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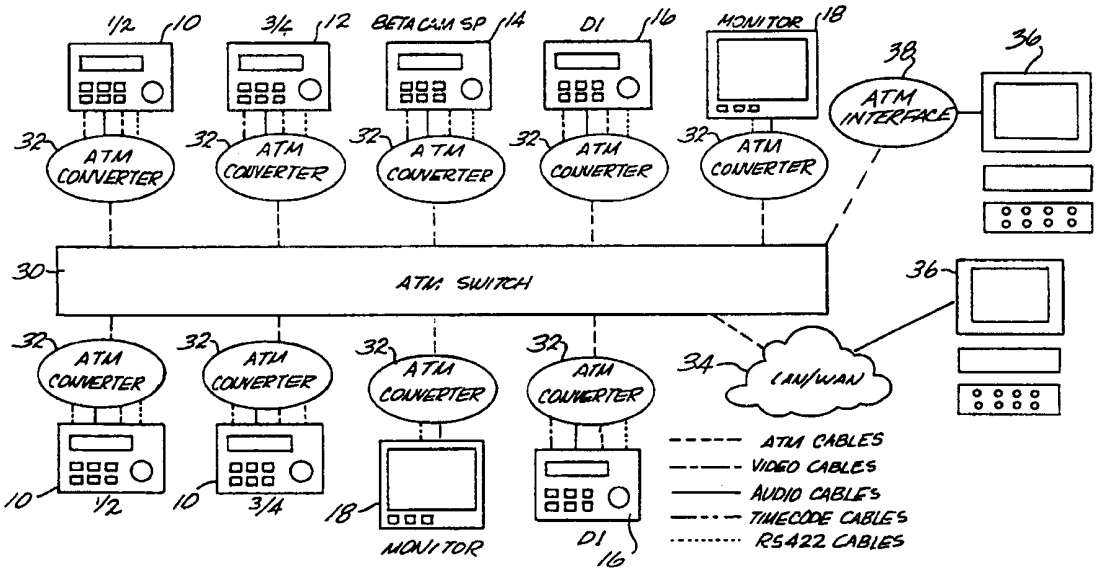

(57) Abstract

An interconnected system of professional video devices (10–18) that is used for video editing, production and the like according to a preferred embodiment of the invention. The system includes audio/video devices such as 1/2 inch videotape decks, 3/4 inch videotape decks, BetaCam tape decks and D1 video decks. There may also be a number of monitors (18). A single asynchronous transfer mode (ATM) switch (30) is used in place of video routers, audio switches, timecode switches and RS–422 control signal switches. Each audio/video device must be connected to the ATM (30) switch through an ATM converter (32). For analog devices an A/D–D/A converter is placed between the audio/video device (10–18) and the ATM converter. The ATM converter can include within it the A/D–D/A converter.

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SYSTEM AND APPARATUS FOR CONNECTING A NUMBER OF PROFESSIONAL VIDEO DEVICES USING AN ATM SWITCH

BACKGROUND OF THE INVENTION

Figure 1 shows a typical arrangement for connecting a number of professional video devices together at one location. In this system, there are 1/2 inch videotape decks 10, 3/4 inch videotape decks 12, BetaCam tape decks 14 and D1 video decks 16 (BetaCam is a trademark of Sony Corporation). There are also a number of monitors 18. In this system, various switches and routers are used so that any of the various video decks 10, 12, 14 or 16 can be connected to any of the monitors 18. Further, the same switches and routers are used to connect the output of any of the video decks to the input of any of the other video decks to allow video editing. The first switching device is video router 20. Video router 20 is a standard piece of equipment in the industry which accepts a multitude of digital video inputs and has a multitude of digital video outputs. Examples of such video routers include Probel 32x32 Serial Digital Router, Part No. 6621. The video router can be controlled remotely to cause any of the digital video inputs to be connected with any of the digital video outputs. However, many video decks used in the industry are analog devices, such as 1/2 inch decks 10, 3/4 inch decks 12 and BetaCam decks 14, which are all analog devices having analog video outputs. Therefore, the analog video output of each of these video decks has to be run through an analog to digital converter (A/D converter) 21 to convert the analog output of the deck into a digital video signal which can be connected to the video router 20. Similarly, the output of the video router 20 is digital, but many of the video decks, such as 1/2 inch deck 10, 3/4 inch deck 12 and BetaCam deck 14 are analog devices and accordingly only have analog video inputs. Thus, the digital video output of the video router 20 must be connected through a digital to analog converter (D/A converter) to be converted into an analog video signal which can be used by the analog video decks. In most installations, a combination analog to digital and digital to analog converter (A/D-D/A converter) 21 is used.

Alternatively, an analog video router (not shown) may be used in place of the digital video router 20. In this alternative embodiment, A/D-D/A converters would, of course, not be needed between the analog video devices and the analog video router. However, a D/A-A/D converter may still be needed to connect digital video devices, such as D1 video deck 16 to the analog video router. Some digital video devices may not have analog video ports. Other digital video devices, such as most D1 video decks, include analog video ports which could be connected directly to an analog video router. However, for top quality in professional systems, a separate, professional quality A/D-D/A converter is preferred over the A/D-D/A converter built into the digital video device.

In a similar manner as the video router, audio switch 22 is a standard piece of equipment in the industry that accepts a number of digital audio inputs and can connect any of these digital audio inputs to any one of the audio switch's digital audio outputs. Again, as with the video signals, many of the devices connected to the system are analog devices which have analog audio inputs and outputs. Thus, as with the video router, such devices must be connected to the audio switch through A/D - D/A converters. Alternatively, an analog Audio Router may be used, such as Probel 64x64 Dual 32x32 Analog Audio Router, Part No. 6411P. If an analog audio router is used instead of a digital audio router, A/D - D/A converters for the audio are needed for the digital decks to convert from digital to analog, but not needed for the analog devices.

Each of the video decks also has time code inputs and outputs and RS-422 control line inputs and outputs. These are connected to a time code switch 24, such as Probel 64x64 Timecode Router, Part No. 6415 and RS-422 switch 26, such as Probel 64x64 RS422 Router, Part No. 6521, respectively, in a similar manner as they are connected to the video router and audio switch.

Overall, the prior system is quite complicated, involving four different switches and routers and an A/D - D/A converter for each of the analog video and audio devices in the system. Additionally, each of the video decks must be connected to the various switches and routers with four sets of input/output cables, namely, video cables, audio cables, timecode cables and RS-422 control cables. Accordingly, the cabling costs and complexities in installing a prior art system is a substantial undertaking. In fact, the typical cost just for the cabling in a system of this type is up to $100,000. A further disadvantage of the prior art systems is that the control protocol that are used to route the video and other signals through the video router and other switches are mostly proprietary and are not compatible with other distribution systems and networks. Thus, the system is closed to further expansion and connection with other devices such as computers.

SUMMARY OF THE INVENTION

A system is provided according to the invention which includes a number of sources of video signals, such as professional video decks, each with an ATM converter connected to the source of video signals for converting the video signals into packets for transmission over an ATM network. The ATM converter is connected to an ATM network which links both inputs and outputs of video, audio, time code and control codes signals of the video decks with to the inputs and outputs of video, audio, time code and control codes signals of other video devices or computers through the ATM network.

In an alternative embodiment, the ATM converter is included as part of the video device and the video device includes an ATM port which is connected directly to the ATM switch with

typical cabling used in ATM networks, such as fiber. This ATM port is either in addition to or as a replacement for the traditional video, audio, timecode and control code inputs and outputs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a system of professional video devices according to the prior art.

FIG. 2 is a block diagram of a system of professional video devices according to a preferred embodiment of the invention.

FIG. 3 is a rear perspective view of a video device including an ATM converter according to a preferred embodiment of the invention

DETAILED DESCRIPTION

FIG 2. shows an interconnected system of professional video devices that is used for video editing, production and the like according to a preferred embodiment of the invention. As in FIG. 1, the system includes 1/2 inch videotape decks 10, 3/4 inch videotape decks 12, BetaCam tape decks 14 and D1 video decks 16. There are also a number of monitors 18. However, in the system of FIG. 2, no video router, audio switch, timecode switch or RS-422 control signal switches are used. Rather a single asynchronous transfer mode (ATM) switch 30 is used in place of all of these devices. In order to use the ATM switch in place of the video router and audio and other switches, each audio/video device must be connected to an ATM converter 32. For analog devices an A/D - D/A converter (not shown) is placed between the audio/video device and the ATM converter. In this regard some models of the ATM converter included within them the A/D -D/A converter.

Besides typical video devices normally connected to systems as shown in FIG. 1, the system utilizing ATM converters shown in FIG. 2 can also be connected to almost any computer network 34, including LANs (Local Area Networks) and WANs (Wide Area Networks). Most networks are able to easily connect to an ATM switch because ATM is a standard communications protocol and most modern microcomputer networks, such as Novell NetWare Microsoft Windows NT and Apple Computer's AppleTalk, can easily interface with ATM switches (NetWare is a trademark of Novell, Inc., Windows NT is a trademark of Microsoft Corporation and AppleTalk is a trademark of Apple Computer, Inc.). A common way to achieve this interface is to use a readily available Ethernet/ATM converter (not shown). In this way, a standard computer 36, such as a PC, an Apple Macintosh or Sun SPARCstation can send and receive video, audio, time code and RS-422 control signals through the ATM switch to and from any of the video devices connected to the ATM switch (Macintosh is a trademark of Apple

Computer, SPARCstation is a trademark of Sun Microsystems). Alternatively, computers such as PCs, Apple Macintoshes and Sun SPARCstations can be connected to the ATM switch directly through commercially available ATM interface cards 38 which are installed directly into the computers.

The ATM switch, in combination with the ATM converters are used to create a virtual connection (or virtual circuit) between any of the outputs of any of the audio/video devices or computers and any of the inputs of the audio/video devices or computers. For example, virtual connections can be made between the output of one of the BetaCam tape decks 14 and the input of D1 video deck for each of the video signal, audio signal, time code signals and RS-422 control signals. Alternatively, more than one virtual circuit can be established from a single output of a video device. For example, virtual circuits can simultaneously be established between the video output of BetaCam 14 and the video input of D1 deck 16, between the video output of BetaCam 14 and the video input of monitor 18, and between the video output of BetaCam 14 and the computer 36, through the computer network 34.

In another alternative use of virtual circuits, each of the outputs of a video device, such as BetaCam tape deck 14 can be connected to different devices, each output using a different virtual circuit. For example, separate virtual circuits may be established for each of the connections between the video output of 3/4 inch deck 12 and the video input of monitor 18, between the video output of 3/4 inch deck 12 and the video input of D1 video deck 16, between the time code output of 3/4 inch deck 12 to the computer 36 and between the RS-422 inputs and outputs of 3/4 inch deck 12 and D1 video deck 16 and computer 36.

The system shown in FIG. 2 has several advantages. First, it allows conventional video devices to be connected to any of the computers throughout a local area network or even a wide area network and allow any of the computers to control the operation and receive the audio and video output of any of the professional video devices connected to the system. Besides providing much wider distribution and access to the video devices, using the ATM network of FIG.2 allows for distribution and control of video devices from much more remote locations than the traditional system. Traditional cabling as shown in FIG. 1 is limited to cable runs of about 200 meters, and the furthest that two devices could be located from each other is limited to this distance. The allowable distance between video devices (including computers) in the ATM network system, on the other hand is limited only by the limitations of the LAN or WAN to which the ATM switch is connected, which today typically means that distances of 25 miles between units is easily attainable using one ATM switch. Thousands of miles can be attained using multiple ATM switches and/or repeaters.

The next advantage is that the cost of cabling in the FIG. 2 ATM system is greatly reduced

over the traditional FIG. 1 system. The vast bulk of the cabling in the FIG. 2 system is the ATM cabling that links the ATM converters with the ATM switch. This cabling is typically either fiber or Category 5 twisted pair cabling. Category 5 twisted pair cabling is limited to runs of 100 to 200 meters and is only capable of OC-3 ATM transmission, but it is often found pre-existing in built out office space. This type of cabling is usually sufficient for a network where all of the devices are the same floor of the same building as the ATM switch. In cases of larger installations or multiple floor installations, typically multiple ATM switches are used, such as one ATM switch per floor, with pre-existing twisted pair cabling used between the ATM switches and devices on the same floor and fiber used to connect the multiple ATM switches to each other. Even in cases where twisted pair cabling is not installed for an ATM network, or where fiber cabling is to be used throughout the system, retrofitting space with ATM cabling is straightforward and relatively inexpensive.

In an alternative embodiment, additional cabling in the FIG. 2 ATM system is eliminated by building the ATM converter 32 into the video devices 10, 12, 14, 16 and 18. The back panel 40 of such a video device including an ATM converter (ATM video device) 42 is shown in FIG. 3. In addition to standard A/V connectors 44 commonly found on professional video devices, the ATM video device includes an ATM port 46 which is an input/output port that is connected to a standard cable to connect the ATM video device to the ATM switch 30.

In another alternative embodiment (not shown) ATM video device does not include standard A/V connectors 44, but only includes the ATM port 46. In this embodiment, standard A/V connectors 44 are not needed because virtual circuits can be established through ATM port 46 for any of the inputs or outputs found in standard A/V connectors 44.

In another alternative embodiment (not shown) public broadband networks other than ATM are used. Examples of public broadband networks that can be used in place of ATM and that are available or under development include frame relay, IP WANs and Gigabit Ethernet. In each case, the ATM converter 32 and ATM switch 30 shown in FIG. 2 are replaced with the appropriate converter and switch/router for the public network utilized. For example, if a Gigabit Ethernet network is used, the ATM converter in FIG. 2 is replaced with a Gigabit Ethernet converter and the ATM switch is replaced with a Gigabit Ethernet switch. In any case, the functionality of the system shown in FIG. 2 described for use with an ATM network is applicable to the other public networks as well.

Although the invention has been described with reference to specific embodiments, this description is not meant to be construed in a limiting sense. Various modifications of the disclosed embodiment as well as alternative embodiments of the invention will become apparent to one skilled in the art upon reference to the description of the invention. It is therefore contemplated

that the appended claims will cover any such modifications of embodiments that fall within the true scope of the invention.

WHAT IS CLAIMED IS:

1. An apparatus comprising:

a source of video signals;

a converter connected to the source of video signals for converting the video signals into packets for transmission over a public broadband network;

a port connected to the converter for connecting the apparatus to a public broadband network and transmitting the packets over the public broadband network.

2. The apparatus of claim 1 further comprising a housing which comprises the source of video signal, the converter and the port.

3. The apparatus of claim 1 wherein the source of video signal is a source of digital video signals.

4. The apparatus of claim 1 wherein the source of video signals is a source of analog video signals and wherein the apparatus further comprises an analog to digital converter connected between the source of analog video signals and the converter.

5. The apparatus of claim 1 wherein the apparatus further comprises a source of audio signals and the converter further comprises a converter for converting the audio signals into packets for transmission over the public broadband network.

6. The apparatus of claim 1 wherein the apparatus further comprises a source of time code signals and the converter further comprises a converter for converting the time code signals into packets for transmission over the public broadband network.

7. The apparatus of claim 1 wherein the apparatus further comprises a source of video device control signals and the converter further comprises a converter for converting the video device control signals into packets for transmission over the public broadband network.

8. The apparatus as in one of claims 1-7 wherein the public broadband network comprises an asynchronous transfer mode network.

9. A system of interconnected video devices comprising:

a plurality of output video devices each comprising a video output for supplying video signals;

wherein one or more of the output video devices comprises:

a converter for converting the video signals supplied by the video output into packets for transmission over an asynchronous transfer mode network (ATM);

an ATM output for outputting the packets;

a plurality of input video devices each comprising a video input for receiving video signals;

wherein each of a plurality of the input video device comprises:

an ATM input for receiving packets of video data from an asynchronous transfer mode network;

a converter connected to the ATM input for converting the packets of video data received by the ATM input into the video signals received by the video input;

an ATM switch connected to the ATM outputs and ATM inputs for receiving packets of video data from one of the ATM outputs and delivering the received packets of video data to one of more of the ATM inputs.

10. The system of claim 9 wherein one or more of the video devices is a computer.

11. The system of claim 9 wherein an audio plurality of the output video devices comprise an audio output for supplying audio signals;

wherein each of the audio plurality of the output video devices comprise:

a converter connected to the ATM output for converting the audio signals supplied by the audio output into packets for transmission over an asynchronous transfer mode network.

12. The system of claim 9 wherein an audio plurality of the input video devices comprise an audio input for receiving audio signals;

wherein each of the audio plurality of the input video devices comprise:

a converter connected to the ATM input for converting packets of audio data received by the ATM input into audio signals received by the audio input.

13. The system of claim 9 wherein a time code plurality of the output video devices comprise a time code output for supplying time code signals;

wherein each of the time code plurality of the output video devices comprise:

a converter connected to the ATM output for converting the time code signals

supplied by the time code output into packets for transmission over an asynchronous transfer mode network.

14. The system of claim 9 wherein a time code plurality of the input video devices comprise a time code input for receiving time code signals;

wherein each of the time code plurality of the input video devices comprise:

a converter connected to the ATM input for converting packets of time code data received by the ATM input into time code signals received by the time code input.

15. The system of claim 9 wherein a video device control plurality of the output video devices comprise a video device control output for supplying video device control signals;

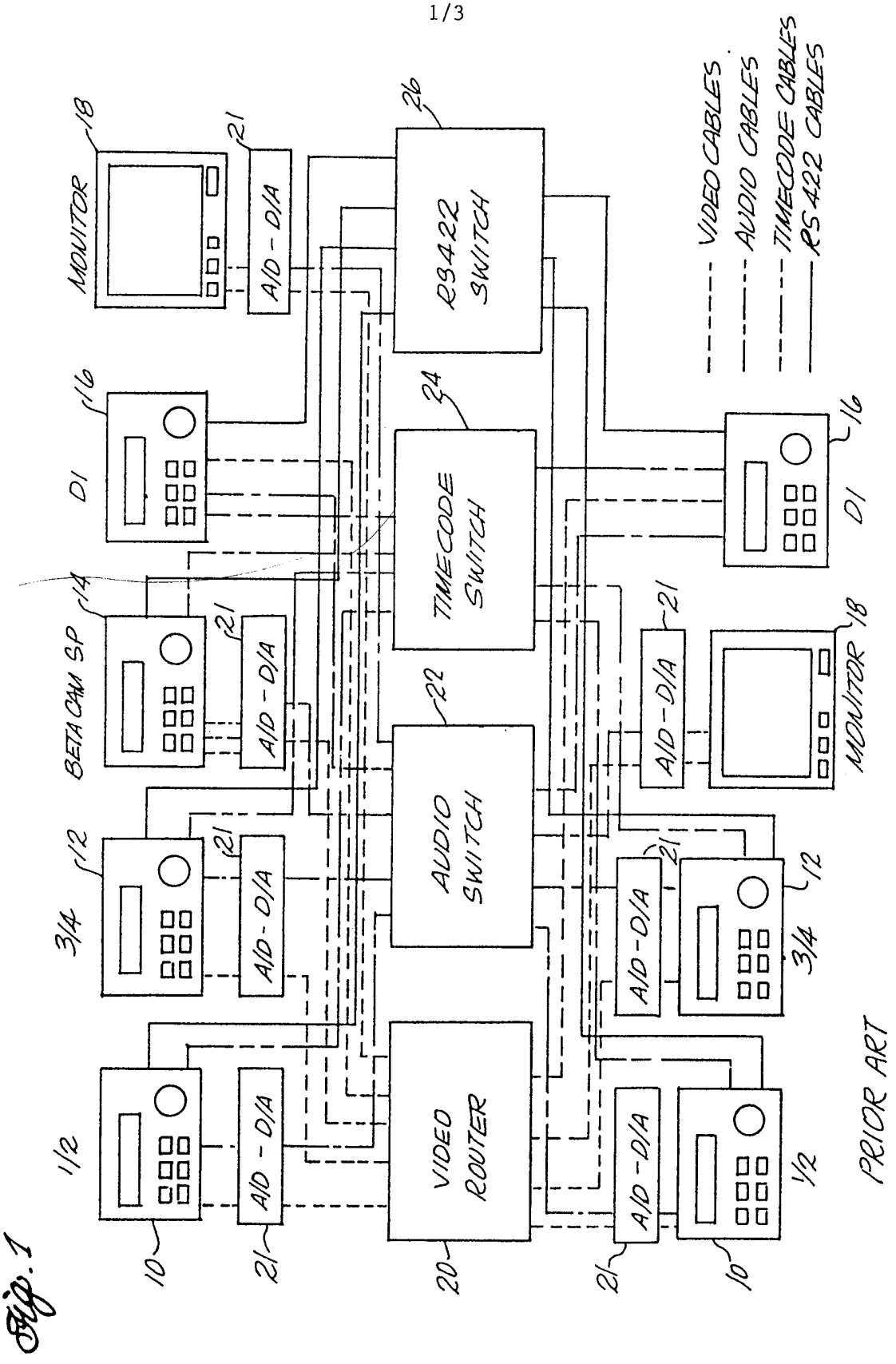
wherein each of the video device control plurality of the output video devices comprise:

a converter connected to the ATM output for converting the video device control signals supplied by the video device control output into packets for transmission over an asynchronous transfer mode network.

16. The system of claim 9 wherein a video device control plurality of the input video devices comprise a video device control input for receiving video device control signals;

wherein each of the video device control plurality of the input video devices comprise:

a converter connected to the ATM input for converting packets of video device control data received by the ATM input into video device control signals received by the video device control input.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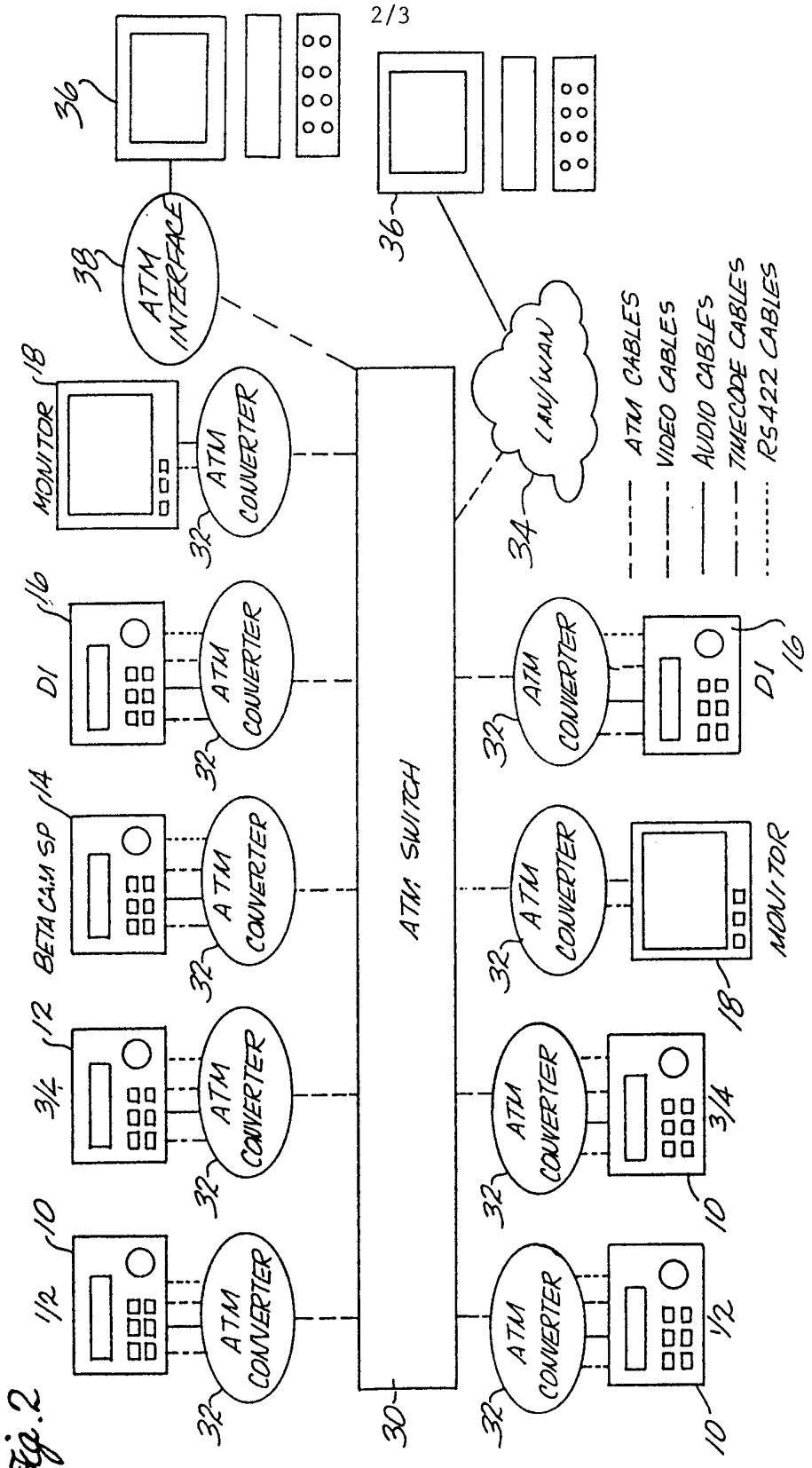
AUDIO CABLES
TIMECODE CABLES
RS 422 CABLES
MONITOR
18
A/D - D/A
21
RS422 SWITCH
26
D1
16
TIMECODE SWITCH
24
BETA CAM SP
14
AUDIO SWITCH
22
3/4
12
1/2
10
VIDEO ROUTER
20
PRIOR ART

Fig. 1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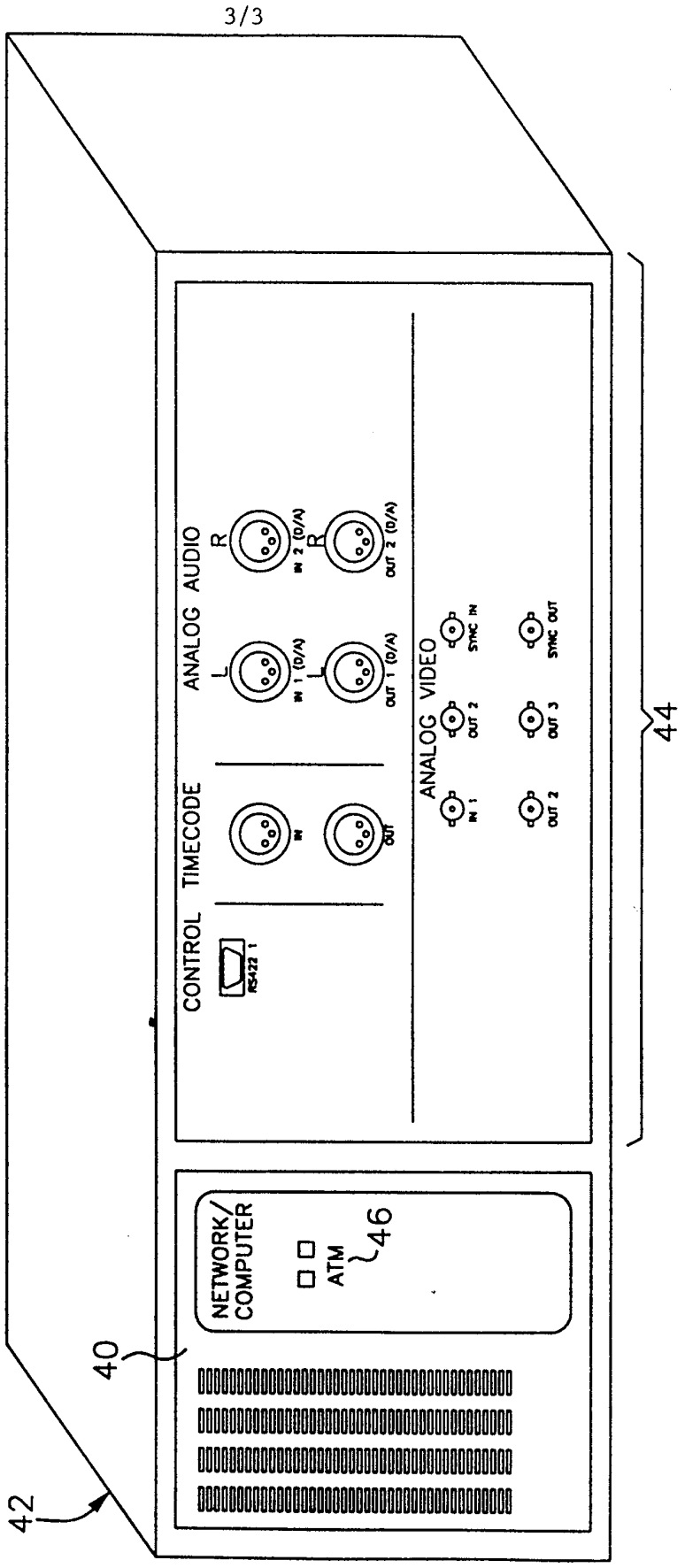
3/4
12
BETACAM SP
14
D1
16
MONITOR
18
ATM CONVERTER
32
ATM SWITCH
30
ATM INTERFACE
38
36
LAN/WAN
34
ATM CABLES
VIDEO CABLES
AUDIO CABLES
TIMECODE CABLES
RS422 CABLES

Fig. 2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TIMECODE
ANALOG AUDIO
ANALOG VIDEO
RS422 1
IN
OUT
L
R
IN 1 (D/A)
OUT 1 (D/A)
IN 2 (D/A)
OUT 2 (D/A)
IN 1
OUT 2
OUT 2
OUT 3
SYNC IN
SYNC OUT
NETWORK/
COMPUTER
ATM
46
40
42
44

FIG.3

INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/US 98/20382

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/765

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

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	EP 0 727 909 A (SONY CORPORATION) 21 August 1996 see the whole document	1-5,8-12
Y		6,7, 13-16
A	WO 97 23092 A (PHILIPS ELECTRONICS N. V. ET AL.) 26 June 1997 Abstract	3
Y	WO 97 00579 A (THOMSON CONSUMER ELECTRONICS, INC.) 3 January 1997 see page 3, line 10 - page 5, line 12; figures 1-4B	6,7, 13-16

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☒ Patent family members are listed in annex.

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18 January 1999	11/02/1999

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

information on patent family members

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