United States Patent

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[54] **TOUCH-ACTUATED MODE CONTROL CIRCUIT**
14 Claims, 7 Drawing Figs.

[52] U.S. Cl. ..... **325/315,** 328/5, 340/258 C
[51] **Int. Cl.** **H04b 1/16**
[50] **Field of Search** ..... 325/315; 340/258 C; 328/1, 5; 307/308; 200/DIG. 1

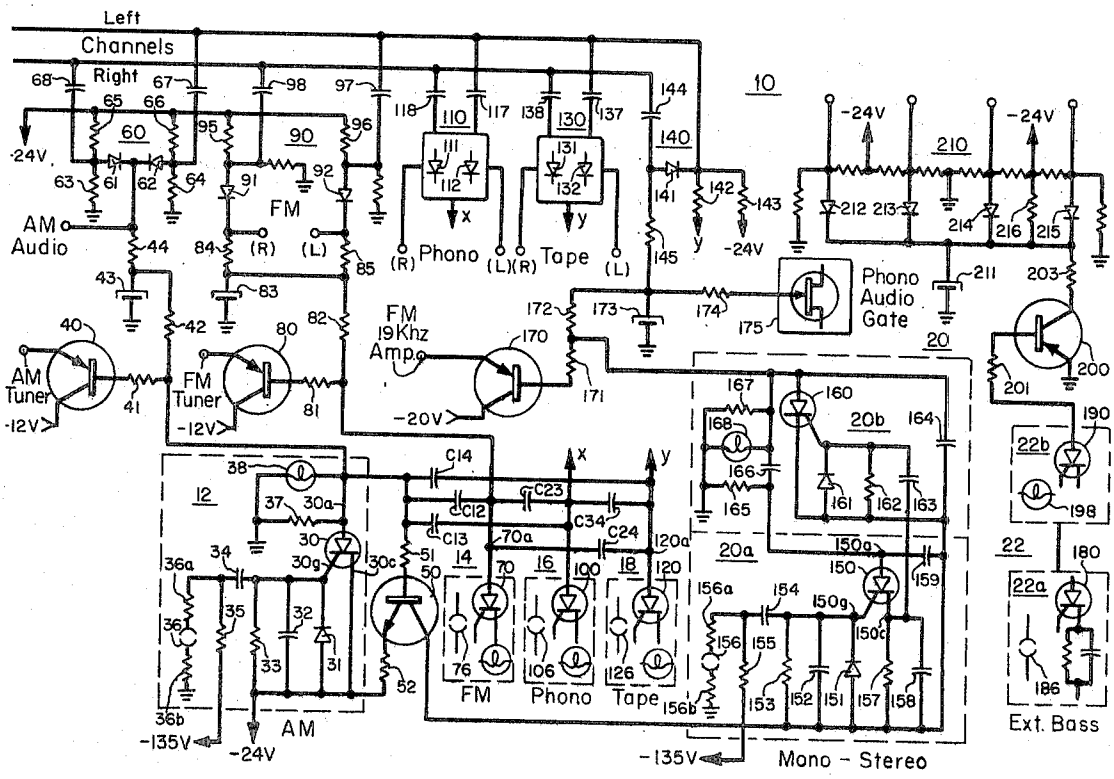
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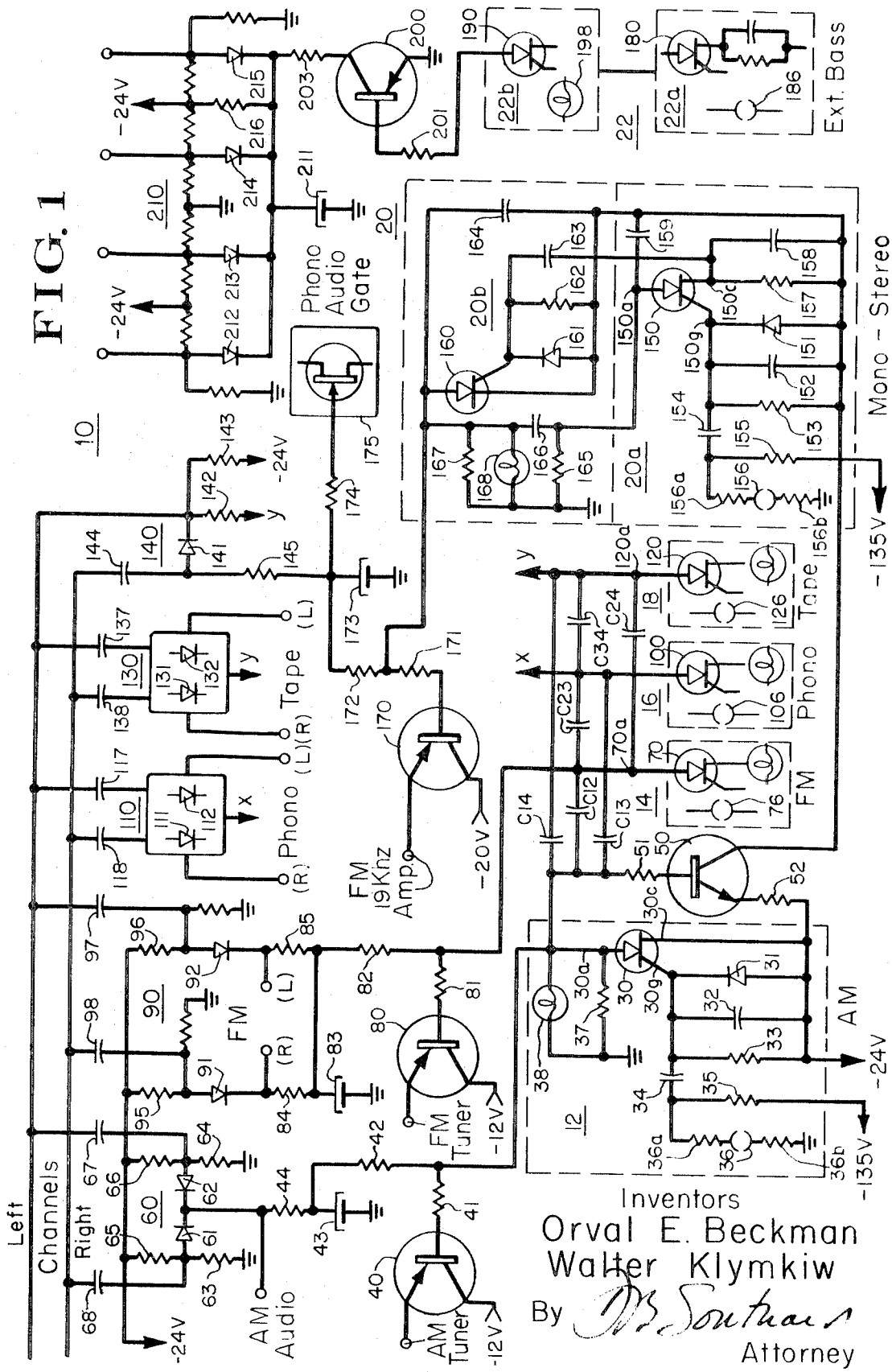
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ABSTRACT: A touch-actuated, master control or function network for selecting respective operational modes for an AM/FM/phonograph/tape complex, including optional monostereo and extended bass modes. The control network includes a plurality of functionally interrelated, solid-state switching circuits having a silicon controlled rectifier (SCR) as the operative control element. When one of the basic operational modes (AM, FM, phono, tape) is selected, provision is made to automatically deactivate or cutoff any of the switching elements of the remaining modes if previously in an operative condition. Provision is also made to prevent selection of the optional stereo mode while the complex is in the basic AM operational mode. The individual SCR switching circuits are effectively controlled by voltage level changes produced upon contacting an associated touch-responsive element in conjunction with an included storage capacitor in the gating circuit of the particular SCR. Such arrangement provides immunity to false operation of the switching circuits due to extraneous noise pickup, transients and the like.



3 Sheets-Sheet 1

FIG. 1



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FIG. 2

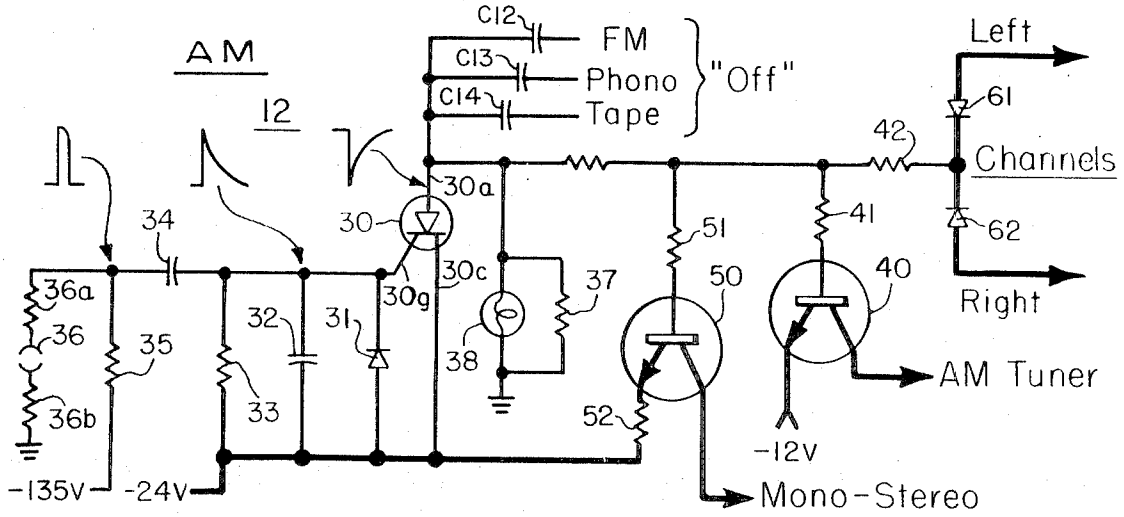


FIG. 3

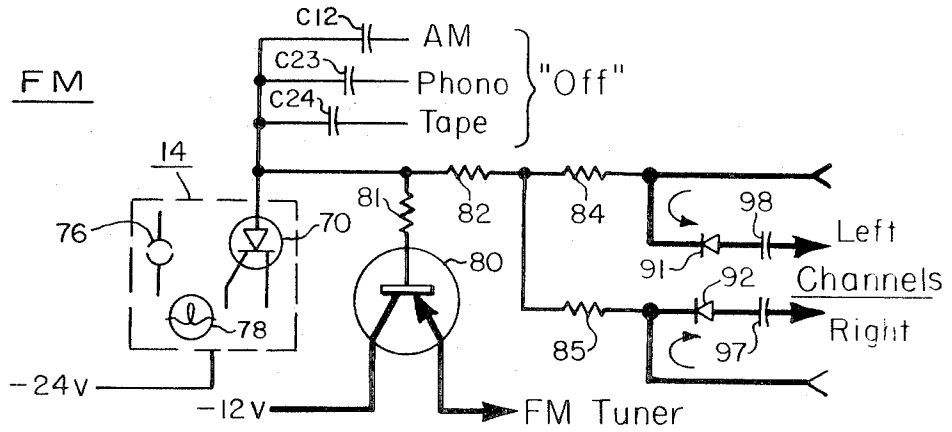
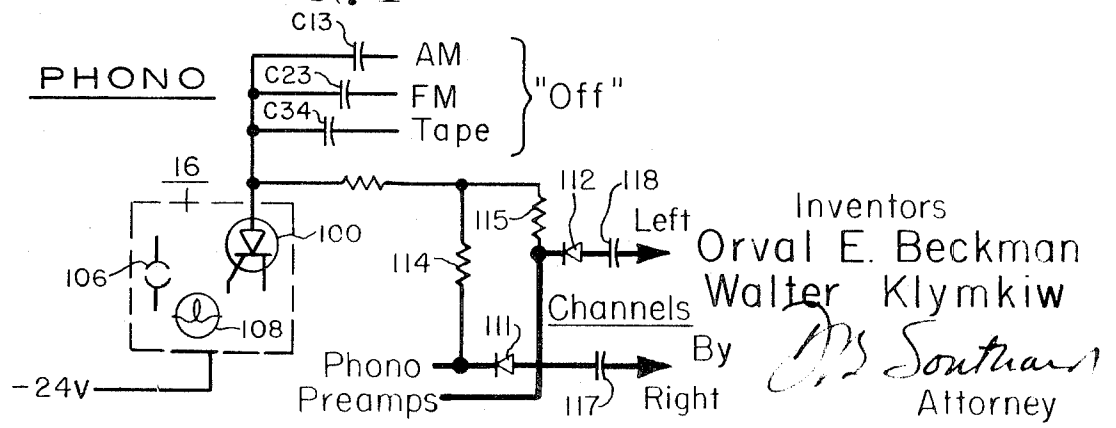


FIG. 4



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FIG. 5

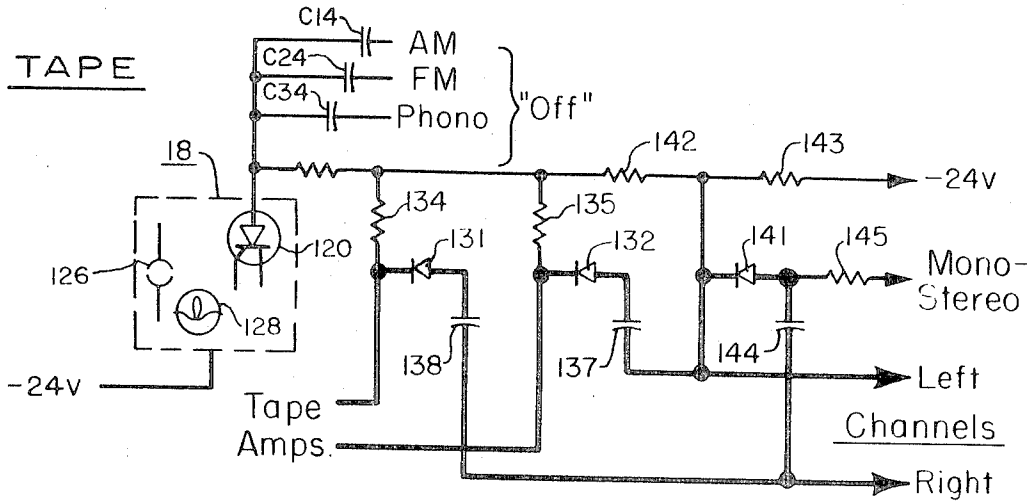


FIG. 6

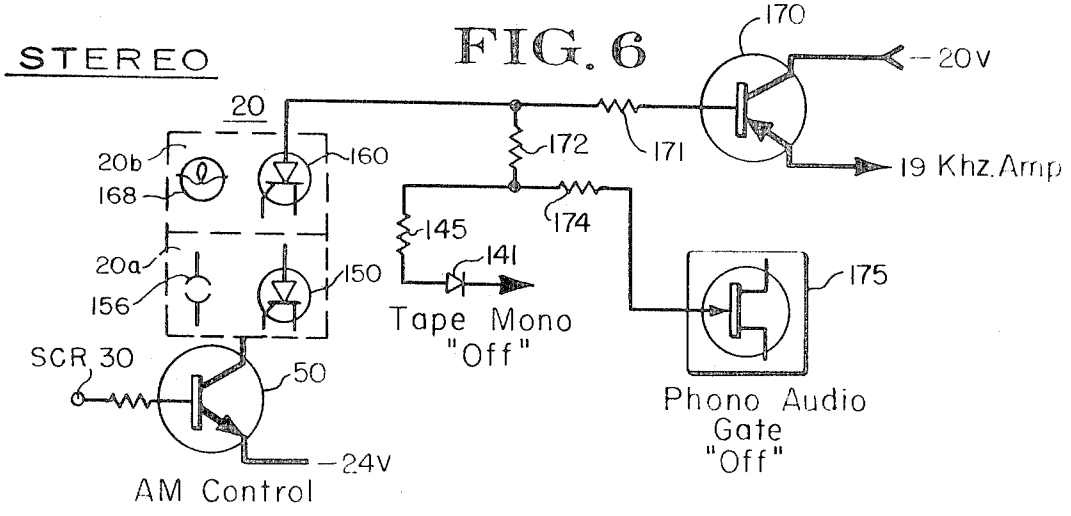
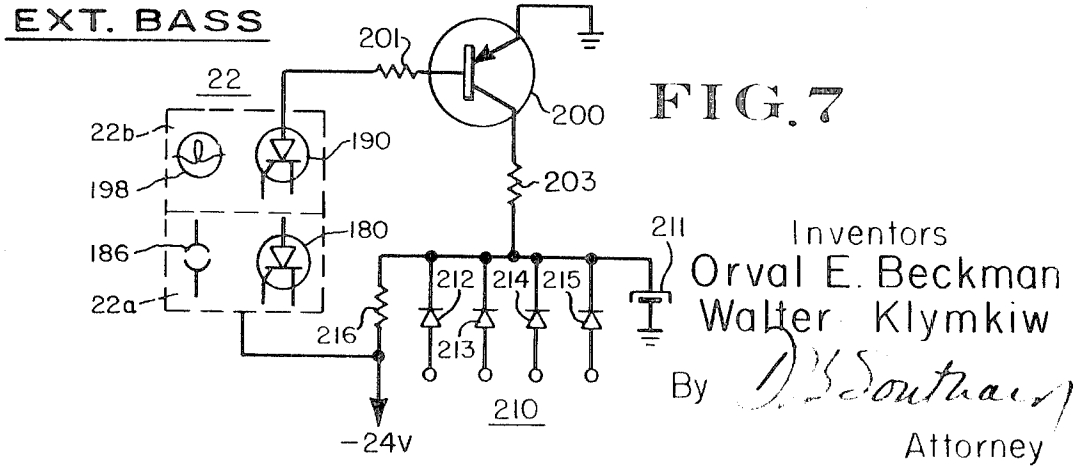


FIG. 7



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TOUCH-ACTUATED MODE CONTROL CIRCUIT

BACKGROUND OF THE PRESENT INVENTION

The present invention relates in general to touch-responsive circuits and more particularly to a novel, all solid-state, touch-actuated master control or function switch network for selectively controlling the operational mode for an AM/FM/phonograph/tape complex, including optional monostereo and extended bass modes.

Touch-responsive circuits have of course been used to some measure in the past, usually for selective control of a single circuit element such as a lamp, motor, or the like. The circuit is usually made operable by contact of a touch-responsive element whereby the increased capacity resulting from the person touching the element is effective to alter the nominal biasing arrangement on a switching device, such as a transistor or other semiconductor biswitch element. Still other circuit arrangements operate on an increase in noise level effected upon touching an associated control button, which may then be rectified or otherwise utilized to alter the operation of the included control switching element.

Such touch responsive circuits have not proved entirely reliable in the past, however, being subject to false operation due to transients, extraneous noise pickup and the like or, conversely, failure to operate under certain conditions. Moreover, prior touch-responsive circuits are nominally intended to control only a single load of a rather simple nature as referenced above. Until now, there has been no serious attempt to provide a complete control or function network involving many separate operational modes and which are functionally interrelated, and further, in some instances, dependent upon the particular functional mode selected at any given time.

SUMMARY OF THE PRESENT INVENTION

Accordingly, it is an object of the present invention to provide an improved solid-state, touch-actuated control or function switch network for selectively controlling the operational mode for an AM/FM/phonograph/tape complex, including optional monostereo and extended bass modes.

A more particular object of the present invention is to provide such a control function network for an AM/FM/phonograph/tape complex which comprises a plurality of touch-actuated, solid-state switching circuits wherein operative switching characteristics are dependent upon voltage level changes in respective gating circuits thereof induced through low-level skin conduction of a user contacting a control element rather than capacitive changes or noise pickup which contribute to unreliable operation under certain operating conditions.

Another object of the present invention is to provide a touch-actuated, solid-state control function network of the foregoing type wherein selection of any of the basic AM, FM, phonograph or tape operational modes is effective to activate appropriate circuitry, provide a visual indication of such selected mode, and automatically deactivate any of the remaining functional modes if previously in the activated condition.

Still another object of the present invention is to provide a control function network of the foregoing type wherein provision is made to prevent activation of the optional stereo mode while the console complex is in the "AM" mode requiring monaural reception conditions.

In accordance with the present invention, a touch-actuated, solid-state control function network is provided for the selective control of the various operational modes of an AM/FM/phonograph/tape console complex, including optional monostereo and extended bass modes. The overall control network includes a plurality of functionally interrelated solid-state switching circuits, which when suitably actuated, are effective to initiate a number of desired control functions. In a preferred embodiment, each of the switching circuits for selecting respective AM, FM, phono or tape modes includes a silicon controlled rectifier (SCR) device coupled between a unidirectional voltage source and a plane of reference potential. The gating circuit of each of the SCR elements includes a voltage divider and storage capacitor operative to apply a potential of a given polarity and magnitude thereto so that the SCR is initially nonconductive. A contact or touch-responsive element comprising a pair of insulated half-rings is also provided in the particular SCR gating circuit which when touched or "shorted" permits a discharge pulse from the associated storage capacitor to trigger the SCR to its "on" or conductive state. Conduction of the SCR is in turn used to activate appropriate circuitry, including a panel mounted lamp to indicate the particular operational mode selected, as well as other appropriate control functions. For example, contacting the touch element to trigger on the particular SCR switching element for "AM receiver" operation is effective to bias on a control transistor to apply operating power to the tuner of the AM receiver. In addition, an indicating lamp is energized and a pair of switching diodes are forward biased to effectively short circuit left and right audio channels of the complex for monaural reception. Further, a second control transistor, interconnecting the optional monostereo switching circuit, is biased to prevent conduction, thereby insuring the latter is in the required monaural mode. Lastly, suitable discharge pulses are generated in respective storage capacitors interconnecting the anode circuit of the SCR controlling AM receiver operation and each of the SCR switches controlling FM, phonograph and tape modes so as to render any of the latter nonconductive, if previously in an activated condition.

A similar functional sequence is provided by the FM, phonograph and tape switching circuits, with the exception that appropriate switching diodes are forward biased to selectively couple audio information to each of the left and right audio channels as distinguished from the short circuiting thereof effected in the AM operational mode.

The SCR switch circuits for selecting the optional monostereo and extended bass modes are somewhat different in that an initial or first SCR is rendered conductive only momentarily upon contact of the two half-ring touch element. However, such momentary conduction is effective to generate suitable control pulses through associated storage capacitors for application to a second SCR device. If the latter is already in a conductive state, it will be rendered nonconductive. If on the other hand it is nonconductive, the same will be suitably triggered to the "on" state. The second SCR device in the monostereo switch module controls the operation of a switch transistor to selectively apply operating power to the 19 kHz. amplifier in the FM receiver, apply a predetermined bias voltage to a diode connected across the left and right audio channels, and apply a suitable control signal to an audio gate included in the phonograph subunit. The second SCR device in the extended bass switching circuit controls the bias to a network of diodes which selectively couples or blocks off low frequency (bass) components in the processed audio signal to a large bypass capacitor serially connected between a common terminal for each of the diodes and ground.

The novel features which are believed to be characteristic of the present invention are set forth with particularity in the appended claims.

The invention itself, however, will best be understood by reference to the following description taken in conjunction with the drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial block and schematic diagram of a touch-actuated, solid-state control or function switch network for an AM/FM/phonograph/tape complex which has been constructed in accordance with the present invention;

FIG. 2 is a schematic representation of that portion of the control function network as shown in FIG. 1 providing selection of the AM operational mode;

FIG. 3 is a schematic representation of that portion of the control function network as shown in FIG. 1 providing selection of the FM operational mode;

FIG. 4 is a schematic representation of that portion of the control function network as shown in FIG. 1 providing the tape operational mode;

FIG. 5 is a schematic representation of that portion of the control network as shown in FIG. 1 providing the tape operational mode;

FIG. 6 is a schematic representation of a portion of the control function network shown in FIG. 1 for selective control of the optional monostereo modes; and

FIG. 7 is a schematic representation of a portion of the control function network shown in FIG. 1 for selective control of the optional extended bass mode.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a touch-actuated, master control or function switch network **10** is shown suitable for use with an AM/FM/phonograph/tape unit or complex **11**, including facilities for optional monostereo and extended bass modes. As shown, the control network **10** comprises a plurality of solid-state switching circuits for selecting basic operational modes (including AM, FM, phono and tape), indicated generally at **12**, **14**, **16** and **18**, respectively, and associated circuitry for initiating desired control functions. Additional switching circuits **20** and **22** are provided for controlling optional monostereo and extended bass modes, respectively, in conjunction with any of the former, except that provision is made to prevent selection of the stereo mode in combination with AM receiver mode.

As shown, switching circuit **12** controlling the AM receiver mode includes a silicon controlled rectifier (SCR) device **30**, which in turn is utilized to control the operation of a transistor **40** for applying power to the AM tuner (not shown), a further transistor **50** coupled to the monostereo switching circuit **20** serving as an effective interlock for various operating conditions, and also a diode switch network **60** connected across the left and right audio channels of the console complex and coupled to the detector stage of the AM receiver (not shown).

A switching circuit **14** similar to that of circuit **12**, shown in block form for convenience, is provided for controlling the selection of the FM receiver mode. Circuit **14** includes an SCR device **70**, in turn controlling the operation of a transistor **80** for applying operating power to the FM tuner (not shown) and a diode switch network **90** for coupling derived audio information from a received FM multiplex signal to respective left and right audio channels in the complex **11**. Phonograph switching circuit **14** (likewise shown in block form) includes a similar SCR switching element **100** for controlling a diode switch network **110** coupling audio signals from appropriate preamplifier stages (not shown) to respective left and right audio channels of the system complex, as indicated. The tape switching network **18** includes a similar SCR switching element **120** for controlling a diode switch network **130** passing audio signals from suitable amplifier stages (not shown) to respective left and right audio channels of the complex **11**. In addition, SCR element **120** is further coupled to a single diode switch network **140** connected across the left and right system channels.

Switching network **20** for controlling the optional monostereo modes includes a SCR device **150** in a first switch portion **20***b* which in turn controls an additional SCR device **160** in a second switch portion **20***b*. SCR **160** is used to control the operation of a transistor **170** for applying operating power to the FM receiver's 19 kHz. amplifier stage (not shown). SCR **160** is also coupled to the diode switch network **140** and to an audio gate **175** controlling phonograph stereo operation. Switching circuit **22** for controlling the extended bass mode includes an SCR element **180** in a first switch portion **22***a* which is used to control an additional SCR element **190** in a second switch portion **22***b*. SCR **190** is utilized to control the action of a transistor **200** coupled to a four-diode switch network **210**. The latter determines whether or not the low frequency (bass) components of the derived audio signals in each of the left and right channels are bypassed to ground through a suitable capacitor element **211**.

Additionally, a plurality of capacitors C_{12} through C_{34} interconnect the anode circuits of the SCR elements **30**, **70**, **100** and **120**. Capacitor C_{12} is connected between anode **30***a* and anode **70***a*; capacitor C_{13} between anodes **30***a* and **100***a*; and capacitor C_{14} between anodes **30***a* and **120***a*. Similarly, capacitor C_{23} is connected between anodes **70***a* and **100***a*; capacitor C_{24} between anodes **70***a* and **120***a*; and capacitor C_{34} between anodes **100***a* and **120***a*. Capacitors C_{12} through C_{34} insure the deactivation of any of the remaining switching circuits **12** through **18** upon activation of any one thereof, as will be subsequently explained.

For a better understanding of the operation of the control function network **10** embodying the present invention, it is believed helpful to consider the various selectable modes individually, together with the associated circuitry thereof to effect the desired switching operations.

AM MODE OPERATION

Referring to FIG. 2, switching circuit **12** is shown in conjunction with the various circuit parameters for selecting and sustaining the AM receiver operational mode. Switch circuit **12** includes SCR element **30** having its cathode **30***c* connected to a source of regulated −24-volt potential and its anode **30***a* returned to a reference point, in this case ground, through the lamp element in parallel with a resistance **37**. Resistance **37** is of course included to insure operation of switching circuit **12** should the lamp element **38** burn out by maintaining a circuit path from SCR anode to ground. The gate **30***g* of SCR **30** is likewise coupled to the −24-volt source but through a resistance **33** connected in parallel with a diode **31** and capacitor **32**. The gate **30***g* is also connected to a storage capacitor **34** in series with a resistance **35** returned to a −135-volt source of potential. A two half-ring contact element **36** is connected between the junction of capacitor **34** and resistance **35** through a limiting resistance **36***a* and ground through a second limiting resistance **36***b*.

In operation, capacitor **34** charges to some predetermined voltage level since it is connected between two unequal unidirectional potential sources. Since gate **30***g* is maintained at a negative voltage (−24 volts), SCR **30** is initially in the "cutoff" or nonconductive state. Anode **30***a* at this point remains at approximately ground or zero potential. When, however, an individual contacts the two insulated half-rings of the touch element **36**, a lower impedance is presented to capacitor **34** with respect to ground potential. The resulting momentary discharge action of capacitor **34** creates a positive-going pulse at the junction of capacitor **34** and resistance **35**, as indicated. A positive-going pulse likewise appears at the gate **30***g* as shown, thereby triggering SCR **30** to its "on" or conductive state. Anode **30***a* rises from ground potential to approximately the potential appearing at the cathode **30***c*, less the internal junction drop of the SCR **30**, or to about −23 volts DC. SCR **30** will remain in the conductive state until either the anode current thereof is reduced below a certain minimum value required to sustain conduction, or alternatively, by an interruption of anode-cathode current, such as effected by momentarily "shorting" together the two electrodes causing the internal flow of current to cease. Limiting resistances **36***a* and **36***b*, of relatively high values, are provided for appropriate protection of all persons contacting the touch element **36** from static discharge conditions and the like as well as to minimize spurious operation of the circuit **12** itself that may otherwise result.

In any event, the voltage rise at the anode of SCR **30** is used to initiate various control functions, namely:

a. the −23-volt potential developed across load resistance **37** illuminates lamp **38**, indicating that the AM mode has been selected;

b. the negative anode voltage through resistance **41** forward-biases transistor **40** into conduction whereby the approximately −12-v. DC potential impressed on its cathode **40***c* is now applied to the tuner of the AM radio receiver;

c. the negative anode voltage through resistance 51 removes transistor 50 from saturation thereby interrupting the −24-v., DC potential applied through its emitter-collector circuit to the monostereo switching circuit 20 to insure that the same reverts to the "monaural" mode, the latter function to be discussed in more detail subsequently; and

d. the negative anode voltage through resistance 44 forward-biases diodes 61 and 62 into conduction, thereby interconnecting left and right audio channels for monaural operation for the AM audio signals coupled to the junction of diodes 61 and 62.

In addition to the foregoing, the abrupt change in anode voltage from ground reference to approximately −23-v. DC causes the resultant change in charge level of capacitors C_{12}, C_{13} and C_{14} to generate and selectively apply relatively large amplitude, negative-going pulses to respective anodes of the SCR elements 70, 100 and 120. If any of the latter are nonconductive (i.e., anode at ground reference), the applied pulse will of course have no effect. If, however, a particular SCR is in the conductive state, the large negative-going pulse impressed across the small internal drop between associated anode and cathode electrodes momentarily reverse-biases the element, current therethrough ceases, and it will revert to its nonconductive or "cutoff" state.

Accordingly, it will be noted that actuation of switching circuit 12 is accomplished by way of a voltage pulse effected through low-level skin conduction of the user's finger in contacting the two insulated half-rings of touch element 36. This arrangement has been found to be significantly more reliable than those relying on changes in capacitance levels or on rectified noise pickup. Moreover, the present arrangement is provided even further immunity to false operation on transients, noise or other source of extraneous pulse information otherwise appearing at gate 30*g* by the filtering action of capacitor 32 connected between the gate and the −24-v. DC source. Diode 31 is connected between gate 30*g* and cathode 30*c* in a manner to be reverse biased when SCR 30 is conducting and forward biased when SCR is switched to cutoff. Accordingly, the "switch-off" time of the SCR is effectively speeded up.

FM MODE OPERATION

The switching circuit 14 and associated circuitry parameters for selecting and sustaining FM receiver operation is shown in FIG. 3. Switching circuit 14 is similar to switching circuit 12 and thus, for convenience and simplification, is represented in block form only. Initiating contact with the two half-rings of touch element 76 triggers SCR element 70 into its conductive state and effects the following control functions:

a. indicator lamp 78 is lit to show selection of the FM mode;

b. transistor 80 is forward biased into conduction so that the −12-v. DC impressed on its collector 80*c* is now applied to the tuner of the FM receiver;

c. diodes 91 and 92 in network 90 are forward biased to pass left and right audio FM stereo multiplex signals to respective left and right system channels; and

d. negative-going pulses are generated by capacitors C_{12}, C_{23} and C_{24} and selectively applied to the anodes of SCR elements 30, 100 and 120 to render any of the same nonconductive, if previously in the "on" or conductive state.

PHONOGRAPH MODE OPERATION

Switching circuit 16 in block from is shown in FIG. 4 together with the associated circuitry to effect the desired control functions when selecting the phonograph operational mode. Contacting the touch element 106 triggers the SCR 100 to its conductive state which initiates the following:

a. indicator lamp 108 is energized to show this particular mode has been selected;

b. diodes 111 and 112 of network 110 are forward biased to couple audio signals from associated phonograph preamplifier stages to respective left and right system channels;

c. negative-going pulses are generated by capacitors C_{13}, C_{23} and C_{34} which when applied to the anodes of SCR elements 30, 70 and 120 are effective to render the same nonconductive, if previously in a conductive state.

TAPE MODE OPERATION

Switching circuit 18 in block form is shown in FIG. 5 together with associated circuitry to effect the desired control functions when selecting the tape operational mode. Contacting touch element 126 triggers SCR 120 to its conductive state and initiates the following:

a. indicator lamp 128 is energized to show that this particular mode has been selected;

b. diodes 131 and 132 of network 130 are forward biased to pass audio signals from associated amplifier states to respective left and right system channels;

c. a bias voltage of a predetermined value is also applied to the cathode of diode 141 through resistance 142. If monostereo switching circuit 20 is in the "monaural" mode, such applied voltage to diode 141 is sufficient to render the same conductive to short circuit left and right system channels. If, however, the monostereo switching circuit 20 is in the "stereo" mode, sufficient voltage is applied from the latter to the anode of diode 141 to maintain it in the reverse-biased condition, and the left and right system channels thereby remain electrically isolated from one another;

d. negative-going pulses are generated by capacitors C_{14}, C_{24} and C_{34} which when applied to the anodes of SCR elements 30, 70 and 100 are effective to render the same nonconductive, if previously in the conductive state.

MONOSTEREO OPERATIONAL MODES

Switching circuit 20 for selecting either optional monaural or stereo modes differs somewhat from the switching circuits 12, 14, 16 and 18 for selecting basic AM, FM, phono and tape modes, respectively. The difference is required in view of the different control functions to be effected and also because monaural and stereo modes are to be in conjunction with, and in addition to, any of the selected former or basic operational modes. Switching circuit 20 is shown in block form in FIG. 6, but is set forth schematically in FIG. 1.

As indicated, circuit 20 includes a first switch portion 20*a* comprising an SCR element 150 with substantially the same gating circuitry as described in connection with switching circuit 12, with included circuit elements 151 through 156 operative in the same manner as circuit elements 31 through 36 for switching circuit 12. In addition, however, a further resistance 157 is inserted between its cathode electrode 150*c* and a reference terminal to which the −24-volt v. DC reference potential is selectively applied through transistor 50, which resistance is of a relatively high value, on the order of 1.5 megohms. A capacitor 158 is connected in parallel with resistance 157 and a further capacitor 159 is connected between its anode and the aforementioned reference terminal, as indicated.

Contacting touch element 156 likewise triggers SCR element 150 to its "on" or conductive state by virtue of the generated positive-going pulse appearing at its gate 150*g*. However, the conduction thereof is only momentary because of the relatively high value resistance 157 included in series with its anode-cathode circuit. Nevertheless, such momentary conduction is effective to generate a positive-going pulse at its cathode 150*c* and a similar but negative-going pulse at its anode 150*a*. The negative-going pulse coupled through a capacitor 166 to the anode 160*a* of SCR element 160 is of no effect if the latter is in the nonconductive state. However, the positive-going pulse coupled through a capacitor 163 to the gate 160*c* of SCR 160 is sufficient to trigger the same into conduction, and initiate the following:

a. energize indicator lamp 168 in the anode circuit of SCR 160 to show selection of the stereo mode;

b. bias transistor **170** into conduction through resistance **171** so as to apply the −20-v. DC potential impressed on its collector **170***c* to the 19 kHz. amplifier stage in the FM receiver (for stereo FM operation);

c. reverse-bias diode **141** in network **140** to insure isolation between respective left and right system channels (for stereo tape operation);

d. bias the phonograph audio gate **175** in the form of a field effect transistor (FET) to its off condition, thereby insuring the required isolation between left and right system channels (for stereo phonograph operation).

The foregoing control functions are of course permissible only if the AM operational mode is not activated and thus transistor **50** is conductive to apply the −24-v. DC reference potential to the common terminal to which circuit elements **151, 152, 153, 157, 158, 161,** and **164** are connected. Absence of the −24-v. DC reference potential thereto prevents conduction of SCR **150** entirely since its conduction path is effectively open circuited. Accordingly, if switching circuit **20** is in the stereo mode, contacting touch element **36** (FIGS. **1** and **2**) in AM switching circuit **12** will bias off control transistor **50** serving as an interlock, thereby automatically insuring the monostereo switching circuit **20** reverts to the mandatory monaural mode for AM operation. This is accomplished by interruption of the −24-v. DC reference potential which then limits the current through SCR **160** to a level below that required to sustain conduction.

It is of course to be realized that as a prerequisite for stereo FM operation, an appropriate FM multiplex signal must be received and processed by the FM receiver. Accordingly, switching circuit is, and can only be, intended to initiate appropriate control functions to render the receiver capable of stereo operation, i.e., by applying operating power to the associated 19 kHz. amplifier stage. Such amplifier stage must still receive an appropriate input (19-kHz. pilot) signal before an output will be developed. Accordingly, the FM receiver will continue to operate on a monaural basis unless and until suitable multiplex signals are received, at which time associated receiver circuitry may be activated, operating in an entirely known manner, and thereby provide stereo operation.

When switching circuit **20** is in its stereo mode, i.e., SCR **160** conductive, the monaural mode can also be established by merely momentarily contacting the touch element **156** once again. As before, this causes conduction of SCR element **150** during a predetermined time interval, with attendant positive- and negative-going pulses appearing at respective anode and cathode electrodes **150***a* and **150***c*. Under these reference conditions, the positive-going pulse applied to the gate **160***g* of SCR **160** has no effect. However, the negative-going pulse applied through capacitor **166** to anode **160***a* thereof is of sufficient amplitude to drive the latter further negative and reverse-bias SCR element **160** to its nonconductive state. Hence, SCR element **160** is alternately driven to "on" and "off" conditions in flip-flop fashion by successive triggering of SCR element **150** to momentary conduction levels.

EXTENDED BASS MODE

Switching circuit **22** for controlling the optional extended bass function for the complex **11** is similar to the monostereo switching circuit **20**, except that the −24-v. DC reference potential is not applied through a control transistor serving as an interlock. Extended bass function is therefore selectable in conjunction with any of the other operational modes, at will.

FIG. **7** shows the switching circuit **22** in block form together with the associated circuitry for effecting the desired control functions upon actuation thereof. Contacting touch element **186** causes momentary conduction of SCR element **180** and the generation of appropriate control pulses. If associated SCR element **190** is in its nonconductive state, a suitable positive-going pulse applied to its gate circuit **160***g* triggers it to its conductive state, and initiates the following:

a. energizes indicator lamp **198** to show this particular mode is selected;

b. biases transistor **200** into conduction through resistance **201** which in turn reverse-biases diodes **212, 213, 214** and **215** in network **210** to prevent the selected low frequency (bass) components of the derived audio signals from being bypassed to ground through capacitor **211**. Bass components suitably developed in appropriate final amplifier stages in the system complex are further processed and selectively coupled to respective left and right system channels for aural reproduction along with other derived audio information.

Again contacting touch element **186** shown, causes momentary conduction of SCR **180** whereby a generated negative-going pulse at its anode is suitably applied to the anode of SCR **190** to reverse-bias the latter to its nonconductive state. This cuts off transistor **200** and the diodes **212–215** are again forward biased by resistance **216** so that selected low frequency components are now bypassed directly to ground through capacitor **211**.

While only a particularized embodiment of the present invention is set forth and described herein, it will of course be understood that other variations and modifications may be effected by those skilled in the art without substantially departing from the true scope and spirit of the invention. Accordingly, the appended claims are intended to cover all such modifications and alternative constructions that may fall within their true scope and spirit.

What is claimed is:

1. A touch-actuated, solid-state switching circuit, including in combination:

first and second unidirectional voltage sources, said second source having a higher given magnitude than said first source;

a plane of reference potential;

solid-state switching means having conductive and nonconductive states and including a control electrode, a cathode electrode connected to said source of lower potential level and an anode electrode returned to said plane of reference potential;

actuating control means comprising a first resistance interconnected between said control electrode and said source of lower potential level, a storage capacitor coupled between said control electrode and said voltage source of higher potential level through a second, limiting resistance, and a touch-responsive element having a pair of normally insulated terminals connected between the junction of said storage capacitor and second resistance and said plane of reference through a third limiting resistance, said touch-responsive element upon being contacted in a manner to present a low impedance between said insulated terminals causing a discharge pulse to be generated by said storage capacitor effective to trigger said switching means to its conductive state;

means for minimizing spurious operation of said switching means in the presence of transient signals and extraneous noise pickup; and

additional means connected between said control and cathode electrodes of said switching means to effectively shorten switch-off time thereof.

2. A touch-actuated, solid-state switching circuit in accordance with claim **1** wherein said solid-state switching means comprises a controlled rectifier device, wherein said means for minimizing spurious operation thereof comprises a further capacitor connected between the control electrode of said switching means and said source of lower potential level, and wherein said means for shortening switch-off time of said switching means includes diode means poled so as to be reverse biased during conduction of said switching means and forward biased when said switching means is rendered nonconductive.

3. A touch-actuated, solid-state switching circuit in accordance with claim **1** wherein an indicator lamp is connected between the anode of said switching means and said plane of reference potential and which is energized upon said switching means being rendered conductive.

4. A touch-actuated, solid-state switching circuit, including in combination:

first and second solid-state switching means each having conductive and nonconductive states and each including anode, cathode and control electrodes,

said first switching means having its cathode coupled to a source of unidirectional potential through a load impedance and also to the cathode of said second switching means through a first coupling capacitor, said first switching means having its anode coupled to the anode of said second switching means through a second coupling capacitor, said anode of said second switching means being returned to a plane of reference potential, and said cathode of said second switching means being connected to said source of unidirectional potential; and

actuating control means coupled to said control electrode of said first switching means, including a touch-responsive element and pulse generating means, said touch-responsive element having a pair of normally insulated terminals which when bridged permits said pulse means to generate and apply a control pulse of predetermined duration to the control electrode of said first switching means to render the same conductive, said cathode impedance being of a selected value to prevent conduction of said first switching means upon cessation of said control pulse,

said momentary conduction of said first switching means developing positive- and negative-going pulses at respective cathode and anode electrodes thereof, said positive-going pulse coupled to the control electrode of said second switching means being effective to trigger the same to conduction if previously in a nonconductive state, and said negative-going pulse coupled to the anode of said second switching means being effective to reverse-bias the same to nonconduction if previously in a conductive state.

5. A touch-actuated, solid-state switching circuit in accordance with claim 4 wherein said solid-state switching means comprise respective controlled rectifier devices, and wherein said pulse generating means includes a storage capacitor coupled to the control electrode of said first switching means and permitted to charge to a predetermined level from a source of unidirectional potential, said storage capacitor generating said control pulse by discharging through said touch-responsive element when the same is suitably contacted.

6. A touch-actuated, solid-state switching circuit in accordance with claim 4 wherein said solid-state switching means comprise respective controlled rectifier devices with diode means connected across respective cathode and control electrodes in a manner to shorten switch-off time thereof, and wherein further capacitor means is connected between cathode and control electrodes of said first switching means providing a filtering action to minimize spurious operation thereof on transient signals and extraneous noise pickup.

7. A touch-actuated, solid-state control function network for selecting a plurality of basic operational modes and at least one optional mode for a multifunctional complex formed of particular, interconnected subunits operative through first and second system channels, comprising in combination:

a plurality of switching circuits for selectively controlling said basic operational modes, each of said switching circuits including solid-state switching means having a control electrode, and cathode and anode electrodes connected across a source of unidirectional potential of predetermined magnitude;

diode means connected to each of said switching means for selectively coupling respective system channels to respective subunits, each providing a particularized function and collectively comprising said complex;

actuating control means including a touch-responsive element coupled to the control electrode of each of said switching means for selectively actuating the same and biasing an associated diode switch means to pass signal information to respective system channels;

circuit means interconnecting each of said switching means which, upon actuating a particular switching means, automatically deactivates any of the remaining switching means if previously in an activated condition; and

additional switching circuit means for providing said optional mode, said additional switching circuit including first and second solid-state switching means having conductive and nonconductive states and including control, cathode and anode electrodes, said first and second switching means having respective cathodes coupled to said source of unidirectional potential and respective anodes interconnected through a first coupling capacitor, said first switching means having its cathode further coupled to the control electrode of said second switching means through a second coupling capacitor,

and additional actuating control means coupled to the control electrode of said first switching means, including a touch-responsive element which when actuated permits momentary conduction of said first switching means for developing positive- and negative-going pulses at respective cathode and anode electrodes thereof, said positive-going pulse coupled to the control electrode of said second switching means being effective to forward-bias the same to conduction if previously in a nonconductive state, and said negative-going pulse coupled to the anode of said second switching device being effective to reverse-bias the same to nonconduction if previously in a conductive state.

8. A touch-actuated, solid-state control function network in accordance with claim 7 wherein said multifunctional complex includes AM receiver, FM receiver, phonograph and tape subunits, the selective activation of which being controlled by said basic operational modes, and wherein said diode switch means associated with the switching means for activating the AM control mode is effective to apply derived audio signals from said AM receiver to said system channels connected in common, and wherein each of said remaining diode switch means are effective to selectively apply derived audio signals from each of said remaining subunits to said system channels maintained in electrical isolation from one another.

9. A touch-actuated, solid-state control function network in accordance with claim 7 wherein each of said solid-state switching means comprises a controlled rectifier device, and wherein said means for automatically deactivating any of said switching means includes capacitance means coupled between anodes of respective pairs of said switching means, said capacitance means being effective upon activation of a particular switching means to apply a negative-going pulse to each of the anodes of the remaining unselected switching means so as to reverse-bias the same if previously in a conductive state.

10. A touch-actuated, solid-state control function network in accordance with claim 8 wherein transistor means is included having an input coupled to the anode of said switching means for selecting said AM operational mode, and collector-emitter electrodes interconnecting a source of operating power and said AM receiver, actuation of said last named switching means forward-biasing said transistor means to conduction so as to apply said operating power to said AM receiver.

11. A touch-actuated, solid-state control function network in accordance with claim 8 wherein transistor means is included having an input electrode coupled to the anode of said switching means for selecting the FM operational mode, and collector-emitter electrodes interconnecting a source of operating power and said FM receiver, actuation of said last mentioned switching means forward-biasing said transistor means to conduction so as to apply said operating power to said FM receiver.

12. A touch-actuated, solid-state control function network in accordance with claim 7 wherein said optional mode comprises monostereo operation, and wherein means are included to apply operating power to a selective portion of said FM

receiver, and to insure said respective system channels are electrically isolated from each other upon said second switching means of said additional switching circuit being rendered conductive.

13. A touch-actuated, solid-state control function network in accordance with claim 7 wherein said optional mode comprises extended bass operation, and wherein additional switch means are included for coupling selected low frequency components of derived audio signals by a selected subunit to ground upon said second switching means of said additional switching circuit being rendered conductive.

14. A touch-actuated, solid-state control function network in accordance with claim 7 wherein one of said basic modes comprises AM receiver operation and said one optional mode comprises monostereo operation, and wherein interlock means are included to prevent selection of the stereo mode in conjunction with said AM receiver mode, said interlock means including transistor means interposed in the circuit path supplying operating power to said switching means for selecting monostereo operation, said transistor means being reverse biased upon actuating said switching means for selecting said AM receiver operation so as to open circuit said circuit path supplying power to said switching means for establishing said stereo mode.

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