United States Patent [19]

Rose et al.

[11] **3,896,490**

[45] **July 22, 1975**

[54] **AUTOMATED BROADCAST PROGRAMMER**

[76] Inventors: **Andrew M. Rose,** 3655 Prune Ridge Ave., Apt. 220, Santa Clara, Calif. 95051; **Geoffrey L. Bryan,** 6205 Poe Rd., Bethesda, Md. 20034

[22] Filed: **Aug. 9, 1974**

[21] Appl. No.: **496,056**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 294,786, Oct. 4, 1972, abandoned.

[52] **U.S. Cl.** **360/69;** 360/27; 360/71; 360/72

[51] **Int. Cl.**...**G11b 15/02;** G11b 15/18; G11b 27/22

[58] **Field of Search** ..... 360/71, 72, 69, 27, 74, 360/12; 179/100.1 TC, 100.1 PS; 325/152, 158, 166, 157, 2; 340/171

[56] **References Cited**

UNITED STATES PATENTS

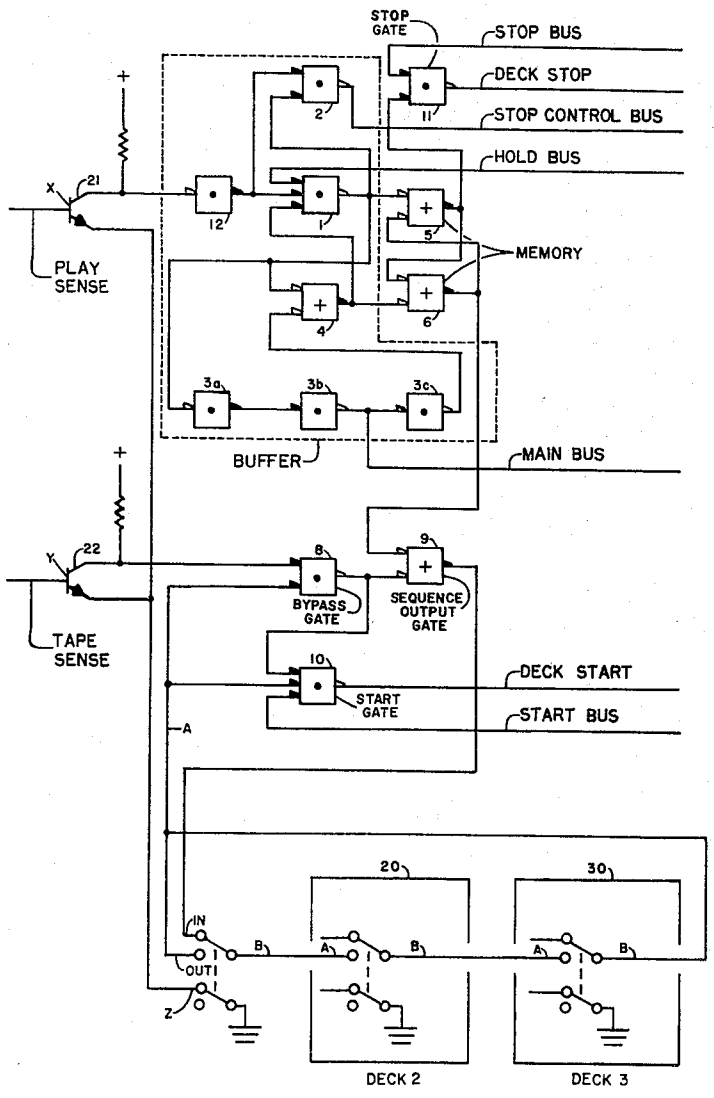
2,806,944	9/1957	Sheffield et al.	325/158
2,921,291	1/1960	Hembrooke	360/69
3,169,773	2/1965	Redlich et al.	360/72
3,305,645	2/1967	Nisbet	360/71

Primary Examiner—Alfred H. Eddleman
Attorney, Agent, or Firm—Rene A. Kuypers

[57] **ABSTRACT**

This invention relates to an automated system for use in radio broadcasting which enables programming to function automatically when live broadcasting cannot be scheduled. The system is characterized by a feedback arrangement between various tape decks and a control unit whereby the condition of the decks is constantly being monitored to determine whether it has tape (i.e., is ready to play) as well as whether it is actually in play. The invention is further characterized by fail-safe circuitry to prevent the system from going off the air.

9 Claims, 5 Drawing Figures



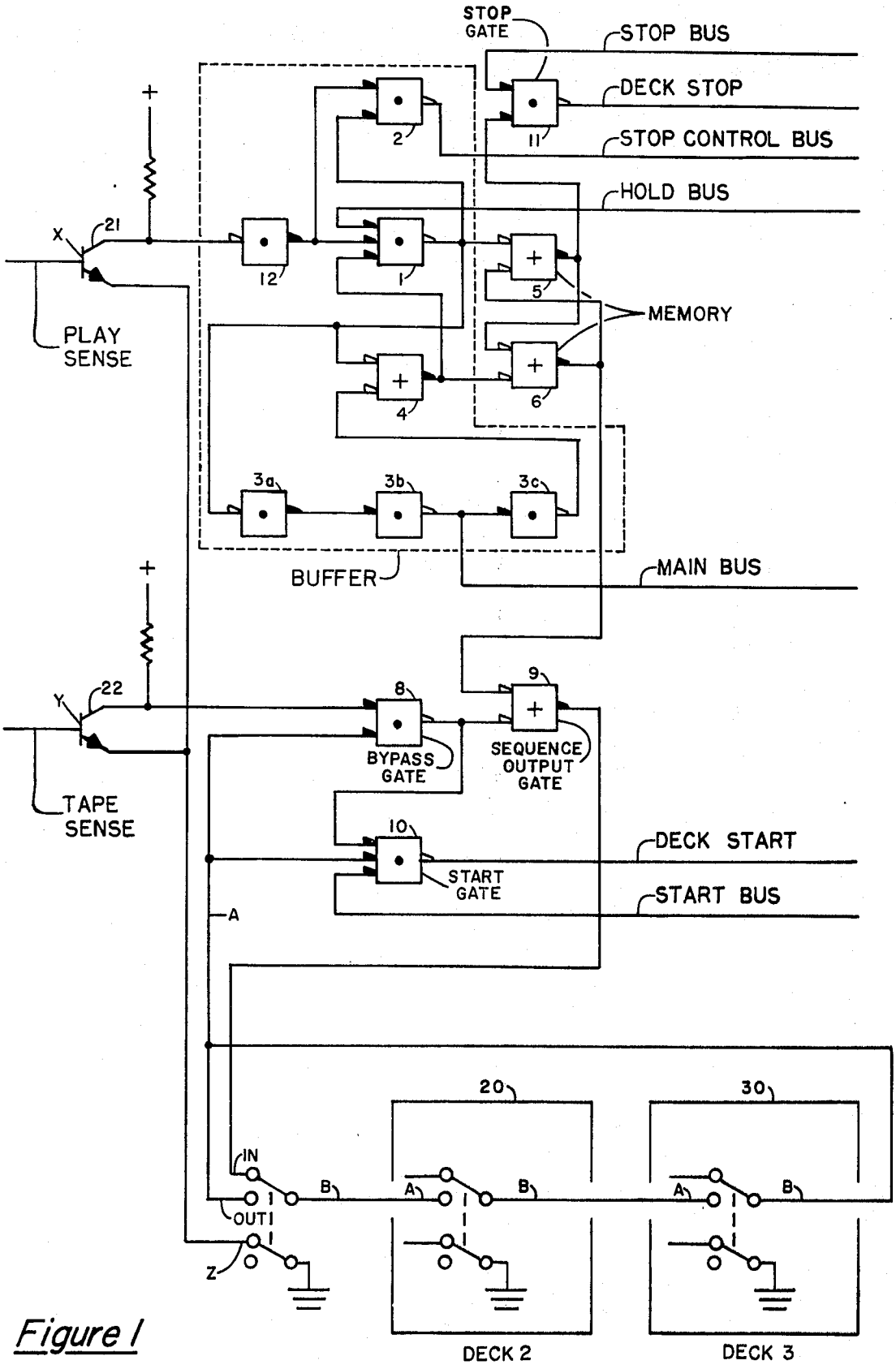

STOP GATE
STOP BUS
DECK STOP
STOP CONTROL BUS
HOLD BUS
MEMORY
PLAY SENSE
BUFFER
MAIN BUS
BYPASS GATE
SEQUENCE OUTPUT GATE
TAPE SENSE
DECK START
START GATE
START BUS
IN
OUT
DECK 2
DECK 3

Figure 1

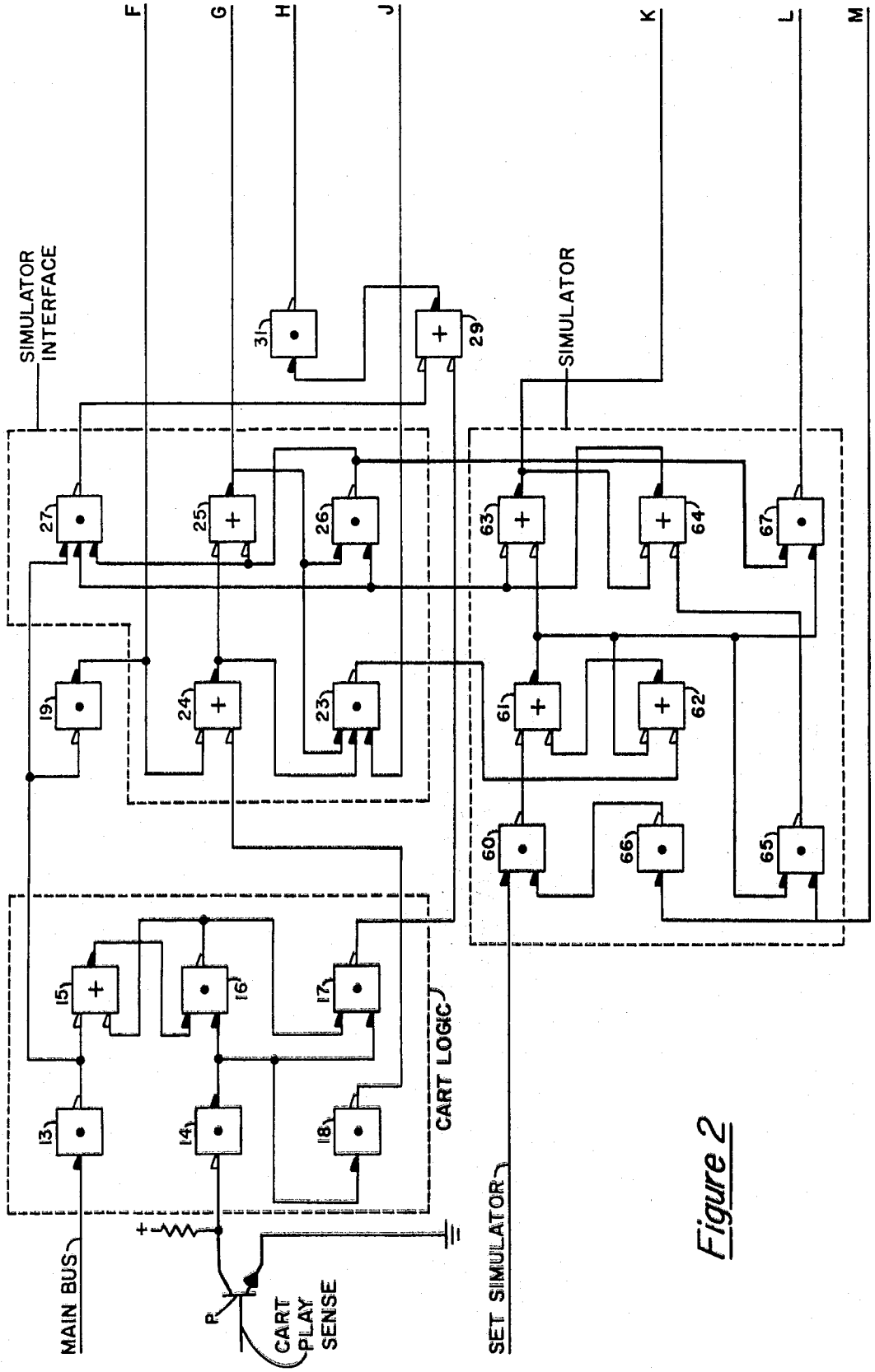

F
G
H
J
K
L
M
SIMULATOR INTERFACE
SIMULATOR
CART LOGIC
MAIN BUS
CART PLAY SENSE
SET SIMULATOR
R
13
14
15
16
17
18
19
23
24
25
26
27
29
31
60
61
62
63
64
65
66
67

Figure 2

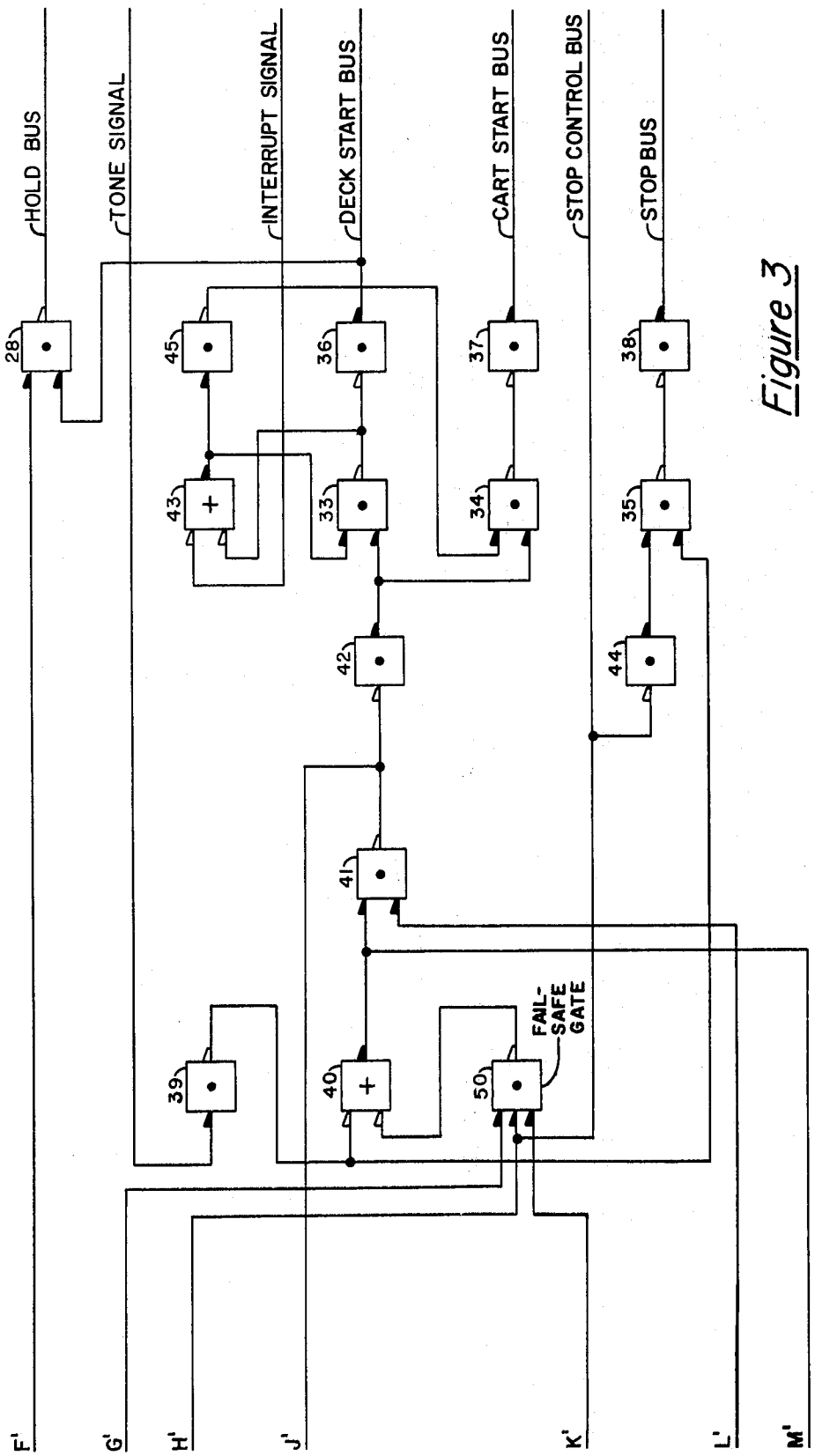

HOLD BUS
TONE SIGNAL
INTERRUPT SIGNAL
DECK START BUS
CART START BUS
STOP CONTROL BUS
STOP BUS
28
45
36
37
38
43
33
34
35
42
44
41
39
40
50
FAIL-SAFE GATE
F'
G'
H'
J'
K'
L'
M'

Figure 3

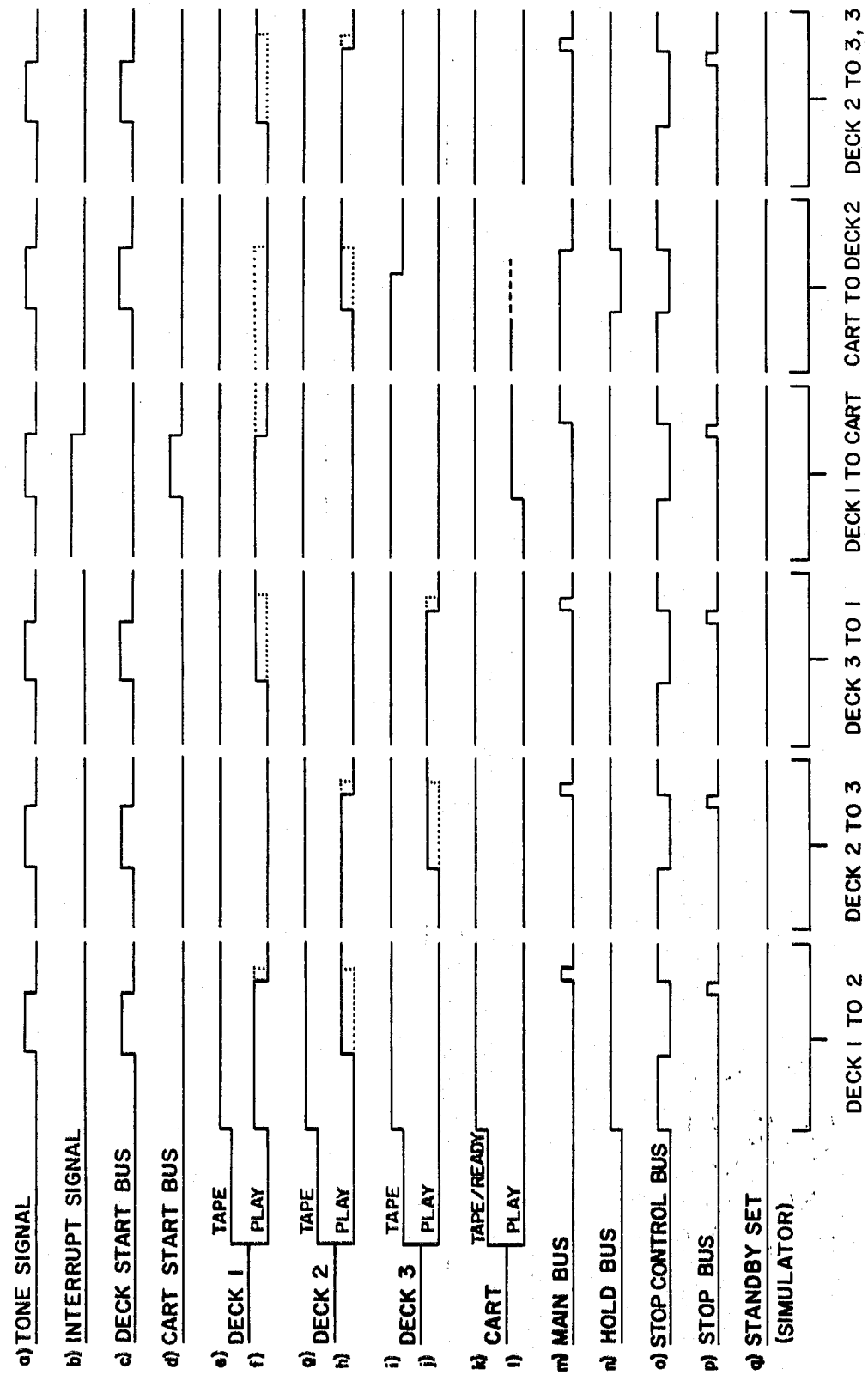

a) TONE SIGNAL
b) INTERRUPT SIGNAL
c) DECK START BUS
d) CART START BUS
e) DECK 1 TAPE
f) PLAY
g) DECK 2 TAPE
h) PLAY
i) DECK 3 TAPE
j) PLAY
k) CART TAPE/READY
l) PLAY
m) MAIN BUS
n) HOLD BUS
o) STOP CONTROL BUS
p) STOP BUS
q) STANDBY SET (SIMULATOR)
DECK 1 TO 2
DECK 2 TO 3
DECK 3 TO 1
DECK 1 TO CART
CART TO DECK 2
DECK 2 TO 3, 3 OUT OF TAPE, DECK 2 TO 1

Figure 4

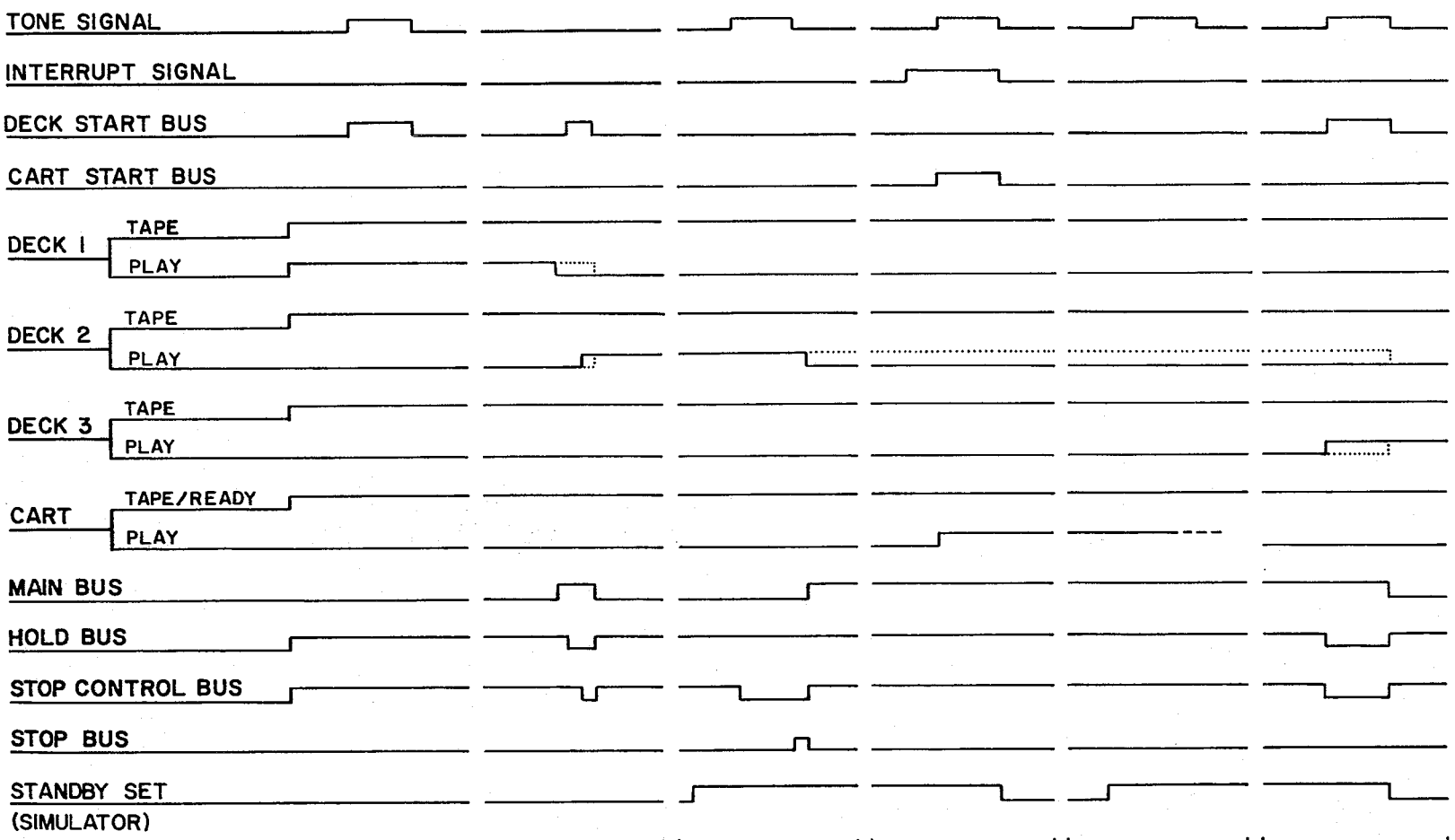

TONE SIGNAL
INTERRUPT SIGNAL
DECK START BUS
CART START BUS
DECK 1
TAPE
PLAY
DECK 2
TAPE
PLAY
DECK 3
TAPE
PLAY
CART
TAPE/READY
PLAY
MAIN BUS
HOLD BUS
STOP CONTROL BUS
STOP BUS
STANDBY SET
(SIMULATOR)
DECK 1 TO 2, DECK 2 DOES NOT START
FAIL-SAFE START OF DECK 2
DECK 2 TO STANDBY
STANDBY TO CART
CART TO STANDBY
STANDBY TO DECK 3

Figure 5

AUTOMATED BROADCAST PROGRAMMER

This is a continuation-in-part application of copending application Ser. No. 294,786 filed October 4, 1972, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to the field of radio broadcasting and in particular to the field of automated radio broadcasting without live announcing.

2. Description of the Prior Art

In the investigation of various prior art commercial automated broadcasting systems using tape machines, it has been discovered that most of these systems do not provide adequate safeguards to minimize against the possibilities of "dead air". Automated broadcast systems of the type being discussed provide for automatic sequencing between a plurality of tape decks after every three-minute musical selection as well as for periodic taped announcements, for example, every 15 minutes, from a tape cartridge deck. One of the shortcomings of the known prior art systems is that when it is ready to sequence or initiate a second tape deck after the completion of the musical selection from the first deck and the second deck is per chance out of tape, a stop command is generated to cause the system to go off the air. Since a radio station is conventionally a business enterprise, the above-described "dead air" occurrence is not beneficial to the commercial interests of the station.

Another recognized shortcoming of known prior art automatic tape deck sequence systems utilized in automated broadcast stations resides in the reliance placed by these systems on "silence sensors." Silence sensors are utilized to detect the presence of audio. The silence detector, which is always active, is designed to initiate a second tape deck upon encountering a specified time of no audio-output from a first tape deck. However, the use of silence detection is not an entirely satisfactory arrangement since it might sequence the second tape deck after encountering a long, soft passage of music. The triggering of the second deck by the silence detector might occur in the middle of a musical selection which is a source of annoyance to the listeners.

SUMMARY OF THE INVENTION

In the automated broadcast programmer of the instant invention a fail-safe system has been devised to provide nearly continuous, uninterrupted 24 hour a day operation by constantly monitoring the status of each one of a plurality of tape machines. Tape machine as defined herein is meant to include reel-to-reel and cassette tape transports as well as tape cartridge transports, the latter playing endless contained tape loops. The tape machines are constantly monitored by means of a feedback arrangement which provides status information concerning the machines. The status information signals provided by the feedback are first, whether the respective machine is in the reproducing or play mode and second, whether the machine has recorded information (i.e., tape) for reproducing. These feedback signals are returned to a controller, which electronically processes these signals and issues commands based on the type of status signal received.

The controller's commands upon processing the feedback signals provide certain fail-safe operations to assure continuous operation of the broadcast station.

Thus in the event that a tape machine runs out of tape due to breakage, the controller will by-pass this deck and will prevent the system from trying to start this out-of-tape deck.

The controller also provides fail-safe circuitry which prevents more than one tape deck from running at one time. The circuitry utilized in the controller to achieve this fail-safe result comprises a memory arrangement, which is associated with each tape deck. Each respective memory remembers whether its deck has been in play or not. Accordingly, when two decks are accidentally put into play a stop control signal is generated by the controller to stop the tape deck whose memory indicates that it was first in play.

Fail-safe circuitry is additionally provided to make sure that a machine is running at all times. Thus, if none of the machines is sending a feedback reproducing or play signal to the controller, the controller produces a signal to start the machine next in the desired sequence.

The controller of the instant invention also provides circuitry such that if the automated system is not successful in getting the next machine in the sequence to start playing, the deck that was previously running will continue to run. This is accomplished by the controller circuitry which realizes that it has not succeeded in starting the next tape machine in sequence because no feedback play signal is being received. Therefore, the previous deck will remain in the play mode to prevent a "dead air" situation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts several tape decks which are coupled together in an automated broadcast programmer and wherein the logic associated with one such tape deck is shown.

FIG. 2 depicts additional logic circuitry, which is utilized with a cart deck, as well as the logic utilized for a deck simulator and simulator interface.

FIG. 3 shows the logic circuitry which generates the various bus signals.

FIG. 4 represents a timing chart which is utilized with the deck and cart logic of FIG. 1.

FIG. 5 illustrates a second timing chart which is employed with the simulator and simulator interface of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to FIG. 1, there are illustrated two decks 20 and 30 as well as the logic circuitry for the controller for a third deck (not shown). The third deck associated with deck 1 is not shown in order to simplify the drawing. Although the instant invention will be described with respect to decks which play audio tape for an automated radio station, it will be appreciated by those skilled in the art that the invention can be modified for use with tape using a video frequency or recording, as well as decks using photographic images. The tape decks, which are utilized in a desired sequence, and a cart deck, which is inserted as desired in the sequence for playing station identifications (i.d.'s), commercials, and public service announcements (p.s.a.'s), are utilized in a broadcast automation system to allow a radio station to operate without attending personnel.

Decks 1, 2 and 3 are conventional reel-to-reel tape decks which are interconnected to one another for sequencing as desired by the broadcast station operator. As an example, the pre-recorded tape on each respective deck may be characterized by a different music style. Accordingly, after each playing of a three minute semi-classical selection starting on deck 1, for example, the automated system is sequenced or switched to deck 2, which may have Broadway show tunes, after which selection there is automatic transfer to deck 3 which may have pop songs. Although the invention is being described with respect to three decks, it should be understood that as many decks may be used as is required to lend variety and prevent tedium to the listening audience. Switching is initiated from deck 1, to deck 2, to deck 3 by a 25 hertz tone which is pre-recorded on the tapes after each musical selection. This aspect of the invention will be discussed in greater detail hereinafter.

The control logic shown in FIG. 1, utilized NAND type circuitry. Control logic circuitry as shown associated with deck 1 is similarly provided for each of the decks 2 and 3 but is not shown for purposes of simplicity. This means that when both input terminals to a logic element are at a high (H) voltage level, its output will be at a low (L) voltage level. The H voltage level will be indicated by a black flag, whereas a L voltage level will be indicated by a white flag. Furthermore, the plus (+) sign inside the logic gate will indicate that the OR function is being performed by the gate, that is, when both or one of the input signals is L, the output will be H. On the other hand, the AND function shown by a period (.) will be performed when all inputs are H and the resulting output is L.

Considering now the logic of FIG. 1 in the quiescent state (i.e., with no decks or carts running), the circuitry is designed such that if the deck has tape threaded thereon a H signal will be produced at the deck by a tape sensor (not shown), whereas, conversely, a L signal will be generated by a lack of tape on the deck. For example, a broken tape on a deck will generate a L signal. These signals from the tape deck indicating the status of the tape are designed as tape sense signals and constitute a feedback signal from the deck to the control logic or controller. The tape sense signal is generated from the deck by means of a relay (not shown).

Similarly, another feedback signal identified as a play sense signal is generated from the deck indicating that the deck is in the play mode. The play sense signal on the deck is generated from the tape drive solenoid (not shown). The play sense signal is applied to the base electrode 21 of transistor X and the tape sense signal is applied to the base element 22 of transistor Y.

In the quiescent state therefore, the feedback signal applied to the base 21 of transistor X will be L and the signal applied to the base of transistor Y will be H. In other words, the decks not being in play, the play sense signal will be L, whereas the decks are assumed to have tape and accordingly, this feedback signal is H. In view of the L signal applied to the base element 21, transistor X is made non-conducting and the H input to the one-input NAND gate 12 causes its output to become L.

The H input applied to the base of transistor Y causes it to become conductive presuming that switch Z is activated in the upward position. Therefore, a L signal will be applied to NAND gate 8 and its output will be H, which is in turn applied to NAND gate 10 as well as to NAND gate 9. One of the input terminals of gate 10 operating in the AND mode, going L causes its output to go H. The H output of gate 10 is applied to the deck 1 start terminal. This terminal must be L to start deck 1. It should be noted that in the quiescent state, the input signals applied to gates 7 and 10 are such that they are in an indeterminate state.

Returning again to gate 12, it was observed that the L output of inverter 12 is applied as an input signal to the buffer and in particular to NAND gates 1 and 2 causing their respective outputs to go H. The output of gate 2 is applied to the stop control bus. The H out state of gate 1 is applied to consecutive inverters 3*a*, 3*b* and 3*c* causing the latter's output to go H. Since a L signal is applied to the input of NAND gate 4, its output will go H.

The NAND gates 5 and 6 are interconnected to one another to form a bi-stable flip-flop or memory device. In the quiescent state, only one input to the respective gates 5 and 6 are H whereas the second input terminal cannot be determined, therefore, causing the memory to be in a indeterminate state. The stop bus during the quiescent state is L causing the output of NAND gate 11 to go H. This output signal comprises the deck 1 stop signal. This signal must be L to enable a deck to be stopped.

Let it now be assumed that one of the decks (deck 1) is put into operation or initiates playing a musical selection lasting three minutes. This will be identified as the play or reproduction mode. In the play mode, the play and tape sense signals applied to the respective base terminals of respective transistors X and Y will be H. These signals can be viewed at the extreme left hand side of the timing chart shown in FIG. 4. It can be seen from the timing chart of FIG. 4 that initially decks 2 and 3 have tape indicated by the H signal but are not in the play mode as indicated by the L signal. Similarly, the cart machine is not in the play mode indicated by the L signal, whereas the tape/ready signal is H indicated that tape is present in the machine.

Therefore, when deck 1 is initially put in the play mode, the output of inverter 12 is H caused by transistor X being made active. This H signal is applied simultaneously to NAND gates 1 and 2. The hold bus is also H at this time as seen in FIG. 4(n). The hold bus is L only under two conditions: (a) no tape decks have been running, and (b) when a tape deck is being started. The third H input to NAND gate 1 arises from the NAND gate 4. This H input signal results from the H output of gate 1 during the quiescent state which becomes a L signal after being applied to the consecutive inverters 3*a*, 3*b* and 3*c*. The L pulse applied to the NAND gate 4 operating as an OR function causes its output to go H thereby making all inputs to the NAND gate 1 functioning as an AND to be H and its output to revert to the L state. The L output of gate 1 is continually applied as one of the inputs to gate 4 whereas its second input is H after passing through inverters 3*a*, 3*b* and 3*c*. However, the L output of gate 1 applied to gate 4 keeps the buffer locked into this output state. It should be noted that the output of inverter 3*b* is the main bus output and is L at this point in time as seen in FIG. 4(*m*). The output of gate 3*b* is simultaneously applied to similar points in the logic circuitry for the other two decks.

The L output signal produced by gate 1 is applied to the S (set) input terminal of the bi-stable flip-flop memory gate 5. The L input to NAND gate 5 operating as

an OR gate causes its output to go H. At this time, both inputs to gate 6 are H so that a second L input is also applied to gate 5. The setting or H output signal of gate 5 of the memory as just described is shown in FIG. 4(*f*). The tape sense feedback signal is also H at this time as seen in FIG. 4(*g*). It can accordingly be appreciated that when deck 1 is put into the play mode, its associated memory will become set. The memories associated with decks 2 and 3 will be re-set as well be described at a later time.

During this time the stop bus will be L (see FIG. 4(*p*) so that the output of the stop gate 11 will be H. This signal is applied to the on-off control of deck 1. This signal must be L to stop deck 1. Also during this time the L output state of the transistor Y collector is applied as one of the inputs of gate 8. Since the latter gate 8 operates in the AND mode, its output is H. This H is applied to gate 10 and as one input to gate 9. The L output of gate 6 is applied as the other input to gate 9. Since gate 9 is operating in the OR mode and has at least one L input, it will produce a H. Assuming that switch Z is poled to activate the upward contact, the H output of sequence output gate 9 is applied to terminal A of the sequence switch associated with deck 2. This H signal will be applied to the next deck's logic. The start gate 10 is enabled by a H input signal from the sequence input, the deck start bus and a H output signal from gate 8. Gate 8 is H when there is a tape sense signal applied to the base terminal of transistor Y or there is no sequence in signal. Since there is no sequence input signal because deck 1 is running, the start gate 10 will not be enabled and its output will be H.

In operation, the system is now ready to be switched from deck 1 to deck 2. The reason for this change is that the three minute musical selection being played on deck 1 is finished and the second tape deck with a different type of music selection is to follow the first selection. The reason for this switching of tape decks is to give the listener a variety of music and change of pace.

After the first-mentioned musical selection is completed, a 25 hertz tone is produced from the deck 1 tape and is identified on the timing chart (see FIG. 4(*a*). The start bus immediately reverts to the H state for the length of the tone (see FIG. 4(*c*). Therefore, the gate 10 associated with deck 2 will have its output revert to the L state since all of its inputs are now H, one input is the sequence input coming from switch Z of deck 1's logic; one coming from the start bus; and the third from gate 8 in the logic for deck 2, which is H since deck 2 has tape, thereby causing the next machine (i.e., deck 2) to be started. It should be noted hereat that the timing chart indicates just prior to the generation of the tone signal that a tape sense feedback signal (see FIG. 4*g*) from deck 2 is H indicating that the latter has tape threaded thereon, but the play sense feedback signal (see FIG. 4*h*) is L indicating that deck 2 was not in play. However, after the generation of the 25 hertz signal, the play sense signal of deck 2 goes H, indicating that deck 2 is playing.

It can be readily seen from the timing chart that there is a condition at this particular point in time wherein decks 1 and 2 are in overlapping relationship. The following discussion will show how deck 1 will be turned off and deck 2 will continue playing for the next three minute interval.

The play sense signal of deck 2 goes H as previously stated. It should be noted hereat that the control circuitry being discussed is that associated with deck 2 and which is identical with the control circuitry of deck 1. Since this is true, the output of NAND gate 1 associated with deck 2 will remain H when the play sense signal of deck 2 goes H since the output of NAND gate 4 is L as previously described. This results from the fact that both inputs to NAND gate 4 are H since the logic associated with deck 1 is holding the main bus L and prior to the start of deck 2, gate 1 was H. Accordingly, the output of the stop control signalof the NAND gate 2 is L since both inputs are H. This L signal is shown in the timing chart (see FIG. 4*o*) aid is applied indirectly to the control circuitry of deck 1 to turn off the latter. Therefore, the play sense signal of deck 1 reverts to the L state as also seen on the timing chart (see FIG. 4*f*). It should be noted that the listener experiences the effect of the music fading away in deck 1 while the music from deck 2 comes in. The transition is accordingly pleasant to the ear of the listener.

It should be noted hereat that dotted lines are associated with the play sense signal of decks 1 and 2. With respect to deck 1, the dotted line indicates that even though the play sense signal reverts to a L state, the bistable flip-flop still remains set or H for a short period of time. Similarly, the play sense signal of deck 2 is shown to revert to the H state although its associated flip-flop still remains in its L or unset condition. It will now be shown how the respective decks 1 and 2 flip-flops are respectively reset and set.

It will be recalled that the main bus was L since deck 1 was in play and no other deck was running. In addition, since deck 1 has ceased to play, the main bus went H (see FIG. 4*m*). With respect to the control circuitry of deck 2, the main bus goes H and after inversion by inverter 3*c* is applied as a L signal to NAND gate 4. This L signal causes gate 4 to switch to the H state. This H signal is applied to both gates 1 and 6. Since NAND gate 1 inputs are now all H, its output becomes L and is applied as a signal to memory gate 5. The output of gate 5 goes H and is fed into the second input of gate 6. The output of gate 6 therefore reverts to H state and the memory is accordingly set. The dotted line associated with deck 2 shows that flip-flop reverts to the H state shortly after the play signal goes H. In the manner previously described with respect to deck 1, the main bus will revert to the L state since deck 2's gate 1 is L see FIG. 4*m*).

Similarly, the flip-flop associated with deck 1 is re-set since when its play sense feedback signal goes L, the output of NAND gate 1 goes H which is applied as one of the inputs to OR gate 5. The H output of gate 1 is also applied to gate 4. The second input to gate 4 is applied from the main bus signal. Therefore, the output of gate 4 is L which causes gate 6 to go H. With either inputs of gate 5 being H its output is L and therefore the flip-flop is re-set. This is shown by the dotted line of the play sense signal of deck 1 switching to the L state. This re-set of the memory operation similarly occurs in all other situations where the main bus is L and the associated gate 1 is H.

The operation of the above-described logic circuitry operates in the same manner when the three-minute selection has been played on deck 2 and transfer is to be made to deck 3. The selections on deck 2 might be of a semi-classical nature and those on deck 3 might be of show tunes. The transfer is initiated inthe manner above described with the generation of the 25 hertz

tone signal. The operation may be viewed and understood by referring to the appropriate section of the timing chart. Similarly, after the playing of the selection on tape 3, the operation of the control unit transfer back to tape 1 as seen in the timing chart.

At various time periods in an automated broadcast station, for example, every 15 minutes, various public service announcements are to be played between the music selections. The public service announcements are recorded on tape and will be played on a cart machine. The cart machine is similar to a deck machine except that the tape that is utilized does not employ a 25 hertz tone signal. The cart machine is self stopping.

Therefore, in the operation of the instant invention let us assume that after the playing of a three-minute selection on deck 1, transfer is to be made to the cart for the playing of a special public service announcement. The cart cycle is initiated by the interrupt signal generated by a time clock (see FIG. 4*b*). The time clock will cause an interrupt signal, for example, at thirteen minutes after the hour. During the interrupt signal, the tone (see FIG. 4*a*) and cart start signals (see FIG. 4*d*) are also generated. These two signals cause the cart to start the desired ID announcement. It should be noted from the timing chart that the deck start bus signal (see FIG. 4*c*) remains L during this period of operation. During this cycle of operation, deck 1 is still running and must be turned off. This is accomplished in the following manner by referring to FIG. 2.

At intervals during the normal operation of the system it is desirable to be able to make special recorded announcements, whether they ask the legally required station identifications, commercials, or any of a number of similar items. This material is contained ona tape cartridge, commonly referred to as a cart, and played back on a specially designed tape machine, known as a tape cartridge machine, or, more simply, as a cart machine. These carts contain an endless loop of tape which, if the loop were opened, lasts from a few seconds up to thirty minutes. Thus, the material of interest recorded on a cart may be of any length up to the limit placed by the amount of tape actually in the cart loop. The cart machine is started by a momentarily applied command, similar to the above discussed tape decks. Stopping is done automatically by the cart machine itself when it goes completely through the loop once and reaches the beginning of the recorded data. This is referred to as recueing and a cart in this state is said to be cued. Thus, every time the cart is started it will instantly reproduce the recorded information without requiring any external cue commnds, unlike standard tape decks.

Under normal operation of the invention, the control device sequences in the previously described manner between the tape decks. Upon an externally produced level, generated by a timer, the normal sequence of decks is interrupted and the cart machine becomes the machine which will be started by the next tone. After the cart start command is (see FIG. 4*d*) removed from the cart machine, this level returns L and the sequence reverts back to the decks, with a deck being started by the first tone after the level is L. This externally produced level is known as the interrupt signal (see FIG. 4*b*, deck 1 to cart.)

By going H, the interrupt signal causes there to be no other change in the status of the entire system except to alter what machine will be started next. In the event that a tone is present, causing a deck start command to be given to a deck, the interrupt signal is blocked until the tone ends, as will be discussed later. If this blockage were not in the controller, two machines would be started by the one tone, one a deck and the other a cart machine. This would occur because the interrupt signal would switch a start command from a deck to the cart while this start command was present. With the blockage that is included in the controller the interrupt signal is allowed to switch only to that device which the next tone will cause to be started. Thus, the circuitry assures that only one start bus will be active at a time, and the states of the buses cannot be reversed during the presence of a tone.

The cart logic section determines if a tape deck is to be stopped; that is, whether a stop command is to be generated by the deck logic unit at the end of a tone signal. This determination must be made because it is unnecessary to cause a stop command to be sent to a cart machine; it will stop automatically, independent of any tone signal.

When a cart is being started by a tone signal coming from a tape deck, it is necessary for the deck logic unit for that deck to generate a stop command for that deck. However, when a tape deck is being started by a cart machine, no stop commands are to be generated, despite the fact that a tone signal will be produced by the cart. This tone signal merely indicates that it is time for the next device to be started, but it does not imply that the cart should be stopped when the tone signal ceases. As stated above, the cart machine will independently determine the proper point at which to stop itself.

Referring now to FIG. 2, the logic circuit for the cart machine is depicted and it is observed that prior to the start of the cart machine the main bus is L. This is applied to inverter gate 13 producing a H output. This H signal is one of the two signals applied to the two-input NAND gate 15. The other input to gate 15 is the output of gate 16. Since the cart machine is not in play, inverter gate 14 has a H input and a L output. This L output is applied as an input to gate 16 and gate 17. As indicated on the logic circuit, gate 16 produces a L when both its inputs are H. In all other cases, the output is H. Gate 14 applies a L signal to an input to gate 16, which therefore forces the output gate 16 to be H. This resulting H is applied as the second input to gate 15. Since neither of the inputs to gate 15 is L, the output of this gate goes L. This L is in turn fed back to the remaining input to gate 16, forcing the output of gate 16 H regardless of the level applied to the other input to gate 16. Thus, since gate 16 cannot go L until gate 15 goes H, the output of gate 15 cannot change until the main bus changes state. The main bus will not change from a L to a H until the deck with a set memory is stopped (see FIG. 4*m*).

When the cart is started, a L signal is applied to inverter 14 causing it in turn to output a H signal. As just mentioned, this H signal will produce no change in the state of gate 16 because gate 15 outputting a L signal keeps the output of gate 16 H. Gate 17 is also a two-input NAND gate with one input coming from the now H output of gate 16. The other input to gate 17 is the output of gate 14, which was L before the cart was started. With two H inputs, the output of gate 17 goes L. This L is indirectly applied to the stop bus through gates 29 and 31.

Gate 29 is a two-input NAND gate. One input comes from gate 17 while the other comes from the simulator gate 27, which is presently H for reasons to be discussed below. As indicated, gate 29 will produce a H output if either of its inputs goes L. Therefore, when gate 17 has a L output, gate 29 creates a H signal. Gate 31 is an inverter with its output tied to the stop control bus and input coming from gate 29. When gate 29 creates a H signal, gate 31 will produce a L output and, as a result, the stop control bus goes L (see FIG. 4o). As discussed previously, when the tone ends, the L stop control bus will cause the operating tape deck to be stopped. Only one deck is running because no deck start signal appeared on the deck start bus (see FIG. 4*c*.)

When the deck stops, the main bus goes H (see FIG. 4*m*) and remains H indefinitely since no decks are operating. Inverter gate 13 now creates a L signal since its input has gone H. With a L input applied to one of its inputs, gate 15 generates a H signal. This H signal goes to gate 16. Now both inputs to gate 16 are H since gate 15 is H and the cart machine is in the play mode, therefore gate 16 produces a L output. This L output is applied to both gate 17 and to gate 15. Since both inputs to gate 17 are not H, the output of gate 17 must revert to a H level, which is applied to gate 29 and in turn to gate 31 and the stop control bus.

With two H inputs gate 29 must drop its output L and gate 31 will no longer generate a L. The inverted output of gate 30 no longer holds the stop control bus L (see FIG. 4o). At this point it can be seen that the stop control bus is formed by connecting the outputs of a number of gates to one common point. This "wired-or" configuration will produce a L signal at the common point if either the first gate or the second gate or etc., up to the total number of common gates, output a L. If none of the gates is generating a L, the common point is pulled H. The main bus switches state in the same manner because it is also in the wired-or configuration.

The L output of gate 16 is also fed back as an input to gate 15. Gate 15 will continue to produce a H as long as gate 16 generates a L, regardless of the states of the main bus and gate 13. Thus, when the next tone causes a deck to be started, eventually resulting in the main bus going L, the states of the gates in the cart logic section, except for gate 13, do not change and no stop control signal will be generated by them. When the cart machine automatically stops itself, the state of the gates will then, and only then, revert to their originally described state. If the interrupt signal goes H before the cart machine stops and if a tone signal is also produced, the interrupt signal is automatically taken L by the tone and the system will operate as if the interrupt signal had never gone H. This will also occur if no cart is in the cart machine and a tone signal occurs.

Under certain situations it is desirable to have the control device stop the operation of all machines upon the end of normal sequencing tone. To accomplish this, the device contains a simulator and interface circuitry.

Upon an external, operator-produced signal, the simulator becomes the next machine in the sequence. The first tone produced after this will put the simulator into play. If a tape deck produces this tone, the stop control bus is activated, because two machines are in play. The operation of the controller under this condition is identical to the previously described deck to cart sequence. With gate 25 producing a L signal, gate 26 remaining H and gate 27 generating a L to the now H gate 29 and L producing gate 31 until the deck stops. In the event that a cart is playing, the output of gate 27 with appropriate consequences on gates 29 and 31 remains H and thus no stop control signal is generated. When neither the cart machine nor a deck is running, gate 26 switches L and remains L, holding gates 25 and 27 H as long as the simulator is in play.

In the event that the cart produced the tone, no stop commands will be issued since the tone producing device is self-stopping.

The simulator is stopped as soon as a deck or the cart is restarted. When gate 26 has control of the system and gate 25 is thereby forced to generate a H output, one input to gate 23 is H. As soon as a deck or a cart is started, placing a H signal as an input to gate 25 and the start command ends the other inputs to gate 23 go H and gate 23 generates a stop command to the simulator until the simulator stops and gate 25 switches state.

This restarting can be accomplished by either directly operating a machine or by activating the tone detector. In the second case the machine which the controller will start will be the machine which was scheduled to go next prior to the readying of the simulator. To prevent the starting of two machines during the presence of a tone, the simulator will not become the next machine during the presence of a tone in a manner similar to the blockage of the interrupt signal. Thus, if a tone is being detected and the operator attempts to cause the simulator to be next, the circuit will ignore the operator command and will complete the sequencing that is in progress.

A certain special signal must be generated when the controller starts a tape deck after a cart has been played, after the simulator has been in control or any time no deck was in the play mode prior to the commencement of the starting of a deck.

As was discussed previously, the next tape deck that will receive a start command is the first tape deck with tape which is in sequence after the deck with the set memory. Also mentioned earlier was the fact that a tape deck is permitted to set its memory whenever the deck is in play and either the main bus is H or the main bus is being held L by the same deck. This means that a deck can set its memory any time it is in play and no other deck has been or is still in play. Since memories are cleared only when the main bus is L, the memory of the last deck which was running remains set after sequencing to a cart or to the simulator. Upon the next tone (see FIG. 4*a*, cart to deck 2 and FIG. 5*a*, simulator to deck 3) a deck start command signal is generated on the deck start bus (see FIG. 4*c* and FIG. 5*c*). The fact that no deck was running and that a deck is being started causes the hold bus to go L. This bus originates at gate 28. Gate 28 produces a L output whenever the main bus is H and the deck start bus is H. The state of the main bus is inverted by gate 13 and again by gate 19. Thus, the output of gate 19 is the same state as the main bus. Gate 19 has its output tied directly to one of the inputs to gate 28 while the deck start bus goes directly into the other input causing the hold bus to perform in the described manner.

The hold bus is an input to the gate 1 shown in FIG. 1. Each deck has a similar gate and the hold bus signal is also applied to these gates. When the hold bus is L, the output of all three gates are held H and none of the decks can set a memory or take the main bus L. How-

ever, the deck which was started will generate a stop control signal. Since the other condition for the generation of a stop signal is that there be no tone present, no unwanted stop command will be produced since the hold bus goes H when the tone ends allowing the deck which was started to set its memory and eliminating the stop control signal. Therefore, the stop control bus is L until the tone ends, at which time it reverts to the H state. Since no action is taken due to a L stop control bus unless this bus is L when there is no tone, the circuit produces a stop control signal which causes no action. There is a reason for not defeating the stop control signal in this situation which will be discussed later.

If the hold bus did not exist, the first tone after a no deck playing situation would start two decks and, upon the completion of the tone, stop the first deck started.

When the tone starts, the first deck in the sequence with tape after the deck with the set memory, which is not running at this point, will be started. Without the hold bus, the newly started deck would be allowed to set its memory because there would be no other deck setting its memory. As soon as this new memory was set, the sequence line to the next deck would go H. Since the tone is still present, the next deck with tape after the newly started deck would also be started. When the tone ended the deck which would have been the only one running would be stopped, because the controller would have reached a state exactly equivalent to that achieved when it is sequencing between two decks. Thus, the hold bus is necessary to hold the state of all the memories constant until the tone ends. Once the tone ends, the start bus is L and no deck will be started. Therefore, it is a safe time to allow the memories to change.

Gates **33, 34** and **35** are all two-input NAND gates which, after their outputs are inverted by gates **36, 37** and **38** respectively, form, in order, the deck start bus, the cart start bus, and the stop bus. In general terms, one input to each gate is an output from control logic which causes the gate to become active under the correct conditions of the tone signal, which controls the second inputs in the desired manner.

The tone signal will be L when there is no tone. This L is inverted to a H by gate **39.** This H signal is applied as an input to gates **40** and **35.** As indicated on the logic circuit, gate **35** is a two-input NAND gate with the active state occurring with both the first and the second inputs H. The second input to gate **35** is the output of the inverter gate **44** which is H when the stop control bus goes L. This occurs since the input to gate **44** is the stop control bus. Therefore, when there is no tone present and the stop control bus is L, gate **35** has both inputs H and generates a L. This L is then inverted by gate **38** and causes the stop bus to go H, stopping a deck as previously described.

When gate **36** has a L input, it will generate a H and take the deck start bus H. The necessary L occurs only when both inputs to gate **33** are H. One of these inputs, which is simultaneously applied to gate **34** goes H whenever a machine is to be started. A machine will be started whenever the simulator is not next and a tone signal is generated. This signal goes H whenever gate **42** generates a H. The other input to gate **33** comes from gate **43** and is the complement of the second input to gate **34.** Thus, when gate **43** generates a H, this H will be directly applied as an input to gate **33** and gate **45,** while the latter inverts the H and applies a L to gate **34.** This action assures that gate **34** cannot have both inputs held H whenever both inputs to gate **33** are H. It is also true that both inputs to gate **33** cannot be H if both inputs to gate **34** are H. Since the cart start bus goes H when both inputs to gate **34** are H, producing a L to inverter gate **37,** this complementing second input to both gates determines whether a deck or a cart will be started by the next tone.

Gate **43** will be H, selecting a deck to be started by the next tone, whenever either of its inputs are L. One input is the interrupt signal which is an externally applied signal L except when a cart is to be started. The other input comes from the output of gate **33.** As discussed above, gate **33** produces a L whenever the deck start bus is to be taken H. This means that gate **43** will output a H whenever a cart is not next or when a deck is being started. Thus, once the deck start bus is taken H, an interrupt signal will not switch the output of gate **43** until the deck start bus goes L, which will occur when the tone signal ends. This prevents the system from starting two machines from one tone which must not happen for reasons discussed earlier. Once the tone has ended, however, the interrupt signal will cause gate **43** to generate a L, inhibiting the deck start bus and applying a H via inverter gate **45** to one of the inputs to gate **34.** The other input to gate **34** will go H whenever a machine is to be started, and the output of gate **34** will go L. This L is inverted by gate **37** to take the cart start bus H. When the tone ends the cart start bus goes L and the interrupt signal reverts to its L state, allowing the deck start bus to go H when a machine is to be started next.

Whenever a machine is to be started, gate **42** will apply a H to both gates **33** and **34.** This H is generated when the input to gate **42** is L. This occurs whenever both inputs to gate **41** are H since gate **41** will then apply a L to gate **42.** One input to gate **41** is H whenever the simulator is not next, and the other is H during a tone. If either no tone is present or the simulator is next, gate **41** has a H output and no machine will be given a start command. The tone signal comes from gate **40,** which produces a H output when either of its inputs are L.

One input to gate **40** is tied to gate **39** and goes L when the normal tone signal goes H. The other input comes from gate **50** and goes L whenever there are no machines running and the simulator is not operating. Thus, when gate **50** will cause the control device to start something whenever nothing is running. Since gate **50** generates a L until something actually starts, the internally produced tone signal generated by this gate will cause the control device to generate a start output until something actually starts.

This important gate goes L and gnerates the internal tone signal whenever all three of its inputs are H. The first input to gate **50** comes from gate **25** which produces a H when its inputs are L, this occurring when both inputs to gate **24,** which drives gate **49,** are H. Both inputs to gate **24** go H when neither a deck nor a cart machine are operating. The first input comes from gate **19** to gate **24** and is H whenever the main bus is H, that is, when no tape decks are operating. The second input comes from gate **18** which is H whenever no cart is running. This H occurs because the input to gate **18** is L since there is no cart play sense signal being received.

The second input to gate **50** comes from the simulator and is H when the simulator is not playing. The third input comes from the stop control bus and goes H when the stop control bus is H. This third input is needed only when the gate **50** is causing a tape deck to be started.

As explained before, the hold bus goes L when a deck is being started and no deck was running prior to the start command. The stop control bus, also as mentioned previously, will go L as soon as a deck starts and will remain L until the deck start bus goes L. When gate **50** determines that nothing is operating and causes a deck to be started, the hold bus and the stop control bus will operate in the above manner. Until the stop control bus indicates that a deck has been started, gate **50** will continue to cause the deck start bus to remain active. The hold bus must be active to prevent two decks from being started, as discussed earlier, since there is a delay between the output of gate **50** going H and the deck start bus going low at all points.

In the situation where the deck normally next in the sequence is out of tape, that is, when it is sending a L tape sense signal back, the control device will not attempt to start it and will instead start the machine after the empty machine. Referring to the timing diagram of FIG. **4** (deck **2** to **3**, **3** out of tape, etc.) it can be seen what happens when a deck, in this case deck **3**, has no tape and is normally the next machine.

Deck **2** is in the play mode and is sending back a play signal (see FIG. **4***h*). As discussed previously, deck **2** will generate a H sequence out signal via its gate **9**. This H signal is applied to the logic associated with deck **3**, in particular to gates **8** and **10**. The other input to gate **8** comes from the collector of the tape sense transistor associated with deck **3**. Since deck **3** is generating a L signal, the respective transistor will be off and its collector will apply a H to the second input of gate **8**. As indicated on FIG. **1**, gate **8** is functioning in the AND mode and produces a L output under the above conditions, namely that it is receiving a H sequence input signal, indicating that the associated deck is to be next, and that this deck has no tape. This L signal is applied to gates **9** and **10**. Gate **9** is functioning as an OR device and will now generate a H output. This H is applied, as previously discussed, to the next deck in the sequence, namely deck **1**. If deck **1** has tape, its gate **9** will not go H. The H input to AND operating gate **10** will prevent its input from going L. Thus, deck **3** cannot be started when it does not have tape since only when gate **10** generates a L will deck **3** start. When the next tone causes the deck start bus to go H, only deck **1** will be started. Similar signals will be generated any time a deck is to be next and there is no tape on the deck. Another possible situation that may occur is that for any of a number of reasons, the machine that the control device attempts to start does not actually start. In this case, the deck running prior to the tone will not be stopped which prevents the control device from creating a situation where nothing is running.

Referring to FIG. **5**, deck **1** was running prior to the tone. Deck **2** is normally next and since it has tape, the control device will attempt to start it on the next tone. The tone signal goes H and, since the interrupt signal is L, the deck start bus goes H. Gate **10** in deck **2**'s logic will produce a L and deck **2** should start but as can be seen on FIG. **5**, deck **2** does not start. The stop control bus will not go low since there are not two machines running and as a result no stop command will be issued to deck **1**.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than is specifically described.

We claim as follows:

1. An automated broadcast programmer comprising:

a. a first machine which is adapted to play recorded information;

b. a second machine which is adapted to play recorded information;

c. a control means;

d. a first signal feedback means coupled between said first machine and said control means for indicating to said control means that said first machine is in a state to become operative;

e. a second signal feedback means coupled between said first machine and said control means for indicating to said control means that said first machine is operative;

f. a third signal feedback means coupled between said second machine and said control means for indicating to said control means that said second machine is in a state to become operative;

g. a fourth signal feedback means coupled between said second machine and said control means for indicating to said control means that said second machine is operative, whereby said second and fourth feedback means cause said control means to generate signals which induces the operation of said first, or alternatively, said second machine.

2. An automated broadcast programmer in accordance with claim **1** wherein said recorded information is of an audio frequency.

3. An automated broadcast programmer in accordance with claim **1** wherein said recorded information is of a visual frequency.

4. An automated broadcast programmer in accordance with claim **2** wherein said recorded information has sequence signals recorded thereon.

5. An automated broadcast programmer in accordance with claim **1** wherein said first feedback means comprises first electrical signal producing means which indicates that said first machine has recorded information for reproducing and said second feedback means comprises second electrical signal producing means which indicate that said first machine is in the reproducing mode, and wherein said third feedback means comprises third electrical signal producing means which indicate that said second machine has recorded information for reproducing and said fourth feedback means comprises fourth electrical signal producing means which indicates that second machine is in the reproducing mode.

6. An automated broadcast programmer in accordance with claim **4** which further includes sequencing means,

said sequencing means causing only said first or alternately said second machine to become operative except during the presence of said sequencing signal.

7. An automated broadcast programmer in accordance with claim **6** wherein said sequence means includes further means for stopping said first machine after said second machine has been started.

8. An automated broadcast programmer in accordance with claim 6 which further includes a third machine and a fifth and sixth feedback means coupled between said last-mentioned machine and said control means wherein said fifth feedback means indicates that said third machine is in a condition to become operative and said sixth feedback means indicates that said third machine is operative,

said control means causing said sequencing means to activate said first, or second or third machine at all times,

said sequencing means causing only said first or second or third machine to be operative except during the presence of a sequence signal.

9. An automated broadcast programmer in accordance with claim 8 wherein said sequencing means includes further means and wherein said third feedback means indicates that said second machine is not in a state to become operative and wherein said first and fifth feedback means indicate that said first and third machines are in a state to become operative and said second feedback means indicate that said first machine is operative,

said control means preventing said sequencing means from starting said second machine after the initiation of said sequencing signal,

thereby causing said third machine to be started and said first machine to be stopped upon the completion of said sequencing signal.

* * * * *