set up is a welcome means for initial and continuous evaluation of the mixing. A quick and inexpensive reference cut may then be made at any cutting facility by furnishing an encoded two track tape: The encoded tape does not necessarily require an additional generation, since it may be recorded simultaneously with the four track master (although SQ requires an additional Discrete Module).

PROFESSIONAL SQ MATRIX HARDWARE

SQ encoding has been presented with a number of schemes, depending upon the particular encoder and the type of effect desired. The older CBS Model 4200 encoder had a switch for "normal" or "interior" modes, which changed the phase relationship of the rear channels with respect to the front channels. The newer 4211 Model has been described as a four input/two output device; but it actually has twelve inputs, corresponding to "normal" (SQ 4/2 code), "forward looking" and "backward looking" encoding. These various configurations are designed to optimize one or another effect, at the expense of others. CBS calls the three modes a "universal encoding set," [26].

SQ encoding is further complicated by the introduction of the so called "position encoder" or the "pan pot module," Model 4212. The Position Encoder may be used for panning around the 360° field in 24 segments (15° increments), or an (X)-pan switch permits diagonal or left-right front/left-right rear pans. The Position Encoder nominally consists of eight pan pots, and may be expanded in sets of eight. In order to encode a sound inside the 360° circle, other than on a diagonal between speakers, at least two of the pan pots must be used; the relative signal level and position setting of each panner may then be used for locating the sound. See Figure 5. While the 4212 provides a means for achieving a quad mix from a stereo mixing console, it is primarily required for any quad panning where optimum SQ encoding is desired. Its output, because it is phase shifted, will not usually provide optimum positioning for discrete four track tapes [27].

If simultaneous discrete four track tape and encoded SQ two track tape masters are required, the Model 4213 Discrete Module must be added to the encoding system. This module compensates for the phase shift of the Position Encoder so that a four track tape with optimal positioning can be obtained while making an optimally encoded SQ tape.

The SQ professional decoder, Model 2400B, now incorporates full SQ logic, W-M and F-B (a prototype of the para-matrix has been demonstrated).

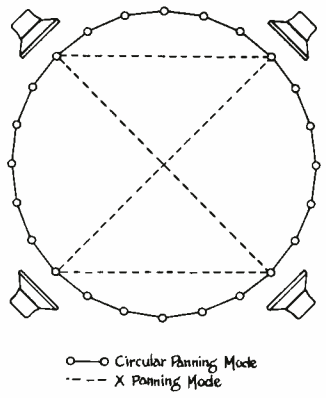

Fig 5 - Panning Modes of 4212 Position Encoder

The price tags on SQ equipment are as follows: 4211 SQ Encoder, $2800; 2400-B SQ Decoder, $2800; 4212 Position Encoder, $1800 per 8-input module; 4213 Discrete Module, $1600. The 4211 encoder will be available in limited quantities, beginning in January of 1974, according to Benjamin Bauer of CBS Laboratories. The 2400-B decoder is now in stock. Judging from these prices, a minimum investment for optimum SQ encoding, 8-channel Position Encoder included, and decoding is $7400 [28].

PROFESSIONAL QS MATRIX HARDWARE

Sansui offers a six input (four corners and the side centers) QS encoder, designated Model QSE-4. It provides optimal encoding when used with any conventional mixing console equipped with standard pan pots. While the corner inputs are normally used, the side inputs are available where added stereo separation is required, or for panning a 180° arc with a stereo pan pot.

Optimal positioning of the encoded QS tape, since it is entirely done by the encoder, allows the four track output of the mixing console to be utilized for making a simultaneous four track master tape, with no additional special equipment.

The Sansui QS professional decoder, with the latest *vario-matrix logic* is designated Model QSD-4. It contains provisions for special decoding of existing QS recordings with good monaural quality, as well as means for checking stereo and monaural compatibility.

The total price for a complete QSE-4/QSD-4 encoding-decoding pair is $5000, with immediate availability from Sansui [29].

CUTTING A QUAD DISC

CD-4 cutting requires a highly specialized laquer channel. In addition to a Neumann lathe with the latest SX-74 (or SX-68/4) head, and the associated four track tape machine, a variety of unique cutting electronics must be used. These electronics are required because the high-frequency carrier system is generated and processed with the audio at the cutting stage of CD-4 recording. Moreover, because only half-speed cutting is now possible with CD-4, associated signal processing such as noise reduction systems and equalization, must be special half-speed versions. Four monitor channels must be provided (although this is certainly desirable with QS or SQ, it is mandatory with CD-4). The cost of the special CD-4 cutting electronics, which occupies three full racks, is quoted by JVC at between $62K and $67K, with a delivery schedule of no less than four months. See Figure 6.

Besides the additional cutting equipment costs of CD-4, the system requires at least twice the mastering time of conventional systems. The current half-speed system represents an improvement over the original third-speed version (still be-

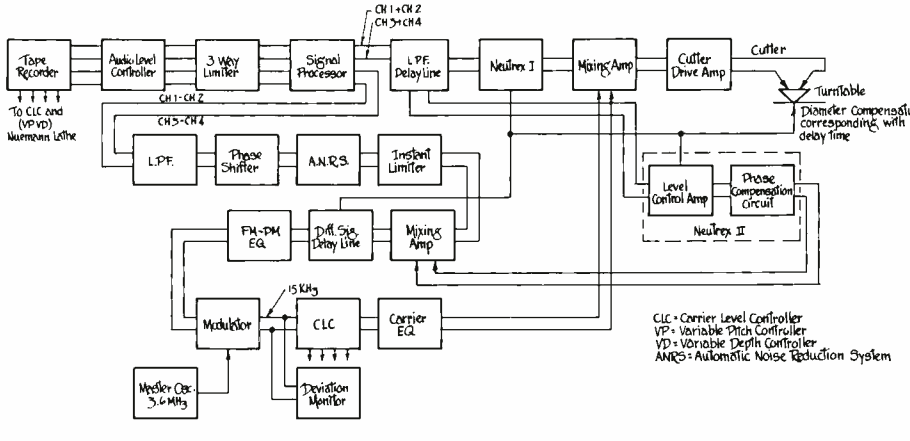

Fig 6 - Half Speed Cutting System