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(54) **Speaker cabinet with energy absorbent means.**

(57) A tube 12 which is filled with polyurethane elastomer absorbs energy imparted to it caused by relative movement between the cone and a rear wall 16 of a speaker cabinet 10. The tube is adhered to the magnet assembly of the speaker and the back wall 16. Sound is permitted to pass out of the cabinet from the air within the cabinet from waves passing through openings 34 in the tube, and sound is also able to pass out of the back wall of the cabinet via the interior of the tube.

EP 0 459 682 A2

The present invention relates to speaker energy absorbent means, a speaker cabinet and a method of absorbing energy in a speaker cabinet.

According to one aspect of the present invention a speaker cabinet arrangement includes a speaker mounted within the cabinet arranged to emit sound from a front wall of the cabinet, the speaker being spaced from the rear wall of the cabinet with energy absorbent means arranged to act between the speaker and the rear wall.

The energy absorbent means may be located between the speaker and the rear wall, and the energy absorbent means may extend directly from the speaker to the rear wall.

The energy absorbent means may be connected to the speaker and may be connected to the magnet and chassis assembly. The energy absorbent means may be connected by adhesive.

The energy absorbent means may be connected to the rear wall, and that connection may be by adhesive.

The rear wall may include an opening and that opening may be at least partially coincident with a hollow portion of the energy absorbent means.

The energy absorbent means may extend through the rear wall, or partially through the rear wall.

According to another aspect of the present invention a speaker energy absorbent means is adapted to be located in a speaker cabinet between a speaker and the rear wall of a cabinet.

The energy absorbent means may comprise a hollow member. The hollow portion of that member may be in communication with the interior or exterior or both of the speaker cabinet. The energy absorbent means may be generally tubular and may be generally cylindrical.

The energy absorbent means may comprise damping means.

The energy absorbent means may comprise a compressible member.

The energy absorbent means may have a Youngs Modulus of less than 20 or 10 or 5 or 2 or 1 E/GPa and the Youngs Modulus may be in the region of 0.02 E/GPa. Alternatively or additionally the Youngs Modulus may be in the region of 5 to 13 MN/m^2 or 8 to 10 MN/m^2 or preferably $9MN/m^2$.

The present invention also includes a method of absorbing energy in a speaker cabinet comprising absorbing energy between the rear wall of a cabinet in which a speaker is mounted and the speaker.

The present invention also includes a method of absorbing energy in a speaker cabinet when using energy absorbent means as herein referred to.

The present invention includes any combination of the herein referred to features or limitations.

The present invention may be carried into practice in various ways, but one embodiment will now be described by way of example, and with reference to the accompanying drawings, in which:-

Figure 1 is a side sectional view through a speaker cabinet 10, and

Figure 2 is an end view of a tube 12 used in Figure 1.

As shown in Figure 1, the cabinet 10 has a front wall 14 and a rear wall 16. A speaker 18 is secured to the front wall and, in use, sound is radiated from the diaphragm 26, which is driven by the coil 22 in the field of the magnet assembly 24.

Without the tube 12, when a coil 22 of the speaker moves backwards in the magnetic field of the speaker 24, the speaker diaphragm also moves backwards thereby compressing the air in the cabinet and exerting a rearwards force on the rear wall 16 of the cabinet, and the cabinet emits a slowly decaying vibration a short time after the instant where noise leaves the front of the diaphragm. Furthermore, the sound reverberates within the cabinet and the cabinet has its own natural frequency which can result in the cabinet resonating. This problem is particularly severe with the lower frequencies emitted by the speaker. The problem of the cabinet vibrating is exacerbated by the forwards force acting on the magnet assembly 24 and the chassis 18 and therefore the front wall of the cabinet has a resultant force which is opposite to that of the coil in the speaker moving rearwardly. In addition, the phase of the sound emitted by the vibration of the cabinet, and in particular the rear wall vibration may be out of phase with that emitted from the diaphragm of the speaker, thereby interfering with the emitted sound, and again the problem is particularly severe in the lower frequencies, generally below 1000 Hz.

The tube 12 is designed to reduce the vibration of the cabinet and to reduce the time for any remaining vibrations of the air within the cabinet, or vibrations of the cabinet, to die away to a minimum.

The tube 12 is attached to the speaker magnet assembly by means of four projecting rims 28 which extend around the periphery of the magnet assembly. Furthermore, the spaced surfaces 30 of the tube from which the rims project abut the magnet assembly and are glued to the magnet assembly. The tube 12 extends rearwardly and extends at least partially through an opening in the rear wall with a reduced diameter portion 32 of the tube 12 being glued to the rear wall.

When the coil moves rearwardly the reactant force on the magnet assembly biases the magnet assembly in the forwards direction, and that force is transmitted to the tube to urge the tube forwardly and therefore exert a forwards force on the rear wall. At the same time the air in the cabinet is compressed by the rearwards movement of the speaker diaphragm, and a sound wave travels within the cabinet towards the rear wall to urge the rear wall rearwardly. The forward and rearward forces exerted on the rear wall at least

partially cancel each other out thereby ensuring that a minimal level of noise is emitted by the cabinet vibrating or by air vibrating in the cabinet. Similar but opposite forces and vibration are dealt with by the tube in the opposite manner to that described herein when the coil moves forwardly.

The material of the tube can be rubber based or is a heavily filled polyurethane elastomer, the filler being for example of mineral origin. Such a material is resilient and able to absorb the energy imparted to it caused by relative movement between the cone and the rear wall. This characteristic has two advantages at least. The first is that the sound wave travelling from the fabric of the speaker to the rear wall of the cabinet takes a small amount of time to travel that distance. That extremely small delay is approximately equal to the time taken for a force to be transmitted along the tube. The second advantage is that, although the force between the cone and rear wall are transmitted equally between the two, the internal molecular structure of the tube absorbs a lot of the energy resulting from that force thereby ensuring rapid decay of any vibration. A significant advantage of this damping effect of the tube is that the cabinet does not tend to vibrate to any real extent at a natural frequency and thus the bass notes tend to be emitted clearly at their intended level without being distorted by the natural frequency of the cabinet. A related advantage is that, because the tube absorbs energy, that energy is not able to be released into the air thereby distorting the emitted sound.

The adhesive bond between the tube and the magnet assembly and back wall provides an intimate contact and ensures that forces are transmitted quickly into and from the tube at approximately an 85% level with very little reflection of vibrations.

Sound is still permitted to pass out of the cabinet from the air within the cabinet from waves passing through openings 34 in the tube located adjacent to the magnet assembly and out of the back wall of the cabinet via the interior of the tube.

The tube may have a relatively low Bulk Modulus of less than 1×10^3 or $1x\ 10^2$K/Pa.

The Youngs Modulus of the tube may be less than 20 or 10 or 5 or 2 or 1 E/GPa and is preferably in the region of 0.02 E/GPa.

The specific gravity or density of the tube may be in the region of 1.5 to 3.5 gm/cm^3 and may be substantially 2. 3 gm/ cm^3.

The shore hardness A of the tube may be between 50 and 100 and may be substantially 75.

The elongation of the tube at break may be between 35 and 95% and may be substantially 65%.

The tensile strength of the tube may be between 1 and 2 MN/m^2 and may be substantially 1.5 MN/m^2.

Claims

1. A speaker cabinet arrangement including a speaker mounted within the cabinet (10) arranged to emit sound from a front wall (14) of the cabinet, the speaker being spaced from the rear wall (16) of the cabinet characterised in that energy absorbent means (12) are arranged to act between the speaker and the rear wall.

2. An arrangement as claimed in Claim 1 in which the energy absorbent means (12) is located between the speaker and the rear wall (16).

3. An arrangement as claimed in any preceding claim in which the energy absorbent means (12) is connected to the speaker.

4. An arrangement as claimed in any preceding claim in which the energy absorbent means (12) is connected to the rear wall (16) of the cabinet.

5. A speaker energy absorbent means (12) adapted to be located in a speaker cabinet between a speaker and the rear wall (16) of the cabinet.

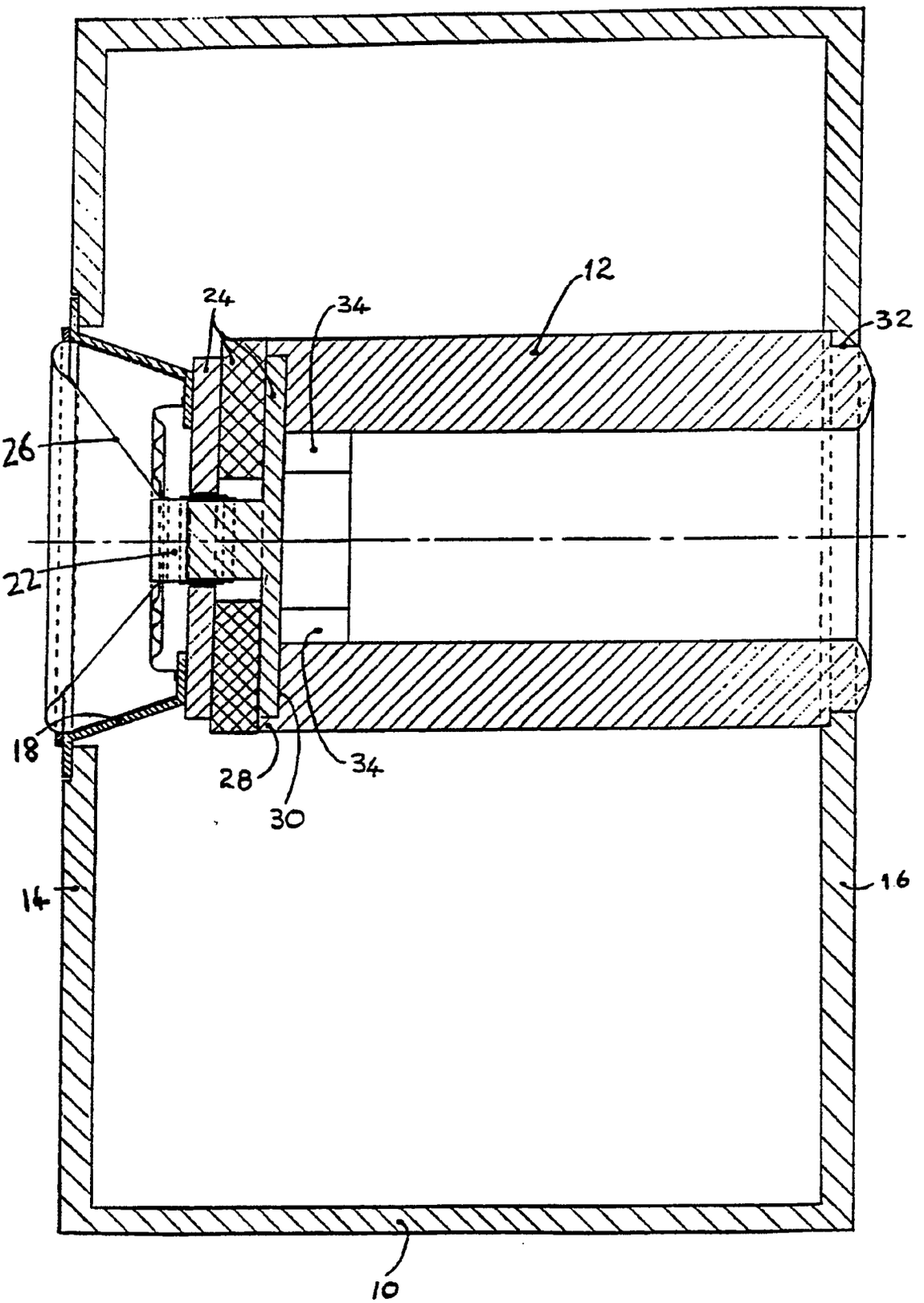
6. A speaker energy absorbent means as claimed in Claim 5 in which a hollow portion of the member (12) is arranged to be in communication with the interior of a speaker cabinet when located in a speaker cabinet.

7. A speaker energy absorbent means as claimed in Claim 5 or 6 in which a hollow portion is arranged to be in communication with the exterior of a speaker cabinet when located in a speaker cabinet.

8. A speaker energy absorbent means as claimed in any of Claims 5 to 7 comprising a compressible member.

9. A method of absorbing energy in a speaker cabinet comprising absorbing energy between the rear wall of a cabinet in which a speaker is mounted and the speaker.

10. A method of absorbing energy in a speaker cabinet when using energy absorbent means as referred to in any of Claims 1 to 9.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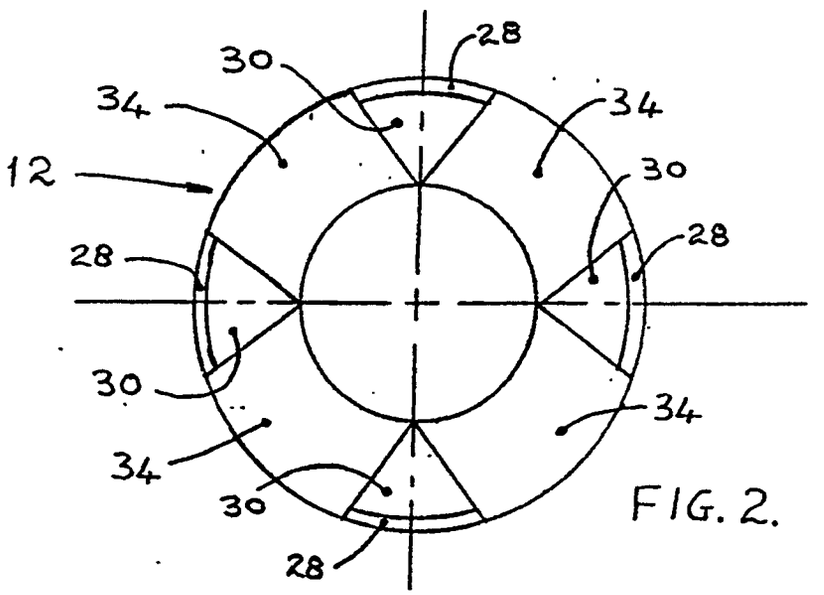

FIG. 2.