A remote control entertainment system wherein a central control (14) and several add-on circuits (22, 30, 33, 34) are coupled to conventional home entertainment components and selectively control the home entertainment components in response to signals transmitted through a common carrier transmission bus (12) by a remote control (10) is provided. The central control (14) and several add-on circuits (22, 30, 33, 34), in addition to applying control signals to conventional components of a conventional home entertainment system and controlling the output of the home entertainment system in a plurality of locations also produces a verification command signal that is transmitted by the common carrier transmission bus (12) to the remote control (10) to thereby provide verification at the remote control that the command transmitted to the central control has been performed.
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REMOTE CONTROL ENTERTAINMENT SYSTEM

BACKGROUND OF THE INVENTION

This invention is directed to a remote control entertainment system that can be utilized with off-the-shelf audio and video components, and, in particular, to a remote control entertainment system that permits conventional components, such as a high fidelity amplifier, turntable, tape player, etc., to be utilized to service a multiplicity of rooms in the same building and be controlled from each and every room within the same building.

Heretofore, remote control multi-room entertainment systems have often had one or more of the following drawbacks. Many such entertainment remote control systems require custom installation utilizing a specific manufacturer's equipment. Moreover, such systems usually work on either a "line of sight" or "ultrasonic tone" principle which is limited to a maximum distance of twenty feet. Alternatively, such systems require a hard wired hookup between a transmitter in the remote control and a receiver in a central control. Moreover, many systems, although permitting remote control of the system from a remote location, do not admit of multiple room use, cannot be utilized with more than two sets of loudspeakers, do not provide independent speaker volume control and do not provide an indication at the remote control of the operational status of the remote control home entertainment system. The instant invention overcomes each and every disadvantage noted above that is present in conventional audio and video remote control systems and is adaptable for use with most off-the-shelf audio and visual components being presently offered in the marketplace.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the instant invention, a remote control entertainment system for use with conventional audio and visual components in a plurality of rooms in a
building is provided. A common carrier transmission bus is adapted to have impressed thereon a plurality of digital command signals produced by a remote control circuit. A central control circuit is coupled to the common carrier transmission bus for detecting the digital command signal impressed on the common carrier transmission bus by the remote control circuit and, in response thereto, is adapted to produce a function control signal and/or a mode control signal to thereby control either the type or manner in which the audio and visual entertainment is presented, the different rooms in which such entertainment is presented and the manner in which it is presented within each particular room. Additionally, the central control circuit is adapted, in response to producing control signals, to impress upon said common carrier transmission bus a digital verification signal that is detected by said remote control circuit so that a signal indicating the type of entertainment selected and the type of control thereof that has been commanded by the central control circuit is indicated at the location of the remote control circuit.

Accordingly, it is an object of the instant invention to provide an improved remote control entertainment system that can be utilized with most conventional off-the-shelf audio and video equipment.

A further object of the instant invention is to provide a remote control entertainment system that does not require any "hard wired hook ups" other than the common carrier transmission bus, between the remote control and the central control.

Still a further object of the instant invention is to provide a remote control entertainment system that permits more than two sets of loudspeakers to be utilized in more than two rooms with a conventional amplifier-preamplifier and provides independent loudspeaker volume control in each pair of speakers in each room.

Still another object of the instant invention is to provide a remote control entertainment system whereby the operational status of the system is indicated at the remote control when the system is in operation.
Still a further object of the instant invention is to provide a remote control entertainment system whereby verification of each command transmitted by the remote control is indicated at the location of the remote control.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification and drawings.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a block circuit diagram of a remote control entertainment system constructed in accordance with the instant invention;

Fig. 2 is a block circuit diagram of the control signals and low level audio signal connections of the remote control entertainment system depicted in Fig. 1;

Fig. 3 is a block circuit diagram of the remote control circuit of the instant invention;

Fig. 4 is a block circuit diagram of the mode select circuit and the central control circuit illustrated in Fig. 1;

Fig. 5 is a block circuit diagram illustrating the single room control circuit of the remote control entertainment system illustrated in Fig. 1;

Fig. 6 is a block circuit diagram of the tape control circuit illustrated in Fig. 1;

Fig. 7 is a block circuit diagram of the simultaneous speaker amplifier protection circuit and the low level matching circuit illustrated in Fig. 2; and

Fig. 8 is a block circuit diagram of the memory tuner circuit illustrated in Fig. 1.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first made to Fig. 1 wherein a block circuit diagram of a remote control entertainment system, constructed in accordance with the instant invention, is depicted. The remote control entertainment system includes a remote control, generally indicated as 10, coupled through a common carrier transmission bus, generally indicated as 12, to a central control, generally indicated as 14. By way of an exemplary embodiment of the instant invention, the common carrier transmission bus of the instant invention is a conventional single phase 110-120 VAC line current in a building (hereinafter "AC bus"). The term "common carrier transmission bus" refers to the type of system disclosed in U.S. Patent No. 2,114,718 to Levy wherein signals are transmitted to a modulated radio frequency carrier wave over the same wires that furnish power to the system and thereby eliminate the necessity of providing an additional hard wired connection between the remote control 10 and the central control 14.

As is discussed below, each of the remote controls 10 include a remote control circuit 16 coupled through an AC interface circuit 17 to the AC bus 12 that supplies power to the remote control and, in a conventional building, the AC interface would include a male plug (not shown) that could be inserted into any female receptacle in the building in order to permit remote control command signals to be impressed on the AC bus. The central control 14 also includes an AC interface circuit 17' and, in addition thereto, a main logic and power supply circuit 19 and a three room control circuit 20. As is explained in detail below, the main logic and power supply 19 is coupled through AC interface circuit 17' to the AC bus in order to receive signals impressed upon the AC bus by the remote control circuit 16 and, additionally, transmit verification command signals to the remote control circuits 10 through the respective AC interface 17', the AC bus 12 and the AC interface 17', the AC bus 12 and the AC interface circuit 17 intermediate the AC bus and the remote control circuits. The AC interface circuit 17'
would therefore, in an exemplary embodiment of the instant invention, also include a male plug (not shown) that could be inserted into any female wall receptacle in the same manner discussed above with respect to the AC interface circuits 17 of the remote control.

In addition to the three room control circuit 20, an additional three room control circuit 22 can be selectively added to the three room control circuit 20 to increase the number of rooms in which the operation of loudspeakers by the remote control entertainment system of the instant invention can be achieved. A detailed schematic of each room control circuit utilized in the three room control 21 and additonal three room control 22 is illustrated in Fig. 5 and will be discussed in greater detail below.

The remote control entertainment system of the instant invention is particularly characterized by its use with conventional off-the-shelf video and audio components. As is illustrated in Fig. 1, amplifier 24 is a conventional high fidelity amplifier-preamplifier manufactured by most major manufacturers. Phono 25 refers to any conventional turntable or phonograph, tuner 26 refers to any conventional FM tuner and tape player 27 refers to any conventional reel-to-reel, cassette or other type of tape player that includes therein a remote control jack. Moreover, it is noted that the instant invention is also equally compatible with any combination amplifier-FM tuner commonly referred to as an "FM receiver" and, accordingly, any explanation with respect to the tuner 26 of the instant invention will be equally applicable to a conventional FM-receiver.

Still referring to Fig. 1, the main logic and power supply circuit 19 of the central control 14 is coupled through a control bus 29 to a mode selector circuit 30 to thereby permit tuner mode control signals 31 to be applied to a memory tuner 33, tape mode control signals 34' to be applied to a tape relay 34 and phono mode control signals 36 to be applied to the phono 25 in a manner to be discussed in greater detail below. It is noted that the tape player 27 is adapted to apply low level tape player audio signals 38 produced thereby through the mode selector 30 to amplifier 24 in the same manner that tuner 26 and phono 25 are
adapted to respectively produce and apply low level FM audio signals 39 and low level phono-audio signals 40 through mode selector 30 to amplifier 24. Amplifier 24 is adapted to apply the low level audio signals applied through the mode selector to the main logic and power supply 19 which, in turn, is coupled to the respective room control circuits 21 and 22 in order to permit same to be reproduced in respective locations that are selected by the central control 14. Thus, as will be detailed below, the central control 14 functions as a central communications interface between the respective stereo components, such as the phono 24, tuner 26 and tape player 27, and the respective modules to which they are coupled, such as the mode selector 30, memory tuner 33 and tape relay 34, and additionally receive and decode all commands transmitted from the remote controls 10 and insures that the commands received therefrom are performed in the manner detailed below.

Referring now to Fig. 3, the remote control circuit 16 and the interface circuit 17 of the remote control 10 are illustrated as receiving its power from the AC bus which is a standard 110-120 volt VAC power line. As noted, above, the remote control 10 would be provided with a male plug (not shown) that is inserted into any female receptacle in the building to thereby couple the remote control to the communication carrier AC transmission bus of the remote control entertainment system. Accordingly, the AC power signal from the AC bus is applied to a step-down transformer 41 and a bridge rectifier circuit 42 to thereby apply a power signal at the terminal Vcc of a microprocessor 43 in the remote control circuit 16. The step-down transformer 41 and rectifier circuit 42 provide the energizing interface between the AC bus and the remote control circuit 16 and are part of the AC interface circuit 17. Additionally, a clock buffer circuit 46 is coupled to a clock output CL of the microprocessor 43 and applies a first clock input to an AND gate 47, which AND gate is utilized in the interface circuit to gate into the microprocessor DATA signals received from the AC bus. The AC interface circuit 17 also includes a line coupling transformer 49 that receives an information signal from an AC bus, transforms same into a DATA signal and applies the DATA signal through a level
detector 50, amplifier 51 and a shaper circuit in order to apply a DATA IN signal to the other input of AND gate 47 so that the clock buffer 46 gates the DATA IN signal into the microprocessor 43 of remote control circuit 16.

The remote control circuit 16 includes microprocessor circuit 43 which circuit is formed on a dedicated circuit chip and has coupled thereto a panel having keyboard switches 54 which apply inputs to the microprocessor 43 so that the microprocessor will produce specific binary coded function command signals representative of the function selected by a specific key. For example, the keyboard switches of the portable controller would include a first switch for turning the entire system on and off, a second switch for turning the speakers in that room on and off, a third switch for controlling the volume of the speakers in the room in which the remote control is located, a fourth switch for turning the speakers in other rooms on and off, three additional switches for selecting between the tuner, phono, tape player and, additionally, any other additional switches for adding on additional tape players, etc. Additional switches could be provided for selecting FM radio stations utilizing the memory tuner, selecting different tracks on an eight track player or selecting records on an automatic turntable when the system is in a phono mode. Additionally, separate switches could be included for disposing the tape player into a play, stop, fast forward, rewind, reverse, play, pause and record mode and, additionally, any additional switches that may be deemed necessary or appropriate to form a particular command function. Additionally, a room and house code selector 55 selects specific room codes and house codes to be utilized in the system and these specific room codes and house codes are detected as a first input of the microprocessor and the specific manually operated switch actuated by the user that is representative of a particular command signal is also detected by the microprocessor.

Accordingly, as long as none of the keyboard switches 54 are actuated, the remote control remains in a stand-by mode and no command data signal is produced by the microprocessor 43. However, when a manually operated switch in the keyboard 54 is actuated, the
microprocessor 43 integrates into a binary word a specific binary number representative of the specific switch that is actuated and a specific binary number representative of a room code and house channel code. For example: room 3, house channel 10, command no. 1 (power on) would define three binary words and these binary words are then applied through a data signal injector 57 and line coupling transformer 49 to the AC common carrier transmission bus and are transmitted as an amplitude modulated signal on the AC bus. The binary word is amplitude modulated so that each binary "1" or "HIGH" binary pulse in the binary word is approximately a 700 micro-second duration pulse and each binary "zero" or "LOW" pulse in the binary word is represented by a pulse having a duration of approximately 400 micro-seconds.

Turning next to Fig. 4, after the command data signal is AC modulated and impressed upon the AC bus, it is applied through AC interface circuit 17', which is identical to the AC interface 17, described with respect to the remote control 10. The main logic of the central control, illustrated in Fig. 4, includes, therein, a central control microprocessor 62 that continuously monitors the AC common carrier transmission bus. Accordingly, the command data signal that has been amplitude modulated and transmitted along the AC bus is applied to the interface circuit 17' and is transmitted through a line coupling transformer 49, level detector 50, amplifier 51 and Schmidt trigger shaper 52 to AND gate 47 whereafter it is gated as a COMMAND DATA IN signal 63 to the microprocessor 62 in the same manner discussed above with respect to interface circuit 17. The central control microprocessor 62 compares the binary words with an internal set of binary words to assure that the central unit is set to the same house code stored in code selector 55. If not, the microprocessor ignores the entire word. However, if they are the same, a command will be executed by the microprocessor.

If the microprocessor 62 executes the command, the following sequence occurs. First, the microprocessor 62 will transmit through line 63, the AC interface 17', AC bus 12 and interface 17 in the remote control unit, a command verification signal that is substantially the same binary word as the command signal. This
verification command signal is transmitted through the line coupling transformer 49 of the AC interface circuit 17 and is ultimately clocked through the AND gate 47 to the remote control microprocessor 43 to thereby light up an LED 60 that is associated with the particular switch that is actuated on the remote control unit.

For example, if a power on switch 54 were actuated at the remote control unit, a power on command signal would be transmitted by the microprocessor 43 through interface circuit 17 to the AC bus and would be decoded by the interface circuit 17' and detected by the central control microprocessor 62. If the central control microprocessor 62 executes a power on control signal to thereby turn on some or all of the components in the remote control entertainment system, a command verification signal would also be transmitted through the interface circuit 17' and the AC bus to the remote control unit to thereby light up an LED that is positioned adjacent to the power on switch, thereby verifying to the person at the remote control that the central control 14 has, in fact, received the power on command and has executed that command. Accordingly, the instant invention is particularly characterized by remote control units that can transmit command signals to a central control unit and can verify that the specific command signals have been received and executed by a central control.

Referring to Figs. 2, 4 and 5, the microprocessor 62, in the central control 14, executes a control command in response to being addressed by the remote control by either producing a plurality of room control signals or a plurality of function control signals. Specifically, referring to Fig. 2, the function control signals include two address signals AO and Al, input-output signal I/O, a clock signal Cl and a read-write signal R/W. The function control signals are utilized to address the mode selector 30, memory tuner 33 and tape control 34, and are applied thereto by a function bus 66. The room control signals are applied along a room control bus 68 and includes three address signals B0, B1 and B2. A read-write signal R2/W2 is applied to both three room control circuits 21 and 22, which circuits are illustrated in detail in Fig. 5, and will be discussed in greater detail below. In addition to the room
control signals applied on the room control bus 68, four room
control signals, including a volume-up signal \( V_u \), a volume-down
signal \( V_d \), applied on the room control bus, and a speaker on-off
signal \( S_0 \) and an all speaker signal \( S_A \) are produced by the central
control 14 and applied to the appropriate room control circuits 21
and 22.

Referring specifically to Fig. 4, the function control
signals produced by the microprocessor of the control circuit are
transmitted on the function control bus 66, in order to enable a
particular unit, such as the phono, tuner or tape player, to be
selected. For example, a predetermined binary address code is
selected for each unit and is serially read and applied as a serial
signal I/O to an address decoder and data enable circuit 70.
Moreover, the signal I/O is detected by the central control 14, to
verify that the mode selector is coupled thereto. Thus, the address
signals AO, Al and the clock signal, together with the input-output
signal enables the serial data which appears as the signal I/O to
be decoded by the address decoder 70 and to be applied to a shift
register 71 wherein the previous address code stored therein is
indexed by a count of one and is stored therein until a new address
code is applied thereto. The shift register 71 is therefore indexed
by a count of one and will respectively energize, in sequence,
either the low level signal phono relay 73a, the low level signal
tuner relay 74a, the low level audio tape relay 75a or the auxiliary
relay 76. Thus, the shift register cyclically indexes the respec-
tive relays to thereby select, in sequence, one of the four specific
components to be operated. Additionally, the shift register 71 also
coincidentally addresses the AC phono relay 73b, AC tuner relay 74b,
AC tape relay 75b or AC auxiliary component relay 76b in order to
assure that the specific component that is selected receives power
from the power supply, and thereby assures that the specific
component that is selected is not only turned ON but also that the
remaining components are not energized.

One exception, however, in the mode selector circuit 30 is
the bypass circuit generally indicated as 73 and is utilized when
the tape player 27 or, alternatively, a secondary tape player that
is coupled to the auxiliary jack is recording audio fidelity signals produced by the phono or the FM tuner. For example, if the FM tuner has been selected by the shift register 71, and the tape player 27 is to be utilized to record the audio fidelity signals produced by the tuner 26, a manually actuated tape bypass switch 74 is actuated to thereby transmit a binary "1" signal through bypass OR gate 75 to the AC relay 75b of the tape player 27, to thereby energize the tape player and permit same to allow the tape player 27 to be disposed in a tape recording mode. Manually operated auxiliary bypass switch 76 and OR gate 77 operate in the same manner to permit the auxiliary jack to be utilized with an additional tape player and permit the tape player to record the audio fidelity signals produced by the phono 25 or tuner 26. Finally, the shift register can be cycled to produce a remote record signal 78 through a remote record switch 79 in order to permit the AC tape relay 75b or AC AUX relay 76b to be selected by the remote control addressing the central control and thereby causing the central control to produce an appropriate remote record signal 78.

Also, in order to permit the phono 25, tuner 26, tape player 27 or auxiliary component to be manually selected, manually operated AUX switch 81, tape switch 82, tuner switch 83 and phono switch 84 are each connected thorough a function encoder 85 to thereby manually impress upon the input-output data line an input-output signal that is identical to the signals discussed above that are produced by the microprocessor 62.

Referring next to Fig. 5, the room control circuit 21 includes three circuits (not shown) identical to the circuit illustrated in Fig. 5 and each circuit is coupled in parallel therewith. As noted above, the microprocessor produces the address code signals B0, B1 and B2 and applies them on the room control bus 60 to an address decoder circuit 88 which circuit, in response thereto, applies room selector signals 89 to a room selector circuit 90. The room selector circuit 90 produces a first room selector signal 91, a second room selector signal 92 and a third room selector signal 93. As is hereinafter explained in detail, the first room selector signal 91 is applied to a speaker control
circuit in order to energize a speaker volume control circuit, generally indicated as 94. Similarly, the second room selector signal 92 is applied to a speaker volume control circuit (not shown) for a second room and a third room selector signal 93 is applied to a speaker volume control circuit (not shown) for a third room in order to permit the speaker volume control to be effected in the second and/or third rooms in the identical manner that will be explained below with respect to the control of volume in the first room.

Speaker volume control circuit 94 includes a volume-up AND gate 96 and a volume-down AND gate 97 which AND gates receive as a first input thereto the first room selector signal 91 produced by the room selector 90. A second input 98 is coupled to a high level voltage contact H of a rotary potentiometer 99 that includes a rotary wiper 100 that is mechanically linked to a motor M. The lowest level voltage contact L of the potentiometer 99 is coupled to the second input of the volume-down AND gate 97. The third input of the volume-up AND gate 96 is the VOLUME UP signal \( V_U \) and the third input to the VOLUME DOWN AND gate 97 is the VOLUME DOWN signal \( V_D \). The outputs of both AND gates 96 and 97 are coupled to the motor M, which motor is, in turn, physically coupled to the wiper 103 of a volume control potentiometer 104. The volume control potentiometer 104 is coupled to a pair of speakers 105 which represent a pair of stereo speakers within the room. Accordingly, the operation of the speaker volume control circuit 72 is as follows. When the first room selector signal 91 is a HIGH level signal, the first inputs 91 of AND gates 96 and 97 receive a HIGH LEVEL binary input. If the rotary wiper 100 of the potentiometer 99 is positioned at any contact other than \( H \), a HIGH LEVEL signal 98 is applied to the second input of the AND gate 96. In this case, in response to a VOLUME UP signal \( V_U \) applied to the AND gate 96, the motor M is rotated, thereby moving the wiper 103 of the volume control potentiometer 104 to increase the volume of the audio signal produced by speakers 105. However, when a VOLUME DOWN signal is applied to AND gate 97, the motor M will rotate the wiper of the volume control potentiometer 104 in a direction to reduce the volume of the speakers 105. It is noted,
however, that when the wiper of the potentiometer 99 reaches either the contact H or the contact L, an end of travel signal is applied to the AND gates 96 or 97, respectively, to limit the travel of the motor M. Specifically, when the wiper 100 of the potentiometer 99 is in contact with the contact H, a LOW LEVEL signal is applied as the second input to AND gate 96, thereby inhibiting the transmission of the VOLUME UP signal $V_U$ from being transmitted to the motor. Similarly, when the rotary wiper 100 is positioned in contact with contact L, a LOW LEVEL signal L is applied as the second input to AND gate 97 to thereby prevent the VOLUME DOWN signal $V_D$ from being transmitted through the AND gate to the motor M. By utilizing the end of travel potentiometer 99, two directional adjustments of the volume control of the speakers can be selected by the remote control 10. Also, manually operated VOLUME UP switch 108 and a manually controlled VOLUME DOWN switch 109 are also provided at the outputs of the AND gates 96 and 97 to permit manual adjustment of the volume control at the location of the room control circuit as well as at the remote control location.

As noted above, the central control circuit 14 also produces a speaker on-off signal $S_O$, which signal is applied to a speaker on-off decoder circuit 111. Decoder circuit 111 is coupled through a relay K1 to an on-off actuator for turning on the power by closing relay actuated switch K1' to thereby permit the speaker to be selectively turned ON and OFF by the signal $S_O$ produced by the microprocessor 43. Thus, the speakers 105 in a particular room can be turned off from the remote control unit when the remote control unit instructs the microprocessor 62 to produce signal $S_O$. Furthermore, the speakers can also be turned ON and OFF by a manually operated speaker-on switch 113 and a manually controlled speaker-off switch 114 from the room wherein the room control circuit is located. Furthermore, an LED 115 is coupled to the speaker on-off decoder to indicate at the room control circuit whether or not the speakers in each particular room were turned ON or turned OFF.

Finally, an all speakers decoder circuit 116 is adapted to receive an all speaker signal $S_a$ produced by the microprocessor 62.
Alternatively, a manually operated all speaker signal can be produced by manually operated all speaker switch 117 to thereby apply a positive all speaker signal to the first input of AND gates 96 and 97 in order to assure that all three pairs of the speakers are capable of being controlled at the same time in response to the VOLUME UP and VOLUME DOWN signals being respectively applied thereto. Accordingly, the instant invention permits the volume control of the speakers in each and every room to be adjusted simultaneously or, alternatively, permits each of the loudspeakers in each of the rooms to be independently adjusted by the remote controls. As will be explained in detail below, however, most off-the-shelf amplifier-preamp amplifiers and receivers are designed to energize no more than two pairs of speakers at one time. Accordingly, when the all speakers decoding feature of the instant invention is utilized with a room control circuit for more than two rooms, a simultaneous speaker circuit including a low level matching circuit 130 and a load protection circuit 131, illustrated in Fig. 7, must be utilized in order to permit simultaneous operation of more than two speakers. Similarly, if more than three rooms are to be controlled, an additional three room control circuit 22, that is a duplicate of the first three room control circuit 21, can be coupled to the central control and addressed and controlled in the same manner discussed above with respect to the room control circuit 22, to thereby permit speakers in any one of six rooms or any combination of rooms up to six rooms, to be selected and the volume control thereof remotely adjusted. Still a third room control circuit can be added to control nine rooms without exceeding the power requirements of most off-the-shelf components.

Reference is now made to Fig. 6, wherein a circuit diagram of the tape control circuit 34, illustrated in Fig. 1, is depicted. The tape control circuit 34 is preferably included in an independent module and, as explained in detail below, permits remote control operation of any solenoid operated, logic controlled reel-to-reel, cassette or video tape recorder which is equipped with a remote control jack. The tape control circuit 34 includes an address decoder 120, which address decoder receives address signals AO and
Al from the microprocessor 62. Signals AO and Al, in combination with input-output data signal I/O and read-write signal R/W are applied to control the respective functions selected thereby. Specifically, the address decoder 120 disposes a function decoder 131 into a tape control mode whereby the function decoder can be indexed through a count of seven to thereby simultaneously generate a play control signal 122, fast forward signal 123, rewind signal 124, stop signal 125, play signal 126, pause signal 127 and record signal 128, which signals are respectively applied to play relay K1, fast forward relay K2, rewind relay K3, stop relay K4, play relay K5, pause relay K6 and record relay K7. The function decoder circuit will further return the signal I/O and the read-write signal R/W to the central control to thereby indicate to the central control the state of the function decoder and permit a verification signal to be transmitted to the remote control when the precise function is selected by the function decoder 121. The actuated relay coils K1 through K7 of the tape control module represent the solenoid operated logic controlled terminals of a tape player equipped with a remote control jack and, accordingly, based thereon, the instant invention permits each of the tape recorder functions to be remotely selected.

Referring next to Figs. 2, 5 and 7, simultaneous speaker circuits, comprised of a low level matching circuit and an amplifier protection circuit, are provided in order to permit the central control to energize speakers in more than two rooms at a time. As is illustrated in Fig. 2, the low level matching circuit 130 is coupled intermediate the mode selector and the amp-preamp in order to receive the low level output audio signals from the mode selector and effect low level matching thereof. The amplifier protection circuit 131 is coupled intermediate the amplifier 24 and detects the number of speakers turned on and automatically matches the speaker load to the ideal maximum amplifier power load, thereby assuring sufficient power to energize the speakers and further assuring that no damage to the amplifier-preamplifier occurs as a result of the driving of more than two pairs of speakers in a conventional stereo mode.
Referring next to Fig. 7, the amplifier protection circuit 131 is energized by a 12 Volt signal produced by a step-down transformer (not shown) disposed between the central control and the amplifier protection circuit. The 12 Volt current signal is applied through line 150 to the speaker relays $K_1$ of each of the room control circuits, which speaker relays are coupled in parallel. The 12 Volt current signal is applied through line 150 and powers the speaker relays $K_1$, in each room control circuit when speakers in any number of rooms, from one to six or more, are energized. A voltage drop resistor 151 is placed in series with the speaker line 150 in order to measure a predetermined voltage drop, as each of the speaker relays $K_1$ are actuated. For example, if twelve volts is applied along line 150 and none of the room speaker relays $K_1$ in the room control circuits are energized, a twelve volt drop will be seen across the resistor 151. However, each time that a relay $K_1$ in a room control circuit is energized, the voltage drop across the voltage drop resistor 151 will be reduced.

As noted above, most conventional off-the-shelf amplifiers are suitable for use with no more than two pairs of loudspeakers and, if more than two pairs of loudspeakers are coupled thereto, the amplifier is likely to become overloaded unless the impedance at the output thereof is increased accordingly. A first comparator 152 is, therefore, biased by a potentiometer 153 to measure when the voltage drop across the resistor 151 drops below a first voltage level (such as 11 volts). Specifically, when the comparator detects that the voltage drop across resistor 151 is above the first voltage level, an off signal is applied to relay 156. However, when the voltage drop across resistor 151 is less than the first voltage level, an on signal is applied to the relay 156 to thereby turn on and, hence, open normally closed relay switches 156 coupled to resistors $157_L$ and $157_R$, which resistors are respectively coupled in series with the hot leg of each left and right channel of the amplifier output and in series with the speaker load output. As aforementioned, relay switches 156 are normally closed, so that resistors $157_L$ and $157_R$ are short circuit. Thus, when the relay coil 156 is turned on by the comparator, in response to a drop in the voltage across resistor
151 below the first voltage level, the relay switches 1562 are opened thereby adding resistors 157L and 157R in series with channel outputs of the same amplifier and speaker load. The output impedance of the amplifier is thereby increased and is protected from overloading. Similarly, comparator 159 and potentiometer 160 are utilized to detect when the voltage drop across resistor 151 drops to a second level and, in response thereto, is adapted to turn on relay 1581 to thereby open normally closed switches 1582 and add resistors 158L and 158R into the circuit, thereby once again increasing the impedance load at the output of the left and right channels of the amplifier. Accordingly, by measuring the voltage drop across voltage drop resistor 151, the load protection circuit measures when speakers in zero to two rooms are being simultaneously driven, when loudspeakers in three to five rooms are being simultaneously driven and when six or more rooms are being simultaneously driven and, in response thereto, assures that for each of these conditions, the impedance load at the audio output of the amplifier is increased and that sufficient power to energize the speakers is provided and, further, that no damage to the amplifier-preamplifier occurs as a result of the driving of more than two pairs of loudspeakers.

As aforenoted, the outputs 161 and 162 of comparators 152 and 159 are applied to a status decoder 163, which decoder energizes LED 164 when zero to two rooms of loudspeakers are energized, LED 165 when three to five rooms of loudspeakers are energized and LED 166 when six or more rooms of loudspeakers are energized.

Also coupled to the status decoder is low level matching circuit 130. It is noted that potentiometer 176 is commonly coupled to the LED 164, potentiometer 168 is commonly coupled to LED 165 and potentiometer 169 is commonly coupled to LED 166. Potentiometer circuits 167, 168 and 169 select three distinct voltage levels and are coupled through a summing diode (not shown) to a first input of an operational amplifier 170. The second input 171 of the operational amplifier 170 is the low level audio signal produced by the mode selector, and the output 172 of the operational amplifier is
a low level audio signal that is applied to the amp-preamp of the remote control entertainment system.

Thus, the matching circuit assures that the entire system is appropriately balanced by attenuating the low level audio signal produced at the output of the mode selector circuit when an additional number of speakers is added to the circuit. The three potentiometer circuits, 167, 168 and 169, select three distinct levels and reference the first input of the operational amplifier to one of these three levels in response to zero to two rooms of loudspeakers being energized, three to five rooms of loudspeakers being energized or six or more rooms of loudspeakers being energized and automatically assures that the gain of the operational amplifier 170 and, hence, the level of the audio signals produced at the output thereof are appropriately attenuated. Accordingly, the instant invention provides a simultaneous speaker circuit including an amplifier protection circuit 131 and a low level matching circuit 130 to thereby permit a conventional amplifier-preamplifier that is normally utilized with only two loudspeakers to simultaneously drive pairs of loudspeakers in more than two rooms without imbalancing the low level audio signals of the system and furthermore without overloading the output of the amplifier-preamplifier power circuits.

Finally, referring to Figs. 2 and 8, a memory tuner 33 of the instant invention is adapted to receive signals produced on the function signal bus 66 and, additionally, is adapted to be coupled to an off-the-shelf FM tuner 26 in the manner illustrated in Fig. 8. Specifically, the address signals AO and Al are applied to the address decoder circuit 139 which is, in turn, coupled to a station select and home decoder circuit 140 which includes a counter that is serially indexed through a count of 5 in response to each I/O pulse applied thereto. However, when the I/O signal is continuously applied to the decoder 104 for at least two seconds, the station select and home decoder is reset to the initial count (1) thereof. Specifically, when the address codes AO and Al are applied to the address decoder and a short addressing pulse I/O is applied to the station decoder 140, the station select and home decoder will be indexed by a count of one.
Manually operated switches 142a through 142e permit each of the five counts of the station select and reset decoder to be manually selected at the location of the memory tuner. Each of the five counts of the station select and reset decoder are applied to a digital tuner 182 having a digital display 183. Additionally, the five LED's, 141a through 141e, are coupled to the respective outputs of the station select and reset decoder for indicating which of the five preset conditions have been selected by the station select and reset decoder. The digital tuner is a conventional preset digital tuner and includes five memories for permitting five distinct preset radio frequencies to be stored therein and, in response to each of the frequencies stored therein being selected, the specific frequency is displayed by digital display digits 183, each disposed in a conventional seven digit numerical display orientation. Such digital tuners, having digital displays which permit specific frequencies to be stored therein, are known in the art and, accordingly, no further discussion with respect thereto is contained herein.

The digital tuner 182 applies a tuning signal 141 to a Varactor tuner 185, which tuner is coupled to an FM antenna 184 to thereby produce a tuning signal 144. Tuning signal 144 is applied through a mixer 145 and is combined with a carrier signal 147 produced by a local oscillator 146 and is applied to the FM antenna jack of the FM tuner 26, to override the tuning mechanism thereof. Thus, the memory tuner circuit, illustrated in Fig. 8, permits a conventional FM tuner to be utilized in combination with the memory tuner and central control and to be turned on and off by remote control 10 and, additionally, in response to the actuation of a button on the remote control, to select one of five preset stations stored in the digital tuner with the additional feature that the station select and reset decoder will always return to a predetermined count if the station select button on the remote control is actuated for more than two seconds to thereby permit the person at the remote control location to always be able to return to a home or reference point.
Accordingly, the instant invention is particularly characterized by a central control that can be addressed from a remote control along a common carrier transmission bus by selectively coupling the remote control to any outlet of the common carrier transmission bus and in combination with the specific components of the system, such as the room control circuits, gate control circuits, mode selector circuits, memory tuner circuit and simultaneous speaker circuit, permit remote control of conventional off-the-shelf audio components. Furthermore, by utilizing a Varactor tuner 142 of the type discussed with respect to Fig. 8, a digital tuning circuit for tuning a television whereby the Varactor tuner produces a signal that is applied to the antenna jack of the television, can be utilized to remotely tune and control a television in the same manner that such control is provided to an FM tuner. Thus, a television could be coupled to an auxiliary jack and be switched in and out of the system in the same manner discussed above with respect to the memory tuner.

Also, it is noted that the description of the instant invention refers to a microprocessor circuit 43 in the remote control and a second microprocessor circuit 62 in the central control, which microprocessors are conventional dedicated programmable circuit chips that are fabricated by and manufactured by instructing the manufacturer, or persons of ordinary skill in the art to design the chip to produce signals of the type disclosed herein. Moreover, both of the microprocessors of the instant invention could be replaced by a conventional hard wired digital logic system for producing the signals however the size of the respective central control and remote control would be increased thereby.

Finally, as discussed above, the instant invention is particularly suitable for use with a common carrier transmission bus such as a conventional 110-120 VAC voltage line utilized to energize a building, house or any other structure. Nevertheless, it is apparent that the term communication carrier transmission bus could also refer to an RF transmitter and receiver that could impress an RF binary coded signal of the type discussed above into
transceivers in both the remote control and central control, and would also avoid any permanent hard wired connections between the transmitter and the receiver and would further permit the remote control units to be readily utilized in any room in a building.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.
CLAIMS

WHAT IS CLAIMED IS:

1. A remote control system comprising in combination a common carrier transmission bus, remote control means adapted to be selectively coupled to said transmission bus for producing a plurality of digital command signals and for impressing said digital command signals on said transmission bus, a central control circuit means adapted to be selectively coupled to said common carrier transmission bus for detecting said digital command signals impressed upon said common carrier bus by said remote control means, said central control circuit means being adapted to produce at least one of a function control signal and address control signal in response to said digital command signal being applied thereto.

2. A remote control system, as claimed in claim 1, and including a first low level audio signal producing means for producing a first low level audio signal and a second low level audio signal producing means for producing a second low level audio signal and mode selector means coupled intermediate said first low level audio signal producing means and second low level signal producing means and said control circuit means, said mode selector means in response to receiving an address control signal from said central control means being adapted to selectively energize one of said first low level audio signal producing means and second low level audio signal producing means.

3. A remote control system, as claimed in claim 2, and including audio transducer means, said mode selector means being adapted to receive one of said first low level audio signals and said second low level audio signals when said function control address signal selects one of said first and second low level audio signal producing means and is adapted to apply one of said first low level audio signal to said audio transducer means.

4. A remote control system, as claimed in claim 3, wherein said audio transducer means includes at least one high level audio signal amplifier means and at least one speaker means.
5. A remote control system, as claimed in claim 3, wherein said central control circuit means in response to a digital command signal produced by said remote control means is adapted to produce a function control signal, said first low level audio signal producing means is a tape player means and tape control circuit means coupled intermediate said tape player means and said mode selector means, said mode selector means being adapted to produce a tape player control signal in response to a function control signal being applied thereto, said tape control means being adapted to dispose said tape player means into a plurality of tape player modes in response to said tape player control signals being applied thereto.

6. A remote control system, as claimed in claim 5, wherein said tape player means includes a plurality of electro-mechanical switch means for selecting and controlling specific operative tape modes of said tape player means, said tape player control means including a plurality of electro-mechanical switch means that are adapted to be operatively coupled to said remote control electro-mechanical switch means of said tape player means, and function decoder means for receiving said function control signals and in response thereto selectively activating one of said electro-mechanical switch means of said tape control means so that a corresponding electro-mechanical switch means in said tape player means is actuated to thereby dispose said tape player means into a predetermined operative tape mode.

7. A remote control system, as claimed in claim 6, wherein said function decoding means includes a counter means adapted to be cyclically and serially indexed by a count of one through a predetermined count in response to said function control signal being applied thereto, each count of said counter means producing a tape control signal for selectively activating a predetermined electro-mechanical switch means in said tape control means.

8. A remote control system, as claimed in claim 5, wherein said second low level audio signal producing means is an FM tuner means, and tuner control circuit means coupled intermediate
said tape player means and said mode select means, said mode select means being adapted to produce an FM tuning control signal in response to said function control signal being adapted to tune said FM tuner means to one of a plurality of frequencies in response to an FM tuning control signal being applied thereto.

9. A remote control system, as claimed in claim 8, wherein said tuner control means includes station select means for receiving said FM tuning control signal and in response thereto for producing one of a plurality of predetermined select signals, and preset memory means having stored therein a plurality of preset tuner frequencies, the preset memory means being adapted to produce a predetermined frequency select signal representative of a predetermined frequency in response to said select signal being applied thereto, and operative means for coupling said predetermined frequency select signal to said FM tuner means to thereby tune said FM tuner means to said predetermined frequency represented by said frequency select signal.

10. A remote control system, as claimed in claim 9, wherein said station select means includes a counter means, said counter means being adapted to be cyclically and serially indexed through a predetermined count, and in response to each count thereof produce a select signal, said counter means being adapted to be reset to a predetermined count in response to said FM tuning control signal being continuously applied thereto for a predetermined interval of time.

11. A remote control system, as claimed in claim 3 or 8, wherein said first low level audio signal producing means is a phonograph means, said first low level audio signal produced thereby being a phonograph signal.

12. A remote control system, as claimed in claim 3, wherein said audio signal transducer means includes low level audio signal amplifier means for receiving said low level audio signal produced by said mode selector means and producing a high level audio signal representative thereof, and at least two speaker means, each of said speaker means being physically disposed at
locations remote with respect to the other speaker means, and a plurality of speaker control circuit means, each speaker control circuit means being disposed intermediate said low level audio amplifier means and a speaker means, each of said speaker control circuit means being coupled to said central control means, said central control means being adapted in response to a predetermined digital command signal produced by said remote control means to produce at least one first speaker control signal, each of said speaker control circuit means being adapted to transmit said high level audio signal produced by said amplifier means to said speaker means in response to said first speaker control signal being applied thereto.

13. A remote control system, as claimed in claim 4, wherein said central control circuit means is adapted to produce at least one volume control signal in response to a volume control command signal produced by said remote control means, said speaker control circuit means being adapted to attenuate the level of said high level audio signal applied to said speaker means in response to said volume control signal being applied thereto.

14. A remote control system, as claimed in claim 13, wherein said central control means is adapted to produce room control signals in response to a room control command signal produced by said remote control means, a speaker selector circuit means coupled intermediate said central control means and each of said speaker control circuit means, said speaker selector circuit means being adapted to produce at least one select signal in response to said room control signal being applied thereto, each of said speaker control circuit means being adapted to transmit said high level audio signal produced by said amplifier means to said speaker means in response to said select signal being applied thereto.

15. A remote control system, as claimed in claim 12, 13 or 14, wherein each speaker means includes at least one speaker disposed at a location.

16. A remote control system, as claimed in claim 12, 13 or 14, wherein each speaker means includes a left channel speaker
and a right channel speaker, and said high level audio signals produced by said amplifier means are right and left channel audio signals.

17. A remote control system, as claimed in claim 12, and including simultaneous speaker circuit means disposed intermediate said amplifier means and each of said speaker control circuit means, said simultaneous speaker circuit means being adapted to detect when a predetermined number of speaker means are coupled to said amplifier means for receiving said high level audio signals produced thereby and in response thereto coupling a resistance means in series with said amplifier means whereby the output of said amplifier means is prevented from being overloaded.

18. A remote control system, as claimed in claim 17, wherein said simultaneous speaker circuit means further includes a low level matching circuit means adapted to be disposed intermediate said mode selector means and said amplifier means, said matching circuit means being adapted when said predetermined number of speaker means are detected to receive said low frequency audio signals produced by said mode selector and attenuate same to a different level and transmit same to said amplifier means.

19. A remote control system, as claimed in claim 2, wherein said mode select means includes a selecting circuit means, said selecting circuit means being coupled intermediate said central control means and said first low level audio signal means and said second low level audio signal means, said selecting circuit means being adapted in response to an address control signal produced by said central control means to apply to one of at least said first and second low level audio signal producing means a select signal, said first and second low level audio signal means being energized in response thereto.

20. A remote control system, as claimed in claim 19, wherein each low level audio signal producing means includes a low level audio signal actuation means and a power actuation means coupled in parallel with said low level audio signal actuation means, said low level audio signal actuation means and power actuation means in one of said low level audio signal producing
means being actuated in response to said actuation signal being applied thereto.

21. A remote control system, as claimed in claim 20, and including bypass circuit means coupled to the power actuation means of said second low level audio signal producing means, said bypass circuit means being adapted to actuate said power actuation means of said second low level audio signal producing means when said first audio signal actuation means and power actuation means of said first low level audio signal producing means is actuated in response to said select signal being applied thereto.

22. A remote control system, as claimed in claim 1, wherein said remote control means includes first interface circuit means and remote control circuit means, said remote control circuit means being adapted to produce a plurality of digital command signals, said interface circuit means being adapted to receive said plurality of digital command signals from said remote control circuit means and encode and impress same on said common carrier transmission bus.

23. A remote control system, as claimed in claim 22, wherein said central control means includes a control circuit and a second interface circuit means intermediate said control circuit means and said common carrier transmission bus, said second interface circuit means being adapted to detect and decode said encoded command signal impressed on said common carrier transmission bus, and in response thereto produce a digital command signal to said central control circuit.

24. A remote control system, as claimed in claim 23, wherein said control circuit means is adapted to produce a digital command verification signal in response to said central control means producing a control signal, said second interfacing circuit being further adapted to receive said verification command signal and encode and impress said verification signal on said common carrier transmission bus, said first interface circuit means being adapted to detect and decode said encoded verification command signal and apply said decoded verification command signal to said remote control circuit means, said remote control circuit means
being adapted to produce an indication signal representative of the verification command signal applied thereto.

25. A remote control system, as claimed in claim 1, wherein said central control means is adapted in response to producing one of at least a function control signal and address control signal in response to said digital command signal being applied thereto, to impress upon said common carrier transmission bus a digital verification signal, said remote control means including detection means for detecting said verification signal and producing an indication signal in response thereto.

26. A remote control system comprising in combination a common carrier transmission bus, remote control means adapted to be selectively coupled to said transmission bus for producing a plurality of digital command signals and for impressing said digital command signals on said transmission bus, a central control circuit means adapted to be selectively coupled to said common carrier transmission bus for detecting said digital command signals impressed upon said common carrier bus by said remote control means, said central control circuit means being adapted to produce a predetermined control signal in response thereto, and to impress upon said common communication carrier bus a digital command verification signal, said remote control means including detector means for detecting said verification signal and producing an indication signal in response thereto.

27. A remote control system, as claimed in claim 26, wherein said remote control means includes first interface circuit means and remote control circuit means, said remote control circuit means being adapted to produce a plurality of digital command signals, said interface circuit means being adapted to receive said plurality of digital command signals from said remote control circuit means and encode and impress same on said common carrier transmission bus.

28. A remote control system, as claimed in claim 27, wherein said central control means includes a control circuit and a second interfacing circuit means intermediate said control circuit means and said common carrier transmission bus, said second
interfacing circuit means being adapted to detect and decode said encoded command signal impressed on said common carrier transmission bus, and in response thereto produce a digital command signal to said central control circuit.

29. A remote control system, as claimed in claim 28, wherein said control circuit means is adapted to produce a digital command verification signal in response to said central control means producing a control signal, said second interfacing circuit being further adapted to receive said command verification signal and encode and impress said verification signal on said common carrier transmission bus, said first interface circuit means being adapted to detect and decode said encoded command verification signal and apply said decoded command verification signal to said remote control circuit means, said remote control circuit means being adapted to produce an indication signal representative of the verification command signal applied thereto.

30. A remote control system, as claimed in claim 26, and including indication means coupled to said remote control means for receiving an indication signal produced thereby, and in response thereto verifying a command signal was received by said central control.

31. A remote control system for use in combination with a common carrier transmission bus comprising in combination a remote control circuit means for producing a plurality of digital command signals, and interfacing circuit means disposed intermediate said remote control circuit means and a common carrier transmission bus for encoding said digital command signal and impressing said digital command signal on said common carrier transmission bus, said interfacing circuit means being adapted to detect command signals impressed upon said common carrier transmission bus, decode said impressed command signals and apply said impressed command signals to said remote control circuit means.

32. A remote control system, as claimed in claim 31, including keyboard means having a plurality of manually operated switches, each switch being representative of a distinct command, said switches being coupled to said remote control circuit means so
that said remote control circuit means produces a predetermined digital command signal in response to each of said manually operated switches being actuated.

33. A remote control system, as claimed in claim 32, and including a code selector circuit means coupled to said remote control circuit means, said code selector means storing code information representative of a location and a system reference, said remote control circuit means being adapted in response to the actuation of a manually operated switch to produce a digital command reference signal that is a binary digital word representative of at least the particular command selected by the manually operated switch and the system reference and location stored in said code selector circuit means.

34. A remote control system, as claimed in claim 33, wherein said common carrier transmission bus is an AC line, and said interfacing circuit means effects encoding of said binary digital word produced by said remote control circuit means by amplitude modulating said binary digital word and impressing said amplitude modulated binary digital word on said AC line.

35. A remote control system, as claimed in claim 34, wherein said interface circuit means includes transforming and rectifying means for transforming said power from said AC line to a power signal for energizing said control circuit means.

36. A remote control system, as claimed in claim 35, wherein said interface circuit means also includes a line coupling transformer means, said line coupling transformer means being adapted to encode said digital command signals produced by said remote control circuit means and decode digital command signals received from said AC line.

37. A remote control system, as claimed in claim 32, wherein said remote control circuit means is adapted to produce indication signals in response to detecting command signals impressed upon said common carrier transmission bus, and indication means disposed adjacent said manually operated switch means, said indication means being adapted in response to said indication signal being applied thereto to indicate that a command representa-
tive of a command selected by a manually operated switch adjacent to the indication means has been performed.

38. A central control system for use in combination with a remote control system, a common carrier transmission bus having digital command signals impressed thereon, an audio signal amplifier for producing audio signals and a speaker means for producing sound in response to audio signals being applied thereto, comprising in combination, interface circuit means adapted to be selectively coupled to a common carrier transmission bus for decoding digital command signals impressed on a common carrier transmission bus, a central control circuit means for receiving said decoded command signals from said interface circuit means and in response thereto producing function control signals and address control signals, and speaker control circuit means, said speaker control circuit means being adapted to be disposed intermediate an amplifier means and a speaker means for controlling the audio signals applied by an amplifier means to the speaker means and being further adapted to be disposed intermediate said control circuit means and the speaker means for receiving said function control signals and address control signals and in response thereto being adapted to control the audio signals that are applied by an amplifier means to the speaker means.

39. A central control system, as claimed in claim 38, wherein said speaker control circuit means includes a volume control circuit means, said volume control circuit means being adapted to selectively vary the amplitude level of said audio signals applied to the speaker means in response to a function control signal being applied thereto.

40. A central control system, as claimed in claim 39, wherein said speaker control circuit means includes a selector circuit means, said selector circuit means being adapted to apply a selector signal to said volume control circuit means to actuate same in response to said address control signal being applied thereto.

41. A central control system, as claimed in claims 39 or 40, wherein said volume control circuit means includes a motor, said
motor being adapted in response to a function control signal being applied thereto to vary the amplitude level of the audio signal applied to the speaker.

42. A central control system, as claimed in claim 40, wherein said selector circuit means is adapted to produce one of a first, second and third selector signal in response to said address control signals being applied thereto, a plurality of volume control circuit means, and at least a speaker means coupled to each of said volume control circuit means, each of said volume control circuit means being adapted to control the volume of a distinct speaker means in response to a selector signal being applied thereto.

43. A central control system, as claimed in claim 38, and including a speaker actuation decoder means for receiving a function control signal and in response thereto disposing said speaker control circuit means to effect transmission of an audio signal produced by an amplifier means to a speaker means.

44. A central control system, as claimed in claims 38, 39 or 40, and including mode selector means, said mode selector means being adaptable for use with at least one low level audio signal producing means, said mode select means being adapted to selectively apply to said amplifier means low level audio signals produced by a low level audio signal producing means in response to an address control signal being applied thereto.

45. A central control system, as claimed in claim 44, wherein said mode selector means is further adapted to produce low level audio signal producing means control signals in response to one of said function control and address control signals being applied thereto.

46. A central control system, as claimed in claim 38, wherein said central control circuit is adapted to produce a binary digital word command verification signal when said function control signals and address control signals are produced thereby, said interface circuit means being adapted to decode said binary word signal and being further adapted to impress on a common carrier communication bus said command verification signal.
47. A central control system, as claimed in claim 46, wherein said interface circuit means includes amplitude modulation means and demodulation means for demodulating modulated command control signals detected on said common carrier communication bus and for modulating and impressing upon a common carrier communication bus said command verification signals produced by said central control circuit means.
INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. 3 G11B 31/00
U.S. CL. 369/2,6

II. FIELDS SEARCHED

<table>
<thead>
<tr>
<th>Classification System</th>
<th>Classification Symbols</th>
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<tr>
<td>U.S.</td>
<td>369/2,6-12,24;179/2A;2.51;340/147R,147P,147MD, 162,163,167R,167A,694,695,310R,310A;445/352-355;375/36</td>
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Minimum Documentation Searched

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

III. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of Document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to Claim No.</th>
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<tbody>
<tr>
<td>X</td>
<td>N - Journal of the SMPTE, Vol. 84, issued January 1975 &quot;Digital Remote-Control and Monitoring system (AFRA Bus-System) for Automation, in Broadcasting Studios&quot;, Hogel et al; see, pages 15-17 and Fig. 2 and Fig. 8.</td>
<td>1-7,19-20,22</td>
</tr>
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<td>X</td>
<td>US, A, 4,131,882, Published 26 December 1978, See col. 2-col. 4, Hollabaugh et al.</td>
<td>1,22,25-27,30-33,37,46</td>
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<td>X</td>
<td>US, A, 3,967,264, Published 29 June 1976, See col. 2, lines 9-65, Whyte et al.</td>
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<td>X</td>
<td>US, A, 4,163,218, Published 31 July 1979, See Figs. 3-4, Wu.</td>
<td>1,22,25-27,30-33,37,46</td>
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<td>P</td>
<td>US, A, 4,257,031, Published 17 March 1981, See Fig. 2, Kirner et al</td>
<td>1,22,25-27,30-33,37,46</td>
</tr>
<tr>
<td>X</td>
<td>US, A, 3,854,122, Published 10 December 1974, See Fig. 2, Cross</td>
<td>1,22,25-27,30-33,37,46</td>
</tr>
<tr>
<td>X</td>
<td>US, A, 4,162,486, Published 24 July 1979, See Figs. 3-8, Wyler.</td>
<td>31-36,47</td>
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</tbody>
</table>

* Special categories of cited documents:

"A" document defining the general state of the art
"E" earlier document but published on or after the international filing date
"L" document cited for special reason other than those referred to in the other categories
"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed
"T" later document published on or 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

IV. CERTIFICATION

Date of the Actual Completion of the International Search
22 September 1981

Date of Mailing of this International Search Report
30 SEP 1981

International Searching Authority
ISA/US

Signature of Authorized Officer

Form PCT/ISA/210 (second sheet) (October 1977)
| X | US, A, 4,174,517, Published 13 November 1979, See Figs. 1-5, Mandel. | 31-36, 47 |
| X | N, Technische Mitteilungen PTT, issued June 1979, Hartlauer, "New Technologies adapted in a combined compact radio equipment, see pages 222-226. | 2-11/3, 12-21, 38-47 |
| X | US, A, 2,071,316, Published 23 February 1937, See Fig. 1, Auran dt | 2-4, 13-21, 38-47 |
| X | US, A, 3,369,078, Published 13 February 1968, See Figs. 1-2, Stradley | 2-4, 13-21, 38-47 |

**Observations Where Certain Claims Were Found Unsearchable**

This international search report has not been established in respect of certain claims under Article 17(3) (a) for the following reasons:

1. Claim numbers_______, because they relate to subject matter not required to be searched by this Authority, namely:

2. Claim numbers_______, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically: Claim 11/8 depends on claim 8 which depends on claim 5 which already recites that "said first low level audio signal producing means is a tape player means", it cannot also be a phonograph means as in claim 11/8. In claim 23 it is not clear what the "central control means" (line 2), the "control circuit means" (lines 3-4) and "central control circuit" (last line) are. Note also claim 28.

**Observations Where Unity of Invention is Lacking**

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers: