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[54] **PROGRAMMING SYSTEM**

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[51] **Int. Cl.** **G09b 5/04**

[58] **Field of Search**..... 179/1 B, 1 SW, 100.1 PS, 179/100.11

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[57] **ABSTRACT**

A programming system for activating a plurality of audio sources in accordance with a preselected program sequence in which the termination of audio signals from an activated source is detected and, after a predetermined time delay, advances a sequencing network to activate a subsequent audio source. This same operation continues in accordance with a preselected sequence which may be rapidly and simply programmed prior to or during operation.

10 Claims, 2 Drawing Figures

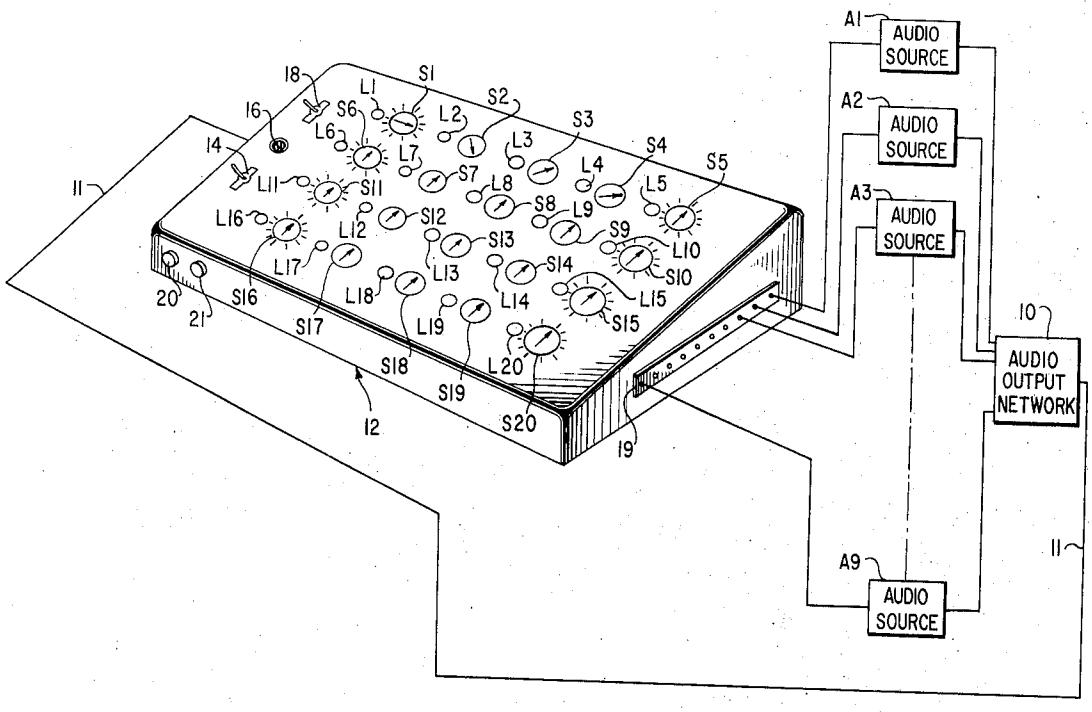
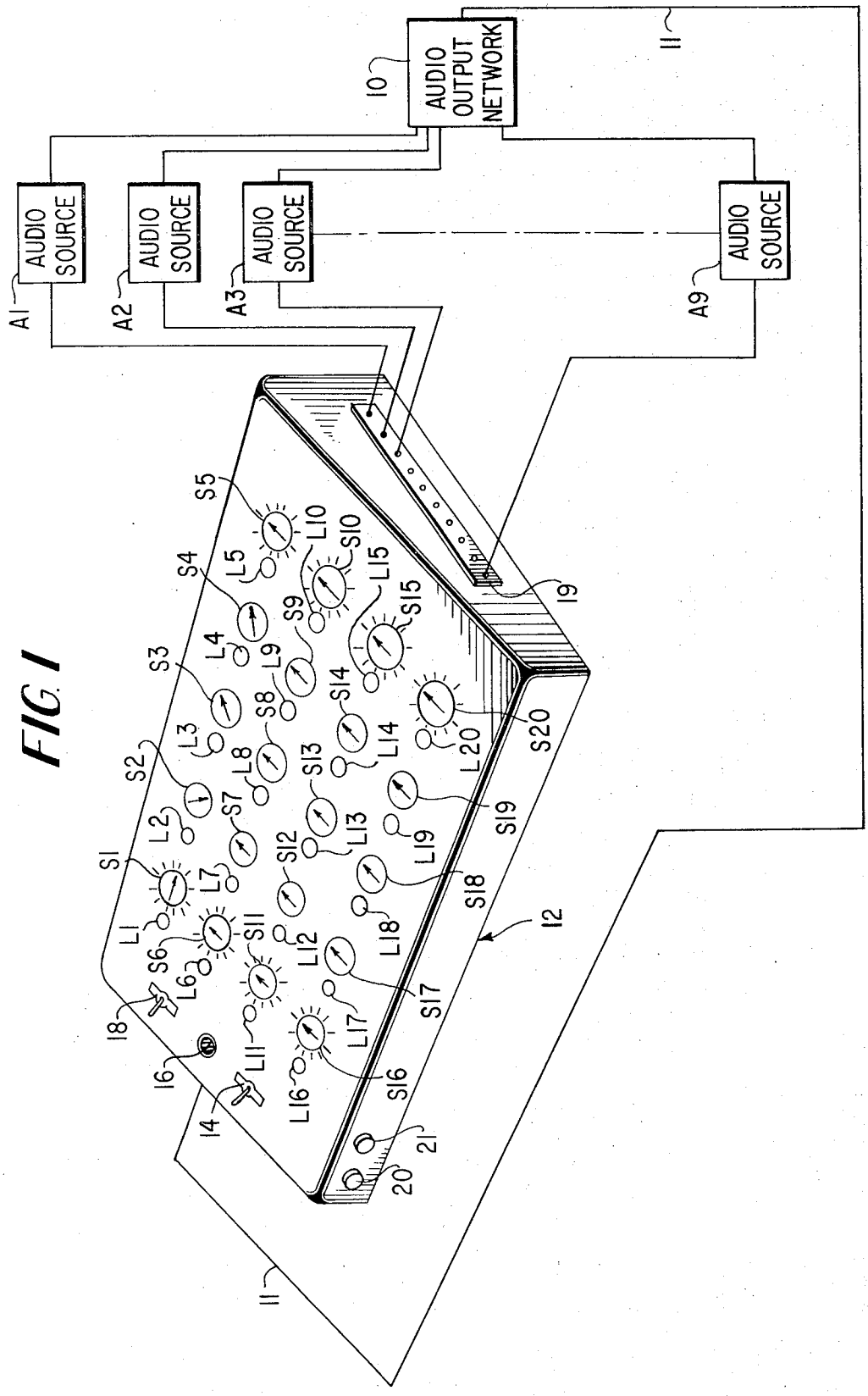


FIG 1


AUDIO OUTPUT NETWORK
10
11
AUDIO SOURCE
A1
A2
A3
A9
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
S19
S20
L1
L2
L3
L4
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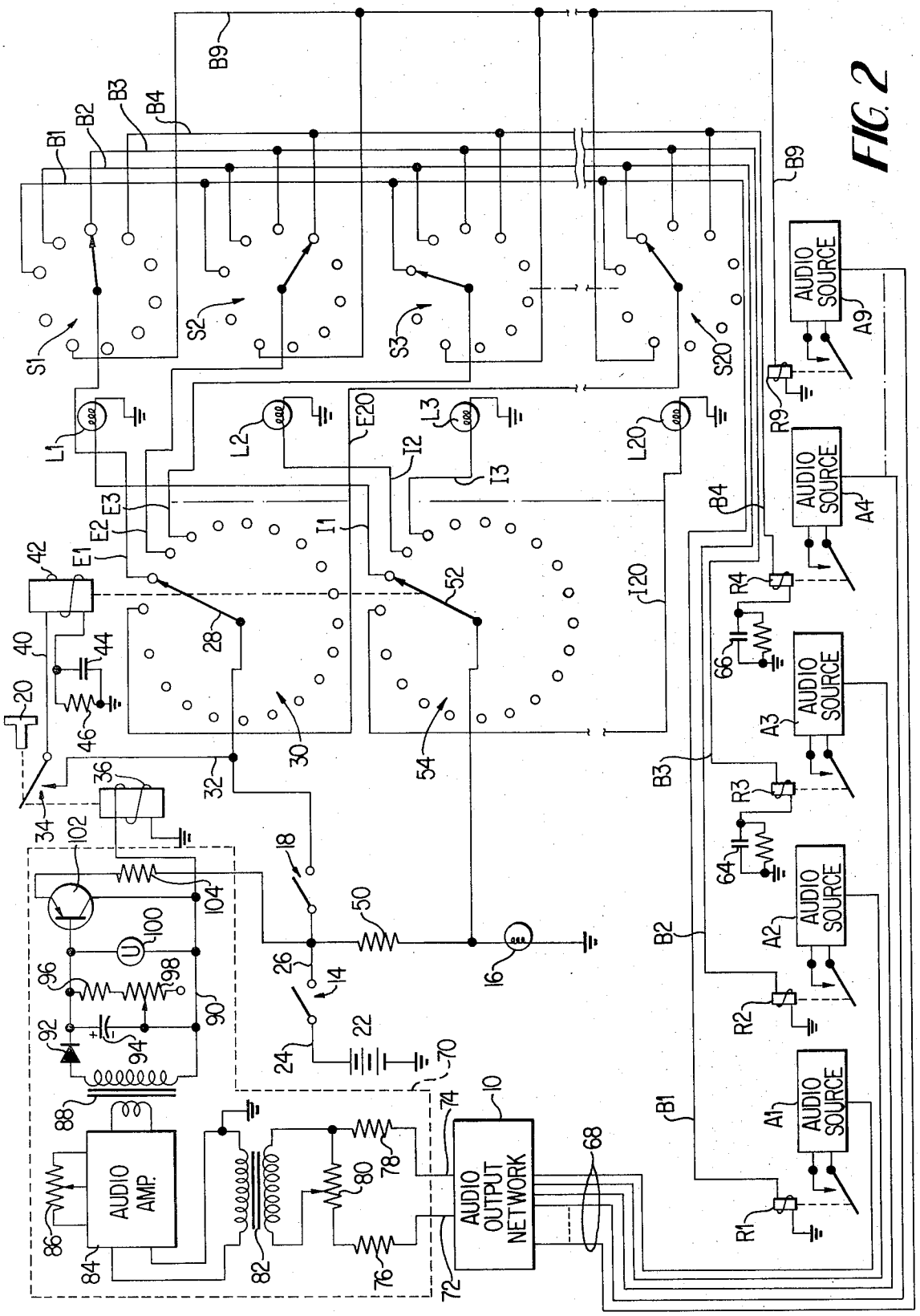


FIG. 2

PROGRAMMING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to control systems and more particularly to a programming system for sequentially activating a plurality of audio sources by detecting the termination of the signals from each source and thereafter advancing the system for the energization of a subsequent source.

2. Description of the Prior Art

In many instances it is desirable to automatically control the operation of a number of different audio sources such that a particular program sequence is followed, especially in connection with the operation of commercial broadcasting stations. Generally, the signals broadcast from a commercial broadcast station originate from a number of audio sources such as tapedecks, phonograph turntables, cartridge tape players, and the like, each containing different information segments such as music, commercial messages, station identification sequences, weather and news reports, etc. Further, these various sources may be used for different types of information at different times and in the case of a tapedeck, for example, may be used for music on one occasion, commercial messages on another occasion and any other information as recorded. These segments must thereafter be placed in sequence or programmed by the station director prior to their ultimate broadcast. In view of the diversity of program materials and the frequent changes which are made from day to day, there has developed a need for a simple yet reliable apparatus for (1) initiating the operation of a particular audio source, (2) detecting the termination of that source, and thereafter initiating the operation of the next audio source in a desired sequence, and (3) enabling the accomplishment of the previous two functions with sufficient flexibility to facilitate rapid programming and reprogramming of broadcast materials without rewiring or restricting the use of any one source to a particular type of information (such as music) and at the same time preserving continuity of the overall programmed output.

Much of the effort directed to solving these problems in the past has resulted in only partially satisfactory systems which exhibit material shortcomings in their lack of flexibility, their impractical cost, and/or their inefficiency in operation. More specifically, conventional prior art systems have been deficient in two primary categories. The first is their inability to simply monitor the termination of the operation of each of the various audio sources for keying or initiating the operation of a subsequent source, and the second resides in the extremely limited degree of flexibility afforded to the system operator in programming the various broadcast materials to effectuate a desired sequence.

Prior art systems which respond to the termination of an audio segment from a source such as a tape cartridge or phonograph turntable are most commonly dependent upon mechanical, magnetic or tone-keying subsystems to deactivate the audio source and provide a signal for actuating a subsequent source. While these systems have been accepted and utilized in the past, they have been found to be at least partially unsatisfactory in that the audio source must be modified to respond to the particular termination signal, and further,

that the mechanical tripping mechanism, the magnetic trigger or the keying tone must be applied or otherwise incorporated into the audio source at the end of each information segment. Efforts have been made to overcome these disadvantages, as exemplified by U. S. Pat. No. 3,281,542; however, the resulting systems still lack the degree of flexibility necessary to enable the programming of large numbers of music, news, and other information segments from diverse audio sources such as tape cartridges, phonograph turntables, open reel tapedecks and the like.

Thus, while systems designed to provide direct audio keying and improved programming flexibility have long been desired, a simple and effective circuit for accomplishing the same in an economically feasible manner has heretofore been unavailable.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to automatically sequence the operation of a plurality of audio sources in direct response to the termination of the signals emanating from each individual source.

The present invention has a further object in that a desired program sequence of operation of a plurality of diverse audio sources may be readily accomplished independently of the content or design of each individual source.

An other object of this invention is to provide unlimited flexibility in programming and reprogramming the sequential operation of any number of different audio sources in direct response to the termination of the operation of each source in the desired sequence.

The present invention is summarized in that a programming system includes a plurality of audio sources, a selector in the form of a plurality of multiposition source selection switches each connected to apply an activating signal to one of the sources, a sequencing network connected with the selector and actuable stepwise to sequentially energize each source selection switch, and a detector connected to receive the audio output signals from the sources and coupled to the sequencing network for advancing the same one step in response to the termination of the audio output signals for a predetermined time delay whereby the sources may be activated in accordance with a preselected program sequence.

Among the other features which are described below, the present invention is materially advantageous over the prior art in its increased flexibility, economy of design and direct response to the termination of audio signals.

Other objects and advantages of the present invention will become apparent from the following description of a preferred embodiment when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic illustration, partially in block form, of a preferred embodiment of a programming system in accordance with the present invention; and

FIG. 2 is a detailed schematic diagram of the electrical circuitry of the system of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is embodied in an audio system such as that used in connection with a commercial broadcasting station having a number of different audio sources A1 through A9 each containing one or more segments of audio information. Output signals from sources A1 through A9 are fed through an audio output network 10 which may be of any suitable construction and, for purposes of example, may include peripheral broadcasting apparatus at the frequency of the broadcasting station. As shown in FIG. 1, he output of audio output network 10 is fed via line 11 to the input of a program control console illustrated generally at 12.

Control console 12 includes a master on-off switch 14 having associated therewith a suitable indicator lamp 16 as well as a sequence control switch 18. The control console 12 is also provided with a suitable number of individual sequence selector switches, such as the 20 illustrated switches S1 through S20, each having at least as many positions as there are audio sources in the system. In addition, a set of indicator lamps L1 through L20 associated with each of the switches S1 through S20, respectively, is provided to apprise the station operator of the particular switch actuated at any one time. Actuating control signals from the console 12 are fed from a suitable terminal strip 19 to each of the sources A1 through A9 for actuating the same in accordance with the desired sequence. A sequence initiation pushbutton 20 and a time delay control 21 are also provided on console 12 for reasons more fully explained below.

Before proceeding to a detailed description of the programming system circuit in accordance with the present invention, a general description of overall system operation will be provided. Initially, each of the sources A1 through A9 is provided with a particular information segment such as a musical selection, a commercial message, a weather report or the like and is placed in a standby mode such that the particular message will be played back upon receipt of an actuation signal from the system console 12. As will be appreciated below, the various sources need not be prepared in any particular sequence since the ultimate sequence of the audio events fed to the audio output network 10 will be controlled in accordance with the preselection of switches S1 through S20 of the console 12. In other words, even though it may be desired to begin a particular sequence with a musical segment followed by a short commercial message, source A1 may contain a weather report, source A2 might contain a station identification message, source A3 may contain the desired initial musical segment, etc.

After the audio sources A1 through A9 have been prepared and placed in their standby modes, the program director, with the knowledge of the content of the different audio sources, may thereafter select the desired sequence by operating the switches on the console 12. Each of the switches S1 through S20 are energized in sequence such that the particular audio source selected by switch S1 will be the first to be played back through the audio output network, the next source will be that selected by S2, the third source by switch S3, etc. Thus, switch S1 may be set to position 3 whereby source A3 will be energized first in the sequence and the entire program preset by adjusting the remaining switches S2 through S20 in like manner.

Upon energizing main power switch 14, sequence switch 18, and pushbutton 20, the program sequence will begin and, in the above example, a control actuation signal will be supplied through switch S1 to source A3 to initiate its operation. At the termination of the particular information segment contained by source A3, the absence of an audio signal on line 11 fed back to the console 12 will cause the system, after a predetermined time delay set by control 21, to sequence one position thereby removing the energization signal from switch S1 and applying the same to switch S2. As this occurs, lamp L1 associated with switch S1 will be extinguished and lamp L2 will become lit. Further, the particular audio source selected by switch S2 will be supplied with a control signal to initiate its operation. The program continues in this manner until all of the selector switches S1 through S20 have been energized and will repeat itself until stopped by the operation of sequence control switch 18.

Accordingly, it can be appreciated that the system of the present invention provides a great degree of flexibility in that a particular program sequence may be rapidly established by the selection of the positions of switches S1 through S20 and stopped at any time for reprogramming as desired by the station operator. Of course, even greater flexibility is accomplished by the use of diverse audio sources such as phonograph turntables, tape cartridges and tapedecks, for example, which may each contain a number of individual information segments to be played one at a time. As will be more fully described below with respect to the schematic diagram of FIG. 2, the system directly responds to the discontinuance or termination of audio signals from the particular source actuated by the control console 12, with the time delay of the silence period necessary to sequence the system to its next position variable to accomplish the desired sequencing without responding to momentary signal pauses of the particular information segment being broadcast.

Referring now to FIG. 2, operating potential for the system is supplied by a suitable power source, represented by battery 22 via line 24 to the main power switch 14. Switch 14 supplies the operating potential to a branched main power line 26 which is coupled through switch 18 to the movable contact arm 28 of a 20-position rotary stepping switch 30. As shown in the drawing, switch 18 also supplies operating potential over line 32 to a set of normally open relay contacts 34 controlled by a relay coil 36 as well as sequence initiation pushbutton 20. The movable contact of switch 34 is coupled over lead 40 to one side of a relay coil 42 of stepping switch 30, with the other side of coil 32 returned to ground through a parallel network formed of a capacitor 44 and a resistor 46.

The twenty fixed contacts of stepping switch 30 are connected via energization lines E1 through E20 to the movable contact of switches S1 through S20, respectively, with only the first three energization lines and switches and the last shown in the drawing for purposes of clarity. In the example set forth herein, switches S1 through S20 each have 10 fixed contacts (and thus 10 positions) with the first 9 thereof connected in parallel via control signal busses B1 through B9 for keying the operation of each of the nine audio sources A1 through A9.

The operating potential on power line **26** is also coupled through a dropping resistor **50** to one side of the ground returned main indicator lamp **16** as well as to the movable contact **52** of a second 20-position stepping switch **54.** Stepping switch **54** has its movable contact **52** ganged together with the movable contact **28** of switch **30** for sequential operation by relay coil **42.** In addition, the 20 fixed contacts of switch **54** are connected by indicator signal lines I1 through I20 to lamps L1 through L20, respectively, with only the first three lines and lamps and the last illustrated in the drawing for purposes of clarity.

Control busses B1 through B9 are each connected to a respective one of a set of control relays R1 through R9 which, in turn, serve to actuate a respective set of normally opened contacts connected to each of the audio sources A1 through A9 for initiating operation thereof. Each of the relay switches associated with relay coils R1 through R9 may be connected to any suitable point within the various audio sources A1 through A9 and, for example, may be coupled in series with the AC supply thereof such that each source remains dormant until its associated set of contacts are closed.

In those cases where the relay switches are connected in the power supply of the audio source, it is necessary that the contacts remain closed until the audio segment has terminated. For those sources, as exemplified by sources A1, A2 and A9, the relay coils R1, R2 and R9 are directly returned to ground such that the presence of an actuating signal on the relay coil holds the contacts closed until the actuating signal ceases. It is also noted, that the switch contacts may be connected with a suitable initiation circuit (not shown) in the audio source whereupon momentary closure of the contacts initiates the operation of the source sequence without requiring that the contacts be maintained closed at all times. In those cases, as exemplified by sources A3 and A4, the relay coils R3 and R4 are returned to ground through a parallel network formed of a resistor **60, 62** and a capacitor **64, 66.** Thus, upon the receipt of a control signal at relay coil R3, for example, the coil will become momentarily energized until a sufficient stored charge has been developed across capacitor **64** to release the relay contacts.

The audio output signals from the various audio sources A1 through A9 are connected through a set of audio lines indicated generally at **68** to the audio output network **10** for appropriate processing and/or transmission. The output from the audio network **10** is also supplied to a silence sensing network indicated generally at **70** by input lines **72** and **74.**

Lines **72** and **74** are connected through a series network formed of resistors **76** and **78** and a potentiometer **80** which has one side and its movable contact coupled across the input winding of an audio transformer **82.** The output winding of transformer **82** is fed through an audio amplifier **84,** having an appropriate control potentiometer **86,** to the input winding of an impedance matching transformer **88.** One side of the output winding of transformer **88** is fed by lead **90** to the winding of relay coil **36** which has its opposite end returned to ground. The other side of the output winding of transformer **88** is connected to the anode of a diode rectifier **92** which has its cathode electrode coupled through an electrolytic capacitor **94** to line **90.** Coupled in parallel with capacitor **94** are a fixed resistor **96** and a variable resistor **98** which is operated through control knob **21** (FIG. **1**) and serves as a means for adjusting the time delay at which the silence sensing network **70** responds to the termination of audio signals from the previously energized audio source. A voltmeter **100** is optionally connected across the capacitor **94** and enables monitoring of the function of the resistor-capacitor network for preselecting the above noted time delay. A switching transistor **102,** which is responsive to the voltage developed across capacitor **94,** has its collector electrode tied to line **90** and its base electrode coupled to the junction of the cathode of diode **92** and capacitor **94.** Operating potential for the transistor **102** is supplied at its emitter electrode through a resistor **104** which is connected with power line **26** as illustrated.

In operation, when main power switch **14** is closed, operating potential is supplied from source **22** to power line **26** activating the silence sensing network **70** and causing the energization of the main indicator lamp **16.** When it is desired to begin the sequence, the audio sources A1 through A9 are prepared as noted above and the various selector switches S1 through S20 are adjusted to accomplish the desired sequence. For purposes of example, switches S1, S2 and S3 are illustrated in positions corresponding to the sequential actuation of audio sources A3, A4 and A1 in that order for the first three positions of stepping switches **30** and **54.**

To begin the sequence, contacts **18** are closed thereby applying power through switch **30** and energization line E1 to selector switch S1. Since switch S1 is in position **3,** corresponding to the activation of audio source A3, the energizing potential at its movable contact is supplied through the third fixed contact thereof and thence via bus B3 to relay R3. The potential applied to relay coil R3 causes the momentary actuation of the relay contacts thereby keying the start of audio source A3. The output of audio source A3 then commences and is supplied over its output line in bundle **68** to the audio output network **10** for broadcast.

The signals from the audio output network **10** are also connected to the input of the silence sensing circuit **70** where they are coupled by transformer **82** to the audio amplifier **84.** The signals are thereafter amplified at a gain dependent upon the setting of potentiometer **86** and fed through transformer **88** and diode **92** to the capacitor **94.** A stored potential will thereafter be developed across capacitor **94** so as to back bias transistor **102** and hold the same in a non-conductive state. Accordingly, relay coil **36** will be isolated from the power source **22** allowing contacts **34** to remain open.

At the termination of the musical selection from audio source A3, the signal appearing at the output of audio output network **10** will cease and the charging potential supplied to capacitor **94** will no longer be present. Dependent upon the setting of potentiometer **98,** the developed charge across capacitor **94** will begin to drop such that after a predetermined time delay the value of the potential fed to the base of transistor **102** will be insufficient to hold the same non-conductive. Thus, transistor **102** turns on and will apply operating potential from resistor **104** to the relay coil **36.** Contacts **34** will then be closed and will apply operating potential from line **32** over line **40** to the stepping coil **42** of rotary switch **30.** Since coil **42** is returned to ground through the R-C combination of capacitor **44**

and resistor **46**, a momentary movement of the movable contacts **28** and **52** of switches **30** and **54** is effectuated to advance the same to the next position in the sequence.

Energizing potential is thus removed from switch S1 and supplied over line E2 to switch S2 for energizing the next source in the programmed sequence. In the illustrated embodiment, switch S2 has been set to its fourth position to supply operating potential via bus B4 to relay coil R4. The operation of relay coil R4 is identical to that described above with respect to relay coil R3 and causes the activation of audio source A4 which then supplies information signals to the audio output network **10** for broadcast.

In the same manner as described above with respect to audio source A3, the output signals originating with audio source A4 and applied through audio output network **10** are fed to the silence sensing circuit **70** whereupon a charging signal is once again coupled through transformer **88** and diode rectifier **92** to capacitor **94**. The capacitor therefore begins to charge causing transistor **102** to again revert to its non-conductive or quiescent state. With the collector-emitter path of transistor **102** in a high impedance condition, operating potential is thus removed from relay coil **36** permitting contacts **34** to drop back to their normally open position. The system will remain in this state until the termination of signals from audio source A4 whereupon the signals applied to storage capacitor **94** will be removed, and the stored charge thereacross will begin to decay. After the preselected time delay, transistor **102** will turn on reducing the impedance across its collector-emitter path to a nominally low value for actuating coil **36**. As contacts **34** close, the stepping coil **42** is again momentarily actuated to advance movable contacts **28** and **52** of switches **30** and **54**, respectively, to position **3**. The above sequence continues in like manner until the 20th position is reached by switches **30** and **54** whereupon the sequence will repeat itself unless sequence switch **18** is opened.

As mentioned above, with sequence switch **18** open, the entire programming system may be reset by the repositioning of selector switches S1 through S20 to establish a different program as desired by the operator. Of course, the program may also be adjusted even when the system is in operation with switch **18** closed since the particular lamp of the set L1 through L20 associated with the actuated switch in the sequence will be energized by the operation of switch **54** so that the operator can follow the progress of the sequence during a particular broadcast.

Thus, it can be appreciated that the programming system in accordance with the present invention embodies a number of material advantages over the prior art especially in its simplicity of design, its accuracy of operation and its high flexibility enabling the rapid programming and reprogramming of a number of audio sequences to broadcast various audio information segments recorded or stored on any number of different audio sources. Furthermore, the silence sensing network in accordance with this invention responds directly to the termination of audio signals thus eliminating the need to modify, alter or preadjust each individual audio source to accommodate for mechanical or magnetic sensing systems heretofore employed.

It is also noted that while each of the source selection switches S1 through S20 has ten positions and thus can accommodate **10** audio sources, it is preferable that one of the positions of each of the switches be left unconnected to an audio source such that a break in the sequence may be incorporated into the program at desired intervals. Thus, should it be desired to operate three different sources to playback a musical selection, for example, and thereafter momentarily halt the sequence for a live announcement, the fourth switch in the sequence S4 may be set to position **10** and the sequencing system will automatically stop at that point. After the live message has been aired, and it is desired once again to reinitiate the programmed sequence, one need only actuate pushbutton **20** to sequence the stepping switches **30** and **54** to their next position whereupon the next selected audio source will be actuated and the sequence will again continue.

While only 20 source selection switches have been illustrated and only nine audio sources provided in the illustrated embodiment, it should be understood that any number of source selection switches and/or audio sources may be utilized in accordance with the present invention with the number of positions provided by each switch and the number of source actuation busses at least equal to the number of audio sources desired to be utilized. Likewise, inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A programming system comprising:

a plurality of audio sources which operate in response to an actuating signal;

selector means including a plurality of multiposition source selection switches each capable of connecting an input to one of a plurality of outputs, each output connected with one of said plurality of audio sources to pass an actuating signal to a preselected one of said sources;

sequencing means connected with said selector means and actuable stepwise to sequentially supply said actuating signal to the input of each of said plurality of source selection switches; and

detector means connected to receive audio output signals from said plurality of audio sources and coupled to said sequencing means for advancing the same one step in response to the termination of said audio output signals for a predetermined time delay whereby said plurality of audio sources may be activated in accordance with a preselected program sequence.

2. The invention as recited in claim **1** wherein each of said source selection switches comprises a rotary switch having a movable contact connected with said sequencing means and a set of fixed contacts connected respectively to said plurality of audio sources.

3. The invention as recited in claim **1** further including a plurality of indicator lamps each associated with one of said source selector switches and wherein said sequencing means comprises a first stepping switch connected with said source selection switches and a second stepping switch connected to sequentially energize said indicator lamps.

4. The invention as recited in claim **1** wherein said selector means includes a plurality of actuator relays

each associated with a respective one of said audio sources and coupled to said source selector switches, one of said relays being connected in series with a parallel network formed of a resistor and a capacitor whereby said relay is actuated momentarily upon receipt of an actuating signal.

5. The invention as recited in claim **1** wherein said detector means comprises storage means coupled to said audio sources, and control means having a quiescent state and an active state, said control means assuming said quiescent state in response to a voltage signal from said storage means at a first predetermined level and switching to said active state for advancing said sequencing means in response to the change of said voltage signal to a second predetermined level.

6. The invention as recited in claim **5** wherein said control means comprises a transistor switch.

7. The invention as recited in claim **6** wherein said control means further includes a relay responsive to the conductive state of said transistor for advancing said sequencing means.

8. The invention as recited in claim **5** wherein said storage means comprises a storage capacitor connected in parallel with a resistance to receive audio output signals from said audio sources.

9. The invention as recited in claim **8** wherein said detector means further includes an audio amplifier connected through an audio transformer and a diode rectifier to said storage capacitor.

10. The invention as recited in claim **8** wherein said resistance comprises a variable resistor whereby said predetermined time delay may be varied.

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