Letters to the Editor

A STEREO GROOVE PROBLEM

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Our work on the development of a stereo cutter has brought to our attention a phenomenon that has undoubtedly been observed by others in the recording field and plagued them also in their test evaluation of the stereo groove.

With the development of a cutter capable of recording amplitudes up to 50 cm/sec, we experienced difficulty in accurately reproducing both channels of the stereo groove equally and without distortion. With high amplitudes, we continually noticed that the left channel test information could be reproduced accurately and without distortion while we experienced trouble in maintaining linearity of the right channel.

After analyzing cutter action, we dismissed this factor as the cause of the distortion. Naturally, our next suspect was the cartridge. However, after an investigation that included actuating the cartridge with the same stereo cutter, we eliminated the pickup as the cause. We then analyzed the performance of the conventional tone-arm design, and we began to see the start of an answer. It was found that a serious and unsuspected source of this trouble in reproducing equal quality from both sides of the stereo groove was the presence of a skating force.

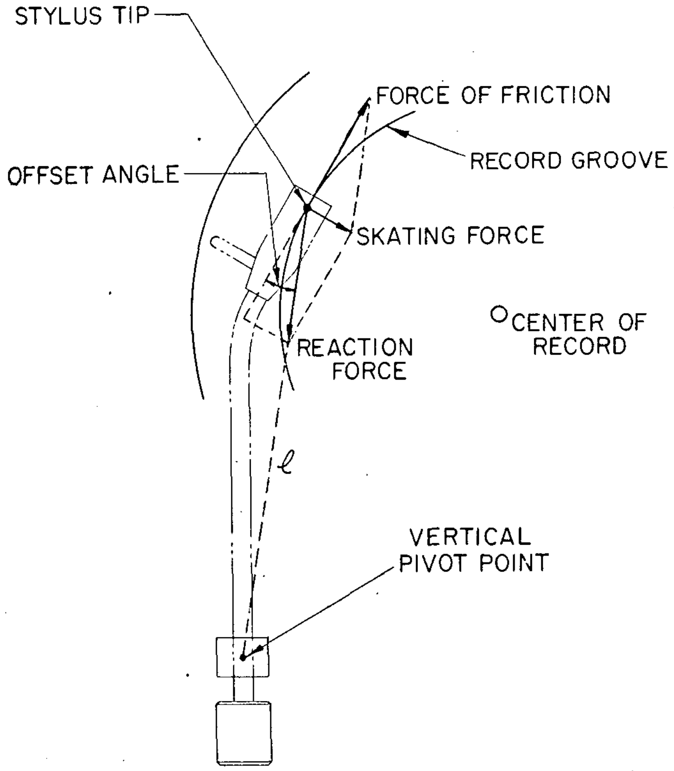

Fig. 1. Position of the arm on the record.

Skating is a term applied to the force that tends to pull the arm toward the center of the record. It is produced by friction between the reproducing stylus and the groove walls. It is determined by the length of the arm, the magnitude of the offset angle, the tracking force, and the record material. When signals were observed on an oscilloscope, this skating force affected the right channel (outer groove wall) producing right channel information distortion. The left channel (inner groove wall) did not exhibit this information distortion. With the use of high level recording techniques plus the use of pre-emphasis, it is quite possible to develop levels up to and in excess of 30 cm/sec. Therefore, skating can be a continued source of distortion and annoyance to the listener. An anti-skating system was then developed from the information in Figs. 1, 2, 3 and 4 and Formula I.

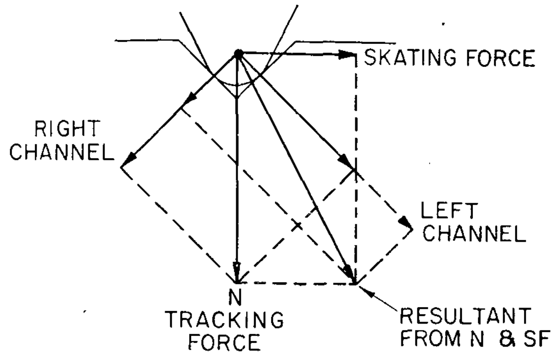

Fig. 2. Distribution of the tracking force.

F = Friction Force	l = Arm Length
RF = Reaction to Friction Force	α = Offset Angle
RV = Reaction Vector	T = Anti-skating Torque
SF = Skating Force	N = Tracking Force
ST = Skating Torque	μ = Coefficient of Friction

$$F = RF = -F$$
$$RV = RF/\cos\alpha = -F/\cos\alpha$$
$$(RF/\cos\alpha)\sin\alpha = SF$$
$$SF = -F\tan\alpha$$
$$T = ST \times l = SF\cos\alpha \times l = F\tan\alpha\cos\alpha \times l;\ \text{and } F = \mu N$$
$$T = \mu N \sin\alpha \times l$$

Formula I.

Fig. 1 shows a conventional arm positioned on a record and is a vector diagram of some of the forces acting on the reproducing stylus.

Fig. 2 shows why skating force is of importance and also illustrates how the skating force is related to the force which produces friction.

It was established after tests with an unmodulated groove and using different record materials and record radii that groove speed

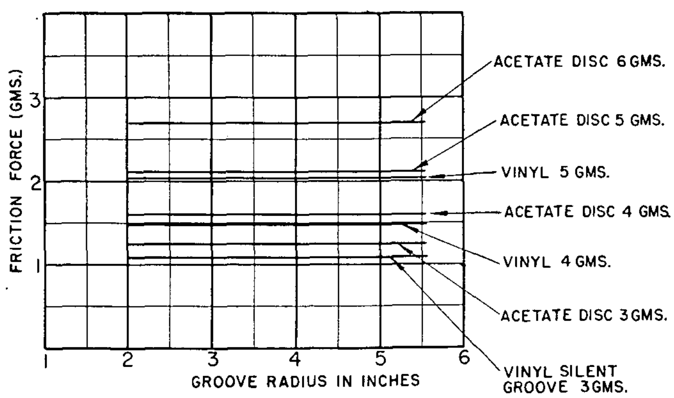

Fig. 3. Effect of record materials and record radii on skating force.

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did not affect this skating force (Fig. 3). Tests were then made with a modulated groove using a 5 cm/sec signal at 4 kc and a 1 kc signal at 30 cm/sec. The 30 cm/sec signal produced a significant friction force (Fig. 4). This result, particularly at 30 cm/sec, seemed to confirm the previously mentioned visual indication that a skating force does affect high level information reproduction of stereo records.

The skating force was found to be a torque producing clockwise rotational force in a horizontal plane about the vertical pivot of the arm; therefore, to counteract this skating force, a torque of the same magnitude and opposite in direction was applied to the arm. An anti-skating force of 0.8 gram was applied to an experimental arm, using a tracking force of 3 grams. The 0.8 gram value was determined from the information in Figs. 1, 2, 3 and 4 and Formula I.

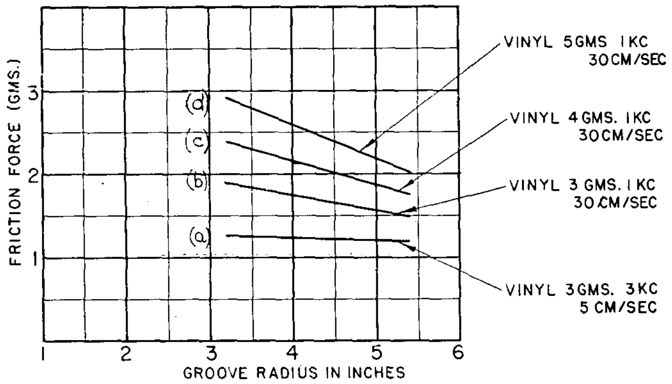

Fig. 4. Effect of modulating the signal on skating force.

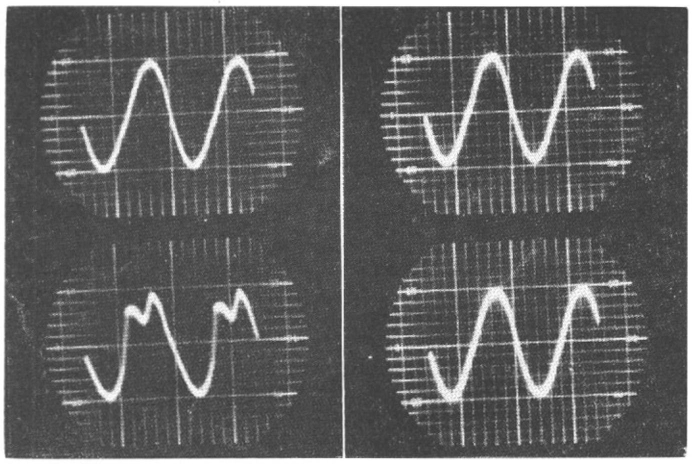

Fig. 5. Application of anti-skating to the tracing of a high level stereo groove. *a.* without; and *b.* with anti-skating provisions.

When the arm with anti-skating was used to trace a high level stereo groove (30 cm/sec) all traces of breakup were removed, as shown in Fig. 5. Further experiments revealed that this skating force was present in a large group of commercially available arms, and that each reproduced the same phenomenon.

A complete technical paper on the skating phenomenon was presented at the 1960 Convention and is available from the Secretary of the Society for those interested in further amplification of this letter.

THE REDUCTION OF WIND NOISE IN MICROPHONES

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THE PITFALLS OF IMPROVISED WIND SCREENS: Noise in microphones caused by air in motion has long been a major problem. In a few instances wind screens have been manufactured for specific microphones, but a solution to wind noise has usually been left to the user of the microphones to improvise.

In the course of our investigations, many microphone and wind screen combinations were tested. For these tests a wind velocity indicator was mounted on the roof of our plant. The two microphones and screens to be compared were mounted on five-foot stands and placed within a few feet of the wind indicator.

In the laboratory the microphones were fed to separate amplifiers, each equipped with a vu meter. A speaker was also used for an AB check. With this equipment we were able to make a rapid and impartial test. Curves were also run of the microphones with and without screens to determine the effect of the screens on axial and polar response.

Every type of microphone and wind screen we could find was tested; most of them were found to suffer from a loss in high frequency response due to the high density of the cloth used. Equalization would take care of this, but the serious result and one that cannot be easily compensated for was the loss of much of the directivity in unidirectional types of microphones, due to a cavity effect or phase condition created by this cloth density. As a result, the microphone was accepting a large percentage of the sound it should have been cancelling.

It is comparatively simple to construct a screen and judge by ear its effect on wind noise and response, but it is another thing to evaluate the degrading of polar response by the same method. The loss of directivity in many microphones was so complete that the user might as well have used a nondirectional unit.

Screens constructed of perforated sheet metal were found to have the worst cavity effects. After the removal of the cloth there still remained sufficient cavity to degrade polar response. This was due to the high ratio of solid to open area. Wire mesh was found to be far superior, and the more open the mesh the better.

Some wind screens were found to vary from day to day due to humidity. On a dry day, when the cloth covering was stretched tightly, they were at their best, but with high humidity the cloth would loosen sufficiently to move in and out with gusty wind, seriously reducing its effectiveness.

When the cloth was taut and in its best operating condition, another effect was noted. Wind would not only cause noise by striking the microphone diaphragm, but would also create sound when passing over the surface of the screen. Screens having rough and irregular surfaces were the greatest offenders. After the sorting was complete, we found that the best in this regard were the large spherical ones with smooth surfaces. An 18-inch sphere was the most successful.

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