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Heated Stylus Recording Technique

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On May 9th a paper on the heated stylus recording technique, using the Fairchild Thermostylus System, was delivered to the New York Section of the Audio Engineering Society. The speaker was Theodore Lindenberg, Engineer in Charge of the Disc Division of the Fairchild Recording Equipment Corporation. Some of the highlights of the question and answer period that followed the talk are given here.

Q: When using a heated, or, as you call it, "Thermo-Stylus" for cutting in lacquer, is there a noticeable difference in driving power required to the head?

TL: At middle and low frequencies there is very little difference. When a sharp jewel is used, somewhat less power is required; but the driving power required to record high frequencies is appreciably less.

Q: Would it be possible to obtain the heating effect by the use of radio frequencies, thus eliminating lead wires to the stylus?

TL: This might be possible if the cutting jewel, the sapphire itself, could be properly metallized and effectively isolated from the stylus shank to avoid conduction of heat to the cutterhead.

Q: Did you get any steady state measurements of the temperature at the tip of the stylus?

TL: Very frankly, no. We were very careful, of course, to determine what varying degrees of heat and steady-state tones would do to the response of the cutter and, of course, we did determine when the heat is carried to an extreme degree we were apt to affect the cutter performance somewhat. However, steady state measurements have not been made in this case.

Q: In your optical measurements, do you take your reading on a feather edge on the high frequencies or do you take it at the spectrum volume?

TL: That is a good question, because I think those who have done appreciable recording work have noticed that with some cutting jewels the feather-edge measurement is not the same as the measurement which is attained from the light reflected by the walls of the grooves themselves. However, as I stated before, the jewels must have flat sides; and if they do have flat sides, you can take your measurement from the pattern itself because that is the measurement of the playback value. The feather-edge measurement in many cases will be the in-air pattern of the cutter. That has been our experience.

Q: What material have you used for the jewel?

TL: We have used sapphire.

Q: You heat the sapphire?

TL: Yes. We heat the sapphire directly. The coil is wound on the sapphire and is impregnated with refractory cement. The motive is to get the heat directly to the disc. If we heat the shank of the cutter, less heat will go to the disc and more to the head.

Q: Will it be possible to use a harder lacquer mixture which will give even a greater number of playbacks when cutting with the Thermo-Stylus?

TL: As far as being able to cut a harder lacquer, it probably is possible. I think Mr. LeBel of Audiodisc can give more information. Can you make lacquer harder, C. J.?

LeBel: Well, we can make lacquer as hard as you want it. (*Laughter*) The question is what will happen—well, I can give you a practical answer. After you get hot stylii in use all over the country, it will be practical to make a hard lacquer, if you want harder lacquer. On the other hand, at the present time it would be out of the question to run hard lacquer infrequently, or on an interrupted schedule. The problem of changing over disc manufacturing systems is formidable. You have to scrub the equipment out, practically with a tooth brush.

Q: Do you get any modulation from the use of a.c. for heating the stylus in such proximity to the cutter?

TL: We have been unable to measure any in this case. In this particular cutterhead design the jewel is well separated from the magnetic field and the hum in the groove, if any, is unmeasurable.

Q: Can't the record be heated before you make the recording to accomplish the same result?

TL: Mr. Kettering of the Fairchild Recording Equipment Corporation told me he had done that a good many years ago to improve the cutting. That was in the early days of lacquer recording when the material was inclined to be rather difficult, and he had gotten away with it successfully. However, the real advantages of this Thermo-Stylus technique are gained by creating a rather high heat directly at the tip of the stylus. As I said, it is hard for us to tell just what the temperature is, but in the coil it runs anywhere from 400° to 600° F. It would be rather difficult to heat an entire disc to a temperature such as that. We have found that much heat is necessary to achieve cutting where you get the lowest surface noise and minimum frequency deviation.

(*Remark from audience:* You'd better not be in the room when you heat the whole disc to 500°.) (*Laughter*).

Q: What effect do you notice on diameter equalization when you use the heated stylus? How much reduction in diameter equalization could you accomplish?

TL: The curve we showed you a moment ago indicated a loss at 8,000 cps at 4" diameter of about 5 to 5½ db, under standard methods, with standard cutting jewels of professional grade. When the heated stylus is used, where we also have the small face, that loss drops to less than 2 db, so, as you can see, there is about 3 db gain.

Q: How far up did you go in the frequency spectrum?

TL: In this particular case our measurements went to 10,000 cps. The channel used was flat to about 9,000 cps.

Q: Have you noticed the effect on temperature when the suction pipe is closer to the stylus or further away? Does that affect the temperature?

TL: I suppose it does to some extent. We have used suction in a good deal of the work. The effect is very noticeable on the leads that go to the coil. Under some conditions these leads are actually hot enough to become slightly incandescent. The vacuum, of course, tends to cool them; but there has been no noticeable effect on the noise level of the disc.

Q: You mentioned before that you start cutting first and then turn on the heat. What is the reason for that?

TL: The reason is that the chip becomes extremely limp and quite soft when the Thermo-Stylus is used. If you start the chip with the heat turned on, the chip will lie right down in the groove. Come around one revolution and you have some smoke that messes up the record. If you start the chip cold, it will throw in toward the center as it usually does. Once the chip is cleared and running, the heat can be turned on and the chip will lie perfectly.

Q: How is the coil held onto the stylus to prevent it from falling?

TL: The coil is encased in cement which holds it firmly so that it can neither vibrate nor slip down nor off the stylus.

Q: I presume it is a ceramic cement.

TL: It is a ceramic cement and soluble so that the coil may be removed to enable resharpening the stylus.

Q: What about the amount of groove echo?

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TL: I might state that Mr. Fine of the Reeves Sound Studios has just put through some discs cut with the Thermo-Stylus and he remarked that there is a considerable decrease in echo, particularly in microgroove work.

Q: Has any work been done on finding out whether or not there is a reduction in modulation noise when the Thermo-Stylus is used?

TL: Modulation noise is very difficult to measure quantitatively. We all know that under high modulation, in particular, lacquer is subject to it. There have been some excellent articles written on the subject. I have observed the fact that, under a powerful microscope and with rather careful scrutiny using proper illumination, the groove is of a higher calibre when the Thermo-Stylus method is used than any I have previously observed, with the possible exception only in wax. I would imagine that the action of the heat practically eliminates the modulation noise as far as the original recording is concerned.

(The meeting was then adjourned, and the audience was invited to inspect Reeves Sound Studios, which uses the Thermo-Stylus technique in disc recording.)