United States Patent

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[15] **3,688,262**

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[54] **MODULAR AUDIO-VISUAL CONTROL SYSTEM**

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[21] Appl. No.: **67,551**

[52] **U.S. Cl.**.....**340/147 R,** 307/115, 340/147 P, 340/325, 340/339, 353/48, 353/103

[58] **Field of Search** ..340/147, 147 P, 171, 325, 339, 340/163; 307/115; 318/567, 569; 353/48, 103; 35/42.5; 178/6.8; 317/137

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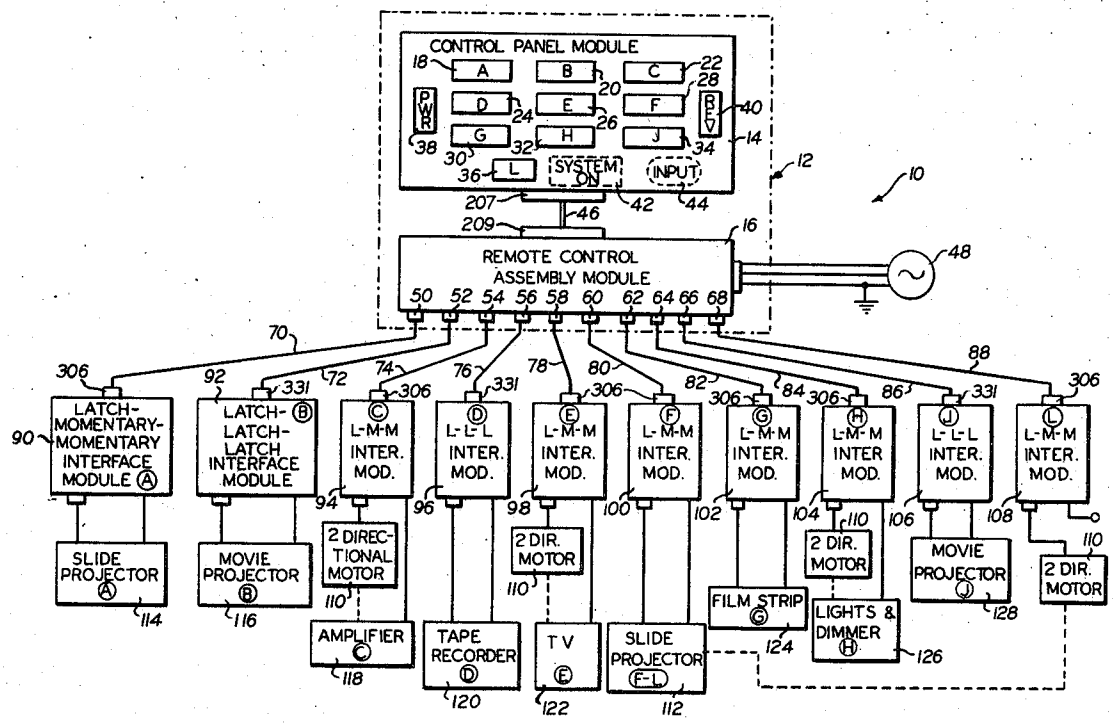
[57] **ABSTRACT**

A modular control system which is adaptable to be controlled either manually or by a tone generator such as a touch-tone telephone or a prerecorded tape, includes a modular selection means which selectively provides one of a plurality of particular audio-visual device control paths from one of a plurality of operational mode control paths which are common to a plurality of audio-visual devices, and a momentary device control path which is particular to one of the devices. The modular selection means includes means for selectively providing a momentary device control path from a plurality of such paths, with a different one of such paths being associated with a different one of the devices. An audio-visual device control interface module is removably connected between the modular selection means and each of the devices to be controlled. The interface module provides a portion of the plurality of audio-visual device control functions, such as three, for the device connected thereto, a different one of such functions being provided for a different one of the audio-visual device control paths. The interface module includes either a latch relay and a pair of momentary relays connected in parallel, or three latch relays connected in parallel depending on the functions desired. A bidirectional motor is connected to the pair of momentary relays of such an interface module to provide momentary rotary control functions, such as focus control for a projector, with one direction being associated with each relay.

22 Claims, 7 Drawing Figures



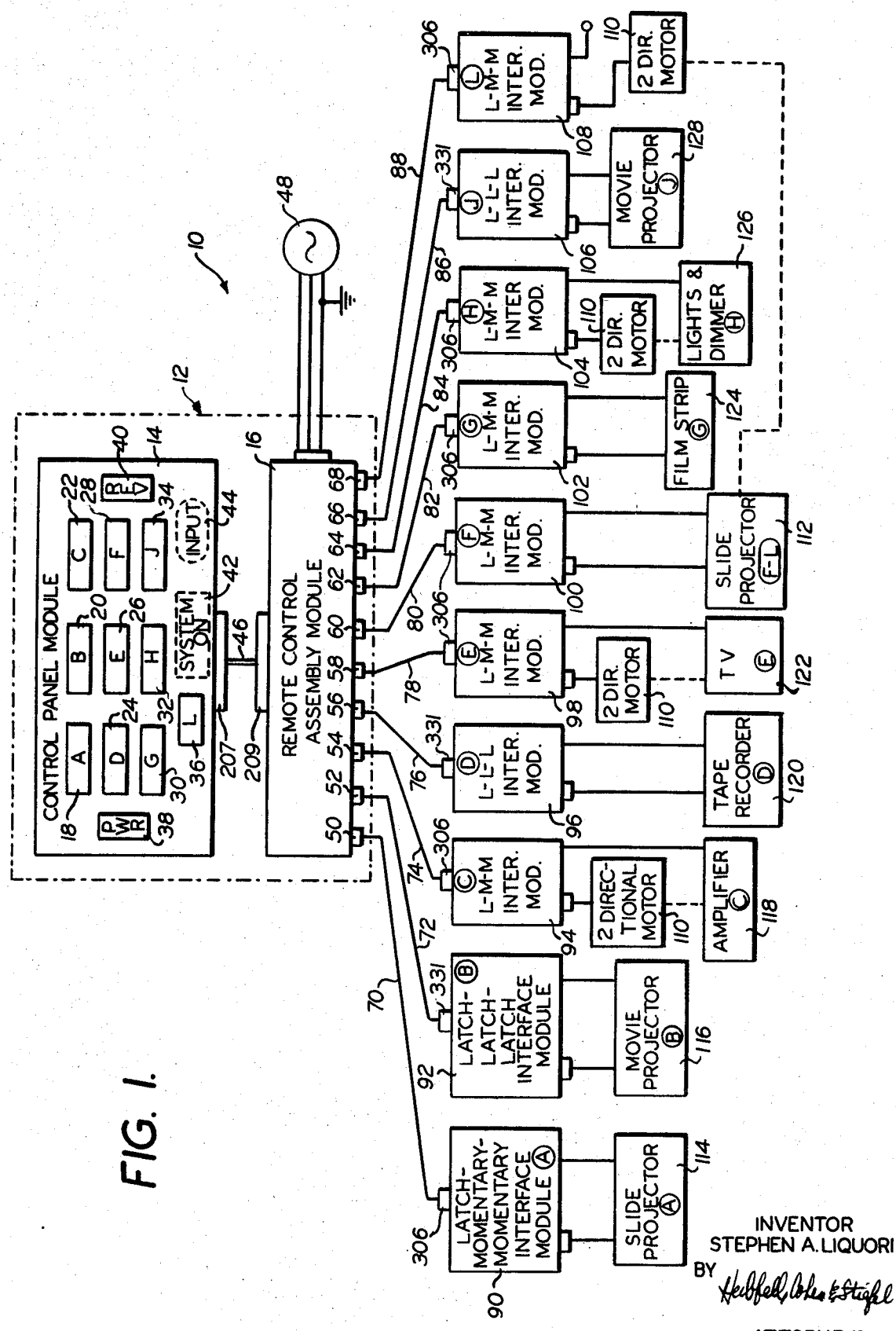


FIG. 1.

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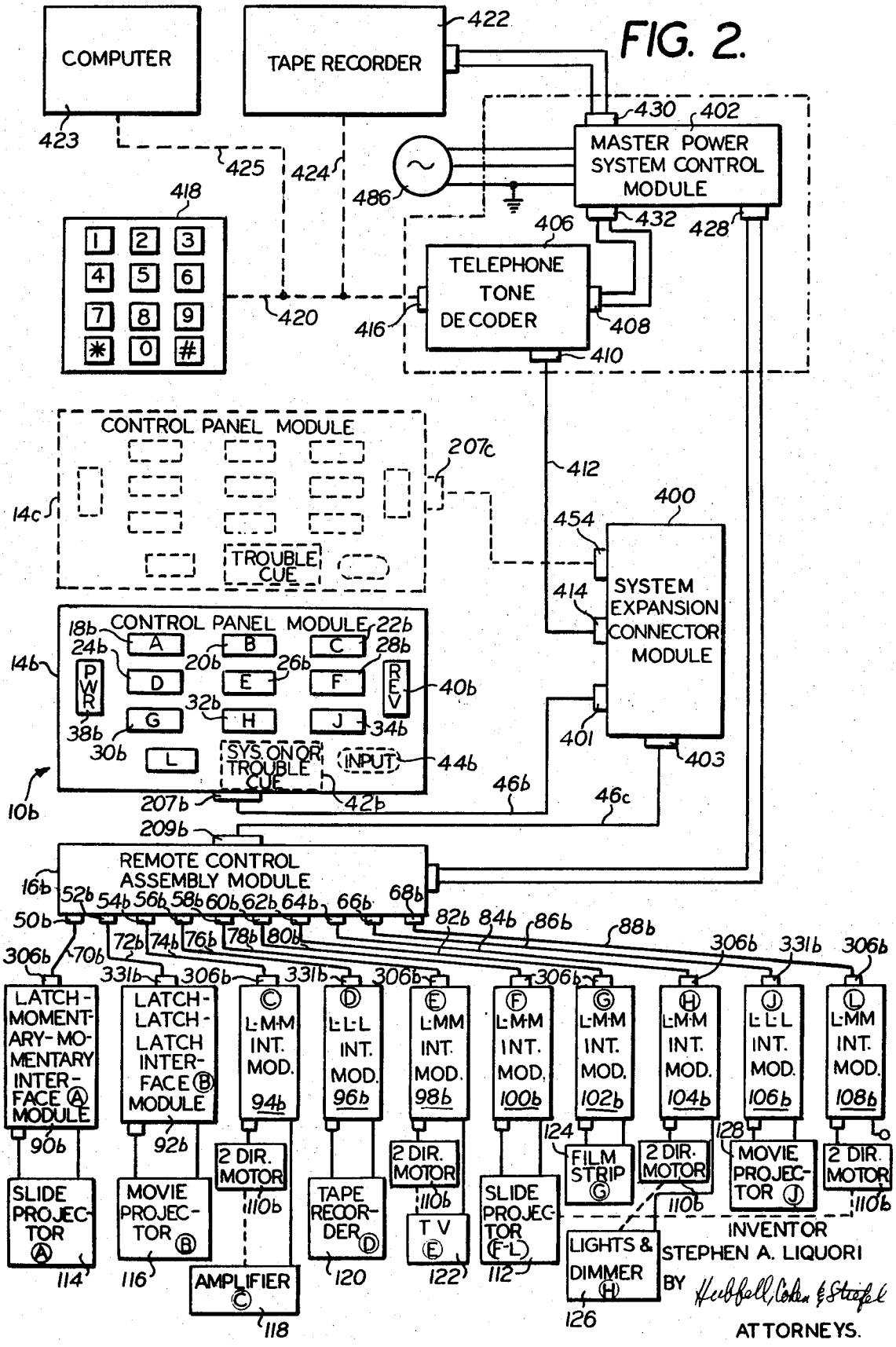
FIG. 2.


COMPUTER
TAPE RECORDER
422
423
425
424
430
402
MASTER POWER SYSTEM CONTROL MODULE
486
418
1 2 3
4 5 6
7 8 9
* 0 #
420
406
432
428
TELEPHONE TONE DE CODER
416
408
410
CONTROL PANEL MODULE
207c
412
14c
TROUBLE CUE
400
454
414
SYSTEM EXPANSION CONNECTOR MODULE
401
403
CONTROL PANEL MODULE
18b
22b
24b
28b
20b
26b
32b
34b
40b
38b
30b
A B C D E F G H J L
PWR
REV
SYS ON OR TROUBLE CUE
INPUT
44b
42b
46b
46c
10b
207b
209b
REMOTE CONTROL ASSEMBLY MODULE
16b
52b 54b 56b 58b 60b 62b 64b 66b 68b
50b
72b 74b 76b 78b 80b
82b 84b 86b 88b
306b 331b
70b
LATCH-MOMENTARY-MOMENTARY INTERFACE (A) MODULE
90b
LATCH-LATCH-LATCH INTERFACE (B) MODULE
92b
(C) L-M-M INT. MOD. 94b
(D) L-L-L INT. MOD. 96b
(E) L-M-M INT. MOD. 98b
(F) L-M-M INT. MOD. 100b
(G) L-M-M INT. MOD. 102b
(H) L-M-M INT. MOD. 104b
(J) L-L-L INT. MOD. 106b
(L) L-M-M INT. MOD. 108b
2 DIR. MOTOR
110b
124
128
FILM STRIP (G)
MOVIE PROJECTOR (J)
SLIDE PROJECTOR (A)
MOVIE PROJECTOR (B)
TAPE RECORDER (D)
T V (E)
SLIDE PROJECTOR (F-L)
LIGHTS & DIMMER (H)
114
116
AMPLIFIER (C)
118
120
122
112
126
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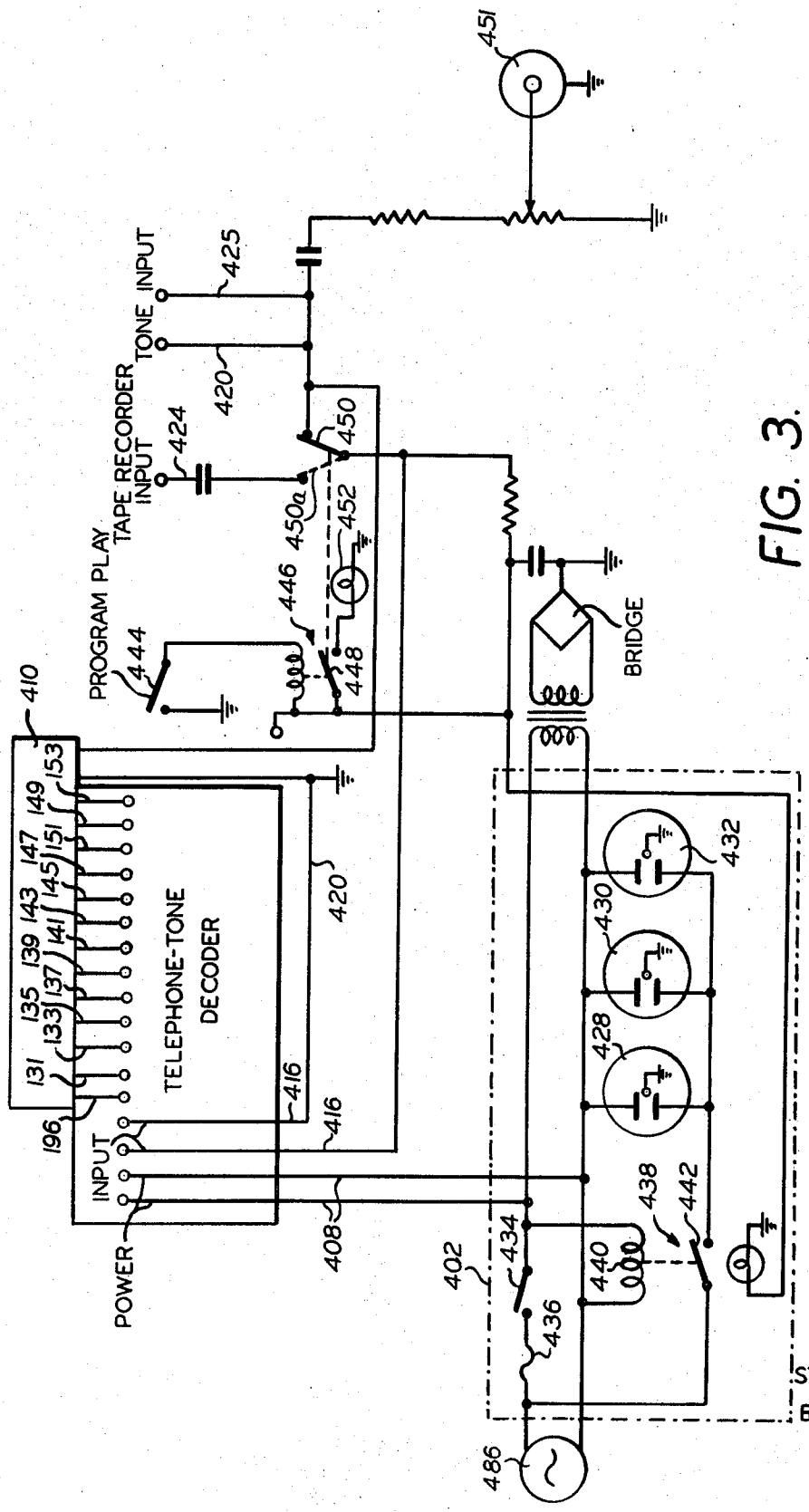

FIG. 3.

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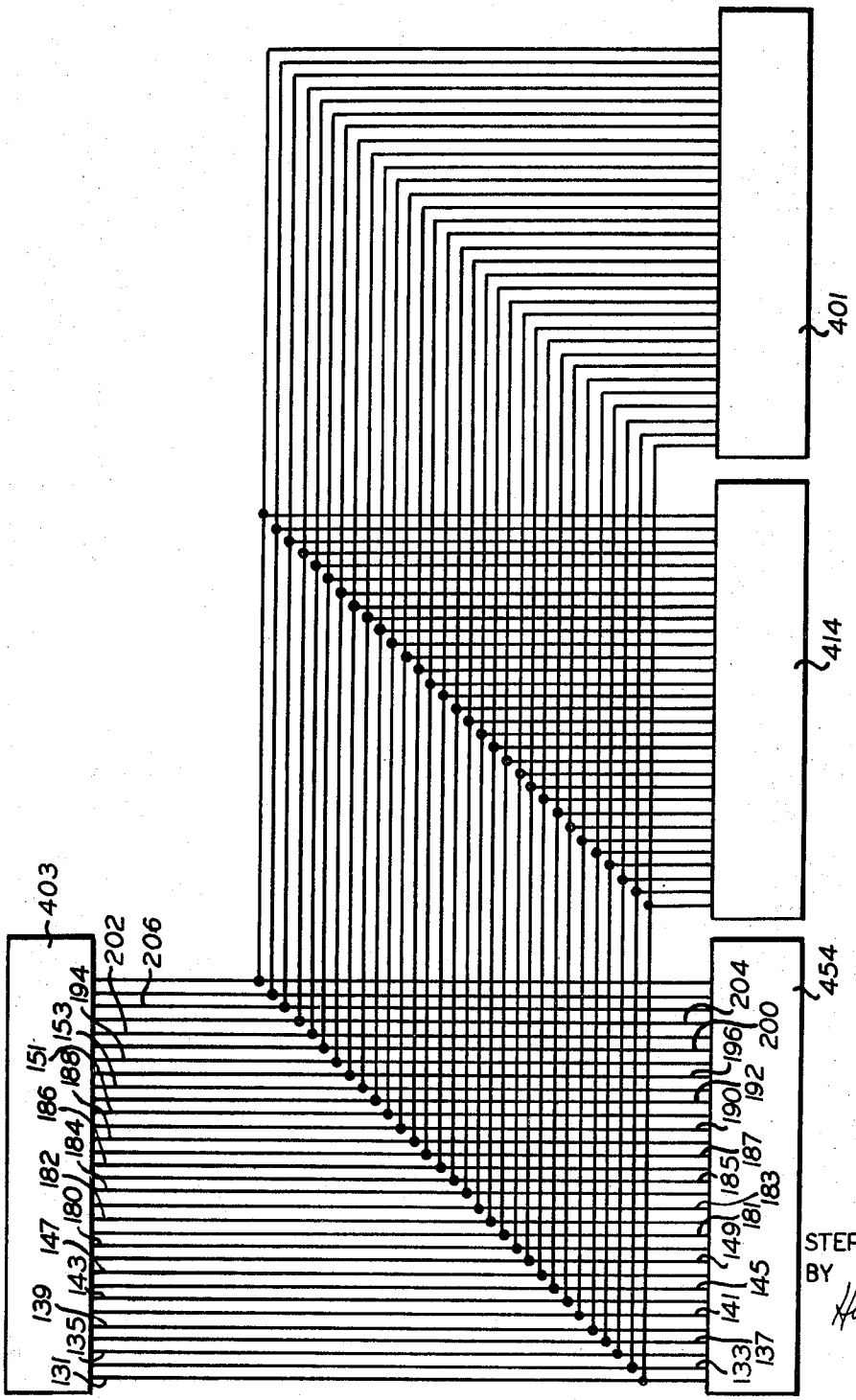

FIG. 4.

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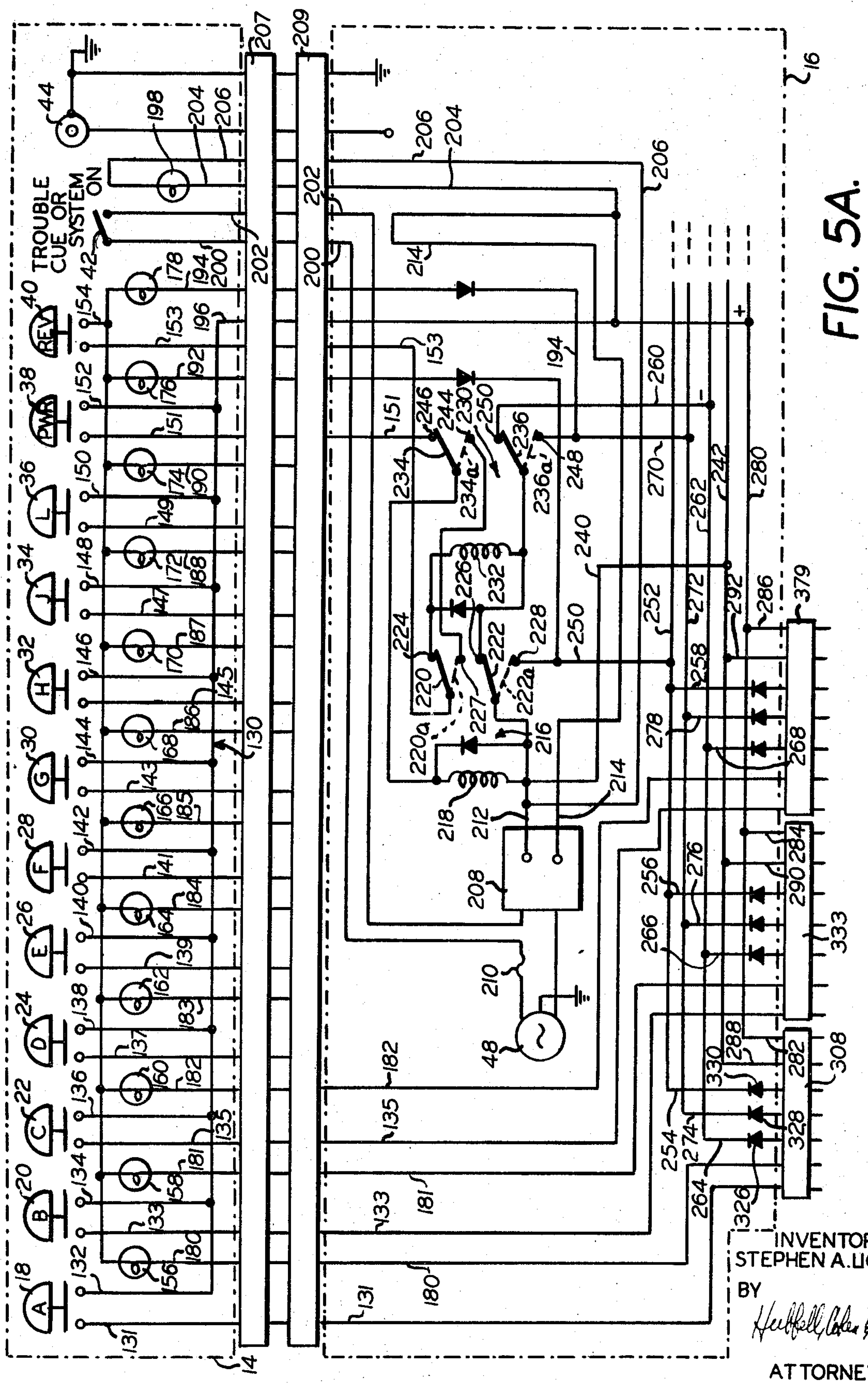

FIG. 5A.

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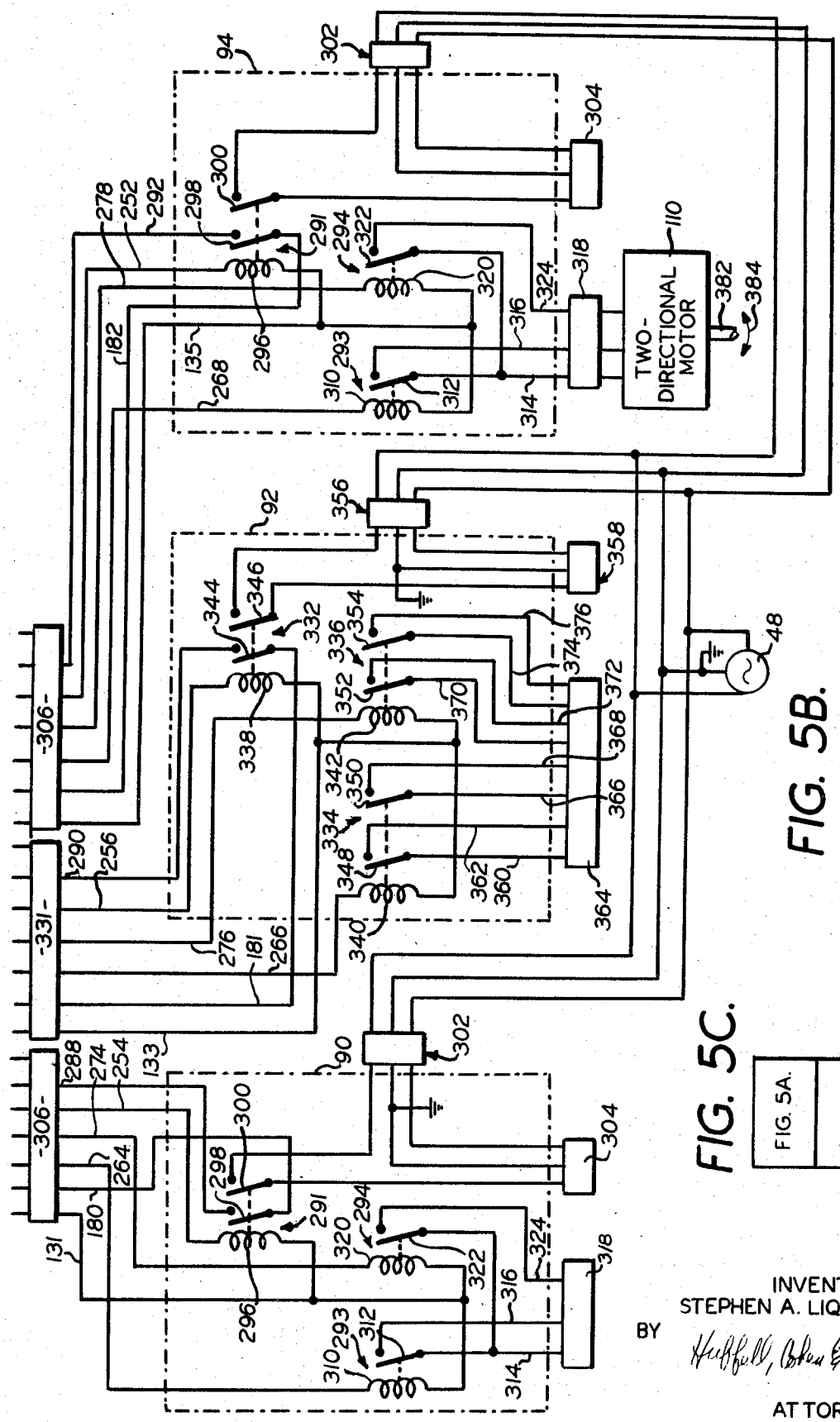

FIG. 5B.

FIG. 5C.

FIG. 5A. FIG. 5B.

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MODULAR AUDIO-VISUAL CONTROL SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to modular audio-visual device control systems in which a plurality of audio-visual device control functions are provided from a momentary device control function.

2. Description of the Prior Art

Audio-visual control systems are well known. These systems are normally utilized to control the operation of either a single audio-visual device, or a plurality of these devices, such as any combination thereof, where the term "audio-visual" as used hereinafter throughout the specification and claims is defined as encompassing devices which provide either solely an audio output such as a tape recorder, or solely a visual output such as a slide projector as well as those devices which provide both an audio and a visual output such as a movie projector. Such control systems have found widespread use in the area of what is commonly termed "teaching machines."

These audio-visual control systems are "hard-wired" systems, that is systems which are wired to do a specific function in a specific manner. These "hard-wired" systems normally provide a fixed specific type of function, such as a momentary function which is one that is intermittent or unstable, or a latch function which is one that is continual or stable, to each of the devices to be controlled so as to provide a fixed specific quantity of functions to each device to be controlled as well as for the system as a whole. Therefore, these prior art systems are not versatile or flexible, and once such a system has been "hard-wired" to provide these specific parameters for the system, these parameters cannot easily be changed without considerable loss of time and expense to the user of the system. Furthermore, these systems normally require a separate "hard-wired" circuit path and associated relay for each function to be performed, with a specific control button being required for each function to be performed. If such a prior art control system were to be utilized, for example, to control ten audio-visual devices with three functions desired for each device, such as turning the device on, having the device operate in a forward position and in a reverse position, thirty control buttons providing thirty "hard-wired" paths would be required. This is both cumbersome and costly as well as having limited flexibility and versatility. In an attempt to simplify such a system, some prior art control systems have utilized multi-position relays to provide a plurality of functions. However, in such instances, "hard-wired" paths are still utilized for each of the functions, thereby still providing no or limited flexibility.

Where such a system is utilized, for example, in an auditorium environment where the programs to be presented as well as their format may vary from day-to-day or week-to-week, the expense and inconveniences associated with altering the audio-visual control system which has been provided for a specific program format is both inefficient and uneconomical. Therefore, separate control and "hard-wired" paths must be provided in such a system for all possible contingencies or utilizations of the system. This too results in a rather cumbersome and costly system.

Furthermore, these systems are not capable of directly and easily interfacing with an automatic control mechanism such as a computer control mechanism, or standard touch-tone telephone control mechanism. Therefore, if it is desired to control such a prior art system automatically, as from a prerecorded tape, an elaborate switching network must be utilized in conjunction with the system. This too results in considerable increased cost for the system as well as a more cumbersome system. This lack of versatility and flexibility in the prior art audio-visual control systems has made these systems uneconomical, inefficient and impractical when it is desired to provide a variety of program formats using a single audio-visual control system.

These disadvantages of the prior art are overcome by the present invention.

SUMMARY OF THE INVENTION

A modular control system which provides a plurality of audio-visual device control functions, where a function is defined as a device controlling operation such as "on-off," "play film" or "rewind film," for a plurality of audio-visual devices from a momentary, that is intermittent, device control function is provided. The modular control system includes modular selection means which selectively provide a particular audio-visual device control path, where a control path is defined as a signal path for a control signal. The modular selection means includes means for providing an operational mode control path, such as a forward mode, a power mode or a reverse mode, the operational mode control path being common to the plurality of audio-visual devices to be controlled by the system of the present invention. A momentary device control path is associated with the momentary device control function and is particular to one of the plurality of audio-visual devices. The modular selection means provides the particular audio-visual device control path from the common operational mode control path and the particular momentary device control path.

The modular selection means may include frequency responsive means which are responsive to tones, such as provided by a conventional touch-tone telephone, if automatic operation of the system or operation via telephone lines from a remote location is desired. In this instance, a particular frequency or tone is associated with a particular momentary device control function and the frequency responsive means selectively provides the particular momentary device control path in response to the particular frequency detected. If manual operation is desired, the modular selection means includes a control module which contains a plurality of momentary device control function providing means, such as control buttons connected in parallel, with a particular momentary device control path being associated with a particular momentary device control function. Furthermore, the modular selection means includes means for changing the operational modes of the system, such as a pair of double-pole-double-throw latch relays which inhibit all modes but the selected mode, in order to provide a different particular audio-visual device control path for the momentary device control function and associated path by changing the common operational mode control path.

Modular audio-visual-device control interface means are removably connected between the modular selection means and one of the plurality of audio-visual devices for selectively providing one of the plurality of audio-visual device control functions for this device in accordance with the particular audio-visual device control path which is established.

The modular audio-visual-device control interface means includes a plurality of relays connected in parallel, each relay of the plurality of relays being associated with a different audio-visual device control path for providing one audio-visual device control function each. The interface means or modules may provide a latch function and two momentary functions,wherein the momentary functions may be unidirectional rotary movements when a two-directional motor mechanism is utilized in conjunction with the momentary function providing means, or the interface module may provide three latch functions. Momentary relays, such as single-pole-single-throw relays, provide the momentary functions and latch relays,such as double-pole-single-throw relays, provide the latch functions. The various modular means which comprise the modular control system are removably connectable in the system such as by male and female plugs, and comprise building blocks which may be utilized to increase the versatility of the system by varying the types and quantity of control functions provided by the system in an easy and efficient manner.

BRIEF DESCRIPTION OF DRAWING

FIG. 1 is a block diagram of the preferred embodiment of the present invention;

FIG. 2 is a block diagram of an alternative embodiment of the present invention;

FIG. 3 is a schematic diagram,partially in block of a portion of the embodiment shown in FIG. 2;

FIG. 4 is a schematic diagram of another portion of the embodiment shown in FIG. 2; and

FIGS. 5A and 5B when taken together as shown in FIG. 5C is a partial schematic diagram of the embodiment shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

General Description

Referring now to the drawings in detail and especially to FIG. 1 thereof, the audio-visual control system of the present invention, generally referred to by the reference numeral **10**, is shown. As shown and preferred, the audio-visual control system **10** includes a modular selection means, generally referred to by the reference numeral **12**, which preferably includes a control panel module **14** and a remote control assembly module **16**, to be described in greater detail hereinafter. Preferably, the control panel module **14** includes a plurality of control buttons. Most preferably there are 12 such buttons **18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38**, and **40** so as to have the same quantity of buttons on control panel module **14** as on a conventional Western Electric touch-tone telephone pad so as to be interfaceable therewith or replaceable thereby to enable remote operation, such as via telephone lines, as will be explained in greater detail hereinafter. In addition, as shown and preferred, another control button **42**, labeled "SYSTEM ON," can be included on the control panel module **14** for selectively providing a master power function for the system **10** if desired. Furthermore, an input jack **44** may be included on the control panel module **14** to provide an additional control input to the system **10**, as will be described in greater detail hereinafter.

The control panel module **14** preferably has a 31 conductor output which is preferably connected to a 31 conductor input of the remote control assembly module **16**. This thirty-one conductor interconnection is illustratively shown by the single conduction path **46**. Preferably, the remote control assembly module **16** is removably connectable, such as by a plug, to a source of AC power **48** such as a **120** volt AC source supplied through a conventional wall outlet. The remote control assembly module **16** preferably provides a plurality of outputs through a plurality of multiple conductor connectors, illustratively shown as comprising 10 such connectors **50, 52, 54, 56, 58, 60, 62, 64, 66**, and **68**. Preferably, each of the connectors **50** through **68**, inclusive, provides seven output paths only one such output path **70, 72, 74, 76, 78, 80, 82, 84, 86**, and **88** being illustratively shown for each connector **50** through **68**, inclusive, respectively. Each connector **50** through **68**, inclusive, via paths **70** through **88** inclusive, respectively, is preferably connected to an audio-visual-device control interface module, illustratively shown as comprising 10 such modules **90, 92, 94, 96, 98, 100, 102, 104, 106**, and **108**, one interface module being provided for and connected to each output connector **50** through **68**, inclusive, of the remote control assembly module **16**. Preferably, these audio-visual-device control interface modules **90** through **108**, inclusive, are one of two basic types, each type preferably providing three audio-visual-device control functions, where an audio-visual device control function is defined as a device controlling operation such as ON-OFF, or FORWARD, or REVERSE for an audio-visual device.

One of the preferred two basic types of interface modules **90** through **108**, inclusive, is termed a "LATCH-LATCH-LATCH INTERFACE MODULE," illustratively represented by interface modules **92, 96** and **106**, and will be described in greater detail hereinafter, with such interface module **92, 96** and **106** preferably providing three audio-visual latch control functions, which are bistable functions. The other of the preferred two basic types of interface modules **90** through **108** inclusive, is termed a "LATCH-MOMENTARY-MOMENTARY INTERFACE MODULE," illustratively represented by interface modules **90, 94, 98, 100, 102, 104** and **108** and will be described in greater detail hereinafter, with such interface module **90, 94, 98, 100, 102, 104** and **108** providing an audio-visual latch control function and a pair of audio-visual momentary control functions,which are unstable functions. As shown and preferred in FIG. 1, the "LATCH-MOMENTARY-MOMENTARY INTERFACE MODULE" can be modified, as will be described in greater detail hereinafter, to provide bidirectional, that is in two directions, rotary control by means of a two-directional motor rotary mechanism electrically connected to the momentary function providing portion of the interface module as illustrated by modules **94, 98, 104**, and **108**, which motor **110** is preferably mechani-

cally connected to a rotary shaft of the control knob of the audiotvisual device to be controlled. In this manner rotary control functions such as volume, focus, or dimming of lights can be provided.

Furthermore, as shown and preferred in FIG. 1, each of the interface modules **90** through **108**, inclusive, is connected to at least one audio-visual device to be controlled, with interface modules **100** and **108** illustratively being shown as both controlling the same audio-visual device, illustratively shown as being a conventional slide projector **112**, to provide five audio-visual control functions thereto, four audio-visual momentary control functions and one audio-visual latch control function, one of the six possible control functions (latch function of module **108**) illustratively shown as not being utilized. For purposes of illustration, interface module **90** is connected to a conventional slide projector **114**, interface module **92** is connected to a conventional movie projector **116**, interface module **94** is connected to a conventional amplifier **118**, interface module **96** is connected to conventional tape recorder **120**, interface module **98** is connected to a conventional television receiver **122**, interface module **102** is connected to a conventional film strip device **124**, interface module **104** is connected to room lighting and dimmer switch arrangement **126**, and interface module **106** is connected to a conventional movie projector **128**, in addition to the connection of interface modules **100** and **108** to slide projector **112**. Preferably, each of the control panel module **14** control buttons **18** through **36**, inclusive, is operatively associated with one of the interface modules **90** through **108**, inclusive, respectively, to provide a momentary device control function thereto in response to the operation of the respective control button **18** through **36** inclusive.

"CONTROL PANEL MODULE"

Now referring to FIGS. **1** and **5A** and describing the control panel module **14** in greater detail. As shown in FIG. **1**, each of the control buttons **18** through **36**, inclusive, labeled A, B, C, D, E, F, G, H, J, and L, respectively, controls a designated interface module **90** through **108**, inclusive, with the interface modules illustratively being labeled with the associated letter as well as the audio-visual device controlled thereby. Preferably, each of these control buttons **18** through **36**, inclusive, is a push-button momentary switch which closes an open circuit associated therewith only when the respective button **18** through **36**, inclusive, is depressed. Control buttons **38** and **40** are also preferably push-button momentary switches which close an open circuit only when depressed to provide a power operational mode or a reverse operational mode, respectively, in a manner to be described in greater detail hereinafter. These operational modes are preferably common to all the remote control assembly module output connectors **50** through **68**, inclusive, through the circuit shown in FIGS. **5A**, as will be described in greater detail hereinafter. The power operational mode control button **38** is illustratively labeled "PWR" and the reverse operational mode control button **40** is illustratively labeled "REV" in FIGS. **1** and **5A**.

As shown and preferred in FIG. **5A**, control buttons **18** through **40**, inclusive, are connected in parallel via an associated circuit, generally referred to by the reference numeral **130**, through one connector **132** through **154**, inclusive, of each pair of connectors **131–132** through **153–154**, inclusive, which is associated with each of the control buttons **18** through **40**, inclusive. Preferably, a lamp or light **156** through **178**, inclusive, respectively, is associated with each of the control buttons **18** through **40**,inclusive, providing a visual indication of either the POWER ON state of the audio-visual associated devices,or of the common operational mode of the system **10** with respect to control buttons **38** and **40**. Lights **156** through **178**, inclusive, are preferably also connected in parallel in circuit **130** via separate paths **180** through **194**, inclusive, respectively, for each of the control buttons **18** through **40** inclusive, respectively. Conductors **131** through **153**, inclusive, via associated illumination paths **180** through **194**, inclusive, and common connection path **196** provide a particular momentary device control path, or circuit path, for the particular associated control button **18** through **40** inclusive to the remote control assembly module portion **16** of the modular selection means **12**. If a SYSTEM ON control button **42** is provided on the control panel module **14**, this control button **42** is preferably a single-pole-single-throw latch switch which is also operatively associated with a light **198** to provide a visual indication of when the system **10** is in the ON state. Four parallel conductive paths **200, 202, 204** and **206** provide the signal path for this information to the remote control assembly module portion **16** of the modular selection means **12**, in a manner to be described in greater detail hereinafter, light **198**, via paths **200, 202, 204** and **206**, being operatively connected so as to be ON when switch **42** is closed.

Furthermore, as shown in FIG. **5A**, if an input jack **44** is provided it is connected in parallel in the circuit as shown in FIG. **5A**. As shown in the preferred embodiment in FIG. **5A** a 31 conductor or pin male connector **207** is utilized for the output connector.

"REMOTE CONTROL ASSEMBLY MODULE"

Now referring to the remote control assembly module portion **16** of the modular selection means **12**. As shown and preferred in FIG. **5A**, the 31 pin male output connector **207** of the control panel module **14** is pluggable into a 31 pin female input connector **209** of remote control assembly module **16**, to provide a plurality of parallel circuit paths, hereinafter termed audio-visual device control paths as these paths provide the various routings for the particular control functions of the audio-visual devices, in a manner to be described in greater detail hereinafter.

Furthermore, as shown and preferred, the remote control assembly module **16** includes a DC power supply **208**, which is illustratively shown as being 24 volts when a 120 volt AC power is supplied to the remote control module **16**, the power supply **208** supplying DC power to operate the various portions of the control panel module **14**, remote control assembly module **16**, and audio-visual device interface modules **90** through **108**, inclusive, in a manner to be described in greater detail hereinafter. Preferably, the DC power supply **208** is conventional and includes a transformer and rectifier to provide the DC power for the system **10**

from the AC power input 48. A conventional fuse 210 is preferably provided between the AC power source 48 and the DC power source 208 to protect the system 10 against current overloads.

For purposes of illustration, the output leads of the DC power supply 208 are labeled B minus (B—) for lead 212 and B plus (B+) for lead 214. Preferably, the B— circuit path 212 of power supply 208 is connected in parallel to a double-pole-double-throw latch relay 216, termed the power mode latch relay, which includes a solenoid portion 218 and an armature portion comprising switches 220 and 222 which are two-position switches having a first contact position 224 and 226, respectively, and another contact position 227 and 228, respectively, where contact position 228 represents the common or ground for latch relay 216. Contacts 224 and 226 are preferably connected to another double-pole-double throw latch relay 230,termed the reverse mode latch relay, having a solenoid portion 232 and an armature portion comprising two-position switches 234 and 236. Contacts 224 and 226 of relay 216 are preferably connected across the solenoid 232 of relay 230, with contact position 226 being further connected, in parallel, to switch 236 of relay 230. Switch 234 of relay 230 is connected to solenoid 218 of the power latch relay 216, which solenoid 218, is also connected, in parallel, via path 240 to a common bus 242 of the remote control assembly module 16. Two-position switch 234 of relay 230 has an open circuit contact position 244 and a closed circuit contact position 246, and two-position switch 236 has contact positions 248 and 250 which are selectively connected to contact position 226 of the power mode latch relay 216 which thereby determines the common or ground for the operational mode for relay 230 as well as relay 216. Power mode latch relay 216 and reverse mode latch relay 230 comprise a means for selectively providing a common operational mode in a manner to be described in greater detail hereinafter.

As shown and preferred in FIG. 5A, the power mode relay 216 and reverse mode relay 230 are operatively connected so that only one of these two operational modes is possible at a given time. When switches 220 and 222 are in the position shown by the solid lines in FIG. 5A, the system 10 is in what is termed the forward mode, which is the normal mode of operation. When switches 220 and 222 are in the position shown by dotted lines 220*a* and 222*a*, with switch 222 in contact position 228 and switch 220 in contact position 227, the system 10 would be in what is termed the power mode. With switches 220 and 222 in the position shown by the solid lines but with switches 234 and 236 of the reverse mode latch relay 230 in the other latch position shown by dotted lines 234*a* and 236*a*, with switch 234 in contact position 244 and switch 236 in contact position 248, the system 10 would be in what is termed the reverse mode. In this manner, as will be described in greater detail hereinafter, the preferred system of the present invention shown in FIG. 1 and FIGS. 5A and 5B when taken together as shown in FIG. 5C, will be operated in the power mode, the reverse mode, or the normal forward mode.

In order to provide these common operational modes to the balance of the system 10 including interface modules 90 through 108, inclusive, contact position 228 of the power mode relay 216 is connected in parallel via path 250 to the power mode common bus 252 which is common to all the audio-visual device control interface modules 90 through 108, inclusive, via parallel connector paths 254, 256, and 258, respectively, for the three interface modules 90, 92, and 94, illustratively shown, modules 96 through 108, inclusive, being omitted from FIG. 5A for purposes of clarity, the interconnections to this common power mode bus 252 being similar thereto for the balance of the interface modules 96 through 108, inclusive. Contact position 250 of the reverse mode latch relay 230 is connected in parallel via path 260 to the forward mode common bus 262 which is also common to all the interface modules 90 through 108, inclusive, via parallel connector paths 264, 266, and 268, respectively, for the three interface modules 90, 92 and 94 illustratively shown, the interconnections to this common forward mode bus 262 being similar thereto for the balance of the interface modules 96 through 108, inclusive. Finally, contact position 248 of the reverse mode latch relay 230 is connected in parallel via path 270 to the reverse mode common bus 272 which is also common to all the interface modules 90 through 108, inclusive, via parallel connector paths 274, 276 and 278, respectively, for the three interface modules 90, 92 and 94 illustratively shown, the interconnections to this common reverse mode bus 272 being similar thereto for the balance of the interface modules 96 through 108, inclusive.

The B+ circuit path 214 is preferably connected, in parallel, through the SYSTEM ON switch 42, via path 202, to a B+ common bus 280 which is also common to all the audio-visual device control interface modules 90 through 108, inclusive, via parallel connector paths 282, 284, and 286, respectively, for the three interface modules 90, 92 and 94 illustratively shown, the interconnections to this common B+ bus 280 being similar thereto for the balance of the interface modules 96 through 108, inclusive. The B— circuit path 212 is also connected in parallel, via path 240 to a common B— bus 242 which is also common to all the interface modules 90 through 108, inclusive, via parallel connector paths 288, 290 and 292, respectively, for the interface modules 90, 92 and 94 illustratively shown, the interconnections to this common B— bus 242 being similar thereto for the balance of the interface modules 96 through 108, inclusive.

"AUDIO-VISUAL DEVICE CONTROL INTERFACE MODULES"

Referring now to FIG. 5B, and describing the audio-visual device control interface modules 90 through 108, inclusive in greater detail. As was previously mentioned, only three such interface modules 90, 92 and 94 are shown in detail in FIG. 5B, the other interface modules 96 through 108, inclusive, being omitted for purposes of clarity. However, interface module 90 is exemplary of the "LATCH-MOMENTARY-MOMENTARY" interface module type,with interface modules 94, 98, 100, and 102, 104 and 108 preferably being similar thereto in structure and operation, interface modules 94, 98, 104 and 108 differing slightly therefrom by means of the interconnection of each to a two-directional motor 110; and interface module 92 is exemplary of the "LATCH-LATCH-LATCH" inter-

face module type, with interface modules **96** and **106** being preferably identical thereto in structure and operation.

Describing first the audio-visual device control interface module "LATCH-MOMENTARY-MOMENTARY" type as exemplified by interface module **90**, this type module preferably includes a double-pole-single-throw latch relay **291**, and a pair of single-pole-single-throw momentary relays **293** and **294**, with relays **291**, **293** and **294** all being connected in parallel with each other. Preferably latch relay **291** comprises a solenoid coil **296** and an armature including switches **298** and **300**,with the solenoid coil **296** being connected between path **131** and path **252**, which is the power mode common bus, via path **254**, so as to latch switches **298** and **300** in the closed position when control button **18** is initially depressed with the system **10** in the power mode. This relay **291** is termed the power mode latch relay due to its interconnection with the power mode common bus **252**. Switch **298** opens or closes a circuit between path **180** and **288** which turns ON light **156** when switch **298** is latched in the closed position. Interface module **90** has an AC power input terminal **302**, such as a three-conductor male plug, and an AC power output terminal **304**, such as a three-conductor female plug, with the AC power input terminal **302** being connected to the source of AC power **48** such as by a plug interconnection. Preferably, the audio-visual device to be controlled, such as the slide projector **114** has its power input which is normally a male plug, plugged into the AC power output **304** of the interface module **90**. Switch **300** provides an open or closed circuit between the AC power input **302** and the AC power output **304** of the interface module **90** to supply AC power to the audio-visual device to be controlled, in this instance the slide projector **114**, to turn the device ON or OFF; the device **114** being turned ON when the switch **300** is latched in the closed position. Preferably, interface module **90** is pluggable into the remote control assembly module **16** by means of a six pin or conductor male connector **306** which plugs into a seven pin or conductor female connector **308** to complete the audio-visual device control or circuit paths thereto.

Momentary relay **293** includes a solenoid coil **310** and an armature **312**, with the solenoid coil **310** being connected between path **131** and path **262**, which is the forward mode common bus, via path **264**, so as to operate relay **293** and close switch **312** whenever control button **18** is depressed. This momentary relay **293** is termed the forward mode momentary relay due to its interconnection with the forward mode common bus **262**. Switch **312** is connected in parallel across a pair of output leads **314** and **316** which provide the forward momentary function to the slide projector **114**. Preferably, these leads are provided from a three pin or conductor male plug connector **318** which plugs into a three pin or conductor female connector (not shown) of the slide projector **114**, though other types of interconnection and connectors could be utilized if desired.

Momentary relay **294** includes a solenoid coil **320** and an armature **322**, with switch **322** being connected in parallel with output lead **314**. The other terminal of the switch **322** is connected to the third output lead **324** of the three conductor output connector **318** to open or close the circuit between conductors **314** and **324**. Solenoid coil **320** is connected between path **272**, which is the reverse mode common bus,via path **274**, and path **131** so as to operate relay **294** and close switch **322** each time the control button **18** is depressed when the system **10** is in the reverse mode. This relay **294** is termed the reverse mode momentary relay due to its interconnection with the reverse mode common bus **272**.

Preferably, blocking diodes **326**, **328** and **330** are provided on paths **264**, **274**, and **254**, respectively, so as to isolate the operation of the associated operated relay from the other corresponding relays of the other interface modules **92** through **108**, inclusive, connected in parallel to the common operational mode buses **252**, **262**, and **272**. Blocking diodes **326**, **328** and **330** are connected in the circuit so as to be forward biased when the associated momentary control button **18** is depressed to complete the control path, or circuit path, through the enabled relay **291**, **293** or **294** dependent on the mode of the system **10**, and to be back-biased in the opposite direction.

Now describing in detail the "LATCH-LATCH-LATCH" interface module **92** associated with movie projector **116**, interface module **92** preferably being identical in structure and operation with interface modules **96** and **106** as was previously mentioned. Preferably, interface module **92** is pluggable into the remote control assembly module **16** by means of a six pin or conductor male connector **331** which plugs into a seven pin or conductor female connector **333** to complete the audio-visual device control or circuit paths thereto. As shown and preferred, interface module **92** includes three latch relays **332**, **334** and **336** connected together in a parallel arrangement with each other, each latch relay **332**, **334** and **336** preferably being a double-pole-single-throw latch relay. Each latch relay **332**, **334** and **336** includes a solenoid coil **338**, **340** and **342**, respectively, and an armature including switches **344** and **346**, **348** and **350** and **352** and **354**, respectively. Interface module **92** preferably has an AC power input terminal **356** similar to AC power input **302** of module **90**, such as a three-conductor male plug which is pluggably connected to the source of AC power **48**, and an AC power output terminal **358** similar to AC power output **304** of module **90**, such as a three-conductor female plug, into which the power input (not shown), which is normally a male plug, of the audio-visual device to be controlled, in this instance movie projector **116**, is plugged to receive AC power.

Latch relay **332** controls the supply of AC power to the AC power output terminal **358**, and hence to the projector **116**, in a manner to be described in greater detail hereinafter. Solenoid coil **338** of latch relay **332** is connected between paths **133** and **256**, path **256** being connected to the power mode common bus **252**, so as to latch switches **344** and **346** in the closed position when control button **20** is initially depressed with the system **10** in the power mode. This relay **332** is termed the power mode latch relay due to its interconnection with the power mode common bus **252**. Switch **344** of the armature portion of relay **332** is connected between paths **181** and **290**, where path **290** is connected in parallel to common bus **242** to complete the circuit between paths **181** and **290** when switch **344** is

latched in the closed position. Switch **346** of power mode latch relay **332** is connected between the AC power input **356** and the AC power output **358** to provide a closed circuit therebetween when switch **346** is latched in the closed position.

Latch relays **334** and **336** provide the audio-visual device latch control functions for the associated movie projector **116**, such as "play" and "rewind." Solenoid coil **340** of latch relay **334** is connected between control path **133** which is the momentary device control path, or circuit path, associated with control button **20** which controls the functioning of the movie projector **116**, and control path **266** which is connected in parallel to the forward operational mode common bus **260** to complete a circuit between paths **133** and **266** and latch relay **334** when control button **20** is initially depressed when the system **10** is in the forward mode. This relay is termed the forward mode latch relay due to its interconnection with the forward mode common bus **260**. Switch **348** of the armature portion **348–350** is preferably connected across a pair of output paths **360** and **362** of a pluggable output connector **364**, such as a male plug, to complete a circuit therebetween when switch **348** is latched in the closed position so as to provide a latch control function path to the projector **116** which is preferably pluggable into connector **364**, such as by a female plug (not shown). Similarly, switch **350** of the armature portion **348–350** is connected across another pair of output paths **366** and **368** of the output connector **364** to provide a closed circuit therebetween when switch **350** is latched in the closed position to provide the balance of the latch control path to complete the circuit and provide the latch control function to the projector **116** when four pins or conductors are required to provide a latch control function, such as in a Kodak movie projector.

Solenoid coil **342** of latch relay **336** is connected between momentary device control path **133** and control path **276**, where path **276** is connected in parallel to the reverse operational mode common bus **272**, so as to complete a circuit between paths **133** and **276** and latch relay **336** when control button **20** is initially depressed when the system **10** is in the reverse operational mode. This relay is termed the reverse mode latch relay due to its interconnection with the reverse mode common bus **272**. Switch **352** and switch **354** of the armature **352–354** are each connected between a pair of latch control paths **370** and **372**, and **374** and **376**, respectively, to complete a circuit through these two respective paths when switches **352** and **354** are latched in the closed position to provide the audio-visual device latch control function to projector **116** in the reverse mode of the system **10**. As shown and preferred, output connector **364** is an eight pin or conductor male connector pluggable in an eight pin female connector of the projector **116**, such as a Kodak movie projector. If a different type of projector connector is required, output leads **360**, **362**, **366**, **368**, **370**, **372**, **374** and **376** may be increased or decreased, such as by providing additional switches for the armature portions of the respective relays **334** and **336**, so as to adapt the connector **364** for such an audio-visual device requirement.

If desired, either of the interface module basic types as exemplified by modules **90** and **92** may be modified to provide special types of audio-visual device control functions such as volume control, focus control of a projector, or dimming control of room lights. Such special functions can be provided by a modification to the basic "LATCH-MOMENTARY-MOMENTARY" interface module exemplified by interface module **90**. As was previously mentioned, interface modules **94**, **98**, **104** and **108** are examples of this type of interface module, and are all preferably similar in structure and operation to interface module **94** shown in FIG. **5B**. Furthermore, as also previously mentioned, interface module **94** is preferably similar in structure and operation to previously described interface module **90**, the same reference numerals being utilized for identical parts thereof, with the exception that the output leads **314**, **316**, and **324** of the momentary latches **293** and **294** via connector **318**, which is preferably a three-conductor male plug, are directly interfaced such as by a plug interconnection, with a conventional two-directional motor **110** having a rotary output shaft **382** which is preferably mechanically linked to the rotary shaft (not shown) of the device to be controlled, which for module **94** is preferably the volume control shaft of amplifier **118**. Rotary shaft **382** of the bidirectional motor **110** rotates in one of two directions, clockwise or counterclockwise, indicated by double-sided arrow **384**, at a time, the direction being **293** on which momentary relay **293** or **294** is enabled. The balance of the circuitry associated with interface module **94** is identical with that described for interface module **90** and will not be described in greater detail hereinafter.

Suffice it to say that solenoid coil **296** of power relay **291** is connected between momentary device control path **135** and control path **258**, which is connected in parallel to the power operational mode common bus **252**,so as to latch switches **298** and **300** in the closed position when control button **22** is initially depressed with the system **10** in the power mode; switch **298** is connected between control path **182** and control path **292**, which is connected to the common bus **242**, to complete the circuit therebetween when switch **298** is latched in the closed position; and switch **300** is connected between the AC power input **302** and the AC power output **304** to complete the circuit therebetween each time switch **300** is latched in the closed position. Furthermore, solenoid coil **310** of momentary relay **293** is connected between momentary device control path **135** and path **268**, which is connected in parallel to the forward operational mode common bus **262**, to complete the circuit therebetween thereby permitting current to flow through coil **310** each time button **22** is depressed when the system **10** is in the forward operational mode. Switch **312** associated with solenoid coil **310** is connected between output paths **314** and **316** to complete the circuit therebetween to the motor **110** each time the control button **22** is depressed when the system **10** is in the forward operational mode. In addition, solenoid coil **320** of momentary relay **294** is connected between the momentary device control path **135** and path **278** to complete a circuit therebetween, current being provided therethrough each time control button **22** is depressed when the system **10** is in the reverse operational mode. Switch **322**, which is associated with solenoid coil **320** and is connected between paths **314** and **324** thereby closes each time

the control button 22 is depressed when the system 10 is in the reverse mode so as to provide an opposite direction momentary control function to the motor 110. As was previously mentioned, blocking diodes 326, 328 and 330 function to isolate the operation of relays which are similarly connected to the respective operational mode common buses 262, 272 and 252, respectively. A similar blocking diode, the same reference numeral being utilized therefor, is preferably associated with each parallel connecting path to the respective operational mode common bus for each of the interface modules 90 through 108, inclusive, which are pluggable into the remote control assembly module 16, each blocking diode 326, 328 and 330 being operatively connected so as to be back-biased to other than its particular associated momentary control function caused by the depressing of the associated control button 18 through 40, inclusive. Preferably, the associated six pin male connector 306 of interface module 94 is pluggable into a seven pin or conductor female connector 379 of remote control assembly module 16 to complete the audio-visual device control or circuit paths thereto.

As shown and preferred, for interface module 98, the rotary shaft 382 thereof is mechanically connected to the volume control of the television 122; for interface module 104, the rotary shaft 382 thereof is preferably mechanically connected to the wiper arm of a dimmer switch (not shown) associated with the room lights 126; and for interface module 108, the rotary shaft 382 thereof is mechanically connected to the focus control of slide projector 112.

"OPERATION"

Now referring to FIGS. 5A and 5B taken together as shown in FIG. 5C and describing the operation of the system 10. For purposes fo illustration, we shall describe the operation of the system 10 in detail with respect to interface modules 90, 92 and 94, the detailed operation of interface modules 100 and 102 being similar to that of interface module 90, the detailed operation of interface modules 96 and 106 being similar to that of interface module 92, and the detailed operation of interface modules 98, 104 and 108 being similar to that of interface module 94.

In order for the control system 10 of the present invention to be operable, power must be supplied to the system 10. This is accomplished by closing switch 42 which completes the circuit from the AC power source 48 to the DC power supply 208 to supply power to the control system 10 through the remote control assembly module 16. In order to supply power to any of the audio-visual devices 112 through 128, inclusive, to be controlled by the system 10, the system 10 must be initially placed into the power mode and the appropriate associated control buttons 18 through 36, inclusive, depressed for the devices which it is desired to turn ON. For example, if it is desired to supply power to slide projector 114, the power mode control button 38 is depressed which latches the double-pole-double-throw power mode relay 216 in the position indicated by the dotted lines 220*a* and 222*a*. This supplies power to the power operational mode common bus 252 via path 250 and completes the circuit to light 176 thereby turning the light 176 ON so as to provide an indication that the system 10 is in the power mode.

In order to supply power to the slide projector 114, which is associated with interface module 90, control button 18 is then depressed which completes the circuit path or audio-visual device control path from momentary device control path 131, through coil 296, via control path 254 to the power-operational mode common bus or control path 252. This latches power relay 291 in the closed position, closing switches 298 and 300; switch 300 closing the power circuit between the AC power input 302 and the AC power output 304 to supply power to the slide projector 114, and switch 298 completing the circuit to light 156 to provide a visual indication that projector 114 is ON. Relay 291 will remain latched in a POWER ON position until control button 18 is depressed again while the system 10 is in the power mode. This unlatches relay 291 thereby placing switches 298 and 300 in the open position.

Similarly, if it is desired to supply power to movie projector 116 and amplifier 118, which are associated with interface modules 92 and 94, respectively, for movie projector 116, control button 20 is then depressed to latch power relay 332 in the closed position by completing the circuit path, or audio-visual device control path from momentary device control path 133, through coil 338, via control path 256, to the power operational mode common bus or control path 252, latching switches 344 and 346 in the closed position to turn ON light 158 and supply power to the movie projector 116; and,for amplifier 118, control button 22 is then depressed to latch power relay 291 in the closed position by completing the circuit path from momentary device control path 135 through coil 296, via control path 252, to the power operational mode common bus or control path 252, latching switches 298 and 300 in the closed position to supply power to the amplifier 118 and to turn ON light 160. Similarly, if it is desired to supply power to any of the other associated audio-visual devices 120, 122, 112, 124, 126 or 128, to turn it ON, the appropriate control button 24 through 36, is then depressed so as to latch the respective power relay of the interface module 96 through 108, inclusive, associated with the audio-visual device 120, 122, 112, 124, 126 or 128 to be controlled. For purposes of illustration, the power relay 291 of interface module 108 is not utilized as its function is not desired in the example shown, although it may be utilized, if desired, to control the supply of power to an audio-visual device by interconnection of the device with interface module 108.

As was previously mentioned, the power mode relay 216 can be latched either in the power mode position indicated by dotted lines 220*a* and 222*a* or the forward operational mode position indicated by the solid lines. In order to operate the particular audio-visual devices which have been turned ON, the system 10 must be changed from the power operational mode to either the forward operational mode or the reverse operational mode. For purposes of explanation, we shall assume that the system 10 is initially changed to the forward operational mode. This is accomplished by once again depressing power mode control button 38, which thereby latches power mode relay 216 in the forward operational mode position indicated by the solid lines 220 and 222 and inhibits the reverse operational mode. The position of relay 216 and relay 230 in this mode, as shown by the solid lines, completes a circuit from the power supply 208, via switches 222 and 236, through

path 260, to the forward operational mode common bus 262. If it is desired to operate the slide projector 114 which is associated with interface module 90 in this forward mode so as to advance slides, for example, control button 18 is then depressed. This completes the circuit or audio-visual device control path, via momentary device control path 131 through coil 310 of relay 293, via control path 264, to the forward operational mode common bus or control path 262 to momentarily close switch 312 as long as control button 18 is depressed. The closure of switch 312 completes the circuit between output leads 314 and 316 and provides the momentary control function to slide projector 114 in this forward mode.

Similarly, for movie projector 116 which is associated with interface module 92, if control button 20 is depressed with the projector 116 ON, the circuit or audio-visual device control path is completed via momentary device control path 133, through coil 340 of relay 334, via control path 266, to the forward operational mode common bus or control path 262 to latch switches 348 and 350 in the closed position. When the control button 20 is no longer depressed, relay 334 still remains latched until the next time control button 20 is depressed in this mode to unlatch the relay 334. This completes the circuit to the movie projector 116 to provide a forward mode latch control function such as PLAY.

Furthermore, similarly for amplifier 118 which is associated with interface module 94, if it is desired to adjust the volume of the amplifier, if that is the function to be performed, in the upward direction so as to increase the volume, for purposes of explanation, control button 22 is depressed with the amplifier 118 ON, and the circuit or audio-visual device control path is completed via momentary device control path 135, through coil 310 of relay 293, via control path 268, to the forward operational mode common bus or control path 262 to momentarily close switch 312 as long as control button 22 is depressed. The closure of switch 312 supplies power to the bidirectional motor 110 to cause shaft 382 to rotate, for purposes of explanation, clockwise thereby similarly rotating the volume control shaft of the amplifier 118, so as to increase the volume of the amplifier 118. Similarly, if control buttons 24 through 36 are depressed in the forward mode, and the associated device is ON, the relay associated with the forward mode in the associated interface module 96 through 108, inclusive, will be operated so as to provide the associated forward mode control function for the associated audio-visual device.

In the preferred system 10 of the present invention, if it is desired to cause a different operation of the particular audio-visual device, such as illustratively shown as being the opposite or reverse of the function performed in the forward operational mode, the system 10 must be placed in the reverse operational mode. This is accomplished by then depressing reverse mode control button 40 which completes the circuit or audio-visual device control path via path 153, through switch 220, coil 232 and switch 222, to latch relay 230 in the position shown by dotted lines 234*a* and 236*a*. This completes the circuit through path 194 to light 178 to turn the light 178 ON thereby providing a visual indication that the system 10 is in the reverse mode. An open circuit is provided in the reverse mode for the power mode relay 216 between path 151 and coil 218. The latching of relay 230 in the reverse mode position completes the circuit from the power supply 208 to the reverse operational mode common bus or control path 272 via path 212, switches 222 and 236a, and path 270.

Thereafter, each time the control button 18 through 36, inclusive, is depressed for an audio-visual device which is ON, the associated device will be operated in the reverse mode. Assuming slide projector 114, movie projector 116 and amplifier 118 to still be ON, and initially discussing the operation of slide projector 114, when control button 18 is now depressed in the reverse mode the circuit or audio-visual device control path is completed via momentary device control path 131, through coil 320 of relay 294, via control path 274, to the reverse operational mode common bus or control path 272 to momentarily close switch 322 of momentary relay 294 as long as control button 18 is depressed. This completes the circuit between output leads 314 and 324 to supply a momentary control function in the reverse mode to the slide projector 114, such as to reverse slides,which is an advancing of slides in the opposite direction. For movie projector 116, when control button 20 is depressed in the reverse mode, the circuit or audio-visual device control path is completed via momentary device control path 133, through coil 342 of relay 336, via control path 276, to the reverse operational mode common bus or control path 272 to latch switches 352 and 354 of relay 336 in the closed position to provide the latch control function, such as rewind, in the reverse mode. Relay 336 remains latched in this position until control button 20 is depressed again in this mode. For amplifier 118, when control button 22 is depressed in the reverse mode of the system 10, the circuit or audio-visual device control path is completed via momentary device control path 135, through coil 320 of relay 294, via control path 278, to the reverse operational mode common bus or control path 272 to momentarily close switch 322 of relay 294 as long as control button 22 is depressed. The closure of switch 322 completes the circuit between output leads 314 and 324 to cause the motor 110 and shaft 382 thereof to rotate in the counterclockwise direction, thereby similarly rotating the volume control shaft of amplifier 118 so as to decrease the volume of the amplifier 118.

Similarly, if control buttons 24 through 36,inclusive,are depressed in the reverse mode, and the associated device is ON, the relay associated with the reverse mode in the associated interface module 96 through 108, inclusive, will be operated so as to provide the associated reverse mode control function for the associated audio-visual device. For example, if, in the reverse mode, control button 24 is depressed, the tape recorder 120 may rewind instead of play as in the forward mode. If control button 26 is depressed, the television 122 volume may decrease instead of increase; if control button 28 is depressed, slide projector 112 may reverse slides,as in projector 114,instead of advance slides; if control button 30 is depressed, film strip 124 may reverse instead of advance; if control button 32 is depressed, room lights 126 may get brighter instead of dimmer; if control button 34 is depressed, movie projector 128 may rewind instead of

play; and if control button **36** is depressed, the focus control of slide projector **112** may be rotated counter-clockwise instead of clockwise.

If it is desired to turn OFF the associated audio-visual devices which are ON, the system **10** must once again be placed in the power mode, as was previously mentioned. However, the system **10** preferably can be in only one operational mode at a time. Therefore, the system **10** must first be taken out of the reverse mode. This is accomplished by once again depressing the reverse mode control button **40** to unlatch relay **230** and thereby return the switches **234** and **236** to the position shown by the solid lines **234** and **236**. The circuit to light **178** is thereby opened which extinguishes light **178**, and the system **10** is now, once again, in the forward operational mode. The power mode control button **38** is then depressed, thereby once again latching power mode relay **216** in the position shown by dotted lines **220a** and **222a**, turning ON lamp **176**. The control buttons **18** through **36**, inclusive, of the audio-visual devices which it is desired to turn OFF are then depressed. This unlatches the associated power relay **291** or **332** of the associated interface modules **90** through **108**, inclusive, the power relay **291** of interface module **108** not being utilized as previously mentioned. This opens the circuit between the associated AC power input **302** or **356** and the associated AC power output **304** or **358**, respectively, thereby turning OFF the associated audio-visual device and extinguishing the light **156** through **174**, inclusive, associated with the particular control button **18** through **36**, inclusive. One or all of the audio-visual devices **112** through **128**, inclusive, can be turned OFF at this time. If they are not all turned OFF, the system **10** can then be placed in the forward operational mode by, once again, depressing the power mode control button **38**, as was previously described. If all the associated audio-visual devices have been turned OFF, and it is desired to turn OFF the control system **10**, switch **42** is then placed in the open position thereby opening the circuit to the power supply **48**.

"ALTERNATIVE EMBODIMENTS"

Referring now to FIG. **2**, an alternative embodiment of the system **10** shown and described with reference to FIGS. **1**, **5A**, **5B** and **5C**, is shown, with the same reference numerals, followed by the subscript *b*, being used to identify components in FIG. **2** which are identical with those in the embodiment shown in FIGS. **1**, **5A**, **5B** and **5C**. The modular control system shown in FIG. **2**, generally referred to by the reference numeral **10***b*, provides either manual or automatic or programmed control of the system **10***b* in a manner to be described in greater detail hereinafter. This modular audio-visual control system **10***b* preferably includes a control panel module **14***b* having control buttons **18***b* through **42***b*, inclusive, and a remote control assembly module **16***b*. The control panel module **14***b* output connector **207***b* is preferably pluggably connected to a system expansion connector module **400** to be described in greater detail hereinafter, as is the remote control assembly module **16***b* input connector **209***b*, connector **207***b* being pluggably connected to the system expansion connector module **400** via an input connector **401**,and connector **209***b* being pluggably connected to the system expansion connector module **400** via another input connector **403** such as by male-female plug interconnections. Preferably, 31 conductor paths **46***b* and **46***c*, respectively, only one such path being shown for purposes of clarity, are provided by each interconnection **207***b*–**401** and **209***b*–**403**.

The pluggable output connectors **50***b* through **68***b*, inclusive, of the remote control assembly module **16***b* are pluggably connected to interface modules **90***b* through **108***b*, inclusive, respectively, through associated input connectors **306***b* and **331***b*, input connectors **306***b* being for the "LATCH-MOMENTARY-MOMENTARY" type interface modules **90***b*, **94***b*, **98***b*, **100***b*, **102***b*, **104***b*, and **108***b*, and input connectors **331***b* being for the "LATCH-LATCH-LATCH" type interface modules **92***b*, **96***b*, and **106***b*. Connectors **50***b* through **68***b*, inclusive, are connected to interface modules **90***b* through **108***b*, inclusive, via six conductor paths **70***b* through **88***b*, inclusive, respectively, one such path being shown for each six-conductor path array for purposes of clarity. As shown and preferred, interface modules **90***b* through **108***b*, inclusive, are identical with interface modules **90** through **108** inclusive, respectively, both in structure and manner of operation and, for purposes of illustration, are connected to identical audio-visual devices **112***b* through **128***b*, inclusive, to perform the identical audio-visual device control functions described with reference to the embodiment shown in FIGS. **1**, **5A**, **5B** and **5C**. Remote control assembly module **16***b* is preferably pluggably connected to a source of AC power **48***b* through a master power system control module **402**, to be described in greater detail hereinafter. Up to this point in this discussion, the modular audio-visual control system **10***b* is identical with the control system **10** previously described with the exception of the addition of the system expansion connector module **400** and the master power system control module **402**.

The master power system control module **402** is preferably included in a modular programmer portion **404** which also preferably includes a conventional telephone-tone decoder **406**, such as a Bramco/Leedax Model MD47C 12 digit touch-tone decoder which decodes the 12 digit touch-tone information to provide a single momentary digital control signal in a conventional manner, and will not be described in greater detail hereinafter. Suffice it to say that the decoder **406** has an AC power input **408** which is pluggably connected to the master power system control module **402** and, therethrough, to the source of AC power **48***b*. In addition, the telephone-tone decoder **406** has a signal output connector **410** which preferably provides 12 possible control signal paths, illustratively shown as one such path **412** for clarity, which is pluggably connected to the system expansion connector module **400** via an input connector **414**.

The telephone-tone decoder **406** also preferably includes a signal input connector **416** for receiving the touch-tone input signal which is decoded to provide the single momentary digital control signal on one of the 12 control paths **412**. A conventional touch-tone telephone pad **418** such as provided on a standard conventional touch-tone telephone manufactured by Western Electric for the Bell System, is connected to the decoder **406** through a conventional telephone line

420 to provide remote control of the system 10*b* thereby. In addition a conventional tape recorder 422 and computer 423, preferably each having a touch-tone output, are preferably connected to the decoder 406 input 416 via conductors 424 and 425, respectively, such as telephone lines if transmission thereover is desired, or conventional cables, to preferably provide the 12 touch-tone input signal to the decoder 406. If a tape recorder 422 is utilized as the source of input signal it is also preferably pluggably connected to the master power system control module 402 and therethrough to the AC power source 48*b*. The interconnection of the touch-tone telephone pad 418, the tape recorder 422, or the computer 423 to the system 10*b* via decoder 406 may be omitted if control thereby is not desired.

Referring now to FIG. 3, the programmer portion 404 of the system 10*b* is shown in greater detail. As shown and preferred, the master power system control module 402 includes three pluggable sockets 428, 430, and 432 through which the remote control assembly module 16*b*, the tape recorder 422, and the decoder 406 are,respectively, pluggably connected, such as by male-female plug interconnections. Sockets 428, 430, and 432 are preferably connected in parallel. A master power key switch 434 is connected between the AC power source 48*b* and the sockets 428, 430 and 432 to supply power thereto in the closed position and an open circuit in the open position. Preferably, a fuse 436 is provided to protect the system 10*b* from current overloads. A single-pole-single-throw momentary relay 438 having a solenoid coil 440 and an armature portion or switch 442 is preferably connected in parallel to the master power key switch 434 for supplying current to coil 440 so as to close switch 442 when switch 434 is in the closed position and thereby complete the circuit to the sockets 428, 430 and 432 supplying AC power thereto. When such a key master power switch 434 is utilized to control the supply of AC power to the system 10*b* the SYSTEM ON control button 42*b* and associated circuitry on control panel module 14*b* is not required for this purpose and may be utilized for another purpose,such as for signaling cue or trouble if more than one control panel module 14*b* is utilized in the system 10*b*, as will be described in greater detail hereinafter.

Preferably, the master power system control module 402 also includes a program play select switch 444 which is operatively connected to a double-pole-double-throw relay 446 having a solenoid coil 447 and an armature portion comprising switches 448 and 450. Switch 448 is a single throw switch which closes a circuit to turn ON the light 452 when switch 444 is in the closed position. Switch 450 is a double-throw switch which is in the position indicated by the solid line 450 to complete a circuit to the telephone-tone decoder 406 input 416 from the telephone pad input 420 and the computer tone input 425 when the switch 444 is in the open position, and which is in the position indicated by the dotted line 450*a* to complete a circuit to the decoder 406 input 416 from the tape recorder output 424 when the switch 444 is in the closed position. The decoder 406 31 pin or conductor output connector 410 provides an output signal on one of the momentary device control paths 196, 131, 133, 135, 137, 139, 141, 143, 145, 147, 151, 149, or 153 through the system expansion connector module 400 to both the control panel module 14*b* and the remote control assembly module 16*b*, in a manner to be described in greater detail hereinafter, in response to the tone input on either path 420, 425 or 424 dependent on the position of switches 444 and 450. In addition, if it is desired to record a tone signal format for a program, the tape recorder 422 has its signal input plugged into jack 451 and is placed in the record mode, with switch 444 open and switch 450 in the position shown by the solid line 450.

Referring now to FIG. 4, the detailed schematic of the system expansion connector module 400 of the present invention is shown. This connector module 400 preferably includes a parallel matrix array including the 31 pin male connector 403 and three 31 pin pluggable female connectors 401, 414, and 454, respectively. A corresponding control path of the 31 possible control paths provided from the male connector 403 is connected in parallel to the corresponding control path of each of the male connectors 454, 414 and 401 to provide 31 parallel paths for each connector 454, 414 and 401 interconnected with the 31 parallel paths of the male connector 403, these paths corresponding to control paths 131, 133, 135, 137, 139, 141, 143, 145, 147, 149, 180, 181, 182, 183, 184, 185, 186, 187, 188, 190, 151, 192, 153, 196, 194, 200, 202, 204, and 206.

If desired, one or more additional control panel modules 14*c* identical to control panel modules 14 and 14*b*, could be included in the system 10*b*, control panel module 14*c* being shown by dotted lines for purposes of illustration, such control panel module 14*c* being pluggably connected to the system expansion connector module 400 via connector 454 and 207*c*. When two or more control panel modules 14*b* and 14*c* are utilized, the SYSTEM ON control button 42*b* could be utilized as a trouble or cue button for signaling one control panel, for example 14*c*, from the other control panel 14*b* by depressing button 42*b* to flash the light associated with button 42*c* on the other control panel module 14*c*, control buttons 42*b* and 42*c* and their associated lights being connected in series to each other and in parallel to the power supply 208 via system expansion connector module 400. If desired, the two control panel modules 14*b* and 14*c* may be located at remote locations from each other.

"OPERATION OF ALTERNATIVE EMBODIMENT"

Now describing the operation of the embodiment shown in FIG. 2. The operation of the control panel module 14*b*, remote control assembly module 16*b*, and associated interface modules 90*b* through 108*b*, inclusive, is identical to that described with reference to the embodiment shown in FIG. 1 and will not be described in greater detail hereinafter. In order to turn ON the control system 10*b* shown in FIG. 2, the key master power switch 434 is closed which completes the circuit to the sockets 428, 430 and 432. This supplies power to the remote control assembly module 16*b* through socket 428. In the embodiment shown in FIG. 2, a direct connection is provided between the AC power input and the DC power supply 208 so that closure of switch 434 supplies AC power to the DC power supply 208. Power is also supplied to the decoder 406 and the

tape recorder encoder **422** via sockets **432** and **430**, respectively.

If it is desired to operate the system **10*b*** manually in the manner previously described with reference to the embodiment shown in FIG. **1** the program play switch **44** is left in the open position, telephone pad **418** and computer **423** are not operated, and the control panel module **14*b*** may, therefore, be operated in the manner previously described with reference to the control panel module **14** to control the audio-visual devices **112** through **128**, inclusive, via connector module **400**, remote control assembly module **16*b***, and interface modules **90*b*** through **108*b***, inclusive, respectively, in the manner previously described with reference to the embodiment shown in FIG. **1**. If it is desired to operate the control system **10*b*** via programmed control from tape recorder **422** in an automatic fashion, the program play switch **444** is closed. This operates relay **446** to close switch **448** and place switch **450** in the position shown by dotted line **450*a***. This turns ON light **452** to provide an indication that the system **10**b is in the programmed control mode and closes the circuit between the tape recorder **422** tone output **424** and the tone decoder **406**. As the tape recorder **422** plays back the tape upon which tones have been encoded in the desired program format, such tones preferably being of the 12-digit touch-tone variety, one such tone being associated with each of the control buttons **18*b*** through **40*b***, inclusive, respectively, a decoded output signal is provided from decoder **406** via path **196** and the appropriate associated momentary device control path **131, 133, 135, 137, 139, 141, 143, 145, 147, 151, 149,** or **153**. The operation of the system **10*b*** except for the decoding of the tone input to provide the associated momentary device control signal on these paths **131** through **153**, inclusive, and **196**, is identical to that previously described with reference to the embodiment shown in FIG. **1** and will not be described in greater detail hereinafter. Suffice it to say that when a tone signal is decoded to provide an output on paths **151** and **196** the system **10*b*** is placed into the power operational mode, and when a tone signal is decoded to provide an output on paths **153** and **196** the system **10*b*** is placed into the reverse operational mode, the system **10*b*** normally being in the forward operational mode when not in the power mode or the reverse mode.

If it is desired to operate the control system **10*b*** via the touch-tone telephone pad **418** or the computer **423**, the program play switch **444** is opened. This opens switch **448**, extinguishing light **452**, and switch **450** returns to the position shown by the dotted line **450*a***. This completes the circuit between the decoder **406** and the computer and touch-tone telephone pad outputs **425** and **420**, respectively. Thereafter, either the computer **423** or the touch-tone telephone pad **418** is operated to control the system **10*b***, the computer tone output **425** being similar to the tape recorder tone output **424** and providing automatic operation therefrom. A single control button on the touch-tone telephone pad **418** preferably corresponds to one of the control buttons **18*b*** through **40*b***, inclusive, and when the corresponding control button on the telephone pad **418** is depressed, the associated touch-tone signal is transmitted via line **420** to the decoder **406** where it is decoded and sent out through the connector module **400** to the appropriate momentary device control path in the remote control assembly module **16b** to control the system **10*b*** in the manner previously described with reference to the embodiment shown in FIG. **1**.

Furthermore, it is to be noted that when the control panel module **14*b*** is connected in the system **10*b*** during automatic program control operation, the various lights associated with the respective control buttons **18*b*** through **40*b***, inclusive, will be lit and extinguished in the manner previously described with reference to the embodiment shown in FIG. **1**. If such a visual display is not desired during automatic operation, the control panel module **14*b*** may be disconnected from the system by unplugging it from the connector module **400** and the system **10*b*** will still be able to function automatically.

When an additional control panel module **14*c*** is utilized in the system **10*b***, the operation of the system **10*b*** is identical with that just previously described. However, since the control panel modules **14*b*** and **14*c*** are connected in parallel, the audio-visual devices **112** through **128**, inclusive, may be controlled from either panel **14*b*** or **14*c***. As was previously mentioned, in this instance the SYSTEM ON buttons **42*b*** and **42*c*** are trouble or cue buttons for signaling between the two panels **14*b*** and **14*c***.

By utilizing the system of the present invention considerable versatility and flexibility are provided for an audio-visual control system so as to provide a plurality of audio-visual device control functions of either a latch or momentary nature from a single momentary device control function for a variable number of audio-visual devices. Furthermore, this control may be provided either manually or automatically from one or more locations in an easy and efficient manner.

It is to be understood that the above described embodiments of the present invention are merely illustrative of the principles thereof and that numerous modifications and embodiments of the invention may be derived within the spirit and scope thereof, such as by utilizing a tone generator and a multichannel FM receiver to provide the momentary device control signals to the remote control assembly module of the system, through the decoder, in order to control the audio-visual devices, or by providing a different available quantity of control buttons and/or control paths to provide a different available quantity of audio-visual device control functions.

What is claimed is:

1. A modular control system for providing a plurality of audio-visual device control functions for a plurality of audio-visual devices from a momentary device control function comprising

modular selection means for selectively providing a particular audio-visual device control path, said modular selection means including means for providing a plurality of common operational mode control paths, said common operational mode control path providing means including means for selectively providing one of said common operational mode control paths from said plurality of common operational mode control paths, each of said common operational mode control paths being common to said plurality of audio-visual devices, said modular selection means further in-

cluding a momentary device control function providing means for selectively providing a plurality of momentary device control functions, a momentary device control path being associated with said momentary device control function, said momentary device control path being particular to one of said plurality of audio-visual devices, said particular momentary device control path being associated with a particular momentary device control function, said modular selection means providing said particular audio-visual device control path from said selected one of said common operational mode control paths and said particular momentary device control path, a different particular audio-visual device control path being provided in combination with said particular momentary device control path and a different one of said common operational mode control paths, a different audio-visual device control function being selectively provided in accordance with said different particular audio-visual device control path, and modular audio-visual device control interface means removably connected between said modular selection means and said plurality of audio-visual devices for selectively providing one of said plurality of audio-visual device control functions to each of said plurality of audio-visual devices to which an audio-visual device control path has been provided, a different momentary device control path being associated with each momentary device control function, each of said momentary device control paths being particular to a different associated one of said plurality of audio-visual devices, said particular audio-visual device control path being selectively provided for each audio-visual device from one of said selectively provided associated momentary device control paths and said selected common operational mode control path, each of said momentary device control paths providing a different particular audio-visual device control path with said selected common operational mode control path, a different audio-visual device control function being provided in accordance with said different associated audio-visual device control path.

2. A modular control system in accordance with claim 1 wherein said modular selection means includes frequency responsive means, a different particular frequency being associated with each momentary device control function, said frequency responsive control means selectively providing one of said different momentary device control paths in response to said particular associated frequency.

3. A modular control system in accordance with claim 2 wherein said frequency responsive means includes tone responsive means, a different particular tone being associated with each of said different particular frequencies.

4. A modular control system in accordance with claim 1 wherein said modular selection means includes a plurality of monostable means each having a stable state and an unstable state, a different momentary device control function being associated with a different monostable means, said associated momentary device control function being provided from said monostable means in said unstable state.

5. A modular control system in accordance with claim 1 wherein said means for selectively providing said common operational mode control path from said plurality of common operational mode control paths includes means for inhibiting said plurality of common operational mode control paths except for said selectively provided common operational mode control path.

6. A modular control system in accordance with claim 1 wherein said common operational mode control path selective providing means includes a latch relay means having an associated latch position for each of said plurality of common operational mode control paths, said associated common operational mode control path being established in said associated latch position, each of said plurality of common operational mode control paths other than said associated latched common operational mode control path being inhibited when said associated latched common operational mode control path is established.

7. A modular control system in accordance with claim 1 wherein

said modular audio-visual-device control interface means includes a plurality of relay means connected in parallel, each relay means of said plurality being associated with a different one of said different audio-visual device control paths for providing said different audio-visual device control functions.

8. A modular control system in accordance with claim 7 wherein said audio-visual device control functions include a latch control function, one of said plurality of relay means providing said latch control function.

9. A modular control system in accordance with claim 1 wherein said modular audio-visual-device control interface means includes a plurality of interface modules, each interface module being removably connected between a particular audio-visual device of said plurality of audio-visual devices and said modular selection means for selectively providing a pair of said plurality of audio-visual device control functions for each of said particular audio-visual devices in accordance with said audio-visual device control paths.

10. A modular control system in accordance with claim 4 wherein one of said interface modules includes a pair of relay means connected in parallel, each relay means being associated with a different one of said pair of audio-visual device control paths for providing one of said different audio-visual device control functions.

11. A modular control system in accordance with claim 10 wherein one of said relay means is a latch relay means and the other of said relay means is a momentary relay means, an audio-visual device latch control function being provided from said latch relay means and an audio-visual device momentary control function being provided from said momentary relay means.

12. A modular control system in accordance with claim 10 wherein both of said relay means are latch relay means, an audio-visual device latch control function being provided from each of said latch relay means.

13. A modular control system in accordance with claim 10 wherein both of said relay means are momentary relay means, an audio-visual device momentary

control function being provided from each of said momentary relay means.

14. A modular control system in accordance with claim 13 wherein said one interface module includes a bidirectional rotary means operatively connected to said pair of relay means and to said particular audio-visual device for providing a unidirectional rotary movement to said audio-visual device for each of said pair of audio-visual device control paths for providing said pair of audio-visual device control functions.

15. A modular control system in accordance with claim 1 wherein said plurality of momentary device control functions comprises twelve momentary device control functions.

16. A modular control system in accordance with claim 3 wherein said plurality of momentary device control functions comprises twelve momentary device control functions, said associated tones being telephone touch-tones.

17. A modular control system in accordance with claim 10 wherein another of said interface modules includes a pair of relay means connected in parallel, each relay means being associated with one of said particular pair of audio-visual device control paths for providing one of said different audio-visual device control functions, signal blocking means being associated with each relay means of said interface modules for isolating the audio-visual control path associated with one of said pair of relay means in one interface module from another of said pair of relay means in said other interface module.

18. A modular control system in accordance with claim 1 wherein said modular selection means includes indication means associated with said momentary device control path for providing an indication when said audio-visual device control path is provided.

19. An audio-visual device control interface module for selectively providing a plurality of audio-visual device control functions in accordance with a plurality of different audio-visual device control paths, a different one of said plurality of audio-visual device control functions being provided in accordance with a different one of said audio-visual device control paths, said interface module being adapted to be removably connectable between an audio-visual device to be controlled and a means for providing said plurality of audio-visual device control paths, said interface module comprising

a first relay means associated with one of said audio-visual device control paths for providing one of said audio-visual device control functions to said audio-visual device,

a second relay means associated with another of said audio-visual device control paths for providing another one of said audio-visual device control functions to said audio-visual device, said second relay means being connected in parallel with said first relay means, and

a third relay means associated with a different one of said audio-visual device control paths than said first and second relay means for providing a different one of said audio-visual device control functions to said audio-visual device than said first and second relay means, said third relay means being connected in parallel with said first and second relay means.

20. An audio-visual device control interface module in accordance with claim 19 wherein said first relay means is a latch relay means and said second and third relay means are each momentary relay means, an audio-visual device latch control function being provided from said latch relay means and an audio-visual device momentary control function being provided from each of said momentary relay means.

21. An audio-visual device control interface module in accordance with claim 19 wherein each of said relay means are latch relay means, an audio-visual device latch control function being provided from each of said latch relay means.

22. An audio-visual device control interface module in accordance with claim 20 further comprising a bidirectional rotary means operatively connected to said second and third relay means and to said audio-visual device for providing a unidirectional rotary movement to said audio-visual device for each of said second and third audio-visual device control paths for providing said second and third audio-visual device control functions.

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