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United States Patent [19]

Sangveraphunsiri et al.

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[45] **Date of Patent: Dec. 31, 1996**

[54] **APPARATUS FOR PERFORMING CONCURRENT SEEKS ON PLURAL INTEGRATED DRIVE ELECTRONICS (IDE) DISK DRIVES WITHOUT ADDITIONAL DEVICES**

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[73] Assignee: **Advanced Logic Research**, Irvine, Calif.

[21] Appl. No.: **353,336**

[22] Filed: **Dec. 5, 1994**

Related U.S. Application Data

[63] Continuation of Ser. No. 935,713, Aug. 27, 1992, abandoned, which is a continuation-in-part of Ser. No. 926,675, Aug. 10, 1992, abandoned.

[51] **Int. Cl.**[6] **G06F 7/00**; G06F 13/00

[52] **U.S. Cl.** **395/841**; 395/44.1; 364/DIG. 1; 364/236.2; 364/243; 364/243.7; 364/248.1; 364/256.8

[58] **Field of Search** 369/14–15; 371/10.1, 371/11.1, 51.1; 395/275, 425, 575, 800, 840, 841, 441, 182.04, 182.05

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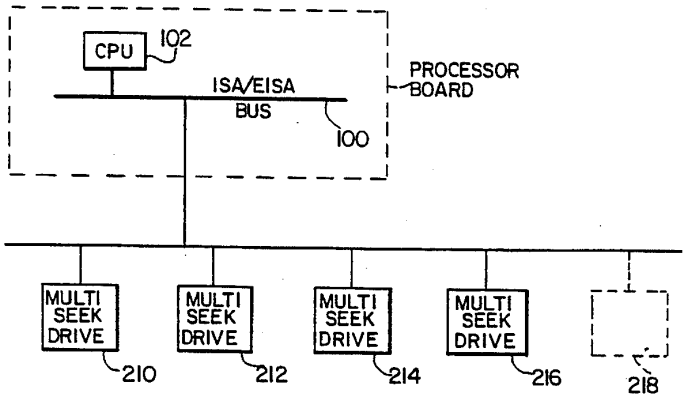
[57] **ABSTRACT**

An interface allows a given CPU (Central Processing Unit) to communicate concurrently with a large number of disk drives in a high-performance, low-cost system. Plural seek operations can be performed concurrently, to serve a common processor. Also, heterogeneous physical drives—of any physical or logical configuration (storage capacity, number of heads, and so forth)—can be combined into one or more "logical" drives as seen by a host operating system. An "on-board" embodiment provides an "enhanced" IDE (Integrated Drive Electronics) disk drive that is an extension of the industry-standard IDE drives, allowing an arbitrary number of independently seeking IDE drives on a conventionally single-seeking, two-drive-maximum bus. In a "paddle board" embodiment, low-cost IDE drives of arbitrary physical size, storage capacity and geometry, can be combined simply and inexpensively into a high-performance storage device. For example, a 3.5"80 MB (megabyte) drive can be transparently combined with a 2.5" 60 MB drive. The inventive concept can thus be embodied with either a "paddle board" controller (with standard IDE drives), or with no additional controller (employing "enhanced" IDE drives).

12 Claims, 17 Drawing Sheets



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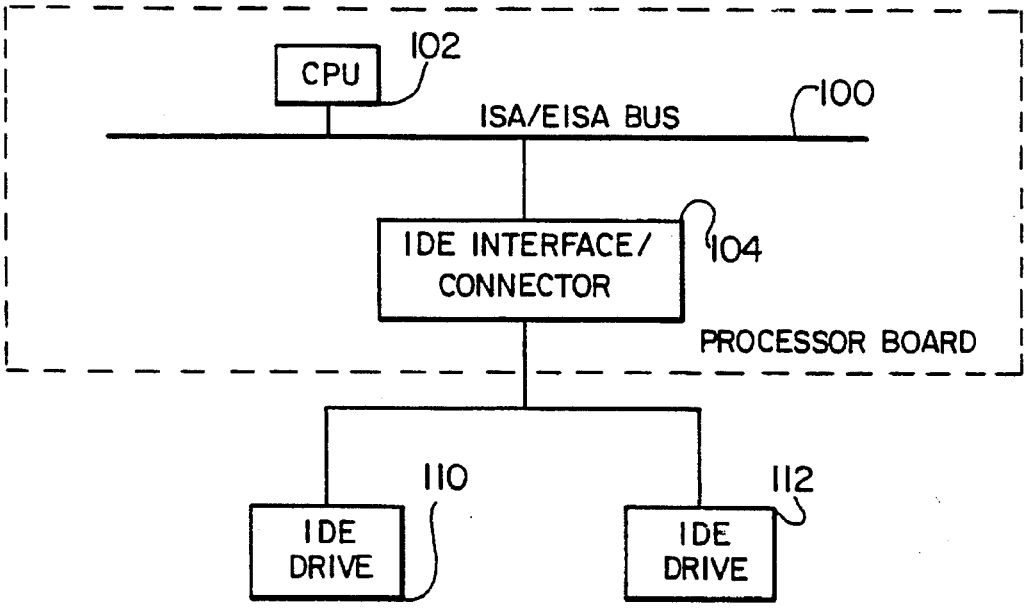

PRIOR ART

FIG. 1

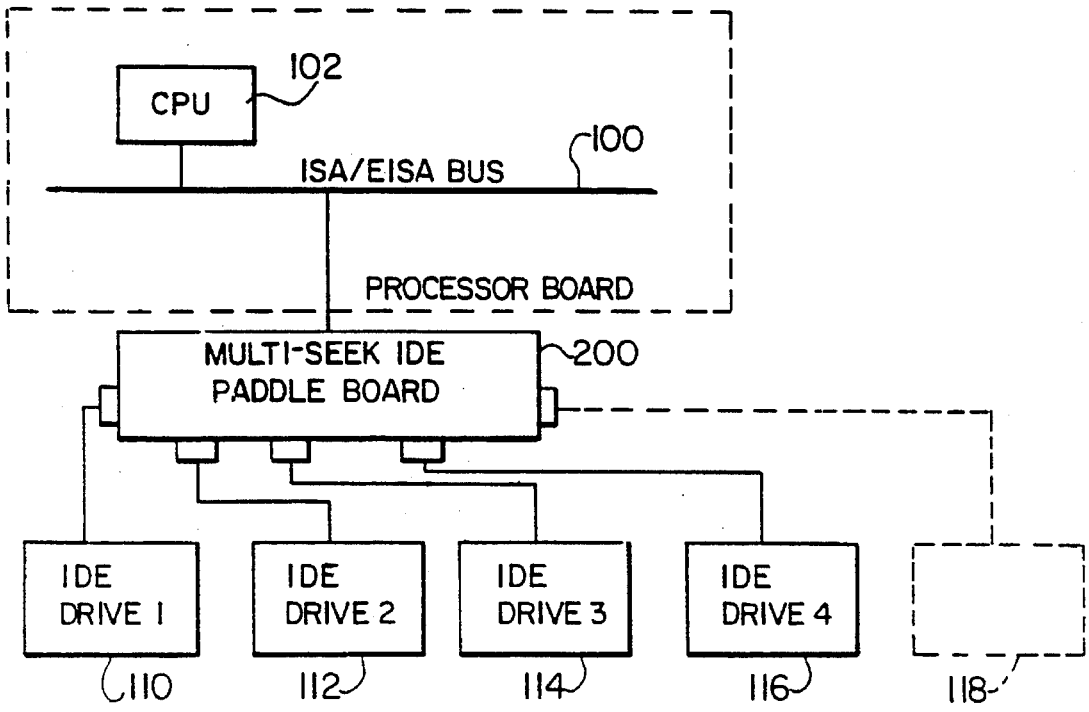

FIG. 2A

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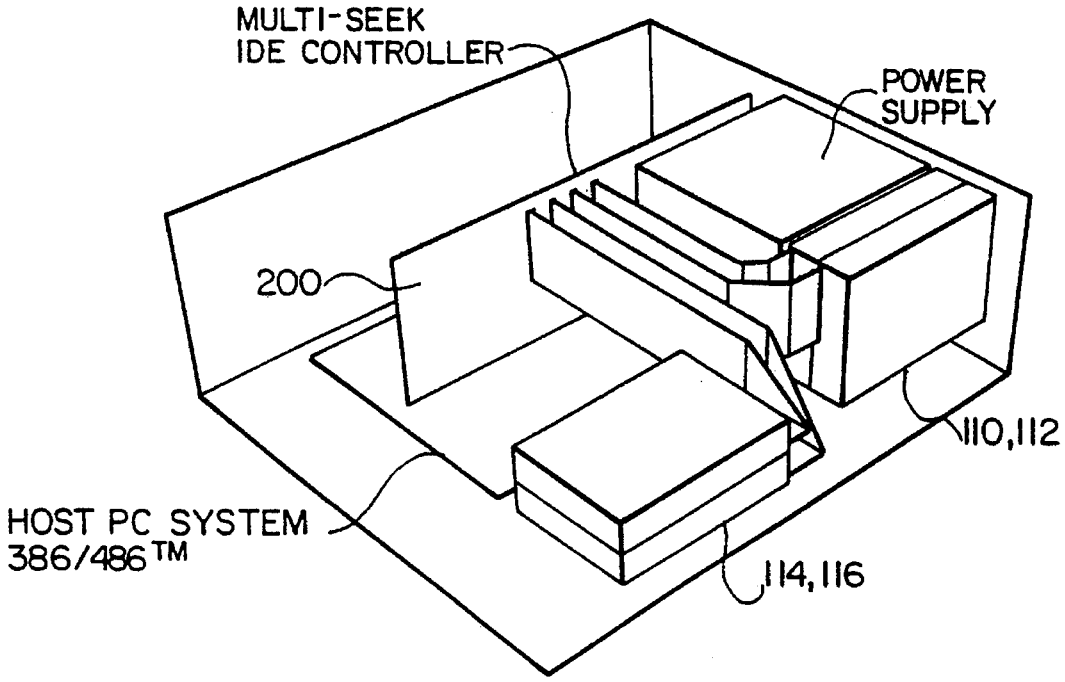

FIG. 2B

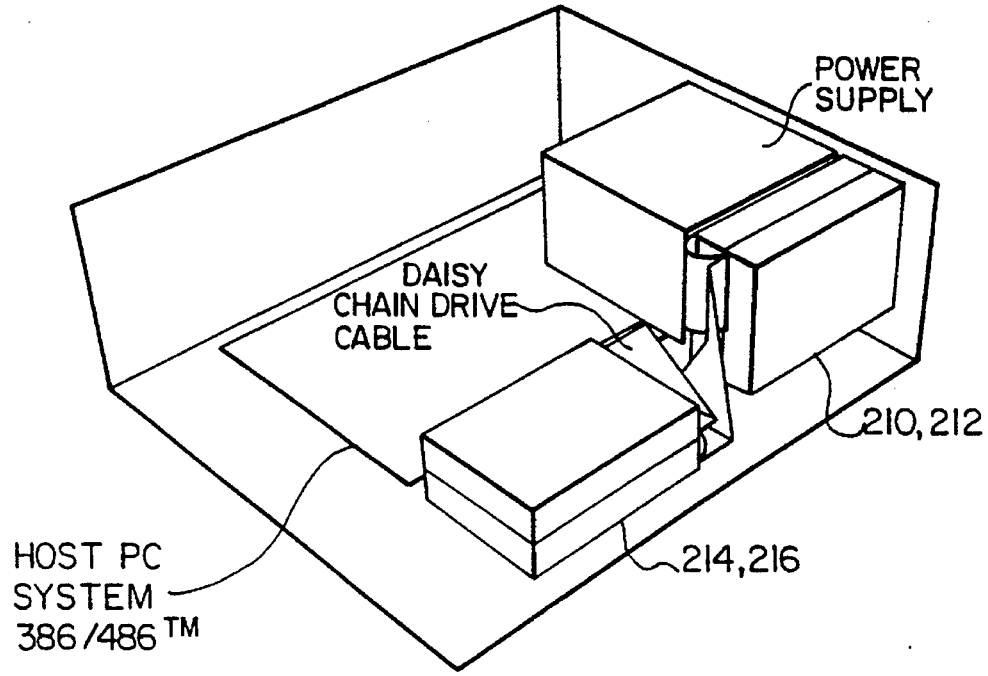

FIG. 2D

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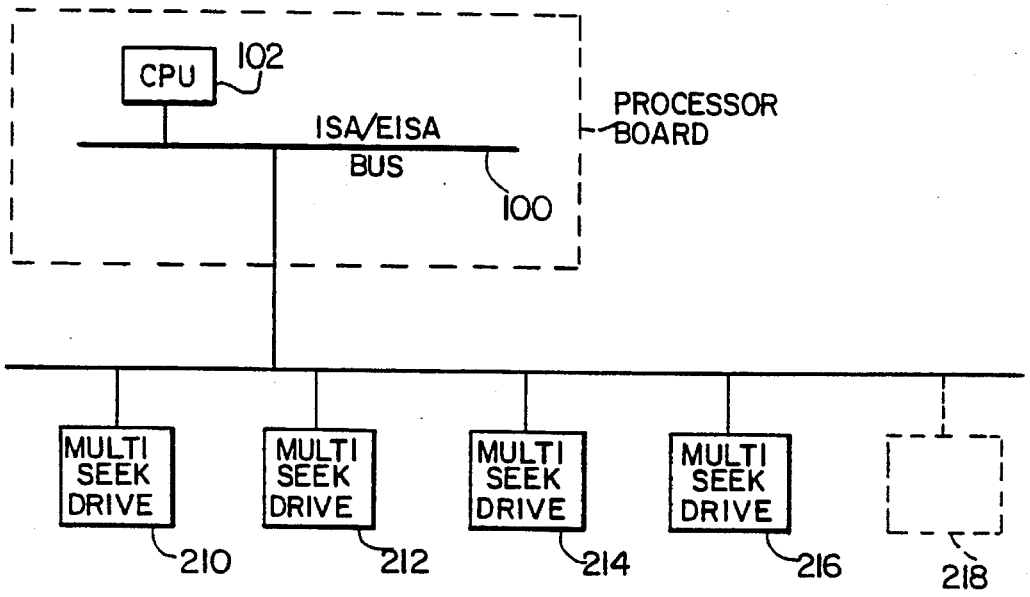

FIG. 2C

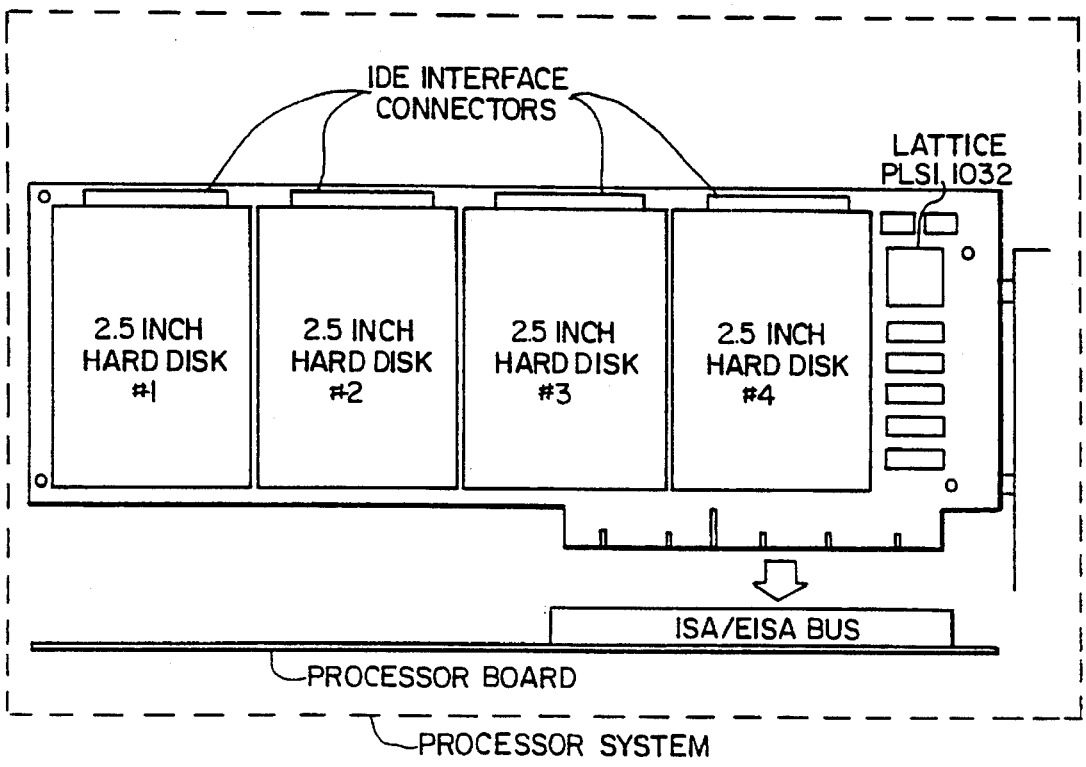

FIG. 2E

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