

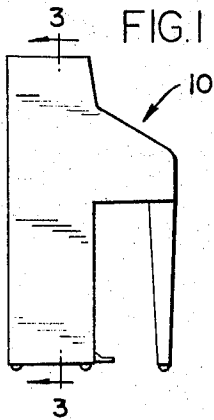
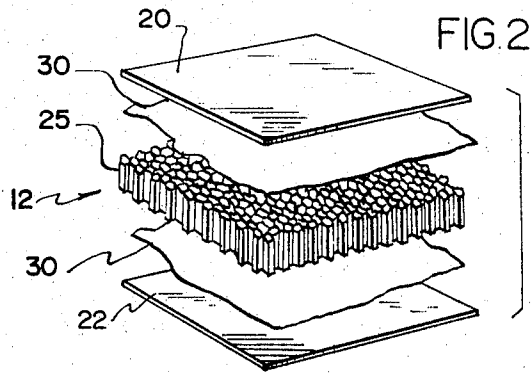
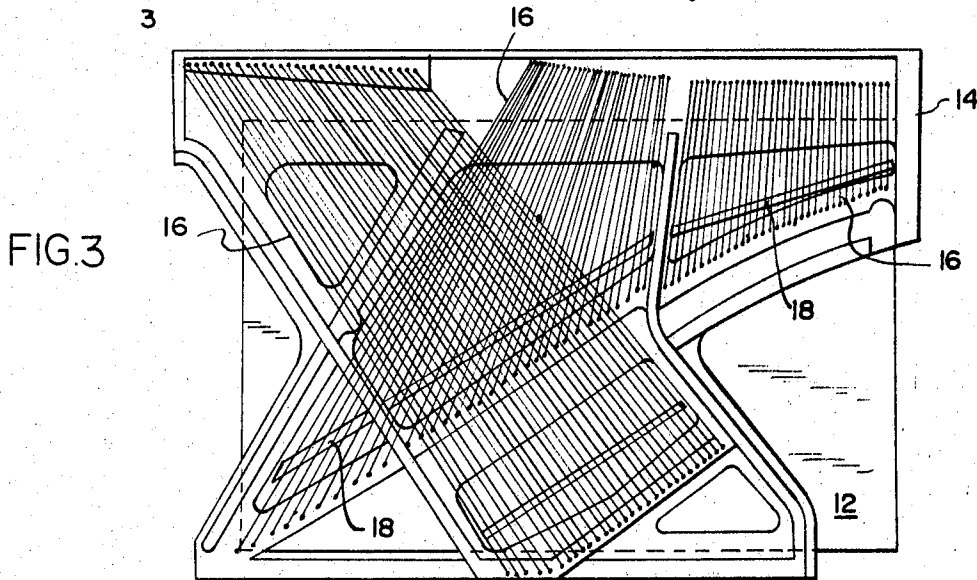
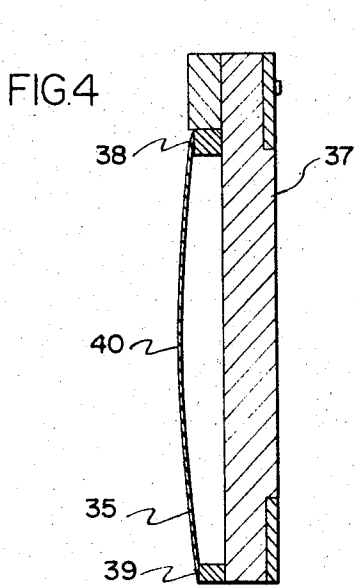
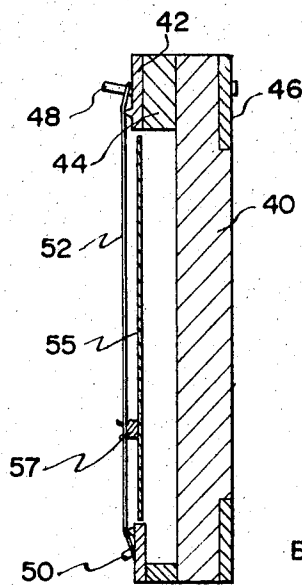
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LAMINATED SOUNDBOARD FOR A STRING INSTRUMENT

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LAMINATED SOUNDBOARD FOR A STRING INSTRUMENT

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3 Claims

ABSTRACT OF THE DISCLOSURE

This soundboard for use in a piano includes a honeycomb core of low density material sandwiched between first and second thin sheets of plastic material. The sheets have a relatively high modulus of elasticity to give the board great stiffness, and are bonded to the core. The core, which makes up almost 90% of the volume of the board but only 10% of its weight, provides for low internal attenuation of the piano tones and gives excellent response to all frequencies which are concerned in the piano. The board can be supported in the piano around the peripheral edges in the conventional manner or can be supported solely by the strings which are connected to bridges fastened to the board so that the soundboard behaves as a free-moving diaphragm.

Background of the invention

It is known in the piano industry that to get the best tones with minimum internal loss it is desirable to make the piano soundboard from a wood that has a high strength-to-weight ratio. Sitka spruce has one of the highest strength-to-weight ratios of any wood in common use, and for this reason it is the most frequently selected material for making piano soundboards. The high strength-to-weight ratio is desirable because stiffness with a low mass provides good response to high frequencies and reduces internal losses. Wood soundboards, however, have certain drawbacks. For instance, the frequency response characteristics of the wooden soundboards change with moisture and temperature. The wooden soundboard also shrinks and swells with changes in moisture, giving rise to variations in the tuning of the piano. Furthermore, it is extremely difficult to get a wood board that has uniformity in the material which, of course, affects the transmission of the sound energy at various frequencies. The non-uniformity of wood also makes it difficult to make two soundboards exactly alike. Wood can be treated to correct for these deficiencies but the treatment is very expensive.

Summary of the invention

It is an object of this invention to provide a piano soundboard that has a strength-to-weight ratio superior to any known soundboard.

It is another object of this invention to provide a piano soundboard wherein the frequency response and tuning remain stable with changes in moisture and temperature and which is of a material uniform throughout.

In one embodiment of this invention, a low density honeycomb core made from paper, for instance, is sandwiched between first and second thin sheets, which have a high coefficient of elasticity, to form a laminated piano soundboard. The core occupies nearly 90% of the volume yet contributes to only 10% of the weight so the board exhibits a much higher strength-to-weight ratio than the previous wooden soundboards. Because of the great stiffness, low mass and, consequently, low density, it has outstanding frequency response especially in the higher frequency ranges. The board may be formed into a crown without molding and using supporting ribs. This can be

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accomplished by using, on one side of the board, sheet material which has a coefficient of contraction different from the sheet material on the other side of the board. Therefore, during the bonding process, when the sheets are cured to the core, one side will contract greater than the other side to put a crown in the board. The board can be mounted in the piano in the conventional fashion by supporting it around the peripheral edges and leaving it free to move in the center as a diaphragm. In another application, the board can be made flat and supported within the piano solely by the connection of the strings to bridges mounted to the soundboard. In this manner, the board presents a free-moving diaphragm which greatly reduces any changes in piano tone due to temperature or moisture variations.

Description of the drawing

FIG. 1 is a side elevation view of a piano in accordance with this invention;

FIG. 2 is an exploded, perspective view of the construction of the device of this invention;

FIG. 3 is a cross-section taken generally along the lines 2—2 of FIG. 1;

FIG. 4 is a transverse, cross-section in elevation of a portion of a piano in accordance with this invention; and

FIG. 5 is a transverse cross-section in elevation of a portion of a piano showing an embodiment different from that of FIG. 4.

Detailed description

FIG. 1 illustrates a piano 10 in which is mounted a soundboard 12, which is shown in FIGS. 2 and 3. A piano plate 14 is also mounted in the piano 10 and has strings 16 stretched across it to provide the various tones or frequencies of the piano. Wooden bridges 18 are connected to the soundboard 12 and have the strings 16 pressed thereacross. Therefore, when the hammers of the piano (not shown) strike the various strings to produce the tones, the vibration is transmitted through the bridges 18 to the soundboard 12 to move the same in the manner of a diaphragm to reproduce the tones in an amplified fashion.

What has been described so far is a conventional piano. In such pianos it has been found that the most efficient soundboards are made from a material having a high strength-to-weight ratio. Such a board has great stiffness coupled with low mass and low density to give excellent piano tones. In the piano industry today Sitka spruce has been considered one of the most ideal materials for making the soundboards. In addition to having one of the best strength-to-weight ratios of any wood in common use, it also exhibits a fairly low internal loss. Sitka spruce also exhibits some stability with changes in moisture and temperature. All of these characteristics are desirable for good piano tone and for keeping the piano in tune over long periods of use. However, wood which exhibits these detailed characteristics is extremely costly. This invention is directed to a unique way of constructing piano soundboards which incorporate all these desirable characteristics at a low cost.

The soundboard 12 is made from a lightweight laminated panel formed by bonding first and second thin sheets or skins of material 20 and 22, which have a relatively high modulus of elasticity, to a core 25 which is made of a low density material such as paper honeycomb, metal honeycomb, end grain balsa wood, or even molded styrene. The laminated panel may be made by many processes, but preferably it is made utilizing bonding techniques. Although bonding techniques are well known, a brief description will be given for illustrative purposes.

The skin material is selected which has a very high modulus of elasticity. Such materials could be epoxy,

plastic sheeting, plastic-impregnated cardboard, or metal. One material that was used with success in this invention was formica. The formica skins 20 and 22 are cleaned thoroughly and the surfaces to be bonded are sprayed with any well known structural adhesive. A low density honeycomb core 25 is then prepared using a suitable material such as paper phenolic laminate, resin impregnated glass, cotton phenolic laminate, or even metal. The surfaces of the skins 20 and 22 and the core 25, which are to be bonded together, are then mated and a layer 30 of adhesive film is placed between the skins and the core. This adhesive film can be in the nature of a liquid spread onto skins 20 and 22, or can consist of a sheet of thermosetting glue. Another system which has been highly successful combines the skin and adhesive layer into one. Here an open weave cloth such as fiber glass matting or screen is used to bind together a polyester, epoxy, adhesive, or other substance which hardens to a rigid material. This substance as it hardens serves not only as the skin, but also as the adhesive, since the honeycomb material is pressed against the reinforcing cloth and binding liquid while the skin is still wet. The skins and core are then placed in a tight fitting relation and then bonded to complete a cure using the proper time, temperature and pressure cycling in accordance with the adhesive structure materials being used.

The finished product is a laminated, lightweight soundboard having thin surface portions which have a high modulus of elasticity and a core of a low density material. In addition, the laminated soundboard 12 has all the advantages of the spruce boards in that the skins by having a high modulus of elasticity exhibit great stiffness, and yet, because the core 25 occupies about 90% of the volume while only about 10% of the weight, the board has low mass and density.

Because of its construction, the laminated soundboard 12 is relatively free from changes due to moisture and temperature and is uniform from panel to panel. Therefore, not only are excellent tones attained at the factory, but also the piano remains in tune for many years because of its independence from the environment in which it is located. Because the skins have a high modulus of elasticity, the internal attenuation of the sound is low and because there is relatively little mass, the board has excellent response to high frequencies.

The construction of such a laminated piano soundboard has added advantages. For instance, it is known, as shown in FIG. 4, if a piano soundboard such as 35, is mounted to the piano back 37 only at the peripheral edges 38 and 39 thereof, and a crown such as at 40 is formed in the board, excellent tone qualities may be gained. In effect, the board acts as a diaphragm fixed at its edges and having a free center. This is very desirable because the maximum amplitude of vibration exists at or near the geographical center of the diaphragm and works its way to the edges thereof. The crown such as shown at 40 has previously been placed in wooden soundboards by warping and pressing in molds. The laminated construction of the board of this invention lends itself to a very easy and relatively inexpensive way of placing the crown in the board. By choosing one of the skins from a material such as phenolic backing sheet and the other skin from a material such as fiber glass and polyester resin, the crown may be placed in the board during the bounding process. When heat is applied during the curing stage, one side of the laminated panel will contract more than the other side because the coefficient of contraction of the two materials is different, thereby causing the panel to bend and to remain in that position so that a permanent crown is placed in the panel. Because of the strength and nature of the skin material, the panel is supported in two directions; i.e., longitudinally and transversely, as compared to only one dimension for wood. Therefore, when crowns are molded into wooden soundboards, it is necessary to apply support ribs to the soundboard so the crown will be re-

tained over the life of the piano. Due to the fact that the panel of this invention has support in both directions, the crown will remain in the panel, without the use of ribs, for the life of the piano.

Supporting the edges of the soundboard so that it is a fixed diaphragm with a moving center is really not the most optimum mode of operation, for there is still some dampening of the sound energy at the fixed portions of the diaphragm. Because of the great strength of the soundboard of this invention coupled with the fact that it is lightweight, it is possible to mount this board in a piano in a fashion not previously introduced into the industry.

FIG. 5 shows a piano back 40 having a piano plate 42 fastened to the back through a pin block 44 and a binder 46. Inserted in the pin block is a tuning pin 48 and at the bottom of the piano is located a hitch pin 50. A string 52 is connected between the tuning pin 48 and hitch pin 50 in the conventional manner. The soundboard 55, constructed in accordance with this invention, has a bridge 57 which is fastened to it, for instance, by glue. The string 52 is then connected or coupled to the piano soundboard 55 through the bridge 57. It should be understood that although only one string is shown, there are, of course, a plurality of strings in the piano, all of which are connected through bridges to the piano soundboard as shown in FIG. 3. It is the connection of these strings to the bridges of the soundboard which provides the sole support for the board. The importance of this can be understood by the fact that the soundboard now acts as an undampened, free-moving diaphragm which gives unsurpassed tone quality. Furthermore, the soundboard is free from any effects of temperature or moisture so that the tuning of the piano will be perpetuated over its life span.

Although the embodiment described illustrates the use of the soundboard of this invention in a piano, it should be clear that other uses for this soundboard could be made, for instance, in other string instruments, such as violins or banjos.

What has been described, therefore, is a unique laminated piano soundboard which has a strength-to-weight ratio superior to any known board. The board is of uniform construction and has a frequency response which remains stable with change in moisture and temperature during the life of the piano.

I claim:

1. In a piano having a plate with strings attached thereto and means for striking the strings to produce a plurality of tones, the combination including, a soundboard supportedly mounted in the piano about the edges thereof and comprising a core formed from low density material, skin means having a high modulus of elasticity, means bonding said skin means to said core to form a laminated structure, said skin means comprising first and second skins each having a different coefficient of contraction whereby bonding said first and second skins to said core causes one skin to contract more than the other to place a permanent crown in said soundboard, and means coupling said soundboard to the strings so that striking the strings produces tones to move said soundboard as a diaphragm fixed at the edges and having a free center, whereby said low density core provides frequency response to all tones produced by the strings of a piano, and the stiffness of the high modulus of elasticity skin means provides for low internal attenuation on sound energy.

2. The piano of claim 1 wherein said first skin is made of a phenolic material and said second skin is made of fiber glass and polyester resin.

3. The string instrument of claim 2 wherein said core represents on the order of 90% of the volume of said laminated structure and on the order of 10% of the weight thereof.

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