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# United States Patent [19]

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Erickson et al.

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[54] **METHOD FOR PERFORMING SEQUENCE OF ACTIONS IN DEVICE CONNECTED TO COMPUTER IN RESPONSE TO SPECIFIED VALUES BEING WRITTEN INTO SNOOPED SUB PORTIONS OF ADDRESS SPACE**

[75] Inventors: **Gene R. Erickson; Douglas E. Hundley**, both of Poway; **P. Keith Muller; Curtis H. Stehley**, both of San Diego, all of Calif.

[73] Assignee: **NCR Corporation**, Dayton, Ohio

[21] Appl. No.: **577,678**

[22] Filed: **Dec. 21, 1995**

[51] Int. Cl.<sup>6</sup> ..... **G06F 15/02**

[52] U.S. Cl. .... **395/829**

[58] Field of Search ..... 395/821, 823, 395/829, 832, 846, 882, 284, 309, 500, 473

### [56] References Cited

#### U.S. PATENT DOCUMENTS

4,589,063	5/1986	Shah et al.	395/828
4,777,589	10/1988	Boetner et al.	395/823
5,016,161	5/1991	Van Loo et al.	395/678
5,016,166	5/1991	Van Loo et al.	395/674
5,127,098	6/1992	Rosenthal et al.	711/202
5,280,587	1/1994	Shimodaira et al.	395/880
5,420,987	5/1995	Reid et al.	395/830
5,548,778	8/1996	Hirayama	395/823
5,553,244	9/1996	Norcross et al.	395/280
5,642,481	6/1997	Pedrizetti	395/185.01
5,671,442	9/1997	Feeney et al.	395/834

#### FOREIGN PATENT DOCUMENTS

551148 7/1993 European Pat. Off. .

#### OTHER PUBLICATIONS

"The Performance of Message-Passing Using Restricted Virtual Memory Remapping", by Shin-Yuan Tzou and David P. Anderson, in *Software-Practice & Experience*, vol. 21(3), 251-267 (Mar. 1991).

"The DASH Local Kernel Structure" by David P. Anderson and Shin-Yuan Tzou, Report No. UCB/CSD 88/463, Nov. 7, 1988, Computer Science Division (EECS), University of California, Berkeley 94720.

"A Users' Guide to PICL—A Portable Instrumented Communication Library" By G.A. Geist et. al., Oak Ridge National Laboratory, Mathematical Sciences Section, P.O. Box 2009, Bldg. 9207-A, Oak Ridge, TN 37831-8083 (Aug. 1990).

"Architecture and Implementation of Vulcan" By Craig B. Stunkel, et. al., IBM Research Division, Yorktown Heights, New York (Sep. 22, 1993).

"MPI-F: An MPI Prototype Implementation on IBM SP1" by Hubertus Franke et. al., pub. by IBM, T.J. Watson Research Center, Yorktown Heights, New York 10598.

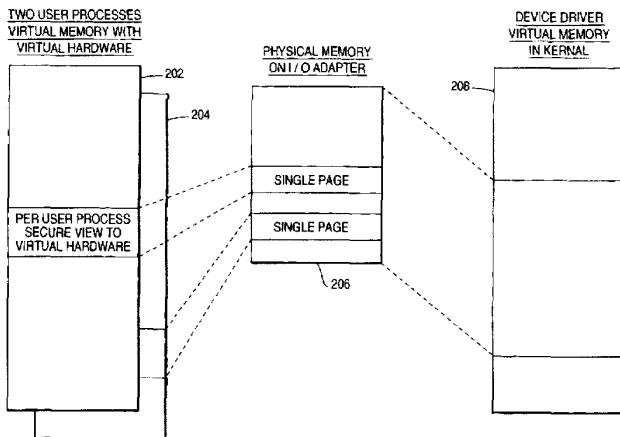
Primary Examiner—Moustafa M. Meky

Attorney, Agent, or Firm—Merchant, Gould, Smith, Edell, Welter & Schmidt

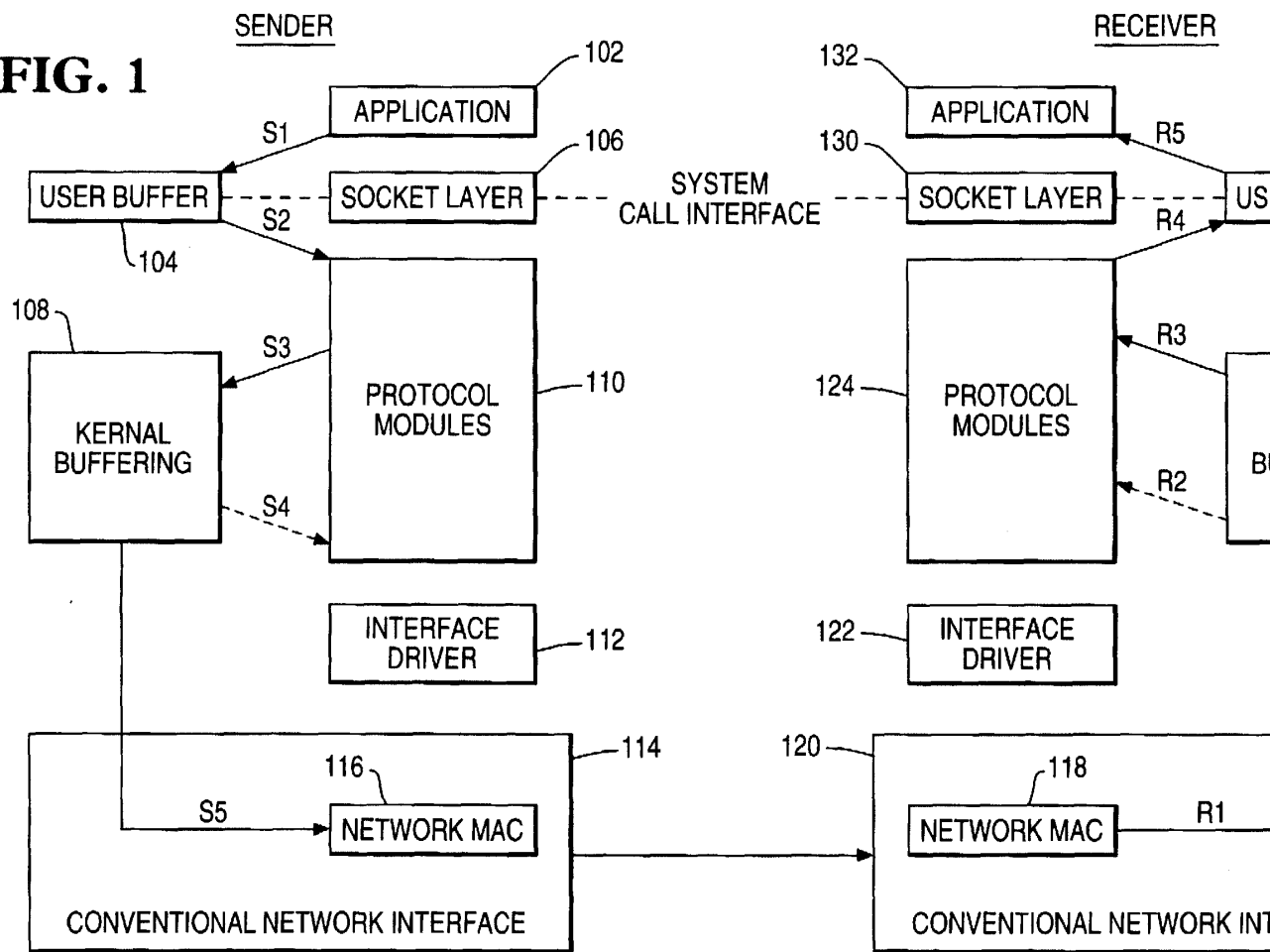
### [57] ABSTRACT

A method of controlling an input/output (I/O) device connected to a computer to facilitate fast I/O data transfers. An address space for the I/O device is created in the virtual memory of the computer, wherein the address space comprises virtual registers that are used to directly control the I/O device. In essence, control registers and/or memory of the I/O device are mapped into the virtual address space, and the virtual address space is backed by control registers and/or memory on the I/O device. Thereafter, the I/O device detects writes to the address space. As a result, a pre-defined sequence of actions can be triggered in the I/O device by programming specified values into the data written into the mapped virtual address space.

**19 Claims, 7 Drawing Sheets**



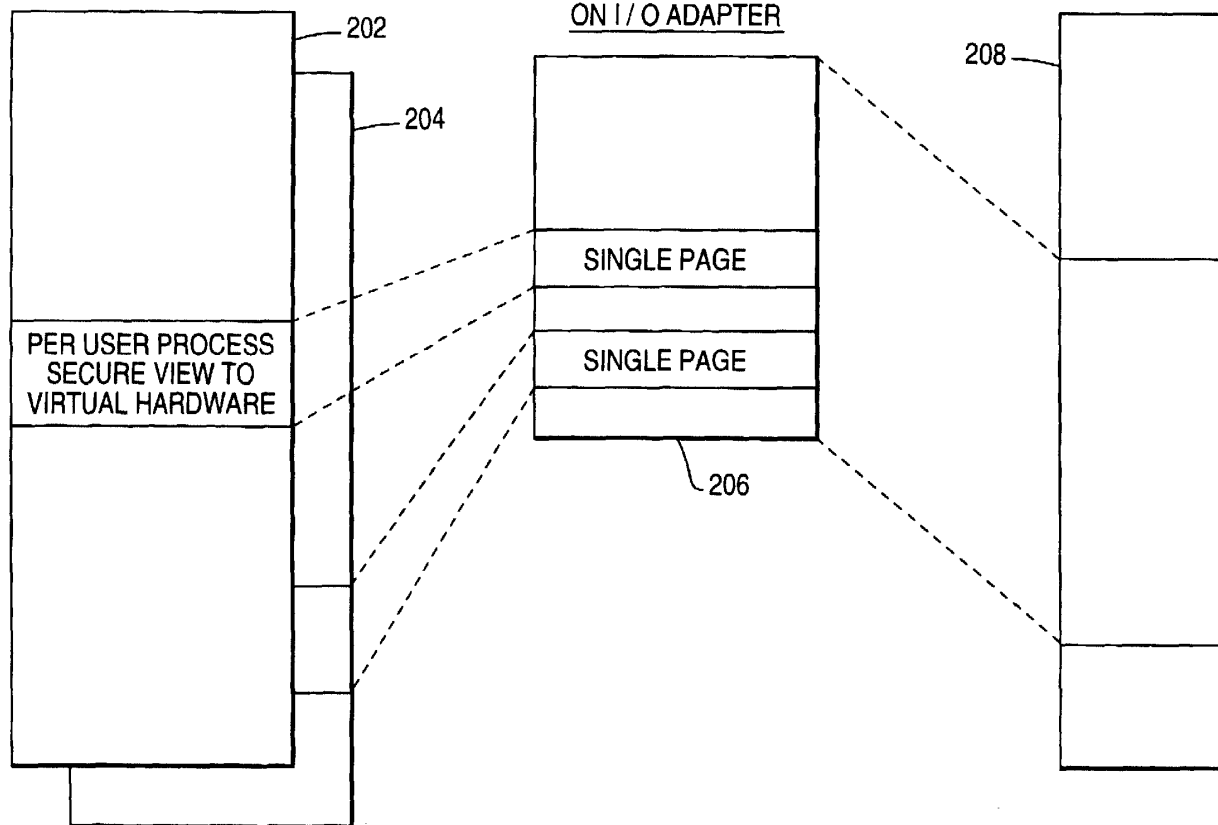
**FIG. 1**



TWO USER PROCESSES  
VIRTUAL MEMORY WITH  
VIRTUAL HARDWARE

**FIG. 2**

DEVICE D  
VIRTUAL M  
IN KER



**FIG. 3**

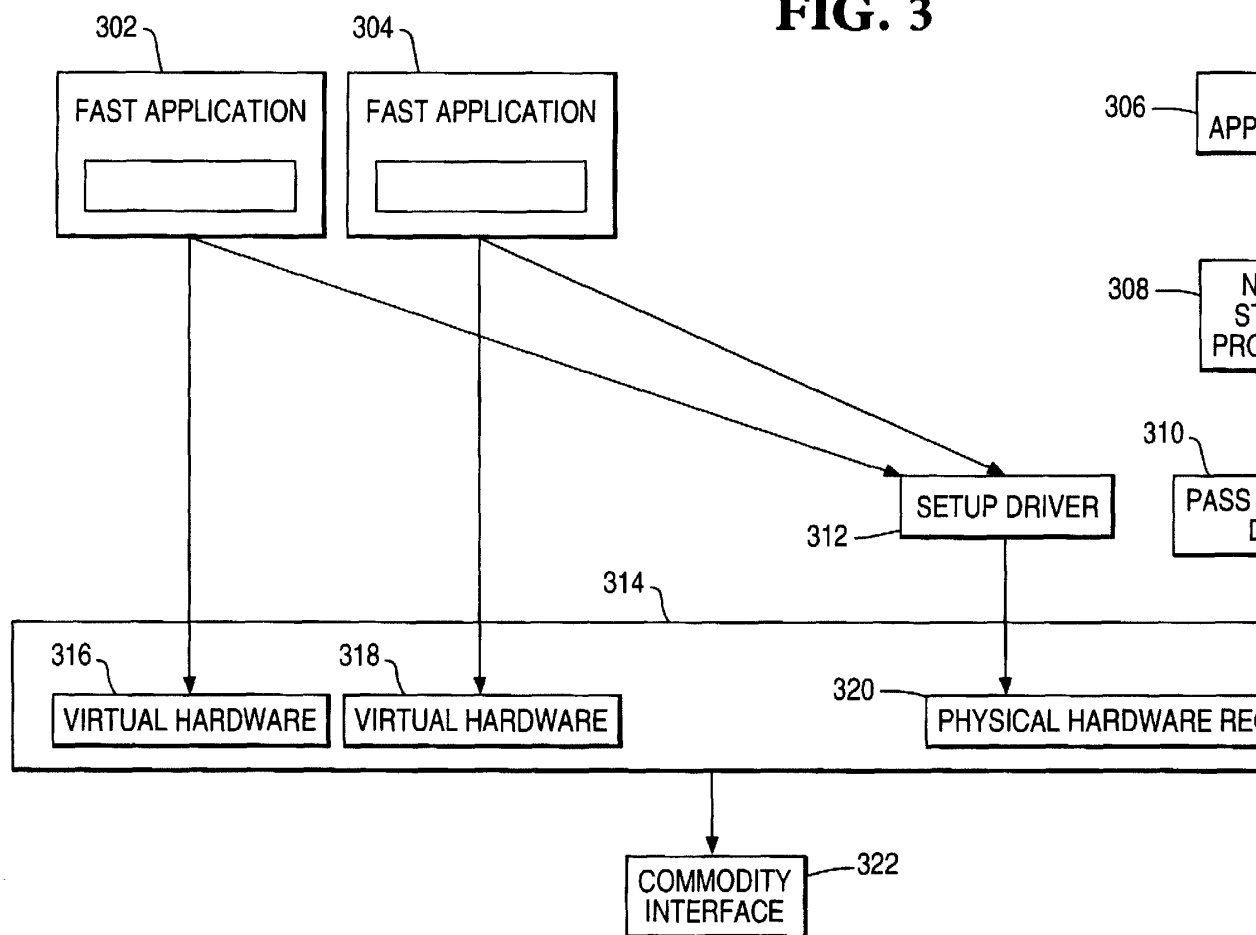
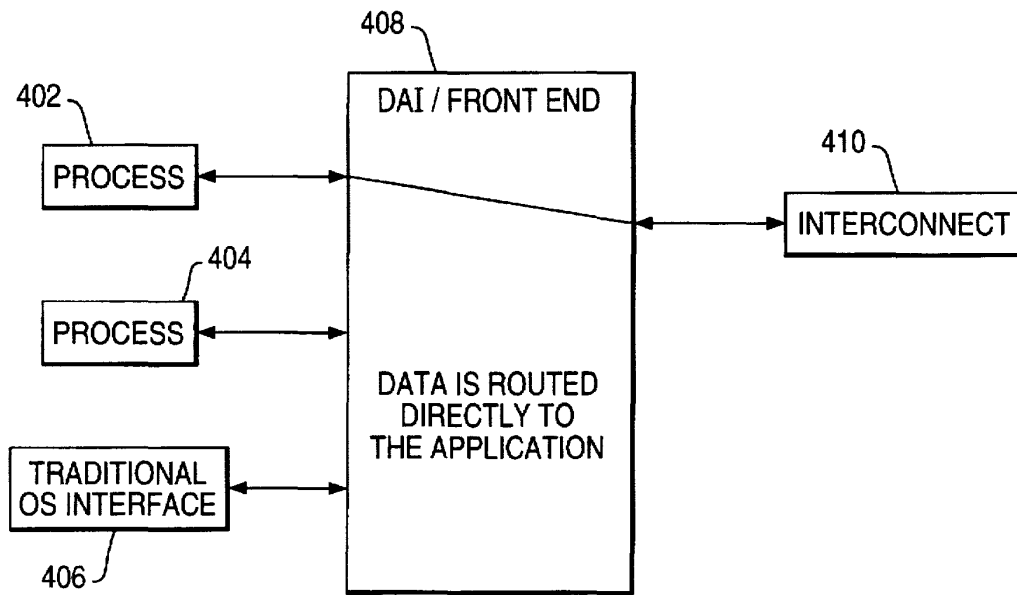


FIG. 4



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