



TEST

Garrards neuer Zero-100 S

Der neue Plattenspieler von Garrard. Man erkennt deutlich den zusätzlichen Führungsstab an der Außenseite des Tonarms, der den Tonkopf tangential zu den abgetasteten Plattenrillen hält.



Unter der Bezeichnung Zero-100 S wird von der englischen Firma Garrard als erstes und einziges Gerät dieser Art ein automatischer Plattenspieler angeboten, der mit einem integrierten Tangential-Tonarm ausgerüstet ist. Durch eine technisch interessante und relativ einfache Konstruktion des Tonarms ist es gelungen, den horizontalen Fehlwinkel und die damit zusammenhängenden Abtastverzerrungen praktisch von vornherein auszuschalten und zugleich zwei weitere Forderungen zu erfüllen, daß nämlich der Tonarm auf der einen Seite die beim Automatik- oder Wechslerbetrieb notwendige Unkompliziertheit und Robustheit besitzt und auf der anderen so leichtgängig ist, daß moderne Tonabnehmer hoher Nadelnachgiebigkeit gut geführt werden.

Das Laufwerk des komfortabel bedienbaren Geräts bietet durchweg gute, solide Daten, die es ähnlich wie die Abtasteigenschaften seines Tonarms als hochwertige HiFi-Komponente charakterisieren.

Den Garrard-Plattenspieler mit Tangential-Tonarm gibt es in den Ausführungen Zero-100 S als automatischen Einzelspieler und Zero-100 als Plattenwechsler.

Stratos Tsofanoglou

Laufwerk mit den heute üblichen zwei Geschwindigkeiten, dessen antimagnetischer, aus zwei miteinander verbundenen Teilen bestehender Aluminium-Plattenteller mittels eines Gummireibrades von einem „Synchro-Lab“-Motor angetrieben wird. Beim „Synchro-Lab“ handelt es sich um einen kombinierten Induktions- und Synchronmotor, der die Vorteile beider Konstruktionsarten, also kräftiges Drehmoment und Synchronlauf mit der Netzfrequenz, in sich vereinen soll. Er ist an drei Punkten mit dem Chassis elastisch verbunden und trägt eine leicht konisch geschliffene Stufenrolle auf seiner Welle. Durch Höhenverstellung des Zwischenrades an dieser konusförmigen Rolle kann eine Feinregulierung der Geschwindigkeit erreicht werden. Als optische Kontrolle hierfür dient ein unter dem Plattenteller aufgeklebter Stroboskopring, der über ein beleuchtetes Spiegelsystem vorn am Chassis in einem Schacht sichtbar wird.

Der Tonarm des Zero-100 S besteht aus einem 22 cm langen flachen Aluminiumstab, der rechteckig profiliert und innen hohl ist. An seinem vorderen Ende ist ein Metalltonkopf drehbar angebracht. Dieser Tonkopf trägt auf der rechten Seite ein weiteres Lager, in das ein dünner, runder Stab greift, der neben dem eigentlichen Arm läuft und an seinem anderen Ende in der Nähe der vertikalen Tonarmachse – aber unabhängig von ihr – gelagert ist. Aufgabe des runden Stabs ist es, den Tonkopf so zu verstellen, daß unabhängig von der Position des Tonarms auf der Schallplatte die Längsachse des Tonabnehmers immer im rechten Winkel zum Radius der jeweils abgetasteten Rille steht, also eine Tangente zu ihr bildet. Vorausgesetzt, daß der Abtastdiamant im geometrisch richtigen Punkt steht, existiert beim Zero-100 S praktisch kein horizontaler Abtastfehlerwinkel mehr (Abweichungen kleiner als $0,5^\circ$). Um die richtige Montage des Tonabnehmers zu ermöglichen, wird eine Einstelllehre mitgeliefert. In den Tonkopf passen alle gängigen Tonabnehmersysteme mit international genormtem Abstand der Befestigungslöcher.

Beim Modell Zero-100, das zusätzlich als Plattenwechsler verwendet werden kann, aber sonst völlig identisch mit dem Zero-100 S ist, läßt sich ferner der Tonkopfschlitten geringfügig nach vorn neigen, damit auch bei Abtastung der letzten Schallplatten eines Sechserstapels der vertikale Abtastwinkel von 15° annähernd erhalten bleibt. Wie es allerdings bei allen Geräten, die eine ähnliche Einrichtung aufweisen, der Fall ist, verändert sich durch die Neigung des Tonkopfes die Lage des Abtaststiftes, so daß der „richtige“ vertikale Abtastwinkel mit einer Zunahme des tangentialen Fehlwinkels erkauft wird. Da aber Plattenwechsler wohl nur bei Partys und ähnlichen Gelegenheiten, wo die Wiedergabequalität keine primäre Rolle spielt, in Frage kommen, darf dieser Punkt nicht als Beurteilungskriterium angesehen werden.

Ausbalanciert wird der Tonarm durch ein drehbares Gegengewicht, das elastisch mit ihm gekoppelt ist. Durch die elastische Ankopplung geht erstens nur ein Teil der Gegengewichtsmasse in die dynamische Masse des Tonarms ein, außerdem wird eine bessere Dämpfung und eine Herabsetzung der Tonarm-Eigenresonanz erreicht. In Verbindung mit Tonabnehmern mittlerer und hoher Nadelnachgiebigkeit liegt die Eigenresonanz im Bereich der Tiefen außerhalb des Wiedergabebereichs.

Die Auflagekraft stellt man mit Hilfe eines Reitergewichts, das auf einer Schiene unterhalb des Tonarms verschoben wird, ein.

Um zusätzliche mechanische Reibung zu vermeiden, entschied man sich bei Garrard für eine magnetisch arbeitende Antiskating-Einrichtung. Ihre Wirkungsweise basiert auf dem Prinzip der Abstoßung von zwei gleichen Polen. Die Kompensation läßt sich kontinuierlich anhand von zwei Skalen – eine für elliptische und eine für sphärische Abtaststifte – einstellen.

Die Bedienung des Geräts erfolgt über drei Kippschalter und zwei konzentrische Drehknöpfe, die alle griffnah vorn auf der Platine placiert sind. Wahlweise kann der Zero-100 S als automatischer oder manueller Plattenspieler eingesetzt werden. Ein hydraulischer, sehr plattenschonend arbeitender Lift ist vorhanden. Seine Hydraulik tritt auch beim automatischen Betrieb in Aktion, so daß ein sanftes Aufsetzen des Tonarms immer gewährleistet wird. Bis zu minimalen Auflagekräften (etwa 0,5 p) funktioniert die Automatik einwandfrei ohne Rückwirkungen auf das Abtastverhalten des Tonarms. Das sehr schnelle Zurücksetzen des Tonarms nach Beendigung des Spiels oder bei Betätigung der leichtgängigen Stop-Taste ist zwar etwas ungewöhnlich, beeinträchtigt jedoch in keiner Weise die Zuverlässigkeit der Automatik.

Gleichlauf

Beide Testgeräte zeigten sehr gute Gleichlaufeigenschaften, vor allem aber das Modell Zero-100 S, wobei dies offensichtlich nicht modell-, sondern exemplarbedingt ist. Ohnehin ist der Unterschied von 0,01% auch meßtechnisch kaum der Rede wert. Gehörmäßig bleiben die Tönhöhenschwankungen sogar bei in dieser Hinsicht heiklen musikalischen Passagen (Klavier, Orgel) unter der Wahrnehmungsgrenze.

Laufruhe

Bei Laufwerken mit Reibradantrieb und hochtourigen Motoren – wie beim Garrard Zero-100 S – sind Ergebnisse der hier erzielten Art als sehr odentlich zu bezeichnen. Unter diesem Aspekt gesehen gehört der Garrard sogar in die Spitzengruppe der Plattenspieler seines Antriebsprinzips.

Schwache, dumpfe Rumpel-Geräusche werden erst bei großen HiFi-Lautstärken hörbar. Größere Laufruhe läßt sich zur Zeit nur bei entsprechend gut konstruierten Laufwerken mit Riemenantrieb oder sehr langsam rotierenden Gleichstrommotoren erreichen. Nicht vergessen sollte man allerdings, daß sehr viele Musikschaallplatten aufgrund von Unebenheiten der Oberfläche stärkere Laufgeräusche verursachen als mancher Plattenspielerantrieb.

Drehzahlfeinregulierung

Für die Vorkommnisse in der täglichen HiFi-Praxis ist der gebotene Variationsbereich von mehr als einem halben Ton völlig ausreichend. Die Regulierung läßt sich gut anhand des sehr deutlichen, beleuchteten Stroboskops vornehmen.

Abtastverhalten des Tonarms

Betrachtet man die mit unserem Referenztonabnehmer erzielten Ergebnisse für sich, so wird deutlich, daß die Tiefenabtastung des Tonarms den Leistungen der gehobenen HiFi-Mittelklasse entspricht, während seine Abtastfähigkeit in den Höhen sogar zur Spitzenklasse zählt. Wird zudem die Tatsache berücksichtigt, daß der Arm des Zero-100 drei Lager mehr besitzt als konventionelle Tonarme, so ist das Resultat außergewöhnlich gut. Auf jeden Fall eignet sich das Gerät zur Verwendung hochwertiger Abtaster, die es bei nur geringfügig höherem Auflagedruck exakt führen kann, als er in absoluten Spitzentönen wie dem Rabco SL-8 E oder dem Dual 1219 benötigt wird. Unser Referenztonabnehmer benötigte genau 1,15 p, um 70μ horizontal, 56μ vertikal und den vierten Pegel der Shure-Platte ohne Verzerrungen abzutasten: Eine sehr schonende Auflagekraft auch bei Verwendung elliptischer Nadeln.

Auflagekraft	Bei sorgfältiger Ausbalancierung des Tonarms und genauer optischer Einstellung stimmen Ist- und Sollwerte gut überein. Der maximale Unterschied um knapp 0,1 p (beim Zero-100 S) ist nicht nennenswert, so daß die Einrichtung für die Auflagekraft als genau gelten kann.
Skating-Kompensation	Auch hier stellte ich gute Übereinstimmung zwischen Skalenwerten und tatsächlich benötigter Kompensation fest. Lediglich war bei beiden Geräten eine geringfügige Überkompensation festzustellen, wenn man einen elliptischen Abtaststift mit den Verrundungen 5 μ und 18 μ verwendete. Beim Tangential-Tonarm des Garrard ist jedoch die Einstellung der Skating-Kompensation unkritischer als bei konventionellen Tonarmen, da hier der mitbeeinflussende Faktor „horizontaler Fehlwinkel“ praktisch entfällt. Die magnetische Korrektur-Einrichtung funktionierte über den ganzen Abspielbereich einer 30-cm-Platte einwandfrei.

TECHNISCHE DATEN

Plattenspieler Garrard Zero-100

	Herstellerangaben	Messungen
Drehzahlen	33 $\frac{1}{3}$, 45 Upm	
Drehzahlfeinregulierung	$\pm 3\%$	+ 3,2%, -3,3%
Plattenteller: Gewicht Durchmesser		1,62 kg 29,1 cm
Gleichlaufschwankungen	Wow < 0,1%, Flutter < 0,05%	$\pm 0,095\%$ (nach DIN 45539)
Drehzahldifferenz zwischen Anfang und Ende einer 30-cm-Platte bei Verwendung eines vollen Lenco-Clean-Röhrchens		0,56%
Rumpel-Fremdspannungsabstand		40 dB (nach DIN 45544)
Rumpel-Geräuschspannungsabstand		61,6 dB (nach DIN 45544)
Abmessungen	37,5 x 17 x 33,5 cm (B x H x T)	
Empfohlener Preis einschl. MwSt.	Chassis mit Tonarm 498,- DM Haube und Zarge (schwarz) 125,- DM	

TECHNISCHE DATEN

Plattenspieler Garrard Zero-100 S

	Herstellerangaben	Messungen
Drehzahlen	33 $\frac{1}{3}$, 45 Upm	
Drehzahlfeinregulierung	$\pm 3\%$	+ 3,2%, -3,4%
Plattenteller: Gewicht Durchmesser		1,62 kg 29,1 cm
Gleichlaufschwankungen	Wow < 0,1%, Flutter < 0,05%	$\pm 0,085\%$ (nach DIN 45539)
Drehzahldifferenz zwischen Anfang und Ende einer 30-cm-Platte bei Verwendung eines vollen Lenco-Clean-Röhrchens		0,58%
Rumpel-Fremdspannungsabstand		39,5 dB (nach DIN 45544)
Rumpel-Geräuschspannungsabstand		62,3 dB (nach DIN 45544)
Abmessungen	37,5 x 17 x 33,5 cm (B x H x T)	
Empfohlener Preis einschl. MwSt.	Chassis mit Tonarm 448,- DM Haube und Zarge (schwarz) 125,- DM	

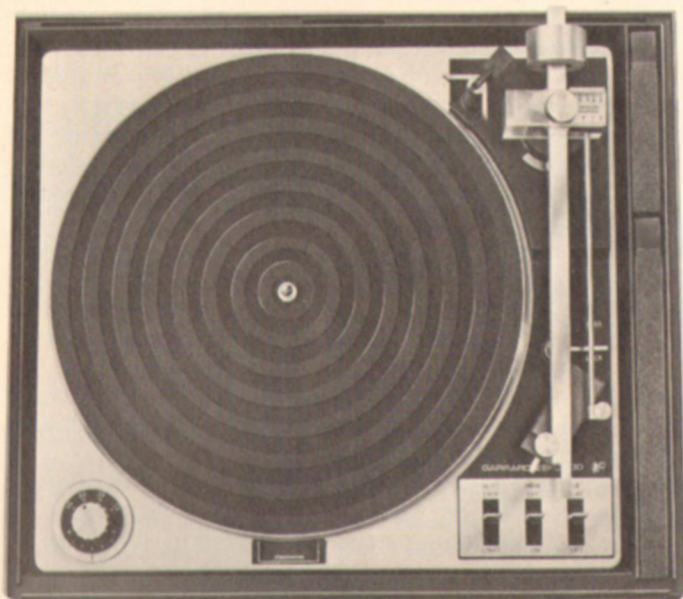
Abtastverhalten

Tonarme Garrard Zero-100 S und Zero-100

Bei Verwendung eines Tonabnehmers Shure V 15 II/7

	Auflagekraft	Amplitude
Unterer Frequenzbereich (mit Platte DG 641001) Seitenschrift	0,3 p	28 μ leicht verzerrt
	0,5 p	35 μ leichter Summton
	0,75 p	56 μ leicht verzerrt
	1,0 p	70 μ Summton
	1,25 p	90 μ leicht verzerrt
	1,5 p	90 μ leichter Summton
Tiefenschrift	0,3 p	28 μ leicht verzerrt
	0,5 p	35 μ
	0,75 p	56 μ sehr leicht verzerrt
	1,0 p	56 μ
	1,25 p	56 μ
	1,5 p	56 μ
Oberer Frequenzbereich (mit Platte Shure TTR-101 RM 2)	0,3 p	Pegel Nr. 2 leicht verzerrt
	0,5 p	Pegel Nr. 3 leicht verzerrt
	0,75 p	Pegel Nr. 4 sehr leicht verzerrt
	1,0 p	Pegel Nr. 4
	1,25 p	Pegel Nr. 4
	1,5 p	Pegel Nr. 4

Garrard "Zero-100" Automatic Transcription Turntable



MANUFACTURER'S SPECIFICATIONS

Speeds: Two—33 $\frac{1}{3}$ and 45 RPM, each variable approx. \pm 3%
Wow: Better than 0.10% rms. **Flutter:** Better than 0.05% rms.
Rumble: Negligible. **Motor:** Two-sections—4-pole induction for starting torque and synchronous for constant running speed.
Pickup Arm: Counterbalanced, with sliding weight to adjust stylus force; head pivots laterally as it tracks a record to maintain negligible tracking error; magnetic anti-skating system calibrated for both conical and elliptical styli; head adjustable for 15-deg. vertical tracking angle for either 1 or 3 records; lever-controlled lift, with viscous-damped lowering. **Power consumption:** approx. 9 watts. **Dimensions:** 14 $\frac{3}{4}$ " w., 13 $\frac{1}{4}$ " d., 6 $\frac{3}{4}$ " h. **Weight:** 11 $\frac{1}{2}$ lbs. **Price:** \$189.50. Optional extras: mounting base with or without cover; record-platform extension to play six 7-in. small-hole records; record spindle adapter to play up to six records with large center holes automatically.

Incorporating practically every known plus feature in one automatic turntable, the new Garrard Zero-100 unit introduces for the first time in an automatic a zero-tracking-angle device on the arm which causes the head to maintain practically perfect tangency to the record groove at all diameters. It is well known that a minimum tracking angle is one of the desiderata in any record-playing mechanism, but on all conventional arms, the tracking angle will vary from a value of as much as +4 deg. at the outer grooves to -1 or -2 deg. somewhere between the start and the finish, then rise again to a value of perhaps +1 or +2 deg. at the innermost grooves.

Arms have been introduced that corrected this problem, but they were only for single-play turntables—never before on automatics. The importance of a near-zero tracking error is attested to by the number of such arms that have been on the market in the past and which no longer are. A little study of the problem of perfect tangency will convince anyone that a solution by the parallelogram method is possible. The principal reason the earlier "parallelogram" types were not successful is that the increased number of bearings caused too much friction.

Now with the availability of improved types of free-rolling bearings, the same principle has been worked out with complete satisfaction.

A simple list of all the "Zero-100" features should serve to spotlight the changes that have been incorporated in this model of the Garrard. We will elaborate on them later on:

- 15-deg. vertical tracking angle adjustment.
- Sliding-weight stylus-force adjustment—easy to adjust as little as one-tenth of a gram.
- Magnetic anti-skating control.
- Spring-loaded tonearm safety restrictor (lock).
- Long-taper variable speed control.
- Illuminated stroboscope, with two bands of lines, one for each speed.
- Rotating manual spindle.
- Proven "Synchro-Lab" motor—combination of induction and synchronous types.
- Lightweight, balanced, full-diameter platter.
- Safe 2-point record support.
- Handsome combination of chrome, brass, and plexiglas for tonearm mounting.
- Adjustments for arm lowering position, lifting height, and lifting-height restriction.

All of these features combined into one automatic turntable make news, even though some are found on other units. Only in the Zero-100 are they all put together. Taking them individually, we first come to the vertical tracking-angle adjustment. This is a simple lever which has two positions marked "M" and "A". In the "M" position, the cartridge head is set for a 15-deg. tracking angle on a single record, played Manually. In the "A" position, the cartridge is tilted slightly so it is at the proper 15-deg. angle for the third record of a stack of six, the maximum number that may be stacked on the machine.

The stylus-force adjustment is by means of a sliding weight on the arm, which is first balanced with the weight at "0" and then the weight is moved to the desired stylus force. A movement of 1 $\frac{1}{4}$ in. varies the stylus force by only one gram, so an accurate setting can be made to any desired amount up to three grams or even down to one-quarter of a gram.

The anti-skating control involves no mechanical linkage to the arm. A simple slide on the fixed arm mounting serves to place a shield between a fixed magnet and one mounted on the movable gimbal which supports the arm. Separate calibrations are provided for conical and elliptical styli.

While most turntables have a lock to hold the arm on its rest, it is usually a solid one, and lifting the arm could cause damage when it is supposedly locked. On the Zero-100, the lock is sufficiently firm, yet if the arm is lifted when locked, a restraining spring gives slightly to remind you that it was locked, suggesting that you release it.

The variable-speed device on modern turntables usually employs a tapered spindle on the motor shaft against which the idler wheel is moved up or down to provide the speed change. If the taper is steep, the idler contact with the shaft can vary, causing an unwanted wow. In the new Garrard, the tapered shaft is long, with a gradual taper that ensures good contact and allows a more accurate setting of the speed. The two speeds are indicated by a built-in stroboscope—a series of lines in the usual fashion, but placed on the underside of the platter, illuminated by a neon bulb, and viewed by a series of mirrors from the top of the unit. The two bands of lines allow accurate setting for either speed. We consider a built-in strobe highly important when variable speed is offered.

The rotating manual spindle is now common on high-quality turntables and is now a part of the Garrard. The "Synchro-Lab" motor, a unit which employs both an induction section and a synchronous section, makes for the best of two worlds—quick starting, and constant speed. The platter is non-ferrous, and is

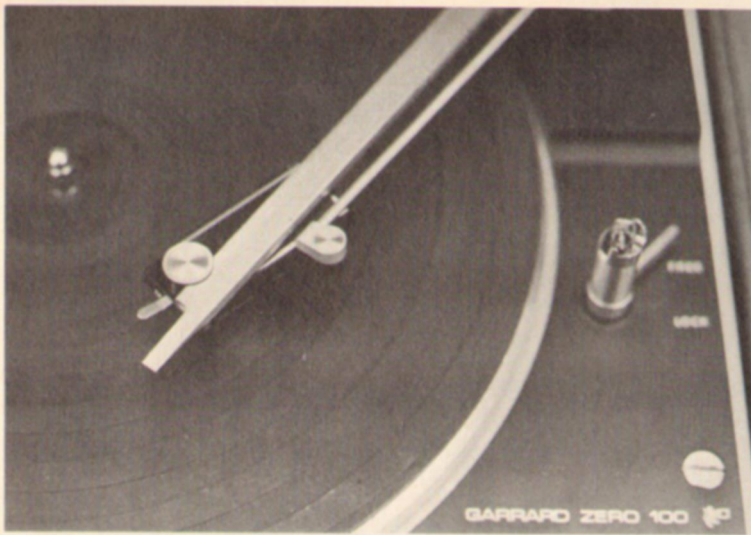


Fig. 1—When the arm is near the center grooves of the record, the angle is changed by the controlling tubular component at the right. This part is pivoted on the rear of the head and provides practically perfect tangency throughout the entire record.

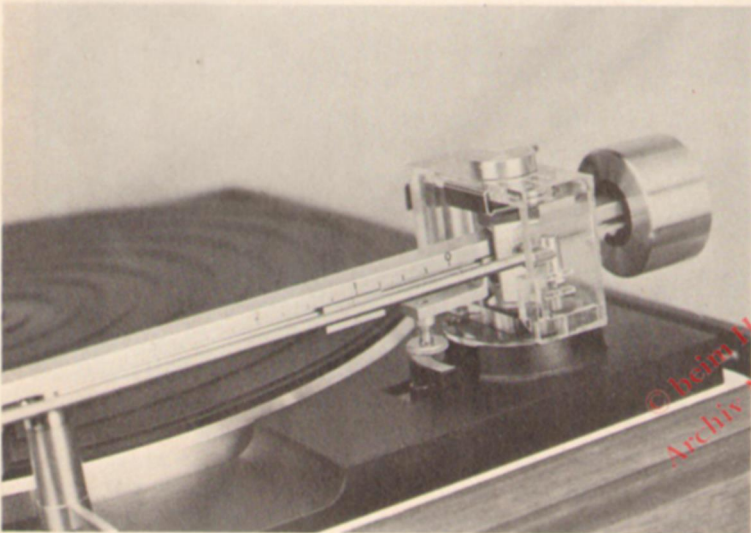


Fig. 2—The plexiglas arm-mounting structure accommodates the anti-skating magnets and the indicator for proper setting. The sliding weight under the arm moves $1\frac{1}{8}$ in. for a change of 1 gram in stylus force. The counterweight is brass.

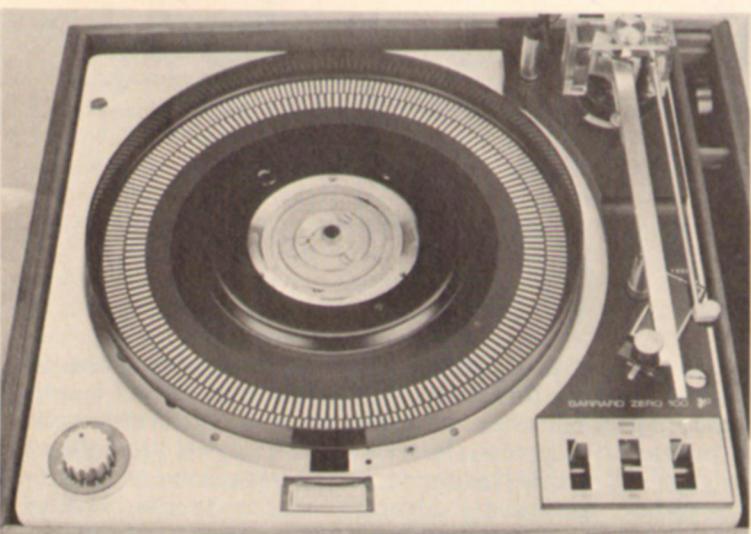


Fig. 3—With the platter removed and inverted, the two bands of stroboscope lines are seen on the underside of the platter. They are illuminated by a neon bulb and viewed through a mirror visible through the opening directly in front of the platter.

a lightweight component with a full rubber surface for the disc, providing damping needed to support the entire record surface.

In the Zero-100, Garrard retains the reliable two-point support for the stack of records. Once the stack is placed on the automatic spindle, a plastic clip steadies the stack, yet allows the bottom record to drop gently to the platter on a cushion of air.

The tonearm pivot mounting uses a gimbal for the two bearings, and it is in a strong plexiglas structure which mounts the anti-skating magnet. Another magnet is mounted on the gimbal, and a shield may be interposed variably between the two magnets to adjust the amount of compensation applied. An indicator on the shield shows the settings suggested for both conical and spherical styli, with the calibration such that the setting is made to the value of stylus force applied by means of sliding weight on the arm. The arm structure accommodates a variety of adjustments for setdown position and for lifting height, together with another to permit adjustment of the amount of lift so as to clear records remaining on the spindle.

The speed control remains similar to that on the SL-95 series, in that the control has four positions—one for 45 rpm, 7-inch records, and three for $33\frac{1}{3}$, with setdown positions for 12-, 10-, and 7-in. discs. Under the knob is the vernier speed adjustment which provides approximately 3 per cent increase or decrease in the normal speed.

The operating controls also are similar to the SL-95B—three tabs: automatic start, stop and reject; manual motor start; and cue, for lifting and lowering the arm.

Performance

The Zero-100 performed just about as we expected after reading the specifications. Wow measured .08 per cent—that is in the band from 0.5 to 6 Hz. Flutter, in the band from 6 to 250 Hz, measured .03 per cent, both of which are excellent. The variable-speed control gave a range of a little better than ± 3 per cent on $33\frac{1}{3}$ rpm, and a little less than that on 45 rpm. No change in speed was noted over a line-voltage range from 85 to 135 volts, but the expected change came when the line frequency was varied, due to the synchronous section of the drive motor.

While the skating of the arm should be much less pronounced with the near-zero tracking error, it can be shown that some skating tends to exist, but the amount is certainly less than that with conventional arms. This is probably the reason why the magnetic anti-skating feature works so well, and we could certainly see for ourselves that there is a difference in the sine wave shown on the scope when the anti-skating compensation is set properly. Similarly, using the same cartridge on a conventional arm and on the Zero-100 arm, a difference could also be observed on the scope. For all our performance measurements, we fitted a Stanton 681-EE cartridge which tracked perfectly at $\frac{1}{2}$ gram, less than the pressure Stanton recommends. At 1 gram, it was less sensitive to floor vibrations, and at $1\frac{1}{2}$ grams, not at all. Signal to noise ratio measured 41 dB unweighted, or with the standard "A" weighting, 56 dB, using the CBS BTR-150 broadcast test record, which also supplied the 3000-Hz signal for the wow and flutter measurements. Arm resonance was measured at just under 10 Hz, and the change cycle required only 10 seconds from the completion of the last groove on one record to the setdown on the outer grooves of the next. Thus the Garrard Zero-100 is certainly the finest in a long line of automatic turntables which have been around for over 50 years. And as usual, each new model contains improvements over its predecessors, with constant research which strives to better performance, appearance, and reliability. We think you will like it.

C.G. McP.

Check No. 48 on Reader Service Card

Garrard Zero 100 Automatic Turntable



● GARRARD's new top-of-the-line automatic turntable, the Zero 100, features a novel articulated tone arm designed for zero lateral tracking error. The tone arm's cartridge head is pivoted in the horizontal plane, and a separate linkage, parallel to the stainless steel tone-arm shaft, constantly changes its offset angle as it moves over the record surface. Garrard claims the arm has a maximum tracking-angle error of only 90 seconds, which is $1/40$ of a degree! This is far lower than can be achieved by any conventional pivoted tone arm, and Garrard's use of precision-loaded ball bearings appears to have eliminated problems of pivot play and friction that have troubled similar designs.

In other details also, the arm of the Zero 100 differs from that found on competing automatic turntables. Anti-skating correction is applied by two ceramic disc magnets. The repulsion between the like poles of the magnets applies an outward torque to the arm that is adjusted by a sliding magnetic shield. The shield position is indicated on a dual calibrated scale, marked to match the stylus force from 0 to 3 grams for conical styli and from 0 to 2 grams for elliptical styli. The arm is balanced by an elastically isolated rotatable brass counterweight. Tracking force is set by a separate sliding brass weight on the arm, whose scale is calibrated from 0 to 3 grams in $1/4$ -gram intervals. No springs are used anywhere on the arm. The slide-in cartridge-mounting plate has an overhang adjustment, with a separate plastic jig for accurate positioning of the stylus. A two-position lever on the front of the cartridge head tilts the cartridge to set the vertical tracking angle for a single record or for the center of a full six-record stack. The tone-arm rest post has a built-in lock, spring-loaded so that attempting to lift the locked arm cannot cause damage.

The $11\frac{1}{2}$ -inch cast-aluminum platter is driven by a Synchro-Lab constant-speed motor at $33\frac{1}{3}$ or 45 rpm. As on the Garrard SL-95B, the playing-speed control of the Zero 100 also sets the arm indexing point for 7-, 10-, and 12-inch records at $33\frac{1}{3}$ rpm and for 7-inch records at 45 rpm. A record of any size can be played manually at either speed, of course. The platter is covered with a ribbed, matte-surface rubber mat. There are removable automatic and single-play spindles (the latter rotates with the record), and a single edge-support post for the record stack in automatic operation. Three levers control all operating functions: automatic start/stop, manual start/stop, and cueing. This last operates with a slightly damped lift and a slow, smooth descent that is totally free of lateral drift.

The vernier speed-adjustment control is a ring concentric with the speed selector. The nominal range is ± 2.5

per cent at 45 rpm and ± 3.5 per cent at $33\frac{1}{3}$ rpm. Illuminated stroboscope markings under the platter are continuously visible through a window on the motorboard during play. The Garrard Zero 100 is \$189.50. A molded plastic base and a dust cover are available for \$6.50 each.

● *Laboratory Measurements.* The articulated arm of the Garrard Zero 100 lived up to the claims made for it, insofar as we could measure its performance. The limiting angular resolution of our tracking-error protractor is about 0.5 degree, and at no time did we find an error larger than that. Without a doubt, the tracking error of the Zero 100 has been reduced below ordinary measurable limits—and it is certainly far less than the inherent errors involved in cartridge mounting.

The arm showed no sign of resonances or other side effects from its unusual construction. The tracking-force calibration was accurate within 0.1 gram over its full range. The force increased by about 0.2 gram over a stack of six records when initially set for a single record. This is typical of the better automatic turntables we have tested. We were pleased to see that Garrard's anti-skating correction, unlike that on most arms, was approximately correct when set for the tracking force in use. One would expect the automatic reduction in head-offset angle toward the inner grooves of the record to require less anti-skating compensation. Perhaps the wedge-shaped magnetic shield achieved this result; at any rate, the correction was equally accurate over the entire record.

The turntable started rapidly at line voltages as low as 70 volts, and its speed was absolutely stable and unaffected by changes in line voltage or load. The vernier speed adjustment had a range of about ± 3 per cent. The Zero 100 measured well: wow and flutter were 0.1 and 0.025 per cent at $33\frac{1}{3}$ rpm, and 0.13 and 0.05 per cent at 45 rpm. Unweighted rumble was -32 dB, decreasing to -35 dB when the two channels were paralleled to cancel vertical rumble. With CBS RRL weighting, the rumble was -55.5 dB, one of the lower figures we have obtained since we started making weighted measurements.

● *Comments.* Despite its unconventional design (or perhaps because of it), the Garrard Zero 100 was very easy to get used to. In particular, the finger lift (a straightforward extension of the main arm) was exceptionally convenient to use. We also appreciated the smooth cueing (a carry-over from the SL-95B). Indeed, everything worked smoothly, quietly, and just as it was meant to. If there were any "bugs" in the Zero 100, we didn't find them.

It appears to us that the Zero 100 was designed, first and foremost, as a single-record player, and only secondarily as a changer. Only 12-inch records (six of them) can be played automatically, since the changer's record-edge support post is fixed for that size. Ten-inch LP records are not common, but it is well to be aware of this limitation.

Obviously, the Zero 100 was designed to be used with the best cartridges. Its maximum tracking force of 3 grams, or 2 grams with elliptical styli, would rule out most low- or medium-price cartridges.

Garrard's Zero 100, in basic performance, easily ranks with the finest automatic turntables on the market. Its novel arm—which really works as claimed—and its other unique design features suggest that a great deal of development time, plus sheer imagination, went into its creation. In our view, the results were well worth the effort.

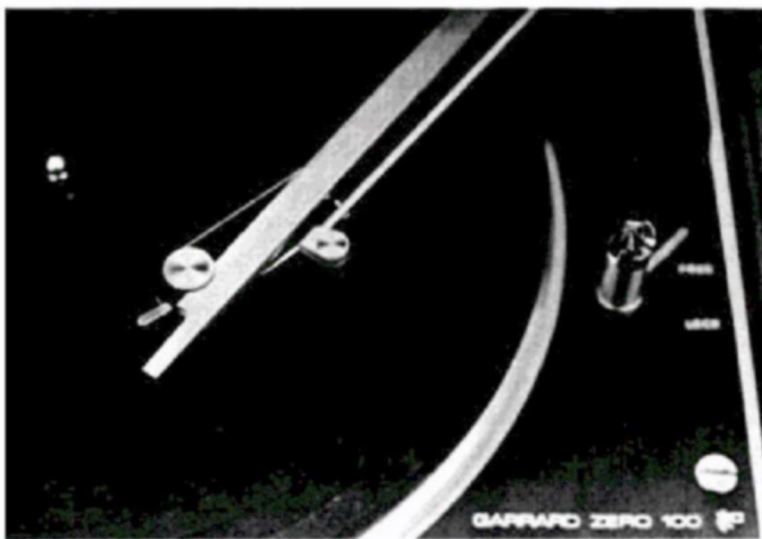


Fig. 1—When the arm is near the center grooves of the record, the angle is changed by the controlling tubular component at the right. This part is pivoted on the rear of the head and provides practically perfect tangency throughout the entire record.

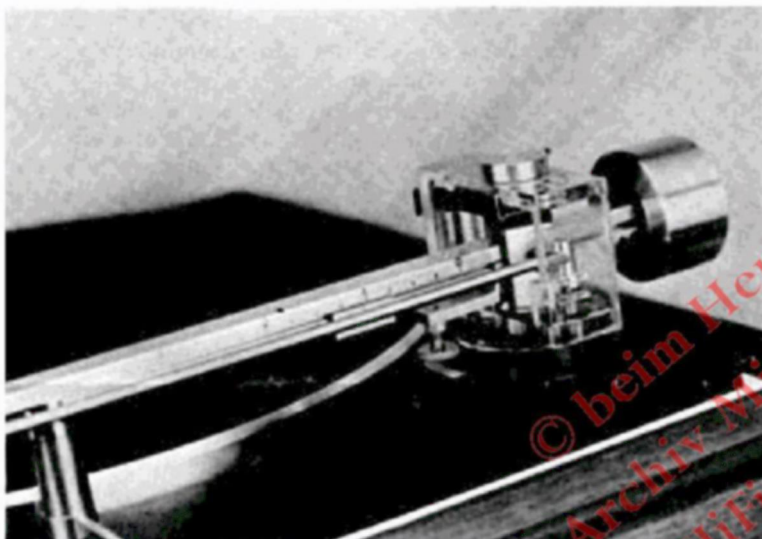


Fig. 2—The plexiglas arm-mounting structure accommodates the anti-skating magnets and the indicator for proper setting. The sliding weight under the arm moves 1 1/4 in. for a change of 1 gram in stylus force. The counterweight is brass.



Fig. 3—With the platter removed and inverted, the two bands of stroboscope lines are seen on the underside of the platter. They are illuminated by a neon bulb and viewed through a mirror visible through the opening directly in front of the platter.

a lightweight component with a full rubber surface for the disc, providing damping needed to support the entire record surface.

In the Zero-100, Garrard retains the reliable two-point support for the stack of records. Once the stack is placed on the automatic spindle, a plastic clip steadies the stack, yet allows the bottom record to drop gently to the platter on a cushion of air.

The tonearm pivot mounting uses a gimbal for the two bearings, and it is in a strong plexiglas structure which mounts the anti-skating magnet. Another magnet is mounted on the gimbal, and a shield may be interposed variably between the two magnets to adjust the amount of compensation applied. An indicator on the shield shows the settings suggested for both conical and spherical styli, with the calibration such that the setting is made to the value of stylus force applied by means of sliding weight on the arm. The arm structure accommodates a variety of adjustments for setdown position and for lifting height, together with another to permit adjustment of the amount of lift so as to clear records remaining on the spindle.

The speed control remains similar to that on the SL-95 series, in that the control has four positions—one for 45 rpm, 7-inch records, and three for 33 1/3, with setdown positions for 12-, 10-, and 7-in. discs. Under the knob is the vernier speed adjustment which provides approximately 3 per cent increase or decrease in the normal speed.

The operating controls also are similar to the SL-95B—three tabs: automatic start, stop and reject; manual motor start; and cue for lifting and lowering the arm.

Performance

The Zero-100 performed just about as we expected after reading the specifications. Wow measured .08 per cent—that is in the band from 0.5 to 6 Hz. Flutter, in the band from 6 to 250 Hz, measured .03 per cent, both of which are excellent. The variable-speed control gave a range of a little better than ± 3 per cent on 33 1/3 rpm, and a little less than that on 45 rpm. No change in speed was noted over a line-voltage range from 85 to 135 volts, but the expected change came when the line frequency was varied, due to the synchronous section of the drive motor.

While the skating of the arm should be much less pronounced with the near-zero tracking error, it can be shown that some skating tends to exist, but the amount is certainly less than that with conventional arms. This is probably the reason why the magnetic anti-skating feature works so well, and we could certainly see for ourselves that there is a difference in the sine wave shown on the scope when the anti-skating compensation is set properly. Similarly, using the same cartridge on a conventional arm and on the Zero-100 arm, a difference could also be observed on the scope. For all our performance measurements, we fitted a Stanton 681-EE cartridge which tracked perfectly at 1/2 gram, less than the pressure Stanton recommends. At 1 gram, it was less sensitive to floor vibrations, and at 1 1/2 grams, not at all. Signal to noise ratio measured 41 dB unweighted, or with the standard "A" weighting, 56 dB, using the CBS BTR-150 broadcast test record, which also supplied the 3000-Hz signal for the wow and flutter measurements. Arm resonance was measured at just under 10 Hz, and the change cycle required only 10 seconds from the completion of the last groove on one record to the setdown on the outer grooves of the next. Thus the Garrard Zero-100 is certainly the finest in a long line of automatic turntables which have been around for over 50 years. And as usual, each new model contains improvements over its predecessors, with constant research which strives to better performance, appearance, and reliability. We think you will like it.

C.G. McP.

Reprinted from

AUDIO JULY 1971

Equipment Profiles

Garrard "Zero-100" Automatic Transcription Turntable



MANUFACTURER'S SPECIFICATIONS

Speeds: Two—33 $\frac{1}{3}$ and 45 RPM, each variable approx. $\pm 3\%$.
Wow: Better than 0.10% rms. **Flutter:** Better than 0.05% rms.
Rumble: Negligible. **Motor:** Two-sections—4-pole induction for starting torque and synchronous for constant running speed.
Pickup Arm: Counterbalanced, with sliding weight to adjust stylus force; head pivots laterally as it tracks a record to maintain negligible tracking error; magnetic anti-skating system calibrated for both conical and elliptical styli; head adjustable for 15-deg. vertical tracking angle for either 1 or 3 records; lever-controlled lift, with viscous-damped lowering. **Power consumption:** approx. 9 watts. **Dimensions:** 14 $\frac{1}{4}$ " w., 13 $\frac{1}{4}$ " d., 6 $\frac{3}{4}$ " h. **Weight:** 11 $\frac{1}{2}$ lbs. **Price:** \$189.50. Optional extras: mounting base with or without cover; record-platform extension to play six 7-in. small-hole records; record spindle adapter to play up to six records with large center holes automatically.

Incorporating practically every known plus feature in one automatic turntable, the new Garrard Zero-100 unit introduces for the first time in an automatic a zero-tracking-angle device on the arm which causes the head to maintain practically perfect tangency to the record groove at all diameters. It is well known that a minimum tracking angle is one of the desiderata in any record-playing mechanism, but on all conventional arms, the tracking angle will vary from a value of as much as +4 deg. at the outer grooves to -1 or -2 deg. somewhere between the start and the finish, then rise again to a value of perhaps +1 or +2 deg. at the innermost grooves.

Arms have been introduced that corrected this problem, but they were only for single-play turntables—never before on automatics. The importance of a near-zero tracking error is attested to by the number of such arms that have been on the market in the past and which no longer are. A little study of the problem of perfect tangency will convince anyone that a solution by the parallelogram method is possible. The principal reason the earlier "parallelogram" types were not successful is that the increased number of bearings caused too much friction.

Now with the availability of improved types of free-rolling bearings, the same principle has been worked out with complete satisfaction.

A simple list of all the "Zero-100" features should serve to spotlight the changes that have been incorporated in this model of the Garrard. We will elaborate on them later on:

- 15-deg. vertical tracking angle adjustment.
- Sliding-weight stylus-force adjustment—easy to adjust as little as one-tenth of a gram.
- Magnetic anti-skating control.
- Spring-loaded tonearm safety restrictor (lock).
- Long-taper variable speed control.
- Illuminated stroboscope, with two bands of lines, one for each speed.
- Rotating manual spindle.
- Proven "Synchro-Lab" motor—combination of induction and synchronous types.
- Lightweight, balanced, full-diameter platter.
- Safe 2-point record support.
- Handsome combination of chrome, brass, and plexiglas for tonearm mounting.
- Adjustments for arm lowering position, lifting height, and lifting-height restriction.

All of these features combined into one automatic turntable make news, even though some are found on other units. Only in the Zero-100 are they all put together. Taking them individually, we first come to the vertical tracking-angle adjustment. This is a simple lever which has two positions marked "M" and "A". In the "M" position, the cartridge head is set for a 15-deg. tracking angle on a single record, played Manually. In the "A" position, the cartridge is tilted slightly so it is at the proper 15-deg. angle for the third record of a stack of six, the maximum number that may be stacked on the machine.

The stylus-force adjustment is by means of a sliding weight on the arm, which is first balanced with the weight at "0" and then the weight is moved to the desired stylus force. A movement of 1 $\frac{1}{2}$ in. varies the stylus force by only one gram, so an accurate setting can be made to any desired amount up to three grams or even down to one-quarter of a gram.

The anti-skating control involves no mechanical linkage to the arm. A simple slide on the fixed arm mounting serves to place a shield between a fixed magnet and one mounted on the movable gimbal which supports the arm. Separate calibrations are provided for conical and elliptical styli.

While most turntables have a lock to hold the arm on its rest, it is usually a solid one, and lifting the arm could cause damage when it is supposedly locked. On the Zero-100, the lock is sufficiently firm, yet if the arm is lifted when locked, a restraining spring gives slightly to remind you that it was locked, suggesting that you release it.

The variable-speed device on modern turntables usually employs a tapered spindle on the motor shaft against which the idler wheel is moved up or down to provide the speed change. If the taper is steep, the idler contact with the shaft can vary, causing an unwanted wow. In the new Garrard, the tapered shaft is long, with a gradual taper that ensures good contact and allows a more accurate setting of the speed. The two speeds are indicated by a built-in stroboscope—a series of lines in the usual fashion, but placed on the underside of the platter, illuminated by a neon bulb, and viewed by a series of mirrors from the top of the unit. The two bands of lines allow accurate setting for either speed. We consider a built-in strobe highly important when variable speed is offered.

The rotating manual spindle is now common on high-quality turntables and is now a part of the Garrard. The "Synchro-Lab" motor, a unit which employs both an induction section and a synchronous section, makes for the best of two worlds—quick starting, and constant speed. The platter is non-ferrous, and is

Stereo Review

The tonearm pivot mounting uses a gimbal for the two bearings, and it is in a strong plexiglas structure which mounts the anti-skating magnet. Another magnet is mounted on the gimbal, and a shield may be interposed variably between the two magnets to adjust the amount of compensation applied. An indicator on the shield shows the settings suggested for both conical and spherical styli, with the calibration such that the setting is made to the value of stylus force applied by means of sliding weight on the arm. The arm structure accommodates a variety of adjustments for setdown position and for lifting height, together with another to permit adjustment of the amount of lift so as to clear records remaining on the spindle.

The speed control remains similar to that on the SL-95 series, in that the control has four positions—one for 45 rpm, 7-inch records, and three for 33 $\frac{1}{3}$, with setdown positions for 12-, 10-, and 7-in. discs. Under the knob is the vernier speed adjustment which provides approximately 3 per cent increase or decrease in the normal speed.

The operating controls also are similar to the SL-95B—three tabs: automatic start, stop and reject; manual motor start; and cue, for lifting and lowering the arm.

Performance

The Zero-100 performed just about as we expected after reading the specifications. Wow measured .08 per cent—that is in the band from 0.5 to 6 Hz. Flutter, in the band from 6 to 250 Hz, measured .03 per cent, both of which are excellent. The variable-speed control gave a range of a little better than ± 3 per cent on 33 $\frac{1}{3}$ rpm, and a little less than that on 45 rpm. No change in speed was noted over a line-voltage range from 85 to 135 volts, but the expected change came when the line frequency was varied, due to the synchronous section of the drive motor.

While the skating of the arm should be much less pronounced with the near-zero tracking error, it can be shown that some skating tends to exist, but the amount is certainly less than that with conventional arms. This is probably the reason why the magnetic anti-skating feature works so well, and we could certainly see for ourselves that there is a difference in the sine wave shown on the scope when the anti-skating compensation is set properly. Similarly, using the same cartridge on a conventional arm and on the Zero-100 arm, a difference could also be observed on the scope. For all our performance measurements, we fitted a Stanton 681-EE cartridge which tracked perfectly at $\frac{1}{2}$ gram, less than the pressure Stanton recommends. At 1 gram, it was less sensitive to floor vibrations, and at 1 $\frac{1}{2}$ grams, not at all. Signal to noise ratio measured 41 dB unweighted, or with the standard "A" weighting, 56 dB, using the CBS BTR-150 broadcast test record, which also supplied the 3000-Hz signal for the wow and flutter measurements. Arm resonance was measured at just under 10 Hz, and the change cycle required only 10 seconds from the completion of the last groove on one record to the setdown on the outer grooves of the next. Thus the Garrard Zero-100 is certainly the finest in a long line of automatic turntables which have been around for over 50 years. And as usual, each new model contains improvements over its predecessors, with constant research which strives to better performance, appearance, and reliability. We think you will like it.

C.G. McP.

Reprinted from Audio, July 1971 issue

● GARRARD's new top-of-the-line automatic turntable, the Zero 100, features a novel articulated tone arm designed for zero lateral tracking error. The tone arm's cartridge head is pivoted in the horizontal plane, and a separate linkage, parallel to the stainless steel tone-arm shaft, constantly changes its offset angle as it moves over the record surface. Garrard claims the arm has a maximum tracking-angle error of only 90 seconds, which is 1/40 of a degree! This is far lower than can be achieved by any conventional pivoted tone arm, and Garrard's use of precision-loaded ball bearings appears to have eliminated problems of pivot play and friction that have troubled similar designs.

In other details also, the arm of the Zero 100 differs from that found on competing automatic turntables. Anti-skating correction is applied by two ceramic disc magnets. The repulsion between the like poles of the magnets applies an outward torque to the arm that is adjusted by a sliding magnetic shield. The shield position is indicated on a dual calibrated scale, marked to match the stylus force from 0 to 3 grams for conical styli and from 0 to 2 grams for elliptical styli. The arm is balanced by an elastically isolated rotatable brass counterweight. Tracking force is set by a separate sliding brass weight on the arm, whose scale is calibrated from 0 to 3 grams in $\frac{1}{4}$ -gram intervals. No springs are used anywhere on the arm. The slide-in cartridge-mounting plate has an overhang adjustment, with a separate plastic jig for accurate positioning of the stylus. A two-position lever on the front of the cartridge head tilts the cartridge to set the vertical tracking angle for a single record or for the center of a full six-record stack. The tonearm rest post has a built-in lock, spring-loaded so that attempting to lift the locked arm cannot cause damage.

The 11 $\frac{1}{2}$ -inch cast-aluminum platter is driven by a Synchro-Lab constant-speed motor at 33 $\frac{1}{3}$ or 45 rpm. As on the Garrard SL-95B, the playing-speed control of the Zero 100 also sets the arm indexing point for 7-, 10-, and 12-inch records at 33 $\frac{1}{3}$ rpm and for 7-inch records at 45 rpm. A record of any size can be played manually at either speed, of course. The platter is covered with a ribbed, matte-surface rubber mat. There are removable automatic and single-play spindles (the latter rotates with the record), and a single edge-support post for the record stack in automatic operation. Three levers control all operating functions: automatic start/stop, manual start/stop, and cueing. This last operates with a slightly damped lift and a slow, smooth descent that is totally free of lateral drift.

The vernier speed-adjustment control is a ring concentric with the speed selector. The nominal range is ± 2.5 per cent at 45 rpm and ± 3.5 per cent at 33 $\frac{1}{3}$ rpm. Illuminated stroboscope markings under the platter are continuously visible through a window on the motorboard during play. The Garrard Zero 100 is \$199.95. A molded plastic base and a dust cover are available for \$6.95 each.

● *Laboratory Measurements.* The articulated arm of the Garrard Zero 100 lived up to the claims made for it, insofar as we could measure its performance. The limiting angular resolution of our tracking-error protractor is about 0.5 degree, and at no time did we find an error larger than that. Without a doubt, the tracking error of the Zero 100 has been reduced below ordinary measurable limits—and it is certainly far less than the inherent errors involved in cartridge mounting.

The arm showed no sign of resonances or other side effects from its unusual construction. The tracking-force calibration was accurate within 0.1 gram over its full range. The force increased by about 0.2 gram over a stack of six records when initially set for a single record. This is typical of the better automatic turntables we have tested. We were pleased to see that Garrard's anti-skating correction, unlike that on most arms, was approximately correct when set for the tracking force in use. One would expect the automatic reduction in head-offset angle toward the inner grooves of the record to require less anti-skating compensation. Perhaps the wedge-shaped magnetic shield achieved this result; at any rate, the correction was equally accurate over the entire record.

The turntable started rapidly at line voltages as low as 70 volts, and its speed was absolutely stable and unaffected by changes in line voltage or load. The vernier speed adjustment had a range of about ± 3 per cent. The Zero 100 measured well: wow and flutter were 0.1 and 0.025 per cent at $33\frac{1}{3}$ rpm, and 0.13 and 0.05 per cent at 45 rpm. Unweighted rumble was -32 dB, decreasing to -35 dB when the two channels were paralleled to cancel vertical rumble. With CBS RRL weighting, the rumble was -55.5 dB, one of the lower figures we have obtained since we started making weighted measurements.

● *Comments.* Despite its unconventional design (or perhaps because of it), the Garrard Zero 100 was very easy to get used to. In particular, the finger lift (a straightforward extension of the main arm) was exceptionally convenient to use. We also appreciated the smooth cueing (a carry-over from the SL-95B). Indeed, everything worked smoothly, quietly, and just as it was meant to. If there were any "bugs" in the Zero 100, we didn't find them.

It appears to us that the Zero 100 was designed, first and foremost, as a single-record player, and only secondarily as a changer. Only 12-inch records (six of them) can be played automatically, since the changer's record-edge support post is fixed for that size. Ten-inch LP records are not common, but it is well to be aware of this limitation.

Obviously, the Zero 100 was designed to be used with the best cartridges. Its maximum tracking force of 3 grams, or 2 grams with elliptical styli, would rule out most low- or medium-price cartridges.

Garrard's Zero 100, in basic performance, easily ranks with the finest automatic turntables on the market. Its novel arm—which really works as claimed—and its other unique design features suggest that a great deal of development time, plus sheer imagination, went into its creation. In our view, the results were well worth the effort.

Reprinted from Stereo Review, July 1971 issue

**HIGH
FIDELITY**

First Automatic to Offer Tangent Tracking

Comment: Newest and best of the Garrards is the Zero 100 which, for the first time, offers the advantages of tangent tracking in an automatic record player. The trick is accomplished by an articulated arm/head system: parallel to the tone arm and linked to it by pivots is an auxiliary arm. As the pickup moves across a record, the head or shell pivots (in response to movement of the auxiliary arm) so that the stylus remains tangent to the record groove. This

action is not quite the same as radial tracking but its effect is very similar: it permits the playback stylus to traverse the disc while remaining tangent to the groove, thus eliminating tracking-angle error. The actual "error" read by CBS Labs using this arm was within plus or minus 0.25 degree which is the accuracy limit for reading its test instrument.

The use of a pivoted/articulated arm to achieve tangent tracking permits its combination with a turntable for automatic changer use since it is the inward swing of an arm that triggers the change mechanism. The Zero 100 thus may be used as a full automatic for a stack of records, as an automatic single-play unit, and as a completely manual player, including the option of letting the platter rotate first and cueing the disc at will. In the latter two modes, the short spindle rotates with the record, a desirable feature that eliminates possible enlarging of center holes. A built-in cueing device permits raising and lowering the arm in any mode, and a locking device secures the arm when the unit is turned off.

Aside from tangent tracking, the new arm has many other worthwhile and advanced features. A platform slides out of the shell for convenient installation of the pickup; a gauge supplied with the unit permits adjusting the pickup position for correct stylus overhang. Another adjustment, on the front of the shell, sets the vertical angle for manual or automatic play; in the latter mode the pickup angle is optimized for the third record in a pile, which is the generally accepted compromise setting for changer use. The arm is balanced initially by a movable rear counterweight; vertical stylus force then is set by moving a sliding weight along the underside of the arm, measuring the stylus force applied against an engraved scale. CBS Labs found this adjustment to be absolutely accurate; there was no measurable error in the arm's scale when checked against laboratory instruments.

Antiskating compensation is applied in an ingenious and effective way by means of a built-in magnetic system: a pair of opposing ceramic magnets are mounted in the arm pivot together with a magnetic shield. The shield, which may be moved by a top-side control, regulates the amount of magnetic repulsion, and thus the amount of antiskating, exerted on the tone arm. The antiskating control itself has two scales, one for elliptical styli, the other for conicals. Again, CBS Labs found that the amount of force applied was correct across the diameter of a record. In passing, we also might note that the absence of springs—and the use of precision sliding members—for these adjustments tends to make them more accurate and more stable over long periods. Arm friction laterally measured 0.1 gram—not the lowest ever measured but low enough. Vertically, the friction was very low, below 20 milligrams. Stylus force needed to activate the automatic trip was 0.3 grams. Tested with a Shure V-15 Type II Improved cartridge, the arm showed a resonance at 6 Hz, with a 7-dB rise—lower (better) than average. Altogether, this new arm strikes us as an excellent piece of engineering; it probably is the best arm yet offered as an integral part of an automatic player.

The two-speed (33 and 45 rpm) platter is driven by Garrard's synchronous motor which proved, in CBS Lab tests, to run absolutely accurate, with no measured speed error, at test-line voltages of 105, 120, and 127 volts AC. To deliberately vary the speed (and thus the pitch of recorded music) there's a control that permits modifying either speed by 3.5 per cent either way. Average flutter was insignificant at 0.07 per cent. Rumble, measured as -56 dB by the CBS-ARLL method, compared favorably with that measured in other top-line automatics. For record stacking, the Zero 100 employs the "two-point" support system found in other recent Garrards: a combination of the retracting member in the long center spindle and a small plastic platform at the outer edge of the platter. In addition to the controls and adjustments already described, the Zero 100 has a record-

diameter selector concentric with the speed selector and vernier adjustment. An illuminated built-in strobe indicator peeps out near the front of the turntable. An escutcheon at the right holds three tab controls for automatic stop/start, manual off/on, and cue play/lift. Operation is simple, quiet, and reliable. The change cycle in automatic mode takes 7 seconds with the turntable set for 33 rpm.

All told, we feel that Garrard has come up with a real winner in the Zero 100. Even without the tangent-tracking feature of the arm, this would be an excellent machine at a competitive price. With the novel (and effective) arm, the Zero 100 becomes a very desirable "superchanger" with, of course, manual options.

The Zero 100 is supplied with stereo signal cables, a short spindle, a long spindle, and a single-play 45-rpm doughnut adapter. Available accessories include three optional bases: Model WB-2, walnut, \$19.95; Model B-2, molded plastic, \$6.95; Model B2P Powermatic (controls power to system), \$15.95. A hinged dust cover, Model D-2, \$6.95, fits any of these bases. Also available is a mounting board, Model MB-11, \$2.25, for custom built-ins. An automatic 45-rpm doughnut spindle, Model LRS-100, lists for \$3.80; additional cartridge slideholders, Model C-3, are priced at \$3.00 each.

Reprinted from *High Fidelity Magazine*, September 1971 issue



Fella Here's Got a Record Turntable that Just About Does Everything But the Dishes

BY MICHAEL N. MARCUS

Garrard Zero 100 Changer

I am one who generally does not get too turned on by record playing equipment, regarding anything more complex than my seven-year-old AR manual turntable as little more than a laboratory curiosity: technical marvels are nice to look at... but would I really want to own one? Oh, occasionally I've been tempted by some of those smoothly whirring automatons with seductive tone arms that all but pour my wine for me, but after regaining my senses I have generally dismissed such wonders as ostentatious, at least, probably prone to mechanical foulups, and definitely too expensive.

However, Garrard's new "Zero 100" super record changer has definitely altered my spartan outlook. This unit has every imaginable gadget and gee-gaw one might possibly desire, and it works. And considering how much it does, and how well it does it, at 200 bucks it doesn't even seem expensive. The changer has so much in it that an analysis of its innards is almost a case study in record player design.

The most obviously unusual thing about the Zero 100 is its tone arm set-

up, which is the source of the "Zero" in the name. The unit is supposed to have zero tracking error.

You see, when discs are first cut on a recording "lathe," the cutting stylus is mounted on a moving carriage affair suspended from a rail that goes from the outside edge of the disc to the hole in the middle. The cutting stylus cuts the grooves in the blank disc at right angles to the rail, and is always at the same tangential angle to all of the grooves.

The problem develops in play-back, because a normal pivoting tone arm swings in an arc across the record surface, and only at two points will it be tracking on the same tangent angle as the original cutting stylus. When the two angles are not the same, you get distortion. With a good normal tone arm, this tracking distortion is quite small, and some engineers say it is not worth trying to eliminate; but I will say that in my own tests, using identical virgin records, and virgin styli in identical good cartridges, the Zero 100 on occasion sounded markedly "crisper" than other turntables.

The Zero's tone arm is actually two arms: a basically normal-looking stainless steel bar, that tapers into a handy finger grip, and along side of it a metal rod. The cartridge head, instead of being fastened rigidly to one arm, is attached with NASA quality ball bearing pivots to both the arms, at points an inch or so apart.

At the other end of the arm assembly, the rod and the bar are again linked together with two pivots, and

the whole tone arm system is free to flex like one of those articulating parallelogram rulers you find on drafting tables. Now, as the tone arm moves across the record, the cartridge head is pivoted, rotating about the end of the main arm. The angle between the stylus and the arm changes as it moves across the record, but the angle between the stylus and the grooves remains the same. Neat, eh?

Next problem to be solved is *skating*, the tendency found in all pivoting tone arms to move toward the center of the disc, often causing sonic distortion and excess wear on the "inside" wall of the record groove. Most recent turntables and changers have some kind of mechanism to apply a contrary force to neutralize skating, usually involving a system of pivoting bars or troublesome pulleys and weights.

On the Zero 100, there is a seemingly foolproof arrangement using two opposed ceramic magnets. There is a metal shield between them, and the shield is adjustable (it's calibrated in grams) back and forth to provide just enough magnetic repulsion to produce a twisting force to counteract the skating pressure of the particular cartridge being used.

A good many cartridges seem to use a number "15" in their model numbers. This is a reference to the 15 degree vertical angle of the cutting stylus. Tone arms can be designed to recreate this 15 degree angle on play-back, but a hassle develops with record changers, where the cartridge has a different vertical angle with each additional record on the platter. A couple of changer makers attack this problem by putting the tone arm support on sort of an elevator, which jacks up the whole deal to accommodate piles of records. The Zero 100

does it more simply, right at the cartridge head, with a sliding wedge that when set for manual will track at 15 degrees with one record on the platter, and when set for automatic play will reach 15 at the third record on the stack. The changer can handle six discs, so of course this arrangement is a compromise, but is certainly better than nothing.

Ideally, we should have some kind of automatic device that can sense how many LPs have dropped onto the platter, and adjust the height of the arm accordingly—but I wouldn't want to have to design it, or pay for it.

Other neat stuff on the Zero include a plus-or-minus 3 percent speed adjustment with an illuminated stroboscope disc; a hot-shot "Synchro-Lab" motor that starts up fast like a normal induction motor, but synchronizes to the 60 Hz frequency of your AC power line to maintain constant accurate speed in spite of voltage variations... so you don't need to use that nifty plus-or-minus 3 percent speed adjustment; the world's best tone arm hold-down clip; an accurate and easy stylus force setting arrangement; and a really gentle, well-damped cueing system that will set the stylus down within a couple of words of the exact groove you want.

The turntable itself is a pretty heavy cast aluminum job, 11½ inches in diameter—a size which is big enough, but lets you pick up records without having to jab into the rubber platter mat. The changer is easy to operate, with three positive-but-soft tab levers instead of the clunky handles found on the cheapies, and it is so quiet while running that I've accidentally managed to leave it on all night a few times. In sum: I don't know what you could need that it ain't got.

From *ROLLING STONE*, © 1971 by Straight Arrow Publishers, Inc. All rights reserved. Reprinted by permission. September 16, 1971 issue.

"Reproduction quality was excellent with no detectable wow, flutter or rumble under stringent listening conditions. End of side distortion, which is always a possibility with pivoted arms, was virtually absent, due no doubt to the tangential tracking arm.

In terms of measurements, wow and flutter were so low as to defy accurate measurement, being at about the lowest value available on test records (even the special ones I have acquired from friends in the recording industry)."

Reprinted from *The Gramophone*, August 1971 issue



"One could go on cataloging the virtues of the Zero 100 indefinitely."

Reprinted from *Modern Hi-Fi and Stereo Guide*, Fall 1971 issue

Reviews of the Garrard Zero 100 and the Zero Tracking Error Tonearm.

AUDIO

Garrard "Zero-100" Automatic Transcription Turntable

Incorporating practically every known plus feature in one automatic turntable, the new Garrard Zero-100 unit introduces for the first time in an automatic a zero-tracking-angle device on the arm which causes the head to maintain practically perfect tangency to the record groove at all diameters. It is well known that a minimum tracking angle is one of the desiderata in any record-playing mechanism, but on all conventional arms, the tracking angle will vary from a value of as much as +4 deg. at the outer grooves to -1 or -2 deg. somewhere between the start and finish, then rise again to a value of perhaps +1 or +2 deg. at the innermost grooves.

Arms have been introduced that corrected this problem, but they were only for single-play turntables—never before on automatics. The importance of a near-zero tracking error is attested to by the number of such arms that have been on the market in the past and which no longer are. A little study of the problem of perfect tangency will convince anyone that a solution by the parallelogram method is possible. The principal reason the earlier "parallelogram" types were not successful is that the increased number of bearings caused too much friction. Now with the availability of improved types of free-rolling bearings, the same principle has been worked out with complete satisfaction.

A simple list of all the "Zero-100" features should serve to spotlight the changes that have been incorporated in this model of the Garrard. We will elaborate on them later on:

- 15-deg. vertical tracking angle adjustment.
- Sliding-weight stylus-force adjustment—easy to adjust as little as one-tenth of a gram.
- Magnetic anti-skating control.
- Spring-loaded tonearm safety restrictor (lock).
- Long-taper variable speed control.
- Illuminated stroboscope, with two bands of lines, one for each speed.
- Rotating manual spindle.
- Proven "Synchro-Lab" motor—combination of induction and synchronous types.
- Lightweight, balanced, full-diameter platter.
- Safe 2-point record support.
- Handsome combination of chrome, brass, and plexiglas for tonearm mounting.
- Adjustments for arm lowering position, lifting height, and lifting-height restriction.

All of these features combined into one automatic turntable make news, even though some are found on other units. Only in the Zero-100 are they all put together. Taking them individually, we first come to the vertical tracking-angle adjustment. This is a simple lever which has two positions marked "M" and "A". In the "M" position, the cartridge head is set for a 15-deg. tracking angle on a single record, played Manually. In the "A" position, the cartridge is tilted slightly so it is at the proper 15-deg. angle for the third record of a stack of six, the maximum number that may be stacked on the machine.

The stylus-force adjustment is by means of a sliding weight on the arm, which is first balanced with the weight at "0" and then the weight is moved to the desired stylus force. A movement of $1\frac{1}{8}$ in. varies the stylus force by only one gram, so an accurate setting can be made to any desired amount up to three grams or even down to one-quarter of a gram.

The anti-skating control involves no mechanical linkage to the arm. A simple slide on the fixed arm mounting serves to place a shield between a fixed magnet and one mounted on the movable gimbal which supports the arm. Separate calibrations are provided for conical and elliptical styli.

While most turntables have a lock to hold the arm on its rest, it is usually a solid one, and lifting the arm could cause damage when it is supposedly locked. On the Zero-100, the lock is sufficiently firm, yet if the arm is lifted when locked, a restraining spring gives slightly to remind you that it was locked, suggesting that you release it.

The variable-speed device on modern turntables usually employs a tapered spindle on the motor shaft against which the idler wheel is moved up or down to provide the speed change. If the taper is steep, the idler contact with the shaft can vary, causing an unwanted wow. In the new Garrard, the tapered shaft is long, with a gradual taper that ensures good contact and allows a more accurate setting of the speed. The two speeds are indicated by a built-in stroboscope—a series of lines in the usual fashion, but placed on the underside of the platter, illuminated by a neon bulb, and viewed by a series of mirrors from the top of the unit. The two bands of lines allow accurate setting for either speed. We consider a built-in strobe highly important when variable speed is offered.

The rotating manual spindle is now common on high-quality turntables and is now a part of the Garrard. The "Synchro-Lab" motor, a unit which employs both an induction section and a synchronous section, makes for the best of two worlds—quick starting, and constant speed. The platter is non-ferrous, and is a lightweight component with a full rubber surface for the disc, providing damping needed to support the entire record surface.

In the Zero-100, Garrard retains the reliable two-point support for the stack of records. Once the stack is placed on the automatic spindle, a plastic clip steadies the stack, yet allows the bottom record to drop gently to the platter on a cushion of air.