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# United States Patent [19] Bergsten

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[45] **Date of Patent:** **Jun. 6, 2000**

[54] **DATA STORAGE CONTROLLER PROVIDING MULTIPLE HOSTS WITH ACCESS TO MULTIPLE STORAGE SUBSYSTEMS**

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- [73] Assignee: **Ark Research Corporation**, San Jose, Calif.
- [21] Appl. No.: **08/828,888**
- [22] Filed: **Mar. 31, 1997**
- [51] **Int. Cl.**<sup>7</sup> ..... **G06F 12/02**
- [52] **U.S. Cl.** ..... **711/114; 711/148; 711/153; 711/162; 707/204; 714/204**
- [58] **Field of Search** ..... **707/204; 711/162, 711/148, 114, 153; 714/6**

### [57] ABSTRACT

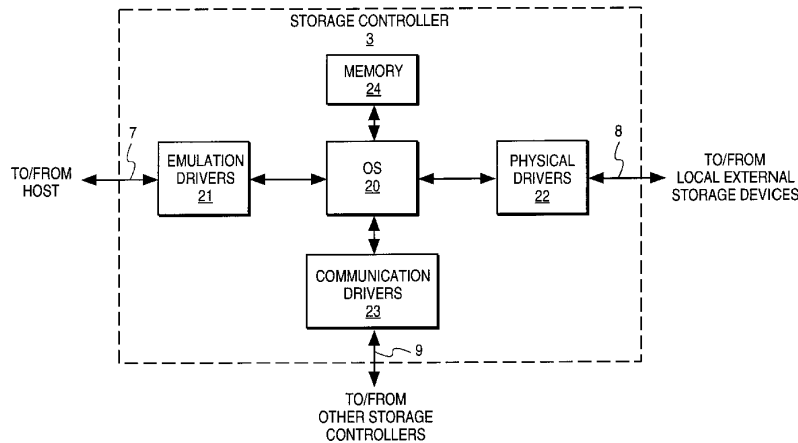
A computer network comprises a number of storage controllers, each coupled to one of a plurality of storage arrays, each storage array including at least one mass storage device. Each storage controller may be coupled to at least one host processing system and to at least one other storage controller to control access of the host processing systems to the mass storage devices. Multiple copies of data are maintained in storage arrays that are geographically remote to each other, such that any copy can be accessed by any host. Each storage controllers includes an interface with a host that emulates a mass storage device and an interface with a local storage array that emulates a host. The interfaces to the host and local storage arrays are independent of the type of host or devices in the local storage array. Two or more hosts may be dissimilar to each other, and two or more storage arrays may include dissimilar mass storage devices. Hosts access stored data using virtual addressing. During a data access, the storage controller connected to the accessing host maps a virtual address provided by the host to a real physical location in any of the storage arrays, such that the actual location of the data is transparent to the host. The storage controllers provide automatic back-up and error correction as well as write protection of back-up copies.

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**40 Claims, 18 Drawing Sheets**



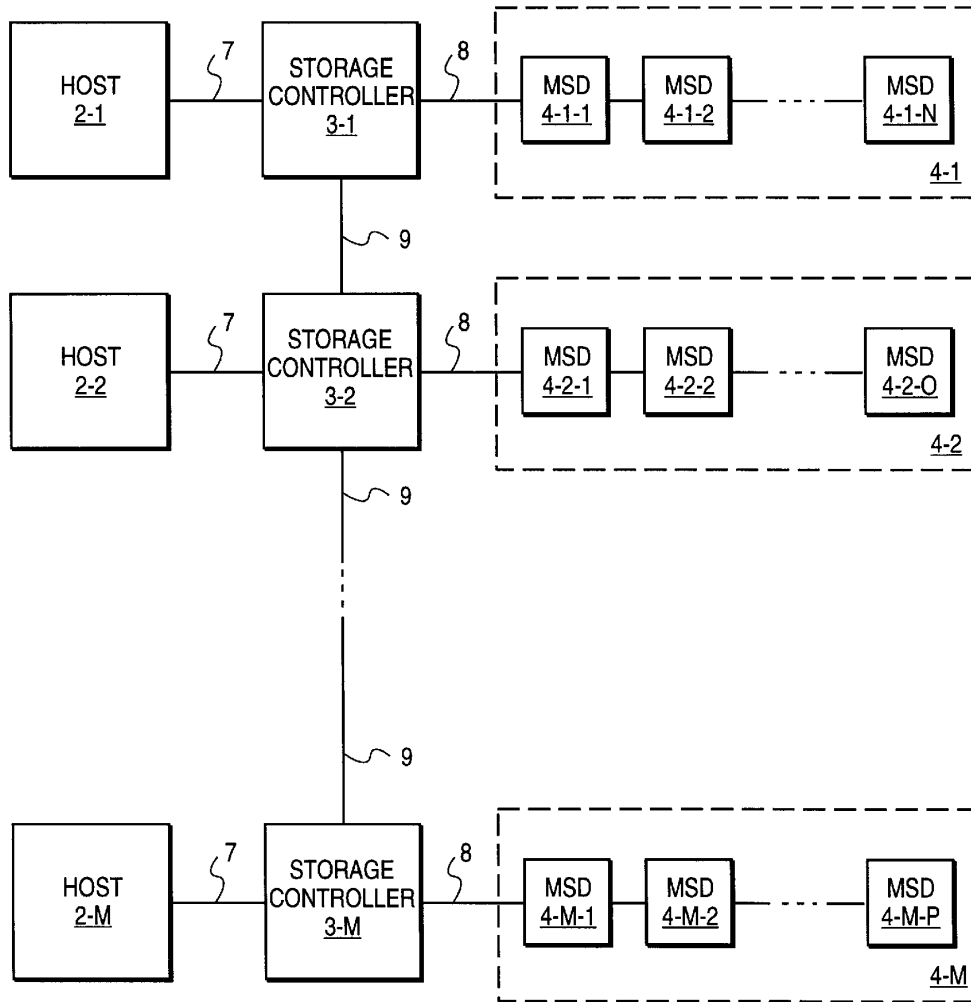


FIG. 1

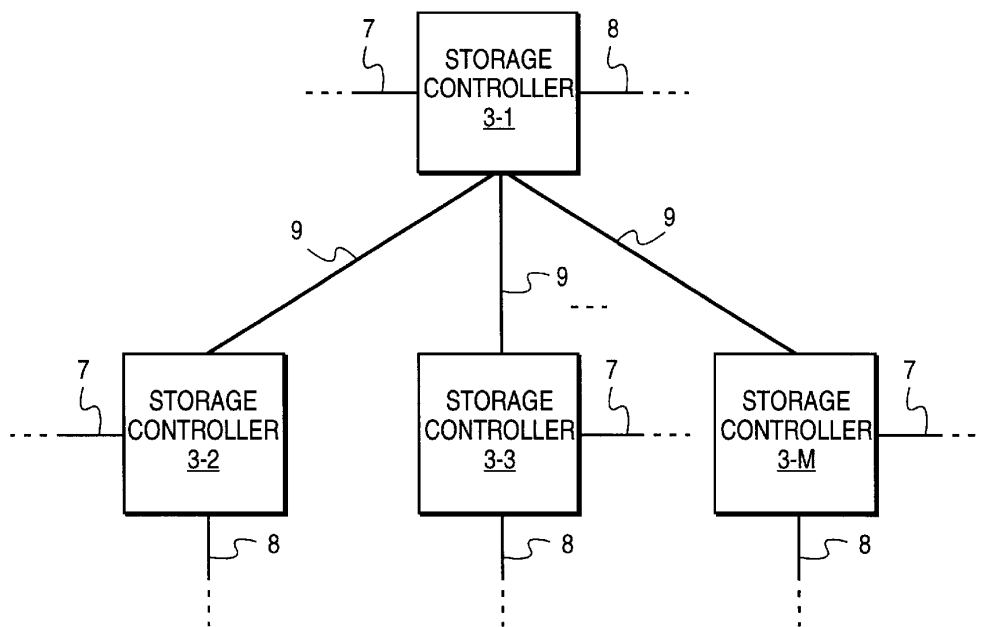


FIG. 2

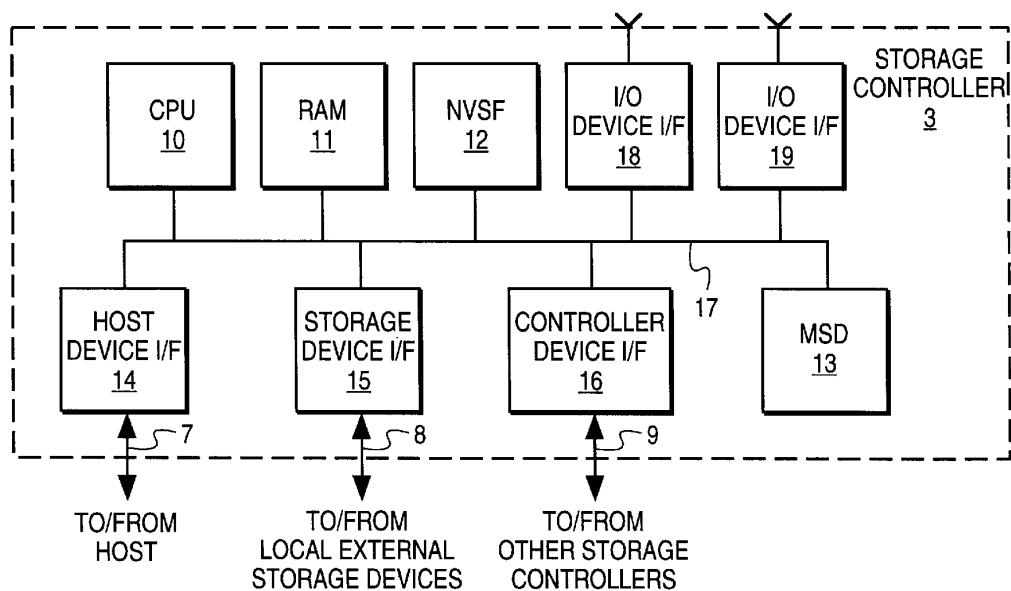
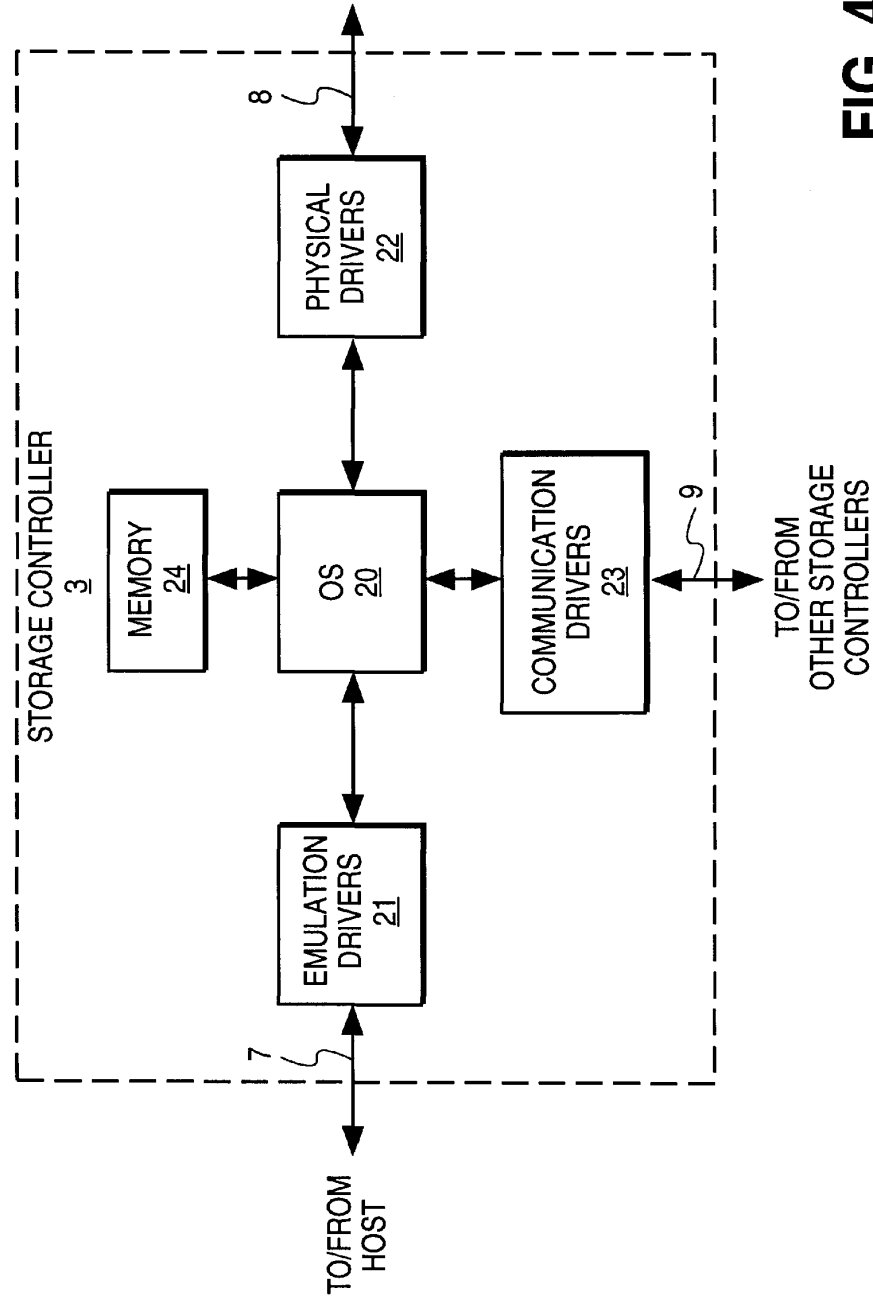


FIG. 3



**FIG. 4**

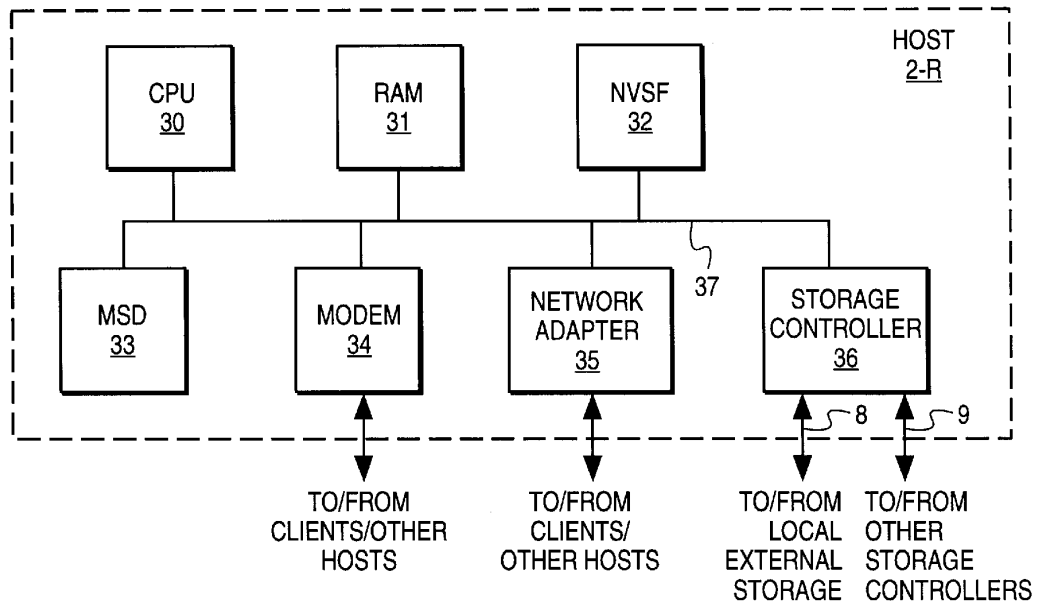


FIG. 5

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