

[54] DISK ARRAY SYSTEM FOR PROCESSING AND TRACKING THE COMPLETION OF I/O REQUESTS

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[58] Field of Search 710/3, 5, 9, 27, 710/57; 709/235; 711/4, 201, 114; 714/6, 5, 7; 395/500.46

References Cited

U.S. PATENT DOCUMENTS

Table of references with columns for patent number, date, inventor, and classification code.

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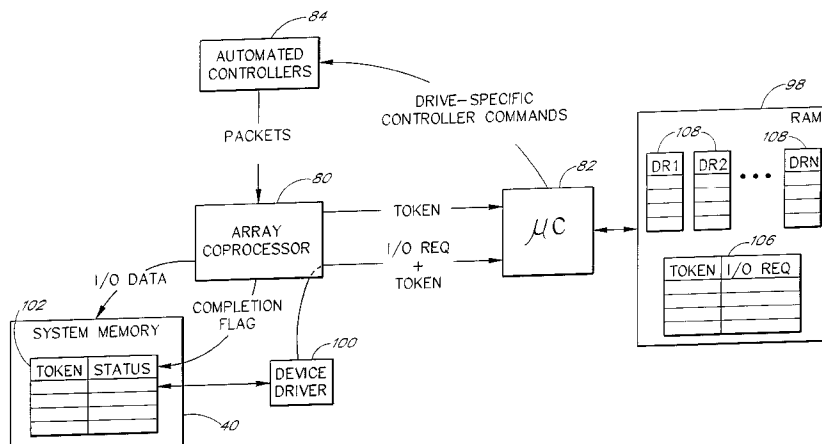
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[57] ABSTRACT

A high-performance RAID system for a PC comprises a controller card which controls an array of ATA disk drives. The controller card includes an array of automated disk drive controllers, each of which controls one respective disk drive. The disk drive controllers are connected to a microcontroller by a control bus and are connected to an automated coprocessor by a packet-switched bus. The coprocessor accesses system memory and a local buffer. In operation, the disk drive controllers respond to controller commands from the microcontroller by accessing their respective disk drives, and by sending packets to the coprocessor over the packet-switched bus. The packets carry I/O data (in both directions, with the coprocessor filling-in packet payloads on I/O writes), and carry transfer commands and target addresses that are used by the coprocessor to access the buffer and system memory. The packets also carry special completion values (generated by the microcontroller) and I/O request identifiers that are processed by a logic circuit of the coprocessor to detect the completion of processing of each I/O request. The coprocessor grants the packet-switched bus to the disk drive controllers using a round robin arbitration protocol which guarantees a minimum I/O bandwidth to each disk drive. This minimum I/O bandwidth is preferably greater than the sustained transfer rate of each disk drive, so that all drives of the array can operate at the sustained transfer rate without the formation of a bottleneck.

23 Claims, 9 Drawing Sheets



## U.S. PATENT DOCUMENTS

5,596,708	1/1997	Weber .....	714/6	5,717,954	2/1998	Grieff et al. ....	710/57
5,598,549	1/1997	Rathunde .....	711/114	5,720,025	2/1998	Wilkes et al. ....	714/6
5,619,723	4/1997	Jones et al. ....	710/3	5,729,705	3/1998	Weber .....	710/128
5,619,728	4/1997	Jones et al. ....	710/27	5,734,861	3/1998	Cohn et al. ....	711/134
5,651,132	7/1997	Honda et al. ....	711/114	5,742,792	4/1998	Yanai et al. ....	711/162
5,664,096	9/1997	Ichinomiya et al. ....	714/48	5,784,569	7/1998	Miller et al. ....	709/235
5,671,349	9/1997	Hashemi et al. ....	714/48	5,860,091	1/1999	Dekoning et al. ....	711/114
5,687,390	11/1997	McMillan, Jr. ....	710/5	5,937,428	8/1999	Jantz .....	711/114
				5,974,502	10/1999	Dekoning et al. ....	711/114

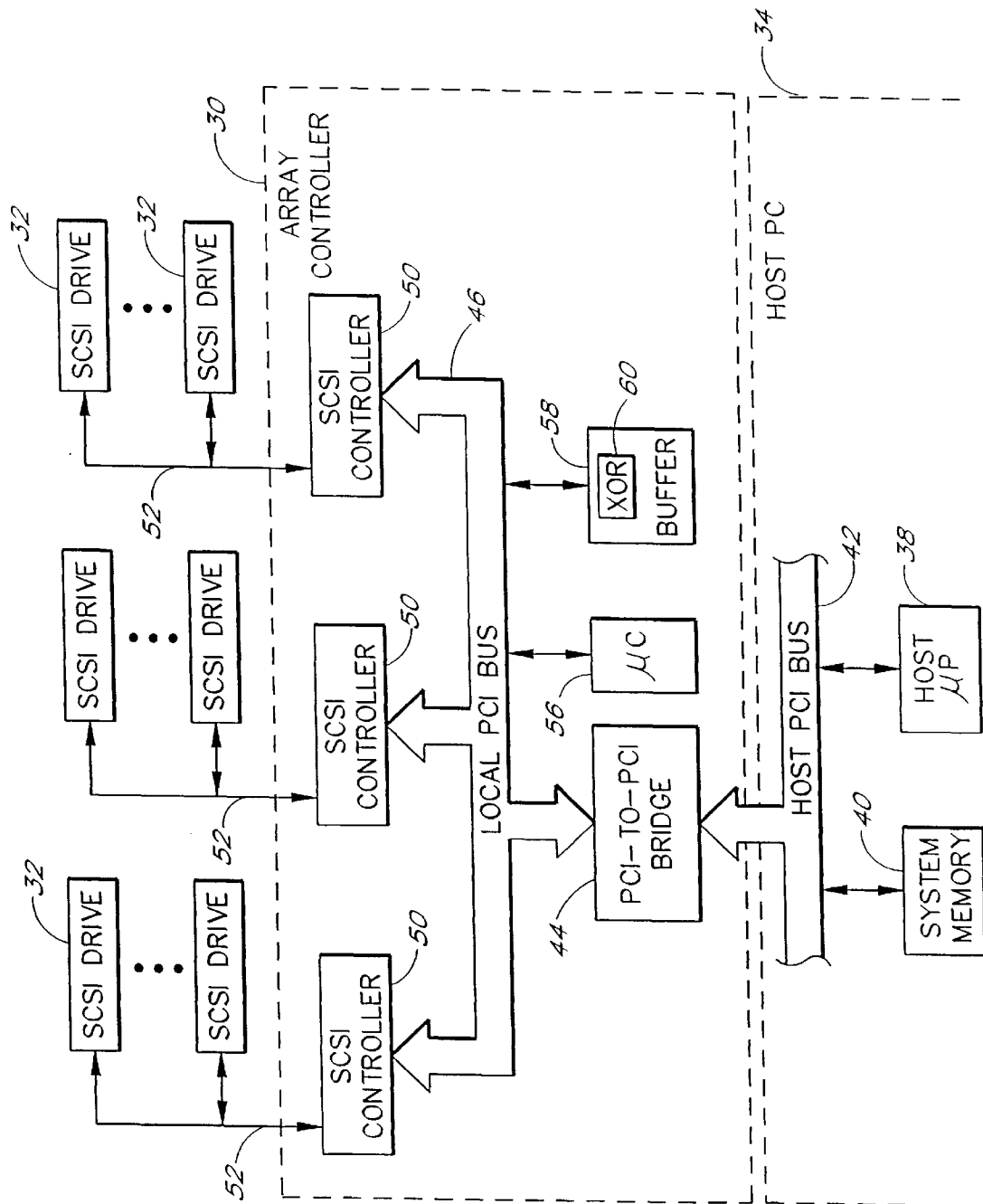


FIG. 1  
(PRIOR ART)

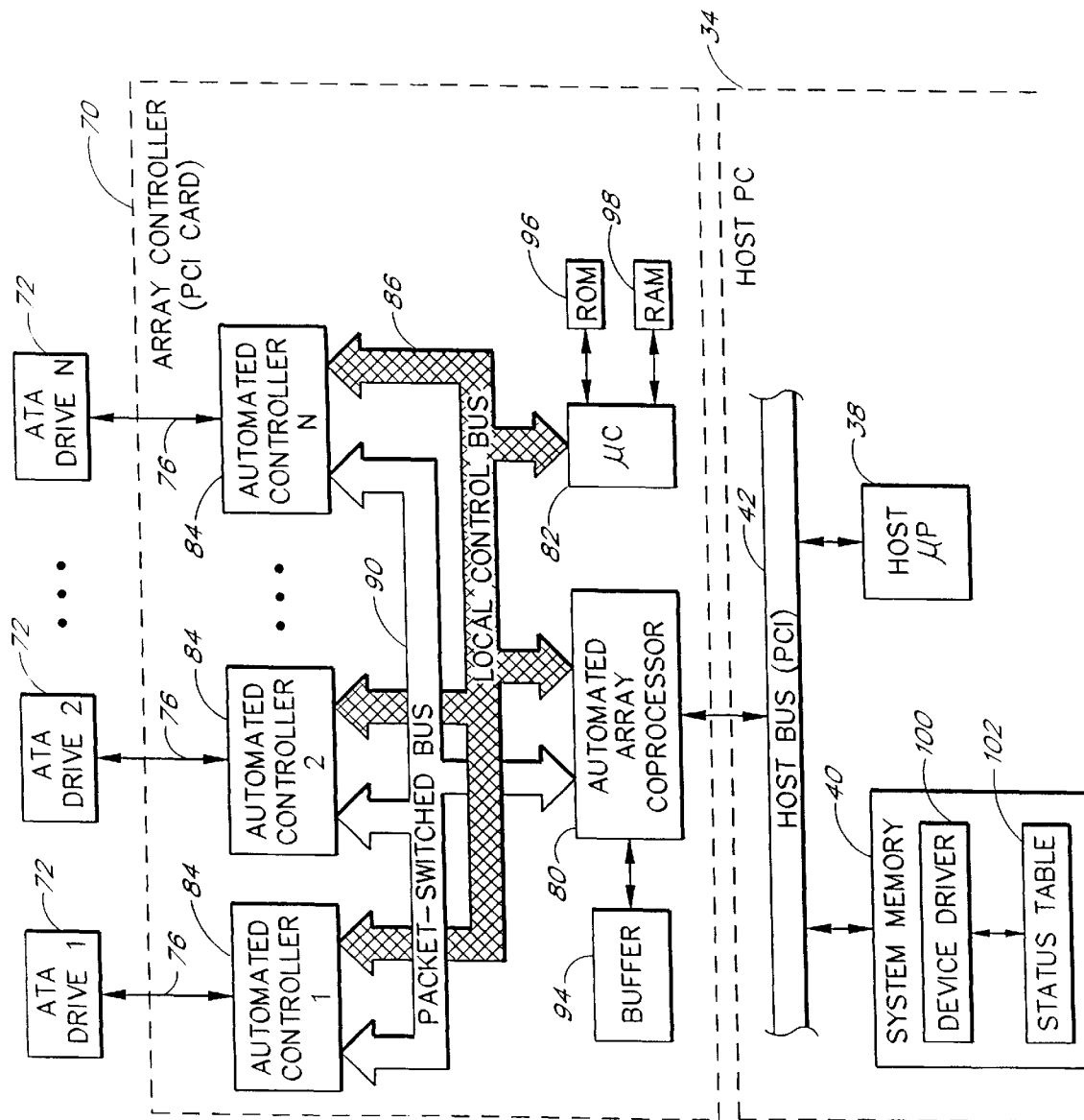


FIG. 2

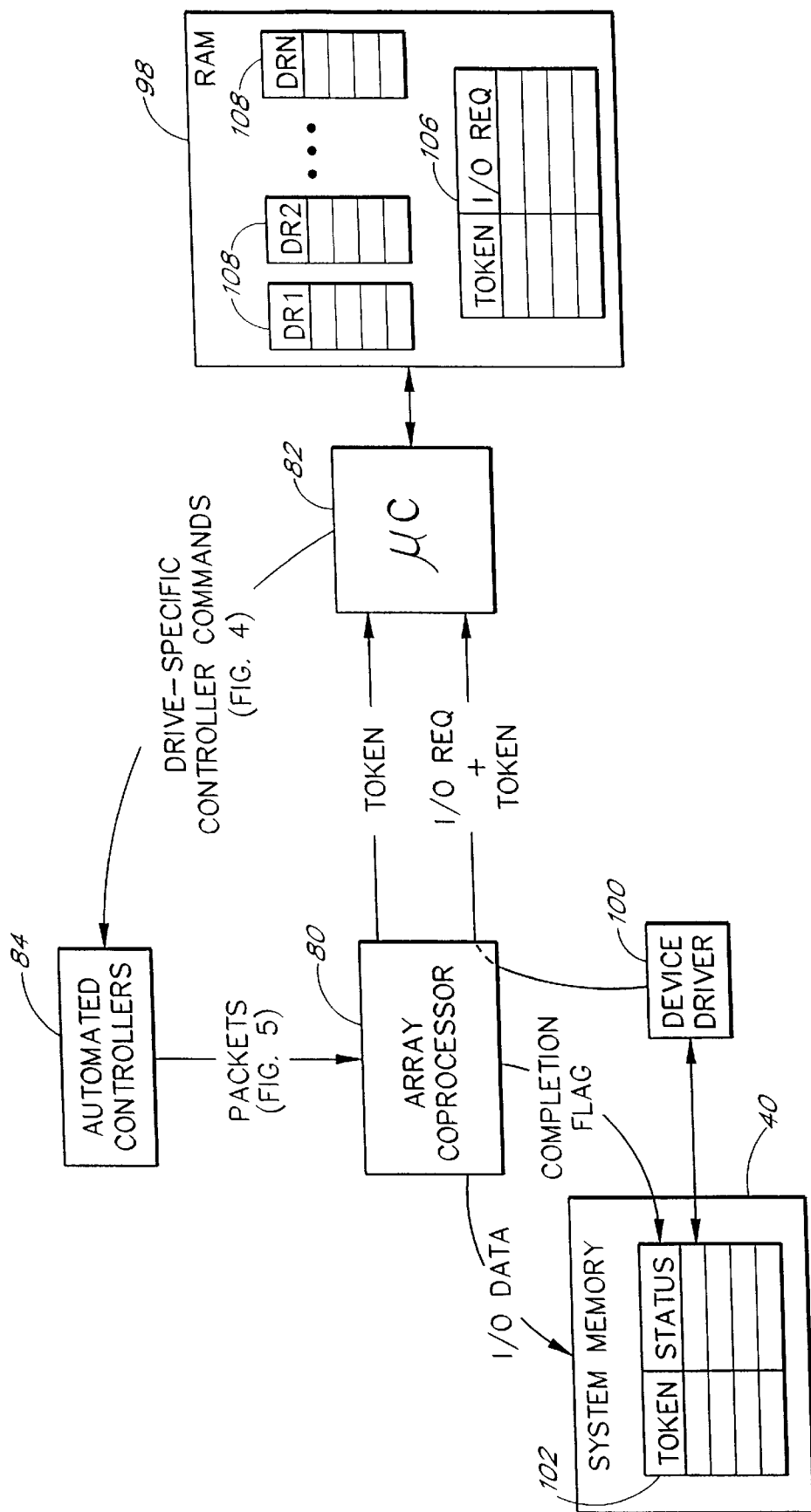


FIG. 3

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