THE FASCINATING STORY OF THE MUSIC RECORD

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When Thomas Alva Edison invented the 'phonograph' in 1877, he made use of a tin-foil wound over a cylinder. Subsequently, he improved it and developed the wax cylinder record in 1888.

German-born Emile Berliner produced the first disc records in U. S. A. around 1893. They were made of hard rubber and the signal-to-noise ratio was no better than 6 db (this means that the noise voltage was as much as half of the peak audio signal voltage)!

Around 1900, Eldridge Johnson developed the 78 r. p. m. shellac records which remained the standard for nearly 50 years. The material consisted of 13% shellac, 75% wood flour filler and 12% of other additives. The original recording was done on a wax disc which was then graphited and nickel-plated to produce the female 'masters' used for moulding the records. The signal-to-noise ratio was as good as 30 to 32 db (noise voltage 1/35 of the peak signal voltage). The popularity of these disc records forced Edison to abandon his cylinder record and to come up with his famous 'Diamond Disc' 10" 78 r. p. m. records along with a fine diamond stylus for playback.

It is interesting to note that until 1925, phonograph recording, manufacture as well as reproduction did not use electricity at all! In order to get adequate sound from the gramophone, a large stylus force of about 225 gm was made use of. Naturally the records wore out quickly.

Electrical recording was first developed by Bell Laboratories around 1924, and electrical playback the next year. The stylus force could now be brought down to 110 gm. By 1946, it had dropped dramatically to 25 gm. In 1957, the high-quality magnetic cartridge operating at a stylus force of just 1 gm was introduced!

Audible sound may have a pitch ranging from 20 Hertz (cycles per second) for deep bass to 20,000 Hz for high treble. The response of the ear is not uniform and peaks at a medium pitch of about 2000 Hz. In music the bass sounds have much higher amplitudes than treble notes. Therefore, to improve the overall quality of the recording, the recording stylus is given a non-linear response. With reference to a standard 1000 Hz note, a 100 Hz note is attenuated by 11 to 13 db, while a 10,000 Hz note is boosted to a similar extent. These 'recording levels' got standardised by 1950.

In a high-fidelity (hi-fi) phonograph amplifier, proper frequency correction (bass lift and treble cut) is introduced. Any other distortion of the music signal is avoided, so that the sound reproduced by the loudspeakers is an exact replica of the sound which was originally recorded on the disc.

The 12" 33 r. p. m. long-play (LP) record was first introduced in 1948. These records are compression-moulded from vinyl plastic (vinyl chloride vinyl acetate copolymer) to which various additives are added in order to obtain the desired characteristics. The signal-to-noise ratio improved dramatically to about 60 db (noise voltage 1/1000 of the peak signal voltage). The LP record was first introduced in India in 1965. Soon afterwards the production of 78 r. p. m. shellac records was phased out.

Meanwhile hi-fi music reproduction was getting more and more sophisticated. Whereas hi-fi amplifiers achieved a 'dynamic range' of 80 db with negligible distortion, a matching music source was not forthcoming. While ordinary mortals are satisfied with the reproduction from a medium-quality cassette player providing a signal-to-noise ratio of about 40 db, hi-fi enthusiasts (referred to euphemistically as 'audiophiles') are not satisfied with the performance of either a high-quality cassette player or a LP record player providing a signal-to-noise ratio of 60 db.

Another breakthrough was needed, and it turned out to be indeed revolutionary. It came in 1982 in the form of the Compact Disc (CD)

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player. In this system, the music signal is sampled 44,100 times a second and each sample voltage is represented as a 16-digit binary number. For stereo music, there are two such signals. The Compact disc, made of aluminium-coated perspex, is 12 cm in diameter and 0.12 cm thick, and provides a playing time of upto 74 minutes. On one side of the disc there are nearly 20,000 tracks, spaced at 1.6 microns, on which the binary digits are stored in the form of minute pits, 0.5 micron wide and 0.8 to 3.6 microns long (1 micron = 1/1000 mm). The pit and the disc surface correspond to binary 0 and 1 respectively. As the disc rotates at a varying speed of 486 to 196 r. p. m. maintaining a constant linear velocity of 120 cm/sec in the pick-up zone, the pick-up head containing a tiny solid-state laser slowly traverses the record from the inner to the outer tracks. The laser beam is directed somewhat obliquely at the track and from the reflected beam the digital information is retrieved. Each second about 1.4 million zeros and ones are read from the disc! The audio signal is reconstructed electronically from the sequence of numbers. There is no question of wear and tear of the record. Noise is practically absent, the typical signal - to - noise ratio being 90 db (noise voltage 1/32000 of the peak signal voltage) ! It is not surprising that 'audiophiles' are going crazy over CD music !

It is indeed a remarkable transformation that has taken place in music reproduction since the time of the noisy records played 100 years ago !