Preface

Research and development in magnetic recording at IBM over the past twenty-five years for data processing applications has led to several different device configurations. The five papers in this chapter deal with various types of tape, disk, and drum devices, including such special geometries as the diskette, the magnetic strip, and the magnetic cartridge.

The dramatic pace of improvement in the performance and reliability of magnetic storage devices has been sustained for many years, as shown in the introductory paper by Stevens. Some of the key developments, in addition to the advancements in magnetic heads and materials, include the vacuum column tape drive, the moving-head disk file, the flexible diskette, and the magnetic cartridge mass store. Other significant contributions were the development of the I/O software interface and the access methods.

The evolution of the disk file technologies is reviewed in detail by Harker *et al.* Some of the complexities of mechanical, electrical, and hydrostatic design have required, in addition to engineering improvements, a number of studies into basic properties and mechanisms. One significant innovation was the extension of classical air bearing theory to account for the effects of compressible fluids. This led to the development of the self-acting slider bearing for magnetic heads. Other key developments include the fabrication of smooth stable disk substrates, the formulation of high-performance magnetic coatings, the precise design of head-positioning actuators, and the innovations in coding and electronics that ensure reliable writing and reading of data.

A highly important aspect of the development of disk files has been the interaction among the many kinds of device improvement. An advance in any one area tends to demand refinements in another, *e.g.*, smaller head/disk spacings required more precise track-to-track positioning and improved disk surface finish.

The third paper in this chapter, by Harris *et al.*, surveys the concepts and developments that were incorporated into tape handling machines. One of the fundamental contributions was the low-inertia vacuum column buffer, which mechanically absorbed the transient condition of starting and stopping the tape. The authors use an early tape drive, the IBM 726, as a base reference for discussing subsequent design changes and reliability improvements. Among these were the high-torque, low-inertia motor, an important innovation in the tape transport mechanisms. Another was the adoption of a microprogrammed controller using solid state switches. Later, when large-scale storage of data and the management of tape reels became more complex, the Mass Storage System was developed, in which magnetic cartridges were stored in cells and automatically loaded into a drive.

The fourth paper, by Engh, describes the flexible disk system. The new disk required a plastic mailing jacket, which was adopted as a permanent enclosure; a new head design adapted to contact recording; and a new disk surface having reduced roughness. Another problem to be resolved was the demand for tighter tolerances due to the interchangeability among diskettes and drives. A further series of improvements produced faster speeds, dual magazines, and automatic handling.

The final paper in this chapter, by Mulvany and Thompson, reviews manufacturing capabilities in a discussion of processes, materials, tools, and testing techniques. The main topics are the manufacturing aspects of the read/write head and its air bearing support, the disk substrate and its magnetic coating, the completion of head/disk assemblies, and performance testing.

The development of magnetic recording devices and systems requires scientific and engineering effort in many disciplines, including magnetics, surface physics, hydrodynamics, mechanics, physical chemistry, control theory, information theory, electronic circuits, optics, and others. Because of the limitations of space, the review papers in this chapter show only the overall structure of these contributions.

Other areas of magnetic recording technology not covered in this chapter appear in the paper by Pugh *et al.* (third chapter), which includes the work on ferrite cores, thin magnetic films, and bubble memories. Another related paper is the one by Hsiao *et al.* (first chapter), which details the improvements in reliability, availability, and serviceability in tape and disk systems.

Editor