A circuit (Fig. 5) for interconnecting electrical components (Fig. 3) in a stacked arrangement through the use of connector elements (20, 22). The circuit (Fig. 5) includes reset circuitry (Fig. 7) for automatically resetting the power-up sequence of the electrical components (Fig. 3) in the stack to allow the components to be powered up in any desired sequence. The circuit (Fig. 5) can also include identification circuitry (26) for generating a unique identifier for each component in the stack and termination circuitry (Fig. 6) for selectively establishing terminal connections between the first and last components in the stack.
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NETWORK HUB INTERCONNECTION CIRCUITRY
HAVING POWER RESET FEATURE

Field of the Invention

The present invention relates generally to hubs used to interconnect electrical components in a communications network. More particularly, the present invention relates to circuitry for interconnecting a group of hubs in a stacked configuration.

Background of the Invention

In a communications network, large numbers of components such as computers, workstations, or file servers, are electrically connected by a communication network technology such as ethernet, asynchronous transfer mode (ATM), fiber distributed data interface (FDDI), a technology known as TP-PMD (a copper-wire derivative of FDDI), and a networking technology known as 100VG-AnyLAN, which uses an access method called demand priority access method (DPAM). An ethernet or other communication network typically includes a hub which is connected to the arrangement of components by communication cables, and which allows the computers, workstations, or file servers to exchange data signals. Data signals sent from a transmitting component to a receiving component are transmitted to the hub and repeated at the hub for transmission to the receiving component. The hub enables multiple computers, workstations, or file servers to share resources in a variety of applications. These applications include client-server database systems, in which a back-end database "engine" handles queries from multiple client front-ends running on desktop personal computers. The volume of data carried over the communication network escalates considerably as new users, new applications software, and more powerful computers or workstations are added to the network. As the volume of data carried over the network increases toward the maximum capacity, the data transfer rate through the hub and communication cables
decreases, causing delays in computer applications and severely reducing the effectiveness of the network. Further, as the number of users associated with a network increases, more access ports are needed. To alleviate this problem, it is highly desirable to increase the capacity and/or the speed of the network.

A typical network hub includes one or more devices for routing data transfers between a number of ports (e.g., 12) in a workgroup. Each port may be assigned to one or more individual users or one or more individual computers, workstations, or servers. To increase the number of ports available to a workgroup, multiple hubs may be connected. Hub connections are typically achieved by uplink cables, such as unshielded twisted pair (UTP) cables, shielded twisted pair (STP) cables, or fiber optic cabling. In large, complex networks, a significant number of cables may be required. Cables present significant design limitations. For example, the total length of cable between hub units in a high-speed (e.g., 100 megabits per second) network must be less than 205 meters, and the total length of cable from a hub unit to a computer or other component must be less than 100 meters. Because of the length limitations of cables, the number of network hubs which may be interconnected is limited. Further, cables cause signal delay which can contribute to delays in network applications; thus, longer cables cause increased delay. In addition, signal reflection occurs at cable termination or connection points; thus, an increased number of cables causes increased delay. The reflected signals at the cable termination points contribute to signal degradation and inhibit network performance. The signal reflection and signal delay associated with cables also limit the number of network hubs which can be interconnected. A further limitation of cables is that it can be difficult, particularly for large cables, to provide adequate shielding for protecting the signals carried by a cable from the effects of RF interference. These and other limitations of cables become more pronounced as the speed of the communications network increases.

When a group of network hubs are stacked together to increase the capacity of a network, each hub in the arrangement typically must be powered up in a
predetermined order (e.g., from the bottom to the top of a stack of hubs). If the hubs are not powered up in the prescribed order, network errors may result. Accordingly, it would be desirable for a communication network hub or other arrangement of electrical components to be easily configured and expanded without the concerns of signal reflection, propagation delay, and errors in the power-up sequence of the network.

Summary of the Invention

To overcome the above problems, and provide other advantages, the present invention provides for an arrangement of electrical components, such as communication network hubs connected by connector elements, and a circuit for interconnecting electrical components such as network hubs in a communications network, each network hub including a reset means for automatically resetting the power-up sequence of a stacked arrangement of hubs. The reset means allows the network hubs to be powered up in any order.

The network hubs can be communication network hubs for exchanging communication signals between network devices such as computers, workstations, file servers, or other devices. According to exemplary embodiments, the hubs can include a plurality of substantially identical receiving slots for receiving connector elements to electrically connect two network hubs. The connector elements can include a dielectric connector body which is provided with electrical traces disposed on the connector body for cooperating with electrical contacts disposed in the receiving slots such that the electrical traces are brought into electrical contact with the electrical contacts when a connector element is inserted into a receiving slot. The connector element can also include an aligning means such as a slotted groove on the connector body which cooperates with an aligning element disposed in the receiving slot for ensuring the proper alignment of electrical traces and electrical contacts.
Brief Description of the Drawings

A more complete understanding of the present invention will result from taking the following Detailed Description of Preferred Embodiments in conjunction with the attached drawings in which like reference numerals indicate like elements, and in which:

Figure 1 is a diagram of an arrangement of interconnected network hubs according to an embodiment of the present invention;

Figures 2A-B are diagrams showing a perspective view and a cross-sectional view, respectively, of a connector element according to an embodiment of the present invention;

Figure 3 is a diagram of an electrical component for use with the connector element of Figures 2A-B;

Figures 4A-B are diagrams showing a method for interconnecting electrical components and an arrangement of interconnected components respectively;

Figure 5 is a block diagram of a circuit for interconnecting electrical components according to an embodiment of the present invention;

Figure 6 is a schematic diagram of a terminating circuit suitable for use in the interconnection circuitry of Figure 5; and

Figure 7 is a schematic diagram of the reset circuitry according to an embodiment of the present invention.

Detailed Description of Preferred Embodiments

Referring now to Figure 1, an arrangement of interconnected electrical components according to one embodiment of the present invention is shown. The electrical components are in the form of communication network hubs 10 arranged in a stack and connected by connector elements 12 such as those which will be described below with reference to Figure 2. The hubs 10 are stacked together, and the hubs and connector elements 12 form a substantially continuous signal bus for conducting
signals between the hubs 10 and between the network devices (not shown) connected to the hubs 10.

Referring now to Figure 2A, a perspective view showing a face of a connector element 40 according to one embodiment of the present invention is shown. The connector element 40 has a substantially rectangular body, and electrical traces 42 are disposed on the connector element 40, such as by printing. The electrical traces 42 include ground traces and signal traces which are brought into electrical contact with ground contacts and signal contacts, respectively, of an electrical component when the connector element 40 is inserted into in the receiving slots provided in the electrical component. The connector element 40 can be provided with one or more slotted grooves such as slotted grooves 44. The slotted grooves 44 provide an aligning means to ensure that the ground traces and signal traces are brought into electrical contact with the appropriate ground contacts and signal contacts, respectively, when the connector element is inserted into a receiving slot of an electrical component. It will be appreciated that other suitable aligning means, such as bumps located on the surface of the connector element 40 or projections extending from the connector element 40, can be used instead of the slotted grooves 44. It will be further appreciated that the signal traces and ground traces comprising signal traces 42 may be arranged so that no aligning means is necessary. The connector element 40 can also be provided with a layer 46 of electrically conductive material located on a portion of each face of the connector element 40. The electrically conductive layer 46 serves as a grounding shield to protect the connector element from the effects of RF interference.

Referring now to Figure 2B, a cross-sectional view of the connector element 40 is shown. The connector element 40 includes an inner layer 48 which contains electrically conductive signal leads 48G and 48S for appropriately conducting electrical signals between ground traces and between signal traces, respectively.

Signal leads 48G and 48S can be formed, for example, by depositing copper layers on inner layer 48 and etching the copper layer to form signal leads 48G and 48S. Inner
layer 48 is surrounded by a dielectric layer 50, on which the signal traces are printed on the edges of each surface of the dielectric layer 50. Signal leads 48G and 48S are appropriately connected between ground traces and signal traces, respectively, through dielectric layer 50. Conductive layers 46 are provided on portions of opposite surfaces of the connector element 40 as grounding RF shields. Signal leads 48G are connected to grounding shields 46 as shown. It will be appreciated that the connector element 40 is constructed so as to form a microstrip which is protected from RF interference by the grounding shields 46. It will be further appreciated that the dimensions of the dielectric layer 50 may be selected to ensure that the impedance of the connector element 40 matches the impedance of the driving circuits of the electrical components to be connected. By tuning the impedance of the connector element 40, signal reflection and degradation is significantly less than that in network hubs which use conventional cables.

Referring now to Figure 3, an electrical component for use with the connector element 40 is shown. The electrical component shown is in the form of a network hub 52 for routing communication signals between networked electrical devices such as servers, workstations or computers. It will be appreciated that many other types of electrical components may be adapted for use with the connector element of the present invention. The ethernet hub 52 includes a plurality of communication ports 54 for connecting to communication cables associated with the networked devices. The network hub 52 also includes two receiving slots 56 for receiving a connector element 40. The receiving slots 56 are preferably located on opposite surfaces of the hub 52 so as to allow a group of hubs 52 to be interconnected in a stacked configuration. Each receiving slot 56 contains signal contacts and ground contacts (not shown) for connection to the ground traces and signal traces on the connector element 40. Each receiving slot 56 can also be provided with an aligning element such as one or more bumps, slots, etc. to cooperate with corresponding aligning elements located on the connector element 40, and thereby ensure proper alignment of the electrical traces on the connector element with the electrical contacts in the receiving slot. The receiving slots 56 can be provided with a protective covering (not
shown) to prevent the electrical contacts of the hub 52 from being exposed. The hub 52 also can include an uplink port 58 for connecting various stacks of network hubs. The hub 52 also includes a power terminal 60 for receiving power.

Referring now to Figures 4A-B, a method for interconnecting hubs, and an arrangement of interconnected hubs, respectively, according to one embodiment of the present invention are shown. To connect two hubs, a connector element 40 is inserted into a receiving slot 56a on the top surface of a first hub 52a. A receiving slot (not shown) on the bottom surface of a second hub 52b is aligned with the connector element 40, and the second hub is fitted onto the connector element 40 to electrically connect the two hubs. More hubs may be added to the stack, either beneath the first hub or above the second hub. Brackets 62 or other suitable retaining elements may be used to provide structural integrity to a stack of hubs. The signal traces, ground traces and grounding shields of each connector element 40 used in the stack cooperate with the hubs to form a substantially continuous bus for communicating signals between the hubs in the stack. Because the connector elements 40 connecting the hubs form a microstrip which is shielded from the effects of RF interference by grounding shields 46, and because the dimensions of the connector bodies can be selected to match the impedance of the connector elements and the network hubs to reduce signal reflection, the substantially continuous bus formed by the connector elements and the network hubs in the stack may accommodate a relatively large number (e.g., 16) of network hubs. Further, additional stacks of large numbers of hubs may be functionally connected together by uplink communication cables, such as cable 64, inserted into the uplink communication port 58 of any of the hubs in an interconnected stack, as shown in Figure 4B. Standard data cables 66 connect the network hubs 52 to the network devices 68.

In accordance with the exemplary embodiments of the invention, relatively large numbers of network hubs or other electrical components may be interconnected to serve an increased number of network users without the signal delay, reflection, and interference associated with data cables.
Referring now to Figure 5, a functional block diagram of a circuit for
interconnecting electrical components in an arrangement, such as the stacked
arrangement of network hubs depicted in Figure 1, is shown. The circuit of Figure 5
is preferably contained in a network hub or other electrical component. The circuit
shown is an example of a circuit in a hub in the middle of a stack, and includes a top
connector 20, and a bottom connector 22, which are preferably connector elements of
the type shown in Figure 2. It will be appreciated that the circuits in the hubs located
at the top or bottom of a stack would not include a top connector or bottom
connector, respectively. The connector elements can be connected by one or more
busses such as bus 24 for communicating data and control signals. The circuit of
Figure 5 can also include programmable array logic (PAL) 26 which receives a
PRESENT_DOWN signal and an ID_IN signal from bottom connector 22, and a
PRESENT_UP signal from top connector 20. The PAL 26 provides an ID_UP signal
to top connector 20, and generates a TERM_EN signal which is supplied to
terminators 30 for establishing terminal connections between bus 24 and the network
hub if the network hub is the first hub or last hub in a stack. The circuit further
includes a reset line RESET for supplying a reset signal to automatically reset the
power-up sequence of the stack. By automatically resetting the power-up sequence of
the stack whenever a new hub is added, the hubs in the stack can be powered up in
any order. The circuitry of Figure 5 is present in each network hub or other
electrical component in the stack or arrangement.

Each network hub or other electrical component in the arrangement includes an
identifier means for generating a unique identifier for the component. The identifier
means in the embodiment of Figure 5 is implemented by the programmable array
logic (PAL) 26. The PAL 26 receives a unique identifier signal on bus ID_IN from
bottom connector 22, increments the identifier to generate a new unique identifier,
and transmits the new unique identifier signal to the top connector 20 on bus ID_UP.
In the circuit of Figure 5, if a component is at the bottom of a stack, the signals on
bus ID_IN are all high, and PAL 26 will supply all low signals on bus ID_UP. In
this manner, each network hub or other electrical component in the arrangement is
assigned a unique identifier to allow for bus arbitration and otherwise facilitate
communication between the hubs and the network devices associated with the hubs.
According to the preferred embodiment of the present invention, the identifier signal
transmitted on bus ID_UP is used as the unique identifier for the current network hub.

It will be appreciated that the identifier signal on bus ID_IN could alternatively be
used as the unique identifier for the current network hub. Busses ID_IN and ID_UP
are preferably 4-line busses, which allow up to 16 unique identifiers to be generated.
Larger busses can be used to allow the generation of more unique identifiers for
larger stacks or arrangements.

Each network hub or other electrical component in the arrangement can also
include a terminating means for selectively establishing a terminating connection
between the bus 24 of the circuit of Figure 5 and a network hub if the network hub is
the first or last hub in the stack or arrangement. As will be appreciated by those
skilled in the art, a terminating connection is necessary to prevent signal reflection
and allow for the propagation of data signals on the bus 24 from one network hub in
the stack to another. In the circuit of Figure 5, the terminating means is
implemented by PAL 26 and terminators 30. PAL 26 receives a signal on the line
PRESENT_DOWN from the bottom connector 22, which indicates the presence of a
network hub below the bottom connector element 22. PAL 20 also receives a signal
on the line PRESENT_UP from the top connector 20, which indicates the presence of
a network hub above the top connector 20. According to the preferred embodiment
of the present invention, a grounded or low state of the signal on lines
PRESENT_DOWN or PRESENT_UP indicates the presence of a connector element
above or below the current network hub, respectively. It will be appreciated,
however, that an alternate convention could be used.

PAL 26 determines whether it is at the bottom, middle, or top of a stack based
on the signals on lines PRESENT_UP and PRESENT_DOWN, and bus ID_IN. If
PAL 26 determines it is in a network hub on the bottom of a stack (i.e., the signals
on line PRESENT_DOWN and bus ID_IN are all high), then it drives bus ID_UP
with all low signals, and generates a termination enable signal on line TERM_EN to selectively establish terminating connections as will be described with respect to Figure. 6. If PAL 26 determines that it is not in the bottom of the stack (i.e., the state of the signal on line PRESENT_DOWN is low and the signals on bus ID_IN are not all low), then PAL 26 increments the signal on bus ID_IN by 1, and outputs the incremented signal on bus ID_UP. If PAL 26 determines that it is at the top of a stack (i.e., the signal on line PRESENT_DOWN is low and the signal on line PRESENT_UP is high), then it generates a termination enable signal on line TERM_EN. It will be appreciated that the PAL 26 located in a hub at the top of a stack still increments the signal on bus ID_IN by one and outputs the incremented signal on bus ID_UP to establish the unique identifier for the current (top) network hub even though no top connector is present. If the signals on each of the lines of bus ID_IN are all high, and the signal on line PRESENT_DOWN is low, then there are too many components connected in the stack. If the bus ID_IN is a 4-line bus, then this condition will be reached if more than 16 busses are present in a stack. In this condition, the signals on the lines of bus ID_UP are all maintained at the high level, thereby creating a non-unique identifier. The two or more components having the same identifier will detect an error or conflict condition, and this error condition can be detected by a network administrator.

The signal on line TERM_EN, which is generated by PAL 26, functions to establish terminating connections between the bus 24 and the network hub only when one of the signals on lines PRESENT_UP or PRESENT_DOWN indicate that there is no network hub located above or below the current network hub. That is, if the signal on either line PRESENT_UP or PRESENT_DOWN is high, indicating that the current network hub is at the top or bottom of a stack, respectively, the signal on line TERM_EN is driven to a low state to enable a terminating connection to be established. If the signals on both lines PRESENT_UP and PRESENT_DOWN indicate that there are network hubs both above and below the current network hub, the signal on line TERM_EN is driven to a high state, and terminating connections between bus 24 and the current network hub are not established. It will be
appreciated that alternate conventions of the TERM_EN signal can be used. The specific details of the terminating connections will now be described with respect to Figure 6.

Referring to Figure 6, a schematic diagram of a terminating circuit suitable for use as a terminator 30 in Figure 5 is shown. Terminator 30 receives a signal on line TERM_EN as an input. If the signal on line TERM_EN is low, indicating that the current network hub is at the bottom or top of a stack, then switches 40 are all closed and each line of the associated bus 24 is connected through resistances 42 to a reference voltage supplied by voltage source VREF. Resistances 42 preferably provide an impedance matched or tuned to the frequency of the signals on the bus 24. The voltage source VREF or other suitable element is located in each network hub. If the signal on line TERM_EN is high, indicating that the current network hub is located in the middle of a stack, the switches 40 are all opened to disconnect the lines of the associated bus from the voltage source VREF.

Referring now to Figure 7, a schematic diagram of a reset circuit according to an embodiment of the present invention is shown. A reset circuit such as that shown in Figure 7 is present in each network hub in an arrangement. When a new network hub is added to an arrangement of hubs and powered up, power will be supplied to the circuit of Figure 7 at terminals PWR. When power is received at terminals PWR, reset signal generator 40 generates a global reset signal on line G_RESET. This global reset signal on line G_RESET is transmitted to all of the network hubs in an arrangement as shown in Figure 5. One or more of the signal traces on the connector element, as shown in Figure 2A, may be used to transmit the global reset signal to each hub in the arrangement. Accordingly, each individual hub in the arrangement receives a global reset signal on line G_RESET, and includes NAND gate 42 and amplifier 44 for generating reset control signals RESET and RESET’ to cause the individual hub to power up again. In a preferred embodiment of the present invention, reset signal generator can be implemented by a Power on Reset, such as a TL7705, available from Texas Instruments NAND gate 42 can be implemented by a
7414C132 NAND gate, and amplifier 44 can be implemented by a 74F125 amplifier. It will be appreciated that other suitable components and arrangement can be used for the reset circuit of Figure 7.

While the foregoing description has included many details and specificities, it is to be understood that these are intended to illustrate the present invention and are not to be construed as limitations of the invention. Numerous modifications will be readily apparent to those of ordinary skill in the art without departing from the spirit and scope of the invention, as defined by the following claims and their legal equivalents.
WHAT IS CLAIMED IS:

1. An arrangement of interconnected network hubs, comprising:
   a plurality of network hubs, each hub having two receiving slots, the receiving
   slots having electrical contacts disposed therein; and
   at least one connector element, each connector element cooperating with one
   receiving slot from each of two network hubs to electrically connect the two network
   hubs,
   wherein each hub in the plurality of network hubs includes a reset means for
   automatically resetting a power-up sequence of the arrangement when a new network
   hub and connector element are added to the plurality of network hubs.

2. The arrangement of claim 1, wherein each network hub further includes a
   termination means for selectively establishing a terminal connection between the
   network hub and a connector element if the network hub is a first hub or a last hub in
   the arrangement.

3. The arrangement of claim 2, wherein each network further includes an
   identification means for generating a unique identifier.

4. The arrangement of claim 3, wherein the identification means and the
   termination means are implemented by programmable array logic.

5. The arrangement of claim 4, wherein the programmable array logic
   generates the identifier by receiving a first identification signal from a first connector
   element, increments the identifier to generate a new unique identifier, and transmits
   the new unique identifier as a second identification signal to a second connector
   element.

6. The arrangement of claim 1, wherein the receiving slots are substantially
   identical.
7. The arrangement of claim 2, wherein the terminal connection is established by connecting a resistance between the network hub and the connector element.

8. The arrangement of claim 1, wherein the connector element includes a connector body having electrical traces disposed thereon.

9. The arrangement of claim 8, wherein the electrical traces are brought into electrical contact with the electrical contacts in a receiving slot when a connector element is inserted into the receiving slot.

10. The arrangement of claim 8, wherein the electrical traces are printed on the connector body.

11. The arrangement of claim 8, wherein the connector body includes a first layer of electrically conductive signal leads, a dielectric layer surrounding the first layer and having first and second surfaces, and first and second electrically conductive layers disposed on the first and second surfaces, respectively, to provide RF shielding.

12. The arrangement of claim 8, wherein the electrical traces include ground traces and signal traces and the electrical contacts include ground contacts and signal contacts.

13. The arrangement of claim 12, wherein each receiving slot further includes an alignment element and the connector element includes an aligning means which cooperates with the alignment element to ensure that signal traces and ground traces are brought into electrical contact with signal contacts and ground contacts, respectively.

14. The arrangement of claim 13, wherein the aligning means includes a slotted groove in the connector body.
15. The arrangement of claim 9, wherein each network hub further includes a identification means for automatically assigning a unique identifier to each network hub in the plurality of network hubs.

16. The arrangement of claim 15, wherein each network hub further includes a termination means for selectively establishing a terminal connection between the network hub and a connector element if the network hub is a first hub or a last hub in the arrangement.

17. The arrangement of claim 16, wherein the identification means and the termination means are implemented by programmable array logic.

18. The arrangement of claim 17, wherein the programmable array logic generates the unique identifier by receiving a first identification signal from a first connector element as the unique identifier, increments the identifier to generate a new unique identifier, and transmits the new unique identifier as a second identification signal to a second connector element.

19. The arrangement of claim 17, wherein the terminal connection is established by connecting a resistance between the network hub and the connector element.

20. A circuit for interconnecting electrical components in a stack, comprising: identifier means for automatically assigning an identifier to each electrical component in the stack;

termination means for automatically configuring electrical connections to terminal components in the stack as terminal connections; and

reset means for automatically resetting a power-up sequence used to provide power to each component in the stack when a new component is added to the stack.
21. The circuit of claim 20, wherein the reset means includes a means located in the new component for generating a global reset signal when the new component is added to the stack; means located in each component for receiving the global reset signal and causing the power-up sequence to be restarted.

22. The circuit of claim 21, wherein the identifier means and termination means are implemented by programmable array logic.
# INTERNATIONAL SEARCH REPORT

**International application No.**
PCT/US96/03352

## A. CLASSIFICATION OF SUBJECT MATTER


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):

- U.S.: 395/309, 280-282, 284, 830, 835, 836, 882, 500, 182.05, 200.1, 800; 340/825.02; 361/735, 746; 439/69, 74

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

**NONE**

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

- APS: Network?, Hub?, (connect?, or coupl?, or interfac?), reset?, terminat?, power(w)up sequenc?, PAL or (programmable array logic), (identifier# or address?)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
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<th>Relevant to claim No.</th>
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<td>A</td>
<td>US, A, 5,392,285 (KURTS) 21 FEBRUARY 1995, see fig. 1 and col. 2, lines 15-57</td>
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<td>20-22</td>
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<td>Y</td>
<td>US, A, 5,058,110 (BEACH ET AL.) 15 OCTOBER 1991, see fig. 1 and col. 2, line 59 - col. 3, line 29</td>
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<td>A</td>
<td>US, A, 4,809,362 (CLAUS ET AL.) 28 FEBRUARY 1989, see fig. 3 and col. 3, line 24 - col. 5, line 9</td>
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<td>Y</td>
<td>US, A, 4,562,535 (VINCENT ET AL.) 31 DECEMBER 1985, see fig. 1 and col. 2, line 44 - col. 3, line 5</td>
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[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search: 20 JUNE 1996
Date of mailing of the international search report: 22 JUL 1996

Name and mailing address of the ISA/US:
Commissioner of Patents and Trademarks
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Washington, D.C. 20231
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Authorized officer: GOPAL C. RAY
Telephone No. (703) 305-9647

Form PCT/ISA/210 (second sheet)(July 1992)
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<td>A</td>
<td>US, A, 5,434,516 (KOSCO) 18 JULY 1995, see fig. 1 and col. 1, line 63 - col. 2, line 18</td>
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A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):
G06F 13/00, 15/173; H04L 12/42, 12/44, 12/46; H04J 3/24; H04N 7/10

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :
395/309, 280-282, 284, 830, 835, 836, 882, 500, 182.05, 200.1, 800; 340/825.02; 361/735, 746; 439/69, 74