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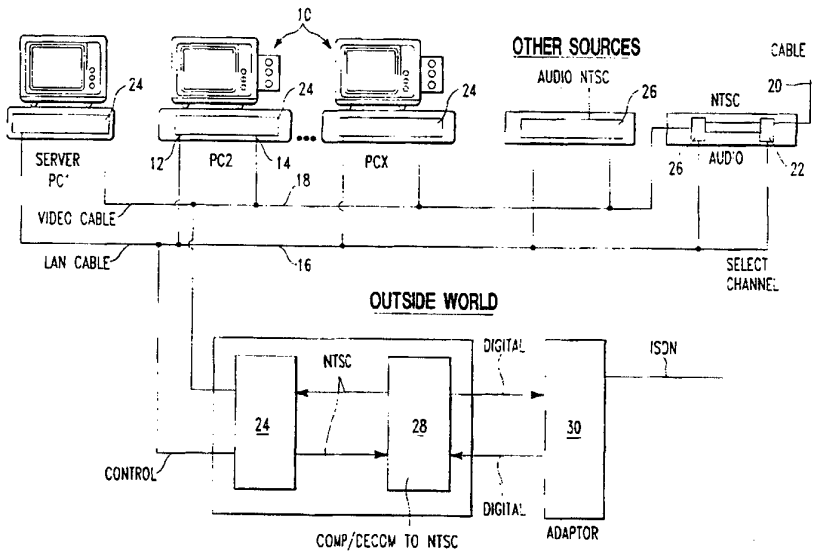

(57) Abstract

A data and television network for digital computer workstations that operate on a local area network (LAN) to exchange data. The network includes a baseband local area network (A-LAN), connected to a first port of a plurality of workstations, for transmitting and receiving data signals between selected ones of the workstations and a broadband local area network (B-LAN) connected to a second port of the plurality of workstations, for transmitting and receiving television signals between selected ones of these workstations. Each television signal is transmitted at a selected frequency channel so that no two transmissions interfere. A software program, stored in and operable on the computer of each workstation, generates and receives data messages, transmitted via either the A-LAN or the B-LAN, to and from the computer of another workstation, respectively. These data messages initiate and control the transmission of the television signals on the B-LAN such that a plurality of television signals are transmitted simultaneously on the B-LAN, with each television signal assigned to a separate frequency channel.

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DATA AND TELEVISION NETWORK FOR DIGITAL COMPUTER WORKSTATIONS

BACKGROUND OF THE INVENTION

The present invention relates, generally, to a communication network or system for transmitting both data and television signals between a plurality of digital computer workstations. More particularly, the invention relates to a communication system that employs an industry standard baseband local area network (LAN) for transmitting data and a special broadband local area network for transmitting television signals between user workstations connected on the LAN, as well as between local workstations and selected remote workstations which are not connected to the LAN.

As so-called "multimedia" applications are incorporated into digital computer workstations (also known as desktop computers, personal computers or "PCs") it becomes possible to use such workstations for "videoconferencing" with the users of one or more similar workstations at either nearby or remote locations. To achieve this capability, a workstation must include, as a minimum:

(1) an image display (e.g., CRT display);

(2) a sound transducer (e.g., loudspeaker);

(3) a digital computer for processing data, connected to supply image and control signals to the digital display for imaging data;

(4) a circuit for converting the video portion of the TV signal into image and control signals compatible with the

image display for displaying a picture on this imaging device; and

(5) an analog amplifier or the like which provides the proper gain and impedance for driving the loudspeaker with the audio portion of the TV signal.

A conversion circuit of the aforementioned type, which digitizes an analog video signal and formats this digitized signal in such a way as to permit display of the video image on a digital computer display, is well known. Such a circuit, called a "video window controller", is available for both the Personal Computer or "PC" and the PS/2 computer of International Business Machines Corp. as well as the MacIntosch computers of Apple Computer Corp. The circuit useable with the PS/2 computers is sold by IBM under the part number PN-34F3087.

If two-way communication with the digital computer workstation is desired, it is necessary also to provide the workstation with a video camera, aimed appropriately at the workstation user, for producing a video signal representing the image of the workstation user, and a microphone arranged to pick up the voice of the workstation user and to generate an analog audio signal in response thereto.

The term "television signal" or "TV signal", as used herein, is intended to mean a conventional NTSC (or other standard) signal which includes both a video and an audio portion. The terms "video signal" and "audio signal" will be

used to separately denote only the video portion and audio portion, respectively, of the television signal. As is well known, the video portion, at baseband, lies within a frequency range of 0 to 4.75 MHz whereas the audio portion lies within a frequency of 0 to 15 KHz. As desired, these video and audio signals can be combined and modulated upward to a 6 MHz wide (in Europe, a 7 MHz wide) frequency channel within a broadband spectrum of 50 to 800 MHz.

Similarly, broadband (50-800 MHz) television signals containing one or more active channels can be tuned and demodulated to produce the video and audio portions (signals) of a single television signal at baseband.

As used herein, the term "baseband signals" is intended to define information signals within the frequency range of 0 to 50 MHz. Computer data is normally transmitted by baseband signals. The term "broadband signals" is thus intended to mean information signals at a frequency higher than the highest baseband frequency -- typically in the frequency range of 50 to 800 MHz. If the upper limit of the baseband range terminates at 25 MHz, the lower limit of the broadband range can commence at this frequency.

It is well known in the television industry to transmit the audio portion of a television signal -- i.e., the "audio signal" -- with amplitude modulation (AM) on a carrier at 4½ MHz. Among all the industry standards, only the French standard SECAM transmits sound with amplitude modulation (AM).

The video portion of the television signal ("video signal") is transmitted in AM with a given polarity.

It is also known to transmit both baseband and broadband signals on a common "backbone communication network" such as a local area network (LAN) which is connected to a plurality of user workstations. The U.S. Patent No. 4,885,747 to Foglia discloses a so-called "filter coupler" or "F-coupler" by which (1) baseband signals (data) are transmitted between a backbone network and a given workstation via a twisted pair shielded cable in a balanced mode, and (2) broadband (television) signals are transmitted between the same backbone network and the same workstation via the same shielded cable in an unbalanced mode. The disclosure of this U.S. patent is incorporated herein by reference. A coupler which enables the transmission of both baseband and broadband signals on a LAN twisted pair cable is termed a "video coupler" or "V-coupler".

With the Foglia system, a number of television programs (satellite television, VCR or a "live" broadcast from a television camera) is "broadcast" to all workstations connected to the LAN (an IBM token ring, in this case) from a coaxial video cable through a so-called "tap/combiner". While each workstation can select one from a number of television channels that are broadcast on the broadband frequencies, and while it is even possible for a workstation to broadcast to all other workstations by means of a TV camera or some other program source, it is not possible for any particular

workstation to transmit television signals to any other particular workstation or workstations on the LAN, or to transmit to any remote workstation not connected to the LAN, thereby to provide true videoconferencing capability.

The U.S. Patent No. 4,564,940 to Yahata discloses a so-called "broadband network system" which includes a private branch exchange (PBX) for interconnecting a plurality of workstations. However, this system is intended to replace an industry standard local area network (LAN) for the multiplex communication of voice and data. No consideration is given to the special problems encountered by the transmission of television signals.

The U.S. Patent No. 4,675,866 to Takumi et al. discloses a transmission system between workstations that provides both a baseband and broadband capability. One or more channels in the broadband network are used for effecting transmission of signals of the baseband network.

SUMMARY OF THE INVENTION

A principal object of the present invention, therefore, is to provide a data and television network for digital computer workstations which enables each workstation to enter into a videoconference with any other selected workstation.

It is a further object of the present invention to provide videoconferencing capability among a plurality of workstations which are all connected on a common LAN.

It is a further object of the present invention to enable a plurality of workstations to conduct a videoconferences between selected workstations even though the videoconferencing workstations are located within different "work groups" of a LAN.

It is a further object of the present invention to enable one or more of a plurality of workstations at a local site to conduct a videoconference with a workstation or videoconferencing site at a remote location.

It is a further object of the present invention to provide a data and television network for digital computer workstations which is secure against the unauthorized monitoring of videoconferences by the connection of a conventional television set to the system.

It is a further object of the present invention to enable any one of a plurality of workstations to select television programming from one of a plurality of programming sources.

These objects, as well as other objects which will become apparent for the discussion that follows, are achieved, by providing a data and television network for digital computer workstation of the type described above wherein each workstation is connected on (1) a baseband local area network (A-LAN) for transmitting and receiving data signals between the workstations and (2) a broadband local area network (B-LAN) for transmitting and receiving television signals between the workstations. Each television signal is transmitted at a

selected frequency channel within the broadband spectrum. In addition, a software program, stored in and operable on the computer of each workstation, generates and receives data messages transmitted, via either the A-LAN or B-LAN, to and from the computer of another workstation, respectively, which initiates and controls the transmission of the television signals on the B-LAN. A plurality of television signals can thus be transmitted simultaneously on the B-LAN, with each signal assigned to a separate frequency channel.

With this network arrangement, every workstation in the system can be a transmitter, and every workstation can be a receiver. Multiple workstations can act as transmitters and receivers simultaneously with the television signals being transmitted on different channels.

The B-LAN can be implemented by providing a separate video cable which interconnects all computer workstations in the network. Alternatively, the aforementioned V-coupler can be provided so that the broadband television information can be transmitted over the same twisted pair wire as the baseband data. Hereinafter this wire, which can be either a shielded or unshielded twisted pair wire, will be designated as the "LAN cable".

According to a particular feature of the present invention, the data messages which control the transmission and receipt of television signals are transmitted over a dedicated frequency channel on the B-LAN.

According to another particular feature of the present invention, the television signals may be transmitted to or received from the outside world, for example using the ISDN packet switching protocol.

According to another feature of the present invention, individual work groups (for example, work groups on each floor of a building) of a local area network may be coupled together via "bridges" for transmission of television signals from one work group to another.

According to another feature of the present invention, system security may be provided by the simple expedient of inverting the video signal that is transmitted on the B-LAN and/or utilizing a SECAM audio signal standard where SECAM is not normally used, and an NTSC audio signal standard where SECAM is used. Such security measures would prevent an unauthorized person from simply attaching a conventional television receiver to the B-LAN cable and tuning to the various frequency channels to extract confidential transmissions.

According to another feature of the present invention, a dedicated "video server" computer is coupled to the A-LAN and B-LAN to effect special software control of the system.

According to another feature of the present invention, audio messages and/or video frames may be stored at a workstation in digital form for subsequent playback or transmission.

For a full understanding of the present invention, reference should now be made to the following detailed description of the preferred embodiment of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a preferred embodiment of the data and television network according to the present invention.

Fig. 2 is a representational, perspective view of a digital computer workstation of the type employed with the data and television network according to the invention.

Fig. 3 is a block diagram showing a number of circuit boards employed in a workstation for implementation of the present invention.

Fig. 4 is a block diagram which illustrates the operation of a workstation in the data and television network.

Fig. 5 is a block diagram showing an actual implementation of a video window controller and modulator/demodulator circuit board according to a preferred embodiment of the present invention.

Fig. 6 is a block diagram of an RF modulator circuit according to the preferred embodiment of the present invention.

Fig. 7 is a block diagram of a video window controller circuit board according to the preferred embodiment of the present invention.

Fig. 8 is a representational diagram of the present invention employed in a local area network that is divided into two separate work groups.

Fig. 9 is a representational diagram showing the number of "video bridges" required in a LAN divided into three work groups.

Fig. 10 is a representational diagram of a LAN divided into three work groups in star configuration.

Fig. 11 is a block diagram of a video bridge comprising a plurality of video switches.

Fig. 12 is a block diagram of a single switch employed in the video bridge of Fig. 11.

Fig. 13, comprised of Figs. 13A and 13B, is a flow chart of a software program for a workstation, which controls the initiation of a video conference between workstations.

Fig. 14, comprised of Figs. 14A and 14B, is a flow chart of a software program for a workstation, which controls the termination of a video conference between workstations.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be described with reference to Figs. 1-14 of the drawings. Identical elements shown in the various figures are identified with the same reference numerals.

Fig. 1 illustrates the data and television network according to the present invention. The system comprises a number of computer workstations PC 2...PC X which will be described in detail below in connection with Fig. 2. Suffice it to say at this point that each computer workstation has a first input/output port 12 for transmitting and receiving data signals and a second input/output port 14 for transmitting and receiving television signals.

The system further includes a baseband local area network (A-LAN) connected to the first port 12 of each workstation, for transmitting and receiving data signals between selected ones of these workstations. The A-LAN comprises a LAN cable 16 which may, for example, be shielded twisted pair wire of an IBM token ring or unshielded twisted pair wire of an Ethernet system.

A broadband local area network (B-LAN) is connected to the second port 14 of each workstation for transmitting and receiving television signals between selected ones of the workstations. The B-LAN network may comprise a standard co-axial video cable 18. As will be further explained below, the broadband television signals can also be transmitted on the

LAN cable 16 with the aid of video couplers ("V-couplers"). The television signals are transmitted from one workstation to another at a selected frequency channel. Full duplex communication between two workstations -- for example, between PC 2 and PC X -- requires the use of two channels -- for example, one for transmission from PC 2 to PC X and another for transmission from PC X to PC 2.

Each workstation, PC 2...PC X, has stored therein a software program for generating and receiving data messages, transmitted via either the A-LAN or the B-LAN, to and from another workstation, respectively, for initiating and terminating a videoconference. The data messages initiate and control the transmission of the television signals on the B-LAN such that a number of television signals can be and are transmitted simultaneously on the B-LAN with each television signal assigned to a separate frequency channel.

With the system so configured, each workstation is capable of being both a receiver and a transmitter of television signals simultaneously. The television signals are generated at baseband as an NTSC video signal and a separate audio signal. These signals are modulated into a 6 MHz wide signal and then placed into one of the fifty-four channels (channels 2 to 55) in the 100-450 MHz "superband".

If a European television standard is used, the baseband video signal may be either a SECAM or PAL color television

signal which is modulated with audio into a 7 MHz wide channel.

As shown further in Fig. 1, it is also possible to obtain television signals from other sources. For example, a television camera or video player may produce an NTSC video signal and audio signal which may be placed on the B-LAN, under control of the A-LAN, for receipt by any and all of the workstations. Alternatively, or in addition, a cable television signal received on a coaxial cable 20 may be demodulated into an NTSC and audio signal for transmission on the B-LAN. The channel selected from among the many channels delivered by the cable 20 is controlled by data messages transmitted via the A-LAN cable 16 with a standard tuner and demodulator 22.

Whereas the video cable 18 is designed to serve the "B-LAN" or broadband local area network, one frequency channel of this cable may be dedicated to serve the "A-LAN" or baseband local area network. In this case, the LAN cable 16, which serves to transmit data and signalling messages between the workstations 10 may be eliminated. In this case, only one cable, namely the video cable 18, is needed to transmit the baseband information (A-LAN) and the broadband information (B-LAN).

The television signals are modulated into the proper channel for transmission on the B-LAN, under control of data messages received on the A-LAN, by an RF modulator within a

television control circuit board 24 located in each workstation. This same circuit board contains a tuner and demodulator for receiving the television signal on a selected channel on the B-LAN and demodulating this signal into the separate NTSC video and audio signals for displaying an image and producing sound at the respective workstation. If the particular unit is to serve only as a source, a separate circuit board 26 may be provided which does not contain the tuning and demodulating capability.

For a connection to the outside world, a modulating and demodulating circuit board 24 is required to convert to and from baseband NTSC video signals. The signals to be transmitted outward are digitized and compressed, and the signals received from the outside world are decompressed and converted to analog NTSC in a conventional codec 28. The digital signals are transmitted and received on the telephone network via an adaptor 30 using the network protocol of ISDN packet switching or the like.

A videoconference with a remote location in the outside world is preferably controlled by software in the video server PC 1.

Fig. 2 illustrates a workstation 10 containing the essential elements required for practicing the present invention. This workstation comprises an image display 32, a digital computer for processing data 34, a video camera 36, a microphone 38 and a loudspeaker 40. In addition, or in place

of the microphone 38 and loudspeaker 40, a conventional telephone handset 42 may be provided. Controls for audio volume and/or channel selection 44 may be arranged as desired.

The computer workstation is otherwise conventional and is provided with a keyboard 46 and/or other input devices as needed.

Figs. 3 and 4 illustrate conceptually the hardware contained in a PC workstation. As shown in Fig. 3, the hardware comprises a video window controller 48 and a modulator/demodulator circuit board 52 in addition to the conventional VGA card 50 and LAN board 54. The video window controller 48 operates to convert the NTSC video signal into red, green and blue analog signals which are supplied to the VGA monitor. It also receives data, timing and control signals from the VGA card for imaging data on the VGA monitor.

The principal functions of the mod/demod board 52 will now be described with reference to Fig. 4. Control messages received via the A-LAN, or a designated channel on the B-LAN, are decoded in the LAN board 54 and supplied to the mod/demod board 52 via the PC bus. As illustrated in Fig. 4, the board 52 comprises a modulator 56 and demodulator 58 under control of frequency synthesizers 60 and 62, respectively. The modulator receives baseband NTSC video from the video camera at the workstation and AM audio from the microphone and converts these signals to a television signal at a selected

frequency channel. This television signal is then supplied to the B-LAN video cable.

Similarly, the demodulator 58 receives television signals on various channels via the B-LAN video cable and tunes and demodulates one channel into NTSC and audio signals at baseband.

The channel frequencies required for operation of the modulator and demodulator are generated by frequency synthesizers 60 and 62. These synthesizers operate in response to an address decode and to channel selection data received from the PC bus.

Returning, for a moment, to Fig. 3 it may be seen that the video cable may be connected to the LAN cable via a video coupler or "V-coupler", if desired. With such an arrangement, it is unnecessary to provide a separate video cable connecting all the workstations together. In this case, the video signals are passed to the already existing LAN cable for transmission from one workstation to another.

Fig. 5 illustrates the video window controller and mod/demod boards in greater detail. As is shown in this diagram also, the television signals may be transmitted on a separate video cable 64 or via the existing LAN cable 66 using a V-coupler 68.

Television signals received either via the video cable 64 or the LAN cable 66 and V-coupler 68 are passed to a CATV tuner 70 which is tuned to the desired channel by a frequency

received from a programmable phase lock loop 72. The baseband NTSC signal is passed to an NTSC to RGB converter 74 and then to a video window controller 76. The audio portion of the television signal is supplied through an electronic switch 78 to an amplifier 80 which drives a speaker or the telephone handset.

Conversely, the NTSC signal received from the video camera is passed through an electronic switch 82 to an RF modulator 84. The audio signal received from a microphone is also passed through a switch 86 to the RF modulator 84. This audio signal may be sampled and digitized in an A/D converter 88 and then supplied to a microprocessor 90 for storage on a hard disk for subsequent retrieval and "playback". The retrieved digital signal is then passed to a D/A converter 92 and transmitted via the switch 78 to the amplifier 80 and speaker.

If desired, similar arrangements can be provided to store and retrieve one or more frames of video information.

The RF modulator combines the video and analog signals into a 6 MHz wide baseband television signal and places this signal on a selected frequency channel for transmission via the video cable 64. The channel frequency is selected and supplied to the RF modulator by a programmable phase lock loop 94.

The programmable PLLs 72 and 94 are controlled by the microprocessor 90. This microprocessor receives control and

data signals from the PC bus and supplies interrupt requests, data and address information to the PC bus to establish and eventually terminate videoconference transmissions with another workstation. The microprocessor 90 also supplies control signals to the audio switches 78 and 82, A/D and D/A converters 88 and 92 and to the video window controller 76.

The video window controller 76 operates with a video memory or "VRAM" 96 to supply analog display signals to the VGA monitor. The video window controller receives synchronization and other signals from the VGA feature connector 98 which is contained on the VGA card in the workstation.

Details of the various portions of the circuit of Fig. 5 are illustrated in Figs. 6 and 7. These circuits indicate standard logic elements and, in some cases, the actual integrated circuit chip designation. The microprocessor 90 is preferably an Intel 8051 or a Z-8 series microprocessor.

A preferred implementation of the RF modulator is shown in Fig. 6. A preferred embodiment of the video window controller is illustrated in Fig. 7. The integrated circuit chip part numbers used in these circuits, and their manufacturing sources, are set forth in the Table below:

TABLE

Manufacturers	Integrated Circuits
Media Computer Technologies, Inc. 3160 De La Cruz Blvd. Santa Clara, CA 95054	Part No. MVM 121A (PC Video)
Philips Semiconductors 2001 W. Blue Heron Blvd. P.O. Box 10330 Riveria Beach, FL 33404	Part No. TDA 5512 T (synthesizer) Part No. TDA 8708 (analog to digital converter) Part No. SAA 9051 (digital multistandard decoder) Part No. SAA 7197 (phase locked loop)
Seimens Components, Inc. Integrated Circuits Division 10950 North Tantau Avenue Cupertino, CA 95014	Part No. TDA 5667 (RF Modulator) Part No. SL 5770 (RF Modulator)
Motorola Corp. Phoenix, AR	Part No. MC 13176 (SAW stabilized oscillator)

Fig. 6 shows in detail how the audio and video signals are placed on a selected frequency channel for transmission to another workstation. The RF modulator, which can be either a TDA 5667 or SL 5770 integrated circuit, places the audio and video signals on separate carriers, that is, a 41.25 MHz video carrier and a 45.75 MHz audio carrier. The center frequency of this channel is 44 MHz.

In order to provide security for the system, one or both of the following measures may be used: The audio signal may be transmitted with frequency modulation (FM) rather than the standard amplitude modulation (AM) normally used for NTSC television. This is accomplished simply by

applying the audio signal at the proper input pin to the integrated circuit.

In addition, or alternatively, the video signal may be transmitted in inverted form. This is accomplished by simply grounding a pin on the integrated circuit.

The 44 MHz television signal is passed through a vestigal sideband filter that eliminates the lower sideband, and is then mixed with an 880 MHz signal to produce an 836.5 MHz (center frequency) television signal. This signal is passed through a bandpass filter, which can be a cellular telephone filter for example, and then mixed with another high frequency signal of selected frequency in the range of 894-1250 MHz. The mixed signal is passed through a lowpass filter which passes signals below 800 MHz. The resulting signal, in the frequency range of 50 to 500 MHz, is supplied through an amplifier and a signal splitter to the video cable.

The circuit of Fig. 7 is substantially embodied in a video window controller integrated circuit: MVM 121A. The NTSC signal is digitized in an A/D converter, then decoded and supplied to the video window controller. The output of this integrated circuit is passed to the VGA monitor through a D/A converter.

Figs. 8-12 illustrate how the data and television network according to the present invention may be expanded to include different work groups within a local area

network. For example, if the local area network is divided into work groups, with each work group on a separate floor of a building with data "bridges" between them, the data and television network according to the invention may be similarly configured with "video bridge" between work groups.

Fig. 8 shows the basic configuration wherein a local area network is divided into two work groups: work group A and work group B. Work group A contains a number of PC nodes 101 arranged on a LAN cable 100 for data transmission and a video cable 102 for television transmission. Optionally, the cost of laying a separate video cable 102 may be avoided by providing V-couplers 104, enabling the transmission of television signals also on the LAN cable 100.

As is standard practice in the industry, the LAN cable of work group A is connected to the LAN cable 106 of work group B via data bridges 108 and 110, respectively. Such bridges enable data transmission from one of the workstations 101 in work group A to one of workstations 111 in work group B.

Similarly, television transmission between workstations in different work groups may be effected through video bridges 112 and 114, respectively, which are interconnected by a video cable 116.

The transmission of the television signals between the video bridges 112 and 114 may be optionally effected via the data cable 118 through the use of V-couplers 120.

The video bridges 112 and 114 comprise a number of "video switches" which adapt the frequency channel of a transmitted television signal from one work group to another. Since the maximum number of television signals received in any one work group cannot exceed the number of PC workstations in that work group, the maximum number of video switches required in any given bridge is equal to the number of PC nodes in the work group with which the bridge is associated.

Fig. 9 provides the example of two bridges, bridge 1 and bridge 2, dividing work groups A, B and C, respectively. Bridge 1, which services work groups A and B, contains a maximum of ten switches because work group A contains ten nodes. Bridge 2, which services work groups B and C contains a maximum of five switches because work group B contains five nodes. The bridges 1 and 2 may have less than ten or five switches, respectively, because it is unlikely that all the nodes will be operative to transmit or receive television signals at the same time.

If the LAN work groups are arranged in a star configuration as is shown in Fig. 10, the number of switches in each video bridge must be equal to or less than the number of nodes in the associated LAN work group.

The structure of a video bridge is shown in Fig. 11. As may be seen, the individual switches are connected in parallel. In this example, there are twenty-five switches for converting television transmissions from work group A to work group B and twenty-five switches for converting television transmissions from work group B to work group A. A single CPU, common to all switches, controls the channel selection (both the received channel and the transmitted channel) in each switch.

The video bridge of Fig. 11 can be used to convert the television transmissions from one work group to another, and can also be used as a repeater within the same work group. When used as a repeater, the frequency channel allocations of the television signals remains the same from one side of the bridge to the other.

Fig. 12 shows the contents of a video switch in detail. The television signal received from work group A on one of channels 2-55 is passed to a tuner 130 which demodulates the channel identified by a signal from the CPU 132. The television signal is output on channel 3 to mixers 134 and 136 which receive carrier frequencies from oscillators 138 and 140, respectively. The oscillator 140 is controlled by the CPU 132. The output of mixer 136, at the selected frequency channel, is laundered through a low pass filter 142 and then supplied to work group B via an amplifier 144.

The operation and the data and television network will now be described with reference to Figs. 13 and 14 which detail the procedure for initiating and terminating a video conference call.

Flow charts showing the operation of the software in the initiating workstation are Figs. 13A and 14A; flow charts for the responding workstation are Figs. 13B and 14B.

In a typical videoconferencing session established in the system shown in Fig. 1, let us assume that the user of PC 2 wishes to conduct a videoconference with the user of PC X. The PC 2 software generates and transmits a call set up message over the A-LAN to the PC X requesting a link and indicating its transmit channel on the B-LAN. PC 2 then awaits a handshake reply from PC X. If no response is received within a prescribed time, the call may be aborted or some other options may be made available, such as the option to leave an audio, and possibly also a video message.

An audio message of any reasonable length, and one or two frames of a video message may be digitized and stored in the digital memory of a computer workstation (such as a hard disk) for later playback by the workstation users.

Meanwhile, the PC X receives the set up data message from PC 2 and sends a reply, indicating whether PC X is, or is not busy. If PC X is busy, the response includes a busy message which is transmitted to PC 2. If PC X is not busy,

it may still respond with a message that is it is unavailable to take calls.

When PC 2 receives a responding message from PC X, it either aborts the call, if PC X is busy or unavailable, or acknowledges the call set up.

If PC X accepts the call, it responds to the call set up acknowledgement with its own acknowledgement indicating the channel on which it will transmit. Thereafter, both PC 2 and PC X tune their receivers to the calling workstation's channel, enable their video windows and audio outputs, and enable their transmitters to broadcast on their own transmit channel. The call then proceeds until one or the other workstations terminates the call.

Referring to Fig. 14 and assuming that the user of PC X terminates the call, this workstation sends a call hang-up message over the A-LAN to PC 2 to announce its intention to disconnect. PC 2 receives the call hang-up message and, unless this message was received in error, both workstations close their input video windows and disable their audio outputs. PC 2 then disables its transmitter and receiver and returns to the idle state. Thereafter, PC 2 transmits a call hang-up acknowledgement indicating that its transmitter is off line. When PC X receives this acknowledgement message, it disables its transmitter and returns to the idle state. Both workstations are then ready for the next videoconferencing call.

In the software system described above, each PC workstation maintains a table, which is constantly updated, of the frequency channel allocations in the B-LAN network. Whenever a PC workstation initiates a call, a table look-up procedure is used to find a vacant channel.

Alternatively, a single status table may be maintained in one of the workstations which serves as the network server (PC1 shown in Fig. 1). In this case, a request for frequency channel allocation is made via the A-LAN to this network server which performs a table look-up to find a vacant channel and then allocates the use of this channel for a video conference.

It will be understood that for each two-way video conference between workstations, two channels must be allocated: one for transmission to, and one for transmission from each workstation.

There has thus been shown and described a novel data and television network for digital computer workstations which fulfills all the objects and advantages sought therefor. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and the accompanying drawings which disclose the preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope

of the invention are deemed to be covered by the invention, which is to be limited only by the claims which follow.

C L A I M S

What is claimed is:

1. A data and television network for digital computer workstations, wherein each workstation includes:

(1) an image display;

(2) a digital computer for processing data and connected to supply image and control signals to said display for displaying data thereon;

(3) a video camera for producing a video signal representing an image;

(4) a microphone for converting sound into an audio signal;

(5) a modulator connected to said video camera and said microphone for converting a video signal received from said camera and an associated audio signal received from said microphone into a television signal at a selected frequency channel;

(6) a demodulator for converting a television signal at a selected frequency channel into a video signal and an associated audio signal;

(7) a video window controller connected to said demodulator for converting a video signal received from said demodulator into image and control signals supplied to said display for displaying a video image on said display;

(8) a sound transducer connected to said demodulator for converting an audio signal received from said demodulator into sound;

(9) a first input/output port connected to said computer for transmitting and receiving data signals; and

(10) a second input/output port connected to said modulator means said demodulator for transmitting and receiving television signals;

said network comprising, in combination:

(a) a baseband local area network (A-LAN), connected to said first port of a plurality of workstations, for transmitting and receiving data signals between selected ones of said workstations;

(b) a broadband local area network (B-LAN) connected to said second port of said plurality of workstations, for transmitting and receiving television signals between selected ones of said workstations, each television signal being transmitted at a selected frequency channel; and

(c) a software program, stored in and operable on said computer of each workstation, for generating and receiving data messages, transmitted via one of said A-LAN and B-LAN, to and from the computer of another workstation, respectively, said data messages initiating and controlling the transmission of said television signals on said B-LAN such that a plurality of television signals are transmitted

simultaneously on said B-LAN, with each television signal assigned to a separate frequency channel.

2. The data and television network defined in claim 1, further comprising codec means, connected to the A-LAN and B-LAN, for digitally encoding and decoding television signals for transmitting and receiving encoded digital television signals to and from a telephone network.

3. The data and television network defined in claim 1, wherein said A-LAN and said B-LAN are divided into a plurality of work groups, said network further comprising video bridge means connecting the B-LAN of one group with the B-LAN of another work group, for changing the frequency channel of the television signals transmitted on said B-LAN from one work group to another.

4. The data and television network defined in claim 3, wherein said video bridge means includes a plurality of controllable switch means connected in parallel, each switch means being operative to change the frequency channel of one television signal from a selectable first channel to a selectable second channel.

5. The data and television network defined in claim 3, wherein said video bridge means further includes processor

means, responsive to data messages transmitted on said A-LAN, for controlling said plurality of switch means to select said first and second channels.

6. The data and television network defined in claim 1, wherein said television signals comprise a non-standard color video signal to provide security against unauthorized access.

7. The data and television network defined in claim 6, wherein said color video signal is inverted from a standard video signal.

8. The data and television network defined in claim 1, wherein said television signals comprise a non-standard audio signal to provide security against unauthorized access.

9. The data and television network defined in claim 8, wherein said audio signal is a different modulation type from the standard modulation.

10. The data and television network defined in claim 1, further comprising means for digitizing said audio signal and means for storing portions of said digitized audio signal for subsequent playback.

11. The data and television network defined in claim 1, further comprising means for digitizing said video signal and means for storing portions of said digitized video signal for subsequent playback.

12. The data and television network defined in claim 1, wherein said data messages are transmitted on said A-LAN.

13. The data and television network defined in claim 1, wherein said data messages are transmitted on said B-LAN.

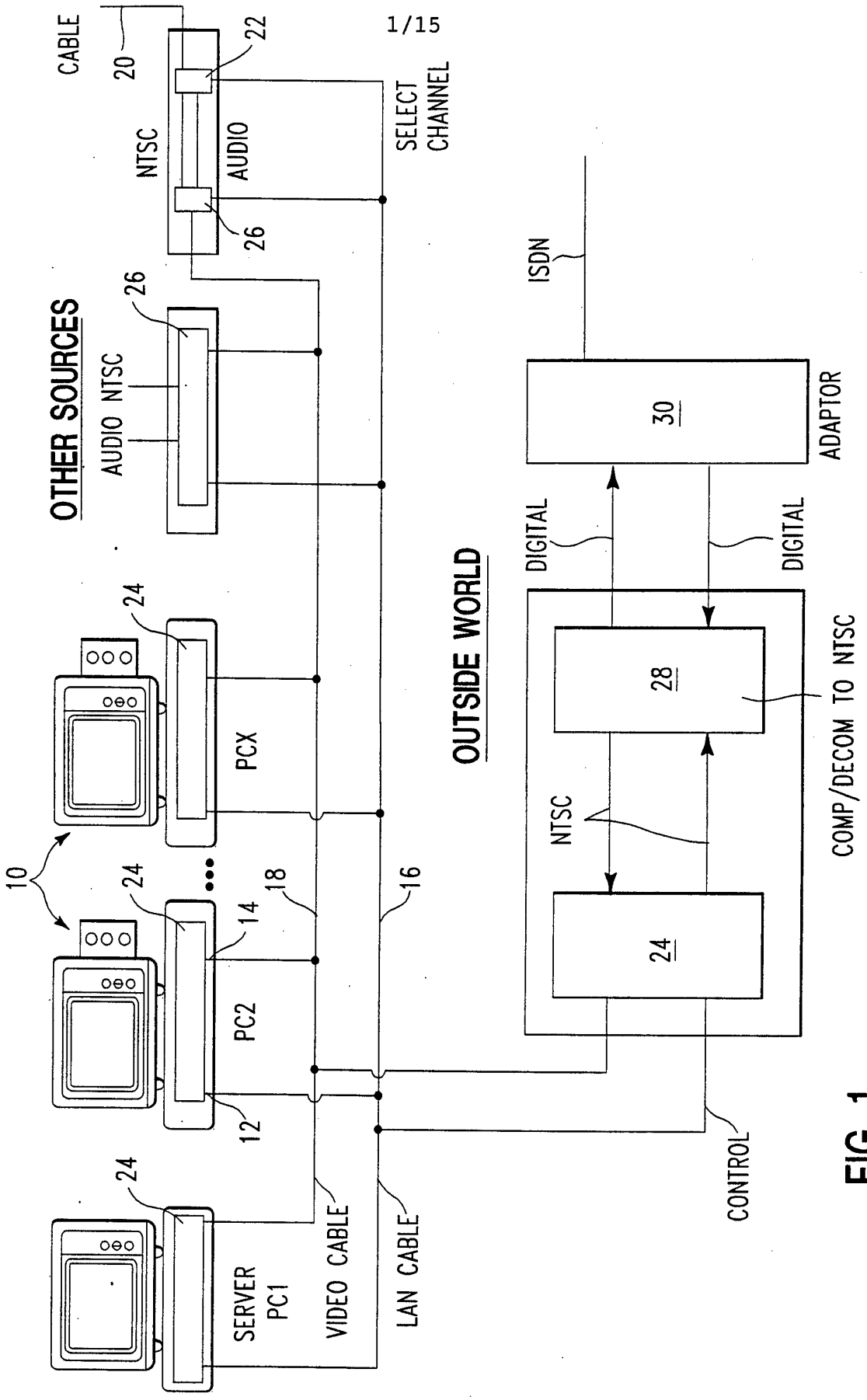
1/15
CABLE
20
22
NTSC
AUDIO
SELECT CHANNEL
26
OTHER SOURCES
AUDIO NTSC
ISDN
30
ADAPTOR
DIGITAL
DIGITAL
OUTSIDE WORLD
24
PCX
10
18
16
14
28
COMP/DECOM TO NTSC
NTSC
PC2
12
CONTROL
SERVER PC1
VIDEO CABLE
LAN CABLE

FIG. 1

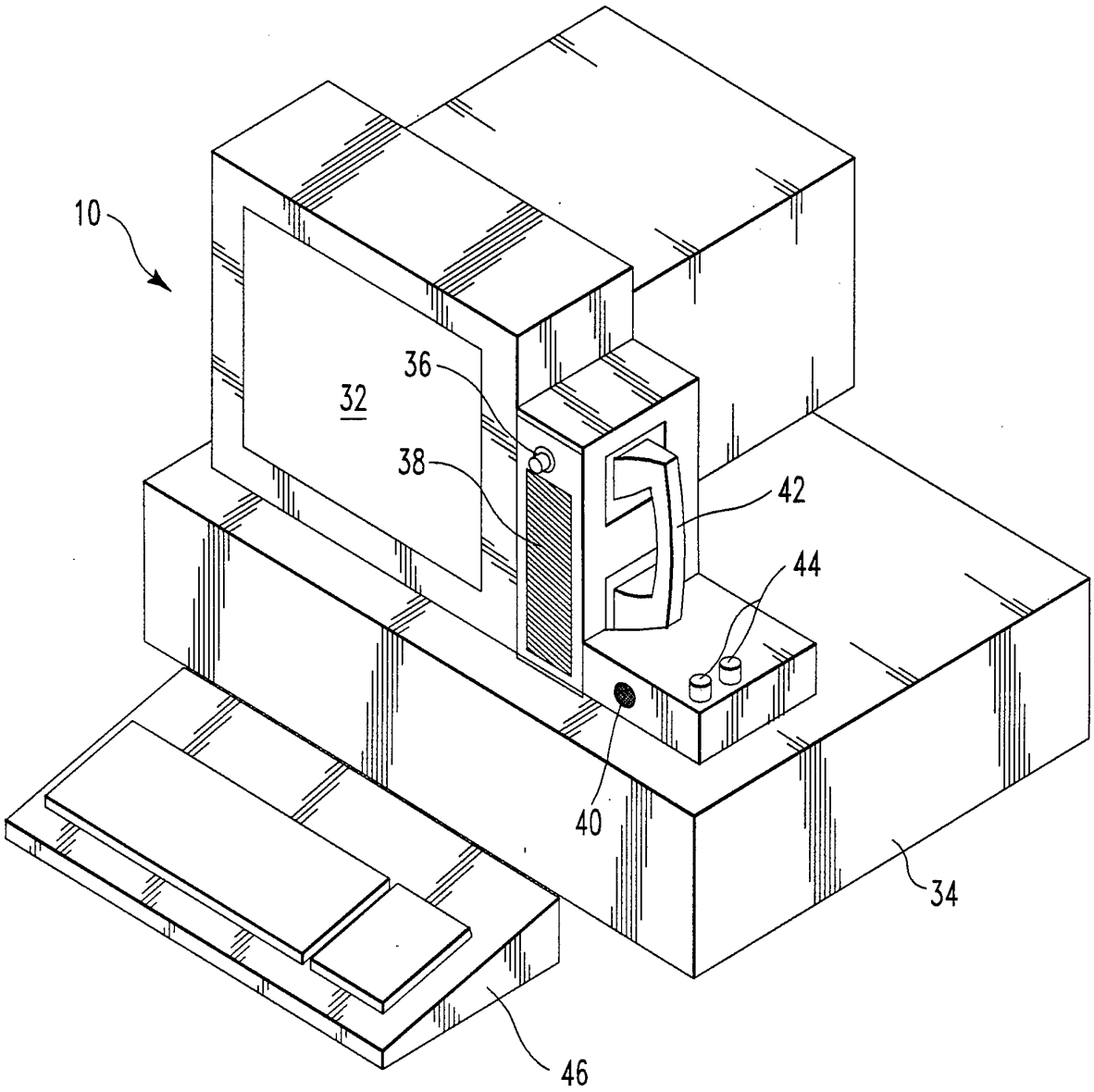

FIG. 2

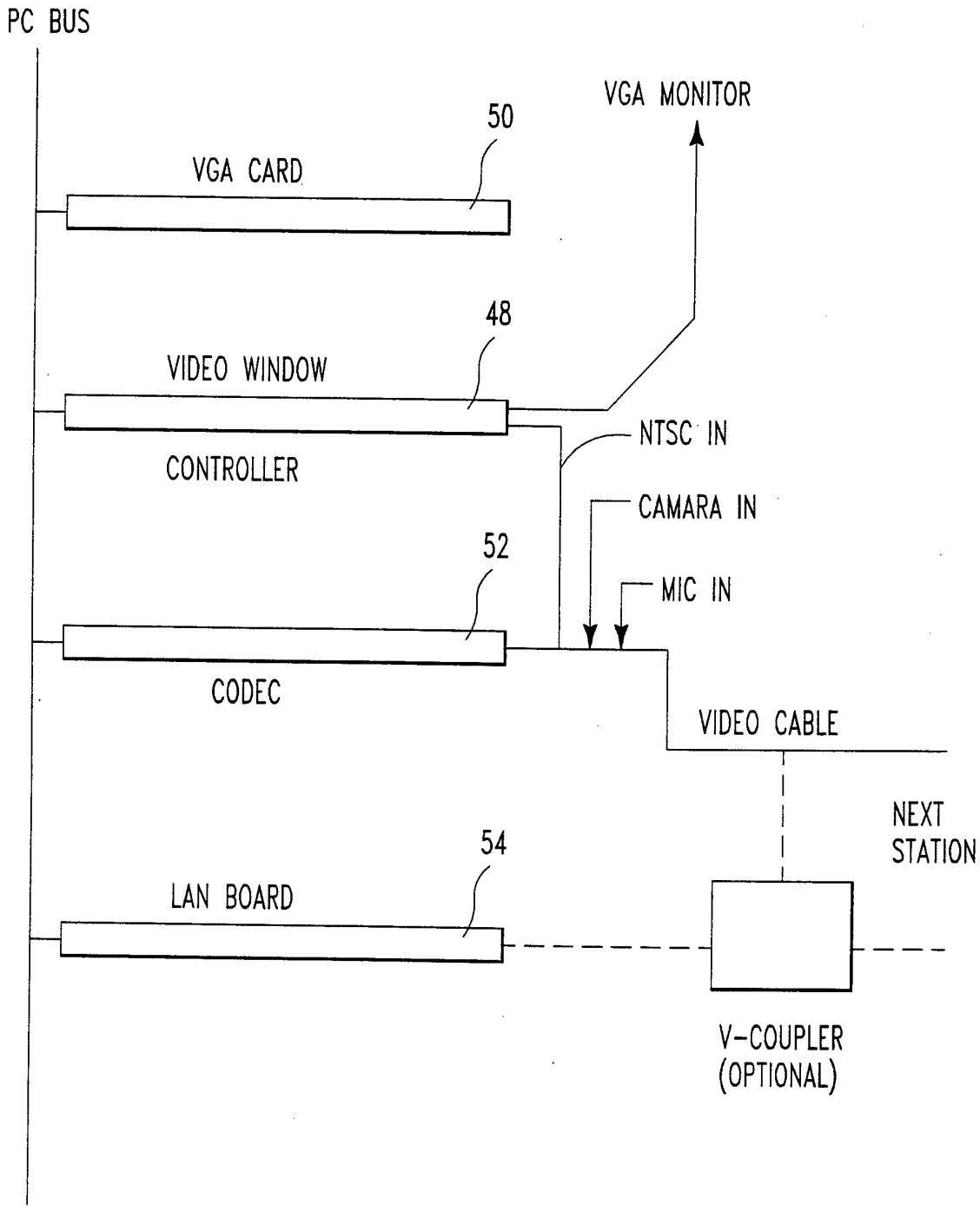
PC BUS
VGA MONITOR
50
VGA CARD
48
VIDEO WINDOW
CONTROLLER
NTSC IN
CAMARA IN
52
MIC IN
CODEC
VIDEO CABLE
NEXT
STATION
54
LAN BOARD
V-COUPLER
(OPTIONAL)

FIG. 3

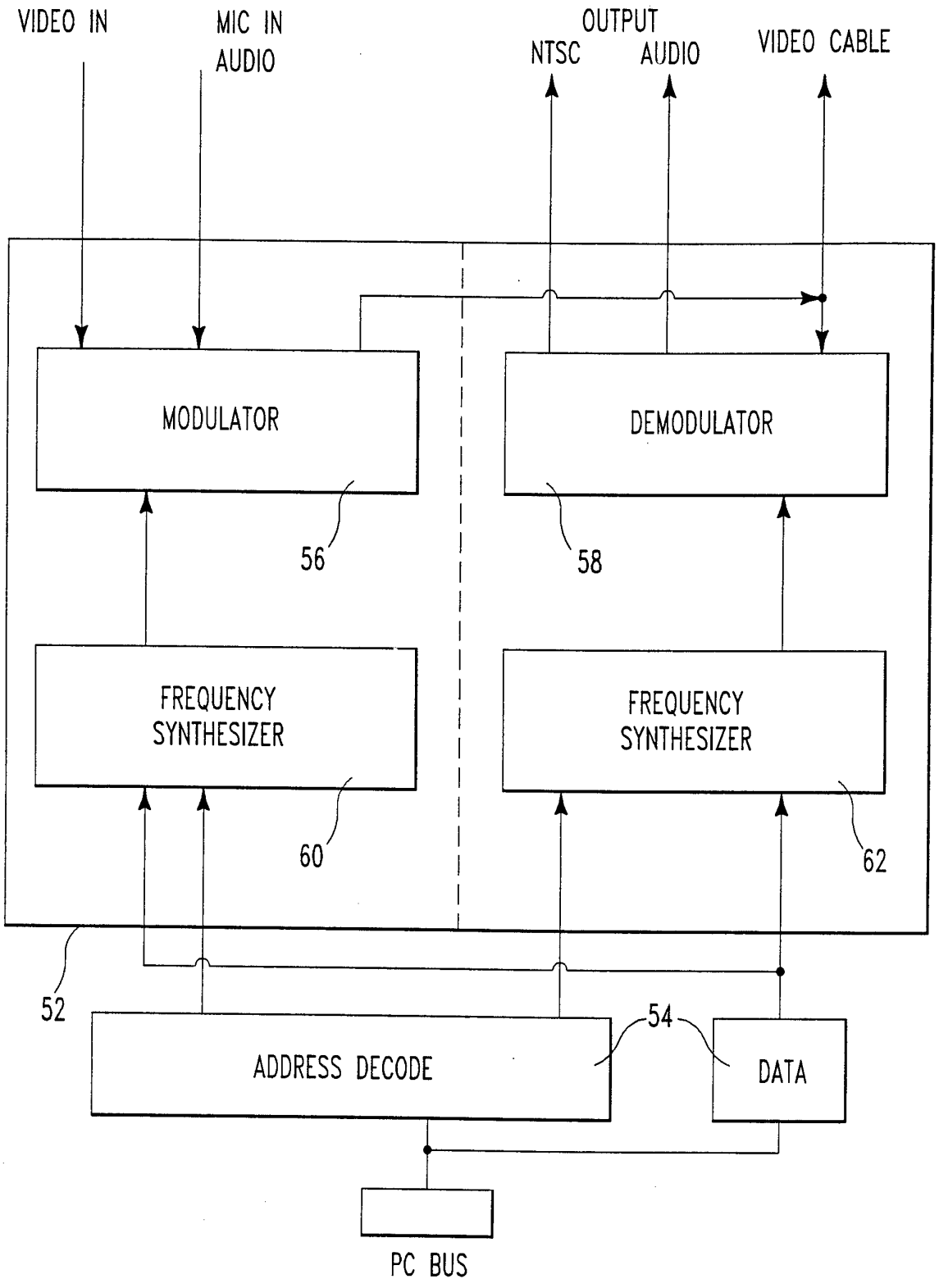
VIDEO IN
MIC IN
AUDIO
OUTPUT
NTSC
AUDIO
VIDEO CABLE
MODULATOR
DEMODULATOR
56
58
FREQUENCY
SYNTHESIZER
FREQUENCY
SYNTHESIZER
60
62
52
54
ADDRESS DECODE
DATA
PC BUS

FIG. 4

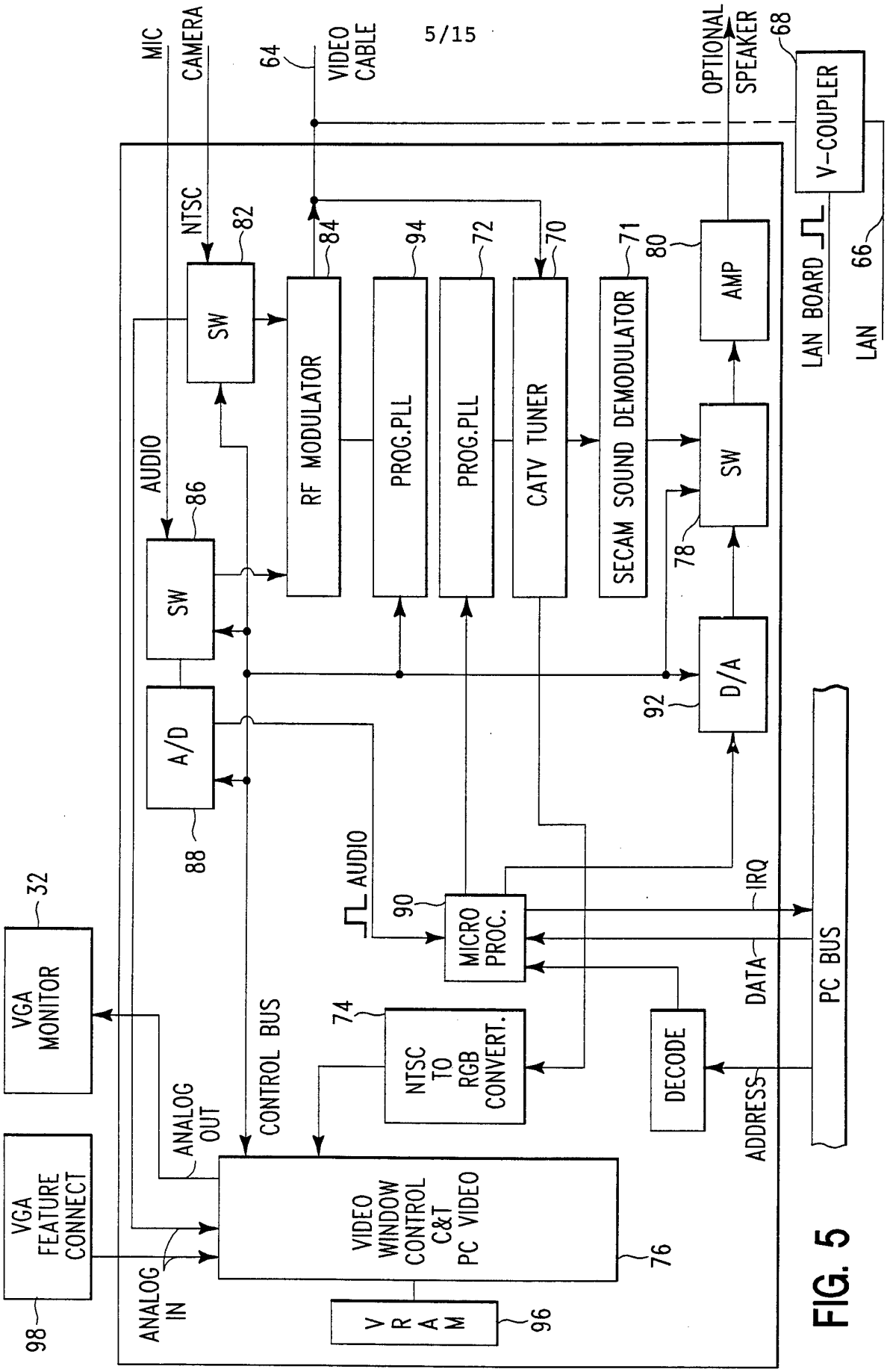
MIC
CAMERA
64
VIDEO CABLE
OPTIONAL SPEAKER
68
V-COUPLER
LAN BOARD
66
LAN
NTSC
82
84
94
72
70
71
80
SW
RF MODULATOR
PROG.PLL
PROG.PLL
CATV TUNER
SECAM SOUND DEMODULATOR
AMP
AUDIO
86
SW
78
SW
A/D
88
D/A
92
AUDIO
90
MICRO PROC.
IRQ
DATA
ADDRESS
PC BUS
32
VGA MONITOR
74
NTSC TO RGB CONVERT.
DECODE
CONTROL BUS
ANALOG OUT
VGA FEATURE CONNECT
VIDEO WINDOW CONTROL C&T PC VIDEO
76
ANALOG IN
98
V R A M
96

FIG. 5

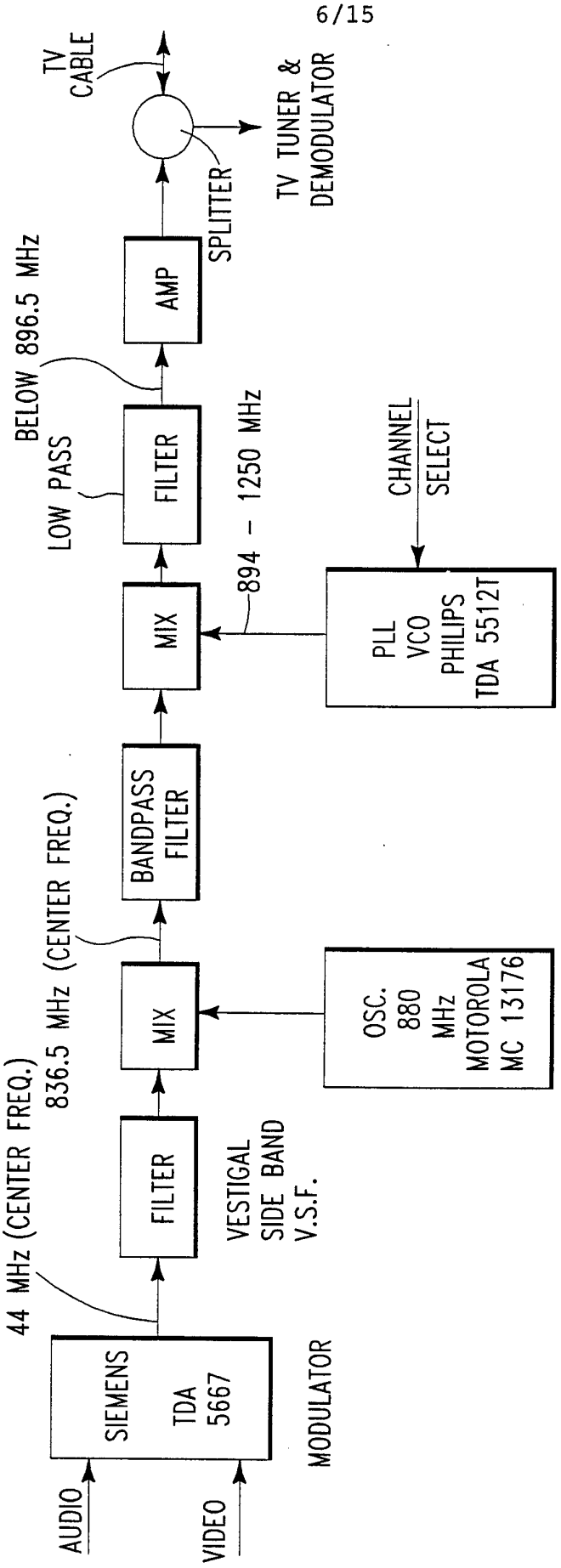
TV CABLE
TV TUNER & DEMODULATOR
SPLITTER
AMP
BELOW 896.5 MHz
LOW PASS
FILTER
894 - 1250 MHz
CHANNEL SELECT
MIX
PLL VCO PHILIPS TDA 5512T
BANDPASS FILTER
836.5 MHz (CENTER FREQ.)
MIX
OSC. 880 MHz MOTOROLA MC 13176
44 MHz (CENTER FREQ.)
FILTER
VESTIGAL SIDE BAND V.S.F.
SIEMENS TDA 5667
MODULATOR
AUDIO
VIDEO

FIG. 6

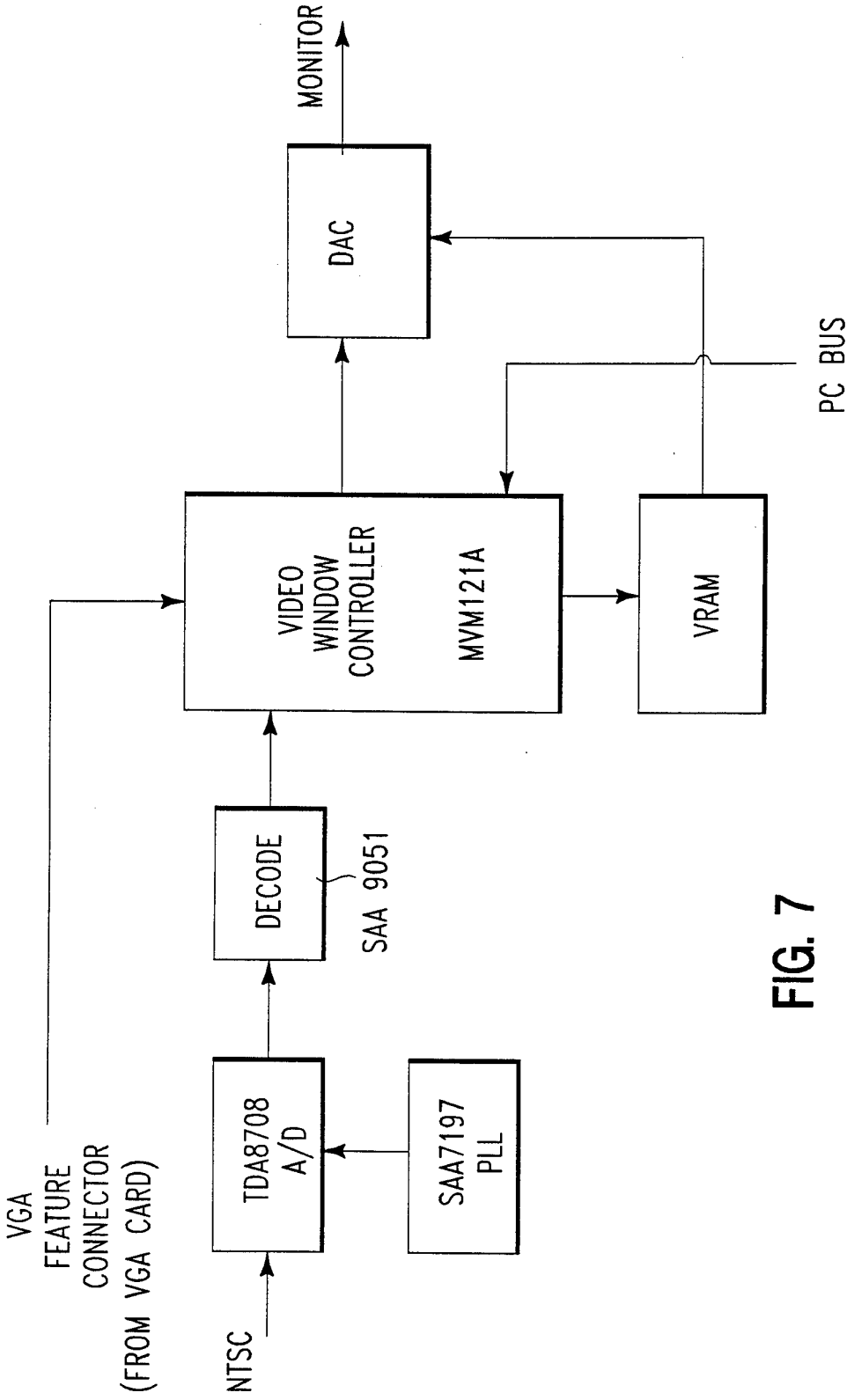
MONITOR
DAC
PC BUS
VIDEO WINDOW CONTROLLER
MVM121A
VRAM
DECODE
SAA 9051
TDA8708 A/D
SAA7197 PLL
VGA FEATURE CONNECTOR (FROM VGA CARD)
NTSC

FIG. 7

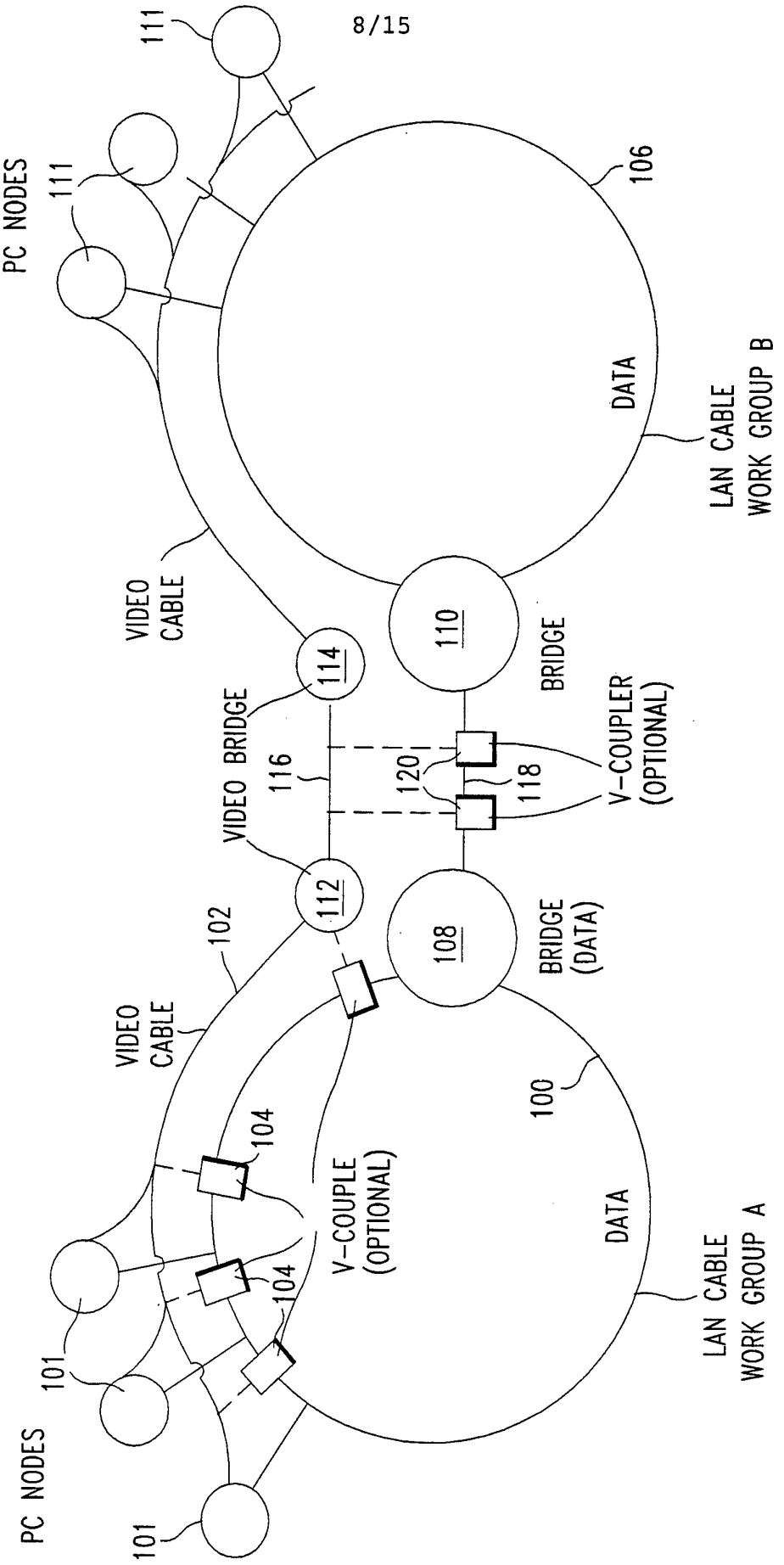
PC NODES
111
111
106
DATA
LAN CABLE
WORK GROUP B
VIDEO
CABLE
110
BRIDGE
114
VIDEO BRIDGE
116
120
118
V-COUPLER
(OPTIONAL)
112
102
108
BRIDGE
(DATA)
VIDEO
CABLE
100
104
104
V-COUPLE
(OPTIONAL)
DATA
LAN CABLE
WORK GROUP A
101
PC NODES
101

FIG. 8

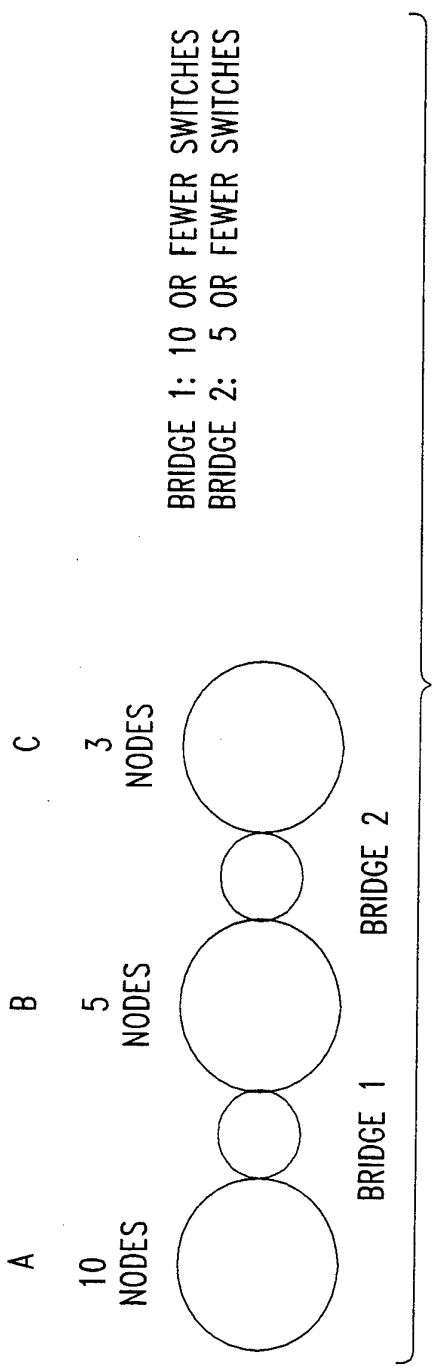
A
10
NODES
B
5
NODES
C
3
NODES
BRIDGE 1
BRIDGE 2
BRIDGE 1: 10 OR FEWER SWITCHES
BRIDGE 2: 5 OR FEWER SWITCHES

FIG. 9

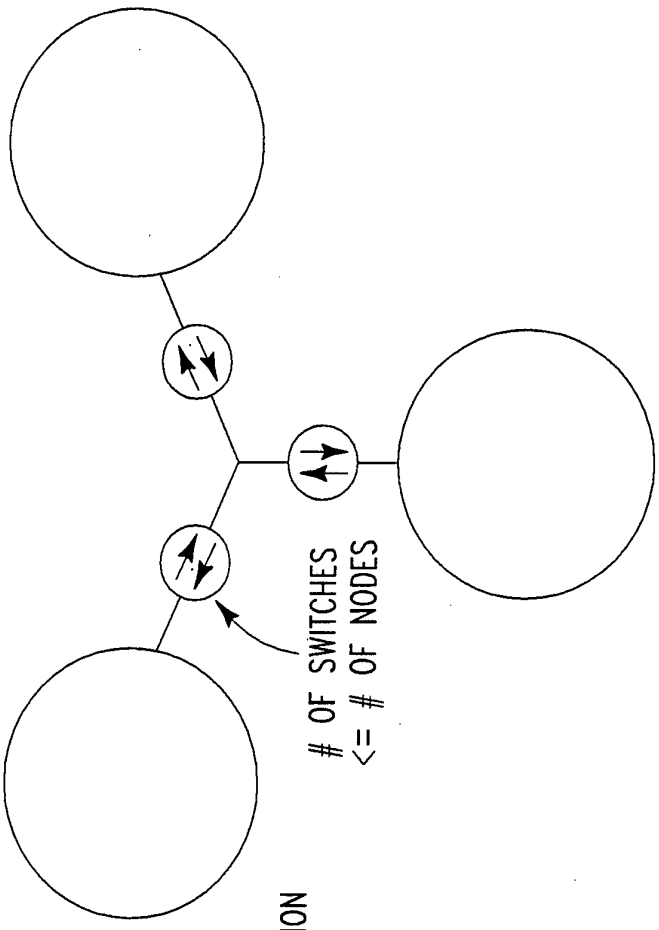
LAN
OF SWITCHES
<= # OF NODES
STAR CONFIGURATION
VIDEO BRIDGE

FIG. 10

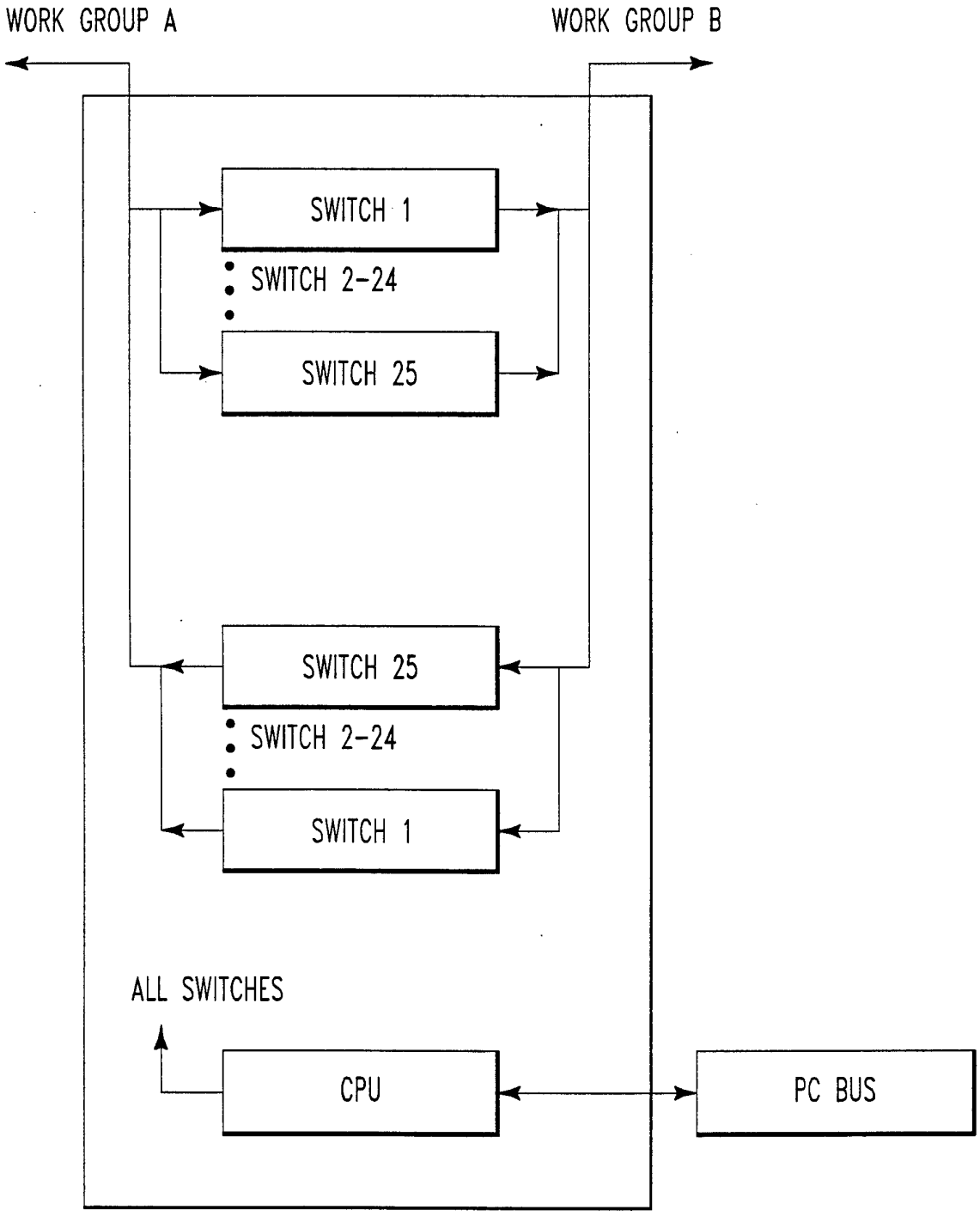
WORK GROUP A
WORK GROUP B
SWITCH 1
SWITCH 2-24
SWITCH 25
SWITCH 25
SWITCH 2-24
SWITCH 1
ALL SWITCHES
CPU
PC BUS

FIG. 11

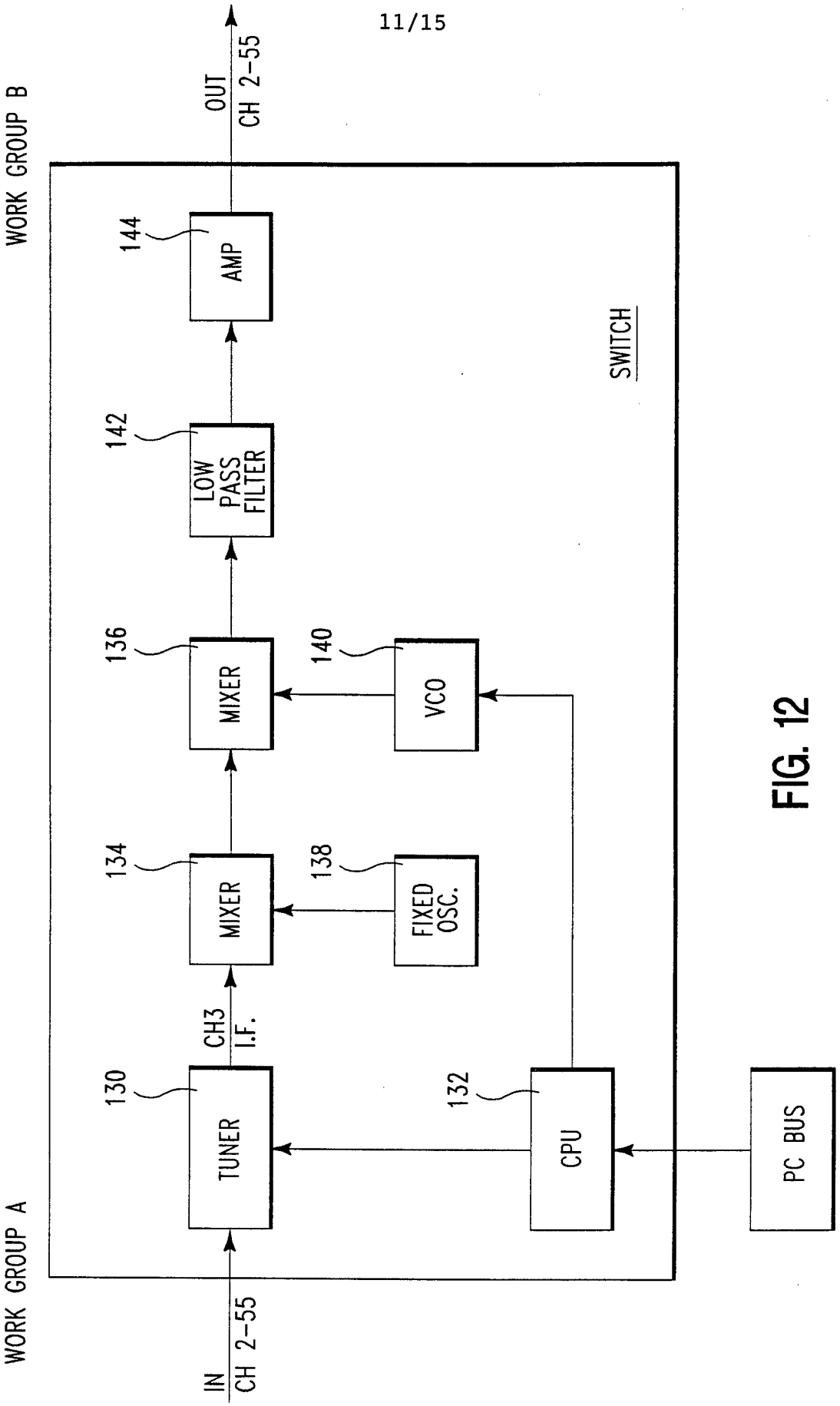
WORK GROUP A
WORK GROUP B
IN
CH 2-55
OUT
CH 2-55
SWITCH
TUNER
130
CH3
I.F.
MIXER
134
FIXED
OSC.
138
MIXER
136
VCO
140
LOW
PASS
FILTER
142
AMP
144
CPU
132
PC BUS

FIG. 12

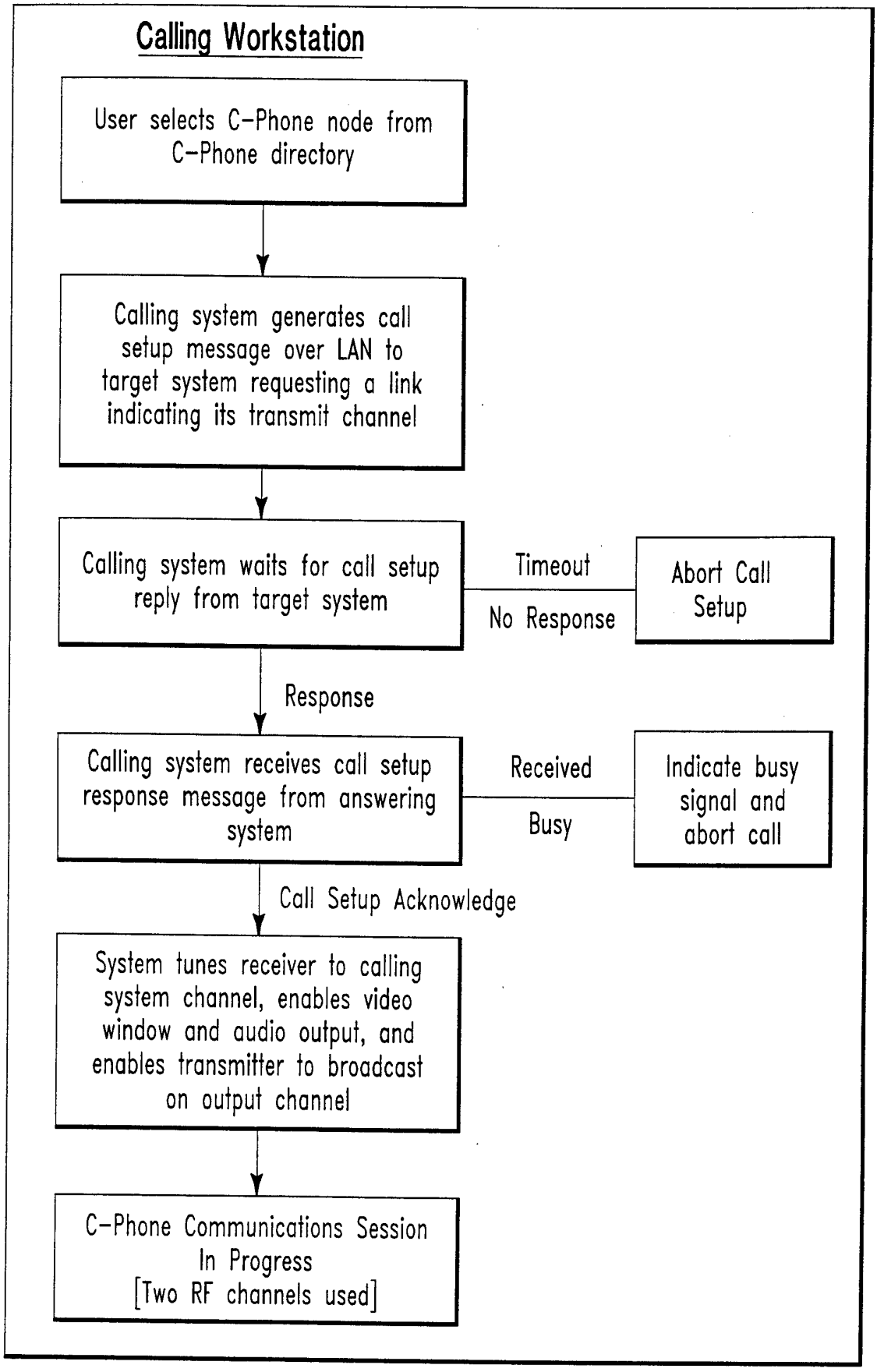
Calling Workstation
User selects C-Phone node from C-Phone directory
Calling system generates call setup message over LAN to target system requesting a link indicating its transmit channel
Calling system waits for call setup reply from target system
Timeout
No Response
Abort Call Setup
Response
Calling system receives call setup response message from answering system
Received
Busy
Indicate busy signal and abort call
Call Setup Acknowledge
System tunes receiver to calling system channel, enables video window and audio output, and enables transmitter to broadcast on output channel
C-Phone Communications Session In Progress
[Two RF channels used]

FIG. 13A

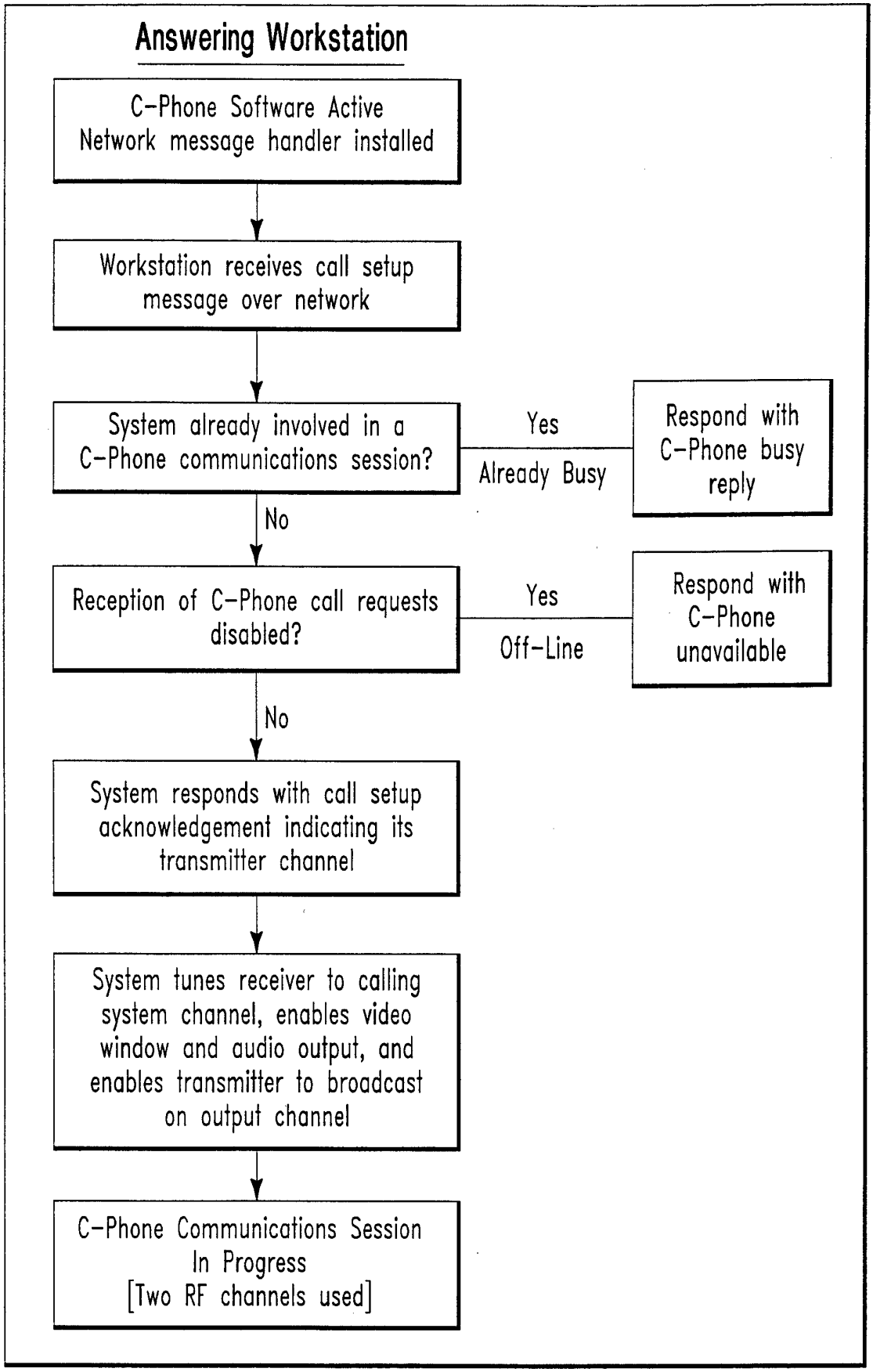
Answering Workstation
C-Phone Software Active
Network message handler installed
Workstation receives call setup message over network
System already involved in a C-Phone communications session?
Yes
Already Busy
Respond with C-Phone busy reply
No
Reception of C-Phone call requests disabled?
Yes
Off-Line
Respond with C-Phone unavailable
No
System responds with call setup acknowledgement indicating its transmitter channel
System tunes receiver to calling system channel, enables video window and audio output, and enables transmitter to broadcast on output channel
C-Phone Communications Session In Progress
[Two RF channels used]

FIG. 13B

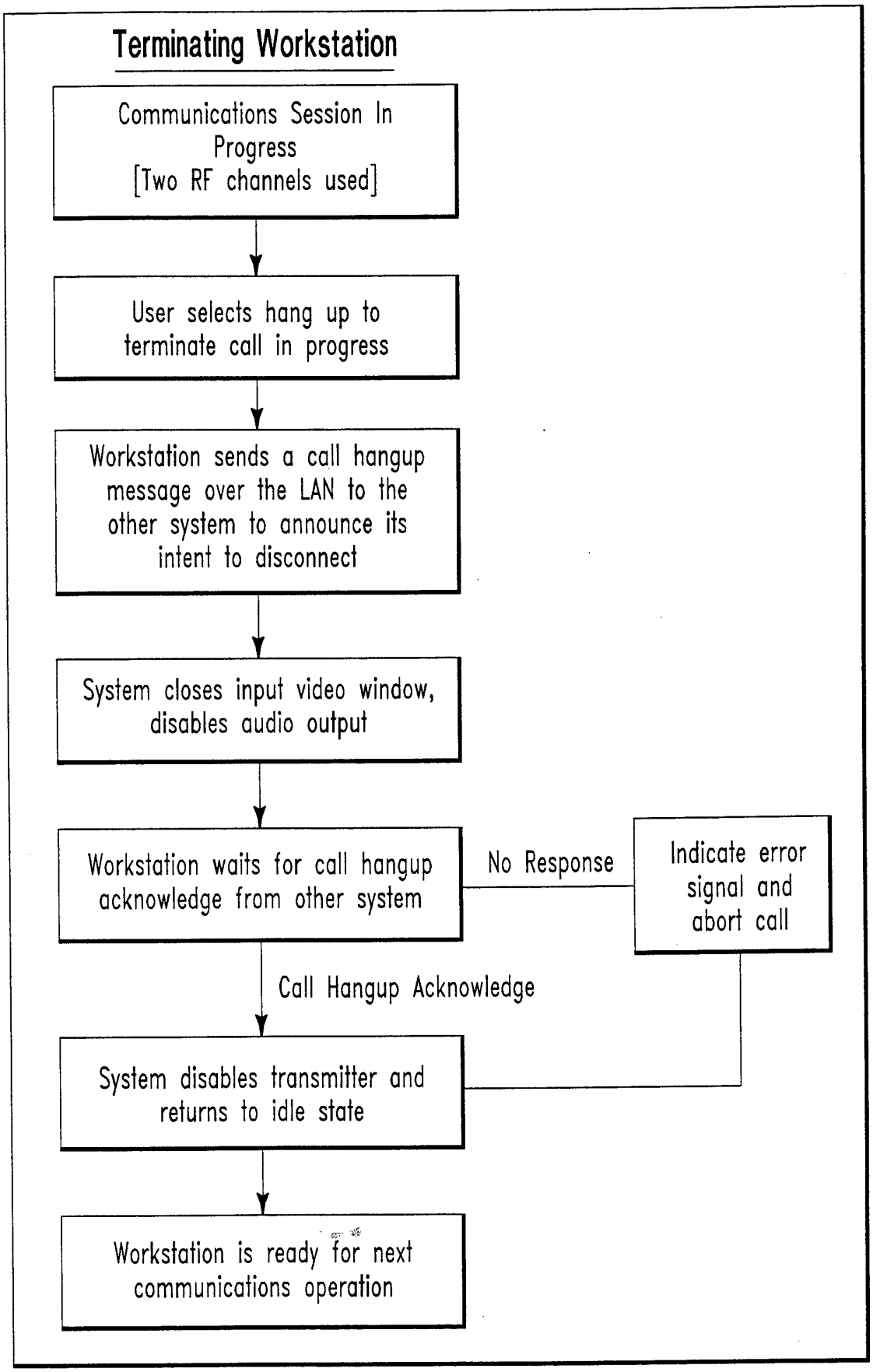
Terminating Workstation
Communications Session In Progress [Two RF channels used]
User selects hang up to terminate call in progress
Workstation sends a call hangup message over the LAN to the other system to announce its intent to disconnect
System closes input video window, disables audio output
Workstation waits for call hangup acknowledge from other system
No Response
Indicate error signal and abort call
Call Hangup Acknowledge
System disables transmitter and returns to idle state
Workstation is ready for next communications operation

FIG. 14A

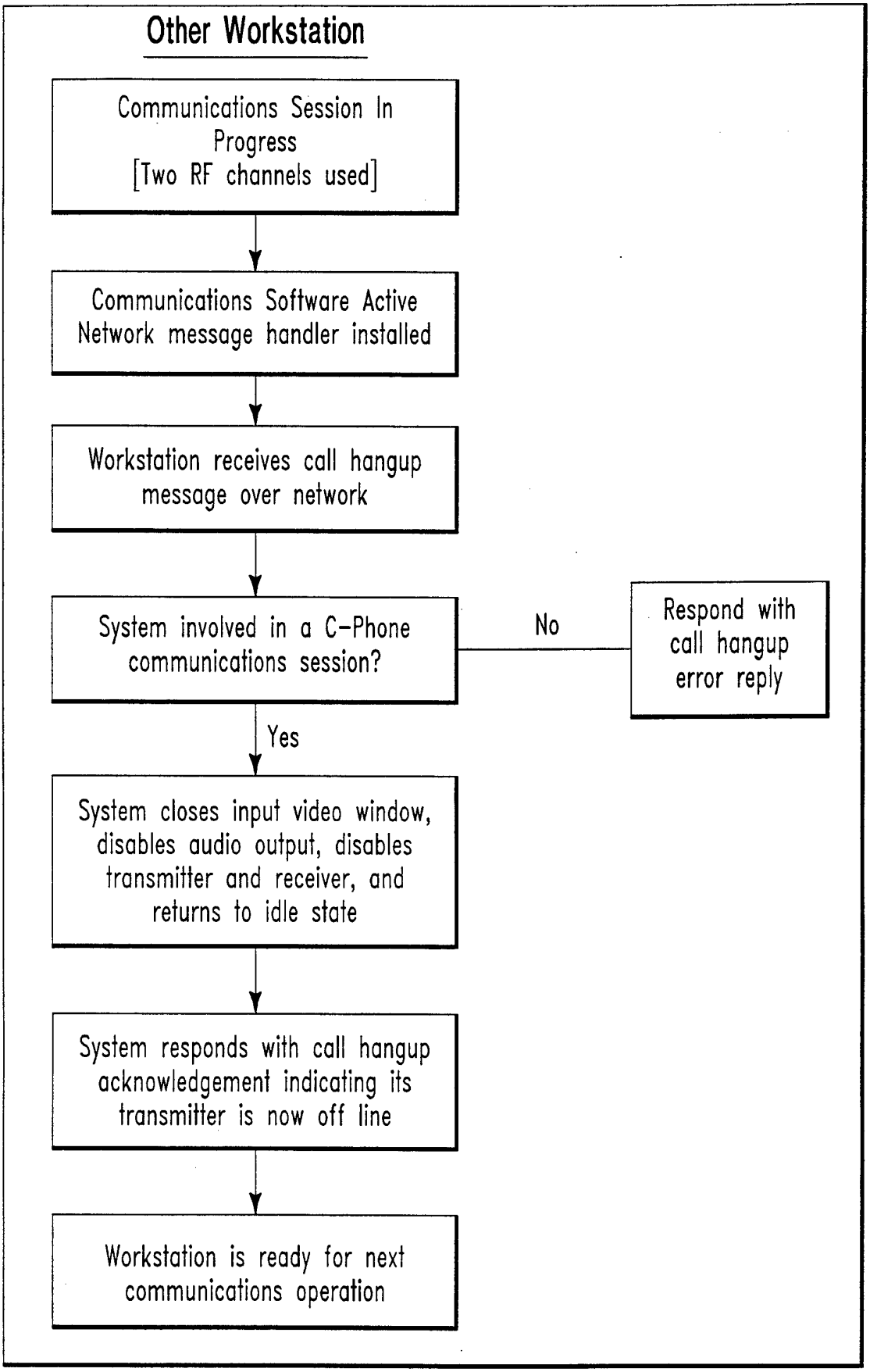
Other Workstation
Communications Session In Progress [Two RF channels used]
Communications Software Active Network message handler installed
Workstation receives call hangup message over network
System involved in a C-Phone communications session?
No
Respond with call hangup error reply
Yes
System closes input video window, disables audio output, disables transmitter and receiver, and returns to idle state
System responds with call hangup acknowledgement indicating its transmitter is now off line
Workstation is ready for next communications operation

FIG. 14B

INTERNATIONAL SEARCH REPORT

Inter. ıal Application No
PCT/US 93/06587

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 H04N7/14

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 5 H04N

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.
Y A	FR,A,2 590 429 (P. SORRIAUX) 22 May 1987 see abstract; figure 1 see page 3, line 22 - page 5, line 9	1 2-13
Y A	NTZ NACHRICHTENTECHNISCHE ZEITSCHRIFT vol. 42, no. 8 , August 1989 , BERLIN DE pages 486 - 493 XP96553 P. PERNSTEINER ET AL. 'VIDEO- UND DATENKOMMUNIKATION IM VBN' see page 488, right column - page 490, right column, line 32; figure 10	1 2-13
A	US,A,4 885 747 (FOGLIA) 5 December 1989 cited in the application see abstract; figure 1 see column 3, line 27 - column 5, line 50	1-13

-/--

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

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 1993	07. 12. 93

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016	MACHWIRTH, C

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 119 588 (INTERNATIONAL STANDARD ELECTRIC CORPORATION) 26 September 1984 see abstract; figures 1,2 see page 5 - page 8	1-13
A	US,A,4 675 866 (TAKUMI ET AL.) 23 June 1987 cited in the application see abstract; figures 1-6	1-13
A	US,A,4 564 940 (YAHATA) 14 January 1986 cited in the application see abstract; figure 1	1
A	IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATION vol. 9, no. 9 , December 1991 , NEW YORK US pages 1395 - 1404 XP267530 P. VENKAT RANGAN ET AL. 'SOFTWARE ARCHITECTURE FOR INTEGRATION OF VIDEO SERVICES IN THE ETHERPHONE SYSTEM' see abstract; figures 1,3,8	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. nal Application No
PCT/US 93/06587

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A-2590429	22-05-87	FR-A-	2564270	15-11-85
		AU-A-	3660584	05-12-85
		CH-A-	661627	31-07-87
US-A-4885747	05-12-89	EP-A-	0329912	30-08-89
		JP-A-	2007742	11-01-90
EP-A-0119588	26-09-84	DE-A-	3309403	20-09-84
		AU-A-	2551284	20-09-84
		BE-A-	899175	17-09-84
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US-A-4675866	23-06-87	JP-A-	60226247	11-11-85
		JP-A-	60251744	12-12-85
US-A-4564940	14-01-86	JP-A-	59122161	14-07-84
		CA-A-	1200928	18-02-86
		DE-A-	3378398	08-12-88
		EP-A,B	0117362	05-09-84