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NOVEMBER 1966 60c

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AUDIO

November, 1966 Vol. 50, No. 11

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AUDIO Articles

AUDIO Reviews

AUDIO Profiles

AUDIO in General

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Next Month Coming

Articles

Annual Tape Recorder Issue

'The Early Flutter Spoils the Recording' in which Lewis A. Harlow gives us some hints on how to maintain a recorder and what kind of reels to use for minimum flutter.

'The Hows and Whys of Tape Editing' by noted editing authority Joel Tall.

'Get to Know the Decibel—Better' in which George H. R. O'Donnell simplifies the unnecessary calculations involving the ubiquitous dB.

Profiles

Altec A7-500, A7-500W-1 Speaker Systems

Sony Integrated Amplifier—TA 1120 and Servomatic Turntable with arm and cartridge.

About the Cover

The ultimate goal is to diminish the difference between live and recorded performance not by reducing the quality of live but by ever raising the capabilities of reproduction.

Our model's gown is an original by Minissale, furs are by Becker & Burns, and photography is by Mano Mehanian—all of Philadelphia.

AUDIO CLINIC

Joseph Giovanelli

Organizing a "patch Panel"

Q. It is my desire to organize a "patch panel" circuit for my stereo system, which includes:

1. *Marantz stereo control Center*
2. *Marantz dual power amplifier*
3. *Fisher 200 FM tuner*
4. *Fisher 1000 MX adapter*
5. *Sony 777S type recorder*
6. *Revere Pro tape deck*
7. *Eico HFT92 AM-FM tuner*
9. *Rek-O-Kut L-34 turntable*
10. *Empire turntable and tonearm*
11. *Bogen P-61 turntable*
12. *Shure cartridge*
13. *Lafayette K-165 remote control stereo adapter*
14. *The system also includes a TV set.*

It is my impression that in using the appropriate plugs (pin/phone), sockets (pin/phone), plus shielded cable, I can simply duplicate the outputs and inputs on the rear apron of the Marantz equipment by connecting the aforementioned shielded cable and plugs into the various inputs and outputs and bringing them out to the face plate of the patch panel. In addition, if I repeat this process with the remaining components, again using the appropriate plugs and sockets, and again bringing the connecting cables out to the patch panel, I should be able to make whatever connections and disconections that I wish, without having to move either the components or the entire console cabinet in which the components are installed. I believe it is also feasible to connect speaker cable (No. 18) to the two sets of speaker connection terminals on the Marantz amplifier and bring them out to the patch panel; here I would connect the speakers to separate terminals or to the appropriate number of pins or phone jacks.

Would there be a noticeable loss of output capacity with such an arrangement? I recognize that any additional speakers that I connect here will reduce the output capacity of the amplifier to the main speaker system, but these speaker terminals would be only used for the experimental connection of external speakers (temporarily). In any event, all speakers have independent on and off switches.

In addition, I wish to connect the output signal from the TV set (I propose to tap the output signal from the terminals of the TV speaker, through an SPTS switch, thence to the center channel of the main speaker system, allowing me, I believe, to choose whatever speaker I wish, with both speakers being activated by the TV amplifier.) Naturally, the main (Hi-Fi) speaker would be off on such occasions.

Lastly, I have a transistorized mixer which I also propose to connect into the same patch panel as the other components. I cannot see any objection or conflict here.

I would appreciate your analysis of the suggested arrangement, and any suggestions, changes, or recommendations.

Alfred N. Williams, St. Albans, N.Y.

A. What you propose is basically a good idea, especially when a large amount of equipment is involved as is true in your installation. Your approach is exactly what I took in my recording facilities.

Keep in mind that there are various design considerations to observe.

Once the Marantz system has been grounded to the rack by way of the speaker connections, you must watch your shielding. Connect all shields to the plugs on the rear of the amplifier and preamplifier. Do not terminate the shields to the conectors on the patch board, however.

The connectors for use on the patch board should be standard phone jacks and plugs rather than pin plugs. (Pin plugs work satisfactorily when they are not going to be disturbed very much, as in the case of permanently installed music systems.) In your case, the whole object is to have a system in which flexibility is the keynote. This means that the patches will be constantly connected,

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70 Mk II

4-speed Automatic Turntable, $84.50.

• Garrard's exclusive pusher platform record changing principle for gentleness and reliability in automatic play • Dynamically balanced, flat silhouette, counterweight-adjusted tone arm • Low mass, cutaway slide-in shell • Needle pivots set in miniaturized ball bearings • Calibrated stylus pressure gauge with precision ¼ gram click adjustments • Adjustable anti-skating control • Exclusive full-size, heavy, balanced cast "sandwich" turntable • Double shielded Laboratory Series® 4-pole shaded motor • Super-sensitive trip with Dupont Delrin® • Two interchangeable spindles: short for single play, long one-piece spindle for automatic when desired.

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4-speed Automatic Turntable, $44.50. Built to full Garrard standards, the 40 Mk II 4-speed unit is an exceptionally compact automatic turntable at the price of an ordinary record changer. It was designed to introduce new concepts of performance and versatility where space must be considered.

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disconnected, and re-connected in various ways. Further, I do not suggest that you use the miniature plugs and jacks found on transistor radios and other portable equipment. I believe you will have strain relief problems involving the cables associated with such plugs. Further, I am not sure that the jacks will stand up under such heavy use.

Here is another point whereby you considerably increase your flexibility. The phonograph cables should appear on the patch panel rather than be plugged directly into the Marantz preamplifiers. It is not good practice to connect the cartridges directly to the patch panel (this will result in a loss of highs because of excessive cable length and will also introduce hum into the system.) I suggest that you obtain some kind of amplifier-equalizer for each phonograph system. The output of these amplifier-*equalizers* should appear on the patch panel. The equalizers should have the required number of equalization settings and sufficient gain to enable their outputs to be patched into high-level inputs on your tape recorders or your preamplifier.

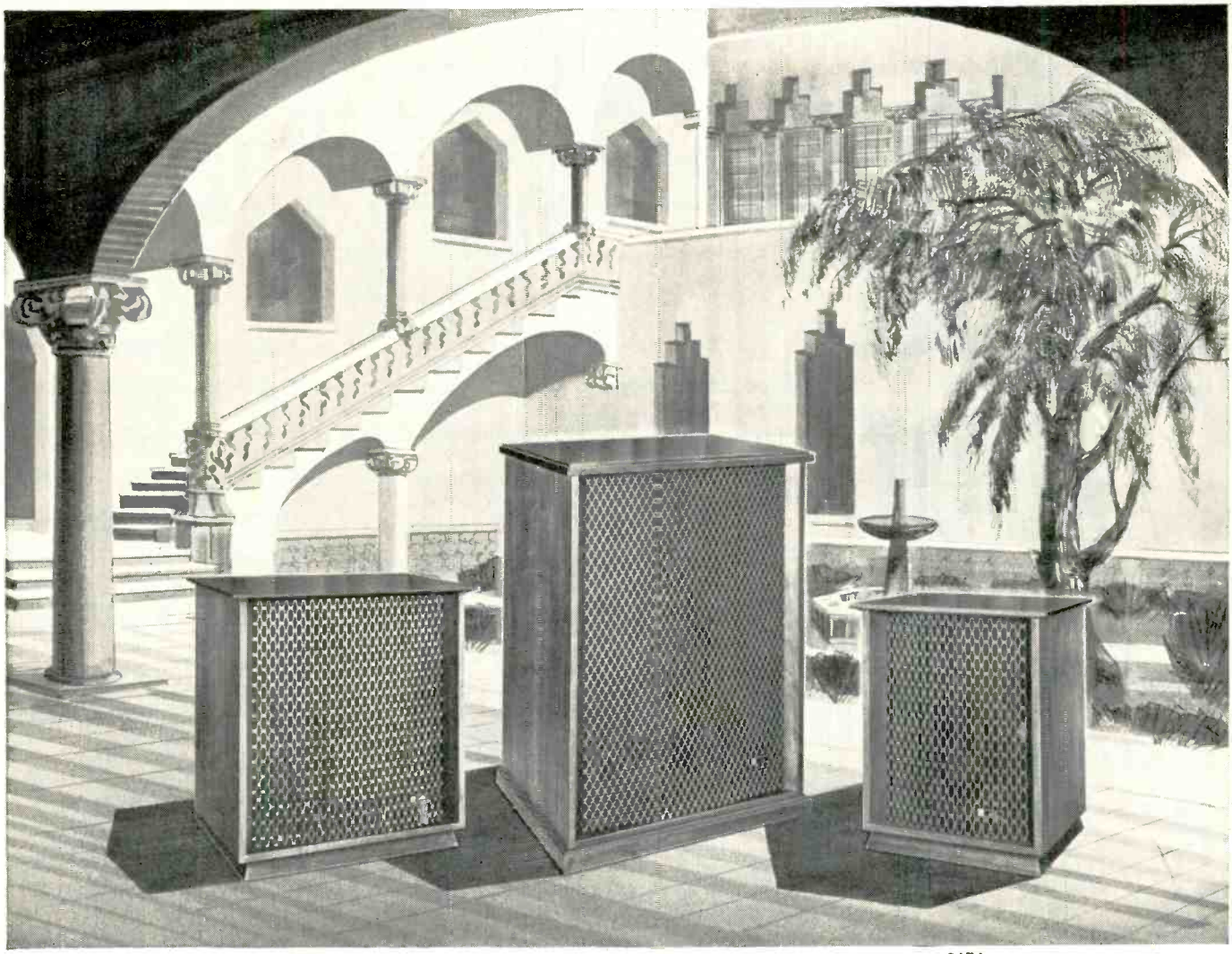
This arrangement makes for even more flexibility than you might think. Suppose that the cartridge is plugged into a minibox with a switch on it which can connect the two "hot" leads of the cartridge together. This will allow the cartridge to be used for monophonic records. Merely by opening the switch, stereo can be heard once more. The output of the switching arrangement can be fed to another set of terminals on the minibox. These, in turn, can be fed to the input of your equalizers.

If your tape deck does not have preamplifier outputs, it would be a good idea to use similar amplifier-equalizers to feed from the tape heads. These equalizer outputs can be fed into the patch network.

As for the speaker arrangements, each speaker should be brought to its own jack on the board. The amplifier output connections should also be brought to the board. This permits connection of any external amplifier to the speakers, and to connect any external speaker to the amplifier.

Here, again, it is possible to obtain greater flexibility by using what are called "normal" jacks. These "normals" are really nothing more than closed-circuit phone jacks. Let's examine the speaker connections. Each speaker is connected to the closed-circuit jack just as though it were an open-circuit jack. The amplifier output

(Continued on page 72)



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LETTERS

Tape Track Fringing

SIR:

In occasional EQUIPMENT PROFILES—for example, the one on the Knight KG-415 in the January issue—the comment has been made that frequency-response measurements made with Ampex standard tapes 31321-01 and 31331-01 that "the bump at 100 Hz on the 7½-ips curve we have seen so often on many different recorders that we have come to believe that the standard tape has the boost, rather than all of the recorders."

The two standard tapes referenced are recorded full track, and this seeming increase in response at lower frequencies is perfectly normal when the tapes are played back on half-track, two-track, or four-track equipment. Two factors influence this apparent rising response—the playback head "fringing" effect, and playback-head "bumps." Both are functions of the wavelength of the signal recorded on the tape, and are therefore dependent on tape speed.

Fringing is the result of the magnetic flux on each side of the head (as well as directly under the head gap) contributing to the current induced in the head coil. This additional current, of course, appears as an increase in signal output. Fringing becomes quite pronounced at long wavelengths, and grows progressively more noticeable as the wavelength increases. (Had the equipment under test provided better low-frequency response, the reproduced output from the full-track standard tape would have continued to rise to the 50-Hz region.) The degree of fringing depends upon the playback-head shielding, and a correction factor cannot be specified which will apply to all heads. At 7½ ips, different recorders may exhibit a fringing effect ranging from less than 1 dB to approximately 5 dB when full-track tapes are reproduced on narrow-track heads, even though the recording is "flat."

Head bumps are a function of playback-head geometry, resulting when the pole pieces on the head (as well as the gap) begin to pick up the magnetic flux and transmit it to the head coil. As frequency decreases, bumps and dips in the output may become noticeable. The largest bump will occur when a ½ wavelength of the signal on the tape equals the distance across the two pole pieces; there will be progressively smaller bumps at 1½ wavlengths, 2½ wavelengths, and so on. The largest dip will occur at 1 wavelength, with progressive smaller dips at 2 wavelengths, 3 wavelengths, and so on. Some professional recorders now provide variable low-frequency equalization to minimize the effect of head bumps.

The standard tapes you referenced will ensure accurate high-frequency equalization adjustments on narrow-track equipment. However, the lower frequencies recorded on these tapes will result in correct reproduce indications only for full-track recorders. A correction factor, determined for the particular recorder under test, would be necessary to make such readings valid for narrow-track heads. If low-frequency equalization on such recorders is adjustable, it should be accomplished by adjusting for flat over-all (record-reproduce) response.

For your information, Ampex Standard Tape No. 31321-04 is specially recorded on 7½-ips, ¼-track equipment. This tape should be used when testing such recorders.

HAROLD W. LINDSAY, Manager,
Audio Engineering Department,
Ampex Corporation,
401 Broadway,
Redwood City, Calif. 94063

Mate for "El Cheapo"

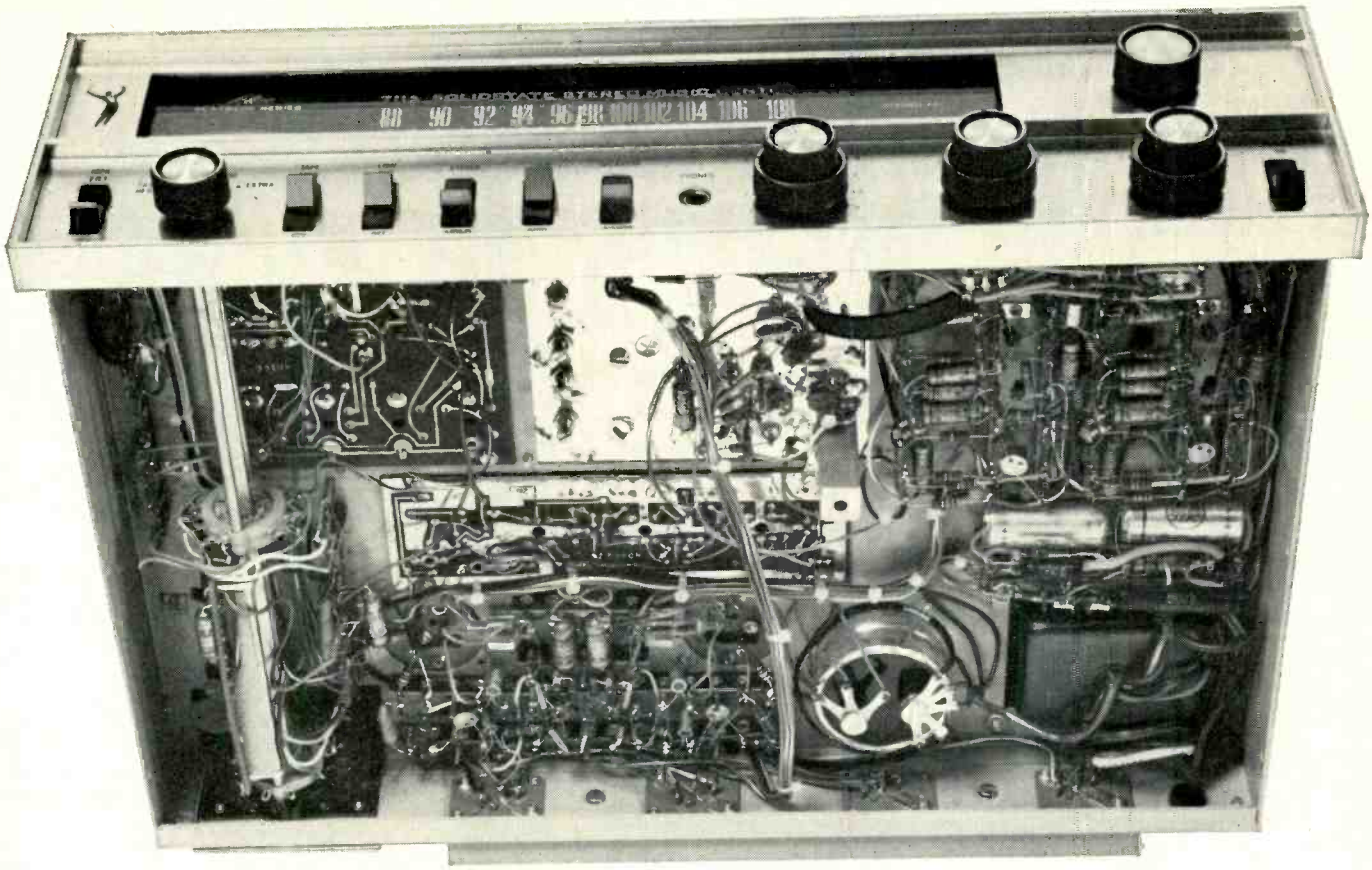
SIR:

I recently obtained several back issues of AUDIO here in Japan. A friend and I have started construction of "El Cheapo 2-30" which was featured in the November, 1964, issue. We are using Japanese parts and American transistors.

Both of us intend to expand our respective systems to include a tape deck, turntable, and FM multiplex tuner. We are attempting now to find a compatible pre-amp for the "El Cheapo." We do not desire the multitude of equalizing controls prevalent in some preamps but want a circuit equal to the power amplifier's quality and drive requirements. The circuit should be transistorized. Has a suitable circuit appeared in a past issue of AUDIO? If so, I would appreciate knowing the issue in which it appeared.

J. M. RUDHOLM,
USNSGA, Box 12,
FPO San Francisco, Calif. 96668

(Our recommendation would be the series of five articles by Aschinger which started in November, 1963, and ended in March, 1964. We have had few submissions of good preamp circuits since then. Ed.) •



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AUDIO ETC.

Edward Tatnall Canby

THAT LP REVOLUTION . . .

I. Angelim and Seraphim

As I confidently predicted in July (see upper right corner of p. 45, July issue), the new low-price LP revolution has broken out this fall all over the place, and particularly among the big companies. It's very frustrating for me, at the moment; because with our new and long-leisurely deadline for monthly copy, many of the new record lines have been announced as I write—yet the discs themselves are still to be seen and heard in solid plastic. By the time you get to reading this, *you* can rush right out and buy them. All I can do is talk.

(Yah, yah, I know—my colleague reviewers elsewhere probably've got there with the mostest firstest, or something. Well—OK! No new label worthy of its plastic will fold its tents for at least a couple of months; so I'll get to 'em.)

In July, I figured the big companies would soon begin to move into the new field come this fall, and so it has happened. That's what I'll talk about first.

Quite awhile back, Epic, sister-label to Columbia (or should I say niece?), announced its new low-priced line, called *Crossroads Records*. Just guess what the list price is. You guessed right. $2.49 stereo/mono. (Seems everybody has to undercut the original Nonesuch price by that big one cent.). No Crossroads discs are on hand at this writing. Floods expected momentarily. The label listed 20 releases in the first batch, all of them out of the Czech Supraphon catalogue.

Columbia isn't talking—yet. Let Epic take the rap.

Then we have the European giant, Philips, whose local outlet, aside from its own name-products, is Mercury. Big new doings over there. Philips announces its *World Series* label (no baseballs included), to sell at the unbelieveable low price of . . . etcetc. (Philips puts the penny back on again. It's $2.50, flat, for any record in the line, as of the list price.)

Philips, as noted in July, has enormous resources to throw into the $2.50 musical hopper. Their first release, too, lists no less than 20 items, out of Europe. The big specialty of this label, which I'll put aside for the moment, is COMPATIBILITY—one, single record for both mono and stereo. At last—somebody big has come out with the inevitable . . . but more of this later, below.

RCA Victor? Well, no news to report at this early juncture and I bet I can guess why. RCA already has so many labels it doesn't know where to go next. As an earlier pioneer in the "plain Jane" low-cost reissue field, RCA has had two labels straddling the new price area—Camden and Victrola. What has happened now is easily guessed. I discovered in September that the erstwhile Camden label was nowhere to be seen in Schwann's price listings. Only RCA Victrola. And guess what the new price on the old Victrola label is? Well, you didn't guess *quite* right. RCA has gone halfway. Yep, $2.50 for mono, all right. But $3 for stereo. How long will *that* last? Shall see. And see below, II.

Then, still another entry, we have a quite sensational line from Angel (out of E.M.I. in England, with all the multifarious E.M.I. world-over connections), called, by the most seraphic of logic, *Seraphim*.

The Seraphim label, very neatly packaged in pre-shrunk cellophane, white with black type and an overlay of blue, is as prolific as the others—a huge batch of these discs came in just in time to swamp me at the last possible minute. Seraphim, it seems, is going to run to high-quality reissues of the fabulous earlier E.M.I. repertory, back into 78-rpm days but also up into stereo and to the present in some releases. I've tried one very recent (continental) recording on the label—just lovely, and as good as an Angel.

I have one thorny question to solve concerning Seraphim. *Isn't that word a plural?* At this writing, nobody around here seems to know and my dictionary ain't. Maybe by next month I'll find out whether it ought to be *Seraph* for mono and *Seraphim* for stereo? *(Our dictionary says yup,* Seraph *is but one high-order angel;* Seraphim *is many.* ED.)

Angel must be holding in reserve that other Angelic term and its plural—Cherub and Cherubim. Remember those ancient lines, "Cherubim and Seraphim, ta-da, ta-da, ta-da," etcetc . . .? All very Baroque, this Angel stuff!

By the time you read this . . . well, you can add the rest. Umpteen more new labels, priced at either $2.49 or $2.50 for mono and stereo (boy, that penny seems important), and based very largely, as with Nonesuch and the other earlier $2.50 labels, on European imports. With roughly twenty discs per initial release for each of these, we will have such a plethora of LP records, come Xmas, that bulldozers won't be able to shove through the piles.

No—I still hazard a guess that the first-line celebrity records will *not* come down to $2.50, nor anything like it. You just can't pay for the Boston Symphony, for Callas and de los Angeles and Resnik and the other opera names, for Heifetz and Horowitz, Stokowski and Bernstein and von Karajan (and even such high-priced ghosts as Toscanini, Bruno Walter *et al.*) and still have money left over for publicity and for the stockholders.

Instead, as I figure it, there is now underway a very healthy competition-style development among the upper-bracket offerings, namely, a more-for-your-money movement. Fine! Not only fine quality—a crucial requirement—but superb extras such as high-style decor and, more important, voluminously handsome program and art material, of the sort that is mostly impossible to include in the low-price issues.

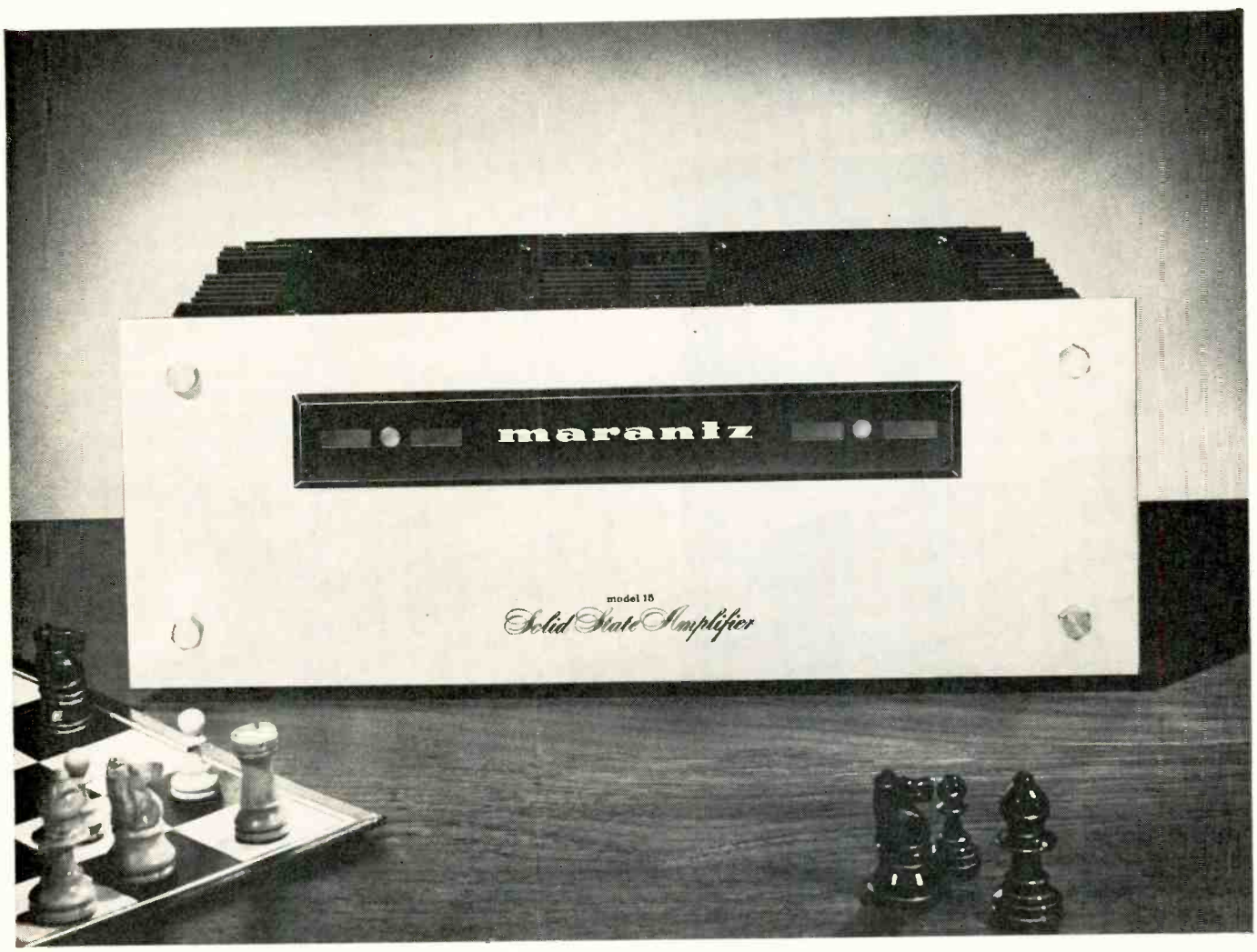
At a list price of $4.79 mono and $5.79 stereo—or often the higher price for both types of disc, as in many imports—these quality extras are the most significant aspect of the price picture for those of us who buy in both price ranges. A big sixty-four-page book, with texts, background material galore, handsome pictures, is enough to sell some albums without any records at all. Splendid thing, I say.

Go look at the multiple-disc RCA, Columbia, Angel albums, and many others at the same price, and you'll see what I mean. Worth it.

II. $5.79 vs. $2.50

1. Are the $2.50 discs worth it, in terms of technical quality? 2. What about the high-price imports versus the low-price imports on these new labels? Is it really meaningful, this $2.50 *vs.* $5.79 differential, as among rival imports? 3.

Marantz makes an incredible move *forward...*



model 15 solid-state 120-watt stereo power amplifier

With one devastating move, Marantz has check-mated all existing power amplifiers. The strategy was straightforward—build an amplifier to a set of specifications bordering on the far edge of the possible, then add a series of unique features to complete the coup. □ The 15's specifications are designed to test the mettle of your other components, while allowing them to perform to the limit of their abilities. *Power output*—60 watts per channel, with safe, full-power operation from 20 to 20,000 Hz. *Harmonic distortion*—less than .1 at full power, infinitely better than any other amplifier. *Hum and noise*—better than 90 db below 60 watts. *Response*—±1 db from 10 to 60,000 Hz. □ As playing partner to these performance characteristics, Marantz has created features of equal caliber. A safety circuit rendering short circuits completely harmless, even at full power. Instantaneous, distortion-free overload recovery. Separate power supply for each channel. High input impedance, permitting the use of even tube pre-amps without distortion. □ If having the finest power amplifier ever built is important to you, there's no need to ponder your next move. See and hear the 15 at your Marantz dealer's immediately.

marantz
A SUBSIDIARY OF SUPERSCOPE, INC.

FOR FURTHER INFORMATION, WRITE MARANTZ, INC., 37-04 57TH ST., WOODSIDE, NEW YORK 11377, DEPARTMENT C-17.

Check No. 59 on Reader Service Card.

And what about stereo-mono compatibility, along with synthetic stereo? These are remaining big questions.

1. There is much misunderstanding, I think, in respect to the technical quality possible at the new low price. Actually, there is every reason why it can be *precisely as good* as at the high-price level —and it often is. For, indeed, the records are mostly made in the same plants, on the same equipment, indiscriminately. Without the slightest doubt, given a first-quality tape, the $2.50 record can be and often is *technically identical* with the high-priced spread, if you see what I mean.

Cast Iron Cutting Styli

I say this because I think many record buyers have the mistaken idea that low-priced records are somehow pressed on separate equipment, probably obsolete, on inferior plastic that includes, perhaps, 10 per cent powdered sand as a filler along with a bit of cornmeal and a dash of grated Fiberglas. Also, that the masters are cut on old celluloid with cast iron cutting styli of variable radii, unpolished. 'Taint true!

There is not the slightest doubt that a large number of $2.50 discs (often available at lower prices, discounted) *are* technical duds. I should know. My own second record of the Canby Singers has suffered from certain troubles of the sort, not including Fiberglas and sand. (But it has been re-cut, to correct the unintended trouble, along with others of the sort.) There is also not any doubt at all that many $2.50 discs are just plain superb in quality. First-line. I think we must realize that the differences are largely, in the over-all, a matter of quality control, which can be more rigid in the more expensive lines, and/or in small volume runs.

The $2.50 market has expanded so fast that the processing plants, already operating on small margins, simply haven't been able to do a good job. A whole passel of related human factors unite here, to make it probable that the big-volume low-priced disc, *pressed and cut identically with the high-priced lines,* will tend to come out variably as inferior products.

Against this, the reputable manufacturers fight tooth and nail, as best they can. It all depends on who is doing the needling, the checking, the supervising of a million details. And how big, how fast, how pressured the rush-job turns out to be. In this tossing maelstrom of super-production, in this maze of splitting executive headaches, things can go wrong, horribly wrong, in so many seconds. Quality is up for grabs. First-line quality is a miracle of achievement—but, keep in mind, *it is always possible* and, in spite of all, even quite probable.

All of which reminds me of an old and honorable practice in the audio component field (and many others), by which two product lines emerge from an identical design, differing *only* in the degree of tolerance in quality control.

For people who really listen, we offer the first receiver with $400 specifications that sells for $279

ADC 606

90 watt, solid-state, FM Stereo Receiver

SPECIFICATIONS

Amplifier Section

Power:
90 watts (IHF) @ 4 ohms
70 watts (IHF) @ 8 ohms

Total Harmonic Distortion:
@ rated output, .5%
3 db below rated output, .2%

IM Distortion:
@ rated output, .5%
3 db below rated output, .3%

Frequency Response:
10-60,000 Hz ±1 db

Hum and Noise:
With volume control minimum, —78 db
Magnetic phono input, —65 db
Musical instrument input, —60 db
Auxiliary input, —75 db

Input Sensitivities:
Magnetic phono, 3 mv
Musical instrument, 50 mv
Tape, 100 mv
Auxiliary, 100 mv

Tuner Section

Usable FM Sensitivity IHF:
1.6 uv

Harmonic Distortion
(100% modulation): .5%

FM Stereo Separation:
35 db at 400 Hz
32 db at 1,000 Hz
20 db at 8,000 Hz

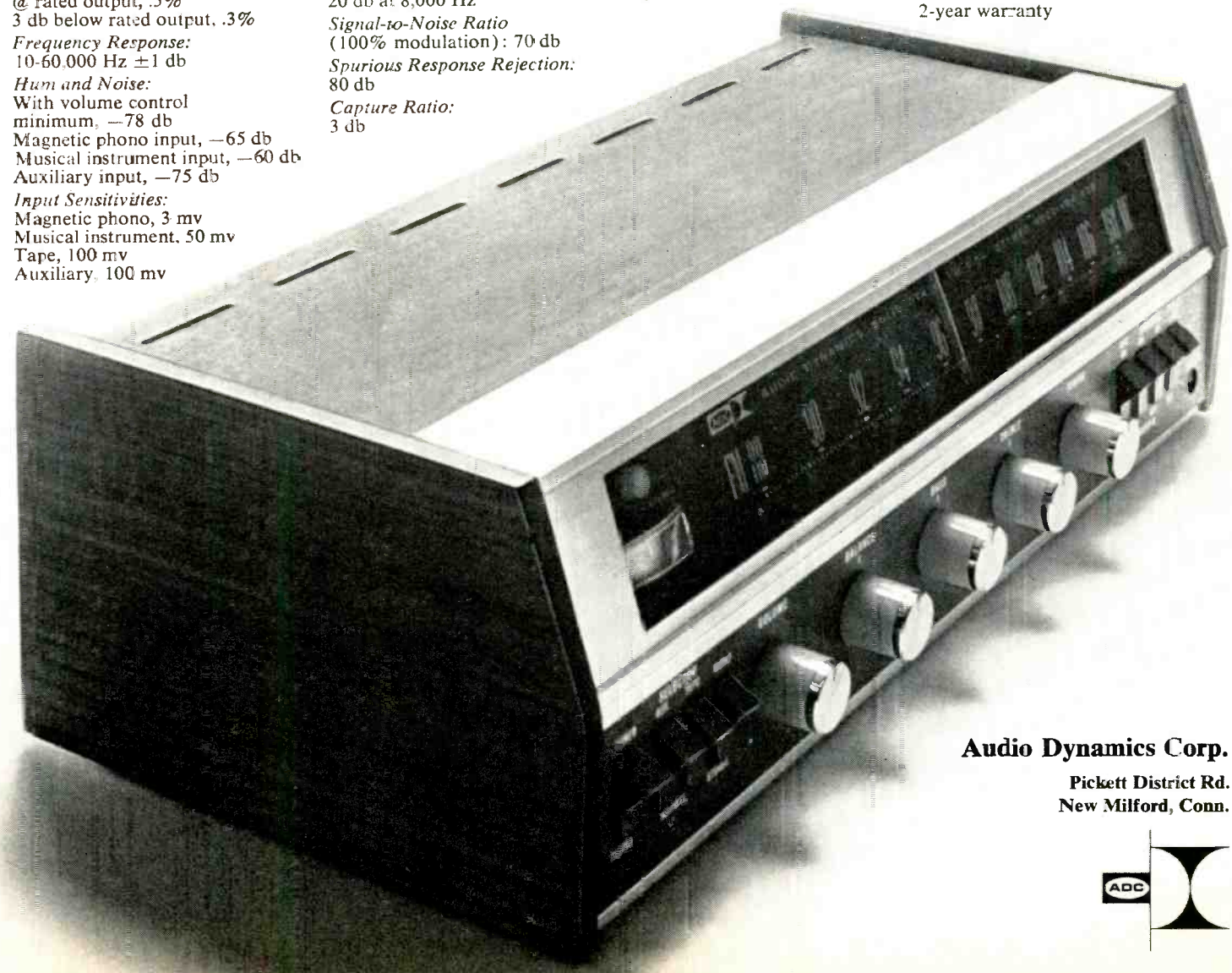
Signal-to-Noise Ratio
(100% modulation): 70 db

Spurious Response Rejection:
80 db

Capture Ratio:
3 db

FEATURES

First, true bookshelf depth: 17" wide, 5" high, 9" deep
Side panels eliminate need for separate cabinet
Large, readable, FM dial
Complete tape playback and monitoring facilities
Headphone jack
Musical instrument input
Automatic frequency control (switchable) for FM
Independent control for 2 sets of speakers
Each channel separately fused, plus main power fuse
Automatic FM stereo switching
2-year warranty



Audio Dynamics Corp.
Pickett District Rd.
New Milford, Conn.

Though it is not by choice, of course, much of the fluctuating quality found on the new $2.50 discs, good and bad, is due to this factor, quality control. Or slipping controls, out of control in the mad scramble to meet deadlines. Other factors are of truly less import, and, believe you me, that includes the quality of the original recorded material. For as we know, many of the low-priced reissues are significantly improved over the original releases of some years back, or from many years ago. Quality control is what *really* counts.

(And so I'm hoping the next copy I get of my own record won't have bubbles in the plastic, the way the last one did.) Thump, thump, thump. A typical quality-control error.

Imports vs. Imports

2. As to high-priced *vs.* low-priced imports, I refer you again to the July issue, which said it all in so many words. There is, again, virtually no technical differentiation between the $5.79 import and the $2.49 domestic-release import. Only the same old outward differences—availability, quality control, associated art and booklet material, exclusivity.

And so, as expected, there are now more inadvertent overlappings such as the Heliodor *vs.* Archive release mentioned in July (p. 45). I've just caught Angel out on a similar limb, for instance. Last season, Capitol Imports sent out a detailed listing of all the many European releases available, high-priced, along with its periodic bulletin, something about a Grape Vine ("News of Great Import . . ."). Listed there was German Odeon ST 91262, which featured nine unusual Handel songs in German, sung by Edith Mathis. I was much interested in this particular disc for musical reasons, and as a buyer I would gladly have paid the $5.79 (am I right?) price for its exclusive virtues.

But look now, quick, at the new Seraphim label. Did you ever! Seraphim stereo 60015 is none other than Edith Mathis singing nine Handel songs—the very same recording! Only now she sells at $2.50 list. Absolutely Angelic, too.

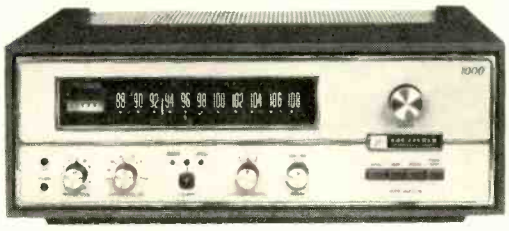
I suspect you'll find plenty more of these curious identical twins, at two prices, if you do an occasional bit of snooping around. That is, twins until the direct-import people get around to removing the higher-priced item from their lists. Takes time.

The direct imports that remain at $5.79, of course, are still—for the moment—decidedly worth considering as exclusive items for the connoisseur and worth their higher price. But you never know when they'll suddenly jump. Many won't, ever.

So you see, again, technical quality is *not* the determining factor. Demand, distribution, and sales, plus the old speculative urge, determine which discs go out at which prices.

(Continued on page 81)

No ad man can do it justice.



If you follow the ads in the hi-fi publications, you know that every tuner from $99 up is the absolute ultimate in sensitivity, selectivity, separation and frequency response.

That's what ad men get paid for.

But suppose somebody really does make the finest FM stereo tuner. What is there left for his ad man to tell you? Only this:

Forget about the ads. Make the rounds of the stores and listen to as many tuners as you can. Compare. Especially on a live multiplex music broadcast where distortion is easily detected. Count the number of stations you can tune in clearly. And while you're tuning, watch the signal-strength meter. Between stations, it should drop all the way to zero. That's an indication of selectivity.

Even if you do nothing else, you'll have no trouble evaluating Fisher against other makes.

But if you feel technologically insecure, take an engineer friend with you. Or an electronics technician. Ask him what he thinks of the new all-solid-state TFM-1000, Fisher's most expensive FM stereo tuner at $499.50.

Above all, ask your expert friend what he knows about Fisher and what the name means to him in comparison with others in the field.

Then you can read the stereo ads just for laughs.

(For more information, plus a free copy of The Fisher Handbook, write to Fisher Radio Corporation, 11-22 45th Road, Long Island City, N.Y. 11101.)

ILLUSTRATED: THE FISHER TFM-1000 BROADCAST MONITOR SOLID STATE TUNER. FIVE IF STAGES. NEWLY DESIGNED FRONT END UTILIZING FET'S. EXCLUSIVE COUNTER-DETECTOR CIRCUIT. SYMMETRICAL, HARD LIMITERS. USABLE SENSITIVITY (IHF), 1.8 MICROVOLTS. SELECTIVITY (IHF), 70 DB. CAPTURE RATIO (IHF), 0.6 DB. $499.50. CABINET, $24.95.

The Fisher

FISHER RADIO CORPORATION, INC., 11-35 45TH ROAD, LONG ISLAND CITY, N.Y. 11101. OVERSEAS AND CANADIAN RESIDENTS PLEASE WRITE TO FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY, N.Y. 11101.

Check No. 63 on Reader Service Card.

EDITOR'S REVIEW

WELL, THAT WAS THE WEEK THAT WAS, as they say on TV. The week in question was, of course, the week of the High Fidelity Music Show in New York. But those of us hi-fi buffs who infest hi-fi shows are never unhappy about a show, no matter where or when. Of little interest to us are the attendance, the hours, the site, or the attitude of the attendees.

On the other hand, of course, are those whose business and livelihood depends on the kind of people who come to hear and see, as well as on how many of them there are. And in the long run, that includes us, naturally—us at AUDIO, that is.

We hear many comments about all facets of every hi-fi show—the location, the weather, the attendance, and so on. We also hear the over-all tenor of the exhibitors' opinions.

Basically, however, we at AUDIO are more interested in the apparent trend of the industry as far as the product lines are concerned. Of this year's bash, we certainly cannot say that there is a trend toward more transistorization, since that was true for the last two years. A trend—possibly a hopeful one—that we did notice this year was toward the use of larger and larger speaker systems. Not that there is any diminution of interest in the small or medium "bookshelf" enclosures, but, particularly on the part of the old-timers in hi-fi, there is a re-vitalization of interest in large systems. At least, that is what several of the larger-system manufacturers told us.

Not that there has ever been any question about the value of the small speaker systems—especially to those who are not quite so dedicated to hi-fi that they will go to any ends to get the quality and decor they feel best suits them. On the other hand, it is most likely that the small speaker system has been responsible for many of the more recent converts to hi-fi. One has to start somewhere—like from roller skates to bicycle to hot rod. But it does appear to be a trend, in any case.

We were pleased to note another product which has been absent from the audio market place for a few years is on the verge of coming back. Two manufacturers showed prototypes of three-channel electronic crossover equipment, both to be available in early spring. One was a complete amplifier with three channels, and the other was only the network device. We are not mentioning names intentionally because the products are not yet available, and it would only build up hopes in some readers' minds that they could order one tomorrow. We are still often beset with requests for a complete construction article on a three-channel electronic crossover. (And if this isn't an invitation for a contributor who has such a story all ready, we didn't write the previous sentences with sufficient clarity.)

A new changer is on the way, along with a number of additions to the already accepted changer lines. More elaborate integrated amplifiers and receivers are here, and we must leave the details to the manufacturers' advertisements and literature.

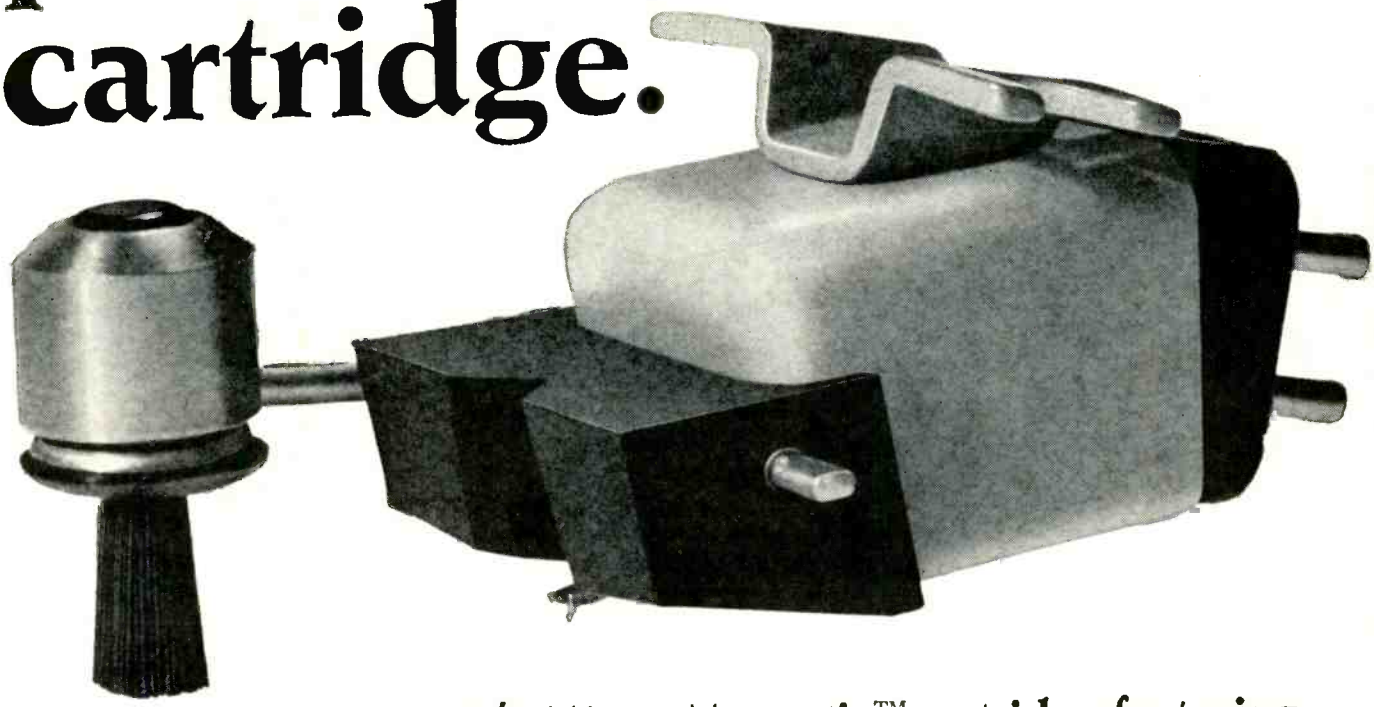
It also appears that the stereo tape cartridge for the automobile is going to be carried from the car to the living room in the coming season—one reel-to-reel tape recorder has an extra slot for the cartridge, and one compact system is similarly equipped, although the former was not exhibited in the N. Y. Show. There were, however, a number of adapters for in-the-home use for cartridge playing.

The competition between the two tape cartridge systems seems to continue unabated. Whereas a fairly large number of manufacturers have chosen one type, the sheer weight of the auto industry which seems to have plumped for the other type may develop into an extremely powerful factor. The best solution seems to be to duplicate all your tapes on both systems.

AUDIO'S FIFTEEN-YEAR ADVERTISING CLUB

The second meeting of our 15-year Advertisers Club was held during the show and was the occasion of the induction of eleven new members. Readers will recall that there were seventeen at the initial meeting in Los Angeles in March. The eleven new companies are Ampex, Audio Devices, Belden, Klipsch, JBL, Magnecord, 3M, Reeves Soundcraft, Rek-O-Kut, and University Loudspeakers. We were pleased to welcome them to one of the more exclusive clubs in existence —28 members.

The total performance cartridge.



New Pickering V-15/3 Micro-Magnetic™ cartridge featuring Dustamatic™ stylus and Dynamic Coupling.

Now, Pickering offers you total performance from all your records with the newly designed V-15/3 cartridge.

The exclusive Pickering V-15 Micro-Magnetic cartridge assures you of the finest in natural sound, while the famous patented V-Guard Floating Stylus provides the ultimate in record protection.

And now, there's a new dimension in the V-15 line. The extremely functional Dustamatic brush assembly for cleaning records *as* you play them, and an entirely new moving system with Dynamic Coupling of stylus to record groove for positive tracking.

There's a Pickering for every installation, from conventional record changers to the most advanced turntable/tone arm systems.

That's *total* performance. Clean records for clean sound.

For free literature on the Pickering V-15/3, plus information on how to choose the correct "application engineered" cartridge for your system, write to Pickering & Co., Plainview, L. I., New York.

For those who can hear the difference. **Pickering**

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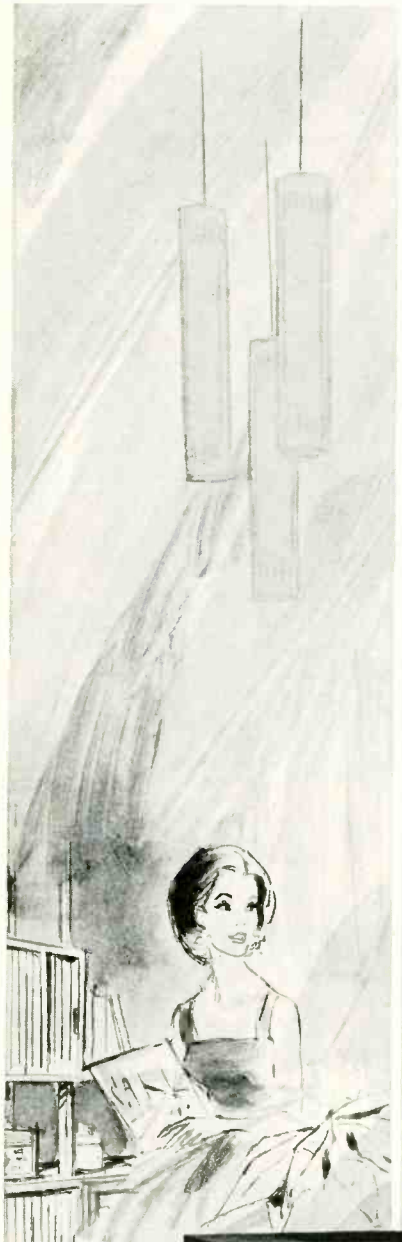
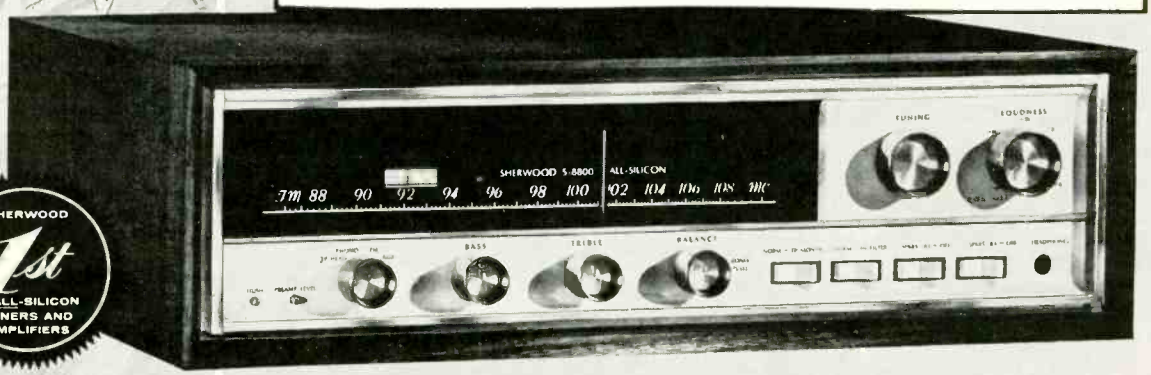
Compare these new Sherwood S-8800 features and specs! *ALL-SILICON* reliability. Noise-threshold-gated automatic FM Stereo/mono switching, FM stereo light, zero-center tuning meter, FM interchannel hush adjustment, Front-panel mono/stereo switch and stereo headphone jack, Rocker-action switches for tape 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.



Now, look at the *new* Sherwood specs!

Model	V-Vacuum Tube S-*ALL-SILICON* T-Germanium Transistor	Power (IHF) 2 channels 4 ohms Watts	FM Sensitivity Microvolts	Price	Dollars Per Watt
Sherwood S-8800	S	140	1.6	$ 359.50	$ 2.57
Altec 711A	S	100	2.2	378.00	3.78
Bogen RT8000	T	70	2.3	319.95	4.57
Dyna FM-3, PAS-3 & S-70	V	90	4.0	404.85	4.49
Fisher 700T	T	120	1.8	499.50	4.16
Fisher 440T	T	70	2.0	329.50	4.70
Harman-Kardon SR-900B	T	100	1.85	449.00	4.49
McIntosh 1500	V&T	85	2.5	499.00	5.87
Marantz 8B, 7T, & 10B	V&T	75*	2.0	1340.00	17.87
Scott 348	V&T	120	1.9	479.95	4.00
Scott 342	T	65	2.5	299.95	4.61

References "T" or "V&T" (above) may include some silicon transistors.
Figures above are manufacturers' published specifications except (*) which are published test findings.



SHERWOOD 1st IN ALL-SILICON TUNERS AND AMPLIFIERS

3-YEAR WARRANTY

S-8800 140-watt FM *ALL-SILICON* Receiver
$359.50 for custom mounting
$368.50 in walnut leatherette case
$387.50 in hand-rubbed walnut cabinet

Sherwood

Sherwood Electronics Laboratories, Inc., 4300 North California Avenue, Chicago, Illinois 60618. Write Dept. A-11

Check No. 65 on Reader Service Card.

TRACKability

Part I

JAMES H. KOGEN*

The poorest phono cartridge in use today in a hi-fi system is undoubtedly much better in all respects than the best one of, say, fifteen yeare ago, and fifteen years from now we'll probably be saying the same thing. In the meantime, the cartridge described here is the first of a "new generation" of cartridges by one maker. The author presents the problem, shows how it should be solved, and concludes with a product which may well be a leader in its field.

IN SOLVING TECHNICAL PROBLEMS, we often go full circle. When we first design a product, we solve as many of the problems as possible. After we are finished, even though the product works, we are practically never satisfied with the solution. So we start all over and try to provide better solutions. This isn't simply a matter of fun for the engineers. It is the basic element that makes for technical progress.

Phonograph cartridges have been made, in one form or another, for over sixty years. A primary requirement in building the first phonograph cartridge was that of making the needle stay in contact with the modulation in the groove of the record (which at that time was a cylinder). Since then we have worked on solving many esoteric problems, such as the elimination of tracing distortion and tracking distortion. The product of today is advanced far beyond that of Thomas Edison's original stylus. And yet we still must solve the same basic problem encountered by Edison, namely, keeping the needle in intimate contact with the groove.

A few years ago, Shure's engineers decided to take another hard look at the existing top-quality phonograph cartridges. The objective was to determine what might be done to make a better cartridge. As usual, the latest products seemed to be the utmost of what could be manufactured. Nevertheless, there were a few areas where performance could be improved.

In order to correct the existing imperfections it was agreed that a thorough, fundamental analysis was needed. Rather than try simply to make improvements on the latest products, a decision was made to go right back to the beginning. Many of the questions that were asked must have been the same ones that Edison asked; but the solution had to be infinitely better. In the following sections we will discuss some of these fundamental considerations.

Definition of "Trackability"

The necessity of keeping the stylus in contact with the record at all times is basic. We call the ability of a stylus to do this "trackability."

A phonograph stylus with good trackability will follow the modulation in the record groove no matter how wild the undulation. A phonograph stylus with poor trackability will lose contact with the record. When this happens, the stylus can no longer perform its basic function. The sound may become muddy. Irritating, scratching noises may be produced. In the worst case, the stylus may jump completely out of the groove. Good trackability is essential to top performance from a phonograph cartridge.

The question the engineer must answer is, "How Good?" Engineers must always seek a compromise between the perfect, ideal solution and the practical one. Fortunately, the solution usually does not have to be perfect. In any case, we must always determine what constitutes satisfactory

*Chief Engineer, Shure Brothers, Inc.

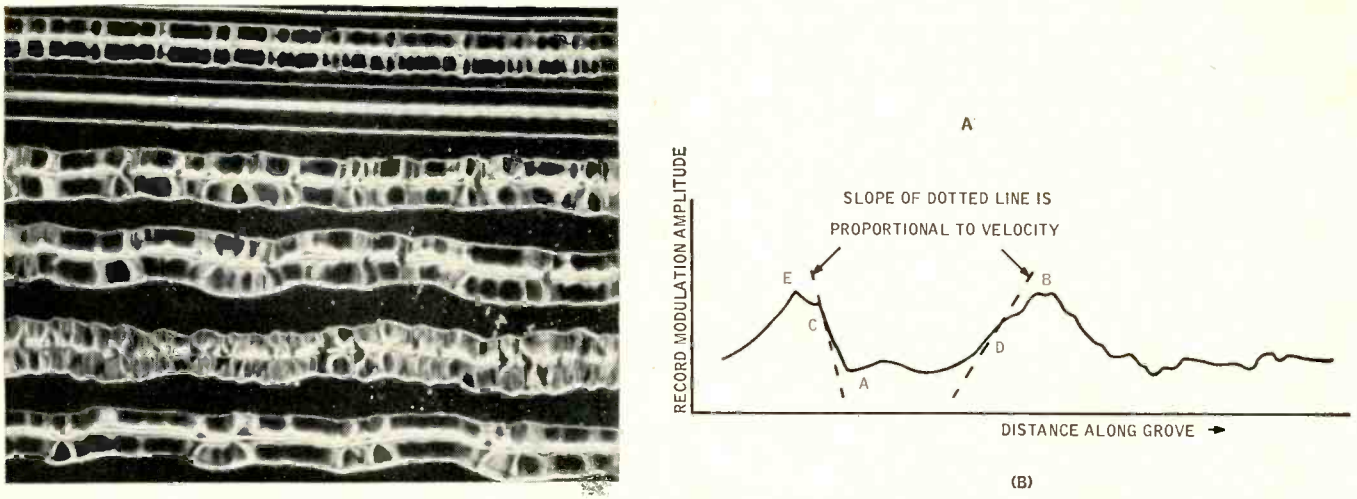


Fig. 1. (A), left, is a photograph of a record groove from directly above the record surface. This groove exhibits extremely high velocity modulation. (B), right, shows modulation amplitude vs. distance along the record groove.

graph cartridge, we must now talk about satisfactory trackability in terms of 1966 records.

What Problems do the Records Impose?

In *Fig.* 1, (A) shows a photograph of the modulation in a typical record groove, and (B) shows a plot of the modulation in terms of amplitude versus distance along the groove. As the needle follows such modulation, there are three conditions which must be met:

1. The needle must be able to follow the maximum *amplitude* variations of the modulation. This means that the needle in its compliant mounting must be able to move up and down far enough to reach the maximum and minimum extremities of the modulation, such as points A and B in (B) of *Fig.* 1.
2. The phonograph stylus must be able to move at the maximum *velocity* imposed by the modulation. This velocity is related to the slope of modulation as shown at points (C) and (D).
3. 3. The phonograph stylus must be able to follow the *acceleration* conditions imposed by the modulation. Acceleration conditions would be maximum at a point such as (E) or (F), and would indicate a maximum rate of change of velocity.

The stylus must be able to satisfy all three of these conditions in order to have satisfactory trackability. It is very important that we emphasize the word *"all"* in this statement. Heretofore, emphasis has been placed on the amplitude aspect, some lesser emphasis on the velocity aspect, and very little emphasis, or even concern, over the acceleration aspect.

The ability of a phonograph stylus to perform its amplitude-tracking function is related to the low frequency performance of the stylus. A cartridge which has poor amplitude trackability will mistrack on large amplitude, low frequency sounds, such as those which come from a bass drum, bass fiddle, or an organ. This is a common failing in many phonograph cartridges.

Trackability as it Relates to Amplitude

How can the user determine whether a phonograph cartridge has good amplitude trackability? The method which has been in vogue for many years is to refer to the compliance specification. It is assumed that if the stylus has high compliance, the trackability at low frequencies (amplitude trackability) is good. For example, a top-performance cartridge rated at 1 gram tracking force might have a compliance of 25 $\times$ 10^6 cm/dyne, whereas a poor cartridge at 1-gram tracking force might have a compliance of 5 $\times$ 10^6 cm/dyne.

The use of the term "compliance" is really an inferential way of specifying amplitude trackability. The user must infer that high compliance is synonymous with good amplitude trackability. Is it necessary to use such an inferential specification? We think it is not necessary. The user is concerned with how the stylus performs, not with measurements of internal parameters. In other words, he is concerned directly with trackability, not with compliance.

As a comparison, consider some of the things that concern an automobile owner, such as acceleration and mileage. These are performance factors. The average automobile owner is not concerned with the piston stroke or compression ratio, even though these parameters may be related to performance. He is primarily concerned with the functional characteristics or the way the product performs.

In the case of the phonograph cartridge, the user is interested in the performance at low frequencies rather than the compliance. The manufacturers should concern themselves, therefore, with providing good amplitude (or synonymously, low-frequency) trackability.

To decide what constitutes good low-frequency trackability, we can look at the standards to which phonograph records are made. These standards specify the maximum groove amplitude which should be cut on a record. This maximum amplitude is about .005 centimeters (.002 inch). Hence, if the record is made according to the standards, the phonograph cartridge must be able to move this distance without losing contact in order to follow any possible modulation which would be cut on the record.

"The word 'subtle' has proved to be a relative one in the history of high-fidelity reproduction. There have been times when many in the hi-fi community were certain that we had reached the ultimate. Each time the subtle difference changed to an obvious difference when better equipment came along."

This then is the specification on the amplitude trackability for an ideal phonograph stylus.

Velocity Trackability

Velocity trackability relates to the capability of the stylus to track in the range of roughly 800 to 2500 Hz. In this range we have many fundamental tones of the human voice and the majority of musical instruments. No standards exist regarding maximum velocity of modulation as for amplitude modulation. The requirement on velocity trackability which must be met by the phonograph stylus is therefore the maximum velocity imposed by the records of the day.

Measurements on a great many records indicate that a maximum velocity on good quality stereo records runs about 25 cm/sec. We have found velocities as high as 40 cm/sec on some seven-inch rock-and-roll records, but these are usually discounted in determining the performance requirements of a high-quality phonograph cartridge. When one considers that typical, good-quality records are cut at a normal velocity of about 3 to 5 cm/sec it is clear that 25 cm/sec is a very high velocity, and would produce a rather loud sound in the average living room. This maximum velocity thus defines the specification for velocity trackability of a practical, ideal cartridge.

Acceleration Trackability

Acceleration trackability refers primarily to the high-frequency capability of the phonograph stylus. Here we have the problem of tracking high-frequency notes and overtones. Sound from such instruments as cymbals, bells, and castanets can impose severe requirements for acceleration trackability.

Acceleration requirements can be determined in a number of ways. In the final analysis, however, we really ought to look at the records which are being manufactured. After assessing the requirements of the most difficult records we might then determine what the phonograph stylus must do.

In order to get a good cross section of "difficult-to-play records," Shure contacted record critics throughout the United States. These critics were asked for their recommendations on records which they have found difficult to play. A long list of suggestions was obtained, the records were purchased, and evaluated by Shure's engineers. Some of these records were found to have acceleration requirements beyond the capabilities of any known phonograph cartridge. For example, one good-quality record required an acceleration of 1500 g's at 14 kHz. This compares to a typical, good-quality phonograph cartridge capability of 300 to 400 g's at that frequency. The acceleration requirements of these records were then chosen as an objective for the ideal cartridge.

The Sound of Poor Trackability

Poor trackability can often be quite obvious and can more often be quite subtle. In one obvious case, the needle may actually skip from one groove to another. In another obvious case, a distinct rattle can be heard, usually with a loud, high-frequency note. In the more subtle case, we may have poor reproduction of a sound which is accompanied by many other sounds. This might be the case, for example, of a poorly reproduced cymbal clash which occurs along with the output of the full orchestra. In this case, unless we are very good listeners, the masking effect of the remainder of the orchestra will cover up the poor reproduction of the cymbal clash.

The word "subtle" has proved to be a very relative one in the history of high-fidelity reproduction. There have been times when many in the hi-fi community were certain that we had reached the ultimate. Each time the subtle difference changed to an obvious difference when better equipment came along. We believe this to be the case for the "subtle" differences in acceleration trackability. Today, this subtle difference may only be noted by the expert listener who describes it as "muddy" or "raspy." When we have achieved the desired acceleration trackability, this sound suddenly becomes clear and even the inexpert listener can tell the difference between the new and the old.

Another interesting aspect of this situation is that on some records a rather poor cartridge may sound better than a good one; although neither will sound as good as the ideal. The reason for this is apparently the fact that a poor cartridge reproduces nothing of the high acceleration modulation. The good cartridge reproduces this modulation, but imperfectly. To illustrate, we might compare the two cartridges in trying to play the modulation produced by a castanet. The very poor cartridge will reproduce practically nothing. Hearing nothing, the listener would not be upset unless he knew that the castanet was supposed to be present. A good cartridge would partially reproduce the castanet sound, but might not do so perfectly. The listener would be irritated because he would hear a distorted sound. In such a case, one might well choose the rather poor cartridge. In practice, such a situation occurs in a relatively small percentage of records, so that the expert still prefers to use the very good cartridge. Ideally, he would like an even better cartridge that would play the most difficult modulation.

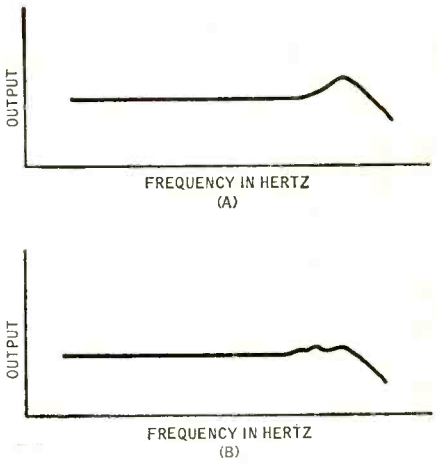


Fig. 2. (A) is a representation of proper trackability with a tracking force of 2 grams. (B), shows improper trackability of the same cartridge with a tracking force of ¾ gram.

Effects of Frequency-Response Measurements

Thus far we have tried to stress the importance of trackability with regard to following amplitude, velocity, and acceleration requirements imposed by the record. We have related these requirements to the need to provide true reproduction of the original sound. We will now discuss the effects of trackability on the measurement of frequency response.

The frequency-response measurement has long been considered the primary technique for measuring the quality of a phonograph stylus. This measurement tells whether the stylus is capable of reproducing frequencies within the audio spectrum of 20 to 20,000 Hz. It also tells whether there will be accentuation or reduction of frequencies within this spectrum as denoted by peaks and valleys in the response curve.

It is basic in frequency-response measurements that the stylus track the modulation in the groove. To make a proper frequency response measurement of a phonograph cartridge the stylus must not be driven to a point where it loses contact with the record. In other words, trackability must be perfect during the complete frequency-response measurement.

It has been our observation that many frequency-response test records are cut at a modulation level beyond

the tracking capability of most phonograph cartridges at their minimum specified tracking force; particularly in the high-frequency region. This means that the response measurement, usually above 10 kHz, is most probably erroneous. When proper tracking takes place, the response curve is normally quite smooth, although there may be peaks and dips. When good trackability is not obtained during the frequency response measurement, the curve will appear quite ragged, and may even show double peaks where only one would be expected. In *Fig.* 2, (A) shows the kind of frequency-response curve one would expect when the needle is tracking properly, and (B) shows the kind of curve which is often obtained under conditions where the needle is not tracking properly.

In a measurement of a stereo cartridge we usually show both the desired-channel response and the crosstalk response. The desired-channel response would be obtained, for example, in the right channel by playing a groove with right-channel modulation. The crosstalk response would be obtained in the right channel by playing a groove with left-channel modulation. We have found that the resonant peak of the crosstalk response is usually a good indication of the actual response of the stylus, and should coincide reasonably well in frequency with the main-channel resonance. (A) in *Fig.* 3 shows a measurement made under proper tracking conditions where the two peaks coincide in frequency, and (B) shows a condition of poor trackability wherein the crosstalk resonance is 2 to 3 kHz higher in frequency than the resonance indicated by the main-channel response. This curve indicates that the main-channel response measurement was taken under conditions where the stylus was not tracking properly.

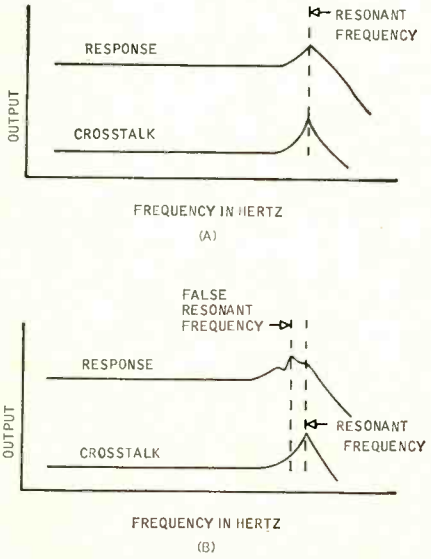


Fig. 3. (A) Response (upper) and crosstalk (lower) curves of a cartridge tracking properly at 2 grams tracking force. (B) Curves of same cartridge tracking improperly at ¾ grams.

Figures 2 and 3 indicate that unless proper tracking exists during the measurement an erroneous frequency-response curve will be obtained. The trackability problem in frequency-response measurements almost always occurs in the high-frequency region above 10 kHz. This problem arises primarily because of the inability of the stylus to satisfy the *acceleration trackability* requirements imposed by the test record.

The Design of the Stylus and Transducer

So now we have the challenge of trackability. The stylus must be able to satisfy the amplitude, velocity, and acceleration requirements. Concurrently, the phonograph cartridge must have a suitable frequency response. It must be reliable and insensitive to the effects of temperature. It must not collapse after being played for extended periods of time. It must have reasonable clearance between the record and the under surface of the cartridge, so that the cartridge will not bounce against warped records. It must be insensitive to hum. It must be capable of minimizing tracing distortion and vertical-tracking-error distortion (it should have a 15 deg. vertical tracking angle). And finally, and certainly far from least, it must be manufacturable at a reasonable cost.

With these requirements in mind, Shure engineers began the design of a new phonograph cartridge. They did not ask the question, "How can we improve our present product?" The question which was asked was, "If we wanted to design the ideal, practical cartridge, how would we do it?"

The first part of the study involved an evaluation of the restrictions imposed by the acceleration-trackability requirement. This requirement limits inertia and compliance of the stylus and transducer.

To start, a study was made of transducing mechanisms. This study covered a variety of aspects such as the simplicity of the transducer, cost, reliability, and the restrictions that the transducer might place on the over-all design. The latter requirement means that one would not be able to use a transducer with excessive mass, or one with excessive stiffness.

After an exhaustive study of the pros and cons of every transducer which appeared even remotely feasible, it was concluded that we simply could not find a better transducer than the one which we had been using, namely the moving magnet. This transducing device, as shown in *Fig.* 4, has the following advantages:

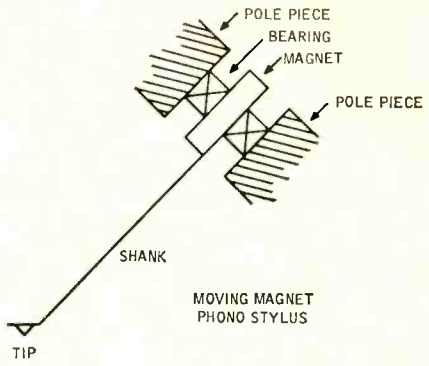


Fig. 4. Representation of the generating element of a modern moving-magnet cartridge.

1. It adds no stiffness to the system. The magnet is simply attached to the end of the stylus and in moving produces an electrical signal in the coil.
2. The moving magnet transducer requires no external source of bias voltage.
3. It does not require large permanent magnets which may be attracted to steel turntables.
4. The stylus is removable for easy replacement.
5. Output level is sufficient for any hi-fi amplifier as evidenced by the millions of such cartridges now in use.
6. The transducer is rugged, since no moving wires are employed.
7. Hum pickup can be eliminated without difficulty.
8. The transducer is not temperature sensitive.
9. The mass added by the magnet constitutes only about 10 per cent of the total effective mass of stylus and transducer at the stylus tip. As will be shown later this amount of added mass in within the limit allowable for meeting trackability and frequency-response requirements.

Consideration was also given to more esoteric methods of transduction, such as light-beam pick offs from the stylus, capacitive pick offs, and acoustical pick offs. All of these added considerable complication to the system and offered little or nothing in the way of advantages.

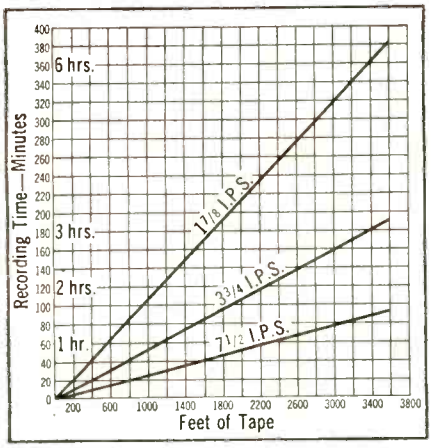
As a result of this study, our conclusion was that the moving-magnet transducer would offer the most potential for meeting the requirements of the ideal cartridge.

Continued Next Month

Some plain talk from Kodak about tape:

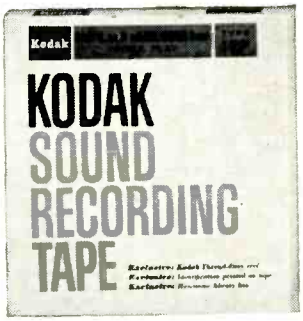
Uninterrupted listening pleasure... and the answer to a searching question

Recording a pop tune or even the whole top ten isn't much of a problem with standard sound tapes. But people always want more—like getting a whole Wagnerian opus on a single reel. Actually, the problem of long playing time involves two variables: how fast you run the tape, and how much tape length you get on a reel. The latter variable is a function of reel size and tape thickness. The following chart will give you an idea of running times with different lengths of tape:



Some like it slow. Taking it slow is the obvious way to get longer playing time. Halve the speed and you double the time it takes for the tape to run. This works very well up to a point. As a matter of fact, it is the historical trend—from 15 ips to 7½ ips to 3¾ ips and so on. But as you cut the speed, and thereby compress the recording, you make the microscopic perfection in the tape more and more important. Furthermore, at slow speeds the increased dependence upon short wavelength information and the concurrently reduced flux-carrying capacity of the tape makes head and equipment design more difficult. But even though improved quality slow-play tape recordings are strongly dependent upon improved equipment, you are still ahead with the built-in quality of KODAK Tapes—high output tape Type 34A, with its output and noise advantages, or low-print tape Type 31A.

Some like it thin. The other avenue is to go to a thinner tape . . . one that packs more length on the reel. This too is an appealing idea—one that explains the proliferation of double and triple play tapes. So what's the catch? Well, for one thing, very thin tapes require careful habits on the part of the home recordist. Your recording/playback heads should be in good shape, as thin tape is more liable to physical distortion and breakage. Make sure that your recording equipment is in top shape so that it produces smooth starts and stops. You can help with a smooth start by turning the reels away from one another (gently, please) so as to take up any slack in the tape which may have occurred during threading. Also, forget the fast-rewind knob—store tapes "as played." Fast rewind can set up a lot of tension and often cause erratic winding. All this can result in "stretched" or "fluted" tapes. In a nutshell, treat thin tapes with loving care. When you record, be careful not to overload on input (if you have a VU meter, keep the needle slightly below the record level you would normally use for regular tape). Last but not least, make sure you get your tape from a reliable maker—like Kodak. It takes a lot of extra care in winding, slitting and over-all handling to come up with a superior triple-play tape like Kodak's famed Type 12P. Because of its highly efficient oxide, Type 12P gives you a signal-to-noise ratio better by close to 6 db compared to the other leading triple-play tape. Add to this the advantage of back printing (so you always know what type of tape you're using—even when it's in the wrong box), and a dynamically balanced reel that reduces the stress and strain on a thin tape, and you can see why KODAK 12P Tape is becoming so popular.



KODAK Tapes—professional types and the long-playing variety—are available at most electronic, camera, and department stores. If you've had trouble finding them at your favorite store, Kodak would like to help. Simply tell us where you'd like to buy KODAK Tape, and we'll see what we can do about having these stores stock it. In the meantime, we'll rush you the names of nearby Kodak dealers where you'll be *sure* to find KODAK Tape; also, a very informative booklet "Some Plain Talk from Kodak about Sound Recording Tape." Just fill out the coupon below.

Mail coupon today

Eastman Kodak Company
Department 940
Rochester, N.Y. 14650

Gentlemen: I would like to be able to get KODAK Sound Recording Tape at the following stores:

1) _____ Camera store

2) _____ Department store

3) _____ Electronic supply store

Please send names of nearby outlets and my free copy of "Some Plain Talk from Kodak about Sound Recording Tape."

Name _____

Address _____

City & State _____ Zip _____

EASTMAN KODAK COMPANY, Rochester, N.Y.

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TYPE II

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.)

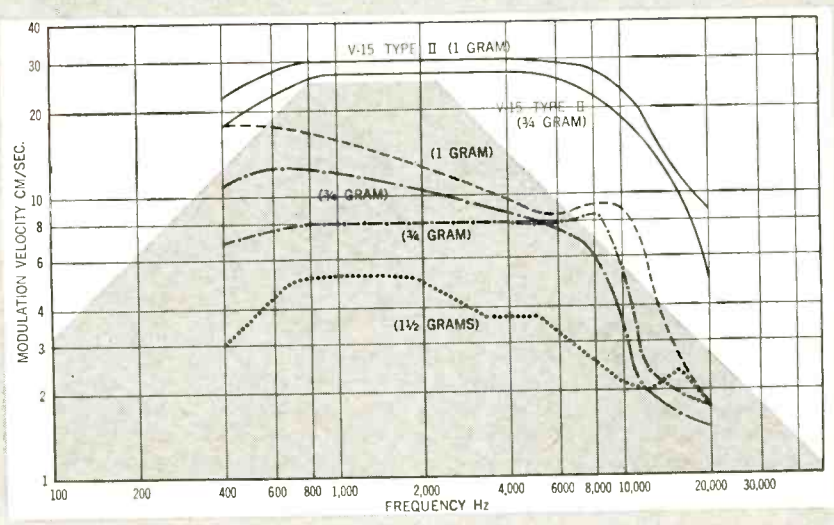
(2) A reprint of the definitive technical paper describing the Shure Analog and trackability in cartridges, which appeared in the April 1966 Journal of the Audio Engineering Society, is available (free) to the serious audiophile.

(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.

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High Fidelity Phono Preamp with FET's

WILLIAM A. RHEINFELDER

INTRODUCTION TO FET's

FET's or Field Effect Transistors are a newcomer to the family of amplifying devices which includes vacuum tubes and normal transistors, which are often called bipolar transistors in contrast to FET's. In bipolar transistors amplification is achieved by use of both types of carriers, electrons and holes, while a FET relies on carriers of one polarity only, such as electrons, and is also called a unipolar transistor.

FET's function very much the same way as vacuum tubes and amplification is achieved by control of an electric field. This field is set up in a semiconductor by applying voltage to the ends of a channel, such as a bar of N-channel germanium (rich in electrons or negative charges). The electrodes are termed source (cathode) and drain (plate) and are biased exactly like a vacuum tube for a N-channel device, with positive voltage to drain. In order to control the field set up in the semiconductor, a third, insulated electrode is added, the gate (grid), which is biased negatively with respect to source (cathode). In a field-effect device no gate (grid) current flows, but rather a control voltage is used to control gain just as in a vacuum tube. Because of this similarity, it is generally much easier to follow the existing tube circuitry for design. Knowledge of standard transistorized circuits is of little use with FET's. However, design with FET's is much simpler than with normal transistors, due to their high input impedance and ready capability. New work, shown in this article indicates the superiority of FET's over both vacuum tubes or normal transistors, particularly in audio applications.

For a better understanding, the chief characteristics of transistors, tubes, and FET's are summarized in Table I.

FET Performance Characteristics

NEW CIRCUIT DESIGN PROCEDURES for FET's were recently developed[1,2], which result in far superior circuit performance than is possible with the best transistor or vacuum tube circuits. It appears now, that FET's will replace both vacuum tubes and bipolar transistors in all linear (amplifier) applications within the next two to five years. Presently available FET's[3] surpass all previously known active devices with regard to noise, overload, linearity (distortion), gain, current economy, input impedance, and so on. For example, while transistors have a lower noise level than tubes (4 to 6 dB at audio frequencies, about 3 db in uhf-TV-tuners), FET's in turn are better than the best transistors. An improvement of 2 to 4 dB over the best bipolars was noted with presently available FET's in audio circuits. Tubes as a rule have an output capability from 12 to 20 dB higher than bipolar transistors in audio voltage-amplifier circuits. Again FET's provide more signal than even tubes for the same distortion.

The linearity of FET voltage amplifiers itself is phenomenal. Take the typical case of a transistor stage running about 5 per cent distortion in the output. If the distortion is measured directly at the base, it will read about 4.8 per cent. This is typical for normal transistors because the distortion is generated in the very nonlinear forward-biased base-emitter diode, while the amplification process itself is usually reasonably linear. The high distortion of normal transistors is inherent and cannot be removed but only minimized.

A vacuum tube by comparison may read 10 per cent distortion in the output, with about 0.5 per cent read directly at the grid. The distortion generated in the grid circuit is mainly due to the normal grid current of vacuum tubes of about 1 microamp.

A FET measured under the same conditions shows no measurable distortion in the gate at all. As a matter of fact, a FET single-stage amplifier was driven into heavy output overload (heavily clipped sine wave) with about 30 per cent distortion. When measured at the gate, the distortion still read 0.01 per cent (the distortion of the generator itself). This means that distortion in FET's is limited to output overload which is essentially determined by supply voltage. Below the start of output clipping, output distortion in FET's runs at extremely low levels, far less than with both vacuum tubes or transistors.

The reduced noise level and higher output capability result in an increased dynamic range for the FET amplifier. Other characteristics, such as gain in excess of pentode amplifiers and performance at low current levels are obvious advantages. Among these is excellent temperature stability. FET circuits were demonstrated which perform without deterioration when submerged in liquid nitrogen (−200°C) and at ambient temperatures as high as +180°C.

Circuit Designs with FET's

The obvious question then is what circuit-design procedures must be followed to obtain this excellent performance. Briefly, the essentials are correct d.c. biasing, realistically specified FET's, and high-impedance amplifier design as with vacuum tubes.

A FET behaves in any respect as an ideal pentode not having a screen grid (with the possible exception of feedback capacitance). FET's, being "field" devices, want to operate at high voltage for best performance. Drain current is of little importance as long as the drain voltage itself is correct. Extensive tests indicated that the optimum drain voltage in voltage-amplifier applications falls at 45 per cent of the supply voltage, regardless of the specific FET or drain current. Also, for the best all-around performance in audio circuits, a load resistance of 100k ohms is best (lowest distortion, wide frequency response). Another good choice is 220 K ohms where increased gain is achieved with increased distortion and somewhat reduced frequency response. All of this is quite familiar from vacuum-tube design. The objective is then to bias the FET so that the required

[1]"Biasing Consideration for FET's," Engineering Report 2. (Available from Dickson Electronics Corp., 310 S. Wells Fargo Road, Scottsdale, Arizona.) *Literature*

[2]"Design Criteria for FET Voltage Amplifiers", Engineering Report 3. *ibid.*

[3]Q-series by Dickson Electronics

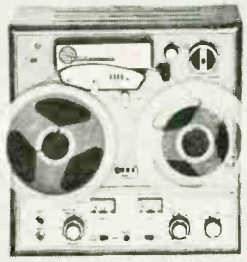
Soundsibility!

Soundsibility — superb sound with sensible features — it's a tradition with Viking tape recorders. In keeping with this tradition Viking introduces the new Model 423 — designed to bring you excellence in performance, true stereo fidelity and the utmost in practical operating convenience.

A three-speed unit with solid state stereo electronics, Model 423 also has three motors for highest reliability. Other features include hyperbolic heads, illuminated recording meters and directional control levers. A remote pause control* fits every Model 423 and lets you interrupt and resume recording or playback conveniently from your easy chair. So sensible even the model number is meaningful — 4 tracks, 2 heads, 3 speeds. Uniquely, with all these features, it's less than $250.00.

*Remote pause control and walnut base optional accessories.

You'll also find soundsibility in other Viking models which set a standard of excellence for tape recorders.

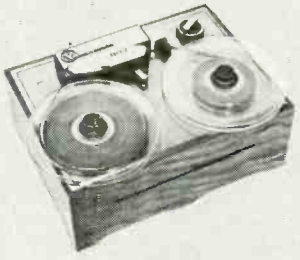


88 Stereo Compact

The "final touch" for stereo music systems. Features tape monitor with three heads, sound-on-sound recording, exceptional fidelity even at slow speed for less than $340.00.

880 Stereo Portable

Same features as Model 88 plus detachable speakers, power amplifier with stereo headphone output in portable case. Carry along for "on the spot" recording or connect to music system for less than $440.00.



807 "Tape Turntable"

Connects to music system for playback only of all standard monaural or stereo tapes. Features two popular speeds. Use it also to duplicate tapes with another tape recorder. Walnut base included for less than $125.00.

Viking OF MINNEAPOLIS
DIVISION OF THE TELEX CORPORATION
9600 Aldrich Ave. S. Minneapolis, Minnesota, 55420

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drain voltage is achieved (determined by the above conditions).

It was clear after running numerous tests that conventional FET specifications fall far short of what is essential amplifier information. For example, tests performed on one type of FET (one 2N number from one manufacturer), showed the optimum gate voltage to range from 0 to 10 volts. What makes matters worse is that the exact gate voltage must be accurate to a tolerance of 20 per cent in practical circuits. Consequently, every FET needed a tedious manual adjustment and production circuits on that basis are, of course, impractical. The following parameters of FET's were found absolutely meaningless: pinch-off voltage, shorted drain current, shorted transconductance, and so on. Going through a typical FET data sheet, not a single parameter was found that was useful for amplifier design. It was a situation similar to a case where fifty different tube types were dumped into one basket and labeled by the same type number based on a parameter such as cathode current or filament voltage, or the like. Intelligent circuit design is then an impossibility.

TABLE 1
COMPARISON OF TUBES, TRANSISTORS, AND FETS
(Approximate normal values)

	Vacuum Tube	Transistors (NPN)	FET (N-Channel)
Electrodes	Plate	Collector	Drain
	Cathode	Emitter	Source
	Grid	Base	Gate
Plate Supply	100 to 250 V.	10 to 35 V.	100 to 250 V.
Grid Bias	—0.5 to —10 V.	+0.2 to 0.6 V.	—0.5 to —10 V.
Grid Current	1 μA	100 μA	1 nA
Plate Load	22 to 220 k ohms	1 to 22 k ohms	22 k to 220 k ohms
Filaments	yes	no	no
Power Gain	high	low	very high
Noise Level	medium	low	very low
Distortion	low	high	very low
Input Resistance	50 M ohms	1000 ohms	5000 M ohms
Temperature Range	—50 to + 200°C	—50 to +80°C	—200 to +80°C

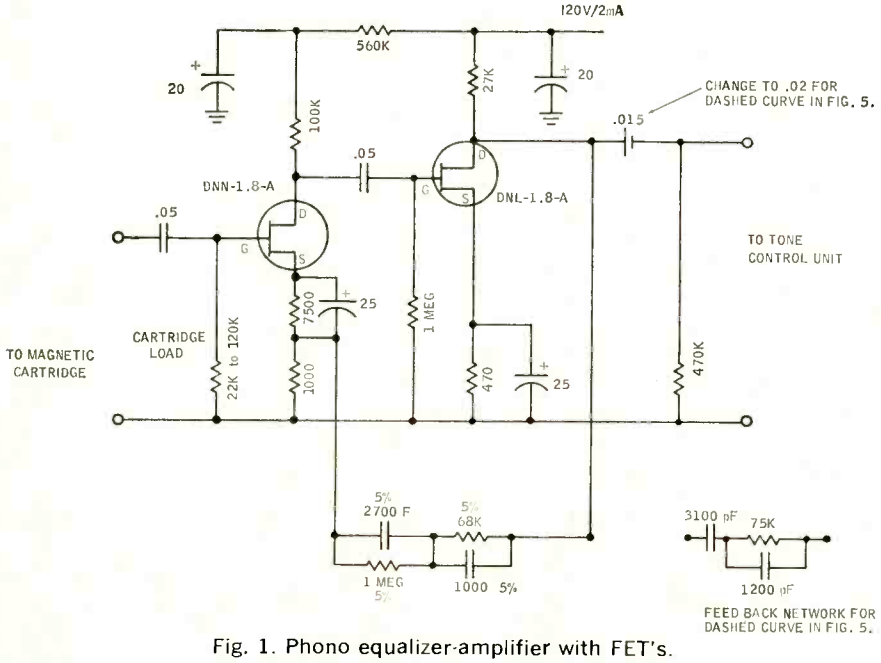

Fig. 1. Phono equalizer-amplifier with FET's.

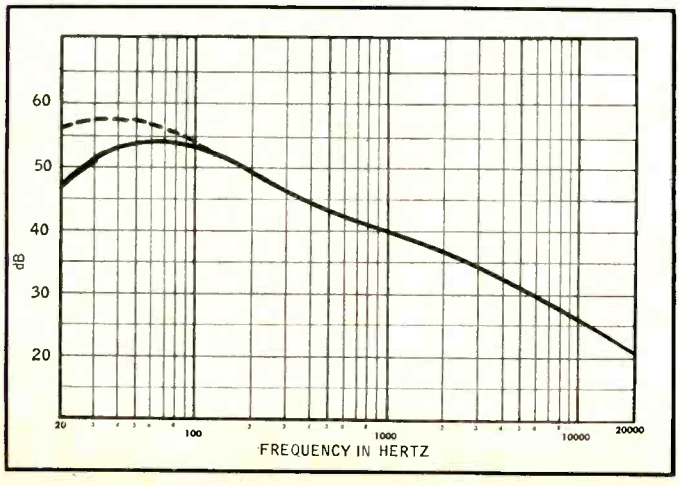

Fig. 2. Response of equalizer-amplifier of Fig. 1.

At least one manufacturer[4] has recognized this problem and has come out with a new series of FET's fully specified for amplifier performance. Using these devices, truly excellent performance is possible.

In addition to correctly specified devices, a few points on circuit design should be observed. Biasing of FET's is about as critical as for a pentode[4] if a high supply voltage is used (120 V). At bipolar transistor voltages (15 V.) bias becomes much more critical (2 per cent tolerance) and this causes difficulties in practical circuits. Therefore, high voltage operation is essential. Since the drain voltage in small signal amplifiers is close to but never more than 60 volts, a minimum FET breakdown of 60 volts is required for small-signal applications (100 volts and up for large-signal applications). Only for lowest noise operation is a reduced supply voltage justified (30 volts), particularly since distortion is not as critical in input stages.

Gate bias itself is best achieved by a self-bias resistor in series with the source-terminal. Due to the lower current drain of FET's as compared to tubes, this self-bias resistor is usually considerably larger than with vacuum tubes and generally should be bypassed. If feedback is to be applied to the source terminal, this is best accomplished by a separate feedback resistor in order to keep the local feedback down.

Phono-Equalizer Section with FET's

For the hifi-hobbyist, the superior performance of FET's suggests their immediate application to all kinds of hi-fi circuits. For the purists (like the author himself and many professional audio people), transistors were never a substitute for tubes. They simply had too much distortion and were

[4]Dickson Electronics Corp.

Great new ideas have one thing in common.

The new Empire Royal Grenadier, in principle, is really over 2000 years old. The Romans discovered that a cylindrical shape was best for projecting sound in their outdoor arena.

They used an urn.

This knowledge was not brought to bear on modern sound reproduction until 1963 when Empire developed the Grenadier.

The cylindrical design was applied to get the woofer as close to the floor as possible and thereby prevent standing waves from developing in the listening area.

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It came about only by an awareness of, and tenacious experimentation with, long-standing scientific principles.

The result is most certainly a "first."

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too unstable. Perfectionists who are used to equalization tolerances of ±0.1 dB never could "warm up" to transistors. Also, the peaks of certain musical instruments are up to 30 dB above the average, and the required high output capability is simply not possible with bipolar transistors. The situation is quite different with FET's.

The first portion of a phono-preamplifier consists of a phono equalizer. The circuit for this equalizer is shown in *Fig.* 1 and its frequency response in *Fig.* 2. The popular two-stage feedback circuit is used with series voltage feedback from the output into the first "source." This type of feedback decreases the output impedance and increases the input impedance particularly at the high frequencies where this is most beneficial. Any incorrectness in equalization (which is sometimes called a disadvantage of the circuit) is easily compensated by added components in the feedback network. The following changes as compared to a vacuum tube circuit are noticed:

a) Self-bias in the first stage by a bypassed 7500-ohm resistor. This resistor may have to be changed for different type FET's.

b) Large decoupling resistor for the first stage (560 K). This resistor drops the first-stage drain supply to about 30 volts for least noise.

c) Drain resistor for second stage is 27 K. This resistor was accurately adjusted for least distortion with feedback connected. Due to the parallel loading of the feedback network itself, a rather low value of drain resistence results.

d) The gate resistor of the first stage is made equal to the load resistor for the cartridge rather than using a 1/2-Meg. gate resistor and a separate cartridge load. A smaller gate resistance results in reduced noise due to possible leakage currents. While the amplifier will work with large gate resistors, it is a good idea (also in tube circuits) to keep the d.c. gate resistor as low as possible. Since the cartridge load is needed at the high frequencies only, a.c. coupling is permissible. As a matter of fact, d.c. coupling may also be used, although here some rejection of unwanted lows was desired. The exact cartridge load depends on the compliance of the stylus and the cartridge inductance and is best determined with a test record. The correct value results in the flattest response above 10 kHz. (Before this test, the minimum stylus force should have been deterined, usually at 100 Hz and peak amplitude by observing tracings distortion on the oscilloscope.)

In addition, the following comments are offered regarding low-frequency equalization: Most musical instruments (with the exception of the organ) produce no significant fundamental output below about 80 Hz. For correct bass boost, for example, frequencies from 70 to 150 Hz only should be boosted. Boost below 70 Hz results in change of tonal character, and above 150 Hz in so-called "boomy" bass. Consequently, equalization extending indefinitely at low frequencies is a serious shortcoming of many preamplifiers because noises other than music are emphasized. Ideally, a rather sharp roll-off should be provided. Two possibilities are given in *Figs.* 1 and 2 to suit the individual's needs. Both input and output coupling capacitors are utilized for low-frequency rolloff. Therefore, these capacitors may need a slight readjustment with different resistors for the cartridge load or the input of the following tone control.

The performance of this phono-equalizer is excellent and reliable. Different FET's of the same type will operate equally without circuit readjustment. The equivalent input noise at 1000 Hz is −114 dB[5], the wideband output noise is −74 dB[5] (gain is 40.0 dB at 1000 Hz). This noise level is 8 dB lower than in the best professional tube circuit using d.c. filaments and with all traces of hum removed. It is 2 dB better than the best transistor circuit[6]. The overload level for 1 per cent distortion is +31 dB[5], 5 dB better than a tube circuit (even operating at twice the supply voltage) and 18 dB better than a normal transistor circuit. Distortion at 30

(Continued on page 74)

TABLE II
COMPARISON OF PHONO PREAMPLIFIERS

	Tube	Transistor	FET
Device, 1st stage	ECC83	2N1192	DNN-1.8-A
Device, 2nd stage	ECC83	2N1193	DNL-1.8-A
Gain, 1000 Hz	40	40	40 dB
Min. Output Noise, wideband	−66	−72	−74 dB*
Min. Input Noise, at 1000 Hz.	−106	−112	−114 dB*
Max. Output Level, per cent THD.	+26	+13	+31 dB*
Distortion at 30 V. output	in heavy overload		0.06 per cent
Overload-to-noise ratio	92	85	104 dB
Supply Voltage	180	15	120 V.
Current Drain	1	5	2 mA.

Note: All measurements with identical equalization and gain.
*With respect to 1V.

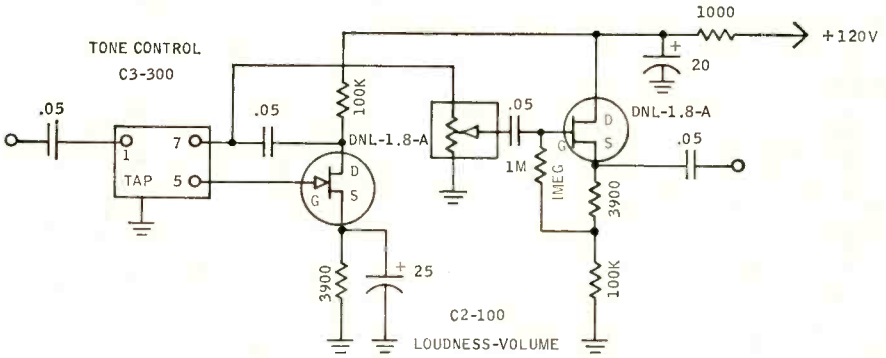

Fig. 3. FET audio control circuit, simplified.

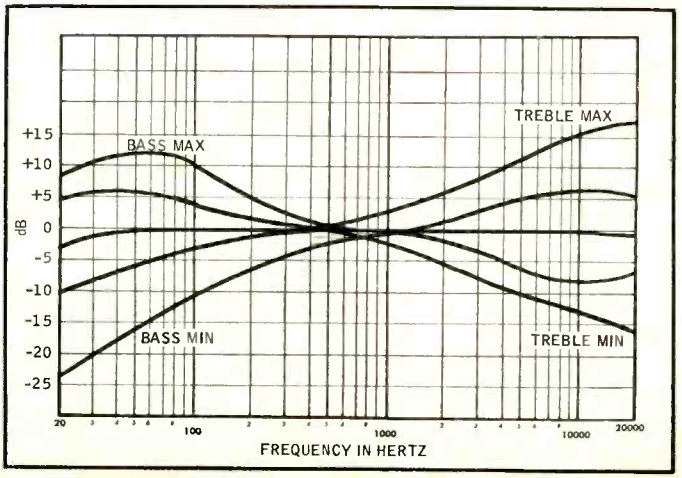

Fig. 4. Tone-control response curves from the Baxandall circuit of Fig. 3.

Sony has developed the world's finest audio transistors...

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Many manufacturers have made fairly good transistor amplifiers. Until now nobody has made a great one. And everybody knows the reason: distortion. Unfortunately, most transistor amplifiers distort in a very special way. Not so much at top power, but rather more at normal listening levels where it hurts most.

The Sony TA-1120 integrated amplifier and TA-3120 power amplifier are the first high-powered transistor units to really overcome the problem of distortion. At all power levels, at all frequencies distortion is kept below that of the finest tube amplifiers. The TA-1120 and TA-3120 both provide 120 watts IHF at 8 ohms, both channels operating. Distortion, at rated output, is 0.1%. And at normal listening levels it is even less, 0.05% at ½ watt. In addition, they have achieved an extraordinarily high damping factor, better than 70 at 1000 cps to assure clean, low-frequency power response. Frequency response is practically flat from 10 to 100,000 Hz (+0 db/−3 db). For safety's sake, an SCR (silicon controlled rectifier) protects the power transistors against accidental shorts and other overloads.

The integrated amplifier, the TA-1120 features a sensible arrangement of the front-panel controls for the greatest versatility and ease of operation

We believe that these are the first great transistor power amplifiers. How can Sony do what other manufacturers couldn't? Sony is a pioneer in transistors. With first after first. Such as the tunnel diode. Transistor television. And the all transistor video tape recorder. The point is that Sony knows transistors. To the 'n'th degree. And designed new, advanced types especially for the driver and output stages of these amplifiers. And silicon transistors are used throughout. They are the most stable. The TA-1120 integrated amplifier, $399.50. A handsome oil-finish walnut enclosure is optional. The power amplifier, TA-3120, $249.50.

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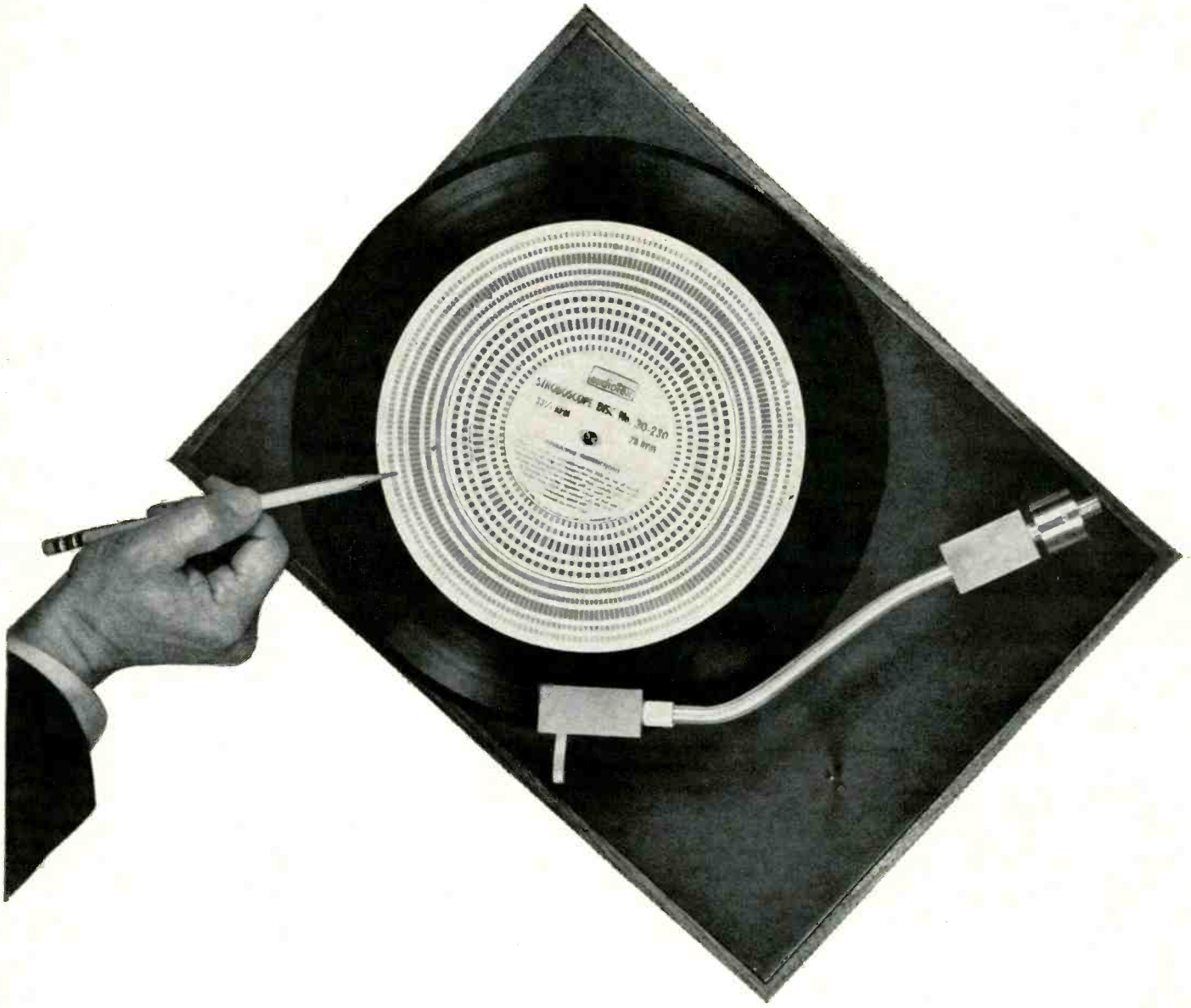
Try this on your record player.



If your turntable speed is off you won't hear the recorded music at its original musical pitch.

How much is "off"? NAB broadcast equipment Standards, to which all AR turntables must conform to pass factory inspection, allow no more than 0.3% inaccuracy—a maximum drift of one line every three seconds on the strobe card shown above. Pitch is kept accurate to within one-twentieth of a half tone.

Some record players have uncorrectable speed errors as high as 1.5%—strobe card drift of 5 lines every three seconds—creating a pitch error of a quarter of a half tone. It is as though the conductor directed his orchestra to tune its instruments higher or lower.

The 2-speed AR turntable meets NAB broadcast Standards in rumble, flutter, wow, and speed accuracy.* The price is $78 including oiled walnut base, transparent dust cover, and center piece for 45-rpm records. In comparing prices be sure to count the cost of these accessories when, as is usually the case, you have to buy them separately.

Literature on AR turntables and speakers will be sent on request.

*Confirmed by many independent test reports. Four magazines chose the AR turntable for their top stereo systems from a field of competing units costing up to twice as much. We will be glad to send you their lists of selected components; you may also have, on specific request, a reprint of an article on how to check turntable characteristics at home.

ACOUSTIC RESEARCH, INC., 24 THORNDIKE ST., CAMBRIDGE, MASS. 02141

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Simulated "Live vs Recorded" Test for Loudspeakers

You think you know how to compare speakers? After you read this you won't be so positive. The author, a respected speaker manufacturer, to be sure, points up the problems and pitfalls likely to be encountered in hit-or-miss speaker comparisons. This study in psychoacoustics was derived from a lecture given by the author to a N. Y. Section meeting of the AES, and is complete except for the aural demonstrations.

EDGAR VILLCHUR*

THE SUBJECT OF THIS DISCUSSION is a method of evaluating loudspeakers with a listening test whose central characteristic is that it has controls. When one introduces a new procedure it is not only necessary to demonstrate the validity of the procedure, but to show that it solves a problem—that is, that it serves some useful purpose. So I will begin by talking not about the procedure itself, but the problem that it is designed to solve.

Suppose you were shown two color reproductions of a Van Gogh painting, one of which has a sky which is obviously blue, whereas in the second, the sky is almost orange. Now either both of these reproductions are grossly inaccurate, or one of them is right and the other wrong (or at least one of them is more right than the other). I don't think that it takes a genius, or one who has written his Ph.D. thesis in modern French painting, to devise a method of finding out which of these two reproductions, if indeed either one, is the accurate one. We have only to compare them to the original painting and we will know.

If I seem to be making an obvious point I would like to assure you that it is far from obvious in the field of sound reproduction. There are writers in the latter field who state, in presumably serious articles, that the way to judge sound reproduction and sound-reproducing equipment cannot be described very exactly; it is mostly subjective; it depends on your taste and hearing; and the use of a direct comparison with the original sound in the so-called "live *vs.* recorded" concert is a misleading procedure. Specifically an article in one of the well-known periodicals, entitled "The Prospects for Psychoacoustics" (although it was actually about listeners' tastes) tried to make the point that when you make a direct comparison between reproduced sound and the sound of the live musicians you introduce a subjective element into the proceedings; that the existence of the concert-hall atmosphere and of the musicians induces in the listener what was called a "will to believe," an aura of acceptance. Therefore, said the writer, when you wanted to judge sound-reproducing equipment expertly, the thing to do was to use the so-called A-B test *without* immediate reference to the original sound.

I can imagine an *Alice in Wonderland* trial in which the jury is instructed that a prerequisite to judging a copy is making sure that the original is nowhere in evidence. I am laboring this point a little because I want you to understand a thoroughly obvious fact—we will never know which one of the two color reproductions was right until we take a look at the original painting, the original Van Gogh. Yet this direct-comparison technique is fought against by a fair number of "experts" in the field of sound reproduction.

I am starting out with the assumption that the purpose of sound-reproducing equipment is to reproduce, not to create, and that the best sound-reproducing equipment is that which produces the most accurate reproduction, and that high fidelity and accuracy mean the same thing.

Now suppose you play a brief interval of reproduced music through a specific loudspeaker.

Is it good, is it bad, is it mediocre? It's really very hard to tell from one sample, for which you have no reference. Let us call this loudspeaker "X".

Now suppose you play the same selection again, and while it is playing switch from loudspeaker "X" to another loudspeaker which we shall call "Y".

Now we are a little better off—we have two things to compare. But still one goes back and forth and the answer is not that clear. You may prefer one or the other. The fact is that even with the most experienced listeners who have worked both with loudspeakers and with live music and have heard the two together, listening for a period of time to sound with a particular coloration tends to make one accept that sound as right, or at least as "not bad." And so the demonstration you have just made for yourself is commonly known as the A-B test, and it has real drawbacks.

The comparison of the two painting reproductions, too, was an A-B test. You all knew what was missing there—the original Van Gogh painting. What is missing from the A-B test of speaker sound is the original sound of

*Acoustic Research, Inc., 24 Thorndike St., Cambridge, Mass. 02141.

the music you played from your record.

It is not likely that you can produce the original musicians. My company and others have indeed staged live *vs.* recorded concerts where we have had the live musicians on stage, but it is a very difficult and costly task. And so the procedure that I am going to describe is a *simulated* live *vs.* recorded test. In 1960 I presented a paper at an AES convention, in which I demonstrated a simulated live *vs.* recorded listening test for tweeters, using random noise as the basic sound source. Last year Consumers Union published an equipment review of loudspeakers and indicated that they had used a similar type of test, but with full-range speakers and with music. I have been given to understand that their development of this test was independent of the test procedure that we used at our company, but *I* cannot claim independent development for the material of this writing. I had thought that the practical difficulties of making a simulated live *vs.* recorded test with full-range multi-driver speakers would be too great, but when I read CU I was intrigued. We tried it at AR and it worked. I mention all of this because I feel that I should give credit where it is due.

And now we turn to the test itself. In the simplest possible terms the staging of a live *vs.* recorded demonstration consists of this: We record a sound, a live sound, whatever it is. Maybe it's a cricket, maybe it's a mechanical device, maybe it's a string quartet. We then take the same animal or device or musician(s) that made that live sound, put it on the stage here, ask it to make the sound again, and try to imitate it by playing back the recording through different speakers.

The "live" sound that I will use here is the output of a loudspeaker. It might help things if you didn't know what the loudspeaker was, or whether or not it itself had significant coloration. In any case we call this loudspeaker a reference speaker. We call it a reference not because it has any standard of greatness, but because it is, literally, the thing to which we refer each time.

Figure 1 illustrates the electrical elements of the recording technique for the simulated live *vs.* recorded test. The sound of the reference speaker, which you can call "Z" or anything you like—it could just as well have been produced by a weird

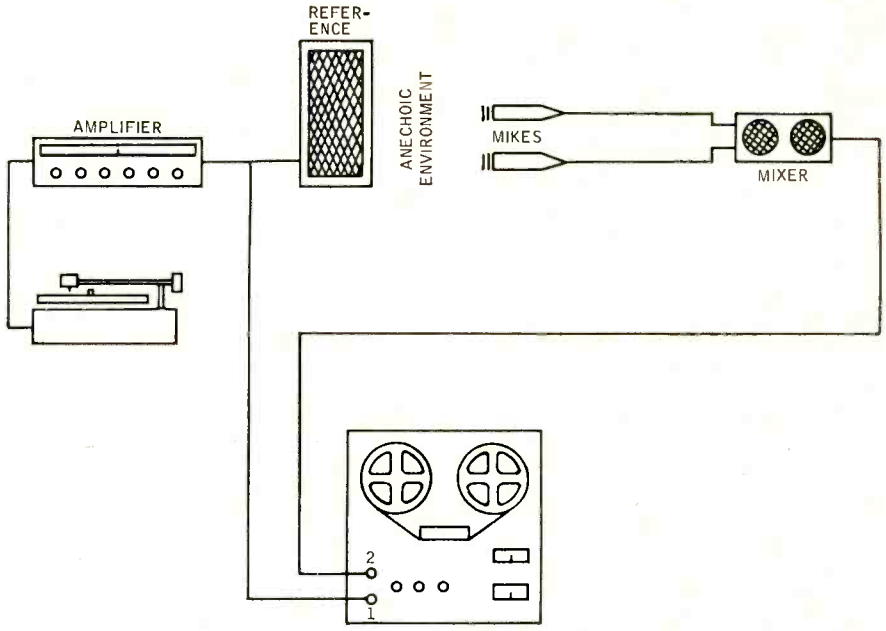


Fig. 1. The record player, amplifier, and reference speaker make up a simulated "live" source. Recording system puts original electrical input to the reference speaker on channel 1, the reference speaker acoustical output on channel 2.

machine clanking away, or by a humming bird, or by live musicians—is recorded anechoically, that is, in a dead environment without echoes. Why must we record it anechoically? Because the recording that we are going to use in the test must contain nothing but the sound of the source. If the recording includes the reverberation and coloration of any particular hall, this coloration will be a false element in the playback because that hall or studio isn't here, and so we will not be able to match the reference sound. It would be as though in comparing graphic reproductions against the original painting, we used a reproduction colored by the light and shadows produced by a particular exhibition hall.

Question: You say you can use any kind of speaker, which presumably might have coloration. Why should it matter whether the acoustical environment of the speaker has coloration or not?

Answer: Let's assume we record in studio A. In order to compare our recorded sound with that of the reference speaker, we are going to have to recreate the reference sound here. We play the reference speaker here, repeating the sound that existed before it was recorded by using the original electrical input, and this sound does not, of course, have the coloration of studio A. But when we play the recording back through our speaker under test it would include not only the sound of the reference speaker but the sound of studio A.

The reference sound is uncolored by any echoes (outside of the original source material) until it enters this studio; and the sound of the recording must similarly be uncolored by echoes until it enters this studio.

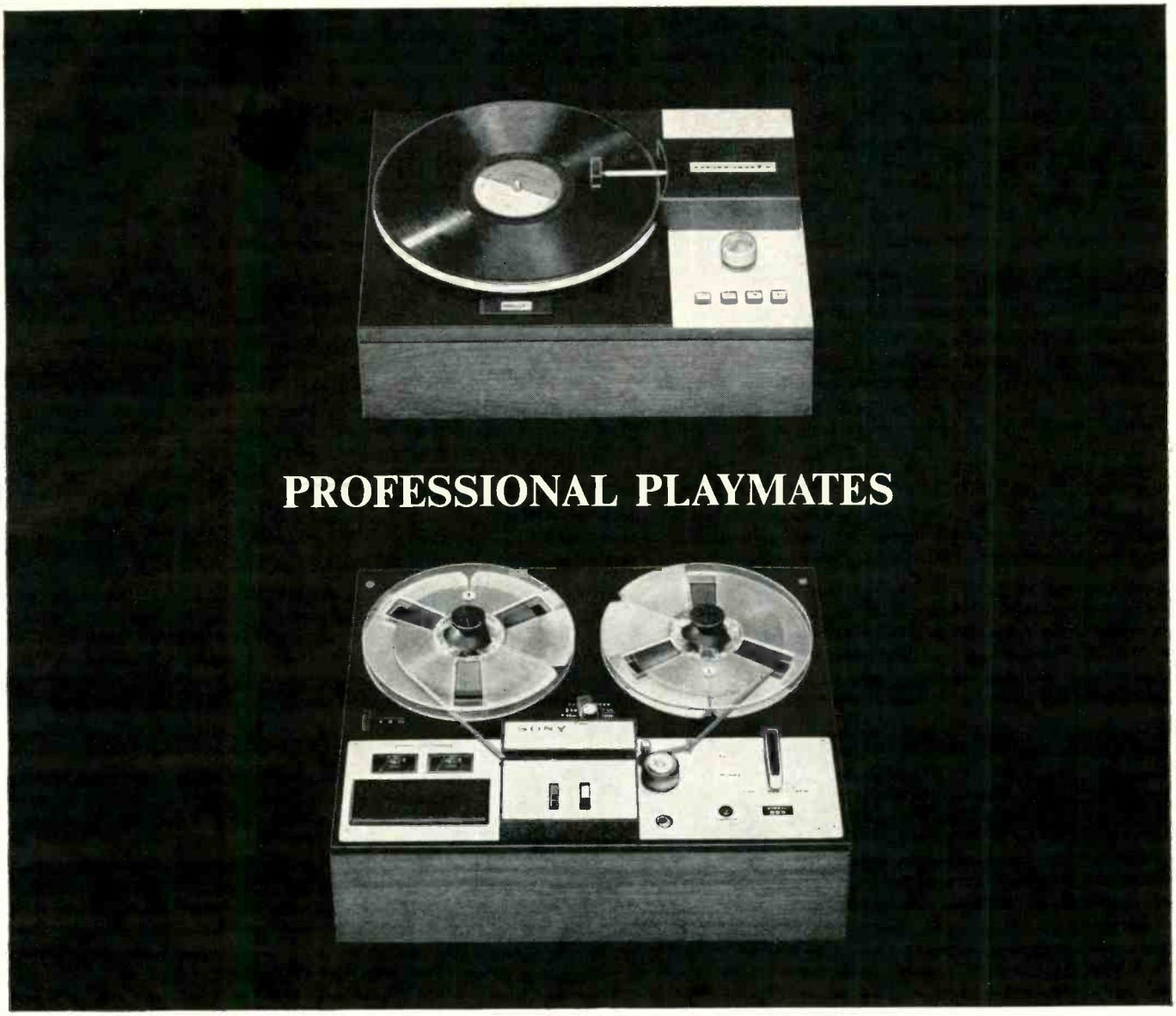
Question: What would be the effect of recording not in an anechoic chamber, but in studio A and then conducting all your further tests in studio A?

Answer: It still wouldn't work. No matter how you slice it the original sound is projected into this studio without any previous reverberation. You must also project the recorded sound without any previous reverberation, or you get double reverberation. Now whether we get the reverberation of studio A plus this studio, or the reverberation of studio A plus itself—studio A twice—it would still be a false element in the recorded sound.

Question: It seems to me that there is still a small error being made here. You cannot record the entire sound of the loudspeaker—you have to record it at some particular position in space, that is, you have to put the microphone at one point. It is a uni-dimensional signal, whereas the sound emanating from a loudspeaker unit in the anechoic chamber is not. Do you put the microphone directly in front of the loudspeaker?

Answer: What you have done is merely to describe *the* difficulty of this whole business, and rather than answer this question now, the whole substance of this paper will answer it. It is the major problem. I can tell you that it is not insurmountable, but I can also tell you that it remains the problem which makes this test less sensitive than I would like it to be.

To continue, the sound is picked up by the microphone of *Fig.* 1 and is recorded on channel 2 of the tape



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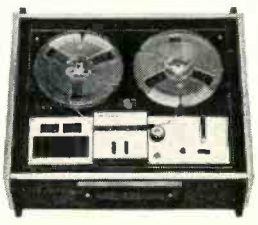

Portable Model 350C

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An Amplifier for the Armchair Listener

R. E. BAIRD

In this day and age everybody advertises twenty-watt or fifty-watt hi-fi amplifiers. Actually the casual listener needs a fraction of one watt for the average living room. Distortionless listening with proper bass equalization for standard recording characteristics is of prime importance.

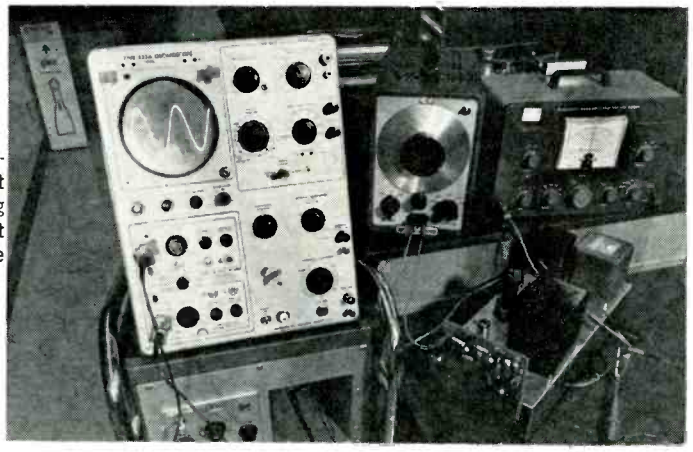


Fig. 1. The author's amplifier at the "proving ground"—the test bench in the case of amplifiers.

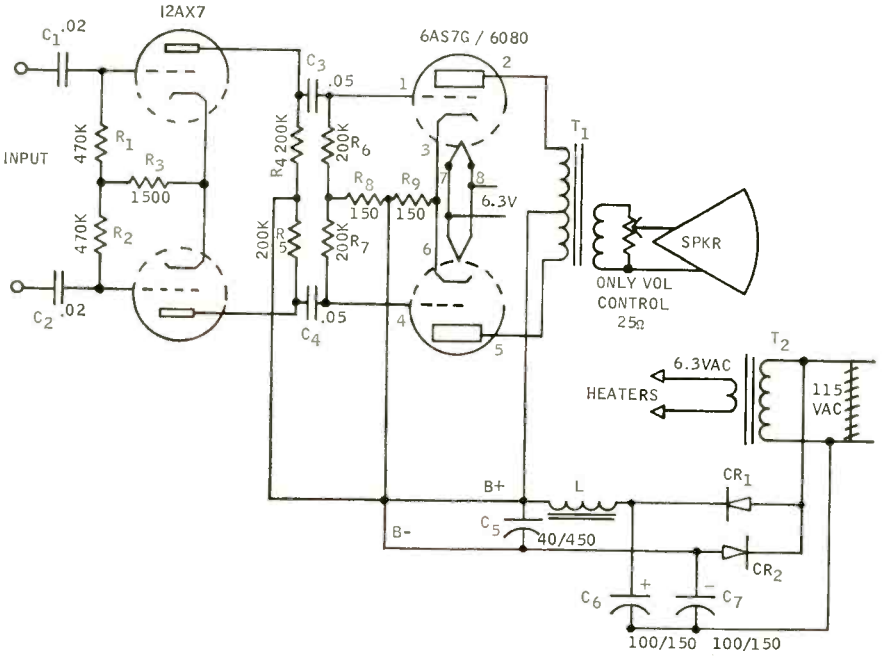


Fig. 2. Schematic of the power amplifier and power supply section of the armchair listener's amplifier.

IN THE GOOD OLD DAYS this writer liked to listen to what comes out of a pair of triodes. There are triodes and triodes, all of which have fallen into disrepute. Everybody cleans up their distortion with umpteen dB of inverse feedback; so beam-power tubes became the accepted thing. The main objection to triodes is that you need a lot of voltage to drive them and they are a little inefficient. If all you need is voltage, it isn't too hard to come by, and what's a couple more watts from the a.c. power line? So we decided to go all the way.

Now if you start looking for power triodes you will scan the tube manual from cover to cover and not come up with anything very exciting. If you pick something out of antiquity you'll probably come up with a filamentary type cathode. Nobody has built a modern triode with an indirectly heated cathode for audio purposes. There seems to be one outstanding exception which isn't listed in *just any* tube manual and this exception is primarily designed as a voltage regulator tube rather than a general purpose audio tube. The 6AS7G/6080 is a twin triode of rather massive proportions with a mu of 2 and a plate-to-plate resistance of 280 ohms. Using a standard push-pull output transformer it would appear that this tube couldn't care less what you hung on it for a load. It should be a natural for any kind of a changing load including a loudspeaker. So we decided to give it a try.

Figure 2 shows the schematic of the finished product. The circuit is simplicity itself. A single 12AX7 supplies enough voltage to drive the 6AS7G to comfortable living room volume. If it were desired to drive the 6AS7G to maximum output a larger driver would be necessary (also more distortion would result). The circuit, as driven, yields less than 1 per cent

PARTS LIST FOR FIG. 2

C_1, C_2	.02 μF, disc ceramic
C_3, C_4	.05 μF, paper
C_5	40 μF, 450 V. elect.
C_6, C_7	100 μF, 150 V. elect.
CR_1, CR_2	400 PIV, 500 mA silicon diodes
R_1, R_2	470k, ½ W.
R_3	1500 ohms, ½ W.
R_4, R_5, R_6, R_7	0.22 Meg, ½ W.
R_8, R_9	150 ohms, 10 W. (or 300 ohms, 20 W.
R_{10}	25 ohms, 10 W. potentiometer.
L_1	200-mA filter choke, 30 H.
T_1	High-quality output transformer, 5000 ohms plate-to-plate.

NOTE: If chassis is grounded, it will be "hot." Isolate with 1-μF capacitor if it is to be exposed.

distortion from 20 Hz to 20 kHz. Frequency response is ± 1 dB from 20 Hz to 20 kHz. Note, there is no inverse feedback whatever. All measurements were made with a fifteen-dollar, twelve-inch, bass-reflex enclosed speaker as a load.

Desiring to use the amplifier with a record player, the next question was what to drive it with? This time we decided to go for something *new*. An article appeared on noise performance of transistors in a late periodical[1] which also included a very interesting equalized preamp for a record player. The circuit included a lot of treble loss, to take care of modern recording characteristics, which we didn't go for. Unless you have a $150 speaker you can probably use the extra treble anyway. So with a somewhat drastic modification we came up with the circuit in *Fig.* 2. And we put a phase splitter on the end to drive the push-pull grids of the 12AX7. An added modification is the derivation of the d. c. supply for the transistor preamp by taking a portion of the cathode voltage from the 6AS7G stage as a source. Since this voltage was positive with respect to ground, NPN transistors were indicated. The 2N1308 is available, low priced, and does the job. *Figure* 3 shows the schematic of the modified preamp. Bass equalization is achieved through C_f and R_f. This yields almost perfect 6-dB-per-octave from 500 Hz down.

Figure 4 provides the over-all response curve for the preamp and final amplifiers together. Frequency response was measured with a constant 15 millivolts input and the previously mentioned loudspeaker as a load. An audio voltmeter was placed across the voice-coil winding. *Figure* 3 also shows the over-all harmonic distortion of the system with speaker connected and measured with a Heath Harmonic Distortion Meter. Measurement of distorion was made at constant signal output (comfortable living room volume).

The results? All we can say is that we like the sound that comes out. We have good solid bass, brilliant treble, and a distortion level that is below the perception of the ear. For living room volume and reasonable hi-fi it certainly is an improvement over some pretty expensive stock units on the market. With the use of the voltage-doubler power supply the whole unit is fairly low priced. Our future plans include a complete second set up for stereo. Æ

[1]W. A. Rheinfelder, Noise performance of transistors in audio circuits. *Electronics World*, Jan. 1965.

The author subtitled this article "Something Old and Something New." The first 6AS7G article to appear in Audio was in March, 1948, which is quite old. Everybody knows how new hybrid amplifiers are. Note, however, that the power supply would make the input—and hence the phono turntable—"hot" to ground. Some care should be taken in connecting to other equipment, as well as in handling. Ed.

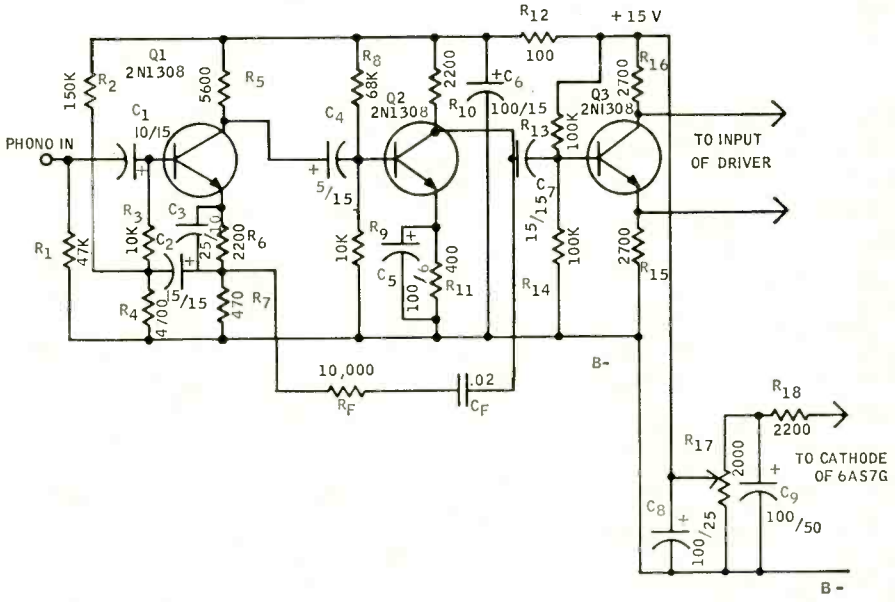


Fig. 3. The preamplifier section employs transistors, powered from the bias voltage of the output tube, a 6AS7G.

C_1	10 μf. 15 V. elect.	R_4	5600 ohms
C_2, C_7	15 μF, 15 V. elect.	R_5	2200 ohms
C_3	25 μF, 10 V. elect.	R_6, R_{10}, R_{18}	470 ohms
C_4	5 μF, 15 V. elect.	R_7	68 k ohms
C_5	100 μF, 6 V. elect.	R_8	490 ohms
C_6	100 μF, 15 V. elect.	R_{11}	100 ohms
C_8	100 μF, 25 V. elect.	R_{12}	100 k ohms
C_9	100 μF, 50 V. elect.	R_{13}, R_{14}	2700 ohms
C_f	.02 μF. disc ceramic.	R_{15}, R_{16}	200-ohm potentiometer
Q_1, Q_2, Q_3	2N1308	R_{17}	10 k ohms
R_1	150 k ohms	R_f	47 k ohms
R_2	10 k ohms	All resistors ½ W.	
R_3, R_9	4700 ohms		

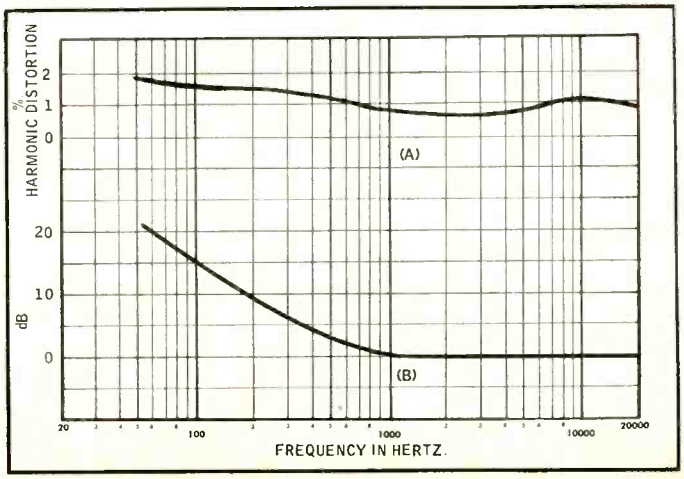


Fig. 4. Response curve of the phono amplifier, is tailored to provide good solid bass from not-so-bassy small loudspeaker enclosures. The THD curve for the amplifier is shown at the top.

Equipment Profile

Fig. 1. The Sherwood S-8800 Stereo Receiver.

SHERWOOD S-8800 STEREO RECEIVER

Sales figures clearly place that component known as a receiver well out in front of its more separatist relatives. That was true in the era of vacuum tubes when receivers were on the disadvantaged side of quality, and it remains true today when the all-in-one unit need not be inferior in any way to individual components.

This new unit from Sherwood is all-transistor and all-silicon-transistor at that. We will not enter into that argument about silicons *versus* germaniums. Let's just leave it with the fact that this unit employs silicon devices throughout.

There is that confusion with transistor amplifiers regarding power output. It has been our practice to measure all transistor amplifiers primarily with 8-ohm loads. Now some amplifiers do best at this impedance with power dropoffs at 4 and 16 ohms. Others pour more power into lower loads, less into high. This latter case is true of this unit. So with both channels operating the S-8800 will deliver an honest 25 watts per channel at mid-band frequencies. (See *Fig.* 2 for the over-all power response.)

There is more power to be had at 4 ohms. So we hooked up the receiver for listening tests to a pair of power-hungry, 4-ohm AR-3's. There's power to spare here. High-volume listening does not audibly approach the clipping point of the amplifiers.

The "typical" transistor amplifier IM curve, looking like nothing more than a single-humped camel back, has been proved unnecessary. This Sherwood model does not exhibit it. *Figure* 3 indicates the IM distortion characteristic, again with both channels driven into 8 ohms. At the low power level of 0.1 watt, IM distortion was 0.09 per cent. There is none of that gritty "transistor sound" here!

The phono input is also an area where transistor technology has been slow in equalling tubes. Sensitivity is quite high —3.3 mV drives the unit to full output. Noise is a quiet 63 dB below this level. Resistance to overload depends on the setting of a phono level control (this also reduces sensitivity, of course). At the worst, overload occurred at 62 mV. With the use of the control to turn down extra-high-output cartridges, Sherwood has this problem very much under control.

The S-8800 struck us as a unit that is stripped for most efficient action. Tone controls are ganged for the two channels. This is lower in cost than providing a total of four controls. We have no quarrel with this practice. Quite the contrary, we applaud it. There really is no need for independent tone control of the two channels in most modern installations with identical speaker systems.

There is one thing we do not like at all. The S-8800 has permanently operating loudness compensation. True, it is not excessive; at quite low settings there is a maximum of 11-dB boost at 100 Hz, but at typical listening levels the boost is on the order of 2-4 dB. Still, perhaps there are ears that do not quite match what Fletcher and Munson found. (Not that common practice follows the F & M curves anyway.) We like our bass compensation defeatable. Call it a personal perverseness if you will, but that's it.

The lovely sound of this unit is more than just compensation. FM, both mono and stereo, is flawless. Stereo FM

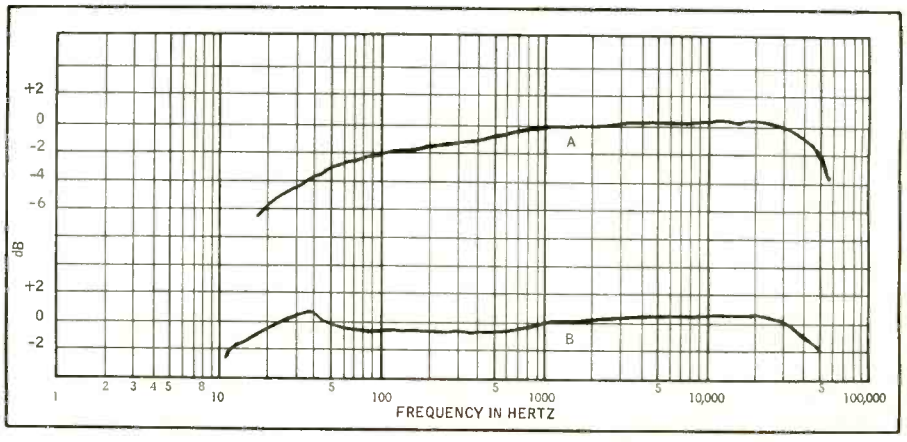


Fig. 2. (A). Power response of the S-8800. 0 dB equals 25 watts per channel into 8-ohm loads with both channels driven. (B). 1-watt frequency-response curve.

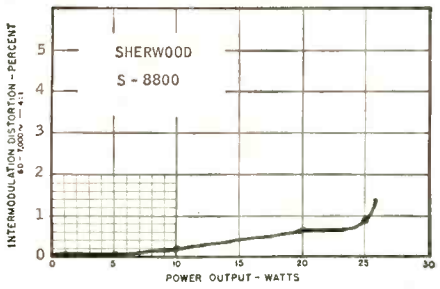


Fig. 3. S-8800 IM distortion with both channels driven; 8-ohm load.

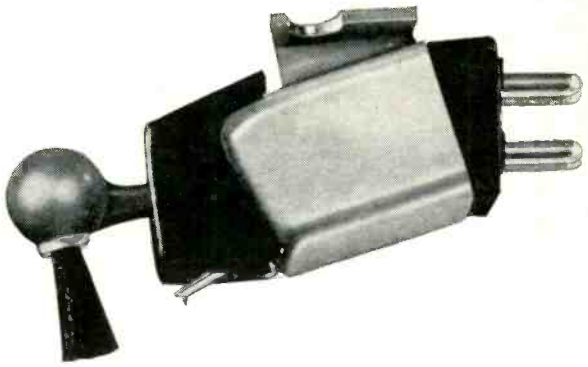


Fig. 4. The Stanton 581EL "Longhair" cartridge.

comes in without background noise (we employ a good outdoor antenna). A small indicator light ignites to show the presence of a stereo broadcast. At the same time, the circuitry is automatically switched to the stereo mode. The front-panel mode switch has only one position for the tuner—labelled FM. If you wish to defeat the automatic switching, pull out on the balance control. This swings the entire receiver to mono.

Tuning is accomplished with the aid of a center-channel indicator meter. As we have noticed in the past, Sherwood put a degree of effort into providing extra smooth tuning action. It is a pleasure.

FM frequency response is ± 1 dB from 30-15,000 Hz. So is RIAA phono equalization.

There are two special niceties worth mentioning. Both are represented by narrow adjustment shafts that protrude from the front panel. The first mentioned earlier, sets phono and tape-head gain to match the FM level. The second is adjustable interchannel muting on FM. This is quite effective and can be set for maximum value against minimum sensitivity loss.

All-in-all there is much to commend this unit. In the listening room it performs splendidly. All sound sources are reproduced flawlessly. With its handsome face and truly pleasurable sound the Sherwood S-8800, priced at $359.50 (less case; walnut case $9.00 additional) will do the music lover proud.

CIRCLE 1

STANTON 581EL STEREO CARTRIDGE

We have a standard procedure that is followed each time a new cartridge comes in. It goes into a turntable and we "live" with it for a while. Before that the stylus went under the microscope to ensure that no damage exists to ruin our records.

Living with a cartridge means using it to play those records with which we are most familiar. In this way a general impression is already established before we ever reach the test bench.

Cartridges have shown a steady and significant rate of improvement over the past few years. It hardly seems that we settle on a favorite that seems to be "it" but what someone else comes along and upsets the applecart.

Today there is a decent variety of cartridges from which to choose. The devil of it all is that the choice is no easier than that of several top-grade speakers. Our ears continue to insist that different cartridges sound unlike each other, sometimes to a significant degree, sometimes only subtly. But they do sound different. In point of fact, we find some sonic differences from sample to sample of the same model. But in products from reputable manufacturers these intra-differences are small.

The Stanton 581EL represents the top-of-the-line for a most reputable firm. As can be seen from the illustration, the 581EL sports a moustache—a brush to sweep the record groove clean in advance of the stylus. The EL designation in the name details the fact that this model has an elliptical stylus; the cartridge system as a whole is of the moving-magnet principle.

Stanton has dubbed this model the Longhair, inspired no doubt by the pivoted brush. Perhaps what was meant is that this is a classic cartridge. As we have come to expect from Stanton, this is one of that select group of state-of-the-art cartridges. As with all the rest, it is not perfect. No cartridge is, nor anything else. But the 581EL does wonders with a record groove. Look at *Fig.* 5, the frequency-response and separation measurements. These are as close to ideal as we could want. This over-all smoothness is to be heard in the listening room. As with all cartridges to date, stereo separation diminishes as frequency rises, reaching a peak at the stylus-assembly resonance point. Nevertheless, the *effect* of stereo is excellent; there is

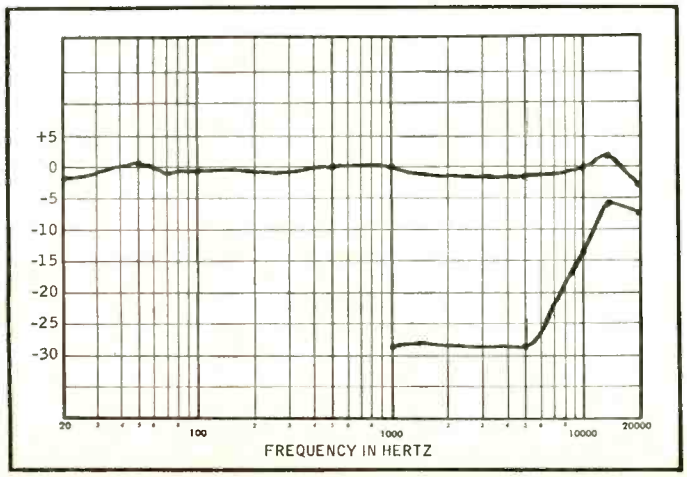


Fig. 5. Frequency response and channel separation of the 581EL. The curves, derived from the CBS STR-100 test disc, are averaged for the two channels.

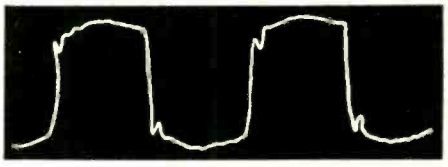


Fig. 6. 1-kHz square-wave response to the CBS STR-111 test disc.

no audible tendency for instruments to wander in position as they ascend or descend their range.

The square wave is nearly perfect as cartridges go. The notch at the leading edge is likely to be the record rather than the cartridge. You would expect clean, sharp transients and you do get them. IM distortion was a satisfactorily low 2.1 per cent on the +9 dB band of CBS STR 111. (The square wave is also derived from this disc.)

Output from 3.54 cm/sec recorded velocity at 1 kHz was 4.2 mV left and 4.4 mV right. This is ideal for tube and transistor preamps.

The brush serves two functions. The first is the obvious one—it sweeps the groove. We have some qualms about the effectiveness of this type of brush as compared against something like the Dust Bug. So much so that we removed it, an easy thing to do.

This revealed the second function. The brush helps hold the stylus in the groove. It is a flexible link from the arm to the groove so it aids in tracking and shock absorbtion. As a consequence, ideal tracking force with the brush is 1.25 grams; removing the brush requires 1.5 grams for the same tracking abilities. (Of course, we compensated for the physical weight of the brush itself.)

Well, no matter. This is a longhair of a cartridge. It makes beautiful music from those records that can. It does well with records we thought cannot. Finally, the list price is all of $49.50 as the elliptical EL, the 0.7-mil 581A and the 0.5-mil 581AA. That's downright inexpensive. CIRCLE 2

Fig. 7. The BSR McDonald 500 automatic turntable.

BSR "McDONALD 500" AUTOMATIC TURNTABLE

It is practically axiomatic by now that all high-fidelity automatic turntables come from somewhere else—none is made in this country. And the latest addition to the imported turntable category is from Britain, and furthermore from the world's largest manufacturer of turntables, record changers, and tape decks—BSR Limited. The American arm of the parent company is BSR (USA) Limited, which is committed to a program of consumer products in the high-fidelity field, with the McDonald 500 being the initial venture into these uncharted markets. Heretofore, BSR products were available only in complete phonograph systems.

Up to now, a high quality turntable was an expensive item, but the McDonald 500 comes with a consumer price of only $49.50, which puts it in reach of the most budget-conscious audio buff. Furthermore, most of the lower-priced record changers were usable only as record changers, and were not equipped with the niceties which the high-fidelity enthusiast has come to expect, such as counterbalanced arm, fine adjustment of stylus force, finger lift, and so on.

Neat and compact, the McDonald 500 measures 14½ by 13 inches, with an over-all depth of 7 inches, and thus will fit into many of the smaller enclosures which cannot accommodate the average turntable. In styling, it is sufficiently attractive that our art director stopped at our desk to admire it without even being asked.

It employs a lightweight, counterbalanced arm with the stylus force being adjustable in ⅓-gram steps from zero to 6 grams. The balance weight may be moved at will after loosening a knurled knob at the top of the arm, and stylus set-down is adjusted by another knurled arm, so that no tools are required to make the necessary adjustments.

One of the claims of the company is that the turntable can be played upside down. It is so rare that this facility is required that we didn't try it, but we did try it at extreme angles, like up to 60 deg. from the horizontal, and it still worked, so we took the rest for granted. With the right side raised 45 deg., the unit tended to trip itself, starting the record over and over.

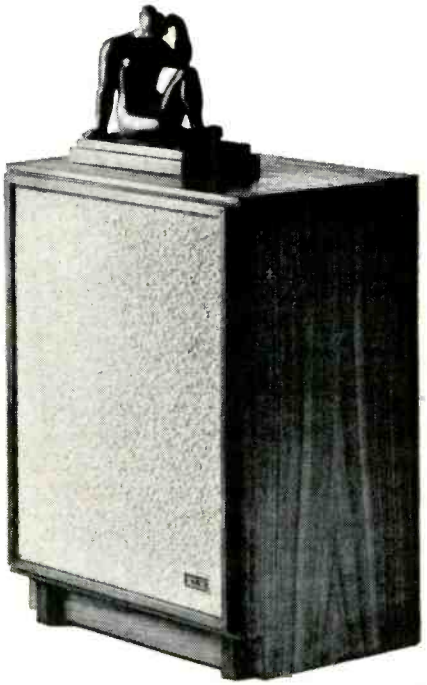
On the serious side, however, the turntable has all the desirable features, and some which we believe to be unique. There is a cuing lift which will drop the stylus back into the same groove from which it was lifted. At the finish of the last record on a stack, the arm returns to its rest, gets latched in place, and the motor shuts off. It can be set for any of the four speeds or for 7-, 10-, or 12-inch records. By placing the record stabilizing over-arm in its off normal position, the unit will continue to repeat the last record indefinitely. When the unit shuts off, the motor shaft is disengaged from the idler. The four-pole motor itself is dynamically balanced and well shielded to avoid radiating an objectionable hum field.

The McDonald 500 functions as a changer, accommodating a maximum of eight records, and it also functions as an automatic single-play turntable, using a separate spindle.

Wow and flutter checked out at 0.2 per cent, while rumble measured 28 dB below a recorded velocity of 3.54 cm/sec at 1000 Hz, which rounds off to —38 dB when weighted with a 50-Hz rolloff. Thus with any but the deepest-bass loudspeakers, this should be recognized as satisfactory in performance. At its price, it is much more than that.

CIRCLE 3

The new KLH* Model Twelve is the result of some pointed questions about what kind of improvements might go into a speaker system designed for perfectionists.



Suggested Retail Price: $275.00

The KLH Model Twelve is the finest moving-coil loudspeaker we have ever made. Not by a spectacular margin (there just isn't that much room for improvement in today's best speakers), but by some important degrees.

Before we began to design the Model Twelve, we asked ourselves some pointed questions. We knew we would not be willing to settle for just a set of more impressive measurements. What real improvements could we conceive of for a speaker designed unabashedly for perfectionists? Which of the improvements that we could make on paper would, in fact, be audible and meaningful? Above all, how could we design a speaker that would be *useful* under the widest range of conditions?

A few answers

We decided that there were a few absolute factors we could improve upon or change significantly in a system for the perfectionist. We could supply a bit more response at extremely low frequencies. We could offer the potential for more very-high-frequency response —for use only with exceptionally good program material. We could make the overall impedance of the system eight ohms for optimum performance with today's transistor amplifiers.

By using an acoustic-suspension enclosure slightly larger than usual, we could also provide a bit more speaker efficiency. The amount we could gain would be just enough to allow the listener a choice of many excellent amplifiers of less than super-power.

A final step

With the aim of *usefulness* uppermost in mind, what else could we do?

We could offer the listener the opportunity to make adjustments in the speaker's overall sound quality—subtle but important adjustments. Adjustments that would allow the listener to modify the speaker's musical balance to account for differences in program material, associated equipment, room acoustics, and personal musical judgments. Instead of the usual mid-range or "brilliance" controls, we could provide the listener, for the first time, with an effective way to tailor the speaker to his own needs.

This is why the Model Twelve comes with a unique series of four multi-position control switches. These adjust the level of broad segments of the frequency range: 300-800 cps; 800-2500 cps; 2500-7000 cps; and 7000-20,000 cps. They are housed in a remote switchbox (connected to the speaker by a thin four-conductor cable) that can be placed next to your favorite seat for maximum effectiveness and ease of use. The amount of adjustment from each switch is limited so that you can make only meaningful adjustments. The Model Twelve cannot be made to sound bad under any conditions. It can only be made better for your own requirements.

Perfectionist's speaker system

We think our approach to the Model Twelve makes sense only for a perfectionist's speaker system. And the Model Twelve is just that. It will reproduce the highest and the lowest frequencies of any conceivable musical interest. Its very-high-frequency capabilities are actually in advance of most of today's program material; as the noise content drops on future recordings, the 7000-20,000 cps control can be turned up for ever more realistic music reproduction.

The Model Twelve's four speakers are used conservatively (in a three-way design) to cover a range at least an octave short of their upper and/or lower limits. The mid-range drivers are housed in special sub-enclosures that are acoustic-suspension in principle. The cabinet is made of one-inch plywood, with quarter-sliced walnut veneer selected for beauty and uniformity of grain. The overall design of the 29" x 22¼" x 15" enclosure has been understated to make the cabinet as unobtrusive as possible in any room.

We believe we have done everything we can to make the Model Twelve the best moving-coil speaker system we have ever made. If you are an unabashed perfectionist, you should go hear the Twelve. It's at your KLH Dealer now. For more information, write: KLH, 30 Cross Street, Cambridge, Mass. 02139, Dept. 700.

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AUDIO MUSIC AND RECORD REVIEW

Record Review • Edward Tatnall Canby

Gold Curtain

Opening Nights at the Met. (Historic Recordings of Metropolitan Opera Stars Re-Creating Their Celebrated Opening Night Roles.)

RCA Victor LM 6171 (3) mono

An actual hunk of the famed great golden curtain of the old Met comes to you with this Limited-Edition release. If that knocks you for a loop, then the album is for you, definitely. But even if you are less than enchanted by a bit of ratty old cloth—I think you'll enjoy the whole thing, even though you can't tell a Mimi from a Sophie, a Samson from a Sarastro, a Bjoerling from a Jeritza, or maybe a Galli-Curci from a Gatti-Casazza. (How many of us can?)

The reason is that even though the whole thing is obviously a publicity tie-in with the opening of the new Met at Lincoln Center this fall, it comes off—it really does. And the credit for that goes directly to the superb big 50-page book accompanying the records, featuring chatty, humorous, very readable notes by Francis Robinson, who is 2nd man at the Met and knows everything. Don't be scared—he puts you at ease in seconds flat.

It's a gimmick. Of course, the 30-odd artists didn't go out and "re-create" their roles for this album. In fact, some were *pre*-created; Lili Pons' 1946 opening-night item, for example, is represented by a recording she made in 1930, and probably just as well. The recordings date from 1906 all the way up to 1958 and were made in all sorts of places not including the Met itself. Most are semi-coincidences, though Victor and the Met did, in truth, work together like blood brothers over many a year. It was just a matter of matching up as many opening nights as possible to the existing recordings in RCA's voluminous back files—and it's amazing how many they could dig up to fit. But a good many of the yearly openers are missing, even so. No recording available. And/or the artist has since flown the coop, to other contracts live or recorded.

Don't expect any critical or historical evaluation of all this material. The atmosphere is the usual one for the Met, a magic aura surrounding the endless parade of celebrities. But there's plenty of history to be inferred in the listening, just the same. Not only the extraordinary change in singing styles over these years, but also a fine capsule history of the recording art, from the beginning of classical music recording straight down to the tape-LP age and the verge of stereo. Just sit back and listen—it's all there.

Opera-at-Large

Mozart: The Marriage of Figaro (in German). Guedon, Prey, Rothenberger, Berry, Mathis; Dresden State Opera Cho. & Orch., Suitner.

Seraphim IC6002 (3) stereo

Here's a relatively new stereo recording of a famous Mozart opera and it's on Seraphim instead of the higher-price Angel label. Howcome?

Most such releases are oldies, reissued, or have some other special reason for the low price—not excluding a lousy performance. This one isn't lousy at all. There are some good reasons for the price, as I figure it.

First, it's in German—and the proper original language is Italian. This was for local consumption, over there. Second, it's out of Dresden, on the other side of the recording curtain (which is mostly sound-transparent these days). Third, it features a youngish, up-and-coming cast rather than a collection of international famous names. For my ear, this is all to the good! And it does lower the price. I like this team, German or no German.

Therefore this is as good a recording as any by which to begin enjoying the sizzling humor of this outrageous situation-comedy. Phew! If you think Mozart was a sissy with frills, just bury yourself in the whirlwind, acid, sharp-edged gayety of this production via the excellent line-by-line, section-by-section translation (you never get lost). One minute I'm thinking of Andy Hardy and Bob Hope, the next it's "Who's Afraid of . . ." etcetc—what a sardonic, worldly-wise musical show this is—and how fast it moves! Unlike later operas, Mozart's are so full of action you are breathless trying to keep up.

In this German version out of the East, the orchestra plays a bit on the hard side—not bad—and the singers, perhaps rightly, are a bit soft, less crackling and sparkling that we expect in the usual high-speed Italian rendition. No real harm done, though some of the familiar arias will sound a bit strange to those who know them well.

It's a very knowing and enthusiastic vocal team, this, with a good mixture of hilarity, sternness, and an awareness of the deeper subtleties behind all the fun—the amorous intrigues with their endless costume exchanges, the hidings behind chairs and in closets, the discoveries and the explanations—and through it all, the play of servant *vs.* aristocrat, matching wits against authority. The Count, for instance, (Hermann Prey) has precisely the right easy-going condescension towards his mercurial menials, which can turn suddenly to hard authority with a quick change of voice and tone. Excellent.

Yep—a bargain, if not the greatest performance on record.

Beethoven: Fidelio. Kuchta, Patzak, Rehfuss; Symphony Orch. & Cho. Norddeutscher Rundfunk, Hamburg, Bamberger.

Nonesuch HB 73005 (2) stereo

This is a first-rate "poor-man's Fidelio" and, for that matter, a good one for anybody, at any price. It is another example of the important continental (and especially German) alternative to the high-priced star-vehicle opera and the star-studded cast: this is the sort of excellent work-horse production that is common in the countries where the operas originate and are still staple fare, the type of performance designed for the local populace, who know the music cold.

The singers are not big stars but they are good singers and moderate stars. The orchestra is a good one and the conductor is excellent; all the principles know very well what "gives" in this music. The result is not a star vehicle but an intelligent, unified, dramatic performance. I'm all for it and, indeed, would a lot rather hear this kind than the other sort, which is all too often stylistically a hodge-podge—and deficient in singing balance, as well, as between big and little names.

Technical quality is perfectly adequate and the stereo is serviceable.

Rameau: Hippolyte et Aricie (1773). Baker, Hickey, Tear, Shirley-Quirk; St. Anthony Singers, Engl. Ch. Orch., Lewis.

L'Oiseau-Lyre SOL 286-7-8 (3) stereo

Fans of "grand opera" seem to think that opera began with Rossini and ended with Puccini (and Wagner, interpolated, along with Gounod and Bizet from France). It didn't. Here is one of the most famous of all operas, though unknown to the Met. The highly researched and carefully prepared recording has a lot of solid value, unfortunately marred by mediocre solo voices in some of the lead parts.

Though this music is from the days of Bach and Telemann in Germany, the style is altogether French—which means that, unless you have been catching up on the spate of new French Baroque music of late, it will be a bit strange to you. (The French went their own way then, as now.) Potentially, it has better entertainment value than contemporary German-Italian Baroque opera; for the variety of music and the continuity was much more "stagey" than in the relatively rigid recitative-aria operas outside France.

But the special French mannerisms and, notably, the typically profuse musical ornamentation in both vocal and instrumental parts, makes for a lot of trouble in a proper restoration.

This splendidly got-up album does just about everything you could ask for in most respects. A gorgeously complete booklet, with immensely interesting material on the opera production of the time—including some fascinating stuff on staging and lighting. (Footlights via oil or tallow lamps floating in a trough of water; the water could be drawn off, to sink the lights down and so dim the stage.) Also, of course, the whole background of this opera and the complete text in French and English.

And orchestral playing which goes right along with the booklet. Excellent, and very knowingly worked out, down to the last detail of elaborate ornament. A monumentally thorough job; and yet the playing is always light and musical.

Alas, again, only the voices disappoint, and they really fail quite miserably. The lead lady, Aricie, has a grainy, somewhat course voice with a dreadfully uncontrolled vibrato and an indifferent sense of pitch; she tries hard but she is woefully inadequate. Her Hippolyte, the hero, is better, but still a more or less conventional singer, only half-adapted to the Baroque style, singing mostly as though this were just another Caruso-style grand opera. Two solid bass voices add drama and authority at the expense of a lot of heavy wobbling, though it is musical enough in essence.

Only one voice is really first-class—the lady villain, Phedre, sung by the American Janet Baker. Now *there* is a voice—*and* a musical ear! She sings circles around all the others. Her dramatic intensity rescues what otherwise would be a dull show.

(Now if only they had taken on Philips' Heather Harper and Helen Watts, out of the new British *Messiah*, for some of these ailing parts! Then we'd really have some Rameau, worthy of the opera's reputation.)

Fortunately, a great deal of this opera was stage spectacle, including plenty of ballet and chorus music, so the big scenes are very much worthwhile in musical terms, especially with the excellent book before you to aid the imagination.

The Intimate Opera of the Baroque (Pergolesi, Purcell, Arne, Carey, Hook, Oswald). Anonymous singers, Intimate Opera Society.

Everest 3138/3 (3) stereo

There's interesting and highly amusing material in this set, which Everest has pried out of British Decca (London). Though the designation is stereo, the curiously pinched, dry sound of the recording implies an "oldie" (if it is new, then it is of course inexplicably substandard)—but the stereo presence is, indeed, helpful to the dramatic presentation even if it is synthetic and the curious tonal quality is not really unpleasant if you are listening to the music.

The Intimate Opera Company was founded in 1930, operated straight through the war and was then broadcast to us, perhaps as a good example of British "carry on" philosophy. The company goes onward now—but, as I say, I suspect this is an earlier manifestation. No matter. This is lusty, imaginative singing, if by no very great voices, and the simple accompaniments are neatly played.

Only Pergolesi's humorous "Music Master" is familiar—but the somewhat rakish style of the other works, all British, clearly is out of that lusty period of British music that began with the Restoration (Purcell's Masque from Timon in Athens) and went on through the Beggar's Opera and the era of glees and catches, and on through the Eighteenth century, until Handel's music slowly brought propriety over from the continent and launched oratorio to replace most opera, both lusty and high-toned.

As might be expected, the Purcell is the deepest (and musically the most serious) of these little works. Others are lightweight but most entertaining—Arne's "Thomas and Sally," or the Sailor's Return," Henry Carey's "True Blue," James Hook's "Musical Courtship," James Oswald's "The Dustcart Cantata."

In its familiar manner, Everest mixes up the cover of the album, omitting two composer's names, changing the spelling from that on the booklet; nor is there any indication as to whether the stereo is synthetic or "real". There should be. But the music *is* worth it!

Montserrat Caballe sings Songs of Enrique Granados. Symph. Orch., Ferrer.

RCA Victor LSC 2910 stereo

If you'd like to hear one of the most recent voice sensations, and yet you are not exactly a grand opera fan, this is your chance. A lovely record.

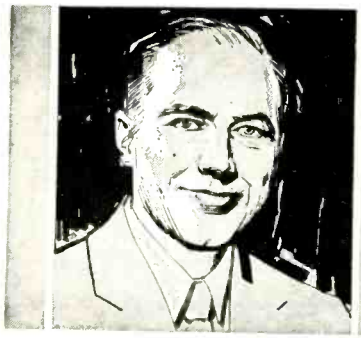
Granados died in a World War I submarine sinking in 1916, just as he was on the way to a biggish international career as Spain's great hope. Compared to De Falla (Spain's other great hope), his music is now a bit tame and old fashioned. But there is plenty of stuff in some of it, notably the first set of songs here (Side 1), *Canciones Amatorias* or, in simple English, Love Songs. The second set, *Tonadillas*, is both more popular and more dated—the consciously "olden-style" music is not of a sort we appreciate today and the folksy tunes are a bit on the obvious side.

All of these were originally set with piano accompaniments; RCA Victor is less than candid in making no mention of this, nor of the orchestrator or orchestrators. But the idea is OK—remove these songs from the stuffy "recital" category implied by piano accompaniment and put them squarely in the big-time opera-style gala performance. RCA knows its audience, as well as its singer; Caballe has a big, flowery voice that seems to have been destined for orchestral accompaniment, whatever the music.

(Oddly enough, the Spanish engineers have subdued the orchestra and brought the voice forward in the miking, so that the accompaniment is actually less compelling than it would have been on the piano. The fault is partly in the orchestrations, which miss a lot of the rhythmic vitality of the original piano parts.)

Caballe's voice is very beautiful in its middle and lower registers, which are marvelously bright and shiny; her high notes, somewhat surprisingly, go "white" and colorless. Her musical ear is excellent, too—almost as good as De Los Angeles, which is saying plenty. So is her dramatic involvement and the sultry projection of this often sensuous music. Very nice. The voice recording is superbly done.

(Continued on page 80)



LIGHT LISTENING

Chester Santon

Marty Gold: Soundaroundus
RCA Victor LSP 3599

This record arrived for review just as the arrival of September was turning the thoughts of an audio buff to the New York High Fidelity Show. It struck me at the time as a reasonably good candidate for turntable use in the 1966 exhibits using popular music to display their sonic wares. Since this review is being written prior to the opening of the show, I have no way of checking on my hunch that this disc might possibly change some minds in the industry about the sound of the Dynagroove process. This stereo record actually has some respectable sound on it. It's not the best record ever made but what pop record is? Marty Gold is one of the select few arranger-conductor in the business with a genuine interest in the audio features of his discs. In his latest release he seems to have persuaded his technical crew to hold down the gimmickry in the Dynagroove process to an absolute minimum. The result is a relatively straightforward record that allows a good home music system to work at its best in reproducing a wide range recording. Thanks to minimal tampering in the later stages of tape to disc transfer, one can hear the truly impressive work of today's better studio mikes, raw tape, and taping facilities. Perhaps the nicest bonus in the disc is the chance to hear under proper conditions the outstanding acoustics of Webster Hall, scene of so many good RCA recordings prior to Dynagroove days. This record proves once more that this fortuitous studio site is one of the very few in the business where it's possible to get lush close-to sound without running the risk of sounding cramped-for-space. The stereo pattern of miking is unusual in the way it picks up solo instruments without losing the smooth cohesion and depth of the rest of the orchestra. Many of the selections are sure-fire hits ("Shadow of Your Smile," "Taste of Honey," "People," and "Walk in the Black Forest") with the only electronic trickery reserved for "Bye, Bye Blues."

133 Authentic Sound Effects
Elektra EKS 7313/14

Any hobbyist or professional in the audio/visual field is acutely aware of the problem of choice when it comes to sound-effect records. Even those blessed with a relatively lavish budget may find it difficult to audition all the discs presently listed in the Schwann catalog under "Sound Effects," not to mention other releases of sounds too specific in nature to be listed under a catch-all heading. Although many labels have been active in taping sounds over the years, only a few firms currently offer truly comprehensive libraries of sound effects designed to satisfy the needs of home movie enthusiasts and others wishing to add sound to picture. Audio Fidelity and Elektra now offer the greatest array of discs for this purpose. In this new multiple album, Elektra has selected from its large library those sound effects most apt to be used by someone starting a basic collection. Naturally, the pressings are as up to date as modern technology can offer, giving a new freshness to sounds that cover categories such as Forms of Transportation (land, sea, and air), Machines, Sports, Weather, Warfare, and finally mere Household and Human.

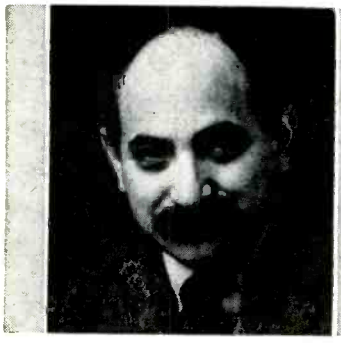
This is a handy package that should take care of anyone who hasn't graduated to the really esoteric type of sound effect currently available.

Show Boat (Lincoln Center Cast)
RCA Victor LSO 1126

Revivals of this Jerome Kern classic, onstage or in record form, seem to come along every few years. Now that Lincoln Center's Music Theatre has mounted a new production of the show, the record fan with a more-than-average curiosity in audio matters has a unique opportunity to do some interesting comparing of disc versions of Show Boat. A few years ago, Columbia Records issued an excellent Show Boat recording with a cast assembled solely for the occasion. Now Victor comes along with a disc documenting the revival that took place this past summer at Lincoln Center. By a rare coincidence, these two leading versions of the show on records happen to offer the same leading lady, the same baritone in "Ol' Man River," and the same conductor. On both the Columbia and Victor disc, Franz Allers leads the orchestra, Barbara Cook sings the part of Magnolia, and William Warfield continues to chart the flow of the Mississippi, a task he began in the 1951 screen version of Show Boat. It's more than mildly instructive to listen to individual segments of these two discs on wide range equipment. It shouldn't be a total surprise to readers of AUDIO to learn that the newer version isn't necessarily the better sounding of the two. Taking the voice of Warfield first, his "Ol' Man River" on the Columbia stereo disc issued in 1962 has the presence one takes for granted when listening to a good system. The same presence is almost there in the RCA-Victor Dynagroove version. What is missing is that touch of frequency range at top and bottom that the audio buff insists upon when selecting his playback equipment. Any change in the voice of Barbara Cook is scarcely discernable. The RCA miking of her songs is closer than Columbia's, so much so that the intake of breath before a long phrase is much more apparent in her newer edition of such great songs as "Make Believe," "You Are Love," and "Why Do I Love You." In the other leading role, baritone Stephen Douglass exhibits an appealing voice and style as the latest Gaylord Ravenal. It is no discredit to his performance to point out that John Raitt in the Columbia version delivers the Ravenal songs with a share more assurance. Constance Towers as Julie and David Wayne as Cap'n Andy round out a cast that, although still better than average, does not replace the Columbia version in my esteem.

Edmundo Ros: Arriba
London Tape LPL 74080

No listener has ever been lulled into slumber by a Ros recording and this reel is no exception. The British maestro's Latin beat is as ebullient as ever in this varied collection. Some of the selections try to resist conversion into Latin rhythm but Ros and his band of arrangers always have the last word. There is no sense of conflict in an item such as "Siboney" which always sounds tailored-to-measure whenever Ros plays it in his well-oiled style. Noro Morales' widely-known piece, "Oye Negra," also gets treated in royal fashion with a glib vehemence that fast Latin tunes thrive on. Among the definitely non-Latin compositions, "Hello Dolly" does fairly well. Only "Get Me To the Church On Time" from My Fair Lady hesitates in hitting its stride, what with an opening that contains pealing bells and a vaguely church-like organ. Adding to the well established appeal of Edmundo Ros' music making in this release is the modified nature of the London Phase-Four stereo process. The aural picture is not as disjointed as it has appeared in other recordings using this decidedly arbitrary process. Without strain to the imagination, one can just about place all sections of the orchestra in one recording studio. No imagination at all is required to appreciate London's cleanliness of sound in this reel. *AE*



JAZZ and all that

Bertram Stanleigh

Bill Evans and Jim Hall: Intermodulation

Verve Stereo V6-8655

This is one of the most satisfying of recent jazz releases. Pianist Bill Evans, and guitarist Jim Hall, are two performers who use their easy going styles to probe deeply into the content of the music they play. While each man has a strongly individual manner of communication, they collaborate superbly without any apparent need to modify their usual approaches. In addition to Cole Porter's *I've Got You Under My Skin* and George Gershwin's *My Man's Gone Now*, the disc offers Hall's *All Across the City*, Evan's *Turn Out the Stars, Angel Face* by Joe Zawinul, and Claus Ogermann's *Jazz Samba*. Each piece is superb, and together they make a delightful program. The recording, by Rudy Van Gelder, is on a par with the performances. Don't pass this by!

George Benson Quintet: It's Uptown

Columbia Stereo CS9325

A vigorous rock group featuring the guitar of George Benson with Ron Cuber, baritone, Lonnie Smith, electric organ, and Jimmy Lovelace and Ray Lucas sharing the drum assignment. The music is a mixture of Benson originals and such standards as *Summertime, A Foggy Day, Willow Weep for Me*, and *Ain't That Peculiar*. The group works together with well-oiled precision, and the results have power and a highly charged blues character. The sound is close up and helps to get across the energy and excitement of this fine new quintet. Guitarists of Benson's calibre are scarce, and this one will certainly bear watching.

Yank Lawson: Ole Dixie

ABC-Paramount Stereo ABCS 567

Bob Thiele, producer of this delightful novelty, has brought together a traditional dixieland group and three Latin drummers. The results of this happy combination are some traditional numbers like *Fidgety Feet, Wolverine Blues*, and *Muskrat Ramble* played with freshness and style. Chico Hamilton, Willie Bobo, and Victor Pantoja add their familiar south-of-the-border accents to the solid work of Yank Lawson, trumpet, Pee Wee Russell, clarinet, Cutty Cutshall, trombone, Dave McKenna, piano, and Bob Haggart, bass. Things are less successful when the group, supplemented by guitarist Bucky Pizzarelli, turns to a bit of bossa nova. But the disc's highlight—*Daydreams* whistled by Bob Haggart—ensures that this one will be a collector's item.

Kai Winding: Dirty Dog

Verve Stereo V6-8661

The free-and-easy trombone of Kai Winding is back again, this time with three more slip horns played by Carl Fontana, Urbie Green, and Bill Watrous. With Buzzy Bavarian, guitar, Bob Cranshaw, fender bass, Herbie Hancock, piano, and Grady Tate, drums, they deliver a half-dozen swinging jazz performances in a lively fashion punctuated by several mumbled grunts, shouts, and other assorted asides. In addition to the title tune, the selections include *Sunrise, Sunset, Blindman, Blindman, Something You Got, The Sidewinder*, and *Herbie* Hancock's *Canteloupe Island*. It's good to encounter the Hancock number again. It was originally heard in the pianist's brilliant Blue Note platter, *Empyrean Isles*, and the very different performance it gets on the present set is a mark of the tune's versatility and a demonstration of the relaxing influence that Winding emanates.

Dick Hyman: Happening

Command Stereo RS899SD

Versatile keyboard performer, Dick Hyman, is heard this time on the harpsichord, and he sounds just as much at home with the style and technique of this instrument as he does in his usual performances on organ and piano. Ably abetted by a top-flight group that includes Tony Mottola, guitar, Ernie Royal and Doc Severinsen, trumpets, Bob Haggart, bass, Phil Bodner and Stanley Webb, woodwinds, Bobby Rosengarden, drums, and Phil Kraus, percussion, Hyman swings through a wide range of items that includes the theme music from *Tom Jones* and *Zorba the Greek*, Beatle tunes, *Yesterday* and *Michelle*, and the *Ballad of the Green Berets* with a vocal by a girl trio. The sound has the characteristic brilliance and presence that makes all Command discs exceptional.

David Blue

Elektra Stereo EKS 74003

Both as a performer and as a song writer, Blue reveals exceptional talent and sensitivity. His lyrics present some of the most imaginative situations and poetic imagery that have been encountered in the folk-rock movement. In addition, the instrumental backgrounds have color, variety, and vigor. And the recording is crisp, close-up, and evenly spread out. A first recording of this quality clearly indicates the arrival of an important new personality. The album includes a booklet with the lyrics of all of Blue's songs. They make fine reading as well as listening.

Billy Larkin and the Delegates: Ain't That a Groove

World Pacific Stereo WPS 1843

Billy Larkin's rock-blues-jazz organ is solidly supported by Fats Theus, tenor, Jimmy Daniels, guitar, and Jessie Kilpatrick, drums. This is an entirely new bunch of "delegates" from those heard on previous Larkin discs, and in my opinion, the change is a decided improvement. Eleven tunes get a vigorous workout; James Brown's *Ain't That a Groove*, Larkin's own *Where Did the Blues Go?*, and Ronnell's *Willow Weep for Me* are particularly outstanding. The stereo sound has body and an excellent spread.

ESP Sampler

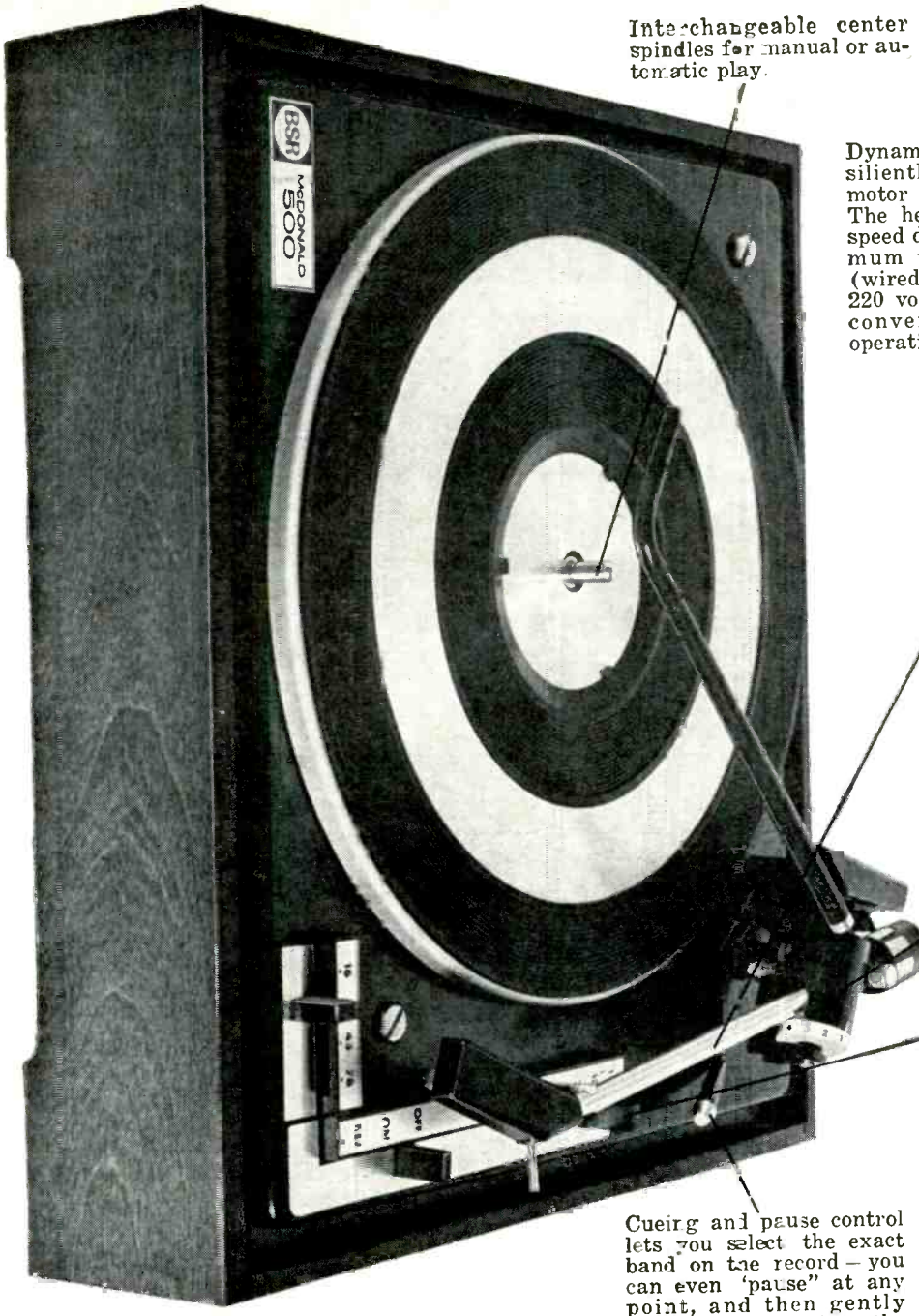
ESP Mono 1033

This is the first of two new samplers introducing the ESP line. When a company specializes in the most advanced varieties of modern programming, record buyers may sometimes be a trifle wary about investing in entire discs whose contents are unknown. This platter should serve to overcome the problem. It offers a total of 18 selections including music by the Fugs, Ornette Coleman, the Ayler Brothers, Pharoah Sanders, Paul Bley, Giuseppi Logan, Charles Tyler, Sunny Murray, and a performance of Auld Lang Syne sung in Esperanto. Anyone who wants a one disc collection of far-out music couldn't make a wiser choice than this.

Timothy Leary, Ph.D.: Turn On, Tune In, Drop Out

ESP Mono 1027

The subject of psychedelic drugs has frequently been linked in the press with jazz musicians, and it is consequently not too surprising that an enterprising record firm specializing in advanced forms of jazz should devote a disc to a talk by the former Harvard professor whose experiments with such controversial items as LSD, marijuana, and cannabis have gained him a considerable amount of notoriety as well as a couple of jail sentences. Dr. Leary presents the case for the employment, and enjoyment, of these drugs in a quietly eloquent manner. One wonders whether the Food and Drug Administration may not decide that some kind of cautionary warning should be required on this fascinating disc. Æ



Interchangeable center spindles for manual or automatic play.

Dynamically balanced, resiliently mounted 4-pole motor shielded from hum. The heavy-duty, constant speed design assures minimum wow and flutter. (wired for either 110 or 220 volt operation—easily convertible to 50 cycle operation).

Low mass tubular aluminum pickup arm is perfectly counter-balanced both horizontally and vertically — less susceptible to external shock, even tracks upside down! The arm is supported on virtually frictionless pre-loaded horizontal ball bearings for sensitive and accurate tracking.

Resiliently mounted, coarse and fine vernier adjustable counterweight. Exclusive micrometer stylus pressure adjustment that permits ⅓ gram settings from 0 to 6 grams.

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Cueing and pause control lets you select the exact band on the record — you can even 'pause" at any point, and then gently lower the stylus into the same groove.

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You already know that the British are experts at building the world's finest changers. And now there's a new automatic turntable available in America from BSR Limited. It's the McDonald 500 Automatic Turntable—$74.50 features for $49.50.*

The reason it's on its side? The McDonald 500 has a truly adjustable, counter-balanced arm . . . a feature you would expect to find only on the $74.50 model. Look over the other McDonald 500 features, too. Think about all the records you can buy with the money you save by getting the McDonald 500—precision crafted in Britain.

*Suggested Retail Price

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Audio Measurements Course

NORMAN H. CROWHURST

Part 10

While much of the measurement technique on tape recorders is "old hat," there are still a number of critical points which should be considered and not a few pitfalls which may not be well known at all.

WHILE TAPE AVOIDS the mechanical problems of transduction inherent with phonographs as a record medium, it poses measurement problems not present there. The recorded groove in a phonograph record can be checked physically—most readily by optical (light) examination. Such a method is not directly available with tape, and the only way to determine what is on the tape is to measure it with a playback head.

From this viewpoint, absolute standards are a little more difficult to achieve on tape. But from another viewpoint, the standard achieved is more definite. Playback characteristic is less dependent on interaction between the record medium and the playback device. Some dependence is possible, because presence of the magnetic circuit of the playback head has a temporary demagnetizing effect on the tape. But this effect is far less subject to variation from head to head and tape to tape than is the interaction between elasticity of the phonograph record material and the mechanical properties of individual pickups.

With these basic observations in mind, the methods applied to tape follow procedures similar to those for phonograph equipment. Different speeds have different equalization characteristics, designed to optimize performance for each particular playing speed. Standards are also set for special systems that may use a different combination of record/playback over-all result.

Speed

For correct results, both recording and playback must be performed at the correct speed. On phonograph, this is checked by using a stroboscope disc on the turntable, with different numbers of black and white radial bands so the pattern appears to stand still when viewed by a light operated on standard 60-Hz supply (*Fig.* 10-1).

With 92 uniform black and white bands, the pattern will appear stationary at 78.26 rpm, which is close to the old standard of 78. For the new standards of 33⅓ and 45, the numbers of bands, 216 and 160 respectively, result in stationary patterns with exact correspondences.

The same method is used with tape by applying a low-friction pulley of known diameter to the tape. A standard diameter for the pulley is prescribed in the NAB standard as 1.4305″ +0.0002 −0, with 72 and 36 equally spaced black and white lines or dots (*Fig.* 10-2). These will give stationary indications at the standard speeds of 1⅞″, 3¾″, 7½″ and 15″ per second, when viewed by a 60-Hz light.

Obviously, laying a paper disc on top of a phonograph test record will not produce any drag. But applying a pulley to a test tape may. One way to check whether or not it does is to play a recorded constant tone and check its frequency as the test pulley is applied. It may change momentarily while the pulley is engaging or disengaging the tape: this does not matter. The frequency of the tone should be the same when the pulley is steadily engaged or disengaged.

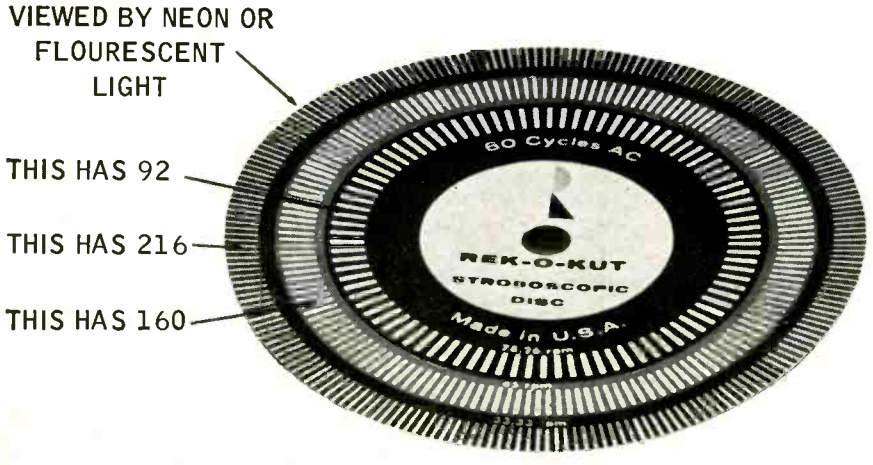

Fig. 10-1. The conventional stroboscope disc used for checking turntable speed on phonographs.

Frequency Response

Apart from the chicken-or-the-egg problem, of where to begin, there is a basic relationship to recognize here: recorded signal is related to the signal *current* fed to the head, while playback is given in terms of *voltage* output from the playback head.

the smoothest, quietest, gentlest, automatic turntable ever designed

The new Miracord 50H achieves a playback quality beyond the capabilities of any other automatic available today. And it accomplishes this with the mechanical reliability, record-handling gentleness and operating simplicity, characteristic of all Miracord turntables.

The 50H embodies every feature known to modern turntable design, and includes several exclusive innovations of its own. It is strikingly handsome, trim and uncluttered, and its very appearance reveals the care and attention lavished on its construction.

The Miracord 50H is powered by a hysteresis motor, assuring locked-in speed accuracy. And it provides the simple, gentle facility of pushbutton operation.

It is also equipped with a dynamically balanced tone arm with interchangeable cartridge insert having a simple, slotted leadscrew control for precise stylus-overhang adjustment. A retractable stylus-position indicator is located on the turntable deck.

The 50H also provides cueing facilities, anti-skate compensation and direct-dialing stylus force adjustment to less than ½ gram.

At $149.50, less cartridge and base, the Miracord 50H is probably the most expensive automatic in the field. This is entirely understandable when you consider it is also the finest. See it at your high fidelity dealer, or write. Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11736.

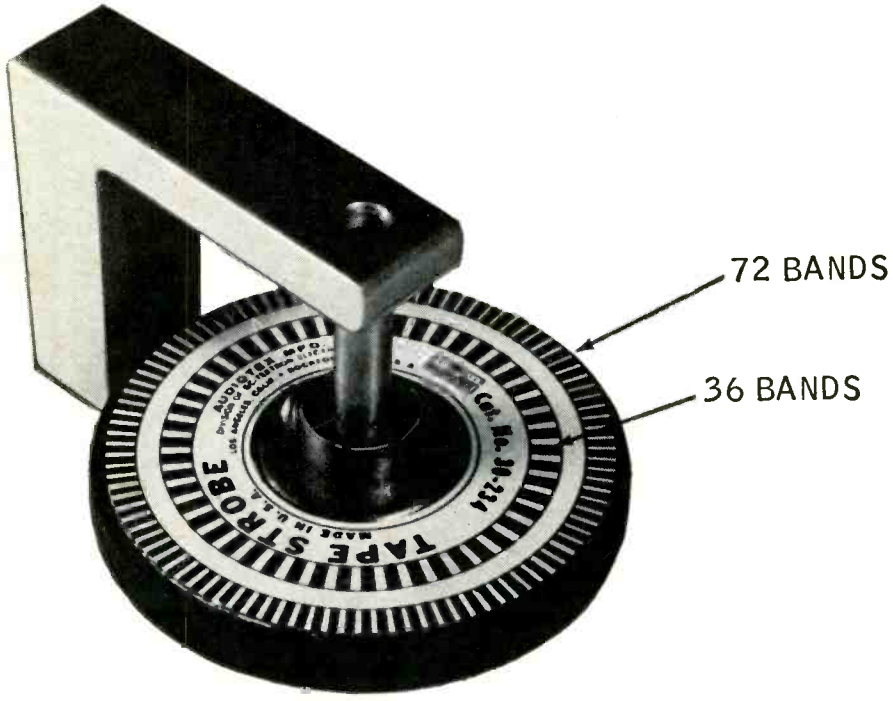

Fig. 10-2. Design for a pulley to check speed on tape, as specified in NAB standard.

As magnetic flux on the tape is basically related to magnetizing current in the record head, and voltage is generated by the rate at which magnetism changes at the playback head, there is a 6 dB/octave inherent correction. If a tape is recorded at constant flux density (constant magnetizing current) with frequency, then the playback needs a 6 dB/octave falling characteristic (*Fig.* 10-3).

The conversion is not this simple, because the recording amplifier would "rather" give constant voltage than constant current. Constant current would result in too low a recorded level of low frequencies and too high a level of high frequencies on the tape. On the other hand, constant voltage would result in distortion at low frequencies, and excessive noise level (due to low recorded level) at high frequencies. So a compromise is needed, the exact choice depending on tape speed.

Through the mid-range, from a low-frequency turnover point of 50 Hz to a high-frequency turnover that depends on speed—3200 Hz for 7½ and 15 ips and 1800 Hz for 1⅞ and 3¾ ips—the characteristic is constant record current, producing constant flux in the tape. The playback characteristic needs a 6-dB/octave rolloff through this range.

Below 50 Hz and above the upper turnover point, the characteristic changes to constant voltage. Thus, assuming a perfect record head, fed with a constant-current drive, and a perfect playback head producing an output from constant-flux recording that rises at exactly 6 dB/octave all the way, the equalization curves would be as shown at *Fig.* 10-.4.

Practical record and playback heads are not perfect: there are both low- and high-frequency losses, as well as a general mid-range loss which we needn't consider here. So both record and playback equalization are needed to correct for these as well as the basic responses set by the NAB.

The starting point recommended by the NAB is a high-quality playback head, the response of which is checked by stimulating it artifically with a constant-current magnetization of its gap, rather than using a tape. This enables the head characteristics to be separated from any characteristics in the test signal on the tape.

Correction can be applied to the head so that its response to such stimulation, as measured at the equalized output from the amplifier, is equivalent to true constant-current excitation (voltage proportional to frequency).

The next step is to apply further equalization so such simulated constant-current excitation produces the required playback characteristic (*Fig.* 10-5). If you are not concerned with determining head losses for their own sake, this final result can be the immediate target of equalization design.

With the head thus adjusted for playback, experimental recordings can be made until this response is again achieved on playback, indicating that the test tape has constant flux density. The record equalizaion is adjusted,

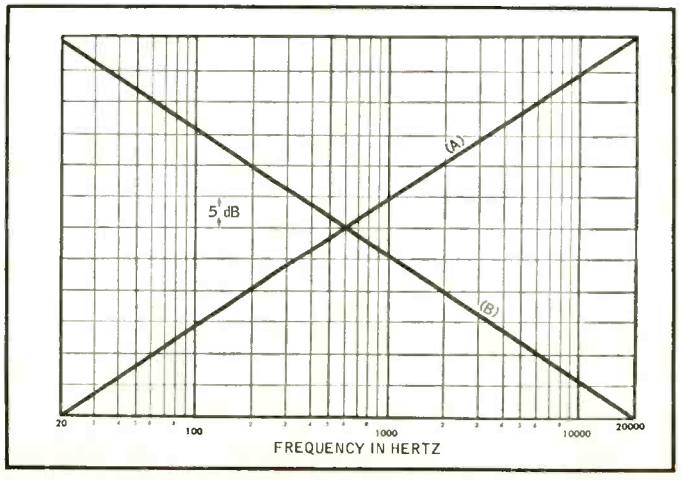

Fig. 10-3. Basic "responses" pertaining to idealized tape recording and playback. Curve "A" represents the output from a constant-flux recording. Curve "B" the offsetting equalization to provide flat response.

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.

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without touching the playback equalization, until this is achieved.

That's the "full treatment"—from scratch. More usually a constant-flux tape, made by these NAB standards, will be used directly to give the response of *Fig.* 10-5. Either way, when this curve is produced by a constant flux excitation, the response will be correct for playing tape recordings with standard NAB equalization.

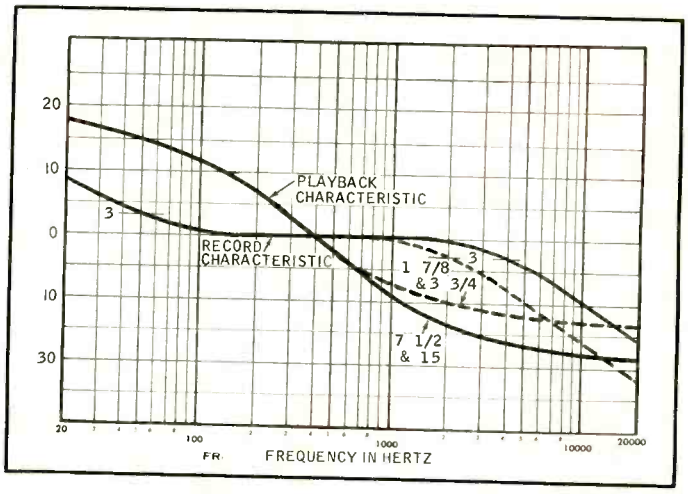


Fig. 10-4. NAB standard equalizations, for record and playback at 7½ and 15 ips. The equalizations shown for 3¾ and 1⅞ ips are those commonly employed in current practice.

Distortion

This is measured just as for phonograph reproducers. A test tape is played and its output is analyzed. The direct bridge method cannot be applied, because the original input is inaccessible.

In measuring either tape or phonograph reproducers for distortion, flutter and wow can show up as distortion elements, unless specific means are taken to avoid such errors. The effect of such errors can vary with the method of measurements used.

The conventional harmonic analyzer, which removes fundamental with a frequency-sensitive bridge circuit, will go off balance due to the presence of flutter or wow, thus leaking fundamental, however carefully the bridge is balanced. This will be more obvious on wow, because the meter indication will fluctuate at the same speed as the wow, or maybe double the speed.

But the meter indication will not thus follow flutter, so a spuriously high reading will be obtained that cannot be identified by looking at the meter indication. However, looking at the distortion residue on an oscilloscope will tell (*Fig.* 10-6). Distortion elements will be represented by a single, clear trace. If either hum or flutter is present, this will show as a multiple trace.

Hum multiplies the simple distortion trace, to look like parallel, crooked lines. Flutter changes the shape of individual distortion traces, according to the pattern by which the bridge is detuned by changing frequency caused by the flutter cycle.

The use of a wave analyzer tends to reduce all readings—fundamental *and* harmonics—similarly: the reading peaks up as the frequency goes through the tune point, but the meter doesn't have time to reach the true peak-reading value. Probably the invalidation of all readings is similar and thus cancels out in figuring distortion as a percentage. But the relative significance of the two methods of measuring distortion still follows the pattern discussed in an earlier installment.

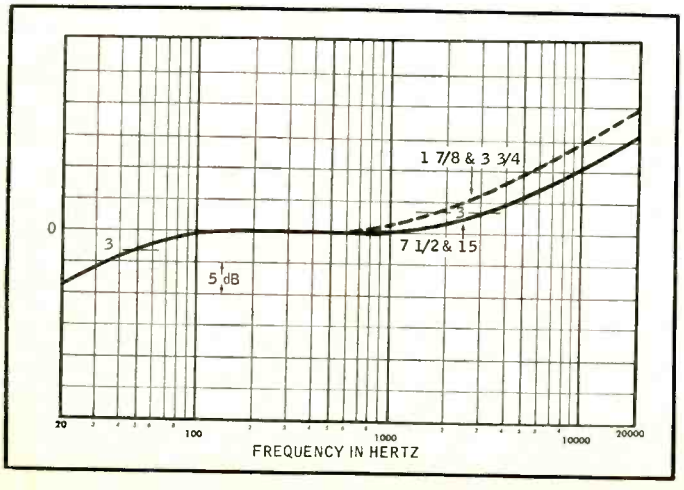


Fig. 10-5. The measured playback response to a constant flux tape, or to constant flux excitation, of a playback head and amplifier, equalized to NAB standard for the two higher speeds, and to general practice for the slow ones.

Flutter and Wow

This is also measured in the same way as for phonograph reproducers. Tape recording is more susceptible to level fluctuations that occur due to varying tape contact against the recording head or due to quality variations in the tape, than phono discs are. So a flutter and wow meter needs more elaborate care to eliminate amplitude fluctuations before measuring frequency variations.

A flutter-and-wow meter for working on tape can (and usually does) include a 3000-Hz oscillator to record the test signal on tape. This enables the measurement to record over-all flutter and wow, from record to playback. If the reading is higher than it should be, you may want to determine whether the deviation occurs mainly on record or playback.

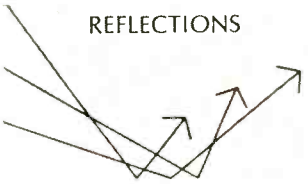
Some units will produce about the same amount in both operations, so

not all cardioid microphones are alike . . .

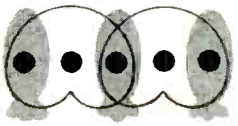
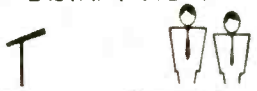
the SHURE UNIDYNE® III

TRUE CARDIOID UNIDIRECTIONAL DYNAMIC MICROPHONE SOLVES ALL THESE COMMON MICROPHONE PROBLEMS!

PROBLEMS CAUSED BY INEFFICIENT REJECTION OF UNWANTED SOUNDS BY THE MICROPHONE

SITUATION	PROBLEM	CAUSES	SOLUTION
REFLECTIONS 	Feedback occurs where a so-called "cardioid" microphone is used and the speakers are placed to the rear of the microphone. A common occurrence in churches, auditoriums, and meeting rooms.	Sound bounces off hard surfaces on the walls, floor and ceiling, in and around the audience area and the microphone used is not effective in rejecting these sounds at all frequencies, and in all planes about its axis.	The Unidyne III rejects sound at the rear with uniformity at all frequencies. Sounds bouncing off floor or other surfaces are uniformly rejected.
 COLUMN LOUDSPEAKERS	Unexplained feedback. Column loudspeakers are used to distribute sound more evenly to the audience in churches and auditoriums.	Feedback occurs when rear and side sound lobes of column speakers coincide with rear and side lobes of so-called "cardioid" microphones.	The Unidyne III solves this problem because it has no rear or side lobes. Thus it rejects the side and rear lobes of the sound column speakers.
REVERBERANT BOOM!	A disturbing, echoing effect of low frequency sound often found in churches, large auditoriums, and arenas.	Low frequency reverberation and boominess occuring when microphone fails to retain unidirectional characteristics at low frequencies.	The Unidyne III maintains a uniform pattern of sound rejection at all frequencies, even as low as 70 cps. The response has a controlled roll-off of the low end—low frequency reverberation diminishes effect of boomy hall.

PROBLEMS CAUSED BY THE MICROPHONE'S INEFFECTIVENESS IN PICKING UP THE DESIRED SOUND

GROUP COVERAGE WITH ONE MICROPHONE 	A single microphone does not provide uniform coverage of a group. This is commonly experienced with choral groups, quartettes, instrumental combos, and speaker panels.	The particular "cardioid" microphone used lacks a uniform pickup pattern, so that persons in different positions within the general pickup area of the microphone are heard with varying tonal quality and volume.	The Unidyne III affords uniform pickup of the group with a resulting consistency in volume and sound quality among the members of the group.
USING MULTIPLE MICROPHONES 	Variation in the pickup level and tonal quality exists throughout the broad area to be covered. This may occur in stage pickup of musical and dramatic productions, panels and audience participation events.	The pickup pattern of the microphones used is too narrow, causing "holes" and "hot spots." The off-axis frequency response of the microphones also varies.	The Unidyne III permits smoothness in pickup as true cardioid pattern gives broad coverage with uniformity throughout coverage area. Eliminates "holes," "hot spots," and variations in sound quality, simplifies blending many microphones.
DISTANT PICKUP 	Too much background noise or feedback results when working with microphone at desired distance from sound source.	Long-range microphones are less directional with lower frequencies. Lobes or hot spots allow background noise or feedback.	Use the Unidyne III to gain relatively long range with effective rejection of sound at all frequencies at the rear of the microphone.

SHURE BROTHERS, INC., 222 HARTREY AVE., EVANSTON, ILL. 60204

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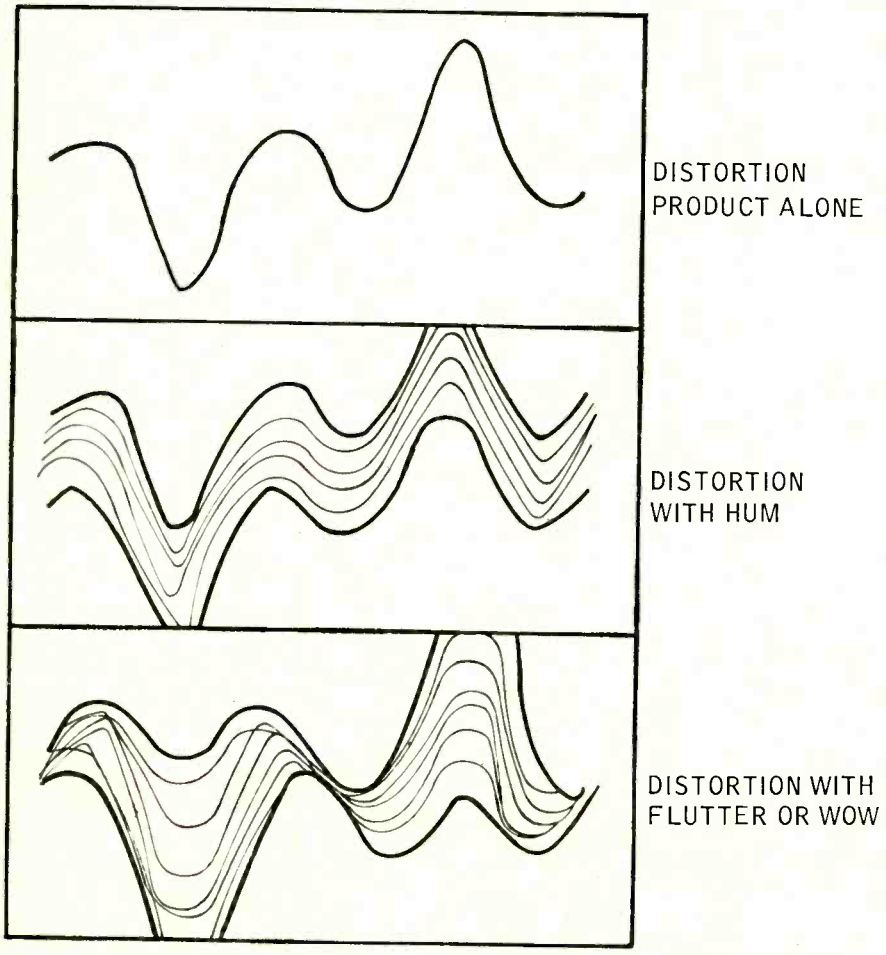

Fig. 10-6. Identifying distortion, hum, and flutter or wow, from the distortion residue obtained from a harmonic distortion analyzer: top, a typical trace due to distortion only; middle, a similar trace with some hum present; bottom, a similar trace when flutter or wow cyclically detunes the fundamental-nulling bridge.

the over-all result is likely to be double the amount of each. But there may also be mechanical reasons why either record or playback would produce more. To check this, tapes should be recorded on one machine and played back on another, preferably one with much lower flutter and wow than the one being tested. By making the exchange each way, it is possible to deduce where most of the flutter and wow occurs.

Special Recorders

In the foregoing we discussed measuring tape machines against NAB standards. But the NAB standards also provide for special recorders, where the tape may not be recorded or played back with the standard NAB characteristics, but where the over-all result, from record to playback, may yet conform to certain standards of frequency response, dynamic range, and distortion.

The NAB standards on this still assume that speed is standard—one of the recognized speeds. Many of the small portable recorders on the market do not conform to this: tape drive is not via the conventional capstan, with separately controlled take-up and rewind drive, but the take-up drive also serves as the "speed control" of the tape past the head (*Fig.* 10-7).

Whether or not the motor maintains constant speed during the running of a tape, the tape speed varies on this type of machine. Usually it will vary somewhat similarly on both record and playback, so that tapes recorded on such a machine will play back without noticeable error in speed. Flutter and wow may be quite unsatisfactory for a professional recorder, but adequate for the special use, such as mobile reportorial jobs.

Such a recorder cannot interchange tapes with other recorders—either to play back their tapes or to play recorded tapes—because of the unusual speed variations. Speech gets difficult to follow (these machines are completely impossible for music, anyway) when played at speeds approaching half or double that at which it was recorded.

The next installment will start on measurements associated with acoustic transducers—microphones and loudspeakers. While waiting for it, why not consider how you would go about establishing a standard of conversion from electrical to acoustical energy, or vice versa? Æ

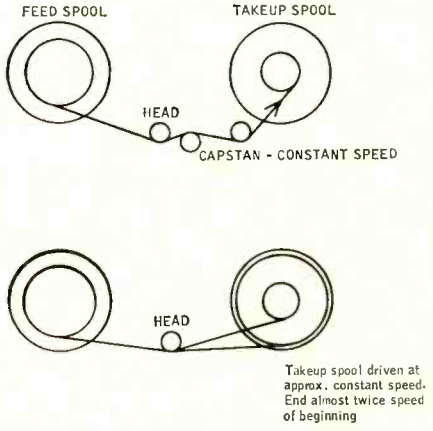

Fig. 10-7. Schematized arrangement of recorders: top, the professional type, whose speed is controlled by a constant-speed capstan; bottom, the inexpensive portables, in which the speed is controlled by the take-up spool.

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. . . this is a hi-fi stereo speaker system?

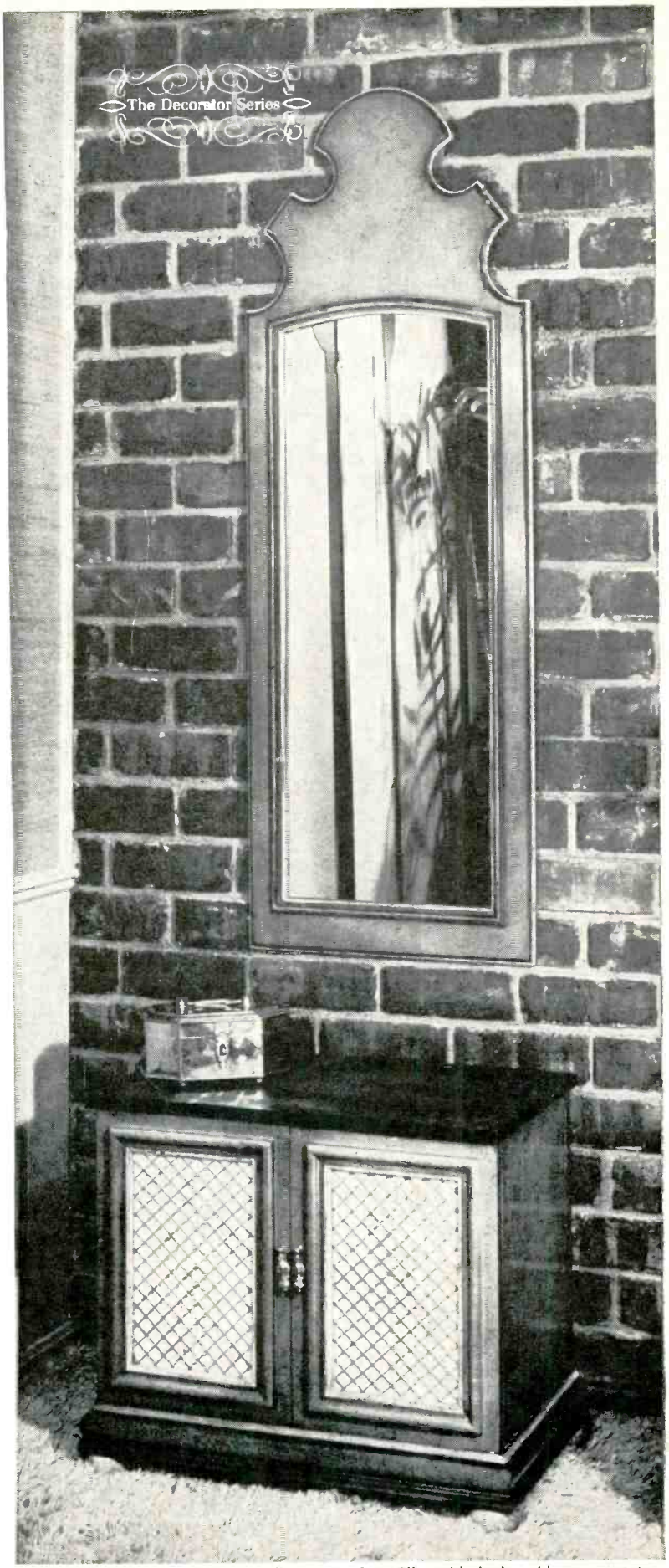
A new sensation in sight and sound—a wholly new concept in hi-fi stereo speaker systems! Designed exclusively for University by Larry Williams A.I.D.*, one of the country's leading designers of high quality furniture.

University's exciting new

Sorrento

is a bold example of perfection, styled and engineered for enduring use and enjoyment. The 4-speaker system—University's newest engineering development—produces the magnificent, live natural sound of music. Music as it is meant to be heard—at an original performance. The rich Seville blue finish of the Sorrento is achieved by an exclusive glazing process and hand rubbed to fine furniture perfection. Natural slate top. Matching console mirror optional at extra cost. For complete literature write desk L-63.

* Design associate.



LISTEN—UNIVERSITY SOUNDS BETTER

UNIVERSITY SOUND

A DIVISION OF LTV LING ALTEC, INC.

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SPECIFICATIONS: 12" high compliance woofer, 8" sculpted back mid-range speaker, patented Sphericon super tweeter, 3½" rigid diaphragm direct radiator secondary tweeter—20 to 40,000 Hz—40 watts IPM (Music Power)-8 or 16 ohms-¼ section 6 db/octave electrical L/C network — 600 and 4,000 Hz crossovers — Presence switch and continuously variable Brilliance Control — 26⅛" x 22½" x 16⅜" — 60 lbs. $369.50.

Check No. 80 on Reader Service Card.

The Annual August Product Compendium Revisions

Any undertaking as extensive as our annual August undertaking must perforce contain some errors of omission and commission. So these pages must be construed as additions and corrections to your August file copies. Each group is referenced to the section and page on which it should be.

First off is Concertone—they were left out of the August compilations altogether. So add this information to that which is found on page 66 of the August issue.

Concertone Model 803

This is a professional-grade stereo tape recorder fitted into a portable case. The special feature of this unit is the 3 + 3 Reverse-O-Matic operation. Both recording and playback may be accomplished in either direction. The unit operates at 3¾ and 7½ ips. Separate record, play, and erase heads are provided for each direction. Signal-to-noise is specified as 50 dB. Two each high-impedance line and microphone inputs are provided. The output from the all-transistor electronics is at 1 volt. Built-in controls allow for add-a-sound and echo as well as off-the-tape monitoring. Rewind is less than 45 second for 1200 feet due to the use of three separate motors. There are built-in power amplifiers. List price is $519.95.

The model 804B is identical except that it is a power-amplifier and caseless deck version. List price is $449.95.

The model 805 is the deck plus Concertone's 30 continuous watt Norton amplifier. Two case-lid speakers are also included in the list price of $589.95.

Concertone 727

A *stereo* battery-operated portable unit. Four speeds from 7½ down to 15/16 ips are offered on this a.c./d.c. unit. Four-track recording with separate record, play, and erase heads are also standard. Power is derived from 6 "D" cells or 117V a.c. Signal-to-noise is 45 dB and output power is 2.5 watts from the transistor circuitry. Maximum reel size is 5 inches and weight is approximately 16 lbs. List price is $289.95.

The SK88 Speakers—are matching units at a list price of $99.95 per pair.

Concertone information—circle 35

Electro-Voice

The RE-15 microphone listed on page 83 of the August issue is incorrectly priced. It should sell at $153.00. E-V tells us that all other specifications are correct.

Electro-Voice information—circle 36

Jensen

Here again a major manufacturer was left out of August. Their speaker systems would have gone on page 62.

Jensen 1200 XL

This is the top of a brand-spanking new line from this venerable name. These are four-way systems in furniture enclosures and we can personally testify to their handsomeness. Each cabinet contains a total of seven speakers arranged in a solid acoustic enclosure. Four of these are Flexair® woofers of 15-inch diameter. There is a compression-driver horn-loaded unit that takes over about 500 Hz. At 4000Hz a compression-horn super-tweeter comes into play. This carries on until 10 kHz when a direct radiating Sono-Dome® ultra-tweeter takes over. Over-all response is stated to be 15 to 25,000 Hz and power-handling capacity is 100 watts. Impedance of the system is 8 ohms. Controls for the mid and high frequencies are provided on the rear panel. Weight is approximately 240 pounds—depending on the style of cabinet. The mediterranean style illustrated is the Model 1200-XLM. There are also contemporary and early American styles. All list for $895.

Jensen 700 XLW

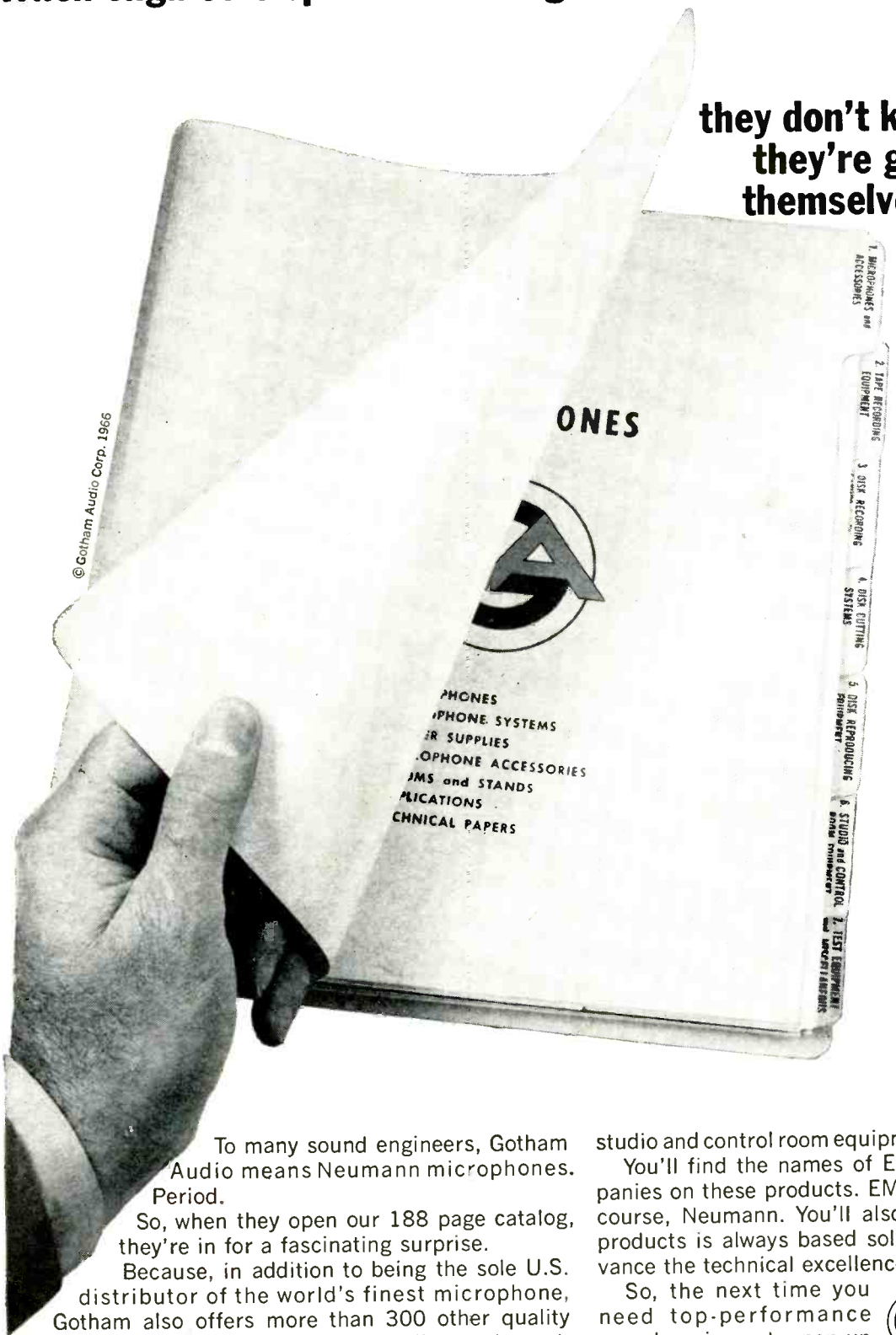
This large-bookshelf unit utilizes the same deluxe components as the 1200 series units except that there is only one woofer—and it is a twelve-inch unit. Again there is a horn-loaded midrange, a compression-driver, horn-loaded tweeter, and the Sono-Dome super tweeter. Frequency range is stated as 20-20,000 Hz. Crossovers are at 600, 4000, and 10,000 Hz. Power rating is 40 watts, impedance is 8 ohms, controls for midrange and high frequency are provided. List price of this walnut only unit is $275.

Jensen X-40 and X-45

These are full-range, ultra-compact systems. Both feature long-travel, low-resonance eight-inch Flexair woofers. The X-40 uses a three-inch direct radiator tweeter and the X-45 uses a compression-driver, horn-loaded tweeter. Both systems employ a high-frequency balance control, both have nominal eight-ohm impedances. Their power rating is 25 watts. Both are in

When engineers open our catalog to select a Neumann microphone,

they don't know what they're getting themselves into.



To many sound engineers, Gotham Audio means Neumann microphones. Period.

So, when they open our 188 page catalog, they're in for a fascinating surprise.

Because, in addition to being the sole U.S. distributor of the world's finest microphone, Gotham also offers more than 300 other quality sound products and services. Tape recording equipment, for example. And disk recording lathes. And disk cutting systems. And disk reproducing equipment. And studio and control room equipment. And test equipment.

You'll find the names of Europe's best-known companies on these products. EMT. Beyer. Studer. And, of course, Neumann. You'll also find that our choice of products is always based solely on their ability to advance the technical excellence of American audio.

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finished hand-rubbed oil-walnut enclosures. The X-40 has a suggested list of $57.00 and the X-45 is $63.00.

The Jensen line is extensive. We do not have space to list the many component speakers in or out of cabinets and in all price categories.

Jensen information—circle 37

H. H. Scott

Model LT-112

Model 388

Model 2503

There are no new products to add to the August Scott listings to be found in a variety of categories. Rather our *faux pas* was to leave out entirely information in the last column of each of these slots. That column was Special Features, the column that tells you what each manufacturer feels is special about his unit. So here they are for Scott:

	Add to page	
Tuners		
Model LT-110B	44	Full color instruction manual, silver plated front end.
Model LT-112C		FET front end, all silicon IF, oscilloscope output.
Model 312C		FET front end, multipath meter, muting, scope output.
Model 315		FET front end, all silicon IF.
Amplifiers		
Model LK-60	39	Direct coupled silicon output. Heavy military type heat sinks, full color wiring diagram.
Model LK-72B		Switchable front panel headphone output, center channel output.
Model 260		Direct coupled silicon output, three position pick-up sensitivity switch.
Model 299T		Direct coupled silicon output, dual clutched bass and treble controls.
Modular Systems	48	

All Compacts feature separate guitar and microphone inputs with mixing, front panel head-phone jack, tape monitor, slide rule dial, precision tuning meter, field effect front end (both AM and FM) separate bass and treble controls for each channel, acoustic suspension loudspeaker systems.

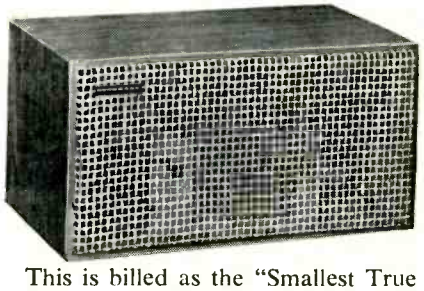
Receivers		
Model 342	47	FET front end, direct coupled silicon output.
Model 382		FET AM/FM, direct coupled silicon output, Scott Signal Sentinel.
Model 344B		FET front end, direct coupled silicon output.
Model 348		FET front end, direct coupled silicon output.
Model 388		FET AM/FM, direct coupled silicon output, wide-narrow switching for AM band width.
Speakers in Enclosures		
Model S-9	65	Each system features Scott's controlled Impedance design for optimum results with all amplifiers.
Model S-10		
Model S-11		
Model S-12		

Scott information—circle 38

UTC Sound

UTC managed to get itself left out entirely from the August listings. Herewith then, complete details on their three most popular speakers. Add this information to page 65 of the August listing.

Maximus 1



This is billed as the "Smallest True High Fidelity Speaker System in the World." 10½ x 5½ x 7¼ inches but the sound belies the size. Two drivers (the bass unit is air suspended) cover the claimed range of 45 to 20,000 Hz. An LC crossover is accomplished at 1900 Hz. Impedance is 8-16 ohms, power handling is 15 watts maximum with 5 watts sufficient to provide room-filling volume. Distortion is stated to be less than 5 per cent at 45 Hz and below 0.5 per cent above 150 Hz. Finish is oiled walnut. List price is $59.50.

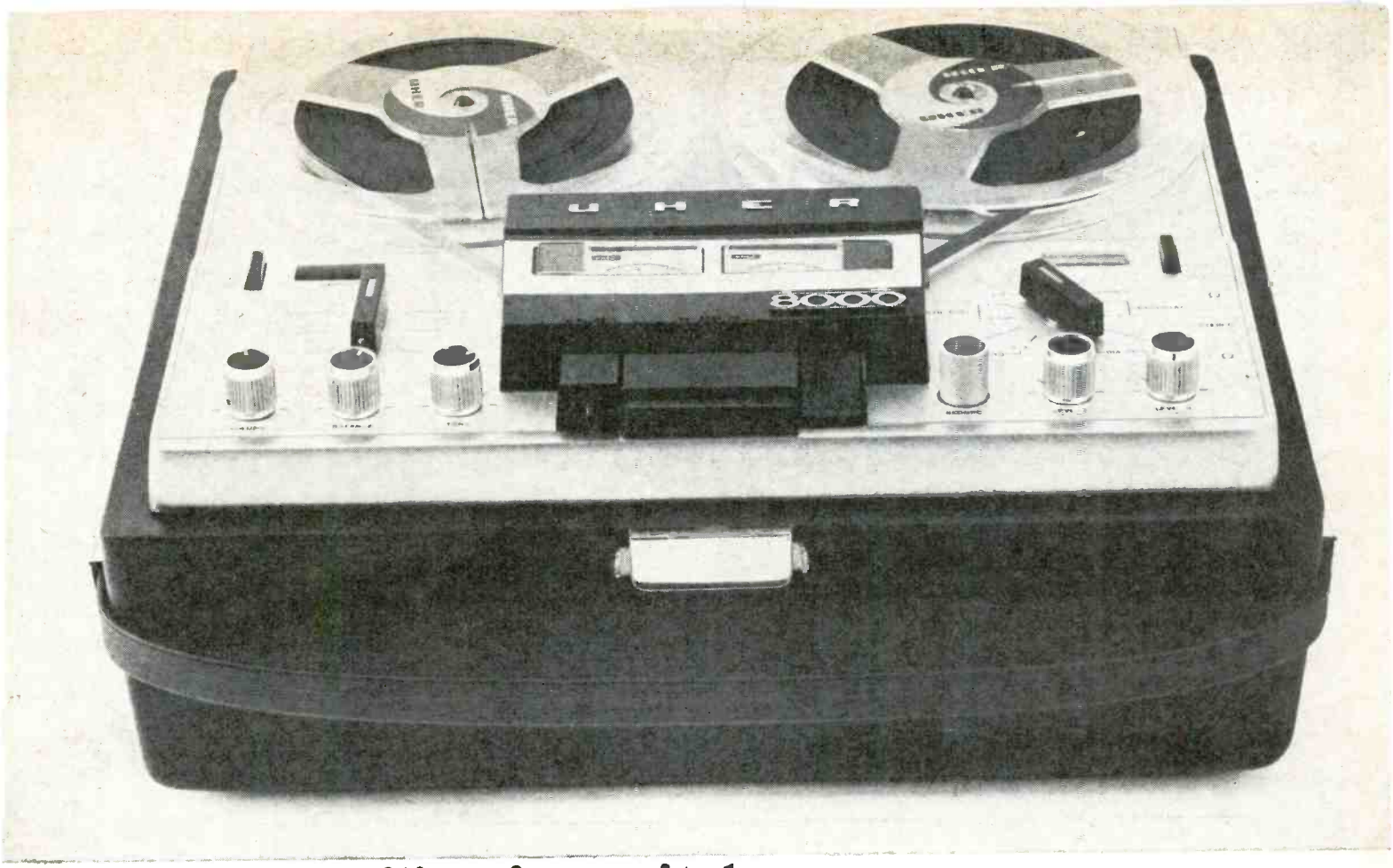
Maximus 5

This unit is a compact three way system with crossovers at 1800 and 8000 Hz. Bass is handled by a 12-inch pneumatic-suspension woofer. Midrange passes to a direct cone radiator. A similar driver is used for the highest frequencies. Over-all response is stated to be 30-20,000 Hz with distortion below 0.75 per cent from 50-20,000 Hz. At 30 Hz distortion is stated to be 3 per cent. Impedance is 8 to 16 ohms and power handling is up to 50 watts IHF power. A control allows upper frequencies to be tailored to match room acoustics. Finish is oiled walnut, the grill cloth snaps in or out. List price is $129.00.

Maximus 7

This is the deluxe system of the UTC line. Four drivers are employed. A 12-inch woofer operates from 25 to 1800 Hz. A pair of direct-drive cone midrange units with dispersion lenses operate up to 8000 Hz where a dome-type super tweeter takes over. Over-all response is thus stated to be 25-35,000 Hz. Distortion is less than 0.75 per cent above 50 Hz and 3 per cent at 30 Hz. Two controls, one for midrange and one for highs are provided to permit a wide range of acoustic tailoring of sound. Impedance is 8-16 ohms, power handling capacity is 75 watts IHF. The cabinet is oil walnut on all six sides with a snap on/off grille. List price is $189.00.

UTC information—circle 39



With just a flip of a switch, the new Uher® 8000E tape recorder offers you 4 track stereo, monaural recording and playback, 4 speeds, 4 heads, synchronous sound on sound, multiplay sound with sound, echo effects, exclusive built-in automatic slide synchronizer (Dia-pilot), optional sound activator, (whew) and a host of other fantastic features. (You'll also flip over its all new solid state circuitry.)

If the above isn't enough reason to switch to Uher,® you should listen to its concerthall sound.

For a demo visit your hi-fi dealer or write for literature, Martel Electronics, Los Angeles: 2339 South Cotner; New York City: 1199 Broadway; Chicago: 5445 North Lincoln Avenue. End wasted tape. Send for the new Martel "Tape Tabulator" for the timing of classical repertoires ($2.75 value). Dept. B, California office. Enclose 25 cents for postage and handling. Sound begins and ends with a Uher Tape Recorder.

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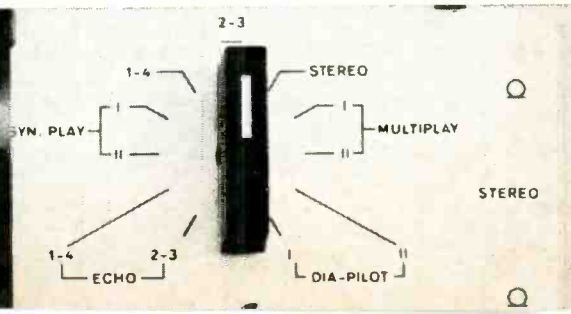
SOLE IMPORTER FOR UHER TAPE RECORDERS.

Circle 39 on Reader Service Card



HERMAN BURSTEIN

Q. When I record and play sine waves on tape, I don't get a single sine wave on the oscilloscope. I get several sine waves superimposed on each other. What does this show?

A. Your multiple sine waves atop one another indicate hum, which can be due to one or more of several causes. Possibly hum is being picked up by the playback head from the power transformer or the tape recorder motor. The transport chassis may be improperly grounded to the tape electronics (do not use the signal lead for such grounding, but run a separate wire between the transport and the electronics). Improper routing of leads or cables may lead to hum pickup. The playback head may be inadequately shielded against stray fields. And so on.

Q. I notice that the specifications given by manufacturers for the 3.75 ips speed in their $500-plus tape recorders are better than the specifications for 7.5 ips in their $200-plus machines. Do these better specifications at lower speed but higher price reflect a truly superior or equal listening quality? I presume a manufacturer uses the same methods of measuring performance at various speeds and various price levels.

A. Yes, it is possible for a high-priced tape machine to perform better at 3.75 ips than a low-priced one at 7.5 ips. While performance tends to deteriorate with reduced speed, neverless good design, parts, and construction can offset this tendency to an appreciable degree—enough so that the state of art today permits close to excellent performance at 3.75 ips. While the differences between 3.75 ips and 7.5 ips are still measurable for a given machine, these differences are becoming increasingly less audible. In my own case, whereas I once used to tape opera at 7.5 ips, I have now entirely committed myself to 3.75 ips. In general I now do more recording at 3.75 ips than at 7.5 ips. On the other hand, I am dealing in first-generation tape, whereas recording companies and others go through several copying stages, so that the listener ultimately winds up with third- or fourth-generation tape. Each stage involves some deterioration. Then it is highly desirable to make the first recording at 7.5 ips and even 15 ips.

Q. Instructions for my tape recorder state, "Connect a 100-ohm resistor in series with the low side of the record head." There are four wires—two white, one black, and one red. What is meant by the low side of the head? I don't get as much bias voltage across the 100-ohm resistor as specified by the manufacturer. Also, my line voltage measures about 95 to 100 volts.

A. The low side is the ground side. This is presumably the white wire for each section of your stereo head. *Each* white wire should go through a separate 100-ohm resistor to ground. Your failure to obtain the specified bias voltage across the resistor under this condition may be due to the low line voltage.

Q. I have two AR-1's and two Radio Shack Electrostatic (3) speakers; also two University N2B crossover networks. I would like to improve the high end. Should I hook the speakers to the 4-, 8-, or 16-ohm amplifier taps? On the N2B crossover I have a choice of either a 6 dB/octave or 12 dB/octave slope. On my AR-1's I have a choice of using the 4-ohm terminals or of switching in a series resistor to present an 8-ohm load. What do you advise?

A. The amplifier tap you choose will make negligible difference in high-frequency response. If you use the 8-ohm connection on the AR-1's, they will draw less power than if you connect directly to their 4-ohm terminals, resulting in relative emphasis of the high-frequency speakers (Radio Shacks). Generally you run into less problems with a 6 dB/octave slope for the crossover network than with a 12 dB/octave slope.

(The reader may be wondering what the above question and answer have to do with tape recorders. Nothing.)

Q. As you know, microphones are somewhat lacking at frequencies above 10 KHz. What I plan to do is to add a treble boost network to the mike input on my machine. I do not want to use an ordinary treble control because this would affect frequencies from 1 kHz up. Instead I wish to match the treble boost network to the microphone, which has fairly flat response up to 10 kHz. Therefore I need a network that will be effective only above 10 kHz. My problem is that I cannot find any reference books that will show me how to design one. Books on audio design above the introductory level seem to be nonexistent. Could you recommend some books that will help me? I am familiar with network synthesis. Would you please comment on the soundness of my idea.

A. I am not enthusiastic about your idea. As you know, treble boost is produced by reducing the middle and low frequencies. Accordingly the pronounced treble boost you are seeking at the high end entails serious reduction of signal level over most of the audio range, with corresponding deterioration in signal/noise ratio. Sharp treble boost would entail a rather complex network, and unless properly located and shielded it might be an additional source of hum pickup. Two discussions of equalization in high-fidelity components to which I can refer you are: Norman H. Crowhurst, *Understanding Hi-Fi Circuits* (Gernsback Library), Chapter 7; Herman Burstein and Henry C. Pollak, *Elements of Tape Recorder Circuits* (Gernsback Library), Chapters 6 and 7.

Q. I am having trouble transporting tape across the heads at constant speed. I have never seen a detailed analysis of the mechanics of tape transport and would appreciate seeing one. It seems to me the variables are: surface of the drive capstan; pressure of pressure roller against tape and drive capstan; deformation of pressure roller against tape and drive capstan; angle of contact of tape against pressure roller due to the line joining the center of the pressure roller and drive capstan not being normal (at right angles) to the tape as it is stretched from the last head or guide to the drive capstan; the negative tension or drag due to the unspooling and friction across the heads; the positive tension due to the takeup spool; the friction of the pressure roller. Which of the above are critical, and which ones have I missed? Can the critical ones be quantified? Do you have any suggestions how I can measure them so that I can get optimum performance?

A. As you yourself have stated, there are many things to be considered in achieving constant tape speed. In addition to the factors you mentioned, there are several others, such as a well-balanced drive motor; the inertia provided by a flywheel on the capstan; the inertia provided by a guiding flywheel; the friction or "stiction" of the tape with respect to the tape heads and guides and other parts contacted by the tape; the torque of the supply and takeup reels, and so on. Between the two of us we still have probably not listed all the factors involved. I cannot quantify the factors. This is about as far as I can go in answering your questions, particularly since the TAPE GUIDE is better equipped to deal with the electronic and magnetic aspects of tape recording rather than the mechanical ones. I suggest that you consult the book by W. Earl Stewart, *Magnetic Recording Techniques* (McGraw-Hill Book Company, New York City), 1958, Chapter 4, "Magnetic Recording Mechanisms." Æ

Now instant movies in sound start at $695.

The new Sony Videocorder deck (model CV-2000D) is both compact and versatile. It's also quite reasonably priced, $695.

It's just like current Sony Videocorder models, but without the built-in TV monitor. Using a separate monitor or TV set, you can tape selected TV programs off-the-air. Add the optional Sony TV camera and you can tape "live" action in sight and sound. Play back your tape, and you'll see instant movies in sound.

This new deck is small enough to fit on a bookshelf, as a part of your hi-fi component system. Light enough (only 44 lbs.) to take wherever you want it to perform. Adaptable enough to use with any TV monitor, small or large screen (the new Sony 8*-inch and 22*-inch receiver/monitors are perfect mates) It can be adapted to work with most home TV sets. Handsome too, in walnut-finish cabinet.

Looking for a Videocorder with its own built-in monitor? Then meet the rest of the Sony Videocorder family. TCV-2010 complete in its own carrying case, $995. The TCV-2020, handsome oil-finish walnut cabinet and with built-in timer to automatically tape TV programs while you're away, $1150. For taping "live" action, there is the Video Camera Ensemble VCK-2000 (camera, elevator, tripod, microphone) at $350. For an unforgettable demonstration visit your Sony Videocorder dealer today. For free 16-page booklet write:

SONY® Corp. of America, 47-37 Van Dam St., Long Island City, N.Y. 11101 Dept. H

*diagonal measurement. The Videocorder is not to be used to record copyrighted material. Sony and Videocorder are registered trademarks of the Sony Corp. All prices suggested list.

they were both good, and some may have preferred one or the other. Now I think there is no doubt as to which of the two sounds was closer to the original, and which speaker is a more accurate reproducer. This is a much easier decision to make. You don't have to bring into play your musical taste (unless you must choose between two types of inaccuracy). It becomes obvious that certain factors sometimes claimed to be relevant—such as the fact that speakers don't sound the same in different acoustical environments—have nothing to do with fidelity. And one old saw in particular, which is perhaps the most ridiculous of all, that you can't tell which speaker is best because we all have different ears and hear things differently, is exposed. It is of course true that we hear things differently, but we hear the live sound at the concert and the reproduced sound in our own living room with the same aberrations, the same distortions—the same ears. We also see things differently. You may be astigmatic, or you may be myopic, but you see the original painting with the same kind of visual aberrations that are operative when you look at the reproduction.

One element in this simulated live *vs.* recorded comparison that may be confusing at first is the fact that a reproducing device—a loudspeaker—is used to create the original sound. If the original sound had been produced by live musicians there would be no problems: the loudspeaker that sounded most like the live musicians would be it. But when we use an original sound which is itself produced by a loudspeaker it takes some mental effort to unscramble things. Maybe the AR-3, which after all was designed by the same company, ought to sound more like the reference AR-4^x than the black box which was designed by another company with a different design approach. The black box, incidentally, is one selected purposely as representative of the so-called "presence" speaker.

To clear up this point, the next thing that I am going to do is to use the black box as reference speaker, to demonstrate that similarities between the reference speaker and the speakers under test are irrelevant. We are testing the ability of any speaker to imitate the reference, and whether or not the speaker under test is similar to the reference has nothing to do with it. If you have a speaker with a particular skewed response curve, the best way to imitate the sound of that speaker through a recording is to use another speaker with *perfectly flat* response. The "flat" speaker will then sound just like the "skewed" speaker it is trying to imitate. The imitator must itself be colorless.

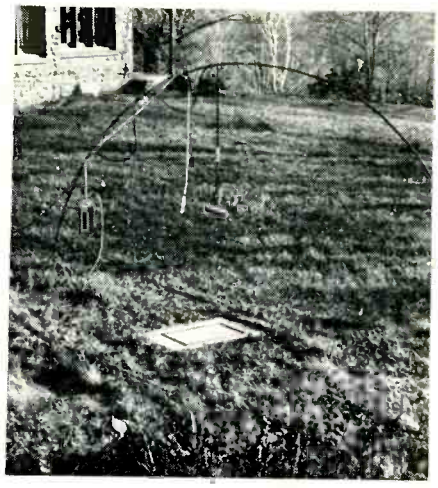


Fig. 3. Open-field recording setup. AR-4^x reference speaker faces into a controlled solid angle of 180 deg.

So we buried the black box in the earth, to be recorded. What I will now show is the attempt of the AR-3 to imitate the black box, and I will compare to that the black box trying to imitate itself. The sound that you hear when you see the green light over the black box is the original live sound as it existed at the recording session. When you see the red light over the black box you will be hearing the black box playing the recording, trying to imitate itself, and the red light over the AR-3 will mean that *it* is trying to imitate the black box. I think that from what you have already heard you should be able to predict which will make a better imitation—the better speaker.

I would like to point out one thing before I proceed. The problem raised earlier, of where to put the microphones, was especially difficult in recording the black box. In the case of the AR-4^x it wasn't too difficult, since the dispersion pattern is not erratic; the treble gradually drops off at the sides, symmetrically in all directions. The fact that it is a two-way rather than three-way system helps. The off-axis response curves of the black box, however, bear little similarity to each other or to the on-axis frequency response curve. They develop peaks and

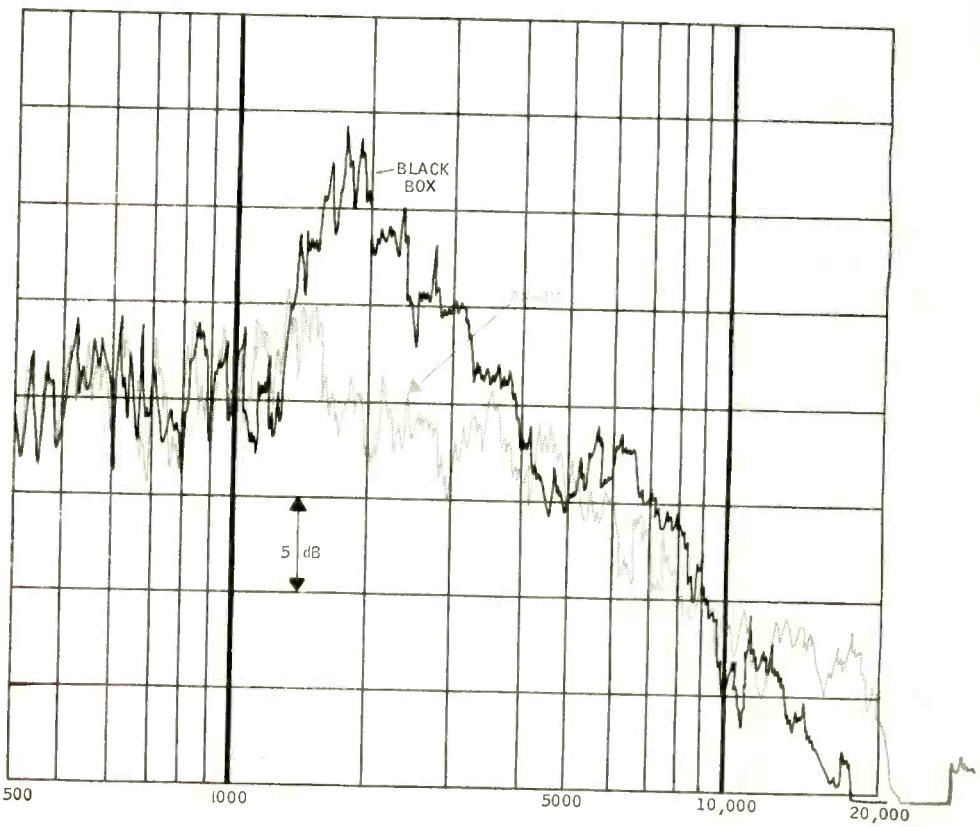


Fig. 4. Comparison of frequency response curves of AR-4x reference speaker and black box, showing why the AR-4x was better able to imitate the black box than the latter was able to imitate itself. Measurements were made in a reverberation chamber and represented integrated power output of speakers. Treble roll-off, caused by increasing absoption during multiple reflections, is typical of reverberation measurements.

holes in different places. When we found the microphone positions that did the best job we could manage, there was one clinker, an exaggeration of a rattle that this particular speaker has. It's not a major rattle. Probably most of you have not heard it so far because you weren't listening for it, but the output of the black box at one particular angle, over a narrow cone of radiation, is out of this world. It may be as loud as the music.

Since the microphone positions which were best able to represent the total color of this speaker were dangerously close to the rattle angle, I think you will notice that the recorded sound will have more rattle than the original sound. (The "rattle angle" is an advanced concept with which audio engineers are becoming more familiar.) What you should listen for is general color, and judge which speaker is able to better reproduce the color of the black box.

Question: It seems to me this test is not absolute from the point of dispersion, and indeed the test speaker which best reproduces the reference speaker as far as dispersion is concerned is the one that will have the identical dispersion angle, not some absolute version of what is best.

Answer: You are right in that this test will not reveal with the same sensitivity defects in dispersion. Similarities of dispersion to the reference may even help the imitation somewhat.

For the demonstration using the black box as reference we recorded the same piece of music.

The first time that I heard an AR-3 sounding like the black box, the hairs on the back of my neck stood up. Remember that you must limit your evaluation and your judgment to which speaker makes the closer match to the reference.

Apparently the black box being the same as the reference speaker didn't help it. In the first demonstration it was not able to reproduce the sound of the AR-4^{x} without strong coloration, and when it reproduced itself with that same coloration it was even worse because the distortions were doubled. It was confusion compounded.

Question: This then is like a third version of your orange-tinted sky, in which the orange is still more so.

Answer: Precisely. It would be as though we took our orange-tinted reproduction and reproduced it again through the same reproducing equipment. It might turn out vermillion or yellow.

Question: You say that it doesn't make any difference what reference speaker you use. In one respect it does. When

you are trying to test a wide-range speaker with a speaker whose range is narrower, you will be able to ascertain how the wide-range speaker performs only in the frequency range covered by the more limited one.

Answer: That is absolutely correct. If your reference speaker is chopped off top and bottom, then in comparing the ability of other speakers to imitate the reference you will not be engaging their ability to reproduce top and bottom. Where this test method really shows its worth is in revealing the relative degree and especially the quality of positive coloration, elements that usually have little to do with frequency extremes. Ideally, and someday when perhaps we or someone else improves this test, it will reveal coloration, frequency balance, frequency extremes, range, and so forth and so on.

Question: Did you try other makes of speakers?

Answer: If I seem to be greeting your question with a blank stare, that is because I want to avoid getting commercial. We did try other speakers, and all I can say is that when there is a particular kind of coloration this test is very useful in revealing it.

Question: Why did you need a reference speaker? Why not work with just one speaker under test, even your own, switching from track A to track B? In this case track A has been a direct electrical recording, and track B has been through the anechoic room.

Answer: You have described a second test method that can be used. You can simply take one speaker, record it, play the recording back into the speaker while it is still in the ground, record it again, and then see how much deterioration there is after the second, third, fourth, and fifth speaker recording and playback. This is one of the things that I had planned to mention towards the end of this paper; the procedure exaggerates whatever deficiencies a speaker has, and makes them easier to spot.

Question: How much coloration do you think the microphones added?

Answer: Not much. As you see, where we had a fairly close match in the first demonstration, the *total* difference was very small.

Question: When you set up your speakers here, how did you determine your level and the damping factors that were used?

Answer: They were all driven by Dyna Mark III's, and the damping factor is, I think, 10 or 15. Because it is that high it doesn't make much difference. As for relative levels, I stood in the back of the hall while some of my colleagues turned knobs until it sounded about right. The objective sound levels of the different speakers may not be the same, but I tried to adjust them so that the subjective level was about the same. That way you can concentrate on the color and not be influenced by loudness.

Question: Is there some correlation between measurements of separate drivers in an anechoic chamber and a speaker that sounds good when compared to itself this way?•

Answer: The answer is, of course, "Yes, if you know how to make your measurements." The anechoic chamber will only give you measurements at one angle at a time, and so our anechoic chamber measurements are, as I think all such measurements should be, made as a family of curves, on and off axis. These anechoic measurements, as well as more direct power measurements in a reverberation chamber, showed the black box as having a "presence" peak of 13-14 dB (see *Fig.* 4) at about 1700 Hz, predicting the nasal, honky quality you heard here.

Question: If you had followed the earlier proposal and recorded over and played over the black box, but each time you moved the microphone to a little different place, then you might have not accentuated some elements. You may have picked a bad spot. I am saying that maybe to be fair to the black box you should try a little more integration. You might, for example, favor your own loudspeaker and pick a good spot for it and pick a bad spot for the black box.

Answer: It is certainly possible, by bad choice or by biased choice of

microphone positions and/or number of microphones to favor one or another speaker. Of course, if you do this, you render the test method useless, except perhaps for making an unethical advertising pitch, and it is too esoteric a method to be really useful from that point of view. It is necessary to develop a method for getting a fair sampling of the reference speaker's output. I think this question really is: Could there have been a microphone position, or series of microphone positions, which would have made the black box do a more creditable job in imitating the AR-4^x, and perhaps the AR-3 a worse job?

There were microphone positions which would have made the AR-3 sound a lot worse in the imitation of the AR-4^x, but we would not find positions which would make the black box do a better job in imitating the AR-4^x. We tried, and we failed. Perhaps if we had used not two microphones but twenty, and had really covered the hemisphere around the speaker, we might have done better and might indeed have recorded sound that was more representative.

Question: I was wondering whether you found the position of the speaker in the actual A-B listening test has an effect on all this?

Answer: All that is important is that all speakers be pretty much in the same position.

Now we will go back to the AR-4^x as reference, and I will play a few tapes with different kinds of music.

During this part of the test, I never switched from A to B, but from a test speaker to the reference, and then to the other speaker. Any differences you hear between the two speakers under test have no meaning without a reference. We go from speaker A to what by definition is the truth—the reference speaker—and then to speaker B. Æ

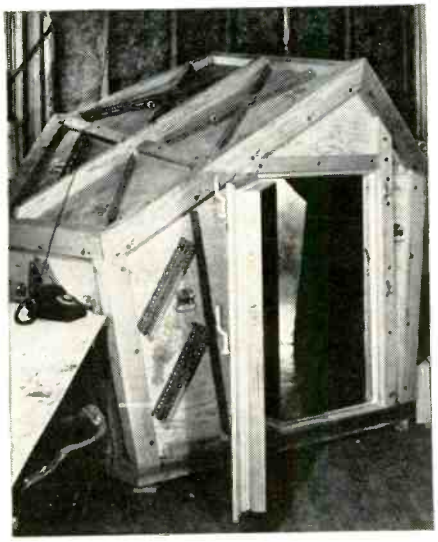
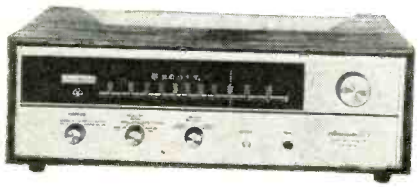


Fig. 5. AR's reverberant chamber for speaker testing.

NEW PRODUCTS

Scott Tuner



The Scott 312C is the latest in a line of tuners from this venerable New England company. Many innovations are claimed for the unit. These include: the Scott silver-plated 3-field-effect transistor front end, all-silicon IF section for improved stability and wide bandwidth, a front panel meter switch that converts the meter to indicate signal strength, zero-center tuning, or multipath indication; automatic stereo switching not affected by momentary signal-strength changes; interchannel muting; separate front panel outputs for stereo tape recording and an oscilloscope (for precise correction of multipath distortion. Usable sensitivity of the 312C is given as 1.7 μV; cross modulation rejection is 90 dB; selectivity is 45 dB; stereo separation is 40 dB. Price of the tuner is $249.95.

CIRCLE 5

Top-Line Automatic

The new Miracord PW-50H features a completely new motor mounting and drive system to achieve inaudible rumble. Drive is from a newly designed Papst hysteresis motor. The PW-50H will track cartridges capable of operating as low as one half gram. At the opposite extreme, it will also accommodate cartridges that must track as high as six grams. The arm is in balance with a vernier motion rear weight. The stylus and cartridge are adjustable by means of a leadscrew at the front of the cartridge head. An alignment gauge is supplied. Other features include a cueing lift, positive anti-skating control, all metal tone arm lock, illuminated speed indicator for all four speeds, and a direct reading tracking force dial. The PW-50H is operated via the traditional Miracord pushbutton system. It lists for $149.50 less base and cartridge.

CIRCLE 6

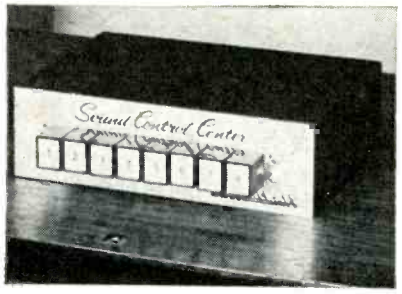
Submerged Sound

Presumably for the benefit of fishes and other underwater denizens, this Model UL-2 from Pioneer Electronics USA Corp. has been specifically designed as an underwater speaker. It may be used in virtually any application ranging from the few feet of a swimming pool to deep-sea probes at depths of up to 100 feet. Frequency range is stated to be 50-20,000 Hz. with a sensitivity of 134 dB/watt. Because of this high efficiency and standard 16-ohm impedance, ordinary amplifiers may be used. The UL-2 has been

successfully employed as an underwater communicator with scuba divers and research teams. It can be used without any modification as an underwater microphone as well as a speaker. Water control of the unit is achieved by using a highly-compliant rubber bag which protects the diaphragm from water pressure. Pioneer states that this device prevents any signal distortion which could be caused by the voice coil going off its true axis in the magnetic field. The speaker may be used in fresh or salt water. It weighs 28 lbs. Cost is $275.00 list.

CIRCLE 7

Speaker Switches



Switchcraft, who offers a variety of switching devices, as befits their name, has announced the Sound Control Centers, models 641 and 642. Up to eight complete stereo speaker systems may be controlled with these models. Thus the audio buff can virtually tailor-make his sound distributing system. The basis for both units is an eight-station switching device. Frequency response through the units is from d.c. to 30 kHz with negligible switching losses. No external power is required for operation. Power handling capacity is 100 watts maximum into a 4-ohm load. The 642 model is for simultaneous distribution of sound to more than one stereo speaker system. The 641 is to be used when it is desirable to restrict sound distribution to one stereo speaker system at a time. A positive interlocking feature between switch stations insures that only one system at a time can be selected. Switchcraft states that these units eliminate audio 'blasting' commonly encountered with the rotary type switches. All connections in and out are made with standard connectors. Operation is by positive fingertip action. List price of either model is $49.50.

CIRCLE 8

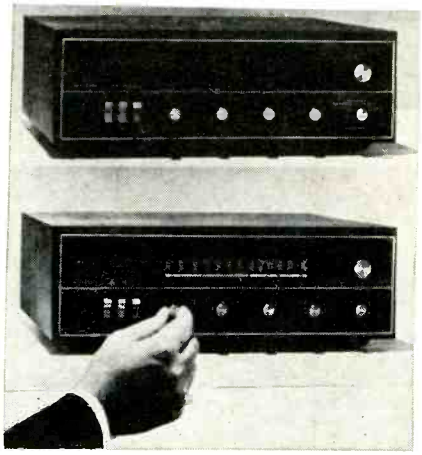
Larger Reel

Many tape recorders, notably the recent Magnecord units, are able to accommodate a larger than 7-inch but smaller than 10½-inch reel. Magnecord has,in fact, offered a blank reel in 8¼-inch size. Now BASF (Badishe Analin- & Soda-Fabrik, AG of West Germany) is marketing a line of tape on this intermediate size reel. Tapes now available include 1800 feet of 1½ mil tape, 2400 feet of 1 mil tape, and 3280 feet of ¾ mil stock. According to our information the entire line of BASF tape types will be available on this size reel.

CIRCLE 9

The Disappearing Dial

,Three new receivers from Harman-Kardon offer peak-a-boo dials that vanish when the set is off only to reapper in all their glory when power is applied. But the changes here are not alone in the face. They go far deeper. The FM *front ends* employ metal oxide silicon field effect transistors (more easily known as MOSFETs). H-K is claiming that these new devices surpass other FETs with lower cross modulation and cross-



talk, superior sensitivity due to lower inherent noise and improved rejection of unwanted signals. The MOSFET also isolates the antenna circuit to provide an improved match with the antenna. The three models break down as follows: model Two Hundred is an FM Stereo receiver with 50 watts IHF, priced at $239.50; the Two Ten is FM Stereo/AM and 50 watts IHF—priced at $269.50; and the 80 watt Seven Twenty is FM Stereo and priced at $369.50. Usable FM sensitivity on this last model is given as 1.8 microvolts. Full power response is stated as 8-40,000 Hz.

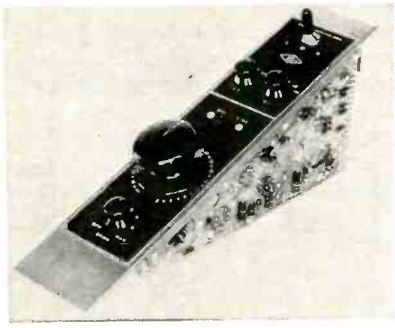
CIRCLE 10

The Right Time

Yale Audio of Florida is offering a fully automatic timer for switching on and off electrical products. Just the thing for non-stay-at-home tape recordists. As many as 48 combinations of time intervals may be present to allow you freedom from the chore of turning equipment on and off. There are many other applications, of course. The timer is perfect for some kinds of time-lapse photography and for display lighting systems. Prices for the Yale Audio Functional Timer start at $39.95; a.c. capacities of up to 1000 watts directly are available. CIRCLE 11

Broadcast Console Insert

The Universal Audio 610 amplifier module has a triangular shape that allows it to be installed on either the sloped front of audio mixing consoles or vertically in a rack. The vacuum tube unit provides all the controls needed for low and high level input channels. An input selector switch allows the operator to connect the input circuit to either a microphone or a line-level bridging circuit. A second switch directs the output



onto any one of three program circuits. An echo-send output, which is isolated from the program output and has its own front-panel gain control, is simultaneously switched to one of three echo channels. The gain control is of the interstage type, maximum microphone-input gain is 63 dB, maximum high-level input gain is 25 dB. Power output is +18 dBm at less than 1 per cent distortion. A blue-ribbon type connector facilitates rapid installation or removal from a console. The width of each unit is 3 inches, the long dimension is 14 inches and the depth, when the front-panel is mounted 20 deg. from the horizontal, is approximately 5 inches. CIRCLE 12

AUDIOCLINIC

(from page 4)

terminals are connected similarly to identical jacks. However, the stationary contacts of these jacks are then connected together. This means that the speaker and amplifier are connected together even when no patch cord is plugged in to make the connection. If it is desired to feed an external amplifier into your speakers, all you do is plug it into the speaker jack. This disconnects your internal amplifier and automatically connects the external amplifier to the speakers. Conversely, if the internal amplifier is to feed external speakers, the external speakers are plugged into the amplifier output jack. This automatically disconnects your main speakers, and allows the amplifier to feed the external speakers. This "normaling" can be done between amplifier and preamplifier. You might also wish to do this with your tuners.

The rule here must be to avoid overdoing the use of these "normals". This can lead to trouble, especially when tape recorder inputs and outputs are involved. If you forget that you have some "normals" on the board in these tape-recorder circuits, you are likely to make conections which will result in feedback under some operating and monitoring conditions. Therefore, it is seriously advised that you do not "normal" your tape recorder. If you want to "normal" your tape player, go ahead.

Another point to be considered is the matter of the TV receiver patching arrangements. I do not like the TV audio to be derived from the speaker terminals of the TV receiver. The audio in such equipment is poor at best. You should consider taking your signal directly from the volume control of the receiver in those instances in which this is possible. Sometimes the volume control is located in some section of the set other than in the detector stage—such as between the voltage amplifier and the power output stage. Under those circumstances, you should make your connections directly to the detector output and forget about the volume control. If you do use the volume control, make your connections *across* the control rather than between the arm of the control and ground. In this way you can turn down the audio coming directly from the speaker in the TV receiver and permit only the audio of your high fidelity system to be heard.

You may find that the high-frequency response is too great or too poor. This is a matter of whether or not you have output taken before or after the de-emphasis network. If the output is taken before the network, highs will be too strident. If you took your output after the network, and if the network is of poor design (normal for many sets), you will have insufficient highs. You may have to "play" with de-emphasis values. If you are ahead of the network, try 100 k ohms and 750/pF, with your output taken at the junction of the two components. The capacitor is grounded, while the free end of the resistor goes to the "hot" detector output terminal.

Your mixer can also be patched in. Remember, however, to treat the shields the same as you did the preamplifier. If the microphone connectors are to be brought up the panel, they should be insulated from it via insulating washers. Better still, you should use the Cannon or Amphenol XL types which can be used for balanced line operation. This will allow even more flexibility as your system grows. High-level inputs of the mixer can be treated as any other high-level source—as discussed earlier.

Ground the mixer to the panel. Return all shields to the *mixer* ends of the cables. The "hot" leads only should be connected to the patch panel. ALL PHONE JACKS SHOULD BE DIRECTLY GROUNDED TO THE METAL PATCH PANEL. This will be the only ground return for these jacks. Should you prefer to make your patch panel on a material other than metal, ground leads must be run to each of the jacks and the ground bus so formed must be grounded to some connection on your equipment, preferably to the preamplifier. In my own case, the equipment is contained in two standard utility racks, and the patch panel is made on a 7-inch rack panel.

There is another kind of patch you should consider using. This is what is known as a "multiple." This is nothing more than four or five jacks which are wired together. There is nothing external wired to them. These are very handy at times. Suppose you have a source having a low-impedance output—as from a cathode follower—which you would like to feed simultaneously into a monitor amplifier and the input of a tape recorder. This can be accomplished by connecting the output into one of the "multiples" and connecting the monitor amplifier and the tape recorder input to two of the others in the string. There will be no loss of performance. The devices are connected together in a very simple way.

See to it that all of your output sources are cathode followers or emit-

ter followers or, a least, of some low impedance. This will allow you to do something else which is very useful.

You can now remove the shorting feature from your preamplifier input-selector switch. This will permit you to switch the preamplifier from one source to another without shorting out the unused sources which might be feeding other switch positions of the preamplifier. This feature is especially useful with the above-mentioned monitoring scheme. Suppose you start out by wishing to monitor what is being recording on tape as described. Then, while the recording is still in progress, you wish to monitor a TV program. You can do this merely by moving a switch on your preamplifier. If the shorting feature were left in place, you would short out the low-impedance output of the device feeding the tape recorder. With the shorting deck disconnected, this will not happen. Further, because the output of the device feeding the recorder is of low impedance, no leakage will be heard in the preamplifier. The matter of leakage is exactly the reason why such switches are equipped with shorting decks.

Do not wire anything until you have made a complete chart of the proposed panel and the various patches which will be used. Note on the chart what "normals" you will be using. What I did was to number each vertical row A-F, and horizontal rows 1-17. You may not have 102 racks on your panel. You will find, however, that more will be needed than you anticipate right now.

Use some sense when laying out the patches to enable easier memorization. For instance, use all odd-number rows as left-channel connections; all even numbered rows are reserved for right-channel connections. Group similar things together. All inputs should be immediately followed by their outputs. You may find that the most frequently used patches should be placed near the left or the right edge of the panel for more ready access.

Frankly, I do not know your background. Hence, I may not have given you sufficient detail. Should this prove to be the case, write to me again. I can then provide more information. I have tried to comment in detail about your problem with the hope that you can proceed to wire your entire system. *Æ*

FET's *(from page 30)*

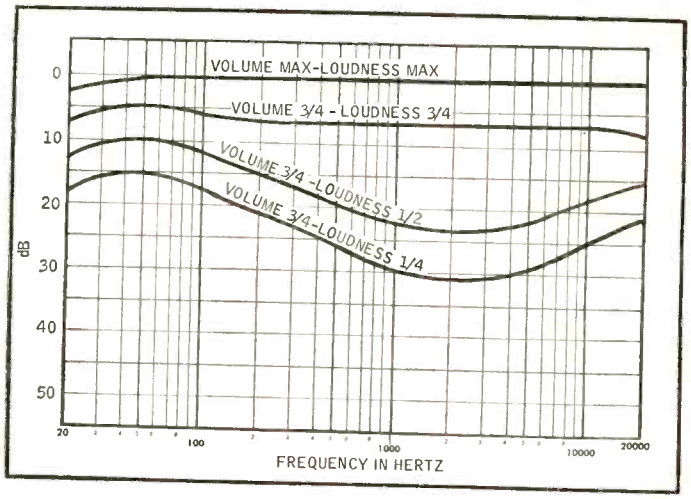


Fig. 5. Response obtained with the Centralab C2-100 loudness control as used in the circuit of Fig. 3.

volts output was 0.06 per cent while even the tube circuit was already in heavy overload. All measurements were taken under identical equalization and gain with all circuits adjusted to the optimum (Table II).

This phono equalizer may be installed directly with the turntable (the author's preference) with the tone and loudness control remote as a separate, compact unit next to the preferred listening position. With this concept, the critical cable from cartridge to equalizer is kept short and full control from a listening position is possible. Two identical units are needed for stereo. Up to 200 feet of cable may be run from the equalizer[5] relative to 1 V. rms.

In the other concept, the phono-equalizer is combined with the following tone control in one chassis. Generally a remote d.c. power supply is preferable to avoid magnetic hum from power transformers to be picked up by the cartridge.

Tone Control Section

The tone control uses the Baxandall[7] circuit which features a variable point of inflexion. It is a feedback-type control of superior quality. The design is greatly simplified by using special components available as low-cost printed circuits (Centralab parts C3-300 and C2-100). These components were originally made available for a high-quality tube control unit designed by C. G. McProud[8]. The circuit of the FET tone control is shown in *Fig.* 3 with curves in *Figs.* 4 and 5. The circuit very much reminds one of a standard tube circuit, although the self-bias resistors are somewhat larger. Also, due to higher loop gain of FET's, feedback circuits perform exceedingly well. It must be remembered that FET's have a voltage gain of about 50 dB as compared to 40 dB for a pentode and 30 dB for a triode. As can be seen from the curves, the performance of the unit is excellent. Gain at 1000 Hz was −1.5 dB due to the feedback with all controls set flat and volume maximum. Noise level was more than 80 dB below 1 V. Overload was 25.5 dB above 1 V. at 1 per cent distortion. This is still an excellent value as compared to tube circuits, but it is somewhat less than for the phono equalizer or the output stage itself. The distortion was traced to diagonal loading of the tone control stage. Where an even higher output level is needed, the source follower may be directly coupled to the drain of the tone control unit with the 1-Meg. and 3900-ohm resistor of the source follower removed and the 100 K resistor

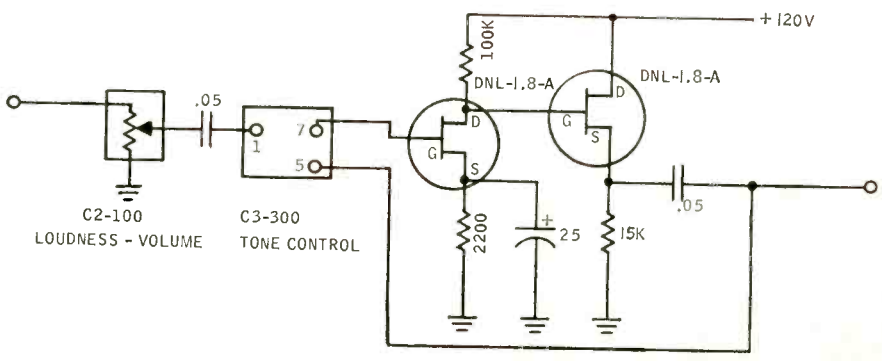


Fig. 6. Alternate circuit of tone control section, with relative locations of the components reversed.

changed to 15 K. The .05 μF coupling capacitor into pin 7 of the Baxandall unit is then removed from the drain of the first stage and tied directly to the source of the output stage. The loudness-volume control must then be relocated to the input of the unit. This modification (*Fig.* 6) results in an overload of 30 dB above 1 V. However, the action of the tone control is not as correct at high volume settings because the Baxandall circuit works best from low-impedance generators (less than 10 K).

Application of FET's to Other Hifi-Circuits

From the previous discussion, it is clear that superior performance is possible in all hi-fi circuits with FET's except where power is required since power-FET's have not become available as yet. The large dynamic range has been used for superior microphone amplifiers[9]. The author has also converted various power amplifiers to FET's with the exception of the push-pull output stage itself. In all cases, superior performance resulted[10]. It was found that a FET phase splitter could drive a pair of EL 34's to 100 watts with ease (distortion out of the phase splitter at this level was 0.1 per cent). FET's are applicable to all kinds of tape-recorder circuitry with the exception of the bias oscillator. Also, superior AM and FM tuners may be built with FET's. Due to the different voltage requirements, it appears that hybrid design with transistors will be unsatisfactory, while hybrid tube designs are entirely possible. It is the author's opinion that it will be only a few years until tubes and regular transistors have been completely replaced by FET's in all amplifier applications. The cost of FET's while still higher than transistors at the moment, will drop sharply since there is no basic reason other than the newness of the device why cost should not be on the order of 50c. It should be clear to the reader that an exciting new era of solid-state design is on the way, particularly in the hi-fi field. Æ

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[5]relative to 1 V. rms.

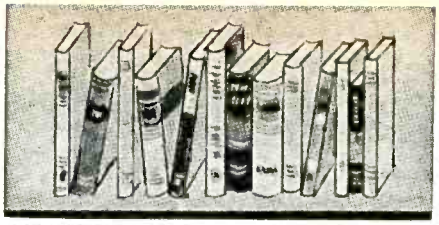
[6]W. Rheinfelder, "Noise performance of transistors in audio circuits" *Electronics World,* Jan. 1965.

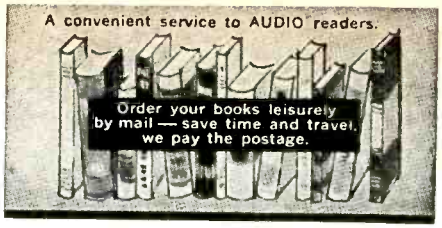
[7]P. Baxandall, "Negative Feedback Tone Control," *Wireless World,* Oct. 1952, pg. 402.

[8]C. G. McProud, Preamp with Presence, AUDIO ENGINEERING, Jan. 1954.

[9]"Professional Microphone Amplifier FETs," Engineering Report 8. *(ibid.)*

[10]"Convert Your HiFi to Solid-State the Easy Way with FETs," Engineering Report 10. *(ibid.)*





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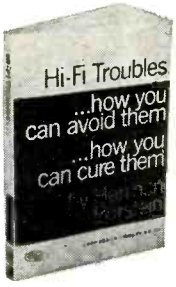

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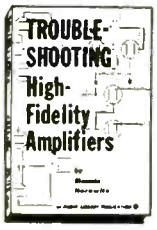

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INDUSTRY

NEWS AND NOTES

TANDBERG OF AMERICA'S parent firm in Norway has just completed a new $2,800,000 plant. The facility will eventually employ 1000 people. Our release also reports that the actual completion date was June 1 and that on the same day, workmen began moving production equipment into place.

The TELEX CORPORATION of Tulsa, Okla., has agreed to acquire the assets and assume certain liabilities of VIKING OF MINNEAPOLIS, Inc., and an associated firm, VIKING TOOL AND DIE Co. This becomes all the more interesting when you are reminded that Telex also owns MAGNECORD, also a tape recorder manufacturer. However, we are told that the Viking products will complement the Magnecord line of professional tape recorders. Just what this means in terms of overlapping products is not spelled out at this time.

AMPEREX is expanding to meet the increased requirements of its West Coast operations. A new office has been opened in Palo Alto, Calif. HANK STEENBEKE, recently named Western Regional Sales Manager, will head up the office.

Back East now for latest news of AUDIO DYNAMICS CORP. PETER PRITCHARD, ADC president said that ground breaking has taken place for a major addition to ADC's New Milford plant. With operations in both Connecticut and Farmingdale, Long Island, this expansion will triple the size of the present Connecticut facility. The one-story building will house new ADC research laboratories, as well as manufacturing, sales, administrative, and engineering facilities.

ELPA'S news is the formation of two divisions to handle their expanded product lines. The first is to be the Record Product Division headed by CARL CARLSON, recently arrived at ELPA. STAN GROSSMAN, long with ELPA moves to head up the Tape Products Division. Product breakdown is as follows: Thorens, Ortofon, P-E, and Watts come under Carl's wing; ReVox, Beyer, Editall and Editab belong to Stan.

From UNIVERSITY comes word that ABRAHAM B. COHEN has been promoted to vice president in charge of engineering. Mr. Cohen is no newcomer to University, having joined the firm in 1947. His position for the past several years has been engineering manager. He has been instrumental in developing University's product line of public address and commercial sound products. In addition to his normal Oklahoma City-based engineering activities, he will co-ordinate the firm's technical research program with the overall parent-firm. LTV's research efforts in electro-acoustics. Abe Cohen holds several patents in the electro-acoustics field, he has been a prolific article writer and frequent lecturer. He is the author of the long-standard reference "Hi-Fi Loudspeakers and Enclosures."

A separate release has informed us that FRANK D. JOHNSON has joined University as general operations manager. He comes to the company from a background rich in production supervision, most recently as production manager of the aerospace division of Pacific Scientific Co.

Changes at JERROLD. MILTON SHAPP has divested himself of 516,351 shares of Jerrold stock. (He is the Democratic candidate for Pennsylvania's governorship). ROBERT H. BEISSWENGER has been elected chief executive officer of the company. Mr. Beisswenger has been president and chief operation officer since early in 1966. The Jerrold Corp. is parent company for both the HARMAN-KARDON and JERROLD-TACO product lines.

ARTHUR D. HALL, formerly with Bell Telephone Labs, has been appointed to the newly created post of vice president and chief engineer of JERROLD ELECTRONICS Corp., the largest of the Jerrold subsidiaries. Mr. Hall will be responsible for all aspects of engineering currently being carried out by Jerrold Electronics. This will include product development for CATV, educational television, instrumentation, television reception for home use, master antenna, industrial TV, closer-circuit TV, and microwave. Æ

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WANTED: One Berlant Concertone 20/20 Tape Recorder Carrying Case. Please state price and condition. Eugene Weaver, 173 W. 133 St. Apt. 5F., New York, N. Y.

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Record Review

(from page 45)

Gluck: Orpheus and Eurydice; highlights. Streich, Klose, Schlemm; assorted orchs., Artur Rother.

Heliodor HS 25005 stereo

Nope, I don't much like these potpourri collections by Heliodor (out of D-G), though the singers here are good ones, as are the (4) orchestras. The opera is not well represented as an entity—these are just the famous excerpts. Moreover, they are done in the now-outdated Nineteenth-century adaptations of the music, including (if I am right) the "extra" music that Richard Wagner, of all people, wrote to liven up the tired old score! That's what he thought, anyhow.

For singers and singer-collectors, maybe yes. Good examples of singing, along with the various familiar orchestral interludes—Dance of the Blessed Spirits, of the Furies, etcetc. But in these days of whole operas on tape and LP there's little excuse for this kind of disjointed montage of bits and pieces, especially in such out-of-date performance.

Note that this is also in the "wrong" language. The first version, at Vienna, was an Italian opera; it was later recast into French at Paris. German it never was.

Flute Concertos by Bach & Telemann. Jean-Pierre Rampal; Saar Radio Ch. Orch., Ristenpart.

Epic BC 1321 stereo

Very interesting—at last we find old Bach, *the* famous Bach, and the once-despised Telemann, both on the same record. Good comparison. Telemann wins hands down here, though it isn't entirely Bach's fault. The two Bach Concertos aren't really for flute at all, though they can be played that way.

You'll recognize both if you know your Bach. One, BWV 1041 in A minor, is a violin concerto (though it *might* have been played on the flute) and is also familiar in Bach's transcription for harpsichord. The other, maybe a violin concerto in the original (lost), is BWV 1056, a harpsichord concerto in F minor, as it is normally heard. This one just might have been for oboe, originally.

Anyhow, in those days they used whatever instrument was handy, and the flute is quite OK—except that on Side 2, Telemann writes *so* beautifully and clearly for the flute's best range and technique—just superb! It fairly blossoms under his treatment. Whereas in the Bach it labors along, never getting its breath, generally in too low a range. It does the same in Bach's authentic flute works—the B Minor Suite, for instance.

Rampal, one of the great flutists of our day (and especially in Baroque music) is particularly good in the Telemann, with its silvery high melodic lines. Ristenpart and his orchestra play a vigorous, if bouncy, accompaniment.

Note that these artists also appear on low-priced U.S. labels at less than half Epic's regular price. The European source is identical; there's no really good reason for the differential. *AE*

Audio ETC.

(From page 14)

Compatible Bandwagon?

3. A slight mystery is developing in my mind in respect to Philips' new compatible *World Series* record, one disc for mono and stereo. The mystery is in the wording of the announcement, which leaves me at this moment completely baffled.

"The new process rests on the principle of 'phase control' . . . The ups and downs of the musical waveforms in both stereo channels are electronically kept in phase. This prevents mutual interference of the two channels when played in mono but in no way lessens the stereo effect . . ."

(I can only say, in figuratively very small type, that I used to think the stereo effect *depended* on phase differences to a very considerable extent (as well as on volume differences and differentiation of quality) and that two signals kept in phase with each other tend to a point-source mono sound. No? Well, maybe I'm confoosed, like Li'l Abner. I'm all set to find out about it—just thought I'd let you in at the beginning. Maybe I'm misunderstanding Philips' English.)

I should say that I've always felt we would sooner or later get away from the cumbersome dual-release structure, mono and stereo, and I've been feeling for a long time that maybe pretty soon the price of *stereo-compatible pickups*—i.e. those which have adequate vertical compliance to ride the stereo grooves, mounted in adequately designed arms—would get down low enough so that even the $14.95 phono portable would play any stereo record monophonically without harm. Maybe the $4.95 phono, too. So even without a compatible process, stereo could win out 100 per cent, soon.

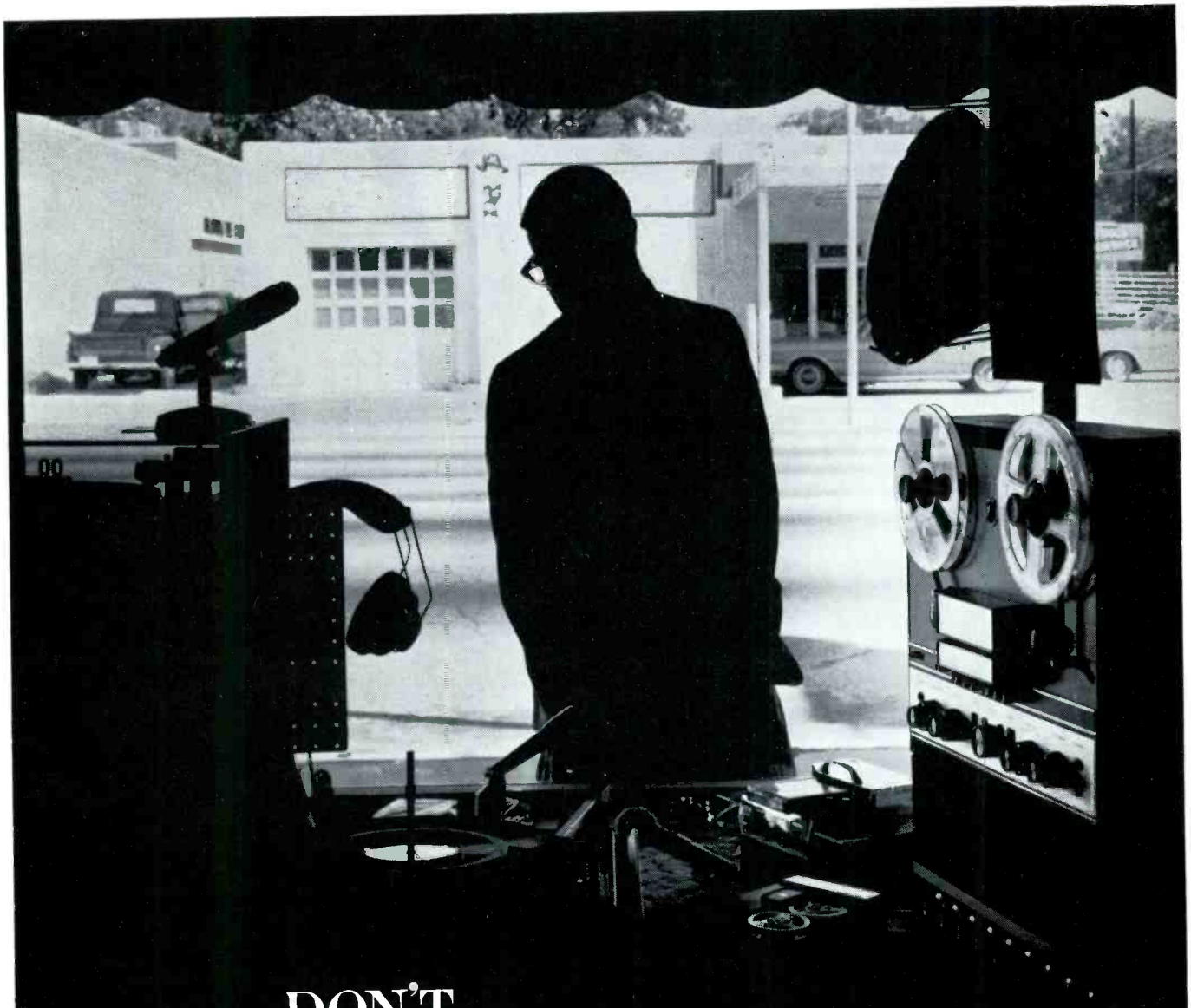
Maybe the answer, aside from Philips, is a *mild* compatibility, calculated to match, say, 90 per cent of existing monotype players at the moment—and growing milder and milder as the players themselves grow more tolerant towards the stereo disc. But, any way you look at it, Philips may finally have broken the 2-disc dam. If others jump on the band wagon, we'll have a stampede. Or maybe I mean a flood or something.

(I can see that band wagon floating downstream, along with the stampeded cows or buffaloes or whatever. Nothing like a mixed metaphor to nail down a point on the nose! An unmixed blessing, definitely.)

Wow—just think. If all the records now on the market in dual form, stereo (real or synthetic) and mono, were to merge into single releases, *we would have only half as many records to cope with!* Dealers, please take note. And collectors, too.

The economics of that possible development are so prodigious that I'll just have to quit right here—my head is spinning, my eyes are double-crossed into reverse stereo, hopelessly incompatible. Seeya next mo. *AE*

Advertising Index



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An important footnote: There is no time limit to our warranty! If an E-V microphone should fail, just send it to us. If there's even a hint that our workmanship or materials weren't up to par, the repair is no charge—even decades from now! Fair enough?

*Patent No. 3,115,207

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