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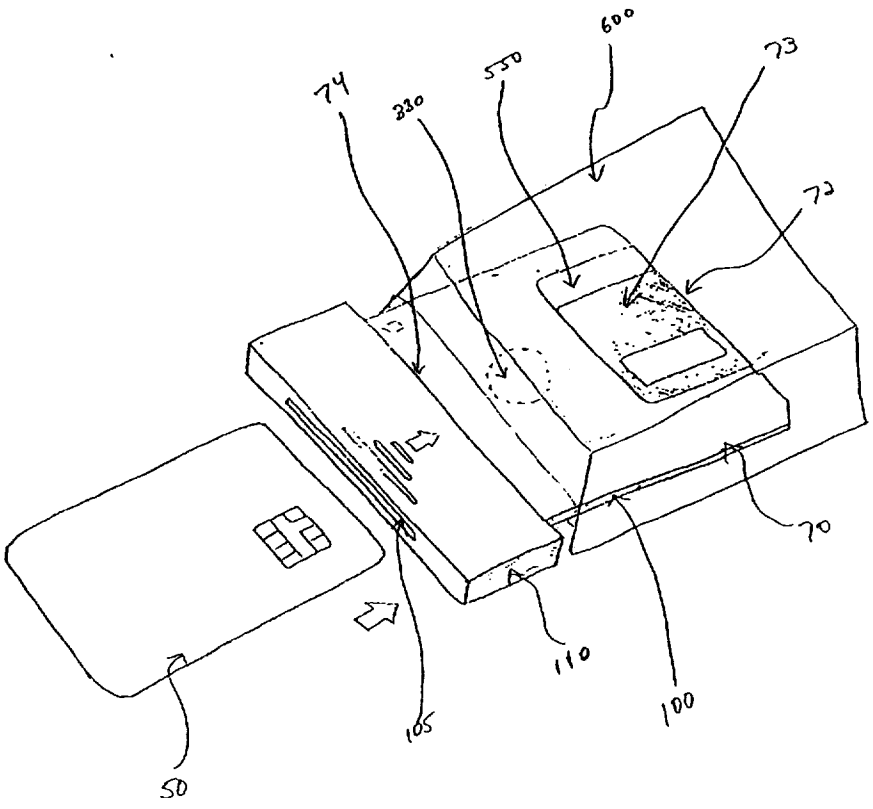
With amended claims.

(54) Title: METHOD AND APPARATUS FOR INTERFACING AN IC CARD WITH A PERSONAL COMPUTER

(57) Abstract

An integrated circuit (IC) card reader (100) uses a personal computer's floppy (3.5") disk drive (600) to provide a cost effective and universally compatible method of communication between an IC card (50) and a personal computer. The IC card interface (110) employs a magnetic head which communicates with the head of the floppy disk drive (600) by receiving and transmitting magnetic fields representing the data sent to the card and received from the card (50).



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METHOD AND APPARATUS FOR INTERFACING AN IC CARD WITH A PERSONAL COMPUTER

Inventor: George Wallner

TECHNICAL FIELD OF THE INVENTION

This invention generally relates to an integrated circuit (IC) card interface device, and more particularly, to an apparatus and method for communicating between an IC card and a computer.

BACKGROUND OF THE INVENTION

Integrated circuit cards (also known as IC cards, chip cards or smart cards) can play an integral role in financial transactions conducted through personal computer networks. Oftentimes, the transmitting or receiving of financial transactions requires the implementation of security precautions. When conducting financial transactions, Internet commerce, Intranet commerce or other applications through computer transmissions, IC cards usually offer needed security for user identification and authentication.

To utilize an IC card in a computer transaction, the typical IC card needs to interface with a personal computer through an IC card reader. Communication between the IC card reader and a personal computer often presents a great challenge in the computer industry because the personal computer must communicate with the IC card reader via a port of the personal computer.

Presently known personal computers contain ports for maintaining communication with peripheral devices such as keyboards, printers, modems, local area networks, scanners, compact disk drives and other peripheral devices not typically a part of the computer itself. These ports, however, may not always be available or suitable for use with an IC card interface device. With the proliferation of peripheral devices available for interfacing with a computer, many of the computer ports may already be in use. If additional ports are needed, the computer may have to be partially disassembled to install the appropriate circuit board and port. An expansion

port installation is usually difficult and expensive. Thus, simply connecting an IC card reader to a personal computer via a port is often not practical.

The interfacing of IC card readers to personal computers is further hindered because currently available interface devices employ either a serial port, a keyboard port or a PCMCIA (PC card) port. An RS232 serial port is typically used to drive an external peripheral, such as a printer, modem or the like. Difficulties are often encountered when attempting to share a serial port with existing peripherals and an IC card reader. Keyboard ports employ non-standard connectors and exhibit varying capabilities, such as supporting only one way communication. Numerous compatibility issues typically exist when attempting to interface an IC card reader with the keyboard port. An adapter can be fabricated to attach to a keyboard port; however, the same adapter would not be compatible with other keyboard ports. Furthermore, in a laptop computer, the keyboard is commonly integrated into the processing unit, thus eliminating any ports between the keyboard and the processing unit. PCMCIA ports usually support a wide range of connection modalities and are highly suitable for providing an interface between the IC card reader and the computer. However, the PCMCIA ports are often not available on all personal computers and are very expensive.

In addition to the commonly known interface devices discussed above, prior art patents disclose various apparatus and methods for providing a communication link between an IC card and a personal computer. Most of these prior art systems establish an electrical coupling between the interface device and the floppy disk drive (3.5") of a personal computer. The prior art electrical interfaces are often expensive, difficult to assemble and require numerous changes to the computer system.

For example, Grieu, U.S. Patent No. 5,338,923 issued August 16, 1994, discloses a system for exchanging data between an electronic object coupled to a transfer device. The system can be applied to the exchange of data elements between a microcomputer and an electronic card that can be inserted into the disk drive slot of the microcomputer or into a memory card socket. The system is limited to an electrical interface between the object

and the transfer device. The electronic connection requires specific bit rates, the insertion of padding information into the flow of data in an effort to limit the bit rate of useful data, a means for replication of some of the useful data and a specific coding means located in the transfer device.

Kaneda et al., U.S. Patent No. 5,036,429 issued July 30, 1991, discloses an IC card adapter including an electronic connector portion which connects the adapter to the electronic device. A control signal from the electronic device may be used to select the desired IC card from the adapter. A switch circuit is included in the adapter which allows the external selection of the IC cards. For all of its functions, this device operates through the electrical interface between the IC card adapter and the computer.

Villwock et al., U.S. Patent No. 5,396,617 issued March 7, 1995, discloses a module for extending the functions of an electronic data processing machine. The device contains a housing with at least one drive for rotating storage media and at least one storage media receptor for an IC card. The device utilizes different drives for the rotating storage media and the IC card. The system described in the '617 patent utilizes the IC card to provide a data compression circuit, error detection and correction circuit or a data protection circuit to be used in conjunction with the rotating storage media. Again, this device operates through an electrical interface.

Tsai, U.S. Patent No. 5,400,216 issued March 21, 1995, discloses an IC card expansion slot assembly mounted on a PC board and aligned with an insertion slot on the front panel of the housing to receive an IC card type hard disk drive. The IC card type hard disk drive is electrically connected to the mobile computer. The slot assembly also comprises a printed circuit board with an extension portion extended out of the housing for the insertion into the IC card expansion slot. The addition of the entire IC disk drive is accomplished through an electrical interface.

A need exists for an effective method and apparatus for providing a cost-effective, universally compatible communication channel between a personal computer and an IC card. The floppy (3.5") disk drive is typically the most common input/output device on a personal computer. A device

that would allow communication between an existing floppy disk drive and an IC card would greatly enhance the availability and affordability of IC card interfaces with personal computers. The device should also allow quick attachment and removal of the IC card interface to/from the personal computer, thus enabling the interface port to be used with other devices if desired.

SUMMARY OF THE INVENTION

The present invention includes an integrated circuit (IC) card reader that preferably uses a personal computer's floppy (3.5") disk drive to provide a cost effective and universally compatible method of connecting an IC card to a personal computer. The head used in a floppy disk drive is typically capable of two-way communication, thus it can write onto the disk and can read from it. The interface between the head and the disk is commonly magnetic, so during writing, the head typically generates a magnetic field that magnetizes the media. During reading, the head typically detects the modulation of the magnetic field generated by the spinning media. In the present invention, the IC card interface employs a magnetic head which communicates with the head of the floppy disk drive by receiving and transmitting magnetic fields representing the data sent to the card and received from the card.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Preferred exemplary embodiments of the present invention will hereinafter be described in conjunction with the appended drawing figures, wherein like numerals denote like elements and:

FIG. 1 shows a diagram of an exemplary apparatus for communicating with an IC card, and

FIG. 2 shows a circuit diagram of an exemplary interface circuit for the present invention.

DETAILED DESCRIPTION OF PREFERRED EXEMPLARY EMBODIMENTS

Referring to Figure 1, an apparatus and method according to various aspects of the present invention is suitably configured to render a diskette drive 600 of a computer an input, an output or an input/output port whereby a communication channel is suitably established between the personal computer and an IC card 50. While the manner in which the communication is determined is described in greater detail below, in general, magnetic head 550 on interface circuit 100 suitably communicates with head 610 of diskette drive 600. An exemplary apparatus and method for communicating with IC card 50 according to various aspects of the present invention preferably comprises floppy disk drive adaptor 70 and interface circuit 100 contained therein. As described in greater detail below, upon insertion of IC card 50 into interface circuit 100, magnetic head 550 of interface circuit 100 suitably communicates with head 610 of floppy disk drive 600 by receiving and transmitting magnetic fields representing data sent to, and received from, IC card 50.

Exemplary floppy disk drive adaptor 70 suitably comprises any adaptor in accordance with the present invention capable of insertion into a floppy disk drive and allowing communication with a magnetic head of a floppy disk drive. In accordance with a preferred embodiment of the present invention, the floppy disk drive adaptor 70 preferably mimics a commonly used 3-1/2" diskette casing, having a first end 72 and a second end 74. The first end 72 includes a sliding door 73 which protects magnetic head 550 of interface circuit 100. Door 73 is preferably open when adaptor 70 is inserted into floppy disk drive 600, otherwise door 73 is preferably closed.

Interface circuit 100 suitably comprises any circuit in accordance with the present invention capable of communicating with a magnetic head of a floppy disk drive and capable of communicating with an electronic IC card. Interface circuit 100 is preferably contained within the casing of floppy disk drive adaptor 70. IC card interface 110 is preferably fixedly attached to second end 74 of floppy disk drive adaptor 70. IC card interface 110

suitably includes a slot 105 which allows insertion of IC card 50, thereby enabling communication between IC card 50 and IC card interface 110.

Referring now to Figure 2, exemplary interface circuit 100 in accordance with the present invention preferably includes IC card interface 110, a card detect 700, an insert detector 710, a microprocessor 200, a power supply 300 and a memory device 400. IC card interface 110 suitably comprises any interface that allows the necessary electrical signals to drive IC card 50. Card detect 700 suitably comprises any device in accordance with the present invention capable of detecting the insertion of an IC card. Insert detector 710 suitably comprises any device in accordance with the present invention capable of detecting the insertion of floppy disk drive adaptor 70. Microprocessor 200 suitably comprises any device in accordance with the present invention capable of being programmed to communicate with IC card 50 and contains interface circuitry to communicate with head 610 of floppy disk drive 600. In accordance with a preferred embodiment of this invention, microprocessor 200 comprises a Z80 microprocessor; however, microprocessor 200 as used herein includes any microprocessor, microcontroller or any other hardwired circuitry. Power supply 300 suitably comprises any device in accordance with the present invention capable of generating power for interface circuit 100. Memory device 400 suitably comprises any device in accordance with the present invention capable of storing data. In accordance with a preferred embodiment of this invention, memory device 400 comprises an EPROM 410 and a random access memory (RAM) 420. EPROM 410 contains the program for implementing the interface functions and RAM 420 is a data buffer.

A common input/output device that exists on a personal computer is typically floppy disk drive 600. In most computer systems, head 610 incorporated into floppy disk drive 600 is preferably capable of two-way communication, thus it can write onto a disk and can read from a disk. The interface between head 610 and a disk is usually magnetic, so during writing, head 610 typically generates a magnetic field that magnetizes the

media. During reading, head 610 suitably detects the modulation of the magnetic field generated by the spinning media. In the present invention, interface circuit 100 preferably includes magnetic head 550. Magnetic head 550 suitably communicates with head 610 of floppy disk drive 600 by receiving and transmitting magnetic fields. The magnetic fields represent data sent to IC card 50 and received from IC card 50.

With continued reference to Figure 2, IC card interface 110 is suitably a standard interface for the necessary electric signals to drive the IC card. The IC card interface preferably complies with ISO standard 7816, but other interface cards may be suitable. The electrical signals utilized by IC card interface 110 preferably include the input/output signals 120, reset signals 125, clock signals 130, power signals (VCC) 135, programming signals (VPP) 140 and a ground 145. I/O signal 120 is suitably a bi-directional TTL signal which includes the actual data transmitted to/from IC card 50. Reset signal 125 suitably resets IC card 50 into its original starting mode. Clock signal 130 suitably provides clock information to IC card 50 for synchronization with interface circuit 100 signals. Power signal 135 suitably provides power to IC card 50 to preform input/output functions. Programming signal 140 suitably provides programming voltage to IC card 50.

Simple insertion of IC card 50 into slot 105 closes card detect circuit 700 which activates aforementioned electrical signals 120, 125, 130, 135 and 140. Removal of IC card 50 simply opens card detect circuit 700 which deactivates aforementioned electrical signals 120, 125, 130, 135 and 140.

IC card interface 110 suitably communicates with microprocessor 200. Digital data is preferably transmitted from IC card interface 110 at transmit junction 160 and preferably received at junction 210 of microprocessor 200. Microprocessor 200 preferably transmits digital data at junction 220 to IC card interface junction 165. Microprocessor 200 is suitably programmed with the necessary protocols to communicate with IC card interface 110. Microprocessor 200 preferably contains a serial T0 or T1 protocol which conforms to ISO standard 7816. Microprocessor 200 also suitably contains

the necessary interface circuitry, as described below, to communicate with head 610 of floppy disk drive 600. Both IC card interface 110 and microprocessor 200 suitably use crystal clock 170 to synchronize transmissions.

Communication between microprocessor 200 and head 610 of floppy disk drive 600 is preferably accomplished by the use of a transmitter driver 250 and a receiver driver 260. Head 610 of floppy disk drive 600 preferably receives the magnetic changes generated by head 550 of interface circuit 100. When transmitting information, the computer suitably sends current through coils 620 in head 610 which produces fluctuating magnetic signals. In a commonly known floppy disk drive, these magnetic signals would magnetize the spinning magnetic media. However, in the current invention, the fluctuating magnetic signals are suitably picked up by head 550 of interface circuit 100.

Transmitter driver 250 suitably comprises any device in accordance with the present invention capable of transmitting data. In accordance with a preferred embodiment of this invention, transmitter driver 250 comprises any suitable digital to analog convertor 253 serially communicating with an amplifier 256 capable of generating a signal suitable for transmission through magnetic head 550. Digital data is preferably transferred serially from transmit junction 255 of microprocessor 200 to digital to analog convertor 253 which generates an analog signal suitable for transmission through magnetic head 550. Transmitter driver 250 suitably generates a similar fluctuating magnetic flux as spinning head 610 of floppy disk drive 600. Thus, the generated signal preferably includes a magnetic pattern similar to the magnetic pattern that spinning head 610 of floppy disk drive 600 would generate when a magnetic media is spinning in front of head 610 aperture. Clock junction 251 suitably provides a clock signal to synchronize the transmission, while enabler 252 suitably activates transmitter driver 250.

Receiver driver 260 suitably comprises any device in accordance with the present invention capable of receiving data. In accordance with a preferred embodiment of this invention, receiver driver 260 comprises any

suitable amplifier 266 communicating with any suitable analog to digital convertor 263. Amplifier 266 suitably amplifies the signal detected by head 550. Analog to digital convertor 263 suitably converts the analog signal from head 550 to a digital signal that is preferably serially received by microprocessor 200. Microprocessor 200 preferably receives the analog magnetic signal at receive junction 265, decodes it and uses the magnetic signal according to its preamble, synchronization, etc.. Microprocessor 200 includes a carrier detect 261 to detect the changing magnetic field. Clock junction 262 extracts the clock signal from the data to provide synchronization for the data.

Simple insertion of floppy disk drive adaptor 70 into floppy disk drive 600 preferably closes insert detector circuit 710 which suitably activates power supply 300. Power supply 300 preferably includes two sources that work in conjunction to provide constant power. An internal battery 310 suitably provides high levels of instantaneous current that is required by interface circuit 100. High levels of instantaneous current is typically required when writing or for powering IC card 50. Internal battery 310 suitably comprises any device in accordance with the present invention capable of providing high levels of instantaneous current that is required by circuit 100. In accordance with a preferred embodiment of this invention, internal battery 310 comprises a Nickel Cadmium battery.

Battery 310 is preferably charged by generator 320. Generator 320 suitably generates power from spinning permanent magnet array 640 on the end of media drive shaft 630 of floppy disk drive 600. Upon a motor spinning media drive shaft 630, a current is generated in coils 330 of generator 320. The current preferably travels from generator 320 through charge controller 340 which prevents battery 310 from overcharging. The current then preferably travels to power supply 300. Simple removal of floppy disk drive adaptor 70 from floppy disk drive 600 suitably opens insert detector circuit 710 which deactivates power supply 300, thus preventing energy depletion.

It will be apparent to those skilled in the art, that the foregoing detailed description of the preferred embodiment of the present invention is representative of an apparatus and method for communicating with an IC card within the scope and spirit of the present invention. Further, those skilled in the art will recognize that various changes and modifications may be made without departing from the true spirit and scope of the present invention. Those skilled in the art will recognize that the invention is not limited to the specifics as shown here, but is claimed in any form or modification falling within the scope of the appended claims. For that reason, the scope of the present invention is set forth in the following claims.

I claim:

1. An apparatus for interfacing an integrated circuit (IC) card with a computer, said apparatus comprising an adaptor and an interface circuit within said adaptor, said interface circuit including a magnetic head device for transmitting and receiving magnetic field information from a disk drive.

2. The apparatus of claim 1, wherein said adaptor being removably received into said disk drive, said adaptor including a slot for receiving said IC card.

3. The apparatus of claim 1, wherein said interface circuit further comprising an interface device for allowing a plurality of electrical signals to drive said IC card, a microprocessor communicating with said interface device and said magnetic head device, a power supply communicating with said microprocessor, a memory device communicating with said microprocessor, an insert detector communicating with said power supply and a card detector communicating with said interface device.

4. The apparatus of claim 3, wherein said power supply includes an internal battery.

5. The apparatus of claim 3, wherein said power supply includes a generator for powering said internal battery, said generator powered by a motor and a media drive shaft of said disk drive.

6. The method of interfacing an integrated circuit (IC) card with a computer comprising the steps of:

providing an adaptor;

providing an interface circuit within said adaptor;

removably inserting said adaptor into a disk drive;

removably inserting said IC card into said adaptor;

transmitting magnetic field information from said IC card to said disk drive, and

receiving said magnetic field information from said disk drive for passing onto said IC card.

7. The method of claim 6, wherein said step of removably inserting said adaptor into said disk drive comprises powering said interface circuit.

8. The method of claim 6 wherein said step of removably inserting said IC card into said adaptor comprises activating said electrical signals.

9. The method of claim 6, wherein said step of transmitting magnetic field information comprises:

driving said IC card with electrical signals;

transmitting information to said interface circuit, and

generating magnetically encoded signals.

10. The method of claim 6, wherein said step of generating magnetic signals comprises:

providing a power supply for supplying power to said microprocessor and associated circuitry;

providing a memory device communicating with said microprocessor;

providing an insert detector communicating with said power supply and said microprocessor, and

providing a card detector communicating with said interface device.

11. The method of interfacing an integrated circuit (IC) card with a computer comprising the steps of:

providing an adaptor;

providing an interface circuit within said adaptor;

removably inserting said adaptor into a disk drive;

removably inserting said IC card into said adaptor;

transmitting magnetic field information from said disk drive to said IC card, and

receiving said magnetic field information from said IC card for passing onto said disk drive.

12. The method of claim 11, wherein said step of removably inserting said adaptor into said disk drive comprises powering said interface circuit.

13. The method of claim 11 wherein said step of removably inserting said IC card into said adaptor comprises activating said electrical signals.

14. The method of claim 11, wherein said step of transmitting magnetic field information comprises:

driving said IC card with electrical signals;

transmitting information to said interface circuit, and

generating magnetic signals.

15. The method of claim 14, wherein said step of generating magnetic signals comprises:

providing a power supply communicating with said microprocessor;

providing a memory device communicating with said microprocessor;

providing an insert detector communicating with said power supply, and

providing a card detector communicating with said interface device.

16. The method of emulating a magnetic disk to communicate with a computer via a disk drive of said computer for the purposes of interfacing an IC card to said computer.

AMENDED CLAIMS

[received by the International Bureau on 30 January 1998 (30.01.98); original claims 1-16 replaced by new claims 1-12 (3 pages)]

1. An apparatus for interfacing an integrated circuit (IC) card with a computer having a disk drive, said apparatus configured to enable a flow of electromagnetic signals between said IC card and said disk drive.

2. The apparatus of claim 1 further comprising an adaptor, said adaptor being removably received into said disk drive, said adaptor including a slot for receiving said IC card.

3. The apparatus of claim 1 further comprising an adaptor and an interface circuit within said adaptor, said interface circuit further comprising

an interface device configured to allow a plurality of electrical signals to drive said IC card;

a magnetic head device configured to communicate magnetic field information with a magnetic head of said disk drive;

a microprocessor communicating with said interface device and said magnetic head device of said interface circuit;

a power supply communicating with said microprocessor;

a memory device communicating with said microprocessor;

an insert detector communicating with said power supply, and

a card detector communicating with said interface device.

4. The apparatus of claim 3, wherein said power supply includes an internal battery.

5. The apparatus of claim 3, wherein said power supply includes a generator for powering said internal battery, said generator powered by a motor and a media drive shaft of said disk drive.

6. The method of interfacing an integrated circuit (IC) card with a computer having a disk drive, comprising the steps of:

removably inserting an adaptor into said disk drive;

removably inserting said IC card into said adaptor;

communicating data between said IC card and said disk drive through said adaptor.

7. The method of claim 6, wherein said step of removably inserting said adaptor into said disk drive comprises powering said interface circuit.

8. The method of claim 6 wherein said step of removably inserting said IC card into said adaptor comprises activating said electrical signals.

9. The method of claim 6, wherein said step of communicating magnetic field information comprises:

applying power to said IC card with electrical signals;

communicating information between said interface circuit and said IC card, and

generating magnetically encoded signals.

10. The method of claim 6, wherein said step of communicating magnetic field information comprises:

supplying power to said microprocessor and associated circuitry via a power supply;

communicating with said microprocessor via a memory device;

providing an insert detector communicating with said power supply and said microprocessor; and

providing a card detector communicating with said interface device.

11. The method of communicating with a computer via a disk drive of said computer by emulating a magnetic disk for the purpose of interfacing an IC card to said computer.

12. The apparatus of claim 1 further comprising an adaptor and an interface circuit within said adaptor, said interface circuit includes a magnetic head device configured to communicate magnetic field information with a magnetic head of said disk drive.

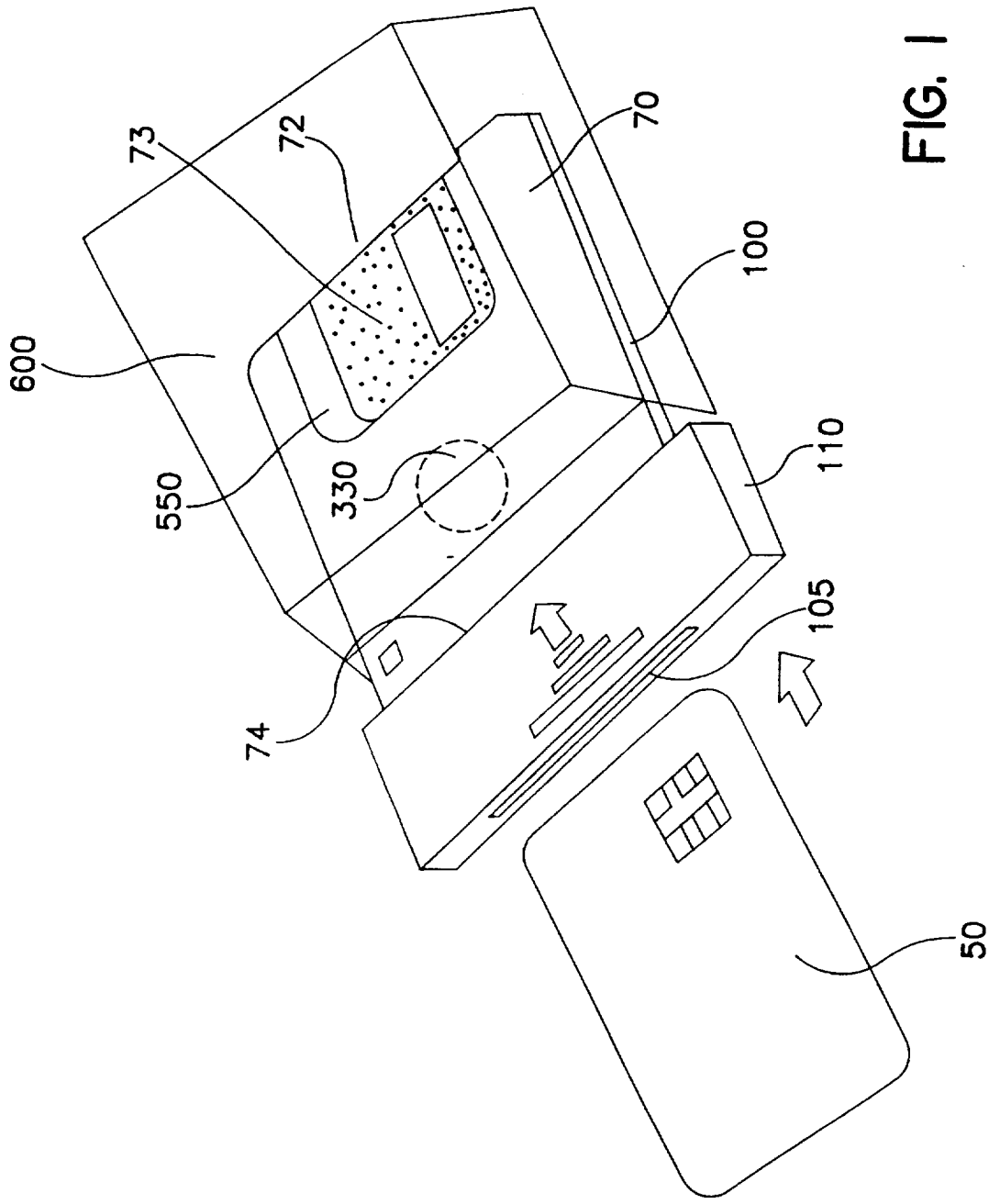

FIG. 1

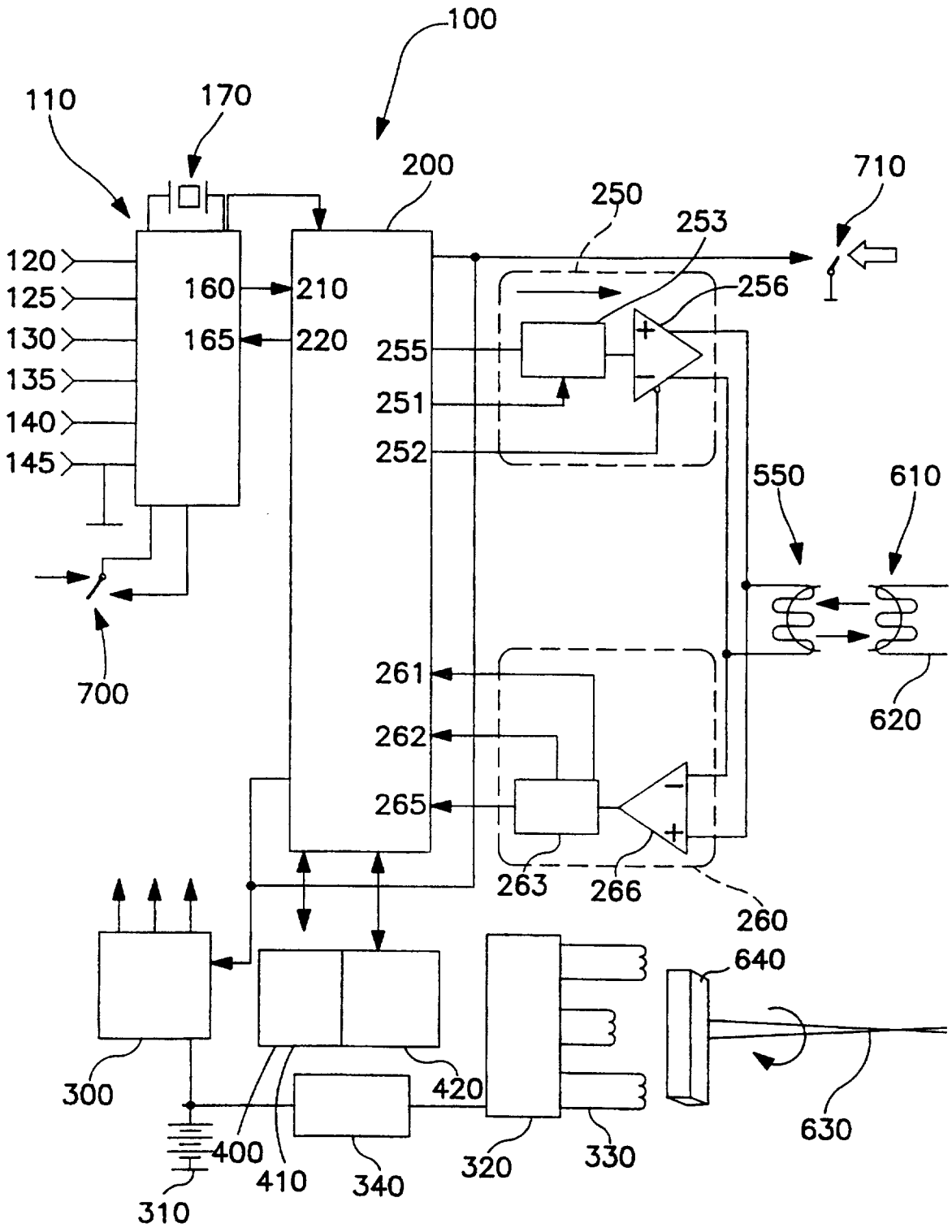
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FIG. 2

INTERNATIONAL SEARCH REPORT

In. ational Application No
PCT/US 97/15693

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K7/08

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06K

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 195 48 831 A (LECHNER STEPHAN DR) 23 May 1996 see the whole document	1,2,6,9, 11,14,16 3-5,7,8, 10,12, 13,15
Y	EP 0 139 593 A (FLONIC S.A.) 2 May 1985 see page 6, line 31 - page 12, line 34	3-5,7,8, 10,12, 13,15
X	WO 95 22096 A (HANDELSBOLAGET STALCASTIN ;ANDERSSON HANS OLOF (SE); JOHANSSON AND) 17 August 1995 see the whole document	1,2,6,9, 11,14,16

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[X] Further documents are listed in the continuation of box C.

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5 January 1998	13/01/1998

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
X	DE 40 21 199 A (SMARTDISKETTE GMBH) 19 December 1991 see column 1, line 3 - line 40 see column 1, line 62 - column 2, line 24	1,2,6,9, 11,14,16
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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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