smooth bump or dip is in the audio spectrum. We can then compensate for this in the electronic circuits.

Additional Factors For Multi-Channel Recording

For stereophonic recording we must add two additional factors — precise phasing between channels and adequate cross-talk rejection.

Phasing Between Channels

The directional quality of stereophonic sound, or of any sound we hear, is dependent on the ability of the brain to distinguish subtle differences in phase and intensity as sound waves arrive first in one ear and then the other. If, in storing and reproducing stereo sound, we destroy the normal phasing between channels, it will result in a most confusing end product.

When we are recording largely independent sources on separate tracks of the tape, phasing is not too much of a problem. When those sources are not isolated — for example, when we are recording an instrument on two channels simultaneously to achieve a center effect — it becomes more important. And when we are mixing and recombining in the recording industry to produce two channel tapes from a three channel master, it becomes quite critical.

Phasing between channels is a function of the alignment of head gaps and the wavelength involved. Tolerances are most critical at slower tape speeds.

At the present state of the art, AMEPX multi-channel heads are manufactured so that all record or reproduce head gaps will fall within two parallel lines spaced 0.2 mils apart.

Crosstalk Rejection

Crosstalk rejection acts the opposite of phasing, in that it becomes more critical as sources on separate channels become more independent. When adjacent tracks are completely independent, such as in our present 4 track ¼-inch tapes, crosstalk rejection on the order of 60 db in the midrange is adequate. Regular stereo tapes (2 track on ¼-inch tape) require less rejection.

Adequate shielding between heads, and maximum track spacing in conjunction with the practical compromises we have already covered (see Signal-to-Noise) are our major means of combating crosstalk. This entails a typical spacing between tracks of 70-100 mils.

Head Assemblies

Finally, we must take a quick look at the magnetic heads. We have already seen the precise tolerances we must secure in aligning the different heads in a stack. The same careful precision must be taken to ensure the straightness of the individual gaps and their perpendicularity, if we are to achieve interchangeability of tapes.

In older, sandwich-type heads it was practically impossible to achieve the required tolerances, with the result that the master tapes could consistently be reproduced only on the equipment that recorded them and then not too sucessfully because of differences in the record and reproduce head stacks. Quoted specifications were thus at times inaccurate when tapes from one equipment were played back on another.

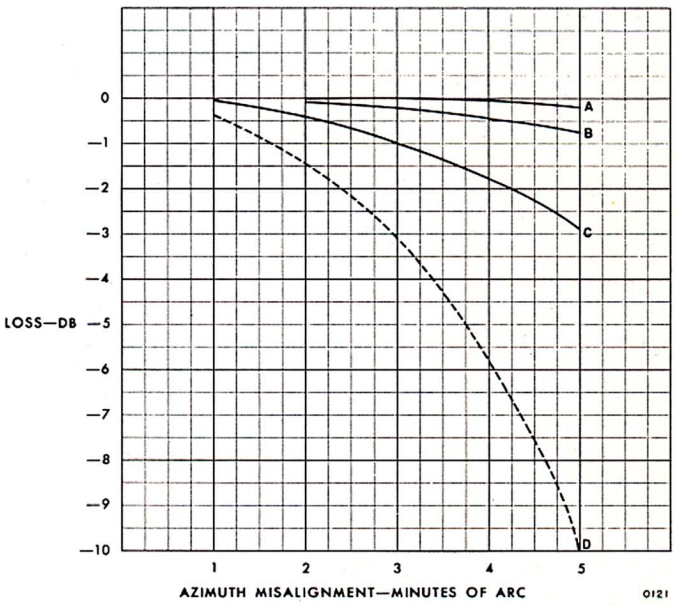
The introduction of cast type heads, with tolerances held by mechancial considerations, has alleviated this problem — but only recently. Today we should be able to play back tape from any recorder on any other comparable equipment, and do it within quoted specifications.

The sandwich type heads were constructed by completely assembling each individual head intended for multi-channel use, stacking those heads one on top of the other, then bolting them together. It was impossible to produce heads with consistent characteristics; you can see that even a slight difference in tightening the bolts that held the head together could cause gaps to be misplaced with respect to each other or the azimuth of each head to be misaligned.

Cast heads are constructed by assembling, potting, and lapping the pole pieces separately. The two pole pieces are then placed in a rigid fixture and potted together. Using this technique, all gaps can be aligned within 0.2 mils with a maximum tilt of less than three minutes from the perpendicular.

BASIC ADJUSTMENTS ON MAGNETIC TAPE RECORDERS

There are certain basic adjustments usually provided on professional quality magnetic tape recorders.



This graph shows the effect of head azimuth misalignment. Curves A, B, and C were taken using a 75 mil gap width at wavelengths of 1, .5, and .25 mil respectively. In Curve D a gap width of 250 mils and a wavelength of .5 mil were used.