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Ortofon Moving Coil Pick-Up Cartridges.

Ortofon's new products include three moving coil pick-up cartridges - SL20E, MC20, SL20Q - and the MCA-76 pre-preamplifier. We believe that these products make an important contribution to the high fidelity industry; and when you have read about them and hopefully have auditioned them at your dealer's, we think that you will agree with us.

What You Should Know About High Quality Pick-Up Cartridges.

The cartridge, via its diamond tip, makes contact with the record surface, and it translates the undulations of the recording grooves into electrical signals which can be amplified and played through a loudspeaker. Its function is to do this as accurately as possible, without changing the signal, and with minimum wear on the record. To accomplish this, the diamond stylus has to move at very high speeds with very high forces involved; and yet it has to touch the surface of the disc very gently with pressures of one to two grams. The cartridge is truly a precision instrument which, at the very beginning of the high fidelity chain, has a very important influence on the quality of the recorded sound.

There are two principal cartridge types (although some esoteric other principles are available) - the magnetic type which involves moving a magnet or a piece of magnetic material in a magnetic field and the dynamic type in which a coil is moved in a magnetic field. It is this latter type to which we refer as moving coil which Ortofon is using in these new products (figure 1.).

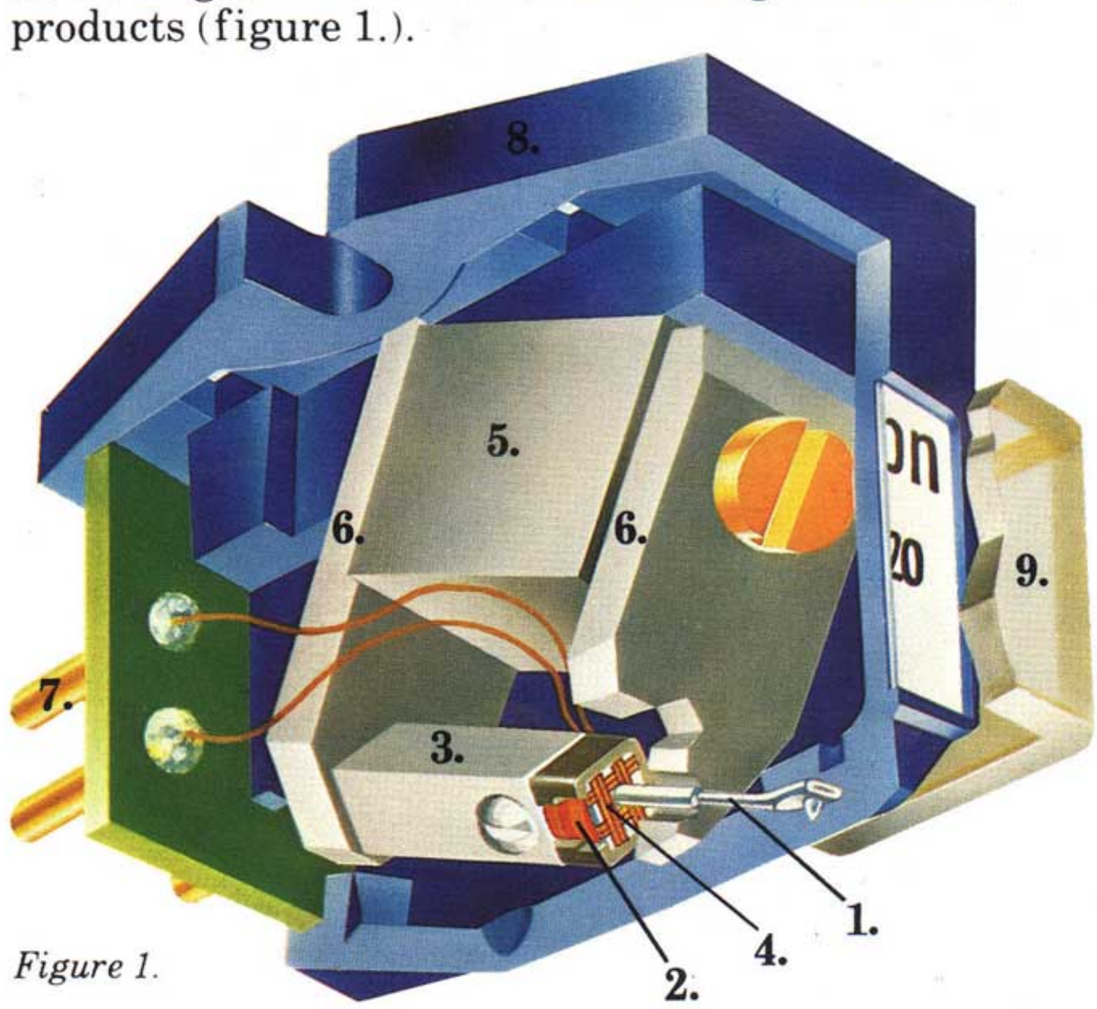


Figure 1.

1. Stepped cantilever
2. New damping mechanism
3. Square pole piece
4. Moving coils
5. Magnet
6. Pole pieces
7. Terminal pins
8. Cartridge body
9. Stylus guard

Magnetic cartridges are the most widely used types. They can provide good quality with adequate output for most amplifiers with which they are used, and they can be constructed with easily replaceable stylii. The moving coil cartridges are more expensive to produce, they have lower output, and it is not practical to provide customer-replaceable stylii with this type of design. However, the moving coil pick-up cartridge offers very high quality of sound reproduction with extremely great linearity and accuracy. It has been the choice of professionals and of serious audiophiles for many years on the basis of its audible superiority over other types.

Ortofon manufactures both magnetic and dynamic cartridges. We feel that there is need for both types in the market, but that the moving coil type is the ultimate for those who want the maximum in accuracy and are satisfied with nothing but the best. Ortofon introduced the moving coil cartridge in 1948 and has always been the leader in development of this type of unit. Our three new models are the latest evolutionary step in this development. We hope that you will better understand and appreciate these products if we explain to you briefly how they work and what we have done now to make them better than ever before.

How The Moving Coil Works.

The moving coil pick-up cartridge is actually a micro-miniature generator. When a coil moves in a magnetic field, a voltage is generated in that coil. Figure 2 shows a sketch of the principle behind the patented construction used in Ortofon moving coil cartridges. A coil winding is pictured in two different positions. In the neutral position the magnetic field by-passes the coil and no signal is generated. In the other position - altered by the movement of the cantilever - the magnetic field passes through the coil winding and sets up an electrical signal. A separate coil is used for each of the two stereo channels, and they are located so that each produces independent signals.

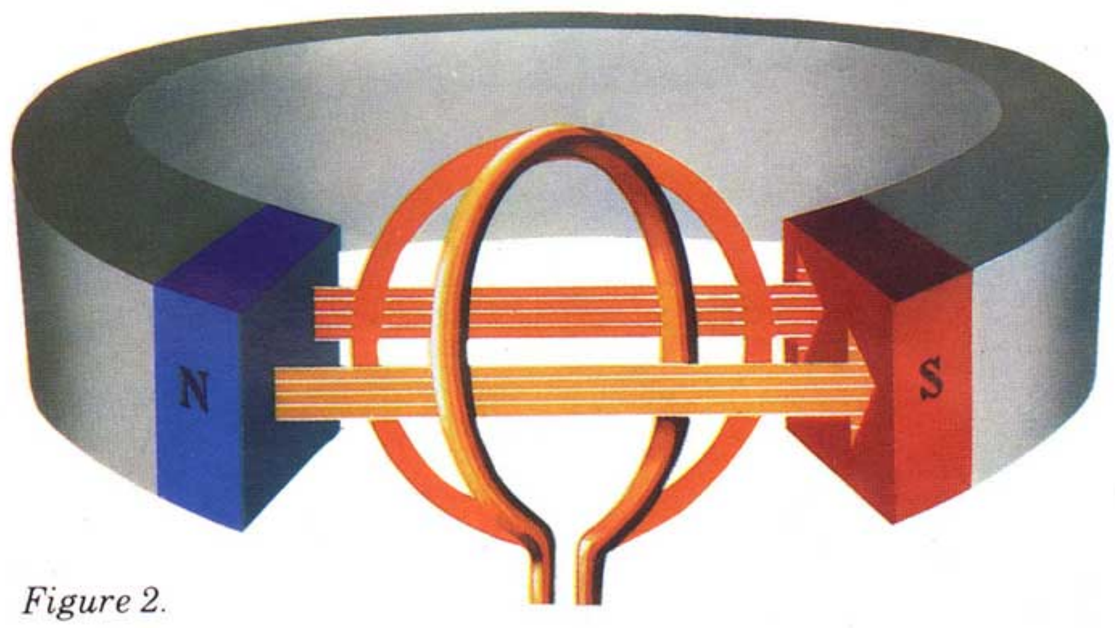


Figure 2.

You will appreciate the technical difficulty of this construction when you realize that these coils are so small that they are wound under a microscope and each contains 28 turns of wire so fine that 1 kilo (2.2 pounds) of this wire will make 800,000 cartridges.

As the diamond tip traces the small variations in the record surface, its movements are transmitted through the cantilever to the two coils. These move to either side of their neutral positions cutting through the magnetic lines of force between the magnet poles. This is the principle on which electrical generators work, and the result is that tiny voltages are obtained from the coils, and these voltages are accurate replicas of the signal which was impressed in the record grooves.

In our new designs we have incorporated three new ideas which make these moving coil cartridges more accurate than ever before.

Stepped Cantilever.

The cantilever is the shaft which connects the diamond stylus to the coils. In all cartridges, regardless of type, the cantilever has to be as light as possible and yet must be as stiff as possible. These are contradictory requirements which must be compromised in practical designs. If the cantilever is heavy, there will be increased wear on the record. If the cantilever flexes, it will not transmit the stylus motion accurately to the coils.

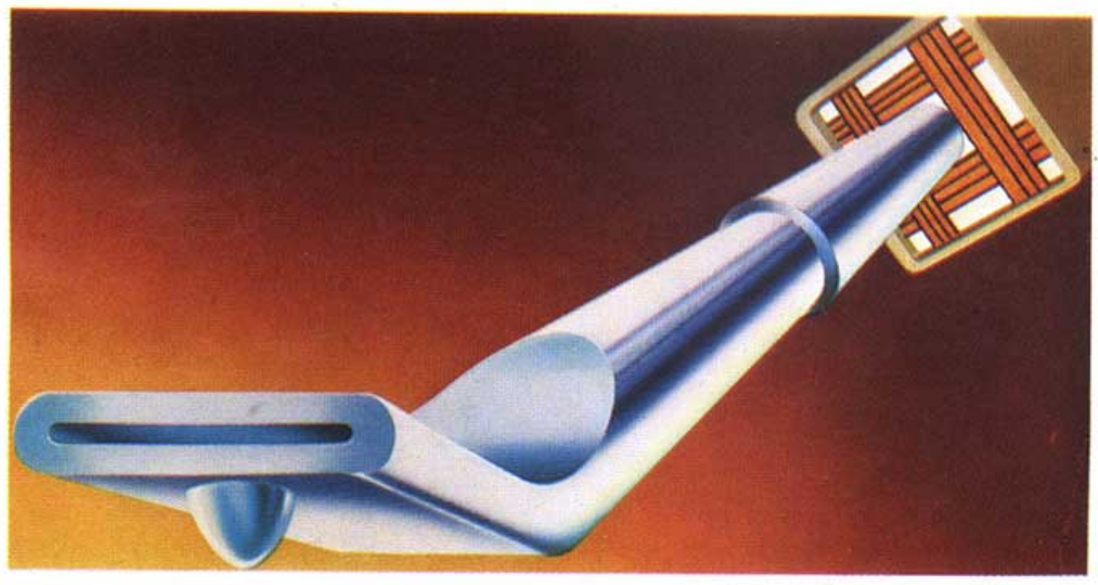


Figure 3.

Figure 3 shows Ortofon's solution of this problem - the stepped cantilever. Here, the step reduces the mass or weight of the cantilever and yet improves its stiffness. The wear on the record is reduced and yet the fidelity of reproduction is improved. This innovation is an Ortofon exclusive feature.

New Damping Mechanism.

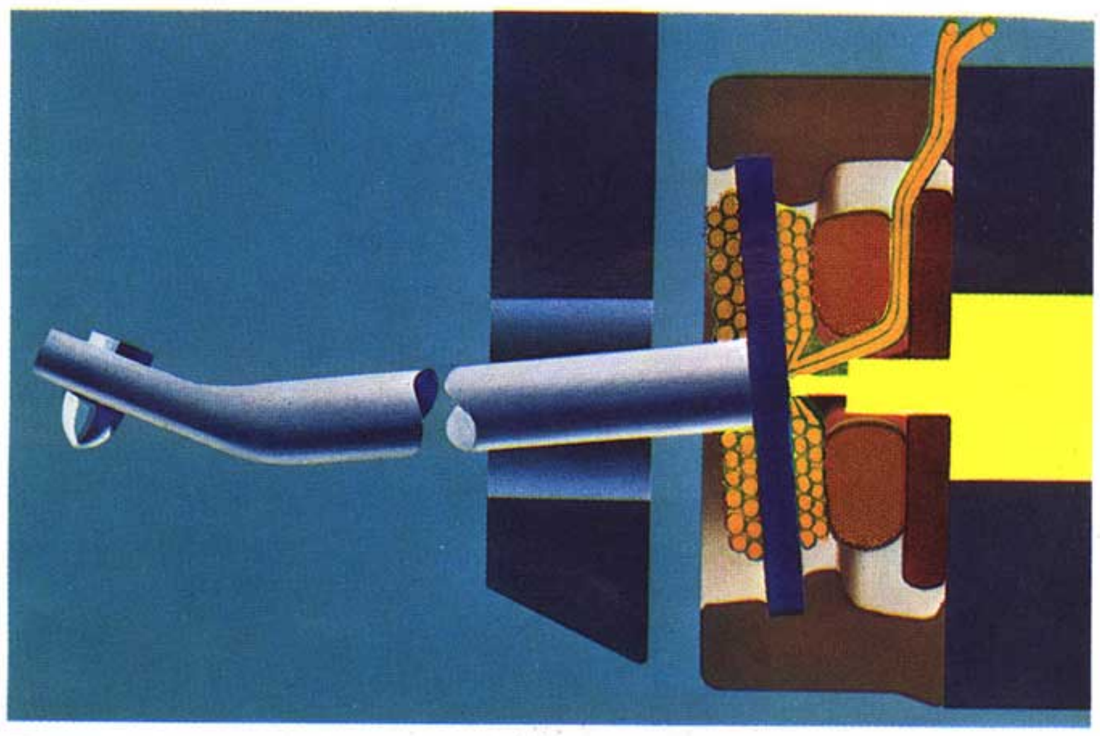


Figure 4.

As we have indicated in discussing the moving coil principle, important elements of the pick-up cartridge move during sound reproduction. As in all mechanical devices, there is the possibility of uncontrolled motion, and this must, of course, be avoided. A moving element tends to have a natural frequency of vibration or resonance, and the designer takes two steps to minimize the effects of this resonance. He tries to have it occur out of the range where its effects might be heard, and he also tries to control it with some form of damping mechanism. His problem is to avoid unwanted effects of this damping which acts not only at the frequencies of desired correction but possibly at other frequencies also.

The Ortofon design uses a very sophisticated damping arrangement which involves a three-part rubber suspension. This confines the correction to the places where it is required, and it further functions without changing under conditions of temperature change. Damping systems of less elegant structure will tend to change with temperature so that the performance of the pick-up cartridge on a hot day will be different than on a cold day.

Ortofon cartridges will maintain the fine level of performance winter and summer, from tropical areas to arctic ones.

The damping mechanism illustrated in figure 4 assures optimum tracking with a flat frequency response, and with ideal transient response while minimizing record wear. The result is smoother, more natural sound, without harshness.

Square Pole Piece.

The conventional magnetic pole piece is round, but we have made an improvement in performance by substituting a square pole piece. This has an important advantage.

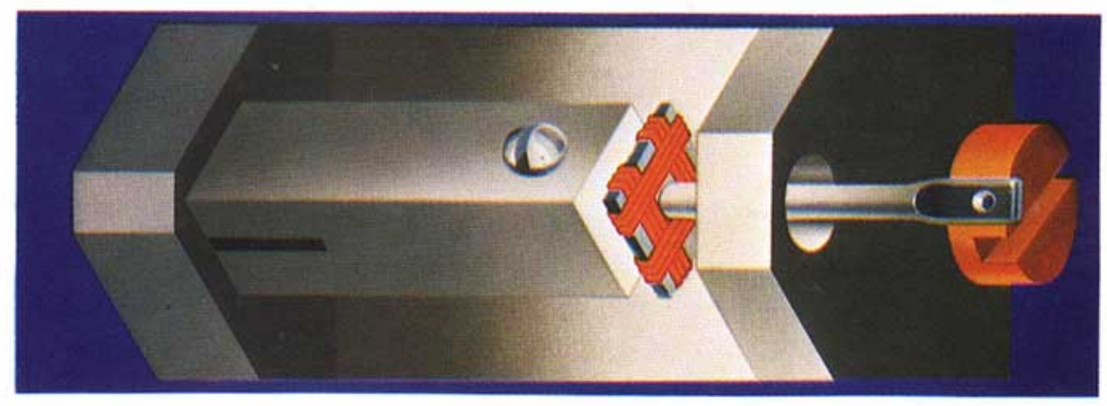
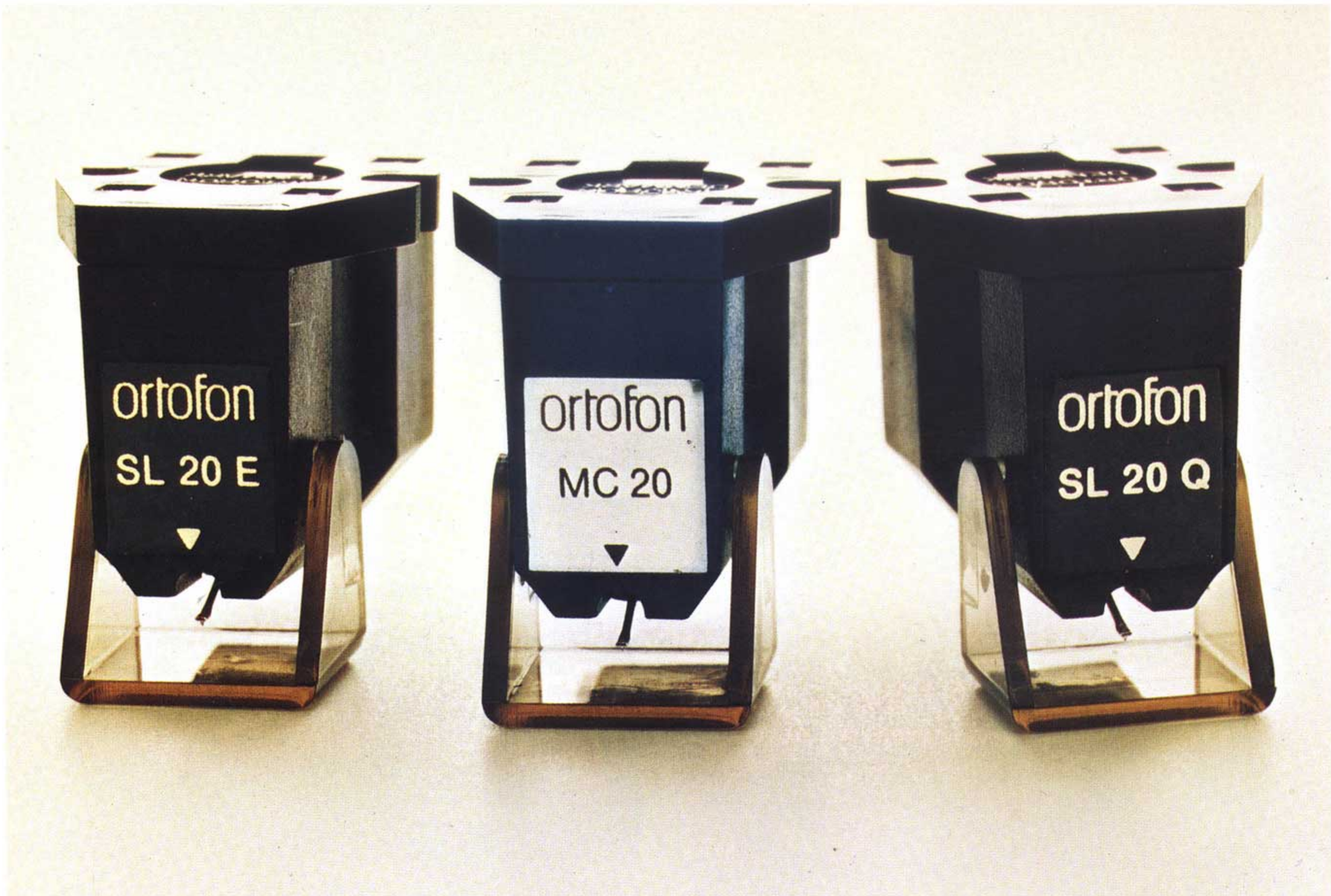


Figure 5.

The magnetic field is made more uniform with the square pole piece, and this means that the moving coils make a more linear translation of the mechanical motion to electrical signal. The result is less distortion of the signal with improved clarity. Figure 5 shows the structure.



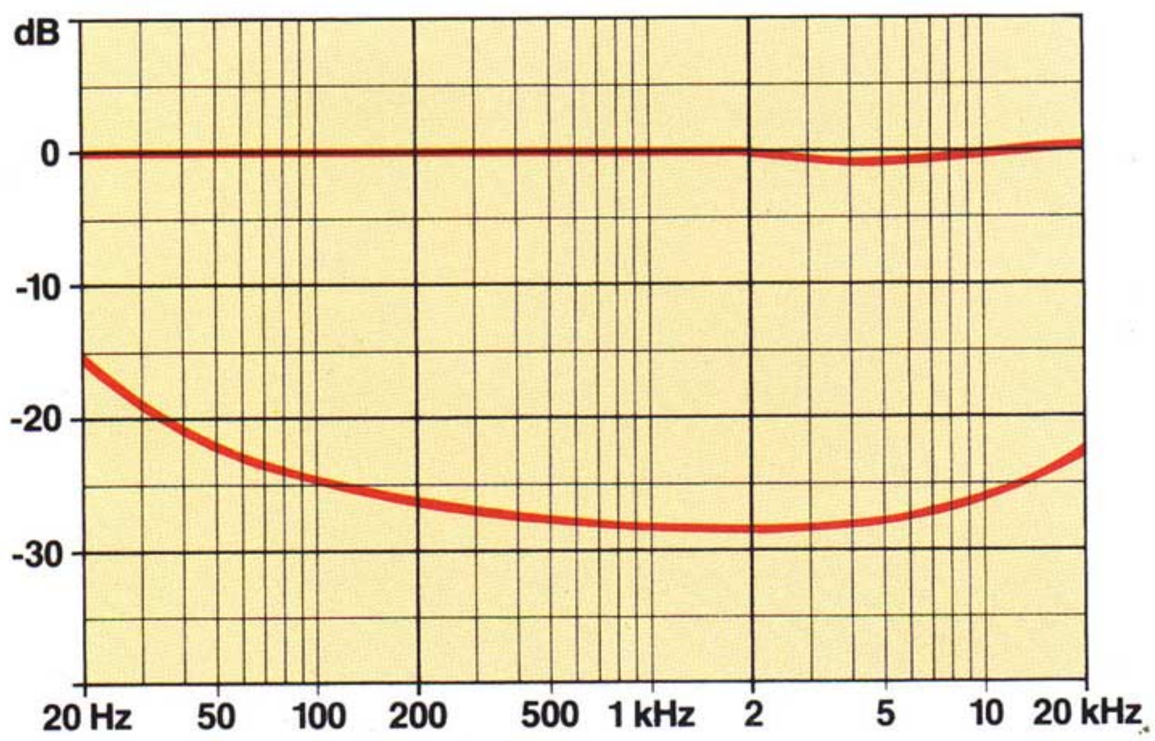
Here Are The Three New Pick-Up Cartridges.

SL 20E. This is the standard Ortofon moving coil cartridge of very high performance. It is the successor to the well-known SL 15E Mk II incorporating the latest advances. It has a very flat frequency response through the entire audio range with excellent tracking. It is supplied with elliptical stylus and is ideal for stereo and all types of four-channel matrix systems.

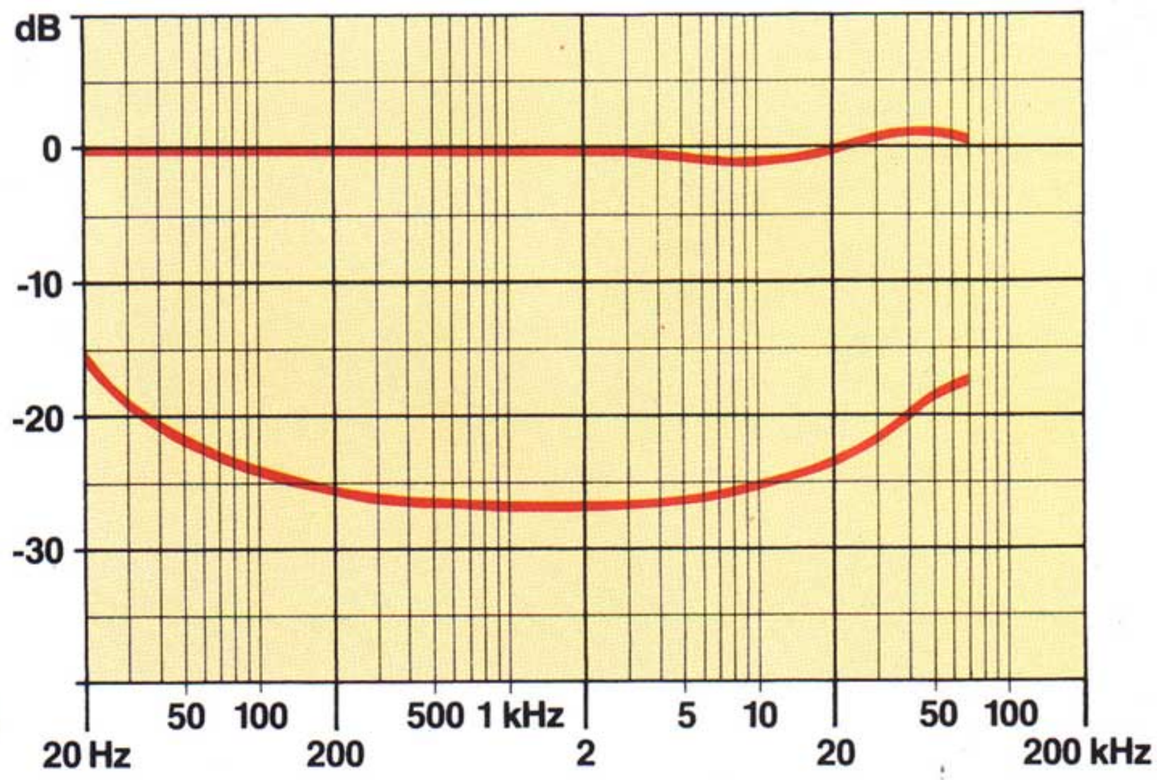
MC 20. The MC 20 is Ortofon's finest cartridge for stereo installations and is recommended for professional applications of the most stringent requirements. It is supplied with a special "fine-line" stylus which minimizes record wear while preserving excellent tracing ability at the highest frequencies. Of course, it is a superior performer on four-channel matrix recordings also.

SL 20Q. This cartridge was specially developed for the playback of discrete (CD-4) four-channel records. Its performance quality is equally impressive with non-quadraphonic systems.

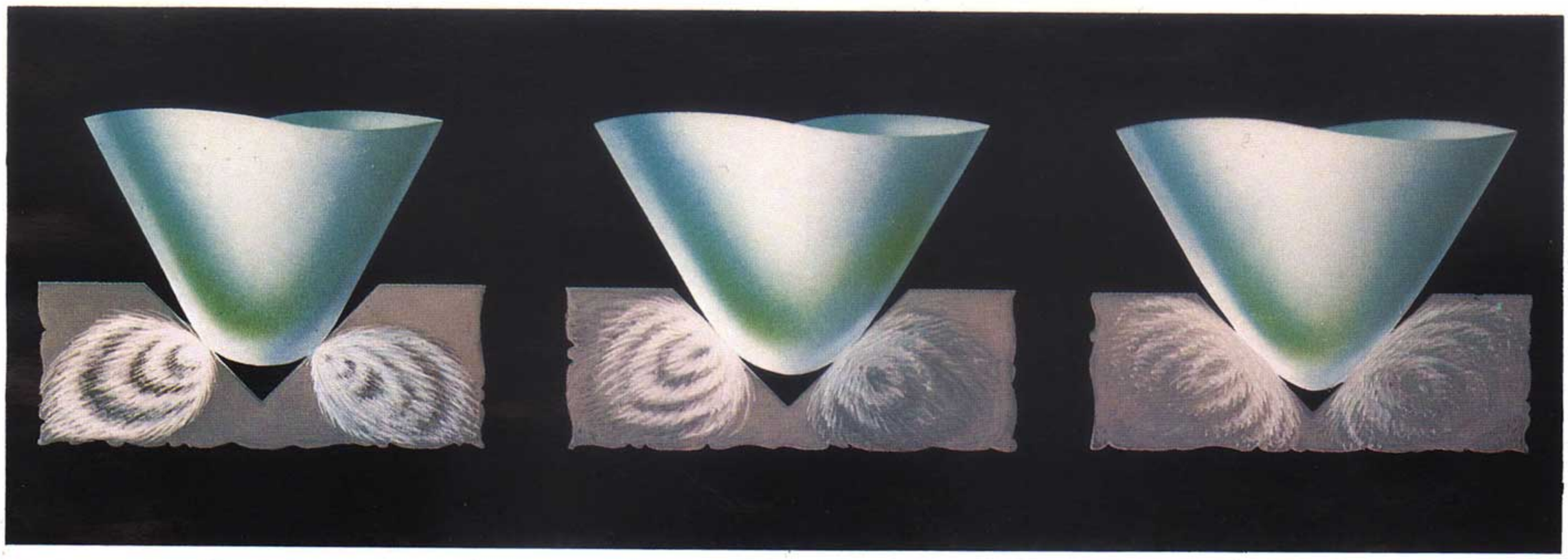
All three new models, incidentally, are housed in a body which fits all standard arms and is simple to mount. They have built-in stylus guards, and gold-plated terminal pins assure perfect electrical contact.



Typical frequency response and channel separation for the MC 20 & SL 20E.



Typical frequency response and channel separation for the SL 20Q.



Elliptical. *Fine-Line.* *Bi-Elliptical.*

Diamonds Are Not All The Same.

Contrary to popular belief, diamond stylii are not all the same. They have different constructions and different shapes, and both of these factors have important consequences when playing recordings.

It is the diamond which makes the contact with the record. To do the best job, the diamond must have small size, precision shape and polish, and resistance against wear and breakage. Ortofon achieves these requirements by using natural, whole diamonds (not small chips on metal shanks). These diamonds are axially oriented for maximum strength, and they are mirror polished to precise shapes. This provides both a longer lasting stylus and a longer lasting phonograph disc.

The three new Ortofon models use special-shaped stylus tips to obtain specific performance goals.

Elliptical (SL20E). The elliptical shaped diamond stylus was introduced to overcome a source of distortion incurred with the conventional spherical stylus formerly used. The original master disc is cut with a triangular cutting saphire, and the groove it produces cannot be followed precisely with a round playback tip. The elliptical tip does conform more closely to the optimum playback shape. Therefore, the elliptical shape reduces the distortion.

Fine-Line (MC20). The fine-line diamond tip has the benefit of the elliptical tip by keeping a thin edge along the groove which can follow the high frequency signals with accuracy. At the same time, the fine-line has greater contact with the sides of the groove in the vertical direction so that it imposes less wear on the record than the elliptical tip. Its shape is made optimum for the standard stereo groove angle so that it gives excellent tracing, low distortion, and low record wear.

Bi-Elliptical (SL20Q). Still greater contact surface with the record groove is achieved with the bi-elliptical diamond tip as shown in the drawing. The thin profile of the tip follows the very fine undulations of the quadraphonic discs recorded with the CD-4 system where response above the conventional audio band must be preserved. The special bi-elliptical shape ensures a perfect tracing of the base band as well as the carrier band frequencies, and this yields superb four-channel discrete reproduction.

How To Choose Between Three Fine Cartridges.

If you want to play CD-4 discrete four-channel recordings, then your choice must be the SL20Q. It can also be used, of course, for conventional stereo play; but then one is paying for a feature which is not being used if one is not using a CD-4 system.

For very fine performance of two-channel recordings, or four-channel matrix recordings, either the SL20E or the MC20 can be used. The elliptical SL20E is the standard reference cartridge with the qualities which have made the elliptical tip synonymous with high fidelity for many years.

The MC20 is a new concept which we feel has the quality of an elliptical tip with a further benefit of reduced record wear and a slight improvement in tracing. We feel that it is the direction of most future designs.

The Long-Awaited Pre-Preamplifier.

Since moving coil pick-up cartridges have a lower signal output than magnetic types, it has been necessary to use some means of boosting that signal. Ortofon has, until now, recommended and supplied a transformer for this purpose. Transformers are free from noise problems and have very low distortion. However, they have some theoretical disadvantages of frequency response and phase shift which offer potential for improvement by other methods. Therefore, we have had our research department spend the past three years working on the development of a pre-preamplifier which could be offered as an alternative to the transformer.

Our goal was to reduce the noise in a pre-preamplifier to the point where it could not be heard and to get other features for convenience and reliability. Here were some of the design goals:

- self-powered to avoid dependence on batteries
- extremely quiet so that noise would be inaudible
- freedom from pickup of external signals - either hum or radio frequency signals
- essentially free of distortion
- capable of eliminating subsonic signals (such as rumble)
- stable and unchanging performance under conditions of ageing, temperature change, and line voltage change
- usable with stereo, four-channel matrix, and CD-4
- attractive, convenient to use, and simple to service

The Performance Of The MCA-76 Pre-Preamplifier.

It took three years of research effort, but we feel that we fully accomplished our goals. The MCA-76 pre-preamplifier is close to the theoretical limits of noise and distortion. It boosts the signal from our moving coil cartridges so that signal levels match the conventional magnetic phono input requirements of associated equipment. Here are some of its features:

a built-in power supply with a specially developed power transformer

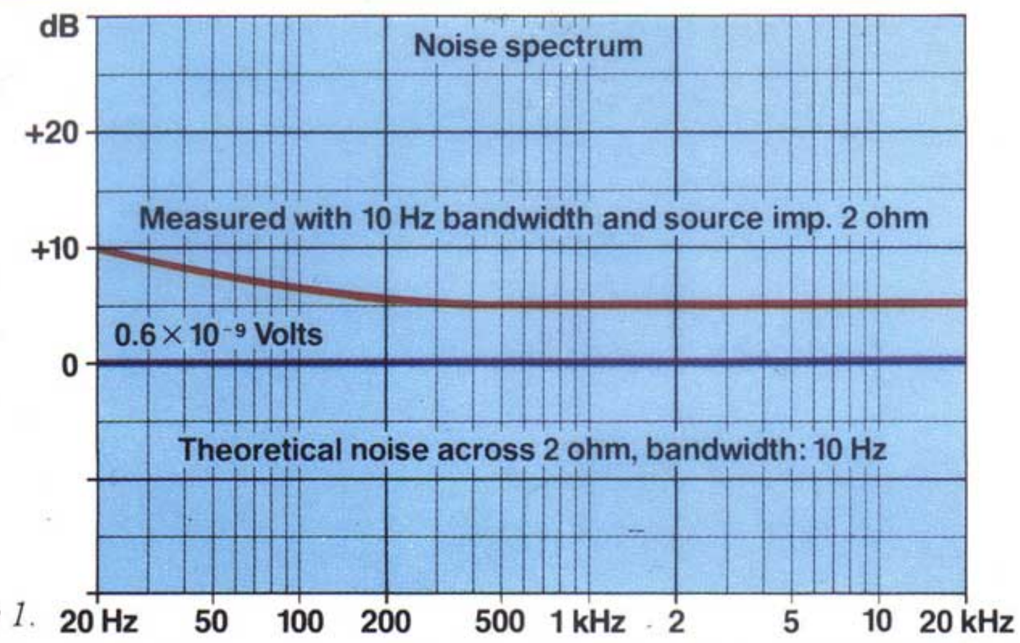
a by-pass switch so that it need not be disconnected when changing between magnetic and moving coil cartridges

a switchable filter to change the high frequency response for best CD-4 performance

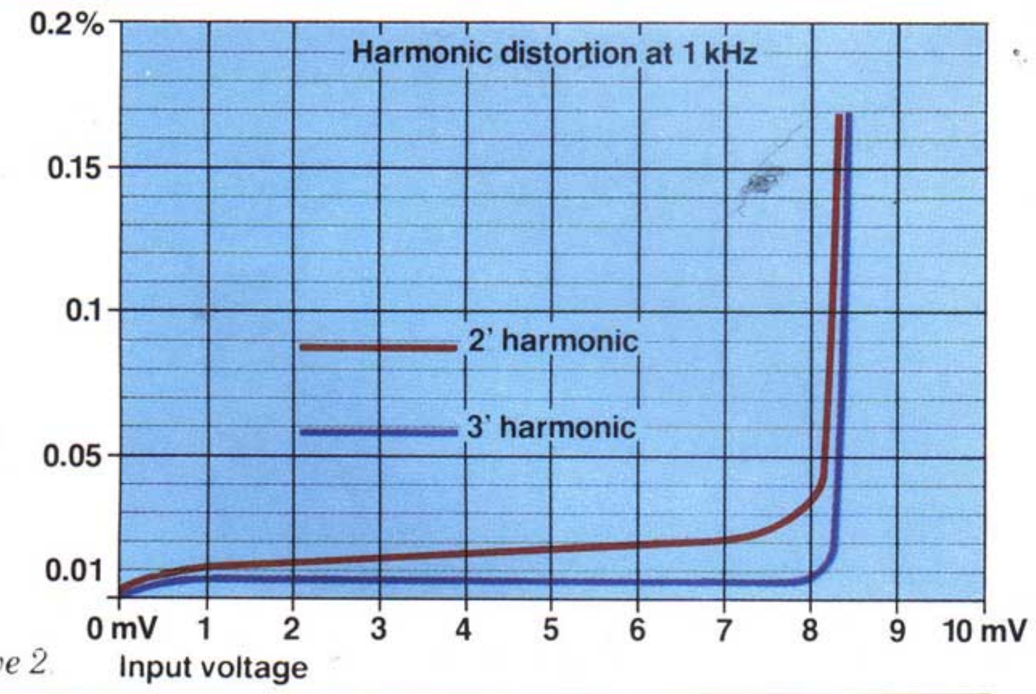
low noise (see curve 1) which is only 5 dB above the theoretical minimum possible. Since the MCA-76 has a low output impedance, it also reduces noise generated at the input of associated equipment

low distortion is shown by curve 2 indicating the harmonic distortion

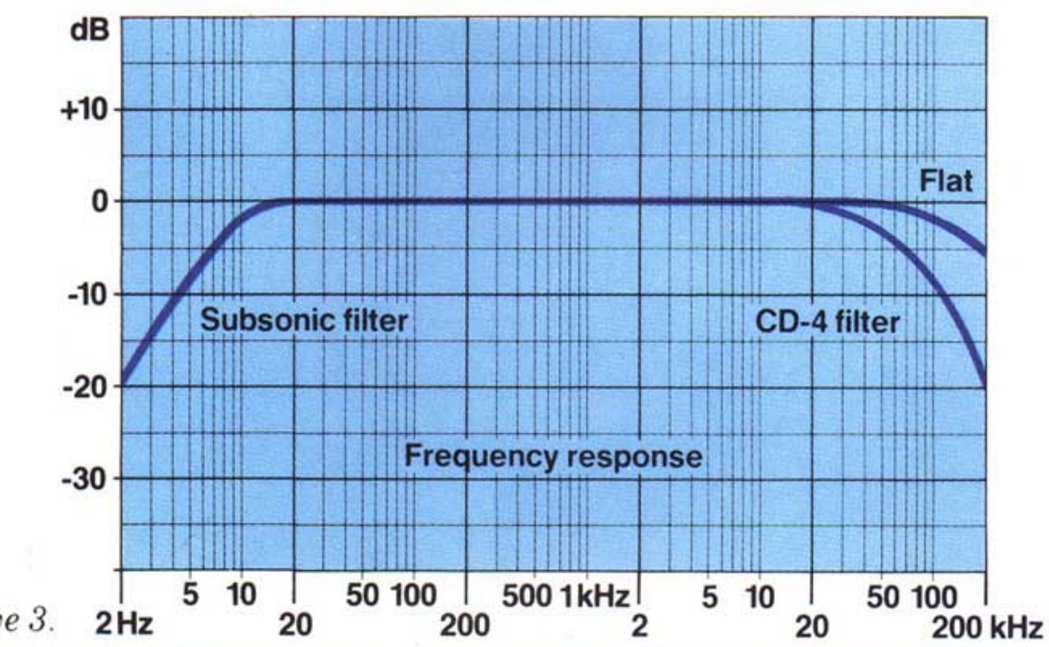
a subsonic filter to cut off sound below 13 Hz (see curve 3). Undesired signals in this range, though inaudible, can cause distortion or even loudspeaker damage



Curve 1.



Curve 2



Curve 3.

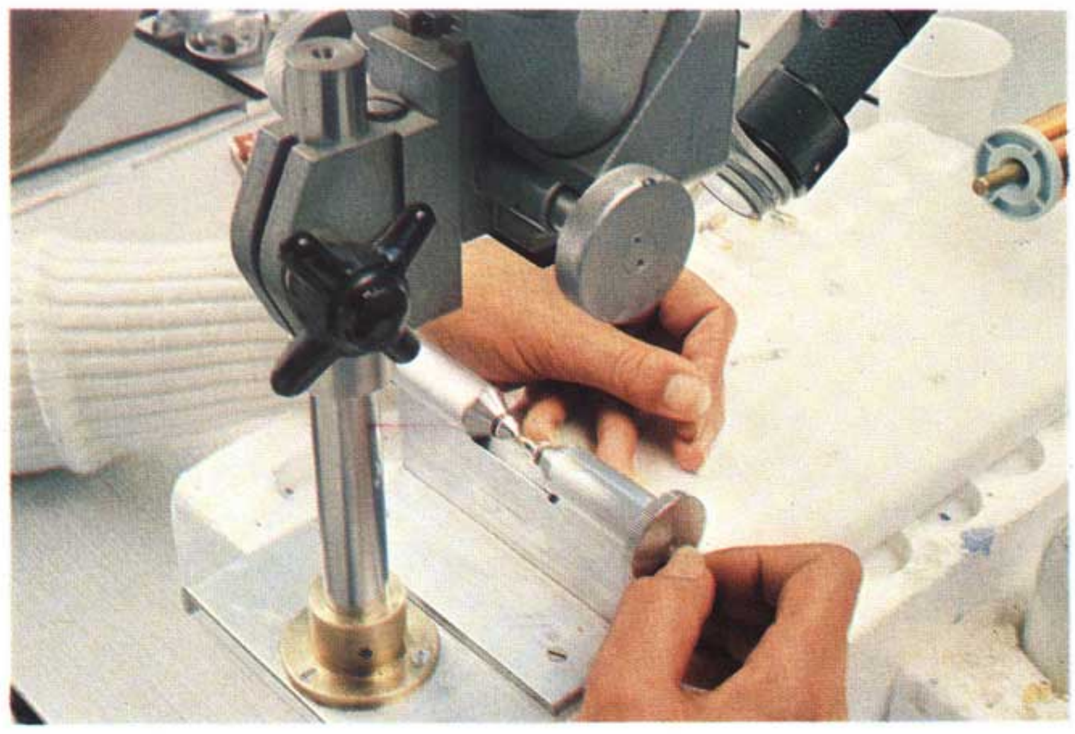
A Lower Cost Alternative To The MCA-76.

The MCA-76 is a deluxe, state-of-the-art unit which necessarily is more expensive than a passive device like our STM-72 transformer.

However, the STM-72 provides excellent performance and has satisfied the needs of discriminating technicians and music lovers alike for several years. It matches the moving coil cartridges to conventional magnetic inputs, it is double shielded for complete freedom from hum, and it covers a frequency range sufficient for CD-4 reproduction. It offers a lower cost alternative to the MCA-76 without sacrifice of sound quality.

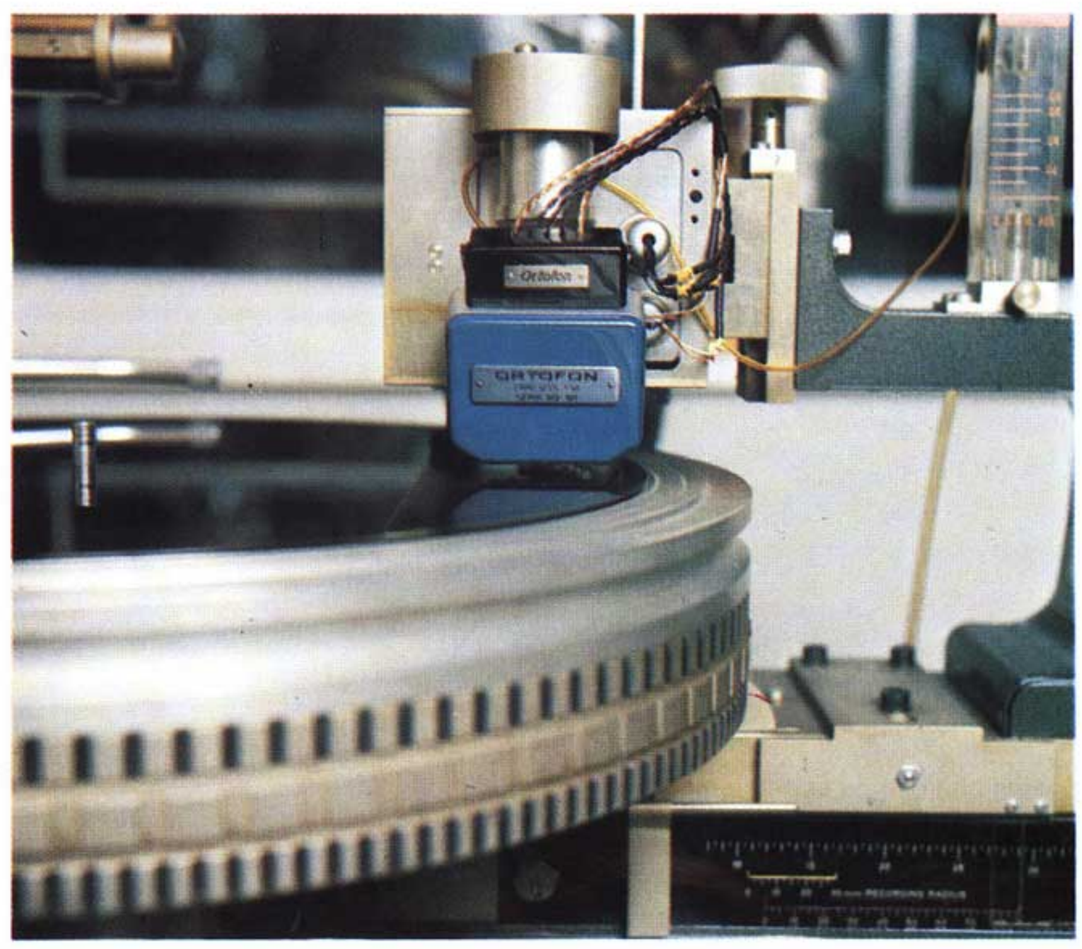
Why Choose Ortofon?

Ortofon's history goes back to 1918 with the invention of the world's first sound on film system. Throughout the years Ortofon has been in the sound industry with film, with recording equipment for disc records, and with playback equipment for phonograph discs. This represents a background of sonic experience which is unique.



The most vital parts in Ortofon pick-up cartridges are hand-made.

Presently Ortofon's activities are concentrated in two areas: one is the production of cutting equipment for making the master records in studios; and the other is making the finest of pick-up cartridges and tone arms with which to play them. We have specialized in making and playing records, and presently most of the major record companies are making records with Ortofon cutters and cutting amplifiers.



Ortofon cutting head in operation.

It is only natural that the company which knows most about making the records should know most about playing them, and our tone arms and cartridges are used by discerning music lovers as well as by studio personnel throughout the world.

That says more for us than we could - or would - ever want to say of ourselves.

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TECHNICAL DATA	SL20E	MC20	SL20Q
Weight (gram)	7	7	7
Output voltage per channel at 1 kHz-5 cm/s (mV)	0.07	0.07	0.07
Output voltage per channel at 1 kHz-5 cm/s with MCA-76 or STM-72 (mV)	3.5	3.5	3.5
Internal impedance: DC resistance (ohm)	2.5	2.5	2.5
Recommended load impedance per channel for CD-4 (kohm)	-	-	100
Recommended load impedance per channel for stereo (kohm)	47	47	47
Vertical tracking angle (°)	20	20	20
Frequency response (Hz-kHz)	5-50	5-60	5-70
±1 dB (Hz-kHz)	20-20	20-20	20-20
Channel separation at 1 kHz (dB)	25	25	25
Channel separation at 30 kHz (dB)	-	-	20
Channel balance (dB)	2	2	2
Compliance: horizontal (cm/dyne)	$25 \cdot 10^{-6}$	$25 \cdot 10^{-6}$	$25 \cdot 10^{-6}$
Compliance: vertical (cm/dyne)	$15 \cdot 10^{-6}$	$15 \cdot 10^{-6}$	$15 \cdot 10^{-6}$
Trackability at 300 Hz at recommended tracking force (µm)	60	60	60
FIM distortion at recommended tracking force, DIN 45.542 (%)	<1	<1	<1
Type of stylus	Elliptical	Fine-Line	Bi-Elliptical
Stylus tip radius (µm)	18/8	8	7
Equivalent stylus tip mass (mg)	0.5	0.5	0.5
Tracking force range (mN)	15-20 (1.5-2.0 gr.)	15-20 (1.5-2.0 gr.)	15-20 (1.5-2.0 gr.)
Recommended tracking force (mN)	17 (1.7 gr.)	17 (1.7 gr.)	17 (1.7 gr.)

TECHNICAL DATA	MCA-76	STM-72
Frequency response: flat	20 Hz-50 kHz +0/–0.5 dB	10 Hz-50 kHz
Frequency response: CD-4	20 Hz-50 kHz +0/–3 dB	
Voltage gain/voltage ratio	34 dB ± 0.5 dB	1:60
Impedance ratio		1:3,600
Input impedance (1000 Hz)	75 ohm	
Output impedance	<140 ohm	
Recommended load impedance for stereo/CD-4		47/100 kohm
Max. input	6 mV. RMS	
Channel separation	>60 dB	
Harmonic distortion (1000 Hz, max. input)		
2' harmonic	0.04%	
3' harmonic	0.01%	
IM distortion (250:8000 Hz, max. input)	<0.01%	
Input noise (Rs=2 ohm, Bw=20-20,000 Hz)	<0.05µV	
Hum level	120 dB below max. input	
S/N ratio (MC 20, SL 20 E, SL 20 Q, 10 cm/sec.)	>69 dB	
Subsonic filter	–20 dB/2 Hz	
CD-4 filter	–20 dB/200 kHz	
Power requirements	90-132/180-264 V. AC/1W.	
Transistor complement	17	
Weight	1.1 kg	
Size (h × w × d)	40 × 60 × 224 mm (1.5 × 2.3 × 8.8 in)	

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