

TALK

SOUND

FROM THE MAKERS OF "SCOTCH" BRAND MAGNETIC TAPE

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LOW FREQUENCY PROBLEMS IN MAGNETIC RECORDING

In ordinary magnetic tape recorders designed for audio use, no great difficulty is encountered in covering the required range of frequencies. However, in special recorders for instrumentation, geophysical or medical uses, it may be desirable to extend the low frequency range several octaves, thereby introducing some rather unique problems.

At the outset, it should be pointed out that these low frequency problems do not concern the recording process but are confined to the reproducing process alone. As the recorded frequency is reduced, a constant amplitude magnetic flux in the reproduce head will yield a head voltage proportional to the frequency. This is due to the fact that the voltage generated in a coil is proportional to the rate of change of magnetic flux linking the coil. Thus a head which delivers 10 millivolts from a certain tape at 1000 cps will produce only 10 microvolts at 1 cps. The amplification of such an infinitesimal signal with any appreciable signal to noise ratio is almost impossible. Increasing the number of turns in the head winding increases this voltage in proportion, but a very large coil may

have a resonance point in the audio range, thus restricting the high frequency response. Indeed, the maximum flat frequency response attainable with conventional heads is only about a dozen octaves, at which point the low frequencies are plagued by noise, and the highs by circuit resonances. It is possible to concentrate this available frequency spread in the low frequency range by using very slow tape speeds, and playback heads with a large number of turns in the windings.

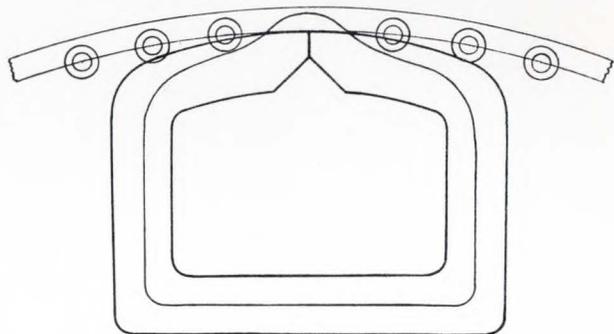


FIGURE 1

The above discussion relates only to the rate of change effect, and the attendant equalization problem. However, another serious loss occurs at

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low frequencies, or more properly, at long wavelengths. The flux in the playback head is relatively constant over a wide frequency range, but at some low frequency it begins to fall off rapidly. In order to understand this loss of flux at long wavelengths, it is convenient to consider the mechanism of the magnetic linkage between the head and the tape. At medium wavelengths, a recorded tape may have many poles confronting the playback head (see Figure 1). These poles are short circuited by the play head surface, with the exception of the pair of poles including the head gap. It is the flux from this pair which links the play head coil and causes a voltage to be developed as the head moves. As these poles become farther apart (i.e. a longer recorded wavelength) the surface pole density becomes less. However, this has little effect until the wavelength exceeds the length of the play head surface in contact with the tape. Then the flux intercepted by the head becomes less than that associated with a pair of poles, and decreases rapidly with increasing wavelength. For this reason it is not feasible to reproduce wavelengths much longer than the length of the head. One means of extending the low frequency range of a playback head is by the addition of curving horns which serve as extra "flux collectors" (See Figure 2).

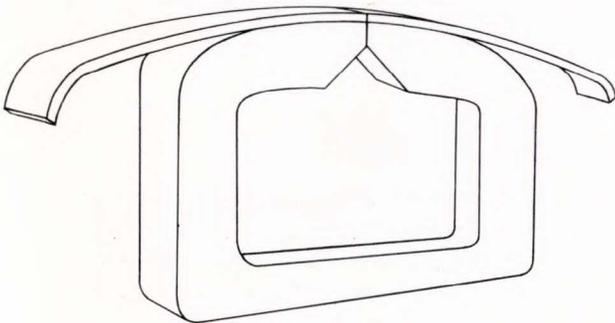


FIGURE 2

Another phenomenon caused by this head-tape linkage effect is that of low frequency peaks and valleys in the response curve (see Figure 3). These are due to reinforcing and cancellation effects taking place when there is, 1) an integral number of wavelengths confronting the head, and 2) an odd number of half wavelengths confronting the head. These excursions are more pronounced when the leading and trailing edges of the head are sharp as opposed to gently rounded or tapered. In some instances "square" pole faces have been employed purposely to cause reinforcing at some low frequency as an aid to equalization. However, most heads are shaped in such a way as to minimize these "bumps" and they are rarely apparent in commercial equipment.

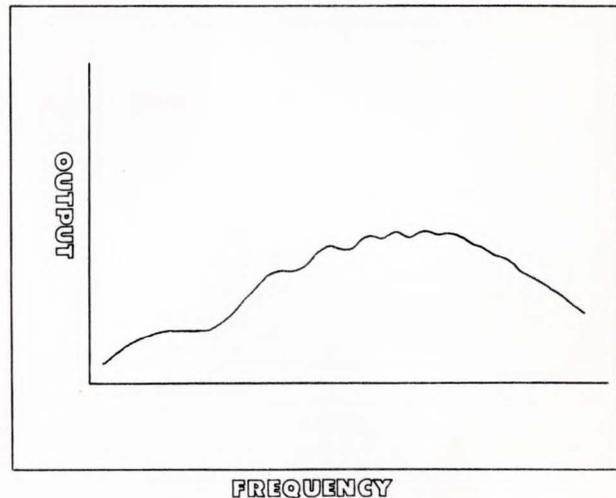


FIGURE 3