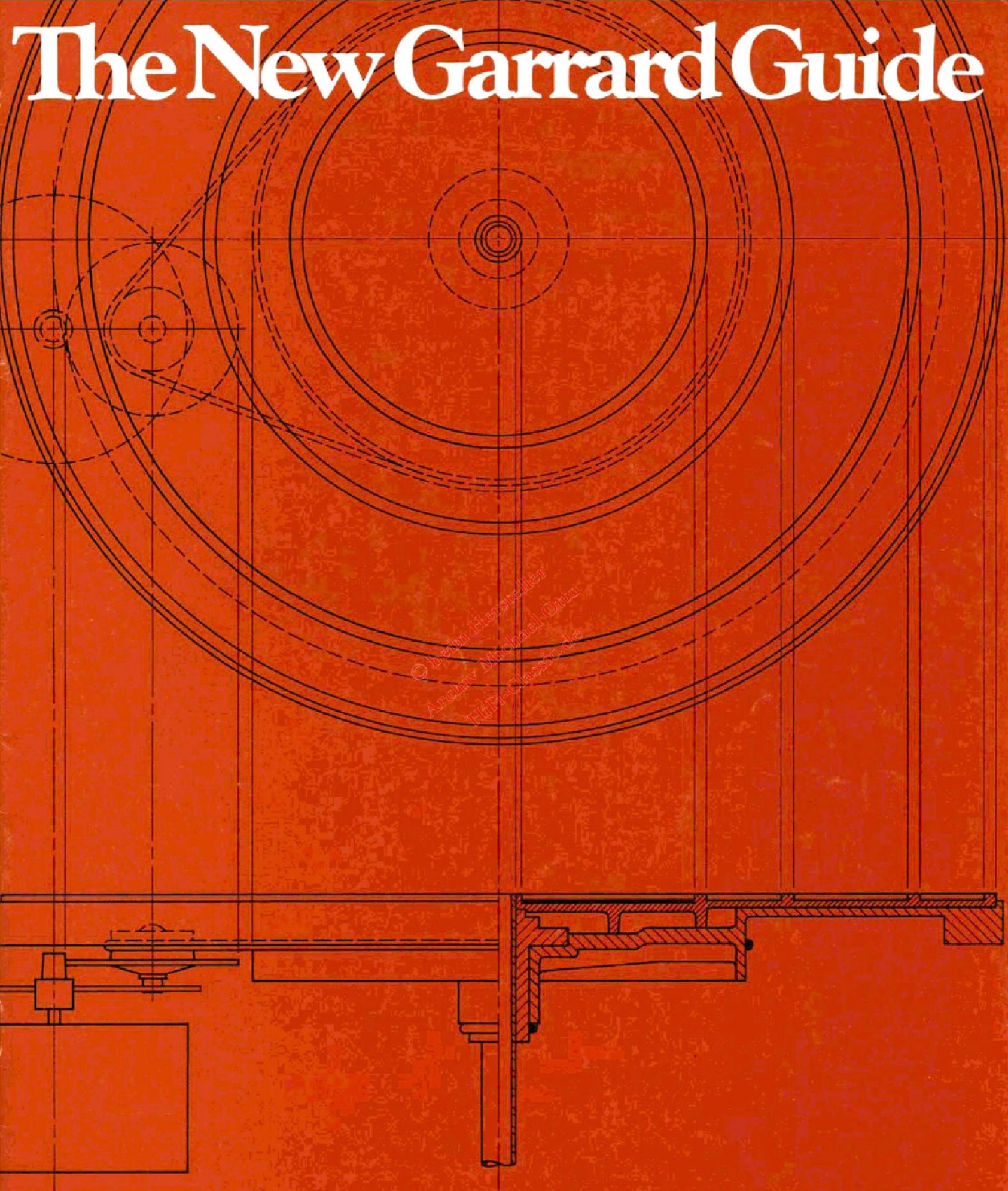
The New Garrard Guide



What you should know about automatic turntables in general and the new Garrards in particular.

The Garrard Tradition

Along with a few other names like Rolls Royce, Burberry and Wedgwood, Garrard is one of the classic British trademarks of our time.

There is no other brand in the world that professionals and laymen alike instantly associate with turntables.

Garrard has made just about every kind of turntable since 1919, except two:

The flimsy kind whose sole appeal is low price. And the overpriced kind that isn't justified by the performance it offers.

At Garrard, simple precision and mechanical integrity have always held a high priority over glamour features and hi-fi pizzazz.

Like a chemist's analytical balance or a gyroscope, a high-fidelity turntable has certain basic mechanical functions that require the utmost precision. The correct rotation of the record, without spurious motions, is one of these. The correct seating of the stylus in the record groove is another. Only then come all the frills, goodies and what-else-is-new.

These priorities have shaped all progress in Garrard engineering over the years. A major model change in the Garrard line means an indisputable improvement in performance or durability, not just a new sales promotion.

It is also because of this emphasis on fundamentals that Garrard turntables range from very reasonably priced but not dirt cheap to fairly expensive but not outrageous.

When you know as much about turntables and sell as many as Garrard does, nothing else really makes sense.

Turntable Fundamentals

What Every Hi-Fi Shopper Should Know

The First Thing to Remember

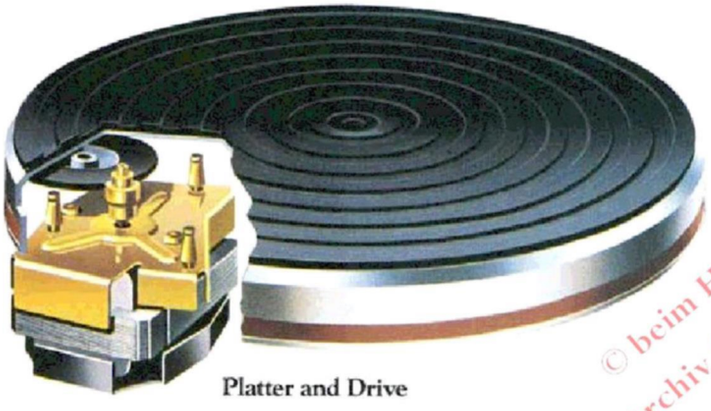
An automatic turntable is three machines, not one. That goes for single-play as well as changer models.

First, there's the platter with its drive system.

Then there's the tonearm. A totally separate engineering problem.

Finally, there's the automatic mechanism. Again, a whole new ball game.

Good design in any one of the three is no guarantee of good design in the other two.

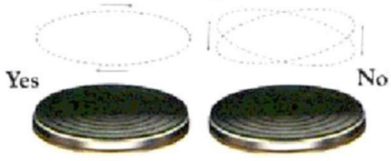


Platter and Drive

The Platter and Drive

This has one function and one function only: to spin the record in the horizontal plane, around its own axis, at the proper speed.

More easily said than done. The point is that the record mustn't be allowed any *other* movements or vibrations whatsoever. Neither up-and-down, nor sideways, nor teeter-totter. Just a dead-smooth, one-dimensional motion.



Any departure from this ideal will be interpreted by the stylus in the record groove as part of the recording and will be reproduced through the loudspeaker. The resulting low-pitched chaos is called *rumble*. (It sounds like a subway train and it mixes very poorly with music.)

If the speed is incorrect–say, 34 instead of 33⅓ revolutions per minute–the music will be reproduced at the wrong pitch. That may be disturbing only to those who can hear the difference between C minor and C sharp minor.

But if the speed is unsteady–for example, varying between 33⅓ and 34 RPM–everybody will hear it immediately and cringe. The wavering, dithery sound produced by this kind of unsteadiness is known as *wow*. (It's especially painful on piano music.)

If the speed varies at a rapid rate, it adds a twittering, chirpy unpleasantness to the sound. This kind of unsteadiness is called *flutter*.

The quality of the platter and drive is inversely proportional to the measurable rumble, wow and flutter content. Totally inaudible amounts even under worst-case circumstances are the design engineer's aim.

To achieve this, particular attention must be paid to the motor and to the type of drive used.

The Motor

The motor of a turntable must not only maintain accurate and unvarying speed but also provide virtually instantaneous starts at full speed. (Otherwise the first few bars of the music will sag.) These two design requirements are, to a certain degree, in conflict.

To start a heavy platter at full speed and to maintain that speed with a load of records takes considerable torque.

Induction motors are capable of such torque but can maintain accurate speed only if the AC voltage in to the house doesn't stray too far from the rated values (such as 110/125 volts). In a few areas, however, excessively low or high voltages can be a problem.

Synchronous motors, on the other hand, are insensitive to voltage changes, since they're designed to lock into the unvarying 60-Hz frequency of the house current, which is very carefully regulated by the power company. But these motors are generally weak in torque. (They're more like electric clock motors, which obviously can't rotate a heavy load.)

The best of both worlds is a fairly elaborate motor with both inductive and synchronous elements, such as the one used in the Garrard Z2000B and other Garrard models.

With only very few and very special exceptions, all turntable motors revolve at a much higher speed than the required 33⅓ or 45 RPM. A typical speed is 1800 RPM. To transmit this motion to the platter at the correctly reduced speed is the job of the drive mechanism.

Drive Systems

The type of drive used in a turntable requires much the same kind of engineering decision as in an automobile. Front engine driving the rear wheels, front engine driving the front wheels, rear engine driving the rear wheels, mid-engine–they all have their partisans, and each comes in executions ranging from superb to so-so. Turntables are no different.

A tried and true solution is the *intermediate idler*, usually made of hard rubber, which acts as a speed-reducing linkage between the motor pulley and the inner rim of the platter.

As proven in many designs, this type of drive

is positive, precise, rugged and trouble-free, an ideal choice for high-quality automatics. It's preferred by Garrard for all but the most advanced changers.

Belt drive, a somewhat costlier system, has even greater performance potential. Here the motor pulley is linked to the platter by means of an elastic belt, which among other things helps to isolate the platter from motor vibrations and also provides a larger contact area.

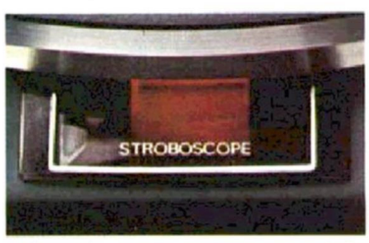
Idler Drive Belt Drive Belt/Idler Drive

Garrard has developed a sophisticated *combination* of belt drive and idler drive, available in the latest top-of-the-line models. It combines the outstanding advantages of both systems to permit precise variable-speed adjustment without electronic circuitry. The motor pulley is coupled to an idler, which in turn drives the platter through a flexible belt.

Another drive system coming into use in high-priced turntables is *direct drive*. The motor in this system is of one piece with the platter and turns at 33⅓ or 45 RPM. This requires elaborate motor windings and a costly electronic system of speed regulation. Garrard, however, has found it possible to achieve comparable performance, at lower cost to the consumer, with belt drive.

Under no circumstances should it be assumed that any one drive system is *inherently* superior to any other. It all depends on the specific application and the specific execution. The proof of the pudding is in the rumble, wow and flutter measurements, which are remarkably low in all Garrard models.

The most advanced automatic turntables, such as the Garrard Z2000B and 990B, also have a *fine-adjustment control* for varying each speed within a few percent. The main reason for this is to satisfy the trained musical ear. Some records may have been recorded slightly off pitch and adjusting the speed gets them back on pitch. It's also useful to be able to change the speed slightly to keep a particular selection in tune with a piano in the house (without calling the piano tuner) or to synchronize a record with a home movie.



A necessary adjunct to such a variable-speed control is a *stroboscope*. This is an optical device that synchronizes moving dots or bars with the invisible 60-times-per-second brightening and dimming of a light bulb energized by the house current. When the dots or bars appear to be stationary, the speed is exactly 33⅓ or 45 RPM.

The Tonearm

This, too, has only one function: to hold the phono cartridge in the proper position with respect to the record groove, with the right amount of downward force.

That means, in effect, that the tonearm is a passive device. Its quality is determined by its physical characteristics, such as its length, shape, mass, etc.

Except for one or two highly specialized designs, all tonearms are hinged both vertically and horizontally on pivots.

Friction in the pivot bearings must be kept to an absolute minimum, otherwise the arm will resist the very small forces that guide the stylus in the spiraling groove. And that means, inevitably, distorted reproduction and accelerated record wear. A high-quality arm should come close to a pharmacist's balance in freedom from pivot friction.

Garrard uses precision-loaded ball bearings for the lowest possible friction, greatest reliability and long life.

The downward force that keeps the stylus in the groove, is, of course, supplied by the tonearm. Since modern cartridges track with an extremely light stylus force, accurate calibration is of paramount importance.

The finest tonearms, such as those used in the more advanced Garrard models, are in completely stable balance in all planes (like unloaded precision scales) with the phono cartridge installed and the stylus force set to zero. The arm is then unbalanced for the required stylus force by means of a small sliding weight.

Tracking Error

As one looks down on the spinning record, the phono cartridge should theoretically be *tangent* to the groove at all times. Another way of saying the same thing is that the pickup head should always remain perpendicular to the straight line drawn through the stylus tip and the turntable spindle.

When a record is made, the grooves of the original master are cut with a mechanism that travels along such a straight line. If the reproducing stylus doesn't follow exactly the same path, the playback can't be entirely accurate.

Such inaccuracy in playback is called *tracking error* and is measured by the amount of deviation from straight-line tracking.

Since the head of a conventional pivoted tonearm swings in an arc of a circle, it's mathematically inevitable that it won't track in a straight line. By making the arm as long as possible and, especially, by situating the phono cartridge at an offset angle, it's not difficult to minimize tracking error over the relatively short distance from the edge of the record to the label.

In a good design, the error is carefully distributed over the playback path in such a way that resulting distortion is minimal. In a state-of-the-art product, however, even a small compromise is unacceptable. Therefore, in the unique Garrard Zero Tracking Error Tonearm (see pages 4 and 5), the error is for the first time eliminated by ingeniously making the offset continuously variable rather than fixed.

Skating

Another design problem arises from the tendency of tonearms to exert an undesirable sideways pull on the stylus, known as *skating force*.

Skating force pulls the stylus toward the inner wall of the groove. It therefore loses contact with the outer wall. This makes for inaccurate reproduction of the information in the groove.

Fortunately, skating force can be neutralized completely by applying an equal and opposite force. An adjustable, calibrated *anti-skating control* is an integral part of the tonearm in all but the lowest-priced changers today. The most sophisticated type of control is calibrated for optimum performance, not only with the particular stylus force used but also with the kind of stylus tip. All the higher-priced Garrard models feature this type of anti-skating control.

The **vertical tracking angle** of the stylus, meaning the slight forward lean of the diamond in the groove, is also somewhat critical. Ideally it should be 15° from the perpendicular when the phono cartridge is properly lined up with the record. The reason, again, is that the groove was originally cut that way. In a changer-type automatic turntable, the angle must vary a tiny amount from record to record as the stack piles up. Garrard's solution is a lever that tilts the cartridge for a choice of two positions: (1) exactly right on the first record, for single-play use; or (2) exactly right on the *middle* record of a full stack, for changer operation. (On the first and last record the angle will then be closer to exactly right.) All the higher-priced Garrard models have this precision feature.

Tracking error, skating force and vertical tracking angle all have to do with the correct seating of the stylus in the groove. *It should sit squarely, symmetrically, facing straight ahead, leaning slightly forward, and pressing both walls of the groove with equal force.*

The finer the detail engraved in the groove, the more important correct seating becomes. With CD-4 discrete 4-channel records, for example, it becomes absolutely critical because of the extremely high frequency of the carrier signal. An improperly seated stylus will misread this signal; with certain stylus configurations even groove damage is a possibility. That's why the Garrard Zero Tracking Error Arm is particularly outstanding for CD-4, making possible the most accurate reproduction of the groove with absolute minimum wear.

The Automatic Mechanism

In all automatic turntables, this is the mechanism that starts the motor, raises and lowers the tonearm, senses the end of the record, returns the tonearm to rest and shuts off the motor.

In a changer model, the automatic mechanism must do all that and change the records, too. They must drop in place one by one, in perfect synchronism with the automatic action of the arm.

The quality of the automatic mechanism is judged by two criteria: reliability of the automatic cycle and gentleness to the records.

Today's best automatics are quite consistently reliable and gentle, but that doesn't mean their automatic mechanisms are all equally well designed. Certain approaches are distinctly superior to others.

The most important differences are seen in the way the various designs stack and drop the records.

Surprisingly enough, some of the highest-priced changer models support the records at the center hole only. Thus the edge of the center hole of the bottom record in the stack bears the entire weight of the stack and takes the full force of the release mechanism when the record drops. The same goes for the next record, and the one after that, until the last record has dropped.

It's claimed that with a precision spindle this process won't result in enlarged center holes even after repeated use. Maybe so, but why not provide a wider margin of safety? (An enlarged center hole is a terrible nuisance because the record can then revolve eccentrically, producing audible wow.)

Garrard is a firm believer in *two-point support* of the stack. The records are held both at the center hole and at the edge, and the release mechanism also operates at both points. This arrangement is more stable as well as obviously easier on the records.

When the removable automatic spindle is exchanged for the single-play spindle, it's preferable if the latter rotates with the record, like the spindles on manual turntables. That way there's no sliding friction against the edge of the center hole, saving further wear and tear in the single-play mode. All the higher-priced Garrard changer models have this type of single-play spindle.

The Zero Tracking Error Tonearm

This Garrard invention is an exclusive feature of the Z2000B. No other multiple-play automatic turntable in the world has a tonearm capable of zero tracking error.

What tracking error means has already been explained under Turntable Fundamentals on page 2. How it was eliminated in a tonearm that's part of a changer mechanism is one of the more exciting chapters in the history of audio engineering.

The idea on which the invention is based is quite simple and straightforward. Since the offset head of a conventional rigid arm can't possibly remain perfectly tangent to the groove at all points on the record, why not hinge the head and make its offset angle variable?

The execution of the idea wasn't as simple. It required the creation of a hinged trapezoid (a kind of double arm), which in turn necessitated four horizontal pivots instead of the usual one.

The brilliance of the engineering that went into this complex design is emphasized by the fact that both mass and friction have been kept as low as in the finest conventional arms.

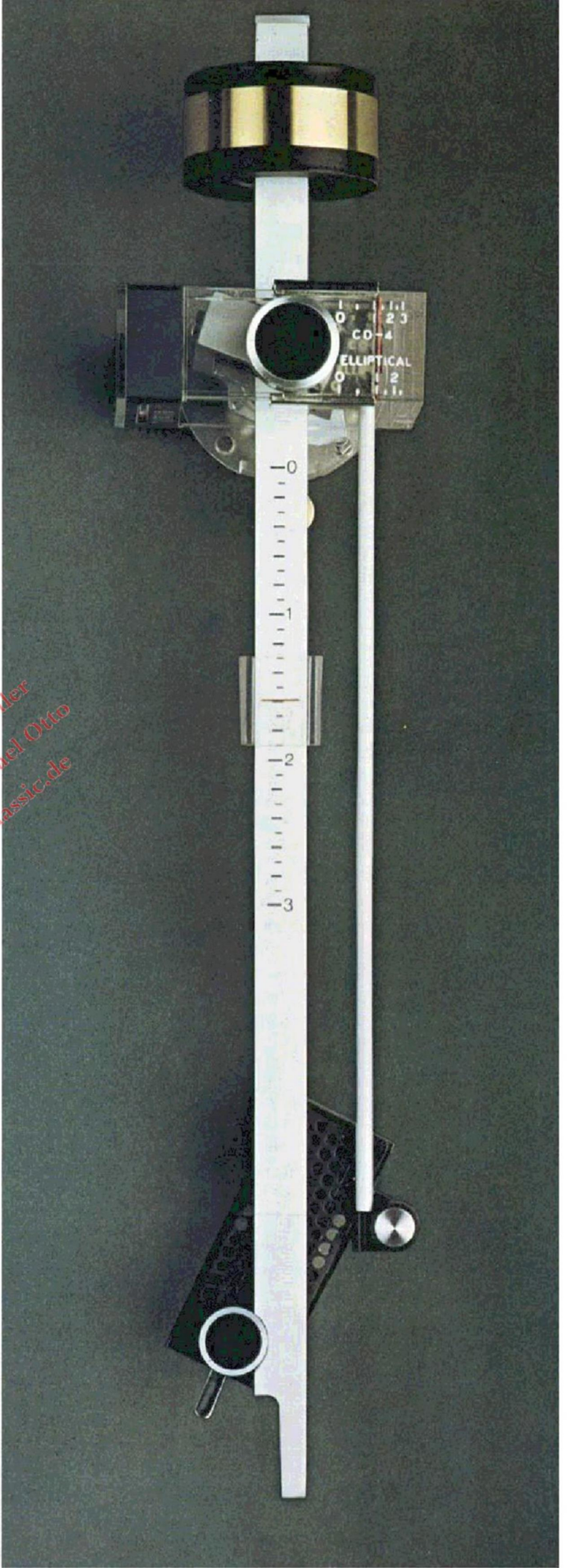
That the project was worth the effort is apparent from the CBS Laboratories test report published by *High Fidelity* magazine shortly after the Zero Tracking Error Tonearm made its first appearance.

The test report stated that the arm measured entirely free from tracking error within the accuracy limit of the test instrument. "It probably is the best arm yet offered as an integral part of an automatic player," wrote *High Fidelity.*

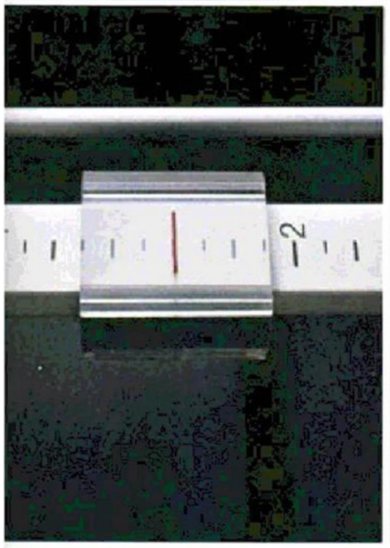
In the "Product Test Reports" of *Popular Electronics,* the prestigious Julian D. Hirsch explicitly stated that the "arm, in spite of its multiple pivots, had negligible friction . . . any cartridge made today can be operated in this arm at the lowest tracking force consistent with the design of the cartridge."

The "Acoustics" column of Rolling Stone magazine summed up the benefits when it reported that "using identical virgin records, and virgin styli in identical good cartridges, the Zero 100 on occasion sounded markedly 'crisper' than other turntables."

And better sound is what all audio engineering innovation is (or should be) about.

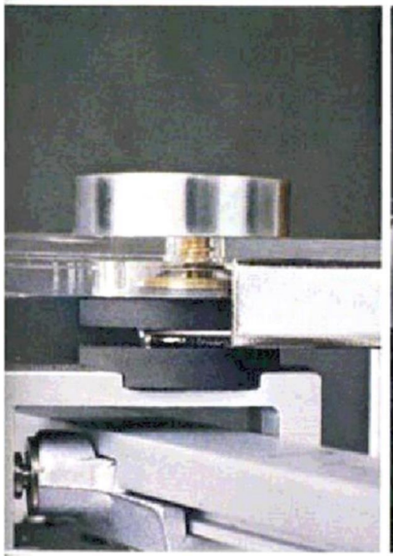


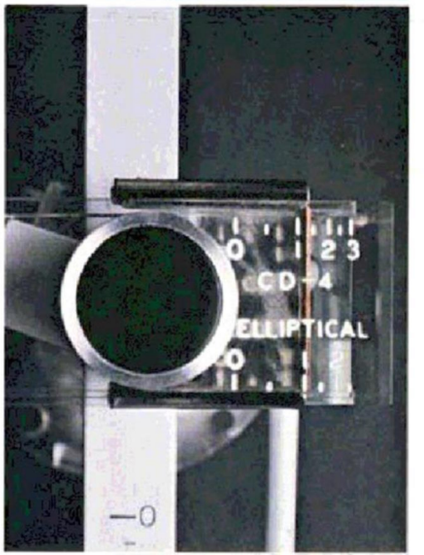
The hinged head is the essence of this unique design concept. Pivoted directly above the stylus tip, the head keeps adjusting its offset angle during play, maintaining perfect tangency and therefore zero tracking error.



The stylus force adjustment is also designed without springs. A small sliding weight is moved along the arm to line up with extremely accurate calibration marks from 0 to 3 grams. "The stylus force indications were very accurate, with less than 0.05 gram error at 1- and 2-gram settings, and only 0.1 at 3 grams," wrote *Popular Electronics*.

Garrard's solution to maintaining the necessary 15° vertical tracking angle consists of a lever that provides a choice of two positions: (M) for single-play use, and (A) for changer operation.





The arm also incorporates a few other ingenious engineering ideas. One of these is a variable anti-skating control that works on the magnetic principle that *like* poles repel each other. This eliminates the need for springs or other mechanically linked controls that couldn't possibly be as accurate.

According to the *Popular Electronics* report, "the anti-skating calibration was correct for equal playback distortion in both channels (a very unusual occurrence among the many arms we have tested)."

The New Z2000B Belt Drive Multiple-Play Turntable

Everything Garrard knows about turntable and tonearm design is in this remarkable new multiple-play automatic. It is a significant engineering advance over the original Zero 100, which a few years ago won the Emile Berliner award for "An Outstanding Contribution to the World of Sound."

This highly refined execution of that innovative concept features, among other things, a number of subtle improvements on our Zero Tracking Error Tonearm, which is described separately on pages 4 and 5. An entirely new drive system is also introduced in this model.

Zero tracking error remains, of course, the number one reason to consider this the *ne plus ultra* of changers. But even without that feature, its absolute performance could still be compared favorably with that of any other automatic turntable at any price, although the Z2000B is far from the most expensive. The Garrard philosophy of putting every dollar into tangible performance and reliability, not into features for features' sake, is especially evident here.

The Z2000B is a two-speed automatic turntable (33⅓ and 45 RPM) with fine-adjustment of either speed within plus or minus 3%. An illuminated stroboscope, visible through a window in front of the platter, is used to monitor each speed.

The motor is Garrard's exclusive Synchro-Lab design. It combines both a 4-pole induction rotor section for starting torque and a synchronous section for constant speed. This is an exceptionally powerful and reliable motor, with the additional advantages of being magnetically screened and shock-mounted.

Belt drive in an ingenious new configuration is used to transmit the power of the motor to the platter. This is an important improvement over earlier versions of the Zero changer.

The tapered motor pulley drives an intermediate idler to provide simple, positive speed changing. The idler, in turn, drives the platter through a flexible belt. Thus, the advantages of belt drive are fully realized without need for a costly electronic system for speed change and pitch control. The savings are passed on to refinements that affect *performance*.

That this approach works to the consumer's advantage is proven by the rumble figure of -64dB (with relative audibility weighting), which is a completely inaudible level even through the largest speakers and the most elaborate amplifiers. Wow and flutter also approach the vanishing point.

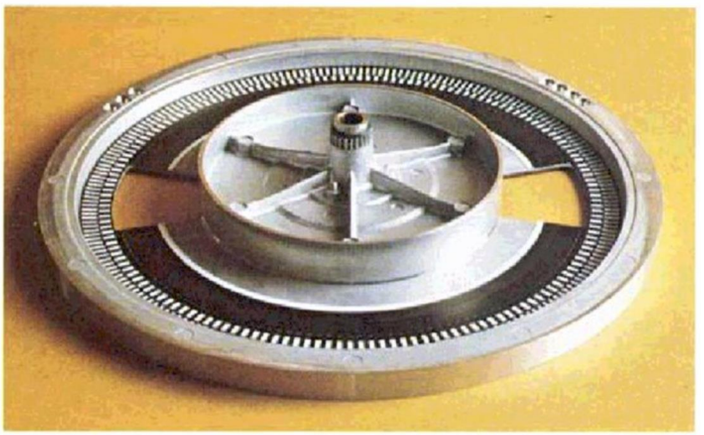
The tonearm itself has been even further reduced in mass and its bearings are even lower in friction than in previous models, which were already noted for these qualities. (See quote from test report on page 4.)

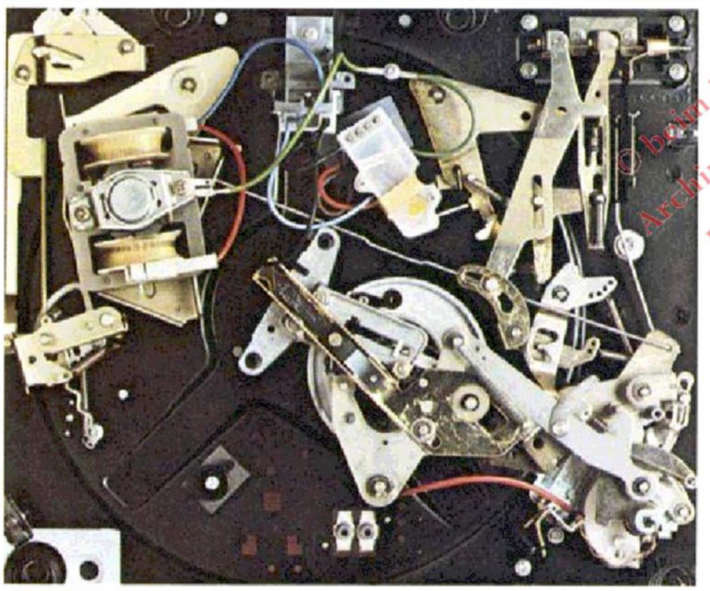
A tilting device allows the phono cartridge to be set for the correct 15° vertical tracking angle when playing a single record or, alternately, when three or more records are stacked for automatic play.

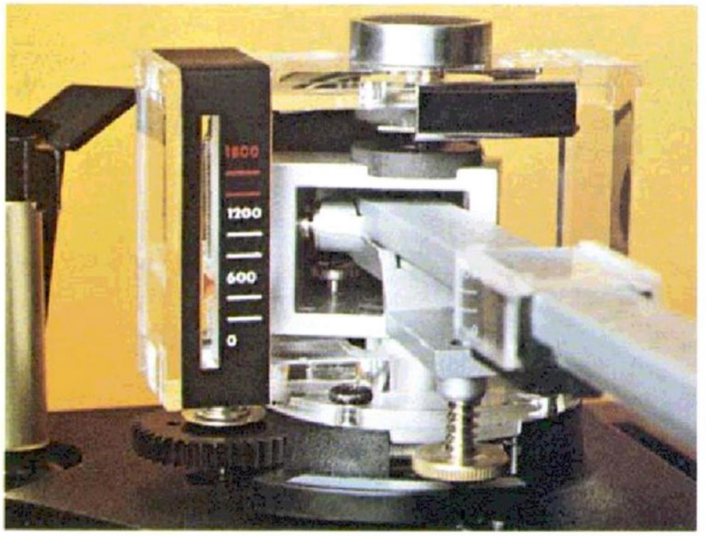
The cue control is viscous-damped not only when lowering but also when lifting the tonearm.

For other features and detailed specifications, see table on back cover.

1. An advanced feature of the Z2000B is the 5-lb., die-cast, dynamically balanced platter. The flywheel effect of this high-inertia platter helps smooth out even the tiniest fluctuations in speed.
2. The underside view of the Z2000B reveals its rugged, heavy-duty construction. As in all Garrard turntables, all cams, gears and levers are metal; no plastic is used.
3. A built-in automatic record counter is an unusual feature of the Z2000B. It keeps track of how many LP sides the tonearm has played, to remind the user of periodic checks for stylus wear.







The New 990B Belt Drive Multiple-Play Turntable

This turntable is of the same basic design as the Z2000B, except for the tonearm. It retains all other important features of the Z2000B, giving up only a few refinements in exchange for a substantial saving.

The arm itself is the finest conventional tonearm ever designed by Garrard. Its curve is calculated to result in the lowest tracking error possible with an offset arm of reasonable length. Its mass and its bearing friction are both extremely low. Stylus force adjustment is precise and made without the use of springs.

The anti-skating adjustment also operates by gravity rather than by springs. This lever-and-sliding weight device is calibrated for both elliptical and CD-4 styli.

The 990B is virtually identical in other essentials to the Z2000B. It has the same outstandingly powerful and reliable Synchro-Lab motor.

It has the same low rumble, wow and flutter measurements because both the platter and the belt-drive system are the same.

It has the same mechanism for the fine-adjustment of speed, except that a disk stroboscope is used.

It has the same two-point support for the record stack, to prevent enlarged center holes.

Considering its extremely reasonable price, the Garrard 990B may well be today's top value in a changer for those who don't absolutely insist on zero tracking error.

For additional details, see table on back cover.

The New Garrard 770M and 440M

When it comes to changers in the lower-medium price range, Garrard is unique.

These three-speed automatics are astonishingly well-made, utterly reliable and very gentle to the records. Garrard's reputation is to a considerable extent based on delivering this kind of quality at this kind of price.

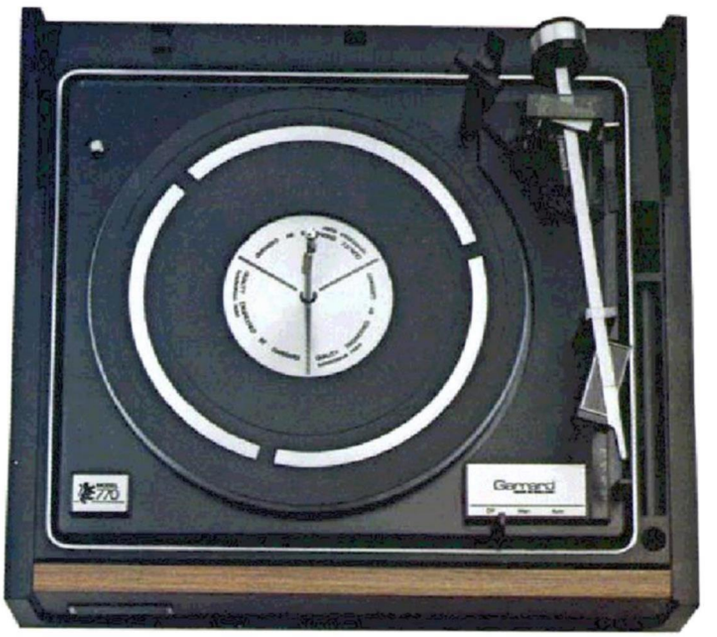
Both the 770M and the 440M are high-fidelity turntables through and through. And each is a complete turntable system, with phono cartridge, base and dust cover, ready to be plugged in and play the first record as soon as it's unwrapped.

The 770M is the latest version of a time-proven Garrard design. It features Garrard's powerful Synchro-Lab motor and a low-mass aluminum tonearm with an adjustable counterweight that permits zero-balancing before the stylus force is set. An adjustable anti-skating control and two-point support for the record stack are additional quality features. The Shure M93E magnetic cartridge is factory-installed and balanced for proper tracking. The newly designed base and dust cover eliminate the need for extra shelf space in the rear when the dust cover is raised.

The classic, very modestly priced 440M represents what Garrard considers the minimum requirements for genuine high-fidelity reproduction. It has a new low-mass tonearm with adjustable anti-skating control, a 4-pole motor, an overhead stabilizer arm for the record stack and a viscous-damped cue control. The magnetic cartridge is a Pickering V15-ATE-4, factory-installed and balanced. The base and dust cover are of the same new design as in the 770M.

Also available is the Garrard 440C, identical to the 440M except for a two-pole motor and a ceramic cartridge. The 440M without cartridge, base and dust cover, is known as the Garrard 440.

For complete features and specifications, see table on back cover.



Model		Zero 2000B	990B	770M	440M/440C	440
Platter	Diameter, in.	11½	11½	10½	10½	10½
	Type	Die cast zinc alloy, dynamically balanced	Die cast zinc alloy, dynamically balanced	Aluminum	Steel	Steel
Drive	Motor	Synchro-Lab	Synchro-Lab	Synchro-Lab	440M: 4-pole 440C: 2-pole	4-pole
	Speeds, RPM	33⅓, 45	33⅓, 45, 78	33⅓, 45, 78	33⅓, 45, 78	33⅓, 45
	Drive linkage	Belt/Idler	Belt/Idler	Idler wheel	Idler wheel	Idler wheel
Performance	Rumble, Din B Standard	−64dB	−64dB	−57dB	−55dB	−55dB
	Wow	0.06%	0.06%	0.08%	0.10%	0.10%
	Flutter	0.04%	0.04%	0.05%	0.08%	0.08%
Tonearm	Type	Variable offset (zero tracking)	Low mass, 'S' tubular	Fixed offset	Fixed offset	Fixed offset
	Balance	Adjustable counterweight	Adjustable counterweight	Adjustable counterweight	Fixed counterweight (no zero balance)	Fixed counterweight (no zero balance)
	Pivots	Precision-loaded ball bearings	Precision-loaded ball bearings	Combination ball bearings/ needlepoints	Combination ball bearings/ needlepoints	Combination ball bearings/ needlepoints
	Stylus force adjustment	Sliding weight	Adjustable counterweight	Spring	Spring	Spring
	Anti-skating adjustment	Magnetic, with CD-4/elliptical calibration	Sliding weight, with CD-4/elliptical calibration	Calibrated spring	Calibrated spring	Calibrated spring
	Vertical tracking angle adjustment	2-position lever	2-position lever	None	None	None
	Cue control	Viscous-damped for both lowering and lifting	Viscous-damped for both lowering and lifting	Viscous-damped	Viscous-damped	Viscous-damped
Automatic Mechanism	Maximum stack of records	6	6	6	6	6
	Stack support	2-point	2-point	2-point	Overhead stabilizer arm	Overhead stabilizer arm
	Record size selection	Linked with speed selector	Linked with speed selector	Linked with speed selector	Linked with speed selector	Linked with speed selector
	Single-play spindle	Rotating	Rotating	Fixed	Fixed	Fixed
Dimensions	Size, in.	15 5/16W x 14⅛D chassis	15 5/16W x 14⅛D chassis	16½W x 15D x 8½H with base and cover	16½W x 15D x 8½H with base and cover	14⅜W x 12½D chassis
Weight	Height above motor board, in.	4⅜	4⅜	4⅝	4⅝	4⅝
Accessories	Height below motor board, in.	2 15/16	2 15/16	2¼	2¼	2¼
	Weight, lbs.	18	18	14	14	10
	Base	BW 30	BW 30	Unipivot BDC5 included	Unipivot BDC5 included	Unipivot BDC5 Optional
	Dust Cover	D 30	D 30			
	Phono Cartridge	Optional	Optional	Shure M93E magnetic included	440M: Pickering V15/ATE-4 included 440C: Ceramic high quality included	Optional

All Garrard turntables have low capacitance tonearm leads and audio cables for optimum CD-4 performance