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(54) **A method of operating a PA system having zone isolator circuits**

Ein Verfahren zum Betreiben eines Beschallungssystems mit Gebietsisolatorschaltungen

Procédé d'utilisation d'un système d'annonce en public avec circuits isolateurs de zone

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(56) References cited:
DE-C- 3 627 960 GB-A- 2 299 238
US-A- 3 989 908

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Description

[0001] The present invention relates in general to a public address system and in particular, but not exclusively, to a public address system used as a voice alarm speaker network in conjunction with a fire or safety alarm system.

[0002] Typically, a public address system comprises a plurality of speakers positioned at convenient locations around building or other site, each coupled to a central control unit including an audio amplifier for driving a audio signal to the speaker units. It is desired to minimise the amount of wiring in a system, in order to minimise cost and complexity and to improve long term reliability. Ideally, it is desired to use a single pair of signal wires coupled to each speaker unit, with the speaker units typically being coupled across the signal wires in parallel. Using a single pair of signal wires minimises cabling costs and aids discrete installation. However, this arrangement has minimal redundancy and a fault such as a short circuit may occur at any point along the signal wires, leading to a malfunction of the system. A short circuit fault generally means that the system must be shut down in order to avoid damage to sensitive components, such as the audio amplifier. An open circuit fault, for example due to an accidental break in the signal wires, can often be tolerated, but loud speakers positioned after the break do not receive an audio signal.

[0003] German patent application DE 3627960C1 discloses a monitoring device for locating a loudspeaker failure for an installation comprising a number of loudspeakers which are in each case allocated a fault detector and a test circuit.

[0004] British patent application GB2299238A discloses a public address system, having a thermistor or other device with a positive resistance/temperature characteristic in series with each loudspeaker to limit current in the event of a short circuit fault, thereby enabling the other speakers to continue

[0005] It is an aim of the present invention to provide a public address system having greater fault tolerance, whilst requiring minimal wiring.

[0006] It is an aim of at least preferred embodiments of the present invention to provide a fault tolerant public address system which maintains operation despite a short circuit fault or a open circuit fault occurring on a single pair of signal wires.

[0007] According to the present invention there is provided a method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

[0008] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic diagram showing a preferred

network topography;

Figure 2 is a schematic block diagram of an isolator;

Figure 3 is a more detailed schematic block diagram of an isolator circuit;

Figure 4 is a circuit diagram for a preferred isolator circuit;

Figure 5 is a schematic diagram of a preferred network; and

Figure 6 is a schematic block diagram of a preferred control circuit.

[0009] The preferred embodiment of the present invention will be described with reference to a public address network for producing an audible signal from a plurality of loud speaker units. As an example, such a public address network can be used to warn of an alarm condition and give information to the occupants of a building.

[0010] Referring to Figure 1, a preferred schematic layout is shown for a network 10 comprising a control station 11 having an amplifier for driving an audio signal 14 and a pilot signal 15 on to signal wires 12. The signal wires 12 are divided into sections 12a, 12b, etc., by isolators 20. Each section is provided with one or more loud speaker units 16 or other devices.

[0011] In a preferred normal operating condition, the pilot signal 15 is detected by each isolator unit 20 which, in response, completes the signal path between relevant sections e.g. 12a, 12b of the signal wires. A successful operating condition is determined when the pilot signal 15 reaches an end of line monitor 13. In this normal condition, the audio signal 14 is supplied to each of the speaker units 16 arranged in parallel across the signal wires 12 such that, for example, an alarm message is heard simultaneously throughout a building.

[0012] The operation of each isolator unit 20 will now be described in more detail. Generally, each isolator unit 20 is of identical construction.

[0013] Referring to Figure 2, a basic structure of a preferred isolator unit is shown in block diagram form. The isolator unit 20 comprises a relay 21 whose contacts are arranged to lie in a signal path between an input coupled to a first signal wire section 12a and an output coupled to a second signal wire section 12b. The signal wires 12a and 12b form adjacent sections to the isolator unit 20.

[0014] The relay 21 operates in accordance with a control signal from a relay driver circuit 22 which is coupled to a short circuit detector unit 23.

[0015] In a first preferred embodiment, the short circuit detector 23 comprises a voltage sensor for determining the load current drawn by an output section of the isolator, i.e. on the signal wires 12b. In a second embodiment, the short circuit detector is arranged to sense voltage developed across both the output load 12b and the input

load 12a, such that the isolator circuit may operate bidirectionally.

[0016] In a normal operating condition, no short circuit condition will be detected and the driver 22 will operate to close the contacts of relay 21, thereby completing the signal path between the input 12a and the output 12b. However when a short circuit fault is detected by the control station 11, the pilot signal is interrupted thus removing power supply from the isolators, the relay 21 de-energises the contacts of the relay open, thereby interrupting the signal path.

[0017] Referring now to Figure 3, a more detailed block diagram of the preferred isolator unit 20 is shown.

[0018] In the preferred embodiment, the signal wires 12 carry both an audio signal 14 and a pilot signal 15. The pilot signal is preferably a non-audio signal such as a subsonic or supersonic signal, and ideally a direct current signal. As shown in Figure 3, each isolator unit comprises means for detecting the pilot signal 15, suitably a low pass filter 24. The low pass filter 24 recovers the direct current component from the signals received at the input 12a to produce a direct current power supply, suitably of around 50 volts DC. In a normal operating condition, the active current source (or constant current generator) 221 supplies a predetermined constant current through a relay driver 222 to the coil of a relay 21 to keep the normally open contacts thereof closed and thereby complete the signal path. Conveniently, the constant current generator 221 provides a current of about 10 milliamps thereby underrunning the coil of relay 21. Advantageously, less power is dissipated and relay life expectancy is improved despite the relay coil being powered for most of the time in a normal operating condition.

[0019] Where the pilot signal 15 is not present at the input 12a to the isolator 20, no power supply is provided through the low pass filter 24 and the contacts of relay 21 remain open to interrupt the signal path through the isolator.

[0020] When the short circuit detector 23 detects a short circuit on the output line 12b, the relay driver 222 is switched to divert current from the coil of relay 21, thereby opening the contacts of the relay and interrupting the signal power through the isolator.

[0021] Referring now to Figure 4, a bi-directional isolator circuit 20 is shown.

[0022] The DC pilot signal 15 can be obtained from the first signal wire input 12a through a first low pass filter comprising inductor L1 and capacitor C2, or from the second signal wire input 12b through a second low pass filter comprising a second inductor L2 and a second capacitor C3. The DC pilot signal is supplied to power the remainder of the isolator circuit through a diode OR gate formed from diodes D1 and D2. The inductors L1 and L2 preferably have an inductance of approximately 90H, i.e. a relatively large value, to minimise loading of the isolator circuit on the audio components of the network.

[0023] As shown in Figure 4, the short circuit detector 23 comprises an AND gate formed of diodes D4 and D6

coupled to either side of the isolator 12a and 12b. Therefore, a single short circuit detector can be used, comprising zener diode Z1, bias resistor R1 and power transistor T1. The relay 21 is closed only if the short circuit detector 23 detects a high resistance on both sides of the isolator 20, and, otherwise, the relay remains open.

[0024] Referring now to Figures 1 and 5, the preferred network will be described in more detail.

[0025] As shown in Figure 5, the audio signal 14 is driven onto the signal wire loop 12 through a transformer TX1. Typically, the transformer TX1 is a 100V line transformer taking an audio signal input from an audio amplifier 114 and providing this to both ends of the signal line loop 12.

[0026] A pilot signal driver 115 is used to superimpose the pilot signal, in this example a DC signal of about 65 volts, onto the loop 12 alongside the audio signal 14. Each loudspeaker unit 16 on the loop 12 filters out the pilot signal 15, such as by using a decoupling capacitor, to leave only the audio signal 14. Therefore, the pilot signal 15 does not affect the audio signal 14.

[0027] In a normal operating condition, the pilot signal 15 travels from one end only all the way along the signal line loop 12 to reach an end of line monitor 13 which produces a normal condition signal and operator feedback, such as a green LED.

[0028] When an open circuit fault occurs on the signal loop 12, the pilot signal does not reach the end of line monitor 13 and an open circuit fault condition is detected. A control circuit 14 provides operator feedback, such as a red LED, and closes line relays RLA1 and RLA2. As shown in Figure 5, closing relays RLA1 and RLA2 connects both ends of the loop 12 (shown as A and A', and B and B', respectively) such that the pilot signal 15 is now supplied to both ends of the loop 12. The network is therefore able to detect an open circuit fault and maintain full operation.

[0029] Referring now to Figure 6, the control circuit 14 comprises a global overcurrent trip detector 141 for detecting a short circuit on the network. If a short circuit is detected by the overcurrent trip circuit 141 or if the pilot signal does not reach the end of line circuit 13, the control circuit 14 causes the network to be shutdown, thereby avoiding possible damage to sensitive components such as the audio amplifier 114. The pilot signal 15 no longer reaches any of the isolators 20, each of which thereby isolate respective sections of the signal wire loop 12.

[0030] After a predetermined delay, reboot circuit 143 causes the pilot signal 115 and the audio signal 114 to be reapplied to the signal loop 12. The isolators 20 will each in turn assess adjacent sections of the signal loop 12 for the short circuit fault, and reconnect the signal path only if the short circuit fault does not occur in the adjacent line sections. For example, referring again to Figure 1, isolator 20b tests for a short circuit in sections 12a and 12b and will connect the signal path 12a to 12b only if no short circuit is detected.

[0031] As discussed above in relation to Figure 5, line

relay control circuit 142 will, in this fault condition, close line relays RLA1 and RLA2 such that the pilot signal 15 is driven from both ends of the loop 12. In this configuration, the pilot signal 15 and the audio signal 14 thereby reach all parts of the signal loop 12, except for the section containing the short circuit fault which is isolated by isolator units 20 at either side thereof.

[0032] A public address network has been described which detects and tolerates open circuit and short circuit fault conditions safely and economically, and which maintains operation of the network despite such fault conditions. Minimal additional circuitry is required, and, advantageously, only a single pair of signal wires are required.

Claims

1. A method of operating a public address network having a series signal path including a pair of signal wires (12) coupled to one or more audio output units (16) and one or more isolators (20) for isolating sections of the signal wires (12), comprising the steps of:

driving an audio signal (14) from one end on to the signal wires (12) for delivery to the audio output units (16);
 driving a pilot signal (15) from the one end on to the signal wires (12) for delivery to the isolators (20);
 detecting the pilot signal at the other end of the series signal path using an end of line detector (13);
 if the pilot signal (15) is not present at the end of line detector (13), then driving the audio signal (14) and the pilot signal (15) from both ends of the audio signal path.

2. A method as claimed in claim 1, further comprising the step of:

driving the audio signal (14) and the pilot signal (15) for powering the isolators (20) onto a second end of the signal wires (12) remote from the first end; and
 if the pilot signal (15) is not present at the end of line detector (13), then removing the audio signal (14) and the pilot signal (15) from the first end, and then driving the audio signal (14) and the pilot signal (15) onto both the first and second ends of the signal wires (12).

Patentansprüche

1. Verfahren zum Betreiben eines Rundrufnetzes, das einen seriellen Signalpfad besitzt, der ein Paar Signaldrähte (12), die mit einer oder mehreren Audioausgabeeinheiten (16) gekoppelt sind, und einen

oder mehrere Isolatoren (20), um Abschnitte der Signaldrähte (12) zu isolieren, enthält, das die folgenden Schritte umfasst:

Schicken eines Audiosignals (14) von einem Ende in die Signaldrähte (12), um es den Audioausgabeeinheiten (16) zuzuführen;
 Schicken eines Vorsteuersignals (15) von dem einen Ende in die Signaldrähte (12), um es den Isolatoren (20) zuzuführen;
 Detektieren des Vorsteuersignals an dem anderen Ende des seriellen Signalpfads unter Verwendung eines Endes eines Leitungsdetektors (13);
 falls das Vorsteuersignal (15) an dem Ende des Leitungsdetektors (13) nicht vorhanden ist, Schicken des Audiosignals (14) und des Vorsteuersignals (15) von beiden Enden des Audiosignalpfads.

2. Verfahren nach Anspruch 1, das ferner die folgenden Schritte umfasst:

Schicken des Audiosignals (14) und des Vorsteuersignals (15), um die Isolatoren (20) mit Leistung zu versorgen, in ein zweites Ende der Signaldrähte (12) entfernt von dem ersten Ende; und
 falls das Vorsteuersignal (15) an dem Ende des Leitungsdetektors (13) nicht vorhanden ist, Beseitigen des Audiosignals (14) und des Vorsteuersignals (15) von dem ersten Ende und dann Schicken des Audiosignals (14) und des Vorsteuersignals (15) in das erste und in das zweite Ende der Signaldrähte (12).

Revendications

1. Procédé d'exploitation d'un réseau de diffusion publique ayant un chemin de signaux sériels comportant une paire de fils de signal (12) couplés à une ou plusieurs unités de sortie audio (16) et un ou plusieurs isolateurs (20) pour isoler des sections des fils de signal (12), comprenant les étapes suivantes :

le pilotage d'un signal audio (14) depuis une extrémité sur les fils de signal (12) en vue de sa délivrance aux unités de sortie audio (16) ;
 le pilotage d'un signal pilote (15) depuis l'extrémité sur les fils de signal (12) en vue de sa délivrance aux isolateurs (20) ;
 la détection du signal pilote au niveau de l'autre extrémité du chemin de signaux sériels au moyen d'un détecteur de fin de ligne (13) ;
 si le signal pilote (15) n'est pas présent à l'extrémité du détecteur de fin de ligne (13), le pilotage du signal audio (14) et du signal pilote (15)

depuis les deux extrémités du chemin de signaux audio.

2. Procédé selon la revendication 1, comprenant en outre l'étape suivante :

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le pilotage du signal audio (14) et du signal pilote (15) pour exciter les isolateurs (20) sur une seconde extrémité des fils de signal (12) distante de la première extrémité ; et

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si le signal pilote (15) n'est pas présent au niveau du détecteur de fin de ligne (13), le retrait du signal audio (14) et du signal pilote (15) de la première extrémité, puis le pilotage du signal audio (14) et du signal pilote (15) sur les deux première et seconde extrémités des fils de signal (12).

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FIG.1

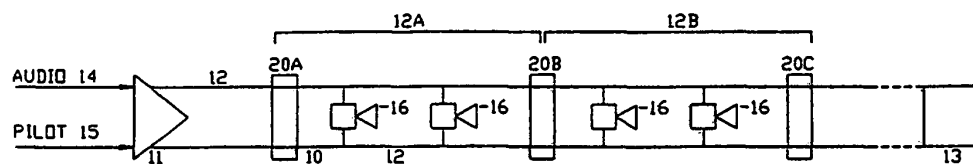


FIG.2

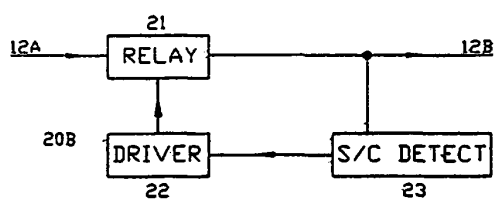
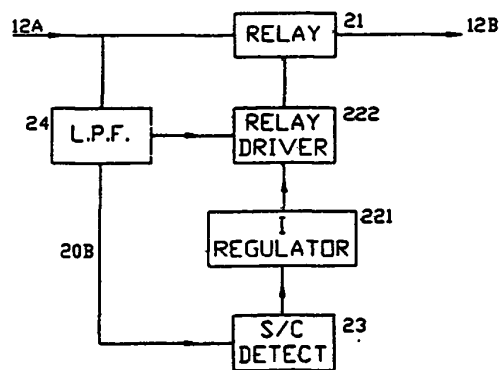


FIG.3



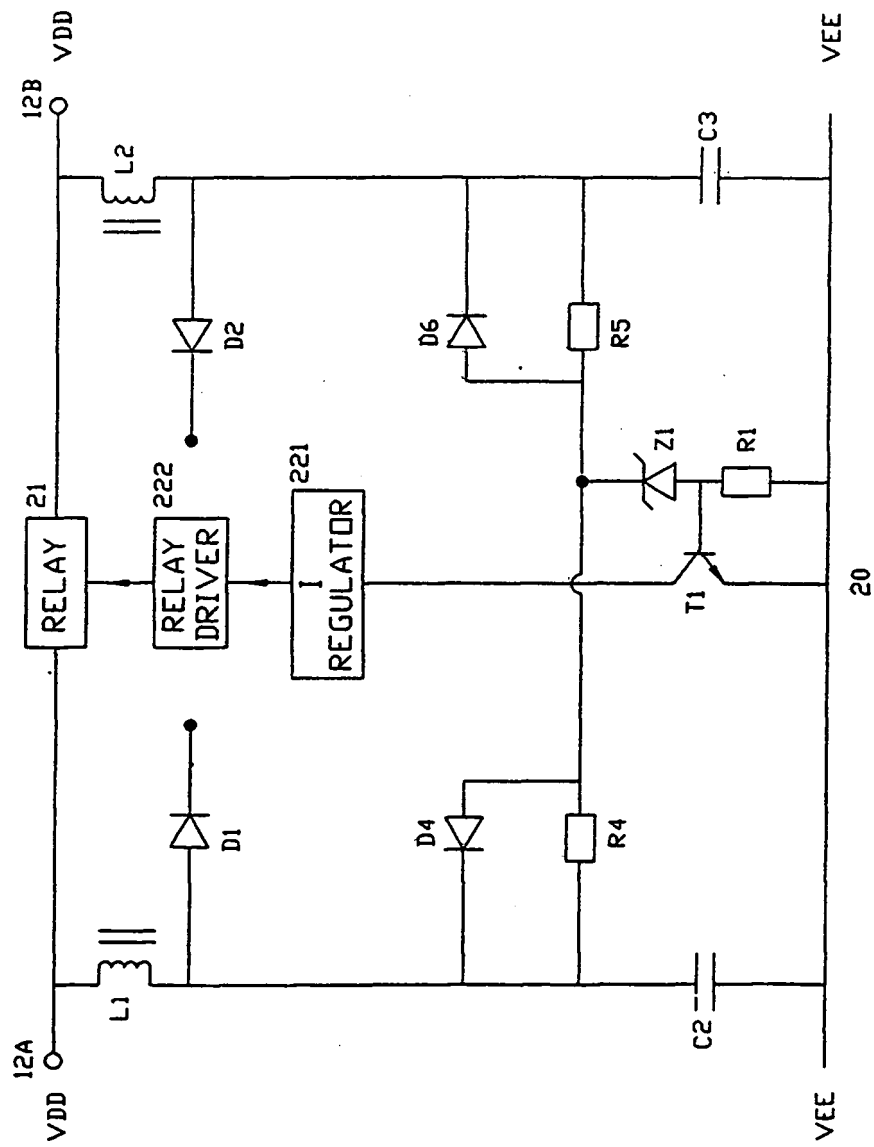
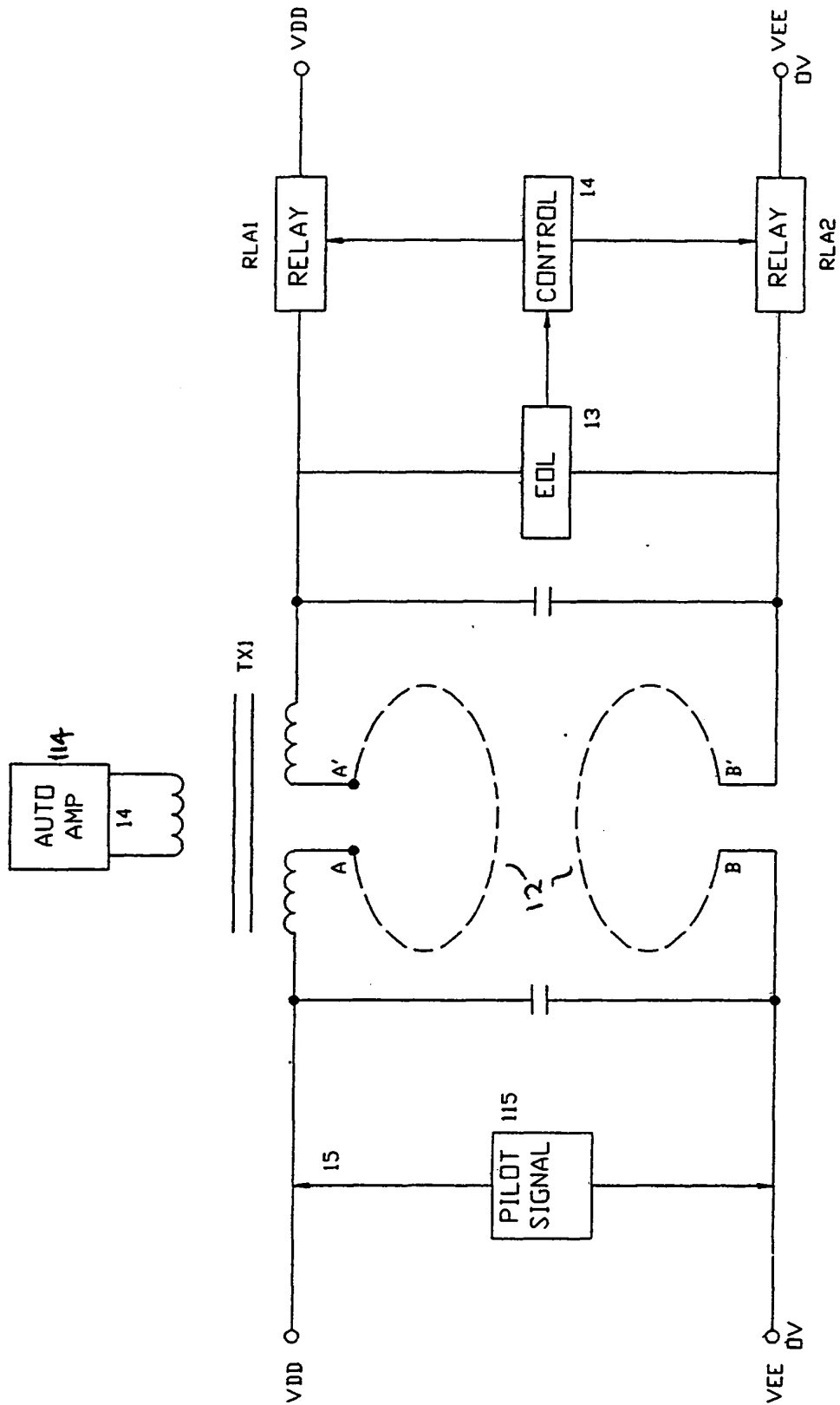


FIG.4



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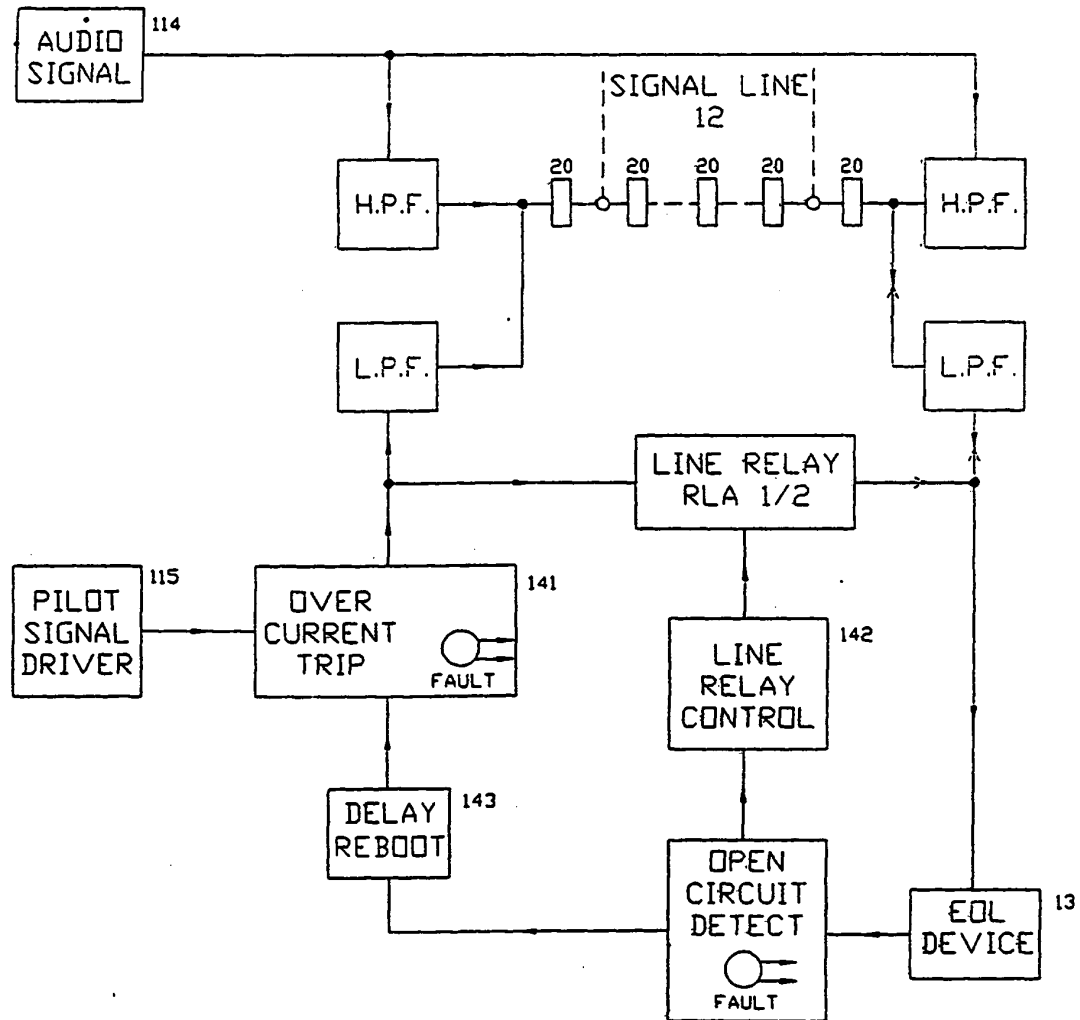


FIG.6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 3627960 C1 [0003]
- GB 2299238 A [0004]