

### US006226755B1

## (12) United States Patent Reeves

US 6,226,755 B1 (10) Patent No.: May 1, 2001 (45) **Date of Patent:** 

(54) APPARATUS AND METHOD FOR ENHANCING DATA TRANSFER TO OR FROM A SDRAM SYSTEM

(75) Inventor: Earl C. Reeves, Tomball, TX (US)

Assignee: Compaq Computer Corp., Houston,

TX (US)

(\*) Notice: Subject to any disclaimer, the term of this

patent is extended or adjusted under 35

U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/236,871

Jan. 26, 1999 Filed: (22)

(51) Int. Cl.<sup>7</sup> ...... G06F 1/04 (52)**U.S. Cl.** ...... 713/400; 713/600

Field of Search ...... 713/400, 500, 713/600; 711/105, 106, 167

(56)**References Cited** 

U.S. PATENT DOCUMENTS

4,207,618 6/1980 White, Jr. et al. . 9/1994 Chan et al. . 5.345.577 5,446,696 8/1995 Ware et al. . 5,684,978 \* 11/1997 Sarma et al. ...... 395/496 5,802,597 \* 9/1998 Nelsen ...... 711/169 6,078,986 \* 6/2000 Uchiyama et al. ...... 711/105

\* cited by examiner

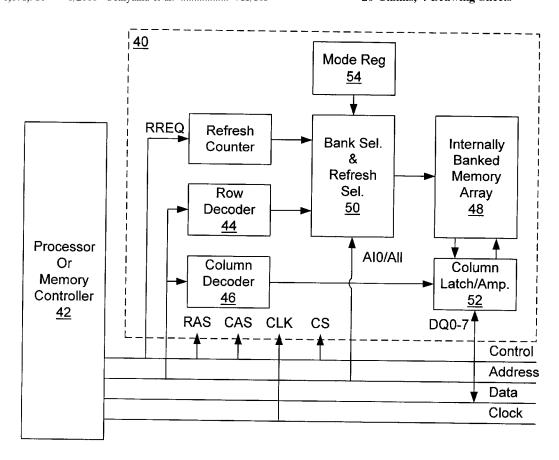
Primary Examiner—Dennis M. Butler

(74) Attorney, Agent, or Firm-Kevin L. Daffer; Conley, Rose & Tayon

(57)**ABSTRACT** 

A computer system, bus interface unit employing a memory controller, and method are presented for optimizing the bandwidth data, address, and control transfer rates across a memory bus coupled to an SDRAM system. The SDRAM system is partitioned such that one partition will undergo pre-charge or refresh in the interim between times in which another partition (or a pair of partitions) initiate a burst read. The burst read cycles coincide with an initial column address of the burst, and are spaced a number of cycles equal to the burst length. Proper spacing of the initial column address, or read request, relative to a non-read requested partition ensures data read from the activated partition will be placed on the memory data bus in seamless fashion. That is, there are no non-data transfers occurring between data burst cycles, even though refresh or pre-charge operations are performed on a non-read partition. Careful placement of the hidden refresh cycles encountered by one partition relative to read cycles on other partitions ensures the data flow resulting therefrom will be optimized to sustain peak bandwidth on a synchronous DRAM memory bus.

#### 20 Claims, 4 Drawing Sheets





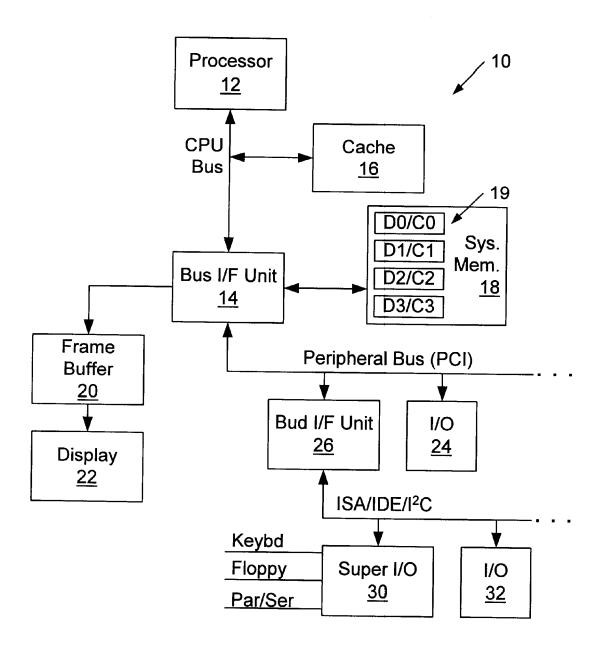


FIG. 1



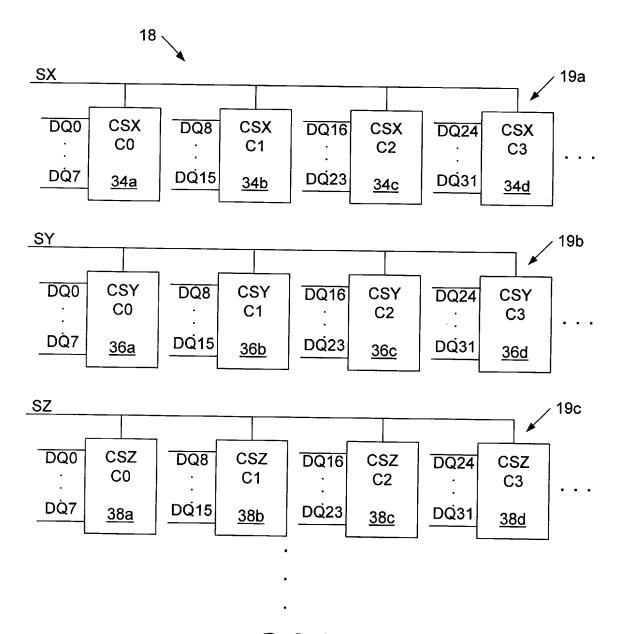


FIG. 2

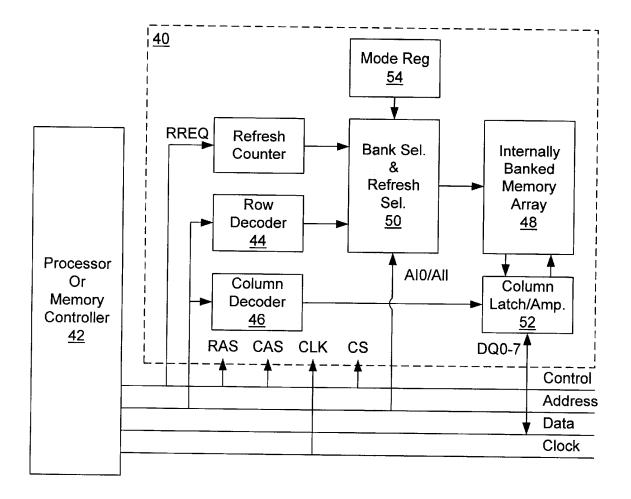
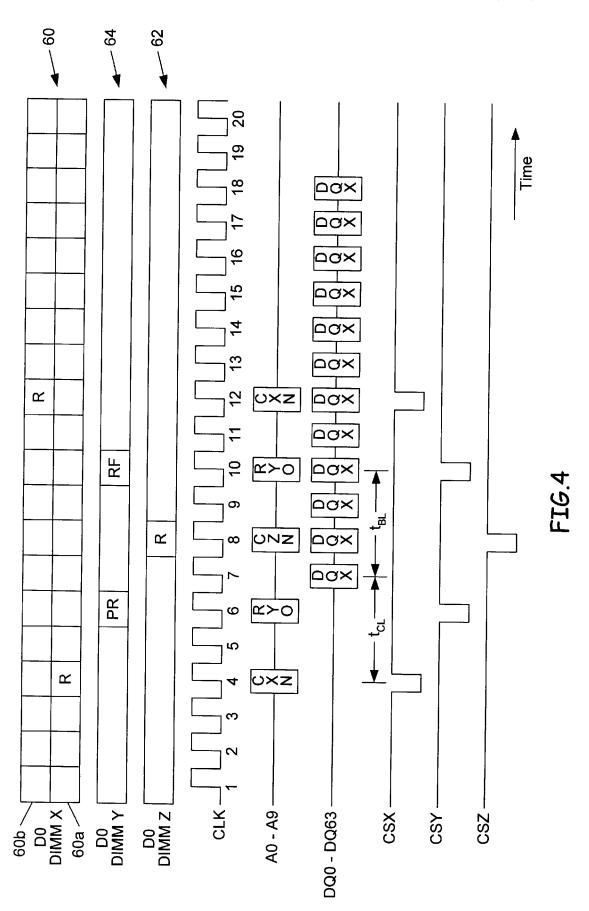


FIG.3



# DOCKET A L A R M

# Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## **Real-Time Litigation Alerts**



Keep your litigation team up-to-date with **real-time** alerts and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## **Advanced Docket Research**



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## **Analytics At Your Fingertips**



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

#### API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

#### **LAW FIRMS**

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

#### **FINANCIAL INSTITUTIONS**

Litigation and bankruptcy checks for companies and debtors.

### **E-DISCOVERY AND LEGAL VENDORS**

Sync your system to PACER to automate legal marketing.

