INTRODUCTION

The desirable characteristics of an improved cross-sectional or B-scan imaging system include diffraction-limited lateral resolution in both dimensions at all depths, large-aperture receiver sensitivity, and real-time imaging. No B-scan system, in use or published, meets all of these desirable traits. Some array systems are proposed in this paper which attempt to meet all of these characteristics in a relatively simple structure.

Most commercial B-scan systems, using manually scanned single transducers operating in the near field region, have none of these characteristics. A number of new approaches have recently emerged which supply some of the desired characteristics. Somer [1,2] introduced a real-time system using phased-array techniques to generate a sector scan. This system is not dynamically focused and has near-field resolution patterns in both dimensions. Kossoff [3] has achieved the lateral resolution and sensitivity of a large aperture by using an array of concentric transducer rings. In the receive mode the array is dynamically focused by connecting the rings together with time-varying delay networks. The system operates on axis with mechanical scan used to form an image. It is thus not real time but provides the desired resolution characteristics. Thurstone [4] has reported on a real-time sector scan system for cardiology. The array was dynamically focused and deflected in one
dimension using computer controlled delay elements. In the orthogonal dimension the system used near field patterns so that the focusing characteristic was realized in one lateral dimension.

CIRCULAR ARRAYS

The primary problem is that of achieving focusing in both dimensions over a large depth range. One method of achieving the desired resolution is the matrix transducer array shown in Fig. 1. Here a controlled delay element is connected to each transducer element to compensate for the difference in propagation time between a reflecting point in the object and each element. Thus if the propagation time to each element \( n \) is \( r_n/c \), a corresponding delay