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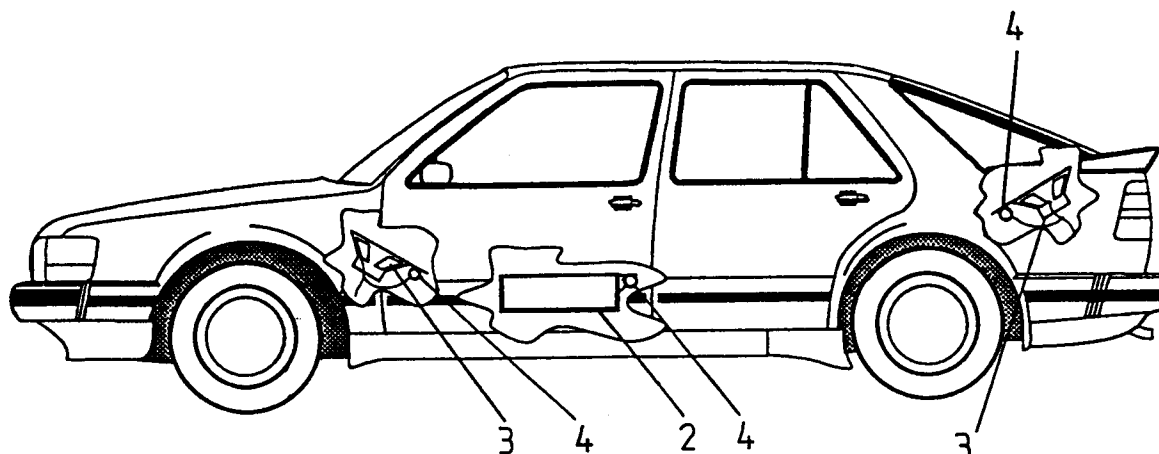
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SF- 33720 Tampere(FI)(54) **Active noise cancellation system.**

(57) The invention relates to an active noise cancellation system for a vehicle having a sound reproduction system, comprising means for generating one or more electrical signal(s) proportional to the noise in the target area, an electronic means (2) receiving these signals, such as an adaptive filter, for generating a noise cancellation signal, one or more sound sources (3) connected to said electronic means for generating cancellation noise in the target area, and one or more sensors (4) for detecting

residual noise in the target area and transmitting it in an electrical form to the electronic means (2) to tune its operation. Specifically for simplification of the mounting of the system, the sound sources for generating cancellation noise are constituted by the loudspeakers (3) of the sound reproduction system of the vehicle, and the sensor or at least one of the sensors (4) for detecting residual noise has been fitted in conjunction with one of said loudspeakers (3).

**FIG. 3****EP 0 539 939 A1**

The present invention relates to an active noise cancellation system for a vehicle having a sound reproduction system, comprising means for generating one or more electrical signal(s) proportional to the noise in the target area, an electronic means receiving these signals, such as an adaptive filter, for generating a noise cancellation signal, one or more sound sources connected to said electronic means for generating cancellation noise in the target area, and one or more sensors for detecting residual noise in the target area and transmitting it in an electrical form to the electronic means to tune its operation.

Figures 1 and 2 in the accompanying drawing illustrate the conventional system for realizing active noise cancellation in a vehicle, such as a car. Figure 1 shows the apparatus components required in such an active noise cancellation system, and Figure 2 shows the placing of the most essential of these in the vehicle.

A conventional active noise cancellation system of the kind shown in Figure 1 comprises first of all detection sensors 1, the purpose of which is to generate a signal proportional to the noise present in the target area. In practice, these detection sensors can be for instance microphones. The signals from these detection sensors are inputted in an electronic means 2, such as an adaptive filter, which in response to said signals being proportional to the noise in the target area generates a noise cancellation signal, which is ideally of equal amplitude but opposite phase to the noise signal, in which case the noise cancellation signal as reproduced through the sound sources 3 will cancel the noise in the target area. In practice, complete cancellation is not possible for the mere reason that the means 2 for generating the cancellation noise is not able to function in real time on account of the many delays involved in the system, but must in practice predict the situation prevailing in the target area. Thus the cancellation can be directed specifically to periodic components of noise. However, in practice the noise can be attenuated about 10–30 dB at the motor noise frequency. In order that the equipment generating the cancellation noise may adjust itself to changes in the target area, the system further includes sensors 4 for residual noise, which may in practice be for instance microphones adapted to listen in the target area. On the basis of the signals generated by these sensors 4 of residual noise, the means 2 for generating cancellation noise can adapt its function to afford optimum attenuation.

Figure 2 shows the placing of the components of the system of Figure 1 in a car. The actual means 2 for generating the cancellation noise is then fitted within the door panel of the vehicle, and the loudspeakers 3 generating the cancellation

noise are placed in the corners of the interior of the vehicle body. The system further comprises several sensors 4 monitoring residual noise, being disposed in the upper part of the interior of the body.

In practice, the placing of the sensors for cancellation noise in the interior of the vehicle body constitutes a problem. The placing of these sensors in such a way that they do not interfere with the other furnishings of the interior of the vehicle is very problematic, since these sensors and particularly the wiring to be brought thereto must be fitted within the upholstery of the interior, which requires rather extensive additional mounting work.

Thus the object of the present invention is to provide an active noise cancellation system for a vehicle, wherein the placing of the sound sources for cancellation noise and particularly that of the sensors for residual noise does not present problems of the kind described above, but these requisite components of the active noise cancellation system can be fitted within the vehicle without any additional work being involved. This is achieved with the noise cancellation system of the invention, the first embodiment of which is characterized in that the sound sources for the generation of cancellation noise are constituted by the loudspeakers of the sound reproduction system of the vehicle, and that the sensor or at least one of the sensors for detecting residual noise is fitted in conjunction with one of said loudspeakers.

The noise cancellation system according to a second embodiment of the invention is again characterized in that the sound sources for generating cancellation noise are constituted by the loudspeakers of the sound reproduction system of the vehicle, and that the sensor or at least one of the sensors for detecting residual noise has been fitted in conjunction with said electronic means.

The noise cancellation system of the invention will be described in more detail in the following, with reference to the enclosed drawing wherein

Figure 1 represents schematically the construction of the noise cancellation system,

Figure 2 represents an arrangement according to the prior art for disposing the components of the noise cancellation system in the vehicle, and Figure 3 represents a solution according to the invention for disposing the components of the noise cancellation system in the vehicle.

In accordance with the invention, it has been realized that almost invariably a sound reproduction system is installed in a normal vehicle, particularly a car, said sound reproduction system typically comprising a central unit and four loudspeakers placed approximately in the corners of the interior of the car. By using these loudspeakers and their wiring routes which are part of the normal outfit of

the vehicle, one can also realize the noise cancellation system of the invention. Therein the loudspeakers 3 of the sound reproduction system are used as sound sources generating the cancellation noise of the noise cancellation system, and the sensors 4 of residual noise are placed in the immediate vicinity of these loudspeakers for instance in the same cabinet with them. The wiring of the sensors can then be drawn by the same routes as the wiring of the loudspeakers, or a single multicore cable can simply be used for both the loudspeaker and the sensor of residual noise pertaining thereto. Thus the fitting of these sensors does not cause any additional work as compared with the mounting of the loudspeakers of a normal sound reproduction system.

Even though the sensors for residual noise are placed very close to the loudspeakers 3 generating the cancellation noise, this does not present a problem. The means 2 for generating the cancellation noise does not directly reproduce this residual noise signal but only monitors some of its frequency components and is controlled in response thereto to generate cancellation noise which most effectively cancels noise at the frequency of noises generated for instance by the motor and tires of the vehicle.

By placing one sensor for residual noise in conjunction with each loudspeaker -- four loudspeakers being normally provided -- of the sound reproduction system, one can achieve a system which is fully sufficient for the detection of this residual noise signal. Further, one sensor can be placed in conjunction with the means for generating cancellation noise, which also does not require additional work from the point of view of wiring or mounting.

Claims

1. An active noise cancellation system for a vehicle having a sound reproduction system, comprising means (1) for generating one or more electric signals proportional to the noise in the target area, an electronic means (2) receiving these signals, such as an adaptive filter, for generating a noise cancellation signal, one or more sound sources (3) connected to said electronic means for generating cancellation noise in the target area, and one or more sensors (4) for detecting residual noise in the target area and transmitting it in an electric form to the electronic means (2) to tune its operation, the sound sources for the generation of cancellation noise being constituted by loudspeakers (3) of the sound reproduction system of the vehicle, **characterized** in that the sensor or at least one of the sensors (4) for

detecting residual noise is fitted in conjunction with one of said loudspeakers (3) and / or said electronic means (2).

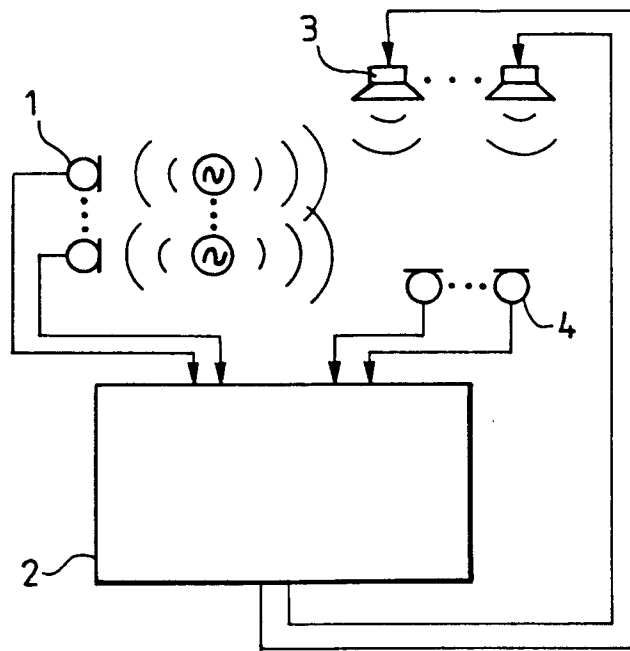


FIG. 1

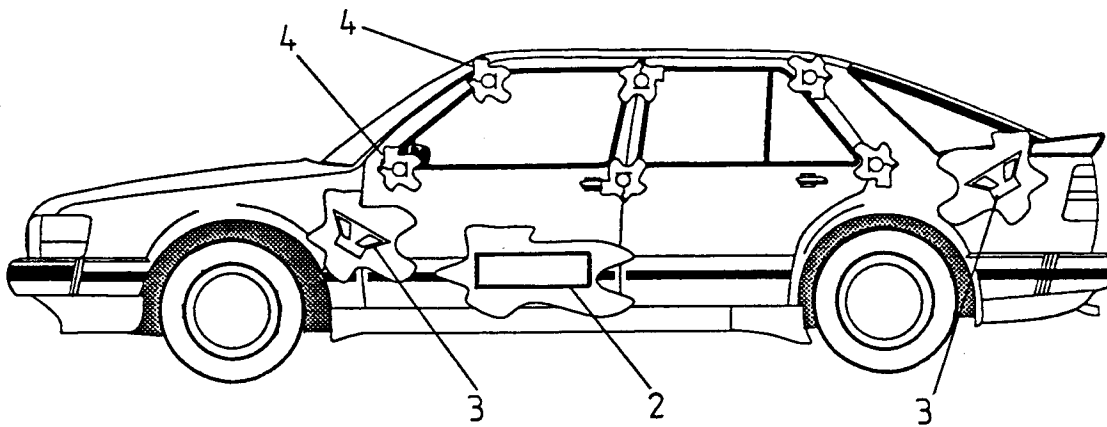


FIG. 2

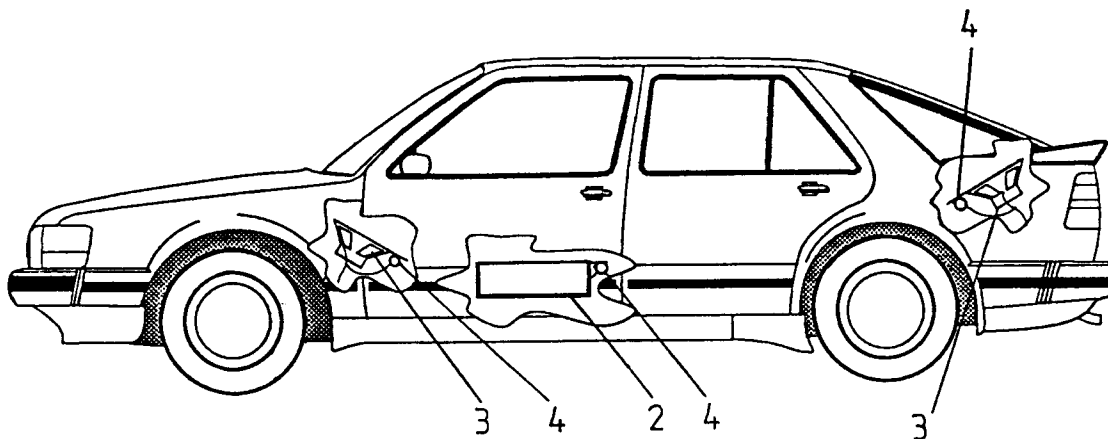


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 92 11 8415

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	FR-A-2 531 023 (AUTOMOBILES PEUGEOT AND AUTOMOBILES CITROEN) * Abstract; page 1, line 33 - page 2, line 10; page 5, lines 12-23; claims 1,3 *	1	G 10 K 11/16
Y	RESEARCH DISCLOSURE, no. 317, September 1990, page 784, Emsworth, GB; ANONYMOUSLY: "An active noise controller" * Whole document *	1	
A	US-A-3 889 058 (GABR) * Column 1, lines 18-30 *	1	
A	WO-A-8 804 621 (SAAB-SCANIA AB)		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 04 M 1 G 10 K 11 B 60 R 13
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28-01-1993	Examiner DE HEERING P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			