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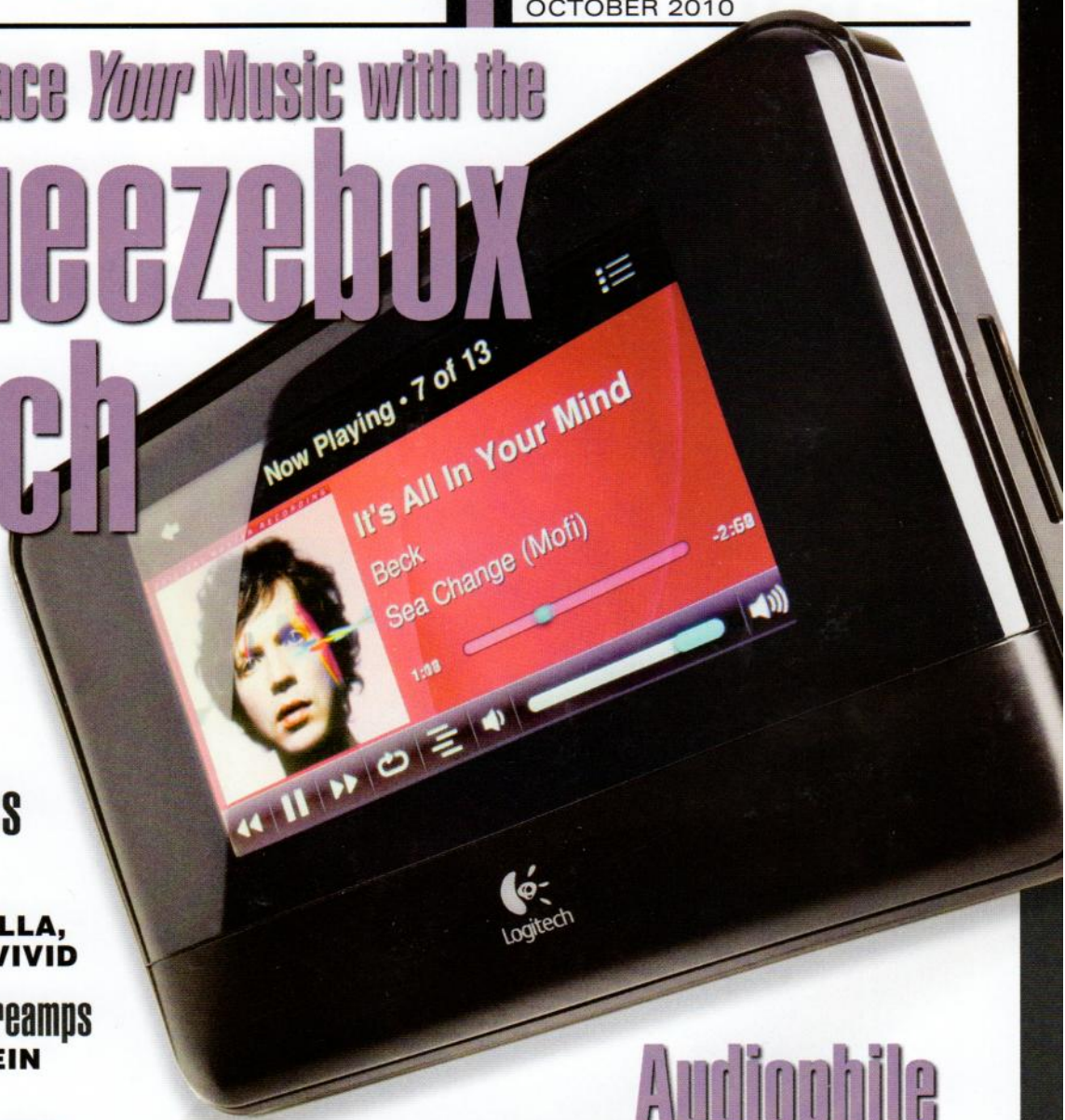

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Michael Fremer

The HiFiction Thales AV tangential-tracking pivoted tonearm

Ideally, LPs should be played with the pickup stylus remaining tangential (*ie*, at a 90° angle) to the groove—just as the lacquer from which the LP was ultimately stamped was cut in the first place. Over the years, many attempts have been made to accomplish this. Back in 1877, Thomas A. Edison's original machines tangentially tracked his cylinders, but Emil Berliner's invention of the flat disc put an end to cylinders altogether. In the 1950s, a number of companies marketed so-called "tangential" trackers that used dual arms, based on conventional pivoting arrangements, to change the angle at which the headshell was mounted as it moved across the LP side. In 1963, Marantz introduced the SLT-12, which used a plastic pantograph to move the stylus across the record surface. Garrard's Zero 100 pivoting arm controlled its independently pivoting headshell with a bar that extended from the main bearing of the tonearm.

There were also tonearms that were moved in their entirety tangentially across the record surface. One used a multiple-ball bearing trolley reminiscent of what Clearaudio uses today. Some, like those made by Rabco in the 1960s, had bead chains and, later, rubber belts that moved the tonearm assembly via motors activated by microswitches. Goldmund, B&O, and many Japanese companies used tiny, servo-controlled motors to nudge the tonearm along a rail, the motors activated by any loss of the stylus's tangency to the groove, as measured by a photoelectric cell or other light-sensing device.

At the dawn of the CD age, Mitsubishi, Technics, and other Japanese manufacturers, as well as ReVox, also produced so-called "parallel" or "linear" trackers. In 1982, Lou Souther patented a purely mechanical linear tracker in which the cartridge was held by an ultra-low-mass tonearm attached to a low-friction bearing trolley riding on glass rods. Clearaudio bought Souther's patent and further developed the technology in a number of models, including the top-of-the-line Master Reference turntable.

All of these devices were fussy to set up and maintain, and few actually maintained tangency to the groove. Most crabbed their way across the record surface, either because of how the motors were actuated (loss of tangency) or because of "yaw" play inherent in the design.

In addition, there is the issue of the large discrepancy between the tonearm's effective mass in the vertical plane, which is small, and in the horizontal plane mass, which is large, due to the fact that the entire arm assemble is being moved. The resonant frequencies of the arm mass/cartridge suspension compliance in the horizontal and vertical planes are thus very different. Other problems are how to dress the tonearm wires, and how to avoid the friction they cause as the arm travels across the record surface.

ALL OF THESE **TONEARMS SURE *LOOK* COOL**, AND SOME OF THEM SOUND VERY GOOD, EVEN IF THEY DON'T ACTUALLY MAINTAIN THE STYLUS'S TANGENCY TO THE GROOVE.

But all of these tonearms sure *look* cool, and some of them sound very good, even if they don't actually maintain the stylus's tangency to the groove. Neither do pivoted arms, of course, yet some of those, too, sound very good.

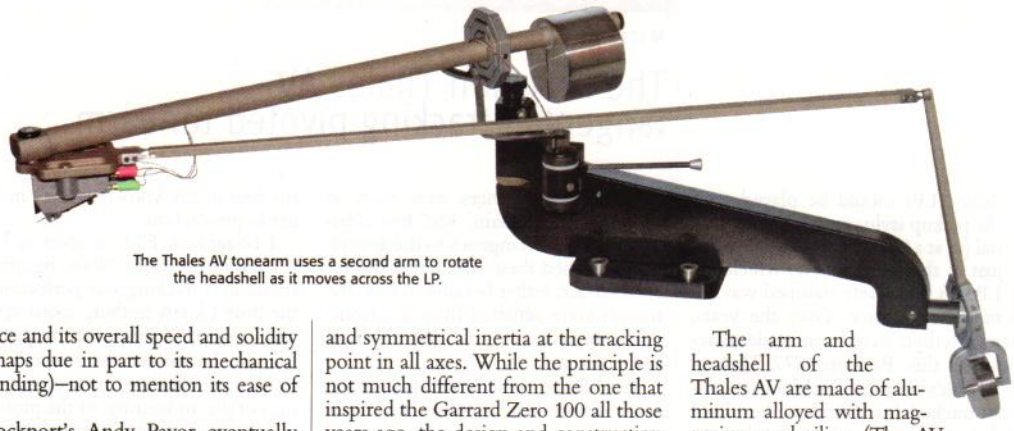
Air Bearings

In the late 1970s and early '80s, Maplenoll introduced an air-bearing–based arm designed by Bruce Thigpen. In this design, a long rail with an arm-tube attached to one end slid, virtually without friction, along a cylindrical bearing of pressurized air. (Because the air bearing is housed between two concentric cylinders, it is referred to as a "captured" bearing.) Thigpen marketed an improved version of this design as the Eminent Technology 1 (ET1), and later, with the help of his friend Edison Price, as the much-improved, ergonomically friendlier ET2, which remains popular today (although, to the best of my knowledge, it's no longer in production).

I bought an ET1 as soon as I saw it back in the early 1980s, figuring its frictionless tracking was perfection. At the time I knew nothing about vertical and horizontal resonant frequencies, nor did I consider the system's large horizontal effective mass or the stiffness of the air bearing, or the problems of resonance and turbulence created at the annular gap at either ends of the cylindrical bearing as the highly pressurized air quickly returns to ambient air pressure.

An assortment of other air-bearing tonearms also appeared in the early 1980s from companies such as Airtangent, Forsell, and others. Some were not high-pressure, captured air bearings but low-pressure "hovercrafts" that floated on a cushion of air blown through holes in the top half of the rail. These arms had a great deal of play fore and aft, as well as yaw (*ie*, these arms pivoted left and right around the bearing's vertical axis). Despite these problems, some of these arms sounded very good. Did they track with true tangentiality? Probably not.

Eventually, I bought a Rockport Technologies 6000 tangential-tracking arm. This featured a sophisticated, low-tolerance, "groove-compensated" air bearing that dealt with the problems of annular gap and bearing slop (see the May 1996 issue, Vol.19 No.5). But I was never happy with the 6000's bass response, and when I reviewed Allen Perkins' original Immedia RPM2 a year later, which was a conventional pivoted arm (see www.stereophile.com/tonearms/597immedia), I sold the Rockport and bought the Immedia. Whatever tracking error the pivoted RPM2 added was more than made up for by its superior bass perfor-



The Thales AV tonearm uses a second arm to rotate the headshell as it moves across the LP.

mance and its overall speed and solidity (perhaps due in part to its mechanical grounding)—not to mention its ease of use.

Rockport's Andy Payor eventually redesigned the 6000, changing its effective vertical mass to get the arm's resonant frequency within the optimal range. But by then I couldn't justify to myself the hassles and tradeoffs inherent in any so-called tangential-tracking arm. I think the amount of distortion added by a *properly set up* and well-designed pivoted arm is lower than what's added by the rest of a typical audio system.

The HiFiction Thales AV

Designed and manufactured by Micha Huber, a fastidious young Swiss mechanical engineer, musician, and watchmaker, the HiFiction Thales AV tonearm ($12,360) offers the promise of a tonearm boasting the advantages of both pivoted and linear tangential-tracking arms, and the disadvantages of neither. He was granted a Swiss patent for the design in 2004.

The arm's geometrical basis is the Thales Circle.[1] As Huber describes it, the design "reduces the perfectly tangential tracking to pivot points, while the pick-up cartridge is taken and aligned on the Thales Circle." You can examine the geometry at www.tonarm.ch/index.php?page=thales, via Huber's explanation and an interactive animation.

Basing a tonearm on the Thales Circle is said by Huber to produce four things: zero tracking error (which is difficult to prove in any way other than the mathematical); minimal friction using traditional pivoted bearings; a short tonearm with little resonance; and symmetrical inertia at the tracking point in all axes. While the principle is not much different from the one that inspired the Garrard Zero 100 all those years ago, the design and construction of the Thales AV is in another league altogether, as you can see in the photo.

The arm itself is relatively short, with a conventional counterweight. At one end, the headshell pivots around a very low-friction, backlash-free bearing weighing a mere 1.62gm. This bearing may look like a simple point of rotation, but it contains 25 individual parts including two ball bearings, each comprising seven tiny balls and a precision adjustment mechanism.

The counterweight end of the arm holds one of the system's two cardanic (gyroscopic) bearings, which use four Vee Jewel bearings, each consisting of a steel shaft with a spherical end held in a conically indented sapphire. When these bearings are properly adjusted, Huber claims that there is no chatter, very low friction, and full control of energy flow. Indeed, the first time I met Huber, in Munich a few years ago, he showed me his bearing and gave it a spin. I don't recall it stopping on its own during the entire time we spoke.

Looking at the picture, you see a thin, two-piece mechanism comprising a long horizontal arm and a shorter vertical arm, attached to the back of the headshell (and the tonearm proper) by a pair of precision sapphire bearings. The horizontal and vertical arms are what maintain the tangency of the stylus to the groove. As the tonearm itself moves across the record, the vertical arm, attached to the horizontal arm with a set of sapphire bearings, acts to compensate for the change in length of the mechanism. It, too, is attached to the main base with a cardanic bearing. Thus, as the complete arm moves in an arc across the record, the headshell, guided by the secondary arm, pivots precisely to maintain groove tangency.

The arm and headshell of the Thales AV are made of aluminum alloyed with magnesium and silica. (The AV stands for "Aluminum Version.") The Thales Original arm ($13,360) is made of pure magnesium while the bearing-parts are plated with gold. The parts are not "cold-formed" but cut from large cast blocks that, because the material is not mechanically stressed, is said to produce a more uniform pathway for the dissipation of vibrational energy.

Setup and Adjustments

While the Thales AV's baseplate is fairly standard, the downward travel of the vertical arm means that only turntables with sufficient rear/side clearance can be used.[2] Large-plinthed 'tables will require a clearance hole to be cut in the plinth to accommodate the low-hanging rear cardanic bearing and the antiskating adjustment knob.

The Thales AV provides every adjustment function found on a conventional tonearm, including vertical tracking angle (VTA) and azimuth. The counterweight can be rotated—not to adjust azimuth, as on some unipivots, but to adjust for differences in vertical tracking force (VTF) that can occur with this design as the tonearm travels from the outer to the inner groove areas. You can adjust it for uniform VTF across the entire LP side, or have it automatically slightly increase the tracking force for the more-difficult-to-track inner grooves.

Setting up and using the Thales AV requires some new skills; while learning them, it's best to proceed with caution. HiFiction provides an overhang template similar to those used with conventional pivoted arms. The sliding

1 Thales of Miletus, 625–547 B.C., was a Greek philosopher. The semicircle over the hypothenuse of a right triangle is sometimes called "Thales circle." See also www.walter-fendt.de/m14e/thalescircle.html. —Ed.

2 Mounting profiles are available for turntables from Audiostone Pythagoras, Brinkmann, Platine-Verdier, Thorens TD 124, Montegiro Lusso, Oracle (custom mounts available).