for one.

GAG OF THE MONTH

Did you hear about the audio buff who complained. "Here I just spent over $700 for a new hi-fi outfit and they start using megaphones again."

For cleaner grooves.

For cleaner tracing.

New Pickering V-15/3 cartridge with Dynamic Coupling for minimum tracing distortion and maximum tracking ability, plus Dustamatic™ feature for dust-free grooves.

As stereo cartridges approach perfection, dust in the grooves becomes intolerable.

The Pickering V-15/3 Micro-Magnetic™ cartridge has a new moving system that reduces tracing distortion close to the theoretical minimum, thanks to Dynamic Coupling of the stylus to the groove. But what good is perfect contact between the stylus tip and those high-velocity turns if dust particles get in the way?

That is why the Dustamatic brush assembly is an essential part of Pickering's total performance cartridge. It cleans the groove automatically before the stylus gets there.

The new moving system also provides a further refinement of Pickering's famous natural sound by extending peak-free response well beyond the audible range, and the patented V-Guard Floating Stylus continues to assure the ultimate in record protection.

There are four "application engineered" Pickering V-15/3 Dustamatic models with Dynamic Coupling, to match every possible installation from conventional record changers to ultrasophisticated low-mass transcription arms. Prices from $29.95 to $44.95.

For free literature complete with all details, write to Pickering & Co., Plainview, L. I., New York.

For those who can hear the difference. Pickering

Check No. 118 on Reader Service Card.

Compare these new Sherwood S-8800 features and specs! ALL - *SILICON* reliability. Noise-threshold-gated automatic FM Stereo/mono switching, FM stereo light, zero-center tuning meter, FM interchannel hush adjustment, Front-panel mono/stereo switch and stereo headphone jack, Rocker-action switches for tape monitor, noise filter, main and remote speakers disconnect. Music power 140 watts (4 ohms) @ 0.6% harm distortion. IM distortion 0.1% @ 10 watts or less. Power bandwidth 12-35,000 cps. Phono sens. 1.8 mv. Hum and noise (phono) —70 db. FM sens. (IHF) 1.6 μv for 30 db quieting. FM signal-to-noise: 70 db. Capture ratio: 2.2 db. Drift ±.01%. 42 Silicon transistors plus 14 Silicon diodes and rectifiers. Size: 16½ x 4½ x 14 in. deep.

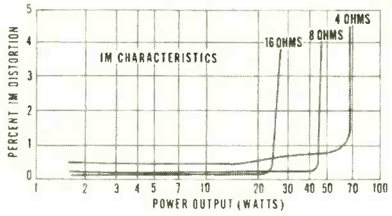
"WE HAVE COME TO EXPECT HIGH PERFORMANCE FROM SHERWOOD and...

the S-8800 did not let us down. The tuner section, with its high sensitivity and very low distortion, is among the best in the business—clean and responsive. FM Stereo comes in loud and clear and, as the curves plotted at CBS Labs show, with very ample separation. The usual increase in distortion, when switching from mono to stereo in receivers, was in this set just about negligible. We would say that Sherwood has come up here with another typically 'hot' front end that makes FM listening a sheer joy.

"As for the amplifier . . . comparing the results with the specifications, it is apparent that the S-8800 does provide the power it claims, and this—for a popularly priced combination set—is considerable. A glance at the IM curves, for instance, shows how much power the S-8800 will furnish before it runs into any serious distortion problem at all three impedences. . . . For rated power bandwidth distortion of 1%, the curve ran below and above the normal 20 to 20 kHz band; and the 1-watt frequency response was virtually a straight line in this area, being down by 2.5db at 40 kHz—fine figures for a receiver . . .

"Those heavy percussion and crisp castanets will come through with just about all the *con brio* the performers have put into them. "

*As appeared in HIGH FIDELITY Magazine Equipment Reports by CBS Labs. November 1966 issue.



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Tracking Capability of Phonograph Pickups

J. G. WOODWARD

TRACKING refers to the ability of a phonograph pickup to maintain proper contact between the stylus and the record-groove walls while playing back the recorded modulation. Despite major advances in pickup design in recent years, mistracking still can be a significant cause of distortion in many pickups. The pickup stylus is held in the record groove by an unbalanced downward force, called the "tracking force" or "bearing weight." The tracking forces used with modern pickups range from ¾ to 5 grams.

Low-Frequency Tracking

For a given tracking force, the ability of a pickup to track low-frequency signals is determined by the pickup compliance. The higher the compliance, the greater the groove-modulation displacements that can be followed without mistracking. Compliance specifications of pickups are listed as a certain number of centimeters per dyne. For example, a compliance of 15×10^{-6} cm/dyne means that if a force of 1 dyne (= 1/980 gram) is applied to the stylus in a pickup, the stylus will be deflected a distance of 15×10^{-6} cm.

It is not unusual for a pickup compliance to be different in the vertical and lateral directions. Some pickup manufacturers state the compliances in both directions. Others list only a single compliance without specifying the direction. Still others list only a recommended tracking force which, of course, is the only factor over which the user has any control, this usually being set by means of a counterweight or adjustable spring on the pickup arm. In principle, if the compliance of a pickup is known, it is possible to calculate the minimum tracking force required to track low-frequency signals. In high-level, low-frequency recorded signals, lateral peak displacements of 0.0015 inch (= 3.8×10^{-3} cm) may occasionally be encountered. In a pickup having a compliance of 15×10^{-6} cm/dyne a lateral force of $(3.8 \times 10^{-3})/(15 \times 10^{-6}) = 0.254 \times 10^3$ dynes, or about 0.25 gram is thus developed. If friction between the stylus and the record is neglected, the components of this force perpendicular to and parallel to the groove wall that is doing the pushing at the instant of maximum displacement are each $0.25/\sqrt{2} = 0.18$ gm., since the groove walls make an angle of 45 deg. with the direction of lateral stylus motion. Unless the force component parallel to the groove wall is balanced by an oppositely-directed force component due to the tracking force, the stylus will slide up the groove wall and skip over into an adjacent groove. Even when mistracking is not so severe as to cause groove skipping, audible distortion of the reproduced sound may occur as the stylus-groove contact varies erratically. To present the catastrophic occurrence of groove skipping a downward-directed tracking force of at least 0.25 gm. is required. This value should be doubled in order to handle simultaneous vertical and lateral excursions of large amplitude. The tracking force must be increased still further to allow for the skating force, for frictional forces in the pivot bearings of the pickup arm or in the mechanical elements of a record changer, and for eccentric and warped records. Thus, one can understand why it takes a most unusual pickup to track all passages on all records with a tracking force of less than 1 gm. However, nearly all modern stereo pickups are capable of good low-frequency tracking when used with somewhat larger tracking forces.

Unfortunately, tracking problems are not restricted to the compliance-controlled, low-frequency region. Other forces that act when reproducing the high-frequency portion of the audio spectrum make high-frequency tracking a problem with many pickups. In the remainder of this article the nature of the high-frequency-tracking problem will be described and some recent measurements illustrating the phenomenon will be discussed.

High-Frequency Tracking

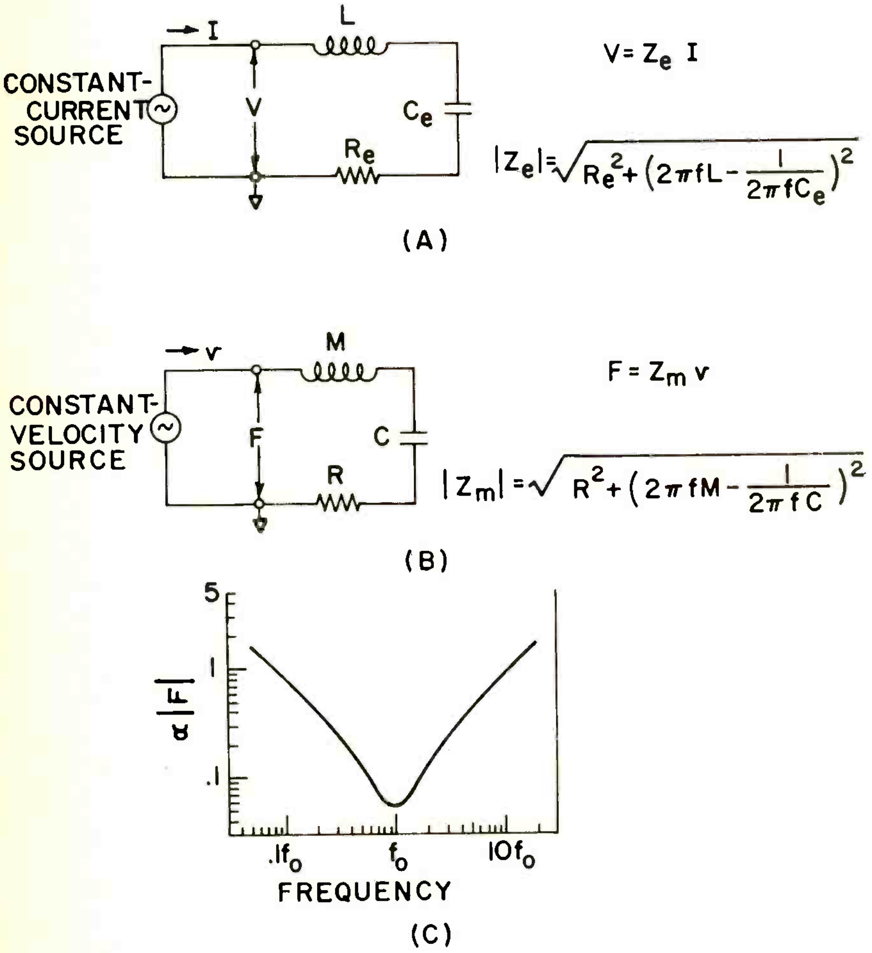
Pickup tracking at high frequencies is best explained in terms of the mechanical impedance of the pickup. In particular we will consider the driving-point mechanical impedance at the stylus. Over much of the audio-frequency range the mechanical impedance of moving-magnet, moving-iron, and moving-coil pickups is closely analogous to the electrical impedance of the simple and familiar network made up of inductance *L*, capacitance *C*, and resistance *R*, shown at (A) in *Fig.* 1. The relation between voltage, *V*, and current, *I*, is determined by the electrical impedance, Z_e. In the mechanical analog shown at (B), the force *F*, applied to the stylus by the record groove is related to the stylus velocity, *v*, by the mechanical impedance, Z_m. The elements making up the mechanical impedance are the effective mass at the stylus, *M*, the compliance, *C*, and the mechanical resistance or damping, *R*. The impedance has its minimum value at the frequency of resonance, f_o, as shown at (C) in *Fig.* 1 where the magnitude of the driving force is plotted as a function of frequency. At frequencies well below resonance the impedance is $Z_{LF} = 1/2\pi fC$ and the moving system is compliance controlled. This is the case treated in the preceding section. At frequencies well above resonance the impedance is $Z_{HF} = 2\pi fM$ and the system is mass controlled.

For the types of pickups considered here, the resonance frequency, f_o, usually lies in the mid-band region, say between 800 and 3000 Hz. The effective stylus-tip mass of modern, high-quality pickups ranges from 0.5 mg. to about 2 mg. The mechanical impedance for a 1-mg stylus and 15-kHz frequency is $Z_{MF} = 2\pi(15 \times 10^3)(1 \times 10^{-3}) = 95$ mechanical ohms. If a lateral signal at 15 kHz having a peak recorded velocity of 10 cm/sec is being reproduced, the peak lateral force, *F*, on the stylus will be:

$F = 95\ (10) = 950$ dynes $= 0.97$ gm. A tracking force at least this large is required if the stylus is to maintain contact with both groove walls throughout each cycle of this 15-kHz modulation. The same result is obtained if, instead of relating the peak velocity to mechanical impedance, one considers the peak acceleration of the mass of the stylus as is sometimes done in discussions of this type. Indeed, the two approaches are completely equivalent for sine-wave signals.

The peak velocity of 10 cm/sec used in this example represents a rather high level for a 15kHz signal, but it is a level that may occasionally be encountered in short bursts. The minimum tracking force of 0.97 gm found necessary in this case is seen to be substantially greater than the force of 0.25 gm found necessary in the low-frequency example calculated earlier. Hence, for a pickup having a compliance of 15×10^{-6} cm/dyne and a tip mass of 1 mg, the latter parameter should be the controlling one in determining the tracking force. If a less massive stylus is used, the tracking force required will decrease proportionately. As in the low-frequency case, the total tracking force should be greater than the value calculated for lateral modulation in order to accommodate simultaneous lateral and vertical motions. When the tip mass is 1 mg or less, a tracking force between 1 and 2 grams should usually be adequate for high-frequency tracking—providing the driving-point impedance acts as a simple mass in the high-frequency range.

It has been found, however, that many pickups—including some of the best—exhibit a mechanical anti-resonance somewhere between 10 and 20 kHz. The anti-resonance is due to the stylus arm bending in a more complex mode. When this occurs the simple circuit depicted at (B) in *Fig.* 1 is no longer adequate. Close to the frequency of the anti-resonance, the circuit shown at (A) in *Fig.* 2 is more appropriate. When moving at the frequency of this anti-resonance the forward and rearward portions of the stylus arm move in opposite phase, and their masses, M_1 and M_2, referred to the stylus, are separated by a shunt compliance, C_1, of the arm as it bends in this mode. The driving-point impedance at the frequency of anti-resonance, f', becomes very large, and the magnitude of the force between the stylus and the groove wall has the general form shown at (B) in *Fig.* 2. The relatively soft vinyl record is deformed in the area of stylus contact, and the magnitude of the groove-wall deformation varies periodically at the frequency of the modulation. Through this means, the compliance of the groove walls lowers the frequency of the anti-resonance slightly. When the frequency of the recorded modulation is close to the frequency of anti-resonance, the large stylus-groove forces that are generated require a greater tracking force if the stylus is to maintain contact with both groove walls. Even when there is no reason to suppose that contact has been lost there still can be an increase in distortion, as will be shown in some of the measurements discussed in the following.



$$f_0 = \frac{1}{2\pi\sqrt{MC}} \qquad Z_{LF} = \frac{1}{2\pi f C} \qquad Z_{HF} = 2\pi f M$$

Fig. 1. (A) Simple series R,L,C electrical circuit having a driving-point impedance Z_e. (B) Analog of the mechanical elements of the moving system of a pickup having a driving-point mechanical impedance, Z_m, at the stylus tip. (C) Typical curve of stylus-groove force as a function of frequency for the simple analog shown at (B). f_o will lie between 800 and 3000 Hz for most modern, high-quality pickups.

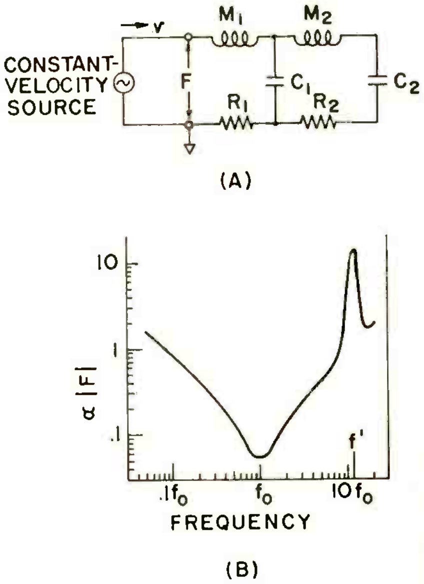


Fig. 2. (A) Analog of the mechanical elements of the moving system of a pickup having a high-frequency anti-resonance. (B) Typical curve of stylus-groove force as a function of frequency. Note the large value of force in vicinity of the anti-resonance at f'.

Sweep-Frequency Tests

Two types of tests that have been used recently in laboratory studies of tracking will be described and examples of test results will be shown. The first type of test employs recorded sweep-frequency signals. The recorded sweep-frequency signals consist on a constant-velocity signal that sweeps from 2 to 20 kHz in slightly less than 1/20th of a second. The sweep is repeated 20 times per second. Thus, the output of a pickup reproducing this signal can be displayed as a stationary pattern on an oscilloscope screen, with the vertical deflection showing the output voltage at each instant and with the horizontal deflection representing frequency. The recorded frequency sweeps upward with time along a logarithmic scale, and blanking markers are inserted at 4, 6, and 10 kHz. An overshooting pulse that marks the start of each sweep at 2 kHz can be used for horizontal synchronization of the oscilloscope. Bands of this signal were recorded on a laboratory test record at four velocity levels and in both lateral and vertical modes.

Figure 3 is an example of sweep-frequency test results, showing photographs of oscilloscope traces of playback voltage for the four recorded levels in the lateral mode, and for three values of tracking force. The pickup under test has a smooth and flat frequency response over the entire frequency range of the sweep, as can be seen in the lower-level traces. However, mistracking occurs for the 20.3-cm/sec signal. This is evidenced by the erratic and irregular traces for this level. Some irregularity is already present in the traces for the 12.7-cm/sec level, and the raggedness of the response is seen to become worse as the tracking force is decreased. The behavior of this pickup for vertical modulation was found to be very similar to that shown here for lateral modulation.

The effects of high-frequency mistracking are shown even more strikingly in the traces for another pickup in *Fig.* 4 for lateral modulation and *Fig.* 5 for vertical modulation. This pickup is one having a mechanical anti-resonance at about 13 kHz. Open-circuit response measurements of the pickup show a very pronounced peak at the frequency of anti-resonance. For the tests shown in *Figs.* 4 and 5, a carefully adjusted R-C load was connected across the terminals of the pickup to give a substantially flat response to almost 15 kHz, as is observed in the lowest-level traces with 2- and 3-gram tracking forces. Irregularities in response are seen to occur due to mistracking in the neighborhood of the anti-resonance even for the 5.1-cm/sec modulation when the tracking force is only 1 gram. The evidences of mistracking become progressively worse as the modulation velocity is increased and are very extreme for the 20.3 cm/sec level. Several of the photographs are double exposures showing two superimposed successive oscilloscope traces. The wild variations seen to occur from one sweep to the next give an idea of how erratic the stylus motion is during mistracking.

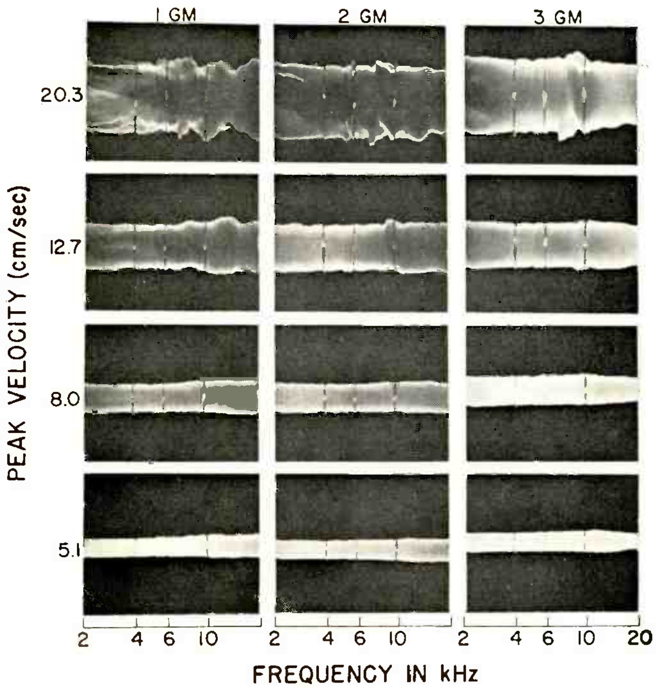


Fig. 3. Oscilloscope traces of the output of pickup "A" when playing lateral sweep-frequency modulation with various tracking forces. Mistracking is indicated by an irregular envelope.

Another, but less extreme, effect is observed when mistracking is approached. This is a gradual shifting to lower frequencies of the upper frequency limit of the pickup response as the modulation level is increased. It appears that as tracking becomes poorer, the frequency of the stylus-groove resonance discussed earlier moves to lower frequencies. A tentative explanation of this phenomenon can be offered in terms of groove-wall deformation. When the driving-point forces at the stylus become comparable to the tracking force, the depth of indentation and the area of stylus-groove contact vary appreciably from point to point in each modulation cycle in a non-linear manner. At high modulation levels the stylus spends a larger fraction of the time in the condition of lower deformation. In this case the effective groove-wall compliance averaged over a cycle is higher. This higher compliance then combines with the driving-point impedance of the stylus to lower the frequency of the stylus-groove resonance. However, before this hypothesis can be verified or elucidated in detail, we must learn a great deal more about the dynamic deformation of the groove walls under a stylus at high frequencies.

Intermodulation Tests

The second type of laboratory test used in studying pickup tracking uses intermodulation as the performance indicator. When two sine-wave signals are passed through a system, any non-linearity in transmission causes each of the signals to modulate the other and so produce distortion in the form of tones having frequencies equal to the sum and difference of the original signals and of their various harmonics. These tones are known as intermodulation products, and their measurement has provided a powerful tool for the analysis of the non-linear behavior of many types of systems, including phonograph playback systems. For example, recorded frequencies of 400 and 4000 Hz have come into rather common use in the study of phonograph-playback distortion at 400 Hz. For studying pickup performance at high frequencies it is more appropriate to use two recorded tones of equal velocity and quite close in frequency as the test signal. For example, to measure the performance at 10 kHz we might use primary tones having frequencies of 9.8 kHz and 10.2 kHz. The first-order sum and difference intermodulation products will then be found at 20 kHz and 400 Hz. The magnitude of these sum and difference tones is a direct indication of the nonlinearity of the playback system, including the stylus-groove relationship. In the case of most pickups it is not feasible to make accurate measurements of the sum tone because its frequency is too high. However, the difference tone is readily measureable and can give useful information.

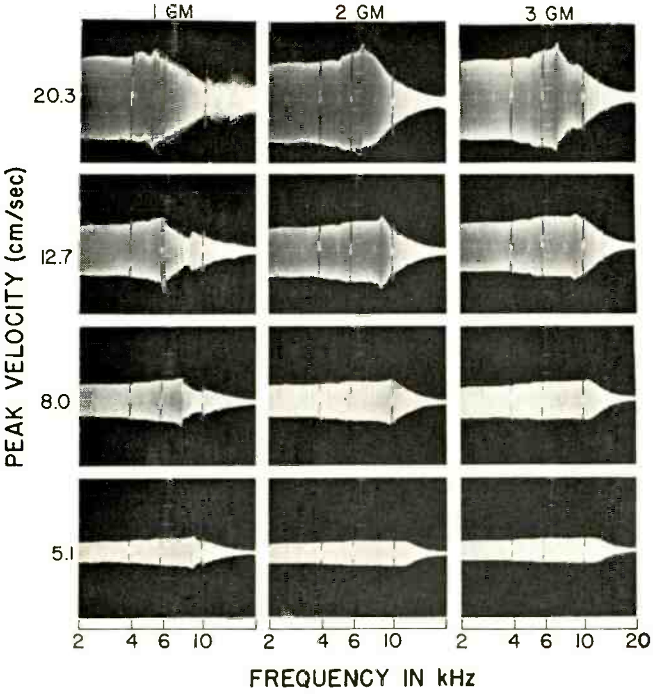


Fig. 4. Oscilloscope traces of the output of pickup "B" when playing lateral sweep-frequency modulation with various tracking forces. Mistracking is seen to be strongly affected by a high-frequency anti-resonance.

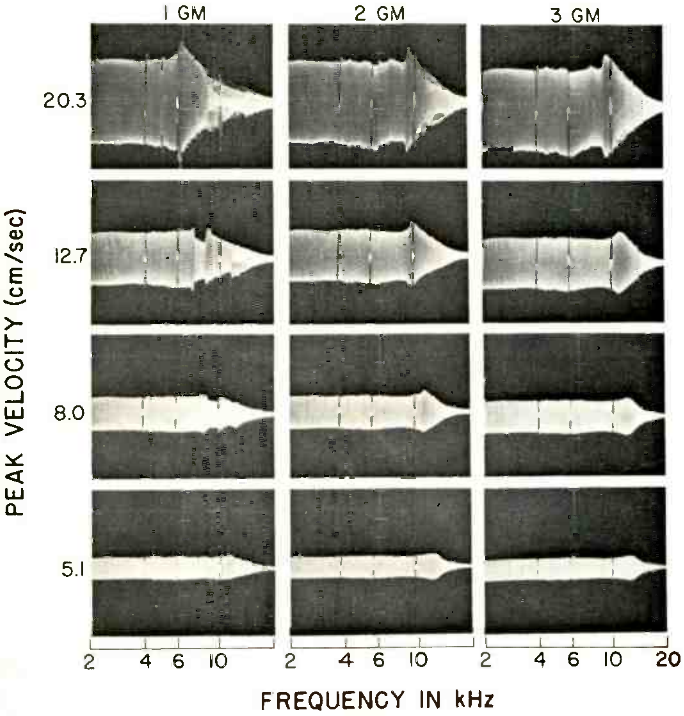


Fig. 5. Oscilloscope traces of the output of pickup "B" when playing vertical sweep-frequency modulation with various tracking forces.

In order to study pickup tracking, as well as other playback phenomena, throughout the range from 2 to 20 kHz while simplifying the data-acquisition problem as much as possible, two tones of equal and constant velocity and separated by 400 Hz were recorded while they glided from a mean frequency of 2 kHz to a mean frequency of 20 kHz. The rate of glide was synchronized with the chart drive of an automatic level recorder. When playing back this test signal the output of the pickup is amplified, passed through a 400 Hz band-pass filter and fed to the chart recorder. Thus, the pen plots a curve showing the magnitude of the difference tone as a function of the mean frequency of the two primary tones as they glide through the high-frequency range. In the measurements presented here the magnitude of the difference tone will be expressed as a percentage of the peak velocity of the two recorded primary tones. The test signals were recorded in the right and left stereo channels. Signals for each channel are carried in four bands near the outside of a 12-inch, 33⅓ RPM record. The peak velocity of the primary tones increases in 4-dB steps from band to band.

The intermodulation measurements shown in *Fig*. 6 were made with the same pickup used for the sweep-frequency tests of *Fig*. 3. The per cent IM is shown as a function of frequency for both channels, for four velocity levels, and for tracking forces of 1, 2, and 3 grams. We note that the per cent IM consistently increases as the tracking force is decreased. This is true even though there is no indication of loss of stylus-groove contact. Since this pickup has no anti-resonance in the 2-20 kHz range, the per cent IM as a function of frequency is fairly constant for a given tracking force. The only notable exception to this occurs for the higher level bands with a 1-gram force. Here, a rise in IM at the low-frequency end of the curve is noted. This is an indication of impending low-frequency mistracking due to too low a compliance.

A second set of IM measurements is shown in *Fig*. 7 for the pickup used in obtaining the sweep-frequency traces of *Figs*. 4 and 5. Tracking forces of 1.5, 2.0, and 2.5 grams were used. The effect of the high mechani-

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cal impedance at the anti-resonance is strikingly evident in these curves. The poor tracking in the neighborhood of the anti-resonance results in a high value of IM. As in the case of the first pickup, lower values of tracking force lead to higher IM at all frequencies.

In the data for both pickups the IM in the right channel is consistently higher than that in the left channel. Tests have demonstrated that this difference is due to the presence of an uncompensated skating force which pulls the pickup toward the center of the record. This puts a greater contact force on the inner groove wall which carries the left channel. Skating-force compensation in the form of a counter-acting force on the pickup arm may be added. This increases the IM in the left channel and decreases it in the right channel to make the two nearly equal.

Discussion

We have seen that high-frequency tracking can be studied by the sweep-frequency technique and by measurement of intermodulation products. The sweep-frequency traces show dramatically the erratic behavior of a stylus when mistracking occurs. However, this technique yields ony qualitative or at most, semi-quantitative results. The IM technique, on the other hand, permits truly quantitative measurements. Although IM measurements do not often show an abrupt onset of mistracking as certain conditions are reached, they do show clearly the deleterious effect of a high mechanical impedance in the range of frequencies covered by the test.

It is appropriate to consider briefly the effects of improper tracking on the quality of music reproduced from stereo records. The extreme case of groove jumping requires no comment. Before this extreme is reached, however, the stylus may slide about or rattle in the groove when high-amplitude, low-frequency passages are played with a pickup having too low a compliance and/or tracking force. The audible results in the reproduced sound are rattles and buzzes of short duration on certain notes of the music. When poor tracking occurs for high-frequency components of the music one or more of several types of distortion may be heard. Perhaps the most readily identifiable result of high-frequency mistracking occurs for percussion instruments or stringed instruments that are struck or plucked. The onset of the sound in such cases is abrupt and is very rich in high-frequency components. The noticeable distortion is in the form of a very short click of "kssh" type of sound at the beginning of the note. In extreme cases the reproduced timbre of the instrument may be altered noticeably. Another manifestation of high-frequency mistracking occurs when a chorus of instruments rich in harmonics is playing at high level. In this case intermodulation products are generated, and the difference tones of the high-frequency components fall in the low- or mid-range of frequencies. Occasionally these difference tones are audible. More often they are partially masked by the much louder components of the music in the same frequency range as the difference tones, and the intermodulation is not recognized for what it is even though it is contributing to a general "muddiness" or lack of clarity in the total sound. High-frequency mistracking is not the only, and may not be even the principal, cause of high-frequency intermodulation in some phonograph systems. Tracing distortion and vertical-tracking-angle errors are other causes. Indeed, even the magnetic recorders used to make the master tapes from which the disc is copied are not always beyond suspicion in this regard, particularly if several generations of tape are needed in the processing.

There is little that the user of a phonograph system can do to control mistracking beyond making certain that the pickup arm is adjusted for minimum friction and that the tracking force has a reasonably high value. There is a limit to how large the tracking force may be, however. If the force is too large, the upward static deflection of the stylus arm will be so great that the pickup cartridge will touch the record. Also, in some cases a tracking force large enough to minimize mistracking will result in accelerated record wear. Not enough is known about the mechanism of wear and its dependence on pickup characteristics to permit a categorical setting of upper limits for the tracking force at the presentime. All things considered, however, it is considered generally preferable to use a tracking force at the upper end of the range of forces recommended by the pickup manufacturer. Fortunately, the manufacturers of many of the better grades of pickup are now aware of the high-frequency tracking problem, and we may expect new pickup models improved in this regard to become available in the next year or two. It remains to be seen, though, how good a compromise can be made between the design parameters required for high-frequency performance and those required for low-frequency performance and for mechanical stability and ruggedness. In any event, this is certain to be an interesting stage in the progressive development of phonograph systems. Æ

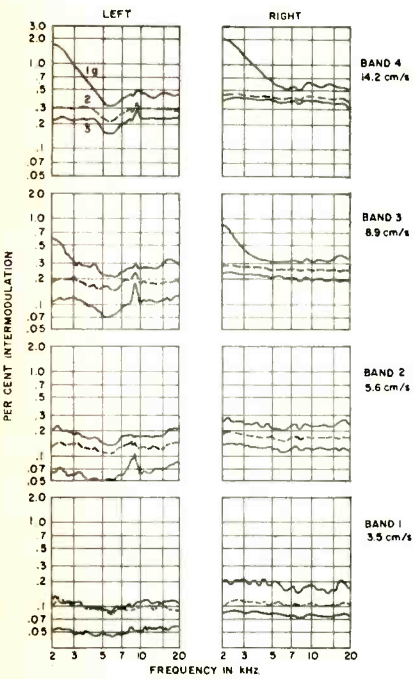

Fig. 6. High-frequency intermodulation measurements in right and left channels for pickup "A" using tracking forces of 1, 2, and 3 grams.

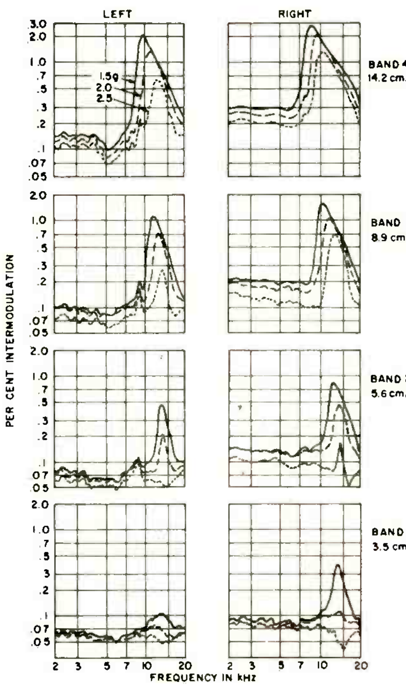

Fig. 7. High-frequency intermodulation measurements in right and left channels for pickup "B" using tracking forces of 1.5, 2.0, and 2.5 grams.

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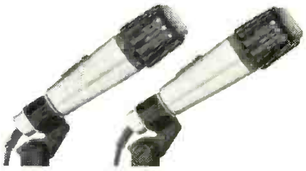

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A Record Player Compendium

On the next two pages are displayed, in convenient chart form, most of the record player mechanisms currently available in the component marketplace. We trust that the information contained in the columns is self-evident, requiring no further explanation. However, we should state that a blank space is indicative of inapplicability to a specific product. A dash in a space shows that the information needed was not available.

The special-features column contains information that cannot be reduced to columnar form. This material has been supplied to us by the respective manufacturers. In fact, we should point out that *all* of the specifications have come to us from the manufacturers.

No rumble specifications have been given since there seems to be no agreed-upon standard from which to derive performance figures. Our experience has been that *all* turntables produce some audible rumble in stereo operation. The degree of audibility is highly dependent on the speakers that will be used. Obviously, a speaker with a resonance peak that happens to coincide with a primary rumble frequency will sound worse than a non-coincidence system of identical rumble specifications. So it behooves the prospective purchaser to attempt to audition a turntable/cartridge/speaker system in advance of purchase. This can result in a highly compatible union. However, we should also point out that only a "worst-case" combination is likely to prove audibly annoying.

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BSR MC DONALD	500	16 33 45 78	–	0.2	–	8	–	Bal.	–	0-6	–	–	–	–	14½	13	7	–	49.50	Coarse and fine balance adjustment, stylus force dialed in 1/3 gram increments, automatic tonearm lock in rest position, arm cueing control, interchangeable spindles.
BENJAMIN (MIRACORD)	PW40A	16 33 45 78	12	–	–	8	2	Unbal.	–	0-7	20	10	3¾	5⅝	14½	12½	8	16	99.50	Auto-repeat function, comes complete with Elac. STS-240 stereo cartridge; pushbutton operation.
	40H	16 33 45 78	12	–	–	8	2	Unbal.	–	0-7	20	10	3¾	5⅝	14½	12½	8	16	110.00	As above, but with hysteresis motor.
	50H	16 33 45 78	12	–	–	8	1	Bal.	–	0-6	15	10	3¾	5⅝	–	–	8	17	149.50	As above, with addition of stylus overhang gauge, anti-skating compensation, adjustable cartridge retainer, pilot light, arm cue, pushbutton operation.
DUAL	1019	16 33 45 78	10⅝	.03	.03	8	1.25	Bal.	1-16	½-5	8	10	3	6	12¾	10½	9	16	129.50	Variable anti-skating, arm cueing control, 6% variable speed adjustment, auto play of single records, rotating single-play spindle, adjustable overhang, 7½ lb. platter.
	1009 SK	16 33 45 78	10⅝	.03	.03	8	1.25	Bal.	1-8	½-5	8	10	3	6	12¾	10½	9	15	109.50	Arm cueing control, auto play of single records, adjustable overhang, 4½ lb. platter.
	1010A	16 33 45 78	10⅝	.09	.09	8	1.25	Spring	1-7	2-7	12	10	3	6	12¾	10½	9	10½	69.50	Interchangeable spindles, auto and manual start, adjustable overhang.
GARRARD	Lab 80 MK II	33 45	12	0.1	.02	9	–	Bal.	4-18	¼-5	10	8	3½	5½	17	14¾	9	16½	99.50	Afromosia wood tone arm, hydraulic arm cue, variable anti-skating, auto play of single records.
	70 MK II	16 33 45 78	10½	0.12	.05	8.5	–	Bal.	4-18	¼-5	15	8	2⅞	6	16¾	14⅛	8⅞	16	84.50	Adjustable anti-skating, click stop stylus force adjust, pusher-platform changing.
	60 MK II	16 33 45 78	10½	0.14	.05	7.5	–	Bal.	4-22	¼-5	15	7	2⅞	4	15⅜	13⅛	7¾	10	74.50	Anti-skating control, arm cueing, dial-type stylus force adjustment.
	50 MK II	16 33 45 78	10½	0.14	.05	7.5	–	Bal.	4-22	¼-5	15	7	2⅞	4	14⅞	12½	7½	9	54.50	Arm cueing control, tubular arm.
	40 MK II	16 33 45 78	10½	0.14	.05	7.5	–	Bal.	4-18	½-8	20	7	2⅞	4	14⅞	12½	7½	9	44.50	Cast aluminum balanced tone arm, lightweight cutaway cartridge shell.
KNIGHT	KN990A	16 33 45 78	10	0.2	.05	7	2	Bal.	2-10	0-5	15	14	5	3½	14	12	8½	12	47.95	Only 1 cent more for choice of cartridge – Empire, Pickering, or Shure.

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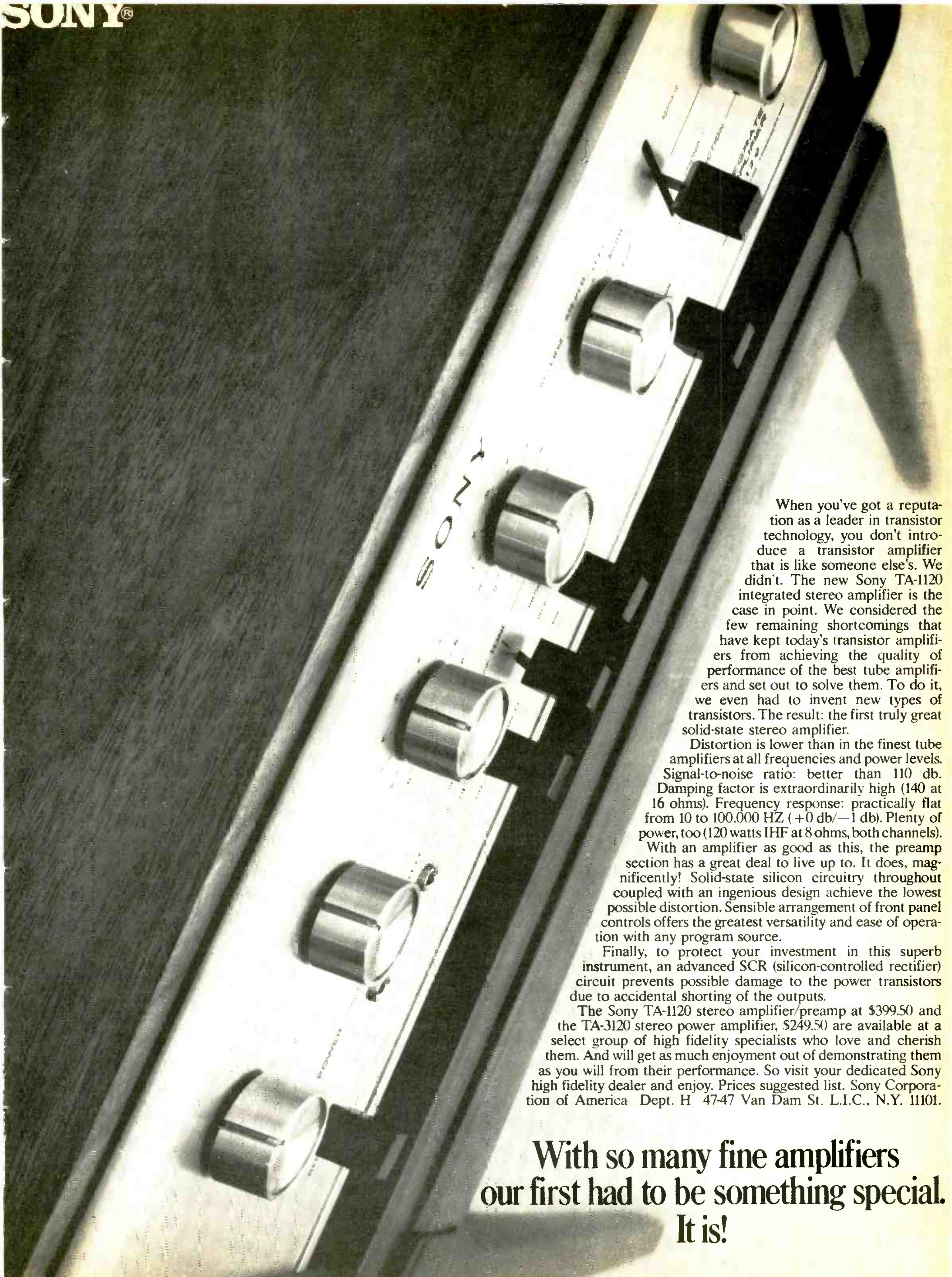


When you've got a reputation as a leader in transistor technology, you don't introduce a transistor amplifier that is like someone else's. We didn't. The new Sony TA-1120 integrated stereo amplifier is the case in point. We considered the few remaining shortcomings that have kept today's transistor amplifiers from achieving the quality of performance of the best tube amplifiers and set out to solve them. To do it, we even had to invent new types of transistors. The result: the first truly great solid-state stereo amplifier.

Distortion is lower than in the finest tube amplifiers at all frequencies and power levels. Signal-to-noise ratio: better than 110 db. Damping factor is extraordinarily high (140 at 16 ohms). Frequency response: practically flat from 10 to 100,000 HZ (+0 db/—1 db). Plenty of power, too (120 watts IHF at 8 ohms, both channels).

With an amplifier as good as this, the preamp section has a great deal to live up to. It does, magnificently! Solid-state silicon circuitry throughout coupled with an ingenious design achieve the lowest possible distortion. Sensible arrangement of front panel controls offers the greatest versatility and ease of operation with any program source.

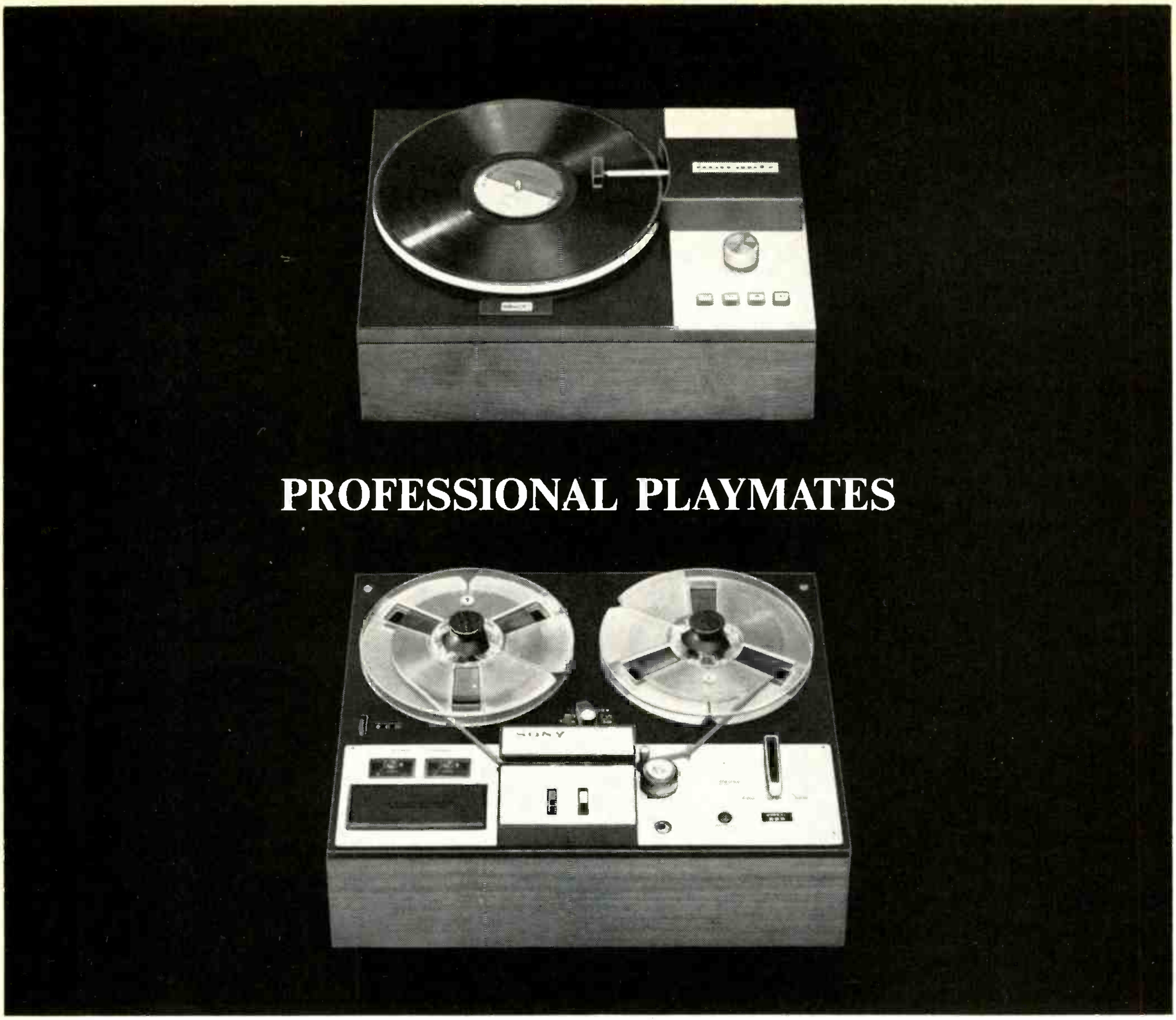
Finally, to protect your investment in this superb instrument, an advanced SCR (silicon-controlled rectifier) circuit prevents possible damage to the power transistors due to accidental shorting of the outputs.

The Sony TA-1120 stereo amplifier/preamp at $399.50 and the TA-3120 stereo power amplifier, $249.50 are available at a select group of high fidelity specialists who love and cherish them. And will get as much enjoyment out of demonstrating them as you will from their performance. So visit your dedicated Sony high fidelity dealer and enjoy. Prices suggested list. Sony Corporation of America Dept. H 47-47 Van Dam St. L.I.C., N.Y. 11101.

With so many fine amplifiers our first had to be something special. It is!

Manual Turntables and Arms

MANUFACTURER	TURNTABLES						Platter						ARMS				Bearings									SPECIAL FEATURES
	MODEL NO.	Speeds r.p.m.	Wow 33⅓ %	Flutter 33⅓ %	Motor type	Drive	Dia. in.	Wt. lbs.	Material	Arm mtg. provision	Size W x D x H in.	Wt. lbs.	MODEL NO.	Overall length in.	Pivot-stylus dist. in.	Cart. mtg.	Vertical	Lateral	Stylus-force method	Max. tkg. error deg.	Cart. wt. range gms.	Arm resonance Hz	Stylus-force range gms.	Wt. (if sep.) lbs.	Price	
ACOUSTIC-RESEARCH	XA	33 45	0.1	.05	18-p PM	belt	11	3.3	alum.	integral	16¾ 12¾ 5¼	13	—	12	9	std. ½-in.	nylon	ball slv.	rear weight	0.5	3-20	10-15	0.5 -8		78.00	
	TA	33	0.1	.05	18-p PM	belt	11	3.3	alum.	integral	16¾ 12¾ 5¼	13	—	12	9	std. ½-in.	nylon	ball slv.	rear weight	0.5	3-20	10-15	0.5 -8		75.00	
ADC													ADC 40	10⅝	9	std. ½-in.	single ball	single ball	counter-weight	—	4-15	6	0-4	—	44.50	Side thrust compensation; plug-in shell.
													ADC 84 E	10⅝	9	std. ½-in.	single ball	single ball	counter-weight	—	4-15	6	0-4	—	89.50	As above, but includes Pt. 4E cartridge.
BENJAMIN	PS-18H	16 33 45 78	0.1	0.1	hys. sync.	idler	12	6	zinc/ alum.	integral	14½ 12½ 5⅝	16		12	8	std. ½-in.	ball race	ball	balance and spring	2	—	—	0-10	—	110.00	Push-button operation; cueing device.
BOGEN	B62	16 33* 45 78	0.2	0.2	4-p	idler	12	7¾	—	integral	16 5/16 14⅛ 3	23		—	—	std. ½-in.	—	—	rear weight	—	—	—	—	3	67.95	Complete with arm, cueing device, wt. adj. gauge. * Continuously variable speed 29-86 rpm.
	B52	16 33* 45 78	0.1	0.1	4-p	idler	12	3	form. steel	integral	14¾ 11 9/16 3	12		11¾	9	std. ½-in.	—	—	rear weight	—	—	—	—		49.95	"Feather-Float" hydraulic cueing; * cont. variable speed, 29-86 rpm.
EMPIRE	208	33 45 78	.05	.05	hys. sync.	belt	12	6	alum.	cutout for 980 arm	17 15 8¾	20	980	12	9	std. ½-in.	ball bearing	ball bearing	balance & calib. spring	0.5	2-25	6	0-8	—	Arm only 50.00	208 Table $125.00.
	398	33 45 78	.05	.05	hys. sync.	belt	12	6	alum.	integral	17 15 8¾	25	980 Arm used in this complete system												185.00	Includes base as complete Troubador system.
	498	33 45 78	.07	.07	hys. sync.	belt	12	6	alum.	integral	16 13¾ 7½	25	980 Arm used in this complete system												170.00	Includes base as complete Troubador system.
EUPHONICS													TA-15	11	8¼	*	knife edge	ball	spring bal.	0.75	1.5 only	12	0.5- 1.5	12	32.50	* Accommodates Euphonics cartridge only TK-15-LS, with cart., pwr. source, $87.50.
														12	8¼	*	knife edge	ball	spring bal.	0.75	1.5 only	12	0.75 -3.0		71.50	TK-15-P; with cart., pwr. source.
													TA-16	13½	11½	*	knife edge	ball	spring bal.	0.25	1.5 only	10	0.5- 1.5	14 gms.	42.50	* Accommodates Euphonics cartridge only TK-16-LS, with cart., pwr. source, $97.50.
														14½	11½	*	knife edge	ball	spring bal.	0.25	1.5 only	10	0.75 -3.0	14	87.50	TK-16-P; with cart., pwr. source.
MARANTZ	SLT-12	33 45	.04	.04	hys. sync.	belt	12	12	alum.	integral	18 14 6½	27					ball race	ball race		0	—	—	—	—	295.00	Patented straight-line tracking arm with integral cartridge. Tracking force — 1 gm.
ORTOFON													RMG 309	16	12½	std. ½-in.	ball race	ball race	balance and spg.	0.83	max. 19	8	0.8	630 gms.	60.00	
													RMG 212	12	9	std. ½-in.	ball race	ball race	balance and spg.	1.2	max. 19	8	0-8	500 gms.	60.00	
													SMG 212	12	9	std. ½-in.	ball race	ball race	balance and spg.	1.2	max. 19	8	0.8	380 gms.	30.00	
PIONEER	PL-41	33 45	.08	.08	4-p hys. sync.	belt	12⅛	4	alum. die cast	integral	20 16 7¾			—	9.6	std. ½-in.	ball race	ball race	static balance	1.0	—	7	0-4	—	220.00	With cartridge, walnut base; dust cover without cartridge $210.00. Without cartridge, cover and base.
REK-O-KUT	R-34	33 45	.08	.08	hys. sync.	belt	12	4	Alum.	integral	15 15 6	20	S-440	12	9	std. ½-in.	ball	ball	balance and spg.	1.0	3-30	9-12	0.2 -5.0	—	89.95	Integral arm, table, and base.
	B-12H	33 45 78	.085	.08	hys. sync.	idler	12	5	alum.	hole in deck	18 16 10	19													165.00	High-torque motor for cueing.
	B-126-H	33 45 78	.09	.09	hys. sync.	idler	12	5	alum.	hole in deck	18 16 8	17													109.95	
	B-16H	33 45 78	.08	.08	hys. sync.	idler	16	9	alum.	hole in deck	20 19 8	34													275.00	
													S-320	12	9	std. ½-in.	ball	ball	balance and spg.	1.0	3-30	9-12	0.2 -5.0		34.95	
SHURE-SME													3009	—	9	std. ½-in.	knife edge	ball	rear weights	—	—	—	—	—	100.50	Adjustable anti-skating, viscous arm lift and lower.
													3012	—	12	std. ½-in.	knife edge	ball	rear weights	—	—	—	—	—	110.50	As above.
SONY	TTS-3000	33 45	.05	.05	servo cont. d.c.	belt	12	3	alum. die cast	—	14 15 5½	14														Slow speed servo-controlled d.c. motor; constant speed can be varied ±5%.
													POA 237	13⅜	9 11/32	std. ½-in.	micro ball	micro ball	balance weight	1° 44′	6-18	9	0- 3.0		85.00	Skating force cancelled at any point on the disc; independent
													PUA 286	15⅜	11¼	std. ½-in.	micro ball	micro ball	balance weight	1° 24′	6-18	8	0- 3.0		99.50	lateral balancer not affected by stylus force used.
STANTON	800B	33	.15	.15	HP sync.	idler	12	3	alum.	rem. board	15⅞ 12⅞ 6½	13	200 Unipoise	11 7/16	8 23/32	std. ½-in.	Uni-pivot		rear weight	0.5	0-12	11	0-5	4.5 oz.		Interchangeable arm boards.
THORENS	TD-150AB	33 45	0.2	.05	sync. 450 rpm	belt	12	7½	Zn alloy	integral inter-change-able	15½ 12¾ 5	15	TP-13	12	9	std. ½-in.	ball and polished sleeves	polished sleeves	rear weight	0.3	6-19	7 min.	0.5- 4.0	—	99.75	Wooden base integral with unit plate. Turntable and platter on floating inner frame; adj. vert. tkg. angle.
	TD-124/11	16 33 45 78	0.1	.05	4-p	belt and idler	12	7	Zn alloy and alum.	built-in wooden panes	15½ 12¾ 7	18														Speed adj. by eddy-current brake; illum. stroboscope; double turntable with clutch assembly; die cast unit plate.



The new Sony Solid State 350 adds professional performance to home entertainment systems

Selecting the brilliant new Sony Solid State 350 to fulfill the stereo tape recording and playback functions of your professional component music system will also enduringly compliment your impeccable taste and passion for music at its finest. With an instant connection to your other stereo components, the versatile two-speed Sony 350 places at your pleasure a full array of professional features, including: 3 heads for tape and source monitoring. Vertical or horizontal operation. Belt-free, true capstan drive. Stereo recording amplifiers and playback pre-amps. Dual V U meters. Automatic sentinel switch. Frequency response 50-15,000 cps ± 2db. S.N. ratio plus 50db. Flutter and wow under 0.15%. Richly handsome gold and black decor with luxurious walnut grained low profile base. This remarkable instrument is yours at the equally remarkable price of less than $199.50. Should you want to add portability to all this, there's the Model 350C, mounted in handsome dark gray and satin-chrome carrying case, at less than $219.50. *For information write Superscope, Inc., Sun Valley, Calif.*

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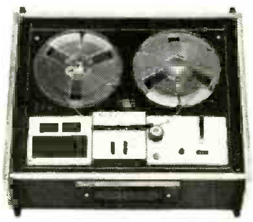

Portable Model 350C

Sony adds an exciting new dimension to home entertainment for less than $149.50

Now, from World-famous Sony, the perfect playmate for your record player—the new Sony model 250 solid state stereo tape recorder. With a simple, instant connection to your record player you add the amazing versatility of four track stereo recording and playback to complete your home entertainment center and create your own tapes from records, AM or FM Stereo receivers, or live from microphones—6¼ hours of listening pleasure on *one* tape! This beautiful instrument is handsomely mounted in a low-profile walnut cabinet, complete with built-in stereo recording amplifiers and playback pre-amps, dual V.U. meters, automatic sentinel switch and all the other superb features you can always expect with a Sony. *All the best from Sony for less than* $149.50. Send today for our informative booklet on Sony PR-150, a sensational new development in magnetic recording tape. Write: Sony/Superscope, Magnetic Tape, Sun Valley, California.

For literature or name of nearest dealer write to Superscope, Inc., Dept. 17, Sun Valley, California.

SONY SUPERSCOPE *The Tapeway to Stereo* ®

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Program Your Listening For Up to Thirty Hours

C. G. McPROUD

PRACTICALLY ANYONE who plays records has longed for some means of playing then in specific orders which are not readily available on any record changer on the market. Old timers will remember the Capehart, which played first one side of a record and then the other, then went on to the next record and played both sides of it. This sort of a changer was almost a necessity in the days of the 78's, when a side was only 4 minutes at most. And in those days, they were pressed in sequences which permitted the listener to play a complete 12-record album in the order intended. The current Lincoln does the same thing.

Then there were a few others in the turnover field which played both sides, but their cost was prohibitive. Not that the Capehart was inexpensive—the mechanism alone was something like $585—it also had the disadvantage of playing with a stylus force of around 6 *ounces,* which is 170 grams. Imagine what that would do to a stereo LP! It took about 25 seconds to go through a change cycle, and if you touched the record during the change, the monster was likely to bite a piece out of it.

The advent of the drop changer heralded a switch in the pressing sequence of multi-record albums. In a three-record album, for example, sides 1 and 6 are on the same disc, 2 and 5 are on the next one, and 3 and 4 on the last. You stacked them on the spindle with side 1 on first, then side 2, and then side 3. After playing the three sides, you simply turned the whole batch over and went through the remaining sides. All well and good, as long as you did not still have some of the older albums with the 1-2, 3-4, 5-6 sequences. Even with a single disc on which a symphony occupies the two sides, you have to turn the record over after playing one side.

With LP's, that no longer was so important, of course, because you could go to the kitchen every twenty minutes for a glass of water at the changeover time.

There was one way in which you could play a complete three-record opera—simply buy two albums and stack them up in the right way. But a few rounds of that and you could afford to have a small boy change them for you.

A Solution to the Problem

Last November we were privileged to view the Seeburg Automatic Music System, originally intended as a background-music installation for restaurants, offices, or other places where high-quality music reproduction was desired on a programmed basis. Nearly everybody associates the name Seeburg with "juke boxes," which, because of their earlier boomy reproduction gave rise to the term "juke box" as a description for particularly boomy sound. This model, however, was a revelation. With its normal speaker systems—theatre-quality units employing a healthy woofer and a horn tweeter with an 800-Hz crossover—the reproduction was easily equal to what we have come to expect from a high-quality component system in our homes. On top of the main cabinet (which measured 31¾ in. high, 40 in. long, and 26¼ in. deep and which weighed 277 pounds), was a small metal box 14¾ in. long, 7 in. high, and 8¼ in. deep. This remote selector unit was connected to the main cabinet by a 15-wire cable. On the box were 30 push buttons and eight signal lights, and except for putting This remote-selector unit was connected to the main cabinet, no further contact with the latter was required. Everything was controlled from this metal box.

Inside the large cabinet was a mechanism such as that shown in *Fig.* 1 together with all the necessary amplifiers and control equipment for the entire system. A complete description of the amplifying system alone would require about as much space as this magazine, since it consists of (in each channel) a three-transistor pre-equalizing amplifier, an audio control amplifier with squelch circuitry, and the five-transistor power amplifier. This doesn't sound so complicated, but there are several refinements that do mix it up a bit before the sound finally reaches the speakers.

For example, it is possible to set up three separate programs, each selectable by a single push button. Program 2 plays at a certain volume, while programs 1 and 3 may be set to play at different levels. Suppose program 2 was for dance music in a restaurant beginning after

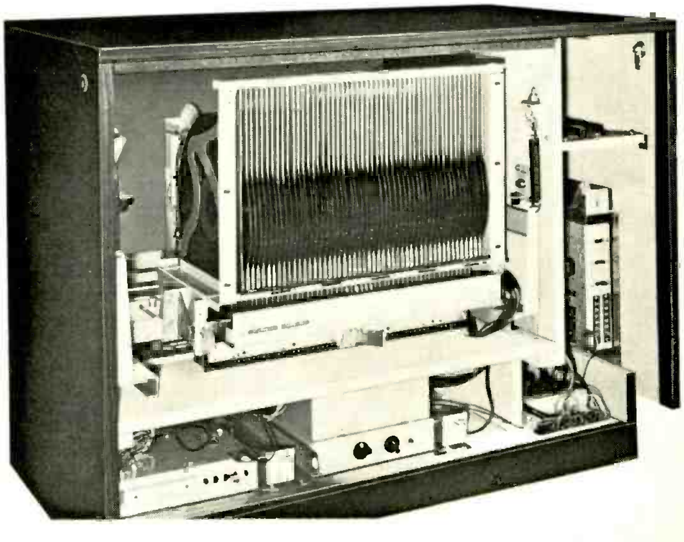

Fig. 1. The Seeburg Automatic Music System.

Try this on your changer.

***1½ grams** (one record)*

***1½ grams** (stack of eight)*

The arm of the AR turntable is designed for neutral balance, so that stylus force doesn't change as the cartridge rides up and down the surface of a warped record. The needle doesn't alternately dig into and lose contact with the groove.

Keeping stylus force the same at different cartridge heights is even more important in changers. The stylus force on the eighth record should be the same as on the first.

In some units it is 50% higher, but it doesn't need to be. We do not believe that automatics are inherently inferior to manuals. It is just that for the same quality they are inherently more expensive. They should be judged by equally high standards, with particular attention paid to whether they maintain constant stylus force and constant speed as records build up on the platter.*

About 4% of recorded selections take up more than one disc; whether you use a changer or a manual turntable the remaining 96% must be turned over by hand. A changer has a real advantage only if a good part of your listening is to the multi-record albums, or if you like to stack unrelated singles.

The AR turntable meets NAB standards for broadcast turntables in rumble, wow, flutter, and speed accuracy. It has been rated as being the least sensitive to mechanical shock of all turntables, and has been selected by professional equipment reviewers** above all other turntables, including those costing twice as much. The price is $78 with arm, oiled walnut base, and transparent dust cover.

**We will be glad to send you a reprint of the article "What the Consumer Should Know about Record Players," describing how the layman can check these characteristics in the home. Please ask for it specifically.*

***Lists of the top equipment choices of four magazines are available on request. All four chose the AR turntable. (Three of the four, incidentally, chose AR-3 speakers.)*

ACOUSTIC RESEARCH, INC., 24 THORNDIKE STREET, CAMBRIDGE, MASSACHUSETTS 02141

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dinner; program 1 was for the cocktail hour, and program 3 for the dinner music. Each would require a different volume setting, although the over-all volume is controllable from the push-button box. The important thing is that the maximum level can be set on two of the programs, and can not be exceeded, if such is the desired condition. This facility tends to complicate the system to a certain extent.

The Select-O-Matic Mechanism

The heart of the whole system is, of course, the mechanism—the Select-O-matic. This is quite an elaborate device which accommodates 50 records placed in padded slots, and which plays either side of any one of them upon command. The handling is gentle, the pickup arm is counterbalanced dynamically so that when one holds the mounting of an arm out of the mechanism in the hand and moves it violently up, down, or sideways, it remains in the same position. Stylus force is furnished by a spring, and is adjustable from 1¾ to 2¼ grams, and anti-skating compensation is even provided. The pickup itself is a two-stylus stereo cartridge, and each time a record is played a small brush dusts the stylus off afterward.

In normal use in a restaurant, for example, three programs are set up on the machine, each in a multiple of 5 records. Thus program 1 might have ten records, program 2 could have twenty, and program 3 the remaining twenty. Pressing one of the program selector buttons starts the playing of the desired program, and all the records in the selected program will play, first one side and then the other. After the completion of the program, it will start over again and play the program once more. This will continue as long as the particular program button remains depressed. However, if a record in another program is wanted, it is simply selected by depressing the lettered button followed by the numbered button identifying the desired record. If it is wanted immediately, pressing the reject button will initiate the change. If not, the machine will play the desired record at the finish of the one being played in the program, or at the first silent space between cuts, if it is a record with a number of selections separated by pauses. Then after changing to the desired record and playing it, the mechanism will search for another one selected out of the program. If no others have been selected, it will resume playing the program.

If, however, one sets up a number of records outside of a program, and then decides to cancel them, this may be done by pressing the cancel button, and all records previously set up out of the program then playing will be canceled, and one can start over again if one wishes.

One other feature is an advantage for background music installations. While the Select-O-Matic mechanism normally operates at 33⅓ rpm, when playing normal LP records, it is arranged so that when records with a 2-in. center hole are encountered, the motor speed is halved and the playing is at 16⅔ rpm. Background records are available cut at this speed, and with the larger center hole, so that when the spindle encounters the center of an LP record, it is held in one position, and the turntable rotates at 33⅓ rpm. If it goes further in with its centering cone, it actuates contacts which change the motor speed to provide the required 16⅔ rpm.

The play motor drives the turntable through a belt onto a heavy flywheel, and the motor itself actually turns at 72 rpm, being a multi-pole synchronous type. For the lower speed, it turns at 36 rpm. The motor is reversible, since the direction of rotation of the record must be reversed when changing from one side to the other.

A second motor, also reversible, but of the capacitor type, is used for the scanning operation.

Memory Systems

The selection of records to be played is not a mechanical process, but instead is done by means of two sophisticated memory core banks, and one, two, three, or any number of sides up to the maximum capacity of 100 may be preselected.

Since each playing of a record erases the magnetic polarity of the core which had previously been impressed with a signal, the second memory system is used to reset the programmed groups at the completion of playing of the program set up. As the last record side of a given program is played, the second memory system rewrites the same program into the memory core bank, and this continues each time a program is completed.

System for home use?

Well, why not? we argued. Of course, it is a little expensive—about $2300 with the two speaker systems included. But for home use, we continued, why not eliminate the amplifiers and the speaker systems, since anyone likely to want such an elaborate record changer would probably already have an excellent hi-fi system. So maybe that gets us down to, say, $1000. Perhaps we could simplify the selection electronics and the switching and reduce it still more, we thought, eliminating the fancy housing, and perhaps simplifying the selector box. We would hope that the selection method could remain so that one could play a three-record opera by pressing C1, C3, C5, C6, C4, and C2, for example, and then sit down and enjoy the next two hours of opera.

Well—we are to get our hope. Several models have been created for the home market, and by the time this is in readers' hands, they will have been shown at the Washington High Fidelity Show. Of greatest interest to the serious audio buff is the component model which contains the Select-O-Matic mechanism with its memory system controlled by a telephone dial and four pushbuttons—on, off, reject, and cancel. The 100 sides may be selected in any order, so that the listener can actually program his listening for some 33 hours of continuous playing. Since any side may be selected by dialing two digits, and since they will be played in the order in which they were selected, any pressing sequence can be accommodated. The index booklet has ten pages, each with five pockets which hold numbered cards on which you list the records you have put in the slots. Thus you have a reference which enables you to select just the side you want without having to resort to your own memory. The elaborate three-program system is eliminated, reducing the over-all cost considerably. Any number of remote selector stations can be connected, since they are parallel-wired.

Another model, also shown in Washington, accommodates the same number of records, but uses a mechanical selection system which does not offer the flexibility of the dial-selection component model. It is housed in a cabinet, and equipped with an FM tuner and two loudspeaker systems as a complete packaged stereo "theater."

Now the record listener can store his entire collection in these models—assuming he has no more than 50 records. Of course, he could connect two, three, or more of the component units to his system, and then store *all* his records, playing any one of them simply by dialing. This could well be the record listener's Utopia—and Seeburg's too, if the idea catches on. Æ

Who would you put in the box?

"Dizzy"?

Shakespeare?

Beethoven?

Uncle Louie singing "Danny Boy"?

Build a world of your own on Scotch® BRAND Magnetic Tape

Whatever your listening preference . . . "Scotch" Brand "Dynarange" Tape helps you create a new world of sound. Delivers true, clear, faithful reproduction across the entire sound range. Makes all music come clearer . . . cuts background noise . . . gives you fidelity you didn't know your recorder had.

Best of all, "Dynarange" is so sensitive it gives you the same full fidelity at a slow 3¾ speed that you ordinarily expect only at 7½ ips. Lets you record twice the music per foot! The result? You use less tape . . . save 25% or more in costs! Lifetime silicone lubrication protects against head wear, assures smooth tape travel. Ask your dealer for a free "Scotch" Brand "Dynarange" Tape demonstration.

Magnetic Products Division 3M COMPANY

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF THE 3M COMPANY

Professional Tone Controls

Part 2

ARTHUR C. DAVIS and DON DAVIS

Typical Equalizer and Filter Circuits

The basic equalizers and filters, and the constant-k, unbalanced, bridged-T circuit for them, along with a sample response curve, are shown in *Figs*. 13 through 22.

A high-frequency rolloff is shown in *Fig*. 13, and a low-frequency rolloff is shown in *Fig*. 14. These are the types of circuit that is used in program-equalizer attenuation settings.

Figures 15 and 16 illustrate the circuits used to produce special effects or to eliminate interference that has a definite spectral frequency. The broadness or sharpness of these curves can be varied by a change in the L-C ratios.

Figures 17 and 18 give the circuits that are used to restore deliberate insertion losses to "shelved" type accentuation.

Figures 19 and 20 show frequency-selective attenuation and "boost" circuits. It is this type of circuit that is used in a typical high-frequency-boost-or-cut portion of a program equalizer or graphic equalizer.

Figures 21 and 22 consist of an 18-dB-per-octave low-pass and high-pass filter. These are extremely useful circuits for limiting the passband of a wide-range system to those frequencies which the transducers involved are capable of handling cleanly, thereby avoiding overload from frequencies not containing useful energy. Variable equalizers and filters are merely series of these basic circuits sequentially selected by means of precision switches such as shown in *Fig*. 23.

Equalizers and filters of this type require careful termination in their rated impedance. *Figure* 24 diagrams the test set-up used to record the frequency response curves that follow.

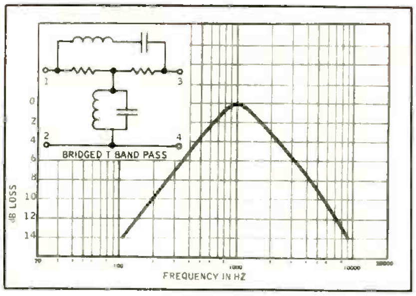


Fig. 15. Bridged-T band-pass equalizer and response curve.

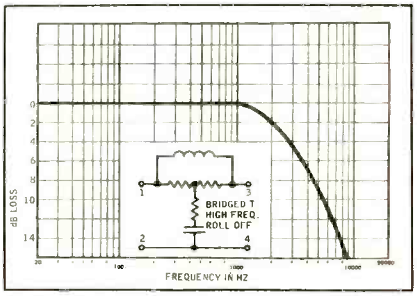


Fig. 13. Bridged-T high-frequency rolloff equalizer and its response curve.

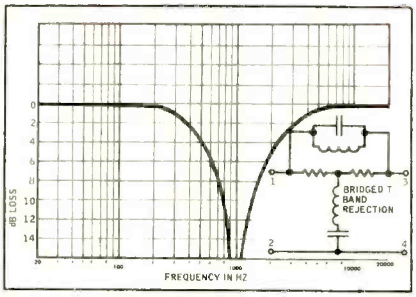


Fig. 16. Bridged-T band-rejection filter and response curve.

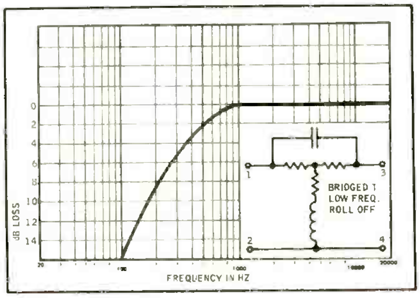


Fig. 14. Bridged-T low-frequency rolloff equalizer and its response curve.

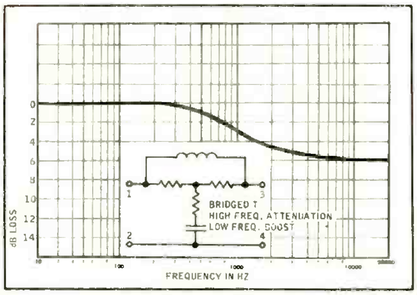


Fig. 17. Bridged-T "shelving" equalizer used to attenuate highs, boost lows, and the resulting response curve.

Design Laboratory Illustrated

The use of a servo-operated recorder-generator assembly allows automatic recording of the amplitude-frequency characteristics of equalizers and filters. Due to the reduced time such testing requires as compared to conventional hand plotting (and the reasonable cost of such test instruments today), high-quality professional equalizers and filters now come with such curves recorded for each individual unit. *Figure* 25 shows a laboratory where equalizers and filters are designed and measured. The output of the recorder-driven test oscillator shown at the lower right corner is flat within ±0.5 dB over its entire frequency range.

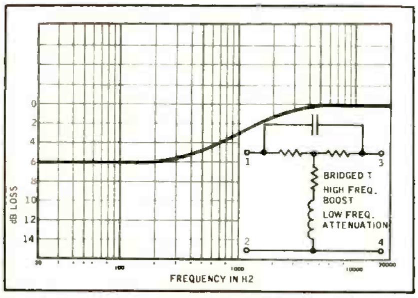


Fig. 18. Bridged-T "shelving" equalizer used to boost highs, attenuate lows, and its response curve.

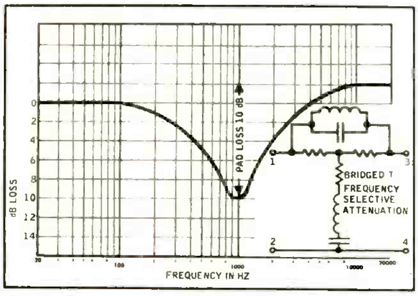


Fig. 19. Bridged-T frequency-selective equalizer used to eliminate or reduce unwanted peaks in response or to produce a desired effect.

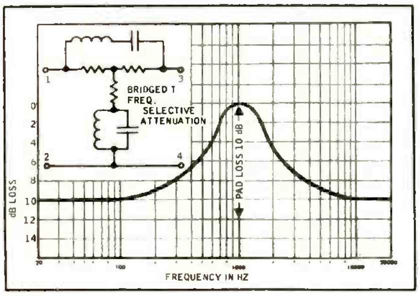


Fig. 20. Bridged-T frequency-selective equalizer used to increase output at a specific frequency.

Commercially Available Passive Controls

Commercially available versions of passive equalizers and filters are available from a number of manufacturers. They take the form of microphone equalizers, program equalizers, graphic equalizers, filter sets, and fixed pre- and post-equalizers.

Microphone or Dialogue Equalizer

A microphone equalizer and its plug-in mounting bracket are shown in *Fig.* 26. This is a series of passive LCR bridged-T, constant-k networks with input and output impedances of 600 ohms. The insertion loss at the "0" or flat setting of the controls is 14 dB. It provides low-frequency shelving at 100 Hz and high-frequency boost at 7 kHz. Maximum boost available at each of these frequencies is 12 dB. It also provides selective attenuation in 2-dB setups up to a maximum of 16 dB at 10 kHz and 16 dB at 100 Hz, as shown in the curve of *Fig.* 27.

This figure shows the frequency-response curve of it at its flat setting, and then one run at maximum bass boost/maximum treble roll off, and another at maximum bass roll off/maximum treble boost.

Program Equalizers

Figure 28 shows a more sophisticated version of the microphone equalizer which is known as a program equalizer. The internal construction showing the mechanical means

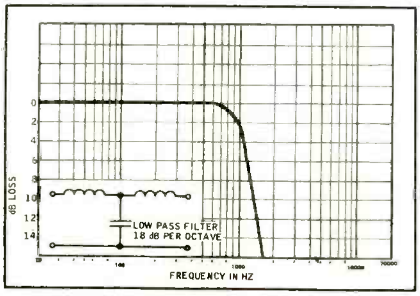


Fig. 21. 18-dB/octave low-pass filter and its response curve.

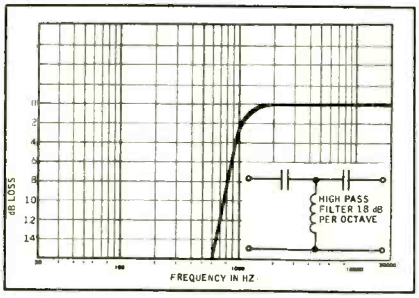


Fig. 22. 18-db/octave high-pass filter.

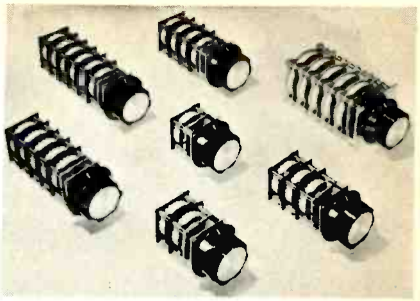


Fig. 23. Precision switches used for attenuators and equalizers in professional audio systems.

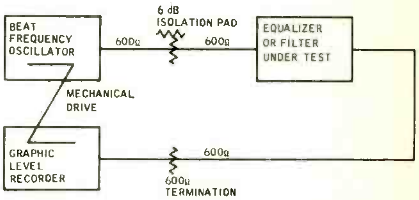


Fig. 24. Block diagram of measurement method employed to record response curves automatically.

of selecting the large number of network-circuit combinations represented illustrates why most of those in use are commercially manufactured units. Equalizers like the microphone unit previously shown are used principally as dialogue equalizers or to correct room problems in a sound stage or studio. Program equalizers, on the other hand, are designed with the playback system in mind as well as the recording system. In addition to its attenuation and boost functions, in 2-dB increments, it allows a choice of two low-frequency shelves at 100 and 40 Hz at the calibrated points and four high-frequency-boost points—3, 5, 10, and 15 kHz. The functions desired are selected by the two knobs at the top of the panel.

On the low-frequency shelving switch are two "off" positions that bypass the entire equalizer and insert a 14-dB loss pad in its place. This allows instant aural comparison between equalized response and "flat" response at the turn of a switch.

Amplitude Response Curves

Figure 29 displays a composite frequency-response chart of the low-frequency shelving at 40 Hz and high-frequency boost at 10 kHz for different amounts of attenuation at each of the steps available. Note that the shelving control affects only the boost portion of the equalizer's response. Similar curves would result from the

Professional Tone Controls

100-Hz setting, but would simply be moved up the frequency scale about 1½ octaves. The high-frequency boost selector was set at 10 kHz although 3-, 5-, and 15 kHz positions are also available. Note here also that the high-frequency boost selector affects only the boost functions of the equalizer. These units are usable in any 600-ohm circuit by simply inserting them in the transmission line at the proper level. A wide variety of response curves can be obtained with this type of equalizer.

Graphic Equalizers

A graphic equalizer is shown in *Fig.* 30. This equalizer allows exceptional control of a signal from 50 to 12,500 Hz. The unit shown consists of 7 boost and 7 attenuate equalizers covering a range from +8 and −8 dB. The total unit has an insertion loss of 16 dB with all controls set at "0" or "flat" position. Each control operates in 1-dB increments. Again, the circuits employed are bridged-T, constant-k, passive networks, designed for use in 600-ohm lines. The special effects possible with this unit range from an "other worldly" voice of the ghost in Hamlet to increased "presence" on a distant microphone pick-up. The operator's imagination is about the only limitation the instrument imposes. The curves of *Fig.* 31 were recorded by measuring each boost setting and each attenuate setting individually at its top and bottom position. This enables one to see the individual filter shapes associated with each control. Where the filter "skirts" cross, interaction occurs if two adjacent controls are used simultaneously. This allows smooth continuous curves to be formed.

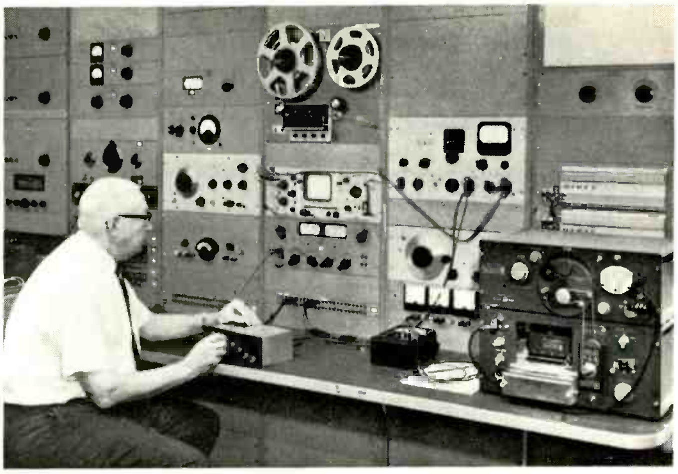


Fig. 25. Co-author Arthur Davis measures response of a graphic equalizer. Note automatic curve-tracing equipment at lower right corner.

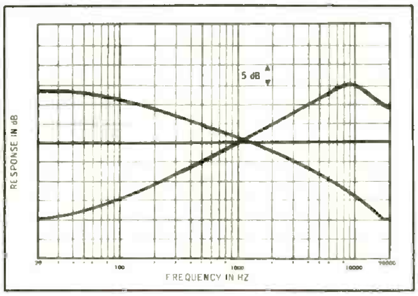


Fig. 27. Limits of curves obtainable with the microphone equalizer of Fig. 26.

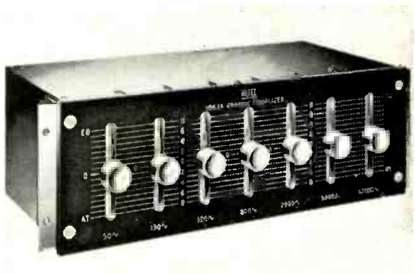


Fig. 30. Graphic Equalizer which will permit boost or cut of 8 dB at any of seven frequencies approximately 1½ octaves apart. One, two, three, or all of the controls may be varied to achieve the desired effect.

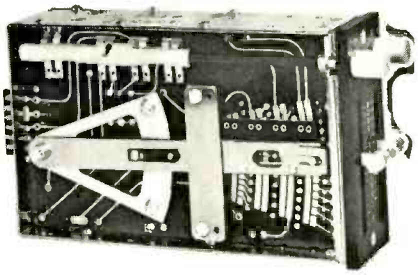


Fig. 28. Program equalizer which will provide the wide variety of curves shown in Fig. 29. Any combination of these curves may be obtained.

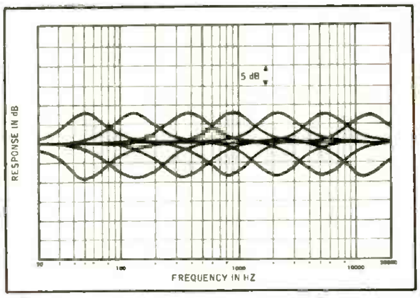


Fig. 31. Composite of 14 individual curves, each of which was run with a single control at its extremes. Superimposed, they appear as shown. If all controls were put at +8, for example, the resultant curve would be practically flat at the +8 level, and similarly would be practically flat at the −8 level if all controls were placed at −8.

(Concluded next month)

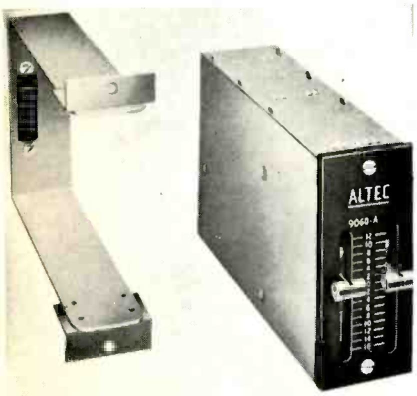


Fig. 26. Altec 9060-A microphone equalizer and its mounting fixture.

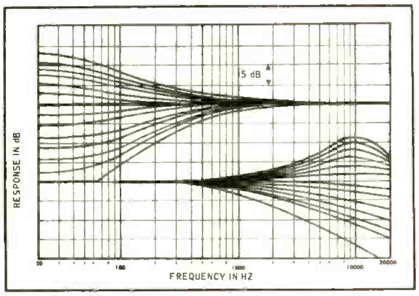
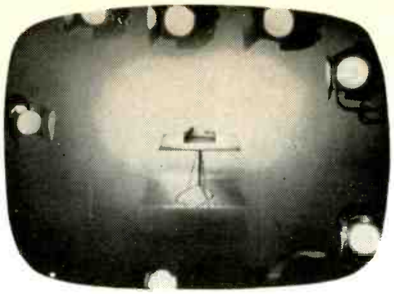


Fig. 29. Composite of curves obtainable with equalizer of Fig. 28.

1. Now...a remarkable demonstration.



2. This is the BSR McDonald 500...

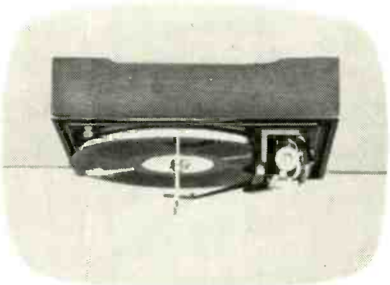
3. precision engineered in England.

4. So perfectly counter-balanced

5. ...it will play upside down!

6. Here's proof...you see it...

7. turning over to a complete...



8. upside-down position. Still playing.

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Did you catch this amazing act on the Johnny Carson "Tonight" Show?

This almost unbelievable demonstration of the tracking ability of the BSR McDonald 500 automatic turntable is being telecast on the popular NBC-TV Johnny Carson "Tonight" Show as well as the "Today" Show starring Hugh Downs. It demonstrates the BSR precision engineered automatic turntable doing a complete 180° turn . . . while it continues to play a record perfectly even when it reaches the completely upside-down position! (The secret is the tone arm that is perfectly counter-balanced horizontally and vertically!) See this remarkable automatic turntable and see its many other unique features. Write for free literature.

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Skating Force: Mountain or Molehill?

R. S. OAKLEY JR.

In which the author discusses the side thrust toward the center of the record which results from modern tone arm geometry, and ways of reducing its effect.

IT IS POSSIBLE to demonstrate dramatically the tendency of a modern tone arm to "skate" toward the center of a rotating record. The demonstration requires a tone arm with an "anti-skating" device. With the device disabled, the needle is placed at the outer edge of a rotating blank vinyl disc. Immediately the tone arm moves toward the record center. When the anti-skating device is brought into play and the tone arm is again placed on the grooveless record, it stays in place.

Equally dramatic was a demonstration first used about five years ago to show that skating force can result in distortion which can be eliminated by an anti-skating device. In this demonstration the output of a stereo cartridge was displayed on an oscilloscope while a very-high-level sine-wave signal on a test record was being reproduced. With the device disabled, distortion was visible in the right-channel display. When the device was brought into play, the distortion disappeared.

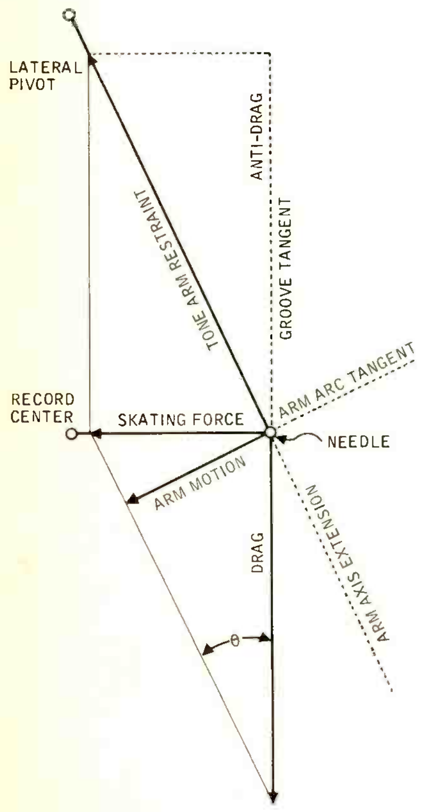


Fig. 1. A diagram of the skating-force vector.

A third demonstration, while perhaps not so dramatic, brings the problem into perspective. Here the output of a stereo cartridge is again displayed on an oscilloscope (or played through loudspeakers) while a test signal is being reproduced. The needle force is low enough that, although left channel information is undistorted, noticeable distortion exists in the right channel. Needle force is then increased by a small fraction and right channel distortion disappears.

To understand exactly what these three demonstrations prove, the nature of skating force should be examined. The following formula applies: $SF = \mu N \tan \phi$, in which SF = skating force, μ = the coefficient of needle/groove friction, N = vertical needle force, ϕ = the angle between the groove tangent and the line from the needle to the lateral tone arm pivot. Since skating force is approximately proportional to needle force, it is customary to express skating force in terms of needle force.

Definition

Skating force is defined as side thrust normal to the groove tangent. The friction of the needle in the groove produces a drag which may be represented as a vector away from the needle along the groove tangent and which must be balanced by an equal but opposite force. Because in a properly designed offset tone arm these two forces are never opposite in direction, a side-thrust vector is formed. This vector, *Fig.* 1, is determined by a parallelogram in which drag and tone-arm restraint (along the line from the needle to the lateral pivot because the arm is restrained at the lateral pivot) are two sides. Side thrust does not coincide with the direction the arm can move (along its arc). Anti-skating force must be applied in this direction, however, and must be proportional to $\sin \phi$ instead of $\tan \phi$.

The element in the skating-force formula for which the least data exists is μ, the coefficient of friction. It should be noted that any given value of μ applies only under certain conditions. The reason for this is that μ varies not only with record material, needle force, needle radius, and perhaps even effective needle mass, but also with groove modulation (both amplitude and frequency) and groove radius. Determining the relative importance of these various factors to the value of μ is beyond the scope of this paper. It can be observed, however, that exact correlation between μ on either a blank record or a sine-wave test band and μ under actual playing conditions is strictly coincidental.

The other element in the skating force formula is ϕ, the angle between the groove tangent and the tone arm axis.

Most modern tone arms are between 8 and 9 in. from pivot to needle tip. Since normal design procedure calls for minimizing distortion due to lateral tracking error over the entire record surface, overhang distance (the distance the needle sweeps past the record center) and offset angle (the angle between the cartridge axis and the line from the needle to the lateral pivot) will be determined from known formulas. Maximum ϕ will be at the outside record radius, but minimum ϕ will not be at the inside record radius. Rather, it will be at an intermediate radius—increasing from that point to the inner radius, as seen in *Fig.* 2. It can be seen, then, that even if the coefficient of friction were constant, skating force would neither be constant nor would it vary in a linear fashion. This complicates the design of anti-skating devices.

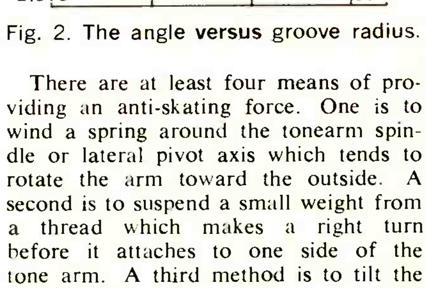


Fig. 2. The angle **versus** groove radius.

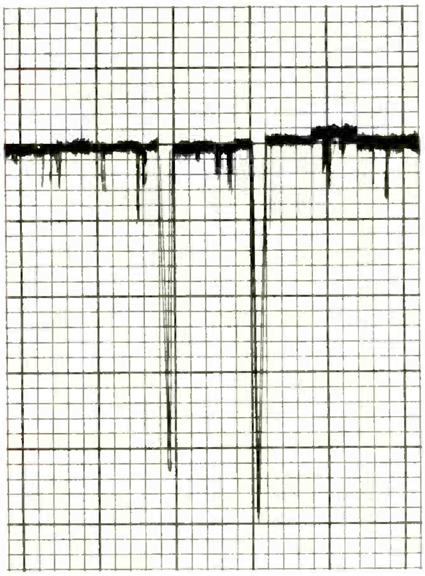
There are at least four means of providing an anti-skating force. One is to wind a spring around the tonearm spindle or lateral pivot axis which tends to rotate the arm toward the outside. A second is to suspend a small weight from a thread which makes a right turn before it attaches to one side of the tone arm. A third method is to tilt the vertical pivot axis so that when vertical needle force is applied (by a spring in this particular case) it is applied with a slight outward thrust. All three of these basically simple ways of supplying anti-skating force suffer from inherent inability to vary the force with $\tan \phi$. A fourth method uses a pin attached to the tone arm spindle which rotates against a lever that carries a small weight. This

Some plain talk from Kodak about tape:

Uniform magnetic sensitivity
(or the lack thereof)

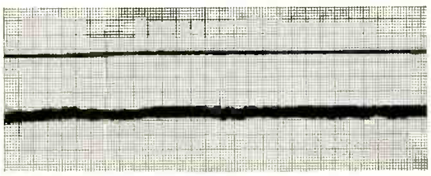
Uniformity for a tape is like kissing babies for a politician. Without it, you're hardly in the running. We take uniformity in all of tape's characteristics very seriously at Kodak. Maybe it's all those years of putting silver emulsions on film that's made us so dedicated to the idea. Uniformity in terms of magnetic sensitivity is one of the most important measures of a tape's performance. Non-uniformity can result in all sorts of bad things like level shifts, instantaneous dropouts, periodic non-uniformity, output variations, distortion, and variations from strip to strip.

Testing for all these possible flaws on a tape is a simple procedure in the lab. Standard industry practice is to record a long wavelength signal (37.5 mil) at a constant input level. The signal from the playback amplifier is then filtered and the output at particular critical wavelengths is permanently charted by a high-speed pen recorder which registers variations on a chart. Instantaneous dropouts caused by foreign matter on the tape surface, for example, would look like this:

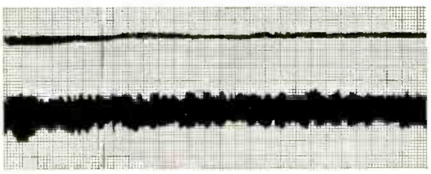


The long and the short of it

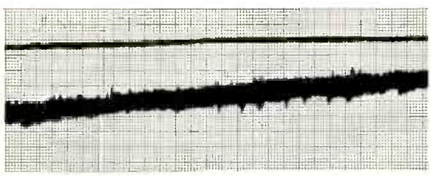
The low frequency procedure gives a good picture of variations in oxide thickness. We take it one step further . . . also test for short wavelength—1.0 mil. This helps evaluate surface smoothness and tape-to-head contact. Taken together, they aid in evaluating the level of lubrication, slitting, and oxide binder characteristics. The smoother the lines, the more uniform the magnetic sensitivity. Guess which graph below is KODAK Sound Recording Tape (the other two graphs represent quite reputable brands of other manufacture):



A.



B.



C.

What looks good sounds good

Congratulations if you picked brand A, Kodak tape. It is notably more uniform . . . doesn't vary more than ¼ db within the reel . . . no more than ½ db from reel to reel.

You benefit as follows:

1. *Within-reel uniformity.*

(a) Less instantaneous and short term amplitude modulation of the signal, which results in a cleaner signal on playback.

(b) Reduced drift gives less variation in frequency response.

(c) Better uniformity across the strip width (no lengthwise coating lines) results in a more nearly balanced output for stereo recordings.

2. *Reel-to-reel uniformity.*

(a) Better coating uniformity gives a more uniform low-frequency sensitivity. This allows splicing of sections of tape from one reel with tape from other reels without obvious signal level changes.

(b) Better coating uniformity also results in a minimum change in optimum bias which allows the professional to establish an operating bias nearer the optimum bias.

KODAK Sound Recording Tapes are available at most camera, department, and electronic stores. New 24-page comprehensive "Plain Talk" booklet covers all the important aspects of tape performance, and is free on request. Write: Department 940, Eastman Kodak Company, Rochester, N.Y. 14650.

Check No. 127 on Reader Service Card

method is the most promising in that it might be possible to shape the bar to vary anti-skating force with tan ϕ. Obviously no method can compensate for changing values of μ. All four methods offer complication of proper initial adjustment of the tone arm—their success in reducing skating force depends heavily on proper adjustment, and improper offer complication of proper initial adadjustment may even aggravate the problem.

A digression on the role of effective arm mass—inertia—is now in order. All of the above has assumed (quite without good reason) that the tone arm is relatively undisturbed by such influences as dust in the grooves, record warp, record eccentricity, external shock, and so on. In fact, the proper relation between the needle and the groove is constantly being upset by such influences—making simple analysis of the need for anti-skating force quite impossible. Although tone-arm inertia does not enter into the formula for skating force, it has been shown that a tone arm with high inertia will be more easily disturbed than one with low inertia. Simply stated, it is useless to reduce skating force unless arm inertia has been reduced to a satisfactorily low figure. Unfortunately, most modern arms have excessively high inertia.

The most serious effect of skating force is that it results in unequal loading of the two groove walls, as shown in *Fig.* 3. Examination of the vector diagram shows that skating force tends to reduce loading on the outside groove wall. Insufficient vertical needle force can result in intermittent loss of contact between the needle and the outside groove wall which is heard as distortion of sine-wave test signals or as noise accompanying loud music passages. But simply increasing vertical needle force (by about 15 per cent above the value which would be required if the two groove walls were equally loaded) will eliminate this distortion.

Less serious is the possibility of wear on the inner groove wall. Loading on the inner groove wall is increased by the same amount as it is decreased at the outer groove wall. This might be a disadvantage if increased loading of the groove necessarily resulted in proportionate record or needle wear. There is

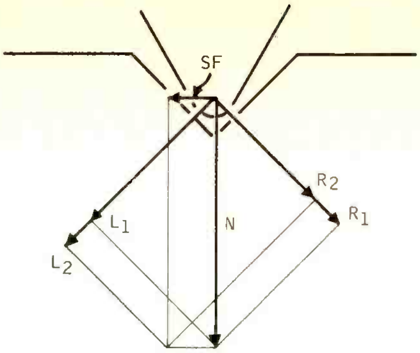


Fig. 3. The uneven groove-wall loading caused by skating force.

evidence and experience to suggest, however, that at low needle forces the record material is elastic enough that permanent deformation does not occur.

Most remote of all is the possibility that inward force on the tonearm will cause the needle (which is usually attached to a lever) to be pushed outward. This could cause lateral tracking error not accounted for in the original tone arm design, it could cause the needle lever to be forced into a region of non-linear operation, or it could cause the stylus assembly to acquire a "set" over a long period of time. Since vertical needle force is about 6 times as great as skating force, and since vertical and lateral compliance should be identical, similar effects would occur first in the vertical angle of the needle lever.

The foregoing would appear to suggest the anti-skating devices are only partially solving a problem that is relatively insignificant to begin with, and at the same time perhaps creating very real problems of tone arm adjustment. The most elegant solution to the "skating" problem would be significant reduction of μ, the coefficient of friction, through improved record material. Until that solution is forthcoming, tone arm designers might well focus their attention on reducing inertia, providing neutral arm balance, reducing sensitivity to external vibration, and providing a means of adjusting overhang distance to achieve the lowest possible distortion from lateral tracking error. At the same time, consumers should use care in properly setting needle force with a good test record—this being the only reliable way to do so. Æ

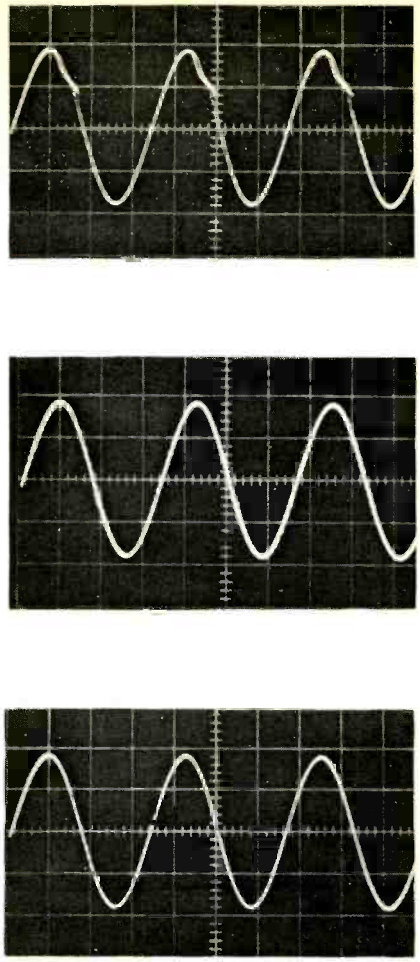


Fig. 4. In this illustration an arm with variable skating compensation has been used to show the possible right-channel distortion caused by the action of skating force. In (A) the right-channel output is shown at 1.5 grams stylus force and using no anti-skating compensation. At (B) the same tracking force and channel are shown with proper skating compensation set. (C) illustrates the same right channel without compensation but at a tracking force of 1.7 grams. The left channel never showed the effect of skating force. The signal used is the +15-dB, 300-Hz band of the CBS STR-111 test disc.

APPENDIX

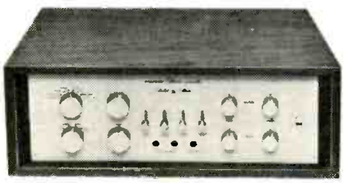
For a detailed analysis of "skating force" the reader is referred to a technical paper entitled "New Approach to Tone Arm Design" presented by Mr. George Alexandrovich (Fairchild Recording Equipment Corp.) to the 1960 Convention of the A.E.S.

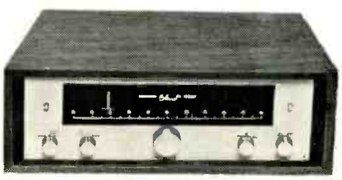
Also extremely informative is an article entitled "The Rational Design of Phonograph Pickups" by Professor F. V. Hunt of Harvard, published in the October, 1962, *Journal of the A.E.S.*

It should be observed that record materials have apparently improved over the last half decade. Data presented by Alexandrovich suggested a range of values for μ of from 0.4 to 0.7. Hunt suggested a range of from 0.25 to 0.5, and new experiments suggest a range of 0.2 to 0.35.

Fig. 5. An AR turntable with an anti-skating device built-on consisting of a bent paper clip held in place with tape. A small piece of thread and a plastic gram weight complete the assembly.

Marantz components are too good for most people.





Are you one of the exceptions? For the most astonishing set of specifications you've ever read, write "Exceptions," Marantz, Inc., 37-04 57th St., Woodside, New York 11377, Department A-17.

marantz
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The Marantz components illustrated, top to bottom: SLT-12 Straight-Line Tracking Playback System • Model 15 solid-state 120-watt Stereo Power Amplifier • Model 7T solid-state Stereo Pre-amplifier Console • Model 10B Stereo FM Tuner

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Audio Measurements Course

NORMAN H. CROWHURST

Part 14

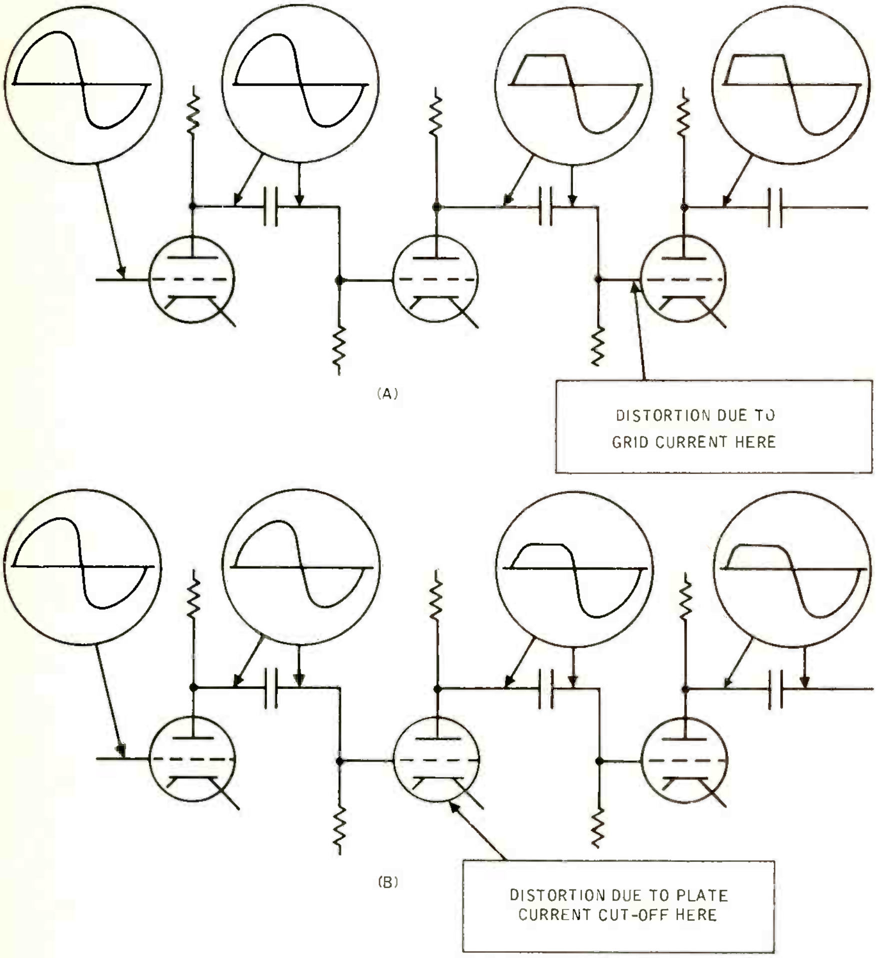

Fig. 14-1. Deductions from stage-by-stage waveform measurement. At (A) the distortion first shown between the 2nd and 3rd stages is due to grid-current loading by the 3rd stage. At (B) a quite similar (but not identical) effect is due to curvature (approaching cut-off) in the 2nd stage.

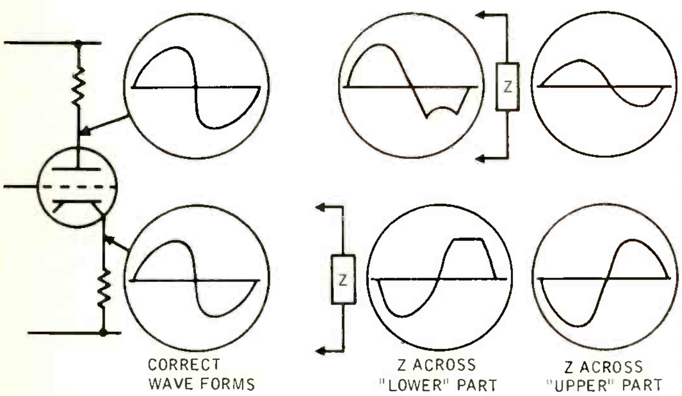

Fig. 14-2. Some of the peculiarities that may show up in measurements associated with split-load phase inverters (here shown with tube). In each of the pairs of waveforms, center and right, the "Z" represents the location of the measuring instrument (voltmeter, scope, or both), while the waveforms are those at both places while the instrument is so connected.

All the measurements discussed in earlier installments concern complete units of equipment: we have not discussed the making of measurements where you have to get "inside" an item of equipment, for either service or development purposes. Yet both of these uses are important in audio work.

Measurements on the old-fashioned tube amplifiers were relatively simple, although some erroneous conclusions could be drawn even there from incorrect interpretations of the voltage indications observed, using either a voltmeter or a scope. But the transistor circuits multiply the possibility for such misinterpretation, which is one reason why transistors took so long to find extensive application in audio work.

Voltage Readings, Tubes and FET's

We shall regard tubes and FET's (*F*ield *E*ffect *T*ransistors) as essentially similar, because for measurement purposes they have both the same kind of characteristics. Both are essentially voltage amplifiers, or devices in which the controlling input signal is a voltage rather than a current.

The kind of mistakes sometimes made are obvious—once you have either made them and found your own

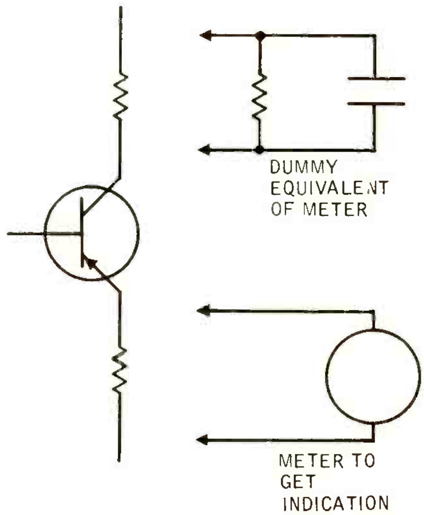

Fig. 14-3. If duplicate identical instrumentation cannot load both outputs of the split-load inverter identically, use a dummy, so the loading is identical while each measurement is made. Only one measurement (across emitter half of load) is shown here. Reverse places to measure other half.

mistake, or else had them carefully explained to you. Two examples will illustrate. The first relates to finding out where distortion occurs in a multistage amplifier (*Fig.* 14-1). Checking waveform at various points through an amplifier shows that flattening first occurs at a certain point.

The logical—obvious, but often erroneous—deduction is that the distortion occurs in the stage between the latest point where no distortion is indicated and the one where it first appears. Quite often it is not in this stage at all, but the one following it is the cause. In tube circuits, grid-current loading will flatten the output of the previous stage, although without this loading it would show no distortion at all at this point.

On the other hand, if the distortion is due to cut-off, rather than saturation (grid saturation), the reverse situation applies: the distortion will show following the stage running into cut-off, not before it [(B) in *Fig.* 14-1].

The other frequent cause of error in simple amplifier measurements concerns phase-inverter balance (*Fig.* 14-2). Voltmeters and scopes used nowadays have high input impedances, that do not appreciably load the circuits to which they are connected. But they may have a capacitive input, if only due to the shielded input lead, that produces an effect that is not quite negligible.

Several things can happen. First the loading caused at high frequencies may destroy balance at those frequencies, although such loss of balance does not occur until the external load (due to the measuring device) is connected. This may have a greater effect on one half of the push-pull than the other, due to asymmetrical internal impedance, and thus cause an indicated lack of balance that does not actually happen until the voltmeter or scope is connected.

Also the instrument loading may unbalance the circuit to a point where the "other half" of the load reaches saturation and reflects a change of waveform into the measured half that does not otherwise occur. The best way to guard against these misleading indications is either to use identical instrumentation to measure both sides of the inverter output simultaneously, or to make up a simulated input circuit, so each can be measured with the "other side" similarly loaded (*Fig.* 14-3).

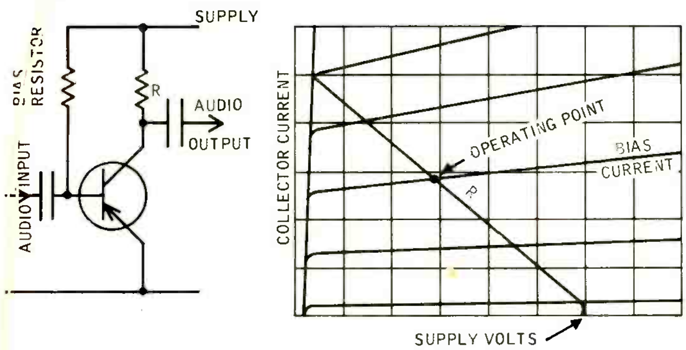

Fig. 14-4. Checking a single transistor stage, the audio performance will verify prediction from the load-line construction quite closely.

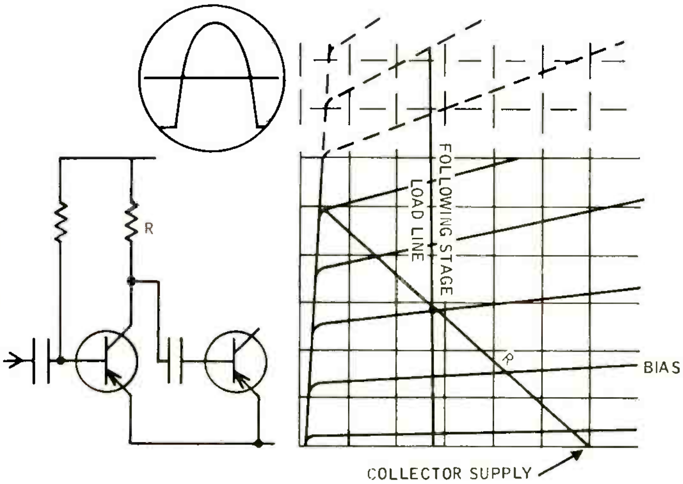

Fig. 14-5. Now couple the following stage, and the condition changes, as partially explained by a new load line.

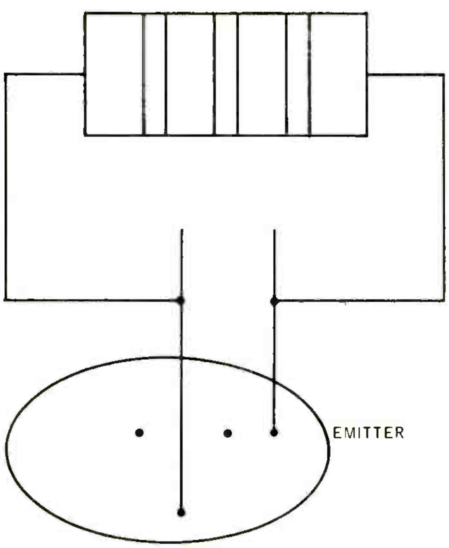

Fig. 14-6. Use a linear resistance of approximately the same average value of the following-stage base resistance, to predict effect of loading on the first-stage output.

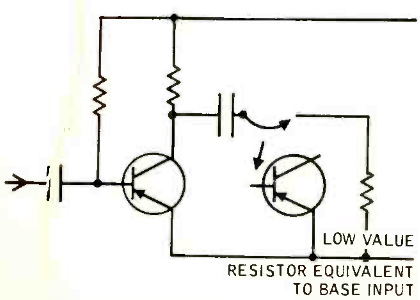

Fig. 14-7. A simple way to make the substitution in the following stage.

Current Amplification, Transistors

Those things, and more like them, are "old hat" to most readers. Now we turn to the problems that only begin to show when we start using circuits primarily built around current amplification, with transistors. If you just dive in and start making waveform and voltage measurements, the results may be very puzzling at first. To make the picture clearer, we'll assume you are starting from scratch, because it's easier to understand that way.

Suppose you are checking out a simple amplification stage (*Fig.* 14-4). Bias is chosen to ensure maximum available swing in each direction, so the collector voltage is approximately half the supply voltage, and an input resistance may be used to simulate the driving impedance of a preceding stage. The previous stage, we'll presume, behaves according to prediction —it probably will.

Now we couple the next stage (*Fig.* 14-5). Three things may now happen: first, the voltage swing disappears, because the following stage loads the collector circuit right down; second, what voltage is left is quite distorted, mainly because the input resistance of the following stage is quite non-linear (even when its amplification is linear); and third, it may be found that the first stage is running into overload at an input level considerably lower than it could handle successfully before the second stage was coupled.

To check, approximately, the true performance of the first stage when loaded by the second, either the current delivered to the second stage must be measured, which is never as easy to do as measuring voltage and its waveform; or the voltage can be measured across a linear resistance of approximately the same value as the average input resistance of the following stage (*Fig.* 14-6).

If plug-in transistors are used, inserting of such a substitute resistor value for measurement can readily be achieved by removing the transistor and pushing a pair of wires (of the same gauge) cut from new transistors, into the base and emitter sockets. To these wires an appropriate low-value resistor is soldered, across which the waveform can be measured (*Fig.* 14-7).

This measurement will separate the three effects for ready analysis. Both voltage swing and current swing can now be determined at this point. Voltage swing is measured directly, but means little, because the linear resistance across which it is measured is in reality a substitute for a non-linear resistance which will change both the value and magnitude of the voltage waveform. But the waveform across the substitute resistor will be reliable indication of current waveform, and its magnitude can be calculated from the resistance value used.

If the loading down by this low input resistance representing the following stage asymmetrically increases current swing of the stage being measured (*Fig.* 14-5), this will allow excessive level and/or distorted waveform to occur at this point, which can be observed across this substitute resistor. Where this occurs, the original current swing (without the loading) can be restored by changing the collector resistor R so collector voltage is much lower, but the same current swing is available (*Fig.* 14-8).

Usually the collector resistor needs to be almost double, but the bias remains almost the same (in current). However, an improved way of obtaining it is to employ voltage feedback, which controls voltage of the operating point without causing appreciable *current* feedback (*Fig.* 14-9). The bias resistor will need to have about 1/10th the value needed for the condition of *Fig.* 14-4.

Putting Stages Together

Operating individual stages under independently simulated conditions, both for source and load resistance, can take a big step toward securing correct operating conditions throughout a multistage amplifier. But things can still happen when stages are connected together that do not show up when the stages are checked separately. This may not seriously invalidate the over-all projected performance, but is far more likely to do so where feedback parameters are involved.

Individual stages can be checked for current gain, available swing, and the cut-off points of coupling networks by this substituted-load process. Tolerably linear values, such as collector-circuit resistances, are arranged to swamp the effects of non-linear resistances, such as base inputs. If necessary, emitter resistors can to some extent linearize effective base input resistance (*Fig.* 14-10) by adding an approximately linear value found by multiplying their actual value by the working current gain of the transistor.

So far, so good, but now, when you put the whole thing together, the total response is *not* the sum of its parts. Maybe the mid-band current gain adds up nicely, but the frequency turnovers on which the feedback stability or over-all effect is based don't add up so nicely.

This is because transistors reflect impedance both ways, as well as contributing current and voltage gain. For the emitter-follower (common-collector) stage, this reflection is fairly simple and predictable: impedances, including resistance and capacitance (or inductance, if present) effects are multiplied or divided by the operating current gain of the stage (*Fig.* 14-11). This can be checked by impedance measurement, each way *Fig.* 14-12).

There are limits to which this reflection effect follows with any accuracy, even in an emitter follower, which coincide reasonably well with the limits at which its current gain begins to change. This too is fairly predictable and verifiable by measurement.

But most amplifier stages use the common-emitter configuration, which alters the picture. In this mode, the input resistance is lowest when the output load is highest (voltage swing highest) so as to approximate constant-current output (voltage rather than current output). When the output is loaded down so output voltage no longer swings, but there is a maximum output current swing, the reflected input impedance is much higher.

This means that output load reflects into the input circuit as an inversion:

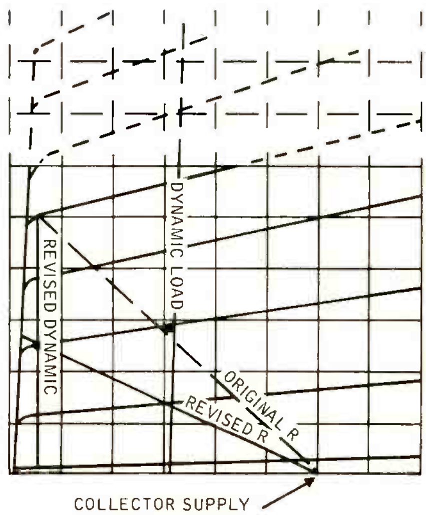

Fig. 14-8. Changing the collector coupling resistor to get back to the proper conditions, when the following stage is coupled. Dashed lines show the condition of Fig. 14-5 repeated for comparison with the revised condition, in solid lines.

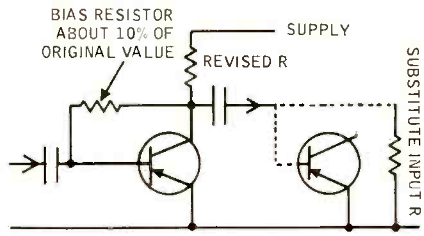

Fig. 14-9. A better way of deriving bias, (one that provides voltage feedback), to stabilize the working position shown in Fig. 14-8, without producing appreciable current feedback, in the output-loaded-down condition.

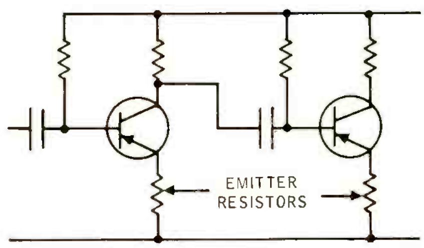

Fig. 14-10. Including emitter resistors to stabilize, or linearize, the base-input resistance reflected to the previous stages.

D-19E/200

D-19E/200 is a cardioid microphone for high quality recording and sound reproduction, and provided with bass roll-off switch for exceptionally clear speech intelligibility and excellent output for above average "reach." It features effective front-to-back discrimination and a non-metallic diaphragm—preventing popping and harshness on close-ups.

TECHNICAL DATA

Frequency range	40-16,000 cps.
Frequency response	± 3 db
Sensitivity	— 53 db
Impedance	200 ± 20%
Dimensions	$7\frac{1}{8}$" long by $1\frac{7}{16}$" diameter
Weight	7 ounces

Here are two economical microphones for a variety of recording, broadcast and public address applications. An accessory W-24 Windscreen is available for the D-19E/200; also fits the D-24E microphone.

Truly noise canceling, the D-58E microphone is the ideal choice for sportscasts, industrial uses or any similar noisy environment.

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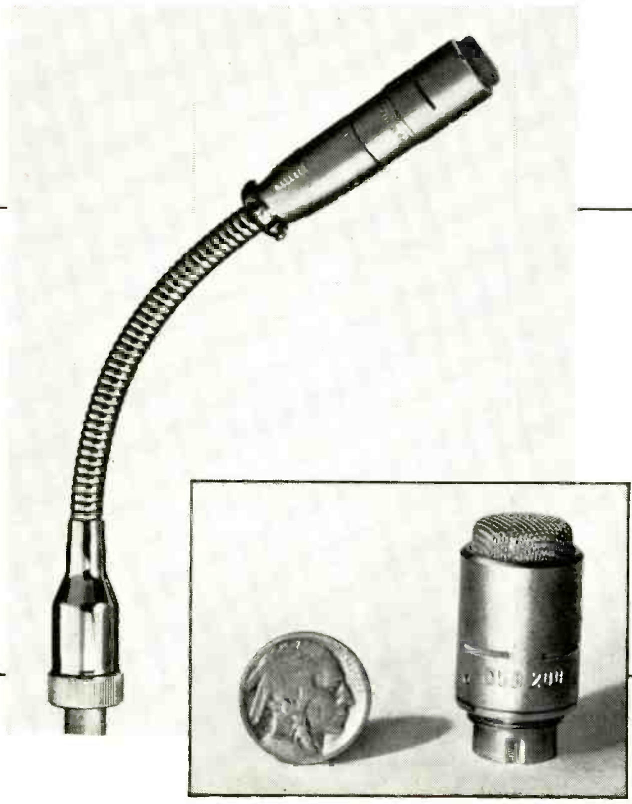

D-58E

D-58E is a noise-cancelling microphone limited to the speech range and offers crisp, clear speech reproduction, for maximum intelligibility. It effectively discriminates against any sound originating beyond 5" from the microphone.

TECHNICAL DATA

Frequency range	70-12,000 cps.
Sensitivity	— 58 db
Impedance	200 or 60 ohm ± 15%
Dimensions	$1\frac{5}{8}$" long by $1\frac{13}{16}$" diameter
Weight	1.1 ounces
Goose neck	8" or 20" length (optional)

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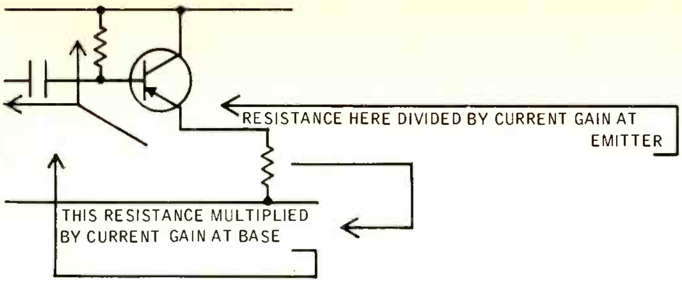


Fig. 14-11. In an emitter follower, resistances and impedances are reflected both ways, multiplied or divided by the working current gain of the stage, with considerable faithfulness.

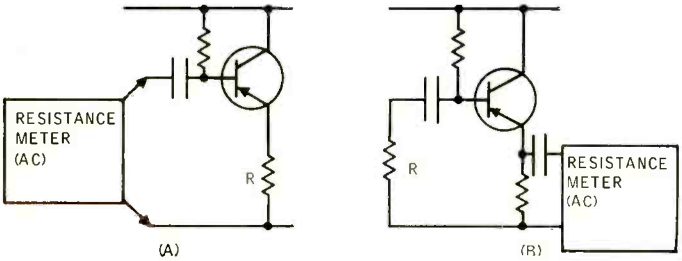


Fig. 14-12. A method of checking the results predicted in Fig. 14-11 by actual measurement. The resistance meter should measure a.c. resistance and in (B) provide a current path. In each case, the resistance meter will measure the reflected value change when the real value R is changed.

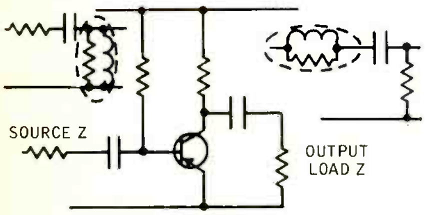


Fig. 14-13. Equivalent circuit reflection with common-emitter stage. The inset schematics represent the equivalents for the circuit in that "side" of the stage. The elements in the dashed lines are those representing reflected values from the other side.

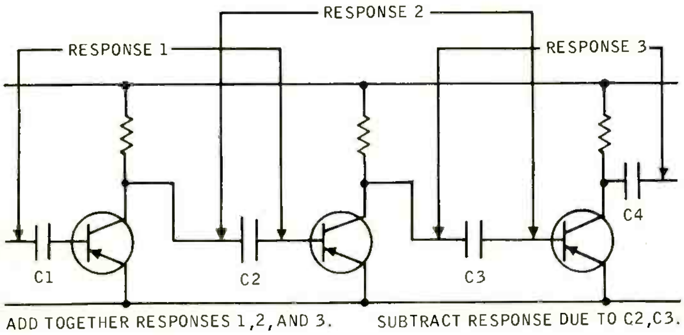


Fig. 14-14. For reasonable prediction, each stage should be measured with both coupling elements included (responses 1, 2, and 3). When adding the results together, the duplication must be eliminated by subtracting the effects of C_2 and C_3.

high value reflects as a low value, and inductance looks like capacitance, and vice versa. A series capacitor (coupling) reflects an impedance component similar to shunt inductance, and so on. The same thing happens in the reverse direction, to reflected collector impedances, due to actual base-circuit elements.

The equivalent circuit makes it look as if resonance, in either base or collector circuit, if not both, inevitable (*Fig.* 14-13). But the relative values preclude actual resonance effects. The reflected elements (in this case inductive, due to actual capacitance) are invariably of changing magnitude equivalent to an inductive reactance that does not represent a simple inductace value) and always of an order well removed from resonance, so they merely effect a progressively changing effective value for the actual circuit capacitances.

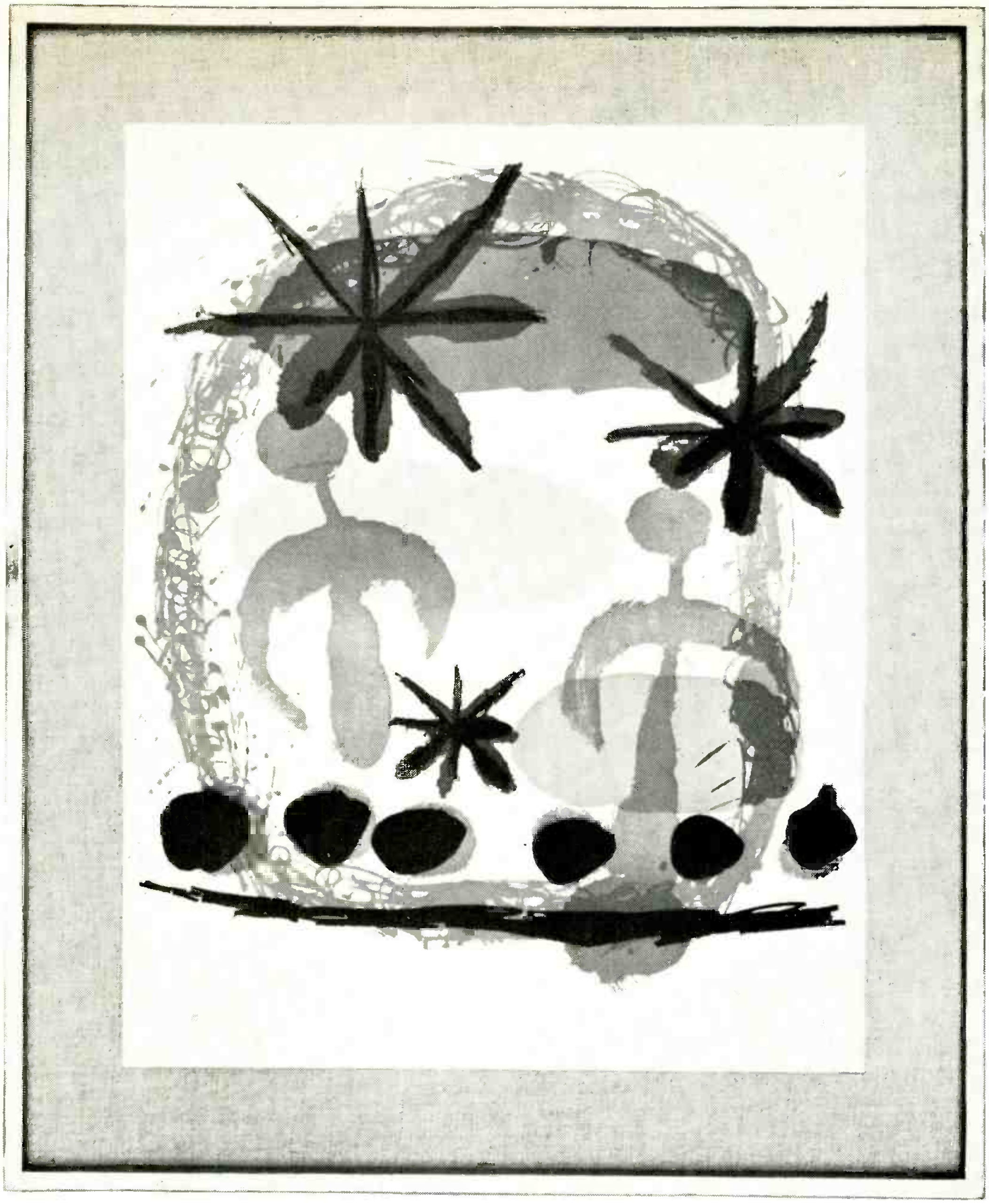
If prediction is attempted in any terms at all, it should be on the basis of magnitude and phase response, rather than on equivalent circuit values, which are continuously changing with frequency. A careful series of measurements on a stage-by-stage basis can help "put the circuit together" but the prediction is limited, because stages can only be measured integrally: each with both of its equivalent coupling elements; when the whole circuit is "put together," each coupling element is present in relation to both the stage preceding it and the one following it.

If, from the measured stage-by-stage responses, added together, the theoretical effects of the individual coupling networks, which are thus included twice each (except the first and last) as part of the preliminary measurements, are subtracted from the whole, an approximation close to the true over-all effect will be predicted, on which over-all feedback parameters can be later figured (*Fig.* 14-14).

Even then, the over-all effect may differ from prediction, as more feedback is applied, because the relative input and output levels are changed at the couplings to those stages, so the response contributed in the presence of feedback differs from that contributed by the same elements in the absence of feedback, or with less of it.

This whole procedure, to be effective, requires close working between measurement and calculation at every stage, to approach a practical operating circuit design. In the next installment we shall pursue this further, by detailing some practical feedback "cutting and fitting." Æ

"CONSTELLATIONS" by Miro.
An original lithograph, 30/150, hand signed by the artist. From the collection of James B. Lansing Sound, Inc.



Art as the dimension of imagination.

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Equipment Profile

Addition

Too late to do anything about it we discovered that the last line of the Profile on the Shure V-15 II was left out. The Shure is a lovely cartridge and what was intended was *"That says a lot and it says all that needs to be said."* Ed.

H. H. SCOTT S-11 SPEAKER SYSTEMS

Scott has been in the business of manufacturing speaker systems for some time now. Our previous investigations have shown that they have been highly competitive in their respective price categories. This newest sample is intended as the top-of-the-line model.

The S-11 is a three-way system employing three separate drivers. It is contained in a walnut enclosure that measures 14½ by 24 in. with a depth of 11½ in. This is the large end of what has come to be called "bookshelf sized." The cabinet is attractively finished on all four sides so it may be used either in an upright or reclining position. At the rear are the knurled-nut connectors and a three-position treble-tilt switch.

The woofer is 12 in. in diameter, is highly compliant, with a long voice-coil throw. This combination is best handled with acoustic suspension and that is what Scott has done.

Two smaller cone speakers disperse mid-range and high frequencies. The driver configuration when the unit is standing tall places the woofer on bottom, the tweeter in the middle, and the mid-range unit toward the top. Even though the woofer and mid-range are thus placed far apart, we were unable to detect any tendency for sounds such as voice to separate into parts. In fact, we were pleased by the excellent blending.

When we first played music with the S-11's we were strongly impressed by the clarity of reproduction. This favorable mark only increased as listening time wore on. These Scotts are as clear a musical sound as we would want.

The testing of speakers remains a highly subjective business. While we can (and do) check frequency response, transient response, and harmonic distortion we find only partial correlation between what our calibrated microphone (a special Syncron S-10) hears and what musical listening tests reveal.

Frequency sweeps were unusually smooth over the entire range of the system. It is flat from mid-range ±5 dB to 48 Hz with usable response extending easily to 36 Hz. At the upper end our ±5-dB tolerance gave us response beyond 20 kHz where our microphone calibration ends. Significant rolloff appears to begin above 22 kHz. All of this is well beyond what our ears know.

Transient response is quite sharp with little hangover. Harmonic generation is extremely low down to 100 Hz rising only to moderate levels an octave lower.

This gives some clue to the *pleasure* we experience in listening to the S-11 systems. But only a *small* clue. We've mentioned the clarity, there is also the over-all balance. There is perhaps a slight tilt in favor of the middle highs (something that is also partly characteristic of our listening room) but it was not at all objectionable. Quite the contrary, it imparted a degree of forward "up-close" projection that was "right."

At our first listening, the bass end seemed rather unpretentious. It took a bit of listening to reveal that it *is* all there; it's just not out of proportion to the rest of the balance. You won't hear bass you are not supposed to hear.

Perhaps we could have wished for greater control of highs than the three-position switch allows. At 10 kHz there is about 3 dB of boost or cut if the switch is moved from its normal position. In most rooms this is really enough to compensate for over- or under-furnishing. But an extreme case could be beyond the adjustability of the system leaving a somewhat bright or dull sound remaining. Since the S-11 is leaning toward the bright side itself we suspect that the only real difficulties would ensue from use in a tiled-floor and wood-panelled room that was also rugless and sparsely furnished. Since that is a pretty tough environment for any speaker we cannot criticize Scott too greatly.

The S-11 is $149.95. Twice that will deliver a stereo pair that will do justice to the finest sound source. We would like to think that we are quite fussy about the kind of sound we want. Certainly these Scotts fulfill our demands without need of qualifications. So, if you seek the best possible sound and also a compact speaker system, then the Scott S-11 is likely indeed to fill the bill.

Check I

DEPARTMENT OF (FURTHER) AMPLIFICATION

In January we published an Equipment Profile test report on the Marantz Model 15 solid-state power amplifier. Shortly after the report went to press, we found that our IM test setup was incorrectly calibrated. After calibrating and improving the distortion of our generators we re-tested the Marantz Model 15, which, fortunately, we were still holding. The differences between the second evaluation and the one reported in January were of such magnitude as to warrant this additional report.

For one thing, the schematic has now been made available for publication. Since the Model 15 is actually two separate amplifiers, with two separate power supplies, only one amplifier of the stereo system is shown. Note that we made an error of assumption in the first report. The lamps that indicate a shorted condition of

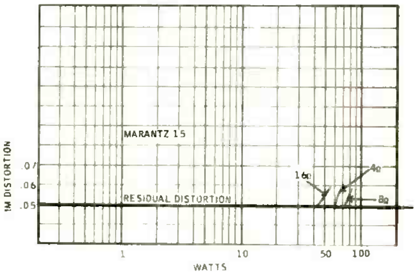
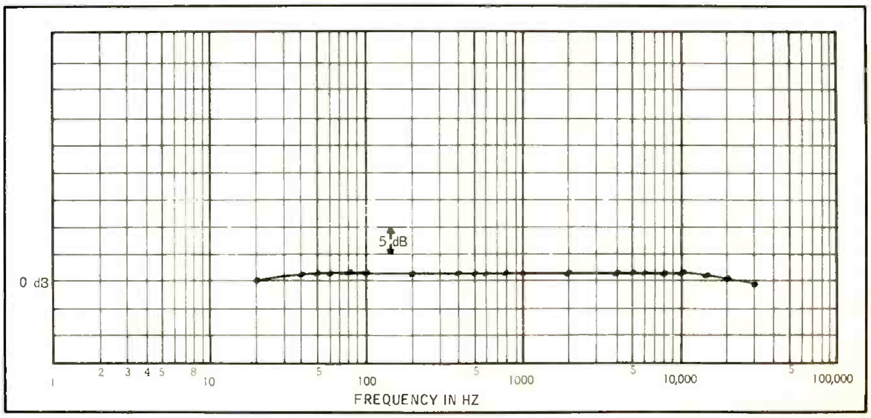


Fig. 1. IM distortion of the Marantz. Note that the residual distortion of the test set-up is shown. With 8- and 16-ohm loads we could only drive the amplifier out of the residual by pushing it well beyond the rated power.

Fig. 2. Below is the power response of the Marantz 15 amplifier. 0 dB = 65 watts across 8 ohms. The manufacturer rates the amplifier as a 60-watt performer.



THIS BOOM MICROPHONE IGNORES EVERYTHING ...EXCEPT THE DIALOGUE

Consistency of sound track quality on an endless variety of locations and sets can be dramatically improved with the remarkable Shure SM5 Boom Microphone. It "hears" the dialogue rather than the ever-changing character of the surroundings.

Because its cardioid directional pattern is uniquely uniform with frequency and symmetrical about its axis, the SM5 is singularly independent of the effects of environment. Even in extreme shooting situations (such as with tight sets, low ceilings, hard walls, low microphone angles, traffic or air conditioner noise and rumble, and changing distance) the SM5 minimizes sound coloration and ambient noise pickup. Equalization changes—on the set or in transfer—are seldom, if ever, necessary.

The highly effective attached windscreen completely encloses the two-stage mechanical filter, so that there are no external "rubber bands" for the wind to "strum." The absence of response-correcting inductors or impedance transformers assures freedom from hum.

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For additional information, write directly to Mr. Robert Carr, Manager of Professional Products Division, Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois.

SHURE SM5

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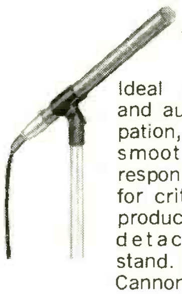

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MODEL SM50 OMNIDIRECTIONAL DYNAMIC

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the output are not part of the fast protective circuit, though they do dissipate the excess power, due to the shorted condition (that otherwise would have to be dissipated in the output power transistors). An electronic circuit employing Zener diodes and transistors in a switching configuration is the fast acting safety device that protects the output and driver transistors.

The schematic shows the delay system used to prevent any turn-on thump in the speakers. A very good feature, we think.

We could not find an instance, again, in which the amplifier did not exceed the manufacturer's published specifications.

Marantz has not published specifications for IM distortion. The results we found and published in January, we thought superb. But we have found as we said that the curves published then were in error. The new tests showed readings that were identical to the residual of our meters up to the rated power of the amplifier for each of the 3 impedance loads. Note that the residual reading of our test setup was 0.05 percent. IM at 4 ohms (the worst case) was 0.06 percent at 70 watts. Below that power level it dropped rapidly to the test set up residual distortion. (See Figure 1) so, while we cannot call the Model 15 a distortionless amplifier, we can say that we are unable to measure it.

There was an error in the illustration of power response. A corrected version appears as Figure 2. We did not intend to imply that the amplifier will not deliver (as the illustration showed) its full rated power over the 20-20,000 Hz range.

Fig. 4. The compact Wharfedale W-20 speaker system.

This is a great amplifier; one of the best we *ever* tested. It is superb-sounding too, and it seems to be indestructible. Neither short, nor open, nor capacitive loads disturb it in the slightest. Overload recovery, even after a direct short, is virtually instantaneous.

At a price of $395.00, the Marantz Model 15 is for those seeking a stereo amplifier representative of the best that there is. Check 2

Wharfedale W-20 Speaker System

Bigger sound seems to be getting smaller and smaller these days. At least that is the conclusion that can be drawn from this tiny pair of speakers from the venerable house of Briggs. The Wharfdale W-20 is all of 14-in. wide, 9¾-in. high, (or you can turn it on its side) and 8½-in. deep. That is bookshelf-sized by anybody's standards.

Speakers are meant to be heard—so we've given these W-20's a lot of listening. We brought other knowledgable ears into our listening room; they were consistently fooled into believing that it was other (larger) speaker systems that they were hearing. That kind of sound *can't* come out of that size box.

Let's forget about that tired phrase, "good for the money." That gives you little idea of the *actual quality* of a product. (After all, a twelve-inch speaker that sells for $4.95 might be surprisingly good value as a replacement speaker but it could never qualify as a "hi-fi" speaker; not as we understand "hi-fi.")

The W-20 *is* good value, no doubt about that. But more important, it is a *musically listenable* speaker. That has nothing to do with its cost which is all of $49.95. Of course, simply the fact that you can begin to consider a speaker in that category as musical is quite remarkable.

The sound is quite wide range, particularly in the bass. No artificial boom, but good solid fundamental bass. The high end too, is well out there and in good balance. There is a rear-panel tweeter control (this is a two-way system) that will tailor the top end to room acoustics. The all-important mid-range is perhaps a bit rough. Not harsh or spitty—just lacking that silky smoothness that we demand from the finest speaker systems.

The Tests

Calibrated microphone tests run out-of-doors indicate some of the reasons for this speaker's qualities. Bass response goes well down to 50 Hz. Below that it just keeps going down into silence. The mid-range shows minor swoops and dips from 2-6 kHz, then smooths out again and continues out to about 14 kHz where it begins to sharply drop off.

Efficiency is low. These are speakers that are best driven from an amplifier capable of 18 or more watts per channel. This, we suppose, is the price that must be paid for the extended bass response. There is a good musical balance here. The overall effect, therefore, is that there is more extended response than actually exists. This is one reason, we believe, for the satisfaction we feel with these little units.

In fact, we are overjoyed with them. They represent a genuine value in a truly small speaker. Certainly they are not the last word in musical realism but they do present a good simulation. We can, therefore, in all good conscience suggest that the Wharfedale W-20 is recommended for whatever use you may have. Check 4

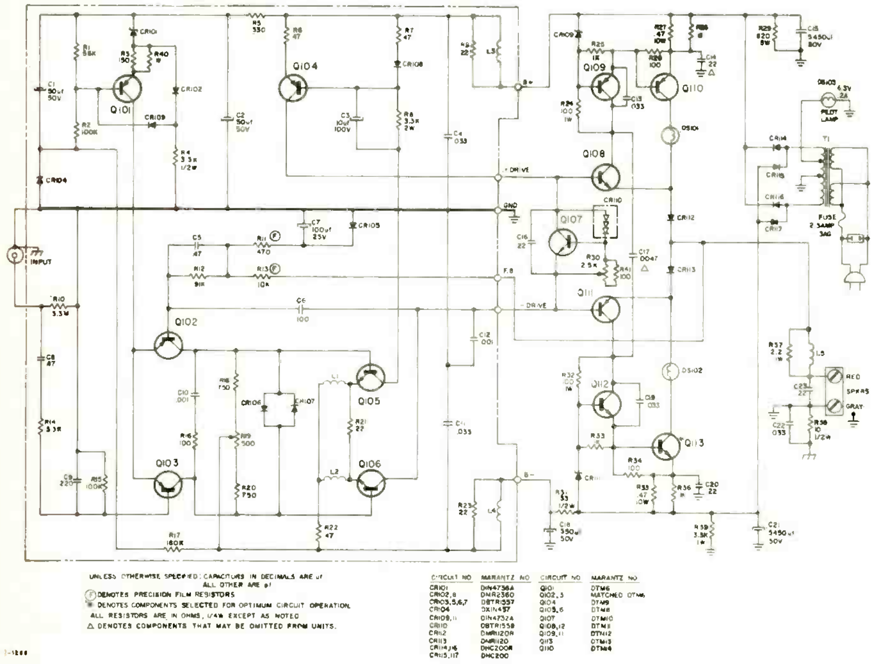

Fig. 3. This schematic represents one complete half of the stereo Marantz 15.

Meet the Mediterranean, the speaker she won't have to hide to enjoy.

Here at last is cabinetry she can revel in. Rich. Striking. Its deeply grained exterior hand-rubbed to a mellow butternut finish . . . accented with antique hardware. And inside . . . the finest 3-speaker system with Sonic-Control. But let her see it, hear it for herself. It's Mediterranean — the one both of you can live with — on demonstration now at University dealers everywhere!

SPECIFICATIONS: 12" ultra-linear woofer, 8" solid-back mid-range, reciprocating flare horn tweeter — 20 Hz to beyond audibility — 50 watts IPM (Music Power) — 8 ohms — 1/4 and 1/2 sections, 6 and 12 db/octave electrical network — 800 and 5000 Hz crossovers — continuously variable Brilliance and Presence controls, 3-position variable bass switch—24⅜" dia., 22½" high—Shipping weight, 74 lbs.

Desk C-73

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A DIVISION OF LTV LING ALTEC, INC.

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Check No. 134 on Reader Service Card.

Tape Guide

HERMAN BURSTEIN

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

Q. My tape recorder has a signal-to-noise rating of 38 dB based on "normal maximum record level." A similar machine of another make claims a ratio of 56 dB. Can there be this much difference, or how may I reconcile the two claims?

A. The answer depends on how much distortion is produced when your machine is operating at "normal maximum record level." I might guess that the distortion is 1 per cent, in which case the signal-to-noise ratio would be about 44 to 46 dB with reference to a recording level that produces 3 per cent distortion. I get this by adding 6 to 8 dB to the 38-dB rating. However, if "normal maximum record level" produces less or more than 1 per cent harmonic distortion, then the signal-to-noise ratio (referred to 3 per cent distortion) would be respectively greater or less than 44 to 46 dB.

Q. Several months ago I recorded some discs on tape at 3.75 ips, quarter-track stereo. After about seven months of playing, these tapes, of double-length polyester, started giving me trouble. I can hear the tracks adjacent to the ones I am playing. I think this is called reverse channel spillover. If this is due to misalignment of the heads, why don't I have the same problem with tapes of conventional thickness? If the trouble is misalignment, can I realign the heads myself?

A. If you are experiencing "spillover" only with thin tapes, it may be that the extraneous sound is not the reverse channel but is print-through of adjacent layers of tape. The thinner the tape, the greater the print-through. Also, print-through increases with storage time, so that it may be unnoticeable immediately after recording but quite noticeable later on.

To align your heads vertically, you can use either an alignment tape or a substance called Magna-See which enables you to see the recorded track on a tape and thereby tell whether the track spans the proper part of the tape. However, moving the head vertically may impair the azimuth alignment, and accordingly you will also need an azimuth alignment tape. I think your best course is to have a competent tape recorder service agency check the vertical alignment.

Q. I am looking for a circuit for a "transistor line transformer" to feed a 50- or 250-ohm mike output into a 50K or 100K high impedance input. This circuit would use a silicon planar transistor and would have to be equal to or superior to the finest mike transformers available. Enclosed is a circuit from a G.E. Transistor Manual. I have constructed two of these but have found that with 40 to 50 feet of mike cable the r.f. and hum pick-up are intolerable (the circut shows an unbalanced — two terminal — input). Can you suggest a high-quality, no-compromise circuit?

A. Circuit design is outside the scope of the TAPE GUDIE column, and I don't have the temerity to try to improve on a G.E. circuit. However, I am not sure that the answer to your problem lies in a better impedance conversion circuit. First, one may question the wisdom of circumventing a microphone input transformer. The transformer permits you to balance out hum through a balanced line connection (center tap of the transformer primary is connected to ground). It is quite possible for a high-quality transformer to give you as good frequency response and as low distortion as your transistor circuit. In other words, I am questioning the idea of transistorization for it's own sake.

Second, your manner of connecting the microphone to the transistor circuit may be accounting for excessive hum and r.f. pick-up. I suggest that you try all possible ways of connecting the microphone shield cable: to one of the hot microphone leads; to the other hot lead; grounded at the transistor circuit end; not grounded at the transistor circuit end; and so on. Make sure that the shield is grounded to the microphone casing.

Q. For the purpose of braking the supply and takeup reels, is it feasible to stop the motors by changing the a.c. to d.c., instead of using mechanical braking? I have heard that this is done. What type of motors are used, and how is it done?

A. The current general practice is to use mechanical braking. However, I understand that in the past some machines have used electrical braking as you describe, and that a very few still do. I believe that a d.c. voltage from about 24 volts upward is momentarily applied to the motors. If this voltage is applied too long, the motor will begin to smell and may burn out. The d.c. is obtained by rectifying the output of one of the secondary windings of the power transformer and using a dropping resistor of appropriate value. I do not have information on specific circuitry or motors suitable for this method of braking. You might look through manuals of tape recorder schematics until you come across a machine that uses d.c. braking.

Q. Recently I received a Wollensak half-track stereo tape recorder. I would like, however, to take advantage of the many quarter-track tapes on the market. Specifically, my questions are:

1. *Nortronics makes a half-track to quarter-track replacement kit for my machine. Could I bypass the electronics in my machine and use the tape-head inputs of my audio amplifier? This would permit me to use the speakers of my audio system instead of the tape machine's speaker.*
2. *Are there any small recording amplifiers that I can use to record stereo? My machine cannot presently record stereo.*

A. If your external amplifier has inputs specifically intended for tape playback heads, you should be able to make a direct connection from your quarter-track stereo head directly to the amplifier without undue difficulty. Use as short a shielded cable as feasible, route it carefully away from sources of hum such as motors and transformers, and make sure the cable has relatively low capacitance (about 25 to 30 μF per foot).

For recording purposes, today there are relatively few makes of tape electronics that you can purchase separately. Consult Nortronics as to what they make. They do have circuit information sheets. Also check the catalogs of mail order houses such as Allied Radio and Lafayette. I doubt that you will find electronics purely for recording; the electronics will probably have provision for both recording and playback. It will be necessary for you to make appropriate adjustments in this electronics, using the controls provided, for bias current, for recording current, for erase current, and for record-level indication. While the manufacturer of the tape electronics will of course supply instructions for making these adjustments, it is often necessary to have instruments in order to achieve optimum performance.

Q. I have two tape recorders. When a tape recorded on one machine is played on the other, the resulting sound is fuzzy (distorted), and there is a definite loss of highs. Tape sounds fine when played on the same machine used for recording. I assume this is due to different azimuth positions of each machine's playback *head. I have a VTVM, 'scope, and audio generator. So I can make a test tape on one of the machines, which has separate record and playback heads, and adjust the playback head on that machine and on the second machine for maximum output. What frequency shall I use on the test tape? With this procedure, everything is adjusted to the record head on one of my machines. How can I be sure this is OK, since commercial tapes will be played?*

A. The proper procedure is to use a commercial test tape having an azimuth alignment tone in the range of 10,000 to 15,000 Hz. 15,000 Hz is preferable. In the case of your three-head machine, align the playback head for maximum output when playing the test tape. Then simultaneously record and play a 15,000-Hz tone, and adjust the record head for maximum output in playback. In the case of your two-head machine, simply adjust the record-playback head for maximum output when playing the test tape.

I don't know whether correct azimuth alignment will remove your distortion problem. It is conceivable that poor motion (flutter) is producing distortion, but tends to cancel out when a tape is played on the same machine on which it was recorded.

Q. Regarding comparative measurements of tape noise, I recently saw a reference to "third-octave noise." Can you tell me what this means, or refer me to some literature? Also, are tape noise figures commonly stated on an unweighted or weighted basis?

A. In some measurements of the noise of a tape or tape machine, it is desired to ascertain how noise varies with frequency. Measurements are taken of noise at selected bandwidths, so that one-third of an octave is measured at a time. An illustration of such procedure appears in "A New Magnetic Tape with Greater Dynamic Range," Preprint No. 290 of the Audio Engineering Society, Box 383, Madison Square Station, New York, N. Y. (price 85c).

Noise figures for tape machines are commonly stated on an unweighted basis. However, the human ear is more sensitive to high-frequency noise than to mid- and low-frequency noise, whereas a good meter will give equal weight to all noise frequencies. Therefore in order to obtain measured results which accord with subjective results, a high-pass filter is sometimes employed to remove the obscuring effects of hum and other low frequencies.

Answer to Cover Quiz

1. F. Schubert; 2. J. Haydn; 3. W. A. Mozart; 4. R. Schumann; 5. L. v. Beethoven.

sound&sight

HAROLD D. WEILER

While many different methods may be employed to analyze, adjust, and evaluate the various components employed in video recording and closed-circuit television systems, the examination of a properly lighted test pattern, such as that illustrated in *Fig.* 1, displayed on a standard video monitor of known quality, is probably the simplest and most effective for general purposes. These two devices will provide a quick and accurate means of determining over-all performance, comparing equipment, checking and making adjustments, and diagnosing many of the problems which may be encountered in video components and installations. Problems in bandwidth, over-all frequency response (r.f., i.f.. and video), phase shift (streaking), shading and contrast of horizontal and vertical signals, as well as focus, centering, aspect ratio, linearity, and distortion can all be interpreted from a test pattern.

A test pattern of the type shown may be obtained from the Electronic Industries Association in Washington, D.C. When a high-quality monitor of the type shown in *Fig.* 2 is employed, any deviation from the normal pattern may be caused by the camera, the transmission system (coaxial cable and/or connectors), the video recorder, or the monitoring equipment employed in the installation. To be certain that this test system is always capable of providing a visual facsimile of the actual signal on the transmission line the monitor employed as a standard should be periodically checked with a high-quality video camera.

If you are to employ successfully the combination of a test pattern and a standard monitor for signal analysis, evaluation and diagnosis you should be familiar with the appearance of an unimpaired video signal. You should also know the various deviations from the normal image created by camera misadjustment or defects, problems in the transmission system, video recorder or in the display monitors included in the installation.

When inserted into a system which is operating perfectly, the standard video monitor should display a test pattern similar to the original. The pattern illustrated is free of discernable defects as indicated by the fact that circles are round, straight lines are straight and that there is a complete range of ten individual gradations of shading between the black and white picture elements.

The first step, in employing this test system is proper "set-up." The test pattern should be mounted on a wall, the camera on a tripod. Both should be in such a manner that the pattern can be centered on and perpendicular to a line through the camera lens axis. The exact distance between the test pattern and the camera is dependent upon the focal length of the lens employed and the physical size of the test pattern itself. Most vidicon cameras used in video recording and closed-circuit television, today, employ a lens with a focal length of 25 mm. for general purpose applications. In this event the correct distance between the test pattern and the focus ring of the camera lens is approximately double the *measured* width of the test pattern. The lens focus ring should be set at the actual *measured* distance between the pattern and the focus ring for the best resolution. The test pattern should be illuminated by a 100-watt lamp in a reflector, mounted about five feet from the test pattern (behind the camera).

The camera, equipment under test, and the standard monitor should be allowed to warm up for at least five minutes to ensure stability. The camera should then be moved slightly closer to or further from the test pattern so that the picture limits (the small white wedges at the borders of the pattern), just touch the edges of the monitor tube mask. The camera and other equipment controls should then be adjusted to provide an optimum picture as described in the individual manufacturer's instruction books.

The first test usually made when evaluating or adjusting video equipment is to determine resolution. The resolution of equipment determines the amount of discernable detail displayed in the picture. A picture which is sharp and clear and on which minute details are easily discernable has good or high resolution. When the picture is blurred, soft, and the smaller details are indistinct, it is said to have poor or low resolution.

Most scenes in addition to the brightness gradations in a horizontal direction also have brightness gradations in a vertical direction. In consequence, the over-all picture quality is dependent upon a combination of the amount of resolvable detail from the top to the bottom of the picture, which is called the vertical resolution, and the resolvable detail from the left to the right side of the picture which is termed the horizontal resolution.

Vertical resolution is primarily dependent upon the size and shape of the pick-up and reproducing-tube scanning beams and is fundamentally limited by the number of horizontal lines scanned.

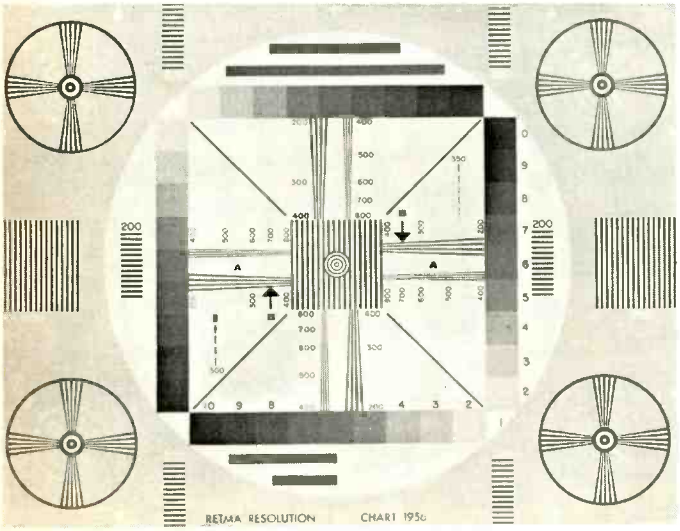


Fig. 1. The RETMA test pattern. Actual size is 18 by 24 in.

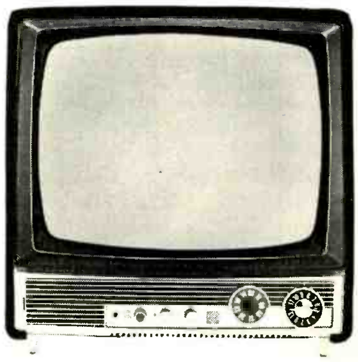


Fig. 2. A high-quality monitor made by GE.

The United States Television Standard. established in 1941, which is the standard in commercial TV broadcasting and most educational and industrial television applications, limits the horizontal scanning line rate to 525 lines. Once this line rate was established, the vertical resolution, in those services where it is employed, is limited to approximately 350 lines.

Vertical resolution is usually expressed in the number of distinct horizontal lines, alternately black and white, which can be perceived in a test pattern. The horizontal wedges, indicated as (A) in *Fig.* 1, are employed for this purpose. These wedges each consist of two groups of four individual converging lines. The vertical resolution is determined by locating the point at which the individual lines are no longer separately visible and then reading the calibration figure adjacent to that point. For example, were we to check a high quality video camera, operating at the standard 525-line rate, we would find the individual lines on the horizontal wedges would merge and become indistinct in the vicinity of point (B) in *Fig.* 1 indicating that the vertical resolution was approximately 350 lines.

In some of the more sophisticated closed-circuit television systems employed by science and industry there are no restrictions on the horizontal line rate, in consequence the vertical resolution can be increased substantially providing much finer detail than can be obtained with the horizontal scanning rate of 525 lines. Horizontal scanning rates as high as 1023 lines are being employed in these installations. These are capable of a vertical resolution of over double the broadcast resolution or 715 lines and in consequence provide a considerably more detailed picture.

Table 1 illustrates some of the horizontal line rates employed today and the vertical resolution which can be obtained through their use.

TABLE 1.

Horizontal Line Rate	Vertical Resolution
525	350
625	440
675	470
837	585
875	610
945	660
1023	715

This article will be continued next month to provide additional information on the use of a test pattern to evaluate, analyze, and adjust video equipment.

MUSIC AND RECORD REVIEW

The Classics

- EDWARD TATNALL CANBY
- OSCAR E. KRAUT
- MARVIN ROTBARD
- LIONEL RUDKO

CHORAL MUSIC

Mahler: Symphony No. 8 ("Symphony of a Thousand"). Soloists, Leeds Festival Chorus, London Symphony Orch. Chorus, Orpington Junior Singers, Highgate Boy's Choir, Finchley Children's Music Group, London Symphony Orch., Bernstein.

Columbia M2S 751 (2) stereo

There must be a good thousand performers here, though they don't say so, what with so many choruses, children, boys and girls both, eight solo singers, organist, and a battery of extra instrumental players. And managing the whole super-planetary, cosmos-shaking get-together is our own Leonard Bernstein. Four LP sides and some of the loudest (and cleanest) disc cutting I ever hope to hear of the sort. Phew! Monster affairs like this can side-track an earnest record reviewer for days at a time, while hundreds of other discs wait.

I remember enthusing over Vanguard's Utah performance of this huge work, some time back. It was unusually fine in the over-all, as are many of Abravanel's productions in the Mormon country. That was a somewhat lean, intense, rather youthful performance (with college choir sound in the chorus). This one is more massive, bigger, more European and, I think, stylistically closer to Mahler's intent. For the endlessly huge climaxes, going on for minutes at a time, the relentlessly top-volume choral parts, often in the very highest registers over and over again, require heasoned, hefty, and mature voices—as do the profoundly felt solo vocal parts. These massed choruses are exactly right for the physical ordeal of the gigantic sound production, solidly mature, competently professional in sound and volume, yet accurate and—most important—enthusiastic. Against them the children's voices are exactly in spirit. The orchestra and large organ together sound positively apocalyptic, tremendous in the loud passages; yet in the inevitable quiet stretches the famous Mahler instrumental color comes out beautifully, solo by solo.

"Imagine that the universe bursts into song," wrote Mahler about the work. "We hear no longer human voices but those of planets and suns circling in their orbits." That sort of super-egoism is not very much to our taste today, quite aside from its astronomical inaccuracy. And much of this interminably loud music will merely make many listeners squirm with uneasiness. It just goes on and on, and the great trance-like state we are supposed to fall into just doesn't happen easily in the living room. It is mass-hysteria music, for all its splendidly controlled shaping, and only an actual performance can approach this state in terms of audience-performer rapport on a vast scale.

Ah—but the soft parts, the marvelous Mahler songs, for the various soloists! Between the dreaded climaxes, the music is just plain out of this world. That's when *my* trance begins, I can tell you.

You'll know in five seconds that Bernstein has these thousands right in his hand. It's a splendidly vital big show, whether you like the cosmos-shaking elements or not. E.T.C.

Beethoven: Mass in C, Op. 86. Soloists, Dresden Cathedral Choir and Orch., Kurt Bauer.

Baroque 2846 stereo

Here we are 'way down at one end of the big Dresden Cathedral, not far from the choir and solo singers. It's a vast place and the music, in stereo, is somewhat overwhelmed by it. This is an East-German performance, not of an international sort but, rather, the kind intended for local listeners, done by the local performing forces. We are, in a way, listening in.

The music is Beethoven's lovely "little" Mass in C of 1807, typically middle-Beethoven, small in comparison to the giant Missa Solemnis of later years but full of splendid material, in an expanded traditional style out of the Haydn-type Masses.

It is an earnest, sincere, and very musical performance but hardly of top competence. The work often goes very slowly and romantically (perhaps the cathedral acoustics demand it), making the piece sound bigger than it really is. No great harm done. The chorus is wobbly in tone but well rehearsed, the soloists, strictly local types, wobble even more earnestly; the orchestra is not particularly audible. And yet—the music is obviously meaningful to these performers; and so it is meaningful for us. I enjoyed it. E.T.C.

Telemann: Two Motets, "Wie ist dein Name so Gross!," "Deus Judicium Tuum Regi Da!". Soloists, Philippe Caillard Chorale, Saar Radio Chamber Orch., Ristenpart.

Westminster WST 17109 stereo

Such a flood of instrumental Telemann has been resurrected lately that we are just coming to the vocal works—hundreds of them, once we get started. These two motets (cantatas in effect) will amaze those who expect Telemann to sound just like Bach, as of the same period. He couldn't be more different. Yes, in truth, Bach was a conservative, narrow in his outward scope though sublime in inner expression. Yes, Telemann was obviously the more progressive of the two by far. In these late works, one of them produced in 1756, six years after Bach's death, we are teetering on the very edge of the Haydn-Mozart period, yet still solidly in Baroque. Haydn's first little symphonies date from only three or four years later. Mozart was born in the very same year.

The two works are full of experiments. There are many striking instrumental combinations, a rich and big orchestra which, accompanying the Baroque-style arias, has already that busy, bustling quality of activity that is the *galant* style about to be born. There are absolutely weird harmonic progressions—so odd that these musicians clearly don't "hear" them, and flounder at the sense. And those who know French Baroque music—Rameau, Couperin, Campra, Delalande and the rest of that now-burgeoning school—will be astonished at how literally Telemann (he is always known as French-influenced) has borrowed into the French style, especially in the second of these works.

Westminster's get-up is annoying, at least to those who want some idea as to what is being talked (or sung) about. No texts. Not even the titles of the various sections—just "Bass aria," "Chorus," etc. At Westminster's higher price (for music of a sort that is often available on low-cost labels) there is no excuse fo omitting the texts—the cheap labels often include them, complete with translations. E.T.C.

Zachau: Two Cantatas, "Lobe den Herrn," "Ich will mich mit Dir verloben." Instr. and vocal soloists, Heinrich Schutz Chorale of Heilbronn, Pforzheim Chamber Orch., Werner.
Westminster WST 17103 stereo

A pair of most amiable big Baroque contatas, by a man who has been virtually rediscovered—and well worth it. Not only is he good of his sort, but for many of us he has a special interest: he was young Handel's teacher for eleven years.

It is very interesting, then, to find in this unknown man's work (the Handel biographies hardly make mention of him) a number of tell-tale Handelian mannerisms of the most familiar sort. Not much doubt but that the bigger composer originally got them from this very source.

Such Handel tricks as the dramatic dialogue of short phrases between a solo singer and an instrument, the clear, uncomplicated vocal fugue (as compared to Bach's thick, complex structures), indeed a general clarity of texture that is very much like the *Messiah* sort of writing, even the ultra-Handelian sudden detached slow ending to a rapid piece, all point to the great influence this teacher had on the most imposing figure of the coming generation.

One cantata is very long, a side-and-a-third; the other is big enough. Both are full of instrumental variety—trumpet solos, bassoons, oboes, lots of chorus and solo singing. Very showy, but rather low in tension, more static display and spectacle than high power religious persuading. The performance is earnest, well prepared and nicely recorded, but on the slow side, even for spectacle music.
E.T.C.

Italienische Chormusik der Gegenwart. (Dallapiccola, Peragallo, Petrassi). Monteverdi-Chor Hamburg, Jurgen Jurgens.
Telefunken SLT 43095 stereo
via London

Contemporary Italian choral music, sung by a crack German choir from Hamburg, that's what all the German in this title means. And some of it makes extraordinarily good listening. My particular rave is for two unaccompanied pieces by Dallapiccola, Italy's major big hope, composed before he went into serial music and such—these two are settings of texts by, of all people, Michelangelo, and they are infectuously enthusiastic as well as beautifully written for chorus. I'm trying desperately to get hold of the music, to try them on my own singing group, the Canby Singers.

Other music here, most with modest instrumental accompaniment, is much more serious in mien but it all, interestingly, has a peculiarly Italian flavor, as much out of Caruso and Verdi as out of the older Monteverdi himself (died 1767—this is the "Monteverdi Year"). High colors, flashing drama, tunefulness, passion and, of course, the Italian wit and the Italian mixture of sunshine (technicolor) and tears (saccharin) all at once—these old-fashioned attributes can be found even here, if you listen hard enough.

You might try the Nonsense pieces by Petrassi first. Settings—to Italian words, mind you—of Edward Lear's well known limericks! Crazy, man. (There was a young lady whose nose continually prospers and grows: *C'era una signorina . . .*)
E.T.C.

BACH AND TELEMANN

Telemann: Don Quixote Suite; Suite in A Minor. F. Schmidtmann, recorder; Ensemble Benedetto Marcello (Holland).
Odeon SAXH stereo
(via London)

Telemann: Don Quixote Suite; Suites for Orch. in G, D; Dance Suite (Concerto a 4). Rouen Chamber Orch., Beauchamp.
World Series PHC 9003 stereo/mono

Two imported recordings of Telemann, one Dutch and high priced, the other French and low-priced (though both originate with Dutch record companies). The more expensive disc is decidedly the better one, though price has little to do with it.

Both performing groups are of the new small virtuoso sort, a dozen-odd string players and a keyboardist. (The first to become famous was I Musici.) The Dutch "Marcello" players are good, if not exactly outstanding; but they bring with them an extraordinarily fine recorder player, Friedrich Schmidtmann, who does the well known A minor suite (usually played on a standard flute) with astonishing technique and a warm, knowledgeable musicianship as well. The Odeon disc is worth its price just for this splendid music, on side 2.

As for the Rouen players from France, they have all the hallmarks of a high-power musical promotion job: a virtuoso group chosen via a national contest to bring big-time music to a smallish outlying city. They are young and they play with a hard, brilliant ensemble, over-tense and astonishingly unmusical.

They have not even discovered yet that Baroque "French overture" movements are supposed to be played at a moderate speed with quick doubledotted rhythms, instead of mathematically and lugubriously, as written. (You may not understand this in words but you would recognize it in the music, I am sure.) Their fast movements are unmercifully hacked, without phrasing and subtlety; their slow movements are unshaped and dull; only the middle-speed movements come over with a good effect. Not beautiful at all, and no great credit to Rouen, if you ask me.

"Don Quixote" is one of the dullest of all the thousands of Telemann works, far beneath his usual rich standard. There must have been a reason; the stuff is in a kind of "peasant" style, elaborately over-simple and monotonous, a bit like Haydn's "Toy" Symphony or the simpler Mozart Divertimenti for outdoor use. Rouen just makes it duller. The Dutch do it as well as can be done.

Fortunately, both records include much better music in their supplemental offerings. Rouen's "Dance Suite," a dance-like concerto grosso, is worth the price of *that* disc, and is the best played music on it. E.T.C.

Bach: Lute Music. Walter Gerwig.
Nonesuch H 71137 stereo

Bach on the lute! Yes, he did write for the instrument, or rather, wrote out numerous works for lute which are also well known in other forms. It isn't entirely clear, either, which came first—maybe the lute did in some case. (Leipsic, Bach's town in later years, was a center for the last remaining school of lute playing in Germany.)

Walter Gerwig is excellent. No twangs and buzzes, as so often on amateurish lutes, no hesitations and unclear rhythms, while the fingers hunt for the chords. All is smooth and straightforward here, everything clear and easy to follow as well as very musical. Just as well Gerwig keeps a rather strict and forthright beat. Helps us to get the music's sense.

Included are a number of works more commonly known in versions for solo violin and solo cello—the entire A major cello suite is on Side 2 and part of the E major solo violin suite on Side 1; also works alternatively known for organ and keyboard. Guitarists with a classical urge and even electric-guitar rock & rhythm men will find the lute's abilities quite astonishing as compared to their own instrument's capabilities in this same sort of music. More strings, a wider pitch range with more low bass. E.T.C.

J. S. Bach: Four Sonatas. Kenneth Gilbert, harpsicord, Steven Staryk, violin.
Baroque BC 2858 stereo

The Baroque label (Everest), high priced—at least as officially listed—is wildly erratic in both content and quality, most of the material not even Baroque at all. This disc is a fine one, and Baroque at that, made in Canada by two outstanding Canadian artists. Very nicely recorded in stereo, too.

The four Sonatas are not out of the familiar collection of six works (3 sonatas, 3 partitas) usually recorded by this combo of instruments. These are odd works of the recently discovered sort, "undoubtedly authentic" though not specifically provable as real Bach. Listeners will be pretty sure this *is* Bach. Sounds like Bach. This seems to be a unique recording of all four works.

Two of them, on side 1, are for violin and continuo. The two on side 2 are of a different type, with harpsichord *obbligato* written-out parts. They are actually trio sonatas, the keyboard playing one upper melody in addition to the bass, the violin taking another. An interesting musical difference and it is very well realized, both in the playing and the recording. The violin stands out as a solo on side 1 but on side 2 it recedes somewhat into the background, as merely one of the two upper melodic lines, the other on the harpsichord.

Staryk's violin playing is sweet, somewhat tense with a slightly nervous fast vibrato, but utterly musical, excellent in both pitch and phrasing. Gilbert's harpsichord is solid and rather forthright, always intelligent and also very musical. A fine record and the only one of the music. E.T.C.

Bach: The Four Orchestral Suites. Pablo Casals, Marlboro Festival Orch.
Columbia M2L 355 (2) stereo

Casals: A Living Portrait.
Columbia PC-1 mono.

The living portrait (in Casal's own words), with narration by Isaac Stern to connect the segments) comes with the 90th birthday recording of the Bach suites.

Yes, Casals is a great person, a sage, an Elder, whose words of wisdom become wiser and more universal as he grows still older. He is a great musician in his way, as well as a philosopher. But with all of this, he is of his own time, which is not today.

In music that means a style of playing—on his cello, as a conductor here of Bach—that is straight out of the early years of the century, perhaps 50 years ago. Much as I admire him (and these new performances are far more relaxed and much better in ensemble than the hectic Casals Festival performances of some years ago)—I cringe at this Bach. For it simply ignores all the changes in Bach playing that have occurred in the last couple of decades. All the old falsities are back again—the ultra-slow opening movements, with the wrong rhythms, the fat symphonic sound (even from a small orchestra), the big slowdowns at each ending and so on. And the B Minor Suite, No. 2 with flute, goes right back to the pre-war whirlwind drive that drags the flutist along unmercifully with never a split second to get a breath.

If none of this sounds as though it would bother you in the slightest, then go right ahead—Casals *is* a fine musician and so are his players (who probably know a lot more about Baroque performing that he does—but what can they do?). It's a splendid recording, of the old-style sort.

The extra record is a montage of many of Casals' words of wisdom, in master classes, orchestra rehearsals and so on, with a good many musical illustrations. He is, of course, 101 per cent right on all matters of phrasing, on the soul of music-making, on imagination, spirituality—old-fashioned concepts that have now bowed mostly to logic and computer technology.

I must say I go along with him in his words, his ideas, if not in his Bach. I'm getting old. More than half his age already. E.T.C.

Introducing: OSCAR E. KRAUT

Hans Werner Henze: Five Symphonies (No. 1, No. 5). **Berlin Philharmonic Orchestra** conducted by the composer.
DGG DGS 9204 stereo tape

This is a most provocative 2-reel volume! To be suddenly confronted with not just one, but *five* full-sized symphonies incorporating almost every conceivable resource of a large modern symphony orchestra, and by a composer whose name is barely known in this country, certainly offers plenty of food for thought.

One thing is settled very quickly and that is that Hans Werner Henze is a first-rate composer with great sensitivity and complete command of his medium. He writes with a firm, strong hand, leaving no room for doubt that he has something worthwhile to say and knows how to say it. All of his writing is highly dramatic and charged with intense emotion as evidenced by these recordings. He has the gift of being able to command your attention and carry you along to his climaxes, which is characteristic of really great composers. What is most remarkable is that Henze makes this compelling music in a style of writing which is an outgrowth of the complex 12-tone technique developed by Arnold Schoenberg. This is a little like writing a love letter by means of double acrostics. Yet Henze expresses himself clearly, naturally, and with complete freedom and ease.

Hans Werner Henze is a German composer born in 1926, who received his musical education from disciples of the Schoenberg school in both Germany and France. His *Symphony No. 1* was composed in 1947, when he was only 21. In the liner notes, the composer himself refers to the initial performance of this symphony as an "utter failure." The version performed in this recording is a completely revised and reorganized edition produced in 1963. There are additional indications that the original scores to the *2nd, 3rd* and *4th Symphonies* were also revised for this recorded performance, so that while these performances represent the final and authentic versions of all five symphonies (even beyond the printed scores available), they are not a valid indication of the composer's growth through the twenty years which elapsed between the original production of the *1st Symphony* and these final revisions.

Add to the above that we can hear the composer conduct an excellent orchestra, the Berlin Philharmonic, and we have full assurance that we are listening to a definitive performance of these symphonies. Come to think of it, this is a pretty wonderful and unique contribution which high fidelity can make to the cause of appreciation and understanding of music, especially new music.

All five symphonies are less than 30 minutes each in length and are fairly concise in structure with well defined movements. Except for the *4th Symphony*, which is in one movement, the printed outlines are clear and easy to follow. Henze is very much concerned with structure and form throughout all the symphonies, a characteristic of this school of composition, but as he indicates, his music offers as much to the naïve listener as to the technically well informed.

The Symphony No. 1 in this new version (1963) was scored for a small orchestra, though Henze draws some effects out of this group to rival a full-sized symphony orchestra. It opens quite gracefully and easily with a singing style and before you know it you are on your way. The movement ends just as it began. The second movement is a slow nocturne featuring some effective writing for solo viola. The symphony closes with rhythmic movement full of fireworks somewhat reminiscent of Stravinsky.

Symphony No. 2 composed in 1948, opens rather mysteriously, setting the mood for the remainder of the movement as well as the symphony. A fast second movement follows, finally giving way to a somewhat more lyrical slow closing movement.

Symphony No. 3, written in 1949, was evidently a great success when first performed. It might be characterized as a dance symphony. It opens with an invocation to Apollo, moves into a more lively rhythmic section, rises to a fury, and then closes. The second movement is a stately dance. The third movement is a dance of incantation that moves through a variety of Stravinsky-like rhythms to finally conclude in a blaze of sound.

Symphony No. 4, dated 1955, is seemingly in one continuous movement. Henze indicates that this work was originally incorporated in his opera *Konig Hirsch*, and actually consists of five movements in one. Unfortunately, the opening slow statement is marred in the review copy by a rather serious wow. As the *4th Symphony* got under way the wow effect became less and less noticeable but in these days of electronic music, it becomes difficult to be certain of anything.

This work seems reminiscent of Alban Berg. It is made up of series of recitative-like passages for solo strings and woodwinds.

The last symphony in this set, the *Fifth*, was composed in 1962, and is divided into three distinct movements. The first movement consists of dramatic contrasting material. The following movement is a slow section, giving way to a perpetual motion Finale.

The last two symphonies move much more deliberately than the earlier three and appear to be a great deal more involved. But this is after all one of the great advantages in recording new compositions, namely the unlimited opportunity to become thoroughly familiar with the work and the musical idiom used through repeated playings. There is a definite limit as to how much can be absorbed at a single performance, unless a printed score is available.

Technically, DGG has done well by Henze and his music since the tonal balance is quite smooth, lush and full bodied, with the Berlin Philharmonic coming through crisp and clean and all instruments equally balanced. DGG deserves a vote of thanks for making these symphonies of Hans Werner Henze available. It is to be hoped that some of his other work may become similarly available soon. O.E.K.

Introducing: MARVIN ROTBARD THREE FROM COLUMBIA

Tchaikovsky: Capriccio Italien; Waltz from Eugene Onegin. Rimsky-Korsakov: Capriccio Espagnol; Bridal Procession from Le Coq d'Or. The Philadelphia Orchestra, Ormandy cond.

Columbia MS 6917 stereo

This combination of the two *Capriccios* appears coupled on more records than I care to count. Columbia throws in an extra measure, however, by also provided the two extra tidbits to round out each side of this disc.

The Philadelphians under Eugene Ormandy are what they are. That is a fully polished and musically professional group that need take a back seat to no other orchestra. The music at hand here is the big, brassy kind of sound that hi-fi buffs use to show off their rigs. Let me at once say that the engineering here is excellent with widespread but not over-blown stereo.

And the two feature works have great musical value. The two Russians' views of Italy and Spain respectively are models of this sort of expositional writing. I tend to lean toward the Tchaikovsky for its sheer brilliance of scoring; although I will concede that Rimsky is more colorful. But the real charmer of this disc is the little *Waltz*. If you want to know why the Philadelphia strings are famous, listen to this work.

Ormandy's conceptions of the major works is perhaps lacking in the kind of fire that is needed to transform these oft heard opuses into a fresh appearance. Still, you simply cannot say that this is bad; Ormandy is far too much the musician to allow that.

So Sound is the real hero here. The Columbia engineering is correctly and usefully lavished—and the surfaces are quiet enough to allow you to hear the tape hiss of the master. M.R.

Russian Sailor's Dance: New York Philharmonic, Leonard Bernstein.

Columbia MS 6871 stereo

"When you hear this kind of music, you want to get up and dance," quotes the liner notes of Mr. Bernstein. If by that he means that all the music of this album is dance music, then I must agree. Here's the list of what is on the disc:

Russian Sailor's Dance, Gliere; *Brazilian Dance*, Camargo Guarnieri; *Norwegian Dance No. 2, Opus 35*, Grieg; *Slavonic Dance, Opus 46, No. 1*, Dvorak; *Danzon Cubano*, Aaron Copeland; *Trepak* (from the *Nutcracker*), Tchaikovsky; *Galop, Waltz, and Danzon*, Leonard Bernstein; *Hungarian Dance No. 6*, Brahms; *German Dance No. 8 (K.605, No. 3)*, Mozart; *Batuque*, Oscar Lorenzo Fernandez; and the *Hoe-Down* from *Rodeo*, Copland.

Bernstein has selected eleven charmers here. Many are well-known. Less popular, perhaps are the Guarnieri, Copland *Danzon* and the Fernandez. The first named is one of those brassy Latin-American numbers whose origin is almost cliche. Nevertheless, this is a sprightly and attractive dance. The Copland *Danzon Cubano* is jazz-oriented Copland sound at its best. And the *Batuque* of Fernandez' presents a heavily-scored-for-brass syncopated-beat march. But Latin sound is not the focal point of this disc. The best number easily is the *Hoe-Down* which is swung to perfection by Bernstein. In fact Bernstein brings to these numbers an infectious *Joie de vivre* that is a pleasure to behold. Everyone concerned seems to have enjoyed making this recording. Certainly, I enjoyed listening to it. What with Bernstein and Columbia's fine stereo sound, this is a highly recommended collection. M.R.

ONE FROM LONDON

George Gershwin: Porgy and Bess, Symphonic Suite. The London Festival Orchestra, Robert Farnum, cond.

London SPC 21013 stereo

This is a new one from those responsible for London's Phase 4 stereo. It must be said that this is technically nearly "straight," although there are some strange shifts in perspective as solo percussion comes in closer than the entire orchestra. Still, on the whole, this is a sonically stunning recording.

I wish I could say the same about the performance. Perhaps it is more accurate for me to complain about the arrangement. What we usually hear in concert as a synthesis of this Gershwin operatic masterpiece is an orchestral arrangement made in the 1940's by Robert Russell Bennett. This recording features a new arrangement of the score by conductor Robert Farnum. I'm sure his intentions were good. But the Gershwin flavor seems to fare better in its post-depression dress. Mr. Farnum's score is smart and modern. And there is its failing, I think. Gershwin just does not come out right in completely modern dress.

Don't let me prejudice you. There must be a valid case to be made for this re-orchestration. Certainly, it has been done in a musicianly manner. And Farnum the conductor would seem to be faithful to Farnum the arranger. Most important of all is the near indestructability of Gershwin. In the end he still manages to shine through. M.R.

TWO FAVORITE SUITES

Bizet: L'Arlesienne Suite No. 1. Grieg: Peer Gynt Suite. Suite No. 1, Op. 46, The Cleveland Orchestra, George Szell, cond.

Columbia MS 6877 stereo

George Szell and his Clevelanders turns in a fine pair of performances here. These two suites are both delivered up crisply and smartly.

Both works are culled from larger efforts written as incidental music for dramatic theater productions. The thirty-four year old Georges Bizet was commissioned in 1872 to supply incidental music for Daudet's popular *L'Arlesienne*. The play, rarely performed today, is a somber affair involving two brothers. The older brother dominates the play while the younger is clearly a dullard. To simplify things the emotional older brother ultimately commits suicide over an unhappy love affair involving a girl from Arles. (It is she whose name is lent to the play, though she never actually appears.) The shock of this restores the younger to normalcy and he assumes his rightful place as the new family leader.

Bizet's contributions to the production did not receive critical praise. Nevertheless this suite, extracted from the work (there is also a less well-known second suite) has assumed a permanent place in the concert repertoire.

Grieg, on the other hand, faired well with his score of background music to Henrik Ibsen's great drama *Peer Gynt*. The five selections of the *Suite No. 1* are culled from twenty-two pieces written for the play in 1867. Ibsen's drama tells the tragic story of Peer Gynt's search for the perpetual youth of an adventurous life. He is, in fact, a character not altogether unlike another rogue, Till Eulenspiegel.

The sections of the suite are not in the order in which they appear in the play. Rather, Grieg arranged them in a logical way so the suite could stand independently. And it does.

If anything can be criticized in this recording it is a return to the practice of allowing the first strings to take the melody line in *Solvejg's Song*. It is interesting to note that this number is usually included in performances even though it rightfully belongs to a second suite Grieg extracted from the score. In any case, wherever it goes. I do prefer to hear a soprano rightfully take her place here, rather than the violins.

Columbia turns in its usually fine engineering to accompany George Szell's equally fine readings. M.R.

Introducing: LIONEL RUDKO

Wagner: Die Walkure. James King, Regine Crespin, Gottlob Frick, Hans Hotter, Birgit Nilsson, Christa Ludwig. Vienna Philharmonic. Georg Solti.
London Loy 90122 stereo

This recording of Die Walkure completes for London Records the unique project of committing to disc the entire Ring cycle. This is a monumental achievement and London is to be commended for the huge effort it must have been.

Wagner was, and the Ring epitomizes, theater composition.

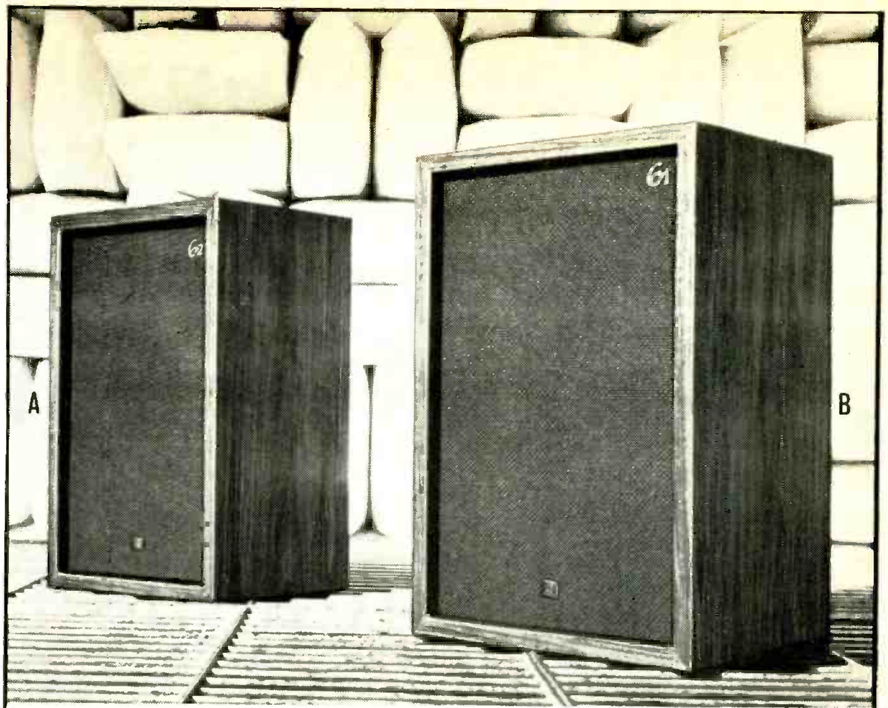
He thought not in terms of music primarily, but in terms of music drama. The previous concept of opera as a vehicle for the exploitation of the prima donna of the day, was completely foreign to him. His concept was a wedding of the arts, in which the music, libretto, sets and staging, were woven together into a tapestry of human emotion and experience. Condemned and revered in turn, he left a legacy to the opera theatre that opened new vistas in the evolution of this art form.

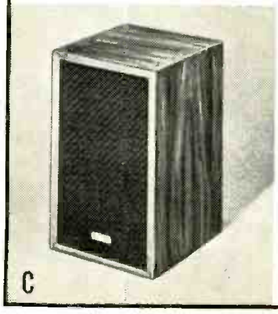
The opening bars of Act I portend good things to come, for the listener that is, not for Siegmund and Sieglinde. The sound is excellent, bass response is solid and transient. Individual definition of instruments is excellent and every detail reproduces with utmost clarity.

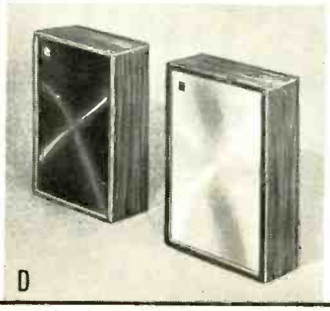
There isn't too great an opportunity to evaluate the principals vocally until the later part of Act I. No sooner has Sieglinde drugged Hunding when the sparks begin to fly. From then until the end of the act, can be heard the best singing of the entire opera. Siegmund and Sieglinde are an aural delight. What a pleasure to hear singers perform with the bel canto ease and freedom so seldom heard in German opera.

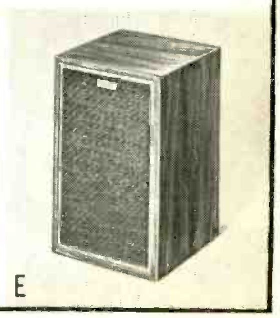
Bouquets to James King and Regine Crespin. Gottlob Frick, in the role of Hunding, is adequate vocally. His high notes are rather forced and intonation not too secure. Sound addicts such as myself, will revel in the luscious lows, the thundering tympani and the brash, brilliant brass. I must say, in reference to both conductor and orchestra, that I have seldom heard brass choirs with such precision of attack and excellent balance. The Vienna Philharmonic is one of the great orchestras of the world and they sound it.

If fault must be found, I would say a little more prominence in the wind section would have been desirable. I have always had an aversion to the









thin and reedy oboe sound in central European orchestras. The recording technicians have created the feeling of stage movement by shifting voices from speaker to speaker and fading in an out to enhance the impression of depth. I found this created a pleasant illusion, although it remains for each listener to reach his own conclusion in this regard.

Just as our hopes have been bouyed in Act I, that here might be the performance with as ideal a cast as could be mustered, along comes Wotan (Hans Hotter) and plunges us to the depths. It is particularly saddening to witness the decline of an artist who through the years has been enjoyed and respected. Yet what artist can be expected to retain full command of his vocal powers indefinitely? The question this proposes is, when should an artist face this realization? Mr. Hotter has a tremolo of at least a minor third which is in evidence throughout his lengthy monologue in this act. The most appropriate critique is provided by Mr. Hotter himself when, early in the act, Wotan bemoans, *O Heilege Schmact* (*O Divine Disgrace*). The perfectly cast opera is still an elusive goal.

It is inconceivable to me that whoever was responsible for casting this recording would jeopardize its excellence in this manner. Christa Ludwig as Fricka is not brilliant but is in good voice and performs her task ably. Birgit Nilsson is assured and professional as is to be expected. She is one of the world's outstanding singers and a welcome member of any cast. She sings intelligently and her rendition, subsequently, of the famous *Hoyotoho* is devoid of any scooping of the last "ho" as is so often the case.

We have been alternately raised to the heights and plunged to the depths in Acts I and II. Act III maintains this pattern of inconsistency. Some of the most inspired passages of the entire opera are heard here. The vocal interplay of the Valkyries as they bear the dead heroes across their steeds, is an awesome stereo experience as their cries appear from all sides. The orchestra rises to its height, the sound is overwhelming and joy reigns once again.

However, it is short lived as Wotan returns, and from then to the end of the opera, even the excellent strivings of Brunnhilde are insufficient to offset the monotonous repetitions of our lamentable Wotan.

We have been witness in this recording, to potential brilliance reduced to mediocrity through a major error in casting. In a work of such importance and magnitude, as is *Die Walküre*, no stone should be left unturned to assemble a cast of at least equal accomplishment. L.R.

Light Listening

- RICHARD L. LERNER
- CHESTER SANTON
- ROBERT SHERMAN

Mr. Music . . . Mantovani • **London PS 474**

One of the occupational hazards of reviewing records is a fairly subtle one. It's a small trap that many reviewers of popular music fall into at some time or other. I would describe this particular hazard as the Process of Taking the Artist for Granted. For some reason (years of unshakeable success?) Mantovani seems to be the artist most frequently dismissed in this fashion in the field of popular records. When record reviewers for audio industry magazines leave their monastic cells and gather once a year at the New York High Fidelity show, their shop talk usually finds the name of Montovani cropping up most frequently when the discussion turns to "What can one say today about So and So's records?" I've had my problems of staring blankly at a typewriter with each new release of a Mantovani-a-month on the London Records schedule. I'm sure London's treasurer doesn't share my feelings and we'll never know how many of the label's projects in other fields of music have been launched on earnings provided by Mantovani's popularity. As for the artist's standing with the record retailer, I still remember the day in the late 50's when the New York office of London Records demonstrated its first batch of stereo discs. While members of the audio press were wondering aloud why the loudspeakers for the right and left channels were about 12 yards apart (we found the answer later when we played the same discs with only six or eight feet separating the speakers), most of the record dealers present were interested solely in the first appearance of a Montovani album in the new medium. In recent months, review copies of his albums have been coming to me in tape form. Album number 474 is the first Mantovani disc release I've heard in some time. Here, as they say in confessional booths, was an opportunity to Turn Over a New Leaf and listen to Mantovani without taking his music for granted. A fresh exposure to his sound on records is not a dull or thankless task—if you've been hearing him solely on tape. A good deal of the past year's technical improvement in London classical discs is evident in this album. The wider frequency range of the disc, as opposed to commercial tapes, brings out more instrumental color and identity in stereo sound that is superior to tape in depth and easily its equal in separation. Over the years there has been a gradual change in the Mantovani style, most of it in the direction of a more logical tonal balance. The strings no longer cascade over the rest of the orchestra as well as themselves. In this collection of old and new favorites, the woodwinds and other segments of the large ensemble are given a full opportunity to shine and the album is all the better for it. If you can discipline yourself into thinking you've never heard Mantovani's music in the past, a fresh appraisal of the orchestra's current sound on discs is well worth trying—if only as an exercise in keeping your musical reflexes flexible. C.S.

Stanley Black: Broadway Blockbusters • **London SP 44088**

A recent sampling of the London Phase 4 Stereo process shows that it, like the label's conventional recordings, sounds better on disc than on 4-track, reel-to-reel tape at 7.5 ips. Following an interval during which I've reviewed Phase 4 in tape form only, a return to discs affords quite a different perspective on the special London process used in this series of releases. On this particular record of show songs for chorus and orchestra, the channels of sound cohere well enough so that the ear is almost lured into imagining an unbroken curtain of sound between the speakers. Considering the amount of echo introduced in the processing, this is not an easy trick to pull. There may be a trade secret involved in London's use of echo in this series. The sound is far cleaner than most I've heard where echo was applied with a liberal hand. In some of the heartiest songs the Broadway stage has provided in recent decades, the reverb is all on the plus side in ultra-close pickup of chorus and orchestra. The only glaring giveaway of the presence of echo in the processing occurs in the rare moments when one voice is heard in a line of a song. As for the performance by Black's chorus and orchestra, it seems to be a hard fact that distance lends some sort of enchantment in show business even as it does in other matters. I've rarely heard a chorus throw itself into its job with such gusto on this side of the Atlantic—where gusto was supposed to have been invented. If, like me, you believe in the use of an ample bunch of woofers in each channel of a playback system, you'll probably go along with my conjecture that the drummer in Black's orchestra went through several sets of skins in the course of this recording. C. S.

I Do! I Do! (Original Broadway Cast)
RCA Victor LSO 1128

A word of caution about the words "Broadway Cast" in the title above. "I Do" is a musical without the usual principals, chorus, and lengthy roster of supporting players. The "cast" is Mary Martin and Robert Preston. This latest David Merrick production is a musical version of the famous play of 1951, "The Fourposter" by Jan de Hartog. Millions of playgoers over the years found diversion and entertainment in its slender story of a marriage unfolded by the two participants. The fact that a tale such as this now makes its appearance as a two-person musical offers some clue to the shortage of plots currently facing Broadway producers. David Merrick has been fortunate in securing the services of Harvey Schmidt (music) and Tom Jones (lyrics) who created off-Broadway's "The Fantasticks" and the on-Broadway "110 in the Shade." Their pleasant songs for "I Do, I Do" give Mary Martin and Robert Preston a surprisingly stable platform from which to launch an evening of virtuoso sleight-of-hand. Heard on records, the absence of a musical's usual trappings is not a handicap. C.S.

Baja Marimba Band: Watch Out
A and M Tape 118

Unwind this tape past a well-designed playback head to learn what can be done today on commercial releases using 3.75-ips speed. As this speed, once almost unthinkable for music in high fidelity circles, is subjected to more development and refinement it becomes increasingly difficult to dismiss it as a bona fide medium for the reproduction of music. The more albums I hear at this speed, the more apparent becomes a basic fact of life in the transfer of sound from master tape to the final reel playing at 3.75. You've got to start out with a master tape that is several notches above the quality of master that most labels are willing to settle for at a recording session. Every extra effort the Herb Alpert A & M label exerts in the making of a tape master plays some part in the sound they are able to market at 3.75 tape speed. In the latest album by the nine-man Baja Marimba Band, there is a crispness in the sound that any disc maker would be proud to call his own. It's a crispness that certainly comes in handy in the versatile Latin stylings that any Alpert-groomed outfit is bound to feature. Since versatility is one of the first attributes Herb Alpert is apt to look for in any group he sponsors, the Baja band delivers a program varied enough for anyone. "Gay Ranchero" and "Ghost Riders in the Sky" are the best examples the album offers of their carefree side. "Sabor a Mi" and "Tomorrow Will Be Better" prove that the band can make pretty music with the best of them. The slower arrangements even offer an attraction you seldom hear in a pop aggregation—a flute player with good tone and adequate breath control. C.S.

Living Marimbas: Latin Soul
RCA Camden CAS 2105

If you're in the mood for some puzzlement, put this low-price RCA release on your turntable. You may end up agreeing with me that it sounds better through a good home system than does a typical RCA popular release in the higher-priced Dynagroove series. The difference doesn't make sense but there it is, underlining once more the weird state of affairs in the record business today. If the almost anonymous artists in this release of Latin music with a marimba foundation had happened to be household names, they would in all probability have ended up on Dynagroove with sound tailored for the indifferent machines found in the majority of homes. Instead, they have been left to shift for themselves in one of the large studios of RCA's Webster Hall, where, without the dubious benefits of Dynagroove, their sound reaches home speakers with a minimum of fancy processing. The result, in terms of audio-buff listening pleasure, is more than the customer is entitled to in view of the price he paid for the disc. Quite apart from the advantage this record enjoys through absence of Dynagroove's limited sound range, there has been a definite improvement in the quality RCA is putting into its latest Camden pressings. In point of time on the market, Camden is one of the oldest labels in the low-price field. Until recent months, the raw materials going into the actual disc simply weren't good enough to put Camden in the same league with expensive discs. The appearance of Elektra's Nonesuch label offering good stereo pressings at a price of $2.50 forced most of the industry, not only RCA, to reexamine its low-price lines and upgrade the sound in order to remain competitive. Here the listener gets all the sonic breaks as Leo Addeo leads his ten musicians in authentic Latin numbers such as "Ella" or "La Ultima Noche" and more familiar pop tunes such as "It Happened in Monterey" and "El Rancho Grande." C.S.

More Skitch Tonight
Columbia CS 9250

Is there a more versatile orchestra currently before the public than the Skitch Henderson crew? It is the orchestra's good fortune that phonograph records actually give it a chance to demonstrate this versatility. Although only a sidelight to its regular activity on the "Tonight" TV show, the making of records at least gives the band an opportunity to be heard in something more than mere accompaniment or a guest-welcoming fanfare. The steady appearance of a stream of Henderson recordings with this fine band would indicate that there still exists an audience for tasteful arrangements of popular music delivered with impeccable musicianship. As arranger and performer at the piano, Skitch Henderson has always occupied a special niche in my esteem. This respect for the chap as a person dates back to a time in the early Fifties when I chanced upon him discussing component sound equipment in the showroom of a dealer situated in the Radio City area. Even a totally objective listener will have much to admire in this latest Henderson album. In addition to his own arrangements, there are stylings by such experts as Torrie Zito, Deane Kincaide, Tom Newsom, and Dick Reynolds. There are several delicious items in brisk tempo —"It's Delovely," "Titter Pipes," and "Arriba." "Trumpets Olé" is a great sonic showcase for trumpeters Doc Severinsen, (he's only the best in the business among New York's free lance musicians) Clark Terry, Snooky Young, and Jimmy Maxwell. Anyone who grew up during the era of the big bands will get a special charge out of the Henderson performance of Claude Thornhill's famous signature theme, "Snowfall." Its inclusion in the album is a logical one since Skitch and Thornhill once played as a team when Andre Kostelanetz used two pianos in his large orchestra of former days. The sound produced by the band in this album is the best in the "Tonight" series. Thanks to the intelligent use of today's better mikes, the sound has the warmth of a good close pick-up without any loss of transparency. A neat job by all hands makes this a disc that's very easy to recommend. C.S.

Sour Cream and Other Delights
RCA Victor LSP 3663

Apparently the wild success of Herb Alpert's Tijuana Brass has rankled the rest of the industry a bit more than we've suspected. Even austere RCA Victor is willing to forget some of its dignity as a corporate giant to poke some uneasy fun at the famous Alpert instrumental style as well as the design of the jacket cover on one of the first best sellers of his A & M label. That, if you recall, was the album called "Whipped Cream and Other Delights," complete with a picture of a girl encased in what looks like whipped cream. Victor's spoofing of the original cover includes the same color scheme and lettering in the artwork, plus a bevy of five similarly encased "beauties" that has to be seen to be believed. The instrumental fun poked at a dozen Alpert-identified tunes by a group called The Frivolous Five doesn't come up to the job done by the art department on the cover but the tenuous neo-Mexican doodling of the band may provide a laugh or two. C.S.

Bing and Louis
M-G-M MS 591

Not all albums being released these days are recently recorded productions. Any confusion this fact may cause at the consumer level is not too serious a matter. Some re-issues, despite new modesty in packaging and a lower price, are a distinct improvement, technically, over the original releases they have supplanted in the catalogs. The updating of sound possible with the industry's current cutter heads has been very gratifying to customers aware of the difference. To date, practically all the re-cutting has been in the field of classical recording, where the music doesn't go out of date too readily and consumers are far more aware of price as such. This re-issue of an older album by Bing Crosby and Louis Armstrong would indicate that the idea could catch on in the popular field. If the stars are important enough and the performance one that could not be easily duplicated today, we may see more such re-issues. This recording of Bing and Louis romping through oldies such as "Dardanella," "Brother Bill," and "Muskrat Ramble" originally appeared in stereo as MGM S-3882. It is one of the quirks of the Schwann LP catalog that this record was not a part of the listing of Armstrong discs when it was released early in 1961. Then, as now, it is to be found only in the Crosby column. Next time you have occasion to look up a collaboration by two highly rated vocal luminaries, the first name listed on the cover seems to take precedence. If that doesn't work, apparently one tries the listing of the second artist. C.S.

Introducing: RICHARD L. LERNER
Continental Airlines

Playhouse, Volume 1
Caedmon CVF 501

Music Hall, Volume 1
Verve and MGM CFM 401

Golden Moods Music, Volume 4
Verve and MGM CPK 104

Classical Concert Hall, Volume 4
DGG Archive CCK 204

Continental A' Go Go
Verve and MGM CKG 301

These are all recorded tape releases made under the auspices of Ampex. The first two listed are mono recordings; the rest are stereo. All are 3¾-ips recordings offering about 80 to 90 minutes of total play. As may be guessed from the titles, these are recordings of the program music featured on Continental Airlines. They are all sets of program material designed to entertain you (more or less) while you jet your way wherever Continental's yellow-tailed birds fly. This is the kind of programming that is uniquely suited to recorded tape. On these releases there is only one interruption. In fact, machines equipped with reversing triggers activated by a twenty-hertz pulse (as are the Ampex units) will reverse automatically giving you the entire program without interruption. Try *that* with disc.

Now comes the question of the programs. Clearly these are not tapes designed primarily for attentive listening. At least, I don't think so. They are background tapes—sound to be played as atmosphere behind a more engrossing activity. This is true of the music tapes; it may be less true of the talk performances. But make up your own mind.

CVF 501 has eight dramatic selections and each is excellent. *Lorelei's Diary* from *Gentlemen Prefer Blondes* is read by Carol Channing. *Blithe Spirit,* Act II, Scene 1 is read by Noel Coward and Margaret Leighton. Julie Harris, Hal Holbrook, Kevin McCarthy, and Edward Woodward devote time to something called the *White House Saga.* Ogden Nash reads (as only he can) three of his poems. *The Celebrated Jumping Frog of Calaveras County* is delivered by Walter Brennan (who is good, but I wish it had been Hal Holbrook). From Act 1, Scene 1 of *Ceasar and Cleopatra* by G. B. Shaw, we are treated to Claire Bloom, Max Adrian, and Judith Anderson. Finally, there is a beautiful excerpt from Dorothy Parker's *The Waltz,* recited ably by Shirley Booth.

This is a formidable pack of talent reading first-rate literature. I would pick out the *Blithe Spirit* selections as the high point of this fine collection of dramatic snippets.

CMF 401 is a mixture of personalities and situations that are supposed to be part of the atmosphere of a music hall. Jimmy Durante, Will Holt and Martha Schlamme, Stanley Holloway, Yves Montand, Jackie Mason, and Martyn Greene are the stars. Each is on his own, doing a selection he does best. Best of the lot is the closing number—a generous section of the original cast album of *The Fantasticks.*

Next comes CPK 104 with Russell

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Arkansas
PINE BLUFF
Raley House of Music

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Anaheim Electronics
Henry Radio
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BERKELEY
Cal Hi Fi
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Pacific Electronics
BEVERLY HILLS
Sound Center
CAMPBELL
Alco Home Electronic Center
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CARMICHAEL
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PLEASANT HILL
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Lafayette Electronics
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SAN BERNARDINO
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SUNNYVALE
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CIRCLE NO. 101 ON READER SERVICE CARD

Garcia, Julius LaRosa, David Rose and orch., Lena Horne doing *The Lady is a Tramp,* Manuel and his Strings, the perennial Bing Crosby, Andre Previn, Fran Jeffries, Ella Fitzgerald, Ray Charles, Margaret Whiting, the George Shearing Quintet, and I'm sure I left someone out.

CCK 204 has orchestras and artists of the DGG stable in performances of *Sinbad the Sailor* from *Scheherazade* by Rimsky-Korsakov, a portion of Act III of Verdi's *Il Trovatore,* the *Overture to The Marriage of Figaro*—Mozart, the popular last movement from the Dvorak *New World Symphony,* Sarasate's *Gypsy Airs,* some snippets from Orff's *Carmina Burana,* the first movement of the *Concerto for Piano in G Major* by Ravel, the *Suite from the 17th Century*—J. H. Schein, excerpts from the *Miraculous Mandarin* by Bela Bartok, the *Prize Song* from Wagner's *Die Meistersinger,* the *Coppelia Ballet Suite* — Delibes, and Johann Strauss' *Radetzky March.* Beautiful recordings all and reasonably generous portions.

And then there is CGK 301. This is a solid ninety minutes of teen-type dance music by name (to them) artists and groups. Although there *are* selections by Count Basie, Billie Holiday, Pete Seeger, Louis Armstrong, and so on, so I'm not sure just for whom this tape was designed.

This group of tapes represents an interesting phenomenon. The music tapes are clearly designed, in these presentations at least, as background music. It is not within the scope of this report to engage in the question of a world that has soft music behind it. Rather I must report that all of these tapes represent well-chosen programs that have been recorded with some variability traceable to the original recordings. But at their best they are good indeed. It is quite impressive to hear just how good a tape can sound at this slower speed. R.L.L.

American Airlines Astrovision

Classical Program No. 3

Vanguard CW3

Popular Program No. 23 Kapp W23

Here are two more tape recordings that are copies of what airlines offer to willing passengers. This time it is American Airlines. I won't begin to list the selections offered; these seem to be ample samples of the recent catalogs of the respective recording companies. Let me instead comment on these 3¾-ips four-track tapes. No wide-hub reels here. These tapes each offer over three hours of music. Recording from so many sources offer the risks and rewards that must accrue. For the most part the technical quality is excellent; it is never bad.

There are over twenty selections on the classical tape and half again as many on the pop album. Either way, if you divide into the 190-odd minutes you can see that the excerpts are generous. For the most part they are complete selections that can stand on their own merits (as much as a complete movement can ever stand apart from its symphony).

I do wish that the proofreader of the classical program was a bit more careful. There is a concerto by *Vivaldo* and an opera called *Eugene Onegrin.* And then, there is so much in the way of titles to list, that there is absolutely no room to offer any information but the title and artist of each one.

Still, if it is good background music you seek, you will find your needs well served by these tapes. And, at times, if you have nothing better to do, you might even consider listening to them. R.L.L.

Introducing: ROBERT SHERMAN

Spontaneous Flamenco: Carlos Montoya, guitar, with Virgilio Manuel Blanco, piano, and Juan Vallejo, singer.

Paramount ABC 857
(4-track stereo tape)

The title of this colorful release may be a bit redundant (improvisation being so essential an ingredient of flamenco), but it does serve to underscore the impulsive, deeply personal nature of Montoya's playing. The song and dance forms he uses (*Cante Jondo, Bulerias, Soleares,* and so on.) have been tapped countless times on other recordings, but in the hands of so imaginative an artist, each new performance emerges with its own shape, its own variety of dazzling virtuosity. In three of the eight numbers, Montoya's sizzling guitar patterns blend with the strident, impassioned singing of Juan Vallejo, and the improvisational give-and-take between two kindred flamenco spirits adds yet another vigorous dimension to the music. One more duet doesn't come off nearly so well, but it's worth hearing for the sheer novelty: it's a *Fandango,* with Montoya on guitar, and Virgilio Manuel Blanco playing the piano! The trouble here may be partly a matter of listening habit (the piano just doesn't *sound* flamencan—you keep expecting the music to turn into Granados' *Spanish Dance #5* or something), but I think it's also that Blanco's keyboard themes and figurations can't begin to keep pace with Montoya's in terms of originality or emotional drama. The piano, in other words, loses its status as an equal musical partner, and seems out of place as an accompanying instrument. R.S.

Album: Peter, Paul, and Mary.

Warner Bros. WSTC 1648
(4-track stereo tape)

Peter, Paul, and Mary have sparked so many folk trends that they are quite entitled to sit back and catch their breath. This, essentially, is what they are doing on this attractive tape. Rather than striking out into unexplored territory, PP & M simply offer a sort of compendium of the various musical styles and forms that have intrigued them in the past. Thus we find sharp-edged gospel harmonies (*And When I Die*), gentle, soft-spun love songs (*Sometime Lovin'*), a peculiar mingling of blues and country music (*The Other Side of This Life*) and pensive ballads-with-a-moral (*The Good Times We Had*). Paul Stookey indulges his penchant for zany humor by imitating, via multiple recording techniques, all the vocal and instrumental sounds in a spoof rock-'n-roll number, Mary Travers takes a tender solo in a latter-day lullaby *For Bobbie,* and Peter Yarrow leads the Trio in the poignant *Mon Vrai Destin.* Best of all, in this day of folk-rock and super-sophisticated folk-pop, PP & M also find nothing amiss in a simple, completely "straight" version of the Weavers' classic *Kisses Sweeter Than Wine.* This may not be the "in" type of folk music any more, but it still is a joy to hear. R.S.

You Were on My Mind: Marti Shannon, with Orchestra conducted by Ben McPeek.

RCA Victor LSP 3633 (stereo)

A strong, sultry voice and hard-driving intensity are Marti Shannon's chief musical calling cards, and they account for both the strength and weakness of her debut album. Strength, because individual tracks here explode with genuine excitement: Dick Fariña's *Hard Lovin' Losers,* for instance, and a compelling Shannon original, *War Drums.* Weakness, because the unrelenting pace of Ben McPeek's arrangements, along with the constant high-tension level of the singing, gives everything a basic sameness, whether it be a ballad of love, of longing, of protest, of war. The talent is unquestionably there, however, and hopefully Miss Shannon will develop a more pliable approach to go with it. Indeed, the occasional moments when her voice softens, come off so well that pianissimos just might turn out to be her forte, after all. The dozen songs here are about equally divided between fine examples of the current folk-pop style (i.e., *Some Day Soon,* by Ian Tyson, and Tom Paxton's lovely *The Last Thing on My Mind*), and run-of-the-ballad items of minimal interest. R.S.

Golden Hits, Volume II: The Smothers Brothers

Mercury STX 61089
(4-track stereo tape)

The humor of the Smothers Brothers is an acquired taste, and those who have acquired it will no doubt be pleased to know that Tom and Dick remain true to their irreverent and irrelevant selves. The title of their latest album is the first clue to their brand of wit (there *is* no Volume I), and thereafter, it's every folk song for itself, as the Brothers take on such tunes as *Pretoria, Michael, Row the Boat Ashore, Hangman,* and *My Old Man,* and leave them down for the count. In most instances, these are the old stop-and-start, play-on-lyrics routines which launched the boys to fame some five years and ten recordings ago, but their acts have been refurbished, spruced up and otherwise improved (it says here), and the disc therefore merits a place in every complete Smothers Brothers library. R.S.

Jazz and All That

Bertram Stanleigh

Johnny Hodges, Wild Bill Davis: Blue Pyramid
Verve Stereo V6-8635

The awesome magnificence of the Hodges alto is once again made manifest as this veteran demonstrates his mastery of the blues idiom. His long-lined phrasing has the backing of two of his colleagues from the Ellington band: Lawrence Brown, on trombone, and Jimmy Hamilton, on clarinet. Further links with the Duke are provided in such fare as *Stormy Weather, The Brown Skin Gal in the Calico Gown,* and *Pyramid.* The eminently serviceable contributions of Wild Bill Davis help to flesh out the contours of a group whose rhythm requirements are met by Billy Butler, guitar, Bob Bushnell, fender bass, Jimmy Jones, piano, and either Herbie Lovelle, Joe Marshall, or Johnny Hodges, Jr., on drums. Everything is done to a turn in a singing, swinging style that gives Hodges lots of elbow room for his solo work but nonetheless provides a very solid group sound. The recording is clean and well balanced with just the right amount of reverb. B.S.

Clark Terry & Chico O'Farrill: Spanish Rice
Impulse Stereo AS9127

Conductor-arranger Chico O'Farrill has put together a virtuoso group of jazz and Latin musicians for this mad, hectic romp starring the trumpet of Clark Terry. With trumpet and flugelhorn assignments shared with Snooky Young, Joe Newman, and Ernie Royal, Barry Galbraith, and Everett Barksdale, guitars, George Duvivier, bass, Grady Tate, drums, and a quartet of Latin percussion, a bright, swinging collection of trivia is offered in a mood of lightheaded tomfoolery. In addition to *Peanut Vendor, El Cumbachero, Que Sera, Mexican Hat Dance,* and six more south-of-the-border items, Terry adds a slapstick version of *Happiness Is,* about key figures in the music business, and the title tune, *Spanish Rice,* a wacky bit of high jinks obviously concocted for the occasion by the performers. This may not be a disc to please all jazz fanciers or all Latin-music enthusiasts, but it's plain to hear that it pleased all of the participants. B.S.

Gabor Szabo: Spellbinder
Impulse Stereo AS 9123

Here's another new Impulse release with more than a modicum of performer deviltry. On a superb rhythmic base supplied by Chico Hamilton, Ron Carter, Victor Pantojo, and Willie Bobo, Szabo improvises with total freedom, and the results range from such foolish nonsense as a version of the Sonny and Cher hit, *Bang Bang,* complete with vocal, to a glorious duet with Ron Carter of *My Foolish Heart* that is bound to become one of the classic performances. In between are a number of pleasantries performed in Szabo's crisp sound with just a bit more amplification than I care for. The resulting quality is frequently closer to the sound of a jazz koto than to that of a guitar. But one can even overlook matters as important as sound quality when one hears such a sure, clean technique. To make that technique as evident as possible, Szabo has been given recording treatment that is almost clinical in its capture of close-up detail and crisp transient sounds. B.S.

Sonny Rollins: Tenor Titan
Verve Stereo VSPS-32

These are mono recordings made in 1957 and 1958 that have been "electronically enhanced for reproduction in stereo" and repackaged. Of the five tunes, four were recorded at the Music Inn in Lenox, Mass. with members of the Modern Jazz Quartet. *I'll Follow My Secret Heart* and *Limehouse Blues* are performed with Percy Heath and Connie Kay, and *You Are Too Beautiful* and *Doxy* also include *John Lewis.* The final band was cut in New York in 1957 with Dizzy Gillespie, Ray Bryant, Tommy Bryant, and Charlie Persip. The pseudo-stereo effect has been realized with a degree of success that makes me wonder if these were not actually true stereo tapings. The sound is fresh and spacious, but the playing is hardly likely to please any of Rollins' current admirers. The most useful function of this reissue is simply to demonstrate how much this leading figure in modern jazz has developed in the last ten years. B.S.

Kenyon Hopkins: Mister Budwing
Verve Stereo V6-8638

This is music from the original soundtrack of a new MGM film by the composer of movie scores for *Baby Doll, The Hustler,* and *The Property is Condemned.* It is a jazz-rooted background not unlike some of the scores of Henry Mancini. Hopkins has a sure way of writing for brass and reed choruses, but his arrangements for rhythm instruments are generally a bit angular, and he has a tendency to tie segments together with the kind of solo bridge passages that are standard film-music clichés. Some rearrangement for disc recording purposes could have made for a more cohesive musical package, but it is clear that as a background to a dramatic presentation this is a highly effective, ably crafted piece of creation. The recording has the typical sound of a big-scale Hollywood production—bright, full, and filled with special reverb effects. B.S.

Toots Thielmans: Contrasts
Command Stereo RS 906 SD

Guitarist, whistler, harmonica player, and the composer of *Bluesette,* Toots Thielmans is afforded the opportunity to display all of his multi-faceted talents in the ultra high-fi sound of this new Command release. Backed by an orchestra that includes such luminaries as Phil Bodner, on clarinet and flute, Phil Kraus, vibes, Bucky Pizzarelli and Al Casamenti, guitar, George Duvivier, bass, Grady Tate, drums, Eddie Shaughnessy, percussion, four trombones, and a thirteen-man string section, Toots has a field day with such widely varied material as *Sweet Georgia Brown, Sweet and Lovely, Spanish Flea, Royal Garden Blues, Cherokee,* and seven other numbers, including a new and superior edition of *Bluesette.* B.S.

Roswell Rudd: Everywhere
Impulse Stereo A-9126

In a span of eight years, this thirty-one-year-old trombonist has travelled from the ranks of the white traditionalist jazz combos to the forefront of the almost entirely black new-music practitioners. No matter who he plays with, he seems to fit in, and most important, vigor and enthusiasm with which to say he has something to say and lots of it. Heard with Giuseppi Logan, flute and clarinet, Lewis Worrell, bass, Charles Haden, bass, Beaver Harris, drums, and Robin Kenyatta, alto, Rudd offers four long compositions—two of them his own—in performances that have an easy self-confidence along with a fierce emotional intensity. B.S.

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About Music

HAROLD LAWRENCE

Recording Flamenco in Hollywood

HOLLYWOOD. During the Christmas season Los Angeles is a city desperately trying to stir up Yuletide spirits. Signs everywhere proclaim "Season's Greetings," red and green neon lights flicker in the San Fernando Valley, reindeer teams prance through the air over traffic intersections, and Santa is seen in department store windows, atop "topless" night clubs, and climbing down chimneys of ranch houses. Shuttling back and forth from my hotel to the recording studio, I spotted what I think is the most striking sign in all Hollywood, ranking second only to "We Squeeze Navels"—"Ho, Ho, *Ho!* Christmas Trees! Painted, Flocked, or Fireproofed!" The flocked pine outnumbered all others here. In fact, nearly every Christmas decoration in Los Angeles County seemed to be flocked.

Somehow Los Angeles didn't quite make it. The sun was too brilliant, the sky too blue, and the temperatures too high to convince me it was really December. And there were the ubiquitous palm trees.

But to at least one Hollywood family, the Southern California weather did not interfere with Christmas. Guitarists Celedonio Romero and Sons settled here nearly ten years ago after leaving their native city of Málaga in Andalusia. Since then they have become one of the most popular attractions of the musical circuit, performing almost one hundred concerts a year across the country. Between Christmas and New Year the Romeros return to their homes in the Hollywood hills to relax and celebrate the season with their friends. There are all-night parties, chamber-music soirées, much cooking of paella, drinking of sherry, and talking. But the Romeros work, too, and the major project of this season has been the final preparation of a two-LP recording of flamenco music for four guitars.

Like all Andalusians, the Romeros grew up with the sounds of flamenco around them. They absorbed the traditional flamenco *cantes* (songs) with their characteristic harmonies, their *compás* (set rhythm), and their *coplas* (stanzas). But only when performers improvise on the raw material of flamenco can the music come to life; as in jazz, improvisation is the lifeblood of this Andalusian art form. Each of the Romeros knows by heart the words of countless flamenco chants still being sung throughout Southern Spain, and their playing reflects this intimate knowledge. For this recording, the Romeros decided to round up an authentic *jaleo* to re-create the flavor of a real flamenco evening. Freely translated, *jaleo* means "hell raising." Its members sing, dance, snap their fingers, clap, shout, and otherwise encourage themselves and their fellow performers. Jaleadors function both as the percussion of the flamenco "orchestra" and its audience. But don't for a moment believe that the noise-making is random, merely the uninhibited expression of a group of peppery Spaniards. The clack of a palm on the wrong beat can throw off an entire piece. Anyone who has heard a fine dancing troupe like the late Carmen Amaya's knows how important the jaleo can be to the over-all impact of the flamenco experience. The exciting rhythmic patterns set up with heels (*taconeo*), palms (*palmas*), finger-tips (*pitos*), and castanets (in the Sevillanas), must be performed with razor-sharp precision to be truly effective.

When the Romeros located their jaleo (a singer from Málaga, a dancer from Seville, and a couple from Madrid), I booked a studio in Hollywood for six sessions and emplaned for Los Angeles to attend rehearsals at the home of the Romeros and meet with the recording engineers.

The combination of four guitars and jaleo poses considerable problems for the recordist. In this case, all the Romeros play guitars made by Miguel Rodriguez of Cordoba, sensitively constructed instruments noted less for volume than for warmth and purity of tone.

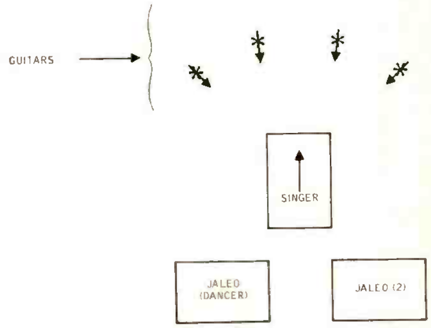

Fig. 1. The studio setup for recording these flamenco performances.

Against this we had to contend with the transient-loaded sound of the jaleo's heels, palms, castanets, fingers, and shouts of exhortation which, in tutti passages, would tend to obliterate the sound of the guitars. In live performance, the spectator can compensate for this by his visual perception: he *sees* the guitarists playing and therefore imagines he hears them at all times. Because the visual element is missing in a recording, the producer must restore proper aural balance.

There are roughly three ways of dealing with this problem: (1) Isolate the guitars from the jaleo; close-mike the instruments and place the jaleadors in a separate booth with their own microphone pickup. (2) Hold down the over-all volume level of the jaleo in performance. (3) Establish the focal point for the basic microphone setup to cover both forces.

The first method is undesirable because it would break up the *cuadro flamenco*, thus preventing intimate collaboration between jaleo and guitarists. Such an arrangement would also place the jaleo and guitarists on different planes of perspective and result in an artificial sound. The second method would make the engineer's job easier but only at the price of emasculating the musical results. In true flamenco music, no one can predict exactly when the lightning of intense feeling will strike, and when it does, look out! If the instrumentalists and jaleo have to think about reining in, you're nowhere. We chose the final alternative as best from the musical and technical standpoints.

The recording sessions took place at United Recording's Studio A on Sunset Boulevard. The dimensions of the room were 18 feet high, 55 feet long, and 40 feet wide. The Romeros sat in a line in the center of the studio, with the outer players (Celin and Celedonio) turned in slightly. Three Neumann U-67s set to an omnidirectional pattern were suspended approximately 7 feet above the guitarists. This provided the basic pickup. The jaleo was placed opposite to and facing the Romeros. (See *Fig.* 1.)

The principal dancer Raul Martín arrived with his own platform, a yard square of braced plywood. After a rehearsal of the Sevillanas it was decided to replace the platform because the hollow sound made the listener aware of its size. Engineer Ben Jordan found a larger platform in the studio that was equally solid and into which fiberglass had been stuffed. The effect was perfect.

We now tackled the palmas, pitos, and castanets of Isabel and Choly Martín (no relation to the dancer) and obtained good presence, except for a piercing, ringing sound on certain claps and on the castanets generally. Moving the Martíns back away from the microphones failed to eliminate the ringing and dissipated the stereo effect by excessive "bleeding" into the other inputs. Acoustical treatment was called for, something that would take the edge off the sharper sounds of the castanets and palms without in any way reducing the total impact. Waist-high panels were placed on either side of the Martíns' platform and an absorptive gobo rolled up behind. It worked.

The same careful balancing was applied to the Romeros and finally to the singer, whom we placed in the center between the two groups. The basic balance achieved, we prepared to "take" the first of the eighteen pieces to be recorded.

What happened in the next fifteen hours of recording is what every producer and engineer dreams of. Within the first seconds of the joyful *Sevillanas*, the excitement in the studio soared. Only eight performers were there but it would take a sophisticated ear to realize there weren't more. Although nothing was done to enhance or inflate the basic sound, one got the impression of a throng of participants. Accents were shooting forth from all directions—a guitar *rasgueado* (vigorous strumming effect), a machine-gun rat-tat-tat of the dancer's heels, an unexpected counter-rhythm in the *palmas*, the low-pitched cries of the female jaleador. After a rousing crescendo, the piece suddenly ended. Pause. Then a torrent of Spanish words as Romeros and jaleo exchanged compliments. For two minutes and thirty seconds the performers seemed to have forgotten about the microphones and the people in the control room behind the glass panel. They were in their native Spain halfway around the globe, playing in some *cafe cantante* for themselves and for a small but knowing audience. Æ

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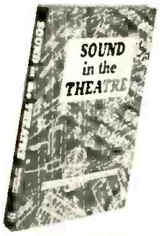

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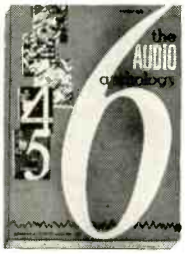

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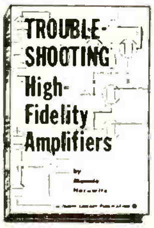

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