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(54) **Sound and public address system with decentralised amplification**

(57) Sound and public address system based on the joint disposition of the amplifier and the speaker, wherein the amplification is performed with pulse-width modulation switching techniques and the amplifier is powered by a switched DC/DC voltage converter without insulation, which provides a clear improvement in the energy efficiency; all amplifier-speaker assemblies being connected to an area feeder that supplies the required power

at a suitable voltage, wherein in addition the system is provided with means for monitoring the state of the amplifiers-speakers with verification that the speakers are emitting sound based on injecting a signal that allows the monitoring using either piezoelectric sensors or auxiliary coils identical to those of the speaker, transmitting the state of the speaker either through an exclusive connection or through the audio line, using a directional coupling circuit.

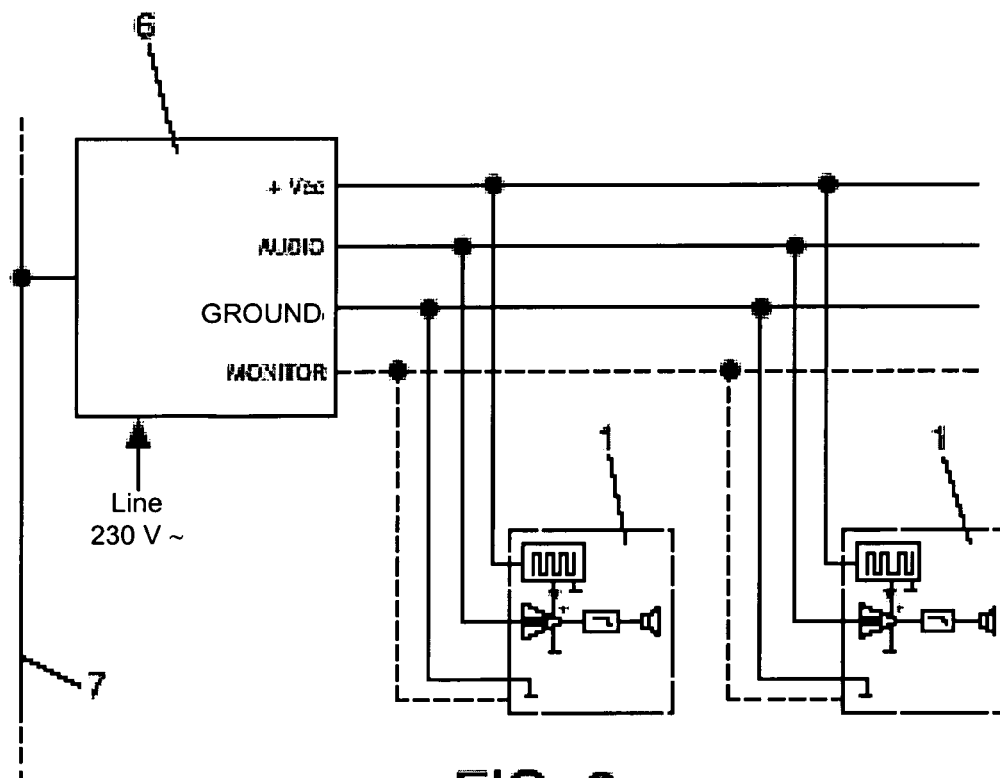


FIG. 2

Description

OBJECT OF THE INVENTION

[0001] The object of the present invention is a sound and public address system with decentralised amplification, from among sound and public address systems intended for broadcasting environmental music and general notices, whether for information or in case of emergency.

[0002] The present invention is characterised by an improvement in the energy efficiency of the self-amplified speakers, as well as by the possibility of an individualised and complete monitoring of the amplifiers and speakers and the amplifier-speaker adaptation.

[0003] The sound and public address system is provided with a decentralised power supply and disposes on each speaker an amplifier that operates with pulse width modulation supply techniques, achieving an improved efficiency that reaches 80-90%. On another hand, each amplifier is powered according to its power and the impedance of the corresponding speaker through a switched dc-dc voltage converter without insulation, which has an efficiency also on the order of 80-90%.

[0004] Each amplifier disposed on the speakers of a given area is powered from a feeder using a direct current voltage such that it can be considered in the very low voltage range and provides sufficient power, avoiding the drawbacks of power supply at grid values.

[0005] On another hand, the configuration of the speakers and the area feeder, in combination with monitoring lines and sensor components or means that capture the state of the speakers, allow to completely monitor each and every self-amplified speaker of a sound and public address installation.

[0006] Therefore, the present invention lies within the field of sound and public address systems, and more specifically within the characteristics that provide an efficient electrical consumption, as well as allow to obtain information on the state of the speakers.

BACKGROUND OF THE INVENTION

[0007] Currently known are several different inventions that disclose decentralised installations related to sound and public address systems. The development of decentralised installations began with the appearance of modular ranges of electro-acoustic components that allowed to provide sound, in most cases, without technical calculations and with a full flexibility of the distribution, the amplification of the speakers or the power employed.

[0008] Among the inventions disclosing decentralised installations is patent ES 440095 for "Improvements in electro-acoustic installations". This patent teaches the advantages derived of the disposition of individual amplifiers on each speaker or group of speakers, allowing to use the desired power at each speaker, to individually control the maximum sound level, mix sound points in

mono or stereo in the same group of speakers and turn on the desired speakers at each time.

[0009] Patent ES 450.651 for a "System for distribution of sound, or in general any low-frequency signal" has the improvement over the aforementioned invention that the amplifiers of each speaker have a high input impedance, allowing to connect many such speakers in parallel controlled by a single control element. The amplified speakers described herein are powered at grid voltage by an AC/DC linear power supply.

[0010] Patent ES 487.314 for "Improvements in low-frequency signal distribution and control systems" analyses the possibilities of controlling the signals to be emitted both inside and outside the amplifier-speaker system.

[0011] Patent ES 9200416 for "Improvements in sound installations with decentralised amplification" describes the installation of decentralised amplifiers in inside the sound control modules or next to the speakers, which can be powered either at grid voltages or with DC voltages.

[0012] On another hand, another aspect that operates jointly in sound and public address systems, given their importance for broadcasting informative and/or emergency messages, is that relates to monitoring or supervising the state of the amplifiers and speakers. Said monitoring is performed by measuring the impedance of a speaker or group of speakers connected to an amplifier, either continuously or with a certain frequency. Another manner in which the monitoring can be performed is by tracking a high-frequency pilot signal to the end of each line of speakers.

DESCRIPTION OF THE INVENTION

[0013] Although all of these systems have a number of advantages in relation to the state of the art existing at the time of their application, there are however certain improvable aspects. On one hand, the energy efficiency attained is not optimal. On another, although there are means of information on the state of the speakers in order to determine the presence of an open circuit or short circuit, said speaker state monitoring systems do not show their true state, particularly if they involve measuring their impedance when there are several speakers, as the impedance variation is very small.

[0014] Another difficulty present in the sound and public address systems is the low energy efficiency of the power supply and amplification means employed.

[0015] Therefore, the object of the present invention is to develop a sound and public address system with decentralised amplification that overcomes the aforementioned drawbacks, providing a high energy efficiency, that is provided with area feeders that supply the desired power at a voltage such that it prevents the problems resulting from power supply at a very low voltage or at grid voltage, as well as providing an improvement in the capacity to monitor the area amplifiers and speakers.

[0016] The invention of a sound and public address system with decentralised amplification basically consists of disposing amplifiers with specific constructive characteristics on each speaker, wherein the amplifiers are powered by an area feeder at a suitably selected voltage, and wherein the assembly or system formed by the amplifiers and area power supplies are provided with an interconnection that allows a continuous monitoring of the amplifiers and speakers.

[0017] Thus, the system architecture described above could be referred to as with distributed amplification, each amplifier being incorporated in each speaker, providing an improved energy efficiency and an improved monitoring capacity.

[0018] The amplifiers disposed on each speaker operate with pulse width modulation (PWM) techniques instead of the linear amplification conventionally used, achieving improvements in the efficiency reaching 80-90% compared to the efficiencies of 50-60% of linear amplifiers.

[0019] As the technique described above implies the generation of electromagnetic noise, in order to prevent its transmission in addition to using radio-frequency techniques in the amplifier design the output voltage is filtered with a low-pass filter.

As the amplifier is placed directly on the speaker, the length of the connections between the amplifier and the speaker is clearly reduced, minimising the emission of electromagnetic perturbations caused by the length of the interconnection lines.

[0020] In addition, in order to improve the efficiency, each amplifier is powered by a switched DC/DC voltage converter without insulation, with efficiencies approaching 90%, much higher than the efficiencies of 50-60% of linear sources.

[0021] The required input voltage and power for each amplifier disposed on the speaker is not provided at the grid voltage, which would imply problems regarding electrical safety related to insulation of the cables and feeders, nor at a voltage of 12-15 V, as this voltage would not be enough to provide the power required for a group of speakers of an area. Therefore, the supply voltage has a value such that it belongs in the group of very low voltages without an associated electrical hazard, while allowing to provide sufficient power to feed several speakers with a certain power.

[0022] In addition, together with the described architecture in which the amplifiers are disposed directly on each speaker and they are powered by an area feeder, interconnection means are disposed between them that allow transmitting the monitoring signals captured directly on the speaker itself.

[0023] Monitoring of the state of the amplifiers-speakers is based on injecting a signal with a frequency under that of the audio signal and to monitor the presence and amplitude of said signal by a piezoelectric sensor disposed on the speaker cone or membrane, said signal being duly amplified and filtered. In this way the operation

of the assembly can be checked, ensuring the presence of a signal directly in the moving element of the speaker, i.e. verifying that the speaker sounds, not only that it receives the audio signal or that it has a specific impedance.

[0024] The test signal is generated by a microprocessor with a digital-analogue conversion output, the signal being received by the sensor after it is amplified and filtered, inserted in the microprocessor by an analogue-digital converter.

[0025] The microprocessor itself generates an error signal in case of failure that is transmitted to the area feeder via a connection bus that connects each and every amplifier disposed on the speakers.

[0026] Alternatively to the monitoring scheme described, after injecting the signal with a low frequency under the range reserved for the useful audio signal, the signal is monitored by measuring its presence and amplitude using an auxiliary coil identical to the main speaker coil.

[0027] The transmission of the state of the speakers from the microprocessor can be performed by a specific connection to the rest of the installation and more specifically to the control station, or by injecting a signal with a frequency that is not in the useful audio signal range, through the same cable that carries the useful audio signal to the amplifiers, employing a directional coupling circuit for such purpose.

[0028] The directional coupling circuit will send the monitoring signal to the connection line with the area feeder and will block this signal so that it does not enter the audio amplifier.

DESCRIPTION OF THE DRAWINGS

[0029] To complete the description being made and in order to aid a better understanding of the characteristics of the invention, the present descriptive memory is accompanied by a set of drawings that form an integral part of it where, for purposes of illustration only and in no way limiting the invention, the following is shown:

Figure 1 represents the blocks forming each of the component elements of the assembly.

Figure 2 shows the union and communication between the amplifiers of each speaker and an area feeder.

Figure 3 shows the elements that conform the monitoring in one of its embodiments.

Figure 4 is the same as the previous figure showing another embodiment.

Figures 5 and 6 show an additional alternative for the monitoring embodiments shown in figures 3 and 4 in which the injection of the signal related to the state of the speakers is performed in the same audio

cable using a differential coupler.

Figure 7 shows a block diagram in which a filter is incorporated to equalise the sound.

PREFERRED EMBODIMENT OF THE INVENTION

[0030] In view of the aforementioned figures, a preferred embodiment of the proposed invention is described below and the drawings are explained.

[0031] Figure 1 shows the elements composing each of the amplifier-speaker assemblies (1) where the amplifiers are mounted joined to each speaker without insulation (5).

[0032] The amplifier is provided with a switching amplifier (2) that operates with switching techniques based on pulse width modulation (PWM) and the amplified signal is passed through a low-pass filter (3) that eliminates all electromagnetic noise and is finally fed to a speaker (4).

[0033] The switching amplifier (2) is powered through a switched DC/DC voltage converter.

[0034] Figure 2 shows how the amplifier-speaker assemblies (1) are connected to each of the area feeders (6). It can be seen that from the area feeder (6) are taken to each amplifier-speaker assembly (1) the power voltage (+Vdc), the AUDIO signal, the reference or EARTH and a monitoring connection that will allow to know remotely the state of each amplifier and speaker.

[0035] Each of the area feeders (6) receives the grid power supply at the grid voltage and the signal from the general line of the installation (7).

[0036] The monitoring means employed are housed in each of the amplifier-speaker assemblies, and through the monitoring line or the audio signal inform on the state of the amplifier-speaker state.

[0037] Figure 3 shows a form of embodiment of the monitoring in which a signal (9) is injected; this signal is sinusoidal and has a frequency under the range reserved for the useful audio signal, monitoring the presence and amplitude of this signal by a piezoelectric sensor (8) placed on the speaker cone itself, subsequently processed by filtering and amplification (10) and sent to a microprocessor (11).

[0038] The monitoring signal (9) is generated with a certain period at an output that is provided with a digital/analogue converter, and is received by the microprocessor at an input provided with an analogue/digital converter.

[0039] Finally, the microprocessor (11) generates the error signal to send it to the area feeder or to the control unit. This signal is sent through a specific interconnection line (12).

[0040] Figure 4 shows similar elements for monitoring the state of the speakers, where the presence and monitoring of the injected signal is performed by an auxiliary coil (14) identical to the main coil of the speaker, having the same amplification and filtering means of the signal

obtained, the error signal being sent through a specific interconnection line (12).

[0041] Figures 5 and 6 show the same solutions described in figures 3 and 4 respectively, where the signal containing the information regarding the state of the amplifier-speaker assembly is injected in the same cable that carries the useful audio signal to the speakers, using a signal with a frequency out of the audio range, which is injected by a directional coupling circuit (15), that sends the monitoring signal to the connection line with the area feeder and blocks this signal so that it is not passed to the audio amplifier.

[0042] In any of the four monitoring solutions described the amplifier-speaker assembly is incorporated an external indicator lamp that allows to see the malfunctioning module to facilitate the maintenance. This signalling consists of a lamp placed on the front of the speaker that can be seen from the area for which sound is provided and, depending on its illumination, informs on its state by remaining on when the module is in service and flashing when it is malfunctioning, turning off if no power is received.

[0043] Finally, figure 7 shows another of the improvements made in the union of the amplifier with the speaker, based on the disposition of filters (16) inserted in the amplifier, allowing to equalise the speaker.

[0044] Due to the joint disposition of the amplifier and speaker, the equalisation filters can be incorporated during the manufacturing process in a fixed or adjustable manner, to correct the deficiencies inherent to each speaker individually.

Other consequences of the joint assembly of the amplifier and speaker is that the amplifier will never provide the speaker with a power greater than admissible, protecting it and increasing its reliability and allowing to adjust for each speaker the sound level emitted to adapt it to the specific needs or each area.

[0045] The essence of this invention is not affected by variations of the materials, shape, size and arrangement of its component elements, described in a non-limiting manner that should allow its reproduction by an expert.

Claims

1. Sound and public address system with decentralised amplification, **characterised in that** it is formed by:

- A series of amplifier-speaker assemblies connected to an area feeder, wherein the feeder is mounted jointly to the speaker;
- An area feeder connected to the amplifier-speaker assemblies with at least the power voltage, the audio line signal and the reference line or earth;
- Means for monitoring the state of the amplifiers-speakers that verify that sound is being emitted by the speaker.

2. Sound and public address system with decentralised amplification according to claim 1, **characterised in that** the amplifier associated to each speaker, which operates with pulse width modulation techniques with a high energy efficiency, is connected to the speaker by a very short connection and through a low-pass filter and that these two characteristics prevent the electrical noise from being transmitted to the surroundings as electromagnetic perturbations. 5
3. Sound and public address system with decentralised amplification according to claim 2, **characterised in that** each amplifier is fed through a switched DC/DC voltage converter without insulation with a high energy efficiency. 10
4. Sound and public address system with decentralised amplification according to claim 1, **characterised in that** the power voltage supplied by the area feeders is within the very low voltage range yet can provide sufficient power for several speakers, such as a power voltage value around 48V. 20
5. Sound and public address system with decentralised amplification according to claim 1, **characterised in that** the monitoring means are provided with: 25
 - A microprocessor which, through a digital / analogue output injects a sinusoidal control signal with a frequency under that of the useful audio signal; 30
 - Means for monitoring the presence of the injected signal;
 - Means for amplifying and filtering the signal generated by the monitoring and presence means; 35
 - A specific interconnection line that sends the signal generated by the microprocessor to a control station or area feeder. 40
6. Sound and public address system with decentralised amplification according to claim 5, **characterised in that** the means for monitoring the injected signal consist of a piezoelectric sensor placed in the speaker cone or membrane. 45
7. Sound and public address system with decentralised amplification according to claim 5, **characterised in that** the interconnection with the area feeder or control station is performed through the cable that carries the audio signal, and is provided with a directional coupling circuit that sends the monitoring signal to the area feeder and blocks this signal so that it does not enter the audio amplifier. 50
8. Sound and public address system with decentralised amplification according to claim 5, **characterised in that** the means for monitoring the injected signal consist of the use of an auxiliary coil identical to the main coil of the speaker. 55
9. Sound and public address system with decentralised amplification according to claim 8, **characterised in that** the interconnection with the area feeder or control station is performed through the cable that carries the audio signal, the signal having a frequency that does not belong to the audio range, and is provided with a directional coupling circuit that sends the monitoring signal to the area feeder and blocks this signal so that it does not enter the audio amplifier.
10. Sound and public address system with decentralised amplification according to any of claims 5 to 9, **characterised in that** the amplifier-speaker assembly is provided with an external indicator lamp that shows the state of the amplifier-speaker assembly, placed on the front of the speaker and visible from the area for which sound is provided, and depending on the form of illumination it indicates its state (on, in service; flashing, malfunction; off, no power).
11. Sound and public address system with decentralised amplification according to claim 2, **characterised in that** by incorporating filters in the amplifier-speaker assembly it is possible to individually equalise the speaker, which can be performed directly in the factory.

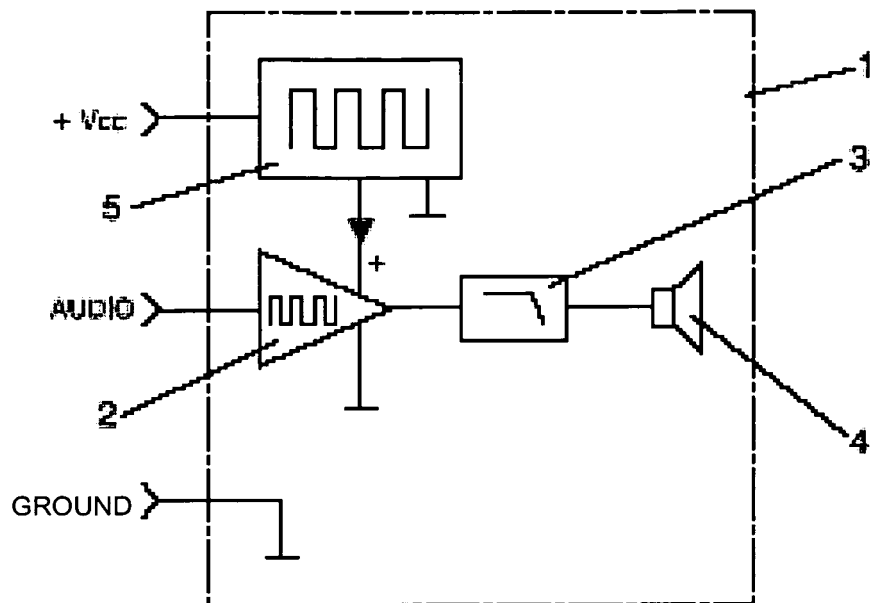


FIG. 1

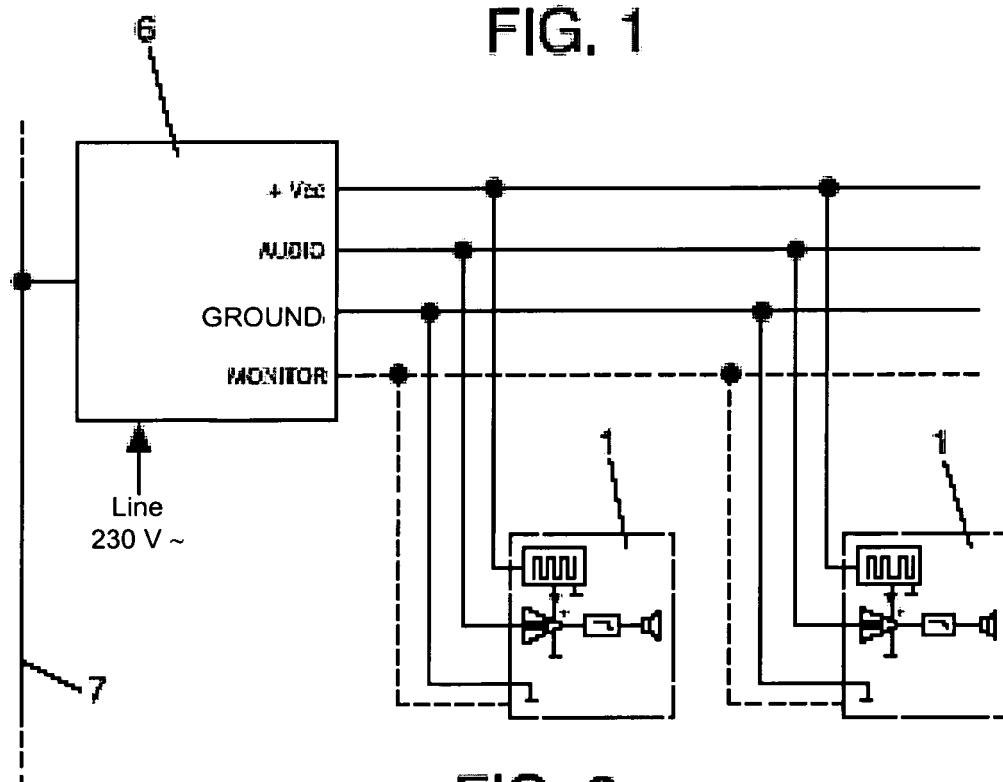


FIG. 2

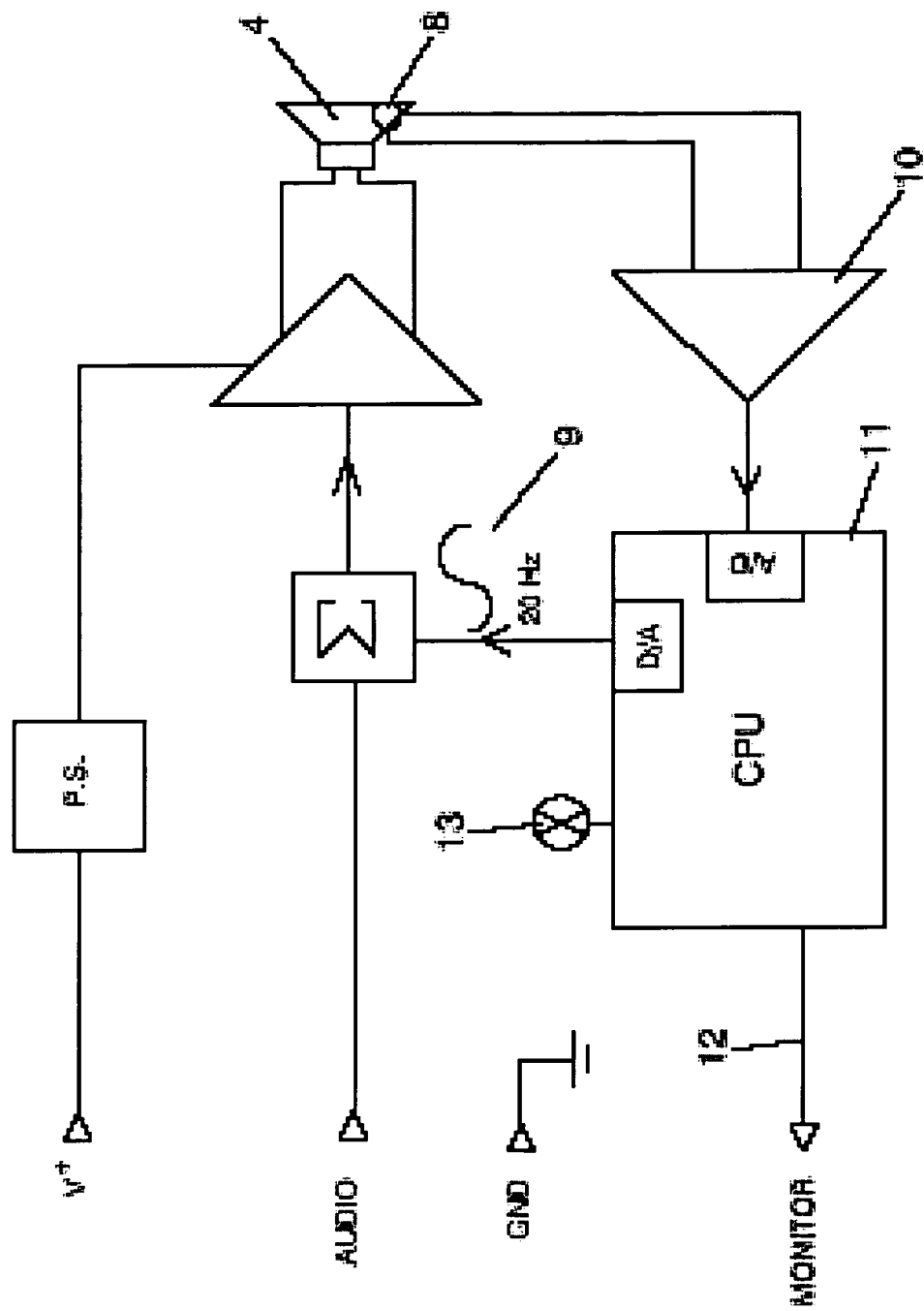


FIG. 3

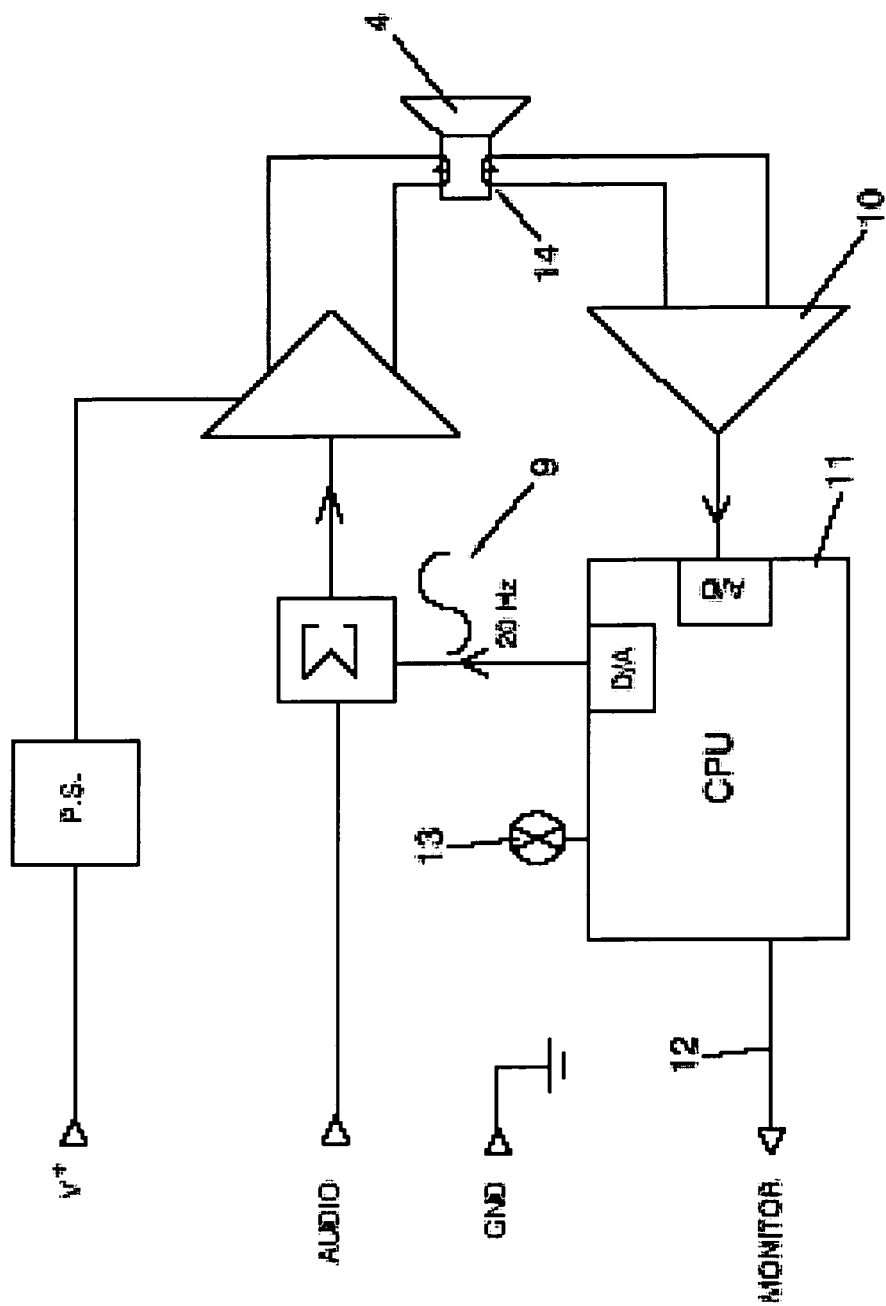


FIG. 4

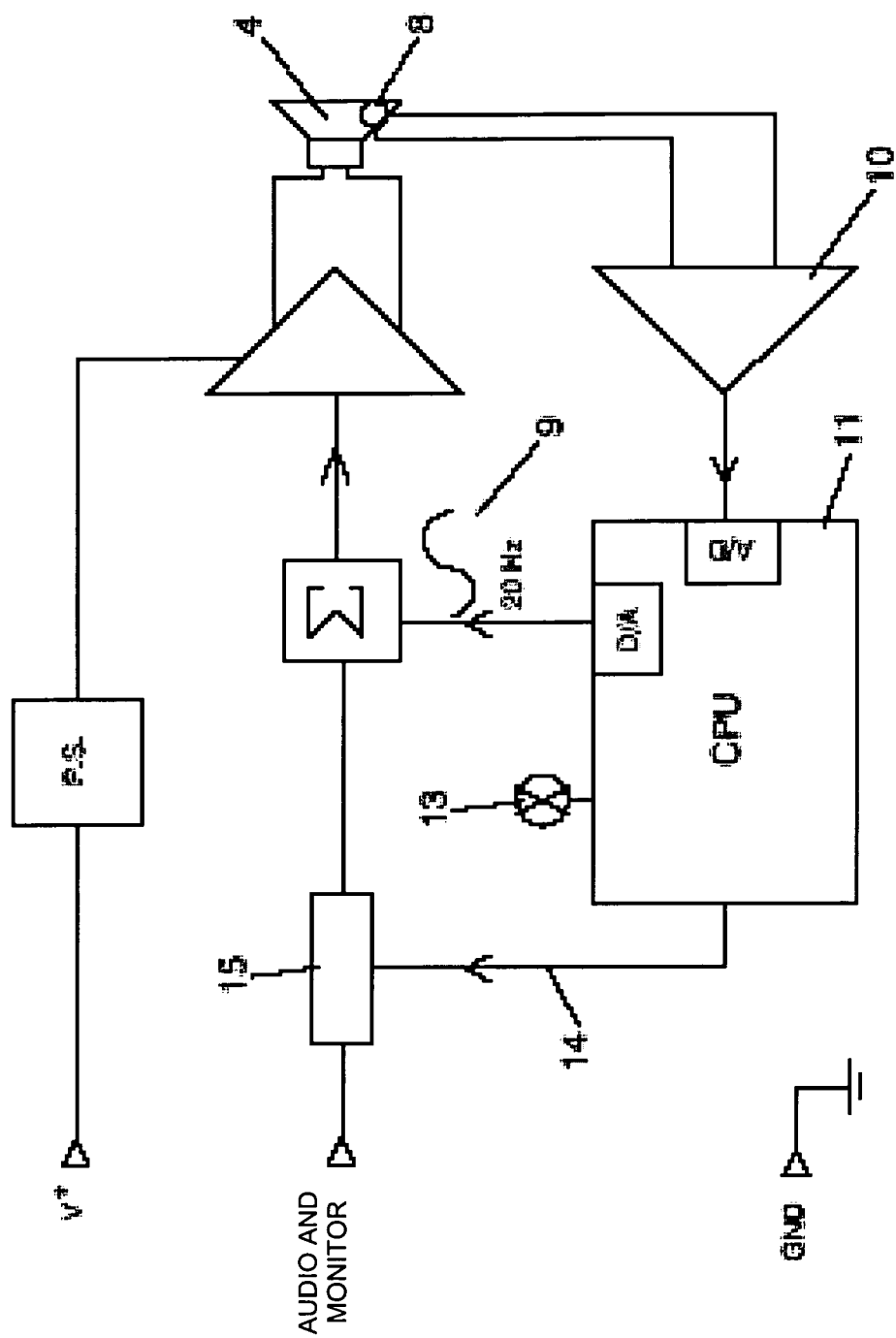


FIG. 5

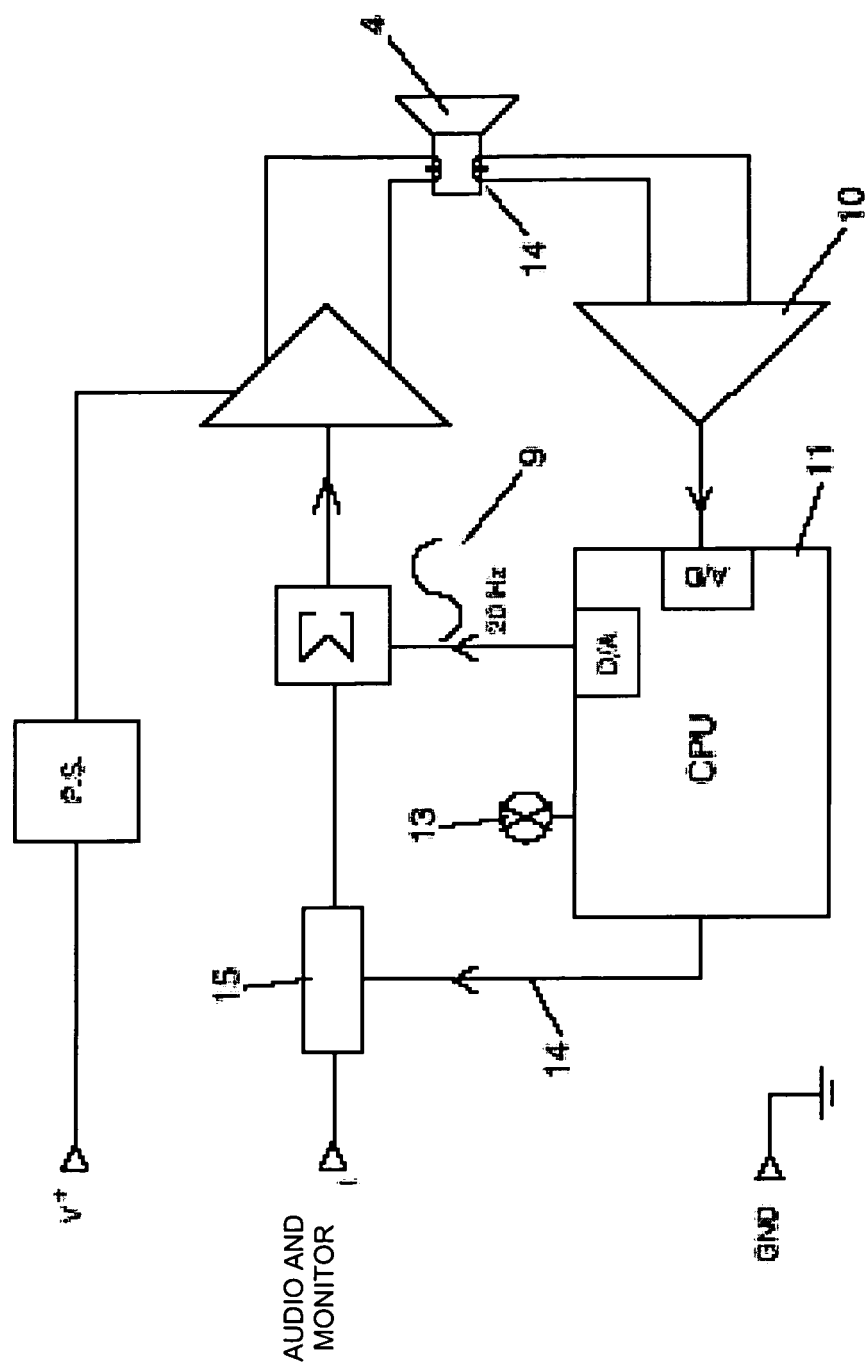


FIG. 6

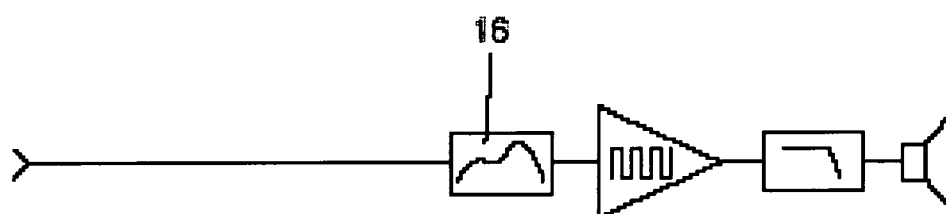


FIG. 7



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Application Number
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Place of search The Hague		Date of completion of the search 8 December 2005	Examiner Moscu, V
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