# THE B.A.S. SPEAKER

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## In This Issue

In his first article ( BAS Speaker, March 1976), John Gombos described a filing system that he has used for eleven years. Gombos follows up that piece in this issue with one that should be of particular use to the Society's members: a subject guide to the Speaker from Volume 1, Number 1, through Volume 4, Number 5 (Oct. 1972 through Feb. 1976).

We return this month to the subject of tonearms. Mike Riggs discusses the oft mentioned but seldom explained specification "effective mass" and casts a critical eye on the significance of "seesaw frequency," as championed by David Gammon of Transcriptors. It is therefore especially appropriate that this issue includes reports from two members on their experiences with the Transcriptors Vestigal arm. Mark Dimirsky, from Manitoba, solved the Vestigal's problems by replacing it with a SME, while Rhode Island member Jeffrey Nelson discovered the Formula 4. Nelson and California member Dow Williams present in this issue the first—to our knowledge—reviews of the Formula 4.

To round out this month's series of users' reports, California members Steve Seto and Nate Garfinkle review the Phase Linear 1000 and the Quad 405 current dumping amplifier, respectively.

## Application Forms

You may have noticed that the past two issues of The Speaker included an application form. We hope that you will pass the form along to a friend who might be interested in joining the BAS. We will be sending you renewal forms for 1976-1977 sometime in the late summer.

**Membership dues are $12 per year (October 1 to September 30) or portion thereof. Dues include a one-year subscription to the BAS Speaker. (Note that almost the full amount of dues is allocated to production of the Speaker. The local activities of the BAS are strictly self-supporting.) For further information and application form, write to: The Boston Audio Society, P.O. Box 7, Kenmore Square Station, Boston, Mass. 02215.**

BAS Speaker Mailing

The BAS Speaker is now mailed to more than 600 people, and this is causing us some difficulties. With that many copies to be addressed and put into envelopes, it is no longer possible to do the job at the monthly BAS meeting. As a result, we are trying to gather a group of volunteers to take care of the mailing during the week following the meeting, and this means that copies are often not mailed until the end of the month. So, be patient—your issue will arrive, but later than it used to.

Any Boston-area member who can help with the mailing project should contact Joyce Brinton or Al Foster at meetings or via P.O. Box 7. Volunteers are desperately needed, particularly if we are to avoid having one group do the work every month. In fact, if someone would be interested in taking responsibility for organizing the mailing, that would also be appreciated.

For Sale

•Sony TTS-3000A with SME 3009. Joseph Gemmato, (617) 254-7796.

## An Interesting New Amplifier

David Berning, a founder of The David Berning Company (11007 Candlelight Lane, Potomac, Maryland 20854) and designer of the Berning EA2-150 power amplifier, is a physicist at the National Bureau of Standards. His amplifier is a hybrid design, i.e., it uses both tubes and transistors. It has very little negative feedback (what's there can be cut out entirely with a switch on the front panel) and uses TV horizontal output tubes rather than conventional audio tubes. Berning has designed the amplifier to be unusually efficient, so as to make it run cooler and more reliably than other tube designs. Power output is 150 watts per channel. This would seem to be the per- . feet amp for individuals with large rooms, inefficient speakers, a disdain for "transistor sound," and $850 looking for something to buy.

Berning also makes a hybrid preamp, which he tells me passes the Holman square-wave test with high marks. This goes for a mere $ 275. I have heard the Berning amp-preamp combination driving Magneplanar T-III's. The sound was very impressive indeed.

— Bill Bell (Washington, D.C.)

## A Preamp-Cartridge Switchbox

Abbott Lahti (Power Systems, Inc., 56 Bellis Circle, Cambridge, Mass. 02140) has designed an excellent preamp-cartridge switchbox. The switchbox can be used to do A-B comparisons of preamplifiers without adversely loading them or affecting their performance, and it is completely passive. In addition, there are no pops or clicks when the cartridge and the preamp inputs and outputs are switched.

Some points to remember when assembling your switchbox are:

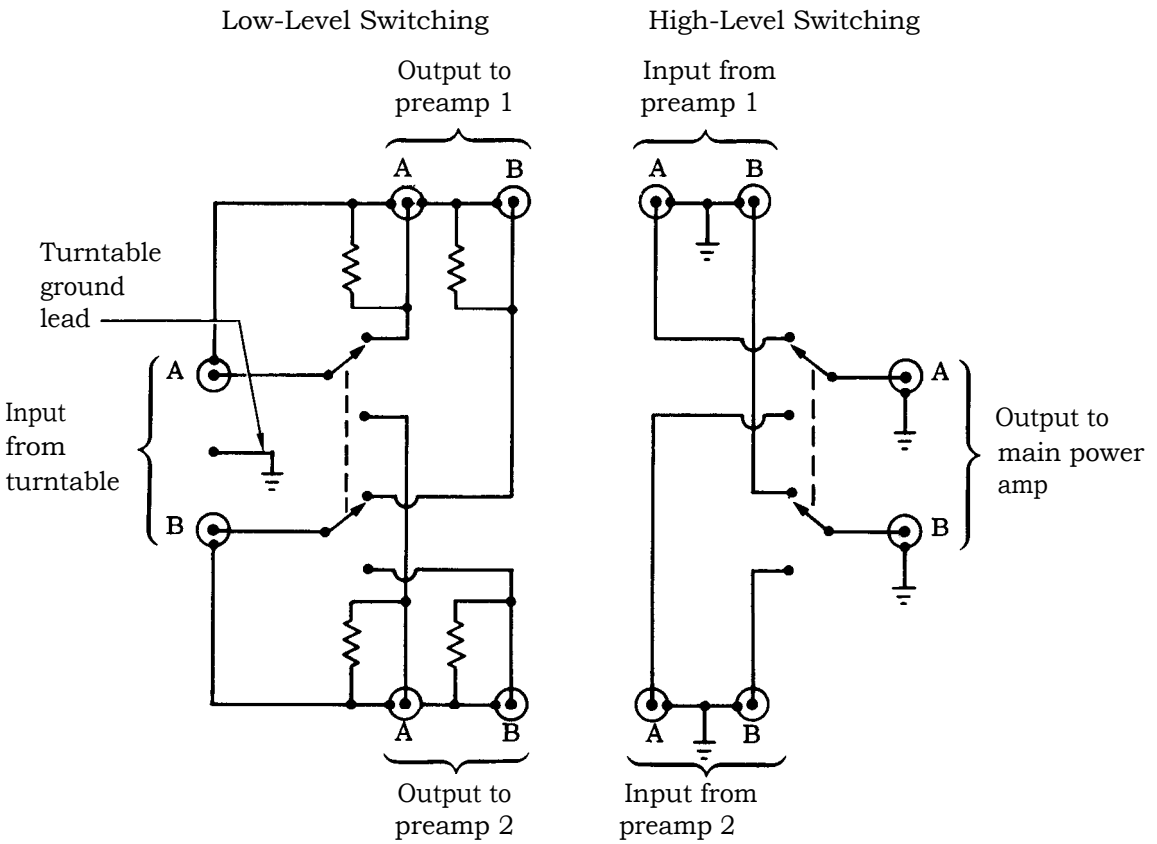
1. The 4-pole, 2-position switch must be a "make-before-break" (shorting) type.

2. It is not necessary to use shielded cable inside the switchbox, but a metal housing is a necessity.

3. Low-capacitance cables must be used from the cartridge to the switchbox. The cables to the preamps' phono inputs also should be low capacitance, and identical to both preamps, to ensure equivalent capacitance. Most switches add about 20 to 30 pF, which is equivalent to about 1 foot of a good cable.

4. All the grounds on the low-level side of the box are tied together and floating.

5. The high-level grounds are connected to the metal case.




Preamp-cartridge switchbox schematic

## Micro-Seiki Mounts

Shortly after the February issue of the Speaker appeared, I received a letter from K. Usui, Export Department, Micro-Seiki Co., regarding U.S. distribution and sales of MSB-1 shock mounts. In brief, Mr. Usui said that Micro-Seiki has entered into an agreement with Teac to market the Micro line in this country beginning April 1, and that the company was no longer able to fill orders direct at the $7.00 price, which was a "service and special price because we did not have any agent in the United States."

Mr. Usui did not indicate whether the MSB-1 itself would be imported by Teac. The last U.S. importer of Micro products, Tannoy, did not import the shock mounts.

— Gary Roboff (Massachusetts)

## Empire 598 Turntable

I once owned an Empire 598 turntable. It therefore behooves me to warn one and all against the beast. Actually, the turntable itself seems to be quite good, though mine had a habit of changing speeds on its own when started. The problem is the tonearm (which is available separately — the Empire 980). Empire boasts that it has the lowest fundamental resonant

frequency of any arm on the market. Alas, they speak the truth. There's lots of metal in this arm, especially in the headshell, making its effective mass very high. Add to that an undecoupled counterweight, no damping, and very low friction, and you get trouble with almost any cartridge you can buy. Certainly that's what comes with Empire's own. My 1000ZE/X used to lift clear of the surfaces of some warped discs by as much as an eighth of an inch. I could see the stylus jiggle and watch my woofers work. The results are audible even today.

On the other side, it must be admitted that the arm and table are solidly constructed, that they're easy to set up and use, that the lift works beautifully, and that pivot friction seems to be very low. With paddle damping for the arm, a Decca V cartridge might feel right at home. Or perhaps it could be made into a doorknocker, or a hood ornament for the family Stutz. Consult your local smithy.

— Michael Riggs (Massachusetts)

## Sounding Off on Sound Guard

I have tried Ball Corporation's Sound Guard record treatment and do not recommend it. Despite the glorious reviews, it audibly degrades the sound of discs to which it's applied. One can easily distinguish treated from untreated records. Two friends successfully picked the treated and untreated sides from a selection of discs to which Sound Guard had been applied on one side only. I also tried the experiment outlined in Audio (April 1976) where the outer half of a record was treated and the inner half was not, and could tell the treated part of the record from the untreated part. Voices sound mellower and the high-end shimmer of percussion instruments is somewhat attenuated.

One may find this difficult to accept, as it has been shown (Radio Electronics, March 1976) that Sound Guard does not cause loss of the carrier on CD-4 discs. I also had difficulty with this, until I realized that the CD-4 carrier signal is very heavily modulated. Other signals, such as the high harmonics of some instruments and the sibilants of the human voice, are very weakly modulated. It's the weak signals that Sound Guard obscures.

I used the following equipment for my tests: Sonus Blue Label, Rabco ST-7, Dyna PAT-5 (phono preamp section connected directly to power amp), Dyna ST-400, and Stax SRX III headphones with SRD-7 energizer. The speakers are large Advents crossed over to Decca London ribbon tweeters at 1 kHz.

I am, by the way, planning to replace my Advents with the Bailey transmission line, using the KEF B139 SP1044 (see Wireless World, May 1972). I should like to hear from members who have built or heard this woofer with the above driver.

— Christopher Gupta (Ontario)

## More on the Fulton J

I would like to mention several updates since my review of the Fulton J Modular appeared in the Speaker. First, the price has been "updated" to $1946 for the pair. Second, a modification to the crossover has substantially tightened up the low end. I urge anyone seeking an education in bass reproduction to listen to the J's. They seem to have no lower limit.' This crossover mod is on all new units and is available for about $75 for older ones.

In reply to Tom Johnson's comments in the February Speaker, the problem of obtaining high volume levels in large rooms with the J's is not one of efficiency. It is still there with the efficiency modification. I was referring to a tendency of the sound to lose transparency and definition at high levels, but before the onset of amplifier clipping. This characteristic is exactly opposite that of the Dayton-Wright electrostatics with their enormous apparent dynamic range. This was well described in Beagle's review of the Dayton-Wrights. My own impressions are similar to his. With the J's, there is a sense of something "clamping down" and restricting the sound. The 95 dB upper limit I referred to is 95 dB average, which is quite loud.

— Desmond Fretz (Maryland)

## Update on Dayton-Wright Speakers

Since I wrote the comments on the Dayton-Wright speakers published in the February 1976 issue of The BAS Speaker , I have had a power supply failure in the speakers' ST-300A transformer. Consequently, I have acquired a recently designed power supply that markedly increases the efficiency of the speakers (Michael Wright claims that the efficiency increase is on the order of 6 dB). My SAE 2500 now has little trouble driving them, even at very high levels (around 100 dB and above). The closest Dayton-Wright dealer, The Audiophile, Inc., Gaithersburg, Maryland, claims that when they installed the new supply in their speakers, they also noticed an opening up of the midrange, but as over five weeks elapsed between my old power supply's failure and the arrival of the new one, I can offer no personal observations on this matter.

The new supply is just one of several improvements to the speakers this year (in production since around February 1976). The electrostatic panels have been changed from plastic, silver-coated ones to perforated metal ones. This was done to reduce production costs and to reduce the required charge-up time of the speakers. The production savings were then applied to improving the ST-300A transformer. Michael Wright wanted to smooth out the midrange and to increase the transparency and detailing.

If you have suitable speakers, you can update your transformer to the current production model. The new supply achieves its greater efficiency by increasing the bias voltage from around 10 kV to about 16.5 kV, but until recently the rear connectors on the speakers were meant to handle only up to around 15 kV. So unless your speakers have suitable connectors, you cannot safely use the new power supply. Wright was looking ahead to using a higher voltage last summer, so Mk 3's manufactured from July 1, 1975 have the appropriate connectors. Certain earlier Ma's and 3's also have appropriate ones (my own speakers were made around June 1, 1975, and they are all right in this regard). The factory has to know the serial number of your unit to determine if the updating can be done (in any case, I recommend that you contact the factory if you have any questions). If you want the updating, the new power supply costs from $ 75 to $100, depending on your location.

Besides the new supply, there is a retrofit kit to bring the transformer completely up to the new design. The kit increases the efficiency of the piezoelectric super-tweeters to the new level of the electrostatic panels and incorporates the new circuitry that smooths out the midrange and increases transparency. I do not have the retrofit kit yet, nor does the dealer, The Audiophile, so I do not know how much improvement is involved; apparently it is considerable. Apparently, if one updates one's ST-300A, then the fully charged speakers will sound like current production units.

Besides any sonic improvements, the main consequence of the new power supply is that the increased efficiency of the speakers makes them less esoteric loads to drive (thus altering part of the general conclusions of my earlier report). Now 150-watt/channel amps should have no problems with them. Thus there is a much broader range of amps from which one can choose. Mike Wright still recommends the Dunlap-Clarke amps (especially the model 500). The Audiophile believes that the best amp to drive the Dayton-Wrights is the C, M Labs 912, which I have heard and found to be very fluid and unstrained. In any case, I think that audiophiles will find the Dayton-Wright a much easier load to drive no matter what good quality amp they use.

— Collins Beagle (Virginia)

## Penguin Stereo Guide—Part II

This is a continuation of the list of outstanding records begun in last month's Speaker. Brian Leeming has culled these discs from The Penguin Stereo Record Guide , which has given them their highest rating. All are available from the BAS Record Importing Service.

- Handel, Concerti Grossi, Op. 3, 1-6, Op. 6, 1-12, Marriner, ASMF, Decca SDDB 294-7. (Op. 6 is available in the U.S. as London 2309).
- Haydn, Symphonies (complete), Dorati, Philharmonia Hungarica, London STS 15310/15, 15257/62, 15249/54, 15127/30, 15131/4, 15135/8, 15182/5, 15229/34, 15319/24, 15316/7.
- Haydn, Piano Trios (entire series), Beaux Arts Trio, Philips 6500-521, 522, 401, 023, 400.
- Haydn, String Quartets 44 and 45 (Prussian), Tokyo Quartet, DGG 2530 440.
- Haydn, String Quartets 74 and 77, Berg Quartet, Telefunken 641 302.
- Honneger, Symphonies 2 and 3, Karajan, Berlin Philharmonic, DGG 2530 068.
- Lehar, The Merry Widow (complete), Matacic, Philharmonia Orchestra, HMV SLS 823 (2 discs).
- Liszt, Piano Concertos 1 and 2, Brendel (piano), Haitink, London Philharmonic, Philips 6500 374.
- Liszt, Piano Concertos 1 and 2, Richter (piano), Kondrashin, London Symphony, Philips 835474.
- Liszt, Piano Music (Sposalizio, II penseroso, etc.), Brendel, Philips 6500 420.
- Mahler, Fourth Symphony, Raskin (piano), Szell, Cleveland Symphony, Columbia MS 6833.
- Mahler, Fifth Symphony, Barbirolli, New Philharmonia Orchestra, HMV SLS 785 (2 discs).
- Mahler, Eighth Symphony (Symphony of 1000), Solti, Chicago Symphony, London 1295 (2 discs).
- Mahler, Ninth Symphony, Haitink, Concertgebouw Orchestra, Philips 6700 021 (2 discs).
- Mahler, Five Ruckert Lieder, Janet Baker (mezzo-soprano), Barbirolli, New Philharmonia Orchestra, HMV SLS 785 (2 discs).
- Mathias, Dance Overture 16 and Harp Concerto, Ellis, harp, Atherton, London Symphony, Welsh National Opera Choir, L'Oiseau Lyre S-346.

## Ensayo on MHS

Below is a list of Ensayo recordings used on the AR demo disc that are available from The Musical Heritage Society. The sonic quality of the MHS pressings is up to that of the AR record, but (as Mike Riggs has pointed out) they are not as quiet—just average.

| | MHS | Ensayo |
|---|---|---|
| AR Side 1 | | |
| Bands 1 & 5: Igor Stravinsky, "L'Histoire du Soldat" | 1365 | ENY-20 |
| Band 2: Pablo de Sarasate, "Nine Spanish Dances" | 1646 | ENY-3 |
| AR Side 2 | | |
| Band 4: "Music of the Late Middle Ages and Renaissance" | 1141 | ENY-37 |

Another MHS disc worth considering is Maurice Ravel's "Trio for Piano, Violin, and Cello" and "Sonata for Violin and Piano" (MHS 1235). I have not heard the original of this Harmonia Mundi recording, but the MHS version is excellent. — Christopher Gupta (Ontario)

## In the Literature

[The current editor of this column will be retiring over the summer; interested replacements may apply at P.O. Box 7.]

Audio, May 1976

- Build a Binaural Mike Set: A simple project for the recordist; uses rather unsophisticated construction, but might be fun to try. (p. 34)
- Record Cleaners: A survey of the devices on the market. Meaningful comments are scarce. (p. 40)
- Equipment review of the Pioneer RG-1 Dynamic Processor; also short of data. (p. 62, 75).

Audio Engineering Society, Journal of the, Jan./Feb. 1976

- Active Crossover Network for Noncoincident Drivers: From hp. (p. 2)
- Technique for Observing Loudspeaker Wavefront Propagation: Describes an elaborate JVC setup in which the pulse response is measured and the data from 3000 pickup locations is stored. Includes fascinating diagrams from six various tweeters. (p. 9)
- The Sound Field in Home Listening Rooms, Part II: by Roy Allison. (p. 14)
- Towards a More Natural Sound System: A new "3+1" quad system. (p. 24)
- Practical Loudness: An Active Circuit Design Approach: A simple circuit that follows "the" Fletcher-Munson curve to within 3 dB over a 40-dB range. Inclusion of the diagram and a dial plate layout makes for a nice construction project. (p. 32)
- The AES announces that the use of "decibel appendages" such as dBm or dBV will no longer be allowed in the journal. (p. 40)

Audio Engineering Society, Journal of the, March 1976

- Intermodulation Distortion Produced by Out-of-Band Program Components: "Prudence would dictate that high frequency noise or program components above 15 or 20 kHz should not be allowed to enter a power amplifier operated with limited headroom [sic] if very low distortion is desired." More in the controversy about TIM, slew rates, feedback, and narrow versus wide bandwidth design (e.g., Bose vs. Harman/Kardon). (p. 103)
- New Modulation Technique for CD-4 Recording: Latest from JVC/RCA uses phase-locked loop to give wider dynamic range. (p. 112)

Audiogram

A rather skimpy (for $10 a year) monthly, this, but a conscientious and regular one, devoid of arrogance. Four issues are out to date, all interesting. Products so far reviewed include the Berning amp and preamp, the Fried Model R, the Allison One, the Micro/Acoustics QDC-1E, the DB Systems preamp and head amp, the Audio Research SP-3A-1 (Paoli modified), the Dayton Wright XG-8 Mk. 3, the Fulton J, the IAD expander, the CM 912 amp, the Quad 405 amplifier and loudspeaker, the dbx 122, the KMAL arm, the Spendor BC-1 speaker, the Win Labs cartridge, and the Denon 103's. Subscriptions from: The Audio Advisor Audiogram, Dulles International Airport, P.O. Box 17202, Washington, D.C. 20041.

db, March 1976

- FM Stereo Separation: Discusses possible sources of poor separation. (p. 17)
- Understanding Harmonic Distortion: Includes measurement techniques and several diagrams of various harmonically distorted waveforms. (p. 24)
- Being Practical About Feedback, Part III: Final part in a series. (p. 37)

*On the back cover, a Teac/Tascam 80-8 recorder (8-track, 1/2-inch, less than $3000) is advertised; an "integral DBX [sic] interface is available optionally."

Electronics, March 18, 1976

- Special on RMS Measurements: True RMS Measurement Reveals the Power Behind the Wave-from (p. 93); How To Measure AC Signals Accurately (p. 94); How to Choose and Use an RMS Meter Accurately (p. 97).

Electronics, April 1, 1976

- Non-Linear Low-Pass Filter Rejects Impulse Signals: A simple op-amp circuit, using an AD507, works as a slew-rate limiter to reject spikes. May be useful as a pop filter. Includes schematic. (p. 82)

EDN, Feb. 20, 1976

- Researchers Use Holography and Computers . . . in Speakers: Philips Laboratory in the Netherlands have devised 12 simultaneous differential equations to describe loudspeaker behavior. A computer is used to find numerical solutions, which are found to agree well with experimental data. Philips also used holographic interferograms to examine standing waves on the cone's surface. Photos are included, and in one case at 9 kHz the standing waves cover the cone, indicating very little output at this frequency. (p. 26)

High Fidelity, May 1976

- Musical America discusses Tashi and gives an excerpt from Cadenza, A Musical Career, the autobiography of Erich Leinsdorf.
- An unusual compilation of futuristic articles includes a piece by BAS member Mark Davis about ambience; he shares this issue with lesser known writers, e.g., Isaac Asimov. (p. 52)
- Part II of the high fidelity biographies features Saul Marantz, Paul Klipsch, and Rudy Bozak. (p. 67)

IEEE Trans. on Consumer Electronics, Feb.1976

- Development of a New System of Cassette-Type Consumer VTR: Description of Sony's Betamax System. (p. 26)
- A Quadraphonic FM Broadcasting System...: By Zenith. Claims mono and stereo compatibility while retaining full 15-kHz audio bandwidth. (p. 84)

Popular Electronics, May 1976

- Build the Audio Detective; A sensitive ac voltmeter. (p. 41)
- A New Audio "Room Expander": A quickie on the Audio Pulse time delay unit. (p. 55)

Radio Electronics, May 1976

- Lots of short bits about TV (flat tube, projection, stereo sound). (p. 4)
- Phase Linear Response: Discussion of guess who's speaker design. (p. 43, and B&O).

Stereo Review, May 1976

- It may be High Fidelity's anniversary, but Stereo Review has come forth with a new layout and lots of new advertisements.
- SR offers an index of their test reports from 1965 to date (May 1976) for 25¢ . (p. 20)
- BASF has changed their open-reel labeling. (p. 21)
- The Audio Pulse delay unit receives further mention by Klein. (p. 22)
- Equipment reviews of the EPI Model 4 preamplifier, the BGW 500 power amplifier, and a very fine inexpensive loudspeaker, the Genesis I. (p. 29)
- Audio Equalizers: BAS member Dan Shanefield offers good advice on the use and non-abuse of program equalizers. (p. 64)

StereOpus, Vol. 1, No. 3

A good issue, despite a rather odd review of the Allison One. Also includes reviews of the Levinson JC-1AC, the Fidelity Research FR-1 Mk. II, the Denon 103's, the Soundcraftsmen PE-2217, the Phase Linear 4000, the Citation 16, the G.A.S. Thaedra, the Sony TA-4650, the Luxman M-4000 and C-1000, the Ace Audio Basic Preamp and Equalizer, the Dahlquist DQ-10, and the Webb TLS speaker (as described in The Audio Amateur). Includes a very interesting "Constructor's Corner" on building the Webb. You may have noticed, by the way, that this particular quarterly really does come out about once every three months.

Wireless World, March 1976

- As TIM is to Audio, so phase effects in loudspeakers are to WW: Phase and Sound Quality (". . . no significance . . . in a mono channel [of a stereo system] . . .") (p. 80); Audibility of Phase Distortion, Letter (p. 60).
- Detailed technical articles on the WW FM tuner and on FM waveforms.

Wireless World, April 1976

- More on phase effects in loudspeakers: Phase Shift in Loudspeakers, Causes And Measurements (p. 73); Phase Effects in Loudspeakers, Letter (p. 53).
- Current Dumping Audio Amplifier, Letter (p. 54)
- Transistor Driver for Valve [Tube] Amplifiers (p. 36)
- More on WW FM tuner and FM waveforms.

— D. Craig, H. Zwicker, M. Riggs

## April BAS Meeting

Business Meeting

The BAS is homeless again. We met this time in an auditorium on the MIT campus, and the first order of business was a call by Jim Brinton for people who might have access to suitable meeting sites.

Al Foster will be bulk ordering Maxell UD-35 open reel tape. Prices are not yet set, but bargains are promised. Get in touch with Al. Also coming from Al —Audio-Technica test records. More information shortly. Attend the meetings for further word.

J. K. Pollard solicited interest in the Audio Amateur's latest modifications to Heathkit's popular IG-18 audio generator. The magazine will offer printed circuit boards if there's enough interest.

Al Foster announced a Speaker mailing session and called for volunteers. [Total attendance was three, making it an all-night job. Volunteers are sorely needed to make this a more manageable chore. Here's a chance to contribute to the success of your organization, hear some good sounds, chat with people of like interests, and get to know one of your BAS officers as something more than a vendor of tape and record bargains.— H.B.]

This month's thieves' market featured Dr. Brian Leeming's overseas record service. Prices are lower than for the same records purchased stateside—take advantage. Jim Brinton delivered some Mark Davis preamps. Abbott Lahti had his phono preamps and phase-locked multiplex modification kits for sale. Ira Leonard had Insight Records' "Fidelity First—An Unrehearsed Experiment." The newer "Pig's Eye Jass" is on order. And Peter Mitchell had mike cable, the last BAS oscillator, and, for the right person, a single 814 mike capsule.

Meeting Feature: Peter Pritchard

Our guest speaker was Peter Pritchard, formerly the President of ADC, where he designed cartridges and the tonearm that bears his name. He now presides over Sonic Research, also a maker of state-of-the-art cartridges. On the face of it, Mr. Pritchard could not have presented a greater contrast to last month's lecturer on tonearm design, Jacob Rabinow. The glib Rabinow presented the image of the compulsive inventor pushing forward the innovations sometimes at the expense of unrefined details. Peter Pritchard spoke in carefully measured words and seemed a man bent on the development of designs based only on carefully measured parameters at every stage.

And yet there was also a certain commonality of viewpoint. Rabinow talked about ideas developed from gut instincts—inventions peppered with stardust. Pritchard approached much the same notion from a more conservative psychological foundation. He spoke of the limitations of knowledge and suggested that major innovations transcend what we understand to be the known parameters of performance. As one case in point, he offered Westrex, who developed the 45 - 45 ° system of cutting stereo records without having the benefit of a cartridge with which to play them. After inventing the technique they went to GE to see if a cartridge could be made that would play the records without cutting them to spaghetti.

He also noted that he has found new pleasures in Mercury's Living Presence recordings of the late fifties. He felt that Mercury could not have known just how good their product was, because they didn't have cartridges good enough to fully demonstrate their fine points.

Even now, no pickup designer knows for sure how much his product is limited by record technology or vice versa. Real innovation has to be more than improving on the known, measured parameters. Quoting Pritchard: "We really don't know quite what we're doing in this industry. I shouldn't really say this for everybody else, but I think it's true to a great degree. We all of us try very hard and we think what we're doing is in the right direction. We're all opinionated (naturally), but we tend to blunder around and very often we achieve things we don't know we've achieved until we look back and we see the significance of it afterwards."

Why Sonus? Dissatisfaction with the state of the art led Pritchard to form Sonic Research and produce the Sonus cartridges—that and the realization that the frontiers of audio performance could not be defined by known test procedures. For a time he believed that electronic componentry had reached its zenith. The specifications were so uniformly excellent that it appeared performance must be essentially identical. Then a customer who "harangued" him at a CES show about the electronic components ADC happened to be using in their booth set Pritchard to listening to a variety of components. And, specs or not, they were definitely not alike. So he began to re-evaluate transducer designs: "What we were measuring, for the most part, was of very little significance . . . If we carried out conventional measurements, and we found they were reasonably satisfactory, then that was only a beginning."

Working first at ADC, he tried to isolate some of the unknowns. What, for instance, accounted for the oft-noted depth and apparent separation of the XLM? The separation measured on steady-state tones was not exceptional. Perhaps another kind of test would confirm what the ear heard. Working in the lab one weekend, he cut gashes into one wall of silent grooves in a test record. Using a dual-trace scope, he played back the gashes and watched the left and right signals. The gash produced the expected "splash" in the appropriate channel, just a slight "tail" in the other, indicating the excess energy was being dissipated in a random manner. Several competing cartridges with exceptional steady-state separation figures produced nearly uniform "splashes" in both channels. Now there was at least a way of seeing what had theretofore been an unmeasurable quality.

When he left ADC, Pritchard had no intention of founding another commercial audio company„ But as a private audiophile without a laboratory to supply him products, he found himself dissatisfied with the choices available. Feeling that significant improvements were possible, he started Sonic Research.

Sonus Products. The Sonus product line consists of two, four, or five cartridges depending on how one counts. The top of the line cartridge is called the Blue Label, the Red Label, or the Green Label, depending on which stylus is used. The same cartridge body is employed in all three. The Green is a spherical tip, the Red is biradial, and the Blue offers the Pathimax stylus, which is similar to the Shibata tip, but is more conical at the intersection of the ground faces. The net effect is the same.

The other Sonus cartridge is the Silver Label, which comes with either the elliptical or the Pathimax stylus. This cartridge is a ruggedized version with somewhat lower compliance and a heavier suspension, making it usable in a wider range of arms. According to Pritchard, its laboratory measurements are equal to or even better than the Blue-Red-Green cartridge, but the sound is not as open or effortless. Prices in the Boston area run from about $40 (for the Silver E) to about $86 (for the Blue).

There's also a Blue Calibrated, which is a selected Blue supplied with a frequency run. When its time to change styli, return it to Sonus and they will replace the stylus and supply a new response chart. According to Pritchard, the cartridge pickers at the factory pick the Blues with the best frequency runs to become Blue Calibrateds.

Pritchard recommends the Blue as having a smoother frequency response. Because the Pathimax contacts a larger surface area on the groove walls, the groove gives less and the stylus traces better on heavily modulated inner grooves. It should give better record wear than the elliptical tip. Even using higher-than-usual tracking forces, Sonus has been able to play records one or two hundred times without discernible wear. The stylus was chosen to take advantage of its better shape and not for CD-4 (though they feel it's a good CD-4 cartridge). Careful alignment is necessary to realize its full potential, however. Pritchard recommends that after adjusting for minimum tracking error, one place a pocket mirror on the turntable and look at the tip from directly overhead to check for vertical alignment.

Design Factors. So how does one design a good cartridge? What are the parameters?

First, says Prtichard, the basic design principle is not critical to the final achievable result. One can use moving coil, moving armature, or something more exotic. The choice boils down to economic factors and to ease of design and manufacture. The more important problem, says Pritchard, is achieving accurate transmission of the motion of the tip to the generating element. It's particularly difficult to get all motion transferred. In this respect, the ideal would be a massless, infinitely rigid, cantilever-armature system. Because the ideal doesn't exist, cartridge makers have to deal with resonances. One way is to taper the cantilever. That suppresses fundamental beam resonances, but not higher order harmonics. Sonus chooses instead to make the cantilever as short and light as possible. This also helps reduce the total mass of the moving parts. Any mass becomes a storage point for resonances. When the stylus beam is long, nodes tend to build and the actual pivot point of cantilever-armature starts to wander, perhaps as much as 10 mils or so. By keeping the cantilever short, there's very little motion wasted in torsion.

The mass of the armature is held down by using very thin, magnetically permeable material and by keeping it very short. The suspension system and the armature have square cross sections, to hold the pivot point firmly in place and suppress rotational motion.

Sonus aimed for perfect symmetry of the moving parts. This contributes to good separation of transients and to steady-state separation that continues to the top of each cartridge's range. The production cartridges are not as good as the laboratory models in this respect, but the production models have to have enough stylus clearance to play ordinary records.

A useful feature of the Sonus' electrical design is low impedance. Inductance is about 100 millihenries and resistance is 300 ohms. This makes it easy to match cartridge and preamp, and it helps also when the Sonus Blue Label is used for CD-4.

Pritchard also explained that it's nearly impossible to lower mass by using a nude diamond. In such styli, the diamond is secured by having a very thin sliver of diamond extend through the cantilever shank, where it's secured with something like epoxy cement. If one doesn't use enough cement, the stylus wiggles in the shank, and if one does use enough, the mass advantage is lost. The Sonus approach is to bond the tip to a tiny bit of steel. The steel is readily enchored to the shank without significantly adding to mass.

Distortion. Pritchard feels one really can't be sure what kinds of distortion predominate in cartridges because it's difficult to say how good the test record is. A cleanly recorded mid-frequency sine wave can be reproduced with 0.1% to 0.2% THD. What distortion exists results chiefly from geometry and is random in nature, so it doesn't show up as even-order harmonics. IM tests don't tell much either, because they look at sum and difference products. For that matter, visual spectrum analyzers don't tell that much because (again) the distortion is mostly transient in nature. The best bet for finding cartridge distortion, says Prtichard, is an oscilloscope and a trained eye.

Some hysteresis distortion is inherent in moving armature designs, but it can be minimized. The moving armature is charged to the point of saturation. If it's a little less than saturated, flux density in the armature will change as it moves toward and away from the pole pieces and charging magnet, especially at high velocities.

In the Sonus, the problem was met by using a very powerful charging magnet and a short armature, and by placing the magnet over the pivot point, so the armature is fully enveloped in the magnetic field and its position relative to the field is effectively unchanging. A side benefit is that the magnet doesn't mechanically bias the stylus.

Do Stylus Suspensions Self-Destruct? Well, they're known to come apart, but so far as Pritchard can discover, stories about suspension materials deteriorating are untrue. When the suspension fails, it's most likely because something has come apart.

Cantilevers, on the other hand, do deteriorate. They're usually made of very thin aluminum and are protected only by the aluminum oxide that forms on the outside. The shank is just thousandths of an inch thick, and it can go. ADC had stylus assemblies coming undone because the cantilever and armature were made of different metals, and there was an electrolytic reaction between them. Sonus puts a plastic barrier between cantilever and armature.

A Sonus Arm? There's a Sonus arm on the back burner now. Pritchard would like to make it an integrated arm-cartridge that could be de-integrated by the user when he got the urge. But integrated designs have never been commercial successes. Dealers react negatively on the basis that the audiophile simply doesn't want to give up the privilege of interchanging cartridges of different manufacture.

The Sonus arm would be a modernized Pritchard, making use of materials not available when the original arm was designed (as an answer to the SME, which was at that time too massive and undamped for the ADC-1). It would be as light as possible and its cross section would change along its length. These features would make it a low-mass, non-resonant device. It would have a simple, damped pivot, and its overhang would be less than that of many current designs. A large overhang reduces tracking 'error, but adds to skating force. He prefers to hedge the compromise in favor of lower skating force, because anti-skating devices put an unwanted load on the stylus suspension system. Not only must it provide uniform restoring force to the stylus to keep it on the record, but it must counter the anti-skating device's tendency to pull the stylus off center.

Though Pritchard would choose to damp his arm, he agrees in principle with Rabinow to the extent that there are other ways of attacking the problem. Pritchard said that "if you can design everything else to its optimum, then you don't need damping." And yes, he and Rabinow are still talking.

Sonus Speakers? Maybe. But don't hold your breath. The field is so fiercely competitive and all the commercial angles so well covered that Pritchard will enter only if he can make a material contribution to the technology.

Unfinished Business—ADC. The present ADC Super XLM Mark II is not Pritchard's design. After BSR bought out the company, they asked for a CD-4 version. Pritchard added a Shibata stylus to the XLM but wasn't happy with the result, so he shelved it to work out a new design. After he left, BSR dusted off the cartridge on the shelf, made it a little more rugged, and called it the Mark II. In theory, it should track inner grooves better, but he doesn't know what kinds of tradeoffs were made in the redesign. Peter Mitchell pointed out that print reviews generally have panned the cartridge for CD-4 use.

Someone wanted to know why ADC cartridges were so compliant that an arm with negative mass was needed to achieve a fundamental resonance between 10 and 20 Hz. Pritchard challenged the assumptions. In the first place, the cartridge was designed for a combined resonance of about 6 Hz. And in the second, their experimentation showed a resonance of about 10 Hz in typical record changer arms.

You pick your tradeoffs, said our guest. A lot of room resonances occur around 10 to 20 Hz, as does much of the feedback transmitted by resonating records, so ADC chose to put the basic resonance lower. True, record warps ought to show up occasionally in that area, but in practice they hardly ever do. Besides, if one keeps the Q of the resonance low enough, there won't be any real trouble. And finally, 6 Hz is a good match to many of the low-cut filters on preamps.

Marketing Footnotes. Pritchard agrees that there's a lot of opportunism in cartridge pricing. This results from market competition and from the fact that much of the public needs a high price to convince it that the puny little cartridge is as important as the electronics or speakers. Moving coil designs have an advantage in this area, because they really are exceptionally expensive to make. Their prices are high even when discounted, and people assume they must be good because they are expensive. There was a time when moving coil designs enjoyed an advantage in having low-mass moving elements, but with modern materials, he feels this gap has been closed.

A recent ad for Sonus cartridges recommends the different stylus configurations of the premium cartridge for different arms. That piece got out without Mr. Pritchard seeing it. As soon as he saw it, he ordered it withdrawn. Any of the cartridges can be used in a high-quality arm.

There was a question about the GE cartridge. Pritchard had worked on that classic, and it came about as close as any design has to becoming a universal standard. What happened, and could it be duplicated? Yes, said Pritchard, the GE was a dream almost too good to be true. It was a sound, economical, reliable, rugged design optimized over a period of years. The highly competitive, cut-throat cartridge market hadn't yet developed, and GE was able to control its market through a system of franchised dealers. They had 75% of the cartridge market wrapped up in their corporate grasp, as only a giant corporation could. And they lost it all in six months, as only a corporate giant could. Up there in the clouds they got a little short-sighted. Stereo, they thought, was only a gimmick that would fade away. When it didn't, they did a patchwork job on the classic design, ruined it, and thereby hastened their decline. Such a utopia will never happen again, mused Pritchard. And yet, for all we know, they could sweep the technology out from under us, Tomorrow, we could be playing records with laser beams.

Get out the stardust and start sprinkling.

— Henry G. Belot

# A Subject Guide to The BAS Speaker

by John E. Gombos

This is a subject guide to The BAS Speaker from Volume 1, Number 1, through Volume 4, Number 5, using the system first described in my March 1976 article. Before I present the guide, I must list some limitations. These are due to the structure of the filing system.

1) Since this is a subject guide, in many cases article titles are not listed—only the subject. In addition, space restrictions caused me to abbreviate many titles. (These actions are not meant as criticism of the authors.)

2) The filing system does not include music reviews, so none are listed in this guide.

3) Filing is partly subjective, so others will disagree with some of my classifications. Also my determination of category is sometimes based on a quick skimming of an article. This may have caused a misunderstanding on my part leading to a misclassification.

## Special Instructions

1) Page numbers were assigned consecutively from the first page of each month's issue to the last page of the final publication of that issue.

2) In some cases, references are made to both the beginning and the middle of an article. This occurs when the article covers more than one subject.

3) The articles in each category are presented in subdivision order with the subdivision indicated on the left. I have used the following abbreviations to indicate subdivisions:

| | |
|---|---|
| AC — Accessories | MN — Maintenance |
| CM — Commercial | OP — Operation |
| CN — Construction | RP — Repair |
| DS — Design | SP — Specifications |
| IN — Installation | TS — Testing |

No abbreviation — General article

| Code | Subject | Date | Page |
|---|---|---|---|
| | **AMPLIFIERS** | | |
| CM | Dynaco Stereo 400 | Nov. 74 | 3 |
| | | May 75 | 11 |
| | | Dec. 75 | 4 |
| CM | Epicure Model 1 | Sept. 74 | 8 |
| CM | Marantz 500 | Nov. 74 | 3 |
| CM | Phase Linear 700 | Nov. 74 | 3 |
| | | Oct. 75 | 8 |
| CM | Amplifier Pricing: $/watt or $/dB | Dec. 75 | 27 |
| DS | Amplifier Protective Devices | Dec. 72 | 2 |
| DS | Slew Rate | Oct. 74 | 5 |
| DS | Myth: Output Transformers Degrade Hi-Fi | June 75 | 2 |
| OP | Altec on Biamplification | Feb. 76 | 8 |

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## MAGNETIC TAPE



## MICROPHONES



## MIXERS



## NOISE REDUCTION



## PREAMPLIFIERS





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## TONEARMS



## TUNERS



## TURNTABLES

## VIDEO RECORDING



## REVERBERATION



## PSYCHOACOUSTICS



## MUSIC



## MISCELLANEOUS





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# Some Notes on Tonearms: Effective Mass and Seesaw Frequency

Michael Riggs

## Effective Mass

Doubtless the term "effective mass" seems cryptic to many audiophiles, for though it's often invoked to explain one tonearm's superiority to another, those invoking it seldom stop to explain what it means. That's unfortunate. The concept is not abstruse; in fact, its manifestations are commonplace, though the name unadorned, in the contexts in which it's usually applied, can mislead.

An arm's effective mass is in part determined by the actual moving mass to which the stylus is attached, but the more important consideration is how that mass is distributed. As an illustration, let's imagine you're at a playground with a child. The child sits on one end of a seesaw. You stand behind him and lift or at the other end and push down. Now the child moves part way up the length of the plank toward the pivot, and you repeat the exercise. This time, however, the action requires much less effort. In fact, if the child sits halfway between the end and the seesaw pivot, the amount of force that must be applied to the end to move the seesaw through a given angle of rotation at a given angular acceleration will be only one quarter that necessary to move it through the same angle with the child sitting on the end. The effect in such a case is identical to that of replacing the child at the end with another of one-fourth his weight. The principle is that of the lever: by moving closer to the fulcrum, the child reduces his effective mass (or, perhaps more appropriately, his apparent mass).

We can summarize by saying that the effective mass of a rotational system is that mass which, if it were concentrated in a single point at a distance equal to the length of the moment arm (from stylus to pivot, in the case of tonearms) from the pivot, would require the same force for the same acceleration as is required by the extended mass of the actual system. This follows from the relation

$$F \text{ (force)} = m \text{ (mass)} \times a \text{ (acceleration)}.$$

Which tells us what? Mainly that the lower an arm's effective mass, the less work the stylus has to perform to push it around. This is a consequence of another well-known relation:

$$W \text{ (work)} = F \text{ (force)} \times x \text{ (distance)}.$$

Obviously, then, we want the arm to weigh very little, and we want as much of that weight as possible concentrated near the pivot. Another way of looking at this is to observe that we want to optimize the length and the moment of inertia of the arm. That's because $F = Ia/r^2$, where r is the distance from stylus to pivot and I is the moment of inertia. Since $F = ma$, $ma = Ia/r^2$; therefore, $m = I/r^2$. As we want a small value for m, the obvious solution would seem to be to make the arm very long. But that would tend to increase I by virtue of $I = mr^2$, which says that each particle in a system contributes to that system's moment of inertia in direct proportion to its mass and to the square of its distance from the pivot—a tough engineering problem, and the reason why moving the child up the seesaw is more beneficial than putting him on a diet.

The significance of effective mass is twofold. First, in an undamped arm it largely determines how close to the theoretically optimum tracking force—the force required for proper oper-

ation of a cartridge in a "perfect arm"—the nominal tracking force can be set. Nominal tracking force must always be somewhat higher than the optimum (which is a function of stylus tip mass) to ensure that while riding over warps the actual tracking force does not fall below the optimum, with mistracking and distortion resulting. All else held constant, the higher the arm's effective mass, the higher the nominal tracking force must be set and the greater the variance of the actual tracking force. This follows from the relation F = ma and the fact that no matter what arm is used, the acceleration it experiences traversing a particular warp is the same. All else remaining equal, the higher the effective mass, the higher the wear factor.

The other important characteristic of effective mass is that it and the dynamic (loaded) compliance of the cartridge determine the low-frequency arm/cartridge resonance point. For a given cartridge, the lower the arm's effective mass, the higher the resonant frequency, as determined by the formula

$$f = 1/2\pi\sqrt{MC},$$

where f is the frequency, M is the effective mass of the arm/cartridge system, and C is the dynamic compliance of the cartridge.

Effective mass is not so important a variable in damped arms as it is in undamped arms. Pivot damping of itself reduces tracking force variations and improves warp tracking. It also reduces the amplitude of the low-frequency resonant peak, thereby making the placement of the peak less critical. But this is not to say that arm mass is something we no longer need worry about. An arm/cartridge system with a 5- or 6-Hz resonance, no matter how well damped, will still pass to the preamp unattenuated a lot of infrasonic garbage, because the response rolloff begins at too low a frequency. A properly damped arm with a higher resonant frequency, say 15 Hz, will filter out most of the noise below that frequency.

Seesaw Frequency

Recently, a new tonearm specification sprang full grown from the head of Transcriptors' David Gammon. He contends that seesaw frequency is an important determinant of how well an arm tracks warps. What he is apparently referring to is the natural vertical oscillation frequency of a tonearm in vertical equilibrium. That's the frequency at which a balanced arm (unobstructed, i.e., not supported by a rest or by a stylus on a disc) will oscillate if tapped lightly on the headshell. The arm is, under such conditions, a pendulum, and, as with any pendulum, its natural frequency of oscillation depends only upon its length and upon the restoring force applied to it—in this case, gravity. Transcriptors claim a 3-Hz seesaw frequency for their Vestigal arm and a 1/2-Hz seesaw frequency for conventional arms. I've not been able to do experiments, but my calculations (which may not be correct) do seem to uphold their claims, except that I get about 1 Hz for conventional arms.

For the sake of argument, let us accept their figures and go on to consider their significance. My first thought was that seesaw frequency might indeed be important in that a faster oscillation might allow an arm to follow better the downsides of warps. Warps, after all, generally occur in the 5-Hz region. If an arm is in perfect balance with the stylus just touching the surface of a record, it will be accelerated upward by warps as they come around on the disc. After the peak of a warp has passed, the arm will move freely, oscillating at its natural frequency. If that frequency is as high or higher than the warp frequency, the arm will follow the warp perfectly. If it is lower, as it seems to be for all known arms, the arm will not descend as rapidly as the downside of the warp, and the stylus will tend to lose contact with the record.

This analysis would lead one to the conclusion that a tonearm's seesaw frequency should be as high as possible, up to about 10 Hz, above which no benefits accrue. That's all very interesting, if it has anything to do with the real world. I think that it doesn't. Tonearms are never in equilibrium while in use and therefore never oscillate in the described manner. It seems unlikely that designing for high seesaw frequency is useful or beneficial in any way.



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B.A.S. Users' Reports

## Transcriptors Turntable with Vestigal and SME Arms

Mark Dimirsky

Audiophiles tend to look at new products with the hope of reaching that elusive quality we call realism in sound reproduction. Products that claim to represent a major advance in technology raise the hopes of audiophiles, and when that product "looks" as though it is well made and designed, then the pressures on the audiophile are great indeed.

I succumbed to these pressures and bought a Transcriptors turntable and Vestigal arm. This letter is about that unhappy marriage and some of my attempts to save the relationship. In a sense then this is a survival guide for those who wish to purchase that sleek-looking turntable and arm.

I took possession of my unit and carefully unpacked it from its surrounding styrofoam. It was undamaged and complete, which I took as a positive omen. The quality of the platter was impressive and the gold plating was beautiful. The security I felt from this great beginning was to be temporary.

One should expect difficulties in setting up a tonearm, but on the way to that problem, I was instructed to install the platter and drive belt. This should occur with consumate ease; it did not. The motor pulley is mounted on adjustable springs and my unit was improperly adjusted such that: (a) the magnet used to start the motor did not cause proper closure of the switch, and (b) the belt was not making proper contact between the pulley and the platter because of a difference in "pitch" between the two. These difficulties can be overcome if one has: a small level, a set of small Allen wrenches, and slot screwdrivers of various sizes. It should be some small consolation to know that this type of adjustment is required only every six to nine months.

All of the above is precursory to Mr. Gammon's crowning glory—the Vestigal arm. With each arm the purchaser should be given three passes to a chiropractor and a rest home. The installation instructions are inadequate, and the arm is finicky regarding adjustment. The patience of an Irish saint is needed in order to deal successfully with the Vestigal arm, and Dimirsky is not an Irish name.

The reader should be able to sense by now some dissatisfaction on my part with the Vestigal arm. While it is terribly problematic, I do believe I have found a way to deal with the device: I took it off and put it in the basement.

[Fellow BAS member] Les Leventhal and I spent at least 15 hours planning for the modification of the Transcriptors so as to accommodate the more civilized SME 3009/2 arm. The following was involved:

a. Replacing two of the glass panels (arm side and back) with glass that is about 1½ inches shorter in height than the original glass.

b. Obtaining 1/2-inch clear plexiglass shaped pentagonally.

c. Preparing the plexiglass for the actual mounting of the SME.

d. Mounting the plexiglass on the turntable's spider.

e. Mounting the arm on the plexiglass.

There were no problems for several months, and several friends were actually panting a bit over the unit. Adversity once more reared its ugly head: the belt broke. Non-catastrophic as that may sound, it became my preoccupation for almost five days. I obtained, from my local dealer, two new belts ("just in case") and found that neither of them fit properly. I won't bore you with the details of contemplating washing, ironing, drying, burning them down to proper size. Here is what to do; cut about 1½ inches from one end of the belt and glue it back together using the quick-setting stuff that will really do a job on your skin if you aren't careful with it.

The turntable now performs to Mr. Gammon's high standards. I feed it regularly and plan to cook it for Thanksgiving.

Incidentally, if anyone out there is interested in a beautiful glass and gold Transcriptors turntable that has been .. .

## The Formula 4 PLS4/D Tonearm — I

Jeffrey S. Nelson

For over a year I have owned a Transcriptors Saturn turntable with Vestigal arm and Stanton 681EEE cartridge. The Vestigal arm has been a difficult piece of equipment to live with, as I am very sensitive to wow. Gordon Holt of The Stereophile has pointed this out as a potential problem with this arm. Piano music, especially, and warps do not get along well with the Vestigal arm, and flat discs today aren't always that easy to find.

The Formula 4 saved me musically and financially. The Formula 4 is a silicone-damped unipivot design with viscous damped cueing. It took 13 days from the time I mailed a certified check (to Mayware Ltd., 15 Heather Walk, Edgware, Middlesex HA8 9TS, England) to the day it arrived. The cost was $89.00, air mail postage included, plus $5.07 for duty on arrival. (An informative brochure is available for $1.00, which is deductible from the purchase price.) The box is marked, "Made in Japan," which, if true, really makes one wonder what it costs to produce this arm, considering its travel history and intermediate handlers.

The arm comes with a small cleaning brush, tweezers, screwdriver, adjustable arm rest, silicone of specified viscosity, audio leads 137 cm long with a specified capacitance of 112 pF, a pair of mounting screws and nuts for the cartridge, weights for bias compensation, and three small alien wrenches of different sizes for arm and base adjustment. The instruction manual is quite clear, but an exploded view of the arm with more detailed photographs, rather than a single completed view of the arm, would certainly have been helpful.

For the average turntable, installation should be relatively uncomplicated. This requires a 1-inch hole, and a template is provided that easily locates the site on the mounting board. This was a 3-hour job on the Transcriptors Saturn, however, because the hole had to be drilled through acrylic. The unipivot is set up after the cartridge is mounted (the leads are correctly color coded) and the eccentric counterweight is put on. The critical point is the careful adjustment of the unipivot, which consists of a clear plastic dome with an adjustable hardened steel needle that protrudes from the top into the center of the dome. Once the center pillar on the arm base, which is a hollow tube with a sapphire concavity at its base, is filled to the appropriate level with silicone, the plastic dome is screwed into the alloy hub of the arm that rests around the central

pillar. Care must be taken not to turn this too tight, stripping the plastic threads, and at the same time to move the fixed insert for the bias thread at the edge of the dome toward the rear and laterally. That way the thread will engage the groove in the dome that is in the same horizontal plane as the tip of the steel pivot needle. When that is done, the arm is lowered into place, with the steel needle resting in the sapphire concavity, surrounded by silicone. The thread is placed over a miniature bias bearing and adjusted so that the thread is horizontal.

Vertical balance is simply a matter of moving the counterweight backward or forward. Lateral balance, which may require three hands, is accomplished by rotating the eccentric counterweight until the alloy hub of the arm is parallel with the arm base. Bias is adjusted by adding calibrated metal discs to the bias weight holder, but fine adjustment, they say, may require the use of a test record. The best I could do was adjust for no lateral drift on a blank portion of the record. The hydraulic lift on the base is adjustable laterally and vertically and is very smooth in operation.

An alignment protractor for tracking error is supplied, and adjustment for this is made by moving the cartridge backward or forward in the nondetachable skeletal head shell, which also rotates on axis for vertical stylus alignment. Tracking force is set by means of a sliding cursor on the arm, calibrated in 0.1-gram intervals up to 3 grams. They claim a nominal effective mass of 4.5 grams. (Can anyone verify this?)

After all this, how have things changed? Quite unlike the Stanton previously, the sound is very smooth and extended at the top. Sibilants are much softer and more natural, and the bass, especially the low bass, is very solid and clean. Sound imaging is dramatically precise, and warp wow is virtually absent, except on severely warped records with, interestingly enough, less stylus motion than with the Vestigal.

I have several minor quibbles. 1) The arm drifts outward about 2 mm when placed on the raised cueing device prior to lowering the arm because of delayed vertical equilibration around the pivot from viscous damping. So one either waits till it stops in 2 to 3 seconds, overcompensates, or moves the arm much more slowly. 2) The eccentric counterweight, with its offcenter hole is not easy to adjust for vertical equilibrium. A tight screw totally immobilizes the rotation of the counterweight, but a slightly loose screw results in the heaviest side of the weight in the dependent position quite rapidly. Fine intermediate adjustments can be difficult, so an extra pair of hands is helpful. A two-part counterweight, with a center that could be tightened after the vertical balance was complete and a concentric outer portion on a fine ratchet to make the lateral adjustment, is a thought. 3) The Transcriptors dust cover no longer fits, because of the rear overhang of the arm. This, however, would probably not be a problem with most turntables.

Perhaps the sound is different in part because of a lead capacitance change, perhaps because of arm-cartridge resonance differences, or maybe as a result of damping of spurious oscillations. Most likely it is a combination of the three and possibly other unknown variables. In any case, if warp wow gets to you as it has gotten to me, and your local record outlets do not have a separate bin for flat records, this arm may be the most economical way to salvage your sanity. My Vestigal awaits a renaissance in flatness. The Formula 4 is a very nicely finished product, but only time and usage will determine its durability. Has anyone tried these viscous damped arms with silicone of different viscosity? Has anyone used one of the Formula 4 cartridges?

## The Formula 4 PLS 4/D Tonearm -- II

Dow O. Williams

The instruction manual for the Formula 4 is clear and unambiguous but barely adequate for a first-time tonearm installer. It is far easier to install and to adjust than the Decca International, which it has replaced. Mounting a cartridge in the nondetachable headshell is, however, a test of patience and dexterity. No matter what the instructions say, affix cartridge to headshell first, then slide on the connections.

Rotation of the head shell for vertical stylus alignment is accomplished by loosening a small screw in the head shell collar. The screw is underneath, for cosmetic reasons, I'm sure. It would be far more convenient on top. However, once the arm itself is leveled and the headshell rotated for vertical stylus alignment, there shouldn't be any further need for headshell alignment.

When set up in static balance, my sample has a very slight lead drag pulling the arm back toward the arm rest. This is a smooth, gentle pull with no consequence, except maybe to reduce the amount of bias compensation needed for perfect stylus/wall contact. This bias correction is of the thread-and-weight kind, but unique in that it applies torque in the exact plane of the unipivot and is exactly the same from beginning to end of arm swing. A number of small weights are supplied so that proper bias can be achieved with any tracking force up to 3.5 grams.

The cueing lever feels a bit rough and stiff but would probably smooth out in use. I simply removed the mechanism and used a Decca Lift instead. (This device is worth its weight in gold. See review by Holt in The Stereophile, No. 2, 1968.)

Phono cables connect to the arm base with a special plug molded onto the cables, making it impossible to use one's own low-capacitance cables, as I had hoped to do. I did reduce the length by 18 inches and replace the RCA plugs. The original length is 4.5 feet, with a total capacitance of 112 pF.

I accidentally set the stylus force at 1/2 gram instead of 1 gram and noticed the error only upon rechecking. This suggests that the tracking force of some pickups might be reduced without sonic deterioration.

Viscous damping is ingeniously applied and probably can be adjusted to optimum by adding more or less silicone fluid to the cup (see BAS Speaker, Oct. 1975). There is enough fluid included to permit experimentation.

Warps and ripples cause little stylus bar flexing or headshell bounce—the entire arm rides the undulations easily. Warp wow is no more noticeable than with the Decca, although the unipivot is in a plane well above the record surface (about 3/4 inch).

Sonic improvements are subtle but definite: The "aether" is cleared up, reducing listening fatigue; image stability is improved; lows go lower and cleaner; stereo spread seems more consistent. There is more to this arm than immediate sonic improvement—it is a pleasure to use, and the simple but elegant design and sturdy construction evoke confidence.



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B.A.S. Users' Reports

# The Phase Linear 1000

Steven L. Seto

It's difficult to put a label on the Phase Linear 1000; it's a changeable beast. To its credit, it is a remarkable piece of equipment, but like any device that is designed to deliberately alter an audio signal, it's not difficult to abuse its power.

First the good news. The Phase Linear 1000 has the potential to work very well. At its best, the autocorrelator seems to be about as effective as a good Dolby B circuit. The peak unlimiter/downward expander is less successful than the autocorrelator, but it is effective on very compressed material and can definitely give some records (e.g., DGG 2530 416, Symphonies 4 and 5 by Mendelssohn) a little added punch. Compared to the dbx 119, the 1000 is generally more satisfying in its action. Together, the two circuits (autocorrelator and peak unlimiter/downward expander) are somewhat synergistic, the whole being more impressive than the sum of the two parts. However, as a stand-alone circuit, the autocorrelator seems more effective, and more valuable, than the peak unlimiter/downward expander.

Now for the bad news. The circuits are not foolproof, and at their worst they can make your system sound sick. In addition, both circuits seem to be as sensitive to the type of music being played as they are to the control settings used while playing it. Thus the 1000 is not easy to use well immediately; it requires experience. Only experience will teach you how to set the controls as source program material changes, and only experience will teach you what types of program material render the 1000 ineffective—or worse.

The autocorrelator is nearly foolproof, and when it gets into trouble it seems to be more a function of the type of music played rather than control setting. Some types of music seem to be able to fool it completely, so that you get very little hiss reduction, or you get a burst of hiss accompanying level changes of some instruments. Unfortunately, the operating principles of autocorrelator circuits predict that this sort of behavior may occur; it's something that you've got to learn to live with. Fortunately the autocorrelator works well most of the time, so that tolerating its shortcomings is pretty easy.

But the peak unlimiter/downward expander—that's another matter entirely. If your system is good at stereo imaging, and if you have a critical ear, then you may find the operation of this circuit to be somewhat dismaying. The problem is that good stereo imaging seems to depend upon the fact that each instrument (or voice) in an ensemble has a level and dynamic range relative to the combined level and dynamic range of all of the other instruments. These levels and ranges must be reproduced accurately for good imaging. If you change the dynamic range of one of the instruments, then you also change the stereo image or perspective. And this is just what happens; as the peak unlimiter boosts one component of an ensemble you can hear the stereo image bend ! Whereas at one point the image is nicely balanced and uniform, suddenly a peak will cause an instrument or section to suddenly leap out at you, only to recede back into the ensemble in the next instant.

This brings up another characteristic, namely the problem of decay time. The 1000 appears to use virtually instantaneous decay of the peak-boosting action; as soon as the signal level of the source declines, the peak unlimiter immediately reduces the gain. It's easy to see why this approach was taken; this way only the signal peak that caused peak unlimiting is affected, and adjacent lower signal peaks are not disturbed. Of course, that's also the problem.

Every instrument has a characteristic decay which our ears learn to associate with that instrument. Thus, when a loud note is produced, there is always a certain way in which the note must decay away in amplitude—but the peak unlimiter manipulates amplitude (gain) in a nearly instantaneous fashion; thus the effect is rather unnatural. Fortunately, the ear, as well as being critical, can also be somewhat forgiving, so that the audible effect is not always as bad as I've made it appear. As with the autocorrelator, it depends on exactly what sort of music you're playing.

One other problem with the 1000 seems to be reliability. Although parts and construction quality of the 1000 are above average, my unit has had and continues to have problems. Two visits to Phase Linear service have not completely corrected the situation, and although I have no doubt that the unit is working correctly electronically, it still has some mechanical problems, namely an intermittent left channel caused by a faulty tape monitor switch. This despite replacement of the switch by the local service station and another inspection at the factory service center in Washington. I have the impression from talking with the servicemen that the switch strip has been giving them some problems.

So what conclusion can be drawn from all of this? It seems that overall, the Phase Linear 1000 can be a useful addition to most systems if you understand, and can live with, its idiosyncrasies. It is my opinion that the peak unlimiter works better than the dbx 119, and the autocorrelator works well regardless. After that it's up to you.

[Ed. Note: Robert Carver of Phase Linear, in a recent appearance on WBUR's "Shop Talk" program, stated that recent versions of the 1000 are significantly improved over the earlier versions.]

## The Quad 405 Current Dumping Amplifier

Nate Garfinkle

The Quad 405 is a 100-watt/channel (into 8 ohms) power amplifier that uses a current dumping output circuit, a Quad invention claimed by the manufacturer to eliminate many of the problems associated with transistor amplifiers.

In a current dumping amplifier, there is, in effect, both a low-power, very high-quality amplifier and a high-power, heavy-duty amplifier. The low-power amp controls the signal at all times, calling upon the high-power section to provide most of the current. The small amplifier is so arranged (it carries an error signal) that provided the larger power transistors get within the target area of the required output current, it will fill in the remainder accurately. Reproduction quality is thus solely dependent upon the small amplifier, which, because of its low power, can be very good. The results are that problems of crossover distortion, quiescent current adjustment, thermal tracking, and transistor matching all disappear.

I received two 405's in late January, to replace my Quad 303 amplifiers, which had been in service since 1968. I installed the power limiter in one, so it could be used to drive my Quad ESL's. The other is used full power to drive a pair of transmission line infrawoofers below 65 Hz. (This system is described in Hi-Fi News, July 1969 and Jan. 1972, and in Audio, March 1970.)

After installing the new amps, we became aware of a different kind of bass from what we had been hearing. It was much deeper and better defined. I could feel the low bass from organ recordings containing really deep bass, such as the Fulton "Organ Music from Westminster" (Ark 10251-S). The pedal tones of the pipe organ were very well defined and extremely clear. The sound just passes in soft waves. The mid and upper ranges are sweet and musical in a way not previously heard from my speakers. The reed tones are separated from the other tones, and each note is detailed and unaffected by others. It is a new experience in my listening room.

I next put on an EMI disc, "Anthems from Kings" (Q4 CSD 3752). This is one of the finest choral with organ accompaniment discs I have ever heard. With the 405, the sound seems to open up in gorgeous detail. The voices are so clear and so positively placed, it's like being there. A slight "edge," heard before, is absent. The dynamics of the voices are very strong. The whole is most pleasurable and realistic.

Next, for something more dynamic, I put on the Sheffield Vol. II. The "Limehouse Blues" cut is one of my favorite test pieces. The bass from the drums hits like a sledgehammer, and the horns and piano are much stronger now, with greater depth. Each instrument can be heard without intermodulation from the others. In another room, I noticed that the sound seemed to float through the hall and into the room much more smoothly and clearly than before.

I cannot explain these things. All I can do is guess that with the elimination of various distortions, I can now hear the instruments and voices without their being changed in some manner. It is more like being at a live performance.

This improvement in the sound takes me back many years to the time when I first heard my old Williamson amplifier. I changed from what I thought at the time was a very good pentode amplifier: my exposure to triodes then made me a convert. I don't think I have ever been as satisfied since changing to higher powered tube amps and to transistor amplifiers by Dyna, Marantz, Sony, etc. For the first time in many years, I feel as though I'm hearing the music as I did in those days, only now it's better. This new amplifier sounds very much better than others. There is no gray area; it's definite. Maybe Peter Walker wasn't satisfied and kept at it till he could use the technology now available to come up with a design that finally matches the triode amplifier sound. Time will tell. Anyway, we now have an amplifier with practically zero distortion and complete control over the speakers. It can be heard.

A friend and fellow BAS member in Illinois, Tom Shedd, corroborates my findings. He writes: "Just a short note to give you my reaction to the Quad 405, which I received and tried out over the weekend. In a word, it's terrific ! It simply wiped out my MC-30's. It's one of those components that, the first time you turn it on, you know is `right'."

The Quad 405 is a sensational amplifier. At $410, it's unbeatable. Praise is due Mr. Walker and associates for persevering and developing this superior product. Another veil has been lifted.

[Ed. Note: An article on the Quad 405 appears in the December 1975 Wireless World.]