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(54)

Hangelnyelő lemezszerű habanyag

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

The invention relates to a noise-absorbing, planar and layer-wise foam material, especially for lining noise insulation hoods and housings, engine casings and the like.

It is known to use a layer of foam material for linings of noise insulation hoods and the like. The foam material layer can have a microporous surface layer due to partial melting. Apart from material properties and structure of the absorber, the noise absorption effect of such foam material linings depends above all on the thickness of the foam material layer.

DE 2 246 621 describes an acoustic plate having elevations and recesses.

Noise absorption concerns the leading-off or absorbing of the highest possible amount of energy from the incident sound wave. The highest energy plane of a sound wave is in the area of the maximum amplitude, that is, of the vertical oscillation of the air particles vertical to the direction of propagation, which is highest at $\lambda/4$ and $3/4 \lambda$. For a porous absorber like foam material, this means that, to achieve a good noise-absorption effect, the lower the sound frequency and the larger the wavelength of the sound wave are, the higher the layer thicknesses need to be. For example, if one takes a sound frequency of 1000 Hz then, taking the sound velocity into account, a wavelength of 0.33 m results, wherein the maximum amplitude occurs at 8 and 24 cm. Even with an ideal porous absorber which is less than 8 cm thick, one cannot achieve complete absorption. In order to reduce 99.9% of the sound at 100 Hz, the thickness of the absorber would have to be approximately 82 cm.

In engine enclosures, machine claddings, especially in the field of motor cars, it is not possible as a rule, in air conditioning passages and the like, to use layer thicknesses of the noise-absorbing material of more than 50 mm. Thus the lower but always clearly present frequency ranges < 1000 Hz represent unsolvable problems, because the layer thickness cannot be increased.

The invention is based on the object of clearly improving the noise absorbing effect in the case of a layer-wise foam material without having to increase the layer thickness.

This object is solved according to claim 1.

An exemplary embodiment of the invention is described in detail with reference to the drawing, in which

Fig. 1 shows a sectional view through a foam material layer,

Fig. 2 shows a diagram which represents the degree of noise absorption in dependence on the sound frequency,

Fig. 3 shows a diagram which represents the coefficient of absorption in dependence on the frequency in the case of a foam material layer,

Fig. 4 shows a diagram which represents the decrease of level as a function of the degree of noise absorption, and

Fig. 5 shows a table which represents the subjectively perceived reduction in sound level.

Fig. 1 schematically shows a cross-section through a layer 1 of polyurethane foam, which represents a porous absorber and has an average layer thickness of, for example, 15 mm. The rear side of the foam material layer 1, which side is turned away from the sound incidence, comes to abut at a lining wall (not shown); it can be formed smooth, while the surface facing the sound incidence is provided with flat elevations 1a arranged offset from each other and with flat recesses 1b lying therebetween. The distance of the elevations 1a can be, for example, approximately 50 mm, and the difference in height from a recess 1b can be approximately 10 to 12 mm. Due to this surface structure, the result is approximately double the noise absorbing surface in relation to a foam material layer of 15 mm thickness having a plane surface.

1c designates a surface layer of the foam material layer which is formed by partial melting and burning of approximately 2 to 3 mm of the foam material at the surface, for example by rolling a hot roller over the foam material layer under pressure. In this way, a mostly closed surface results from the burnt residues of the foam material, especially polyurethane, which is, however, microporous. This surface layer 1c functions as an oscillatory membrane and can have a thickness in the range of 10 to 15 μ .

This microporous surface layer or skin 1c is permeable for air but not for water or oil, due to the surface tension of liquids.

Indentations are preferably provided in the surface layer 1c, which increase the surface for the incident sound and reinforce diffraction effects of the sound. As an example, grooves 1d are indicated in Fig. 1, arranged intersecting each other and rhombus-shaped; these grooves are imprinted into the surface layer 1c and can have a depth of 1 to 3 mm.

The absorption of a noise absorbing material also depends very strongly on the angle of incidence of a sound wave. Fig. 3 shows the absorption coefficient in the case of diffuse sound incidence in dependence on the frequency. In practice, in the case of diffuse sound fields, all angles of incidence occur. The surface structure according to Fig. 1 results in an optimum average angle of incidence. Due to the mostly inclined incidence of sound on the surface, components of sound amplitude occur which are almost parallel to the wall, in the case of which the longitudinal extension of the foam material layer has an effect, so that these components are effectively absorbed as if through a very thick material layer. In this way, sound absorption values are achieved which clearly exceed the sound absorption effect which can be calculated to be obtainable through the layer thickness alone, and are otherwise achieved only with multiple layer thicknesses of a usual planar foam material. These high sound absorption values are supported by deflection effects occurring at the indentations 1d, which are preferably provided at the surface in a rhombus structure.

Fig. 2 shows the degree of sound absorption of foam material layers formed according to the invention at different average thickness dimensions in dependence on the sound frequency. For example, in the case of an average layer thickness of 30 mm and 630 Hz, an absorption value of α greater than 1.0 is obtained, wherein 1.0 corresponds to 100%. For such an absorption value, in the case of a foam material layer of uniform thickness, that is, without the corrugated structure of the microporous surface according to the invention, a layer thickness of 130 mm is needed. The practical meaning of such absorption values is made clear by Figs. 4 and 5. Fig. 4 shows the sound level decrease as a function of the degree of sound absorption α . Fig. 5 represents the subjectively perceived reduction in sound volume. According to this, for example, a noise level reduction of 5 dB in the case of a sound level of 60 dB is already a sound volume reduction of 29% for the human ear.

The rear side of the foam material layer 1 can be coated with a reinforcing material. It can also be formed self-adhesive, in order to facilitate mounting at a wall.

Various modifications of the described form of the surface of a foam material layer are possible. For example, the distance of the flat elevations 1a can be varied, as can the height between elevation and recess. For example, the distance between the elevations 1a can be 40 – 60 mm, especially 45 – 55 mm. Hereby, the height between elevation and recess can be 8 – 15 mm. In special cases, a distance of the elevations of up to 100 mm can be used. Altogether, a surface structuring which is as flat as possible is provided, in order to avoid the

disadvantages of partially lower volume density and thus reduced absorption to a large extent.

The corrugated surface structure is independent of the used layer thickness of the foam material. In the case of a given thickness of the foam material layer, the corrugated surface structure is dimensioned such that in the case of the smallest possible profile depth, an increase of the surface of approximately 180 – 250% is achieved. In the exemplary embodiment according to Fig. 1, having a distance of the elevations of 50 mm and a difference between elevation and recess of 10 to 12 mm, the result is approximately double the surface and an increase of the surface of approximately 200%.

In the embodiment shown, the line of intersection in Fig. 1 approximately follows a sine curve. However, it is also possible to form the recesses, for example, deeper, and the elevations wider than the recesses. Hereby, it is essential that flat dome-shaped elevations 1a result and that the recesses 1b are also formed concave in a flatly rounded manner, such that a continuous change of inclination of the surface results.

The described surface structure leads to a substantial improvement in the sound absorption effect for different types of foam material.

Due to the imprinted groove portions 1d in the surface layer, their microporous structure in the area of the grooves 1d becomes somewhat more open, so that higher frequencies can be better received and absorbed.

Preferably, polyurethane is used as a foam material, which has an approximately 40% open-cell and an approximately 60% closed-cell structure.

Hangelnyelő lemezszerű habanyag

SZABADALMI IGÉNYPONTOK

1. Hangelnyelő, lemezformájú habanyag, melynek a hang előfordulása felé néző felülete kiemelkedésekkel (1a) és mélyedésekkel (1b) oly módon van ellátva, hogy egy hab lemeznek a hang előfordulása felőli felülete az egyenletes vastagság és a terület egységre eső azonos térfogat viszonylatában körülbelül legalább kétszeresére van megnövelve, ahol a hang előfordulásával szemben lévő felület habanyaga egy mikropórusos felületi réteggel (1c) rendelkezik.

2. Az 1. igénypont szerinti habanyag, ahol a felület a felületi kiemelkedések révén a síma lemez felülethez képest körülbelül 180-250 %-kal van megnövelve.

3. Az 1. vagy 2. igénypont szerinti habanyag, ahol a habanyag lemez (1) keresztmetszetében a felület hullámos szerkezetű, és a metszésvonal a mélyedésekben a kiemelkedések metszésvonalával szomszédosan van elhelyezve.

4. A 3. igénypont szerinti habanyag, ahol kiemelkedések (1a) távolsága egymástól körülbelül 40-60 mm, és a magasságok és a mélyedések közötti magasság körülbelül 8-15 mm.

5. Az előző igénypontok bármelyike szerinti habanyag, ahol a felület mélyedésekkel, így rombuszalakban elrendezett horonyrészekkel vagy kisebb bemélyedésekkel van ellátva.

A meghatalmazott



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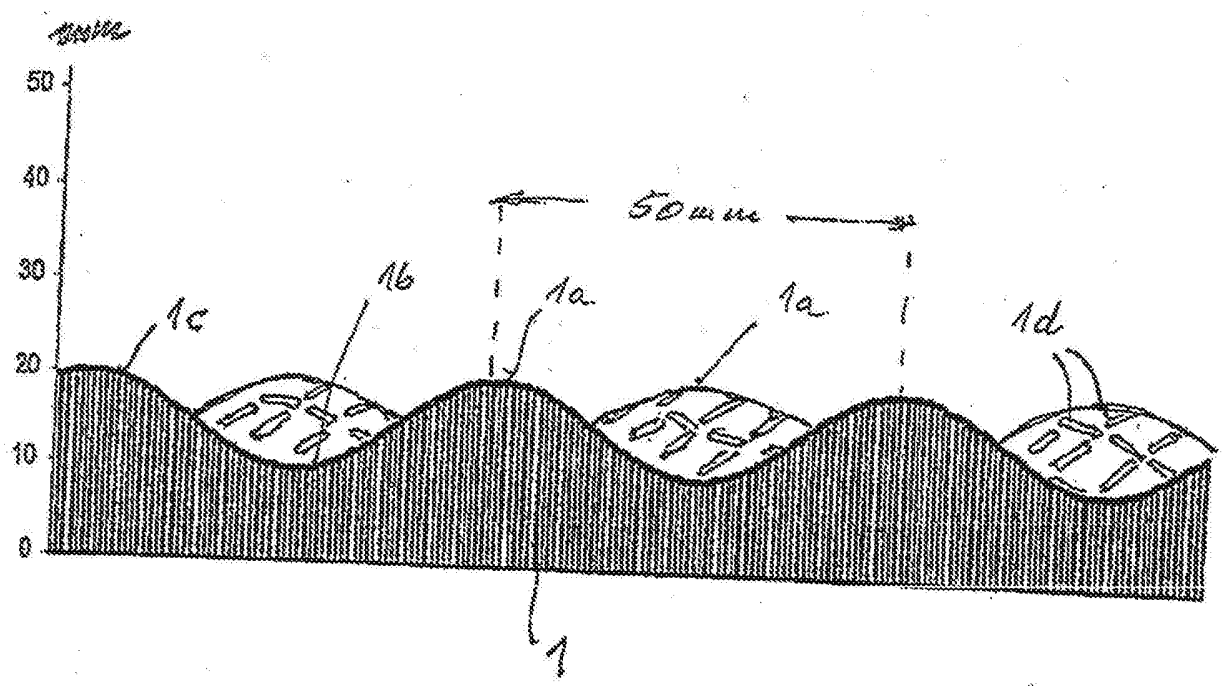
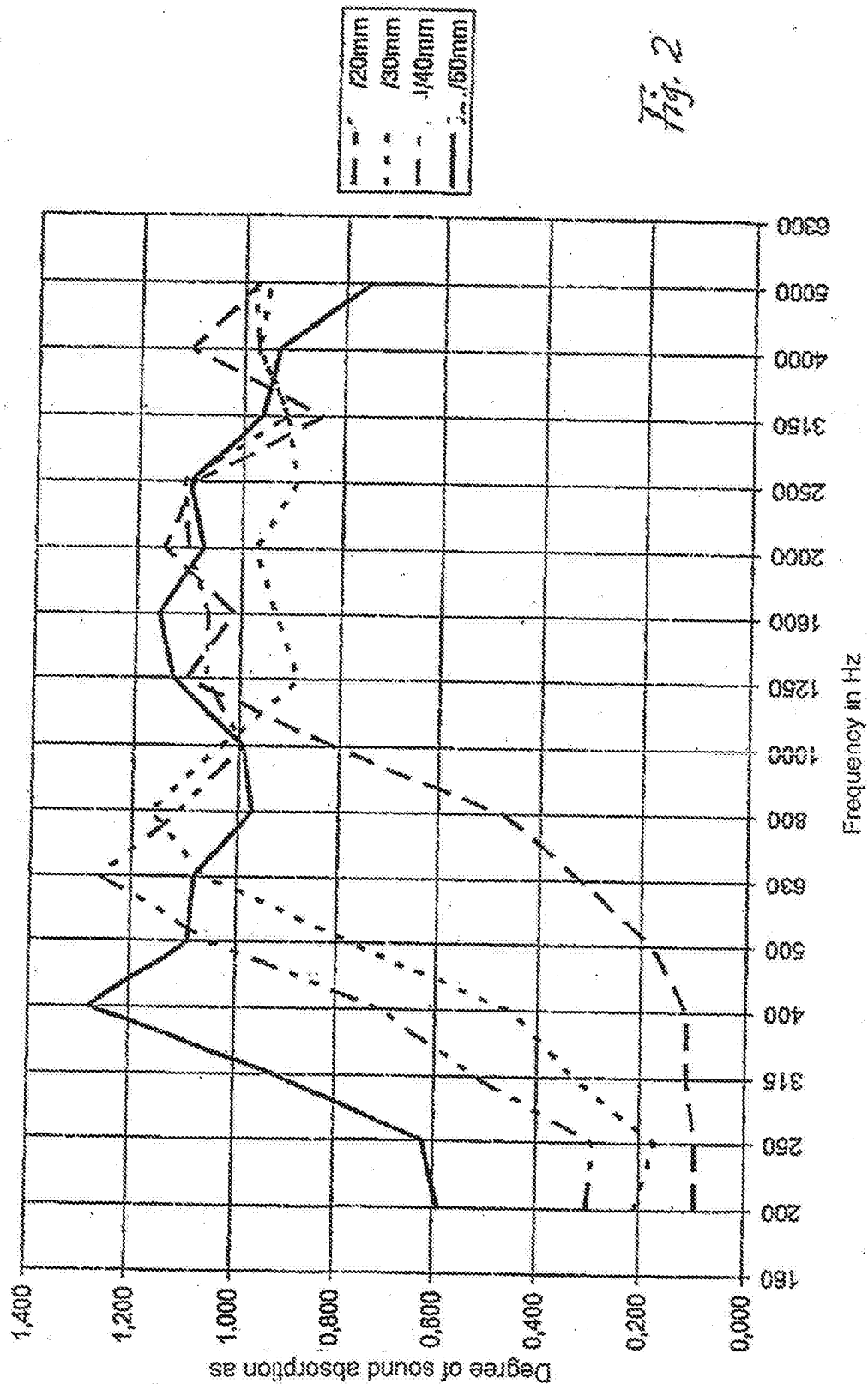


Fig. 1

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Fig. 2



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Diffuse incidence of sound

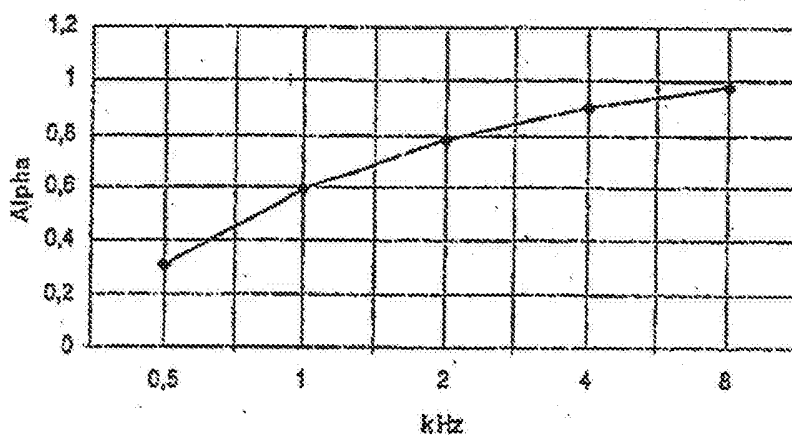


Fig. 3

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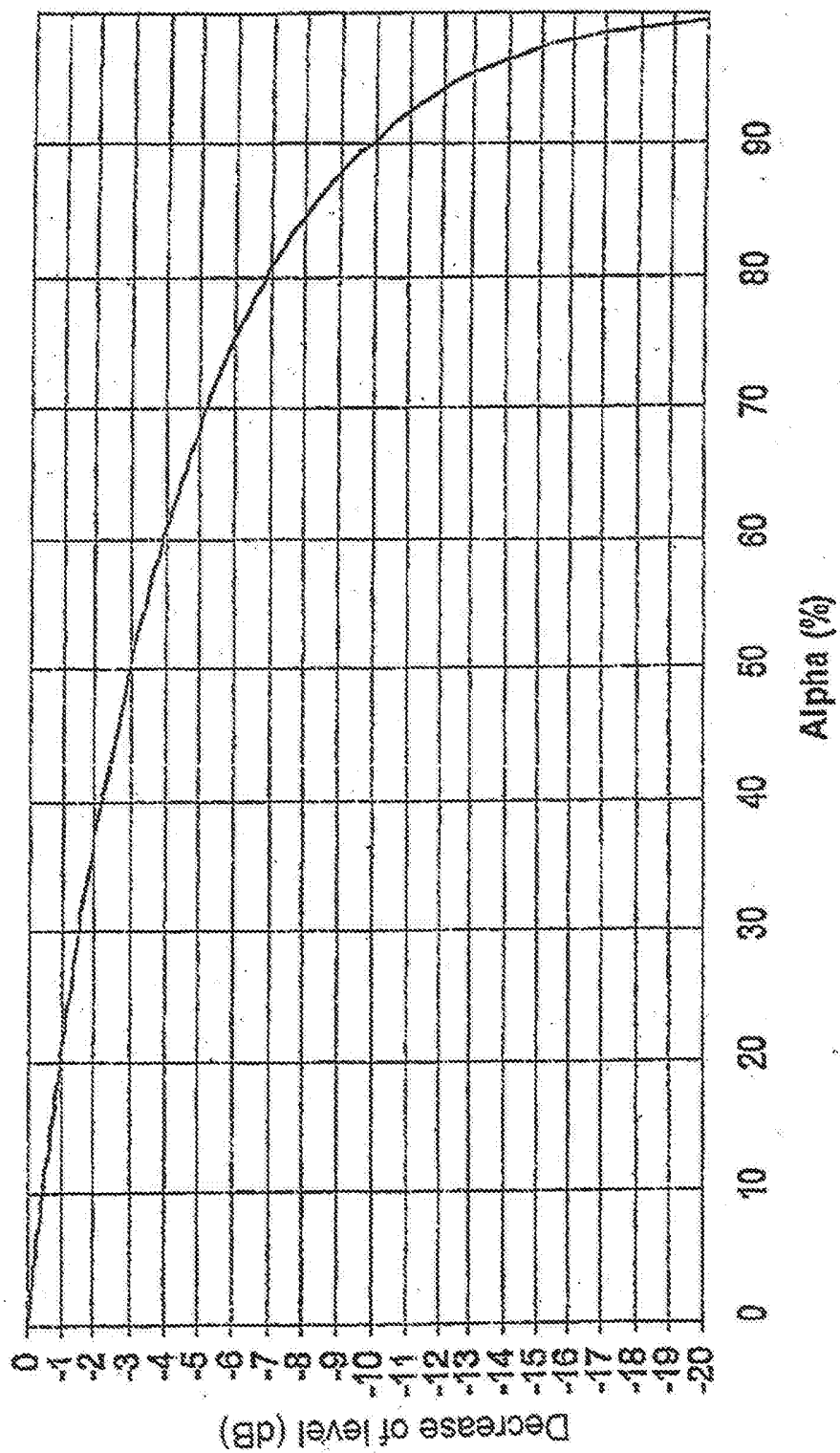


Fig. 4

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Sound level before the reduction	Sound level reduction in dB																								
	2	3	4	5	6	7	8	9	10	12	14	16	18	20	Sound volume reduction in %										
40 dB	17	24	31	37	43	48	53	58	63	71	77	82	87	90	40	43	48	53	58	63	71	77	82	87	90
50 dB	13	19	25	32	38	43	47	52	56	63	69	75	80	84	50	53	58	63	68	73	78	83	88	93	98
60 dB	12	18	24	29	34	38	42	46	50	56	62	68	73	78	60	63	68	73	78	83	88	93	98	103	108
70 dB	12	17	22	26	30	34	38	42	45	52	58	64	69	74	70	73	78	83	88	93	98	103	108	113	118
80 dB	15	21	27	33	38	42	47	50	54	59	64	69	74	79	80	83	88	93	98	103	108	113	118	123	128
90 dB	15	22	28	34	39	44	48	52	55	62	67	72	76	81	82	85	90	95	100	105	110	115	120	125	130
100 dB	16	23	30	35	40	44	49	53	57	63	69	74	78	83	84	87	92	97	102	107	112	117	122	127	132
110 dB	16	24	30	36	41	46	51	55	59	66	71	75	79	84	85	88	93	98	103	108	113	118	123	128	133
120 dB	17	25	32	38	43	48	53	58	61	68	73	77	81	86	87	90	95	100	105	110	115	120	125	130	135
130 dB	17	24	31	37	42	47	52	56	60	67	73	77	81	86	87	90	95	100	105	110	115	120	125	130	135

Fig. 5