United States Patent [19]

Gregg, Jr. et al.

[11] **3,858,195**

[45] **Dec. 31, 1974**

[54] **AUDIO ALARM SYSTEM**

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[73] Assignee: **Jab Company, Inc.**

[22] Filed: **Aug. 28, 1973**

[21] Appl. No.: **392,325**

[52] **U.S. Cl.** **340/311**, 340/221, 360/12

[51] **Int. Cl.** **H04m 11/02**

[58] **Field of Search** ..... 340/310 R, 311, 221, 328, 340/224, 410, 411; 360/12, 6

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Assistant Examiner—Richard P. Lange
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[57] **ABSTRACT**

An alarm control circuit couples a plural track tape player with a plural station paging intercom system to broadcast a plurality of different messages stored on plural track tape, in response to activation of corresponding sensors to which the circuit is connected. Facilities for testing the circuit at one location with minimal disturbance of the paging system, is provided.

14 Claims, 4 Drawing Figures

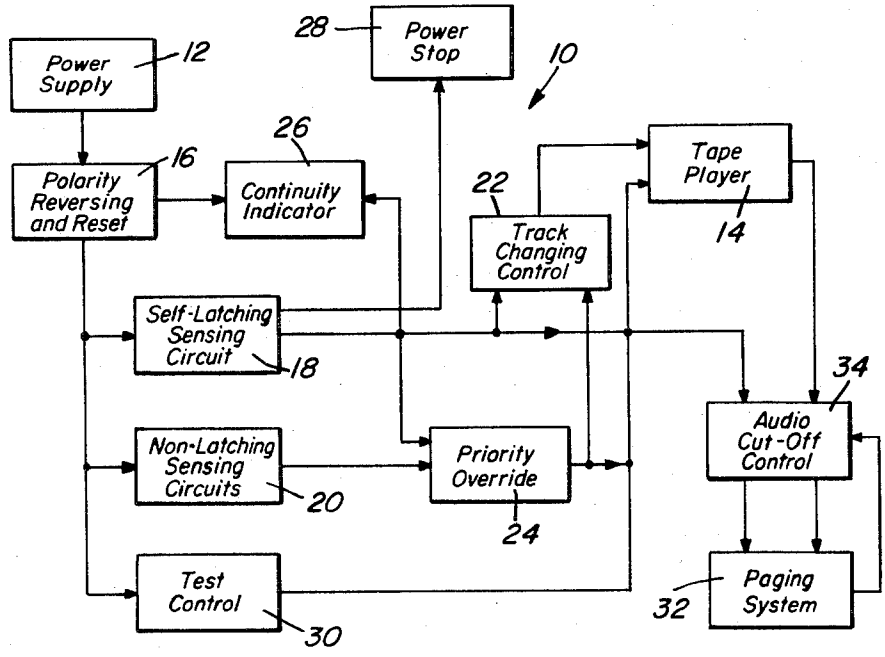


Fig. 1

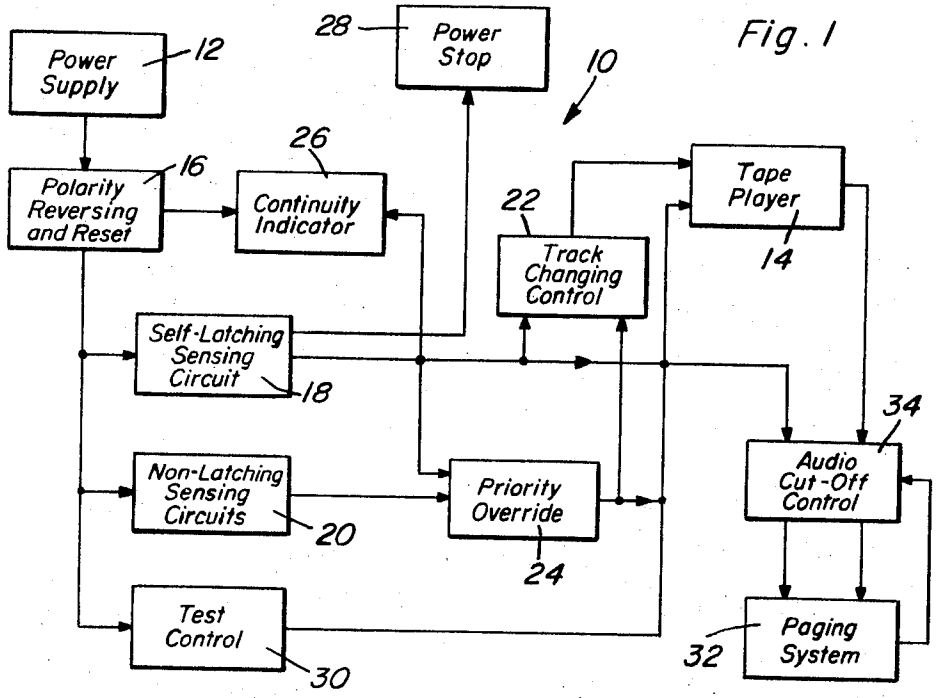

Power Supply
12
28
Power Stop
10
Polarity Reversing and Reset
16
26
Continuity Indicator
22
Track Changing Control
Tape Player
14
Self-Latching Sensing Circuit
18
34
Audio Cut-Off Control
Non-Latching Sensing Circuits
20
Priority Override
24
Test Control
30
32
Paging System

Fig. 4

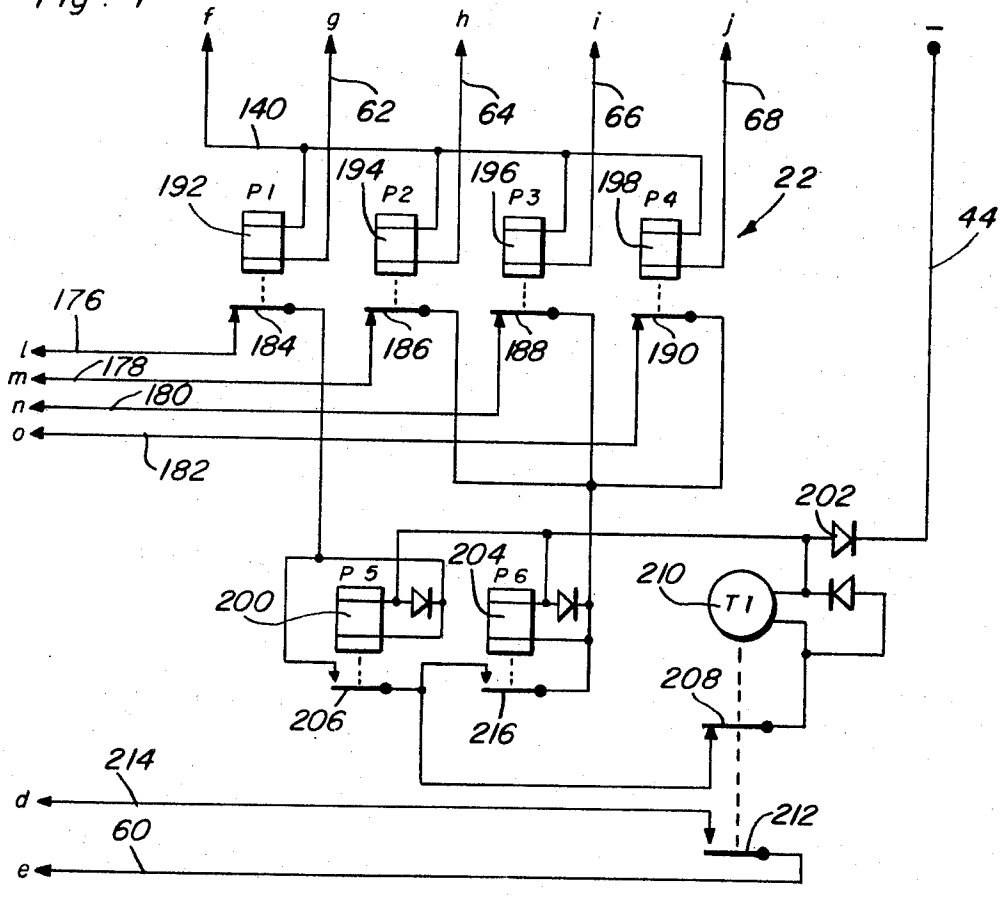

f
g
h
i
j
140
62
64
66
68
192
P1
194
P2
196
P3
198
P4
22
44
176
184
186
188
190
l
178
m
180
n
o
182
202
204
P5
P6
200
210
T1
208
206
216
214
d
60
e
212

Fig. 3

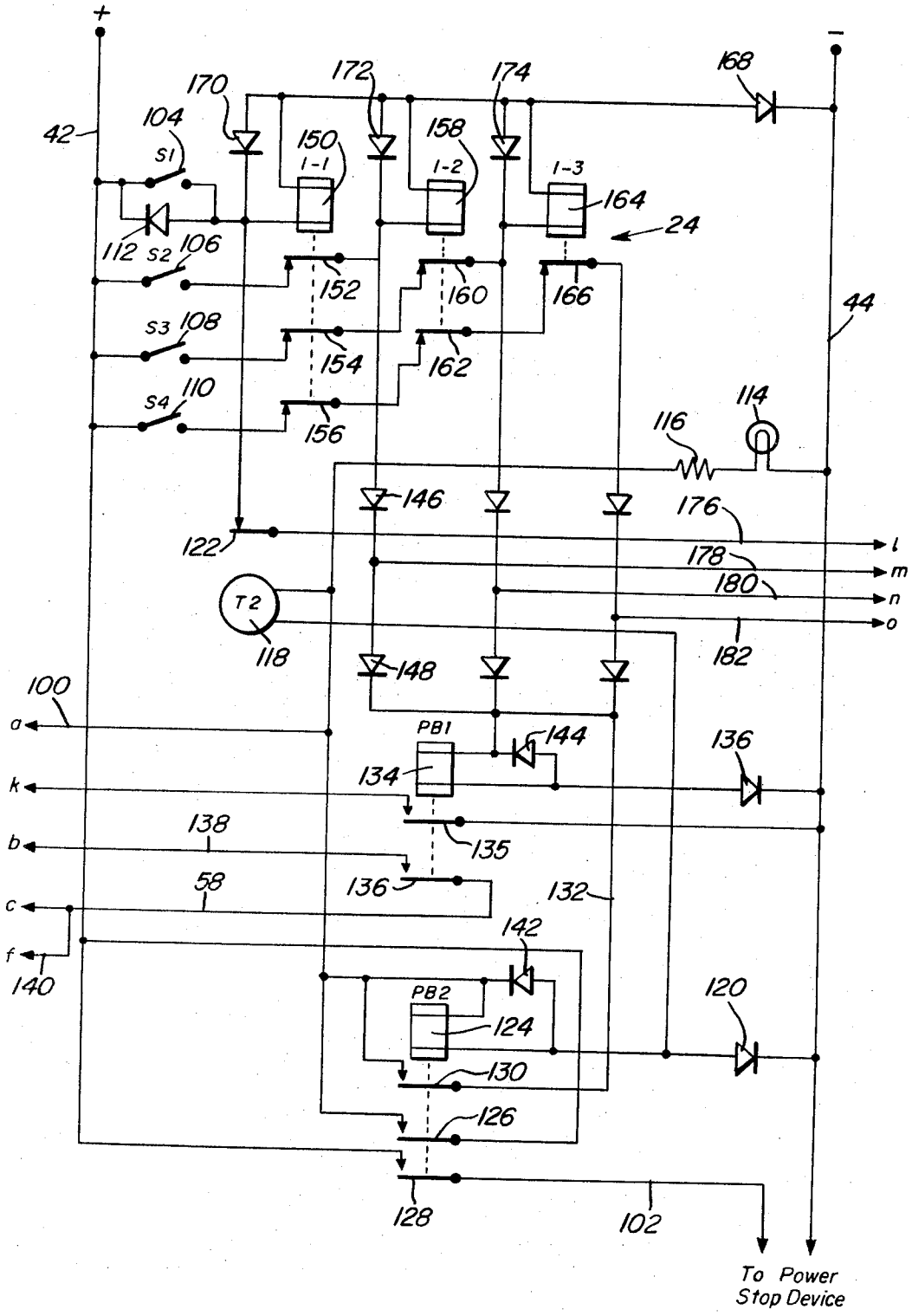
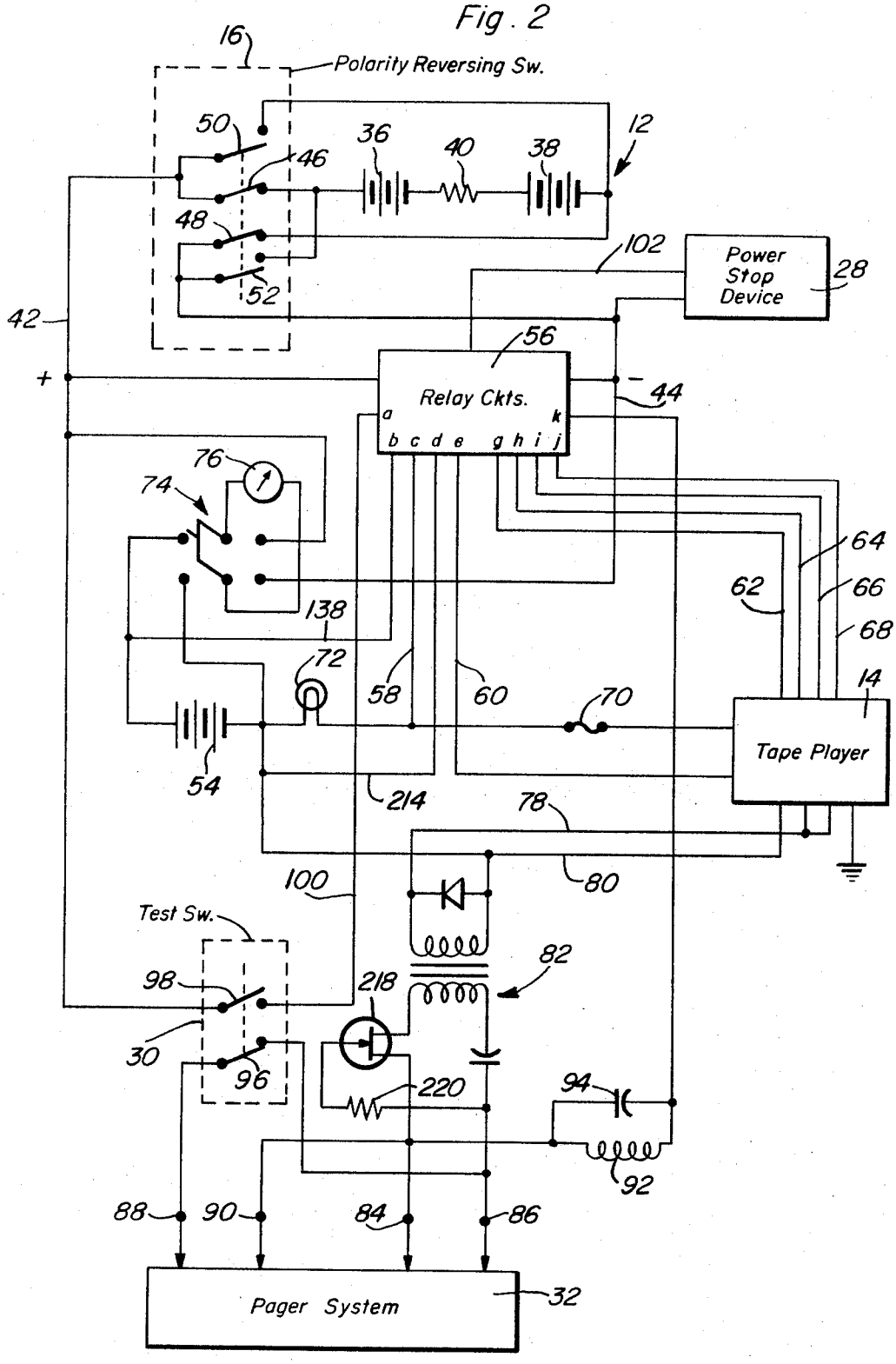

+
−
42
104
S1
112
S2
106
S3
108
S4
110
170
172
174
168
150
I-1
158
I-2
I-3
164
24
152
160
166
154
162
156
44
114
116
146
176
122
178
180
T2
118
182
148
100
a
PB1
144
136
134
k
138
b
135
58
136
132
c
142
f
140
PB2
120
124
130
126
128
102
l
m
n
o
To Power
Stop Device

Fig. 2


16
Polarity Reversing Sw.
50
46
36
40
38
12
48
52
102
Power Stop Device
28
42
56
Relay Ckts.
a
k
b c d e g h i j
44
+
76
74
64
62
66
68
138
72
58
60
70
14
Tape Player
54
214
78
100
80
Test Sw.
98
82
218
30
96
220
94
92
88
90
84
86
Pager System
32

AUDIO ALARM SYSTEM

This invention relates to alarm control systems responding to a plurality of condition sensors to reproduce appropriate messages stored on tape, through an existing paging system.

An alarm control system of the foregoing type is particularly suitable for underground mine installations as disclosed in prior copending application, Ser. No. 262,227, filed June 13, 1972, now U.S. Pat. No. 3,798,672 owned in common with the present application. In such installations, there are a plurality of sensors located at critical points to detect fire and various operational conditions of powered equipment. Also, a commercially available paging system is installed to enable audio intercommunication between personnel at remotely spaced locations. The use of a commercially available plural track, tape player as disclosed in the prior copending application aforementioned, is ideally suited for reproducing different messages in response to activation of corresponding sensors, the messages being reproduced as an audio alarm by broadcast through the paging system. There is, however, a problem in servicing and maintaining the alarm control circuit interconnecting the sensors, tape player and paging system, in an operating condition. The present invention is addressed to the foregoing problem.

In accordance with the present invention a plurality of sensing circuits connected to the sensors are energized by a power source serparate from the tape player, through a polarity reversing switch by means of which one of the sensing circuits associated with the fire sensor, is reset. The other sensing circuits are opened and closed with their sensors and are not latched closed as in the case of the fire sensing circuit. When energized, any one of the sensing circuits initiates operation of the tape player and a track changing operation that stops at a selected track corresponsing to the activating sensor. Thus, a selected message is transmitted from the tape player to the paging system.

Reversal of polarity not only resets the latched fire sensing circuit, but also performs a continuity test through an indicator lamp for the sensing circuit. The tape player may also be tested by closing of a switch bypassing the sensing circuits while another switch is opened to locally restrict reproduction in the paging system.

The alarm control circuit is further operative to stop operation of powered equipment such as a belt conveyor when fires are detected, conserves energy by intermittant deenergization of the sensing circuit in the fire sensing operational mode and automatically but temporarily disconnects the tape player from the paging system while in use.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

FIG. 1 is a schematic block diagram of the alarm control system of the present invention.

FIG. 2 is an electrical circuit diagram of the system depicted in FIG. 1.

FIGS. 3 and 4 are electrical circuit diagrams showing relay circuit details of the circuit illustrated in FIG. 2.

Referring now to the drawings in detail, FIG. 1 is a functional block diagram of the alarm control system generally denoted by reference numeral **10** that includes a power supply **12** independent of the power source for a plural track, tape player **14.** The power supply **12** is connected to a plurality of sensing circuits through a polarity reversing component **16.** The sensing circuits include a self-latching type **18** and a plurality of non-latching types **20.** Anyone of the sensing circuits when energized initiates operation of the tape player and track changing operation through control **22** that stops when the player head (not shown) reaches a track position corresponding to the activated sensor associated with a selected one of the sensing circuits **18** or **20.** A priority override control **24** determines which sensor predominates although no preset activating sequence is imposed on the system. The sensors, such as fire detectors, associated with the self-latching sensing circuit **18** have priority over the other sensing circuits **20** and initiates player operation independently of the other sensing circuits. Thus, only latched sensing circuit **18** is reset by a polarity reversal action through control **16** which activates a continuity indicator **26** for testing the continuity of the sensing circuit **18.** When energized the sensing circuit stops operation of powered equipment through a power stop control **28.**

Operation of the tape player **14** may also be manually initiated in by-pass relation to the sensing circuits by a test control **30.** The tape player transmits its audio output to a paging system **32** and may be partially disconnected therefrom by the test control or automatically and temporarily disconnected while the paging system is in use to avoid message interference, by means of a cut-off control **34.**

Referring now to FIG. **2,** the power supply **12** includes a pair of batteries **36** and **38** interconnected in series by a current limiting resistor **40.** The opposite terminals of the interconnected batteries are normally connected to positive and negative voltage lines **42** and **44** through ganged switches **46** and **48** in the polarity reversing control **16.** When actuated, the switches **50** and **52** also ganged with switches **46** and **48** transfer the same battery terminals to the opposite voltage lines.

The tape player **14** is operated from its own battery **54** through the test control **30** and the sensing circuits in the relay circuit section **56** as diagrammed in FIG. **2** to which the tape player is connected by conductors **58** and **60,** a fuse **70** being placed in line **58.** Conductors **62, 64, 66** and **68** transmit player head position signals from the tape player to the relay circuit section **56** corresponding to the track position of the player head. Operation of the tape player occurs whenever a positive voltage is applied to line **58,** also energizing the player lamp **72** connected between the negtive terminal of battery **54** and conductor **58.** Track changing operation of the tape player stops whenever a negative voltage is applied through conductor **60** from the battery **54.** A double pole, double throw switch **74** alternatively connects a voltmeter **76** across the terminals of battery **54** and the terminals of the power supply **12** through voltage lines **42** and **44** so as to enable monitoring of both voltage sources.

The audio output of the tape player **14** is applied through conductors **78** and **80** to the input primary winding of a transformer **82,** the secondary output winding of which is connected to the paging system **32**

through output terminals **84** and **86** for local audio reproduction. Broadcast of the audio output of the player throughout the paging system is effected through the input terminals **88** and **90** respectively connected to the terminal **86** and **84**, terminals **84** and **90** being coupled to the negative voltage line **44** through the relay circuit section **56** and an LC filter including the choke coil **92** and parallel connected capacitor **94.**

A normally closed switch **96** in the test control **30** is opened when actuated to disconnect terminal **88** from terminal **86** thereby localizing the output of the tape player while operation of the tape player is being tested by manually turning it on through normally open switch **98** ganged with switch **96.** Switch **98** connects the positive voltage line **42** to the relay circuit section **56** through conductor **100** for this purpose. A conductor **102** from the relay section also extends to the power stop device **28** for energization thereof in a fire detecting mode of the system as will be explained hereafter.

The various sensing circuits are shown in FIG. **3** wherein the positive voltage line **42** is connected to four sensor switches **104, 106, 108** and **110.** A diode **112** is connected across the sensor switch **104** in sensing circuit **18** to conduct reverse current in by-pass relation to switch **104** from the negative voltage line **44** through the continuity indicator lamp **114,** resistor **116** and timer switch **122.** An on-off timer **118** is also connected in series with sensor switch **104** and diode **120** across the voltage lines **42** and **44** to intermittantly open the timer switch **122** while the fire sensing circuit is energized in its operating mode to thereby conduct a pulsating current. When energized upon closing of sensor switch **104,** the sensing circuit **18** conducts current from the positive voltage line **42** through timer switch **122** to the relay coil of a self-latching relay **124** completing a relay circuit through the diode **120** to the negative voltage line **44.** When energized, the relay **124** closes its normally open relay holding switch **126** to connect the voltage line **42** directly to the relay coil **124** to maintain it energized. The voltage line **42** is also connected by relay switch **128** to the power stop **28** through conductor **102** and through closed relay switch **130** in series with relay switch **126** current is conducted from the positive voltage line by conductor **132** to the relay coil of player control relay **134,** completing a relay energizing circuit to the negative voltage line through diode **136.** Energization of the relay **134** closes its relay switch **136** to connect the positive terminal of the player battery **54** through conductor **138** to conductor **58** to operate the tape player and condition the track changing control **22** for operation through conductor **140.** The tape player is thus maintained operating by the latching relay **124** upon opening of the sensor switch **104** until the sensing circuit **18** is reset. Diodes **142** and **144** are connected across the coil terminals of relays **124** and **134** to prevent unintended operation due to transient voltages.

The other sensor switches are designed to detect different operational conditions by closing in any sequence to activate sensing circuits without latching as compared to the latching of sensing circuit **18** when an emergency condition is sensed, such as fire, producing shut-down of powered equipment through power stop **28.**

The sensor switches **106, 108** and **110** are interconnected between the positive voltage line **42** and the player control relay **134** by associated parallel sensing circuits through the priority override control **24** and a pair of series connected diodes **146** and **148** in each of the parallel sensing circuits. Since latching relay **124** is not energized by activation of any of the latter sensing circuits **20,** operation of the tape player stops upon opening of the activating sensor switch causing the relay **134** to be deenergized.

The priority override control **24** includes an interlock relay coil **150** having three, normally closed relay switches **152, 154** and **156** in each of the three sensing circuits **20,** respectively. The interlock relay **150** when energized upon closing of sensor switch **104,** will therefore open all of the sensing circuits **20** as long as the sensing circuit **18** is energized giving top priority to sensing circuit **18.** Interlock relay coil **158** on the other hand, is energized simultaneous with the sensing circuit activated by closing of sensor switch **106** to open its normally closed relay switches **160** and **162** respectively connected in series with relay switches **154** and **156** in the remaining two sensing circuits associated with sensor switches **108** and **110.** Thus, closing of sensor switch **106,** will disable the sensing circuits associated with sensor switches **108** and **110.** Finally, a third interlock relay coil **164** is energized upon closing through the sensing circuit established through sensor switch **108** in series with relay switches **154** and **160** to open its relay switch **166** thereby disabling the sensing circuit established through sensor switch **110** in series with relay switches **156** and **162.** Each of the interlock relay coils are connected to the negative voltage line **44** through diode **168,** while diodes **170, 172** and **174** are connected across their terminals.

The sensing circuits are connected to the track changing control **22** through conductors **176, 178, 180** and **182,** the conductor **176** extending directly from the sensor switch **104** of sensing circuit **18** through timer switch **122** while the other conductors extend from the juncture of the series connected diodes **146** and **148** in the parallel sensing circuits **20.** As shown in FIG. **4,** the conductors **176, 178, 180** and **182** are respectively connected to the normally closed relay switches **184, 186, 188** and **190** associated with the track control relay coils **192, 194, 196** and **198** of the track changing control **22.** Each of the track control relay coils to which positive voltage is supplied through conductor **140** from the player control relay **134,** is sequentially energized when its other terminal is grounded by a player head position sensor in the track changing mechanism of the tape player through conductors **62, 64, 66** and **68.** When sensing circuit **18** is energized, current pulsated by intermittent opening of timer switch **122** as aforementioned is conducted by conductor **176** through relay switch **184** to a feed back preventing relay coil **200** connected by diode **202** to the negative voltage line **44** together with a second feedback preventing relay coil **204.** When energized, relay coil **200** closes its relay switch **206** thereby conducting pulsating current from sensing circuit **18** to the normally closed timer switch **208** through which its associated timer **210** is energized. At the end of a timing cycle initiated by energization of the timer **210,** the timer switch **208** opens to prevent recycling of the timer and the normally open timer switch **212** closes to stop the track changing operation of the tape player at a selected track position, by connecting conductor **60** to the negative terminal of the player battery through conductor **214.** Similarly, current from each of the

other sensing circuits **20** energize relay coil **204** closing its relay switch **216** connected in parallel to the track control relay switches **186, 188** and **190** to operate the timer **210** for stopping the track changing operation when the player head reaches a track position corresponding to the activated sensing circuit.

When a normally open sensor switch **104** closes in response to heat, the interlock relay coil **150** is energized to open its three, normally closed relay switches **152, 154** and **156,** respectively connected in series with sensor switches **106, 108** and **110.** Also, the sensor switch **104** connects the positive voltage line **42** through the normally closed relay switch **184** of the recorder track relay **192** to the control relay coil **200** to energize the same and to its normally open relay switch **206** that is closed as a result of energization of its relay coil. The timer **210** is thereby activated through its normally closed timer switch **208** to start a timing cycle present for a selected duration. At the same time the sensor switch **104** connects the positive voltage line **42** to relay coil **124** for energizing the same thereby closing its normally open relay holding switch **126** to maintain the relay coil energized upon opening of the sensor switch **104.** The normally open relay switch **130** also closed by relay coil **124** when energized completes an energizing circuit through relay coil **134** to maintain both relay coils **124** and **134** energized until reset by actuation of the polarity reversing switch **16.** Energization of the relay coil **124** also closes the normally open control switch **128** connected to the power stop device such as a relay in the power drive for a conveyor belt, for example, in order to stop operation of the conveyor belt or any other power equipment.

Energization of the interlock relay **150** prevents simultaneous closing of relay circuits by the sensor switches **106, 108** and **110** by opening its relay switches **152, 154** and **156,** while energization of interlock relay **158** prevents closing of the circuit of sensor **110.** Thus, sensors **106, 108** or **110** when operative complete the energizing circuit for relay coil **134** through one or more of the interlock relay switches in the series with a pair of diodes **146** and **148** bypassing relay **124.** The relay coil **134** is therefore energized either by relay **124** or by one of the sensors **106, 108** and **110** to close its normally open relay switch connecting the positive terminal of the player battery **54** to the tape player **14** through fuse **70** and to the track control relay coils to start operation of the player. At the same time, the normally open relay switch **135** is closed to complete the operating circuit of the pager system by connecting the parallel LC section **92–94** to the negative voltage line **44,** placing the audio output of the player on the pager system through terminals **84** and **86** connected to the secondary winding of transformer **82** coupling the audio output line from the tape player to the paging system.

As the tape player begins operating in response to closing of sensor **104,** the timer **210** initiates a timing cycle as hereinbefore stated closing its normally open timer switch **212** to connect the negative terminal of the player battery to the player for operating its track changing mechanism. Thus, the timer **210** recycles and continues to change the track in the tape player until the player head is positioned on a first track, grounding track relay coil **192** to energize the same. When energized, the track control relay coil **192** opens its normally closed relay switch **184** between sensor **104** and the feedback preventing relay coil to deenergize the same, thereby opening relay switch **206** to deactivate the timer **210.** Track changing operation of the player is thereby stopped with the player head on the track corresponding to the track control relay **192.** The details of the player head displacing means in the track changing mechanism are disclosed in the prior copending application, aforementioned.

When sensor **106** is closed and is in an operative interlock condition, energizing current is conducted from the positive voltage line through diode **146** to the feedback control relay coil **204** through the normally closed relay switch **186** of the second track control relay **194.** The normally open relay switch **216** of relay **204** is thereby closed to complete an energizing circuit for the timer **210** to initiate a track changing operation as hereinbefore described stopping when the player head is positioned on the second track by opening the normally closed relay switch **186** through track control relay coil **194.** The relay switch **186** being connected between diode **146** and relay switch **204,** deactivates the timer **210** to stop the track changing operation as well as to deenergize the relay coil **204.** Similarly, track changing operations are initiated by closing of sensors **108** and **110** connected through normally closed relay switches **188** and **190** to the relay coil **204** for activating the timer **210,** track changing operation stopping on the tracks corresponding respectively to the track control relays **196** and **198.** Any time the circuit is broken by opening of the sensor switches **106, 108** and **110,** the tape player is deactivated and disconnected from the pager system as compared to continued operation upon closing of the fire sensor **104** until reset.

The air of batteries **36** and **38** interconnected in series by the current limiting resistor **40,** supplies power for the relay circuits and pager lines through a polarity reversing switch assembly **16** through which the system is reset and tested utilizing the same batteries. When the polarity reversing switch assembly is actuated, the positive terminal of battery **36** is transferred from voltage line **42** to voltage line **44** and the negative terminal to voltage line **42.** The diodes **202, 136** and **120** respectively connected between the timer **210,** relay coil **134** and relay coil **124,** prevent the relays from operating by blocking flow of current thereto. Reversed current can, however, flow through indicator lamp **114,** in series with resistor **116,** normally closed timer switch and diode **112** to the voltage line **42,** thereby signifying that the sensing circuit **18** has continuity. The indicator lamp **114** will also be illuminated during normal operation when sensor **104** is activated. The player lamp **72** connected across the terminals of the player battery **54** by the relay switch **136** will furthermore signify operation of the tape player upon energization of relay coil **134.** Both the player battery **54** and the relay alarm batteries may be monitored by a voltmeter **76** connected across the terminals of either source of voltage through the double throw, double pole switch **74.**

Normally opened test switch **98** and normally closed test switch **96** are ganged in the test control **30.** When actuated, the normally closed switch **96** is opened to disconnect the audio alarm system from all remote paging stations of the pager system through terminals **88** and **90** leaving only the local paging station operative through terminals **84** and **86.** At the same time the mormally open test switch is closed to by-pass the sensing circuit **18** and energize the relay coil **124** in order to

initiate operation of the audio alarm system as hereinbefore described, to provide an audio alarm only locally for testing purposes.

Under normal operation, in the fire sensing mode, the relay coil **124** is latched by holding switch **126** in order to maintain operation even if the sensor **104** is opened. In order to conserve energy in this operational mode, the on-off timer **118** is energized simultaneously with relay coil **124**, and is operative to intermittantly open and close the energizing circuit for relay coil **124** through the timer switch **122**. Since the other sensing circuits **20** conduct only as long as their sensors **106, 108** and **110** remain closed while detecting some condition, the current conducted is continuous as compared to the pulsating current of sensing circuit **18**.

An electronic switch such as the FET **218** is connected between one terminal of the audio output winding of transformer **82** and terminal **84** to the paging system **32** in order to disconnect the audio alarm from the paging system when it is in use for intercommunication. The audio signal in the paging system when in use, is applied through resistor **220** to the control electrode of the FET **218** to switch it off.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination with a record player having a player head displaceable relative to a plurality of tracks on a record medium from which different messages are reproduced, a plurality of sensors, a source of voltage, at least one self-latching circuit connected to said source of voltage for generating an intermittent player operating signal in response to actuation of one of the sensors, non-latching circuits connected to said source of voltage for generating continuous player operating signals in response to actuation of the other of the sensors, means for transmitting said signals to the record player to select the track at which the player head is positioned, interlock means for disabling the non-latching circuits in response to said intermittent player operating signal, reset means connected to said source of voltage for resetting the self-latching circuit in response to reversal in polarity of the source of voltage, and indicating means connected to said self-latching circuit for monitoring continuity thereof in response to said reversal in polarity.

2. In combination with a paging system adapted to establish intercommunication between a plurality of stations and a plural track record player connected to said paging system for reproducing a plurality of messages from different tracks of a record medium in response to detection of different corresponding conditions by a plurality of sensors; an audio alarm control system for regulating transmission of said messages to the paging system, including a plurality of sensing circuits connecting the sensors to the player for initating operation thereof, priority override means connected to said sensing circuits and responsive to activation of a selected one of the sensors for disabling the sensing circuits associated with the other of the sensors, the sensing circuits associated with the other of the sensors being interconnected in parallel for alternatively initiating operation of the player, one of the sensing circuits associated with said selected one of the sensors being connected to the player independently of the other of the sensing circuits and latching means connected only to said one of the sensing circuits for maintaining the player in operation following activation of said selected one of the sensors.

3. The combination of claim **2** including a source of electrical energy energizing the sensing circuits, polarity reversing means connecting the source to the sensing circuits for resetting said one of the sensing circuits in response to reversal of polarity of the source, means connected to said other of the sensing circuits for deenergization thereof in response to energization of said one of the sensing circuits, and indicator means activated in response to said polarity reversal for signifying circuit continuity of said one of the sensing circuits.

4. The combination of claim **3** including test means for simultaneously initiating operation of the record player in by-pass relation to the sensing circuits and localizing reproduction of a message in the paging system.

5. The combination of claim **4** including audio cut-off control means for disconnecting the player from the paging system in response to transmission of audio signals therethrough.

6. The combination of claim **5** including timing means for intermittantly interrupting energization of said one of the sensing circuits to conserve energy expended during operation of the player in response to activation of said selected one of the sensors.

7. The combination of claim **2** including test means for simultaneously initiating operation of the record player in by-pass relation to the sensing circuits and localizing reproduction of a message in the paging system.

8. The combination of claim **2** including audio cut-off control means for disconnecting the player from the paging system in response to transmission of audio signals therethrough.

9. The combination of claim **3** including timing means for intermittantly interrupting energization of said one of the sensing circuits to conserve energy expended during operation of the player in response to activation of said one of the sensors.

10. The combination of claim **2** including timing means for intermittantly interrupting energization of said one of the sensing circuits to conserve energy expended during operation of the player in response to activation of said one of the sensors.

11. In combination with a paging system adapted to establish intercommunication between a plurality of stations and a plural track record player connected to said paging system for broadcasting a plurality of messages from different tracks of a record medium in response to detection of different corresponding conditions by a plurality of sensors; an audio alarm control system for regulating transmission of said messages to the paging system, including a plurality of sensing circuits connecting the sensors to the player for initiating operation thereof, a source of electrical energy for energizing the sensing circuits, polarity reversing means connecting the source to the sensing circuits for resetting a selected one of the sensing circuits in response to reversal of polarity of the source, interlock means connected to said other of the sensing circuits for pre-

venting energization thereof in response to energization of said selected one of the sensing circuits, and indicator means activated in response to said polarity reversal for signifying circuit continuity of said selected one of the sensing circuits.

12. The combination of claim **11** including test means for simultaneously initiating operation of the record player in by-pass relation to the sensing circuits and localizing reproduction of a message in the paging system.

13. The combination of claim **11** including timing means for intermittantly interrupting energization of said selected one of the sensing circuits to conserve energy expended during operation of the player in response to activation of said one of the sensors.

14. The combination of claim **2** wherein said record player includes a player head, means for displacing said player head to different positions operatively aligned with said tracks on the record medium, position sensing means connecting the record player to the sensing circuits for operating the displacing means to sequentially change the tracks with which the player head is aligned, and means responsive to activation of said sensors for selecting the tracks at which operation of the displacing means stops.

* * * * *