PLAYBACK PHILOSOPHY

All Kuzma products share the same, no compromise design philosophy , in order to produce products which are simple to use, reliable and capable of the highest quality of analogue playback. This policy extends to the choice of only the highest quality materials and the high level of craftsmanship.

How to extract maximum musical information from vinyl records is, in theory, very simple. The cartridge needle should follow the grooves on a record, rotating at the correct speed. The needle movement is then transferred via cantilever to cartridge coils. The rest of the chain should be as solid as possible, the cartridge being connected to a tonearm. This is, in turn, connected to a chassis which also supports a bearing and platter which carries the record.

Problems in Playback

As it is necessary for the system to have the sensitivity to detect the smallest signals in the grooves, in a range of only a few molecules, the system is also sensitive to other vibrations and noise, which will colour and mask the original musical signal. The nature of reproduction dictates that the record must rotate at a constant speed and must allow the tonearm to carry the cartridge precisely over the record surface to follow the spiral groove.

Problems of Construction

Every solution causes new problems, making a series of compromises necessary. The rigid connection must be broken, in order for bearings to allow rotation of the platter. Other bearings in the tonearm allow the cartridge to follow the spiral groove in the record, including allowance for warping and eccentricity. The needle, itself causes some vibration in the groove. Due to the need for low tonearm mass, the minimum of light material must be

used, particularly for tube and headshell. This makes the tonearm less rigid and more prone to vibration.

All other tonearm parts, such as counterweight, bias and cueing device add vibrations. The turntable main chassis is usually some sort of plate, with its own resonance and flexing vibration that cause unwanted movement between the platter and the tonearm. Bearings themselves make noise, which is just another form of vibration. Their function means there must be some slack to allow low friction, but this again causes unwanted movement in both tonearm and platter. In short, each part of the turntable and tonearm vibrates under the influence of bearings, motor noise and other sounds which cause blurring and colouration in the chain of reproduction. Imagine knocking on the wall of your room. You can hear the sound in the other room, which means that this heavy wall vibrated. If a wall can behave in this way it is easy to imagine how all these small, light parts in the tonearm and turntable vibrate. In addition, the motor must drive the platter via a belt. A softer belt, which helps decrease motor noise, affects stability of drive due to stretching of the belt.

Problems of Isolation

Because of the location of the turntable it will be exposed, to some degree, to vibrations caused by music, noises as well as vibration from building and earth caused by wind, traffic, rivers, moon and other more obvious disturbances. A common way of minimising this is to suspend the turntable chassis but this adds another layer of unwanted movement to the tonearm and, by causing a changing distance between motor and platter, produces changes in speed.

Theoretical Solutions

The turntable should have a solid, rigid, non- resonant platter, fixed in a rigid low noise bearing, which has rotational freedom only The chassis, carrying the platter bearing and tonearm base, should be of rigid, non-resonant material, which will not flex and change the position of platter and tonearm. It should be remembered that distances involved are of below 0.00001mm.

The motor drive which rotates the platter should be as stiff and even as possible and as soft as possible, in order to filter out vibration caused by the motor.

All bearings should have as near zero friction as possible, with low starting friction levels, no noise and no vibration, something only theoretically possible. In addition there should be no shaft movement , other than rotational.

The tonearm also should be as rigid as possible while having minimum mass in order to easily move across the record surface. All tonearm parts should exhibit the same properties as well as being non-resonant.

The tonearm should be, as far as possible, isolated from vibration and movement in the surrounding environment. Ideally it should hang in space.

The relationship between the needle and record groove demands a precise geometry if a high level of accuracy is to be achieved. There must be allowance for adjustment, particularly on the tonearm, in order for this precise relationship to be achieved.

Practical Solutions

We at Kuzma Ltd. have been studying the theory and practise of analogue playback since 1975. In that time we have come a long way, continually extracting more information from, what is nowadays called, an "inferior medium". In analogue playback this is a never ending story. There is no known limit to the extent of recoverable information compared to the limits of digital playback. This makes analogue replay closer to the human ear and brain.

Theoretically making a great turntable and tonearm is simplicity itself but in practise many compromises must be made to reach "perfection". All our designs have evolved out of our response to solving these practical difficulties and from the strengths and limitations of the materials chosen. In our designs we attempt to avoid cutting corners and avoid fashionable approaches and gimmicks which confuse the listener and do nothing to improve playback. That is not to say that our turntables and tonearms are for experts only, we are very conscious of making our products as easy to set up and use as possible.

Designing a turntable and tonearm is not a finished process but an ongoing one, as we learn through experience over a period of time. Nevertheless, in various ways, all our products, from 1982 to the present, exhibit the same design philosophy.

Principles of Design

To make a platter with minimum resonance we use metal, for structural rigidity especially at low frequencies and we use either internal rubber damping or a sandwich construction or both, which effectively damp resonance at all frequencies. The sandwich construction, clamped with prestressed screws, aids structural damping especially at low frequencies. This can be seen in both the Stabi Reference and Stabi XL turntables. The platter mat is not too soft (which would make the bass weak with clean higher tones) or too hard (which would make a fast bass and glassy high tones). This seemingly contradictory mat is made from highly damping rubber with a rigid textile material internally. The mat is used to damp vibration in the record caused while the needle is travelling in the grooves and vibrations in the record caused by acoustic energy.

For the bearing's shaft we use a hard , minimum resonant steel with a microstructure which allows us to achieve very low friction and minimum vibration. The contact with the bearing is either of steel or a very hard, polished ruby ball. The bearing material is not metal, which resonates at very high frequencies, nor plastic, which is soft but, again, very hard non-resonant resin, whose structural rigidity and damping properties are achieved by the use of textile. Difficulties of manufacturing this material to close tolerance prevents it being more widely used, though we find it highly suitable for use in our Stabi S, Stabi Ref and Stabi XL turntables. In some designs a plastic bearing material is used which is reinforced by the use of carbon particles to aid rigidity and provide low friction, as is the case in the Stabi turntable.

The bearing shafts have a final polish with diamond dust and pear wood. The critical factor, however, in the production of a good bearing remains the close tolerances allowed in the manufacturing process, which make the bearing as stiff as possible, with as little air slack as possible, to prevent the platter wobbling.

Each tonearm design demands a low mass, accompanied by maximum structural rigidity and minimum vibration of all parts. The tonearm is the carrier of the cartridge and damps cartridge vibration as well as allowing the cartridge to maintain precise geometry in relation to the record grooves. The tube, which connects headshell and bearings, is rigid with low mass, minimal resonance and internally damped.

The bearings allow the cartridge to move with precision across the record, with no slack movement, very low friction, low noise and very low starting friction. The base, which holds the tonearm, should provide a stable platform for the tonearm itself and firm fixture to the turntable chassis, while allowing for height adjustment (VTA).

The counterweight balances the tonearm while providing mass, which helps absorb unwanted vibration and colouration in the tonearm tube.All parts are designed and made in such a way that they are less sensitive to resonance which comes from the music, needle and cartridge combinations and vibration from bearings and turntable themselves.

The main material used is aluminium which, with the addition of damping materials, as well as paint coatings and when clamped together by force or glue, achieves very high rigidity and good damping properties. All metal is from solid blocks, forged not cast and is, therefore, dense and capable of dissipating energy. The tube of Stogi Reference tonearm, for example, is machined from a solid block of aluminium into a tapering tube with a thin wall of varying thickness. This helps to spread vibration and provides an excellent ratio between mass and stiffness.

The ball bearings which are used are precisely glued into position to minimise friction, maximise damping in bearing rings and to avoid air slack in the long term. The bearing itself is chosen with factors of low friction, low starting friction and low noise being of prime importance. Each bearing is tested before use for noise, friction and cleanliness. In the case of the unipivot design, it is also tested for shape and then polished to smooth any surface irregularities. This does not mean merely a mirror finish which may still contain scratches.

Adjustments of the tonearm and cartridge, such as VTA, azimuth, tracking force and bias as well as geometry, are of great importance. Facilities to allow such adjustment should not compromise structural rigidity or create resonance.

The tonearm and the bearing of the platter must be in a fixed relationship to each other. The plate (chassis), which carries both these parts, must be rigid and non flexible therefore the choice of suitable mass and material is important. If one knocks on the chassis plate, the sound heard is the plate flexing, particularly at the ends. To minimise this reaction we use dense wooden plates , which have high damping properties or we use a sandwich construction of metal and acrylic clamped together for structural rigidity and damping. Alternatively we use solid brass which, with the correct shape and mass, has good damping properties and is an almost perfect chassis.

Isolation

The goal here is to filter out any noise and vibration from the surroundings as well as from the motor. The solution is to isolate the turntable chassis and tonearm and platter by means of a spring system or by use of other soft damping material.

If springs are used they act, together with mass provided by chassis, platter, tonearm etc., as a low pass filter. This means, in practise, that the system filters out all vibrations affecting the chassis which are higher in frequency than the resonance of the system, while allowing through frequencies in the range of resonance and below. It is best, therefore, to have the resonance of the system as low as possible. At resonance, however, movements are large. To avoid movement which affects belt tension and speed fluctuation, the system resonance must be damped. This provides better platter drive but makes filtering less effective. Movement of the whole chassis affects tonearm movement and affects sound stability.

To improve filtering, mass must be added and softer springs, which lower the resonance (in the region of 2-4 Hz), must be used. Silicone oil is used to damp the resonance system and the springs themselves which in turn provide stable drive to the platter.

In order for the platter to rotate accurately all parts involved ie motor pulley, belt and platter pulley, must be very precise. The goal is to achieve constant speed at all times not just a precise 33 RPM with minimum wow and flutter. This constant drive is provided by an electronic control, which minimises vibration in the motor and gives a more accurate signal to power them. This is why a low constant friction in the platter bearing, that does not change with rotation at any given point, is so important.

Kuzma Ltd. uses these facts when designing and manufacturing all our products, in order to accurately extract the maximum music from vinyl records. 1995.