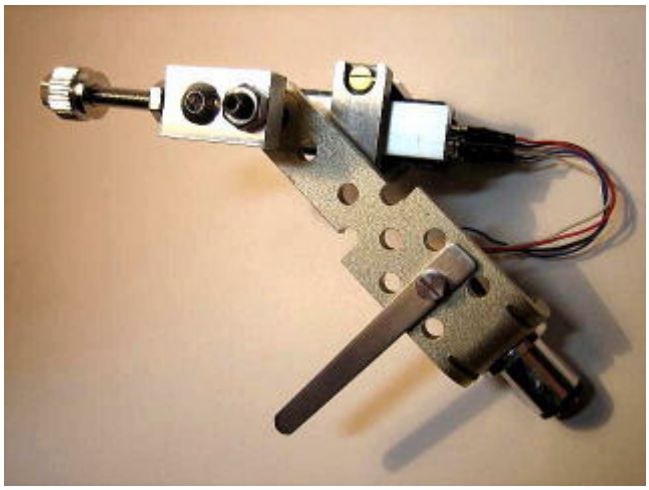
Rotating shell



The rotating shell was actively introduced in the "Radio Technical Magazine" in the late 80s, but recently there have been fewer articles.
However, it seems that there are still many people who appreciate rotating shells.

The only commercially available rotating shell currently available is RS-3, which is sold by mail order by Radio Technical Magazine.
But just being able to get it may be a miraculous situation.
Moreover, the RS-3 is a great product with lateral balancing.

Theoretical considerations of rotating shells are out of hand for me.
Basically, I understand it as "relieving stress" or "separating the vibration system between the shell and tonearm".
In the May '92 issue of "Radio Technical Magazine", Mr. Shiro Horii gave a detailed discussion of rotating shells, so if you are interested, please refer to it.

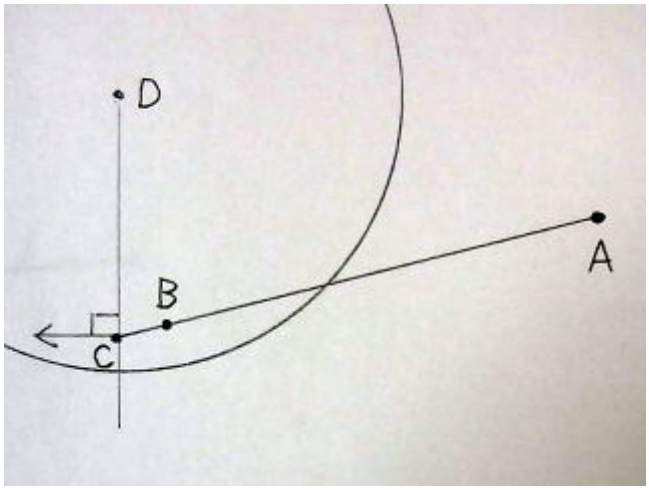
Effects

of rotating shells The effects of the rotating shell are said to be "smoother in the high frequencies", "better separation and localization, and smaller and tighter sound images", "better depth and breadth", "improved tracing ability", and "sound is less distorted even in large amplitude parts around the inside of the record".
However, on the other hand, it has been pointed out that "the sense of realism of the sound image is weak", "the feeling of attack in the ultra-low range recedes", and "the midrange becomes thinner".

Whether or not to introduce it depends on the difference in what each person wants.
However, the reality is that many people have never had a rotating shell in their hands.
Many modern analog player tonearms have integrated shells, making it increasingly difficult to use rotating shells.
If more people could experience the sound of the rotating shell, I think the world's evaluation would be different.

Is it
linear tracking? Looking at the information on the net about the rotating shell, the
rotating shell "automatically rotates along the tangent of the record groove" or "linear tracking" I often see expressions like that.
Some have argued that this is a major advantage of rotating shells, but this is false.

If you have actually used a rotating shell at home, you may have noticed that the rotating shell does not move like that.
In reality, it moves in such a way that a normal arm that has an offset angle becomes a straight arm.



In the figure, A is the horizontal rotation axis of the arm, B is the rotation axis of the rotating shell and the support fulcrum of the cantilever of the cartridge, and C is the position of the needle.
The C needle is pulled tangentially to the arrow by the resistance of the record groove.
Since the position of A does not move, the axis of rotation of B moves so that A and C are in a straight line.
The result is a pure straight arm connecting A and C.
For a normal arm with an offset angle, when the needle is lowered around the perimeter of the record, the shell should rotate so that the cantilever is facing outward.

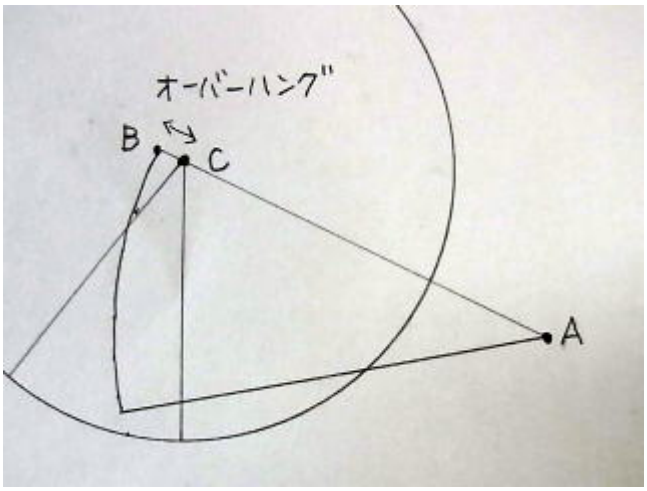
Mechanically, it is the above theory, but in the actual state of use, the "elasticity of bending" of the output lead wire often affects it considerably, or the initial sensitivity of the rotation axis is low, and the angle at the time the needle is lowered to the outer circumference often continues to the inner periphery.
In other words, if the appropriate offset angle is attached when the needle is lowered, it will remain at the angle until the end, so I imagine that it is mistaken for "following linearly".

However, it is by no means the case that such "lead wire elasticity" and "low initial sensitivity" reduce the effect of the rotating shell.
A major factor in the effectiveness of the rotating shell is the separation of the vibrating system of the arm body and the cartridge in the horizontal plane.
If you lightly shake the sub-shell (rotating shell part) from side to side with your finger and it moves smoothly, it should be sufficiently effective.

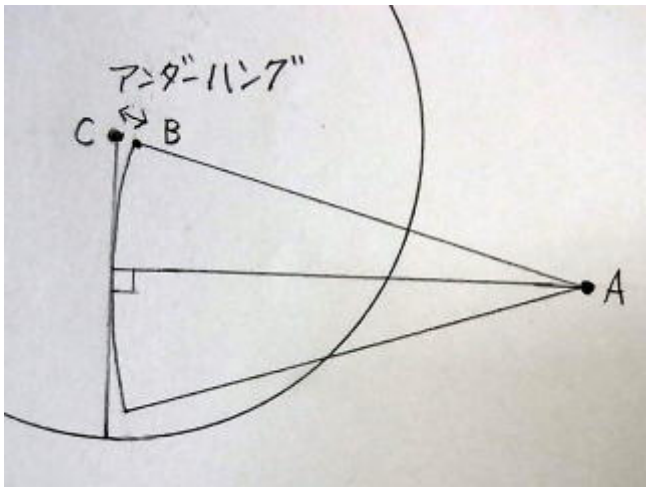
Underhang If you are using an arm with
a normal offset angle, it is set to an **overhang**

to minimize the total tracking error angle from the outer circumference to the inner circumference.
In other words, the arm base is positioned so that the needle position is outward (usually around 15 mm) from the axis of rotation of the turntable.

For pure straight arms, the underhang must be readjusted to minimize the tracking error angle on the inner ~ outer circumference.
In other words, when adjusting the hang, the needle position is in front of the turntable rotation axis, and the tracking error angle is adjusted to 0 at some point on the record.
If you use a rotating shell with an arm with a normal offset angle, you must shift the arm base farther away.



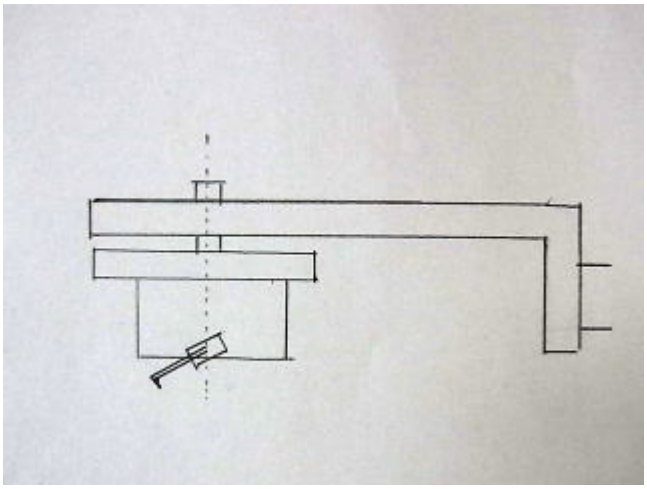
A is the horizontal rotation axis of the arm, B is the needle position, C is the turntable axis
Normal arms are adjusted to the overhang, but with pure straight arms, the tracking error angle is large.



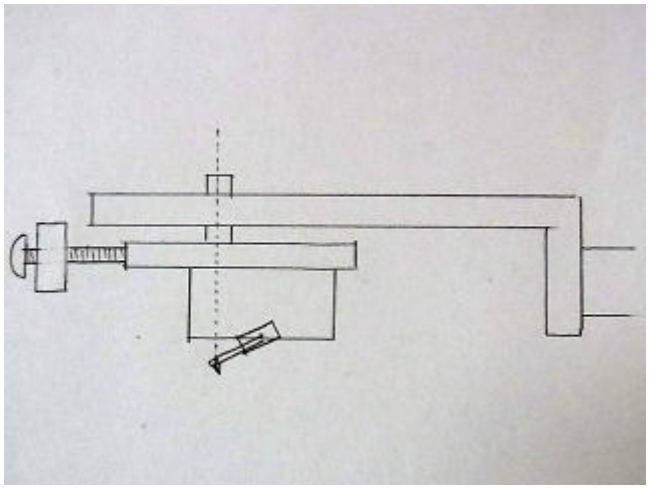
Adjust to the underhang and make sure to set the point where the tracking error angle is 0.

Aligning
with the axis of rotation If you read the instruction manual for the rotating shell RS-1, which was once commercially available, it is instructed to match the position of the axis of rotation of the shell with the position of the support fulcrum of the cantilever of the cartridge (the base of the damper) when installing the cartridge.
The mechanical explanation in this case is given above, but I am adjusting the axis of rotation of the shell to match the position of the needle instead.

It was noted that a major factor in the effect of the rotating shell is to separate the arm body and the cartridge vibration system in the horizontal plane, but in order to thoroughly separate this vibration system, the rotation axis of the shell and the position of the needle are matched, and the center of gravity of the sub-shell and the rotation axis are matched. I think it is a good idea to adjust the weight balance (lateral balance) of the horizontal plane firmly.
Lateral balance adjustment should increase the initial sensitivity of rotation.



When
the axis of rotation of the shell matches the support fulcrum of the cantilever

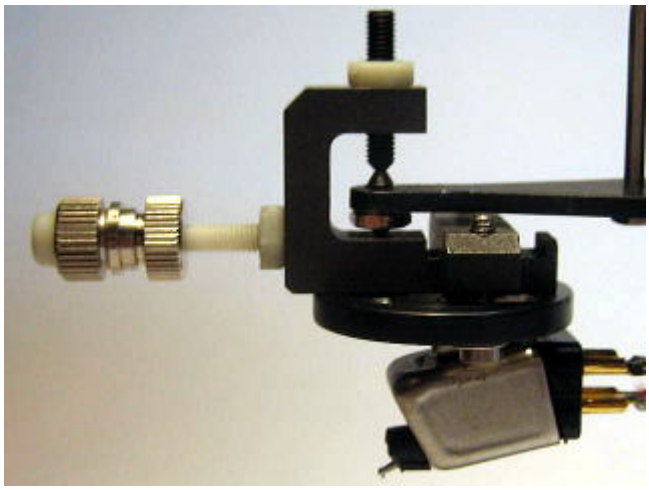


When the axis of rotation of the shell matches the needle position

If the rotation axis and the needle position are well aligned and the lateral balance of the sub-shell is adjusted well, the arm body will not move slightly even if the sub-shell is shaken left and right during record playback.
This is because the length (effective length) from the horizontal axis of rotation of the arm to the needle does not change when the sub-shell is shaken, and the lateral balance of the entire arm is maintained.

Again, the needle does not follow the record groove with "linear tracking" and the sub-shell points in a generally constant direction.
In this case, the elasticity of the shell lead wire seems to have a great influence on the direction of the sub-shell.

Lateral Balance



The screw protruding on the left side of the photo above is the lateral balancer.
By adjusting the position of the screw back and forth, the center of gravity before and after the sub-shell is aligned with the axis of rotation.
You can use two screws to tighten them to each other to securely fix the position.

The left and right centroids of the sub-shell are adjusted by subtle left-right adjustment of the left and right positions of the cartridge, but for most cartridges, the left and right centroids should

match the needle position.
If they do not match, attach a lead sheet next to the body to adjust it.

As you can see from the image of a yajirobae, the center of gravity of the sub-shell is as low as possible relative to the bearing position, which is more stable.
In the rotating shell pictured above, the sub-shell is made of light carbon material, and an aluminum spacer is sandwiched between the sub-shell and the cartridge to lower the center of gravity.

Lead wire

Now, the elasticity of the output lead has a very negative effect on the initial sensitivity of the rotating shell.
In order for the sub-shell to move smoothly from side to side, you want to use a sufficiently soft lead wire.

On the other hand, if the lead wire is too thin, a vibration noise will occur.
I believe that the vibration of the lead wire creates an undesirable character, so I try to reduce the occurrence of vibration by entangling the +- lead wire.
"Smooth rotation" and "vibration of lead wires" are contradictory elements, so it is necessary to come to terms with each way of thinking.

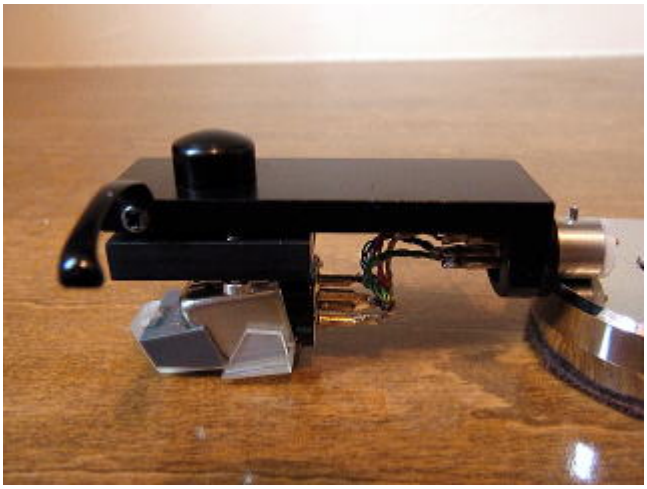
When adjusting the center of gravity before and after the sub-shell, it is also troublesome to handle the lead wires.
Currently, the center of gravity is adjusted including the weight of the lead wire, but the elasticity of the lead wire interferes with the adjustment.

Characteristics
of the **cantilever**
Now, if the vibration system of the arm body is separated, the habit of the arm is less likely to appear in the playback sound.
It is also said that the difference in sound between individual cartridges will be reduced.

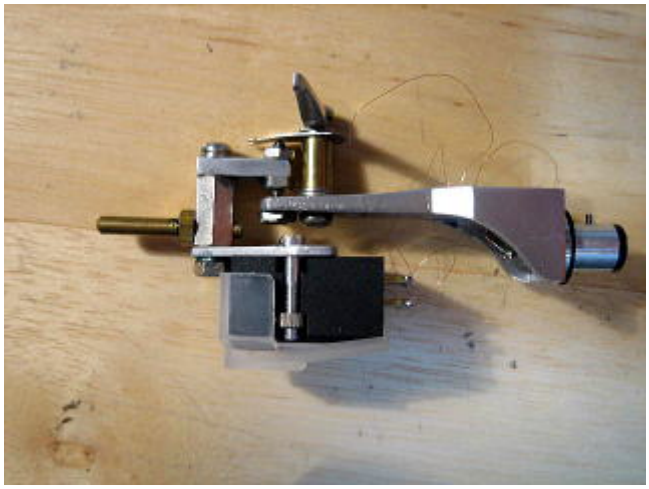
On the other hand, the nature of the cantilever seems to appear in the playback sound.
I prefer the sound of an ordinary aluminum alloy cantilever to a cantilever made of a special metal.
I also feel that thick and short cantilever is preferable to thin and long cantilever.

The current Pickering and Stanton are thick and short cantilever made of aluminum alloy, but when combined with a rotating shell, you can feel a good balance without habit.

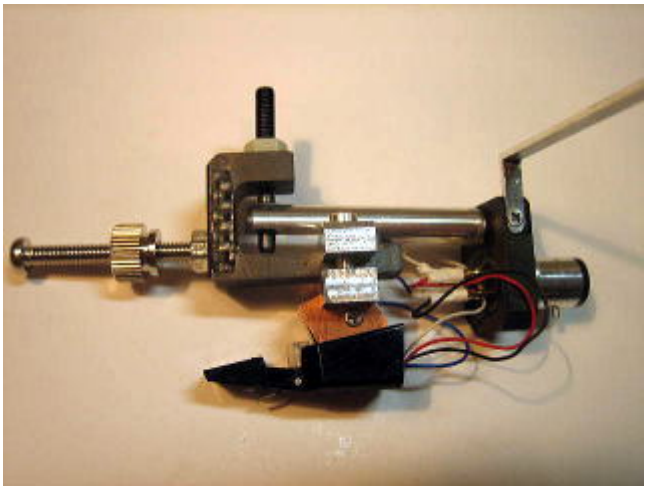
Various rotating shells



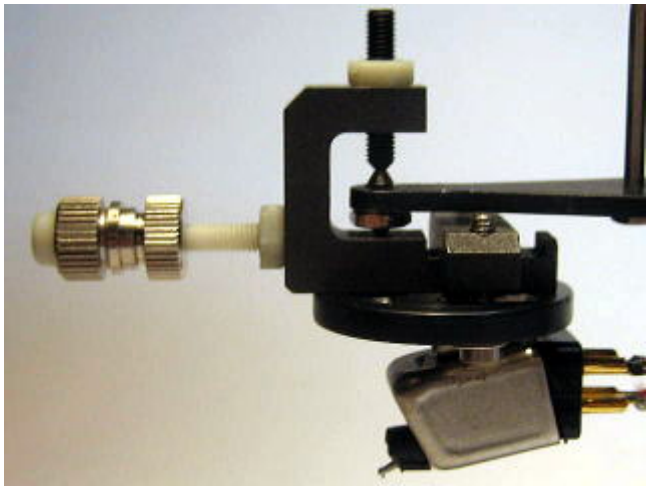
It is based on the RS-1
Audio-Technica shell once sold in a radio technical magazine, and uses bearings on the rotating shaft. The
cartridge is Pickering's NP/AT



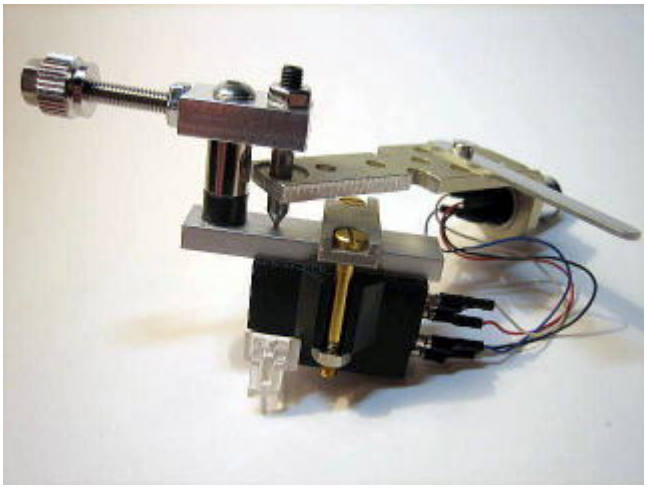
Rotating shell
made by Mr. Hasegawa around 90 The upper side of the rotating shaft is held down by the springy elasticity of metal The
lead wire is an ultra-fine wire The
cartridge is Denon's DL-103



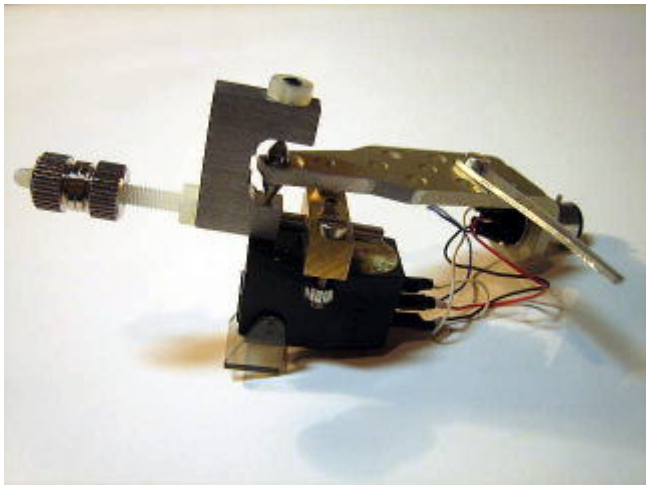
Rotating shell made by Golf 13 The
sub shell is made of carbon and the cartridge mounting position can be adjusted before and after. The
cartridge is a modified version of Audio-Technica.



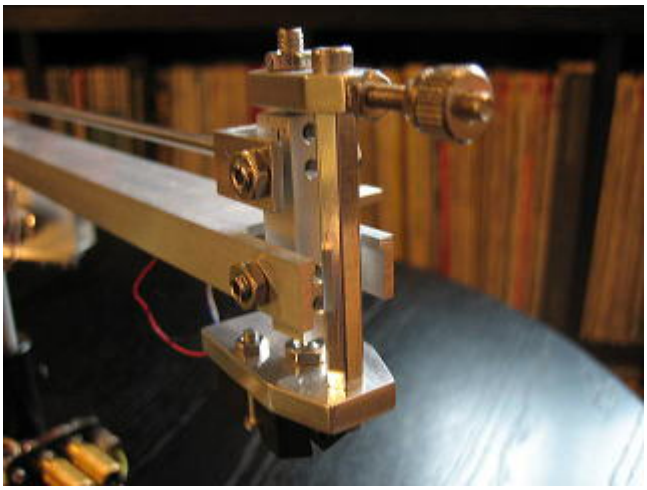
RS-A1 arm with carbon sub-shell and aluminum spacer made by Golf 13 The
cartridge is Pickering's NP/AT



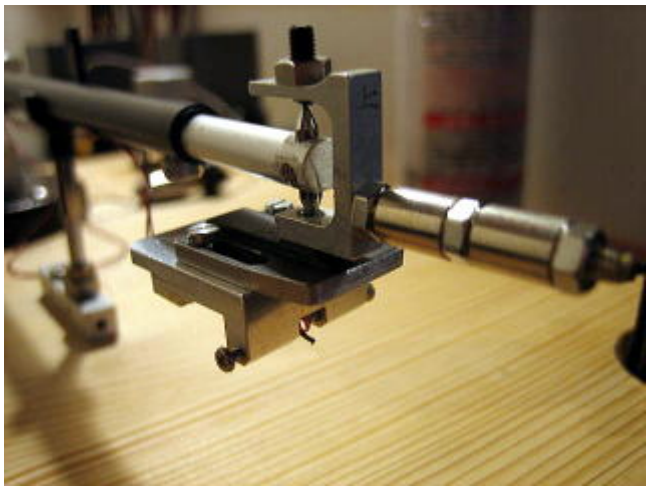
Rotating shell made by Mr. Hasegawa The
sub shell is made of aluminum, and the cartridge mounting position can be adjusted before and after. The
cartridge is Shure's M44



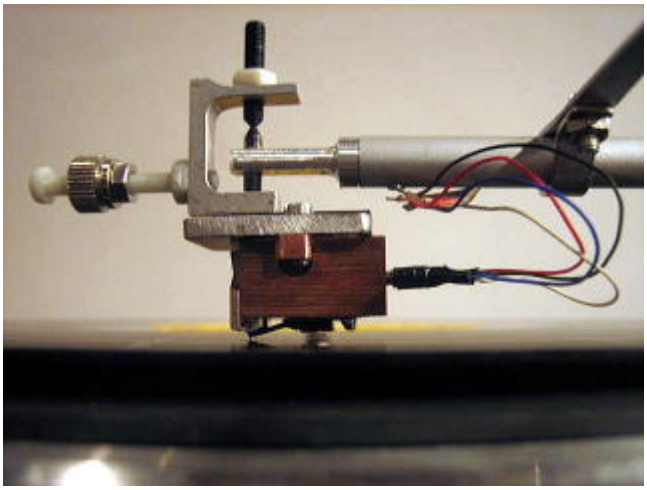
Rotating shell made by Mr. Hasegawa Since the plate is attached to the
round bar, it is possible to adjust the front and rear position and left and right tilt. The
cartridge is an orthophone MC10



Hasegawa's
stress-free arm rotating shell cartridge is Denon's DL-103



The
rotating shell cartridge made by Mr. Hasegawa is a repulsive magnetic circuit mono cartridge made by Mr. Golf 13



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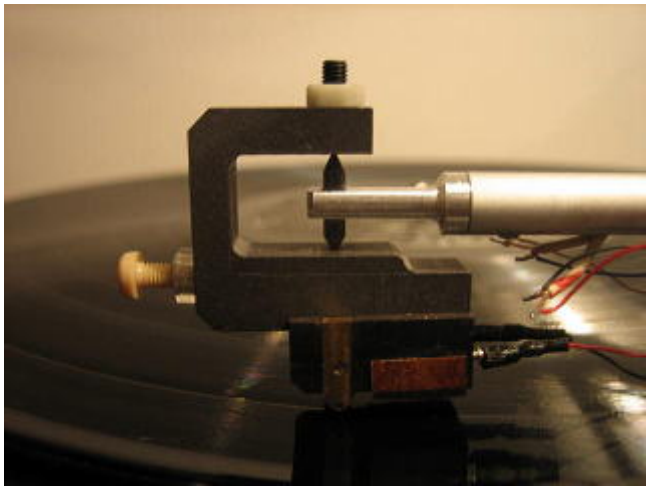
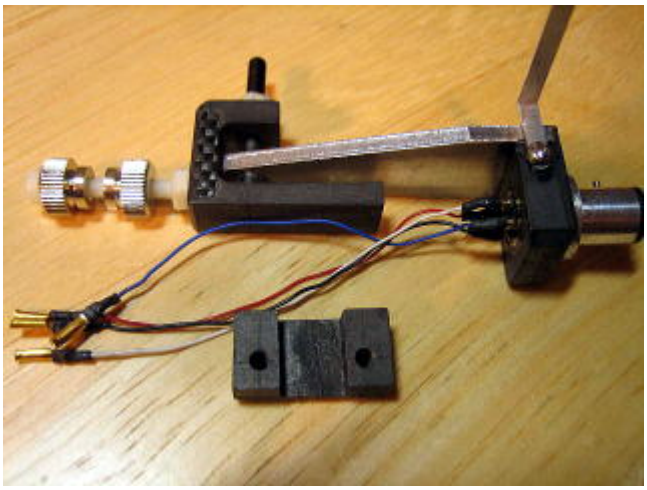
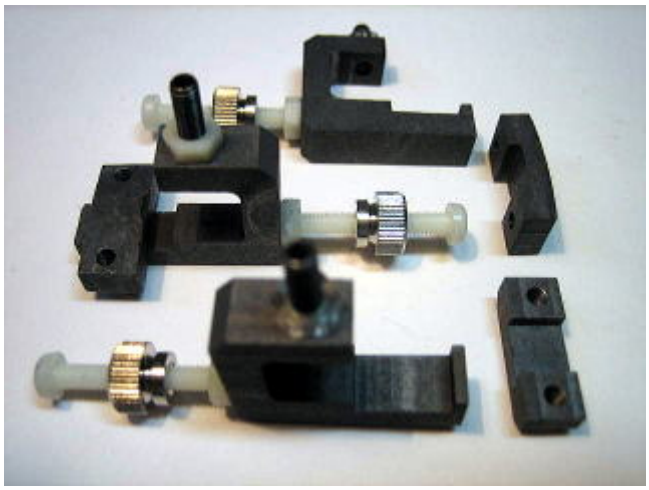


Carbon rotating shell made by Golf 13 Integrated with
rebound magnetic circuit mono cartridge



Rotating shell made by Golf 13 The
sub shell is made of carbon
Slide base allows forward and backward adjustment of cartridge mounting position



Carbon sub-shell by Golf13

Long-lasting needles?

I've been using rotating shells for quite some time, but one common advantage of rotating shells

is that the needles last longer.
It is said that the life of the needle is more often due to the deterioration of the rubber damper than to the wear of the diamond tip.
By using a rotating shell, the stress on the rubber damper can be greatly reduced, which is interpreted as an inevitably longer needle life.

(Sep 05, Revised Nov. 08, Aug. 15)

Linear Tracking Study
In the May '89 issue of the
Radio Technical Magazine, there is an article by Mr. Shun Ishizuka titled "Prototype of Automatic Tracking Errorless Arm".
The article says that "the needle tip automatically points tangentially" when adjusted to match the axis of rotation of the shell and the position of the needle.
However, there were conditions.
1 The rotating shaft is a pivot bearing, the shaft is made of stainless steel spring material with a 30-degree conical tip, and the receiver is chrome-molybtenum steel.
2 The shell lead wire should be ultra-thin. (Even one 50μ copper wire is not enough)
3 Lake angle setting (Set the cartridge forward and down. I have
tried using
various rotating shells at home, but I can't come across a rotating shell that automatically faces tangentially.
The biggest bottleneck is the lead wire.
In reality, if you make the lead wire ultra-fine, it will vibrate grandly and a character unique to the playback sound will appear, so there are different tastes.

Also, in the case of MC cartridges, due to the influence of the earth's geomagnetic field, the cartridge has the property of wanting to face north.
I don't know which is more dominant, the force that rotates the sub-shell tangentially with the resistance of the record groove or the force that faces north with the geomagnetic field.

By the way, is linear tracking such a big advantage?
I regularly use a pure straight arm, so the tracking error angle is large in the outer periphery, but I don't feel any problems.

As a method for eliminating the tracking error angle, many special arms such as turles have been devised.
What I think is a good way is Pata-chan's method.
It is a combination of rotating shell and brush.
When dropping the needle on the outer circumference of the record, the angle between the needle and the groove is maintained to the inner circumference.
This method eliminates the need for complicated mechanisms and enables linear tracking at low cost.

(Sep '15)

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