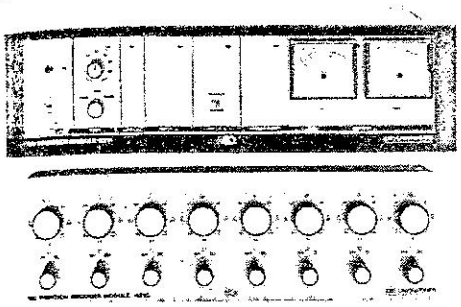

Fig. 2 (a) and (b)

intended for reproduction in the monophonic mode. This characteristic actually is beneficial for the monophonic listener when the programme carries a full measure of reverberation which is so effective with a quadraphonic programme but less desirable in the monophonic mode. That portion of reverberation contained in CB is not heard by the monophonic listener. Nevertheless, for 'on location' broadcasting, where the producer may not have full control over the location of sound sources, a special SQ Broadcast Encoder, Model SQE-2000, shown in fig. 4, has been designed. The SQE-2000 provides for the selection, among others, of the basic, or the so-called 'forward-looking', SQ encoding modes. The latter transmits CB signals as if they were CF, ensuring the monophonic reception of all the signals around the 360° compass.

After a programme is coded in the SQ mode, its signals are applied to a conventional stereophonic disc cutter, either directly or via a master tape. The resulting

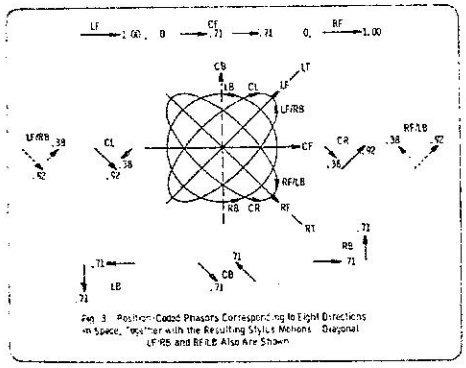

Fig. 3 Position-Coded Phasors Corresponding to Eight Directions in Space, Together with the Resulting Stylus Motions. Diagonal LF/RB and RF/LB Also Are Shown

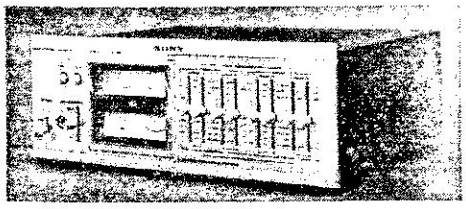

Fig. 4

SQ disc has identical recording time,[5] recording level, frequency response, dynamic range, and freedom from distortion, and it utilizes the same manufacturing process and the same pickup and stylus as the stereo disc. The SQ system is the leading quadraphonic system in the USA, UK, and continental Europe appearing on 40 labels with the number of titles exceeding 500.*

* This figure includes separate releases only without, as is often done, accruing identical titles issued on different labels in different countries.

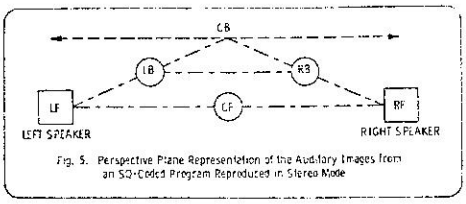

Fig. 5. Perspective Plane Representation of the Auditory Images from an SQ-Coded Program Reproduced in Stereo Mode

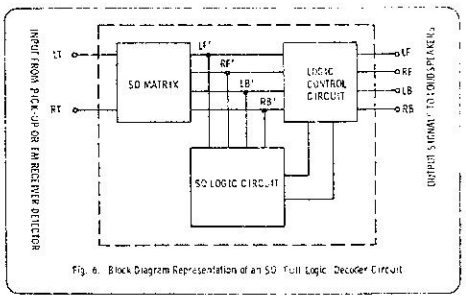

Fig. 6. Block Diagram Representation of an SQ Full Logic Decoder Circuit

The SQ system is a standard of RIAA and EIA in both the USA and Japan, and is protected by thirteen patents currently issued in the USA and others issued and pending elsewhere.

Stereo Reproduction of SQ Records

It is perfectly safe to use SQ records on any stereo player. Many listeners have discovered that SQ records played in this manner offer a quality of reproduction which is at least equal, and often superior, to stereo disc performance. The stereophonic reproduction of the SQ disc is depicted, in perspective, in fig. 5. The front signals LF, CF, and RF are configured

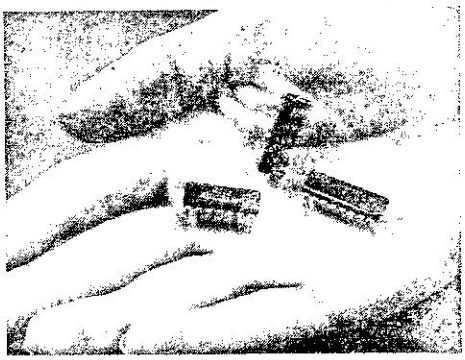

Fig. 7

precisely as conventional stereo signals. The back channels are organized according to appropriate geometry, somewhat spread in space, suggesting image depth. The observer, in effect, is standing outside the quadrangle, looking in. The position of centre-back signals is not defined in the stereo mode, although it is properly localized at centre back in the quadraphonic reproduction mode.

Quadraphonic Reproduction of SQ Records

To reproduce SQ records quadraphonically, a decoder and an additional pair of loudspeaker channels are needed. Decoder circuits have been described in detail elsewhere.[3] A stylized representation of an advanced decoder is shown in block diagram in fig. 6. It consists of three parts: (a) a matrix circuit which resolves the encoded signals LT and RT into four 'decoded' signals LF′, RF′, LB′, and RB′, each of which contains, predominantly, one of the corresponding original signals, LF, RF, LB, and RB, as well as lesser amounts of crosstalk signals; (b) a logic circuit which, by comparing amplitudes and phases of the encoded or decoded signals, decides in which channel a particular signal belongs; and (c) a logic control circuit acting upon the commands of the logic to enhance the desired signals and to attenuate the undesired crosstalk signals, resulting in final output signals LF″, RF″, LB″, and RB″ which aurally are virtually indistinguishable from the original signals.

The SQ decoders may be configured to accommodate a wide variety of users' pockets and levels of technical sophistication. The simplest decoder using an SQ matrix with fixed blend resistors across the front and back channels provides 20 dB separation between the front channels, 8 dB between the back channels, 3 dB between the side channels, and 6 dB between centre-front and centre-back. This arrangement affords a satisfying surround-sound reproduction at minimum cost. The most advanced commercially available SQ decoders use a so-called Full Logic With Variable Blend system which is able to provide infinite separation between the individual channels of the front and back pairs, and up to 20 dB between front and back. This decoder reproduces the orchestral and reverberant sounds with full spatial realism and also aurally provides antiphonal effects with virtual discreteness.

The manufacture of SQ decoders has been greatly facilitated by the development of IC 'chips' to perform the matrix, logic, and control actions described above. Three such chips developed by Motorola are shown in fig. 7. Fairchild Semiconductor Company has also begun to introduce identical ICs. Additionally, the Sony Corporation in Japan produces SQ ICs used for their own decoders as well as for other SQ licensees. Nearly every manufacturer of quadraphonic players in the USA and Japan, both in the high fidelity and popular price categories, offers the SQ decoding capability, as well as a significant number in the UK and continental Europe. Currently there are more than 120 SQ equipment licensees worldwide.

SQ Broadcasting and Stereo Program Enhancement

When a stereo record is reproduced through an SQ decoder, conventional stereo reproduction is obtained over the front loudspeakers with some of the random signals being transferred to the back loudspeakers, resulting in pleasing spatial augmentation. This action may be greatly enhanced by including a forward-looking encoder in the programme circuit and feeding the stereo signal into the corresponding front and the back input channels in any desired proportions.[6]

Some 300 FM stations in the USA broadcast SQ records as they become